Agenda Item F.1
Situation Summary
June 2013

NATIONAL MARINE FISHERIES SERVICE REPORT

National Marine Fisheries Service (NMFS) Northwest Region will briefly report on recent regulatory developments relevant to groundfish fisheries and issues of interest to the Council.

NMFS Northwest Fisheries Science Center (NWFSC) will also briefly report on groundfish-related science and research activities.

Council Task:

Discussion.

Reference Materials:

1. Agenda Item F.1.b, Attachment 1: *Federal Register* Notices Published Since the Last Council Meeting.

Agenda Order:

a.	Agenda Item Overview	Kelly Ames
b.	Regulatory Activities	Frank Lockhart
c.	Fisheries Science Center Activities	John Stein and Michelle McClure
d.	Reports and Comments of Advisory Bodies and Management Entities	
e.	Public Comment	
f.	Council Discussion	

PFMC
05/30/13

Agenda Item F.1.b
Attachment 1
June 2013

Groundfish and Halibut Notices
4/12/13 through 05/29/2013

Documents available at NMFS Sustainable Fisheries Groundfish Web Site
http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/index.cfm

78 FR 26277. Biennial Specifications and Management Measures; Inseason Adjustments - 5/6/13

78 FR 26526. Pacific Coast Groundfish Fishery; Biennial Specifications and Management Measures for the 2013 Tribal and Non-Tribal Fisheries for Pacific Whiting. Action: Final rule - 5/7/13

78 FR 26708. Pacific Halibut Fisheries; catch Sharing Plan; Correcting Amendment. Action: Final rule; correcting amendment – 5/8/13

PFMC
05/30/13

Agenda Item F.1.b
Supplemental NMFS Report
June 2013

Draft Rulemaking Plan for 2013

Groundfish and Halibut

In addition to a list of groundfish and halibut rules that have already been completed over 2013, NMFS is providing a list of rulemakings that are in progress over the remainder of 2013. To start 2013, NMFS prioritized completion of harvest specifications and response to litigation, which caused some of other rulemakings to be delayed.

Completed rules:

1. Reconsideration of Allocation of Whiting (RAW 2), Proposed Rule (1/2/2013)
2. 2013-2014 Harvest Specifications and Management Measures Final Rule (1/3/2013)
3. Reconsideration of Allocation of Whiting (RAW 1), Extension of Emergency Rule (1/17/2013)
4. Trawl Cost Recovery, Proposed Rule (2/1/2013)
5. Tribal Whiting Fishery, Proposed Rule (3/5/2013)
6. Pacific Halibut Catch Sharing Plan, Final Rule (3/15/2013)
7. Reconsideration of Allocation of Whiting (RAW 2), Final Rule (3/28/2013)
8. Inseason Action (5/6/2013)
9. Tribal and Non-Tribal Whiting Fishery, Final Rule (5/7/2013)
10. Pacific Halibut Catch Sharing Plan, Correction (5/8/2013)

In Progress:

1. Chafing Gear Rule Timing: Proposed rule – summer 2013 Final rule – early 2014 Effective – late April/early May 2014 Includes: changes to chafing gear requirements Sectors affected: limited entry (LE) trawl (IFQ/MS/C/P)	**5. Trawl RCA Rule** **(Rockfish Conservation Area)** Timing: Proposed Rule – July/August 2013 Final rule – Fall 2013 Effective – ~November 1, 2013 Includes: changes to trawl RCA Sectors affected: LE trawl (IFQ)
2. Observer/Catch Monitor Rule Timing: Proposed rule – August 2013 Final rule – November 2013 Effective – January 1, 2014 Includes: permitting for new observer providers, observer safety, minor revisions Sectors affected: LE trawl (IFQ/MS/C/P)	**6. Seabird Rule** Timing: Proposed Rule – fall 2013 Final rule – 2014 Effective – 2014 Includes: mandatory streamer lines Sectors affected: LE and open access (OA) fixed gear
3. PIE 2 Rule **(program improvement and enhancement)** Timing: Proposed rule – summer 2013 Final rule – November 2013 Effective – January 1, 2014, except ban on QP transfer removed by 12/15/2013 Includes: QS trading, remove December ban on QP transfer, change opt-out requirements, revise first receiver site license requirements, eliminate double filing of coop reports, exempt certain lenders from control rules Sectors affected: LE trawl (IFQ/MS/C/P) and LE fixed gear	**7. Pacific Halibut Catch Sharing Plan, 2014** Timing: Proposed Rule – Dec 2013 Final rule – Mar 2014 Effective – spring 2014 Includes: changes to commercial and recreational halibut fisheries for Area 2A Sectors affected: LE and OA fixed gear
4. Cost Recovery Timing: Final rule – October 2013 Effective – January 1, 2014 Includes: industry fee to offset NMFS cost of management, data collection, enforcement Sectors affected: LE trawl (IFQ/MS/C/P)	

Pending Actions (in the near future):

1. Amendment 24, 2015/2016 specifications – improved specifications and management measures process
2. Stock complexes

3. Adaptive management program (IFQ Fishery)
4. Permit Rule – Registering a limited entry trawl and limited entry fixed gear permit to a vessel at same time, consider sablefish-endorsed limited entry fixed gear ownership issues
5. Trawl gear issues – broad trawl RCA changes, multiple gears onboard, year-round season for midwater non-whiting trawl, transiting multiple management areas
6. Whiting season date change
7. Risk pool exemption from control rules (IFQ Fishery)
8. Electronic monitoring
9. VMS/declaration changes

NMFS would like to explore with the Council development of regional operating procedures. In particular, NMFS would like to work with the Council on process changes to support decision-making, such as more complete consideration of implementation issues before Council final decision, with the ultimate goal of improving timeliness of NMFS implementation.

As a starting point, NMFS would like to request that more complete analyses are available to the Council before final action and that NMFS has had an opportunity to review those analyses. This would allow NMFS the opportunity to address any concerns with the analyses before Council final action. In addition, it would provide NMFS a better opportunity to highlight implementation issues before final action. However, NMFS cannot guarantee that this would eliminate all need to bring issues back before the Council.

In addition to the process changes, NMFS would like to work with the Council to explore packaging groundfish issues, across all sectors, in a more comprehensive way. We believe this would make analyses and rulemakings more efficient. NMFS has begun doing this for rulemakings and believes that taking a step back and looking at the needs of all sectors of the fishery is warranted. One example, as shown in the table above, is pulling the observer and catch monitor components out of PIE 2 to make NMFS implementation more efficient. As Amendment 24 is being developed, another example of how to package groundfish issues in a more comprehensive way might be to include trawl trailing actions in with analyses of management measures for all groundfish sectors. In this way, groundfish issues would be looked at together for how they interplay and for how they cumulatively affect the fishery (industry and resource).

Science, Service, Stewardship

Agenda Item F.1.c
Supplemental Science Center PowerPoint
June 2013

NMFS Groundfish Science Report

June 2013

Michelle McClure and John Stein



NOAA FISHERIES SERVICE

NWFSC NORTHWEST FISHERIES SCIENCE CENTER

NOAA FISHERIES SERVICE

Overview

- Current Events
  - Assessments
  - Surveys
  - Bycatch reduction and other cooperative work
  - Observers
- Science news
  - Discard in the WC Groundfish fishery through time
  - Juvenile survey
  - and more!

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Summer Assessment Review Schedule

Review Meeting	Panel Timing	Location	Species
Full Panel 2	7/8-7/12	Seattle, NWFSC	Aurora rockfish
			Rougheye rockfish
Full Panel 3	7/22-7/26	Seattle, NWFSC	Shortspine Thd.
			Longspine Thd.
Full Panel 4	8/5-8/9	Santa Cruz, SWFSC	Cowcod
			Pacific sanddab

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Heading out!

The 2013 Joint Pacific Hake and Sardine Integrated Acoustic-Trawl Survey began an 80-day survey, departing Newport, OR on June 6, 2013.

Scientists from NWFSC and SWFSC are collecting Acoustic, Biological and Physical Oceanography data from San Diego, CA to the north end of Vancouver Island, BC.

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2013 West Coast Groundfish Bottom Trawl Survey

Pass 1: May 20 - July 30 Ongoing - Two vessels: F/V Last Straw, F/V Noah's Ark

Pass 2: Aug. 19 - Oct. 29 Upcoming - One vessel: F/V Excalibur

Pass 1: Report

1. Large number (>2000) of eulachon, relative to all other years, taken during leg 1 (May 25-Jun 4)

2. Buoy recovered off Newport from Woods Hole – waiting for information

Biological Measurements

- Length
- Gender
- Age
- Maturity
- Weight
- Stomach contents
- DNA

Ecosystem Data

- Wind speed
- Dissolved oxygen
- Salinity
- Temperature
- Optical backscatter
- In vivo fluorescence
- Irradiance

Pass 1: Status

Stations:
564 planned (usually 752)
~208 completed by June 22
Days-at-sea:
141 planned (usually 188)
39 completed by June 17

Upcoming Reviews

- Programmatic Review (Data for Assessments)
  - September 17-20, Seattle, NWFSC

- Review of Joint Hake/Sardine Survey
  - Early/mid-January, location TBD

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Pacific halibut flexible sorting grid excluders in net loft in Newport, OR just prior to being loaded aboard the *F/V Miss Sue – testing in June*

Observers – Value and Safety

- Sam Rauch letter to Councils
- Observers and their high quality data add value:
  - Greater certainty in stock assessments
  - Distributional information (EFH, hotspots, more!)
  - Bycatch reduction efficacy
- Thanks to the fishing community for ensuring their safety and positive working environments.

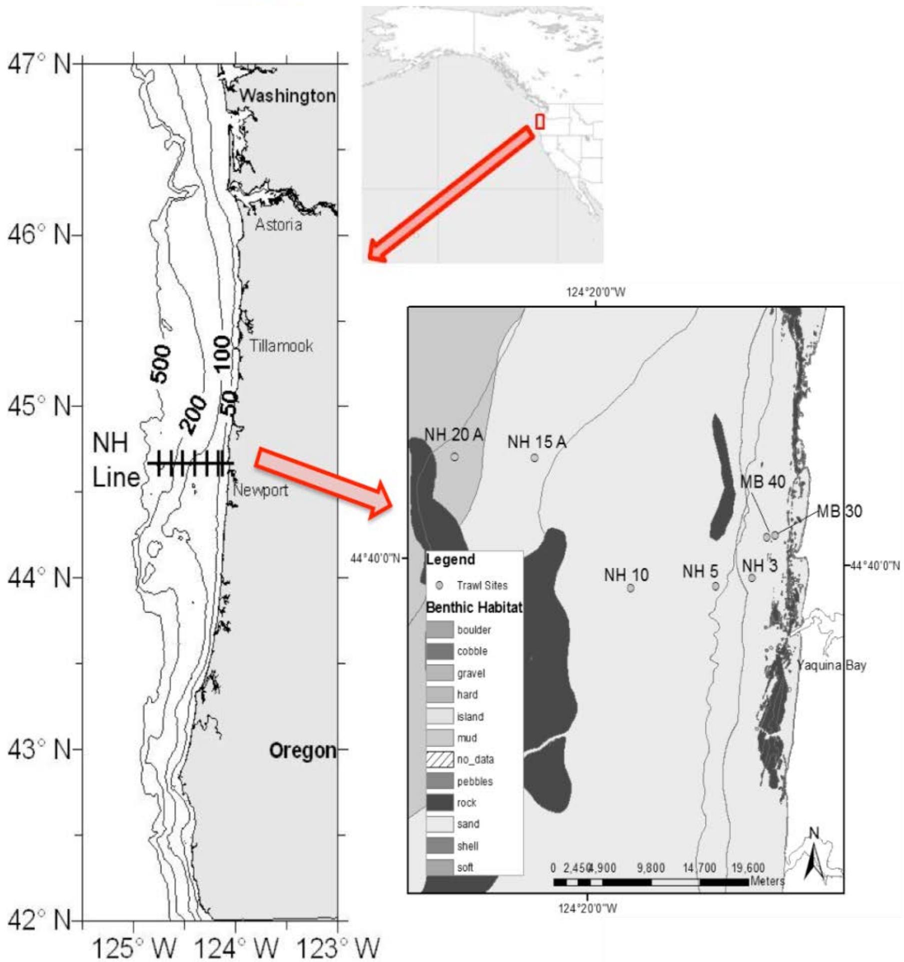
Science, Service, Stewardship

Seasonal Distribution and Habitats of Young-of-the-Year (YOY) Groundfishes Along the Newport Hydrographic Line – a Cooperative Research Study

Waldo Wakefield, Matthew Yergey (PSFMC), Toby Auth, (PSMFC), Ric Brodeur, Bill Peterson, and Captain and Crew of *F/V Miss Yvonne*

NOAA FISHERIES SERVICE

Monthly sampling aboard *F/V Miss Yvonne*



- NWFSC groundfish bottom trawl survey uses gear and sampling locations that overlook the YOY life stage of many groundfishes.
- Sampling along the historically and currently sampled Newport Hydrographic Line (NH Line) allows for comparison of results to ongoing oceanographic, zooplankton, and larval fish sampling by NWFSC.
- 2012 – 1st Year of Sampling completed.
- 2013 – Sampling continues monthly in Year 2.

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Sampling provides information on the distribution and abundance of under-sampled life-history stages of groundfishes

- Sampling conducted using a 2-m wide by 0.5-m high beam trawl equipped with a HD underwater video system
- 3 mm mesh lining captures recently settled groundfishes in the post-larval stage
- HD video also provides means to assess behavior and habitat (see next slide)

Science, Service, Stewardship

Untangling the recreational value of wild and hatchery salmon

Leif Anderson and Todd Lee

Marine Resource Economics 28(2):175-197

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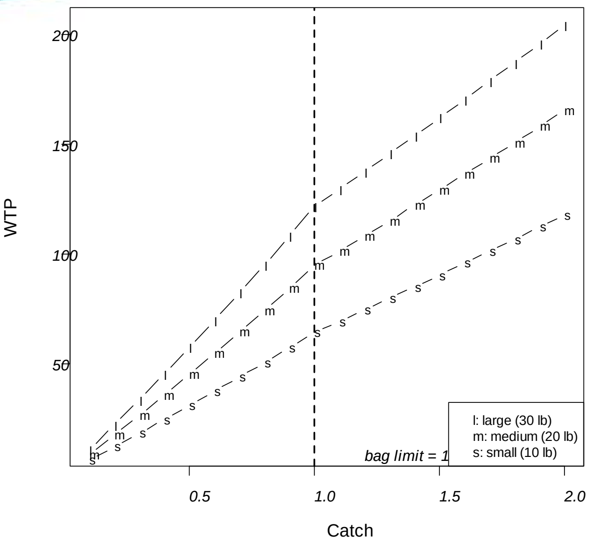
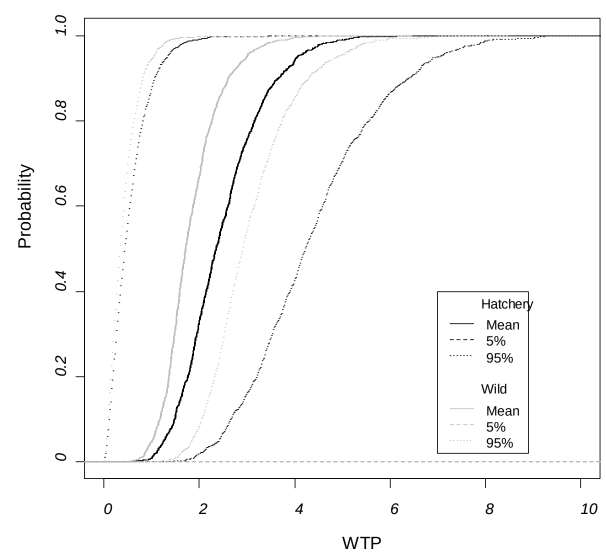
The researchers used a non-market value method to estimate the economic value of recreational fishing to anglers in WA and OR marine waters.

In particular, the study measured the economic value of catching coho and Chinook salmon, and tried to determine whether a fish's origin, "hatchery" or "wild", affects the value anglers place on either retained or released catch.

Significant differences in value are found between hatchery and wild salmon catch, especially for fish that must be released because of a bag limit. The effects of changes in bag limits and catch rates are examined.



Wild King WTP by Size
and Catch Under a Bag Limit of 1



CDFs of WTP per Choice Occasion
for Equivalent Increase in Catch

Science, Service, Stewardship

Interannual variation in pelagic juvenile rockfish (*Sebastes* spp.) abundance – going with the flow

Steve Ralston, Keith M. Sakuma, and John C. Field

Fisheries Oceanography 22: 288–308

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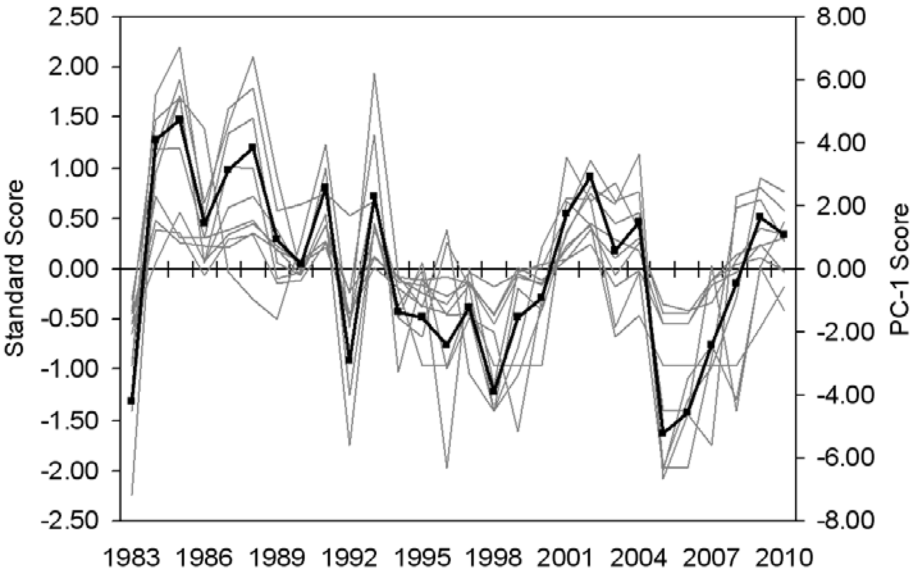
Young-of-the-year Cowcod (*Sebastes levis*)

- A 28-year time series of pelagic juvenile rockfish correlates with recruitment from assessments, and shows that recruitment variability is largely driven by large-scale transport throughout the California Current.
- Results are based on "core area" (Central California) index, comparisons with coastwide indices (shorter time series, but recommended for assessments) are forthcoming.
- Preliminary results from the 2013 survey (still ongoing) show strongest recruitment since 1984, suggesting 2013 will be a very strong year class for most species.



Science, Service, Stewardship

Discarding and Fishing Mortality Trends in the US West Coast Groundfish Demersal Trawl Fishery

Marlene A. Bellman and Eliza Heery (University of Washington)

Fisheries Research 147: 115-126.

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Overview Methods

- Study period 2002-2009
- Discard Estimation using a Ratio Estimator

  - Assumes discard is proportional to a metric of fishing effort

  - Fishing metrics used: groundfish retained weight (in results section) and trawl duration (supplementary mat.)
- Post-Stratified by Area, Depth, Season
- Assumed 100% mortality
- Similar methodology as presented in annual groundfish mortality reporting for this sector of the groundfish fishery (Bellman et al. 2012)

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A. Discard Results

- On average, 29% of annual groundfish catch was discarded.
- Non-Rebuilding Groundfish Species: 68% of total observed discard weight combined across all years.

  Total Discard Fractions: 24% less in 2009 than 2002
- Rebuilding Groundfish Species: 2% of total observed discard weight combined across all years.

  Total Discard Fractions: 39% greater in 2009 than 2002

Largest % of GF Discard:

Pacific hake (*Merluccius productus*)
Arrowtooth flounder***** (*Atheresthes stomias*)
Dover sole (*Microstomus pacificus*)
Spiny dogfish****** (*Squalus acanthias*)
Sablefish (*Anoplopoma fimbria*)

Longnose skate (*Raja rhina*)
Pacific sanddab (*Citharichthys sordidus*)
English sole (*Parophrys vetulus*)
Spotted ratfish (*Hydrolagus colliei*)
Unspecified skate (*Raja sp.*)

*Highest mean discard per tow

**Highest discard in single tow

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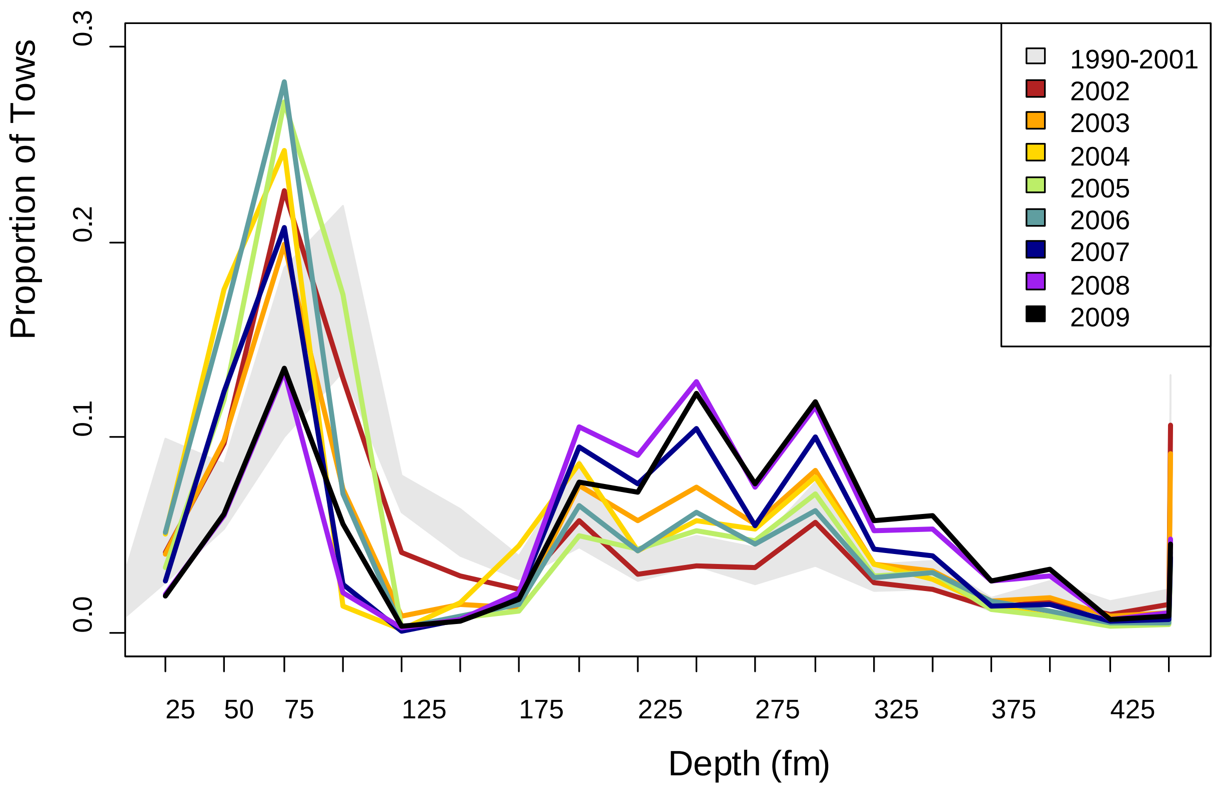
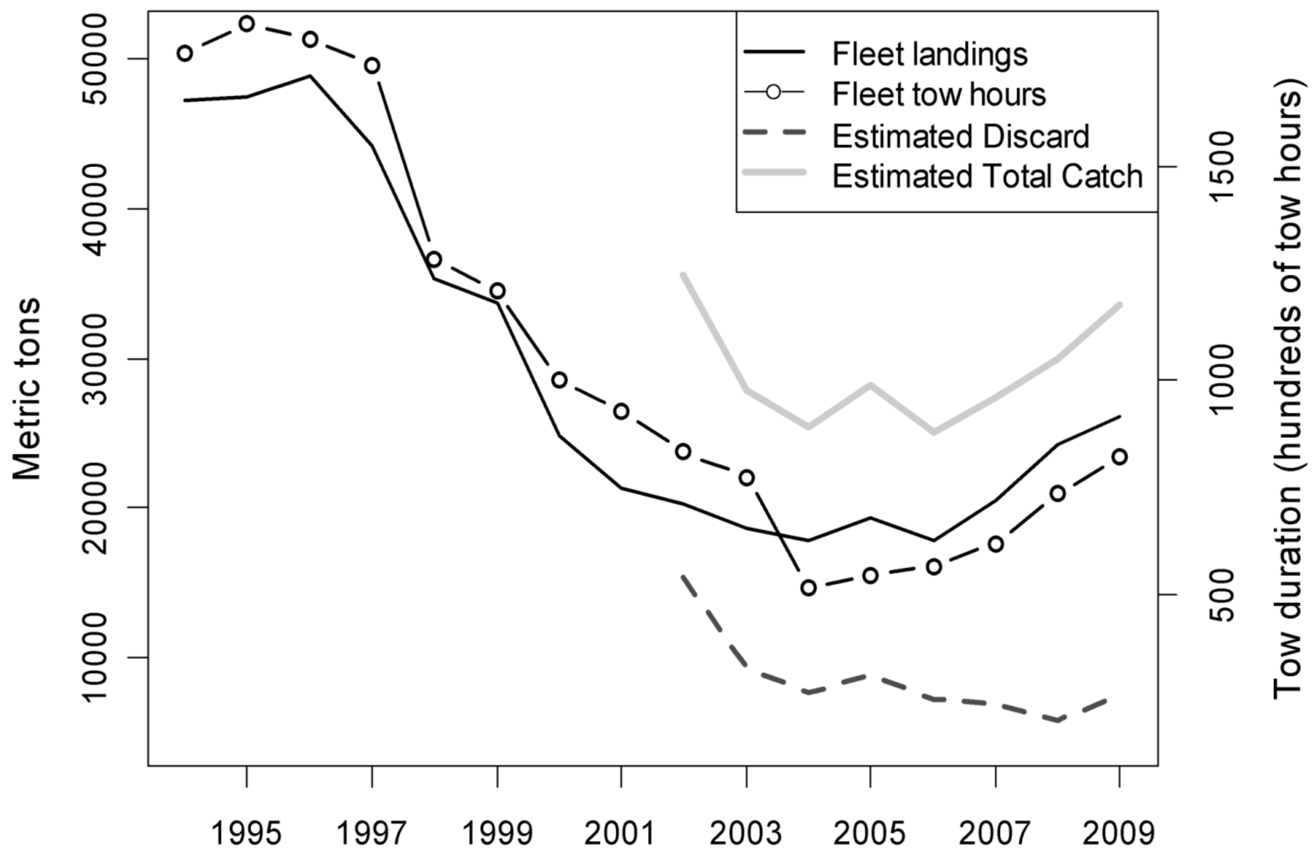
B. Fishery Components

Fishing effort had shifted to deeper water in later years



C. Trends


Fleet landings
Fleet tow hours
Estimated Discard
Estimated Total Catch
Metric tons
10000
20000
30000
40000
50000
Tow duration (hundreds of tow hours)
500
1000
1500
1995
1997
1999
2001
2003
2005
2007
2009

Agenda Item F.2
Situation Summary
June 2013

STATUS OF THE RATIONALIZED TRAWL FISHERY

The trawl rationalization (catch shares) program was implemented in January 2011 and it has now been in place for over two years. In April, the Council received annual reports from the co-op sectors and a report on landings, exvessel value and participation in the shoreside individual fishing quota (IFQ) program. The Amendment 20 trawl rationalization program included an element requiring program participants to submit economic data. At this meeting, the Council will receive its first status report from the Northwest Fisheries Science Center on the results of the Economic Data Collection Program (EDCP). This information is expected to be valuable in evaluating program performance. At this meeting the Council will receive the five reports based on the information collected under this requirement:

- EDCP Administration and Operations Report (Agenda Item F.2.b, EDCP Report 1).
- EDCP First Receiver and Shorebased Processor (Agenda Item F.2.b, EDCP Report 2).
- EDCP Catcher Vessel Report (Agenda Item F.2.b, EDCP Report 3).
- EDCP Catcher-Processor Report (Agenda Item F.2.b, EDCP Report 4).
- EDCP Mothership Report (Agenda Item F.2.b, EDCP Report 5).

Council Task:

Council discussion.

Reference Materials:

1. Agenda Item F.2.b, EDCP Report 1: Excerpt From Economic Data Collection Program Administration and Operations **(full document available on web site and briefing book CD only)**
2. Agenda Item F.2.b, EDCP Report 2: Economic Data Collection Program First Receiver and Shorebased Processor **(available on web site and briefing book CD only).**
3. Agenda Item F.2.b, EDCP Report 3: Economic Data Collection Program Catcher Vessel Report **(available on web site and briefing book CD only).**
4. Agenda Item F.2.b, EDCP Report 4: Economic Data Collection Program Catcher-Processor Report **(available on web site and briefing book CD only).**
5. Agenda Item F.2.b, EDCP Report 5: Economic Data Collection Program Mothership Report **(available on web site and briefing book CD only).**
6. Agenda Item F.2.d, Public Comment. Letter from Dr. Hans Radtke.

Agenda Order:

a. Agenda Item Overview — Jim Seger
b. Report of the NWFSC Economic Data Collection Program — Todd Lee
c. Reports and Comments of Advisory Bodies and Management Entities
d. Public Comment
e. Council Discussion

PFMC
05/29/13

Economic Data Collection Program

Administration and Operations Report

Draft Report for PFMC Review

Do Not Cite

Northwest Fisheries Science Center[1]

May 22, 2013

[1]For questions or comments, please contact the EDC Program at nwfsc.edc@noaa.gov.

Contents

List of Tables

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Acknowledgments

The Economic Data Collection Program and Economic Data Collection Reports reflect collaboration and coordination of individuals across the West Coast. There are numerous individuals to thank for their contributions to this effort.

We would like to acknowledge the efforts of all the Northwest Fisheries Science Center (NWFSC) economists who provided a wide range of input into survey design, implementation, and analysis. The group worked together in an effort to provide high quality data that can distributed in a timely and secure fashion.

We appreciate the efforts of the Northwest Regional Office for support in the Program development, outreach, and communication efforts. The Permit Office staff was particularly instrumental in ensuring coordination with the mandatory participation requirements.

The Northwest Division of the Office of Law Enforcement (OLE) and the National Oceanic and Atmospheric Administration (NOAA) Office of General Council helped extensively with many aspects of the Program development and enforcement. They continue to cooperate with the EDC Program to ensure compliance. Thanks to the Northwest Fisheries Science Center Scientific Data Management staff for building an extremely useful administrative tracking system and database.

We thank PacFIN and AKFIN staff for providing access to important landings, permit, and vessel data. The staff at ODFW, WDFW, CDFG also contributed with data used for the fielding of the baseline data collection. Other data and assistance with interpretation of data was provided by the At-sea Hake Observer Program and the West Coast Observer Program.

Finally and very importantly, we thank the members of the West Coast fishing industry who met with us to discuss the survey development and interpretation of the information collected. We appreciate the time and effort of each participant in the program.

1 Introduction

1.1 Background

In January 2011, the West Coast groundfish trawl fishery transitioned to a catch share program. The catch share program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet, and cooperative programs for the at-sea mothership and catcher-processor fleets. The Economic Data Collection (EDC) program[1] was enacted as part of these new regulations to monitor the economic effects of the catch share program. Annual economic data submissions are required from all fishery participants: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors §50 CFR 660.114. Baseline, pre-catch share data, was submitted in 2011 for the 2009 and 2010 operating years. Data for the first year the fishery operated under the catch share program (2011) was submitted in 2012.

The EDC Program has enhanced the quantity and quality of economic information available for analysis and the management of the West Coast groundfish trawl fishery. Prior to the EDC Program, voluntary cost and earnings surveys were available for 64% of the shoreside catcher vessels with limited entry groundfish permits with trawl endorsements (trawl fleet) (2003-2004 collection[2]) and 57% of the fleet for the 2007-2008 collection[3]. Moreover, no cost and earnings data were available for catcher vessels that delivered to motherships.

This report describes the EDC Program administration and fielding of the surveys, the EDC forms, data QA/QC and data processing, and the handling of confidential information. Separate draft reports that provide basic data summaries from each of the four forms have also been developed. These reports are:

- Economic Data Collection Program, Administration and Operations Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Mothership Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

[1]Additional information on the EDC Program, including the EDC data collection forms can be found at `www.nwfsc.noaa.gov/edc`

[2]Lian, C.E. 2010. West Coast limited entry groundfish trawl cost earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p.

[3]Lian, C.E. 2012. West Coast limited entry groundfish cost earnings survey: Protocol and results for 2008. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-121, 62 p

- Economic Data Collection Program, Catcher-Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, First Receiver and Shorebased Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

This is the first iteration of what is expected to be a series of annual reports. It is envisioned that over time, the scope of the reports will expand, and the methods used will be refined with each annual publication. As such, the data summaries and analyses may change in subsequent years as improvements are implemented.

The four data summary reports have multiple objectives. The first is to provide basic economic data summaries that can be used for a variety of purposes associated with fishery management. Since much of the data collected is confidential under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, the data are summarized as averages or sums for each question on the EDC forms. Thus summarized, the reports make the data available for public use for both informational and research purposes. Second, the data summary reports provide information about the performance of the catch share program. This includes information that can be used to monitor whether and to what degree the goals of the program are being met. It is expected that additional modeling and analysis will be included in each subsequent year. This analysis will provide more detailed information about the performance of the program. These reports will serve as the basis for the five-year review of the catch share program that is mandated in the MSA, as well as the National Marine Fisheries Service (NMFS) National Catch Shares Performance Indicators. Third, the reports either provide, or serve as the basis for economic models that will be used as part of the Pacific Fishery Management Council's (PFMC) biennial specification process for groundfish management. These models include the IO-PAC model[4], as well as estimates of revenue, costs, and net revenue. Last, and perhaps most important, the data reports are expected to provide a useful catalyst to receive feedback on the data collected and its analysis.

1.2 Purpose of the EDC

The economic benefits of the West Coast groundfish trawl fishery and the distribution of these benefits are expected to change under the trawl catch share program. To monitor these changes, the PFMC proposed the implementation of the mandatory collection of economic data. Using data collected from industry participants, the EDC Program monitors whether the goals of the catch share program have been met. The EDC Program will also help meet the requirements of the MSA for catch share evaluation.

The Council's preferred alternative included a mandatory economic data collection provision. This provision, available in Appendix C enumerated several types of data for mandatory collection that are necessary to study the impacts of the catch share program.

[4] Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

Cost, revenue, ownership, employment and other information will be collected on a periodic basis (based on scientific requirements) to provide the information necessary to study the impacts of the program, including achievement of goals and objectives associated with the catch share program.

The provision also referenced the use of the data for other fishery management plan (FMP) actions:

These data may also be used to analyze the economic and social impacts of future FMP amendments on industry, regions, and localities.

The PFMC has enumerated several goals for the groundfish trawl catch share program that involve economic components. These goals include:

- Provide for a viable, profitable, and efficient groundfish fishery
- Increase operational flexibility
- Minimize adverse effects from an IFQ program on fishing communities and other fisheries to the extent practical
- Promote measurable economic and employment benefits through the seafood catching, processing, distribution elements, and support sectors of the industry
- Provide quality product for the consumer
- Increase safety in the fishery

The PFMC has also identified several constraints and guiding principles for the groundfish trawl catch share program:

- Minimizing negative impacts resulting from localized concentrations of fishing effort
- Avoiding provisions where the primary intent is a change in marketing power balance between harvesting and processing sectors
- Avoiding excessive quota concentration
- Providing efficient and effective monitoring and enforcement
- Designing a responsive review evaluation and modification mechanism
- Taking into account the management and administrative costs of implementing and overseeing the IFQ or co-op program and complementary catch monitoring programs and the limited state and federal resources available

The MSA also contains a monitoring requirement to determine whether a limited access privilege program (LAPP) is meeting its goals. §303A.(c)(1)(G) states that any LAPP shall:

include provisions for the regular monitoring and review by the Council and the Secretary of the operations of the program, including determining progress in meeting the goals of the program and this Act, and any necessary modification of the program to meet those goals, with a formal review 5 years after the implementation of the *program and thereafter to coincide with scheduled Council review of the relevant fishery management plan (but no less frequent than once every 7 years).*

The MSA also places importance on social and economic outcomes resulting from catch share programs. Sec. 303A.(c)(1)(C) states that any limited access privilege program (LAPP) to harvest fish submitted by a Council or approved by the Secretary under this section shall promote social and economic benefits.

1.2.1 EDC Program development and background

The EDC Program regulations and forms were developed with input from the Pacific Fishery Management Council (PFMC), the PFMC Scientific and Statistical Committee, the PFMC Groundfish Advisory Subpanel, the PFMC Regulatory Deeming Workgroup, industry members, industry associations and representatives, NGOs, other fishery participants, and public meeting in five coastal communities.

Under the regulations, all members of the West Coast groundfish industry harvesting or processing fish under the catch share program are required to supply economic data. Survey participants include: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors. The economic data are collected through annual surveys of costs, earnings and employment. The EDC Program worked closely with industry members in an effort to develop survey forms that are clear and concise, and to minimize the time required to complete them. Given the relatively small number of participants in the catch share fishery, and the expected consolidation, all members are required to complete the annual surveys[5]. To measure the effect of the catch share program accurately, fishery level data (i.e., West Coast groundfish trawl) is collected where that is feasible. The EDC Program will continue to work closely with industry members to improve the clarity and usefulness of the data collection forms.

It was determined that an annual data collection would be most beneficial in order to monitor and evaluate the economic effects of the trawl catch share program. Since many factors affect the fishery each year, including environmental, regulatory, economic, and others, a consistent survey providing a time series database is necessary to determine the effects of the catch share program. In order to have a baseline of conditions in the fishery prior to the catch share program, two years of data prior to the catch share program were required.

1.2.2 EDC data uses and analyses

Monitoring the economic effects of a catch share program requires a variety of economic data. In general, the data requirements depend on the types of effects that need to be monitored and the economic models used to estimate them. The primary effects of a catch share program can be captured in two broad areas of economic analysis:

[5]Designing an appropriate sampling scheme is problematic with such a small population, especially with heterogeneous operations and the desire to understand the effects of the catch share program on subpopulations of participants.

1. Economic performance measures
2. Regional economic impact analysis

Economic Performance Measures Many of the goals of the catch share program involve increasing the economic performance of the fishing industry, and providing increased net economic benefits to the nation. Economic performance measures include:

- Costs, earnings, and profitability
- Economic efficiency
- Capacity measures
- Economic stability
- Net benefits to society
- Distribution of economic net benefits
- Product quality
- Functioning of the quota market
- Incentives to reduce bycatch
- Market power
- Spillover effects in other fisheries

Estimation of economic performance measures requires information on the costs and earnings of harvesters and processors. Some of the above performance measures are derived through a tabulation of the data, while others require more sophisticated models such as cost function estimation, capacity models, and economic behavioral models. NWC and other economists, as well as researchers in other fields[6] will use the data over time to attempt to monitor the effects listed.

Regional Economic Impact Analysis One common concern associated with catch share programs is their potential effect on regional economies. Some of these effects may increase the regional economic impacts of the fishery (e.g., increased harvest of under-utilized target species), while other may decrease the regional economic impacts of the fishery (e.g., fleet consolidation). In general, the catch share program will likely affect different regional economies in different ways.

Regional economic modeling involves quantifying these changes by tracking the expenditures of all businesses, households, and institutions within a given geographic region. The formal study of these economic relationships is done through input-output analysis, which analyzes the direct, indirect and induced effects, and the resulting economic multipliers associated with each business sector in the regional economy. An input-output model estimates:

[6] As discussed later in this report, only National Oceanic and Atmospheric Administration (NOAA) economists or contractors will have access to the disaggregated data. Nevertheless, a wide variety of useful analyses can be completed with the aggregated data.

- Economic contribution (income and employment) of the fishery to regional economies
- Distributional effects between fishing sectors
- Distributional effects across regional economies
- Measures that can be used to help evaluate community fishery dependence.

Input-out models require data on the cost and earnings of harvesters and processors. They also require information about the location of the expenditures so they can be properly assigned to particular regional economies. On the Pacific coast, the NWFSC's IO-PAC model[7] is used to estimate regional economic impacts. The rest of this report is organized as follows.

- Section 2: EDC Survey Population, Protocols, and Response Rates
- Section 3: Description of EDC Forms
- Section 4: QA/QC Process
- Section 5: Data Processing
- Section 6: Previous Data Collections

[7]Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

2 EDC Survey Population, Protocols, and Response Rates

2.1 EDC participants

Participation in the EDC Program is mandatory according to 50 CFR 660.114[1]. The regulations require submission of an EDC form to gather ongoing, annual data for 2011 and beyond, as well as a onetime collection of baseline economic data from 2009 and 2010.

The EDC Program uses four separate forms to collect data from six participant groups. These participant groups are listed below by form type:

1. Catcher vessel form
   - Limited entry trawl catcher vessel owners: The owner of a catcher vessel with an attached limited entry trawl permit.
   - Limited entry trawl catcher vessel lessees or bareboat charterers: A lessee or bareboat charterer of a catcher vessel with an attached limited entry trawl permit.
2. Mothership vessel form
   - Motherships: For the baseline data collection, mothership participants are owners and lessees of a mothership vessel that received whiting in 2009 or 2010 according to the NMFS' NORPAC database. For 2011 and beyond, regulations define mothership participants as owners and lessees of a mothership vessel registered to a mothership permit at any time in the survey year.
3. Catcher-processor vessel form
   - Catcher-processors: For the baseline data collection, catcher-processor participants are owners and lessees of a catcher-processor vessel that received whiting in 2009 or 2010 according to the NMFS' NORPAC data. For 2011 and beyond, regulations define catcher-processor participants as owners and lessees of a catcher-processor vessel registered to a limited entry trawl permit with a catcher-processor endorsement at any time in the survey year.

[1]A link to the regulations can be found at the EDC Program website: www.nwfsc.noaa.gov/edc

4. First receiver and shorebased processor form
    - First Receivers: For the baseline data collection, regulations define first receiver participants as owners and lessees of a shorebased processor, and all buyers that received groundfish or whiting harvested with a limited entry trawl permit in 2009 or 2010 according to the state fish ticket database. For 2011 and beyond, this group is defined as all owners of a first receiver site license.
    - Shorebased Processors: Owners and lessees of a shorebased processor that received round or headed-and-gutted IFQ groundfish or whiting from a first receiver in 2011 and beyond.

Survey participants are identified using the definitions provided above. For the baseline period, NOAA Fisheries Northwest Regional Office Groundfish Fisheries Permits Office (the Permit Office) provided the contact information for vessel owners, including catcher vessels, catcher-processors, and motherships. Contact information for buyers that received groundfish or whiting harvested with a limited entry trawl permit in 2009 or 2010 were identified using fish tickets and contact information was obtained directly from the state agencies. Lessees were identified using information provided by the vessel owner on their form. As described in the form descriptions contained in Section 3, each vessel form asks for the contact information of any entity that leased the vessel during the survey year.

For the 2011 and subsequent years, contact information for all vessels and first receivers is obtained from the Permit Office. There is currently no method to identify shorebased processors that received round or headed-and-gutted IFQ groundfish, but do not have a first receiver site license.

2.2 Regulations for complete EDC forms

The regulations describe the consequences for failure to complete all required EDC forms. A "complete" EDC form is defined as a form that contains responses for all data fields, which include but are not limited to costs, labor, earnings, activity in a fishery, vessel or plant characteristics, value, quota, operational information, location of expenditures and earnings, ownership information and leasing information. The potential implications of noncompliance for each group are listed below:

1. Catcher vessel form
    - Permit owners: a limited entry trawl permit application (including MS/CV-endorsed limited entry trawl permit) will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i).
    - Vessel owners: participation in the groundfish fishery (including, but not limited to, changes in vessel registration, vessel account actions, or if own QS permit, issuance of annual QP or IBQ pounds) will not be authorized until the required EDC for that

owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v) and §660.140(e).

- Vessel lessees or charters: participation in the groundfish fishery (including, but not limited to, issuance of annual QP or IBQ pounds if own QS or IBQ) will not be authorized, until the required EDC for their operation of that vessel is submitted.

2. Mothership vessel form
    - Permit owners: For permit owner, an MS permit application will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i).
    - Vessel owners: participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v).
    - Vessel lessees or charters: participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
3. Catcher-processor vessel form
    - Permits owners: a C/P-endorsed limited entry trawl permit application will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i).
    - Vessel owners: participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v).
    - Vessel lessees or charters: participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
4. First receiver and shorebased processor form
    - A first receiver site license application will not be considered complete until the required EDC for that license owner associated with that license is submitted, as specified at §660.140(f)(3).

2.2.1 Compliance

Compliance with the EDC regulations is promoted in three ways. First, the EDC Program contacts all entities with incomplete[2] forms via phone and mail (Figure 2.1). Attempts are made to contact the participant via phone and mail in collaboration with the permit office, the NMFS Office of Law Enforcement (OLE), and the NOAA Office of the General Council (GC). During communication attempts, the EDC Program staff informs the participant that the form is required as part of the catch share program and that all submissions must have an answer to each question. The

[2] Incomplete forms include forms that have been submitted with missing responses or forms that have never been submitted.

participant is also told that the Permit Office may be not be able to process administrative actions for the entity and that failure to submit an EDC form may be a violation of the Magnuson-Stevens Act. If this issue is not resolved through this process, other actions may be taken.

The second way compliance is promoted is through the Permit Office. The EDC Program and the Permit Office coordinate to encourage all entities to submit complete forms. The Permit Office has access to the EDC administration database and uses this information to confirm that an entity has completed all required EDCs. The Permit Office requires submission of a complete EDC form as part of the application process for renewing limited entry permits, quota share accounts, vessel accounts, changing vessel registration, issuance of first receiver site licenses, and issuance of quota pounds or bycatch pounds. For this reason, the Office will not review renewals of trawl-endorsed limited entry permits, quota share permits and accounts, vessel accounts, or issuance of first receiver site licenses until all associated surveys are complete (Figure 2.1).

If EDC and permit office coordinated contacts do not result in compliance, the EDC can involve OLE. OLE would most likely be involved when the entity does not have any pending administrative actions from the permit office. In these cases, NMFS reserves the right to conduct verification of economic data with the submitter of the form §660.114(e)(1). This process is referred to as an audit in the regulations. To initiate an audit, the EDC Program sends a letter via certified mail to the participant. The letter, drafted with assistance from the Permit Office, the OLE, and GC, contains information about the issues that need to be resolved, an explanation of the audit procedure, and instructions on how to resolve the issues. The participant has 20 days to respond to the audit or the participant may be considered in violation of Magnuson-Stevens Fishery Management Act §660.114(e)(2). At this point, the OLE may initiate an investigation. To date, no entity has been prevented from participating in a fishery or serving as a first receiver due to failure to submit a complete EDC.

2.3 Administration of the EDC forms

2.3.1 Mailings and deadlines

Forms are mailed to all participants identified by the Permit Office, and any lessees of vessels identified by vessel owners. The forms are mailed to participants in the beginning of May and are due on September 1 of the same year. Forms collect data from the previous fiscal year. For example, in May 2013, the 2012 EDC forms will be mailed to participants and the participants will complete the form for their 2012 fiscal year. Although the EDC forms are labeled for a particular calendar year, the data submitted is for that participant's fiscal year. Participants are instructed to use the fiscal year with the greatest overlap with the calendar year of the form. Because much of the information requested on the forms can be found on the participant's tax forms, this schedule for administering the forms is designed to allow most entities to complete their taxes before the deadline for EDC form submission.

The EDC mailing packets include three documents: a cover letter (Appendix G), an EDC fact sheet (Appendix A), and a copy of the form (Appendix H). The cover letter provides information such as the corresponding regulations that mandate that the entity submit a complete form, instructions on how to complete the form, descriptions of recent changes that have been made to the form since the previous year, and some guidance based on common questions about previous forms.

The definition of a "complete" form is provided in both the cover letter and on the first page of each form. The participants are instructed to answer "NA" if the question is not applicable.

A reminder letter is mailed approximately a month before the September 1 submission deadline to participants who have not submitted a form or who have a submitted an incomplete form

2.3.2 Form submission processing

As stated previously, an EDC form must be complete to meet the regulatory requirements for the EDC Program. For this reason, there is a system for tracking the status of each required form by entity (Figure 2.1).

The EDC administration database was designed and implemented in the spring of 2011 to track receipt and processing of each form. For purposes of the report, an entity is defined as a unique combination of vessel owner or lessee and vessel. There is a distinct entry for each unique combination of entity and survey year. Every communication with survey participants is logged in order to provide an administrative record for any potential enforcement actions. The date a form was received, the number of missing answers, and any potential issues found on the form are logged in the database. Additionally, the date of determination is recorded. The determination date is updated whenever the "complete" status of a form is changed. This determination date is used by the Permit Office to determine eligibility for potential administrative actions.

The number of missing answers on the form is used to determine which of two methods is used complete the form. If there are ten or fewer missing answers, the participant may provide the information over the phone and the EDC Program staff will record that information on the form. If, on the other hand, there are more than ten missing answers, the participant is required to submit the missing information via mail or fax. This system is used to avoid the potential of communication or transcription errors when there are a large number of missing answers.

For any issues related to a form, EDC staff will contact the participant via phone and mail to resolve the issues on the forms. Occasionally communications will be made via email, but no confidential information is included in these communications because email is not considered a secure method of communication.

Participants can request help completing their form by email, fax, or through a toll-free phone number. Through continued conversations with participants, EDC staff attempt to ensure that participants understand the survey questions as thoroughly as possible to maximize data quality.

A separate process for assessing and resolving the accuracy of the data on the form is discussed in Section 4, which discusses the QA/QC Process.

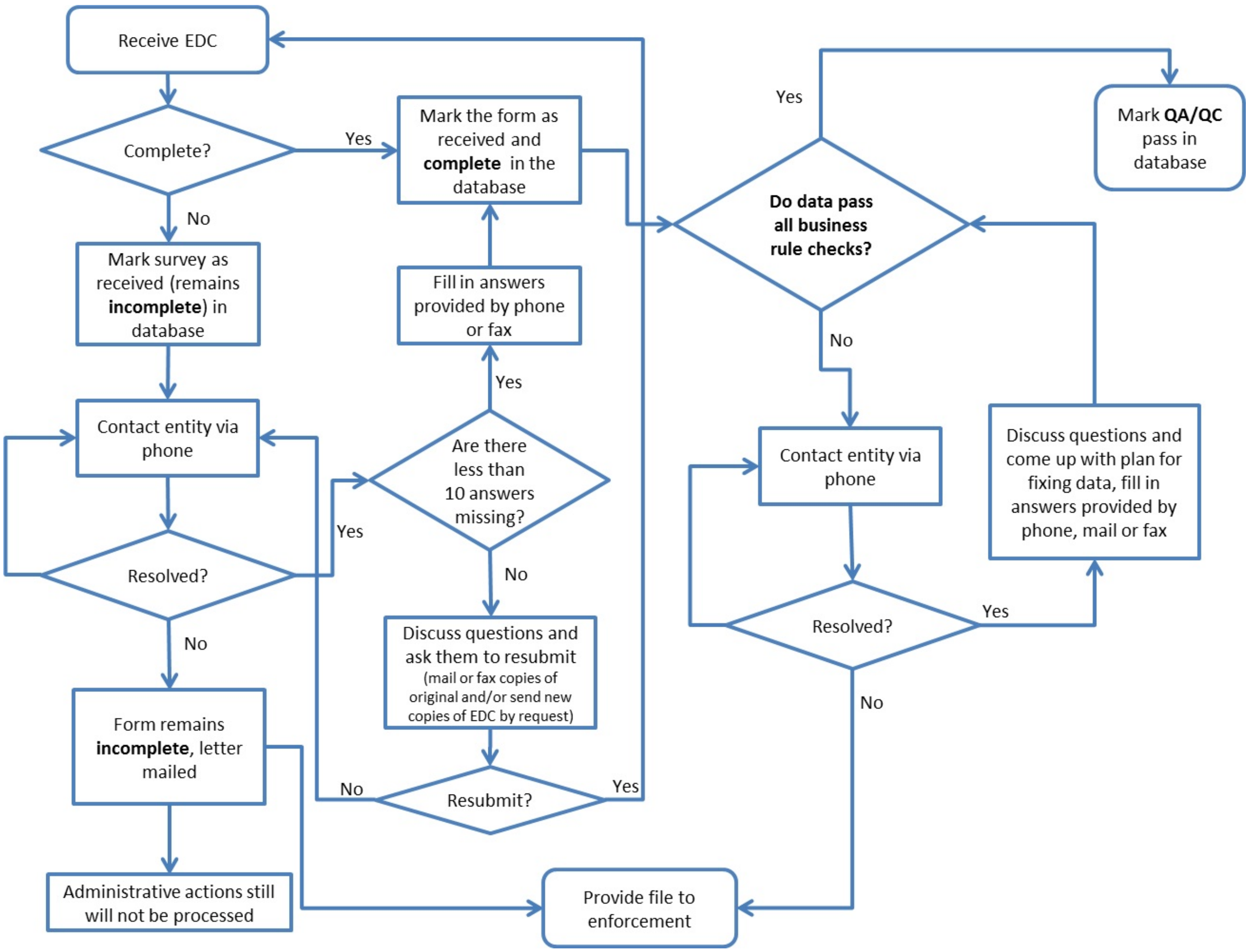


Figure 2.1: Procedures for processing EDC forms.

2.4 Response rates

Table 2.1 summarizes the disposition of the 2009, 2010, and 2011 forms, by form type. For the 2011 EDC, 246 forms were required and of these, 94% of all forms were submitted and complete. Of the remaining 15 forms, five were received, but incomplete, and the other ten forms were never submitted. In all survey years, the compliance rate for catcher-processors and motherships was 100%. The complete response rate for the 2011 catcher vessel was 96%, up from 88% for the 2009 forms and 92% for the 2010 forms. First receivers and shorebased processors have the lowest response rates. For the 2011 forms, 86% of the required 45 forms are complete, of the remaining, 3 are incomplete and 4 have not been submitted. The response rates for the 2009 and 2010 forms were lower at 66% and 76% complete, respectively. Despite the lower response rates in 2009 and 2010, the responses still accounted for over 90% of all groundfish purchases on the West Coast in those years.

Table 2.1: Response rates. Number of forms and percentage of total forms owed by year and survey type.

Survey type	Form status	2009		2010		2011	
		N	%	N	%	N	%
Catcher vessel	Complete	148	88.1	150	90.9	166	94.3
	Incomplete	6	3.6	1	0.6	2	1.1
	Never Submitted	14	8.3	14	8.5	8	4.5
Catcher-processor	Complete	7	100.0	8	100.0	10	100.0
	Incomplete	0	0.0	0	0.0	0	0.0
	Never Submitted	0	0.0	0	0.0	0	0.0
Mothership	Complete	6	100.0	8	100.0	8	100.0
	Incomplete	0	0.0	0	0.0	0	0.0
	Never Submitted	0	0.0	0	0.0	0	0.0
First receiver or shorebased processor	Complete	37	67.3	45	77.6	48	92.3
	Incomplete	0	0.0	0	0.0	2	3.8
	Never Submitted	18	32.7	13	22.4	2	3.8

2.5 Protection of confidential data

NOAA is authorized under the MSA to collect proprietary or confidential commercial or financial information. The MSA specifies how the data should be handled, who should have access to it, and how information should be released.

The EDC Program complies the with the MSA to ensure that the identity of the submitter will only be accessible to the following:

1. Personnel within NMFS responsible for the collection, processing, and storage of the statistics.
2. Federal employees who are responsible for FMP development, monitoring, and enforcement.
3. Personnel within NMFS performing research that requires confidential statistics.
4. Other NOAA personnel on a demonstrable need-to-know basis.
5. NOAA/NMFS contractors or grantees who require access to confidential statistics to perform functions authorized by a Federal contract or grant.

Any information provided to any person other than those listed above will be aggregated so that no statistic identifies the submitter of the data. Data are also aggregated so that no value is displayed that represents fewer than 3 entities, and no one entity represents 90% of any individual statistic. In addition to ensuring that publicly available information does not contain disaggregated confidential information, other safeguards have been put into place throughout the data collection and analysis processes. Anyone that has access to non-aggregated data must sign a non-disclosure agreement (Appendix D).

The EDC Program has identified several key points where confidential data need to be safeguarded. At each of these points, a procedure has been adopted to protect the confidentiality of the data. The paper forms are received and logged into the EDC administrative database, the data are entered into the EDC responses database, and the paper forms are secured in a locked file cabinet. The room where the file cabinets are stored can only be accessed by NOAA employees with keycard access. Only NWFSC economists have access to the file cabinets.

All digital information from the survey is stored on a secure server. The files on the server include the contact lists for survey participants, copies of letters sent to participants, analyses using raw data, the EDC administrative database, and the survey responses database. The secure server is password protected and only NWFSC economists and senior IT support staff have the ability to access the information.

It is common when a participant is resubmitting a form that they submit their information by fax or mail. The EDC Program has a fax machine that is dedicated to receiving EDC data and is located in the same room with the locked file cabinets.

Email submission of confidential information is discouraged, as it is not considered secure. On the occasion that confidential data are sent via email, EDC staff prints the email, files it in the secure file cabinet, and then permanently deletes the information. Unused or outdated paper records with confidential information are shredded.

3 Description of EDC Forms

The 2009 and 2010 forms are identical except for the year of data coverage. Some revisions were made to the 2011 forms to clarify questions and instructions. There are brief descriptions of the changes between the 2009/2010 and 2011 forms within the form description subsections below. Forms for all years can be found at the EDC Program form archive[1] and the 2011 forms appear in Appendix H.

3.1 Catcher vessel form

Form question types are divided into six categories: contact information, vessel characteristics, capitalized expenditures, quota and permit expenses, annual expenses, annual earnings, and crew share.

Contact information

The first part of the form includes administrative information, including contact information for the owner of the vessel, lessee of the vessel (if applicable), and the person who filled out the form. A sub-question asking for lease dates was added in 2011. This information enables the calculation of revenue associated with each form submission.

Vessel characteristics

This section includes information about the vessel and the fisheries in which it participates. These fields include total fuel use and average fuel use, speed, crew size, and total days at sea by fishery. In the days at sea question, the category "Other West Coast fisheries" was added to the list of fisheries on the 2011 form.

[1] www.nwfsc.noaa.gov/research/divisions/fram/economic_data.cfm

Capitalized expenditures

Capitalized expenditures include vessel and on-board equipment, fishing gear, and processing equipment. The total expenditures on vessel and on-board equipment is requested on the form; where total includes all expenditures made on operations in all fisheries, including Alaska. Other capitalized expenditure categories include fishing gear and processing equipment is broken out into expenditures for West Coast fisheries and expenditures that are shared by West Coast fisheries and Alaska. This distinction is an attempt to focus on expenditures pertinent only to West Coast operations, which, in some cases, may be impossible to wholly separate from expenditures for Alaska and other fisheries. Changes were made on the 2011 form to add clarification to the definitions of these expenditures categories.

Quota and permit expenses

This question category asks for the total expenses on purchase and lease of quota shares, quota pounds, limited entry trawl permits and limited entry fixed gear permits. Due to a moratorium on the sale of quota share through 2014, participants are only allowed to lease quota shares. The only change to this section in 2011 was a reformat of the response table.

Annual expenses

This section contains a list of twenty-three expense categories. In this same section the number of pounds of fish landed in Alaska is requested, and will be used to disaggregate the shared expenses between the West Coast and Alaska. There is also a question about whether fish were processed on-board. Few changes were made in 2011: the expense "Commission costs" was appended to "Fishing association costs" and "State licensing and Federal permit fees" was added as a separate category.

Annual earnings

The annual earnings section asks for West Coast at-sea deliveries to motherships, Alaska shoreside landings and at-sea deliveries, and sale and lease of permits, quota shares, and quota pounds. Additionally earnings from salmon disaster relief payments and chartering or research or leasing vessel are requested. This section does not ask for West Coast shoreside landings because this information can be obtained from state fish ticket data.

Crew share

The last section of the form covers the crew share system used on the vessel while participating in the groundfish fishery. This section uses checkboxes for participants to indicate which expenses are deducted from gross revenues before calculating crew shares. "Buy back fees" were added to the list of expenses that could be deducted from total revenue before calculating the crew share. The last page of the form asks about how often the vessel owner serves as captain. This section also includes two questions that ask about the percentages that are paid to crew, captain, and vessel. The first question regards trips when the owner serves as captain and the second is when there is a hired captain on-board. Two "other" category fields were added to the crew share percentage categories in 2011, to account for potential items that were not previously listed.

3.2 Catcher-processor form

Contact information

Like the catcher vessel forms, the catcher-processor form begins with a series of questions about the vessel characteristics, permit information, and contact information for the individual completing the report (and lessee, where applicable), and the same questions regarding the vessel valuation as the catcher vessel survey.

Vessel characteristics

The form asks for fuel use for fishing, processing and steaming in the West Coast whiting fishery and for fuel use steaming between the West Coast and Alaska, and proceeds to query about types of fuel and Days at Sea for various activities relating to the whiting and Alaska fisheries. Participants are asked to provide the number of one-way trips to Alaska, as well as the average number of processing and non-processing crew members.

Capitalized expenditures

This section of the form relates to capitalized expenditures, both shared with Alaska and for the West Coast whiting fishery only. These categories mirror those on the catcher vessel form and relate to new and used vessel and on-board equipment, processing equipment, and fishing gear.

Permit expenses

In the next section, participants provide the total cost of permit expenses, which for the catcher-processor forms includes a section for the purchase and lease of co-op shares.

Annual expenses

The next section collects annual expenses. This includes expenses on crew travel, observer fees, fuel and lubrication, food, freight to the vessel on supplies, communications, offloading, and other supplies that includes items such as linens, clothing, or cleaning supplies. There are also categories for repair and maintenance on fishing gear both shared and for West Coast whiting only, processing equipment repair and maintenance, vessel and on-board equipment repair and maintenance. The form asks for all expenses on insurance premium payments, moorage, lease or bareboat charter, and depreciation. In addition to basic vessel operating costs, this form ask for co-op dues and membership fees, Marine Stewardship Council fees, additives, packing materials, and on-board cargo and product insurance. This section also includes crew expenses, differentiated between processing and non-processing crew.

Offload port

This portion of the form requests the percentage of total off-load value by port, where port locations include Seattle, Blaine or Bellingham, Port Angeles, Westport or Hoquiam, Astoria, Coos Bay, At sea (tramper), and Other.

Revenue

This section is designed for the participant to provide the round weight of all fish processed in all fisheries, which includes Alaska and other fisheries outside the West Coast. Values for revenue resulting from the sale or lease of permits are also requested in this section, along with revenue resulting from a lease or bareboat charter of the vessel. Lastly, the catcher-processor survey asks for revenue information resulting from the sale or lease of quota shares and pounds.

3.3 Mothership form

Contact information

The mothership forms begins with a series of questions about the vessel characteristics, permit information, and contact information for the individual completing the report and lessee, where applicable, and some basic questions regarding the vessel valuation.

Vessel characteristics

Mothership forms ask for fuel use for processing and steaming in the West Coast whiting fishery and for fuel use steaming between the West Coast and Alaska, and proceed to query about types of fuel and Days at Sea for various activities relating to the whiting and Alaska fisheries. Participants are asked to provide the number of one-way trips to Alaska, as well as the average number of processing and non-processing crew members,

Capitalized expenditures

The second section of the form relates to capitalized expenditures, both shared with Alaska and for the West Coast whiting fishery only. These categories mirror those on the catcher vessel form and relate to new and used vessel and on-board equipment, processing equipment, and fishing gear.

Permit expenses

In this section, participants provide the total cost of permit expenses.

Annual expenses

The next section collects annual expenses. This includes expenses on crew travel, observer fees, fuel and lubrication, food, freight to the vessel on supplies, communications, offloading, and other supplies that includes items such as linens, clothing, or cleaning supplies. There are also categories for repair and maintenance on fishing gear both shared and for West Coast whiting only, processing equipment repair and maintenance, vessel and on-board equipment repair and maintenance. The form asks for all expenses on insurance premium payments, moorage, lease or bareboat charter, and depreciation. In addition to basic vessel operating costs, the mothership form asks for co-op dues and membership fees, additives, packing materials, and on-board cargo and product insurance. This form also requests crew expenses differentiated between processing and non-processing crew.

Fish purchases

The mothership form asks for the weight and costs for fish purchased on the West Coast, separated into a category for whiting and a category for all other species.

Offload port

Like the catcher-processor form, the mothership form asks for the percentage of total off-load value by port, where port locations include Seattle, Blaine or Bellingham, Port Angeles, Westport/Hoquiam, Astoria, Coos Bay, At sea (tramper), and Other.

Revenue

The form requests the round weight of all fish processed in all fisheries, which includes Alaska and other fisheries outside the West Coast. This question provides information that can be used to allocate costs between the West Coast and Alaska activities without requiring more detail about these vessels' Alaska operations. Values for revenue resulting from the sale or lease of permits are also requested in this section, along with revenue resulting from a lease or bareboat charter of the vessel.

3.4 First receiver and shorebased processor form

Both first receivers and shorebased processors fill out a single form.

Contact information and facility appraisal value

The first portion of the first receiver and shorebased processor forms asks for state identification numbers, as well as general contact information about the plant and the person filling out the form. This includes questions about the appraised value of the facility.

Capitalized expenditures on buildings and machinery

The second section of the first receiver form covers capitalized expenditures on buildings and machinery.

Employees

This section is followed by a section about employees and payroll. Participants provide the number of production workers and total hours worked the week including the twelfth day during each month to provide a general idea of seasonal shifts in labor. Production workers include workers involved in fabricating, processing, assembling, inspecting, receiving, packing, warehousing, shipping, maintenance, repair, janitorial, product development, or transporting product on-site, as well as the line-supervisors. A subsequent question asks for the number and hours of all other non-production employees, including other supervisors, and individuals involved in sales, advertising, credit, collection, installation, cafeteria, record-keeping, clerical, and routine office functions, guard services, executive, purchasing, finance, and legal. The final question in this section asks for labor expenses for both employee categories, including wages, bonuses, benefits, payroll taxes, and employment insurance.

Expenses

The next section asks for selected expenses and depreciation, specifically quota expenses, utilities, rental or lease payments, repair and maintenance costs, depreciation, custom processing fees, and other expenses. Other expenses include shoreside monitoring costs, offloading expenses, production supplies, cleaning and custodial supplies, packing materials, freight costs, non-fish additives, off-site product freezing and storage, insurance payments, property and excise taxes, and licensing fees. In the 2011 survey, the final portion of this section asks for weight and cost of groundfish purchases by landing origin, including the West Coast, Alaska, and Canada.

Fish purchased and received

The fish received portion of the survey asks for weight of fish paid and not paid for, and the gross cost of fish paid for from vessel sources, including limited entry trawl, limited entry fixed gear, other vessels, and then non-vessel sources. This section is subdivided into more than twenty species categories, adding categories for arrowtooth flounder, pacific sanddab, and sturgeon on the 2011 forms in response to participant suggestion on the 2009 and 2010 forms. The 2011 forms also add a column asking for total weight not paid for transfers from outside this facility, to attempt to capture what some participants described as a high volume of fish transferred between different facilities belonging to a single parent company.

Earnings

The annual earnings portion asks for total weight and total value of fish production by fish type and product type, including fresh, frozen, unprocessed, and other. The final page of the form asks for other earnings, including custom processing revenue, offloading earnings, and sale and lease of quota.

4 QA/QC Process

The EDC Program has implemented several processes in order to ensure high quality data. These processes include double-key entry of all data, business checks to ensure consistency of data within a form, and business checks to ensure that data provided on forms are consistent with external data. Each process is summarized separately below. Figure 4.1 describes the full set of processes, including how discrepancies are resolved.

4.1 Double-key entry

In order to limit the number of errors introduced by data entry mistakes, data from each paper form are entered into electronic PDF forms by two individuals (Figure 4.1). Once the data have been entered twice, an economist confirms that there are no mismatched entries and corrects any miskeys that may have occurred. The data are then loaded into a database where both copies of the data are stored. A program then runs additional checks to ensure that there are no mismatched entries, and does a few simple cleaning steps, such as converting all text to uppercase, standardizing address formats, and removing non-alphanumeric characters. The phone and fax fields are similarly standardized. If any entries still do not match, a flag is created, and the mismatched data will not be available to the economist until the miskey has been resolved. Any changes to the data are "journaled" and the database tracks which user made the changes.

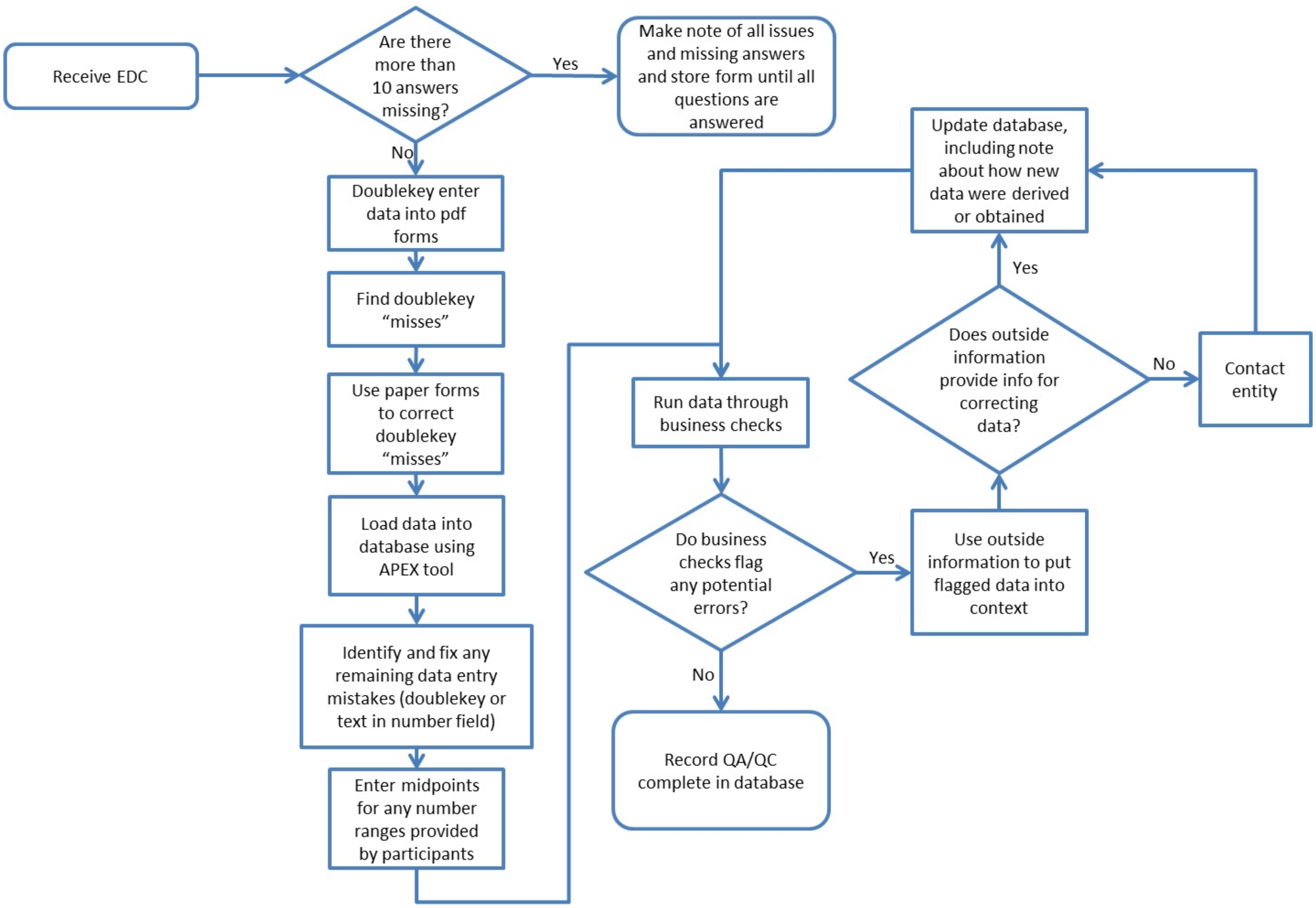


Figure 4.1: Data QA/QC system.

4.2 Data validation

The EDC Program developed a set of business checks to look for potential inaccuracies in the information provided on the forms. These checks are designed to both identify inconsistencies with the information provided within a specific form, and to check for inconsistencies with external data.

The data checks can be separated into two different categories. There are what are referred to as "true errors" versus "potential problems". "True errors" refer to a set of data points that when combined together cannot be correct; whereas "potential problems" are a data point or set of data points that seem unlikely to be correct, but could be correct. One example of a "true error" is a when a participant provides revenue from fishing in Alaska greater than zero, but also records that they spent zero days fishing in Alaska. It is impossible that both data points are true and therefore this is classified as a "true error". An example of a "potential problem" is when the value recorded for a capitalized investment on fishing gear is exactly the same as the value recorded for expenses on fishing gear. In this case, it is possible that they made two separate outlays of exactly the same value, but it is more likely that they recorded the same outlay twice. In both cases, we will contact the participant to obtain additional information.

The set of business checks continues to expand and evolve as the EDC Program matures. These continued developments are a result of increased understanding of the EDC data and external data sources, and additional time to program validation checks. One important way the checks will continue to improve is through the collection of additional years of data. More years of data provide the economists with a better understanding of "typical" responses. Similarly, the economists have a clearer understanding of common mistakes and are better able to both identify the issues and work with participants to correct the issues. The business checks have also improved over time with the incorporation of outside data such as Permit Office data, AKFIN data, and fish ticket data. As our capabilities to access and interpret additional data increase, these data will also be incorporated into the checks.

4.2.1 External data

External data sources are an essential source of information for conducting the business checks. The four most common data sources used for validation are state fish ticket data obtained from the Pacific Fisheries Information Network (PacFIN), At-Sea Hake Observer Program (A-SHOP) data obtained from PacFIN, Permit Office data obtained from PacFIN and directly from the Permit Office, and Alaska Commercial Fisheries Entry Commission (CFEC) obtained from the Alaska Fisheries Information Network (AKFIN). These data provide a larger context to the information provided on the forms and allow for a more productive conversation when contacting survey participants.

State fish ticket data, available through PacFIN, are used to validate information about fishery participation. The data provide the weights and ex-vessel revenue by species and delivery location. For all landings, both the entity that purchased the fish and the vessel that landed the fish are identified on a daily level.

At-sea deliveries are not recorded in the state fish ticket records. This information is obtained from the A-SHOP. This data has a similar format to the state fish ticket data, with daily information about landings by species and includes both the catcher vessel that caught the fish and the mothership that purchased the fish, or the catcher-processor that caught and processed the fish.

The Permit Office maintains a historical database of the owner and holder of every limited entry permit. The vessel owner can be different from the owner of the permit, if the vessel owner is leasing the permit from another company. Additionally, starting in 2011, the Permit Office also maintains a record of all holders of first receiver site licenses. These licenses are not transferable and are entity and location specific.

AKFIN provides an annual list of all catcher vessels identified by the EDC Program that fished in Alaska during that year. This list is created by combining the Coast Guard vessel identification numbers provided by the EDC Program with Alaska commercial fishing vessel licenses information provided by the CFEC.

4.2.2 Catcher vessel form business checks

The internal business checks for catcher vessel forms are relatively simple and can be predominantly classified as checks for "true errors". A full list of all of the business checks performed can be found in Appendix E. Most of the checks are designed to ensure that a complete set of information about each fishery in which the entity participated is recorded on the form.

The set of business checks regarding Alaska operations are the most extensive and include the days at sea fishing in Alaska, the days steaming between the West Coast and Alaska, the number of trips to and from Alaska, the total round weight of landings and at-sea deliveries, and the total revenue from the landings and deliveries. A check is performed to ensure that if any one question implies that the vessel participated in an Alaska fishery, then the respondent provides all of the other relevant Alaska operational information.

A similar check is performed for other fishery activities, though the number of checks is smaller. The checks ensure that if a vessel participated in a particular fishery, then they must provide all of the following information: the average fishing speed, the average daily fuel use, the average crew size, and the total days at sea spent in the fishery.

In a similar fashion, if a participant indicates that they did not participate in a particular fishery, a flag is generated if a different response conflicts with that answer. The most common case is when a participant indicates that they did not participate in any Alaska fisheries, but they recorded a capitalized expenditure for equipment that was shared between the West Coast and Alaska.

Additional consistency checks are performed using external data; primarily permit data, fish ticket data, at-sea deliveries information, and information about whether the vessel fished in Alaska.

These external checks are primarily used to provide context to the responses provided on the forms. For example, a form may have conflicting information about whether the vessel fished in Alaska. In this case, Alaska fish ticket data can be used to determine whether the vessel participated in that fishery.

The 2009 and 2010 data collection forms asked whether the vessel harvested fish. If the vessel did not harvest fish during the survey fiscal year, then they were only required to answer a small subset of the questions on the forms. If a vessel respondent indicated the vessel did harvest fish, this response was verified using state fish ticket, At-Sea Hake Observer Program data, and Alaska fish ticket data.

4.2.3 Catcher-processor form business checks

The business checks for the catcher-processor forms are less extensive than the catcher vessel checks. This is because there are many fewer catcher-processor forms than catcher vessel forms, which means that many errors can be caught visually rather than using a computer program.

The catcher-processor business checks have similar checks for consistency across questions about participation in Alaska fisheries and other fisheries and check that responses to capitalized expenditure questions are consistent with other responses on the forms.

There are two questions specific to the at-sea forms. The first checks that for every product type listed on the form, if a weight of production is listed then a value for that product type is listed and vice versa. Additionally, there is a check to ensure that the offload percentages by port sum to 100%.

4.2.4 Mothership form business checks

The business checks for the mothership forms are nearly identical to the catcher-processor checks. One additional check is added to check that the value of production is greater than the cost of purchases of fish. Values that are flagged by this field are considered a "potential problem" and not "true errors".

4.2.5 First receiver and shorebased processor checks

Each data element reported on the catcher vessel, mothership and catcher-processor forms is relatively simple and discrete. This means that once an issue is flagged by the business rule checks, it is relatively straightforward for the economist to identify the problem and contact the participant to resolve the issue. The first receiver and shorebased processor forms have a more complex data structure and therefore require a more detailed review than what is required for the other forms. Another complication with first receiver and shorebased processor data is the diversity of types of operations, as these businesses range from catcher vessel owners who rent a hoist at the end of a pier to offload their own fish, to businesses that own multiple large processing facilities. The diversity makes it more difficult to distinguish "true errors" from "potential problems".

Checks listed in Appendix E identify potential problems, but additional automated analysis is required in order to identify the sources of the problems. For example, there is a business check to determine whether the total weight of production of a particular species is less than or equal to the total weight of purchase of that species. This provides some information, but often when combined with fish ticket data and the cost of purchase, and value of production, it can become clear whether the issue was a result of an error in the production weight or the purchase weight.

Another more involved check is the analysis of markups, prices, and product recovery rates. A markup is defined as the total value of production of a particular species group divided by the total cost of the purchase of the species group. The product recovery rate is defined as the total weight of production divided by the total weight of purchases of the species group. Besides being of interest for their economic content or information, they can also provide information about potential errors. However, the EDC analysis must use a more ad-hoc approach to determining which values might indicate a problem.

In addition to the complexity of the data provided on the forms, one company may submit forms for multiple facilities. A typical case is a company that has multiple buying locations and/or multiple processing locations. If a company does not track their production by location, the individual facility forms must be combined in order to understand the operations of the company.

To try to address the issues listed above, a set of tables is generated that combine the fish purchase and production information by company, and incorporates state fish ticket data. These tables provide total purchases, total costs, total production, and total revenue by species group. The code then calculates the average price per pound, revenue per pound, markup, and recovery rate by species group. This information, combined with fish ticket data provides a more complete picture of the company's operations and allows the economist to identify potential issues with the data. These tables also allow the economist to discuss the issues with the participant and to assist with identifying potential causes of the issues.

4.3 Resolving data validation flags

Once the business checks have been run, the EDC staff attempt to investigate and resolve all issues that were flagged (Figure 4.1). The first step is to determine if an issue can be resolved by looking at the paper submission. Issues can often be resolved by examining additional notes provided by a participant on the form or occasionally, further inspection of response can reveal a different understanding or the original response. As a second step, EDC staff will use other available data, such as previous phone calls with participants, and external data sources to provide context to the information.

If the above data steps do not resolve a data flag, the EDC staff will call the participant to resolve the issue. All conversations associated with each form are documented in an online database.

Table 4.1 shows a representative example of a typical communication with a participant with potential form issues. On average, each form requires about three communications to complete a form, but the range is between 0 and 14 communications (Table 4.2). Depending on the complexity of the question, it could take several phone calls to resolve a particular issue. Most issues can be resolved with one or two phone calls, but there are some cases were much more effort is required as shown in Figure 4.2. If there are only a few issues that need to be resolved, the economist will collect the information over the phone. If the issues with the form are extensive, the economist will request that the participant resubmit the form via mail or fax. The latter case is most common for the first receiver and shorebased processor form where the data are more complex.

Once the new information has been obtained, the data are entered into the database and a comment is recorded explaining how the data point was resolved. The business checks are then rerun to double-check that the original issue has been resolved and to check that no new flags are created due to any changes in the data. There is a dedicated comment field for each data element in the database.

Data will be modified in the database without communicating with the participant if the participant provided a range of values. In this case, EDC staff enters the midpoint value. The most common case of this is when participants enter ranges of values are when providing the average daily fuel use and average crew size by fishery. The EDC staff will also modify a response if it is known that the value must be zero. This most often occurred when a participant entered the same value for an expense made on equipment used on the West Coast and equipment shared between the West Coast and Alaska. If the vessel did not fish in Alaska, then it was assumed that the shared value should be zero.

Table 4.2 gives the quintile breakdown of communications per form. Approximately half the forms require at least two phone calls, with some forms requiring much more attention, as demonstrated in the communication record above.

Table 4.1: Example of communication record with a participant. Personal identifying information removed and dates changed. Example of communication record with a participant.

	Date	Comments
1	[05/06/2011 02:24 PM]	I called and left a message for Julie, explaining that there are missing responses on her form and asking her to call me back.
2	[05/07/2011 12:52 PM]	Julie called me back and explained that she didn't know that she needed to answer all of the questions. We discussed the missing fields and she told me that she would fax me the responses to the remaining questions.
3	[05/27/2011 10:02 AM]	I received the fax with the missing questions and the form is now complete.
4	[06/21/2011 11:50 AM]	Production weight of crab is four times the purchase weight of crab
5	[07/01/2011 03:15 PM]	I called Julie and explained that we need her to take another look at the crab purchase and production weights, she will call back with the value
6	[09/25/2011 01:50 PM]	Julie called back and explained that they had not recorded purchases of fish from Other Sources on their form, she gave me the purchase weight and cost.
7	[11/06/2011 08:47 AM]	I recorded the purchase weight and cost and entered the new values into the database, I reran the data checks and there are no flags.

Table 4.2: Number of communications with participants. Summary statistics of the number communications with each participant of each form, including emails, phone calls, and voicemails per form during the survey collect period June 2011 through March 2012

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	1	3	3	3	14

```
## Warning:  closing unused RODBC handle 2
## Warning:  closing unused RODBC handle 1
```

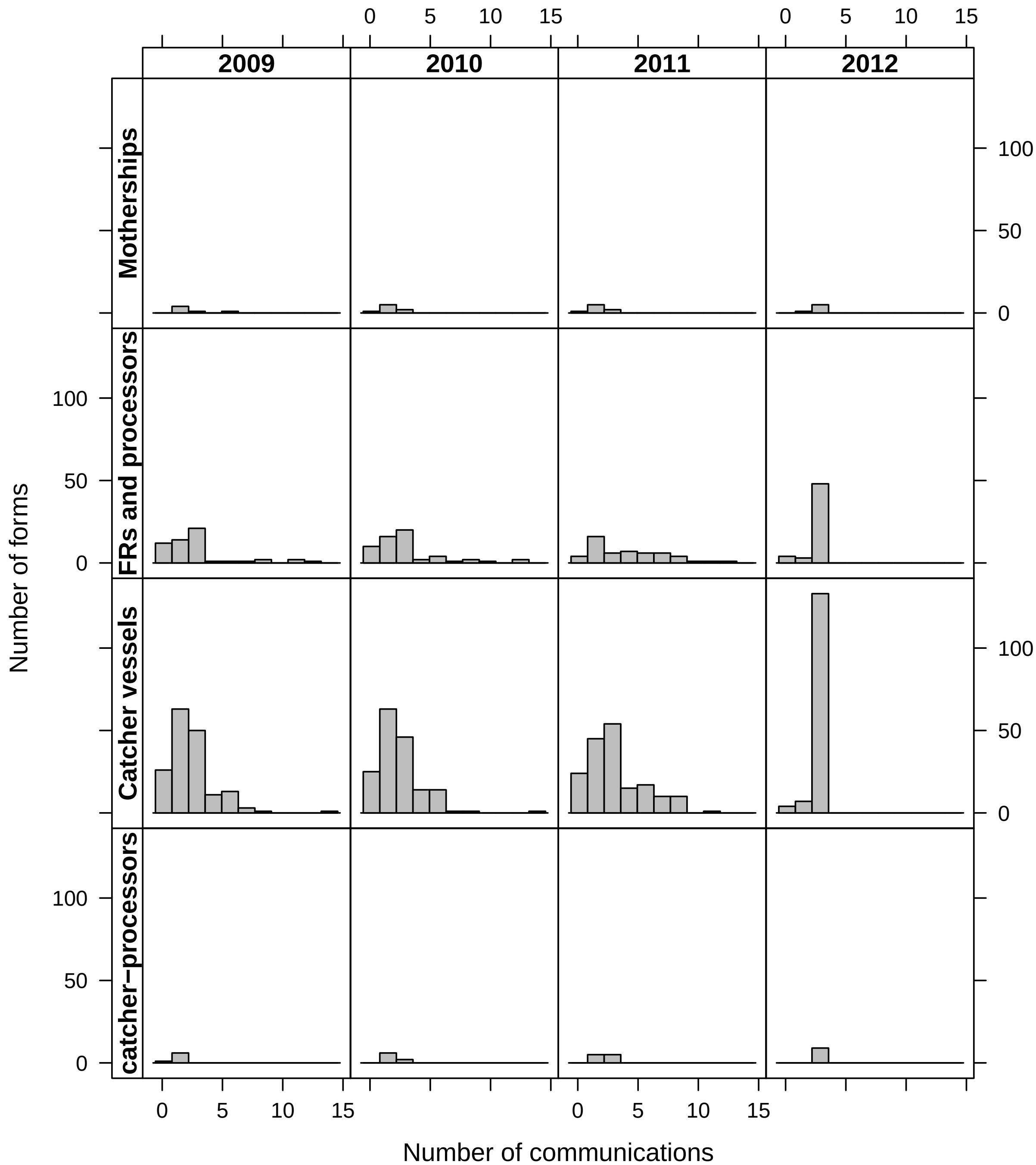


Figure 4.2: Frequency distribution of the number of communications required per form.

As shown in Figure 5.2, buyers typically require the most attention per form, but the number of communications required for both the catcher vessel and first receiver and shorebased processor groups declined from the baseline years to 2011.

4.4 Outlier analysis

The EDC Program used basic single-variable outlier detection methods on the 2009 and 2010 baseline data to identify possible recording errors by participants and in EDC data-entry. After computing a standardized score for each numerical observation, scores with an absolute value greater than 2.5 were considered potential outliers. The list generated from this analysis included 103 observations, and each of these values was hand-checked against the participant's paper form to ensure no error had occurred during the double-key data entry process. No such errors were found. Attempts were made to contact participants regarding extreme values as a part of the QA/QC process, some of the extreme values were explained as the result of unusual circumstances and thus left in the database, and others were the result of a recording error on the part of the participant that was subsequently corrected. Time constraints did not allow for this analysis for the 2011 data, this analysis will be updated for 2011 and future years.

5 Data Processing

5.1 Standardizing NA and zero responses

As mentioned previously in this report, all EDC forms instruct participants to write NA in each answer box that is "Not Applicable" to their operation. In practice, the NAs in the data may represent zeroes, not applicable, or information that is not known. For analysis purposes, it is important to distinguish between these types of responses to ensure that calculations accurately reflect the data provided by all participants. For example, a survey response that indicated expenses on travel as NA might not have incurred any crew travel expenses that year, in which case the expense would be zero, and the fleet average expense on crew travel would be appropriately lowered. However if that participant wrote "NA" in the box because the information on that expense was not available, the value is unknown and should be excluded from calculations.

Despite efforts to contact participants in order to fill in missing information or clarify data on the forms, there are cases where either the participant is unable to provide the information or the participant cannot be reached. In these cases, it is necessary to develop a system to ensure null values are treated appropriately. As a result, the EDC Program has implemented a series of rules that determine for each answer type whether to take one of four actions:

1. Leave a zero as a zero.
2. Convert a zero to NA.
3. Leave an NA as NA.
4. Convert an NA to zero.

Validation checks were developed to determine which values are true zeroes or NAs and which values should be converted. There were three primary data sources used to perform these validation checks; state fish ticket data, information derived from Alaska Commercial Fisheries Entry Commission data provided by AKFIN, and EDC data.

The validation rules are applied after all other QA/QC processes have been completed. The determination about how to handle a particular NA or zero depends on the question type, additional information provided on the form, and outside information. For each variable, the value entered into the database depends on whether the validation check is true or false, and whether the value entered on the form is a NA or a zero. The definitions of the validation checks and descriptions of each of the variables can be found in Appendix F.

6 Previous Data Collections

6.1 Cost-Earnings voluntary data collection

Voluntary Cost-Earnings data has been collected by the economists at the Northwest Fisheries Science Center (NWFSC) since 2005, when data were collected for fishing activities in 2003 and 2004. This voluntary survey and subsequent voluntary surveys were jointly conducted by the NWFSC and Pacific States Marine Fisheries Commission. The voluntary cost-earnings surveys always collect two years of data per form.[1].In Table 6.1, surveys marked as "EDC" are part of the EDC.

A dataset is being constructed that compiles all of the data collected through the voluntary cost-earnings surveys and the mandatory EDC survey. The data set will identify the survey instrument, the year of collection, the survey population, and the question as presented on the form. Many variables have been consistently collected since the initial collection; these variables will be named consistently through time. For variables that have changed over time, new variable names will be developed as needed. One major change between the voluntary cost-earnings survey and the mandatory EDC Program is the way expenses are collected. In the Cost-Earnings forms, the expenses are requested for all activities (West Coast, Alaska, and other), while on the EDC forms, some expenses are requested specifically for West Coast fisheries and some for all fisheries. These distinctions will be clearly defined in the complete dataset.

[1] Lian, C.E. 2010. West Coast limited entry groundfish trawl cost earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p. and Lian, C.E. 2012. West Coast limited entry groundfish cost earnings survey: Protocol and results for 2008. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-121, 62 p

Table 6.1: Previous cost-earnings surveys. List of cost-earnings surveys of West Coast commercial fishing vessels and processors that have been collected (2003-2011).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	EDC
Limited Entry Trawl	X	X			X	X	X	X	X	X
Limited Entry Fixed Gear	X	X			X	X		X	X	
Open Access Groundfish	X	X			X	X			X	
Salmon Troller			X	X		X	X		X	
Salmon Netter						X	X		X	
Crab and Shrimp			X	X		X	X		X	
Mothership Catcher Vessels							X	X	X	X
Catcher Processor							X	X	X	X
Mothership							X	X	X	X
First Receiver and Shorebased Processor							X	X	X	X

Appendix A EDC Fact Sheet

West Coast Groundfish Trawl Catch Share Program

2012

Mandatory Economic Data Collection (EDC)

Overview

In January 2011, the West Coast groundfish trawl fishery transitioned to a new, innovative management approach known as a Catch Share Program. The Catch Share Program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet and cooperative programs for the at-sea mothership and catcher/processor trawl fleets.

As part of this new program, participants in the rationalized fishery are required to provide economic data. The following information provides an overview of the economic data collection (EDC) requirements and seeks to answer some commonly asked questions. For specific guidance, the regulations detailing the EDC program (50 CFR 660.114) are available at: www.nwfsc.noaa.gov/edc

Frequently Asked Questions

Why is there an economic data collection program?

The economic benefits of the West Coast groundfish trawl fishery and their distribution will likely change under trawl rationalization. To monitor these changes, the rationalization program includes a mandatory economic data collection program. Using data collected from industry members, the EDC program will monitor whether the goals of the Catch Share Program have been met. The EDC program will also help meet the requirements of the Magnuson-Stevens Act for catch share evaluation.

What types of data are collected?

In addition to contact information, the EDC program will collect vessel/plant characteristics, capitalized investments, annual expenses, annual earnings, crew/labor payments, and quota and permit expenses that will provide a strong foundation for managers to evaluate the Catch Share Program.

What important dates should I be aware of?

May 2012: Fiscal year 2011 EDC forms are mailed to participants.

September 1, 2012: Fiscal year 2011 EDC forms are due.

NOAA FISHERIES SERVICE

For more details on the Catch Share Program, call 206-526-6140 or go to our website:

www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Trawl-Program/index.cfm

For the full groundfish regulations, see the Code of Federal Regulations (CFR) at 50 CFR part 660, subparts C-G.

West Coast Groundfish Trawl Catch Share Program

Who is required to submit EDC forms?

Fishery Participant	Who is required to submit EDC forms?
Limited Entry Trawl Catcher Vessels	All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit at any time in 2011 and beyond.
Motherships	All owners, lessees, and charterers of a mothership vessel registered to a mothership permit at any time in 2011 and beyond.
Catcher/Processors	All owners, lessees, and charterers of a catcher processor vessel registered to a catcher/processor-endorsed limited entry trawl permit at any time in 2011 and beyond.
First Receivers	All owners of a first receiver site license in 2011 and beyond.
Shorebased Processors	All owners and lessees of a shorebased processor that received round or headed-and-gutted IFQ groundfish species or whiting from a first receiver in 2011 and beyond.

What happens to the data once submitted?

Data are used by Northwest Fisheries Science Center (NWFSC) economists to evaluate the Catch Share Program. Aggregated data and analyses are compiled into a report and presented to the Pacific Fishery Management Council. Future reports will be available online at: **www.nwr.noaa.gov**

Who has access to this data? Is it confidential?

The data are studied by NWFSC economists or their contractors. Everyone who works with this data is required to sign a confidentiality agreement. Responses to the EDC forms are confidential under the Magnuson-Stevens Act and NOAA Administrative Order 216-100.

What happens if I don't submit the economic data collection form?

Economic data collection is mandatory under the Catch Share Program, and thus participation in the EDC program is mandatory under the regulation 50 CFR 660.114. If you do not submit the required EDC form, it may delay the completion of administrative actions such as permit renewal, vessel registration, license issuance, and quota transfers.

Where can I get an economic data collection form?

Forms are available to print at: **www.nwfsc.noaa.gov/edc**

Under the EDC program, NOAA Fisheries mails EDC forms in May of each year to individuals who, according to available records, are required to complete an EDC form. If you do not receive a form by mail, it is still your responsibility to complete and return it by the deadline.

Where can I learn more about the West Coast Catch Share Program?

NOAA Fisheries Northwest Region's Catch Share website: www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Trawl-Program/index.cfm

Who should I contact if I have other questions?

Erin Steiner, Economic Data Collection Program (FRAM Division), Northwest Fisheries Science Center

Mail Address: 2725 Montlake Boulevard East, Seattle, Washington 98112

Phone: (866) 791-3726

E-mail: NWFSC.EDC@noaa.gov

Appendix B Excerpts of Regulations Relevant to EDC Program

For reference, excerpts from 50 CFR PART 660, SUBPARTS C - G FEDERAL PACIFIC COAST GROUNDFISH REGULATIONS FOR COMMERCIAL AND RECREATIONAL FISHING 3-200 NAUTICAL MILES OFF WASHINGTON, OREGON, AND CALIFORNIA regulations are appended here. These are the current regulations, as of May 1, 2012.

(D) Limited entry permits with sablefish endorsements, as described at paragraph (b)(3)(iv) of this section, will not be renewed until SFD has received complete documentation of permit ownership as required under paragraph (b)(3)(iv)(C)(4) of this section.

(E) Limited entry permits with an MS/CV endorsement or an MS permit, will not be renewed until SFD has received complete documentation of permit ownership as required under §660.150(g) and §660.150(f) of subpart D, respectively.

(F) A limited entry permit will not be renewed until a complete economic data collection form is submitted as required under § 660.113(b), (c) and (d), subpart D. The permit renewal will be marked incomplete until the required information is submitted. {added at 75 FR 78334, 12/15/2010}

(ii) Combining limited entry "A" permits. Two or more limited entry permits with "A" gear endorsements for the same type of limited entry gear may be combined and reissued as a single permit with a larger size endorsement as described in paragraph (b)(3)(iii) of this section.

(A) Sablefish-endorsed permit. With respect to limited entry permits endorsed for longline and pot (trap) gear, a sablefish endorsement will be issued for the new permit only if all of the permits being combined have sablefish endorsements. If two or more permits with sablefish endorsements are combined, the new permit will receive the same tier assignment as the tier with the largest cumulative landings limit of the permits being combined.

(B) MS/CV-endorsed permit. When an MS/CV-endorsed permit is combined with another MS/CV-endorsed permit or with another limited entry trawl permit with no MS/CV or C/P endorsement, the resulting permit will be MS/CV-endorsed with the associated CHA as specified at §660.150(g)(2)(iv) and (v). If an MS/CV-endorsed permit is combined with a C/P-endorsed permit, the MS/CV endorsement and CHA will not be reissued on the combined permit. {revised at 76 FR 74725, 12/1/2011}

(C) C/P-endorsed permit. A C/P-endorsed permit that is combined with a limited entry trawl permit that is not C/P-endorsed will result in a single C/P-endorsed permit with a larger size endorsement. An MS/CV endorsement on one of the permits being combined will not be reissued on the resulting permit.

(iii) Stacking limited entry permits. "Stacking" limited entry permits, as defined at §660.11, subpart C, refers to the practice of registering more than one sablefish-endorsed permit for use with a single vessel. Only limited entry permits with sablefish endorsements may be stacked. Up to 3 limited entry permits with sablefish endorsements may be registered for use with a single vessel during the primary sablefish season described at §660.231, subpart E. Privileges, responsibilities, and restrictions associated with stacking permits to fish in the primary sablefish fishery are described at §660.231, subpart E and at paragraph (b)(3)(iv) of this section.

landings reported on state landing receipts. As required at §660.12(b), any person landing sablefish must retain on board the vessel from which sablefish is landed, and provide to an authorized officer upon request, copies of any and all reports of sablefish landings from the primary season containing all data, and in the exact manner, required by the applicable state law throughout the primary sablefish season during which a landing occurred and for 15 days thereafter. {revised at 76 FR 74725, 12/1/2011}

(D) Change in MS/CV endorsement registration. The requirements for a change in MS/CV endorsement registration between limited entry trawl permits are specified at §660.150(g)(2)(iv). {added at 76 FR 74725, 12/1/2011}

(v) Changes in vessel registration of limited entry permits and gear endorsements

(A) General. A permit may not be used with any vessel other than the vessel registered to that permit. For purposes of this section, a permit change in vessel registration occurs when, through SFD, a permit owner registers a limited entry permit for use with a new vessel. Permit change in vessel registration applications must be submitted to SFD with the appropriate documentation described at paragraph (b)(4)(vii) of this section. Upon receipt of a complete application, and following review and approval of the application, the SFD will reissue the permit registered to the new vessel. Applications to change vessel registration on limited entry permits with sablefish endorsements will not be approved until SFD has received complete documentation of permit ownership as described at paragraph (b)(3)(iv)(C)(*4*) and as required under paragraph (b)(4)(vii) of this section. Applications to change vessel registration on limited entry permits with trawl endorsements or MS permits will not be approved until SFD has received complete EDC forms as required under § 660.114, subpart D. {revised at 75 FR 78334, 12/15/2010}

(B) Application. A complete application must be submitted to SFD in order for SFD to review and approve a change in vessel registration. At a minimum, a permit owner seeking to change vessel registration of a limited entry permit shall submit to SFD a signed application form and his/her current limited entry permit before the first day of the cumulative limit period in which they wish to fish. If a permit owner provides a signed application and current limited entry permit after the first day of a cumulative limit period, the permit will not be effective until the succeeding cumulative limit period. SFD will not approve a change in vessel registration until it receives a complete application, the existing permit, a current copy of the USCG 1270, and other required documentation. {revised at 75 FR 78334, 12/15/2010}

(C) Effective date. Changes in vessel registration on permits will take effect no sooner than the first day of the next major limited entry cumulative limit period following the date that SFD receives the signed permit change in vessel registration form and the original limited entry permit, except that changes in vessel registration on MS permits and C/P-endorsed permits will take effect

Vessel account means an account held by the vessel owner where QP and IBQ pounds are registered for use by a vessel in the Shorebased IFQ Program.

§ 660.112 Trawl fishery—prohibitions. {revised at 75 FR 78344, 12/15/2010; revised at 76 FR 53833, August 30, 2011}

These prohibitions are specific to the limited entry trawl fisheries. General groundfish prohibitions are defined at §660.12, subpart C. In addition to the general prohibitions specified in §600.725 of this chapter, it is unlawful for any person or vessel to:

(a) General

(1) Trawl gear endorsement. Fish with groundfish trawl gear, or carry groundfish trawl gear on board a vessel that also has groundfish on board, unless the vessel is registered for use with a valid limited entry permit with a trawl gear endorsement, with the following exception.

(i) The vessel is in continuous transit from outside the fishery management area to a port in Washington, Oregon, or California;

(ii) The vessel is registered to a limited entry MS permit with a valid mothership fishery declaration, in which case trawl nets and doors must be stowed in a secured and covered manner, and detached from all towing lines, so as to be rendered unusable for fishing.

(2) Sorting. Fail to sort catch consistent with the requirements specified at § 660.130(d). {added at 75 FR 78344, 12/15/2010}

(3) Recordkeeping and reporting.

(i) Fail to comply with all recordkeeping and reporting requirements at §660.13; including failure to submit information, submission of inaccurate information, or intentionally submitting false information on any report required at §660.13(d), and §660.113. {revised at 76 FR 53833, August 30, 2011}

(ii) Falsify or fail to make and/or file, retain or make available any and all reports of groundfish landings, containing all data, and in the exact manner, required by the regulation at §660.13, subpart C, or §660.113, subpart D.

(iii) Failure to submit a complete EDC form to NMFS as required by § 660.113. {added at 75 FR 78344, 12/15/2010}

(4) Observers. {added at 75 FR 78344, 12/15/2010}

stored in or accessible through a computer or other information retrieval system; worksheets; weight slips; preliminary, interim, and final tally sheets; receipts; checks; ledgers; notebooks; diaries; spreadsheets; diagrams; graphs; charts; tapes; disks; or computer printouts. All relevant records used in the preparation of electronic fish ticket reports or corrections to these reports, including dock tickets, must be maintained for a period of not less than three years after the date and must be immediately available upon request for inspection by NMFS or authorized officers or others as specifically authorized by NMFS. {revised at 76 FR 74725, 12/1/2011}

(b) Shorebased IFQ Program. {added at 75 FR 78344, 12/15/2010}

(1) Economic data collection (EDC) program. The following persons are required to submit an EDC form as specified at § 660.114:

(i) All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit.

(ii) All owners of a first receiver site license.

(iii) All owners and lessees of a shorebased processor.

(2) Electronic vessel logbook. [Reserved]

(3) Gear switching declaration. Any person with a limited entry trawl permit participating in the Shorebased IFQ Program using groundfish non-trawl gear (i.e., gear switching) must submit a valid gear declaration reporting such participation as specified in § 660.13(d)(5)(iv)(A).

(4) Electronic fish ticket. The IFQ first receiver is responsible for compliance with all reporting requirements described in this paragraph.

(i) Required information. All IFQ first receivers must provide the following types of information: Date of landing, vessel that made the delivery, vessel account number, name of the vessel operator, gear type used, catch area, first receiver, actual weights of species landed listed by species or species group including species with no value, condition landed, number of salmon by species, number of Pacific halibut, ex-vessel value of the landing by species, fish caught inside/outside 3 miles or both, and any other information deemed necessary by the Regional Administrator as specified on the appropriate electronic fish ticket form. {revised at 76 FR 74725, 12/1/2011}

(ii) Submissions. The IFQ first receiver must: {revised at 76 FR 74725, 12/1/2011}

(A) Include as part of each electronic fish ticket submission, the actual scale weight for each groundfish species as specified by requirements at §660.15(c), and the vessel identification number.

including estimates of fish weights or species composition, shall not be submitted on electronic fish tickets.

(iv) Waivers for submission. On a case-by-case basis, a temporary written waiver of the requirement to submit electronic fish tickets may be granted by the Assistant Regional Administrator or designee if he/she determines that circumstances beyond the control of a first receiver would result in inadequate data submissions using the electronic fish ticket system. The duration of the waiver will be determined on a case-by-case basis.

(v) Reporting requirements when a temporary waiver has been granted. IFQ First receivers that have been granted a temporary waiver from the requirement to submit electronic fish tickets must submit on paper the same data as is required on electronic fish tickets within 24 hours of the date received during the period that the waiver is in effect. Paper fish tickets must be sent by facsimile to NMFS, Northwest Region, Sustainable Fisheries Division, 206– 526– 6736 or by delivering it in person to 7600 Sand Point Way, NE., Seattle, WA 98115. The requirements for submissions of paper tickets in this paragraph are separate from, and in addition to existing state requirements for landing receipts or fish receiving tickets.

(c) MS Coop Program (coop and noncoop fisheries). {added at 75 FR 78344, 12/15/2010}

(1) Economic data collection (EDC) program. The following persons are required to submit a complete economic data collection form as specified at § 660.114.

(i) All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl MS/CV-endorsed permit.

(ii) All owners, lessees, and charterers of a vessel registered to an MS permit.

(2) NMFS-approved scales

(i) Scale test report form. Mothership vessel operators are responsible for conducting scale tests and for recording the scale test information on the at-sea scale test report form as specified at § 660.15(b), subpart C, for mothership vessels.

(ii) Printed scale reports. Specific requirements pertaining to printed scale reports and scale weight print outs are specified at § 660.15(b), subpart C, for mothership vessels.

(iii) Retention of scale records and reports. The vessel must maintain the test report form on board until the end of the fishing year during which the tests were conducted, and make the report forms available to observers, NMFS staff, or authorized officers. In addition, the vessel owner must retain the scale test report forms for 3 years after the end of the fishing year during which the tests were performed. All scale test report forms must be signed by the vessel operator.

(3) Annual coop report

(i) The designated coop manager for the mothership coop must submit an annual report to the Council for its November meeting each year. The annual coop report will contain information about the current year's fishery, including: {revised at 76 FR 53833, August 30, 2011}

(A) The mothership sector's annual allocation of Pacific whiting and the permitted mothership coop allocation;

(B) The mothership coop's actual retained and discarded catch of Pacific whiting, salmon, Pacific halibut, rockfish, groundfish, and other species on a vessel-by-vessel basis;

(C) A description of the method used by the mothership coop to monitor performance of coop vessels that participated in the fishery;

(D) A description of any actions taken by the mothership coop in response to any vessels that exceed their allowed catch and bycatch; and

(E) Plans for the next year's mothership coop fishery, including the companies participating in the cooperative, the harvest agreement, and catch monitoring and reporting requirements.

(ii) The annual coop report submitted to the Council must be finalized to capture any additional fishing activity that year and submitted to NMFS by March 31 of the following year before a coop permit is issued for the following year. {revised at 76 FR 53833, August 30, 2011}

(4) Cease fishing report. As specified at § 660.150(c)(4)(ii), the designated coop manager, or in the case of an intercoop agreement, all of the designated coop managers must submit a cease fishing report to NMFS indicating that harvesting has concluded for the year.

(d) C/P Coop Program. {revised at 75 FR 78344, 12/15/2010}

(1) Economic data collection (EDC) program. All owners, lessees, and charterers of a vessel registered to a C/P-endorsed limited entry trawl permit are required to submit a complete economic data collection form as specified at § 660.114.

(2) NMFS-approved scales

§ 660.114 Trawl fishery—economic data collection program. {added at 75 FR 78344, 12/15/2010}

(a) General. The economic data collection (EDC) program collects mandatory economic data from participants in the trawl rationalization program. NMFS requires submission of an EDC form to gather ongoing, annual data for 2011 and beyond, as well as a onetime collection in 2011 of baseline economic data from 2009 through 2010.

(b) Economic data collection program requirements. The following fishery participants in the limited entry groundfish trawl fisheries are required to comply with the following EDC program requirements:

Fishery participant	Economic data collection	Who is required to submit an EDC?	Consequence for failure to submit (In addition to consequences listed below, failure to submit an EDC may be a violation of the MSA.)
(1) Limited entry trawl catcher vessels.	(i) Baseline (2009 and 2010) economic data.	All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit at any time in 2009 or 2010.	(A) For permit owner, a limited entry trawl permit application (including MS/CV-endorsed limited entry trawl permit) will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C. (B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration, vessel account actions, or if own QS permit, issuance of annual QP or IBQ pounds) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C and §660.140(e), subpart D. (C) For a vessel lessee or charterer, participation in the groundfish fishery (including, but not limited to, issuance of annual QP or IBQ pounds if own QS or IBQ) will not be authorized, until the required EDC for their operation of that vessel is submitted.
	(ii) Annual/ongoing (2011 and beyond) economic data.	All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit at any time in 2011 and beyond.	(A) For permit owner, a limited entry trawl permit application (including MS/CV-endorsed limited entry trawl permit) will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C. (B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration, vessel account actions, or if own QS permit, issuance of annual QP or IBQ pounds) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C and §660.140(e), subpart D. (C) For a vessel lessee or charterer, participation in the groundfish fishery (including, but not limited to, issuance of annual QP or IBQ pounds if own QS or IBQ) will not be authorized, until the required EDC for their operation of that vessel is submitted.
(2) Motherships.	(i) Baseline (2009 and 2010) economic data.	All owners, lessees, and charterers of a mothership vessel that	(A) For permit owner, an MS permit application will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C.

		received whiting in 2009 or 2010 as recorded in NMFS' NORPAC database.	(B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C. (C) For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
	(ii) Annual/ongoing (2011 and beyond) economic data.	All owners, lessees, and charterers of a mothership vessel registered to an MS permit at any time in 2011 and beyond.	(A) For permit owner, an MS permit application will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C. (B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C. (C) For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
(3) Catcher processors.	(i) Baseline (2009 and 2010) economic data.	All owners, lessees, and charterers of a catcher processor vessel that harvested whiting in 2009 or 2010 as recorded in NMFS' NORPAC database.	(A) For permit owner, a C/P-endorsed limited entry trawl permit application will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C. (B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C. (C) For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
	(ii) Annual/ongoing (2011 and beyond)	All owners, lessees, and charterers of a catcher	(A) For permit owner, a C/P-endorsed limited entry trawl permit application will not be considered complete until the required EDC for that permit owner

	economic data.	processor vessel registered to a catcher processor permit at any time in 2011 and beyond.	associated with that permit is submitted, as specified at §660.25(b)(4)(i), subpart C. (B) For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v), subpart C. (C) For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC for their operation of that vessel is submitted.
(4) First receivers/shorebased processors.	(i) Baseline (2009 and 2010) economic data.	All owners and lessees of a shorebased processor and all buyers that received groundfish or whiting harvested with a limited entry trawl permit as listed in the PacFIN database in 2009 or 2010.	A first receiver site license application for a particular physical location for processing and buying will not be considered complete until the required EDC for the applying processor or buyer is submitted, as specified at §660.140(f)(3), subpart D.
	(ii) Annual/ongoing (2011 and beyond) economic data.	(A) All owners of a first receiver site license in 2011 and beyond.	A first receiver site license application will not be considered complete until the required EDC for that license owner associated with that license is submitted, as specified at §660.140(f)(3), subpart D. See paragraph (b)(4)(ii)(A) of this table.
		(B) All owners and lessees of a shore-based processor (as defined under "processor" at §660.11, subpart C, for purposes of EDC) that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver in 2011 and beyond.	

(c) Submission of the EDC form and deadline

(1) Submission of the EDC form. The complete, certified EDC form must be submitted to ATTN: Economic Data Collection Program (FRAM Division), NMFS, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112. A complete EDC form contains responses for all data fields, which include but are not limited to costs, labor, earnings, activity in a fishery, vessel or plant characteristics, value, quota, operational information, location of expenditures and earnings, ownership information and leasing information.

(2) Deadline. Complete, certified EDC forms must be mailed and postmarked by or hand-delivered to NMFS NWFSC no later than September 1, 2011, for baseline data, and, for the annual/ ongoing data collection beginning September 1, 2012, September 1 each year for the prior year's data.

(d) Confidentiality of information. Information received on an EDC form will be considered confidential under applicable law and guidance.

(e) EDC audit procedures

(1) NMFS reserves the right to conduct verification of economic data with the submitter of the form. NMFS may employ a third party agent to conduct the audits.

(2) The submitter of the EDC form must respond to any inquiry by NMFS or a NMFS agent within 20 days of the date of issuance of the inquiry, unless an extension is granted by NMFS.

(3) The submitter of the form must provide copies of additional data to facilitate verification by NMFS or NMFS' agent upon request. The NMFS auditor may review and request copies of additional data provided by the submitter, including but not limited to, previously audited or reviewed financial statements, worksheets, tax returns, invoices, receipts, and other original documents substantiating the economic data submitted.

§ 660.120 Trawl fishery—crossover provisions. {revised at 76 FR 74725, 12/1/2011}

The crossover provisions listed at §660.60(h)(7), apply to vessels fishing in the limited entry trawl fishery. {revised at 76 FR 74725, 12/1/2011}

§ 660.130 Trawl fishery—management measures. {revised at 75 FR 78344, 12/15/2010; revised at 75 FR 82296, 12/30/2010; revised at 76 FR 53833, August 30, 2011; revised at 76 FR 74725, 12/1/2011}

(a) General. Limited entry trawl vessels are those vessels registered to a limited entry permit with a trawl endorsement and those vessels registered to an MS permit. Most species taken in limited entry trawl fisheries will be managed with quotas (see § 660.140), allocations or set-asides (see § 660.150 or § 660.160), or cumulative trip limits (see trip limits in Tables 1 (North) and 1 (South) of this subpart), size limits (see § 660.60 (h)(5), subpart C), seasons (see Pacific whiting at § 660.131(b), subpart D), gear restrictions (see paragraph (b) of this section) and closed areas (see paragraph (e) of this section and §§ 660.70 through 660.79, subpart C). The trawl fishery has gear requirements and harvest limits that differ by the type of trawl gear on board and the area fished. Groundfish vessels operating south of Point Conception must adhere to CCA restrictions (see paragraph (e)(1) of this section and § 660.70, subpart C). The trip limits in Tables 1 (North) and 1 (South) of this subpart apply to vessels participating in the

(ii) Registration. A vessel account must be registered with the NMFS SFD Permits Office. A vessel account may be established at any time during the year. An eligible vessel owner must submit a request in writing to NMFS to establish a vessel account. The request must include the vessel name; USCG vessel registration number (as given on USCG Form 1270) or state registration number, if no USCG documentation; all vessel owner names (as given on USCG Form 1270, or on state registration, as applicable); and business contact information, including: Address, phone number, fax number, and email. Requests for a vessel account must also include the following information: A complete economic data collection form as required under §660.113(b), (c) and (d), and a complete Trawl Identification of Ownership Interest Form as required under paragraph (e)(4)(ii) of this section. The request for a vessel account will be considered incomplete until the required information is submitted. Any change specified at paragraph (e)(3)(ii) of this section, including a change in the legal name of the vessel owner(s), will require the new owner to register with NMFS for a vessel account. A participant must have access to a computer with Internet access and must set up online access to their vessel account to participate. The computer must have Internet browser software installed (e.g., Internet Explorer, Netscape, Mozilla Firefox); as well as the Adobe Flash Player software version 9.0 or greater. NMFS will mail vessel account owners instructions to set up online access to their vessel account. NMFS will use the vessel account to send messages to vessel owners in the Shorebased IFQ Program; it is important for vessel owners to monitor their online vessel account and all associated messages. {revised at 76 FR 74725, 12/1/2011}

(3) Renewal, change of account ownership, and transfer of QP or IBQ pounds

(i) Renewal.

(A) Vessel accounts expire at the end of each calendar year, and must be renewed between October 1 and November 30 of each year in order to ensure the vessel account is active on January 1 of the following year. A complete vessel account renewal package must be received by SFD no later than November 30 to be accepted by NMFS.

(B) Notification to renew vessel accounts will be issued by SFD prior to September 1 each year to the vessel account owner's most recent address in the SFD record. The vessel account owner shall provide SFD with notice of any address change within 15 days of the change.

(C) Any vessel account for which SFD does not receive a vessel account renewal request by November 30 will have its vessel account inactivated by NMFS at the end of the calendar year. NMFS will not issue QP or IBQ pounds to the inactivated vessel account. Any QP or IBQ pounds in the vessel account will expire and surplus QP or IBQ pounds will not be available for carryover. A non-renewed vessel account may be renewed in a subsequent year by submission of a complete vessel account renewal package.

(D) Vessel accounts will not be renewed until SFD has received a complete application for a vessel account renewal, which includes payment of required fees, a complete documentation of permit ownership on the Trawl Identification of Ownership Interest Form as required under paragraph (e)(4)(ii) of this section, and a complete economic data collection form as required under §660.114. The vessel account renewal will be considered incomplete until the required information is submitted. {revised at 76 FR 74725, 12/1/2011}

(E) Effective Date. A vessel account is effective on the date issued by NMFS and remains effective until the end of the calendar year.

(F) IAD and appeals. Vessel account renewals are subject to the appeals process specified at § 660.25(g), subpart C.

(ii) Change in vessel account ownership. Vessel accounts are non-transferable and ownership of a vessel account cannot change (*i.e.* , cannot change the legal name of the owner(s) as given on the vessel account). If the ownership of a vessel changes (as given on a USCG or state vessel registration documentation), then a new vessel account must be opened by the new owner in order for the vessel to participate in the Shorebased IFQ Program. {revised at 76 FR 74725, 12/1/2011}

(iii) Transfer of QP or IBQ pounds

(A) General. QP or IBQ pounds may only be transferred from a QS account to a vessel account or between vessel accounts. QP or IBQ pounds cannot be transferred from a vessel account to a QS account. Transfers of QP or IBQ pounds are subject to accumulation limits. QP or IBQ pounds in a vessel account may only be transferred to another vessel account. QP or IBQ pounds must be transferred in whole pounds (i.e., no fraction of a QP or IBQ pound can be transferred). During the year there may be situations where NMFS deems it necessary to prohibit transfers (i.e., account reconciliation, system maintenance, or for emergency fishery management reasons).

(B) Transfer procedures. QP or IBQ pound transfers from one vessel account to another vessel account must be accomplished via the online vessel account. To make a transfer, a vessel account owner must initiate a transfer request by logging onto the online vessel account. Following the instructions provided on the Web site, the vessel account owner must enter pertinent information regarding the transfer request including, but not limited to: IFQ species, amount of QP or IBQ pounds to be transferred for each IFQ species (in whole pound increments); name and any other identifier of the eligible transferee (e.g., USCG documentation number or state registration number, as applicable) of the eligible vessel account receiving the transfer; and the value of the transferred QP or IBQ pounds. The online system will verify whether all information has been entered and whether the transfer complies with vessel limits, as applicable. If the information is not accepted, an electronic message will record as much in the transferor's vessel account explaining the reason(s). If the information is accepted, the online system will record the pending transfer in both the transferor's and the transferee's vessel accounts. The transferee must approve the transfer by electronic signature. If the transferee accepts the transfer, the online system will record the transfer and confirm the transaction in both accounts through a transaction confirmation

Appendix C Council Action on Mandatory Economic Data Collection

Taken from footnote bb in Appendix D to The Rationalization of the Pacific Coast Groundfish Limited Entry Trawl Fishery Draft Environmental Impact Statement (November 2009).

Expanded data collection would include:

Mandatory submission of economic data for LE trawl industry (harvesters and processors), Voluntary submission of economic data for other sectors of the fishing industry, transaction value information in a centralized registry of ownership, and Formal monitoring of government costs.

Mandatory Provisions: The Pacific Fishery Management Council and NMFS shall have the authority to implement a data collection program for cost, revenue, ownership, and employment data, compliance with which will be mandatory for members of the west coast groundfish industry harvesting or processing fish under the Council's authority. Data collected under this authority will be treated as confidential in accordance with Section 402 of the MSA. A mandatory data collection program shall be developed and implemented as part of the groundfish trawl catch share program and continued through the life of the program. Cost, revenue, ownership, employment and other information will be collected on a periodic basis (based on scientific requirements) to provide the information necessary to study the impacts of the program, including achievement of goals and objectives associated with the catch share program. These data may also be used to analyze the economic and social impacts of future FMP amendments on industry, regions, and localities. The program will include targeted and random audits as necessary to verify and validate data submissions. Additional funding (as compared to status quo) will be needed to support the collection of these data. The data collected would include data needed to meet MSA requirements (including antitrust). The development of the program shall include a comprehensive discussion of the enforcement of such a program, including discussion of the type of enforcement actions that will be taken if inaccuracies are found in mandatory data submissions. The intent of this action will be to ensure that accurate data are collected without being overly burdensome on industry in the event of unintended errors.

Voluntary Provisions: A voluntary data collection program will be used to collect information needed to assess spillover impacts on non-trawl fisheries.

Central Registry: Information on transaction prices will be included in a central registry of QS owners. Such information will also be included for LE permit owners/lessees.

Government Costs: Data will be collected and maintained on the monitoring, administration, and enforcement costs related to governance of the trawl catch share program.

Appendix D Non-Disclosure Agreement

STATEMENT OF NONDISCLOSURE

I have read the NOAA Administrative order 216-100 (NAO 216-100) on Protection of Confidential Fisheries Statistics and I understand its contents. I understand that the Magnuson Stevens Act Reauthorization of 2006 provides that economic information is confidential and to the extent the NAO 216-100 is inconsistent with it, NAO 216-100 is inapplicable.

I will not disclose any data identified as confidential to any unauthorized person(s), except as directed by the Assistant Administrator for Fisheries. I am fully aware of the civil and criminal penalties for unauthorized disclosure, misuse, or other violation of the confidentiality of such data.

I understand that I may be subject to criminal and civil penalties under provisions of Titles 5 U.S.C. 552 and 18 U.S.C. 1905, which are the primary Federal statutes prohibiting unauthorized disclosure of confidential data. I may also be subject to civil penalties for improper disclosure of data collected under the Magnuson-Stephens Act.

Notification: This notification is to inform you that NOAA/NMFS monitors all usage of electronic mail, internet activities and data retrieval under the jurisdiction of the Federal Government. There are severe penalties for the misuse of these resources. Your Signature on this form acknowledges you have been notified and are aware of this monitoring.

Name (typed or printed)	Signature	Date
Name of Witness (typed or printed)	Signature	Date

	Affiliation (check one):		Type of Data:
	NMFS		Source
	Other Federal		Subregional
	State		Regional
	Council Staff		Multiregional
	Council Member		Special (specify):
	Contractor		
	Grantee		
	Other (specify):		Other (specify):

Designated NMFS Official

Name (typed or printed)	Signature	Date

Appendix E Internal Data Business Rule Checks

E.1 Catcher vessels

Vessel valuation (Question 8)

If the year of the most recent marine survey valuation is provided then all of the following need to be provided: market value, replacement value, whether the survey value includes the value of permit(s), whether the survey value includes the value of quota, and whether the survey value includes the value of fishing gear.

Fuel use (Questions 12)

If either the number of days at sea participating in West Coast fisheries (whiting, groundfish trawl, groundfish fixed gear, shrimp, crab, halibut, salmon, tuna, other) or the fuel use while participating in the West Coast fisheries is greater than zero then both should be greater than zero.

Average fuel use, speed while fishing and crew size (Question 11)

If days at sea are provided for a West Coast fishery (whiting, groundfish trawl, groundfish fixed gear, shrimp, crab, halibut, salmon, tuna, other), then the fuel use, speed, and crew size should be provided. Speed is not required for groundfish fixed gear, crab, or halibut.

Alaska (Questions 13, 14, 18, 20)

If any of the following are greater than zero, then they should all be greater than zero:

1. Days at sea participating in Alaskan fisheries
2. Days at sea steaming between the West Coast and Alaska

3. Number of one-way trips the vessel made steaming between the West Coast and Alaska
4. Total round weight of all fish landings made by the vessel in Alaska
5. Landings revenue from Alaska shoreside landings and at-sea deliveries

Shared capitalized expenditures and expenses (Questions 15 and 17)

If the days at sea while participating in Alaskan fisheries are not greater than zero then there should only be NAs or zeroes in the following fields:

1. Capitalized expenditures on fishing gear shared by West Coast, Alaska, and other fisheries
2. Capitalized expenditures on processing equipment shared by West Coast, Alaska, and other fisheries
3. Expenses on repair and maintenance on fishing gear shared by West Coast, Alaska, and other fisheries

Chartering/research/leasing vessel (Questions 13 and 20)

Unless the vessel was leased, if either the days at sea while chartering/research or earnings from chartering/research/leasing vessel are greater than zero, then both should be greater than zero.

Hired captain crew share

The vessel, captain, crew, and other shares for when the owner **did not serve as captain** should sum to 100% $\pm$ 2% as long as the vessel fished and the vessel owner served as captain less than 100% of the time in West Coast groundfish fisheries.

Owner on board crew share

The vessel, captain, crew, and other shares for when the owner **served as captain** should sum to 100% $\pm$ 2% as long as the vessel fished and the vessel owner served as captain in West Coast groundfish fisheries.

Capitalized investments and expenses

We have found that participants in the survey often confuse capitalized expenditures and expenses. Additionally, many do not distinguish between the costs related to vessel and on-board equipment and fishing gear. Participants respond to this confusion and record keeping issue in one of two ways, they take the total outlay, divide it and put an equal portion into each field, or they take the total outlay and record it in multiple fields. With the available information, it is impossible to distinguish between the two different response types, so all duplicate entries are flagged and then the participants are called to ensure that the information is being recorded in the correct field and to ensure that there is no double counting. Only non-zero and non-NA responses were compared. In the following fields:

1. Capitalized expenditures on new and used vessel and on-board equipment
2. Capitalized expenditures on fishing gear used in West Coast Fisheries only
3. Capitalized expenditures on fishing gear shared by West Coast, Alaska and other fisheries
4. Capitalized expenditures on processing equipment used in West Coast Fisheries only
5. Capitalized expenditures on processing equipment shared by West Coast, Alaska and other fisheries
6. Repair and maintenance on fishing gear used only for the West Coast (expensed during the year)
7. Repair and maintenance on fishing gear shared by the West Coast and other fisheries (expensed during the year)
8. Repair and maintenance on processing equipment (expensed during the year)
9. Vessel and on-board equipment repair and maintenance (expensed during the year)
10. Depreciation (vessel, on-board equipment processing equipment, and quota share)

Profitability

Although it is possible that a vessel could have greater expenses than revenues within a given year, we still flag all forms where the total variable costs (expenses) are more than the total earnings. The variable costs are calculated, as the sum of all expenses provided on the forms, not included in this check is expenses on landings taxes. The total revenue for the boat is the sum of revenues reported on the form and total revenue reported on the state fish ticket records.

Expenses and revenues on quota pounds, quota shares, limited entry permits

In the first year of the trawl catch share program, it was common for participants to list the expenses and earnings under both expenses and earnings. This check tests whether there are any duplicate responses in any of the expense or revenue fields for quota pounds, quota shares, and limited entry permits. Null responses and zeroes are ignored.

E.2 Catcher-processors

Vessel valuation (Question 8)

If the year of the most recent marine survey valuation is provided, then all of the following need to be provided: market value, replacement value, whether the survey value includes the value of permit(s), whether the survey value includes the value of quota, whether the survey value includes the value of processing equipment, and whether the survey value includes the value of fishing gear.

Alaska (Questions 10, 12, 13)

If any of the following are greater than zero, then they should all be greater than zero:

1. Days at sea participating in Alaskan fisheries
2. Days at sea steaming between the West Coast and Alaska
3. Number of one-way trips the vessel made steaming between the West Coast and Alaska

Fuel use and days at sea (Questions 6 and 12)

If either the number of days at sea participating in West Coast whiting fishery or the fuel use while participating in the West Coast whiting fishery is greater than zero then both should be greater than zero.

Shared capitalized expenditures and expenses (Questions 15 and 17)

If the days at sea while participating in Alaskan fisheries are not greater than zero then there should only be NAs or zeroes in the following fields:

1. Capitalized expenditures on fishing gear shared by West Coast, Alaska, and other fisheries
2. Capitalized expenditures on processing equipment shared by West Coast, Alaska, and other fisheries
3. Expenses on repair and maintenance on fishing gear shared by West Coast, Alaska, and other fisheries

Capitalized investments and expenses (Questions 15 and 17)

We have found that participants in the survey regularly confuse capitalized expenditures and expenses. Additionally, many do not distinguish between the costs related to vessel and on-board equipment and fishing gear. Participants respond to this confusion and record keeping issue in one of two ways, they take the total outlay, divide it and put an equal portion into each field, or they take the total outlay and record it in multiple fields. With the available information, it is impossible to distinguish between the two different response types, so all duplicate entries are flagged and then the participants are called to ensure that the information is being recorded in the correct field and to ensure that there is no double counting. Only non-zero and non-NA responses were compared in the following fields:

1. Capitalized expenditures on new and used vessel and on-board equipment
2. Capitalized expenditures on fishing gear used in West Coast Whiting Fishery only
3. Capitalized expenditures on fishing gear shared by West Coast, Alaska and other fisheries
4. Capitalized expenditures on processing equipment used in West Coast Whiting Fishery only
5. Capitalized expenditures on processing equipment shared by West Coast, Alaska and other fisheries
6. Repair and maintenance on fishing gear used only for the West Coast (expensed during the year)
7. Repair and maintenance on fishing gear shared by the West Coast and other fisheries (expensed during the year)
8. Repair and maintenance on processing equipment (expensed during the year)
9. Vessel and on-board equipment repair and maintenance (expensed during the year)
10. Depreciation (vessel, on-board equipment processing equipment, and quota share)

Weight and value of production (Question 20)

If there is a positive value for weight of production, a positive value should also be listed for value of production.

Off-load value percentages (Question 20)

The percentages of off-load value listed for the eight locations should sum to 100%.

Total round weight (Question 18)

If days at sea are given for processing or Alaska fisheries, total weight should be positive.

E.3 Motherships

Vessel valuation (Question 8)

If the year of the most recent marine survey valuation is provided then all of the following need to be provided: market value, replacement value, whether the survey value includes the value of permit(s), whether the survey value includes the value of quota, and whether the survey value includes the value of fishing gear and/or processing equipment.

Alaska (Questions 10, 12, 13)

If any of the following are greater than zero, then they should all be greater than zero:

1. Days at sea participating in Alaskan fisheries
2. Average fuel use steaming between the West Coast and Alaska
3. Days at sea steaming between the West Coast and Alaska
4. Number of one-way trips the vessel made steaming between the West Coast and Alaska

Fuel use and days at sea (Questions 6, 12)

If either the number of days at sea participating in West Coast whiting fishery or the fuel use while participating in the West Coast whiting fishery is greater than zero then both should be greater than zero.

Shared capitalized expenditures and expenses (Questions 15 and 17)

If the days at sea while participating in Alaskan fisheries are not greater than zero then there should only be NAs or zeroes in the following fields:

1. Capitalized expenditures on fishing gear shared by West Coast, Alaska, and other fisheries
2. Capitalized expenditures on processing equipment shared by West Coast, Alaska, and other fisheries
3. Expenses on repair and maintenance on fishing gear shared by West Coast, Alaska, and other fisheries

Capitalized investments and expenses (Questions 15 and 17)

We have found that participants in the survey regularly confuse capitalized expenditures and expenses. Additionally, many do not distinguish between the costs related to vessel and on-board equipment and fishing gear. Participants respond to this confusion and record keeping issue in one of two ways, they take the total outlay, divide it and put an equal portion into each field, or they take the total outlay and record it in multiple fields. With the available information, it is impossible to distinguish between the two different response types, so all duplicate entries are flagged and then the participants are called to ensure that the information is being recorded in the correct field and to ensure that there is no double counting. Only non-zero and non-NA responses were compared in the following fields:

1. Capitalized expenditures on new and used vessel and on-board equipment
2. Capitalized expenditures on fishing gear used in West Coast Whiting Fishery only
3. Capitalized expenditures on fishing gear shared by West Coast, Alaska and other fisheries
4. Capitalized expenditures on processing equipment used in West Coast Whiting Fishery only
5. Capitalized expenditures on processing equipment shared by West Coast, Alaska and other fisheries
6. Repair and maintenance on fishing gear used only for the West Coast (expensed during the year)
7. Repair and maintenance on fishing gear shared by the West Coast and other fisheries (expensed during the year)
8. Repair and maintenance on processing equipment (expensed during the year)
9. Vessel and on-board equipment repair and maintenance (expensed during the year)
10. Depreciation (vessel, on-board equipment processing equipment, and quota share)

Weight and value of production (Question 20)

If there is a positive value for weight of production, a positive value should also be listed for value of production.

Off-load value percentages (Question 20)

The percentages of off-load value listed for the eight locations should sum to 100%.

Purchase cost and production value (Questions 18 and 20)

Total production value should be higher than total purchase cost.

Total round weight (Question 19)

If days at sea are given for processing or Alaska fisheries, total weight should be positive.

E.4 First receivers and shorebased processors

Weight of fish received but not paid and weight of fish purchased (Question 19)

Especially during the baseline data collection, it was common for participants to record the same value under "Total weight of fish received but not paid for" and under "Total weight of fish purchased." This rule flags the cases where this occurs to verify that fish purchases are not double-counted.

Gross cost of purchases and weight of purchases (Question 19)

Especially during the baseline data collection, participants would often write the same value for the weight and cost of fish purchases. Although it is possible that the price is $1 per pound, it is unlikely. This question flags cases where the value of "Gross cost of fish purchases" is equal to the "Total weight of fish purchased" when the value provided is not zero.

Duplicate weight of fish received but not paid for (Question 19)

The "Total weight of fish received but not paid for" by species from one gear type should not equal the "weight of fish received but not paid for" from "Other Sources" for that species.

Duplicate weight of fish purchased (Question 19)

The "Total weight of fish purchased" by species from one gear type should not equal the weight of fish purchased from "Other Sources" for that species.

Duplicate cost of fish purchased (Question 19)

The "Gross cost of fish purchases" by species from one gear type should not equal the weight of fish purchased from "Other Sources" for that species.

Weight and value of production (Question 20)

If the "Total value of production" is greater than zero, then "Total weight of production" should be greater than zero for that species and product type combination and vice versa.

Fish purchase weight and fish production weight (Question 19 and 20)

The "Total weight of fish purchased" by species recorded in Question 19 should be greater than or equal to the sum of "Total weight of production" by species recorded in Question 20.

Quasi-Profit (Question 19 and 20)

Although it is possible that a company could sell fish for less than the cost of the purchase, we still flag the cases where the "Gross cost of fish purchases" by species in question 19 is greater than the "Total value of production" by species.

Duplicate weight of production (Question 20)

The "Total weight of production" of one product type should not equal the "Total weight of production" of any another product type by species. If this rule is violated, an error message will be created.

Duplicate value of production (Question 20)

Although it is possible that there could be exactly the same value of production for two different product type and species combinations, verify that the "Total value of production" of one product type and species does not equal the "Total value of production" of any other product type and species.

Average hours worked

Based on the assumption that production workers or employees cannot work more than 16 hours per day, 7 days a week, a check is performed to ensure that average hours per workers is never greater than 112 hours/worker or employee.

Average purchase price, production price, markup, product recovery rate

For the most part, the rules above have strict interpretations. In addition to these rules, we also looked several measures by species group, such as the average purchase price (total cost/total purchase weight), the average production price (total value of production/total weight of production), the average markup (total value of production/total cost of purchases), and the average recovery rate (total production weight/total purchase weight). In these cases, individual responses were examined because we did not have enough information about the ranges of these values. In the future, as more information is collected, we will be able to develop a set of appropriate ranges in order to flag specific responses.

Appendix F Rules for Standardizing NAs and Zeroes

The following tables document rules used for handling NAs and zeroes in the EDC data for catcher vessels, catcher-processors and motherships. There are currently no automated rules for handling NAs and zeroes in the first receiver and shorebased processor data due to the complex nature of many participants' business operations. Three sets of tables are presented for each type of form, the rules tables (Sections F.1.1, F.2.1, and F.3.1), the validation check code definitions (Sections F.1.2, F.2.2, and F.3.2), and the variable code definitions (sections F.1.3, F.2.3, and F.3.3). Descriptions of the variable codes can also be found in Appendix H which contains a copy of each of the four EDC forms and the variable code associated with each field on the form.

The "Tables of rules for handling NAs and zeroes" sections present the rule for each variable to determine how to treat NAs and zeroes entered by participants. The tables show whether each variable should be interpreted as an NA or a zero based on whether the validation check is true or false. The first column shows the variable code (VARIABLE) and the second shows the validation check code (VALIDATION CHECK) that is performed. The RAW RESPONSE column holds the value that was entered by the participant on the form, and the last two columns are the value that will be used in analysis, depending on whether the validation check was true or false.

The first two rows of the first table in Section F.1.1 can be used an example. These rows refer to the form field CXFGRSHD, which is defined in Section F.1.3 as "Capitalized expenditures on fishing gear shared between the West Coast and other fisheries". This variable relies on the validation check AKWC, defined in F.1.2 as "The catcher vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data and/or the number of one-way trips to Alaska recorded on the form is greater than zero" to determine how to treat the raw responses provided on the forms. According to the first row, if the raw response was "0" and the validation check was true or the validation check was false, then the value should be interpreted as "0". However, as can be seen in the second line, if the raw response provided on the form was "NA", and the validation check was true, then the value should be interpreted as "NA". The remainder of rules in the "Tables of rules for handling NAs and zeroes" can be interpreted similarly.

F.1 Catcher vessels

F.1.1 Tables of rules for handling NAs and zeroes

Table F.1: Rules for handling NAs and zeroes in catcher vessel data: capitalized expenditures.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
CXFGRSHD	AKWC	0	0	0
CXFGRSHD	AKWC	NA	NA	0
CXFGRWC	WC	0	0	0
CXFGRWC	WC	NA	NA	0
CXONBQALL	WC	0	0	0
CXONBQALL	WC	NA	NA	0
CXPQSHD	PROC	0	0	0
CXPQSHD	PROC	NA	NA	0
CXPQWC	PROC	0	0	0
CXPQWC	PROC	NA	NA	0

Table F.2: Rules for handling NAs and zeroes in catcher vessel data: crew share information.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
SHRPCPTHCPT	HCPT	0	0	NA
SHRPCPTHCPT	HCPT	NA	0	NA
SHRPCPTOONB	OONB	0	0	NA
SHRPCPTOONB	OONB	NA	0	NA
SHRPCWHCPT	HCPT	0	0	NA
SHRPCWHCPT	HCPT	NA	0	NA
SHRPCWOONB	OONB	0	0	NA
SHRPCWOONB	OONB	NA	0	NA
SHRPOONB	NOVALIDATION	0	0	NA
SHRPOONB	NOVALIDATION	NA	NA	NA
SHRPOTHRHCPT1	HCPT	0	0	NA
SHRPOTHRHCPT1	HCPT	NA	0	NA
SHRPOTHRHCPT2	HCPT	0	0	NA
SHRPOTHRHCPT2	HCPT	NA	0	NA
SHRPOTHROONB1	OONB	0	0	NA
SHRPOTHROONB1	OONB	NA	0	NA
SHRPOTHROONB2	OONB	0	0	NA
SHRPOTHROONB2	OONB	NA	0	NA
SHRPVSSHCPT	HCPT	0	0	NA
SHRPVSSHCPT	HCPT	NA	0	NA
SHRPVSSOONB	OONB	0	0	NA
SHRPVSSOONB	OONB	NA	0	NA

Table F.3: Rules for handling NAs and zeroes in catcher vessel data: days at sea.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
DASCHTR	NOVALIDATION	0	0	NA
DASCHTR	NOVALIDATION	NA	NA	NA
DASCRAB	CRAB	0	NA	0
DASCRAB	CRAB	NA	NA	0
DASFSHAK	AK	0	NA	0
DASFSHAK	AK	NA	NA	0
DASFSHAKOTHR	NOVALIDATION	0	NA	NA
DASFSHAKOTHR	NOVALIDATION	NA	NA	NA
DASGRNDFG	GRNDFG	0	NA	0
DASGRNDFG	GRNDFG	NA	NA	0
DASGRNDTWL	GRNDTWL	0	NA	0
DASGRNDTWL	GRNDTWL	NA	NA	0
DASHLB	HLB	0	NA	0
DASHLB	HLB	NA	NA	0
DASOTHRWC	NOVALIDATION	0	0	NA
DASOTHRWC	NOVALIDATION	NA	NA	NA
DASPWHT	PWHT	0	NA	0
DASPWHT	PWHT	NA	NA	0
DASSAMN	SAMN	0	NA	0
DASSAMN	SAMN	NA	NA	0
DASSRMP	SRMP	0	NA	0
DASSRMP	SRMP	NA	NA	0
DASSTMAKWC	AKTRP	0	NA	0
DASSTMAKWC	AKTRP	NA	NA	0
DASTUNA	HMSP	0	NA	0
DASTUNA	HMSP	NA	NA	0

Table F.4: Rules for handling NAs and zeroes in catcher vessel data: expenses.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
EXBAITWC	BAIT	0	0	0
EXBAITWC	BAIT	NA	NA	0
EXCOMMWC	WC	0	NA	0
EXCOMMWC	WC	NA	NA	0
EXCPTWGWC	WC	0	NA	0
EXCPTWGWC	WC	NA	NA	0
EXCWWGWC	CPTWG	0	0	0
EXCWWGWC	CPTWG	NA	NA	0
EXDEPRALL	WC	0	0	0
EXDEPRALL	WC	NA	NA	0
EXFADWC	WC	0	0	0
EXFADWC	WC	NA	NA	0
EXFGRRMSHD	AKWC	0	NA	0
EXFGRRMSHD	AKWC	NA	NA	0
EXFGRRMWC	WC	0	NA	0
EXFGRRMWC	WC	NA	NA	0
EXFLLUBWC	WC	0	NA	0
EXFLLUBWC	WC	NA	NA	0
EXFOODWC	WC	0	0	0
EXFOODWC	WC	NA	NA	0
EXFRGTWC	WC	0	0	0
EXFRGTWC	WC	NA	NA	0
EXICEWC	WC	0	0	0
EXICEWC	WC	NA	NA	0
EXINSEQALL	WC	0	0	0
EXINSEQALL	WC	NA	NA	0
EXLEPLSFG	NOVALIDATION	0	0	NA
EXLEPLSFG	NOVALIDATION	NA	NA	NA
EXLEPLSTWL	NOVALIDATION	0	0	NA

EXLEPLSTWL	NOVALIDATION	NA	NA	NA
EXLEPPUFG	NOVALIDATION	0	0	NA
EXLEPPUFG	NOVALIDATION	NA	NA	NA
EXLEPPUTWL	NOVALIDATION	0	0	NA
EXLEPPUTWL	NOVALIDATION	NA	NA	NA
EXLICFEESWC	WC	0	NA	0
EXLICFEESWC	WC	NA	NA	0
EXMOORALL	NOVALIDATION	0	0	NA
EXMOORALL	NOVALIDATION	NA	NA	NA
EXOBSWC	WC	0	NA	0
EXOBSWC	WC	NA	NA	0
EXOFFLOADWC	NOVALIDATION	0	0	NA
EXOFFLOADWC	NOVALIDATION	NA	NA	NA
EXONBQRMALL	NOVALIDATION	0	0	0
EXONBQRMALL	NOVALIDATION	NA	NA	0
EXOTHRSUPPWC	WC	0	0	0
EXOTHRSUPPWC	WC	NA	NA	0
EXPQRMALL	PROC	0	0	0
EXPQRMALL	PROC	NA	NA	0
EXQPLS	NOVALIDATION	0	0	NA
EXQPLS	NOVALIDATION	NA	NA	NA
EXQPPU	NOVALIDATION	0	0	NA
EXQPPU	NOVALIDATION	NA	NA	NA
EXQSLS	NOVALIDATION	0	0	NA
EXQSLS	NOVALIDATION	NA	NA	NA
EXQSPU	NOVALIDATION	0	0	NA
EXQSPU	NOVALIDATION	NA	NA	NA
EXTRAVWC	WC	0	0	0
EXTRAVWC	WC	NA	NA	0
EXTRUCKWC	WC	0	0	0
EXTRUCKWC	WC	NA	NA	0
EXVSSLSALL	LESSEE	0	NA	0

EXVSSLSALL	LESSEE	NA	NA	0

Table F.5: Rules for handling NAs and zeroes in catcher vessel data: total fuel use on the West Coast.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
FLDSL	WC	0	NA	0
FLDSL	WC	NA	NA	0
FLOTHR	NOVALIDATION	0	0	NA
FLOTHR	NOVALIDATION	NA	0	NA

Table F.6: Rules for handling NAs and zeroes in catcher vessel data: average crew size, average fuel use, and average speed.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RUCWCRAB	CRAB	0	0	NA
RUCWCRAB	CRAB	NA	NA	NA
RUCWGRNDFG	GRNDFG	0	0	NA
RUCWGRNDFG	GRNDFG	NA	NA	NA
RUCWGRNDTWL	GRNDTWL	0	0	NA
RUCWGRNDTWL	GRNDTWL	NA	NA	NA
RUCWHLB	HLB	0	0	NA
RUCWHLB	HLB	NA	NA	NA
RUCWPWHT	PWHT	0	0	NA
RUCWPWHT	PWHT	NA	NA	NA
RUCWSAMN	SAMN	0	0	NA
RUCWSAMN	SAMN	NA	NA	NA
RUCWSRMP	SRMP	0	0	NA
RUCWSRMP	SRMP	NA	NA	NA
RUCWSTMAKWC	AKTRP	0	0	NA
RUCWSTMAKWC	AKTRP	NA	NA	NA
RUCWTUNA	HMSP	0	0	NA
RUCWTUNA	HMSP	NA	NA	NA
RUFLCRAB	NOVALIDATION	0	NA	NA

RUFLCRAB	NOVALIDATION	NA	NA	NA
RUFLGRNDFG	NOVALIDATION	0	NA	NA
RUFLGRNDFG	NOVALIDATION	NA	NA	NA
RUFLGRNDTWL	NOVALIDATION	0	NA	NA
RUFLGRNDTWL	NOVALIDATION	NA	NA	NA
RUFLHLB	NOVALIDATION	0	NA	NA
RUFLHLB	NOVALIDATION	NA	NA	NA
RUFLPWHT	NOVALIDATION	0	NA	NA
RUFLPWHT	NOVALIDATION	NA	NA	NA
RUFLSAMN	NOVALIDATION	0	NA	NA
RUFLSAMN	NOVALIDATION	NA	NA	NA
RUFLSRMP	NOVALIDATION	0	NA	NA
RUFLSRMP	NOVALIDATION	NA	NA	NA
RUFLSTMAKWC	NOVALIDATION	0	NA	NA
RUFLSTMAKWC	NOVALIDATION	NA	NA	NA
RUFLTUNA	NOVALIDATION	0	NA	NA
RUFLTUNA	NOVALIDATION	NA	NA	NA
RUSPDGRNDTWL	NOVALIDATION	0	NA	NA
RUSPDGRNDTWL	NOVALIDATION	NA	NA	NA
RUSPDPWHT	NOVALIDATION	0	NA	NA
RUSPDPWHT	NOVALIDATION	NA	NA	NA
RUSPDSAMN	NOVALIDATION	0	NA	NA
RUSPDSAMN	NOVALIDATION	NA	NA	NA
RUSPDSRMP	NOVALIDATION	0	NA	NA
RUSPDSRMP	NOVALIDATION	NA	NA	NA
RUSPDSTMAKWC	NOVALIDATION	0	NA	NA
RUSPDSTMAKWC	NOVALIDATION	NA	NA	NA
RUSPDTUNA	NOVALIDATION	0	NA	NA
RUSPDTUNA	NOVALIDATION	NA	NA	NA

Table F.7: Rules for handling NAs and zeroes in catcher vessel data: annual earnings.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RVCHTR	LESSOR	0	NA	0
RVCHTR	LESSOR	NA	NA	0
RVDELATSEA	NORPAC	0	NA	0
RVDELATSEA	NORPAC	NA	NA	0
RVDSTER	NOVALIDATION	0	0	NA
RVDSTER	NOVALIDATION	NA	NA	NA
RVLANDDELAK	AK	0	NA	0
RVLANDDELAK	AK	NA	NA	0
RVLEPLS	NOVALIDATION	0	0	NA
RVLEPLS	NOVALIDATION	NA	0	NA
RVLEPSL	NOVALIDATION	0	0	NA
RVLEPSL	NOVALIDATION	NA	0	NA
RVOTHR	NOVALIDATION	0	0	NA
RVOTHR	NOVALIDATION	NA	0	NA
RVPRMTLS	NOVALIDATION	0	0	NA
RVPRMTLS	NOVALIDATION	NA	0	NA
RVPRMTSL	NOVALIDATION	0	0	NA
RVPRMTSL	NOVALIDATION	NA	0	NA
RVQPLS	NOVALIDATION	0	0	NA
RVQPLS	NOVALIDATION	NA	0	NA
RVQPSL	NOVALIDATION	0	0	NA
RVQPSL	NOVALIDATION	NA	0	NA
RVQSLS	NOVALIDATION	0	0	NA
RVQSLS	NOVALIDATION	NA	0	NA
RVQSSL	NOVALIDATION	0	0	NA
RVQSSL	NOVALIDATION	NA	0	NA

Table F.8: Rules for handling NAs and zeroes in catcher vessel data: vessel valuation information.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
VVGEAR	NOVALIDATION	0	NA	NA
VVGEAR	NOVALIDATION	NA	NA	NA
VVMRK	NOVALIDATION	0	NA	NA
VVMRK	NOVALIDATION	NA	NA	NA
VVPRMT	NOVALIDATION	0	NA	NA
VVPRMT	NOVALIDATION	NA	NA	NA
VVQTA	NOVALIDATION	0	NA	NA
VVQTA	NOVALIDATION	NA	NA	NA
VVRPL	NOVALIDATION	0	NA	NA
VVRPL	NOVALIDATION	NA	NA	NA
VVYY	NOVALIDATION	0	NA	NA
VVYY	NOVALIDATION	NA	NA	NA

Table F.9: Rules for handling NAs and zeroes in catcher vessel data: weight of fish landed in Alaska.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
WTAK	AK	0	NA	0
WTAK	AK	NA	NA	0

F.1.2 Validation check descriptions

Table F.10: Description of validation checks used on catcher vessel data for determining whether an NA or zero should be an NA or a zero.

VALIDATION	DESCRIPTION
AK	The vessel fished in Alaska according to AKFIN (or catcher-processor/mothership form DAS)

AKTRP The vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data and/or the number of one-way trips to Alaska recorded on the form is greater than zero, for motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

AKWC The catcher vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data. For motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

BAIT The vessel fished on the West Coast according to fish ticket data in a fishery that requires bait

CPTWG The vessel fished on the West Coast according to fish ticket data and there were crew onboard and the captain wages field is not NA or zero

CRAB The vessel participated in the crab fishery according to fish ticket data

EQUIP The vessel provided information about any of the following on their form: capitalized expenditures or expenses on all on-board and vessel equipment, fishing gear only used on the West Coast and or fishing gear shared between the West Coast and other fisheries, or they didn't fish on the West Coast according to fish ticket data

GRNDFG The vessel participated in the fixed gear groundfish fishery according to fish ticket data

GRNDTWL The vessel participated in the trawl groundfish fishery according to fish ticket data

HCPT The vessel was operated by hired captain

HLB The vessel participated in the halibut fishery according to fish ticket data

HMSP The vessel participated in the tuna fishery according to fish ticket data

LESSEE The survey participant is the lessee of the vessel

LESSOR The vessel is being filled out by a vessel owner who leased the vessel

NORPAC The vessel delivered at-sea according to NORPAC

NOVALIDATION There are no validation checks for this response

OONB The vessel was operated by the owner

PQUIP	The vessel provided information about any of the following on their form: capitalized expenditures on processing equipment shared between the West Coast and Other fisheries or used only on the West Coast or all expenses on processing equipment, or according to information provided on the form, the vessel did not process or head and gut any fish on-board on the West Coast
PROC	The vessel processed at-sea according to information provided on form
PWHT	The vessel participated in the Pacific whiting fishery according to fish ticket data
SAMN	The vessel participated in the salmon fishery according to fish ticket data
SRMP	The vessel participated in the shrimp fishery according to fish ticket data
WC	The vessel fished on the West Coast according to fish ticket data, for motherships and catcher-processors the vessel fished or processed in the West Coast whiting fishery according to NORPAC data
WCGRND	The vessel participated in the West Coast groundfish fishery

F.1.3 Variable descriptions

Table F.11: Description of catcher vessel variables to which validation checks were applied.

FULLCODE	DESCRIPTION
CXFGRSHD	Capitalized expenditures on fishing gear shared between the West Coast and other fisheries
CXFGRWC	Capitalized expenditures on fishing gear used only on the West Coast
CXONBQALL	Capitalized expenditures on vessel and on-board equipment
CXPQSHD	Capitalized expenditures on processing equipment shared between the West Coast and other fisheries
CXPQWC	Capitalized expenditures on processing equipment used only on the West Coast
DASCHTR	Days at sea - Chartering or Research
DASCRAB	Days at sea - Crab
DASFSHAK	Days at sea - Fishing in Alaska
DASFSHAKOTHR	Days at sea - Fishing Alaska or Other
DASGRNDFG	Days at sea - Fixed gear groundfish

DASGRNDTWL	Days at sea - Fixed gear trawl
DASHLB	Days at sea - Halibut
DASOTHRWC	Days at sea - Fishing in other West Coast Fisheries
DASPWHT	Days at sea - Pacific whiting
DASSAMN	Days at sea - Salmon
DASSRMP	Days at sea - Shrimp
DASSTMAKWC	Days at sea - Steaming between West Coast and Alaska
DASTUNA	Days at sea - Tuna
EXBAITWC	Expenses on bait on the West Coast
EXCOMMWC	Expenses on communication on the West Coast
EXCPTWGWC	Expenses on captain wages on the West Coast
EXCWWGWC	Expenses on crew wages on the West Coast
EXDEPRALL	Depreciation
EXFADWC	Expenses on fishing association dues on the West Coast
EXFGRRMSHD	Expenses on fishing gear repair and maintenance shared between the West Coast and other fisheries
EXFGRRMWC	Expenses on fishing gear repair and maintenance on the West Coast
EXFLLUBWC	Expenses on fuel and lubrication on the West Coast
EXFOODWC	Expenses on food on the West Coast
EXFRGTWC	Expenses on freight on the West Coast
EXICEWC	Expenses on ice on the West Coast
EXINSEQALL	Expenses on insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)
EXLEPLSFG	Expenses on lease of fixed gear limited entry permit
EXLEPLSTWL	Expenses on lease of trawl limited entry permit
EXLEPPUFG	Expenses on purchase of fixed gear limited entry permit
EXLEPPUTWL	Expenses on purchase of trawl limited entry permit
EXLICFEESWC	Expenses on license fees on the West Coast
EXMOORALL	Expenses on moorage
EXOBSWC	Expenses on observers on the West Coast
EXOFFLOADWC	Expenses on offloading on the West Coast
EXONBQRMALL	Expenses on vessel and on-board equipment

EXOTHRSUPPWC	Expenses on supplies on the West Coast
EXPQRMALL	Expenses on processing equipment shared between the West Coast and Alaska
EXQPLS	Expenses on lease of quota pounds
EXQPPU	Expenses on purchase of quota pounds
EXQSLS	Expenses on lease of quota shares
EXQSPU	Expenses on purchase of quota shares
EXTRAVWC	Expenses on travel on the West Coast
EXTRUCKWC	Expenses on trucking of fish on the West Coast
EXVSSLSALL	Expenses on lease of vessel
FLDSL	Total diesel
FLOTHR	Other fuel use on West Coast
RUCWCRAB	Number of crew - crab
RUCWGRNDFG	Number of crew - fixed gear groundfish
RUCWGRNDTWL	Number of Crew - trawl groundfish
RUCWHLB	Number of Crew - halibut
RUCWPWHT	Number of Crew - Pacific whiting
RUCWSAMN	Number of Crew - Salmon
RUCWSRMP	Number of Crew - Shrimp
RUCWSTMAKWC	Number of Crew - steaming between West Coast and Alaska
RUCWTUNA	Number of Crew - tuna
RUFLCRAB	Average fuel use - crab
RUFLGRNDFG	Average fuel use - fixed gear groundfish
RUFLGRNDTWL	Average fuel use - trawl groundfish
RUFLHLB	Average fuel use - halibut
RUFLPWHT	Average fuel use - Pacific whiting
RUFLSAMN	Average fuel use - salmon
RUFLSRMP	Average fuel use - shrimp
RUFLSTMAKWC	Average fuel use - steaming between West Coast and Alaska
RUFLTUNA	Average fuel use - tuna
RUSPDGRNDTWL	Average Speed - trawl groundfish
RUSPDPWHT	Average speed - Pacific whiting
RUSPDSAMN	Average speed - salmon

RUSPDSRMP	Average speed - shrimp
RUSPDSTMAKWC	Average Speed - steaming between West Coast and Alaska
RUSPDTUNA	Average Speed - tuna
RVCHTR	Revenue from chartering or leasing the vessel
RVDELATSEA	Revenue from deliveries at sea
RVDSTER	Revenue from salmon disaster payments
RVLANDDELAK	Revenue from Alaska shoreside landings and at-sea deliveries
RVLEPLS	Revenue from lease of limited entry permit
RVLEPSL	Revenue from sale of limited entry permit
RVOTHR	Revenue from other
RVPRMTLS	Revenue from lease of other permits
RVPRMTSL	Revenue from sale of other permits
RVQPLS	Revenue from lease of quota pounds
RVQPSL	Revenue from sale of quota pounds
RVQSLS	Revenue from lease of quota shares
RVQSSL	Revenue from sale of quota shares
SHRPCPTHCPT	Hired captain - captain share
SHRPCPTOONB	Owner on board - captain share
SHRPCWHCPT	Hired captain - crew share
SHRPCWOONB	Owner on board - crew share
SHRPOONB	Percentage of trips vessel owner served as captain
SHRPOTHRHCPT1	Hired captain - other share
SHRPOTHRHCPT2	Hired captain - other share
SHRPOTHROONB1	Owner on board - other share
SHRPOTHROONB2	Owner on board - other share
SHRPVSSHCPT	Hired captain - vessel share
SHRPVSSOONB	Owner on board - vessel share
TRPSAK	One-way trips to Alaska
VVGEAR	Includes value of gear
VVMRK	Market value
VVPRMT	Includes value of permits
VVQTA	Includes value of quota

VVRPL	Replacement value
VVYY	Year of valuation
WTAK	Weight of landings made in Alaska

F.2 Catcher-processors

F.2.1 Tables of rules for handling NAs and zeroes

Table F.12: Rules for handling NAs and zeroes in catcher processor data: capitalized expenditures.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
CXFGRSHD	AK	0	NA	0
CXFGRSHD	AK	NA	NA	0
CXFGRWC	WC	0	NA	0
CXFGRWC	WC	NA	NA	0
CXONBQALL	NOVALIDATION	0	NA	NA
CXONBQALL	NOVALIDATION	NA	NA	NA
CXPQSHD	NOVALIDATION	0	NA	NA
CXPQSHD	NOVALIDATION	NA	NA	NA
CXPQWC	NOVALIDATION	0	NA	NA
CXPQWC	NOVALIDATION	NA	NA	NA

Table F.13: Rules for handling NAs and zeroes in catcher processor data: days at sea.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
DASFPWC	WC	0	NA	0
DASFPWC	WC	NA	NA	0
DASFSHAK	NOVALIDATION	0	NA	NA
DASFSHAK	NOVALIDATION	NA	NA	NA
DASOFFWC	NOVALIDATION	0	NA	NA
DASOFFWC	NOVALIDATION	NA	NA	NA
DASSTMAKWC	AKTRP	0	NA	0
DASSTMAKWC	AKTRP	NA	NA	0
DASSTMWC	WC	0	NA	0
DASSTMWC	WC	NA	NA	0

Table F.14: Rules for handling NAs and zeroes in catcher processor data: expenses.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
EXADTVSWC	NOVALIDATION	0	NA	NA
EXADTVSWC	NOVALIDATION	NA	NA	NA
EXCOMMWC	WC	0	NA	0
EXCOMMWC	WC	NA	NA	0
EXCOOPSHLS	NOVALIDATION	0	NA	NA
EXCOOPSHLS	NOVALIDATION	NA	NA	NA
EXCOOPSHPU	NOVALIDATION	0	NA	NA
EXCOOPSHPU	NOVALIDATION	NA	NA	NA
EXCOOPWC	NOVALIDATION	0	NA	NA
EXCOOPWC	NOVALIDATION	NA	NA	NA
EXCWWGNPRWC	WC	0	NA	0
EXCWWGNPRWC	WC	NA	NA	0
EXCWWGPRCWC	WC	0	NA	0
EXCWWGPRCWC	WC	NA	NA	0
EXDEPRALL	WC	0	NA	0
EXDEPRALL	WC	NA	NA	0
EXFGRRMSHD	AK	0	NA	0
EXFGRRMSHD	AK	NA	NA	0
EXFGRRMWC	WC	0	NA	0
EXFGRRMWC	WC	NA	NA	0
EXFLLUBWC	WC	0	NA	0
EXFLLUBWC	WC	NA	NA	0
EXFOODWC	WC	0	NA	0
EXFOODWC	WC	NA	NA	0
EXFRGTWC	WC	0	NA	0
EXFRGTWC	WC	NA	NA	0
EXINSEQALL	NOVALIDATION	0	NA	NA
EXINSEQALL	NOVALIDATION	NA	NA	NA
EXINSPRODWC	NOVALIDATION	0	NA	NA

EXINSPRODWC	NOVALIDATION	NA	NA	NA
EXLEPLS	LEASE	0	NA	0
EXLEPLS	LEASE	NA	NA	0
EXLEPPU	NOVALIDATION	0	NA	NA
EXLEPPU	NOVALIDATION	NA	NA	NA
EXMOORALL	NOVALIDATION	0	NA	NA
EXMOORALL	NOVALIDATION	NA	NA	NA
EXMSCWC	NOVALIDATION	0	NA	NA
EXMSCWC	NOVALIDATION	NA	NA	NA
EXOBSWC	WC	0	NA	0
EXOBSWC	WC	NA	NA	0
EXOFFLOADWC	WC	0	NA	0
EXOFFLOADWC	WC	NA	NA	0
EXONBQRMALL	NOVALIDATION	0	NA	NA
EXONBQRMALL	NOVALIDATION	NA	NA	NA
EXOTHRSUPPWC	WC	0	NA	0
EXOTHRSUPPWC	WC	NA	NA	0
EXPKGWC	NOVALIDATION	0	NA	NA
EXPKGWC	NOVALIDATION	NA	NA	NA
EXPQRMALL	NOVALIDATION	0	NA	NA
EXPQRMALL	NOVALIDATION	NA	NA	NA
EXSEASTATEWC	NOVALIDATION	0	NA	NA
EXSEASTATEWC	NOVALIDATION	NA	NA	NA
EXTRAVWC	WC	0	NA	0
EXTRAVWC	WC	NA	NA	0
EXVSSLSALL	LESSEE	0	NA	0
EXVSSLSALL	LESSEE	NA	NA	0

Table F.15: Rules for handling NAs and zeroes in catcher processor data: total fuel use on the West Coast.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
FLBUNK	NOVALIDATION	0	0	NA
FLBUNK	NOVALIDATION	NA	0	NA
FLDSL	WC	0	NA	0
FLDSL	WC	NA	NA	0
FLFOIL	NOVALIDATION	0	NA	NA
FLFOIL	NOVALIDATION	NA	0	NA

Table F.16: Rules for handling NAs and zeroes in catcher processor data: average crew size, average fuel use, and average speed.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RUCWNPR	WC	0	NA	NA
RUCWNPR	WC	NA	NA	NA
RUCWPRC	WC	0	NA	NA
RUCWPRC	WC	NA	NA	NA
RUFLFPS	NOVALIDATION	0	NA	NA
RUFLFPS	NOVALIDATION	NA	NA	NA
RUFLSTMAKWC	NOVALIDATION	0	NA	NA
RUFLSTMAKWC	NOVALIDATION	NA	NA	NA

Table F.17: Rules for handling NAs and zeroes in catcher processor data: annual earnings.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RVCHTR	LESSOR	0	NA	0
RVCHTR	LESSOR	NA	NA	0
RVCOOPSHLS	NOVALIDATION	0	NA	NA
RVCOOPSHLS	NOVALIDATION	NA	NA	NA
RVCOOPSHSL	NOVALIDATION	0	NA	NA
RVCOOPSHSL	NOVALIDATION	NA	NA	NA
RVLEPLS	NOVALIDATION	0	NA	NA
RVLEPLS	NOVALIDATION	NA	0	NA
RVLEPSL	NOVALIDATION	0	NA	NA
RVLEPSL	NOVALIDATION	NA	0	NA
RVVALOTHR	WC	0	NA	0
RVVALOTHR	WC	NA	NA	0
RVVALPWHTFILL	FILLET	0	NA	0
RVVALPWHTFILL	FILLET	NA	NA	0
RVVALPWHTFML	FISHMEAL	0	NA	0
RVVALPWHTFML	FISHMEAL	NA	NA	0
RVVALPWHTFOIL	FISHOIL	0	NA	0
RVVALPWHTFOIL	FISHOIL	NA	NA	0
RVVALPWHTHG	HGUT	0	NA	0
RVVALPWHTHG	HGUT	NA	NA	0
RVVALPWHTMINC	MINCED	0	NA	0
RVVALPWHTMINC	MINCED	NA	NA	0
RVVALPWHTOTHR	OTHERWHT	0	NA	0
RVVALPWHTOTHR	OTHERWHT	NA	NA	0
RVVALPWHTRND	ROUND	0	NA	0
RVVALPWHTRND	ROUND	NA	NA	0
RVVALPWHTROE	ROE	0	NA	0
RVVALPWHTROE	ROE	NA	NA	0
RVVALPWHTSTOM	STOMACH	0	NA	0
RVVALPWHTSTOM	STOMACH	NA	NA	0
RVVALPWHTSURI	SURIMI	0	NA	0
RVVALPWHTSURI	SURIMI	NA	NA	0
RVWTOTHR	OTHERSP	0	NA	0

Table F.18: Rules for handling NAs and zeroes in catcher processor data: vessel valuation information.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
VVGEAR	NOVALIDATION	0	NA	NA
VVGEAR	NOVALIDATION	NA	NA	NA
VVMRK	NOVALIDATION	0	NA	NA
VVMRK	NOVALIDATION	NA	NA	NA
VVPRMT	NOVALIDATION	0	NA	NA
VVPRMT	NOVALIDATION	NA	NA	NA
VVQTA	NOVALIDATION	0	NA	NA
VVQTA	NOVALIDATION	NA	NA	NA
VVRPL	NOVALIDATION	0	NA	NA
VVRPL	NOVALIDATION	NA	NA	NA
VVYY	NOVALIDATION	0	NA	NA
VVYY	NOVALIDATION	NA	NA	NA

Table F.19: Rules for handling NAs and zeroes in catcher processor data: weight of fish landed in Alaska.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
WTALL	WC	0	NA	NA
WTALL	WC	NA	NA	NA

F.2.2 Validation check descriptions

Table F.20: Description of validation checks used on catcher-processor data for determining whether an NA or zero should be an NA or a zero.

VALIDATION	DESCRIPTION
AK	The vessel fished in Alaska according to AKFIN (or catcher-processor/mothership form DAS)

AKTRP The vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data and/or the number of one-way trips to Alaska recorded on the form is greater than zero, for motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

AKWC The catcher vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data. For motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

EQUIP The vessel provided information about any of the following on their form: capitalized expenditures or expenses on all on-board and vessel equipment, fishing gear only used on the West Coast and or fishing gear shared between the West Coast and other fisheries, or they didn't fish on the West Coast according to fish ticket data

EXTRAWHTLBS Purchased weight recorded on form accounts for all pounds received by the vessel according to NORPAC

FILLET Production weight or production value of product type recorded on form are greater than zero

FISHMEAL Production weight or production value of product type recorded on form are greater than zero

FISHOIL Production weight or production value of fish oil recorded on form are greater than zero

HAULOUT The vessel was hauled out according to form response

HGUT Production weight or production value of product type recorded on form are greater than zero

LESSEE The survey participant is the lessee of the vessel

LESSOR The vessel is being filled out by a vessel owner who leased the vessel

MINCED Production weight or production value of minced production recorded on form are greater than zero

NOVALIDATION There are no validation checks for this response

OTHERSP Production weight or production value of product type are greater than zero

OTHERWHT Production weight or production value of other whiting product recorded on form are greater than zero

PORT Percentage of total off-load value by location sums to 100

ROE Production weight or production value of roe production recorded on form are greater than zero

ROUND	Production weight or production value of round production recorded on form are greater than zero
STOMACH	Production weight or production value of stomach production recorded on form are greater than zero.
SURIMI	Production weight or production value of surimi production recorded on form are greater than zero
WC	The vessel fished on the West Coast according to fish ticket data, for motherships and catcher-processors the vessel fished or processed in the West Coast whiting fishery according to NORPAC data
WHTLBS	Purchased weight or total purchase cost are greater than zero

F.2.3 Variable descriptions

Table F.21: Description of catcher-processor variables to which validation checks were applied.

FULLCODE	DESCRIPTION
CXFGRSHD	Capitalized expenditures on fishing gear shared between the West Coast and other fisheries
CXFGRWC	Capitalized expenditures on fishing gear used only on the West Coast
CXONBQALL	Capitalized expenditures on vessel and on-board equipment
CXPQSHD	Capitalized expenditures on processing equipment shared between the West Coast and other fisheries
CXPQWC	Capitalized expenditures on processing equipment used only on the West Coast
DASFPWC	Days at sea - Fishing and processing West Coast whiting fishery
DASFSHAK	Days at sea - Fishing in Alaska
DASOFFWC	Days at sea - Off-loading in the West Coast whiting fishery
DASSTMAKWC	Days at sea - Steaming between West Coast and Alaska
DASSTMWC	Days at sea - Steaming in the West Coast whiting fishery
EXADTVSWC	Expenses on non-fish ingredients (additives) on the West Coast
EXCOMMWC	Expenses on communication on the West Coast
EXCOOPSHLS	Expenses on lease of co-op shares
EXCOOPSHPU	Expenses on purchase of co-op shares
EXCOOPWC	Expenses on co-op membership fees on the West Coast

EXCWWGNPRWC	Expenses on non-processing crew wages on the West Coast
EXCWWGPRCWC	Expenses on processing crew wages on the West Coast
EXDEPRALL	Depreciation
EXFGRRMSHD	Expenses on fishing gear repair and maintenance shared between the West Coast and other fisheries
EXFGRRMWC	Expenses on fishing gear repair and maintenance on the West Coast
EXFLLUBWC	Expenses on fuel and lubrication on the West Coast
EXFOODWC	Expenses on food on the West Coast
EXFRGTWC	Expenses on freight on the West Coast
EXINSEQALL	Expenses on insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)
EXINSPRODWC	Expenses on on-board cargo/product insurance on the West Coast
EXLEPLS	Expenses on lease of catcher-processor endorsed permit
EXLEPPU	Expenses on purchase of catcher-processor endorsed permit
EXMOORALL	Expenses on moorage
EXMSCWC	Expenses on Marine Stewardship Council fees on the West Coast
EXOBSWC	Expenses on observers on the West Coast
EXOFFLOADWC	Expenses on offloading on the West Coast
EXONBQRMALL	Expenses on vessel and on-board equipment
EXOTHRSUPPWC	Expenses on supplies on the West Coast
EXPKGWC	Expenses on packing materials on the West Coast
EXPQRMALL	Expenses on processing equipment shared between the West Coast and Alaska
EXSEASTATEWC	Expenses on Sea State data monitoring on the West Coast
EXTRAVWC	Expenses on travel on the West Coast
EXVSSLSALL	Expenses on lease of vessel
FLBUNK	Total bunker fuel
FLDSL	Total diesel
FLFOIL	Total fish oil
PTASTORIA	Percentage of total off-load value in Astoria
PTATSEA	Percentage of total off-load value in at sea
PTBELL	Percentage of total off-load value in Blaine/Bellingham
PTCOOSB	Percentage of total off-load value in Coos Bay

PTOTHR	Percentage of total off-load value in other
PTPANGL	Percentage of total off-load value in Port Angeles
PTSEA	Percentage of total off-load value in Seattle
PTTAC	Percentage of total off-load value in Tacoma
PTWESTP	Percentage of total off-load value in West Port
RUCWNPR	Number of Crew - non-processing
RUCWPRC	Number of Crew - processing
RUFLFPS	Average fuel use - fishing, processing, and steaming in the West Coast whiting fishery
RUFLSTMAKWC	Average fuel use - steaming between West Coast and Alaska
RVCHTR	Revenue from chartering or leasing the vessel
RVCOOPSHLS	Revenue from lease of co-op shares
RVCOOPSHSL	Revenue from sale of co-op shares
RVLEPLS	Revenue from lease of limited entry permit
RVLEPSL	Revenue from sale of limited entry permit
RVVALOTHR	Total value of production - Other species
RVVALPWHTFILL	Total value of production - whiting fillets
RVVALPWHTFML	Total value of production - whiting fishmeal
RVVALPWHTFOIL	Total value of production - whiting fish oil
RVVALPWHTHG	Total value of production - whiting headed and gutted
RVVALPWHTMINC	Total value of production - whiting minced
RVVALPWHTOTHR	Total value of production - whiting other
RVVALPWHTRND	Total value of production - whiting round (unprocessed)
RVVALPWHTROE	Total value of production - whiting roe
RVVALPWHTSTOM	Total value of production - whiting stomachs
RVVALPWHTSURI	Total value of production - whiting surimi
RVWTOTHR	Total weight of production - Other species
RVWTPWHTFILL	Total weight of production - whiting fillets
RVWTPWHTFML	Total weight of production - whiting fishmeal
RVWTPWHTFOIL	Total weight of production - whiting fish oil
RVWTPWHTHG	Total weight of production - whiting headed and gutted
RVWTPWHTMINC	Total weight of production - whiting minced

RVWTPWHTOTHR	Total weight of production - whiting other
RVWTPWHTRND	Total weight of production - whiting round
RVWTPWHTROE	Total weight of production - whiting roe
RVWTPWHTSTOM	Total weight of production - whiting stomachs
RVWTPWHTSURI	Total weight of production - whiting surimi
TRPSAK	One-way trips to Alaska
VVGEAR	Includes value of gear
VVMRK	Market value
VVPRMT	Includes value of permits
VVQTA	Includes value of quota
VVRPL	Replacement value
VVYY	Year of valuation
WTALL	Total round weight of all fish processed in all fisheries

F.3 Motherships

F.3.1 Tables of rules for handling NAs and zeroes

Table F.22: Rules for handling NAs and zeroes in mothership data: capitalized expenditures.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
CXFGRSHD	AK	0	NA	0
CXFGRSHD	AK	NA	NA	0
CXFGRWC	WC	0	0	0
CXFGRWC	WC	NA	NA	0
CXONBQALL	NOVALIDATION	0	0	NA
CXONBQALL	NOVALIDATION	NA	NA	NA
CXPQSHD	NOVALIDATION	0	0	NA
CXPQSHD	NOVALIDATION	NA	NA	NA
CXPQWC	NOVALIDATION	0	0	NA
CXPQWC	NOVALIDATION	NA	NA	NA

Table F.23: Rules for handling NAs and zeroes in mothership data: days at sea.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
DASFSHAK	NOVALIDATION	0	0	NA
DASFSHAK	NOVALIDATION	NA	NA	NA
DASOFFWC	NOVALIDATION	0	0	NA
DASOFFWC	NOVALIDATION	NA	NA	NA
DASPRCWC	WC	0	0	0
DASPRCWC	WC	NA	NA	0
DASSTMAKWC	AKTRP	0	0	0
DASSTMAKWC	AKTRP	NA	NA	0
DASSTMWC	WC	0	0	0
DASSTMWC	WC	NA	NA	0

Table F.24: Rules for handling NAs and zeroes in mothership data: expenses.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
EXADTVSWC	NOVALIDATION	0	0	NA
EXADTVSWC	NOVALIDATION	NA	NA	NA
EXCOMMWC	WC	0	0	0
EXCOMMWC	WC	NA	NA	0
EXCOOPWC	NOVALIDATION	0	0	NA
EXCOOPWC	NOVALIDATION	NA	NA	NA
EXCOSTWCOTHR	WC	0	0	0
EXCOSTWCOTHR	WC	NA	NA	0
EXCOSTWCPWHT	WC	0	0	0
EXCOSTWCPWHT	WC	NA	NA	0
EXCWWGNPRWC	WC	0	0	0
EXCWWGNPRWC	WC	NA	NA	0
EXCWWGPRCWC	WC	0	0	0
EXCWWGPRCWC	WC	NA	NA	0
EXDEPRALL	WC	0	0	0
EXDEPRALL	WC	NA	NA	0
EXFGRRMSHD	AK	0	NA	0
EXFGRRMSHD	AK	NA	NA	0
EXFGRRMWC	WC	0	0	0
EXFGRRMWC	WC	NA	NA	0
EXFLLUBWC	WC	0	0	0
EXFLLUBWC	WC	NA	NA	0
EXFOODWC	WC	0	0	0
EXFOODWC	WC	NA	NA	0
EXFRGTWC	WC	0	0	0
EXFRGTWC	WC	NA	NA	0
EXINSEQALL	NOVALIDATION	0	0	NA
EXINSEQALL	NOVALIDATION	NA	NA	NA
EXINSPRODWC	NOVALIDATION	0	0	NA

EXINSPRODWC	NOVALIDATION	NA	NA	NA
EXMOORALL	NOVALIDATION	0	0	NA
EXMOORALL	NOVALIDATION	NA	NA	NA
EXMSPLS	NOVALIDATION	0	0	NA
EXMSPLS	NOVALIDATION	NA	NA	NA
EXMSPPU	NOVALIDATION	0	0	NA
EXMSPPU	NOVALIDATION	NA	NA	NA
EXOBSWC	WC	0	0	0
EXOBSWC	WC	NA	NA	0
EXOFFLOADWC	WC	0	0	0
EXOFFLOADWC	WC	NA	NA	0
EXONBQRMALL	NOVALIDATION	0	0	NA
EXONBQRMALL	NOVALIDATION	NA	NA	NA
EXOTHRSUPPWC	WC	0	0	0
EXOTHRSUPPWC	WC	NA	NA	0
EXPKGWC	NOVALIDATION	0	0	NA
EXPKGWC	NOVALIDATION	NA	NA	NA
EXPQRMALL	NOVALIDATION	0	0	NA
EXPQRMALL	NOVALIDATION	NA	NA	NA
EXTRAVWC	WC	0	0	0
EXTRAVWC	WC	NA	NA	0
EXVSSLSALL	LESSEE	0	NA	0
EXVSSLSALL	LESSEE	NA	NA	0
EXWTPWCOTHR	OTHERLBS	0	NA	0
EXWTPWCOTHR	OTHERLBS	NA	NA	0
EXWTPWCPWHT	WHTLBS	0	NA	0
EXWTPWCPWHT	WHTLBS	NA	NA	0
EXWTRWCOTHR	EXTRAOTHERLBS	0	NA	0
EXWTRWCOTHR	EXTRAOTHERLBS	NA	NA	0
EXWTRWCPWHT	EXTRAWHTLBS	0	NA	0
EXWTRWCPWHT	EXTRAWHTLBS	NA	NA	0

Table F.25: Rules for handling NAs and zeroes in mothership data: total fuel use on the West Coast.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
FLBUNK	NOVALIDATION	0	NA	NA
FLBUNK	NOVALIDATION	NA	0	NA
FLDSL	WC	0	0	0
FLDSL	WC	NA	NA	0
FLFOIL	NOVALIDATION	0	NA	NA
FLFOIL	NOVALIDATION	NA	0	NA

Table F.26: Rules for handling NAs and zeroes in mothership data: average crew size, average fuel use, and average speed.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RUCWNPR	WC	0	NA	NA
RUCWNPR	WC	NA	NA	NA
RUCWPRC	WC	0	NA	NA
RUCWPRC	WC	NA	NA	NA
RUFLPS	NOVALIDATION	0	NA	NA
RUFLPS	NOVALIDATION	NA	NA	NA
RUFLSTMAKWC	NOVALIDATION	0	0	NA
RUFLSTMAKWC	NOVALIDATION	NA	NA	NA

Table F.27: Rules for handling NAs and zeroes in mothership data: annual earnings.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
RVCHTR	LESSOR	0	NA	0
RVCHTR	LESSOR	NA	NA	0
RVMSPLS	NOVALIDATION	0	0	NA
RVMSPLS	NOVALIDATION	NA	NA	NA
RVMSPSL	NOVALIDATION	0	0	NA
RVMSPSL	NOVALIDATION	NA	NA	NA
RVVALOTHR	WC	0	0	0
RVVALOTHR	WC	NA	NA	0
RVVALPWHTFILL	FILLET	0	NA	0
RVVALPWHTFILL	FILLET	NA	NA	0
RVVALPWHTFML	FISHMEAL	0	NA	0
RVVALPWHTFML	FISHMEAL	NA	NA	0
RVVALPWHTFOIL	FISHOIL	0	NA	0
RVVALPWHTFOIL	FISHOIL	NA	NA	0
RVVALPWHTHG	HGUT	0	NA	0
RVVALPWHTHG	HGUT	NA	NA	0
RVVALPWHTMINC	MINCED	0	NA	0
RVVALPWHTMINC	MINCED	NA	NA	0
RVVALPWHTOTHR	OTHERWHT	0	NA	0
RVVALPWHTOTHR	OTHERWHT	NA	NA	0
RVVALPWHTRND	ROUND	0	NA	0
RVVALPWHTRND	ROUND	NA	NA	0
RVVALPWHTROE	ROE	0	NA	0
RVVALPWHTROE	ROE	NA	NA	0
RVVALPWHTSTOM	STOMACH	0	NA	0
RVVALPWHTSTOM	STOMACH	NA	NA	0
RVVALPWHTSURI	SURIMI	0	NA	0
RVVALPWHTSURI	SURIMI	NA	NA	0
RVWTOTHR	OTHERSP	0	NA	0
RVWTOTHR	OTHERSP	NA	NA	0
RVWTPWHTFILL	FILLET	0	NA	0
RVWTPWHTFILL	FILLET	NA	NA	0
RVWTPWHTFML	FISHMEAL	0	NA	0

Table F.28: Rules for handling NAs and zeroes in mothership data: vessel valuation information.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
VVGEAR	NOVALIDATION	0	0	NA
VVGEAR	NOVALIDATION	NA	NA	NA
VVMRK	NOVALIDATION	0	0	NA
VVMRK	NOVALIDATION	NA	NA	NA
VVPRMT	NOVALIDATION	0	0	NA
VVPRMT	NOVALIDATION	NA	NA	NA
VVQTA	NOVALIDATION	0	0	NA
VVQTA	NOVALIDATION	NA	NA	NA
VVRPL	NOVALIDATION	0	0	NA
VVRPL	NOVALIDATION	NA	NA	NA
VVYY	NOVALIDATION	0	0	NA
VVYY	NOVALIDATION	NA	NA	NA

Table F.29: Rules for handling NAs and zeroes in mothership data: weight of fish landed in Alaska.

VARIABLE	VALIDATION CHECK	RAW RESPONSE	TRUE	FALSE
WTALL	WC	0	0	NA
WTALL	WC	NA	NA	NA

F.3.2 Validation check descriptions

Table F.30: Description of validation checks used on mothership data for determining whether an NA or zero should be an NA or a zero.

VALIDATION	DESCRIPTION
AK	The vessel fished in Alaska according to AKFIN (or catcher-processor/mothership form DAS)

AKTRP — The vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data and/or the number of one-way trips to Alaska recorded on the form is greater than zero, for motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

AKWC — The catcher vessel fished in Alaska according to AKFIN and fished on the West Coast according to fish ticket data. For motherships and catcher-processors, DAS given for Alaska is greater than zero and NORPAC indicates vessel fished and processed the West Coast

EQUIP — The vessel provided information about any of the following on their form: capitalized expenditures or expenses on all on-board and vessel equipment, fishing gear only used on the West Coast and or fishing gear shared between the West Coast and other fisheries, or they didn't fish on the West Coast according to fish ticket data

EXTRAWHTLBS — Purchased weight recorded on form accounts for all pounds received by the vessel according to NORPAC

FILLET — Production weight or production value of product type recorded on form are greater than zero

FISHMEAL — Production weight or production value of product type recorded on form are greater than zero

FISHOIL — Production weight or production value of fish oil recorded on form are greater than zero

HAULOUT — The vessel was hauled out according to form response

HGUT — Production weight or production value of product type recorded on form are greater than zero

LESSEE — The survey participant is the lessee of the vessel

LESSOR — The vessel is being filled out by a vessel owner who leased the vessel

MINCED — Production weight or production value of minced production recorded on form are greater than zero

NOVALIDATION — There are no validation checks for this response

OTHERSP — Production weight or production value of product type are greater than zero

OTHERWHT — Production weight or production value of other whiting product recorded on form are greater than zero

PORT — Percentage of total off-load value by location sums to 100

ROE — Production weight or production value of roe production recorded on form are greater than zero

ROUND	Production weight or production value of round production recorded on form are greater than zero
STOMACH	Production weight or production value of stomach production recorded on form are greater than zero.
SURIMI	Production weight or production value of surimi production recorded on form are greater than zero
WC	The vessel fished on the West Coast according to fish ticket data, for motherships and catcher-processors the vessel fished or processed in the West Coast whiting fishery according to NORPAC data
WHTLBS	Purchased weight or total purchase cost are greater than zero

F.3.3 Variable descriptions

Table F.31: Description of mothership variables to which validation checks were applied.

FULLCODE	DESCRIPTION
CXFGRSHD	Capitalized expenditures on fishing gear shared between the West Coast and other fisheries
CXFGRWC	Capitalized expenditures on fishing gear used only on the West Coast
CXONBQALL	Capitalized expenditures on vessel and on-board equipment
CXPQSHD	Capitalized expenditures on processing equipment shared between the West Coast and other fisheries
CXPQWC	Capitalized expenditures on processing equipment used only on the West Coast
DASFSHAK	Days at sea - Fishing in Alaska
DASOFFWC	Days at sea - Off-loading in the West Coast whiting fishery
DASPRCWC	Days at sea - Processing in the West Coast whiting fishery
DASSTMAKWC	Days at sea - Steaming between West Coast and Alaska
DASSTMWC	Days at sea - Steaming in the West Coast whiting fishery
EXADTVSWC	Expenses on non-fish ingredients (additives) on the West Coast
EXCOMMWC	Expenses on communication on the West Coast
EXCOOPWC	Expenses on co-op membership fees on the West Coast
EXCOSTWCPWHT	Total cost of whiting purchased
EXCWWGNPRWC	Expenses on non-processing crew wages on the West Coast

EXCWWGPRCWC	Expenses on processing crew wages on the West Coast
EXDEPRALL	Depreciation
EXFGRRMSHD	Expenses on fishing gear repair and maintenance shared between the West Coast and other fisheries
EXFGRRMWC	Expenses on fishing gear repair and maintenance on the West Coast
EXFLLUBWC	Expenses on fuel and lubrication on the West Coast
EXFOODWC	Expenses on food on the West Coast
EXFRGTWC	Expenses on freight on the West Coast
EXINSEQALL	Expenses on insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)
EXINSPRODWC	Expenses on on-board cargo/product insurance on the West Coast
EXMOORALL	Expenses on moorage
EXOBSWC	Expenses on observers on the West Coast
EXOFFLOADWC	Expenses on offloading on the West Coast
EXONBQRMALL	Expenses on vessel and on-board equipment
EXOTHRSUPPWC	Expenses on supplies on the West Coast
EXPKGWC	Expenses on packing materials on the West Coast
EXPQRMALL	Expenses on processing equipment shared between the West Coast and Alaska
EXTRAVWC	Expenses on travel on the West Coast
EXVSSLSALL	Expenses on lease of vessel
EXWTPWCPWHT	Total Weight of Whiting Purchased
FLBUNK	Total bunker fuel
FLDSL	Total diesel
FLFOIL	Total fish oil
PTASTORIA	Percentage of total off-load value in Astoria
PTATSEA	Percentage of total off-load value in at sea
PTBELL	Percentage of total off-load value in Blaine/Bellingham
PTCOOSB	Percentage of total off-load value in Coos Bay
PTOTHR	Percentage of total off-load value in other
PTPANGL	Percentage of total off-load value in Port Angeles
PTSEA	Percentage of total off-load value in Seattle
PTTAC	Percentage of total off-load value in Tacoma

PTWESTP	Percentage of total off-load value in West Port
RUCWNPR	Number of Crew - non-processing
RUCWPRC	Number of Crew - processing
RUFLPS	Average fuel use - processing and steaming in the West Coast whiting fishery
RUFLSTMAKWC	Average fuel use - steaming between West Coast and Alaska
RVCHTR	Revenue from chartering or leasing the vessel
RVVALOTHR	Total value of production - Other species
RVVALPWHTFILL	Total value of production - whiting fillets
RVVALPWHTFML	Total value of production - whiting fishmeal
RVVALPWHTFOIL	Total value of production - whiting fish oil
RVVALPWHTHG	Total value of production - whiting headed and gutted
RVVALPWHTMINC	Total value of production - whiting minced
RVVALPWHTOTHR	Total value of production - whiting other
RVVALPWHTRND	Total value of production - whiting round (unprocessed)
RVVALPWHTROE	Total value of production - whiting roe
RVVALPWHTSTOM	Total value of production - whiting stomachs
RVVALPWHTSURI	Total value of production - whiting surimi
RVWTOTHR	Total weight of production - Other species
RVWTPWHTFILL	Total weight of production - whiting fillets
RVWTPWHTFML	Total weight of production - whiting fishmeal
RVWTPWHTFOIL	Total weight of production - whiting fish oil
RVWTPWHTHG	Total weight of production - whiting headed and gutted
RVWTPWHTMINC	Total weight of production - whiting minced
RVWTPWHTOTHR	Total weight of production - whiting other
RVWTPWHTRND	Total weight of production - whiting round
RVWTPWHTROE	Total weight of production - whiting roe
RVWTPWHTSTOM	Total weight of production - whiting stomachs
RVWTPWHTSURI	Total weight of production - whiting surimi
TRPSAK	One-way trips to Alaska
VVGEAR	Includes value of gear
VVMRK	Market value
VVPRMT	Includes value of permits

VVQTA	Includes value of quota
VVRPL	Replacement value
VVYY	Year of valuation
WTALL	Total round weight of all fish processed in all fisheries

F.4 First receivers

We do not currently implement any data processes on the first receiver data outside of the QA/QC described earlier.

Appendix G EDC Cover Letters for 2011 Data Collection

G.1 Catcher vessel cover letter

Economic Data Collection (FRAM Division)
National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd East
Seattle, WA 98112

May 9, 2012

NAME
ADDRESS_LINE_1
ADDRESS_LINE_2

Our records indicate that you are required to submit an Economic Data Collection (EDC) catcher vessel form for fiscal year 2011. Please return the enclosed form for the following vessel and permit by September 1, 2012:

Vessel Name: V_NAME
Coast Guard Vessel ID Number: VID
Federal Limited Entry Permit Number: PID

The West Coast Groundfish Trawl Catch Share Program, also known as trawl rationalization, began on January 11, 2011. Under this program, all owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit at any time in 2011 are required to submit an EDC form (50 CFR 660.114). In order for the Northwest Region to process permit renewals, changes in vessel registration, vessel account actions, and quota pound or individual bycatch quota issuance, all of your required EDC forms must be recorded as complete by September 1, 2012.

If you completed an EDC form last year, you will notice a few changes to the form this year. The most noticeable change is that all owners of a vessel registered to a limited entry trawl endorsed permit are required to complete the entire form, regardless of whether they fished. In addition, we now ask for vessel lease dates to allow us to better match fish ticket landings to the operator of the vessel.

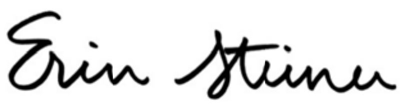
Tips for completing the forms:

- For your form to be recorded as complete, every question must have an answer, whether it is a number, a statement, or “NA”. This means that if you do not have an answer for a specific question, you need to write “NA” in that answer box.
- To avoid delays in processing of your form, if you are filling out the form for the owner of the vessel, make sure that the name of the owner of the vessel entered on the EDC form is the same as the name of the holder of the limited entry permit attached to the vessel.

The EDC data will be used by Northwest Fisheries Science Center (NWFSC) economists to evaluate the catch share program. Aggregated data and analyses will be compiled into a report and presented to the Pacific Fishery Management Council. The data you submit through the EDC program is confidential under the Magnuson-Stevens Act and NOAA Administrative Order 216-100. The individual level data will only be studied by NMFS employees or their contractors, and everyone who works with this data is required to sign a confidentiality agreement. When reporting the data, we will combine your responses with information provided by other participants, and report it in summary form so that individual responses cannot be identified.

If you have any questions about how to complete the form or believe that you are not responsible for completing the form, please contact me. Additional information can also be found on the enclosed Frequently Asked Questions sheet, and on our website where you can also download additional forms: www.nwfsc.noaa.gov/edc.

Sincerely,



Erin Steiner
National Marine Fisheries Service
NWFSC.EDC@noaa.gov
1-866-791-3726

G.2 Catcher-processor cover letter

Economic Data Collection (FRAM Division)
National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd East
Seattle, WA 98112

May 2, 2012

NAME
ADDRESS_LINE_1
ADDRESS_LINE_2

Our records indicate that you are required to submit an Economic Data Collection (EDC) catcher processor questionnaire for fiscal year 2011. Please return the enclosed form for the following vessel and permit by September 1, 2012:

Vessel Name: V_NAME
Coast Guard Vessel ID Number: VID
Federal Limited Entry Permit Number: PID

The West Coast Groundfish Trawl Catch Share Program, also known as trawl rationalization, began on January 11, 2011. Under this program, all owners, lessees, and charterers of a catcher processor registered to a C/P-endorsed limited entry permit at any time in 2011 are required to submit an EDC form (50 CFR 660.114). In order for the Northwest Region to process permit renewals, changes in vessel registration, vessel account actions, and quota pound or individual bycatch quota issuance, all of your required EDC forms must be recorded as complete by September 1, 2012.

Please note that for your form to be recorded as complete, every question must have an answer, whether it is a number, a statement, or "NA". This means that if you do not have an answer for a specific question, you need to write "NA" in that answer box.

The EDC data will be used by Northwest Fisheries Science Center (NWFSC) economists to evaluate the catch share program. Aggregated data and analyses will be compiled into a report and presented to the Pacific Fishery Management Council. The data you submit through the EDC program is confidential under the Magnuson-Stevens Act and NOAA Administrative Order 216-100. The individual level data will only be studied by NMFS employees or their contractors, and everyone who works with this data is required to sign a confidentiality agreement. When reporting the data, we will combine your responses with information provided by other participants, and report it in summary form so that individual responses cannot be identified.

If you have any questions about how to complete the form or believe that you are not responsible for completing the form, please contact me. Additional information can also be found on the enclosed Frequently Asked Questions sheet, and on our website where you can also download additional forms: www.nwfsc.noaa.gov/edc.

Sincerely,

Erin Steiner
National Marine Fisheries Service
NWFSC.EDC@noaa.gov
1-866-791-3726

G.3 Mothership cover letter

Economic Data Collection (FRAM Division)
National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd East
Seattle, WA 98112

May 2, 2012

NAME
ADDRESS_LINE_1
ADDRESS_LINE_2

Our records indicate that you are required to submit an Economic Data Collection (EDC) mothership vessel questionnaire for fiscal year 2011. Please return the enclosed form for the following vessel and permit by September 1, 2012:

Vessel Name: V_NAME
Vessel Coast Guard ID Number: VID
Federal Mothership Permit Number: PID

The West Coast Groundfish Trawl Catch Share Program, also known as trawl rationalization, began on January 11, 2011. Under this program, all owners, lessees, and charterers of a mothership vessel registered to a mothership permit at any time in 2011 are required to submit an EDC form (50 CFR 660.114). In order for the Northwest Region to process permit renewals, changes in vessel registration, vessel account actions, and quota pound or individual bycatch quota issuance, all of your required EDC forms must be recorded as complete by September 1, 2012.

Please note that for your form to be recorded as complete, every question must have an answer, whether it is a number, a statement, or “NA”. This means that if you do not have an answer for a specific question, you need to write “NA” in that answer box.

The EDC data will be used by Northwest Fisheries Science Center (NWFSC) economists to evaluate the catch share program. Aggregated data and analyses will be compiled into a report and presented to the Pacific Fishery Management Council. The data you submit through the EDC program is confidential under the Magnuson-Stevens Act and NOAA Administrative Order 216-100. The individual level data will only be studied by NMFS employees or their contractors, and everyone who works with this data is required to sign a confidentiality agreement. When reporting the data, we will combine your responses with information provided by other participants, and report it in summary form so that individual responses cannot be identified.

If you have any questions about how to complete the form or believe that you are not responsible for completing the form, please contact me. Additional information can also be found on the enclosed Frequently Asked Questions sheet, and on our website where you can also download additional forms: www.nwfsc.noaa.gov/edc.

Sincerely,

Erin Steiner
National Marine Fisheries Service
NWFSC.EDC@noaa.gov
1-866-791-3726

G.4 First receiver and shorebased processor cover letter

Economic Data Collection (FRAM Division)
National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd East
Seattle, WA 98112

May 1, 2012

COMPANY_NAME
ADDRESS_LINE_1
CITY, STATE ZIPCODE

Our records indicate that you are required to submit an Economic Data Collection (EDC) first receiver/shorebased processor form for fiscal year 2011. Please return the enclosed form for the following first receiver site license (FRSL) number and facility name by September 1, 2012:

FRSL Number: FIRST_RECEIVER_SITE_LICENSE
Facility Name: NAME_OF_FACILITY

The West Coast Groundfish Trawl Catch Share Program, also known as trawl rationalization, began on January 11, 2011. Under this program, all owners of a first receiver site license in 2011; and owners and lessees of a shorebased processor that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver in 2011 are required to submit an EDC (50 CFR 660.114). In order for the Northwest Region to process first receiver license applications, all of your required EDC forms must be recorded as complete by September 1, 2012.

Tips for completing the forms:

- For your form to be recorded as complete, every question must have an answer, whether it is a number, a statement, or "NA". This means that if you do not have an answer for a specific question, you need to write "NA" in that answer box.
- To avoid delays in processing of your form, make sure that the name of the facility listed on your form is the same as the name of the facility listed on your first receiver site license.
- In Questions 19 and 20, which pertain to fish purchases and fish production, all activities at the facility should be recorded including fish purchases from other facilities.
- If you are uncertain about how to answer any question on the form, please contact me and we can discuss your facility's operations and how best to answer the questions.

The EDC data will be used by Northwest Fisheries Science Center (NWFSC) economists to evaluate the catch share program. Aggregated data and analyses will be compiled into a report and presented to the Pacific Fishery Management Council. The data you submit through the EDC program is confidential under the Magnuson-Stevens Act and NOAA Administrative Order 216-100. The individual level data will only be studied by NMFS employees or their contractors, and everyone who works with this data is required to sign a confidentiality agreement. When reporting the data, we will combine your responses with information provided by other participants, and report it in summary form so that individual responses cannot be identified.

If you have any questions about how to complete the form or believe that you are not responsible for completing the form, please contact me. Additional information can also be found on the enclosed Frequently Asked Questions sheet, and on our website where you can also download additional forms: www.nwfsc.noaa.gov/edc.

Sincerely,

Erin Steiner
National Marine Fisheries Service
NWFSC.EDC@noaa.gov
1-866-791-3726

Appendix H EDC Forms Used for 2011 Data Collection

This appendix contains the most recent version of each of the EDC forms. An archive of previously fielded forms can be found at the EDC form archive:

http://www.nwfsc.noaa.gov/research/divisions/fram/economic_data_archive.cfm. The appended forms also include the variable name that was assigned to each field on the form. These names match the variable names listed in Appendix F.

H.1 Catcher vessel form

OMB Control No. 0648-0618 Expiration Date: 04/30/2015

Economic Data Collection (EDC) Form

WEST COAST GROUNDFISH LIMITED ENTRY TRAWL CATCHER VESSEL 2011

NOAA Fisheries – Northwest Fisheries Science Center

Who is responsible for submitting. All owners, lessees, and charterers of a catcher vessel registered to a limited entry trawl endorsed permit at any time in 2011

Complete all questions. If a question is not applicable, write "NA" in the answer box. The survey will not be considered complete unless there is an answer to every question.

Submit by September 1, 2012. Completed and signed EDC forms must be mailed and postmarked by or hand-delivered to NMFS no later than September 1, 2012. Mail or deliver to:

Economic Data Collection Program (FRAM Division),
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, WA 98112

Retain a copy. Retain a copy of the completed form

Fillable forms and more information. www.nwfsc.noaa.gov/edc

Questions. Visit the website above or contact Erin Steiner at (866) 791-3726 or NWFSC.EDC@noaa.gov

Public Reporting Burden Statement

Public reporting burden for this collection of information is estimated to take 8 hours per response, including time for reviewing the instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden to Erin Steiner, National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112.

Additional Information

Before completing this form, please note the following: 1) Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number; 2) This information is mandatory and is required to manage commercial fishing efforts under 50 CFR part 660 and under section 402(a) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*); 3) Responses to this information request are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*). They are also confidential under NOAA Administrative Order 216-100, which sets forth procedures to protect the confidentiality of fishery statistics.

I. Contact Information and Vessel Characteristics

SURTYP

2011 CV Survey_DBID SURVEY_DBID

SURYY

Initials INITS Overall Comments CMTOA

1. Provide the following information about this vessel and its physical characteristics.

Item	Vessel Information
Vessel Name	VSSNAM
USCG Vessel Number (if none exists enter State ID)	VSSNUM
Home Port	VSSPT
Length Overall (feet)	VSSLNG
Fuel Capacity (gallons)	VSSFLCAP
Total Horsepower of Main Engines	VSSHP

CMT01

2. Provide the contact information for the **owner of the vessel**. Please make sure that the name provided matches the name of the holder of the limited entry permit attached to this vessel in 2011.

Name of Company, Partnership, or Other Business Entity ONAM			
Business Mailing Address Street / PO Box OADDR			Business Phone ( ) OPH Business Fax ( ) OFAX
City OCITY	State OST	Zip Code OZIP	Business Email OEM

CMT02

3. List the limited entry groundfish permit(s) used with this vessel during 2011 in the **West Coast** (Washington, Oregon, and California) fishery – Do NOT include state fishing permits, e.g.: shrimp, crab, or salmon.

Limited Entry Permit Number PRMTNUM1	Permit Owned or Leased? Owned ☐ PRMTOL1 Leased ☐
Limited Entry Permit Number (2) PRMTNUM2	Permit Owned or Leased? Owned ☐ PRMTOL2 Leased ☐
Limited Entry Permit Number (3) PRMTNUM3	Permit Owned or Leased? Owned ☐ PRMTOL3 Leased ☐
Limited Entry Permit Number (4) PRMTNUM4	Permit Owned or Leased? Owned ☐ PRMTOL4 Leased ☐

CMT03

4.

a. Was the vessel leased or bareboat chartered during 2011?

Yes ☐	Continue to question 4b	
No ☐	Skip to question 5 ➲	

LEASE

b. If the vessel was leased or bareboat chartered during 2011, provide the contact information for the **lessee or charterer** of the vessel. If necessary, use the last page for additional lessees or charterers.

Name of Company, Partnership, or Other Business Entity LNAM			
Business Mailing Address Street / PO Box LADDR			Business Phone ( ) LPH Business Fax ( ) LFAX
City LCITY	State LST	Zip Code LZIP	Business Email LEM

c. Provide the dates the vessel was leased or bareboat chartered in 2011. If necessary, use the last page for additional lessees or charterers.

Begin: LMMBEG / LDDBEG / LYYBEG (mm dd yyyy) End: LMMEND / LDDEND / LYYEND (mm dd yyyy)

CMT04

5. Provide the contact information for the **individual completing this report**. If your address, phone, and email are provided in the owner or lessee/charterer information above, you do not need to repeat them here but please provide your name and title.

CMT05

☐ Vessel **Owner** or Designated Representative ACCOL

☐ Vessel **Lessee or Charterer** or Designated Representative

Name ACCNAM			Title ACCTITLE
Business Mailing Address Street / PO Box ACCADDR			Business Phone ( ) ACCPH Business Fax ( ) ACCFAX
City ACCCITY	State ACCST	Zip Code ACCZIP	Business Email ACCEM

6. Read the following statement, and sign and date the box below.

I certify under penalty of perjury that I have reviewed all the information in this form and that it is true and complete to the best of my knowledge.		
Signature SIGNED	If the Survey was signed enter a "Y" if the Survey was not signed enter a "N"	Date signed SIGMM / SIGDD / SIGYY mm dd yyyy

CMT06

7. Did you harvest any fish (including shellfish) using this vessel during the 2011 calendar year?

HARVEST

CMT07

8. Answer the following questions related to the most recent marine survey value of the vessel.

What was the year of this vessel's last value survey?	VVYY yyyy
What was the *market value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVMRK
What was the *replacement value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVRPL
Did the survey values given above include the value of permits associated with the vessel at the time of the survey?	VVPRMT
Did the survey values given above include the value of quota associated with the vessel at the time of the survey?	VVQTA
Did the survey values given above include the value of all fishing gear on the vessel at the time of the survey?	VVGEAR

CMT08

9. For the remainder of the survey, report values from your 2011 fiscal year. When did this vessel's 2011 fiscal year begin?

FSCLMM	/ FSCLDD	/ FSCLYY
mm	dd	yyyy

CMT09

Please report values from your 2011 fiscal year for the remainder of this survey.

10. Did you have this vessel hauled out in 2011?

Use "Y" for Yes, "N" for No, and "-7" for Not Applicable	HAULOUT

CMT10

11. Provide this vessel's average fuel use (for propulsion or other uses) per day, speed, and crew size (not including captain) when engaged in each of the following activities on the **West Coast** (Washington, Oregon, and California).

- Fuel use per day should be an average that includes steaming to the fishing grounds, harvesting fish, and steaming back to port and should include all fuels used for propulsion or other uses
- Put an "NA" under Fuel Use for all activities in which you did not operate this vessel.

Activity	**Fuel Use**	**Speed While Fishing**	**Crew Size** (not including captain)
West Coast whiting trawl gear (not including other groundfish)	RUFLPWHT gal/day	RUSPDPWHT knots	RUCWPWHT
West Coast groundfish trawl gear (not including whiting)	RUFLGRNDTWL gal/day	RUSPDGRNDTWL knots	RUCWGRNDTWL
West Coast groundfish fixed gear	RUFLGRNDFG gal/day		RUCWGRNDFG
West Coast shrimp trawl gear	RUFLSRMP gal/day	RUSPDSRMP knots	RUCWSRMP
West Coast crab	RUFLCRAB gal/day		RUCWCRAB
West Coast halibut (Pacific or California)	RUFLHLB gal/day		RUCWHLB
West Coast salmon	RUFLSAMN gal/day	RUSPDSAMN knots	RUCWSAMN
West Coast tuna	RUFLTUNA gal/day	RUSPDTUNA knots	RUCWTUNA
Steaming between the West Coast and Alaska	RUFLSTMAKWC gal/day	RUSPDSTMAKWC knots	RUCWSTMAKWC

CMT11

12. How many gallons of fuel did this vessel use (for propulsion or other uses) during 2011 on the **West Coast** (Washington, Oregon, and California)?

- Exclude fuel use for activities related to charter of vessel
- Exclude activities in Alaska and steaming between the West Coast and Alaska

Type of Fuel	**Gallons**
Diesel	FLDSL gal
Other: FLOTHRNAM	FLOTHR gal

If more that one "Other" type was listed, Type out all of the types into the box above separating them with a semicolon. Do the same for the amounts and ensure the order is consistent

CMT12

13. Provide the number of days this vessel was at sea during 2011 in each of the following activities. Please note that there is a special category for days at sea steaming between the West Coast and Alaska. *(This information will be used to allocate some expenditures among the different fisheries in which the vessel participated.)*

- Count partial days as full days
- If you did not participate in a particular activity, please write "NA".

Activity	Days at Sea
West Coast whiting trawl gear (not including other groundfish)	DASPWHT days
West Coast groundfish trawl gear (not including whiting)	DASGRNDTWL days
West Coast groundfish fixed gear	DASGRNDFG days
West Coast shrimp trawl gear	DASSRMP days
West Coast crab	DASCRAB days
West Coast halibut (Pacific or California)	DASHLB days
West Coast salmon	DASSAMN days
West Coast tuna	DASTUNA days
Other West Coast fisheries	DASOTHRWC days
Alaskan fisheries	DASFSHAK days
Chartering / Research	DASCHTR days
Steaming between the West Coast and Alaska	DASSTMAKWC days

CMT13

14. Provide the number of **one-way** trips (count a round trip as 2 one-way trips) this vessel made steaming between the West Coast and Alaska during 2011.

TRPSAK one-way trips

CMT14

II. Capitalized Expenditures

15. Provide the 2011 **capitalized expenditures** associated with each of the following categories for this vessel. Note that some capitalized expenditures are for **All Fisheries** the vessel participates in (West Coast, Alaska, and other) and others are for **West Coast Fisheries only** fisheries (Washington, Oregon, and California). Round all answers to the nearest 100 dollars.

Capitalized Expenditure Category	Capitalized Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Capitalized Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Vessel and On-board Equipment • Include all electronics, safety equipment, and machinery not used to harvest fish • Exclude fishing gear and processing equipment		
New and used vessel and on-board equipment (Regardless of where the vessel fished, enter all expenditures for vessel and on-board equipment under the All Fisheries column)	$ CXONBQALL	
Fishing Gear • Include nets, doors, traps, pots, cables, and fishing machinery used for the West Coast fisheries • Exclude any fishing gear that was only used in Alaska		
Fishing gear used in West Coast Fisheries only		$ CXFGRWC
Fishing gear shared by West Coast, Alaska and other fisheries (if you only fished in the West Coast, enter "NA")	$ CXFGRSHD	
Processing Equipment • Include any equipment used to process or head and gut fish on-board the vessel		
Processing equipment used in West Coast Fisheries only		$ CXPQWC
Processing equipment shared by West Coast, Alaska and other fisheries (if you only fished in the West Coast, enter "NA")	$ CXPQSHD	

CMT15

III. Quota and Permit Expenses

16. Provide the total cost of quota shares, quota pounds, and fishing permits purchased or leased during 2011 in the **West Coast** limited entry fisheries.

	Purchase	**Lease**
Quota Shares	$ EXQSPU	$ EXQSLS
Quota Pounds	$ EXQPPU	$ EXQPLS
Limited Entry Trawl Permit	$ EXLEPPUTWL	$ EXLEPLSTWL
Limited Entry Fixed Gear Permit	$ EXLEPPUFG	$ EXLEPLSFG

CMT16

IV. Annual Expenses

17. Provide the total amount **expensed** during 2011 in each of the following categories for this vessel. Note that some expenses are for **All Fisheries** the vessel participates in (West Coast, Alaska and other) and others are for **West Coast fisheries only** (Washington, Oregon, and California). Round all answers to the nearest 100 dollars.

- Include all chartering expenses, even if directly reimbursed
- If you do not track expenses for captain and crew separately, report the combined expenses under captain, and put "NA" under Crew

Expenses Category	Expenses in **All Fisheries** *West Coast, Alaska, and Other*	Expenses in **West Coast Fisheries Only** *Washington, Oregon, and California*
Captain (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)		$ EXCPTWGWC
Crew (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)		$ EXCWWGWC
Crew or captain travel not deducted from wages		$ EXTRAVWC
Observer fees and electronic monitoring		$ EXOBSWC
Fishing association and commission costs		$ EXFADWC
State licensing and Federal permit fees		$ EXLICFEESWC
Fuel and lubrication (do not include steaming between West Coast and Alaska)		$ EXFLLUBWC
Food		$ EXFOODWC
Ice		$ EXICEWC
Bait		$ EXBAITWC
Off-load expenses (cross-dock fees, port tariffs, hoist fees, etc.)		$ EXOFFLOADWC
Freight to the vessel on supplies		$ EXFRGTWC
Other supplies (cleaning, clothing, safety, etc.)		$ EXOTHRSUPPWC
Communications, including VMS, satellite phone, skymate		$ EXCOMMWC
Trucking of fish to buyer		$ EXTRUCKWC

17. (Continued)

Expenses Category	Expenses in **All Fisheries** *West Coast, Alaska, and Other*	Expenses in **West Coast Fisheries Only** *Washington, Oregon, and California*
Vessel and on-board equipment purchase, repair and maintenance (expensed during 2011)	$ EXONBQRMALL	
Repair and maintenance on fishing gear used in the West Coast Fisheries only (expensed during 2011)		$ EXFGRRMWC
Repair and maintenance on fishing gear shared by the West Coast, Alaska, and other fisheries (if you did not fish in Alaska, enter "NA")	$ EXFGRRMSHD	
Repair and maintenance on processing equipment (expensed during 2011)	$ EXPQRMALL	
Insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)	$ EXINSEQALL	
Moorage	$ EXMOORALL	
Lease or bareboat charter of this vessel	$ EXVSSLSALL	
Total depreciation (vessel, on-board equipment, processing equipment, and quota share) taken during 2011	$ EXDEPRALL	

CMT17

18. Provide the total round weight of all fish landings made by this vessel in **Alaska** during 2011. Round to the nearest 100 pounds. *(This information will be used to allocate some of your expenditures between the different fisheries you participate in.)*

WTAK ____________ lbs in Alaska

CMT18

19. Were any of the fish harvested by this vessel on the **West Coast** (Washington, Oregon, and California) during 2011 processed or headed and gutted on-board?

ONBPRC

CMT19

V. Annual Earnings

20. For each of the earnings sources listed below, indicate the income earned during 2011.

- Landings revenue should include taxes, buyback program fees, and post-season adjustments for fish harvested in 2011.

Earnings Source	Total Revenue
West Coast shoreside landings: *this information will be obtained from fish ticket data*	
West Coast at-sea deliveries to motherships	$ RVDELATSEA
Alaska shoreside landings and at-sea deliveries	$ RVLANDDELAK
Sale of West Coast limited entry trawl permits	$ RVLEPSLTWL
Lease of West Coast limited entry trawl permits	$ RVLEPLSTWL
Sale of other West Coast permits	$ RVPRMTSL
Lease of other West Coast permits	$ RVPRMTLS
Sale of West Coast limited entry quota shares	$ RVQSSL
Lease of West Coast limited entry quota shares	$ RVQSLS
Sale of West Coast limited entry quota pounds	$ RVQPSL
Lease of West Coast limited entry quota pounds	$ RVQPLS
Salmon disaster relief payments	$ RVDSTER
Chartering / research / leasing vessel: include direct reimbursements	$ RVCHTR
Other: RVOTHRNAM	$ RVOTHR

If more that one "Other" type was listed, Type out all of the types into the box above separating them with a semicolon. Do the same for the amounts and ensure the order is consistent

CMT20

VI. Crew Share

21. Did this vessel use a crew share system to pay its crew when operating in the **West Coast groundfish** fisheries during 2011?

CWSHARE

→ Skip to question 23 ➲

CMT21

22. Which of the following expenses were deducted from total revenue before calculating the crew share when this vessel operated in the **West Coast groundfish** fisheries during 2011?

Expense Category	**Deducted from Crew Share?**
Crew or captain travel not deducted from wages	SHRDTRAVCWCPT
Observer fees and electronic monitoring	SHRDOBS
Fishing association and commission costs	SHRDFAD
State licensing and Federal permit fees	SHRDLICFEES
Buyback fees	SHRDBUYBACK
Fuel and lubrication	SHRDFLLUB
Food	SHRDFOOD
Ice	SHRDICE
Bait	SHRDBAIT
Off-load expenses	SHRDOFFLOAD
Freight to the vessel on supplies	SHRDFRGT
Other supplies	SHRDOTHRSUPP
Communications	SHRDCOMM
Trucking of fish to buyer	SHRDTRUCK
Insurance premium payments	SHRDINS
Lease or charter of this vessel	SHRDVSSLS
Quota pounds held at the start of the year	SHRDONBQRM
Quota pounds purchased or leased during the year	SHRDQPPU
Quota shares purchased or amortized during the year	SHRDQSPU
Limited entry trawl permit	SHRDLEP
Other West Coast permit	SHRDPRMTWC
Other: SHRDOTHRNAM	SHRDOTHR

CMT22

23. On what percentage of fishing trips did the vessel owner serve as captain in the **West Coast groundfish** fisheries during 2011?

SHRPOONB ______%

CMT23

24. On trips when the vessel owner **served as captain**, please indicate the share of net revenue (revenue minus the deductions listed in Question 22) going to the vessel, captain, crew, and if applicable, Other.

- The column should sum to 100%.
- If this vessel did not use a crew share system to pay its crew, enter "NA" in each of the boxes below.

Vessel share	SHRPVSSOONB ______%
Captain share	SHRPCPTOONB ______%
Crew share	SHRPCWOONB ______%
Other SHRPOTHROONBNAM1 ______	SHRPOTHROONB1 ______%
Other SHRPOTHROONBNAM2 ______	SHRPOTHROONB2 ______%
Total	100 %

CMT24

25. On trips when the vessel owner **did not serve as captain**, please indicate the share of net revenue (revenue minus the deductions listed in Question 22) going to the vessel, captain, crew, and if applicable, Other.

- The column should sum to 100%.
- If this vessel did not use a crew share system to pay its crew, enter "NA" in each of the boxes below.

Vessel share	SHRPVSSHCPT ______%
Captain share	SHRPCPTHCPT ______%
Crew share	SHRPCWHCPT ______%
Other SHRPOTHRHCPTNAM1 ______	SHRPOTHRHCPT1 ______%
Other SHRPOTHRHCPTNAM2 ______	SHRPOTHRHCPT2 ______%
Total	100 %

CMT25

Questionnaire Comments:

CMTQU

H.2 Catcher-processor form

OMB Control No. 0648-0618 Expiration Date: 04/30/2015

Economic Data Collection (EDC) Form

WEST COAST GROUNDFISH LIMITED ENTRY TRAWL CATCHER-PROCESSOR VESSEL 2011

NOAA Fisheries – Northwest Fisheries Science Center

Who is responsible for submitting. All owners, lessees, and charterers of a vessel registered to a catcher-processor endorsed limited entry trawl permit at any time in 2011

Complete all questions. If a question is not applicable, write "NA" in the answer box. The survey will not be considered complete unless there is an answer to every question.

Submit by September 1, 2012. Completed and signed EDC forms must be mailed and postmarked by or hand-delivered to NMFS no later than September 1, 2012. Mail or deliver to

Economic Data Collection Program (FRAM Division),
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, WA 98112

Retain a copy. Retain a copy of the completed form

Fillable forms and more information. www.nwfsc.noaa.gov/edc

Questions. Visit the website above or contact Erin Steiner at (866) 791-3726 or NWFSC.EDC@noaa.gov

Public Reporting Burden Statement

Public reporting burden for this collection of information is estimated to take 8 hours per response, including time for reviewing the instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden to Erin Steiner, National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112.

Additional Information

Before completing this form, please note the following: 1) Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number; 2) This information is mandatory and is required to manage commercial fishing efforts under 50 CFR part 660 and under section 402(a) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*); 3) Responses to this information request are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*). They are also confidential under NOAA Administrative Order 216-100, which sets forth procedures to protect the confidentiality of fishery statistics.

I. Contact Information and Vessel Characteristics

SURYY

2011 CP SURTYP | Survey _DBID | SURVEY_DBID

Initials | INITS

Overall Comments | CMTOA

1. Provide the following information about this vessel and its physical characteristics.

Item	Vessel Information
Vessel Name	VSSNAM
USCG Vessel Number	VSSNUM
Home Port	VSSPT
Length Overall (feet)	VSSLNG
Fuel Capacity (gallons)	VSSFLCAP
Horsepower of Main Engines	VSSHP

CMT01

2. Provide the contact information for the **owner of the catcher-processor vessel.**

Name of Company, Partnership, or Other Business Entity ONAM			
Business Mailing Address Street / PO Box OADDR			Business Phone ( ) OPH Business Fax ( ) OFAX
City OCITY	State OST	Zip Code OZIP	Business Email OEM

CMT02

3. If the vessel was leased or bareboat chartered during 2011, provide the contact information for **the lessee or charterer of the catcher-processor vessel**. If necessary, use the last page for additional lessees or charterers.

Name of Company, Partnership, or Other Business Entity LNAM			
Business Mailing Address Street / PO Box LADDR			Business Phone ( ) LPH Business Fax ( ) LFAX
City LCITY	State LST	Zip Code LZIP	Business Email LEM

CMT03

4. List the catcher-processor endorsed limited entry trawl permit(s) used with this vessel during 2011 in the **West Coast** whiting fishery below. *West Coast* includes Washington, Oregon, and California.

Catcher-Processor Endorsed Permit Number	Permit Owned or Leased?
PRMTNUM1	Owned ☐ Leased ☐ PRMTOL1
Catcher-Processor Endorsed Permit Number (2)	**Permit Owned or Leased?**
PRMTNUM2	Owned ☐ Leased ☐ PRMTOL2
Catcher-Processor Endorsed Permit Number (3)	**Permit Owned or Leased?**
PRMTNUM3	Owned ☐ Leased ☐ PRMTOL3

CMT04

5. Provide the contact information for the **individual completing this report**. If your address, phone, and email are provided in the owner or lessee/charterer information above, you do not need to repeat them here but please provide your name and title.

☐ Catcher-Processor Vessel **Owner** (or Designated Representative) ACCOL

☐ Catcher-Processor Vessel **Lessee or Charterer** (or Designated Representative)

Name			Title
ACCNAM			ACCTITLE
Business Mailing Address Street / PO Box ACCADDR			Business Phone ( ) ACCPH Business Fax ( ) ACCFAX
City ACCCITY	State ACCST	Zip Code ACCZIP	Business Email ACCEM

CMT05

6. Read the following statement, and sign and date the box below.

I certify under penalty of perjury that I have reviewed all the information in this form and that it is true and complete to the best of my knowledge.	
Signature SIGNED If the Survey was signed enter a "Y" if the Survey was not signed enter a "N"	Date signed SIGMM / SIGDD / SIGYY mm dd yyyy

CMT06

Please proceed to the next page ➲

If a question is not applicable, write "NA" in the answer box.

7. Answer the following questions related to the most recent survey value of the vessel.

What was the year of this vessel's last value survey?	VVYY yyyy	
What was the *market value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVMRK	
What was the *replacement value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVRPL	
Did the survey values given above include the value of permits associated with the vessel at the time of the survey?	VVPRMT	Use "Y" for Yes, "N" for No, and "-7" for Not Applicable
Did the survey values given above include the value of quota associated with the vessel at the time of the survey?	VVQTA	
Did the survey values given above include the value of all processing equipment on the vessel at the time of the survey?	VVPQ	
Did the survey values given above include the value of all fishing gear on the vessel at the time of the survey?	VVGEAR	

CMT07

8. For the remainder of the survey, report values from your 2011 fiscal year. When did this vessel's 2011 fiscal year begin?

FSCLMM / FSCLDD / FSCLYY
mm dd yyyy

CMT08

Please report values from your 2011 fiscal year for the remainder of this survey.

9. Was this vessel hauled out in 2011?

HAULOUT — Use "Y" for Yes, "N" for No, and "-7" for Not Applicable

CMT09

10. Provide this vessel's average fuel use per day (for propulsion or other uses) when engaged in each of the following activities.
    - **West Coast** includes Washington, Oregon, and California.
    - Fuel use should include all fuels used for propulsion or other uses

Activity	Fuel Use
Fishing, processing, and steaming in the West Coast whiting fishery	RUFLFPS gal/day
Steaming between the West Coast and Alaska	RUFLSTMAKWC gal/day

CMT10

11. How many gallons of fuel did this vessel use (for propulsion or other uses) during 2011 in the **West Coast** whiting fishery?
   - Please exclude any steaming between the West Coast and Alaska in these calculations.

Type of Fuel	Gallons
Diesel	FLDSL ____ gal
Bunker oil	FLBUNK ____ gal
Fish oil	FLFOIL ____ gal

CMT11

12. Provide the number of days this vessel was at sea during 2011 in each of the following activities. Please note that there is a special category for days at sea steaming between the West Coast and Alaska. *(This information will be used to allocate some of your expenditures between the West Coast and Alaska in order to avoid asking more detailed information about the vessel's activity in Alaska)*
   - Count partial days as full days

Activity	Days at Sea
Fishing and Processing in the West Coast whiting fishery	DASFPWC ____ days
Steaming in the West Coast whiting fishery	DASSTMWC ____ days
Off-loading in the West Coast whiting fishery	DASOFFWC ____ days
Steaming between the West Coast and Alaska	DASSTMAKWC ____ days
All Alaska fisheries	DASFSHAK ____ days

CMT12

13. Provide the number of **one-way** trips (count a round trip as 2 one-way trips) this vessel made steaming between the West Coast and Alaska during 2011.

TRPSAK ____ one-way trips

CMT13

14. Provide the average number of processing crew members and the average number of non-processing crew members (including the captain) when the vessel was operating in the **West Coast** whiting fishery during 2011.
   - **Processing crew** includes line workers, fishmeal crew, quality control, technicians, cleanup, factory managers, mechanics who work on processing equipment, and combis
   - **Non-processing crew** includes deckhands, wheelhouse, galley, and engineers

Fishery	Average Number of Processing Crew Members	Average Number of Non-processing Crew Members
West Coast whiting	RUCWPRC ____	RUCWNPR ____

CMT14

II. Capitalized Investments

15. Provide the 2011 capitalized expenditures associated with each of the following categories for this vessel. Note that some capitalized expenditures are for **All Fisheries** the vessel participates in (West Coast, Alaska, and other) and others are for **West Coast whiting fishery only**. Round all answers to the nearest 100 dollars. *(Capital investments on the vessel and gear shared across fisheries will be allocated to the West Coast based on days or tonnage.)*

Capitalized Expenditure Category	Capitalized Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Capitalized Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Vessel and On-board Equipment • Exclude processing equipment and fishing gear • Include all electronics, safety equipment, and machinery not used to harvest or process fish		
New and used vessel and on-board equipment	$ CXONBQALL	
Processing Equipment • Exclude all equipment, machines, and buildings based primarily on shore • Exclude any processing equipment that is not used at least partially in the West Coast whiting fishery • Include on-board freezers, storage equipment, packing equipment, conveyers, and on-board cargo handling equipment		
Processing equipment used in the West Coast whiting fishery only		$ CXPQWC
Processing equipment shared by the West Coast whiting and other fisheries	$ CXPQSHD	
Fishing Gear • Include nets, cables, doors, and fishing machinery used in the West Coast whiting fishery • Exclude any fishing gear that is not used at least partially in the West Coast whiting fishery		
Fishing gear used in the West Coast whiting fishery only		$ CXFGRWC
Fishing gear shared by the West Coast whiting and other fisheries	$ CXFGRSHD	

CMT15

III. Quota and Permit Expenses

16. Provide the total cost of co-op shares and catcher-processor endorsed limited entry trawl permits purchased or leased during 2011 in the **West Coast** whiting fishery.

Purchase or Lease of Quota and Permits	**Total Cost**
Purchase of co-op shares	$ EXCQQPSHPU
Lease of co-op shares	$ EXCOOPSHLS
Purchase of catcher-processor endorsed permit	$ EXLEPPU
Lease of catcher-processor endorsed permit	$ EXLEPLS

CMT16

IV. Annual Expenses

17. Provide the total amount **expensed** during 2011 in each of the categories below. Note that some expenses are for **All Fisheries** (West Coast, Alaska, and other) and some expenses are asked for the **West Coast whiting fishery only**. Round all answers to the nearest 100 dollars.

Expenses Category	Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Processing crew (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)		$ EXCWWGPRCWC
Non-processing crew (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)		$ EXCWWGNPRWC
Crew travel not deducted from crew wages		$ EXTRAVWC
Observer fees		$ EXOBSWC
Sea State data monitoring		$ EXSEASTATEWC
Co-op membership fees		$ EXCOOPWC
Marine Stewardship Council fees		$ EXMSCWC
Fuel and lubrication (do not include steaming between West Coast and Alaska)		$ EXFLLUBWC
Food		$ EXFOODWC
Non-fish ingredients (additives)		$ EXADTVSWC
Packing materials		$ EXPKGWC
Freight to the vessel on supplies		$ EXFRGTWC
Other supplies (linens, clothing, cleaning, etc.)		$ EXOTHRSUPPWC
Communications		$ EXCOMMWC
Off-load expenses (cross-dock fees, port tariffs, etc.)		$ EXOFFLOADWC
On-board cargo / product insurance		$ EXINSPRODWC
Repair and maintenance on fishing gear used in the West Coast whiting fishery only (expensed in 2011)		$ EXFGRRMWC
Repair and maintenance on fishing gear shared by the West Coast whiting fishery and other fisheries (expensed in 2011)	$ EXFGRRMSHD	
Processing equipment repair and maintenance (expensed in 2011)	$ EXPQRMALL	
Vessel and on-board equipment repair and maintenance (expensed in 2011)	$ EXONBQRMALL	

17. (Continued)

Expenses Category (continued)	Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)	$ EXINSEQALL	
Moorage	$ EXMOORALL	
Lease or bareboat charter of this catcher-processor vessel	$ EXVSSLSALL	
Depreciation (vessel, on-board equipment, fishing gear, processing equipment, and quota share)	$ EXDEPRALL	

CMT17

18. Provide the total round weight of all fish processed by this catcher-processor vessel in **All Fisheries** (West Coast, Alaska, and other) during 2011. Round to the nearest metric ton. (*This information will be used to allocate some of your expenditures between the West Coast and Alaska in order to avoid asking more detailed information about the vessel's activity in Alaska.*)

WTALL ____________ mt

CMT18

Please proceed to the next page ➲

V. Annual Earnings

19. Provide the total weight and value of production in the **West Coast** whiting fishery during 2011. Report weights to the nearest metric ton.

- Do not include any additional payment you received to cover any shipping, handling, or storage costs associated with the sale beyond the FOB port of discharge.
- Please include any post-season adjustments for products produced in 2011.
- For products produced in 2011 and held in inventory at the end of the year, estimate the value on the basis of the average price received for similar products sold during the year.
- Include products shipped to other establishments of your company.
- Do not include revenue associated with fish caught in any fishery except the West Coast whiting fishery.

Type of Fish	**Total Weight of Production**	**Total Value of Production**
Whiting		
Surimi	RVWTPWHTSURI mt	$ RVVALPWHTSURI
Fillets	RVWTPWHTFILL mt	$ RVVALPWHTFILL
H&G	RVWTPWHTHG mt	$ RVVALPWHTHG
Round (unprocessed)	RVWTPWHTRND mt	$ RVVALPWHTRND
Fishmeal	RVWTPWHTFML mt	$ RVVALPWHTFML
Fish oil	RVWTPWHTFOIL mt	$ RVVALPWHTFOIL
Roe	RVWTPWHTROE mt	$ RVVALPWHTROE
Minced	RVWTPWHTMINC mt	$ RVVALPWHTMINC
Stomachs	RVWTPWHTSTOM mt	$ RVVALPWHTSTOM
Other: RVPWHTOTHRNAM	RVWTPWHTOTHR mt	$ RVVALPWHTOTHR
Other Species		
All other species	RVWTOTHR mt	$ RVVALOTHR

CMT19

20. Provide the percentage, by value, of all products off-loaded from this catcher-processor vessel in the **West Coast** whiting fishery at each of the following locations. The column should sum to 100%.

Location	**Percentage of Total Off-load Value**
Seattle	PTSEA %
Blaine / Bellingham	PTBELL %
Port Angeles	PTPANGL %
Tacoma	PTTAC %
Astoria	PTASTORIA %
Coos Bay	PTCOOSB %
At sea (tramper)	PTATSEA %
Other: PTOTHRNAM	PTOTHR %

If more that one "Other" type was listed, Type out all of the types into the box above separating them with a semicolon. Do the same for the amounts and ensure the order is consistent

CMT20

21. Provide the revenue received during 2011 from the sale or lease of **West Coast** limited entry trawl endorsed permits that were associated with this vessel.

Permits Purchased or Leased	**Revenue Received**
Sale of West Coast catcher-processor endorsed permits	$ RVLEPSL
Lease of West Coast catcher-processor endorsed permits	$ RVLEPLS

CMT21

22. Provide the revenue received during 2011 from the sale or lease of West Coast co-op shares.

Sale / Lease of Quota	**Revenue Received**
Sale of co-op shares	$ RVCOOPSHSL
Lease of co-op shares	$ RVCOOPSHLS

CMT22

23. Provide the revenue received during 2011 from the lease or bareboat charter of this catcher-processor vessel.

$ RVCHTR

CMT23

Questionnaire Comments:

CMTQU

H.3 Mothership form

OMB Control No. 0648-0618 Expiration Date: 04/30/2015

Economic Data Collection (EDC) Form

WEST COAST GROUNDFISH LIMITED ENTRY TRAWL MOTHERSHIP VESSEL 2011

NOAA Fisheries – Northwest Fisheries Science Center

Who is responsible for submitting. All owners, lessees, and charterers of a mothership vessel registered to an MS permit at any time in 2011

Complete all questions. If a question is not applicable, write "NA" in the answer box. The survey will not be considered complete unless there is an answer to every question.

Submit by September 1, 2011. Completed and signed EDC forms must be mailed and postmarked by or hand-delivered to NMFS no later than September 1, 2012. Mail or deliver to

Economic Data Collection Program (FRAM Division),
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, WA 98112

Retain a copy. Retain a copy of the completed form

Fillable forms and more information. www.nwfsc.noaa.gov/edc

Questions. Visit the website above or contact Erin Steiner at (866) 791-3726 or NWFSC.EDC@noaa.gov

Public Reporting Burden Statement

Public reporting burden for this collection of information is estimated to take 8 hours per response, including time for reviewing the instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden to Erin Steiner, National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Blvd E, Seattle, WA 98112.

Additional Information

Before completing this form, please note the following: 1) Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number; 2) This information is mandatory and is required to manage commercial fishing efforts under 50 CFR part 660 and under section 402(a) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*); 3) Responses to this information request are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*). They are also confidential under NOAA Administrative Order 216-100, which sets forth procedures to protect the confidentiality of fishery statistics.

I. Contact Information and Vessel Characteristics

SURYY

2011 MS Survey_DBID SURVEY_DBID Initials INITS Overall Comments CMTOA

SURTYP

1. Provide the following information about this vessel and its physical characteristics.

Item	Vessel Information
Vessel Name	VSSNAM
USCG Vessel Number	VSSNUM
Home Port	VSSPT
Length Overall (feet)	VSSLNG
Fuel Capacity (gallons)	VSSFLCAP
Horsepower of Main Engines	VSSHP

CMT01

2. Provide the contact information for the **owner of the mothership vessel**.

Name of Company, Partnership, or Other Business Entity ONAM			
Business Mailing Address Street / PO Box OADDR			Business Phone ( ) OPH Business Fax ( ) OFAX
City OCITY	State OST	Zip Code OZIP	Business Email OEM

CMT02

3. If the vessel was leased or bareboat chartered during 2011, provide the contact information for the **lessee or charterer** of the mothership vessel. If necessary, use the last page for additional lessees or charterers.

Name of Company, Partnership, or Other Business Entity LNAM			
Business Mailing Address Street / PO Box LADDR			Business Phone ( ) LPH Business Fax ( ) LFAX
City LCITY	State LST	Zip Code LZIP	Business Email LEM

CMT03

4. List the mothership permit(s) used with this vessel during 2011 in the **West Coast whiting fishery** below. West Coast includes Washington, Oregon, and California.

Mothership Permit Number	Permit Owned or Leased?
Mothership Permit Number PRMTNUM1	Permit Owned or Leased? Owned ☐ Leased ☐ PRMTOL1
Mothership Permit Number (2) PRMTNUM2	Permit Owned or Leased? Owned ☐ Leased ☐ PRMTOL2
Mothership Permit Number (3) PRMTNUM3	Permit Owned or Leased? Owned ☐ Leased ☐ PRMTOL3

CMT04

5. Provide the contact information for the **individual completing** this report. If your address, phone, and email are provided in the owner or lessee/charterer information above, you do not need to repeat them here but please provide your name and title.

☐ Mothership Vessel **Owner** or Designated Representative ACCOL

☐ Mothership Vessel **Lessee or Charterer** or Designated Representative

Name ACCNAM		Title ACCTITLE	
Business Mailing Address Street / PO Box ACCADDR			Business Phone ( ) ACCPH Business Fax ( ) ACCFAX
City ACCCITY	State ACCST	Zip Code ACCZIP	Business Email ACCEM

CMT05

6. Read the following statement and sign and date the box below.

I certify under penalty of perjury that I have reviewed all the information in this form and that it is true and complete to the best of my knowledge.	
Signature SIGNED If the Survey was signed enter a "Y" if the Survey was not signed enter a "N"	Date signed SIGMM/ SIGDD / SIGYY mm dd yyyy

CMT06

Please proceed to the next page ➲

If a question is not applicable, write "NA" in the answer box.

7. Answer the following questions related to the most recent survey value of the vessel.

What was the year of this vessel's last value survey?	VVYY yyyy	
What was the *market value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVMRK	
What was the *replacement value* of the vessel from the survey, rounded to the nearest 100 dollars?	$ VVRPL	
Did the survey values given above include the value of permits associated with the vessel at the time of the survey?	VVPRMT	Use "Y" for Yes, "N" for No, and "-7" for Not Applicable
Did the survey values given above include the value of quota associated with the vessel at the time of the survey?	VVQTA	
Did the survey values given above include the value of all processing equipment gear on the vessel at the time of the survey?	VVPQ	
Did the survey values given above include the value of all fishing gear on the vessel at the time of the survey?	VVGEAR	

CMT07

8. For the remainder of the survey, report values from your 2011 fiscal year. When did this vessel's 2011 fiscal year begin?

FSCL/ FSCL/ FSCLYY
mm dd yyyy

CMT08

Please report values from your 2011 fiscal year for the remainder of this survey.

9. Was this vessel hauled out in 2011?

HAULOUT

Use "Y" for Yes, "N" for No, and "-7" for Not Applicable

CMT09

10. Provide this vessel's average fuel use per day (for propulsion or other uses) when engaged in each of the following activities.
- **West Coast** includes Washington, Oregon, and California.
- Fuel use should include all fuels used for propulsion or other uses

Activity	**Fuel Use**
Processing and steaming in the West Coast whiting fishery	RUFLPS gal/day
Steaming between the West Coast and Alaska	RUFLSTMAKV gal/day

CMT10

11. How many gallons of fuel did this vessel use (for propulsion or other uses) during 2011 in the **West Coast** whiting fishery?

- Please exclude any steaming between the West Coast and Alaska in these calculations.

Type of Fuel	Gallons
Diesel	FLDSL gal
Bunker oil	FLBUNK gal
Fish oil	FLFOIL gal

CMT11

12. Provide the number of days this vessel was at sea during 2011 in each of the following activities. Please note that there is a special category for days at sea steaming between the West Coast and Alaska. *(This information will be used to allocate some of your expenditures between the West Coast and Alaska in order to avoid asking more detailed information about the vessel's activity in Alaska)*

- Count partial days as full days

Activity	Days at Sea
Processing in the West Coast whiting fishery	DASPRCWC days
Steaming in the West Coast whiting fishery	DASSTMWC days
Off-loading in the West Coast whiting fishery	DASOFFWC days
Steaming between the West Coast and Alaska	DASSTMAKW days
All Alaska fisheries	DASFSHAK days

CMT12

13. Provide the number of **one-way** trips (count a round trip as 2 one-way trips) this vessel made steaming between the West Coast and Alaska during 2011.

TRPSA one-way trips

CMT13

14. Provide the average number of processing crew members and the average number of non-processing crew members (including the captain) when the vessel was operating in the **West Coast** whiting fishery during 2011.

- **Processing crew** includes line workers, fishmeal crew, quality control, technicians, cleanup, mechanics who work on processing equipment, factory manager, and combis.
- **Non-processing crew** includes wheelhouse, deck crew, engine room, and galley.

Fishery	Average Number of Processing Crew Members	Average Number of Non-Processing Crew (including captain)
West Coast whiting	RUCWPRC	RUCWNPR

CMT14

II. Capitalized Investments

15. Provide the 2011 **capitalized expenditures** associated with each of the following categories for this vessel. Note that some capitalized expenditures are for **All Fisheries** the vessel participates in (West Coast, Alaska, and other) and others are for **West Coast whiting fishery only**. Round all answers to the nearest 100 dollars. *(Capital investments on the vessel and gear shared across fisheries will be allocated to the West Coast based on days or tonnage.)*

Capitalized Expenditure Category	Capitalized Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Capitalized Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*

Vessel and On-board Equipment

- Exclude processing equipment and fishing gear
- Include all electronics, safety equipment, and machinery not used to harvest or process fish

New and used vessel and on-board equipment (Regardless of where the vessel fished, enter all expenditures for vessel and on-board equipment under the All Fisheries column)	$ CXONBQALL	

Fishing Gear

- Include nets, cables, doors, and fishing machinery used in the West Coast whiting fishery
- Exclude any fishing gear that is not used at least partially in the West Coast whiting fishery

Fishing Gear used for West Coast fisheries only		$ CXPQWC
Fishing gear shared by West Coast, Alaska, and other fisheries (if you only fished in the West Coast, enter "NA")	$ CXPQSHD	

Processing Equipment

- Exclude all equipment, machines, and buildings based primarily on shore
- Exclude any processing equipment that is not used at least partially in the West Coast whiting fishery
- Include on-board freezers, storage equipment, packing equipment, conveyers, and on-board cargo handling equipment

Processing equipment used for West Coast fisheries only		$ CXFGRWC
Processing equipment shared by West Coast, Alaska and other fisheries (if you only fished in the West Coast, enter "NA")	$ CXFGRSHD	

CMT15

III. Permit Expenses

16. Provide the total cost of mothership permits purchased or leased during 2011 for use in the **West Coast whiting fishery**.

Permits and Purchased or Leased	**Total Cost**
Purchase of mothership permits	$ EXMSPPU
Lease of mothership permits	$ EXMSPLS

CMT16

IV. Annual Expenses

17. Provide the total amount **expensed** during 2011 in each of the categories below. Note that some expenses are for **All Fisheries** (West Coast, Alaska and other) and some expenses are asked for the **West Coast whiting fishery only**. Round all answers to the nearest 100 dollars.

Expenses Category	Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Processing crew (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)		$ EXCWWGPRCW
Non-Processing crew (include wages, bonuses, payroll taxes, and unemployment insurance)		$ EXCWWGNPRW
Crew travel not deducted from crew wages		$ EXTRAVWC
Observer fees		$ EXOBSWC
Mothership co-op dues		$ EXCOOPWC
Fuel and lubrication (do not include steaming between West Coast and Alaska)		$ EXFLLUBWC
Food		$ EXFOODWC
Non-fish ingredients (additives)		$ EXADTVSWC
Packing materials		$ EXPKGWC
Freight to the vessel on supplies		$ EXFRGTWC
Other supplies (linens, clothing, cleaning, etc.)		$ EXOTHRSUPPW
Communications		$ EXCOMMWC
Offload expenses (cross-dock fees, port tariffs, etc.)		$ EXOFFLOADWC
On-board cargo / product insurance		$ EXINSPRODWC
Repair and maintenance on fishing gear <u>used in the West Coast whiting fishery only</u> (expensed in 2011)		$ EXFGRRMWC
Repair and maintenance on fishing gear <u>shared by the West Coast whiting fishery and other fisheries</u> (expensed in 2011)	$ EXFGRRMSHD	
Processing equipment repair and maintenance (expensed in 2011)	$ EXPQRMALL	
Vessel and on-board equipment repair and maintenance (expensed in 2011)	$ EXONBQRMALL	

17. (Continued)

Expenses Category	Expenditures in **All Fisheries** *West Coast, Alaska, and Other*	Expenditures in **West Coast Fisheries Only** *Washington, Oregon, and California*
Insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)	$ EXINSEQALL	
Moorage	$ EXMOORALL	
Lease or bareboat charter of this mothership vessel	$ EXVSSLSALL	
Depreciation (vessel, on-board equipment, and processing equipment)	$ EXDEPRALL	

CMT17

18. Provide the weight and the cost of fish purchased from catcher vessels in the **West Coast whiting fishery** during 2011. Round weights to the nearest metric ton.

- Please include any post-season adjustments for purchases of fish that were harvested in 2011.
- Total cost should include taxes and vessel buyback program fees paid on behalf of catcher vessels.

Type of Fish	**Total Weight of Fish Received but Not Paid For** (for size or other reasons)	**Total Weight of Fish Purchased**	**Total Cost of Fish Purchases**
Whiting	EXWTRWCPWHT mt	EXWTPWCPWHT mt	$ EXCOSTWCPWH
Other **West Coast** species	EXWTRWCOTHR mt	EXWTPWCOTHR mt	$ EXCOSTWCOTH

CMT18

19. Provide the total round weight of all fish processed by this mothership vessel in **All Fisheries** (West Coast, Alaska, and other) during 2011. Round to the nearest metric ton. *(This information will be used to allocate some of your expenditures between the West Coast and Alaska in order to avoid asking more detailed information about the vessel's activity in Alaska.)*

WTALL mt

CMT19

V. Annual Earnings

20. Provide the total weight and value of production in the **West Coast whiting fishery** during 2011. Report weights to the nearest metric ton.
    - Do not include any additional payment you received to cover any shipping, handling, or storage costs associated with the sale beyond the FOB port of discharge.
    - Please include any post-season adjustments for products produced in 2011.
    - For products produced in 2011 and held in inventory at the end of the year, estimate the value on the basis of the average price received for similar products sold during the year.
    - Include products shipped to other establishments of your company.
    - Do not include revenue associated with fish caught in any fishery except the West Coast whiting fishery.

Type of Fish	Total Weight of Production	Total Value of Production
Whiting		
Surimi	RVWTPWHTSURI mt	$ RVVALPWHTSUF
Fillets	RVWTPWHTFILL mt	$ RVVALPWHTFILL
H&G	RVWTPWHTHG mt	$ RVVALPWHTHG
Round (unprocessed)	RVWTPWHTRND mt	$ RVVALPWHTRNE
Fishmeal	RVWTPWHTFML mt	$ RVVALPWHTFML
Fish oil	RVWTPWHTFOIL mt	$ RVVALPWHTFOII
Roe	RVWTPWHTROE mt	$ RVVALPWHTROE
Minced	RVWTPWHTMINC mt	$ RVVALPWHTMIN
Stomachs	RVWTPWHTSTOM mt	$ RVVALPWHTSTC
Other: RVPWHTOTHRNAM	RVWTPWHTOTHR mt	$ RVVALPWHTOTH
Other Species		
All other species	RVWTOTHR mt	$ RVVALOTHR

CMT20

21. Provide the percentage, by value, of all products off-loaded from this mothership vessel in **the West Coast whiting fishery** at each of the following locations. The column should sum to 100%.

Location	Percentage of Total Off-load Value
Seattle	PTSEA %
Blaine / Bellingham	PTBELL %
Port Angeles	PTPANG %
Astoria	PTASTO %
Coos Bay	PTCOOS %
Tacoma	PTTAC %
At sea (tramper)	PTATSEA %
Other: PTOTHRNAM	PTOTHR %

If more that one "Other" type was listed, Type out all of the types into the box above separating them with a semicolon. Do the same for the amounts and ensure the order is consistent

CMT21

22. Provide the revenue received during 2011 from the sale or lease of **West Coast whiting** mothership permits that were associated with this vessel.

Permits Purchased or Leased	Revenue Received
Sale of West Coast whiting mothership permits	$ RVMSPSL
Lease of West Coast whiting mothership permits	$ RVMSPLS

CMT22

23. Provide the revenue received during 2011 from the lease or bareboat charter of this mothership vessel.

$ RVCHTR

CMT23

Questionnaire Comments:

CMTQU

H.4 First receiver and shorebased processor form

OMB Control No. 0648-0618 Expiration Date: 04/30/2015

Economic Data Collection (EDC) Form

WEST COAST GROUNDFISH FIRST RECEIVER AND SHOREBASED PROCESSOR 2011

NOAA Fisheries – Northwest Fisheries Science Center

Who is responsible for submitting.

- All owners of a first receiver site license in 2011; or
- All owners and lessees of a shore-based processor (as defined under "processor" at §660.11, subpart C, for purposes of EDC) that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver in 2011
- A separate EDC form is required for each processing facility.

Complete all questions. If a question is not applicable, write "NA" in the answer box. The survey will not be considered complete unless there is an answer to every question.

Submit by September 1, 2012. Completed and signed EDC forms must be mailed and postmarked by or hand-delivered to NMFS no later than September 1, 2012. Mail or deliver to

Economic Data Collection Program (FRAM Division),
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, WA 98112

Retain a copy. Retain a copy of the completed form

Fillable forms and more information. www.nwfsc.noaa.gov/edc

Questions. Visit the website above or contact Erin Steiner at (866) 791-3726 or NWFSC.EDC@noaa.gov

I. Contact Information and Facility Characteristics

Initials	Overall Comments
INITS	CMTOA

2011 FR Survey_DBID SURVEY_DBID

1. Provide the buyer identification number issued by the state fish and game agencies associated with this entity or facility. Enter "NA" if this is a processing facility that does not have a buyer identification number.

Processor/Buyer IDs
Washington Department of Fish and Wildlife IDWDFW
Oregon Department of Fish and Wildlife IDODFW
California Department of Fish and Game IDCDFG

CMT01

2. Provide the following information about this receiving or processing facility.

Name of Facility FACNAM		First Receiver Site License Number for 2011 FACFRSL	
Business Mailing Address Street / PO Box FACADDR		Business Phone ( ) FACPH Business Fax ( ) FACFAX	
City FACCITY	State FACST	Zip Code FACZIP	Business Email FACEM

CMT02

3. **Individual completing this report.** If your address, phone, and email are provided above, you do not need to repeat them here but please provide your name and title.

Name ACCNAM		Title ACCTITLE	
Business Mailing Address Street / PO Box ACCADDR			Business Phone ( ) ACCPH Business Fax ( ) ACCFAX
City ACCCITY	State ACCST	Zip Code ACCZIP	Business Email ACCEM

CMT03

4. Read the following statement, and sign and date the box below.

I certify under penalty of perjury that I have reviewed all the information in this questionnaire and that it is true and complete to the best of my knowledge.	
Signature SIGNED If the Survey was signed enter a "Y" if the Survey was not signed enter a "N"	Date signed SIGMM / SIGDD / SIGYY mm dd yyyy

CMT04

5. Appraised value of facility

What was the year of this facility's last appraisal?	BUILDYY yyyy
What was the *market value* of this facility from the appraisal, rounded to the nearest 100 dollars?	$ BUILDMRK
What was the *replacement value* of the facility from the appraisal, rounded to the nearest 100 dollars?	$ BUILDRPL
Did the survey values given above include the value of all processing equipment* contained on-site?	BUILDPQ

Use "Y" for Yes, "N" for No, and "-7" for Not Applicable

CMT05

6. When did your 2011 fiscal year begin?

FSCLMM / FSCLDD / FSCLYY mm dd yyyy

CMT06

Please report values from your 2011 fiscal year for the remainder of this survey.

II. Capitalized Expenditures

7. Provide the 2011 **capitalized expenditures** associated with the facility buildings, machinery, and equipment. Round all answers to the nearest 100 dollars.

Capitalized Expenditure Category	Total Capitalized Expenditures
Capitalized expenditures on buildings (exclude land but include building improvements)	$ CXBUILD
Capitalized expenditures on new and used machinery and equipment (include only equipment used to process*, transport† on-site, or store‡ fish on-site)	$ CXMQ

* *Processing equipment:* All equipment present at this physical location that is used for preparation or packaging of seafood to render it suitable for human consumption, retail sale, industrial uses or long-term storage, including, but not limited to, cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil.

† *Transportation equipment:* Equipment such as trucks, forklifts, etc. used to transport seafood within this physical location.

‡ *Storage equipment:* Equipment present at this physical location for packaging and freezing of seafood.

CMT07

III. Employees and Payroll

Provide the following information about the number of employees and wages. Include full and part-time employees and temporary employees working at this facility. The information is requested separately for production workers and all other employees, which are defined below.

8. Provide the number of **production workers** in the following table. **Production workers** include those workers at this facility (up through and including the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, packing, warehousing, shipping, maintenance, repair, janitorial, product development, or transporting product on-site.

For the week including	Number of production workers (full time, part time, and temporary)	Total Hours Worked
January 12	EWKRNUMJAN workers	EWKRHRJAN hrs
February 12	EWKRNUMFEB workers	EWKRHRFEB hrs
March 12	EWKRNUMMAR workers	EWKRHRMAR hrs
April 12	EWKRNUMAPR workers	EWKRHRAPR hrs
May 12	EWKRNUMMAY workers	EWKRHRMAY hrs
June 12	EWKRNUMJUN workers	EWKRHRJUN hrs
July 12	EWKRNUMJUL workers	EWKRHRJUL hrs
August 12	EWKRNUMAUG workers	EWKRHRAUG hrs
September 12	EWKRNUMSEP workers	EWKRHRSEP hrs
October 12	EWKRNUMOCT workers	EWKRHROCT hrs
November 12	EWKRNUMNOV workers	EWKRHRNOV hrs
December 12	EWKRNUMDEC workers	EWKRHRDEC hrs

CMT08

9. Provide the **number of all other employees** in the following table. **All other employees** includes those involved in supervision above line-supervisor level, sales, advertising, credit, collection, installation, cafeteria, recordkeeping, clerical and routine office functions, guard services, executive, purchasing, finance, and legal. If hours are not tracked for salaried employees, please assume a 40 hour work week.

For the week including	Number of all other employees (full time, part time, and temporary)	Total Hours Worked
March 12	EEMPNUM employees	EEMPHR hrs

CMT09

10. Labor expenses for **production workers** and **all other employees** (include wages, bonuses, benefits, payroll taxes, and unemployment insurance)

Labor Expense Category	2011 Total Expenses
Production workers (see definition in Question 8)	$ EXWKR
All other employees (see definition in Question 9)	$ EXEMP

CMT10

IV. Selected Expenses and Depreciation

11. Quota Expenses

Purchase or Lease of Quota	2011 Total Expenses
Leasing of quota pounds	$ EXQPLS
Purchases of quota pounds	$ EXQPPU
Leasing of quota share	$ EXQSLS
Purchases of quota share	$ EXQSPU

CMT11

12. Utilities

Utility Expense Category	2011 Total Expenses
Electricity	$ EXELECT
Natural gas	$ EXNGAS
Propane gas for transportation and processing	$ EXPROP
Nitrogen gas	$ EXNITRO
Water	$ EXWATER
Sewer, waste, and byproduct disposal	$ EXSWRWASTE

CMT12

13. Rental or Lease Payments

Rental or Lease Payments	2011 Total Expenses
Rental or lease of buildings, job-site trailers, and other structures (including land)	$ EXBUILD
Rental or lease of processing machinery or equipment	$ EXPQ

CMT13

14. What did you spend on repair and maintenance on facility buildings, machinery, and equipment (see definitions on bottom of page 3) expensed in 2011?

$ EXBUILDPQRM

CMT14

15. What was the total depreciation for all capital investments on buildings, new and used machinery and equipment (see definitions of equipment on page 3) taken in 2011?

$ EXDEPR

CMT15

16. Provide the following information on 2011 **custom processing** of fish you owned that was performed by another processor outside of this facility.

	Total weight of fish supplied to custom processors	2011 Custom Processing Fees Paid
Whiting	CUPRWTPWHT lbs	$ CUPRCOSTPWHT
Non-Whiting Groundfish	CUPRWTGRND lbs	$ CUPRCOSTGRND
Other	CUPRWTOTHR lbs	$ CUPRCOSTOTHR

CMT16

17. Other Expenses

Expense Category	2011 Total Expenses
Shoreside monitoring costs	$ EXSSMONITOR
Offloading expenses paid to other facilities	$ EXOFFLOAD
Production supplies (boots, smocks, hair nets, knives ,etc.)	$ EXPRODSUPP
Cleaning and custodial supplies	$ EXCLEANSUPP
Packing materials	$ EXPKG
Freight costs for supplies to the facility	$ EXFRGT
Non-fish ingredients (additives)	$ EXADTVS
Off-site product freezing and storage	$ EXOFFSITE
Insurance payments (property, product, and personal liability)	$ EXINSPROPWRK
Taxes (property and excise)	$ EXTAXES
Licensing fees	$ EXLICFEES
Other Specify EXOTHRNAM	$ EXOTHR

If more that one "Other" type was listed, Type out all of the types into the box above separating them with a semicolon. Do the same for the amounts and ensure the order is consistent

CMT17

18. Provide the following information about the landing origin of groundfish purchases received at this facility in 2011. If this information is not available, place an "NA" in the answer box.

Landing Origin	Total Weight of Groundfish Purchased	Total Cost of Groundfish Purchased
Whiting		
West Coast (WA, OR, CA)	GRWTWCPWHT lbs	$ GRCOSTWCPWHT
Canada	GRWTCNPWHT lbs	$ GRCOSTCNPWHT
Other Specify GROTHRPWHTNAM	GRWTOTHRPWHT lbs	$ GRCOSTOTHRPWHT
Non-whiting groundfish		
West Coast (WA, OR, CA)	GRWTWCGRND lbs	$ GRCOSTWCGRND
Alaska (excluding pollock)	GRWTAKGRND lbs	$ GRCOSTAKGRND
Canada	GRWTCNGRND lbs	$ GRCOSTCNGRND
Other Specify GROTHRGRNDNAM	GRWTOTHRGRND lbs	$ GRCOSTOTHRGRND

CMT18

19. Fish Received. In the table below provide the weight and cost of fish received in 2011. Please note that there are separate columns for fish that were not paid for and fish that were paid for.

- Do not include fish received for custom processing.
- Include fish purchased by you that are custom processed by another processor outside of this facility.
- Include any post season adjustments.
- **LE Trawl Vessels:** fish acquired directly from a vessel registered to a Limited Entry (LE) permit with a trawl endorsement and caught either with trawl or fixed gear.
- **LE Fixed Gear Vessels:** fish acquired directly from a vessel registered to a LE permit with a fixed gear endorsement. Do not include fish caught with fixed gear using a LE permit with a trawl endorsement.
- **Other Vessels:** fish acquired directly from a vessel without a limited entry trawl or fixed gear endorsement, including open access fisheries
- **Non-Vessel Sources:** includes fish acquired from other entities, including first receivers, processors, wholesale dealers, brokers, aquaculture producers, and transfers from outside this facility.
- **Gross Cost of Fish Paid for** includes the value of any taxes paid on behalf of delivering vessels.

Type and Source of Fish	Fish **NOT PAID** for		Fish **PAID** for	
	Total weight not paid for **due to quality or size reasons**	Total weight not paid for **transfers from outside this facility**	**Total weight of fish paid for** from vessels or non-vessel sources	**Gross cost of fish paid for** from vessels or non-vessel sources
Whiting				
LE Trawl Vessels	PUWTRPWHTLET lbs		PUWTPPWHTLET lbs	$ PUCOSTPWHTLET
LE Fixed Gear Vessels	PUWTRPWHTLEF lbs		PUWTPPWHTLEF lbs	$ PUCOSTPWHTLEF
Other Vessels	PUWTRPWHTOV lbs		PUWTPPWHTOV lbs	$ PUCOSTPWHTOV
Non-Vessel Sources	PUWTRPWHTNV lbs	PUWTTPWHTNV lbs	PUWTPPWHTNV lbs	$ PUCOSTPWHTNV
Arrowtooth flounder				
LE Trawl Vessels	PUWTRARTHLET lbs		PUWTPARTHLET lbs	$ PUCOSTARTHLET
LE Fixed Gear Vessels	PUWTRARTHLEF lbs		PUWTPARTHLEF lbs	$ PUCOSTARTHLEF
Other Vessels	PUWTRARTHOV lbs		PUWTPARTHOV lbs	$ PUCOSTARTHOV
Non-Vessel Sources	PUWTRARTHNV lbs	PUWTTARTHNV lbs	PUWTPARTHNV lbs	$ PUCOSTARTHNV
Dover sole				
LE Trawl Vessels	PUWTRDOVRLET lbs		PUWTPDOVRLET lbs	$ PUCOSTDOVRLET
LE Fixed Gear Vessels	PUWTRDOVRLEF lbs		PUWTPDOVRLEF lbs	$ PUCOSTDOVRLEF
Other Vessels	PUWTRDOVROV lbs		PUWTPDOVROV lbs	$ PUCOSTDOVROV
Non-Vessel Sources	PUWTRDOVRNV lbs	PUWTTDOVRNV lbs	PUWTPDOVRNV lbs	$ PUCOSTDOVRNV
English sole				
LE Trawl Vessels	PUWTREGLSLET lbs		PUWTPEGLSLET lbs	$ PUCOSTEGLSLET
LE Fixed Gear Vessels	PUWTREGLSLEF lbs		PUWTPEGLSLEF lbs	$ PUCOSTEGLSLEF
Other Vessels	PUWTREGLSOV lbs		PUWTPEGLSOV lbs	$ PUCOSTEGLSOV
Non-Vessel Sources	PUWTREGLSNV lbs	PUWTTEGLSNV lbs	PUWTPEGLSNV lbs	$ PUCOSTEGLSNV
Lingcod				
LE Trawl Vessels	PUWTRLCODLET lbs		PUWTPLCODLET lbs	$ PUCOSTLCODLET
LE Fixed Gear Vessels	PUWTRLCODLEF lbs		PUWTPLCODLEF lbs	$ PUCOSTLCODLEF
Other Vessels	PUWTRLCODOV lbs		PUWTPLCODOV lbs	$ PUCOSTLCODOV
Non-Vessel Sources	PUWTRLCODNV lbs	PUWTTLCODNV lbs	PUWTPLCODNV lbs	$ PUCOSTLCODNV

19. (Continued)

Type and Source of Fish	Fish **NOT PAID** for		Fish **PAID** for	
	Total weight not paid for **due to quality or size reasons**	Total weight not paid for **transfers from outside this facility**	**Total weight of fish paid for** from vessels or non-vessel sources	**Gross cost of fish paid for** from vessels or non-vessel sources
Pacific sanddab				
LE Trawl Vessels	PUWTRUDABLET lbs		PUWTPUDABLET lbs	$ PUCOSTUDABLET
LE Fixed Gear Vessels	PUWTRUDABLEF lbs		PUWTPUDABLEF lbs	$ PUCOSTUDABLEF
Other Vessels	PUWTRUDABOV lbs		PUWTPUDABOV lbs	$ PUCOSTUDABOV
Non-Vessel Sources	PUWTRUDABNV lbs	PUWTTUDABNV lbs	PUWTPUDABNV lbs	$ PUCOSTUDABNV
Petrale sole				
LE Trawl Vessels	PUWTRPTRLLET lbs		PUWTPPTRLLET lbs	$ PUCOSTPTRLLET
LE Fixed Gear Vessels	PUWTRPTRLLEF lbs		PUWTPPTRLLEF lbs	$ PUCOSTPTRLLEF
Other Vessels	PUWTRPTRLOV lbs		PUWTPPTRLOV lbs	$ PUCOSTPTRLOV
Non-Vessel Sources	PUWTRPTRLNV lbs	PUWTTPTRLNV lbs	PUWTPPTRLNV lbs	$ PUCOSTPTRLNV
Rex sole				
LE Trawl Vessels	PUWTRREXLET lbs		PUWTPREXLET lbs	$ PUCOSTREXLET
LE Fixed Gear Vessels	PUWTRREXLEF lbs		PUWTPREXLEF lbs	$ PUCOSTREXLEF
Other Vessels	PUWTRREXOV lbs		PUWTPREXOV lbs	$ PUCOSTREXOV
Non-Vessel Sources	PUWTRREXNV lbs	PUWTTREXNV lbs	PUWTPREXNV lbs	$ PUCOSTREXNV
Rockfish				
LE Trawl Vessels	PUWTRROCKLET lbs		PUWTPROCKLET lbs	$ PUCOSTROCKLET
LE Fixed Gear Vessels	PUWTRROCKLEF lbs		PUWTPROCKLEF lbs	$ PUCOSTROCKLEF
Other Vessels	PUWTRROCKOV lbs		PUWTPROCKOV lbs	$ PUCOSTROCKOV
Non-Vessel Sources	PUWTRROCKNV lbs	PUWTTROCKNV lbs	PUWTPROCKNV lbs	$ PUCOSTROCKNV
Sablefish (black cod)				
LE Trawl Vessels	PUWTRSABLLET lbs		PUWTPSABLLET lbs	$ PUCOSTSABLLET
LE Fixed Gear Vessels	PUWTRSABLLEF lbs		PUWTPSABLLEF lbs	$ PUCOSTSABLLEF
Other Vessels	PUWTRSABLOV lbs		PUWTPSABLOV lbs	$ PUCOSTSABLOV
Non-Vessel Sources	PUWTRSABLNV lbs	PUWTTSABLNV lbs	PUWTPSABLNV lbs	$ PUCOSTSABLNV
Thornyheads				
LE Trawl Vessels	PUWTRTHDSLET lbs		PUWTPTHDSLET lbs	$ PUCOSTTHDSLET
LE Fixed Gear Vessels	PUWTRTHDSLEF lbs		PUWTPTHDSLEF lbs	$ PUCOSTTHDSLEF
Other Vessels	PUWTRTHDSOV lbs		PUWTPTHDSOV lbs	$ PUCOSTTHDSOV
Non-Vessel Sources	PUWTRTHDSNV lbs	PUWTTTHDSNV lbs	PUWTPTHDSNV lbs	$ PUCOSTTHDSNV
Sharks, skates, rays				
LE Trawl Vessels	PUWTRSHRKLET lbs		PUWTPSHRKLET lbs	$ PUCOSTSHRKLET
LE Fixed Gear Vessels	PUWTRSHRKLEF lbs		PUWTPSHRKLEF lbs	$ PUCOSTSHRKLEF
Other Vessels	PUWTRSHRKOV lbs		PUWTPSHRKOV lbs	$ PUCOSTSHRKOV
Non-Vessel Sources	PUWTRSHRKNV lbs	PUWTTSHRKNV lbs	PUWTPSHRKNV lbs	$ PUCOSTSHRKNV
Coastal pelagic (include sardines and mackerel)				
Vessel Sources	PUWTRCPELV lbs		PUWTPCPELV lbs	$ PUCOSTCPELV
Non-Vessel Sources	PUWTRCPELNV lbs	PUWTTCPELNV lbs	PUWTPCPELNV lbs	$ PUCOSTCPELNV

19. (Continued)

Type and Source of Fish	Fish NOT PAID for		Fish PAID for	
	Total weight not paid for **due to quality or size reasons**	Total weight not paid for **transfers from outside this facility**	**Total weight of fish paid for** from vessels or non-vessel sources	**Gross cost of fish paid for** from vessels or non-vessel sources
Crab				
Vessel Sources	PUWTRCRABV lbs		PUWTPCRABV lbs	$ PUCOSTCRABV
Non-Vessel Sources	PUWTRCRABNV lbs	PUWTTCRABNV lbs	PUWTPCRABNV lbs	$ PUCOSTCRABNV
Echinoderms (include sea urchins and sea cucumbers)				
Vessel Sources	PUWTRECHNV lbs		PUWTPECHNV lbs	$ PUCOSTECHNV
Non-Vessel Sources	PUWTRECHNNV lbs	PUWTTECHNNV lbs	PUWTPECHNNV lbs	$ PUCOSTECHNNV
California Halibut				
Vessel Sources	PUWTRCHLBV lbs		PUWTPCHLBV lbs	$ PUCOSTCHLBV
Non-Vessel Sources	PUWTRCHLBNV lbs	PUWTTCHLBNV lbs	PUWTPCHLBNV lbs	$ PUCOSTCHLBNV
Pacific Halibut				
Vessel Sources	PUWTRPHLBV lbs		PUWTPPHLBV lbs	$ PUCOSTPHLBV
Non-Vessel Sources	PUWTRPHLBNV lbs	PUWTTPHLBNV lbs	PUWTPPHLBNV lbs	$ PUCOSTPHLBNV
Herring				
Vessel Sources	PUWTRPHRGV lbs		PUWTPPHRGV lbs	$ PUCOSTPHRGV
Non-Vessel Sources	PUWTRPHRGNV lbs	PUWTTPHRGNV lbs	PUWTPPHRGNV lbs	$ PUCOSTPHRGNV
Salmon				
Vessel Sources	PUWTRSAMNV lbs		PUWTPSAMNV lbs	$ PUCOSTSAMNV
Non-Vessel Sources	PUWTRSAMNNV lbs	PUWTTSAMNNV lbs	PUWTPSAMNNV lbs	$ PUCOSTSAMNNV
Shrimp				
Vessel Sources	PUWTRSRMPV lbs		PUWTPSRMPV lbs	$ PUCOSTSRMPV
Non-Vessel Sources	PUWTRSRMPNV lbs	PUWTTSRMPNV lbs	PUWTPSRMPNV lbs	$ PUCOSTSRMPNV
Squid				
Vessel Sources	PUWTRSOIDV lbs		PUWTPSOIDV lbs	$ PUCOSTSOIDV
Non-Vessel Sources	PUWTRSOIDNV lbs	PUWTTSOIDNV lbs	PUWTPSQIDNV lbs	$ PUCOSTSQIDNV
Sturgeon				
Vessel Sources	PUWTRSTRGV lbs		PUWTPSTRGV lbs	$ PUCOSTSTRGV
Non-Vessel Sources	PUWTRSTRGNV lbs	PUWTTSTRGNV lbs	PUWTPSTRGNV lbs	$ PUCOSTSTRGNV
Tuna				
Vessel Sources	PUWTRTUNAV lbs		PUWTPTUNAV lbs	$ PUCOSTTUNAV
Non-Vessel Sources	PUWTRTUNANV lbs	PUWTTTUNANV lbs	PUWTPTUNANV lbs	$ PUCOSTTUNANV
Other Shellfish				
Vessel Sources	PUWTRSFSHV lbs		PUWTPSFSHV lbs	$ PUCOSTSFSHV
Non-Vessel Sources	PUWTRSFSHNV lbs	PUWTTSFSHNV lbs	PUWTPSFSHNV lbs	$ PUCOSTSFSHNV
Other Species (please list)				
PUOSPCOTHRNAM				
Vessel Sources	PUWTROSPCV lbs		PUWTPOSPCV lbs	$ PUCOSTOSPCV
Non-Vessel Sources	PUWTROSPCNV lbs	PUWTTOSPCNV lbs	PUWTPOSPCNV lbs	$ PUCOSTOSPCNV

CMT19

V. *Annual Earnings*

20. Fish Production. Provide the 2011 value of production FOB plant (after discounts and allowances and excluding freight charges).

- For products made during 2011 and held in inventory at the end of the year, estimate the value on the basis of the average price received for similar products sold during the year
- Include products shipped to other facilities of your company, estimate the value on the basis of the average price received for similar products sold during the year
- Do not include revenue from products produced in previous years
- Include products made from custom processing performed for you, but do not include products you produced as a custom processing service for others
- Do not include any additional payment you received to cover any shipping, handling, or storage costs associated with the sale beyond the plant
- Include any post-season adjustments

Type of Fish	**Total weight of 2011 fish production** (both processed and unprocessed)	**Total value of 2011 fish production** (both processed and unprocessed)
Whiting		
Surimi	PRWTPWHTSURI lbs	$ PRVALPWHTSURI
H&G	PRWTPWHTHG lbs	$ PRVALPWHTHG
Fillets	PRWTPWHTFILL lbs	$ PRVALPWHTFILL
Roe	PRWTPWHTROE lbs	$ PRVALPWHTROE
Frozen Whole	PRWTPWHTFRZN lbs	$ PRVALPWHTFRZN
Unprocessed	PRWTPWHTUNP lbs	$ PRVALPWHTUNP
Other PRPWHTOTHRNAM	PRWTPWHTOTHR lbs	$ PRVALPWHTOTHR
Arrowtooth flounder		
Processed Fresh	PRWTARTHFRSH lbs	$ PRVALARTHFRSH
Frozen	PRWTARTHFRZN lbs	$ PRVALARTHFRZN
Unprocessed	PRWTARTHUNP lbs	$ PRVALARTHUNP
Other PRARTHOTHRNAM	PRWTARTHOTHR lbs	$ PRVALARTHOTHR
Dover sole		
Processed Fresh	PRWTDOVRFRSH lbs	$ PRVALDOVRFRSH
Frozen	PRWTDOVRFRZN lbs	$ PRVALDOVRFRZN
Unprocessed	PRWTDOVRUNP lbs	$ PRVALDOVRUNP
Other PRDOVROTHRNAM	PRWTDOVROTHR lbs	$ PRVALDOVROTHR
English Sole		
Processed Fresh	PRWTEGLSFRSH lbs	$ PRVALEGLSFRSH
Frozen	PRWTEGLSFRZN lbs	$ PRVALEGLSFRZN
Unprocessed	PRWTEGLSUNP lbs	$ PRVALEGLSUNP
Other PREGLSOTHRNAM	PRWTEGLSOTHR lbs	$ PRVALEGLSOTHR
Lingcod		
Processed Fresh	PRWTLCODFRSH lbs	$ PRVALLCODFRSH
Frozen	PRWTLCODFRZN lbs	$ PRVALLCODFRZN
Unprocessed	PRWTLCODUNP lbs	$ PRVALLCODUNP
Other PRLCODOTHRNAM	PRWTLCODOTHR lbs	$ PRVALLCODOTHR

20. (Continued)

Type of Fish	Total weight of 2011 fish production (both processed and unprocessed)	Total value of 2011 fish production (both processed and unprocessed)
Pacific Sanddab		
Processed Fresh	PRWTUDABFRSH lbs	$ PRVALUDABFRSH
Frozen	PRWTUDABFRZN lbs	$ PRVALUDABFRZN
Unprocessed	PRWTUDABUNP lbs	$ PRVALUDABUNP
Other PRUDABOTHRNAM	PRWTUDABOTHR lbs	$ PRVALUDABOTHR
Petrale sole		
Processed Fresh	PRWTPTRLFRSH lbs	$ PRVALPTRLFRSH
Frozen	PRWTPTRLFRZN lbs	$ PRVALPTRLFRZN
Unprocessed	PRWTPTRLUNP lbs	$ PRVALPTRLUNP
Other PRPTRLOTHRNAM	PRWTPTRLOTHR lbs	$ PRVALPTRLOTHR
Rex sole		
Processed Fresh	PRWTREXFRSH lbs	$ PRVALREXFRSH
Frozen	PRWTREXFRZN lbs	$ PRVALREXFRZN
Unprocessed	PRWTREXUNP lbs	$ PRVALREXUNP
Other PRREXOTHRNAM	PRWTREXOTHR lbs	$ PRVALREXOTHR
Rockfish		
Processed Fresh	PRWTROCKFRSH lbs	$ PRVALROCKFRSH
Frozen	PRWTROCKFRZN lbs	$ PRVALROCKFRZN
Unprocessed	PRWTROCKUNP lbs	$ PRVALROCKUNP
Other PRROCKOTHRNAM	PRWTROCKOTHR lbs	$ PRVALROCKOTHR
Sablefish		
Processed Fresh	PRWTSABLFRSH lbs	$ PRVALSABLFRSH
Frozen	PRWTSABLFRZN lbs	$ PRVALSABLFRZN
Unprocessed	PRWTSABLUNP lbs	$ PRVALSABLUNP
Other PRSABLOTHRNAM	PRWTSABLOTHR lbs	$ PRVALSABLOTHR
Thornyheads		
Processed Fresh	PRWTTHDSFRSH lbs	$ PRVALTHDSFRSH
Frozen	PRWTTHDSFRZN lbs	$ PRVALTHDSFRZN
Unprocessed	PRWTTHDSUNP lbs	$ PRVALTHDSUNP
Other PRTHDSOTHRNAM	PRWTTHDSOTHR lbs	$ PRVALTHDSOTHR
Sharks, Skates, Rays		
Processed Fresh	PRWTSHRKFRSH lbs	$ PRVALSHRKFRSH
Frozen	PRWTSHRKFRZN lbs	$ PRVALSHRKFRZN
Unprocessed	PRWTSHRKUNP lbs	$ PRVALSHRKUNP
Other PRSHRKOTHRNAM	PRWTSHRKOTHR lbs	$ PRVALSHRKOTHR
Coastal pelagic (include sardines and mackerel)		
Processed Fresh	PRWTCPELFRSH lbs	$ PRVALCPELFRSH
Frozen	PRWTCPELFRZN lbs	$ PRVALCPELFRZN
Canned	PRWTCPELCAN lbs	$ PRVALCPELCAN
Unprocessed	PRWTCPELUNP lbs	$ PRVALCPELUNP
Other PRCPELOTHRNAM	PRWTCPELOTHR lbs	$ PRVALCPELOTHR

20. (Continued)

Type of Fish	Total weight of 2011 fish production (both processed and unprocessed)	Total value of 2011 fish production (both processed and unprocessed)
Crab		
Processed Fresh	PRWTCRABFRSH lbs	$ PRVALCRABFRSH
Frozen	PRWTCRABFRZN lbs	$ PRVALCRABFRZN
Canned	PRWTCRABCAN lbs	$ PRVALCRABCAN
Unprocessed	PRWTCRABUNP lbs	$ PRVALCRABUNP
Other PRCRABOTHRNAM	PRWTCRABOTHR lbs	$ PRVALCRABOTHR
Echinoderms (include sea urchins and sea cucumbers)		
Processed Fresh	PRWTECHNFRSH lbs	$ PRVALECHNFRSH
Frozen	PRWTECHNFRZN lbs	$ PRVALECHNFRZN
Unprocessed	PRWTECHNUNP lbs	$ PRVALECHNUNP
Other PRECHNOTHRNAM	PRWTECHNOTHR lbs	$ PRVALECHNOTHR
California Halibut		
Processed Fresh	PRWTCHLBFRSH lbs	$ PRVALCHLBFRSH
Frozen	PRWTCHLBFRZN lbs	$ PRVALCHLBFRZN
Unprocessed	PRWTCHLBUNP lbs	$ PRVALCHLBUNP
Other PRCHLBOTHRNAM	PRWTCHLBOTHR lbs	$ PRVALCHLBOTHR
Pacific Halibut		
Processed Fresh	PRWTPHLBFRSH lbs	$ PRVALPHLBFRSH
Frozen	PRWTPHLBFRZN lbs	$ PRVALPHLBFRZN
Unprocessed	PRWTPHLBUNP lbs	$ PRVALPHLBUNP
Other PRPHLBOTHRNAM	PRWTPHLBOTHR lbs	$ PRVALPHLBOTHR
Herring		
Processed Fresh	PRWTPHRGFRSH lbs	$ PRVALPHRGFRSH
Frozen	PRWTPHRGFRZN lbs	$ PRVALPHRGFRZN
Unprocessed	PRWTPHRGUNP lbs	$ PRVALPHRGUNP
Other PRPHRGOTHRNAM	PRWTPHRGOTHR lbs	$ PRVALPHRGOTHR
Salmon		
Processed Fresh	PRWTSAMNFRSH lbs	$ PRVALSAMNFRSH
Frozen	PRWTSAMNFRZN lbs	$ PRVALSAMNFRZN
Smoked	PRWTSAMNSM lbs	$ PRVALSAMNSM
Canned	PRWTSAMNCAN lbs	$ PRVALSAMNCAN
Unprocessed	PRWTSAMNUNP lbs	$ PRVALSAMNUNP
Other PRSAMNOTHRNAM	PRWTSAMNOTHR lbs	$ PRVALSAMNOTHR
Shrimp		
Processed Fresh	PRWTSRMPFRSH lbs	$ PRVALSRMPFRSH
Frozen	PRWTSRMPFRZN lbs	$ PRVALSRMPFRZN
Canned	PRWTSRMPCAN lbs	$ PRVALSRMPCAN
Unprocessed	PRWTSRMPUNP lbs	$ PRVALSRMPUNP
Other PRSRMPOTHRNAM	PRWTSRMPOTHR lbs	$ PRVALSRMPOTHR

20. (Continued)

Type of Fish	**Total weight** of 2011 fish production (both processed and unprocessed)	**Total value** of 2011 fish production (both processed and unprocessed)
Squid		
Processed Fresh	PRWTSQIDFRSH lbs	$ PRVALSQIDFRSH
Frozen	PRWTSQIDFRZN lbs	$ PRVALSQIDFRZN
Unprocessed	PRWTSQIDUNP lbs	$ PRVALSQIDUNP
Other PRSQIDOTHRNAM	PRWTSQIDOTHR lbs	$ PRVALSQIDOTHR
Sturgeon		
Processed Fresh	PRWTSTRGFRSH lbs	$ PRVALSTRGFRSH
Frozen	PRWTSTRGFRZN lbs	$ PRVALSTRGFRZN
Canned	PRWTSTRGCAN lbs	$ PRVALSTRGCAN
Unprocessed	PRWTSTRGUNP lbs	$ PRVALSTRGUNP
Other PRSTRGOTHRNAM	PRWTSTRGOTHR lbs	$ PRVALSTRGOTHR
Tuna		
Processed Fresh	PRWTTUNAFRSH lbs	$ PRVALTUNAFRSH
Frozen	PRWTTUNAFRZN lbs	$ PRVALTUNAFRZN
Canned	PRWTTUNACAN lbs	$ PRVALTUNACAN
Unprocessed	PRWTTUNAUNP lbs	$ PRVALTUNAUNP
Other PRTUNAOTHRNAM	PRWTTUNAOTHR lbs	$ PRVALTUNAOTHR
Other Shellfish		
Processed Fresh	PRWTSFSHFRSH lbs	$ PRVALSFSHFRSH
Frozen	PRWTSFSHFRZN lbs	$ PRVALSFSHFRZN
Unprocessed	PRWTSFSHUNP lbs	$ PRVALSFSHUNP
Other PRSFSHOTHRNAM	PRWTSFSHOTHR lbs	$ PRVALSFSHOTHR
Other Non-Species Specific Products		
Fish Meal	PRWTNSPCFML lbs	$ PRVALNSPCFML
Fish Oil	PRWTNSPCFOIL lbs	$ PRVALNSPCFOIL
Bait	PRWTNSPCBAIT lbs	$ PRVALNSPCBAIT
Other products	PRWTNSPCOTHR lbs	$ PRVALNSPCOTHR
Other Species (please list)		
PROSPCOTHRNAM	PRWTOSPCOTHR lbs	$ PRVALOSPCOTHR

CMT20

VI. Other Earnings

21. Provide the revenue received by you for **custom processing** of fish owned by another processor outside of this facility in 2011.

	2011 Custom Processing Revenue
Whiting	$ CUPRVALPWHT
Non-Whiting Groundfish	$ CUPRVALGRND
Other	$ CUPRVALOTHR

CMT21

22. Provide the revenue received in 2011 for each of the earnings sources listed below.

Earnings Source	2011 Total Revenue
Offloading earnings received from others	$ RVOFFLOAD
Sale of quota pounds	$ RVQPSL
Leasing of quota pounds	$ RVQPLS
Leasing of quota share	$ RVQSLS
Sale of quota share	$ RVQSSL

CMT22

Questionnaire Comments:

CMTQU

Revised: 11/23/11: v6

Agenda Item F.2.b
EDC Report 2 (Electronic Only)
June 2013

Economic Data Collection Program

First Receiver and Shorebased Processor Report

Draft Report for PFMC Review

Do Not Cite

Northwest Fisheries Science Center[1]

May 22, 2013

[1]For questions or comments, please contact the EDC Program at nwfsc.edc@noaa.gov.

Contents

List of Tables

Summary

This report summarizes information collected from West Coast groundfish first receivers and shorebased processors as a part of the Economic Data Collection (EDC) program, which was enacted to monitor the economic effects of the 2011 transition of the West Coast groundfish trawl fishery to a catch share program. The catch share program consists of cooperative programs for the at-sea mothership and catcher-processor fleets, and an individual fishing quota (IFQ) program for the shorebased trawl fleet. Annual EDC submissions are required from all companies with first receiver site licenses and companies that buy headed and gutted IFQ groundfish from first receivers. This report, and its companion reports covering the other sectors, is the first in what is expected to be an annual series of reports. The scope and methods used are expected to be expanded and refined with each annual publication.

This report covers the years 2009 to 2011. It contains information from first receivers and shorebased processors about annual processing operations, number of employees and payroll, and facility characteristics. The weight and costs of fish purchases by species, and weight and revenue for product production are provided. The report also contains variable and fixed cost information, production, revenues, and calculated net revenue. Finally, a breakdown of costs, revenue, and net revenue per pound of production, and per pound of fish purchased provide basic metrics of the economic performance of first receivers and shorebased processors.

1 Introduction

1.1 Background

In January 2011, the West Coast groundfish trawl fishery transitioned to a catch share program. The catch share program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet, and cooperative programs for the at-sea mothership and catcher-processor fleets. The Economic Data Collection (EDC) Program[1] was implemented as part of these new regulations to monitor the economic effects of the catch share program. Annual economic data submissions are required from all fishery participants: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors §50 CFR 660.114. Baseline, pre-catch share data, was submitted in 2011 for the 2009 and 2010 operating years. Data for the first year the fishery operated under catch shares (2011), was submitted in 2012.

This draft report summarizes the 2009-11 EDC first receiver and shorebased processor survey data. The EDC Program has enhanced the quantity and quality of economic information available for analysis and the management of the West Coast groundfish trawl fishery. While cost earnings data are available for some of the catcher vessels in the groundfish fishery from voluntary cost and earnings surveys[2], this is the first economic data collection from first receivers and shorebased processors. In addition to the first receiver and shorebased processor report, there are four companion reports:

- Economic Data Collection Program, Administration and Operations Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Catcher-Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Catcher Vessel Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Mothership Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

[1] Additional information on the EDC Program, including the EDC data collection forms can be found at www.nwfsc.noaa.gov/edc

[2] Lian, C.E. 2010. West Coast limited entry groundfish trawl cost earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p.

The Administration and Operations report describes the EDC Program administration and fielding of the surveys, the EDC forms, data QA/QC and data processing, and safeguarding confidential information. The other EDC reports provide basic data summaries for the catcher vessel, catcher-processor, and first receiver and shorebased processor forms.

This first receiver and shorebased processor report and other reports, listed above, comprise the first of what is expected to be an annual series of reports. It is envisioned that over time the scope of these reports will expand, and the methods used will be refined with each annual publication. As such, the data summaries and analyses may change in subsequent years as improvements are implemented. In general, the report provides summaries as sector totals or means. Future reports will contain additional summaries that describe the variation of the data, either numerically or graphically. They are not contained in this report due to time constraints.

1.2 Purpose of the report

This report, as well as the other three EDC data summary reports have multiple objectives. The first is to provide basic economic data summaries that can be used for a variety of purposes associated with fishery management. Since much of the data collected are confidential under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, the data are summarized as averages or totals for each question on the EDC forms. Thus summarized, the reports make the data available to the public for both research and informational purposes.

Second, the data summary reports provide information about the performance of the catch share program. This includes information that can be used to monitor whether and to what degree the goals of the program are being met. It is expected that additional modeling and analysis will be included in each subsequent year that will provide more detailed information about the performance of the program. These reports will serve as the basis for the 5-year review of the catch share program that is mandated in the MSA, as well as the NMFS National Catch Shares Performance Indicators. Currently, with just a single year of catch share EDC data, it may be difficult to draw firm conclusions about the performance of the program. In addition, the catch share program may have a transitional period in the first few year as participants learn about the system and develop new business strategies.

Third, the reports either provide or serve as the basis for economic models that will be used as part of the Pacific Fishery Management Council's (PFMC) biennial specification process for groundfish management. These models include the IO-PAC model, as well as estimates of revenue, costs, and net revenue.

Lastly, and perhaps most importantly, the data reports are expected to provide a useful catalyst for feedback on the data collected and its analysis.

1.3 First receiver and shorebased processor form administration

Completion of EDC forms is mandatory for participants in the catch share program. The regulations for defining who is required to complete an EDC form differs between the baseline data collection (2009 and 2010) and all annual/ongoing data collections for 2011 onward. Under 50 CFR part 660 and section 402(a) of the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) all owners and lessees a of shorebased processor and all buyers that receive groundfish or whiting harvested with a limited entry trawl permit as listed in the Pacific States Marine Fisheries Commission's state fish ticket database were required to submit an Economic Data Collection (EDC) Form in 2009 and 2010. Beginning in 2011, a first receiver site licenses was required to land catch share harvested fish. The regulation require all owners of a first receiver site license in 2011 and beyond, and all owners and lessees of a shorebased processor (as defined under "processor" at 660.11, for purposes of EDC) that received round or headed-and-gutted IFQ species groundfish or whiting from a first receiver in 2011 and beyond to submit an EDC form for that year. Owners of multiple facilities are required to submit a form for each processing facility. A first receiver site license application will not be considered complete until the required EDC for that license owner associated with that license is submitted.

A calendar year is used to determine which vessels meet the criteria. For example, in 2012 data were collected from all owners of a first receiver site license in 2011. The forms are fielded on this schedule in order to allow participants the time necessary to complete their taxes, which may contain some information that is required on the EDC forms.

If a form has missing information, or the information provided on the form is believed to be incorrect, EDC Program staff attempt to contact the participant to correct the information. On occasion the participant cannot be reached or the participant cannot provide the missing information. In these cases, the missing or inaccurate data are treated on a case by case basis during analysis as documented in the Administration and Operations report. Data are validated and verified with external data sources whenever possible. These data sources include the Permit Office and state fish tickets.

1.4 About the survey participants

First receiver and shorebased processor operations range from independent catcher vessel owners who unload and truck their own fish, to large multi-facility processing companies with a wide range of product offerings. Many respondents who provide information do not own a physical processing facility and thus do not incur many of the costs on the form. Thus, the summary statistics often are calculated with a large number of zeroes, as can be seen in the comparison of means to medians for many of the variables.

1.5 Understanding the report

Not all business entities with a first receiver license process fish, and much of the survey does not correspond to this type of operation. On 2009 and 2010 forms, a company was permitted to leave most of the survey blank if they did not process any groundfish or whiting. This was changed on the 2011 form and all participants are required to answer all questions. Thus, the data available for this report are from first receivers and shorebased processors who processed in 2009 and 2010, and for all first receivers and shorebased processors in 2011. Based on the information provided on production activities, Table 1.1 shows the number of active processors who provided data used to populate the tables in this report. In 2009 and 2010, this number is the total number used to calculate the mean and median, as indicated in the N headers of the columns in the report. In 2011, the EDC Program received forms from first receivers or shorebased processors that did not report any processing activity, however the total number of companies, regardless of whether they processed fish is used to calculate summary statistics.

Owners of multiple facilities are required to submit a form for each processing facility. For the ease of analysis and to protect confidentiality, businesses that reported for multiple facilities are considered a single "entity". For questions not applicable to a company's particular business operation, the participant is instructed on the form to fill in "Not Applicable" or "NA", which for the purposes of calculating averages and medians in this report are converted to 0. If a particular category had only "NA" responses for all participants, a "—" symbol is used. The "—" symbol also represents cases where the information was not requested on the form for that survey year. In 2009 and 2010 only values from businesses with processing activity are reported in the report, from 2011 onward the values for average and median in every case will reflect the number of businesses who submitted forms. Thus, comparison pre and post baseline is difficult, as the population providing responses has changed along with the new IFQ program regulations.

All data submitted via the EDC Program are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) and under NOAA Administrative Order 216-100. In order to protect these data, a rule of three and a rule of 90-10 are implemented. The rule of three requires a response from at least three companies in order to show a summary statistic. The 90-10 rule requires that no single company's value should comprise over 90 percent of the value of the value displayed. The tables show a '***' for data points where there were less than three companies reporting the information, and/or if one company's responses accounted for greater than 90 percent of the average value. Zeroes are shown if all companies reported zeroes. More information about how confidential data are protected in the EDC Program can be found in the Administration and Operations report.

Table 1.1: Number of companies that reported processing activity and number of companies that submitted EDC forms, number of forms that are complete, forms that were submitted, and total forms owed survey year.

Status	2009	2010	2011
Companies that processed fish	23	25	26
Companies that submitted forms	29	37	35
Complete forms	37	45	48
Submitted forms	37	45	50
Total forms owed	55	58	52

2 Facility Value

2.1 Appraisal value of facility

As mentioned in the introduction, some first receivers act only as offloaders and thus do not have a processing facility. In addition, some business respondents rent a physical location and thus were not able to provide a facility appraised value. Thus, the median for these variables is 0.

Table 2.1: Values from last appraisal of facility.

	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Market value of facility from last appraisal	$262,435	$0	$392,205	$0	$167,844	$0
Replacement value of facility from last appraisal	$1,116,161	$0	$1,234,668	$0	$596,616	$0

3 Employment

This section provides information about number of employees, number of hours worked, and labor costs. These figures include full, part-time, and temporary employees. Workers involved directly with production and non-production employees are provided separately.

3.0.1 Production workers

Production workers include workers at the facility up through and including the line-supervisor level who are engaged in fabricating, processing, assembling, inspecting, receiving, packing, warehousing, shipping, maintenance, repair, janitorial staff, product development, or transporting product on site. The EDC form asks for production worker employment figures for the week that includes the 12th day of the month, thus the following tables present a weekly snapshot of employment for each month throughout the year.

Table 3.1: Weekly employment. Number of production workers for the week that includes the 12th of the month.

Month	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
January	65	29	71	35	58	10
February	53	27	59	23	50	11
March	54	28	54	23	36	10
April	54	28	56	27	38	12
May	64	32	79	37	41	10
June	95	72	86	54	64	12
July	119	113	97	86	97	30
August	90	37	110	73	93	34
September	87	37	82	41	84	38
October	83	35	74	37	61	18
November	67	32	68	28	48	11
December	125	138	102	69	76	18

Table 3.2: Weekly employment. Hours worked by production workers for the week that includes the 12th of the month.

Month	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
January	1,729.5	956.0	1,488.1	537.0	1,680.8	476.0
February	898.1	451.2	1,408.1	415.0	1,376.9	454.0
March	1,196.4	823.3	1,266.8	512.0	1,056.0	431.5
April	1,251.5	834.0	1,636.9	590.0	1,276.4	399.5
May	2,064.2	986.9	2,684.8	1,037.0	1,730.4	394.0
June	2,965.8	2,015.9	2,781.2	1,466.0	2,817.2	508.8
July	5,487.7	2,641.8	3,627.6	2,317.0	4,706.5	1,440.2
August	2,985.5	1,402.0	3,986.9	1,258.2	5,075.5	1,479.2
September	2,400.8	983.0	2,781.2	749.8	3,890.9	1,513.1
October	3,583.6	1,041.0	2,007.0	1,295.0	2,338.0	597.0
November	2,230.3	882.9	1,865.3	604.2	1,647.6	431.0
December	4,633.0	3,108.0	5,020.3	1,266.9	3,334.0	742.0

3.0.2 Non-production employees

All non-production employees include those involved in supervision above the line-supervisor level, as well as individuals in the company responsible for sales, advertising, credit, collection, installation, the cafeteria, recordkeeping, clerical and routine office functions, guard services, executive management, purchasing, finance, and legal affairs. Companies that do not track hours for salaried employees are asked to assume a forty-hour workweek. These employment figures, similar to the production worker data above, are for the week that includes the 12th of March.

Table 3.3: Weekly employment. Number of non-production employees and hours worked for the week that includes March 12 .

	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Hours Worked	534.2	204.0	689.9	200.0	347.4	180.5
Number of employees	8.7	6.0	10.7	5.0	6.6	4.0

4 Costs

This section of the report describes the cost data that are collected on the EDC first receiver and shorebased processor form. For the purposes of the EDC, costs are divided into two categories, variable costs and fixed costs. Variable costs vary with the level of fish production, and generally include items such as fish inputs, additives, labor, and utilities. Fixed costs do not vary with the level of production, and generally include items such as plant facility costs and processing equipment. The designation of a cost as variable or fixed depends on many factors, including the relevant time horizon and use of the data. While some costs would clearly be considered fixed (e.g., the purchase of processing machinery), others are more difficult to categorize as fixed versus variable. For the purposes of this report, we consider the costs listed in Table 4.1 to be fixed, and the costs listed in Tables 4.2, 4.3, 4.4, 4.5, and all tables listed under Section 4.2.6 to be variable. The EDC Program will continue to explore, and possibly improve, the categorization of these costs.

In order to conduct economic analyses of specific fisheries it is important to have costs broken out by fishery. At this time, the EDF Program is investigating methods to accomplish this for first receivers and shorebased processors.

Finally, there are a variety of costs that are associated with running a first receiver or shorebased processing facility that are not requested on the EDC form. This is because it is difficult to determine the share of the costs associated with the facility. These costs include items that can be used for activities other than processing of fish, or are too difficult to allocate to a particular facility in a multi-facility company. These expenses include trucks, and professional fees. In general, the EDC forms attempt to collect costs that are directly related to facility maintenance and processing operations, and not costs that are related to activities or equipment beyond the processing facility (one exception is off-site product freezing and storage). For these reasons, the EDC aggregated measures of costs (variable costs, fixed costs and total costs) underestimate the true costs of operating a business.

4.1 Fixed Costs

4.1.1 Buildings and processing equipment costs

Participants were asked in 2009 and 2010 about selected expenses only if they processed fish. In 2011, this information was requested regardless of whether they processed fish if they possessed a first receiver site license. Because less than half of the respondents provided a value for capitalized expenditures on buildings in 2010 and 2011, and new and used machinery and processing equipment in 2011, the median for these categories is 0.

Table 4.1: Buildings and processing equipment costs. Capitalized expenditures, rental or lease payments, processing equipment expenses, repair and maintenance expenses.

Cost	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Capitalized expenditures on buildings	$267,939	$3,782	$266,477	$122	$104,247	$0
Capitalized expenditures on new and used machinery and equipment	$955,849	$111,496	$974,876	$68,000	$321,096	$15,230
Processing equipment	$21,341	$8,900	$22,332	$9,914	$19,530	$5,526
Rental or lease of buildings, job-site trailers, and other structures	$112,460	$116,290	$108,750	$110,400	$96,896	$88,436
Repair and maintenance on facility buildings, machinery, and equipment	$220,075	$140,857	$214,175	$92,965	$193,781	$81,206

4.2 Variable Costs

4.2.1 Labor expenses

Labor expenses include wages, bonuses, benefits, payroll taxes, and unemployment insurance.

Table 4.2: Employment expenses. Total annual labor expenses for all employees (includes wages, bonuses, benefits, payroll taxes, and unemployment insurance).

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Production workers	$1,478,164	$978,974	$1,295,123	$626,987	$1,437,784	$389,250
Non-production employees	$392,130	$274,900	$415,817	$276,700	$375,234	$208,178

4.2.2 Permit costs

Not enough processors reported permit costs to be able to display this information.

4.2.3 Utility expenses

Many respondents did not provide expenses on natural gas, either because they did not incur this expense or because that information was not available. Because less than half of respondents reported a positive value, the median expense on this category is $0 (Table 4.3).

4.2.4 Other expenses

Some new categories were added in the 2011 survey reflecting feedback on the baseline surveys. Thus information on these categories of spending is only available for 2011 and beyond (Table 4.4).

4.2.5 Custom processing

Custom processing is when a third party, processes fish that are owned by the respondent. The processing occurs outside the facility responding to the EDC. Because most processors did not

Table 4.3: Utility expenses.

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Electricity	$161,155	$88,416	$160,415	$102,800	$139,804	$62,798
Natural gas	$49,464	$741	$41,914	$0	$10,722	$0
Nitrogen gas	—	—	—	—	$16,737	$0
Propane gas	$19,796	$5,179	$35,659	$6,648	$25,431	$5,003
Water	$66,782	$21,051	$79,499	$25,995	$75,184	$7,666
Sewer, waste, and byproduct disposal	$32,789	$16,698	$37,923	$16,194	$37,997	$5,905

report any custom processing activity in all three-survey years, the median costs and revenue for this table are 0 (Table 4.5).

Table 4.4: Other expenses.

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Cleaning and custodial supplies	—	—	—	—	$12,161	$2,493
Freight costs for supplies	$73,601	$0	$69,423	$0	$47,874	$0
Insurance (property, product, and personal liability)	$130,839	$92,096	$118,678	$79,793	$60,473	$37,367
Licensing fees	—	—	—	—	$9,119	$5,791
Non-fish ingredients (additives)	$31,165	$0	$27,055	$0	$46,368	$0
Off-site product freezing and storage	$139,266	$40,948	$152,168	$47,892	$189,330	$2,650
Offloading	—	—	—	—	$23,324	$0
Packing materials	$577,670	$165,813	$486,598	$141,459	$405,614	$68,266
Production supplies	$98,607	$40,627	$102,990	$25,295	$40,626	$9,446
Shoreside monitoring	$7,879	$7,790	$18,278	$200	$3,744	$293
Taxes (property and excise)	—	—	—	—	$41,953	$12,158

Table 4.5: Custom processing: cost, revenue, and weight of custom processing activities

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Cost of custom processing of non-whiting groundfish	56,406	0	16,822	0	24,513	0
Cost of custom processing of non-whiting groundfish, non-groundfish fish	59,118	0	52,225	0	29,023	0
Cost of custom processing of whiting	37,063	0	75,788	0	92,319	0
Revenue from custom processing of non-whiting groundfish	344	0	3,594	0	20,866	0
Revenue from custom processing of non-whiting, non-groundfish fish	16,487	0	19,341	0	33,244	0
Revenue from custom processing of whiting	2,043	0	2,038	0	14,346	0
Weight custom processing of whiting	168,298	0	273,477	0	350,299	0
Weight of custom processing of non-whiting groundfish	177,382	0	55,287	0	73,454	0
Weight of custom processing of non-whiting groundfish, non-groundfish fish	269,671	0	224,221	0	92,672	0

4.2.6 Fish purchases

Respondents are asked to provide the weight and cost of fish received during the survey year. This includes the weight of fish paid for, and weight of those not paid for due to size or quality reasons, as well as the weight of fish not paid for that were transferred from outside the facility.

The cost requested is the gross cost of fish paid for from vessel or non-vessel sources, which includes the value of any taxes paid on behalf of delivering vessels. Purchase weight and cost information is requested by categories for different species types and sources, including Limited Entry (LE) Trawl and LE Fixed Gear for catch share groundfish species, as well as other vessels and non-vessel sources for these species and a selection of non-catch share groundfish species. In the tables below, LE Trawl represents fish acquired directly from a vessel registered to a LE permit with a trawl endorsement and caught with either trawl or fixed gear. LE Fixed Gear sources are those vessels with a fixed gear endorsement. This does not include fish caught with a fixed gear on a LE permit with a trawl endorsement, i.e., the gear switching provision of the catch share program. Other vessels are those without either a LE Trawl or LE Fixed Gear endorsement. Non-vessel sources include fish acquired from other entities, including other first receivers, processors, wholesale dealers, brokers, aquaculture producers, and transfers from outside the facility.

The following tables do not include fish received for custom processing, and do include post season adjustments and fish purchased that are then custom processed by another processor outside the facility. As stated in the introduction to this report, respondents fill out the EDC form according to their fiscal year, so pounds listed for each species may not have been purchased during the calendar year indicated by the column header, and therefore these values may not align directly to state-fish ticket data.

4.2.7 Total cost and weight of fish purchases by source and species

Table 4.6: Total purchase weight and value of whiting by source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fixed Gear	0	0	0	0	—	—
Pacific whiting	LE Fixed Gear	—	—	—	—	***	***
Pacific whiting	LE Trawl	6,843,007	87,129,912	8,561,000	102,130,197	22,675,265	204,027,788
Pacific whiting	Non-vessel	—	—	—	—	2,166,789	24,279,500
Pacific whiting	Other	***	0	526,172	6,519,875	—	—
Pacific whiting	Other Vessel	—	—	—	—	***	***

Table 4.7: Total purchase weight and value of dover, thornyheads, and sablefish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fixed Gear	7,376	18,638	***	***	—	—
Dover sole	LE Fixed Gear	—	—	—	—	193	457
Dover sole	LE Trawl	8,062,773	23,121,194	6,402,776	20,008,309	6,572,008	15,364,917
Dover sole	Non-vessel	—	—	—	—	418,242	798,723
Dover sole	Other	***	***	471,143	1,249,786	—	—
Dover sole	Other Vessel	—	—	—	—	***	***
Sablefish	Fixed Gear	10,838,873	3,569,118	11,690,893	3,674,081	—	—
Sablefish	LE Fixed Gear	—	—	—	—	10,017,023	2,558,688
Sablefish	LE Trawl	11,531,390	5,478,644	8,802,431	3,981,229	8,875,222	2,975,103
Sablefish	Non-vessel	—	—	—	—	1,920,880	750,515
Sablefish	Other	2,435,284	1,015,701	3,604,747	1,705,355	—	—
Sablefish	Other Vessel	—	—	—	—	8,614,729	1,620,421
Thornyheads	Fixed Gear	5,929	7,648	***	***	—	—
Thornyheads	LE Fixed Gear	—	—	—	—	141,223	135,279
Thornyheads	LE Trawl	2,337,480	4,529,363	2,154,851	3,960,391	1,643,623	2,657,570
Thornyheads	Non-vessel	—	—	—	—	30,296	62,305
Thornyheads	Other	***	***	***	0	—	—
Thornyheads	Other Vessel	—	—	—	—	2,659	4,295

Table 4.8: Total purchase weight and value of other groundfish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fixed Gear	***	***	***	***	—	—
English sole	LE Fixed Gear	—	—	—	—	0	0
English sole	LE Trawl	160,907	511,120	95,510	299,093	74,430	158,819
English sole	Non-vessel	—	—	—	—	0	***
English sole	Other	***	***	***	***	—	—
English sole	Other Vessel	—	—	—	—	***	***
Petrale sole	Fixed Gear	***	***	***	***	—	—
Petrale sole	LE Fixed Gear	—	—	—	—	***	***
Petrale sole	LE Trawl	3,013,174	3,799,266	1,597,218	1,387,003	2,039,701	1,415,873
Petrale sole	Non-vessel	—	—	—	—	597,149	337,725
Petrale sole	Other	506,952	398,494	277,237	163,765	—	—
Petrale sole	Other Vessel	—	—	—	—	228	161
Rex sole	Fixed Gear	***	***	***	***	—	—
Rex sole	LE Fixed Gear	—	—	—	—	0	0
Rex sole	LE Trawl	354,667	1,034,291	285,842	865,280	271,410	733,793
Rex sole	Non-vessel	—	—	—	—	76,259	72,869
Rex sole	Other	0	***	74,690	90,201	—	—
Rex sole	Other Vessel	—	—	—	—	1,849	5,072

Table 4.9: Total purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	LE Fixed Gear	—	—	—	—	***	***
Arrowtooth flounder	LE Trawl	—	—	—	—	1,234,126	4,110,655
Arrowtooth flounder	Non-vessel	—	—	—	—	***	***
Arrowtooth flounder	Other Vessel	—	—	—	—	972	9,504
Lingcod	Fixed Gear	10,405	12,692	8,588	10,420	—	—
Lingcod	LE Fixed Gear	—	—	—	—	2,994	3,367
Lingcod	LE Trawl	151,074	226,111	93,664	137,955	358,058	457,219
Lingcod	Non-vessel	—	—	—	—	153,684	155,864
Lingcod	Other	105,949	83,597	100,384	86,007	—	—
Lingcod	Other Vessel	—	—	—	—	12,668	12,915
Rockfish	Fixed Gear	74,636	115,976	182,382	224,163	—	—
Rockfish	LE Fixed Gear	—	—	—	—	68,684	70,233
Rockfish	LE Trawl	1,458,329	2,094,010	878,578	1,665,487	1,576,424	2,921,468
Rockfish	Non-vessel	—	—	—	—	1,810,213	2,082,579
Rockfish	Other	0	***	1,362,707	1,871,696	—	—
Rockfish	Other Vessel	—	—	—	—	77,555	83,341

Table 4.10: Total purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	LE Fixed Gear	—	—	—	—	***	***
Sanddab	LE Trawl	—	—	—	—	177,065	302,823
Sanddab	Non-vessel	—	—	—	—	14,481	16,344
Sanddab	Other Vessel	—	—	—	—	***	***
Sharks, skates and rays	Fixed Gear	9,327	43,151	15,749	58,003	—	—
Sharks, skates and rays	LE Fixed Gear	—	—	—	—	32,796	22,378
Sharks, skates and rays	LE Trawl	520,991	2,672,161	734,108	2,847,569	804,333	2,594,783
Sharks, skates and rays	Non-vessel	—	—	—	—	0	***
Sharks, skates and rays	Other	0	***	112,493	197,319	—	—
Sharks, skates and rays	Other Vessel	—	—	—	—	33,519	70,123

Table 4.11: Total purchase weight and value of crab and shrimp by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	All	38,564,966	18,956,335	71,597,376	35,744,855	—	—
Crab	Non-vessel	—	—	—	—	7,941,561	3,135,104
Crab	Vessel	—	—	—	—	65,056,155	27,035,993
Shrimp	All	11,341,178	29,998,269	15,481,708	41,668,220	—	—
Shrimp	Non-vessel	—	—	—	—	5,499,974	6,673,515
Shrimp	Vessel	—	—	—	—	25,703,576	52,811,385

Table 4.12: Total purchase weight and value of costal pelagics, salmon, and tuna by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	All	5,376,267	47,657,255	5,297,512	46,244,386	—	—
Coastal pelagics	Non-vessel	—	—	—	—	458,326	311,887
Coastal pelagics	Vessel	—	—	—	—	4,605,648	39,367,648
Salmon	All	6,169,533	4,822,417	16,229,749	6,650,876	—	—
Salmon	Non-vessel	—	—	—	—	8,303,967	3,201,382
Salmon	Vessel	—	—	—	—	12,341,500	8,413,789
Tuna	All	8,954,246	8,509,052	12,849,193	10,470,768	—	—
Tuna	Non-vessel	—	—	—	—	0	***
Tuna	Vessel	—	—	—	—	12,115,888	6,106,023

Table 4.13: Total purchase weight and value of halibut, herring, and sturgeon by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	All	568,491	117,882	687,627	148,683	—	—
California halibut	Non-vessel	—	—	—	—	497,716	85,666
California halibut	Vessel	—	—	—	—	639,225	137,372
Pacific halibut	All	2,417,068	517,439	1,894,548	272,335	—	—
Pacific halibut	Non-vessel	—	—	—	—	986,142	104,444
Pacific halibut	Vessel	—	—	—	—	1,211,238	193,757
Pacific herring	All	0	0	***	***	—	—
Pacific herring	Non-vessel	—	—	—	—	***	***
Pacific herring	Vessel	—	—	—	—	***	***
Sturgeon	Non-vessel	—	—	—	—	541,823	187,734
Sturgeon	Vessel	—	—	—	—	202,118	78,091

Table 4.14: Total purchase weight and value of echinoderms, shellfish, squid, other species by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	All	***	***	***	***	—	—
Echinoderms	Non-vessel	—	—	—	—	***	***
Echinoderms	Vessel	—	—	—	—	***	***
Other species	All	2,214,987	10,331,014	4,163,521	16,223,819	—	—
Shellfish	All	6,619,728	2,341,880	5,870,718	1,977,295	—	—
Shellfish	Non-vessel	—	—	—	—	7,112,699	2,747,281
Shellfish	Vessel	—	—	—	—	0	0
Squid	All	397,069	413,525	645,485	861,281	—	—
Squid	Non-vessel	—	—	—	—	484,286	335,060
Squid	Vessel	—	—	—	—	0	***

4.2.8 Mean cost and weight of fish purchases by source and species

Table 4.15: Average purchase weight and value of whiting by source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fixed Gear	0	0	0	0	—	—
Pacific whiting	LE Fixed Gear	—	—	—	—	***	***
Pacific whiting	LE Trawl	297,522	3,788,257	342,440	4,085,208	708,602	6,375,868
Pacific whiting	Non-vessel	—	—	—	—	67,712	758,734
Pacific whiting	Other	***	0	21,924	260,795	—	—
Pacific whiting	Other Vessel	—	—	—	—	***	***

Table 4.16: Average purchase weight and value of dover, thornyheads, and sablefish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fixed Gear	321	810	***	***	—	—
Dover sole	LE Fixed Gear	—	—	—	—	6	14
Dover sole	LE Trawl	350,555	1,005,269	256,111	800,332	205,375	480,154
Dover sole	Non-vessel	—	—	—	—	13,070	24,960
Dover sole	Other	***	***	18,846	49,991	—	—
Dover sole	Other Vessel	—	—	—	—	***	***
Sablefish	Fixed Gear	471,255	155,179	467,636	146,963	—	—
Sablefish	LE Fixed Gear	—	—	—	—	313,032	79,959
Sablefish	LE Trawl	501,365	238,202	352,097	159,249	277,351	92,972
Sablefish	Non-vessel	—	—	—	—	60,028	23,454
Sablefish	Other	105,882	44,161	144,190	68,214	—	—
Sablefish	Other Vessel	—	—	—	—	269,210	52,272
Thornyheads	Fixed Gear	258	333	***	***	—	—
Thornyheads	LE Fixed Gear	—	—	—	—	4,413	4,227
Thornyheads	LE Trawl	101,630	196,929	86,194	158,416	51,363	83,049
Thornyheads	Non-vessel	—	—	—	—	947	1,947
Thornyheads	Other	***	***	***	0	—	—
Thornyheads	Other Vessel	—	—	—	—	83	134

Table 4.17: Average purchase weight and value of other groundfish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fixed Gear	***	***	***	***	—	—
English sole	LE Fixed Gear	—	—	—	—	0	0
English sole	LE Trawl	6,996	22,223	3,820	11,964	2,326	4,963
English sole	Non-vessel	—	—	—	—	0	***
English sole	Other	***	***	***	***	—	—
English sole	Other Vessel	—	—	—	—	***	***
Petrale sole	Fixed Gear	***	***	***	***	—	—
Petrale sole	LE Fixed Gear	—	—	—	—	***	***
Petrale sole	LE Trawl	131,008	165,185	63,889	55,480	63,741	44,246
Petrale sole	Non-vessel	—	—	—	—	18,661	10,554
Petrale sole	Other	22,041	17,326	11,089	6,551	—	—
Petrale sole	Other Vessel	—	—	—	—	7	5
Rex sole	Fixed Gear	***	***	***	***	—	—
Rex sole	LE Fixed Gear	—	—	—	—	0	0
Rex sole	LE Trawl	15,420	44,969	11,434	34,611	8,482	22,931
Rex sole	Non-vessel	—	—	—	—	2,383	2,277
Rex sole	Other	0	***	2,988	3,608	—	—
Rex sole	Other Vessel	—	—	—	—	58	159

Table 4.18: Average purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	LE Fixed Gear	—	—	—	—	***	***
Arrowtooth flounder	LE Trawl	—	—	—	—	38,566	128,458
Arrowtooth flounder	Non-vessel	—	—	—	—	***	***
Arrowtooth flounder	Other Vessel	—	—	—	—	30	297
Lingcod	Fixed Gear	452	552	344	417	—	—
Lingcod	LE Fixed Gear	—	—	—	—	94	105
Lingcod	LE Trawl	6,568	9,831	3,747	5,518	11,189	14,288
Lingcod	Non-vessel	—	—	—	—	4,803	4,871
Lingcod	Other	4,606	3,635	4,015	3,440	—	—
Lingcod	Other Vessel	—	—	—	—	396	404
Rockfish	Fixed Gear	3,245	5,042	7,295	8,967	—	—
Rockfish	LE Fixed Gear	—	—	—	—	2,146	2,195
Rockfish	LE Trawl	63,406	91,044	35,143	66,619	49,263	91,296
Rockfish	Non-vessel	—	—	—	—	56,569	65,081
Rockfish	Other	0	***	54,508	74,868	—	—
Rockfish	Other Vessel	—	—	—	—	2,424	2,604

Table 4.19: Average purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	LE Fixed Gear	—	—	—	—	***	***
Sanddab	LE Trawl	—	—	—	—	5,533	9,463
Sanddab	Non-vessel	—	—	—	—	453	511
Sanddab	Other Vessel	—	—	—	—	***	***
Sharks, skates and rays	Fixed Gear	406	1,876	630	2,320	—	—
Sharks, skates and rays	LE Fixed Gear	—	—	—	—	1,025	699
Sharks, skates and rays	LE Trawl	22,652	116,181	29,364	113,903	25,135	81,087
Sharks, skates and rays	Non-vessel	—	—	—	—	0	***
Sharks, skates and rays	Other	0	***	4,500	7,893	—	—
Sharks, skates and rays	Other Vessel	—	—	—	—	1,047	2,191

Table 4.20: Average purchase weight and value of crab and shrimp by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	All	1,676,738	824,188	2,863,895	1,429,794	—	—
Crab	Non-vessel	—	—	—	—	248,174	97,972
Crab	Vessel	—	—	—	—	2,033,005	844,875
Shrimp	All	493,095	1,304,273	619,268	1,666,729	—	—
Shrimp	Non-vessel	—	—	—	—	171,874	208,547
Shrimp	Vessel	—	—	—	—	803,237	1,650,356

Table 4.21: Average purchase weight and value of costal pelagics, salmon, and tuna by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	All	233,751	2,072,055	211,900	1,849,775	—	—
Coastal pelagics	Non-vessel	—	—	—	—	14,323	9,746
Coastal pelagics	Vessel	—	—	—	—	143,927	1,230,239
Salmon	All	280,433	209,670	649,190	266,035	—	—
Salmon	Non-vessel	—	—	—	—	259,499	100,043
Salmon	Vessel	—	—	—	—	385,672	262,931
Tuna	All	389,315	369,959	513,968	418,831	—	—
Tuna	Non-vessel	—	—	—	—	0	***
Tuna	Vessel	—	—	—	—	378,622	190,813

Table 4.22: Average purchase weight and value of halibut, herring, and sturgeon by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	All	24,717	5,125	27,505	5,947	—	—
California halibut	Non-vessel	—	—	—	—	15,554	2,677
California halibut	Vessel	—	—	—	—	19,976	4,293
Pacific halibut	All	105,090	22,497	75,782	10,893	—	—
Pacific halibut	Non-vessel	—	—	—	—	30,817	3,264
Pacific halibut	Vessel	—	—	—	—	37,851	6,055
Pacific herring	All	0	0	***	***	—	—
Pacific herring	Non-vessel	—	—	—	—	***	***
Pacific herring	Vessel	—	—	—	—	***	***
Sturgeon	Non-vessel	—	—	—	—	16,932	5,867
Sturgeon	Vessel	—	—	—	—	6,316	2,440

Table 4.23: Average purchase weight and value of echinoderms, shellfish, squid, other species by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	All	***	***	***	***	—	—
Echinoderms	Non-vessel	—	—	—	—	***	***
Echinoderms	Vessel	—	—	—	—	***	***
Other species	All	96,304	449,175	166,541	648,953	—	—
Shellfish	All	287,814	101,821	234,829	79,092	—	—
Shellfish	Non-vessel	—	—	—	—	222,272	85,853
Shellfish	Vessel	—	—	—	—	0	0
Squid	All	17,264	18,797	25,819	34,451	—	—
Squid	Non-vessel	—	—	—	—	15,134	10,471
Squid	Vessel	—	—	—	—	0	***

4.2.9 Median cost and weight of fish purchases by source and species

Table 4.24: Median purchase weight and value of whiting by source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fixed Gear	0	0	0	0	—	—
Pacific whiting	LE Fixed Gear	—	—	—	—	***	***
Pacific whiting	LE Trawl	8,570	122,442	0	0	0	0
Pacific whiting	Non-vessel	—	—	—	—	0	0
Pacific whiting	Other	***	0	0	0	—	—
Pacific whiting	Other Vessel	—	—	—	—	***	***

Table 4.25: Median purchase weight and value of dover, thornyheads, and sablefish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fixed Gear	0	0	***	***	—	—
Dover sole	LE Fixed Gear	—	—	—	—	0	0
Dover sole	LE Trawl	12,717	29,076	799	1,776	0	0
Dover sole	Non-vessel	—	—	—	—	0	0
Dover sole	Other	***	***	0	0	—	—
Dover sole	Other Vessel	—	—	—	—	***	***
Sablefish	Fixed Gear	0	0	0	0	—	—
Sablefish	LE Fixed Gear	—	—	—	—	0	0
Sablefish	LE Trawl	57,133	37,022	12,371	5,402	37	79
Sablefish	Non-vessel	—	—	—	—	0	0
Sablefish	Other	0	0	0	0	—	—
Sablefish	Other Vessel	—	—	—	—	0	0
Thornyheads	Fixed Gear	0	0	***	***	—	—
Thornyheads	LE Fixed Gear	—	—	—	—	0	0
Thornyheads	LE Trawl	1,619	4,692	359	999	24	41
Thornyheads	Non-vessel	—	—	—	—	0	0
Thornyheads	Other	***	***	***	0	—	—
Thornyheads	Other Vessel	—	—	—	—	0	0

Table 4.26: Median purchase weight and value of other groundfish by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fixed Gear	***	***	***	***	—	—
English sole	LE Fixed Gear	—	—	—	—	0	0
English sole	LE Trawl	925	1,306	4	12	0	0
English sole	Non-vessel	—	—	—	—	0	***
English sole	Other	***	***	***	***	—	—
English sole	Other Vessel	—	—	—	—	***	***
Petrale sole	Fixed Gear	***	***	***	***	—	—
Petrale sole	LE Fixed Gear	—	—	—	—	***	***
Petrale sole	LE Trawl	42,551	34,732	6,046	5,099	0	0
Petrale sole	Non-vessel	—	—	—	—	0	0
Petrale sole	Other	0	0	0	0	—	—
Petrale sole	Other Vessel	—	—	—	—	0	0
Rex sole	Fixed Gear	***	***	***	***	—	—
Rex sole	LE Fixed Gear	—	—	—	—	0	0
Rex sole	LE Trawl	150	739	131	479	0	0
Rex sole	Non-vessel	—	—	—	—	0	0
Rex sole	Other	0	***	0	0	—	—
Rex sole	Other Vessel	—	—	—	—	0	0

Table 4.27: Median purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	LE Fixed Gear	—	—	—	—	***	***
Arrowtooth flounder	LE Trawl	—	—	—	—	0	0
Arrowtooth flounder	Non-vessel	—	—	—	—	***	***
Arrowtooth flounder	Other Vessel	—	—	—	—	0	0
Lingcod	Fixed Gear	0	0	0	0	—	—
Lingcod	LE Fixed Gear	—	—	—	—	0	0
Lingcod	LE Trawl	112	351	825	727	192	343
Lingcod	Non-vessel	—	—	—	—	0	0
Lingcod	Other	0	0	0	0	—	—
Lingcod	Other Vessel	—	—	—	—	0	0
Rockfish	Fixed Gear	0	0	0	0	—	—
Rockfish	LE Fixed Gear	—	—	—	—	0	0
Rockfish	LE Trawl	23,522	36,533	12,817	15,764	11,488	16,562
Rockfish	Non-vessel	—	—	—	—	0	0
Rockfish	Other	0	***	0	0	—	—
Rockfish	Other Vessel	—	—	—	—	0	0

Table 4.28: Median purchase weight and value of other groundfish (cont.) by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	LE Fixed Gear	—	—	—	—	***	***
Sanddab	LE Trawl	—	—	—	—	0	0
Sanddab	Non-vessel	—	—	—	—	0	0
Sanddab	Other Vessel	—	—	—	—	***	***
Sharks, skates and rays	Fixed Gear	0	0	0	0	—	—
Sharks, skates and rays	LE Fixed Gear	—	—	—	—	0	0
Sharks, skates and rays	LE Trawl	162	1,419	294	349	0	0
Sharks, skates and rays	Non-vessel	—	—	—	—	0	***
Sharks, skates and rays	Other	0	***	0	0	—	—
Sharks, skates and rays	Other Vessel	—	—	—	—	0	0

Table 4.29: Median purchase weight and value of crab and shrimp by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	All	659,106	307,659	2,293,558	1,267,984	—	—
Crab	Non-vessel	—	—	—	—	0	0
Crab	Vessel	—	—	—	—	328,131	142,966
Shrimp	All	0	0	0	0	—	—
Shrimp	Non-vessel	—	—	—	—	0	0
Shrimp	Vessel	—	—	—	—	0	0

Table 4.30: Median purchase weight and value of costal pelagics, salmon, and tuna by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	All	0	0	0	0	—	—
Coastal pelagics	Non-vessel	—	—	—	—	0	0
Coastal pelagics	Vessel	—	—	—	—	0	0
Salmon	All	0	0	116,225	19,957	—	—
Salmon	Non-vessel	—	—	—	—	0	0
Salmon	Vessel	—	—	—	—	32,917	5,662
Tuna	All	1,782	1,759	124,839	62,946	—	—
Tuna	Non-vessel	—	—	—	—	0	***
Tuna	Vessel	—	—	—	—	2,200	1,103

Table 4.31: Median purchase weight and value of halibut, herring, and sturgeon by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	All	0	0	0	0	—	—
California halibut	Non-vessel	—	—	—	—	0	0
California halibut	Vessel	—	—	—	—	0	0
Pacific halibut	All	0	0	0	0	—	—
Pacific halibut	Non-vessel	—	—	—	—	0	0
Pacific halibut	Vessel	—	—	—	—	0	0
Pacific herring	All	0	0	***	***	—	—
Pacific herring	Non-vessel	—	—	—	—	***	***
Pacific herring	Vessel	—	—	—	—	***	***
Sturgeon	Non-vessel	—	—	—	—	0	0
Sturgeon	Vessel	—	—	—	—	0	0

Table 4.32: Median purchase weight and value of echinoderms, shellfish, squid, other species by species and source.

Species	Source	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	All	***	***	***	***	—	—
Echinoderms	Non-vessel	—	—	—	—	***	***
Echinoderms	Vessel	—	—	—	—	***	***
Other species	All	891	312	820	1,178	—	—
Shellfish	All	0	0	0	0	—	—
Shellfish	Non-vessel	—	—	—	—	0	0
Shellfish	Vessel	—	—	—	—	0	0
Squid	All	0	0	0	0	—	—
Squid	Non-vessel	—	—	—	—	0	0
Squid	Vessel	—	—	—	—	0	***

5 Depreciation

Depreciation in the following table includes depreciation for all capital investments on buildings and new and used machinery and equipment taken during the survey year. Depreciation is excluded from the calculations of both fixed and variable costs (Section 4) and net revenue (Section 7.2). It is collected for use in the IO-PAC model.

Table 5.1: Depreciation.

	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Depreciation	\$300,497	\$179,452	\$247,226	\$140,463	\$168,429	\$56,841

6 Revenue

Participants are asked to provide revenue from production of purchased fish as well as from custom processing, offloading, and the sale or lease of quota and permits.

6.1 Revenue from custom processing, offloading, and sale or lease of quota and permits

Participants are asked to provide revenue from a variety of other activities, including revenue from custom processing, sale and lease of quota shares and pounds, and offloading.

Table 6.1: Other revenue.

Revenue Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Custom processing of non-whiting, non-groundfish fish	$16,487	$0	$19,341	$0	$33,244	$0
Custom processing of whiting	$2,043	$0	$2,038	$0	$14,346	$0
Custom processing of non-whiting groundfish	$344	$0	$3,594	$0	$20,866	$0
Offloading	—	—	—	—	$58,211	$0

6.2 Production activities

The product weight and value from production activities free-on-board (FOB) plant are requested for each survey year. Free-on-board plant indicates that the buyer both takes responsibility and liability for the product and pays shipping costs. These production values exclude freight charges, revenue from products made in previous years, products made from custom processing performed for another company, and any additional payments received that covered shipping, handling, or storage costs associated with sale beyond the plant. The total value of fish production does include products made in that survey year and held in inventory at the end of the year, products shipped to other facilities in the same company, products made from custom processing performed by another facility, and any post-season adjustments.

The same species categories are provided as in the fish purchase section, this time divided into product categories that include processed fresh, frozen, unprocessed, and other, as well as additional categories for whiting. There is also a category for non-species specific products such as fishmeal, fish oil, and bait.

6.3 Total value and weight of fish production by product type and species

Table 6.2: Total production weight and value of whiting by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fillet	5,913,750	5,401,941	9,633,726	8,203,630	12,203,027	18,735,603
Pacific whiting	Frozen	***	***	1,252,309	3,753,097	9,063,573	31,185,386
Pacific whiting	Headed-and-gutted	33,977,602	60,355,185	16,728,738	29,511,159	24,041,049	40,067,088
Pacific whiting	Other	***	0	***	***	—	—
Pacific whiting	Roe	0	0	0	0	0	0
Pacific whiting	Surimi	***	***	***	***	***	***
Pacific whiting	Unprocessed	139,670	1,378,853	72,041	643,186	1,241,390	8,382,239

Table 6.3: Total production weight and value of dover, thornyheads, and sablefish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fresh	14,309,647	6,385,055	13,812,198	5,553,627	12,014,561	3,606,959
Dover sole	Frozen	2,724,165	1,269,881	1,990,081	1,266,720	1,609,438	605,338
Dover sole	Other	***	0	***	***	***	***
Dover sole	Unprocessed	***	***	506,386	1,093,883	341,412	1,164,817
Sablefish	Fresh	5,017,556	1,233,221	6,583,020	1,269,233	5,226,343	1,636,120
Sablefish	Frozen	27,114,518	5,527,723	30,130,688	5,599,424	30,305,667	4,230,991
Sablefish	Other	***	***	***	0	***	***
Sablefish	Unprocessed	1,581,598	568,547	1,981,888	689,801	2,510,753	708,948
Thornyheads	Fresh	232,621	193,672	366,276	316,184	***	***
Thornyheads	Frozen	4,215,773	1,797,303	4,506,427	2,034,275	3,862,581	1,131,368
Thornyheads	Other	0	0	***	***	3,182	1,471
Thornyheads	Unprocessed	105,012	85,212	193,557	286,025	570,171	538,341

Table 6.4: Total production weight and value of other groundfish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fresh	448,652	210,604	232,878	104,091	222,159	69,653
English sole	Frozen	98,143	80,929	47,051	43,396	38,185	15,646
English sole	Other	0	0	0	0	0	0
English sole	Unprocessed	28,926	43,145	12,701	25,219	15,936	34,945
Petrale sole	Fresh	4,996,318	1,446,848	1,844,320	464,474	2,379,350	432,981
Petrale sole	Frozen	633,253	206,578	303,380	101,104	357,728	85,422
Petrale sole	Other	0	0	0	0	***	***
Petrale sole	Unprocessed	1,554,753	1,005,201	678,714	362,575	1,075,550	500,910
Rex sole	Fresh	609,140	374,400	363,372	181,933	477,728	222,022
Rex sole	Frozen	398,446	265,406	411,887	324,736	265,624	163,305
Rex sole	Other	0	0	***	***	0	0
Rex sole	Unprocessed	51,024	72,418	27,514	52,140	28,635	56,829

Table 6.5: Total production weight and value of other groundfish (cont.) by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	Fresh	—	—	—	—	811,717	723,819
Arrowtooth flounder	Frozen	—	—	—	—	0	***
Arrowtooth flounder	Other	—	—	—	—	0	0
Arrowtooth flounder	Unprocessed	—	—	—	—	***	***
Lingcod	Fresh	341,611	90,891	298,017	71,080	757,940	190,394
Lingcod	Frozen	59,673	10,035	50,764	24,990	192,812	56,133
Lingcod	Other	***	***	***	***	***	***
Lingcod	Unprocessed	111,294	91,137	77,144	47,407	128,565	49,792
Rockfish	Fresh	3,042,198	1,125,641	2,584,703	969,887	3,031,688	1,077,178
Rockfish	Frozen	749,333	377,321	404,130	216,772	602,256	328,508
Rockfish	Other	***	***	0	0	305,371	164,986
Rockfish	Unprocessed	574,183	495,486	639,377	606,900	1,529,458	1,269,854

Table 6.6: Total production weight and value of other groundfish (cont.). by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	Fresh	—	—	—	—	44,890	9,734
Sanddab	Frozen	—	—	—	—	219,926	69,070
Sanddab	Other	—	—	—	—	***	***
Sanddab	Unprocessed	—	—	—	—	182,817	183,558
Sharks, skates and rays	Fresh	218,342	191,964	58,015	35,079	90,230	37,368
Sharks, skates and rays	Frozen	1,520,332	1,129,559	1,690,729	909,944	1,919,674	925,751
Sharks, skates and rays	Other	***	***	0	0	***	***
Sharks, skates and rays	Unprocessed	0	***	256,189	466,423	513,347	707,500

Table 6.7: Total production weight and value of crab and shrimp by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	Canned	826,638	55,493	1,013,802	63,733	***	***
Crab	Fresh	38,312,882	7,057,529	49,977,449	11,409,357	34,238,692	6,041,141
Crab	Frozen	33,563,409	6,472,240	53,753,583	12,440,746	62,628,800	10,931,573
Crab	Other	0	***	484,027	48,271	0	***
Crab	Unprocessed	948,270	426,111	1,061,282	474,383	4,886,322	1,878,616
Shrimp	Canned	0	0	0	0	***	***
Shrimp	Fresh	5,448,903	3,399,192	5,053,940	3,194,768	3,641,513	1,178,126
Shrimp	Frozen	23,400,774	8,404,742	24,194,901	12,013,054	53,080,118	17,737,167
Shrimp	Other	0	0	***	***	0	0
Shrimp	Unprocessed	***	***	***	***	3,574,616	3,988,514

Table 6.8: Total production weight and value of costal pelagics, salmon, and tuna by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	Canned	—	—	—	—	0	0
Coastal pelagics	Fresh	701,362	2,123,256	***	0	0	***
Coastal pelagics	Frozen	6,125,610	14,942,716	4,798,377	13,140,214	11,671,008	35,701,334
Coastal pelagics	Other	5,989,043	25,396,479	6,480,189	27,659,354	***	***
Coastal pelagics	Unprocessed	***	***	0	***	74,364	28,897
Salmon	Canned	***	***	***	***	***	***
Salmon	Fresh	7,140,642	2,037,991	11,896,653	2,656,044	14,840,395	3,465,156
Salmon	Frozen	***	***	6,693,301	2,334,364	9,373,401	4,373,480
Salmon	Other	373,543	129,618	***	0	0	0
Salmon	Smoked	188,639	18,553	459,965	52,874	***	***
Salmon	Unprocessed	875,682	251,299	1,630,254	402,952	3,678,462	1,614,458
Tuna	Canned	***	***	***	***	74,621	16,966
Tuna	Fresh	632,757	189,187	643,442	161,753	666,674	148,803
Tuna	Frozen	13,708,109	9,871,138	13,703,705	8,167,287	16,176,910	6,157,748
Tuna	Other	***	***	***	***	***	***
Tuna	Unprocessed	0	***	462,273	291,717	3,565,005	1,709,289

Table 6.9: Total production weight and value of halibut, herring, and sturgeon by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	Fresh	***	***	833,761	97,252	423,213	41,061
California halibut	Frozen	***	***	***	***	***	***
California halibut	Other	0	0	***	***	***	***
California halibut	Unprocessed	504,382	97,423	***	***	861,591	147,375
Pacific halibut	Fresh	3,037,733	540,653	1,297,073	136,244	1,451,049	151,686
Pacific halibut	Frozen	298,273	44,963	169,415	19,185	170,472	17,108
Pacific halibut	Other	***	***	***	***	***	***
Pacific halibut	Unprocessed	240,401	49,440	***	***	808,681	105,791
Pacific herring	Fresh	0	0	0	0	0	0
Pacific herring	Frozen	0	0	0	0	***	0
Pacific herring	Other	0	0	0	0	0	0
Pacific herring	Unprocessed	0	0	0	0	***	***
Sturgeon	Canned	0	0	0	0	0	0
Sturgeon	Fresh	463,768	99,750	1,075,917	218,060	777,401	136,059
Sturgeon	Frozen	66,889	5,015	99,466	23,403	***	***
Sturgeon	Other	***	***	0	0	0	0
Sturgeon	Unprocessed	0	0	***	***	***	***

Table 6.10: Total production weight and value of echinoderms, shellfish, squid, other species by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	Fresh	***	***	***	***	***	***
Echinoderms	Frozen	0	0	0	0	0	0
Echinoderms	Other	0	0	0	0	***	***
Echinoderms	Unprocessed	***	***	***	***	***	***
Nonspecies specific	Bait	—	—	—	—	***	***
Nonspecies specific	Fish oil	***	***	***	***	***	***
Nonspecies specific	Fishmeal	***	***	***	***	0	***
Nonspecies specific	Other	***	***	***	***	***	0
Other species	Other	5,729,806	11,914,308	6,364,470	18,845,944	—	—
Shellfish	Fresh	***	***	***	0	***	***
Shellfish	Frozen	***	0	***	0	***	***
Shellfish	Other	0	0	0	0	0	0
Shellfish	Unprocessed	7,582,139	2,210,683	6,481,000	1,836,309	6,490,475	2,042,437
Squid	Fresh	848	816	***	***	***	***
Squid	Frozen	490,282	291,748	794,558	753,678	630,361	349,881
Squid	Other	0	0	***	***	0	0
Squid	Unprocessed	***	***	***	***	749	680

6.4 Average value and weight of fish production by product type and species

Table 6.11: Average production weight and value of whiting by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fillet	257,120	234,867	385,349	328,145	381,345	585,488
Pacific whiting	Frozen	***	***	50,092	150,124	283,237	974,543
Pacific whiting	Headed-and-gutted	1,477,287	2,624,138	669,150	1,180,446	751,283	1,252,097
Pacific whiting	Other	***	0	***	***	—	—
Pacific whiting	Roe	0	0	0	0	0	0
Pacific whiting	Surimi	***	***	***	***	***	***
Pacific whiting	Unprocessed	6,073	59,950	2,882	26,799	38,793	270,395

Table 6.12: Average production weight and value of dover, thornyheads, and sablefish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fresh	622,159	277,611	552,488	222,145	375,455	112,717
Dover sole	Frozen	118,442	55,212	79,603	50,669	50,295	18,917
Dover sole	Other	***	0	***	***	***	***
Dover sole	Unprocessed	***	***	20,255	43,755	10,669	36,401
Sablefish	Fresh	218,155	53,618	263,321	50,769	163,323	51,129
Sablefish	Frozen	1,178,892	240,336	1,205,228	223,977	947,052	132,218
Sablefish	Other	***	***	***	0	***	***
Sablefish	Unprocessed	68,765	24,719	79,276	27,592	78,461	22,155
Thornyheads	Fresh	10,114	8,421	14,651	12,647	***	***
Thornyheads	Frozen	183,294	78,144	180,257	81,371	120,706	35,355
Thornyheads	Other	0	0	***	***	99	46
Thornyheads	Unprocessed	4,566	3,705	7,742	11,441	17,818	16,823

Table 6.13: Average production weight and value of other groundfish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fresh	19,507	9,157	9,315	4,164	6,942	2,177
English sole	Frozen	4,267	3,519	1,882	1,736	1,193	489
English sole	Other	0	0	0	0	0	0
English sole	Unprocessed	1,258	1,876	508	1,009	498	1,092
Petrale sole	Fresh	217,231	62,906	73,773	18,579	74,355	13,531
Petrale sole	Frozen	27,533	8,982	12,135	4,044	11,179	2,669
Petrale sole	Other	0	0	0	0	***	***
Petrale sole	Unprocessed	67,598	43,704	27,149	14,503	33,611	15,653
Rex sole	Fresh	26,484	16,278	14,535	7,277	14,929	6,938
Rex sole	Frozen	17,324	11,539	16,475	12,989	8,301	5,103
Rex sole	Other	0	0	***	***	0	0
Rex sole	Unprocessed	2,218	3,149	1,101	2,086	895	1,776

Table 6.14: Average production weight and value of other groundfish (cont.) by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	Fresh	—	—	—	—	25,366	22,619
Arrowtooth flounder	Frozen	—	—	—	—	0	***
Arrowtooth flounder	Other	—	—	—	—	0	0
Arrowtooth flounder	Unprocessed	—	—	—	—	***	***
Lingcod	Fresh	14,853	3,952	11,921	2,843	23,686	5,950
Lingcod	Frozen	2,594	436	2,031	1,000	6,025	1,754
Lingcod	Other	***	***	***	***	***	***
Lingcod	Unprocessed	4,839	3,962	3,086	1,896	4,018	1,556
Rockfish	Fresh	132,269	48,941	103,388	38,795	94,740	33,662
Rockfish	Frozen	32,580	16,405	16,165	8,671	18,821	10,266
Rockfish	Other	***	***	0	0	9,543	5,156
Rockfish	Unprocessed	24,964	21,543	25,575	24,276	47,796	39,683

Table 6.15: Average production weight and value of other groundfish (cont.). by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	Fresh	—	—	—	—	1,403	304
Sanddab	Frozen	—	—	—	—	6,873	2,158
Sanddab	Other	—	—	—	—	***	***
Sanddab	Unprocessed	—	—	—	—	5,713	5,736
Sharks, skates and rays	Fresh	9,493	8,346	2,321	1,403	2,820	1,168
Sharks, skates and rays	Frozen	66,101	49,111	67,629	36,398	59,990	28,930
Sharks, skates and rays	Other	***	***	0	0	***	***
Sharks, skates and rays	Unprocessed	0	***	10,248	18,657	16,042	22,823

Table 6.16: Average production weight and value of crab and shrimp by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	Canned	35,941	2,413	40,552	2,549	***	***
Crab	Fresh	1,665,777	306,849	1,999,098	456,374	1,069,959	188,786
Crab	Frozen	1,459,279	281,402	2,150,143	497,630	1,957,150	341,612
Crab	Other	0	***	19,361	1,931	0	***
Crab	Unprocessed	41,229	18,527	42,451	18,975	152,698	58,707
Shrimp	Canned	0	0	0	0	***	***
Shrimp	Fresh	236,909	147,791	202,158	127,791	113,797	36,816
Shrimp	Frozen	1,017,425	365,424	967,796	480,522	1,658,754	554,286
Shrimp	Other	0	0	***	***	0	0
Shrimp	Unprocessed	***	***	***	***	111,707	124,641

Table 6.17: Average production weight and value of costal pelagics, salmon, and tuna by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	Canned	—	—	—	—	0	0
Coastal pelagics	Fresh	30,494	92,315	***	0	0	***
Coastal pelagics	Frozen	266,331	649,683	191,935	525,609	364,719	1,115,667
Coastal pelagics	Other	260,393	1,104,195	259,208	1,106,374	***	***
Coastal pelagics	Unprocessed	***	***	0	***	2,324	903
Salmon	Canned	***	***	***	***	***	***
Salmon	Fresh	310,463	88,608	475,866	106,242	463,762	111,779
Salmon	Frozen	***	***	267,732	93,375	292,919	136,671
Salmon	Other	16,241	5,636	***	0	0	0
Salmon	Smoked	8,202	807	18,399	2,115	***	***
Salmon	Unprocessed	38,073	10,926	65,210	16,118	114,952	50,452
Tuna	Canned	***	***	***	***	2,332	530
Tuna	Fresh	27,511	8,226	25,738	6,470	20,834	4,650
Tuna	Frozen	596,005	429,180	548,148	326,691	505,528	192,430
Tuna	Other	***	***	***	***	***	***
Tuna	Unprocessed	0	***	18,491	11,669	111,406	53,415

Table 6.18: Average production weight and value of halibut, herring, and sturgeon by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	Fresh	***	***	33,350	3,890	13,225	1,283
California halibut	Frozen	***	***	***	***	***	***
California halibut	Other	0	0	***	***	***	***
California halibut	Unprocessed	21,930	4,236	***	***	26,925	4,605
Pacific halibut	Fresh	132,075	23,507	51,883	5,450	45,345	4,740
Pacific halibut	Frozen	12,968	1,955	6,777	767	5,327	535
Pacific halibut	Other	***	***	***	***	***	***
Pacific halibut	Unprocessed	10,452	2,150	***	***	25,271	3,306
Pacific herring	Fresh	0	0	0	0	0	0
Pacific herring	Frozen	0	0	0	0	***	0
Pacific herring	Other	0	0	0	0	0	0
Pacific herring	Unprocessed	0	0	0	0	***	***
Sturgeon	Canned	0	0	0	0	0	0
Sturgeon	Fresh	20,164	4,337	43,037	8,722	24,294	4,252
Sturgeon	Frozen	2,908	218	3,979	936	***	***
Sturgeon	Other	***	***	0	0	0	0
Sturgeon	Unprocessed	0	0	***	***	***	***

Table 6.19: Average production weight and value of echinoderms, shellfish, squid, other species by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	Fresh	***	***	***	***	***	***
Echinoderms	Frozen	0	0	0	0	0	0
Echinoderms	Other	0	0	0	0	***	***
Echinoderms	Unprocessed	***	***	***	***	***	***
Nonspecies specific	Bait	—	—	—	—	***	***
Nonspecies specific	Fish oil	***	***	***	***	***	***
Nonspecies specific	Fishmeal	***	***	***	***	0	***
Nonspecies specific	Other	***	***	***	***	***	0
Other species	Other	249,122	518,013	254,579	753,838	—	—
Shellfish	Fresh	***	***	***	0	***	***
Shellfish	Frozen	***	0	***	0	***	***
Shellfish	Other	0	0	0	0	0	0
Shellfish	Unprocessed	329,658	96,117	259,240	73,452	202,827	63,826
Squid	Fresh	37	35	***	***	***	***
Squid	Frozen	21,317	12,685	31,782	30,147	19,699	10,934
Squid	Other	0	0	***	***	0	0
Squid	Unprocessed	***	***	***	***	23	21

6.5 Median value and weight of fish production by product type and species

Table 6.20: Median production weight and value of whiting by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Pacific whiting	Fillet	0	0	0	0	0	0
Pacific whiting	Frozen	***	***	0	0	0	0
Pacific whiting	Headed-and-gutted	0	0	0	0	0	0
Pacific whiting	Other	***	0	***	***	—	—
Pacific whiting	Roe	0	0	0	0	0	0
Pacific whiting	Surimi	***	***	***	***	***	***
Pacific whiting	Unprocessed	0	0	0	0	0	0

Table 6.21: Median production weight and value of dover, thornyheads, and sablefish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Dover sole	Fresh	677	1,882	0	0	0	0
Dover sole	Frozen	0	0	0	0	0	0
Dover sole	Other	***	0	***	***	***	***
Dover sole	Unprocessed	***	***	0	0	0	0
Sablefish	Fresh	0	0	62,251	9,741	0	0
Sablefish	Frozen	0	0	13,127	5,402	0	0
Sablefish	Other	***	***	***	0	***	***
Sablefish	Unprocessed	0	0	0	0	0	0
Thornyheads	Fresh	0	0	0	0	***	***
Thornyheads	Frozen	0	0	0	0	0	0
Thornyheads	Other	0	0	***	***	0	0
Thornyheads	Unprocessed	0	0	0	0	0	0

Table 6.22: Median production weight and value of other groundfish by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
English sole	Fresh	0	0	0	0	0	0
English sole	Frozen	0	0	0	0	0	0
English sole	Other	0	0	0	0	0	0
English sole	Unprocessed	0	0	0	0	0	0
Petrale sole	Fresh	140	40	4,000	690	0	0
Petrale sole	Frozen	0	0	0	0	0	0
Petrale sole	Other	0	0	0	0	***	***
Petrale sole	Unprocessed	0	0	0	0	0	0
Rex sole	Fresh	0	0	0	0	0	0
Rex sole	Frozen	0	0	0	0	0	0
Rex sole	Other	0	0	***	***	0	0
Rex sole	Unprocessed	0	0	0	0	0	0

Table 6.23: Median production weight and value of other groundfish (cont.) by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Arrowtooth flounder	Fresh	—	—	—	—	0	0
Arrowtooth flounder	Frozen	—	—	—	—	0	***
Arrowtooth flounder	Other	—	—	—	—	0	0
Arrowtooth flounder	Unprocessed	—	—	—	—	***	***
Lingcod	Fresh	49	22	30	93	0	0
Lingcod	Frozen	0	0	0	0	0	0
Lingcod	Other	***	***	***	***	***	***
Lingcod	Unprocessed	0	0	0	0	0	0
Rockfish	Fresh	10,806	14,519	6,145	10,345	0	0
Rockfish	Frozen	0	0	0	0	0	0
Rockfish	Other	***	***	0	0	0	0
Rockfish	Unprocessed	0	0	0	0	1,943	2,441

Table 6.24: Median production weight and value of other groundfish (cont.). by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Sanddab	Fresh	—	—	—	—	0	0
Sanddab	Frozen	—	—	—	—	0	0
Sanddab	Other	—	—	—	—	***	***
Sanddab	Unprocessed	—	—	—	—	0	0
Sharks, skates and rays	Fresh	0	0	0	0	0	0
Sharks, skates and rays	Frozen	0	0	0	0	0	0
Sharks, skates and rays	Other	***	***	0	0	***	***
Sharks, skates and rays	Unprocessed	0	***	0	0	0	0

Table 6.25: Median production weight and value of crab and shrimp by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Crab	Canned	0	0	0	0	***	***
Crab	Fresh	12,452	4,151	620,646	227,070	0	0
Crab	Frozen	893,946	206,832	333,494	41,328	13,734	2,289
Crab	Other	0	***	0	0	0	***
Crab	Unprocessed	0	0	0	0	0	0
Shrimp	Canned	0	0	0	0	***	***
Shrimp	Fresh	0	0	0	0	0	0
Shrimp	Frozen	0	0	0	0	0	0
Shrimp	Other	0	0	***	***	0	0
Shrimp	Unprocessed	***	***	***	***	0	0

Table 6.26: Median production weight and value of costal pelagics, salmon, and tuna by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Coastal pelagics	Canned	—	—	—	—	0	0
Coastal pelagics	Fresh	0	0	***	0	0	***
Coastal pelagics	Frozen	0	0	0	0	0	0
Coastal pelagics	Other	0	0	0	0	***	***
Coastal pelagics	Unprocessed	***	***	0	***	0	0
Salmon	Canned	***	***	***	***	***	***
Salmon	Fresh	0	0	11,957	1,437	0	0
Salmon	Frozen	***	***	0	0	0	0
Salmon	Other	0	0	***	0	0	0
Salmon	Smoked	0	0	0	0	***	***
Salmon	Unprocessed	0	0	0	0	0	0
Tuna	Canned	***	***	***	***	0	0
Tuna	Fresh	0	0	0	0	0	0
Tuna	Frozen	0	0	11,541	6,358	0	0
Tuna	Other	***	***	***	***	***	***
Tuna	Unprocessed	0	***	0	0	0	0

Table 6.27: Median production weight and value of halibut, herring, and sturgeon by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
California halibut	Fresh	***	***	0	0	0	0
California halibut	Frozen	***	***	***	***	***	***
California halibut	Other	0	0	***	***	***	***
California halibut	Unprocessed	0	0	***	***	0	0
Pacific halibut	Fresh	0	0	0	0	0	0
Pacific halibut	Frozen	0	0	0	0	0	0
Pacific halibut	Other	***	***	***	***	***	***
Pacific halibut	Unprocessed	0	0	***	***	0	0
Pacific herring	Fresh	0	0	0	0	0	0
Pacific herring	Frozen	0	0	0	0	***	0
Pacific herring	Other	0	0	0	0	0	0
Pacific herring	Unprocessed	0	0	0	0	***	***
Sturgeon	Canned	0	0	0	0	0	0
Sturgeon	Fresh	0	0	0	0	0	0
Sturgeon	Frozen	0	0	0	0	***	***
Sturgeon	Other	***	***	0	0	0	0
Sturgeon	Unprocessed	0	0	***	***	***	***

Table 6.28: Median production weight and value of echinoderms, shellfish, squid, other species by species and product type.

Species	Product	2009 N=23		2010 N=25		2011 N=32	
		Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)	Value ($)	Weight (lbs.)
Echinoderms	Fresh	***	***	***	***	***	***
Echinoderms	Frozen	0	0	0	0	0	0
Echinoderms	Other	0	0	0	0	***	***
Echinoderms	Unprocessed	***	***	***	***	***	***
Nonspecies specific	Bait	—	—	—	—	***	***
Nonspecies specific	Fish oil	***	***	***	***	***	***
Nonspecies specific	Fishmeal	***	***	***	***	0	***
Nonspecies specific	Other	***	***	***	***	***	0
Other species	Other	9	34	0	0	—	—
Shellfish	Fresh	***	***	***	0	***	***
Shellfish	Frozen	***	0	***	0	***	***
Shellfish	Other	0	0	0	0	0	0
Shellfish	Unprocessed	0	0	0	0	0	0
Squid	Fresh	0	0	***	***	***	***
Squid	Frozen	0	0	0	0	0	0
Squid	Other	0	0	***	***	0	0
Squid	Unprocessed	***	***	***	***	0	0

7 Net Revenue and Economic Profit

Net returns from operating a first receiver or shorebased processor are presented in this section. The level of net returns not only indicates whether a vessel is a viable ongoing business, but also the size of net benefit that is created from society's perspective. Two different measures of net returns are examined. They differ in the types of costs that are taken into account, and therefore, their interpretation and use. The first is a monetary, financial measure that attempts to track a first receiver or shorebased processor's net cash flow, which we call *net revenue*. It is calculated as revenue minus monetary costs. The only costs that are included are those that are actually paid or associated with a financial transaction. The second measure attempts to track the broader economic performance of a business and includes all costs regardless of whether there is a cash or financial transaction. Costs are measured by their true resource costs, which may or may not be equal to monetary outlays. This measure is called *economic profit*[1]. The distinction between the two measures is probably most easily understood through an examples relevant a first receiver or shorebased processor.

Labor costs for the net revenue measure are the total payments to the crew and captain. If work is performed that is not paid for, then it is not included as a cost. This commonly occurs in commercial fishing when the owner of a vessel is also the captain, but does not does not draw a captain's wage. In this case, the net revenue is higher than it would be if the captain drew a wage or hired a captain. In the end, the vessel owner-captain is not necessarily any worse off since s/he is the residual claimant to the net revenue. However, the net revenue would be higher than a comparable vessel that hired a captain.[2] Economic profit, on the other hand, accounts for the cost associated with an owner's time that is used as a captain. This is called an opportunity cost in the economics literature and is typically approximated by the wage of a comparably productive captain[3].

One difference between net revenue and economic profit is the treatment of facility capital costs. Net revenue only includes costs that are actually paid, which includes items such as facility repair, maintenance, and upgrades. Economic profit would also include the opportunity cost of owning the facility, a capital asset. By owning a facility, the owner foregoes other investment opportunities that would provide a rate of return. This is called the opportunity cost

[1] Whitmarsh D., James C., Pickering H., Neiland A. 2000. The profitability of marine commercial fisheries: a review of economic information needs with particular reference to the UK. Marine Policy, Vol. 24(3), pp. 257-263

[2] The same would also be true when a vessel owner does not receive a wage for work performed to repair or maintain a vessel or gear.

[3] A more accurate measure would be the owner-captain's most valued wage off the vessel

of capital[4], and is typically approximated by the market rate of return associated with businesses of comparable risk, multiplied by the market value of the vessel.

Both net revenue and economic profit are useful measures for fishery management. Net revenue attempts to measure the annual financial well-being of receiving/processing operations. It can be used to determine if there is a monetary gain or loss, or how changes in fishery management may affect the level of monetary gain or loss. Economic profit is a better indicator of the long-term viability of fishery operations since it includes all costs, and values the costs at their opportunity cost. It can be used to estimate whether there are incentives or disincentives to invest in capital, or enter and leave the fishery. It is also a better measure of the net benefit of the fishery to the nation.

Calculations of net revenue are included in this draft report. The cost categories used in net revenue, based on those reported in the EDC forms, are discussed below. Currently, calculations of economic profit are beyond the scope of the report. Economic profit relies on opportunity costs, which may be different from some of the costs reported on the EDC forms, so additional methods and analyses are required. The EDC Program economists will continue to work on developing measures of economic profit so that it may be included in future reports.

7.1 Net Revenue

Net revenue is calculated two ways: using only variable costs, and using variable costs plus fixed costs (total costs)[5]. The first calculation is called *variable cost net revenue*, while the second is called *total cost net revenue*. Variable cost net revenue is useful to examine changes in fishery operations that are not so great as to affect fixed costs. For example, the cost processing an additional metric ton of fish is better represented by only considering variable costs. Total cost net revenue is usually a better summary measure of financial gain or loss for an entire year, season, or fishery.

There are several caveats associated with the net revenue calculations in this report. As noted in the Section 4, there are a variety of costs that are associated with running a facility that are not requested by the EDC form because it is difficult to determine the share of the cost associated with the facility. These costs include items that can be used for activities other than processing fish, or are too difficult to allocate to a particular facility in a multi-facility company. These expenses include office space, vehicles and transport trucks, storage of equipment, and professional fees. In general, the EDC forms attempt to only capture costs that are directly related to facility maintenance and processing operations, and not costs that are related to activities or equipment outside of the facility. Therefore, the EDC calculated net revenue is an underestimate of the true net revenue. The difference is likely much greater for total cost net revenue than variable cost net revenue since most of the excluded costs are fixed costs.

[4] See Boardman, Anthony, David Greenberg, and Aidan Vining. Cost-Benefit Analysis: Concepts and Practice, Prentice Hall, NJ. 2000. pp. 31-32.

[5] See Section 4 for a more complete discussion of variable and fixed costs used in this report

Another caveat is that the EDC forms do not collect information about income taxes or financing costs. This has several implications. The first is that these costs are not included in the net revenue calculations. Therefore, net revenue is greater than it would be otherwise. The second is that in lieu of financing information (principal and interest payments), EDC total cost net revenue uses the total costs associated with facility and equipment purchases, repair, maintenance and improvements. For example, if a new engine is purchased, the total cost of the engine is used, even though the actual cash outlay, if it were financed, would only be the principal and interest payments made that year. It is likely that many larger capital costs, and perhaps some operating costs, are financed. This would mean that the actual cash outlays in a particular year for those items would be less than what is used in the EDC for the net revenue calculation. Over time, this may balance out to some degree because previously financed or purchased capital and equipment are also not included, except for the year in which they are purchased.[6] Moreover, total cost net revenue is expected to be representative of actual total cost net revenue only when averaged over many years and across facilities because relatively large capital costs occur periodically.

7.2 Net revenue for West Coast activities

Average net revenue is calculated for all companies that processed fish in 2009 and 2010 and all companies that submitted EDC forms for 2011 onward.

West Coast revenue includes the total value of production and revenue from custom processing and offloading.

The variable and fixed costs do not include costs related to acquiring limited entry permits, quota shares, or quota pounds.

$$\text{Variable cost net revenue} = \text{West Coast revenue} - \text{West Coast variable costs}$$

$$\text{Total cost net revenue} = \text{West Coast revenue} - (\text{West Coast variable costs} + \text{West Coast fixed costs})$$

[6] At best it is just a partial balancing out because the interest payments are not accounted in the EDC data

Table 7.1: Revenue, costs, and net revenue

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Revenue	$12,540,529	$11,465,886	$12,556,129	$7,310,501	$12,749,160	$5,753,340
(Variable costs)	$10,390,181	$7,625,324	$11,490,956	$8,404,064	$11,034,941	$4,161,968
Variable cost net revenue	**$2,150,348**	**$312,043**	**$1,065,173**	**$179,012**	**$1,714,219**	**$472,614**
(Fixed costs)	$1,577,664	$582,650	$1,586,610	$362,400	$735,550	$214,956
Total cost net revenue	**$572,684**	**-$57,462**	**-$521,438**	**-$91,139**	**$978,668**	**$65,897**

7.3 Total cost net revenue rates

The total cost net revenue calculated above in Section 7.2 are provided as rates in the following table to provide the total cost net revenue per pound of fish purchased and per pound of fish product produced. The total weights used in these calculations exclude custom processing activities (see Sections 4.2.6 and 6.2) Additionally, the same rates are calculated for variable cost net revenue and the components that are used to calculated the two.

Table 7.2: Revenue, costs, and total and variable cost net revenue by pounds produced and pounds of fish purchased.

Expense	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Revenue per production pounds	$1.297	$1.911	$1.455	$1.724	$1.61	$3.424
Revenue per purchase pounds	$0.953	$1.477	$0.943	$1.211	$0.903	$2.657
Variable cost per production pounds	$1.075	$1.271	$1.332	$1.982	$1.394	$2.477
Variable cost per purchase pounds	$0.789	$0.982	$0.863	$1.392	$0.782	$1.922
Variable cost net revenue per production pounds	$0.222	$0.052	$0.123	$0.042	$0.216	$0.281
Variable cost net revenue per purchase pounds	$0.163	$0.04	$0.08	$0.03	$0.121	$0.218
Fixed cost per production pounds	$0.163	$0.097	$0.184	$0.085	$0.093	$0.128
Fixed cost per purchase pounds	$0.12	$0.075	$0.119	$0.06	$0.052	$0.099
Total cost net revenue per production pounds	$0.059	$-0.01	$-0.06	$-0.021	$0.124	$0.039
Total cost net revenue per purchase pounds	$0.043	$-0.007	$-0.039	$-0.015	$0.069	$0.03

8 Cost Per Pound of Fish Purchases

The average cost per pound of fish purchases by species (or species group) was calculated in two ways. First, a sector-wide average fish cost per pound by source is calculated (Section 8.1). This represents the cost per pound by species for all fish that are delivered shoreside. The second is the mean (and median) of the cost per pound of fish across companies (Section 8.2). These means (and medians) represent the cost of fish per pound for an average company on the West Coast, whereas the industry-wide cost per pound of fish represents the average cost per pound of fish coast-wide.

8.1 Sector-wide fish cost per pound by source

The industry-wide cost C per pound of fish inputs $WT^{fishinputs}$ by species (or species group) e and source of fish s is

$$\frac{\sum_{n=1}^{N} C_{n,e,s}}{\sum_{n=1}^{N} WT_{n,e,s}^{fishinputs}} \quad \forall e, s$$

where N is the total number of companies that submitted EDC data. The industry-wide cost per pound of fish by species or species group and source of fish is calculated for each survey year.

As described in Section 4.2.6, in the following tables, LE Trawl represents fish acquired directly from a vessel registered to a Limited Entry (LE) permit with a trawl endorsement and caught with either trawl or fixed gear. LE Fixed Gear Vessels sources are those vessels without a limited entry trawl with a fixed gear endorsement. This does not include fish caught with a fixed gear on a LE permit with a trawl endorsement. Other vessels are those without either a LE Trawl or fixed gear endorsement, including open access fisheries. Non-vessel sources include fish acquired from other entities, including other first receivers, processors, wholesale dealers, brokers, aquaculture producers, and transfers from outside the facility.

Table 8.1: Sector-wide cost per pound: whiting, dover, thornyheads, sablefish.

Species:Product	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
Dover sole: Fixed Gear	0.4	—	—
Dover sole: LE Fixed Gear	—	—	0.42
Dover sole: LE Trawl	0.35	0.32	0.43
Dover sole: Non-vessel	—	—	0.52
Dover sole: Other	—	0.38	—
Pacific whiting: LE Trawl	0.08	0.08	0.11
Pacific whiting: Non-vessel	—	—	0.09
Pacific whiting: Other	—	0.08	—
Sablefish: Fixed Gear	3.04	3.18	—
Sablefish: LE Fixed Gear	—	—	3.91
Sablefish: LE Trawl	2.1	2.21	2.98
Sablefish: Non-vessel	—	—	2.56
Sablefish: Other	2.4	2.11	—
Sablefish: Other Vessel	—	—	5.32
Thornyheads: Fixed Gear	0.78	—	—
Thornyheads: LE Fixed Gear	—	—	1.04
Thornyheads: LE Trawl	0.52	0.54	0.62
Thornyheads: Non-vessel	—	—	0.49
Thornyheads: Other Vessel	—	—	0.62

Table 8.2: Sector-wide cost per pound: other groundfish.

Species:Product	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
Arrowtooth flounder: LE Trawl	—	—	0.3
Arrowtooth flounder: Other Vessel	—	—	0.1
Lingcod: Fixed Gear	0.82	0.82	—
Lingcod: LE Fixed Gear	—	—	0.89
Lingcod: LE Trawl	0.67	0.68	0.78
Lingcod: Non-vessel	—	—	0.99
Lingcod: Other	1.27	1.17	—
Lingcod: Other Vessel	—	—	0.98
Rockfish: Fixed Gear	0.64	0.81	—
Rockfish: LE Fixed Gear	—	—	0.98
Rockfish: LE Trawl	0.7	0.53	0.54
Rockfish: Non-vessel	—	—	0.87
Rockfish: Other	—	0.73	—
Rockfish: Other Vessel	—	—	0.93
Sanddab: LE Trawl	—	—	0.58
Sanddab: Non-vessel	—	—	0.89
Sharks, skates and rays: Fixed Gear	0.22	0.27	—
Sharks, skates and rays: LE Fixed Gear	—	—	1.47
Sharks, skates and rays: LE Trawl	0.19	0.26	0.31
Sharks, skates and rays: Other	—	0.57	—
Sharks, skates and rays: Other Vessel	—	—	0.48

Table 8.3: Sector-wide cost per pound: other groundfish (cont.).

Species:Product	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
English sole: LE Trawl	0.31	0.32	0.47
Petrale sole: LE Trawl	0.79	1.15	1.44
Petrale sole: Non-vessel	—	—	1.77
Petrale sole: Other	1.27	1.69	—
Petrale sole: Other Vessel	—	—	1.42
Rex sole: LE Trawl	0.34	0.33	0.37
Rex sole: Non-vessel	—	—	1.05
Rex sole: Other	—	0.83	—
Rex sole: Other Vessel	—	—	0.36

Table 8.4: Sector-wide cost per pound: non-groundfish.

Species:Product	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
Coastal pelagics: All	0.11	0.11	—
Coastal pelagics: Non-vessel	—	—	1.47
Coastal pelagics: Vessel	—	—	0.12
Crab: All	2.03	2	—
Crab: Non-vessel	—	—	2.53
Crab: Vessel	—	—	2.41
Salmon: All	1.28	2.44	—
Salmon: Non-vessel	—	—	2.59
Salmon: Vessel	—	—	1.47
Shrimp: All	0.38	0.37	—
Shrimp: Non-vessel	—	—	0.82
Shrimp: Vessel	—	—	0.49
Tuna: All	1.05	1.23	—
Tuna: Vessel	—	—	1.98

Table 8.5: Sector-wide cost per pound: non-groundfish (cont.).

Species:Product	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
California halibut: All	4.82	4.62	—
California halibut: Non-vessel	—	—	5.81
California halibut: Vessel	—	—	4.65
Other species: All	0.21	0.26	—
Pacific halibut: All	4.67	6.96	—
Pacific halibut: Non-vessel	—	—	9.44
Pacific halibut: Vessel	—	—	6.25
Shellfish: All	2.83	2.97	—
Shellfish: Non-vessel	—	—	2.59
Squid: All	0.96	0.75	—
Squid: Non-vessel	—	—	1.45
Sturgeon: Non-vessel	—	—	2.89
Sturgeon: Vessel	—	—	2.59

8.2 Mean and median fish purchase cost per pound by source

The mean cost C per pound of fish inputs $WT^{fishinputs}$ by species e and source of fish s

$$\frac{\sum_{n=1}^{N} \frac{C_{n,e,s}}{WT_{n,e,s}^{fishinputs}}}{N} \quad \forall e, s$$

where N is the total number of companies that submitted EDC data. The median is the median of the cost per pound of fish by company, species or species group and source of fish $\frac{C_{n,e,s}}{WT_{n,e,s}^{fishinputs}} \ \forall e, s$. The mean and median cost per pound of fish by species and source of fish is calculated for each survey year.

Table 8.6: Mean and median fish cost per pound: whiting, dover, thornyheads, sablefish.

Species: Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Dover sole: Fixed Gear	$0.38	$0.39	—	—	—	—
Dover sole: LE Fixed Gear	—	—	—	—	***	***
Dover sole: LE Trawl	$0.50	$0.35	$0.30	$0.31	$0.42	$0.43
Dover sole: Non-vessel	—	—	—	—	$1.75	$0.48
Dover sole: Other	—	—	$1.12	$0.48	—	—
Pacific whiting: LE Trawl	$0.07	$0.07	$0.08	$0.08	$0.11	$0.11
Pacific whiting: Non-vessel	—	—	—	—	$0.14	$0.15
Pacific whiting: Other	—	—	$0.13	$0.11	—	—
Sablefish: Fixed Gear	$3.10	$2.77	$3.27	$3.05	—	—
Sablefish: LE Fixed Gear	—	—	—	—	$3.82	$4.00
Sablefish: LE Trawl	$1.82	$1.77	$1.95	$1.91	$2.25	$2.18
Sablefish: Non-vessel	—	—	—	—	$3.68	$3.91
Sablefish: Other	$6.16	$2.84	$3.12	$2.58	—	—
Sablefish: Other Vessel	—	—	—	—	$4.79	$4.95
Thornyheads: Fixed Gear	$0.77	$0.75	—	—	—	—
Thornyheads: LE Fixed Gear	—	—	—	—	$1.31	$1.01
Thornyheads: LE Trawl	$0.69	$0.52	$0.54	$0.53	$0.86	$0.58
Thornyheads: Non-vessel	—	—	—	—	$0.49	$0.54
Thornyheads: Other Vessel	—	—	—	—	$0.74	$0.81

Table 8.7: Mean and median fish cost per pound: other groundfish.

Species: Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Arrowtooth flounder: LE Trawl	—	—	—	—	$0.17	$0.10
Arrowtooth flounder: Other Vessel	—	—	—	—	$0.11	$0.10
Lingcod: Fixed Gear	$0.70	$0.60	$0.78	$0.70	—	—
Lingcod: LE Fixed Gear	—	—	—	—	$1.07	$0.83
Lingcod: LE Trawl	$0.73	$0.62	$0.81	$0.71	$0.82	$0.75
Lingcod: Non-vessel	—	—	—	—	$1.99	$1.70
Lingcod: Other	$3.19	$2.90	$2.07	$0.92	—	—
Lingcod: Other Vessel	—	—	—	—	$1.16	$1.02
Rockfish: Fixed Gear	$0.63	$0.58	$0.83	$0.77	—	—
Rockfish: LE Fixed Gear	—	—	—	—	$0.98	$1.05
Rockfish: LE Trawl	$0.57	$0.50	$0.56	$0.50	$0.64	$0.55
Rockfish: Non-vessel	—	—	—	—	$1.19	$1.04
Rockfish: Other	—	—	$1.36	$0.81	—	—
Rockfish: Other Vessel	—	—	—	—	$0.84	$0.75
Sanddab: LE Trawl	—	—	—	—	$0.61	$0.60
Sanddab: Non-vessel	—	—	—	—	$2.05	$1.39
Sharks, skates and rays: Fixed Gear	$0.16	$0.15	$0.23	$0.24	—	—
Sharks, skates and rays: LE Fixed Gear	—	—	—	—	$0.91	$0.41
Sharks, skates and rays: LE Trawl	$0.22	$0.18	$0.27	$0.20	$0.33	$0.30
Sharks, skates and rays: Other	—	—	$1.32	$0.72	—	—
Sharks, skates and rays: Other Vessel	—	—	—	—	$0.89	$0.82

Table 8.8: Mean and median fish cost per pound: other groundfish (cont.).

Species: Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
English sole: LE Trawl	$0.66	$0.33	$0.37	$0.33	$0.46	$0.40
Petrale sole: LE Trawl	$1.05	$1.05	$1.11	$1.15	$1.44	$1.42
Petrale sole: Non-vessel	—	—	—	—	$3.01	$2.35
Petrale sole: Other	$2.90	$1.76	$2.86	$1.70	—	—
Petrale sole: Other Vessel	—	—	—	—	$1.40	$1.36
Rex sole: LE Trawl	$0.38	$0.37	$0.37	$0.36	$0.43	$0.37
Rex sole: Non-vessel	—	—	—	—	$1.36	$1.38
Rex sole: Other	—	—	$2.07	$0.38	—	—
Rex sole: Other Vessel	—	—	—	—	$0.58	$0.37

Table 8.9: Mean and median fish cost per pound: non-groundfish.

Species: Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Coastal pelagics: All	$0.68	$0.12	$0.83	$0.12	—	—
Coastal pelagics: Non-vessel	—	—	—	—	$1.21	$0.53
Coastal pelagics: Vessel	—	—	—	—	$0.43	$0.13
Crab: All	$2.57	$1.88	$2.31	$1.84	—	—
Crab: Non-vessel	—	—	—	—	$4.07	$3.41
Crab: Vessel	—	—	—	—	$2.50	$2.42
Salmon: All	$3.05	$2.62	$3.94	$4.18	—	—
Salmon: Non-vessel	—	—	—	—	$3.63	$3.55
Salmon: Vessel	—	—	—	—	$4.61	$5.06
Shrimp: All	$1.45	$0.32	$1.83	$0.37	—	—
Shrimp: Non-vessel	—	—	—	—	$3.66	$3.62
Shrimp: Vessel	—	—	—	—	$1.64	$0.51
Tuna: All	$1.41	$1.00	$1.53	$1.04	—	—
Tuna: Vessel	—	—	—	—	$1.93	$1.90

Table 8.10: Mean and median fish cost per pound: non-groundfish (cont.).

Species: Source	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
California halibut: All	$4.95	$4.50	$4.13	$3.95	—	—
California halibut: Non-vessel	—	—	—	—	$4.85	$4.66
California halibut: Vessel	—	—	—	—	$4.83	$4.84
Other species: All	$0.57	$0.18	$0.50	$0.34	—	—
Pacific halibut: All	$4.00	$3.22	$5.14	$4.33	—	—
Pacific halibut: Non-vessel	—	—	—	—	$7.84	$6.53
Pacific halibut: Vessel	—	—	—	—	$6.13	$6.22
Shellfish: All	$2.56	$2.23	$2.99	$2.72	—	—
Shellfish: Non-vessel	—	—	—	—	$2.88	$2.60
Squid: All	$0.67	$0.29	$0.58	$0.27	—	—
Squid: Non-vessel	—	—	—	—	$1.43	$0.84
Sturgeon: Non-vessel	—	—	—	—	$4.29	$3.56
Sturgeon: Vessel	—	—	—	—	$2.52	$2.49

9 Revenue Per Pound from Fish Products Produced

Similarly to calculations of average cost per pound of fish, the average revenue per pound of fish production by species was calculated in two ways. First, a sector-wide average fish revenue per pound by product type is calculated (Section 9.1). This represents the revenue per pound by species for all fish that are delivered shoreside. The second is the mean (and median of the revenue) per pound of fish across companies (Section 9.2). These means (and medians) represent the revenue of fish per pound for an average company on the West Coast, whereas the industry-wide revenue per pound of fish represents the average revenue per pound of fish coast-wide.

9.1 Sector-wide revenue per pound by product

The industry-wide revenue R per pound of fish outputs $WT^{fishoutputs}$ by species e and production type o

$$\frac{\sum_{n=1}^{N} R_{n,e,o}}{\sum_{n=1}^{N} WT_{n,e,o}^{fishoutputs}} \quad \forall e, o$$

where N is the total number of companies that submitted EDC data. The industry-wide revenue per pound of fish by species or species group and source of fish is calculated for each survey year.

Table 9.1: Sector-wide revenue per pound: whiting, dover, thornyheads, sablefish.

Species: Source	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
Dover sole: Fresh	2.24	2.49	3.33
Dover sole: Frozen	2.15	1.57	2.66
Dover sole: Unprocessed	—	0.46	0.29
Pacific whiting: Fillet	1.09	1.17	0.65
Pacific whiting: Frozen	—	0.33	0.29
Pacific whiting: Headed-and-gutted	0.56	0.57	0.6
Pacific whiting: Unprocessed	0.1	0.11	0.15
Sablefish: Fresh	4.07	5.19	3.19
Sablefish: Frozen	4.91	5.38	7.16
Sablefish: Unprocessed	2.78	2.87	3.54
Thornyheads: Fresh	1.2	1.16	—
Thornyheads: Frozen	2.35	2.22	3.41
Thornyheads: Other	—	—	2.16
Thornyheads: Unprocessed	1.23	0.68	1.06

Table 9.2: Sector-wide revenue per pound: other groundfish.

Species: Source	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
Arrowtooth flounder: Fresh	—	—	1.12
Lingcod: Fresh	3.76	4.19	3.98
Lingcod: Frozen	5.95	2.03	3.43
Lingcod: Unprocessed	1.22	1.63	2.58
Rockfish: Fresh	2.7	2.66	2.81
Rockfish: Frozen	1.99	1.86	1.83
Rockfish: Other	—	—	1.85
Rockfish: Unprocessed	1.16	1.05	1.20
Sanddab: Fresh	—	—	4.61
Sanddab: Frozen	—	—	3.18
Sanddab: Unprocessed	—	—	1.00
Sharks, skates and rays: Fresh	1.14	1.65	2.41
Sharks, skates and rays: Frozen	1.35	1.86	2.07
Sharks, skates and rays: Unprocessed	—	0.55	0.73

Table 9.3: Sector-wide revenue per pound: other groundfish (cont.).

Species: Source	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
English sole: Fresh	2.13	2.24	3.19
English sole: Frozen	1.21	1.08	2.44
English sole: Unprocessed	0.67	0.5	0.46
Petrale sole: Fresh	3.45	3.97	5.5
Petrale sole: Frozen	3.07	3	4.19
Petrale sole: Unprocessed	1.55	1.87	2.15
Rex sole: Fresh	1.63	2	2.15
Rex sole: Frozen	1.5	1.27	1.63
Rex sole: Unprocessed	0.7	0.53	0.5

Table 9.4: Sector-wide revenue per pound: non-groundfish.

Species:Source	2009 N=23	2010 N=25	2011 N=32
	$ per lb..	$ per lb..	$ per lb..
Coastal pelagics: Fresh	0.33	—	—
Coastal pelagics: Frozen	0.41	0.37	0.33
Coastal pelagics: Other	0.24	0.23	—
Coastal pelagics: Unprocessed	—	—	2.57
Crab: Canned	14.9	15.91	—
Crab: Fresh	5.43	4.38	5.67
Crab: Frozen	5.19	4.32	5.73
Crab: Other	—	10.03	—
Crab: Unprocessed	2.23	2.24	2.6
Salmon: Fresh	3.5	4.48	4.28
Salmon: Frozen	—	2.87	2.14
Salmon: Other	2.88	—	—
Salmon: Smoked	10.17	8.7	—
Salmon: Unprocessed	3.48	4.05	2.28
Shrimp: Fresh	1.6	1.58	3.09
Shrimp: Frozen	2.78	2.01	2.99
Shrimp: Unprocessed	—	—	0.9
Tuna: Canned	—	—	4.4
Tuna: Fresh	3.34	3.98	4.48
Tuna: Frozen	1.39	1.68	2.63
Tuna: Unprocessed	—	1.58	2.09

Table 9.5: Sector-wide revenue per pound: non-groundfish (cont.).

Species: Source	2009 N=23	2010 N=25	2011 N=32
	$ per lb.	$ per lb.	$ per lb.
California halibut: Fresh	—	8.57	10.31
California halibut: Unprocessed	5.18	—	5.85
Other species: Other	0.48	0.34	—
Pacific halibut: Fresh	5.62	9.52	9.57
Pacific halibut: Frozen	6.63	8.83	9.96
Pacific halibut: Unprocessed	4.86	—	7.64
Shellfish: Unprocessed	3.43	3.53	3.18
Squid: Fresh	1.04	—	—
Squid: Frozen	1.68	1.05	1.8
Squid: Unprocessed	—	—	1.1
Sturgeon: Fresh	4.65	4.93	5.71
Sturgeon: Frozen	13.34	4.25	—

9.2 Mean and median production revenue per pound by product type

The mean revenue R per pound of fish production by species e and product type o is

$$\frac{\sum_{n=1}^{N} \frac{R_{n,e,o}}{WT_{n,e,o}^{fishoutputs}}}{N} \quad \forall e, o$$

where N is the total number of companies that submitted EDC data, $WT^{fishoutputs}$ is the weight of fish outputs, and $WT^{fishinputs}$ is the weight of fish inputs. The median is the median of revenue per pound of fish by species and product type $\frac{R_{n,e,o}}{WT_{n,e,o}^{fishoutputs}}$ $\forall e, o$. The mean and median revenue per pound of fish by species and source of fish is calculated for each survey year.

Table 9.6: Mean and median revenue per pound: whiting, dover, thornyheads, sablefish.

Species: Product	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Dover sole: Fresh	\$2.38	\$2.69	\$2.45	\$2.71	\$3.29	\$3.39
Dover sole: Frozen	\$2.98	\$2.21	\$3.61	\$2.06	\$2.58	\$2.80
Dover sole: Unprocessed	—	—	\$0.72	\$0.53	\$0.95	\$0.64
Pacific whiting: Fillet	\$1.18	\$1.27	\$0.99	\$1.00	\$0.70	\$0.52
Pacific whiting: Frozen	—	—	\$0.26	\$0.26	\$0.31	\$0.30
Pacific whiting: Headed-and-gutted	\$0.61	\$0.56	\$0.58	\$0.66	\$0.63	\$0.62
Pacific whiting: Unprocessed	***	***	\$0.10	\$0.10	***	***
Sablefish: Fresh	\$4.83	\$4.84	\$5.30	\$5.45	\$5.10	\$4.09
Sablefish: Frozen	\$4.88	\$5.01	\$5.05	\$5.17	\$6.80	\$6.75
Sablefish: Unprocessed	\$2.38	\$2.65	\$2.49	\$2.89	\$4.74	\$3.64
Thornyheads: Fresh	\$1.45	\$1.76	\$1.08	\$1.07	—	—
Thornyheads: Frozen	\$4.52	\$2.63	\$2.25	\$2.49	\$2.94	\$3.43
Thornyheads: Other	—	—	—	—	***	***
Thornyheads: Unprocessed	\$1.64	\$1.68	\$0.96	\$0.79	\$1.69	\$1.14

Table 9.7: Mean and median revenue per pound: other groundfish.

Species: Product	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Arrowtooth flounder: Fresh	—	—	—	—	$0.91	$1.10
Lingcod: Fresh	$3.39	$3.30	$2.84	$2.70	$3.96	$4.21
Lingcod: Frozen	$7.31	$3.09	$2.37	$2.30	$4.84	$5.36
Lingcod: Unprocessed	$8.17	$1.55	$2.06	$1.62	$2.29	$1.47
Rockfish: Fresh	$2.56	$2.27	$2.29	$2.56	$2.81	$3.12
Rockfish: Frozen	$2.53	$2.50	$2.34	$2.11	$2.80	$2.51
Rockfish: Other	—	—	—	—	$2.83	$2.41
Rockfish: Unprocessed	$1.12	$1.14	$1.09	$1.02	$1.32	$1.02
Sanddab: Fresh	—	—	—	—	$3.26	$3.46
Sanddab: Frozen	—	—	—	—	$4.82	$5.08
Sanddab: Unprocessed	—	—	—	—	$1.05	$1.13
Sharks, skates and rays: Fresh	$1.76	$1.34	$1.48	$1.42	$2.23	$1.29
Sharks, skates and rays: Frozen	$1.51	$1.46	$1.76	$1.78	$2.67	$2.59
Sharks, skates and rays: Unprocessed	—	—	$1.41	$0.58	$0.83	$0.60

Table 9.8: Mean and median revenue per pound: other groundfish (cont.).

Species: Product	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
English sole: Fresh	$2.63	$2.75	$2.72	$2.68	$3.20	$3.25
English sole: Frozen	$1.73	$1.90	$1.69	$1.64	$2.65	$2.80
English sole: Unprocessed	$0.67	$0.69	$0.92	$0.79	$1.10	$0.57
Petrale sole: Fresh	$4.22	$4.06	$4.59	$4.08	$5.91	$6.02
Petrale sole: Frozen	$2.67	$2.76	$3.02	$3.29	$3.96	$4.12
Petrale sole: Unprocessed	$1.81	$1.84	$2.32	$2.11	$2.68	$2.51
Rex sole: Fresh	$1.78	$1.75	$2.31	$1.73	$2.74	$2.00
Rex sole: Frozen	$1.54	$1.47	$1.39	$1.40	$1.90	$1.81
Rex sole: Unprocessed	$0.79	$0.69	$0.70	$0.70	$0.70	$0.79

Table 9.9: Mean and median revenue per pound: non-groundfish

Species: Product	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
Coastal pelagics: Fresh	$2.88	$0.25	—	—	—	—
Coastal pelagics: Frozen	$1.16	$0.39	$0.98	$0.35	$0.99	$0.49
Coastal pelagics: Other	$0.23	$0.25	$0.23	$0.24	—	—
Coastal pelagics: Unprocessed	—	—	—	—	$1.72	$1.05
Crab: Canned	***	***	***	***	—	—
Crab: Fresh	$7.65	$3.73	$3.63	$2.92	$5.53	$4.16
Crab: Frozen	$5.60	$4.72	$4.56	$4.24	$6.23	$5.85
Crab: Other	—	—	***	***	—	—
Crab: Unprocessed	$4.15	$2.59	$3.00	$3.00	$4.43	$3.00
Salmon: Fresh	$4.86	$4.12	$5.15	$6.19	$6.59	$6.12
Salmon: Frozen	—	—	$3.72	$3.64	$3.79	$3.62
Salmon: Other	***	***	—	—	—	—
Salmon: Smoked	***	***	***	***	—	—
Salmon: Unprocessed	$4.27	$4.79	$4.89	$5.28	$5.07	$5.39
Shrimp: Fresh	$2.96	$2.27	$3.11	$2.30	$3.09	$2.86
Shrimp: Frozen	$3.76	$2.85	$3.37	$2.28	$4.00	$2.97
Shrimp: Unprocessed	—	—	—	—	$6.38	$4.23
Tuna: Canned	—	—	—	—	***	***
Tuna: Fresh	$2.99	$1.36	$3.29	$1.83	$6.07	$5.53
Tuna: Frozen	$1.80	$1.35	$1.92	$1.73	$2.65	$2.38
Tuna: Unprocessed	—	—	$2.50	$1.73	$2.87	$2.19

Table 9.10: Mean and median revenue per pound: non-groundfish (cont.).

Species: Product	2009 N=23		2010 N=25		2011 N=32	
	Mean	Median	Mean	Median	Mean	Median
California halibut: Fresh	—	—	$8.32	$9.62	$9.24	$11.02
California halibut: Unprocessed	$5.60	$5.41	—	—	$5.59	$5.89
Other species: Other	$1.63	$1.06	$1.31	$0.94	—	—
Pacific halibut: Fresh	$5.47	$4.19	$6.60	$5.43	$9.79	$7.75
Pacific halibut: Frozen	$5.94	$5.45	$8.48	$8.10	$11.26	$11.28
Pacific halibut: Unprocessed	***	***	—	—	$8.14	$7.92
Shellfish: Unprocessed	$3.40	$4.21	$3.52	$4.46	$3.18	$3.00
Squid: Fresh	***	***	—	—	—	—
Squid: Frozen	$6.19	$0.74	$1.17	$0.68	$1.36	$0.92
Squid: Unprocessed	—	—	—	—	***	***
Sturgeon: Fresh	$4.54	$4.73	$3.93	$4.98	$6.78	$5.35
Sturgeon: Frozen	***	***	$4.15	$3.91	—	—

10 Product Recovery Rates

The industry-wide product recovery rate by species is

$$\frac{\sum_{o=1}^{O}\sum_{n=1}^{N} WT_{n,e,o}^{fishoutputs}}{\sum_{s=1}^{S}\sum_{n=1}^{N} WT_{n,e,s}^{fishinputs}} \quad \forall e$$

where N is the total number of companies that submitted EDC data, O is the number of product types, and S is number of species. The industry-wide product recovery rate by species or species group is calculated for each survey year. The weight of fish purchased include fish received from trawl vessel, fixed gear vessels, other vessel, and non-vessel sources. Fish purchased and produced may include pre-product types, listed on the EDC form as "unprocessed".

10.1 Product recovery rate fish purchase weight

10.1.1 Total production weight by species

Table 10.1: Total fish production weight by species

Species	2009 N=23	2010 N=25	2011 N=32
	Lbs.	Lbs.	Lbs.
Arrowtooth flounder	—	—	2,333,247
California halibut	22,878	89,012	196,182
Coastal pelagics	30,650,717	34,901,309	17,955,719
Crab	11,397,560	22,527,421	19,716,464
Dover sole	8,538,529	8,054,138	5,357,355
English sole	334,678	168,313	120,244
Lingcod	203,647	140,984	324,932
Other species	2,147,897	8,945,464	—
Pacific halibut	290,088	247,836	201,557
Pacific herring	—	—	2,708
Pacific whiting	75,882,408	49,111,709	105,192,205
Petrale sole	2,492,793	877,819	1,012,944
Rex sole	710,882	490,459	441,751
Rockfish	1,434,610	1,540,902	2,810,307
Sablefish	6,592,400	6,916,532	6,507,969
Salmon	4,448,602	5,036,853	8,846,451
Sanddab	—	—	267,947
Sharks, skates and rays	1,470,794	1,405,160	1,887,182
Shellfish	1,560,672	1,974,530	1,478,289
Shrimp	12,163,411	14,312,005	22,953,593
Squid	258,674	834,843	350,641
Sturgeon	—	—	139,629
Thornyheads	2,076,187	2,159,128	1,674,864
Tuna	7,398,717	8,654,280	4,648,212

10.1.2 Total fish purchase weight by species

As stated in the introduction to this report, respondents fill out the survey according to their fiscal year, so pounds listed for each species here may not have been purchased during the calendar year indicated by the column header, and these values may not align directly to state-fish ticket data.

Table 10.2: Total fish purchase weight by species

Species	2009 N=23	2010 N=25	2011 N=32
	Lbs.	Lbs.	Lbs.
Arrowtooth flounder	—	—	4,942,838
California halibut	22,878	91,140	224,096
Coastal pelagics	37,300,545	41,421,370	18,396,801
Crab	17,435,282	34,123,164	33,466,817
Dover sole	24,639,304	21,665,970	18,436,452
English sole	778,773	487,241	319,769
Lingcod	316,594	225,396	634,735
Other species	4,576,433	10,373,485	—
Pacific halibut	295,770	272,579	224,997
Pacific herring	—	—	3,620
Pacific whiting	124,963,966	124,902,128	237,932,071
Petrale sole	4,116,861	1,553,923	1,886,642
Rex sole	1,177,582	899,876	976,410
Rockfish	3,230,079	3,711,319	5,293,956
Sablefish	9,494,798	8,738,408	8,287,258
Salmon	4,778,802	6,334,256	11,087,381
Sanddab	—	—	383,817
Sharks, skates and rays	3,046,498	3,186,428	3,244,572
Shellfish	1,560,672	1,977,295	1,516,323
Shrimp	30,100,295	41,047,028	65,550,301
Squid	345,198	895,466	361,404
Sturgeon	—	—	228,749
Thornyheads	4,963,762	4,144,705	3,451,274
Tuna	7,459,333	10,475,118	5,655,452

10.2 Mean product recovery rates

Table 10.3: Average product recovery rate

Species	2009 N=23	2010 N=25	2011 N=32
	Average	Average	Average
Arrowtooth flounder	—	—	0.47
California halibut	1	0.98	0.88
Coastal pelagics	0.82	0.84	0.98
Crab	0.65	0.66	0.59
Dover sole	0.35	0.37	0.29
English sole	0.43	0.35	0.38
Lingcod	0.64	0.63	0.51
Other species	0.47	0.86	—
Pacific halibut	0.98	0.91	0.9
Pacific herring	—	—	0.75
Pacific whiting	0.61	0.39	0.44
Petrale sole	0.61	0.56	0.54
Rex sole	0.6	0.55	0.45
Rockfish	0.44	0.42	0.53
Sablefish	0.69	0.79	0.79
Salmon	0.93	0.8	0.8
Sanddab	—	—	0.7
Sharks, skates and rays	0.48	0.44	0.58
Shellfish	1	1	0.97
Shrimp	0.4	0.35	0.35
Squid	0.75	0.93	0.97
Sturgeon	—	—	0.61
Thornyheads	0.42	0.52	0.49
Tuna	0.99	0.83	0.82

11 Markup

The industry-wide markup by species e is

$$\frac{\sum_{o=1}^{O}\sum_{n=1}^{N} R_{n,e,o}}{\sum_{s=1}^{S}\sum_{n=1}^{N} C_{n,e,s}} \quad \forall e$$

where N is the total number of companies that submitted EDC data, O is the number of product types, and S is number of species. The markup by species is calculated for each survey year. The costs of fish include fish received from all sources. The fish purchases can include pre-processed product types. The production value includes production of unprocessed and processed products.

11.1 Revenue and costs used to calculate markup

11.1.1 Total fish production revenue by species

Table 11.1: Total fish production revenue by species

Species	2009 N=23	2010 N=25	2011 N=32
	Value	Value	Value
Arrowtooth flounder	—	—	$1,702,537
California halibut	$ 721,555	$1,262,874	$1,361,297
Coastal pelagics	$ 12,896,703	$11,460,349	$13,014,790
Crab	$ 77,290,802	$106,290,143	$105,462,206
Dover sole	$ 17,628,416	$16,360,918	$13,962,474
English sole	$ 575,722	$ 292,630	$ 276,279
Lingcod	$ 556,653	$ 452,994	$1,152,158
Other species	$ 5,729,806	$6,364,470	—
Pacific halibut	$ 3,598,579	$2,043,805	$2,458,546
Pacific herring	—	—	$ 9,358
Pacific whiting	$ 46,650,415	$33,100,501	$52,502,246
Petrale sole	$ 7,184,323	$2,826,415	$3,813,896
Rex sole	$ 1,058,609	$ 870,349	$ 771,987
Rockfish	$ 4,438,404	$3,628,211	$5,454,252
Sablefish	$ 33,844,434	$38,701,224	$38,051,629
Salmon	$ 12,952,484	$20,823,765	$28,336,749
Sanddab	—	—	$ 462,266
Sharks, skates and rays	$ 1,804,286	$2,004,933	$2,818,476
Shellfish	$ 8,624,118	$7,732,009	$10,313,451
Shrimp	$ 28,982,683	$29,515,017	$60,605,752
Squid	$ 499,788	$ 826,135	$ 631,170
Sturgeon	—	—	$1,013,383
Thornyheads	$ 4,553,406	$5,100,673	$4,443,300
Tuna	$ 14,690,905	$14,898,677	$20,483,210

11.1.2 Total fish purchase cost by species

Table 11.2: Total fish purchases cost by species

Species	2009 N=23	2010 N=25	2011 N=32
	Value	Value	Value
Arrowtooth flounder	—	—	$1,335,764
California halibut	$ 568,491	$ 687,627	$1,133,396
Coastal pelagics	$5,376,267	$5,297,512	$5,063,952
Crab	$38,564,966	$71,597,376	$72,982,216
Dover sole	$8,450,521	$6,883,313	$7,001,794
English sole	$ 266,653	$ 155,693	$ 127,167
Lingcod	$ 267,251	$ 202,636	$ 526,181
Other species	$2,075,233	$3,983,727	—
Pacific halibut	$2,417,068	$1,894,548	$2,197,380
Pacific herring	—	—	$ 9,648
Pacific whiting	$12,665,435	$9,117,094	$24,842,071
Petrale sole	$3,522,586	$1,907,507	$2,643,976
Rex sole	$ 418,631	$ 358,073	$ 349,502
Rockfish	$2,816,399	$2,423,667	$3,530,627
Sablefish	$24,805,547	$24,098,071	$29,427,854
Salmon	$6,169,125	$16,229,078	$20,641,730
Sanddab	—	—	$ 204,042
Sharks, skates and rays	$ 673,585	$ 859,245	$ 982,151
Shellfish	$6,619,728	$5,870,718	$7,112,699
Shrimp	$11,341,178	$15,481,708	$31,199,998
Squid	$ 396,667	$ 644,995	$ 484,441
Sturgeon	—	—	$ 743,941
Thornyheads	$2,466,913	$2,341,662	$1,817,799
Tuna	$8,954,246	$12,849,193	$15,316,941

11.2 Average industry markup

Table 11.3: Average industry markup table

Species	2009 N=23	2010 N=25	2011 N=32
	Average	Average	Average
Arrowtooth flounder	—	—	1.27
California halibut	1.27	1.84	1.2
Coastal pelagics	2.4	2.16	2.57
Crab	2	1.48	1.45
Dover sole	2.09	2.38	1.99
English sole	2.16	1.88	2.17
Lingcod	2.08	2.24	2.19
Other species	2.76	1.6	—
Pacific halibut	1.49	1.08	1.12
Pacific herring	—	—	0.97
Pacific whiting	3.68	3.63	2.11
Petrale sole	2.04	1.48	1.44
Rex sole	2.53	2.43	2.21
Rockfish	1.58	1.5	1.54
Sablefish	1.36	1.61	1.29
Salmon	2.1	1.28	1.37
Sanddab	—	—	2.27
Sharks, skates and rays	2.68	2.33	2.87
Shellfish	1.3	1.32	1.45
Shrimp	2.56	1.91	1.94
Squid	1.26	1.28	1.3
Sturgeon	—	—	1.36
Thornyheads	1.85	2.18	2.44
Tuna	1.64	1.16	1.34

Appendix A IO-PAC Model Tables

This appendix reports the EDC data for first receivers and shorebased processors that are used in the IO-PAC model[1] was calculated by dividing the total value of production (Table A.1). The average markup (Table A.3) for the IO-PAC model by the total cost of all fish put into production (Table A.2). The costs of fish include fish received from trawl vessel, fixed gear vessels, other vessel, and non-vessel sources. The fish purchased can include pre-processed product types. The production value includes production of unprocessed and processed products.

A.1 Total production revenue

[1]Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

Table A.1: Total value fish production by IO-PAC species

Species	2009 N=23	2010 N=25	2011 N=32
CPS	$ 12,896,703	$ 11,460,349	$ 13,014,790
Crab	$ 77,290,802	$106,290,143	$105,462,206
Dover and Thornyheads	$ 22,181,823	$ 21,461,591	$ 18,408,753
Halibut	$ 4,320,134	$ 3,306,679	$ 3,819,843
HMS	$ 14,690,905	$ 14,898,677	$ 20,483,210
Other groundfish	$ 13,813,711	$ 8,070,598	$ 13,633,376
Sablefish	$ 33,844,434	$ 38,701,224	$ 38,051,629
Salmon	$ 12,952,484	$ 20,823,765	$ 28,336,749
Shrimp	$ 28,982,683	$ 29,515,017	$ 60,605,752
Whiting	$ 46,650,415	$ 33,100,501	$ 52,502,246

A.2 Total fish purchase cost by IO-PAC species

Table A.2: Total cost of fish purchases by IO-PAC species

Species	2009 N=23	2010 N=25	2011 N=32
	$	$	$
CPS	$ 5,376,267	$ 5,297,512	$ 5,063,952
Crab	$38,564,966	$71,597,376	$72,982,216
Dover and Thornyheads	$10,917,434	$ 9,224,975	$ 8,819,593
Halibut	$ 2,985,559	$ 2,582,175	$ 3,330,776
HMS	$ 8,954,246	$12,849,193	$15,316,941
Other groundfish	$ 7,291,845	$ 5,050,459	$ 8,717,496
Sablefish	$24,805,547	$24,098,071	$29,427,854
Salmon	$ 6,169,125	$16,229,078	$20,641,730
Shrimp	$11,341,178	$15,481,708	$31,199,998
Whiting	$12,665,435	$ 9,117,094	$24,842,071

A.3 Markup

Table A.3: Average industry markup by IO-PAC species.

Species	2009 N=23	2010 N=25	2011 N=32
	Average	Average	Average
CPS	2.4	2.16	2.57
Crab	2	1.48	1.45
Dover and Thornyheads	2.03	2.33	2.09
Halibut	1.45	1.28	1.15
HMS	1.64	1.16	1.34
Other groundfish	1.89	1.6	1.56
Sablefish	1.36	1.61	1.29
Salmon	2.1	1.28	1.37
Shrimp	2.56	1.91	1.94
Whiting	3.68	3.63	2.11

A.4 Other IO-PAC inputs

The IO-PAC model uses input from the following summary tables, which show the total value and number of respondents for each category.

Table A.4: Total Production Employee Hours.

Production Employee Hours	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
January	39,777.9	20	37,202.0	23	53,784.7	23
February	20,656.1	20	35,202.8	23	44,060.1	23
March	27,517.3	20	31,669.4	23	33,790.5	23
April	28,784.0	19	40,923.3	22	40,845.5	24
May	47,476.4	19	67,121.1	22	55,372.6	25
June	68,213.1	19	69,531.0	23	90,150.7	25
July	126,217.1	20	90,689.0	23	150,607.2	26
August	68,666.9	20	99,673.2	23	162,414.8	26
September	55,218.8	20	69,529.4	22	124,510.3	26
October	82,422.9	20	50,173.8	22	74,815.0	25
November	51,296.2	19	46,631.3	22	52,722.7	25
December	106,558.7	20	125,508.7	23	106,688.2	24

Table A.5: Total Number of Production Employees.

Number of Production Employees	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
January	1,495.0	20	1,765.0	23	1,848.0	23
February	1,212.0	20	1,471.0	23	1,599.0	23
March	1,233.0	20	1,340.0	23	1,143.0	23
April	1,243.0	19	1,411.0	22	1,225.0	24
May	1,462.0	19	1,977.0	22	1,315.0	25
June	2,195.0	19	2,138.0	23	2,054.0	25
July	2,730.0	20	2,436.0	23	3,099.0	26
August	2,059.0	20	2,750.0	23	2,967.0	26
September	2,011.0	20	2,059.0	22	2,686.0	26
October	1,905.0	20	1,840.0	22	1,955.0	25
November	1,552.0	19	1,711.0	22	1,545.0	25
December	2,881.0	20	2,560.0	23	2,426.0	24

Table A.6: Total Number and Hours of Non-Production Employees.

Non-Production Employees	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Hours Worked	12,286.4	21	17,246.4	22	11,117.6	28
Number of employees	200.0	21	268.0	22	212.0	28

Table A.7: Total Employee Expenses.

Employment Expenses	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Non-production employees	$9,018,992	23	$10,395,436	25	$12,007,477	32
Production workers	$33,997,783	23	$32,378,076	25	$46,009,087	32

Table A.8: Total Expenditurse on Buildings and Equipment.

Capital Expenditures	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Capitalized expenditures on buildings	$6,162,592	14	$6,661,913	13	$3,335,907	10
Capitalized expenditures on new and used machinery and equipment	$21,984,534	21	$24,371,908	20	$10,275,056	20
Processing equipment	$490,838	15	$558,311	17	$624,959	19
Rental or lease of buildings, job-site trailers, and other structures	$2,586,591	22	$2,718,740	23	$3,100,685	24
Repair and maintenance on facility buildings, machinery, and equipment	$5,061,722	22	$5,354,384	23	$6,201,007	27

Table A.9: Total Utiltiy Expenses.

Sum of Utilities Expenses	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Electricity	$3,706,575	22	$4,010,386	23	$4,473,713	27
Natural gas	$1,137,666	12	$1,047,859	12	$343,109	10
Nitrogen gas	$0	0	$0	0	***	***
Propane gas	$455,315	16	$891,484	19	$813,781	21
Sewer, waste, and byproduct disposal	$754,150	20	$948,087	20	$1,215,908	24
Water	$1,535,981	22	$1,987,467	23	$2,405,888	24

Table A.10: Total Other Expenses.

Sum of Other Expenses	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Cleaning and custodial supplies	$0	0	$0	0	$389,167	32
Freight costs for supplies	$1,692,815	23	$1,735,573	25	$1,531,957	32
Insurance (property, product, and personal liability)	$3,009,296	23	$2,966,941	25	$1,935,125	32
Licensing fees	$0	0	$0	0	$291,822	32
Non-fish ingredients (additives)	$716,795	23	$676,366	25	$1,483,764	32
Off-site product freezing and storage	$3,203,129	23	$3,804,195	25	$6,058,569	32
Offloading	$0	0	$0	0	$746,377	32
Packing materials	$13,286,417	23	$12,164,947	25	$12,979,663	32
Production supplies	$2,267,970	23	$2,574,746	25	$1,300,046	32
Shoreside monitoring	$181,209	23	$456,947	25	$119,793	32
Taxes (property and excise)	$0	0	$0	0	$1,342,505	32

Table A.11: **Total Custom Processing.**

Custom Processing	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Cost of custom processing of non-whiting groundfish	1,297,339	3	420,546	3	***	***
Cost of custom processing of non-whiting groundfish, non-groundfish fish	1,359,705	3	1,305,629	4	928,741	4
Cost of custom processing of whiting	852,453	3	***	***	***	***
Revenue from custom processing of non-whiting groundfish	***	***	89,854	3	667,714	5
Revenue from custom processing of non-whiting, non-groundfish fish	379,196	6	483,527	7	1,063,806	5
Revenue from custom processing of whiting	***	***	***	***	***	***
Weight custom processing of whiting	3,870,863	3	***	***	***	***
Weight of custom processing of non-whiting groundfish	4,079,781	3	1,382,174	3	***	***
Weight of custom processing of non-whiting groundfish, non-groundfish fish	6,202,438	3	5,605,518	4	2,965,509	3

Table A.12: Total Other Revenue.

Other Revenue	2009 N=23		2010 N=25		2011 N=32	
	Total	N	Total	N	Total	N
Custom processing of non-whiting groundfish	***	***	$89,854	3	$667,714	5
Custom processing of non-whiting, non-groundfish fish	$379,196	6	$483,527	7	$1,063,806	5
Custom processing of whiting	***	***	***	***	***	***
Offloading	$0	0	$0	0	$1,862,756	13

Appendix B Future Improvements

There are several ways in which the EDC Program will continue to improve the data collection administration and operations with regards to first receivers and shorebased processors.

- There are several points in which the identification of buyers and shorebased processors can be improved. In past data collections, there were two issues with identifying shorebased processors and buyers.
  - First, initially, under the catch share program, the buyer of a fish could use the first receiver site license of an offloader to buy groundfish. This meant that there was no first receiver site license for the true buyer and therefore no way to identify this buyer. Recent changes to the regulations[1] now require that all buyers have a first receiver site license for all physical locations where they purchase, take custody, or control an IFQ landing. The name of the buyer should in all cases now match the name on the first receiver permit and that on the e-ticket. The implementation of these regulations should improve EDC data quality and catch-share performance monitoring for the 2013 survey year and beyond.
  - The second issue the identification of shorebased processors. The first receiver site license program, and previously, the state run licensing program for commercial seafood buyers, can be used for all buyers of seafood, but there is currently no method for identifying processors that do not have a first receiver site license and receive round or headed-and-gutted IFQ species groundfish or whiting from a first receiver.
- The EDC is exploring survey instrument changes that better address businesses with multiple locations.

B.1 Cost allocation

EDC methodology for cost allocation for processors is still under development, with further economic analysis and interviews with participants needed. Processing costs likely differ between some fisheries and product type in terms of expenses on labor, additives, equipment,

[1] For more detailed information see: Compliance Guide Pacific Coast Groundfish Trawl Rationalization Program: Changes for 2012 and beyond Federal Register: 76 FR 74725, December 1, 2011

utilities, and production supplies. Major cost categories include the gross cost of fish paid for, investments through capitalized expenditures, daily operating expenses including labor and utilities, and various other expenses. EDC processor forms have a variety of measures available to allocate costs including gross weight of fish purchased, total weight of production, gross cost of fish purchased, and total value of production.

With one or a combination of these measures, the EDC Program will explore methods to allocate costs between fishery groups. For analysis, the EDC Program has tentatively chosen the following species groups:

- Whiting
- Catch share groundfish
- Fixed gear groundfish
- Open access groundfish
- Crab
- Shrimp
- Salmon
- Coastal pelagics, and highly migratory species including tuna and herring
- Halibut, including Pacific and California
- Other, including squid, echinoderms, shellfish, sturgeon, and “other”

B.2 Processor Types

In this report, all of the first receivers and processors are analyzed as a single group. In subsequent reports, the EDC Program will attempt to partition the entities into groups that will aid in the analysis and interpretation of the data. Some options are to partition the data by whether they process fish. We will also explore partitions based on the species or groups of species processed. Input from participants and fishery managers would be helpful in determining which partitions would be most useful.

Economic Data Collection Program

Catcher Vessel Report

Draft Report for PFMC Review

Do Not Cite

Northwest Fisheries Science Center[1]

May 22, 2013

[1]For questions or comments, please contact the EDC Program at nwfsc.edc@noaa.gov.

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Summary

This report summarizes information collected from the West Coast groundfish trawl catcher vessel fleet as a part of the Economic Data Collection (EDC) program, which was enacted to monitor the economic effects of the 2011 transition of the West Coast groundfish trawl fishery to a catch share program. The catch share program consists of cooperative programs for the at-sea mothership and catcher-processor fleets, and an individual fishing quota (IFQ) program for the shorebased trawl fleet. Annual EDC submissions are required from all fishery participants. This catcher vessel report (and its companion reports covering the other sectors) is the first in what is expected to be an annual series of reports. EDC economists expect to expand and refine the methods used in each new annual publication.

The report covers the years 2009 to 2011. It contains information about annual participation by catcher vessels in the West Coast and Alaska groundfish trawl fisheries, as well as the vessel physical characteristics, fuel use, speed, and crew size and share systems. Fish landings and the ports of delivery are summarized. The report also contains variable and fixed cost information, revenues, and calculated net revenue from West Coast harvest. Finally, a breakdown of costs, revenue, net revenue per day at sea, and per metric ton of harvest provide basic metrics for the economic performance of the catcher vessel fleet.

1 Introduction

1.1 Background

In January 2011, the West Coast groundfish trawl fishery transitioned to a catch share program. The catch share program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet, and cooperative programs for the at-sea mothership and catcher-processor fleets. The Economic Data Collection (EDC) program[1] was enacted as part of these new regulations to monitor the economic effects of the catch share program. Annual economic data submissions are required from all fishery participants: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors §50 CFR 660.114. Baseline, pre-catch share data, was submitted in 2011 for the 2009 and 2010 operating years. Data for the first year the fishery operated under catch share program (2011), was submitted in 2012.

This draft report summarizes the 2009-11 EDC catcher vessel survey data. The EDC Program has enhanced the quantity and quality of economic information available for analysis and the management of the West Coast groundfish trawl fishery. Prior to the EDC Program, voluntary cost and earnings surveys were available for 64% of the shoreside catcher vessels with limited entry groundfish permits with trawl endorsements (trawl fleet) (2003-2004 collection[2]) and 57% of the fleet for the 2007-2008 collection[3]. Moreover, no cost and earnings data were available for catcher vessels that delivered to motherships.

In addition to the catcher vessel report, there are four companion reports:

- Economic Data Collection Program, Administration and Operations Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Mothership Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

[1] Additional information on the EDC Program, including the EDC data collection forms can be found at `www.nwfsc.noaa.gov/edc`

[2] Lian, C.E. 2010. West Coast limited entry groundfish trawl cost earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p.

[3] Lian, C.E. 2012. West Coast limited entry groundfish cost earnings survey: Protocol and results for 2008. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-121, 62 p

- Economic Data Collection Program, Catcher-Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, First Receiver and Shorebased Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

The Administration and Operations Report describes the EDC Program administration and fielding of the surveys, the EDC forms, data QA/QC and data processing, and safeguarding confidential information. The other EDC reports provide basic data summaries for the catcher-processor, mothership, and first receiver and shorebased processor forms.

This catcher vessel report and other reports, listed above, comprise the first of what is expected to be an annual series of reports. It is envisioned that over time the scope of these reports will expand, and the methods used will be refined with each annual publication. As such, the data summaries and analyses may change in subsequent years as improvements are implemented. In general, the report provides summaries as sector totals or means. Future reports will contain additional summaries that describe the variation of the data, either numerically or graphically. They are not contained in this report due to time constraints.

1.2 Purpose of the report

This report, like the other three EDC data summary reports, has multiple objectives. The first is to provide basic economic data summaries that can be used for a variety of purposes associated with fishery management. Since much of the data collected are confidential under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, the data are summarized as averages or totals for each question on the EDC forms. Thus summarized, the reports make the data available to the public for both research and informational purposes.

Second, the data summary reports provide information about the performance of the catch share program. This includes information that can be used to monitor whether and to what degree the goals of the program are being met. It is expected that additional modeling and analysis will be included in each subsequent year, which will provide more detailed information about the performance of the program. These reports will serve as the basis for the 5-year review of the catch share program that is mandated in the MSA, as well as the NMFS National Catch Shares Performance Indicators. Currently, with just a single year of catch share EDC data, it may be difficult to draw firm conclusions about the performance of the program. In addition, the catch share program may have a transitional period in the first few year as participants learn about the system and develop new business strategies.

Third, the reports either provide or serve as the basis for economic models that will be used as part of the Pacific Fishery Management Council's (PFMC) biennial specification process for groundfish management. These models include the IO-PAC[4] model, as well as estimates of

[4] Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

revenue, costs, and net revenue.

Lastly, and perhaps most importantly, the data reports are expected to provide a useful catalyst for feedback on the data collected and its analysis.

1.3 Catcher vessel form administration

Completion of EDC forms is mandatory for participants in the catch share program. Any owner, lessee, or charterer of a catcher vessel registered to a limited entry groundfish permit with a trawl endorsement (limited entry trawl permit) is required to complete an EDC form §660.114(b)(1). For a permit owner, a limited entry trawl permit application (including MS/CV-endorsed limited entry trawl permit) will not be considered complete until the required EDC for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i). For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration, vessel account actions, or if own QS permit, issuance of annual QP or IBQ pounds) will not be authorized until the required EDC for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v) and §660.140(e). For a vessel lessee or charterer, participation in the groundfish fishery (including, but not limited to, issuance of annual QP or IBQ pounds if own QS or IBQ) will not be authorized, until the required EDC for their operation of that vessel is submitted.

A calendar year is used to determine which vessels meet the criteria. For example, in 2012, data were collected from all owners, lessees, and charters of a catcher vessel registered to a limited entry trawl permit during 2011. The forms are fielded on this schedule in order to allow participants the time necessary to complete their taxes, which may contain some information that is required on the EDC forms. Participants are identified using contact information provided by the Northwest Regional Office Permit Office (Permit Office).

If a form has missing information, or the information provided on the form is believed to be incorrect, EDC Program staff attempt to contact the participant to correct the information. On occasion, the participant cannot be reached or the participant cannot provide the missing information. In these cases, the missing or inaccurate data are treated on a case-by-case basis during analysis as documented in the Administration and Operations Report. Data are validated and verified with external data sources whenever possible. These data sources include the Permit Office, state fish tickets, the At-Sea Hake Observer Program data, and the Coast Guard.

1.4 About the survey participants

The EDC catcher vessel participants are identified as any owner, lessee, or charterer of a vessel with a limited entry trawl permit. This includes catcher vessels that deliver whiting to motherships at-sea (at-sea whiting fishery), catcher vessels that deliver whiting to shorebased facilities (shorebased whiting fishery), and catcher vessels that delivery non-whiting groundfish to shorebased facilities (non-whiting groundfish fishery). Additionally, the non-whiting groundfish fishery can be further classified into two additional fisheries, characterized by the composition of target species groups. These fisheries are the DTS fishery which includes dover sole, thornyheads, and sablefish and the near-shore fishery (includes all non-whiting, non-DTS species groups). In addition to these fisheries, many vessels also participate in one or both of the state fisheries for shrimp and crab. The other prevalent activity is fishing in Alaska.

The individuals that complete the forms are as diverse as the types of fisheries in which the vessels participate. This adds to the complexity of developing the EDC forms, because the questions on the forms must be understood by fishermen, family members, accountants, bookkeepers, and chief financial officers. Often times, the forms are completed by multiple individuals since different people manage different parts of the business. For example, the captain of the vessel might know best how much fuel the vessel uses on a daily basis, but the bookkeeper might have the best information about how much was spent on fuel during the year.

1.5 Understanding the report

It is important to remember that the information presented in this report is for all vessels that were required to complete the EDC form, as described above. Throughout the report, these vessels are referred to as EDC vessels. The EDC vessel include: 1) vessels that have historically participated in the trawl fishery and currently still participate; 2) vessels that no longer participate in the trawl fishery but still have a limited entry trawl permit; and 3) vessels that have not historically had a limited entry trawl permit, but have now obtained one to participate in the gear switching program (use of fixed gear is allowed under the program).

The unit of analysis identified in the summary tables varies by the information summarized. There are three different units of analysis, "entities", "vessels", and "participants". An "entity" is defined as a unique combination of an owner or lessee and vessel, whereas as a "vessel" refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel. Therefore multiple forms could be submitted for one vessel, because there were multiple owners or lessees. Finally, "participants" refers to the individuals who actually completed the report. Each summary table clearly states whether the count of individuals represents entities or vessels.

For each value displayed in the summary data tables, N is displayed. In most cases, N represents the number of responses to the question that are not "NA" and not zero, unless noted otherwise. For example, in table 9.1, for the 100 vessels that had expenses on ice, the mean expense in 2011 was $5,870. Therefore to calculate the average expense for ice for the entire fleet, one would need to multiply the mean by 100 and then divide by the total number of vessels (134).

The one major difference between the baseline forms (2009 and 2010) and 2011-current forms is that vessels that did not fish during the survey period were only required to fill out the first few pages of the form during the baseline collection. The vessels that did not fish in 2009 and

2010 only provided the vessel name, vessel ID, home port, length of the vessel, fuel capacity, and horsepower of main engines, contact information, and permit numbers.

One last guideline when interpreting the aggregated data are the use of fiscal year. Although participants are identified on a calendar year basis, they complete the form using information based on the fiscal year of the entity. Currently data are presented for survey year, and therefore data assigned to a survey year may not overlap completely with the calendar year. Information obtained from outside of the EDC Program are adjusted to match the fiscal year provided on each form. For the three years of data collected from catcher vessels, 88% of entities used a fiscal year that is the same as the calendar year.

All data submitted via the EDC Program are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) and under NOAA Administrative Order 216-100. In order to protect these data, a rule of three and a rule of 90-10 are implemented. The rule of three requires a response from at least three entities in order to show a summary statistic. The 90-10 rule requires that no single entity's response should comprise over 90 percent of all relevant responses. The tables show a "***" for data points where there were less than three entities reporting the information, and/or if one entity's responses accounted for greater than 90 percent of the average value. Zeroes are shown if all entities only reported zeroes and/or NAs. More information about how confidential data are protected in the EDC Program can be found in the Administration and Operations Draft Report. Additionally, "—" is used to denote fields where the question was not asked on the form during the survey year.

2 Survey Response Rates

For the 2011 Catcher Vessel EDC forms, 96.0% of all required forms are complete[1]. This is an increase from the 2009 and 2010 collection, when 88.1% and 92.0% were complete, respectively. Over the three years of the data collection, there has been no entity[2] that was unable to renew a limited entry groundfish permit due to a missing or incomplete EDC. This means that the remaining forms that were received incomplete or never received correspond to participants that are no longer in any West Coast federal fishery. Table 2.2 shows that in 2011, the complete EDCs represented 97.0% of all landings value associated with EDC vessels.

Table 2.1: Form status. Number of complete forms, number of incomplete forms, and number of forms that were never received (N = number of forms, % = percent of all forms due in survey year)

Form status	2009		2010		2011	
	N	%	N	%	N	%
Complete	148	88.1%	150	92.0%	166	96.0%
Incomplete	6	3.6%	1	0.6%	2	1.2%
Not received	14	8.3%	12	7.4%	5	2.9%

To further emphasize the response rate, the percentage of complete forms out of all forms required by total revenue associated with vessel forms was calculated 2.2. This was only possible because all vessels with at-sea deliveries completed the required EDC forms.

[1]For explanation of the term complete, please refer to the Administration and Operations Draft Report section regarding regulations for complete EDC forms

[2]An "entity" is defined as a unique combination of an owner or lessee and vessel, whereas as a "vessel" refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Table 2.2: Form response rates as a function of total revenue. The total ex-vessel revenue on the West Coast associated with vessels that were required to submit an EDC form, by form status. If two forms were required for one vessel and one was submitted for one entity, and the other was incomplete, the shoreside landings revenue was attributed to both forms and is therefore counted twice in the table (% = percent of total ex-vessel revenue associated with EDC vessels in survey year. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as a vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.).

Form status	2009		2010		2011	
	Total	%	Total	%	Total	%
Complete	$56,771,023	92.5%	$60,700,423	96.2%	$95,352,292	97.0%
Incomplete	$ 1,277,271	2.1%	$ 315,666	0.5%	$ 492,319	0.5%
Not received	$ 3,297,533	5.4%	$ 2,071,895	3.3%	$ 2,463,935	2.5%

For most of the forms, there is a one-to-one relationship between a vessel and the vessel owner, in which case there is no lessee of the vessel, and one form is submitted for the vessel each year. More than one form is submitted for a particular vessel when the vessel is leased by a third party, or when the vessel is sold during the survey year. The most common occurrence with two forms submitted for one vessel is when the owner of the vessel submits one form and the lessee of the vessel submits another form. Generally, only the lessee operated the vessel during the fiscal year, but occasionally both entities will operate the vessel (Table 2.3).

Table 2.3: Information about forms, entities, and vessels. Number of required forms, number of entities that harvested fish, number of vessels that harvested fish by location, number of vessels that were leased, number of lease contracts, number of vessels that were fished by more than one entity, and number of vessels that were sold during the annual survey qualifying period. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Activity	2009	2010	2011
	N	N	N
Number of required forms	168	163	173
Number of entities that harvested fish	133	130	143
Number of vessels that harvested fish on the West Coast or Alaska	132	129	138
Number of vessels that harvested fish on the West Coast	130	126	132
Number of vessels that harvested fish in Alaska	31	31	35
Number of vessels that were leased	11	8	9
Number of lease contracts	12	9	9
Number of vessels that were fished by more than one entity. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.	***	***	5
Number of vessels sold	***	5	8

3 Vessel Participation on the West Coast and in Alaska

The EDC form asks participants to provide the total number of days spent fishing by fishery on the West Coast and in Alaska. Participants are instructed to count partial days as full days when recording days at sea on the forms. The West Coast fisheries categories on the EDC form are whiting with trawl gear, non-whiting groundfish with trawl gear, groundfish with fixed gear, shrimp, crab, halibut (both Pacific and California), salmon, tuna, and other. The days spent fishing in all Alaskan fisheries is also requested. Additionally, participants provide the total number of days spent chartering or doing research. Most vessels that participate in the catch share fisheries are also involved in other fishing activities.

Although these data provide most of the information necessary for examining vessel participation, several of the fisheries are further disaggregated using information from state fish tickets obtained from the PacFIN database, data collected by the At-Sea Hake Observer Program (A-SHOP) obtained from the NORPAC database, and EDC data (ex-vessel revenue from at-sea deliveries). The whiting fishery is disaggregated into at-sea Pacific whiting and shoreside Pacific whiting; and non-whiting groundfish with trawl gear is further disaggregated into dover-thornyhead-sablefish (DTS) with trawl gear and non-whiting, non-DTS groundfish with trawl gear, commonly referred to as the trawl near-shore fishery.

The disaggregation of reported days at sea into subfisheries uses ex-vessel revenue to classify at-sea deliveries or shoreside landings by the subfisheries. Fish ticket data are compiled from the start date of the vessel's fiscal year through one full year. These data are then used to designate each unique delivery to a fishery. A delivery is assigned to a particular fishery based on the species or species group that resulted in the highest revenue for that delivery. For example, if a fish ticket for a particular vessel on a specific day had a mix of rockfish and Pacific whiting, and the Pacific whiting landings accounted for the majority of the revenue, then all days associated with that trip are designated as "Pacific whiting fishery".

All revenue associated with at-sea deliveries were associated with the at-sea Pacific whiting fishery.

DTS revenue was identified using the landings of the species dover sole, thornyheads, and sablefish. Blackgill rockfish were also included because it is also a deep-water species, which is commonly caught in combination with the other three species. In almost all cases in 2009-2011, the daily deliveries where blackgill rockfish had the highest revenue, sablefish yielded the next highest revenue.

In order to separate the trawl groundfish catch share days from the fixed gear groundfish days, landings with a gear identification of fixed gear were split by the type of limited entry permit attached to the vessel, either a trawl endorsed or gear endorsed permit.

Landings weight was explored as an alternative to using revenue to classify deliveries by fishery. We compared the results of using the highest revenue method versus the highest landings weight method for designating the fishery. The two methods resulted in identification of the same fishery for 95% of all cases. Given that there were few differences in identification of the fisheries, revenue was selected over landings weight because it is assumed to represent the target species more accurately.

In 2009 through 2011, relatively few entities[1] participated in the halibut, salmon, tuna, and other fisheries. Therefore these fisheries were grouped together into an “Other” category. Additionally, groundfish that was caught without a limited entry groundfish permit with a trawl endorsement was also included in the “Other” category. This includes all groundfish caught with fixed gear–with or without a fixed gear endorsed limited entry groundfish permit–or trawl gear without a limited entry groundfish permit. The number of entities that participated in each of these fisheries ranged from zero, for salmon in 2009, to seventeen, for tuna in 2009. Most of these participants’ information cannot be shown due to confidentiality restrictions.

Once each delivery is assigned to a particular fishery, using revenue, annual landings by fishery is calculated for each vessel. The days at sea reported on the forms by participants are then apportioned to a fishery according to the proportion of total landings (or deliveries) in each fishery.

[1] An entity is defined as a unique combination of an owner or lessee and vessel, whereas as a "vessel" refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Table 3.1: Average days at sea. Average days at sea by activity for EDC vessels (N = number of EDC vessels with non-zero, non-NA responses).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
At-sea Pacific whiting	20.5	20	26.8	20	30.6	18
Shoreside Pacific whiting	31.5	35	38.1	35	51.7	26
DTS trawl with trawl endorsement	57.3	102	52.8	93	46.8	65
Non-whiting, non-DTS trawl with trawl endorsement	16.3	75	13.9	61	16.4	46
Groundfish fixed gear with trawl endorsement	17.1	5	52.4	7	32.1	26
Crab	39.3	56	37.9	57	37.3	66
Shrimp	29.7	31	36.3	36	43.3	41
Alaska	102.4	31	111.8	31	129.6	35
Other	14.3	29	24.5	27	16.3	29
Chartering or research	30.0	10	31.8	11	40.5	13

Table 3.2: Total days at sea. Total days at sea for EDC vessels (N = number of EDC vessels with non-zero, non-NA responses).

Activity	2009		2010		2011	
	Total	N	Total	N	Total	N
At-sea Pacific whiting	410.0	20	536.0	20	550.0	18
Shoreside Pacific whiting	1,103.6	35	1,335.0	35	1,343.0	26
DTS trawl with trawl endorsement	5,842.6	102	4,914.6	93	3,045.1	65
Non-whiting, non-DTS trawl with trawl endorsement	1,224.7	75	848.2	61	755.9	46
Groundfish fixed gear with trawl endorsement	85.7	5	366.9	7	834.7	26
Crab	2,198.7	56	2,159.0	57	2,462.6	66
Shrimp	919.5	31	1,307.9	36	1,777.0	41
Alaska	3,173.0	31	3,465.0	31	4,537.0	35
Other	415.4	29	660.2	27	471.3	29
Chartering or research	300.0	10	350.0	11	526.0	13

3.1 Trips to Alaska

The number of trips that were made between the West Coast and Alaska provide additional insight into the patterns of participation. Table 3.3 show the number of one way trips taken by vessels.

Table 3.3: Trips to Alaska. Count of vessels by number of one-way trips between the West Coast and Alaska. (N = number of EDC vessels, % = percent of all vessels in the survey year).

Number of one-way trips	2009		2010		2011	
	N	%	N	%	N	%
1	***	***	5	15.2%	3	9.4%
2	23	76.7%	20	60.6%	25	78.1%
3	***	***	***	***	***	***
4	5	16.7%	6	18.2%	***	***

3.2 Vessel participation in multiple fisheries

A key characteristic of vessels on the West Coast is participation in multiple fisheries. In 2010, only 5.4% of all entities[2] participated in one fishery. Participation in multiple fisheries maintains employment throughout different seasonal fisheries. Diversification of participation could also protect communities from variability in the abundance of target species. Figures 3.1, 3.2, and 3.3 provide additional insight into the portfolio of fisheries in which the EDC vessels participate.

[2]An entity is defined as a unique combination of an owner or lessee and vessel, whereas as a "vessel" refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Table 3.4: Participation in multiple fisheries. Number of entities that participated in one or more fisheries by year (N = number of entities, % = percent of total entities in survey year. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.)

Number of fisheries	2009		2010		2011	
	N	%	N	%	N	%
1	9	6.8%	7	5.4%	22	15.3%
2	34	25.6%	45	34.6%	51	35.4%
3	54	40.6%	43	33.1%	46	31.9%
4	27	20.3%	25	19.2%	19	13.2%
5	6	4.5%	7	5.4%	5	3.5%
6	3	2.3%	3	2.3%	***	***

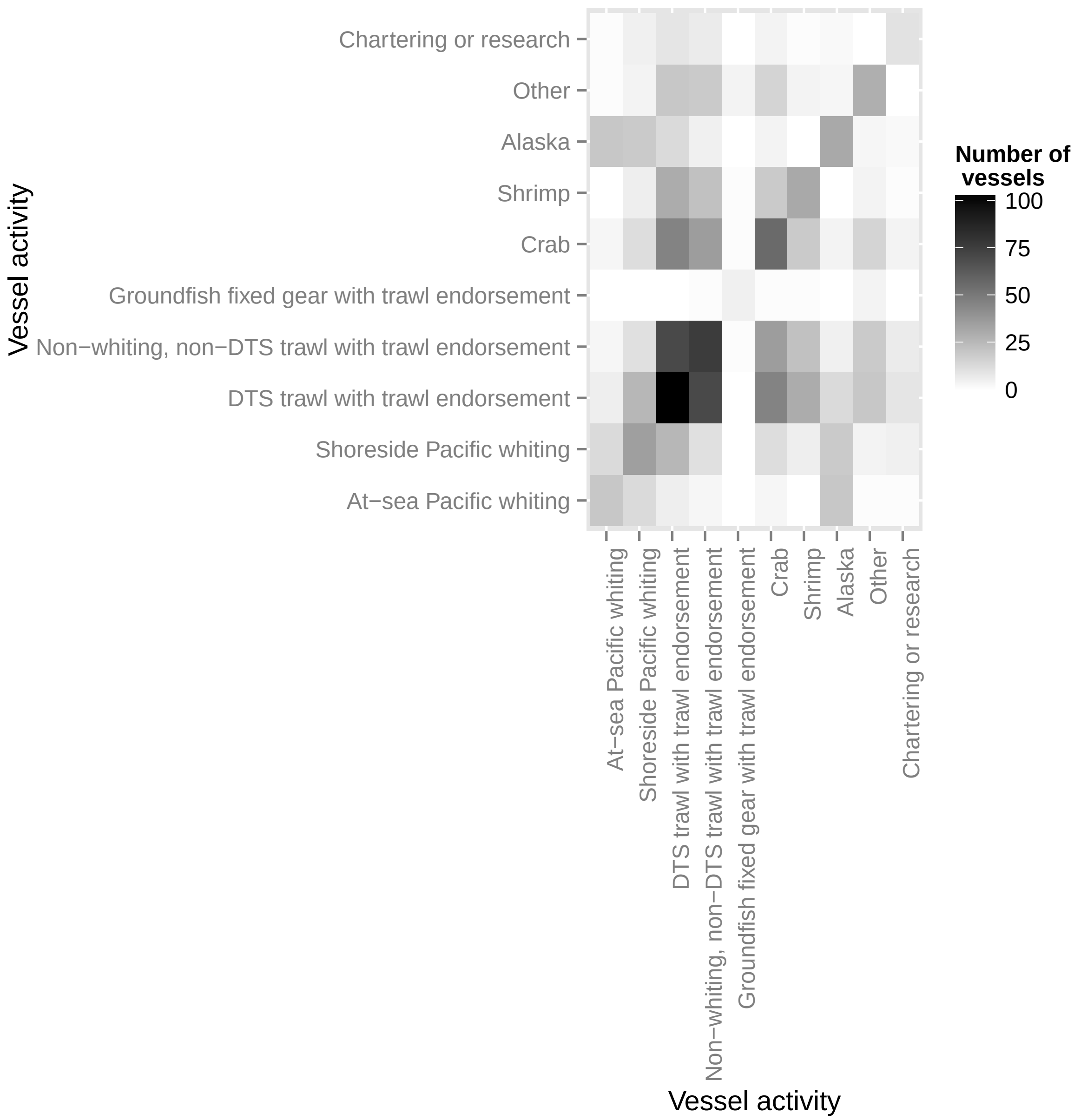

Figure 3.1: Participation in multiple fisheries - 2009. Frequency of participation in multiple fisheries during 2009 fiscal year.

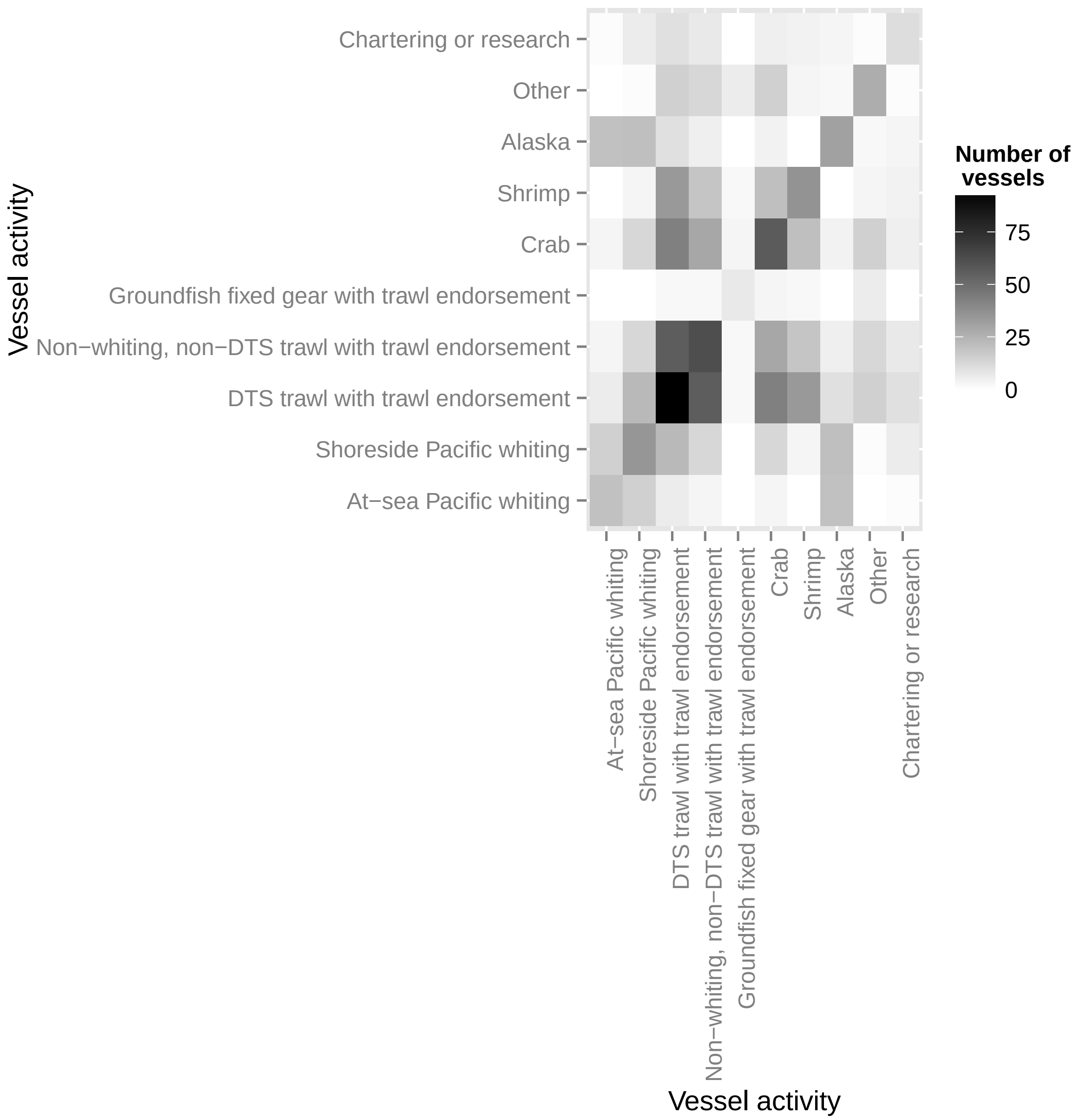

Figure 3.2: Participation in multiple fisheries - 2010. Frequency of participation in multiple fisheries during 2010 fiscal year.

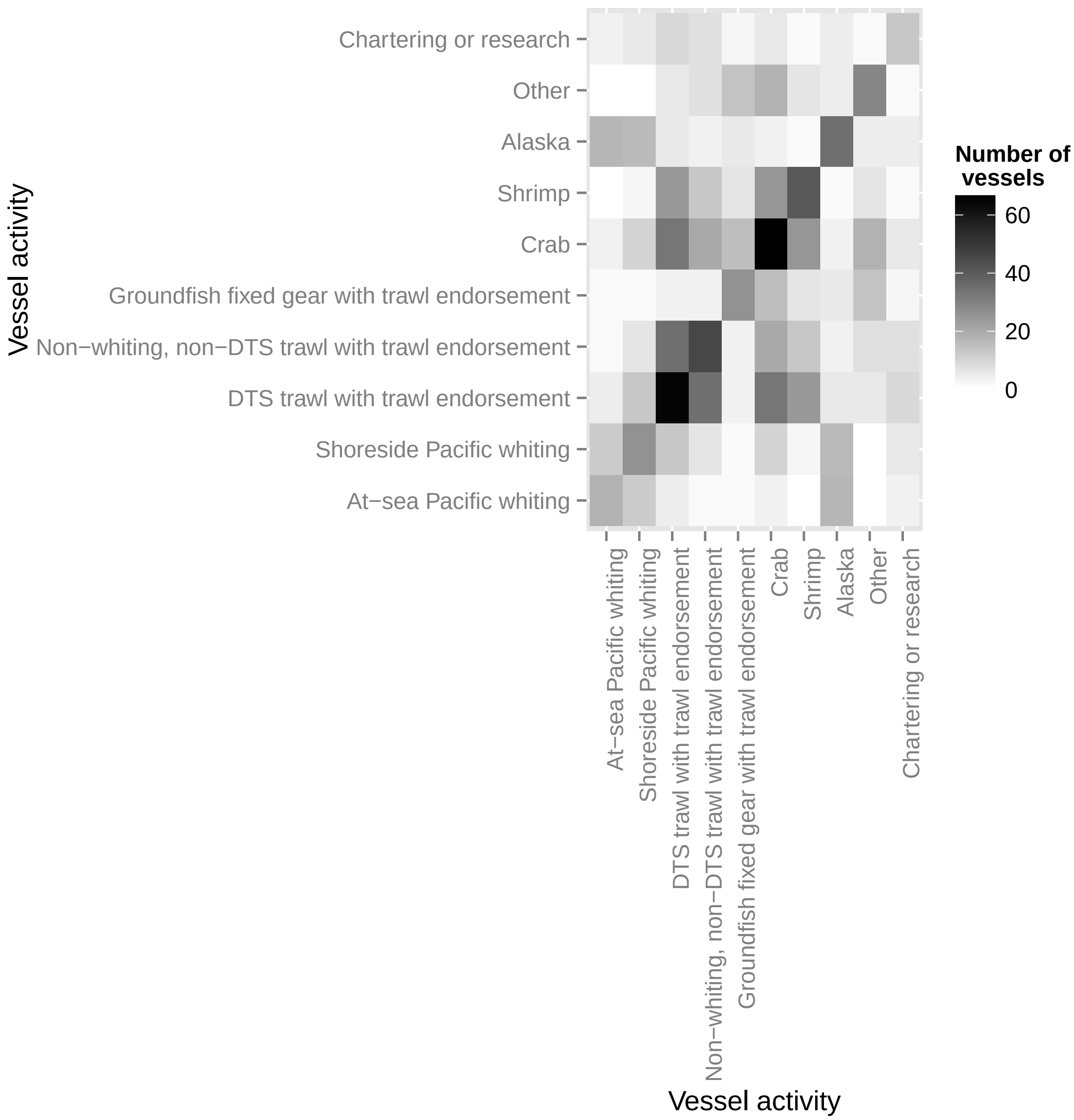

Figure 3.3: Participation in multiple fisheries - 2011. Frequency of participation in multiple fisheries during 2011 fiscal year.

4 Home Port

The vessel home port is an important component of understanding the complexity and diversity of the West Coast fleet. This information will be particularly useful for understanding how the catch share program may affect communities. Among other uses, home port is commonly used as a method for assigning economic activity to communities. Table 4.1 shows the number of entities by home port. There are many measures of home port, including the home port listed on Coast Guard registrations and the port where the vessel made the most landings. In this table, the home port provided by participants on the EDC form is summarized here. Home ports provided on the EDC forms are mapped to the IO-PAC port groupings[1]. These port groupings are also consistent with those used in the PFMC's biennial groundfish management specification process. The ports with the highest concentration of EDC entities are Newport, Astoria, and the Puget Sound region.

In addition to understanding where vessels call their home port, it is important to examine how the home port relates to particular fisheries. Tables 4.2 through 4.11 show the average days at sea by home port and fishery. This provides information about how changes in management for a particular fishery could affect specific port communities. For example, changes in the shoreside Pacific whiting fishery could have a strong effect on Coos Bay, but a change in the at-sea Pacific whiting fishery might not have a noticeable effect in that port.

[1] Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

Table 4.1: Vessel home port. Number of entities by home port reported on EDC form (N = number of entities, % = percent of total entities in survey year. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel).

Home port	2009		2010		2011	
	N	%	N	%	N	%
Alaska	***	***	***	***	3	2.1%
Astoria	20	13.9%	20	13.9%	26	18.2%
Brookings	7	4.9%	7	4.9%	8	5.6%
Coos Bay	20	13.9%	19	13.2%	19	13.3%
Crescent City	7	4.9%	7	4.9%	7	4.9%
Eureka	9	6.2%	9	6.2%	9	6.3%
Fort Bragg	7	4.9%	7	4.9%	7	4.9%
Monterey	3	2.1%	***	***	***	***
Morro Bay	6	4.2%	4	2.8%	6	4.2%
Newport	23	16.0%	23	16.0%	25	17.5%
Puget Sound	25	17.4%	28	19.4%	17	11.9%
San Francisco	6	4.2%	8	5.6%	7	4.9%
South and central WA coast	4	2.8%	4	2.8%	4	2.8%
Tillamook	6	4.2%	6	4.2%	4	2.8%

Table 4.2: At-sea Pacific whiting fishery days at sea by home port. Average number of days vessels fished in the At-sea Pacific whiting fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	***	***	***	***	0	0
Astoria	***	***	***	***	***	***
Brookings	***	***	***	***	0	0
Newport	17	9	25	9	28	9
Puget Sound	28	7	32	7	35	7
San Francisco	***	***	***	***	***	***

Table 4.3: Shoreside Pacific whiting fishery days at sea by home port. Average number of days vessels fished in the Shoreside Pacific whiting fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	***	***	***	***	0	0
Astoria	50	3	61	3	45	3
Brookings	***	***	***	***	***	***
Coos Bay	22	4	***	***	***	***
Crescent City	***	***	***	***	0	0
Eureka	***	***	***	***	0	0
Newport	25	14	33	14	49	15
Puget Sound	30	7	40	9	58	4
South and central WA coast	***	***	***	***	***	***
Tillamook	***	***	***	***	0	0

Table 4.4: DTS trawl with trawl endorsement fishery days at sea by home port. Average number of days vessels fished in the DTS trawl with trawl endorsement fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Astoria	73	18	74	17	62	16
Brookings	54	7	57	7	46	6
Coos Bay	43	17	43	16	52	9
Crescent City	50	7	42	6	22	3
Eureka	60	9	55	8	48	7
Fort Bragg	59	7	53	7	37	6
Monterey	***	***	***	***	***	***
Morro Bay	***	***	***	***	***	***
Newport	44	18	39	16	16	9
Puget Sound	73	5	44	4	43	3
San Francisco	***	***	***	***	***	***
South and central WA coast	96	4	96	3	***	***
Tillamook	72	4	42	5	***	***

Table 4.5: Non-whiting, non-DTS trawl with trawl endorsement fishery days at sea by home port. Average number of days vessels fished in the Non-whiting, non-DTS trawl with trawl endorsement fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	0	0	***	***	0	0
Astoria	18	15	15	12	22	14
Brookings	1	3	4	4	***	***
Coos Bay	17	12	15	11	15	7
Crescent City	2	5	2	5	***	***
Eureka	6	8	4	4	10	4
Fort Bragg	9	6	7	4	11	4
Monterey	***	***	***	***	0	0
Morro Bay	***	***	***	***	0	0
Newport	14	7	8	6	8	5
Puget Sound	5	5	12	4	***	***
San Francisco	29	5	23	5	26	4
South and central WA coast	22	3	***	***	***	***
Tillamook	***	***	***	***	***	***

Table 4.6: Groundfish fixed gear with trawl endorsement fishery days at sea by home port. Average number of days vessels fished in the Groundfish fixed gear with trawl endorsement fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	0	0	0	0	***	***
Astoria	0	0	0	0	41	5
Brookings	0	0	0	0	***	***
Coos Bay	0	0	***	***	***	***
Fort Bragg	0	0	0	0	***	***
Morro Bay	21	4	82	3	35	6
Newport	0	0	0	0	31	3
Puget Sound	0	0	0	0	34	4
San Francisco	0	0	***	***	***	***
Tillamook	***	***	***	***	***	***

Table 4.7: Crab fishery days at sea by home port. Average number of days vessels fished in the Crab fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Astoria	59	6	52	5	43	9
Brookings	25	5	14	5	14	6
Coos Bay	34	10	34	9	33	11
Crescent City	41	5	34	6	34	7
Eureka	64	7	64	7	60	6
Fort Bragg	27	3	36	4	49	4
Monterey	***	***	0	0	0	0
Morro Bay	***	***	***	***	47	3
Newport	30	10	28	10	36	11
Puget Sound	***	***	***	***	***	***
San Francisco	26	3	38	4	42	4
South and central WA coast	***	***	48	3	26	3
Tillamook	***	***	***	***	***	***

Table 4.8: Shrimp fishery days at sea by home port. Average number of days vessels fished in the Shrimp fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Astoria	45	3	46	5	52	7
Brookings	***	***	31	4	52	4
Coos Bay	35	10	36	13	41	12
Crescent City	30	4	50	4	42	6
Eureka	28	4	26	4	28	4
Morro Bay	***	***	0	0	0	0
Newport	9	5	***	***	42	6
Puget Sound	***	***	***	***	0	0
South and central WA coast	0	0	***	***	0	0
Tillamook	***	***	***	***	***	***

Table 4.9: Other fisheries days at sea by home port. Average number of days vessels fished in the Other fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	0	0	0	0	***	***
Astoria	24	5	34	4	12	5
Brookings	***	***	0	0	***	***
Coos Bay	2	5	7	4	12	6
Crescent City	0	0	***	***	0	0
Eureka	***	***	***	***	0	0
Fort Bragg	***	***	***	***	***	***
Monterey	***	***	***	***	0	0
Morro Bay	10	4	30	3	11	3
Newport	27	4	28	4	27	3
Puget Sound	0	0	0	0	***	***
San Francisco	27	3	42	4	15	4
South and central WA coast	***	***	***	***	0	0
Tillamook	***	***	***	***	***	***

Table 4.10: Alaska fishery days at sea by home port. Average number of days vessels fished in the Alaska fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	***	***	***	***	***	***
Astoria	***	***	***	***	***	***
Brookings	***	***	***	***	***	***
Coos Bay	***	***	***	***	***	***
Newport	108	13	120	13	112	13
Puget Sound	106	11	127	11	145	14
San Francisco	***	***	***	***	***	***
Tillamook	***	***	***	***	***	***

Table 4.11: Chartering or research days at sea by home port. Average number of days vessels fished in the Chartering or research fishery on the West Coast by home port reported on EDC form. (N = number of EDC vessels with non-zero, non-NA responses).

Home port	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Alaska	0	0	0	0	***	***
Astoria	***	***	***	***	***	***
Brookings	***	***	***	***	***	***
Coos Bay	21	4	***	***	***	***
Fort Bragg	0	0	0	0	***	***
Newport	36	4	36	4	49	4
Puget Sound	0	0	***	***	36	3
Tillamook	0	0	***	***	0	0

5 Vessel Physical Characteristics

5.1 Average market value, replacement value, vessel length, fuel capacity, and horsepower of main engines

Physical vessel characteristics are shown below in Table 5.1. Survey participants were asked to provide basic information about the vessel and its physical characteristics, including market value, replacement value, vessel length, horsepower of main engines, and fuel capacity from the most recent marine survey. Marine surveys are done on a regular basis and are often required for insurance, financing, and other purposes.

The market value is the marine surveyor's estimate of what the vessel could be sold for in its current condition, and the replacement value is the estimate of what it would cost to replace the current vessel with a new vessel. The mean market value of the EDC vessels in all years was over $1 million, however the median was only $500,000 in 2011. The mean is driven by several very large market values provided by participants. Similarly, the mean replacement value of the EDC vessels was over $2 million and the median was $1,300,000 in 2011.

Table 5.1: Average vessel characteristics. Average market value, replacement value, horsepower, fuel capacity and length (N = number of EDC vessels with non-zero, non-NA responses).

Vessel characteristic	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Market value ($)	1,067,907	123	1,145,910	121	1,175,649	138
Replacement value ($)	1,976,306	121	2,030,050	120	2,229,211	135
Vessel length (feet)	73	140	73	143	72	153
Vessel fuel capacity (gallons)	12,440	139	12,153	142	12,142	154
Horsepower of main engines	650	140	636	143	635	151

The participants provide information about whether the vessel was hauled out. Each year about half of all active fishing vessels are hauled out. The information shown below in Table 5.2 provides context that may be used to explain major costs associated with vessel repair and maintenance.

Table 5.2: Haul outs. Number of EDC vessels (N) that hauled the vessel during their fiscal year (% percent of vessels in survey year).

Haul out	2009		2010		2011	
	N	%	N	%	N	%
YES	85	64.4%	65	50.4%	87	62.6%
NO	47	35.6%	64	49.6%	52	37.4%

Table 5.3: Catcher vessels that processed at-sea. Number of EDC vessels (N) that processed or headed and gutted fish on-board the vessel (% percent of vessels in survey year).

Processed at-sea	2009		2010		2011	
	N	%	N	%	N	%
YES	6	4.5%	7	5.4%	15	10.8%
NO	126	95.5%	122	94.6%	121	87.1%
No response	0	0.0%	0	0.0%	3	2.2%

5.2 Vessel characteristics by whether the vessel fished on the West Coast and in Alaska, only fished on the West Coast, only fished in Alaska, or did not fish

Table 5.4: Average horsepower. Average horsepower of EDC vessels that did not fish on the West Coast or Alaska, fished on the West Coast and Alaska, fished only in Alaska, and fished only on the West Coast. In 2009 and 2010 there was no question specifically for Alaska (N = number of entities with non-zero, non-NA responses).

Characteristic	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fished on the West Coast and Alaska	1,037	40	1,014	42	1,016	38
Fished only on the West Coast	464	92	464	88	462	100
Fished only in Alaska	***	***	0	0	1,060	3
Did not fish	797	17	640	20	765	20

Table 5.5: Average replacement value. Average replacement value ($) of vessels that did not fish on the West Coast or Alaska, fished on the West Coast and Alaska, fished only in Alaska, and fished only on the West Coast. In 2009 and 2010 there was no question specifically for Alaska and if the vessel did not fish in 2009 and 2010, the owner was not required to provide the market value of the vessel (N = number of entities with non-zero, non-NA responses. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fished on the West Coast and Alaska	$3,738,333	39	$3,851,585	41	$4,011,806	36
Fished only on the West Coast	$1,077,293	82	$1,096,138	80	$1,375,713	89
Fished only in Alaska	***	***	$0	0	$6,833,333	3
Did not fish	***	***	***	***	$2,215,333	15

Table 5.6: Average market value Average market value ($) of vessels that did not fish on the West Coast or Alaska, fished on the West Coast and Alaska, fished only in Alaska, and fished only on the West Coast. In 2009 and 2010 there was no question specifically for Alaska and if the vessel did not fish in 2009 and 2010, the owner was not required to provide the replacement value of the vessel (N = number of entities with non-zero, non-NA responses. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fished on the West Coast and Alaska	$2,299,167	39	$2,479,939	41	$2,436,959	37
Fished only on the West Coast	$455,477	84	$473,489	81	$564,468	90
Fished only in Alaska	***	***	$0	0	$5,340,000	3
Did not fish	***	***	***	***	$1,146,406	16

Table 5.7: Average vessel fuel capacity Average vessel fuel capacity (gallons) of vessels that did not fish on the West Coast or Alaska, fished on the West Coast and Alaska, fished only in Alaska, and fished only on the West Coast. In 2009 and 2010 there was no question specifically for Alaska (N = number of entities with non-zero, non-NA responses. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fished on the West Coast and Alaska	22,847	40	22,889	42	21,043	38
Fished only on the West Coast	6,895	92	7,284	88	7,542	100
Fished only in Alaska	***	***	0	0	39,005	3
Did not fish	19,404	16	12,807	19	15,876	20

Table 5.8: Average vessel length. Average length (feet) of vessels that did not fish on the West Coast or Alaska, fished on the West Coast and Alaska, fished only in Alaska, and fished only on the West Coast. In 2009 and 2010 there was no question specifically for Alaska (N = number of entities with non-zero, non-NA responses. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fished on the West Coast and Alaska	86	40	86	42	86	38
Fished only on the West Coast	66	92	67	88	66	100
Fished only in Alaska	***	***	0	0	103	3
Did not fish	80	17	72	20	73	23

6 Vessel Fuel Use, Speed, and Crew Size

Participants are asked to estimate the average daily fuel use while fishing. On average, more fuel is used per day in the Pacific whiting fishery than any other fishery.

6.1 Fuel use

6.1.1 Average fuel use per day by fishery

Table 6.1: Average daily fuel use. Average daily fuel use (gallons per day) by fishery (N = number of EDC vessels with non-zero, non-NA responses).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Pacific whiting	800.9	40	805.5	40	822.9	34
Groundfish trawl gear	298.6	105	304.4	99	322.8	81
Groundfish fixed gear	155.6	8	143.3	9	141.5	26
Crab	173.6	56	178.0	56	170.0	65
Halibut	271.4	7	206.3	6	141.1	7
Salmon	***	***	38.8	4	70.0	5
Shrimp	240.9	36	229.4	36	218.9	43
Tuna	128.9	15	120.1	14	77.9	8
Steaming between West Coast and Alaska	895.5	31	860.5	33	809.8	32

6.1.2 Average fuel use per day by fishery and vessel length class

Table 6.2: Pacific whiting fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the Pacific whiting fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	918	31	921	31	920	28
Medium vessel (> 60 ft, <= 80 ft)	399	9	407	9	396	5
Small vessel (< 60 ft)	0	0	0	0	***	***

Table 6.3: Groundfish trawl gear fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the groundfish trawl gear fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	522	21	516	20	543	16
Medium vessel (> 60 ft, <= 80 ft)	288	48	289	49	286	45
Small vessel (< 60 ft)	182	36	189	30	230	20

Table 6.4: Groundfish fixed gear fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the groundfish fixed gear fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	***	***	***	***	***	***
Medium vessel (> 60 ft, <= 80 ft)	***	***	***	***	200	7
Small vessel (< 60 ft)	91	6	84	7	116	18

Table 6.5: Crab fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the crab fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	342	6	350	6	303	7
Medium vessel (> 60 ft, <= 80 ft)	235	20	239	21	224	26
Small vessel (< 60 ft)	99	30	99	29	97	32

Table 6.6: Halibut fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the halibut fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	***	***	0	0	0	0
Medium vessel (> 60 ft, <= 80 ft)	***	***	363	3	258	3
Small vessel (< 60 ft)	100	4	50	3	54	4

Table 6.7: Salmon fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the salmon fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Small vessel (< 60 ft)	***	***	39	4	70	5

Table 6.8: Shrimp fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the shrimp fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	350	4	340	5	285	5
Medium vessel (> 60 ft, <= 80 ft)	263	21	239	21	239	25
Small vessel (< 60 ft)	160	11	153	10	156	13

Table 6.9: Tuna fishery fuel use. Average fuel use (gallons per day) of vessels that fished in the tuna fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Medium vessel (> 60 ft, <= 80 ft)	251	3	***	***	***	***
Small vessel (< 60 ft)	98	12	98	12	75	7

Table 6.10: Steaming between West Coast and Alaska fishery fuel use. Average fuel use (gallons per day) of vessels that steamed between West Coast and Alaska by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	939	28	917	29	921	26
Medium vessel (> 60 ft, <= 80 ft)	488	3	450	4	321	4
Small vessel (< 60 ft)	0	0	0	0	***	***

6.1.3 Average total fuel use

Table 6.11: Average total fuel use. Average total fuel use (gallons) per entity (gallons). (N = number of EDC vessels with non-zero, non-NA responses. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as a vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.)

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Total diesel use on West Coast	25,531	129	27,768	126	24,401	133
Other fuel use on West Coast	336	7	280	6	***	***

6.2 Speed while fishing or steaming

Participants are also asked to provide the average speed of the vessel while fishing. This value was only required for trawl fisheries, and therefore no speed is provided for halibut, crab, or groundfish with fixed gear.

6.2.1 Average speed by fishery

Table 6.12: Average speed by fishery. Average speed (knots) by fishery (N = number of EDC vessels with non-zero, non-NA responses).

Fishery	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Groundfish trawl gear	2.6	105	2.6	99	2.8	79
Pacific whiting	3.1	40	3.1	40	3.3	34
Salmon	***	***	2.5	4	2.5	5
Shrimp	2.0	36	1.9	36	2.7	42
Steaming between West Coast and Alaska	9.0	31	9.0	32	8.9	32
Tuna	5.0	15	5.2	15	5.5	9

6.2.2 Average speed by fishery and vessel length class

Table 6.13: Groundfish trawl gear fishery fishing speed. Average speed (knots) of vessels that fished in the groundfish trawl gear fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	3	21	3	20	3	16
Medium vessel (> 60 ft, <= 80 ft)	2	48	2	49	3	43
Small vessel (< 60 ft)	3	36	3	30	3	20

Table 6.14: Pacific whiting fishery fishing speed. Average speed (knots) of vessels that fished in the Pacific whiting fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	3	31	3	31	3	28
Medium vessel (> 60 ft, <= 80 ft)	3	9	3	9	4	5
Small vessel (< 60 ft)	0	0	0	0	***	***

Table 6.15: Salmon fishery fishing speed. Average speed (knots) of vessels that fished in the salmon fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Small vessel (< 60 ft)	***	***	2	4	3	5

Table 6.16: Shrimp fishery fishing speed. Average speed (knots) of vessels that fished in the shrimp fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	2	4	2	5	2	5
Medium vessel (> 60 ft, <= 80 ft)	2	21	2	21	3	25
Small vessel (< 60 ft)	2	11	2	10	2	12

Table 6.17: Steaming between West Coast and Alaska fishery fishing speed. Average speed (knots) of vessels that steamed between West Coast and Alaska by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	9	28	9	28	9	26
Medium vessel (> 60 ft, <= 80 ft)	9	3	9	4	8	4
Small vessel (< 60 ft)	0	0	0	0	***	***

Table 6.18: Tuna fishery fishing speed. Average speed (knots) of vessels that fished in the tuna fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	0	0	0	0	***	***
Medium vessel (> 60 ft, <= 80 ft)	6	3	6	3	***	***
Small vessel (< 60 ft)	5	12	5	12	5	7

6.3 Crew size

The EDC forms collect crew size by fishery. The values provided in Table 6.19 exclude the captain. These data provide information about the total number of jobs or positions on vessels; they do not reflect the total number of individuals who served as crewmembers. The EDC Program is currently exploring the state commercial fish license systems to determine whether it would be feasible to collect the license numbers on the EDC forms.

6.3.1 Average crew size by fishery

Table 6.19: Average crew size. Average crew size (excluding captain) by activity (N = number of EDC vessels with non-zero, non-NA responses).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Crab	2.8	56	2.9	57	2.9	65
Groundfish fixed gear	1.9	8	2.0	8	2.6	26
Groundfish trawl gear	2.0	105	2.0	98	2.1	80
Halibut	1.8	7	1.6	6	1.9	7
Pacific whiting	2.6	41	2.6	41	2.7	34
Salmon	***	***	1.7	3	1.8	4
Shrimp	2.0	37	2.0	37	2.0	43
Steaming between West Coast and Alaska	2.9	31	2.9	33	3.1	31
Tuna	1.5	15	1.6	14	1.5	7

6.3.2 Average crew size by fishery and vessel length class

Table 6.20: Crab fishery crew size. Average crew size (not including captain) on vessels that fished in the crab fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	3.6	6	3.3	6	3.5	7
Medium vessel (> 60 ft, <= 80 ft)	3.4	21	3.4	22	3.3	25
Small vessel (< 60 ft)	2.3	29	2.4	29	2.4	33

Table 6.21: Groundfish fixed gear fishery crew size. Average crew size (not including captain) on vessels that fished in the groundfish fixed gear fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	***	***	***	***	***	***
Medium vessel (> 60 ft, <= 80 ft)	***	***	***	***	3.6	7
Small vessel (< 60 ft)	1.3	6	1.5	6	2.1	18

Table 6.22: Groundfish trawl gear fishery crew size. Average crew size (not including captain) on vessels that fished in the groundfish trawl gear fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	2.3	21	2.3	20	2.4	16
Medium vessel (> 60 ft, <= 80 ft)	2.1	49	2.1	50	2.1	44
Small vessel (< 60 ft)	1.8	35	1.8	28	1.8	20

Table 6.23: Halibut fishery crew size. Average crew size (not including captain) on vessels that fished in the halibut fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	***	***	0	0	0	0
Medium vessel (> 60 ft, <= 80 ft)	***	***	1.7	3	2.2	3
Small vessel (< 60 ft)	1.6	4	1.5	3	1.6	4

Table 6.24: Pacific whiting fishery crew size. Average crew size (not including captain) on vessels that fished in the Pacific whiting fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	2.7	31	2.7	31	2.9	27
Medium vessel (> 60 ft, <= 80 ft)	2.2	10	2.2	10	2.2	6
Small vessel (< 60 ft)	0	0	0	0	***	***

Table 6.25: Salmon fishery crew size. Average crew size (not including captain) on vessels that fished in the salmon fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	0	0	0	0	***	***
Small vessel (< 60 ft)	***	***	1.7	3	1.7	3

Table 6.26: Shrimp fishery crew size. Average crew size (not including captain) on vessels that fished in the shrimp fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	2.1	4	2.1	5	2.0	5
Medium vessel (> 60 ft, <= 80 ft)	2.0	22	2.0	22	2.1	25
Small vessel (< 60 ft)	1.8	11	1.7	10	1.9	13

Table 6.27: Steaming between West Coast and Alaska fishery crew size. Average crew size (not including captain) on vessels that steamed between West Coast and Alaska by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Large vessel (> 80 ft)	2.9	28	2.9	29	3.0	25
Medium vessel (> 60 ft, <= 80 ft)	3.0	3	3.0	4	3.2	4
Small vessel (< 60 ft)	0	0	0	0	***	***

Table 6.28: Tuna fishery crew size. Average crew size (not including captain) on vessels that fished in the tuna fishery on the West Coast by size class of vessel (large vessel > 80 ft, 60 ft < medium vessels <= 80 ft, and small vessels <= 60 ft) (N = number of EDC vessels with non-zero, non-NA responses).

Vessel length category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Medium vessel (> 60 ft, <= 80 ft)	1.8	4	1.7	3	***	***
Small vessel (< 60 ft)	1.5	11	1.6	11	1.4	6

7 At-Sea Deliveries and Shoreside Landings

Vessels in the catch share fishery participate in both shorebased and at-sea fisheries. The only fishery for which vessels deliver at-sea is the whiting fishery. There is also a shorebased whiting fleet. Information about the weight of landings or deliveries is not requested on the EDC forms because this information can be obtained from other sources.

Landings and deliveries information are primarily obtained from state fish ticket data provided through PacFIN, and the At-Sea Hake Observer Program database accessed through PacFIN. The weight of landings and deliveries made while fishing in Alaska are obtained from the EDC forms. Species composition is available for West Coast fisheries, but not for Alaska fisheries. Alaska landings weights are provided here because they are used for cost disaggregation in section 9. Landings increased in both the shoreside and at-sea fisheries between 2010 and 2011 (Table 7.1).

Table 7.1: Total landings and deliveries in the West Coast at-sea and shoreside fisheries and Alaska (round metric tons) (N = number of EDC vessels with non-zero, non-NA responses)

Location of delivery	2009		2010		2011	
	Total	N	Total	N	Total	N
Alaska	94,821	31	103,625	31	135,282	34
At-sea	30,927	20	33,965	20	47,728	18
Shoreside	77,926	124	91,980	121	122,873	126

7.1 At-sea deliveries

The at-sea fisheries on the West Coast target Pacific whiting. There is very little bycatch in this fishery (Table 7.2).

Table 7.2: Total at-sea deliveries (metric tons) by species group (N = number of EDC vessels with non-zero, non-NA responses).

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
Arrowtooth flounder	1	20	3	19	7	18
Coastal pelagics	***	***	0	13	9	10
Crab	0	0	0	0	***	***
Dover sole	0	0	1	11	0	7
English sole	0	0	***	***	***	***
Lingcod	1	14	0	7	0	8
Other shellfish	0	5	0	11	***	***
Other species	***	***	10	19	23	18
Pacific cod	***	***	0	0	***	***
Pacific halibut	0	14	1	12	0	6
Pacific herring	0	12	***	***	***	***
Pacific whiting	30,667	20	33,756	20	47,462	18
Rex sole	0	0	2	11	2	9
Rockfish	201	20	114	20	92	18
Sablefish	0	6	5	14	2	14
Salmon	1	19	2	19	4	18
Sharks, skates and rays	9	20	51	20	106	18
Shrimp	0	3	0	3	0	4
Squid	8	20	21	20	19	18
Thornyheads	0	0	0	9	1	8

7.2 Shoreside landings

Pacific whiting makes up the largest part of the total catch by weight in the shoreside groundfish trawl fisheries, (Table 7.3). The next most common species by weight are dover sole, sablefish, and thornyheads. Between 2009 and 2011, there were 12 species grouped into the other groundfish species category. By weight, the most common were sand sole, starry flounder, and rock sole.

Table 7.3: Total shoreside landings (metric tons) by species group of groundfish (N = number of EDC vessels)

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
Arrowtooth flounder	3,542	91	2,971	91	2,284	83
Dover sole	10,883	107	9,947	104	7,583	90
English sole	238	103	148	97	109	70
Lingcod	100	113	71	101	256	86
Pacific cod	66	43	88	43	263	42
Pacific whiting	45,074	38	59,663	43	87,996	62
Petrale sole	1,545	107	720	100	801	73
Rex sole	515	109	405	104	360	81
Rockfish	988	121	1,138	113	1,458	103
Sablefish	3,084	118	2,702	110	2,792	108
Sanddab	278	53	152	39	144	31
Sharks, skates and rays	1,284	111	1,305	106	1,325	91
Thornyheads	2,348	109	2,397	108	1,658	93
Other species	71	56	100	54	100	58

In all three years, shrimp and crab were the highest volume non-groundfish species caught by EDC vessels. Shrimp catch by these vessels increased 151% between 2009 and 2011 and 72% between 2010 and 2011. This change can be partly attributed to increases in shrimp prices and partly due to more flexibility provided by the catch share program.

Table 7.4: Total shoreside landings (metric tons) by species group of non-groundfish (N = number of EDC vessels)

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
California halibut	43	7	54	8	48	5
Coastal pelagics	3	32	4	26	24	30
Crab	2,356	71	2,255	70	2,605	87
Echinoderms	0	9	0	5	***	***
Pacific halibut	2	17	***	***	11	22
Pacific herring	***	***	16	12	1	11
Salmon	2	30	14	34	32	32
Shrimp	5,095	33	7,448	40	12,808	42
Squid	153	62	116	48	23	43
Sturgeon	0	3	***	***	0	0
Tuna	102	17	133	14	59	9
Other shellfish	2	29	2	29	1	32
Other species	120	88	131	85	108	82

7.3 Shoreside landings by state

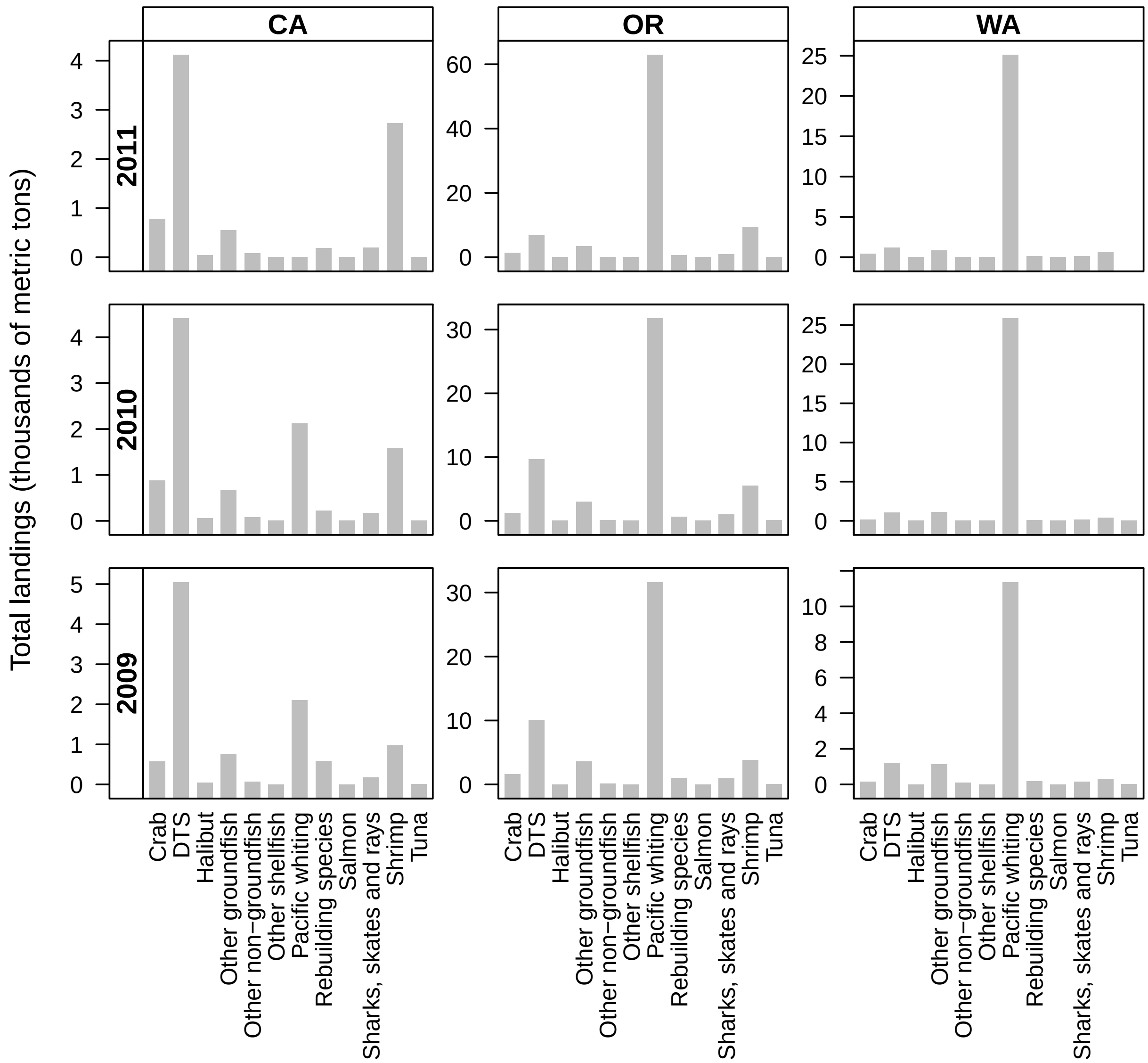

Figure 7.1: Total landings by state (thousands of metric tons).

8 Revenues

There are several sources of earnings for vessels on the West Coast. The primary source is revenue from sale of fish. Ex-vessel revenue is available for all shoreside deliveries, but is not available for at-sea deliveries. EDC data are used for all at-sea delivery revenues. Additionally, the EDC has information about revenue from sale or lease of permits, quota shares, and quota pounds, and from other activities like chartering and research. The full suite of earnings sources can be found in Table 8.1.

8.1 All revenue sources

Table 8.1: Average annual revenue. Annual average revenue ($) for all categories (N = number of EDC vessels).

Activity	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Shoreside deliveries	$406,414	124	$429,780	121	$673,030	126
At-sea deliveries	$363,524	20	$465,202	20	$613,489	18
Alaska shoreside landings and at-sea deliveries	$1,226,537	31	$1,320,654	31	$1,840,863	34
Sale of limited entry trawl permit	$0	0	$403,333	3	***	***
Lease of limited entry trawl permit	***	***	***	***	$126,348	8
Sale of other permits	$136,200	3	$85,000	3	$181,161	5
Lease of other permits	***	***	***	***	$142,412	6
Sale of quota shares	***	***	$0	0	***	***
Lease of quota shares	$0	0	$0	0	$60,009	11
Sale of quota pounds	***	***	***	***	$189,849	17
Lease of quota pounds	$0	0	***	***	$66,892	48
Chartering or leasing the vessel	$117,472	11	$157,493	11	$180,338	13
Salmon disaster payments	$26,051	16	$1,667	3	***	***
Other	$88,833	16	$117,458	9	$134,530	11
Average Total Revenue	$754,217	132	$833,808	129	$1,251,474	138

8.2 Ex-vessel revenue

Table 8.2: Total ex-vessel revenue by species group from shoreside landings of groundfish (N=number of EDC vessels)

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
Arrowtooth flounder	$761,836	89	$634,209	84	$494,452	81
Dover sole	$8,000,402	107	$6,752,932	100	$6,813,548	85
English sole	$158,658	102	$99,860	90	$74,871	68
Lingcod	$163,244	113	$129,062	99	$423,012	85
Pacific cod	$64,184	40	$85,694	36	$322,458	38
Pacific whiting	$6,435,396	38	$9,494,192	39	$20,888,138	46
Petrale sole	$3,105,312	107	$1,811,462	97	$2,514,323	72
Rex sole	$367,118	108	$278,825	98	$268,530	74
Rockfish	$1,115,764	121	$1,197,627	113	$1,645,205	103
Sablefish	$13,209,066	115	$12,179,352	109	$18,019,461	108
Sanddab	$242,051	42	$148,671	28	$176,671	27
Sharks, skates and rays	$543,965	103	$605,825	99	$869,001	86
Thornyheads	$2,529,083	107	$2,612,453	104	$2,095,882	90
Other species	$107,593	40	$146,725	40	$175,037	39

Table 8.3: Total ex-vessel revenue by species group from shoreside landings of non-groundfish species (N=number of vessels)

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
California halibut	$376,413	7	$466,461	7	$480,518	5
Coastal pelagics	***	***	***	***	$8,374	15
Crab	$9,506,019	57	$9,353,747	57	$14,553,530	66
Echinoderms	$0	0	***	***	***	***
Pacific halibut	***	***	***	***	$150,819	3
Pacific herring	***	***	$0	0	$0	0
Salmon	$0	0	***	***	$91,206	6
Shrimp	$3,413,617	32	$5,529,185	36	$14,206,659	41
Squid	$13,995	35	$8,435	24	$1,058	21
Sturgeon	$175	3	$0	0	$0	0
Tuna	$224,324	17	$336,999	13	$233,583	9
Other shellfish	$2,600	21	$1,529	22	$1,166	22
Other species	$40,665	63	$40,934	61	$34,970	56

Table 8.4: Total ex-vessel revenue by species group in at-sea fishery. Revenue data are only available at an annual basis and is not reported by species. It is assumed that all at-sea revenue is derived from Pacific whiting (N=number of vessels).

Species group	2009		2010		2011	
	Total	N	Total	N	Total	N
Pacific whiting	$7,270,479	20	$9,304,038	20	$11,042,798	18

8.3 Ex-vessel revenue by state

[0] It is assumed that all at-sea revenue is derived from landings of Pacific whiting.

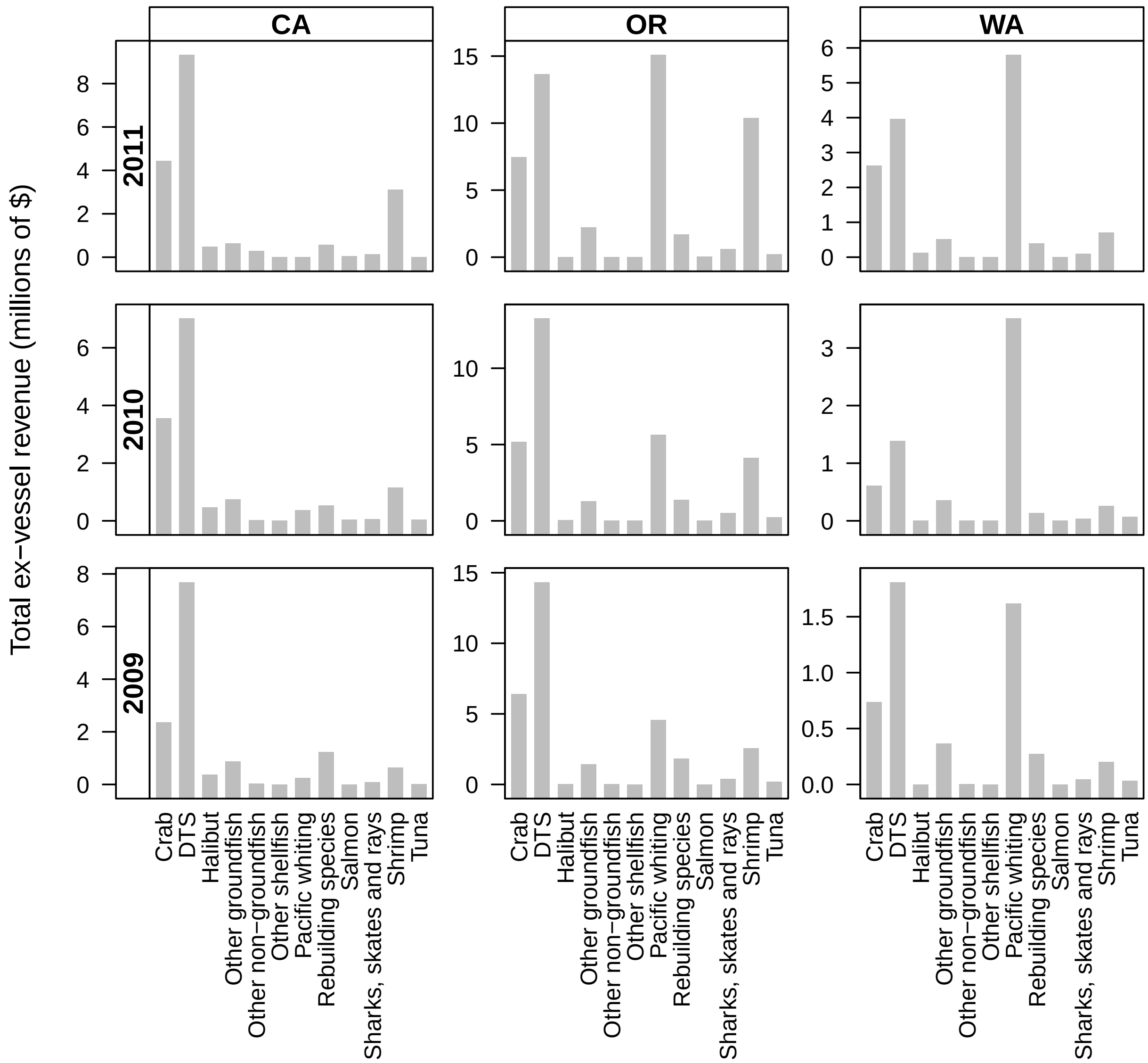

Figure 8.1: Total ex-vessel shoreside revenue (millions of $).

9 Costs

This section of the report describes the cost data that are collected on the EDC catcher vessel form. It reports on variable costs, fixed costs, and total costs, and how those costs are disaggregated to estimate the proportion of each cost that was incurred for West Coast fisheries.

For the purposes of the EDC, costs are divided into two categories, variable costs and fixed costs. Variable costs vary with the level of fishery participation, and generally include items such as fuel and crew payments. Fixed costs do not vary with the level of fishery participation, and generally include items such as vessel capital improvements. The designation of a cost as variable or fixed depends on many factors, including the relevant time horizon and use of the data. While some costs would clearly be considered fixed (e.g., the purchase of a new engine), others are more difficult to categorize as fixed versus variable. For the purposes of this report, we consider the costs listed in Tables 9.2, 9.3 and 9.4 to be fixed, and the costs listed in Table 9.1 to be variable. The EDC Program will continue to explore, and possibly improve, the categorization of these costs.

The cost section of the EDC form collects both "capitalized expenditures" and "expenses" for vessel improvements and maintenance, fishing gear, and processing equipment. This is because certain costs may be treated for tax accounting purposes as either capitalized or expensed. Capitalized expenditures are depreciated over a number of years. Expensed items are fully deducted as a cost for the year in which they occur. In an effort to reduce the reporting burden and errors, these data are collected as they are reported in the business' accounting system.

In order to conduct economic analyses of specific fisheries it is important to have costs broken out by fishery. For some costs, it may be feasible for participants to break out or track costs at the fishery level. However, for most costs this is impossible, or would require additional burden to do so. During the EDC form development process, a key issue was the determination of which costs could reasonably be broken out by fishery or groups of fisheries. Each cost item was assigned to one or more fishery-group category based on how they are commonly tracked by industry members: 1) used on West Coast fisheries only (West Coast Only); 2) used on the West Coast and in other fisheries (Shared); and 3) used in all fisheries (All) regardless of whether they are used on the West Coast.

Some costs that are required for economic analysis are not asked for on the EDC forms because they are available through other sources, or can be calculated through fish ticket or permit office data. These include fish landings taxes and fees.

Finally, there are a variety of costs that are associated with running a catcher vessel that are not requested on the form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than fishing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, pickup trucks, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture costs that are directly related to vessel maintenance and fishing operations, and not costs that are related to activities or equipment off the vessel. For these reasons, the EDC aggregated measures of costs (variable costs, fixed costs, and total costs) underestimate the true costs of operating a business.

9.1 Variable Costs

Variable costs were collected for all West Coast activities, including chartering or research. Unlike fixed costs, variable costs are directly related to fishing operations, and therefore it was possible for vessels to separate expenses for activities on the West Coast from other activities. In all three years, the crew wages made up the largest portion of total variable expenses, followed by captain wages, and fuel and lubrication (Table 9.1). Together, these expenses made up 89.5% of all variable costs on the West Coast in 2011.

Table 9.1: Variable expenses. Average variable expenses on the West Coast for EDC vessels ($) (N = number of EDC vessels with non-zero, non-NA responses).

Expense category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Bait	$9,852	58	$10,848	55	$14,756	71
Captain wages	$79,235	120	$83,004	118	$137,438	126
Communication	$2,294	106	$2,627	101	$2,489	131
Crew wages	$90,355	116	$98,037	114	$144,119	107
Fishing association dues	$4,413	69	$4,448	66	$6,010	94
Food	$5,598	112	$5,704	108	$6,058	106
Freight	$788	14	$992	16	$2,491	20
Fuel and lubrication	$52,728	130	$71,562	125	$81,080	135
Ice	$6,664	94	$5,956	93	$5,870	100
License fees	—		—		$3,191	132
Observers	$5,491	12	$10,362	16	$3,490	111
Offloading	$6,713	42	$7,380	42	$7,423	53
Supplies	$9,010	94	$10,522	88	$6,172	99
Travel	$2,083	31	$2,190	30	$1,801	25
Trucking of fish	$0	0	$3,530	3	$5,248	5
Average total variable costs	$234,515	130	$265,632	127	$364,073	134

9.2 Fixed costs

9.2.1 Costs on vessel and on-board equipment, fishing gear, and processing equipment

Survey participants are asked to provide capitalized expenditures (Table 9.2) and expenses (Table 9.3) for the survey year associated with the following categories:

- New and used vessel and on-board equipment: Includes all electronics, safety equipment, and machinery not used to harvest fish, but not fishing gear or processing equipment

- Fishing gear: Includes nets, doors, traps, pots, cables, and fishing machinery used for the West Coast fisheries
- Processing Equipment: Includes any equipment used to process or head and gut fish on-board the vessel

Table 9.2: Capitalized expenditures on vessel and on-board equipment, fishing gear, and processing equipment. Average capitalized expenditures ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of EDC vessels with non-zero, non-NA responses).

Expenditure category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Vessel and on-board equipment in all fisheries	$84,419	75	$55,548	73	$85,317	99
Fishing gear only used on the West Coast	$26,200	67	$25,817	62	$41,409	93
Fishing gear shared between the West Coast and Other fisheries	$75,457	17	$65,911	20	***	***
Processing equipment used only on the West Coast	***	***	***	***	$3,706	4
Processing equipment shared between the West Coast and Other fisheries	$0	0	$0	0	***	***

Table 9.3: Expenses on vessel and on-board equipment, fishing gear, and processing equipment. Average expenses ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of EDC vessels with non-zero, non-NA responses).

Expense category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Fishing gear repair and maintenance on the West Coast	$22,003	104	$22,943	95	$24,941	108
Fishing gear repair and maintenance shared between the West Coast and Alaska	$60,163	29	$57,955	30	$100,709	31
Processing equipment repair and maintenance in all fisheries	$0	0	***	***	***	***
Vessel and onboard equipment in all fisheries	$69,612	120	$64,579	114	$92,407	119
Average total costs on vessel and on-board equipment, fishing gear, and processing equipment	$94,553	131	$88,860	127	$127,909	132

9.2.2 Other fixed costs

Table 9.4: Other fixed expenses. Average fixed expenses ($) on all other categories (N = number of EDC vessels with non-zero, non-NA responses).

Expense category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Insurance	$35,133	120	$36,631	119	$37,388	131
Lease of vessel	$86,438	12	$108,673	10	$86,546	11
Moorage	$5,635	130	$6,228	124	$5,897	139
Average total fixed costs	$45,347	132	$48,202	129	$48,682	137

Table 9.5: Depreciation. Average depreciation ($) taken during the survey year (N = number of EDC vessels with non-zero, non-NA responses).

Expense	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Expenses on depreciation	$86,704.0	85	$76,542.5	80	$108,638.5	96

9.3 Fixed costs on the West Coast only

As described above, not all costs reported on the EDC forms are for West Coast only operations. Therefore, cost disaggregation was required both to estimate total costs and net revenues on the West Coast and for individual fisheries. Research is currently being conducted to establish a method for allocating vessel level costs to the fishery level. This research explores allocating costs based on three variables, ex-vessel revenue, landings weight (including at-sea deliveries), and days at sea. The analyses below use a "mixed method" which chooses for each cost category the variable for disaggregation that is conceptually consistent with prior expectations from economic theory. A full description of the cost disaggregation method and a sensitivity analysis comparing cost disaggregation by the three variables, and the "mixed" method can be found in the appendix.

Calculation of the costs on vessel and on-board equipment, fishing gear, and processing equipment on the West Coast required first allocating a share of the total shared capitalized expenditures and expenses to the West Coast and then summing the capitalized expenditures and expenses (Table 9.6). The same cost disaggregation methods were also used to calculate the West Coast share of other fixed costs (Table 9.7).

Table 9.6: West Coast costs on vessel and on-board equipment, fishing gear, and processing equipment. Average costs on vessel and on-board equipment, fishing gear, and processing equipment vessel and on-board equipment, fishing gear, and processing equipment on the West Coast (N = number of EDC vessels with non-zero, non-NA responses).

Cost category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Vessel and on-board equipment	$71,628	122	$56,757	118	$111,241	119
Fishing gear	$42,037	125	$44,288	119	$68,962	126
Processing equipment	***	***	***	***	$16,138	6
Average total costs on vessel and on-board equipment, fishing gear, and processing equipment	$108,860	130	$97,904	124	$169,413	130

Table 9.7: West Coast other fixed expenses. Average other fixed expenses on the West Coast (N = number of EDC vessels with non-zero, non-NA responses).

Expense category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Insurance	$23,915	117	$24,986	115	$26,902	121
Lease of vessel	$22,561	12	$48,123	10	$39,455	9
Moorage	$3,772	127	$4,120	120	$4,375	130
Average total other fixed costs	$27,291	130	$30,548	126	$30,955	135

9.4 Summary of West Coast costs

Table 9.8: Summary of costs on the West Coast. Average costs on vessel and on-board equipment, fishing gear, and processing equipment, other fixed costs, and all variable costs on the West Coast (N = number of EDC vessels with non-zero, non-NA responses).

Cost category	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Total costs on vessel and on-board equipment, fishing gear, and processing equipment	$108,860	130	$97,904	124	$169,413	130
Total other fixed costs	$27,291	130	$30,548	126	$30,955	135
Total variable costs	$234,515	130	$265,632	127	$364,073	134

9.5 Quota and permit costs on the West Coast

9.6 Landings taxes and buyback fees

Costs associated with landings taxes were not requested on the catcher vessel forms because it can be calculated based on gross shore-side landings information. These costs were calculated according to the table provided on page 14 of Leonard and Watson (2011)[1] . Unlike in the description in Leonard and Watson (2011), moorage was requested on the EDC forms.

[1]Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

10 Net Revenue and Economic Profit

Net returns from operating a vessel are presented in this section. The level of net returns not only indicates whether a vessel is a viable ongoing business, but also the size of net benefit that is created from society's perspective. Two different measures of net returns are examined. They differ in the types of costs that are taken into account, and therefore, their interpretation and use. The first is a monetary, financial measure that attempts to track a vessel's net cash flow, which we call *net revenue*. It is calculated as revenue minus monetary costs. The only costs that are accounted for are those that are actually paid or associated with a financial transaction. The second measure attempts to track the broader economic performance of a vessel and includes all costs regardless of whether there is a cash or financial transaction. Costs are measured by their true resource costs, which may or may not be equal to monetary outlays. This measure is called *economic profit*[1]. The distinction between the two measures is probably most easily understood through a few examples relevant to fisheries.

Labor costs for the net revenue measure are the total payments to the crew and captain. If work is performed that is not paid for, then it is not included as a cost. This commonly occurs in commercial fishing when the owner of a vessel is also the captain, but does not does not draw a captain's wage. In this case, the net revenue is higher than it would be if the captain drew a wage or hired a captain. In the end, the vessel owner-captain is not necessarily any worse off since s/he is the residual claimant to the net revenue. However, the net revenue would be higher than a comparable vessel that hired a captain.[2] Economic profit, on the other hand, accounts for the cost associated with an owner's time that is used as a captain. This is called an opportunity cost in the economics literature[3], and is typically approximated by the wage of a comparably productive captain[4].

A second example of the difference between net revenue and economic profit is the treatment of vessel capital costs. Again, net revenue only includes costs that are actually paid, which includes items such as vessel repair, maintenance, and upgrades. Economic profit would also include the opportunity cost of owning the vessel, a capital asset. By owning a vessel, the owner foregoes other investment opportunities that would provide a rate of return. This is called the

[1] Whitmarsh D., James C., Pickering H., Neiland A. 2000. The profitability of marine commercial fisheries: a review of economic information needs with particular reference to the UK. Marine Policy, Vol. 24(3), pp. 257-263

[2] The same would also be true when a vessel owner does not receive a wage for work performed to repair or maintain a vessel or gear.

[3] See Boardman, Anthony, David Greenberg, and Aidan Vining. Cost-Benefit Analysis: Concepts and Practice, Prentice Hall, NJ. 2000. pp. 31-32.

[4] A more accurate measure would be the owner-captain's most valued wage off the vessel.

opportunity cost of capital, and is typically approximated by the market rate of return associated with businesses of comparable risk, multiplied by the market value of the vessel.

Both net revenue and economic profit are useful measures for fishery management. Net revenue attempts to measure the annual financial well-being of vessel operations. It can be used to determine if there is a monetary gain or loss, or how changes in fishery management may affect the level of monetary gain or loss. Economic profit is a better indicator of the long-term viability of fishery operations since it includes all costs, and values the costs at their opportunity cost. It can be used to estimate whether there are incentives or disincentives to invest in capital, or enter and leave the fishery. It is also a better measure of the net benefit of the fishery to the nation.

Calculations of net revenue are included in this draft report. The cost categories used in net revenue, based on those reported in the EDC forms, are discussed below. Currently, calculations of economic profit are beyond the scope of the report. Economic profit relies on opportunity costs, which may be different from some of the costs reported on the EDC forms, so additional methods and analyses are required. The EDC Program economists will continue to work on developing measures of economic profit so that it may be included in future reports.

Net revenue is calculated two ways: using only variable costs, and using variable costs plus fixed costs (total costs)[5]. The first calculation is called *variable cost net revenue*, while the second is called *total cost net revenue*. Variable cost net revenue is useful to examine changes in fishery operations that are not so great as to affect fixed costs. For example, the cost of fishing an additional day, or catching an additional metric ton of fish, is better represented by only considering variable costs. Total cost net revenue is usually a better summary measure of financial gain or loss for an entire year, season, or fishery.

There are several caveats associated with the net revenue calculations in this report. As noted in the Section 9, there are a variety of costs that are associated with running a vessel that are not requested by the EDC form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than fishing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, vehicles and transport trucks, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture only costs that are directly related to vessel maintenance and fishing operations, and not costs that are related to activities or equipment off the vessel. Therefore, the EDC calculated net revenue is an underestimate of the true net revenue. The difference is likely much greater for total cost net revenue than variable cost net revenue since most of the excluded costs are fixed costs.

Another caveat is that the EDC forms do not collect information about income taxes or financing costs. This has several implications. The first is that these costs are not included in the net revenue calculations. Therefore, net revenue is greater than it would be otherwise. The second is that in lieu of financing information (principal and interest payments), EDC total cost net revenue uses the total costs associated with vessel and gear purchases, repair, maintenance and improvements. For example, if a new engine is purchased, the total cost of the engine is used, even though the actual cash outlay, if it were financed, would only be the principal and

[5]See Section 9 for a more complete discussion of variable and fixed costs used in this report

interest payments made that year. It is likely that many larger capital costs, and perhaps some operating costs, are financed. This would mean that the actual cash outlays in a particular year for those items would be less than what is used in the EDC for the net revenue calculation. This may balance out over time, because previously financed or purchased capital and equipment are also not included, except for the year in which they are purchased[6]. Total cost net revenue is expected to be representative of actual total cost net revenue only when averaged over many years and across vessels because relatively large capital costs occur periodically.

10.1 Net revenue for all West Coast fishing activities

Average net revenue is calculated for all activities on the West Coast for EDC vessels, and it is reported by fishery for EDC vessels.

West Coast revenue includes all revenue from at-sea deliveries and shoreside landings. The variable and fixed costs do not include costs related to acquiring limited entry permits, quota shares, or quota pounds.

$$\text{Variable cost net revenue} = \text{West Coast revenue} - \text{West Coast variable costs}$$

$$\text{Total cost net revenue} = \text{West Coast revenue} - (\text{West Coast variable costs} + \text{West Coast fixed costs})$$

Table 10.1: West Coast average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue on the West Coast (N = number of vessels). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs (N = number of EDC vessels with non-zero, non-NA responses).

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$443,583	130	$486,567	126	$726,096	132
(Variable costs)	($206,668)	130	($227,833)	126	($314,216)	132
Variable cost net revenue	**$236,915**	**130**	**$258,733**	**126**	**$411,880**	**132**
(Fixed costs)	($136,151)	130	($126,897)	126	($198,505)	132
Total cost net revenue	**$100,764**	**130**	**$131,836**	**126**	**$213,374**	**132**

[6]At best it is just a partial balancing out because the interest payments are not accounted in the EDC data

Table 10.2: Revenues and costs on permits and quota. Revenues and costs from sale, lease, and purchase of limited entry groundfish permits, quota pounds, and quota shares on the West Coast (N = number of EDC vessels with non-zero, non-NA responses).

Type	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Limited entry permit revenues	***	***	309,265	4	140,875	12
Limited entry permit costs	20,277	23	59,644	24	140,814	17
Quota pounds revenues	***	***	333,999	3	103,701	64
Quota pounds costs	19,112	3	48,124	4	77,698	75
Quota shares revenues	***	***	0	0	64,184	13
Quota shares costs	0	0	***	***	***	***

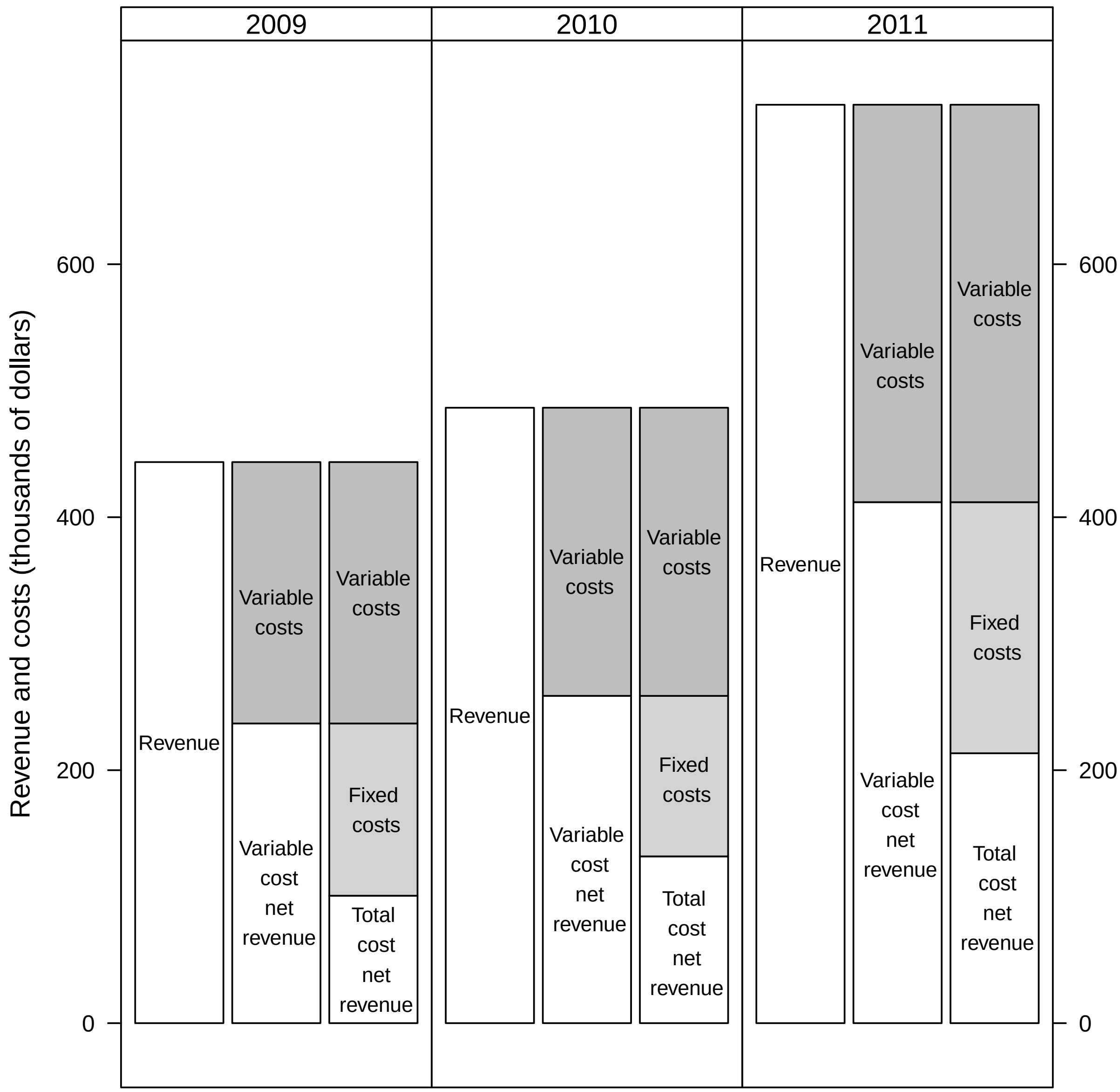

Figure 10.1: West Coast average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue on the West Coast. Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

10.2 Net revenue by West Coast catch share fisheries and other fisheries

Table 10.3: At-sea Pacific whiting fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the at-sea Pacific whiting fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$363,524	20	$465,202	20	$613,489	18
(Variable costs)	($59,341)	20	($77,423)	20	($125,563)	18
Variable cost net revenue	**$304,183**	**20**	**$387,779**	**20**	**$487,926**	**18**
(Fixed costs)	($121,368)	20	($83,098)	20	($159,904)	18
Total cost net revenue	**$182,814**	**20**	**$304,681**	**20**	**$328,023**	**18**

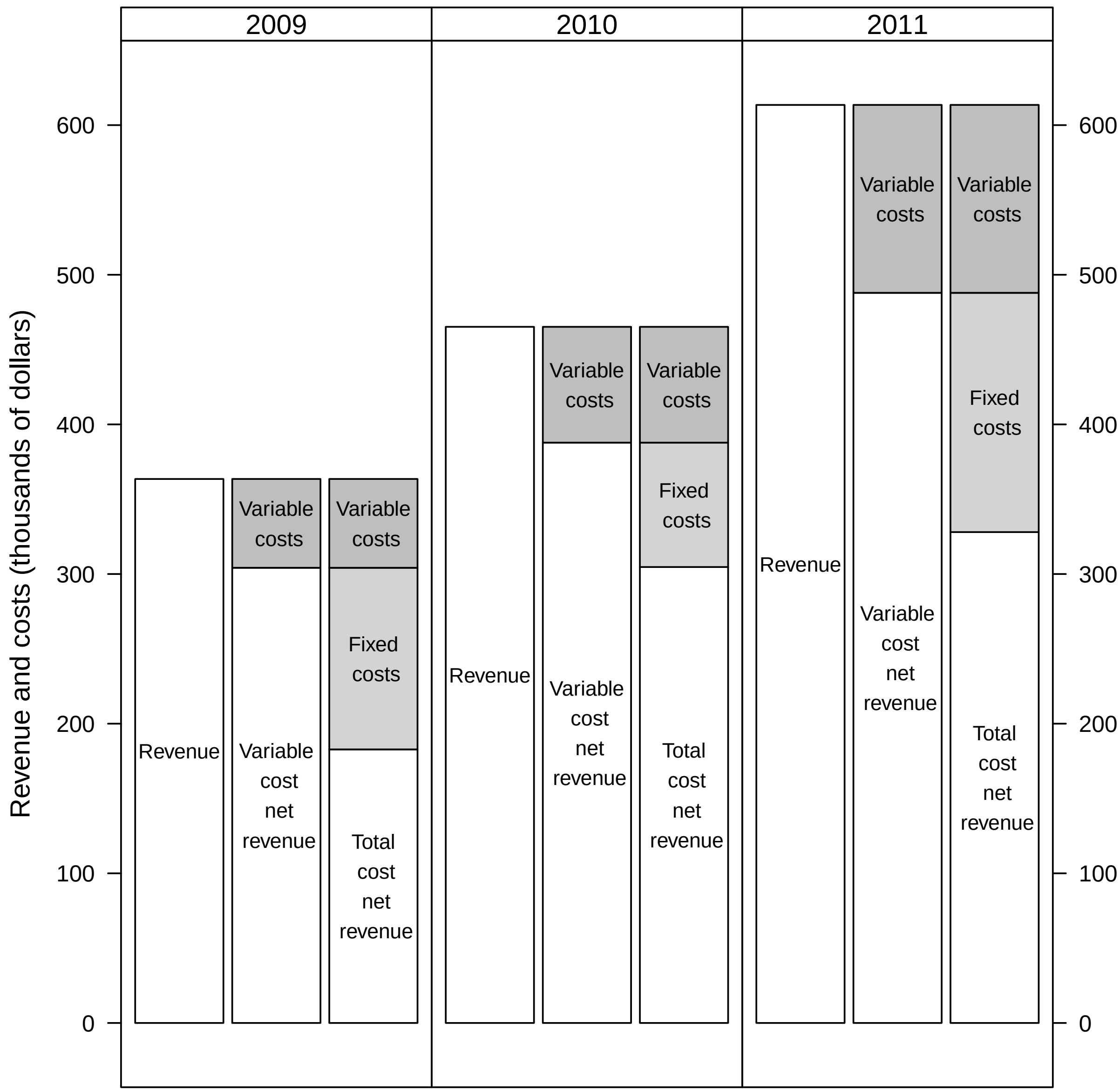

Figure 10.2: At-sea Pacific whiting fishery variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the at-sea Pacific whiting fishery.

Table 10.4: Shoreside Pacific whiting fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the shoreside Pacific whiting fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$187,054	35	$279,318	35	$830,425	26
(Variable costs)	($63,545)	35	($95,057)	35	($260,558)	26
Variable cost net revenue	**$123,509**	**35**	**$184,261**	**35**	**$569,866**	**26**
(Fixed costs)	($111,052)	35	($108,031)	35	($309,555)	26
Total cost net revenue	**$12,457**	**35**	**$76,230**	**35**	**$260,311**	**26**

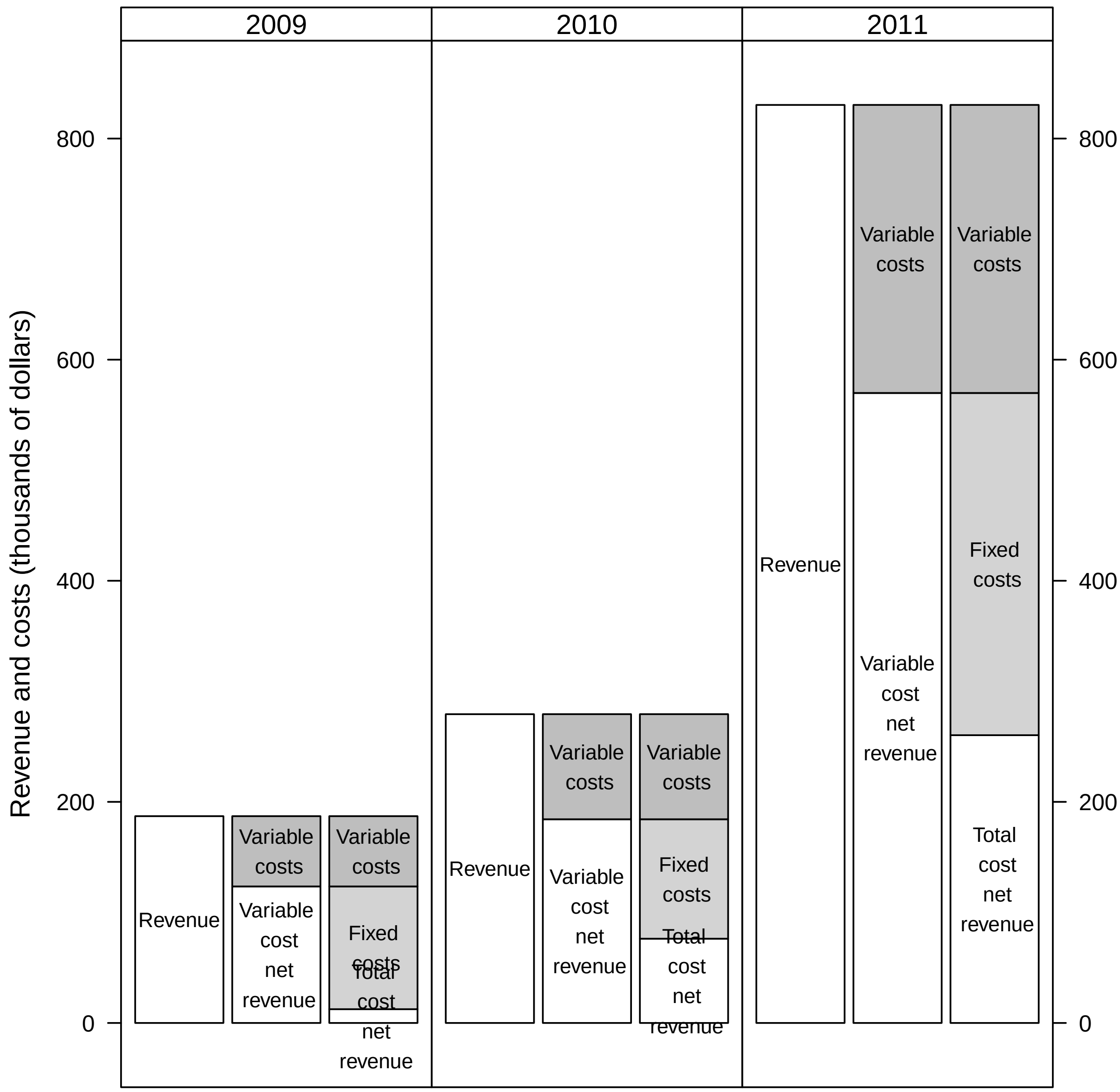

Figure 10.3: Shoreside Pacific whiting fishery variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the shoreside Pacific whiting fishery.

Table 10.5: DTS trawl with trawl endorsement fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the DTS trawl with trawl endorsement fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$252,322	102	$242,959	93	$309,895	65
(Variable costs)	($132,604)	102	($139,060)	93	($171,664)	65
Variable cost net revenue	**$119,718**	**102**	**$103,899**	**93**	**$138,230**	**65**
(Fixed costs)	($69,296)	102	($63,876)	93	($57,851)	65
Total cost net revenue	**$50,422**	**102**	**$40,023**	**93**	**$80,379**	**65**

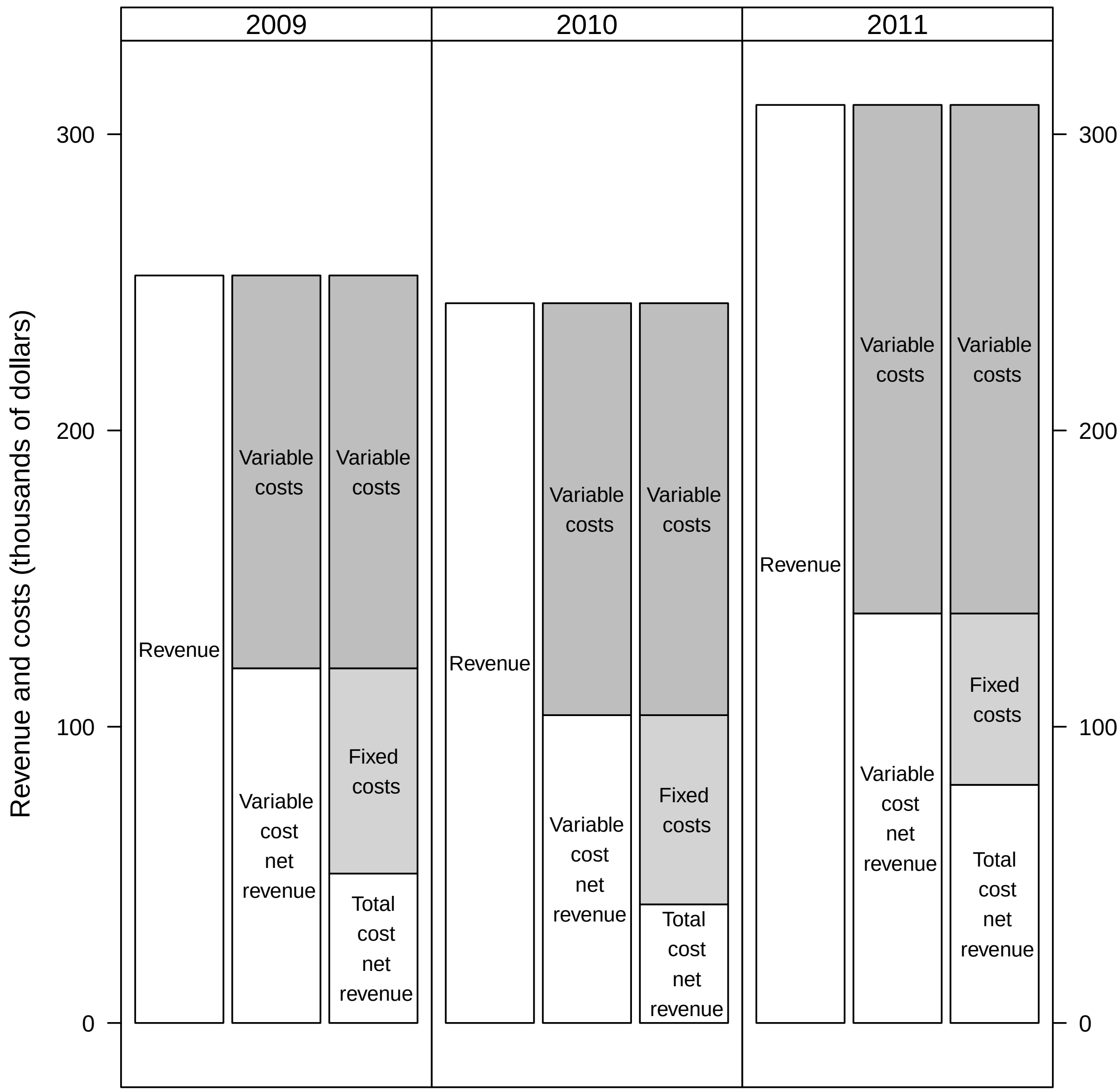

Figure 10.4: DTS trawl with trawl endorsement fishery variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the DTS trawl with trawl endorsement fishery.

Table 10.6: Non-whiting, non-DTS trawl with trawl endorsement fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the non-whiting, non-DTS trawl with trawl endorsement fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$41,687	76	$32,373	62	$89,465	46
(Variable costs)	($27,465)	76	($20,573)	62	($50,168)	46
Variable cost net revenue	**$14,223**	**76**	**$11,801**	**62**	**$39,298**	**46**
(Fixed costs)	($11,821)	76	($9,827)	62	($15,694)	46
Total cost net revenue	**$2,402**	**76**	**$1,974**	**62**	**$23,604**	**46**

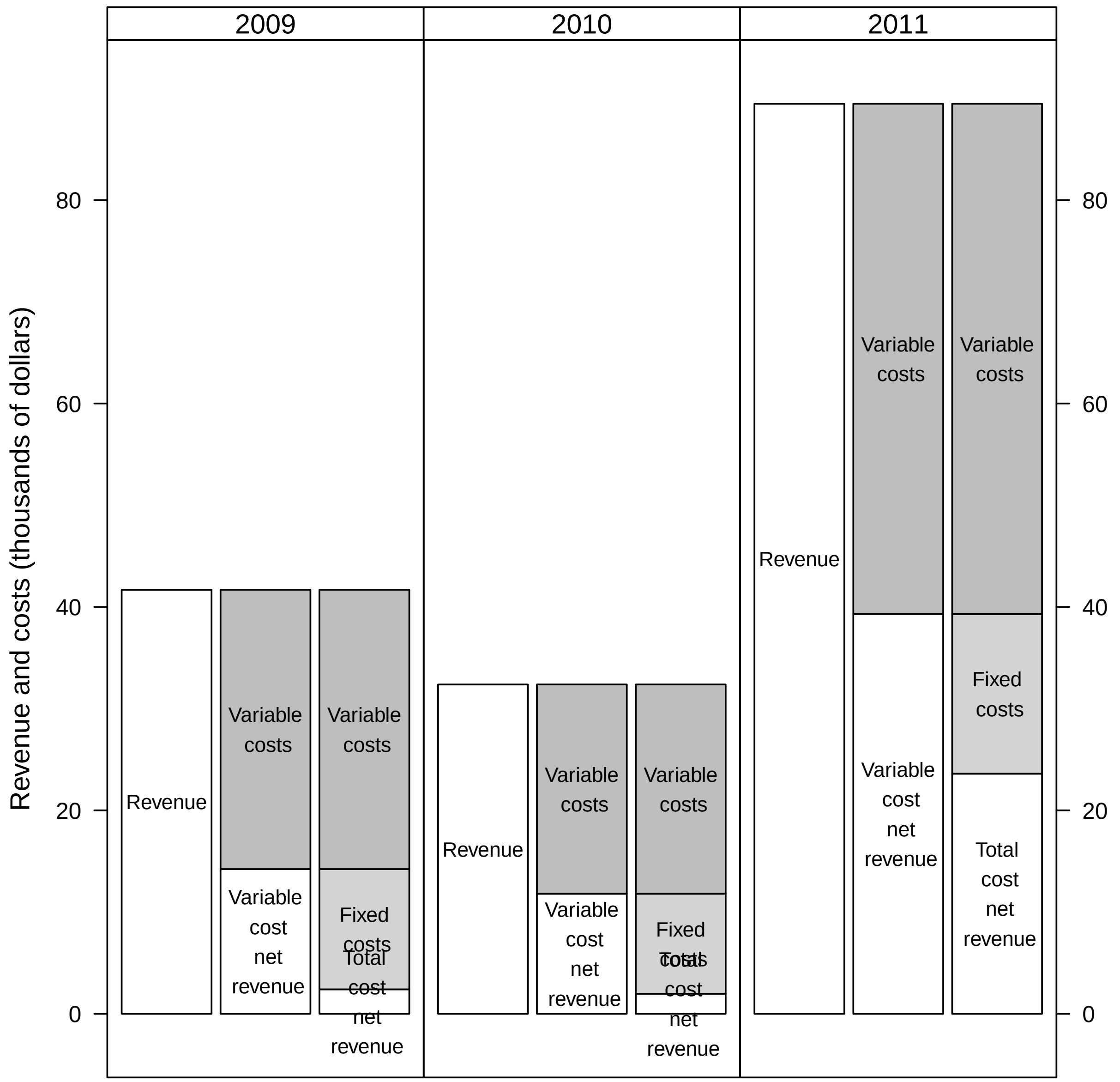

Figure 10.5: Non-whiting, non-DTS trawl with trawl endorsement fishery variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the non-whiting, non-DTS trawl with trawl endorsement fishery.

Table 10.7: Groundfish fixed gear with trawl endorsement fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the groundfish fixed gear with trawl endorsement fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$89,194	5	$137,361	7	$270,411	26
(Variable costs)	($29,534)	5	($54,228)	7	($111,425)	26
Variable cost net revenue	**$59,660**	**5**	**$83,133**	**7**	**$158,986**	**26**
(Fixed costs)	($20,793)	5	($18,517)	7	($107,784)	26
Total cost net revenue	**$38,867**	**5**	**$64,617**	**7**	**$51,202**	**26**

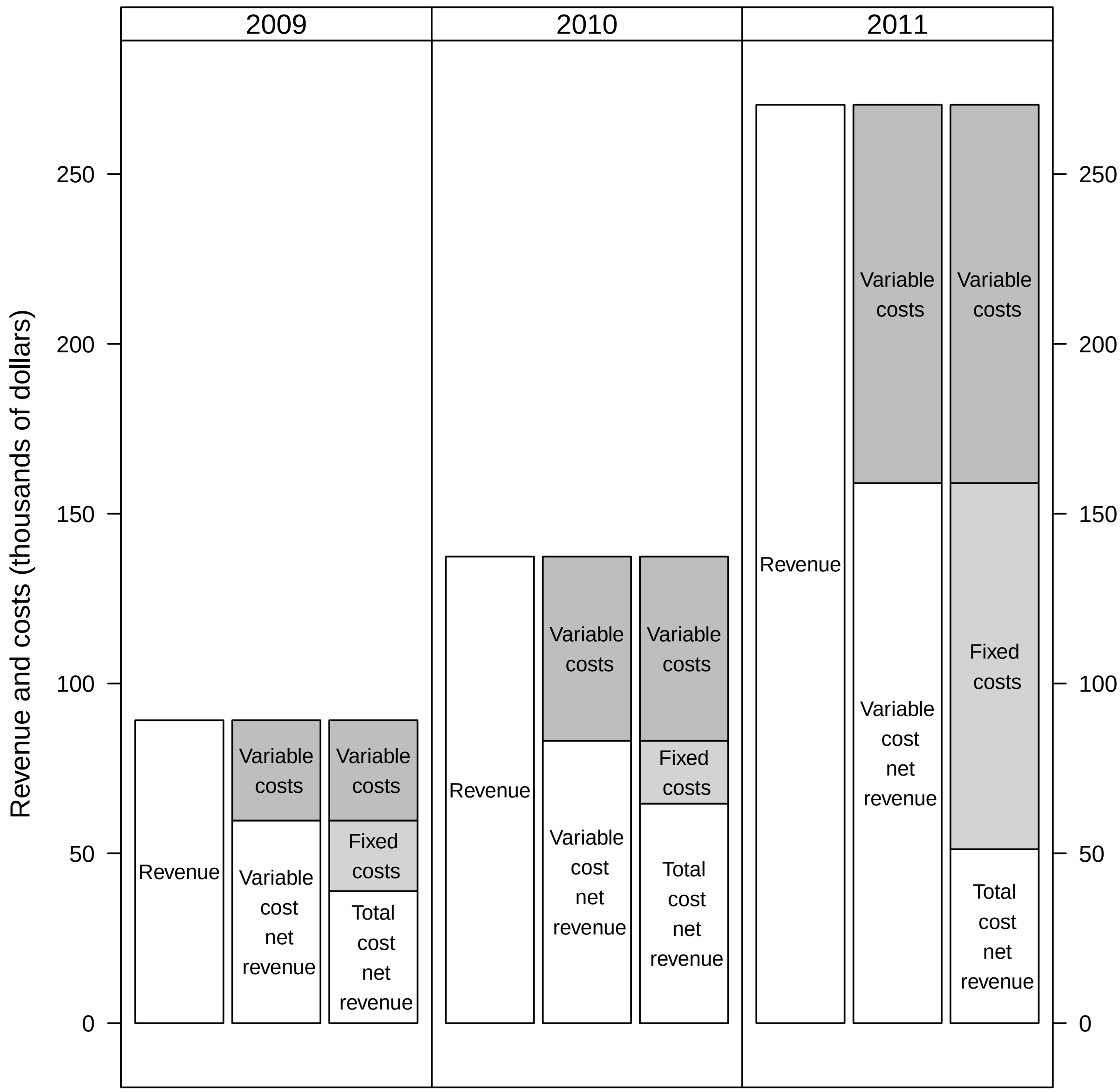

Figure 10.6: Groundfish fixed gear with trawl endorsement fishery variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the groundfish fixed gear with trawl endorsement fishery.

Table 10.8: Other fishery average variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in the other fishery (N = number of EDC vessels with non-zero, non-NA responses). Fixed costs include capitalized expenditures, capital expenses, and other fixed costs.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$178,980	81	$203,211	82	$350,786	91
(Variable costs)	($95,004)	81	($112,730)	82	($176,691)	91
Variable cost net revenue	**$83,976**	**81**	**$90,481**	**82**	**$174,095**	**91**
(Fixed costs)	($40,926)	81	($47,155)	82	($87,818)	91
Total cost net revenue	**$43,050**	**81**	**$43,326**	**82**	**$86,277**	**91**

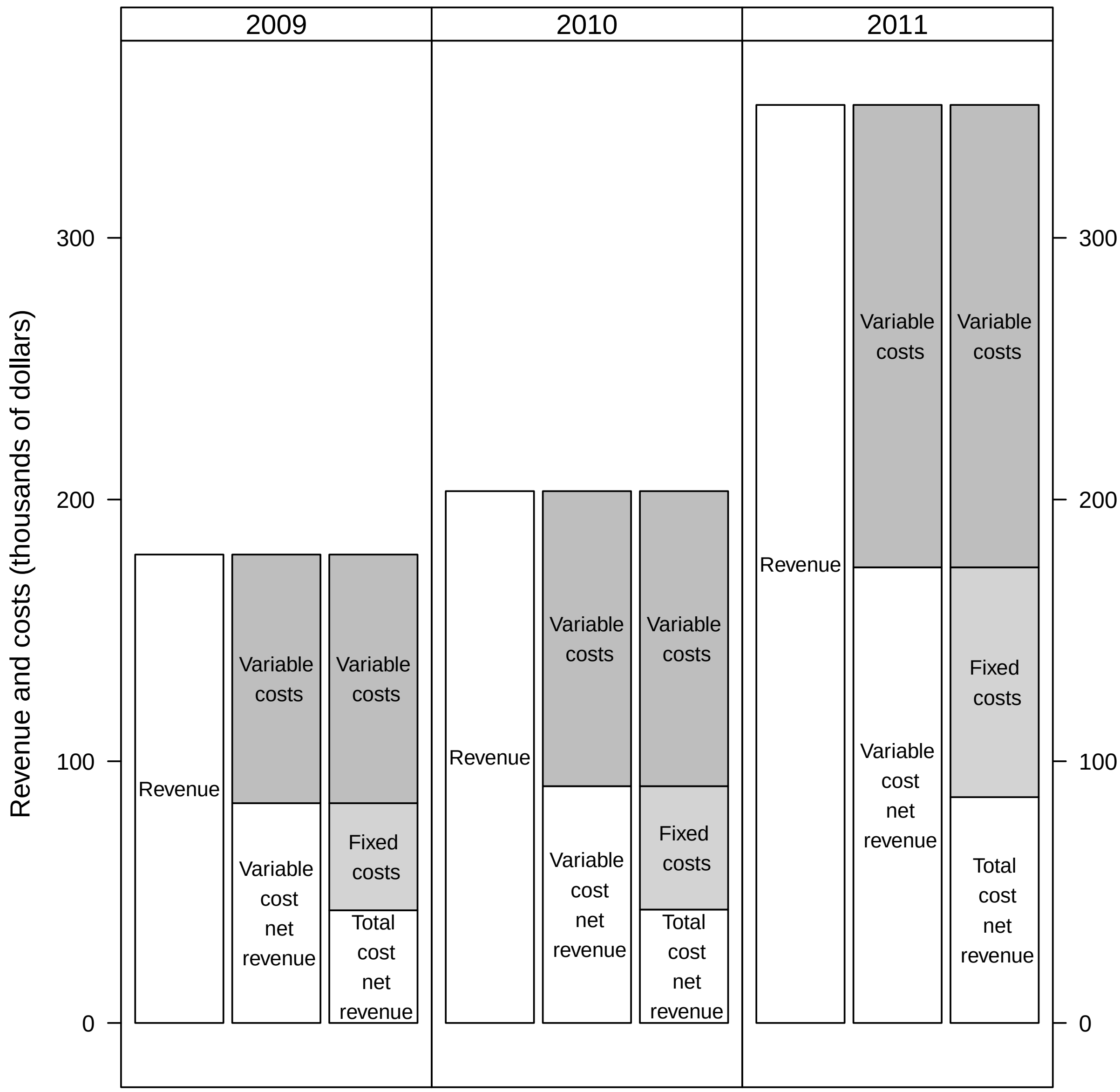

Figure 10.7: Other fisheries variable cost net revenue and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue in other fisheries.

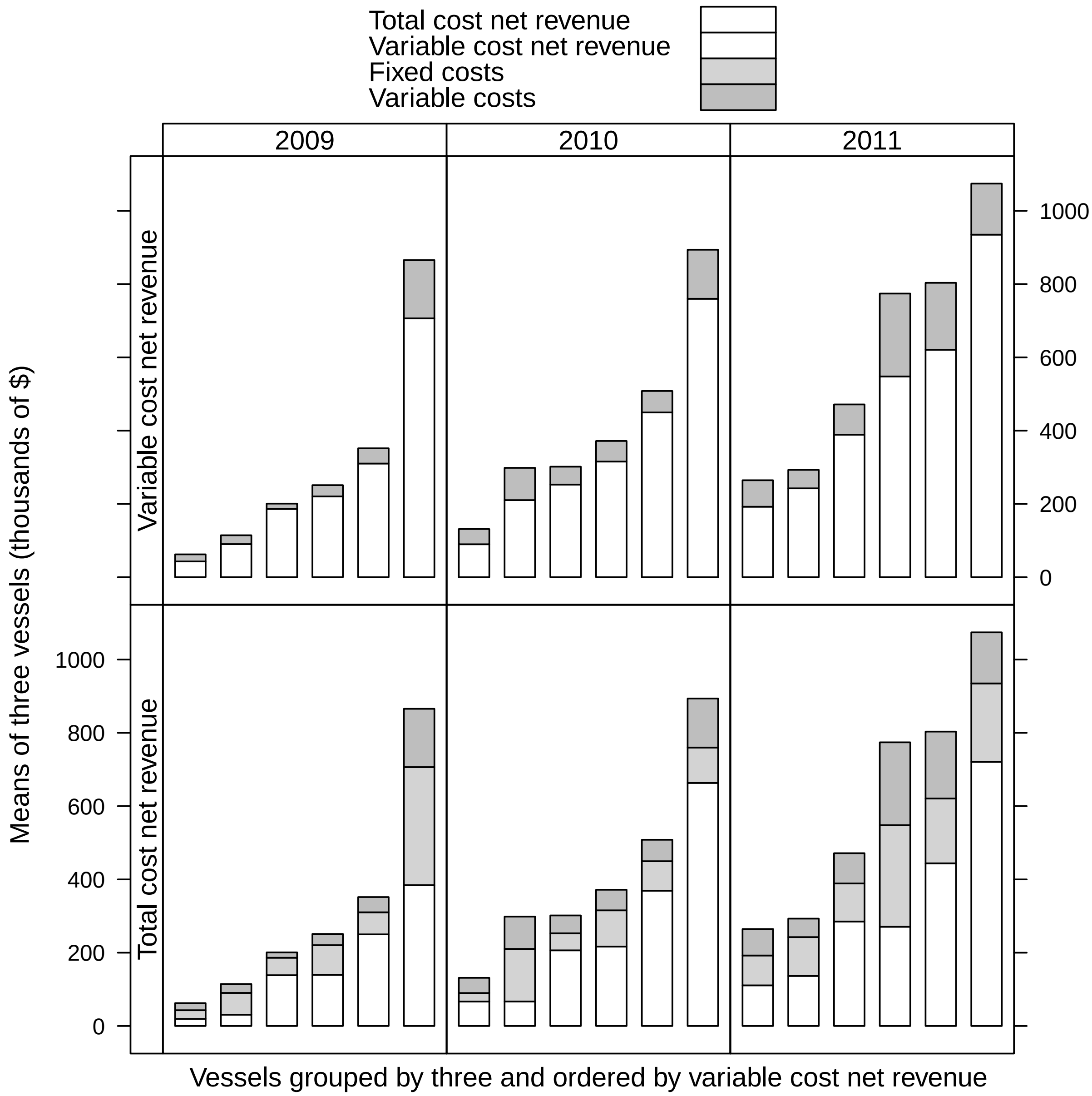

Figure 10.8: Net revenue in the at-sea Pacific whiting fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the at-sea Pacific whiting fishery. To protect confidentiality, vessels were sorted by revenue, put into groups of three vessels, and then means were calculated on the group of vessels.

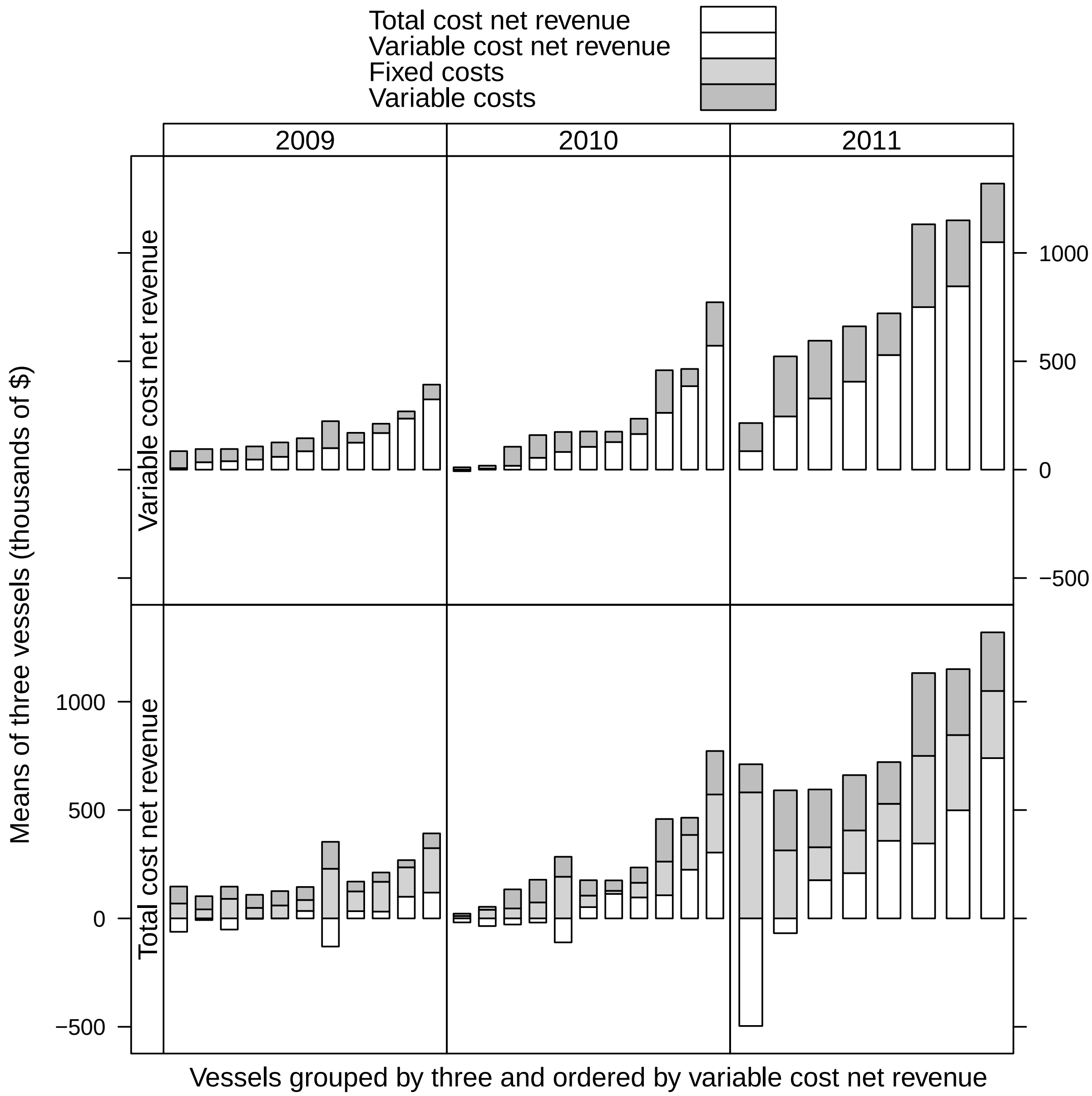

Figure 10.9: Net revenue in the shoreside Pacific whiting fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the shoreside Pacific whiting fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

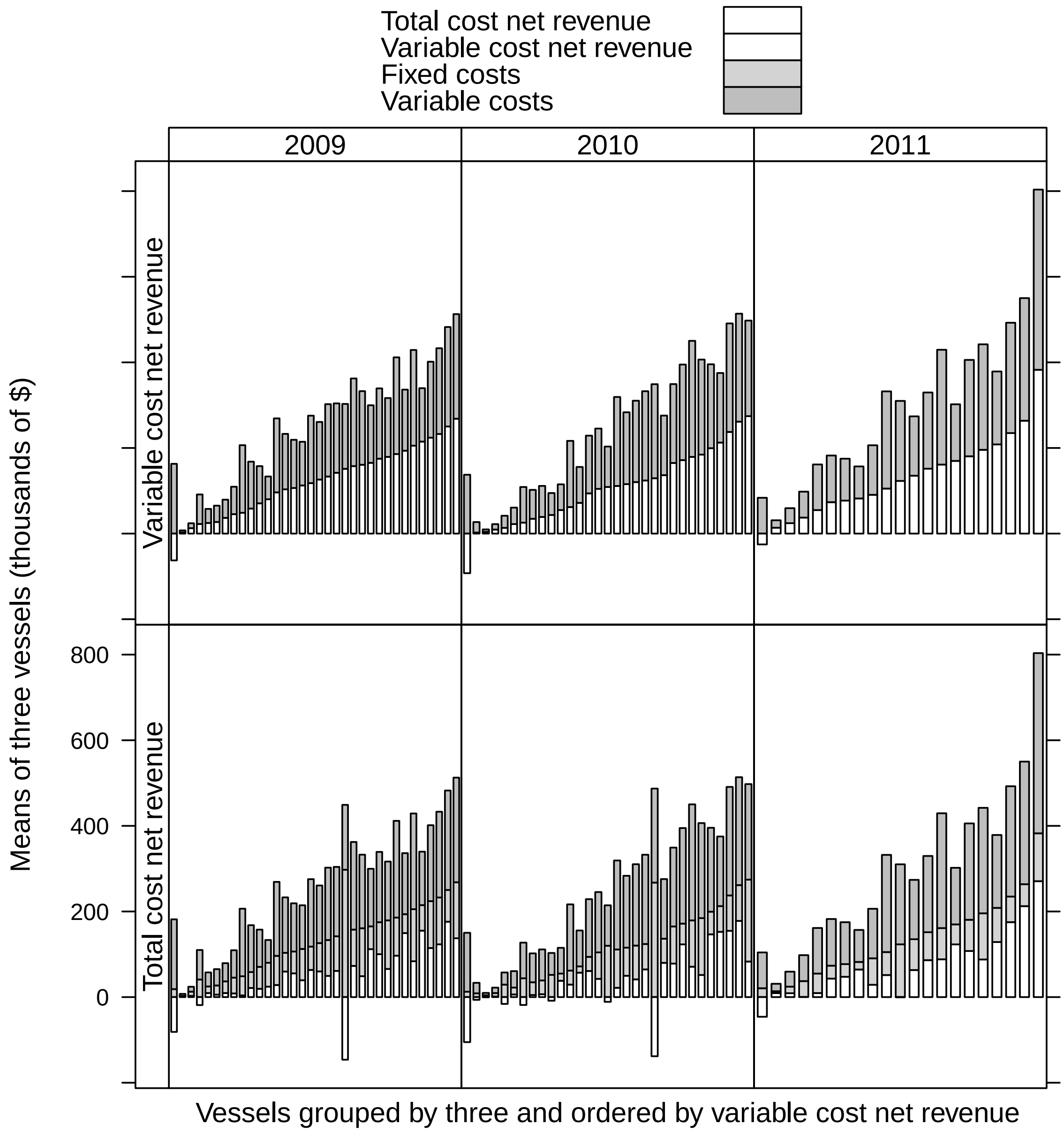

Figure 10.10: Net revenue in the DTS trawl with trawl endorsement fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the DTS trawl with trawl endorsement fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

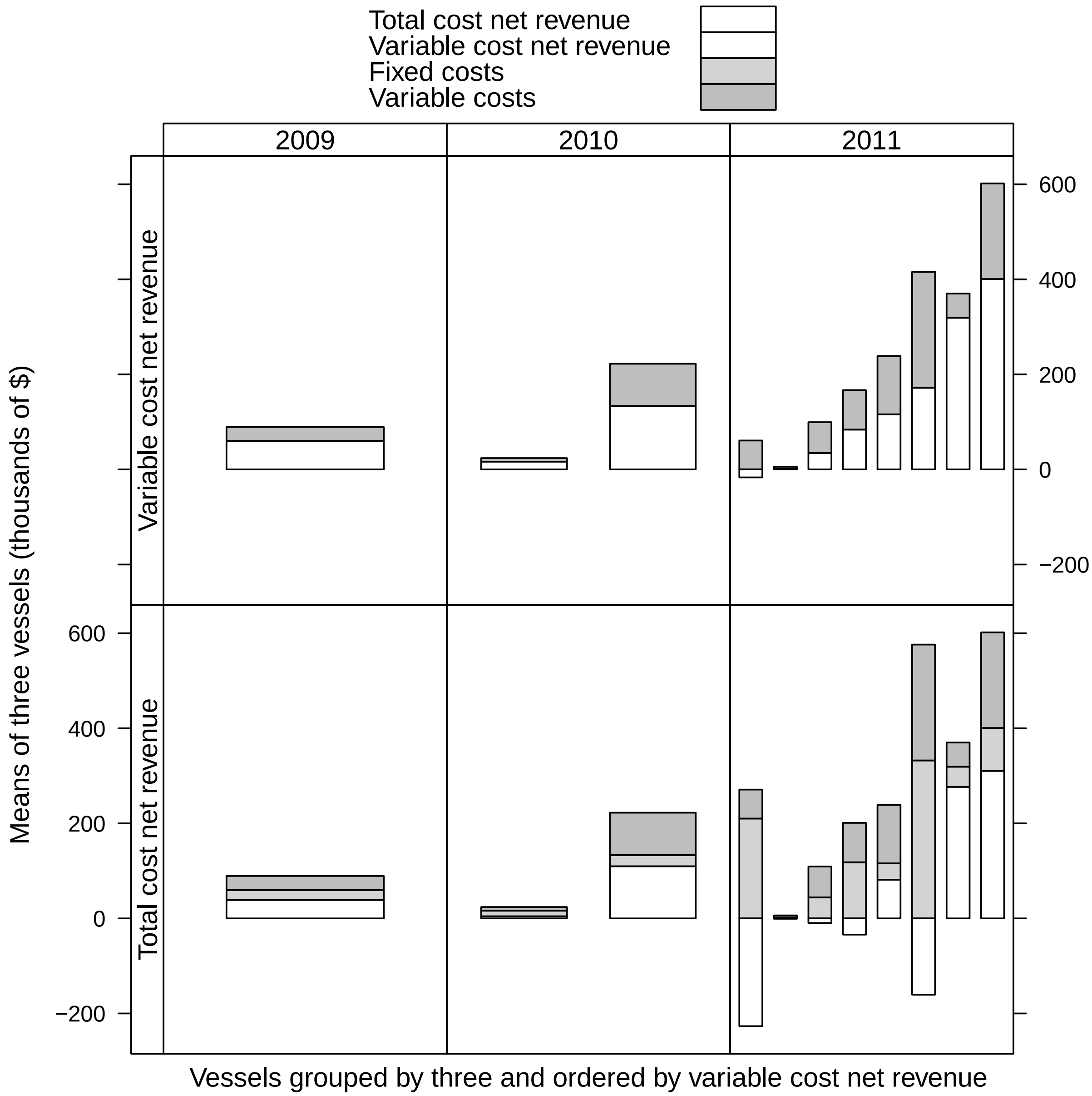

Figure 10.11: Net revenue in the groundfish fixed gear with trawl endorsement fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the groundfish fixed gear with trawl endorsement fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels. There were not enough vessels in the 2009 fishery in order to calculate the means of groups of three vessels.

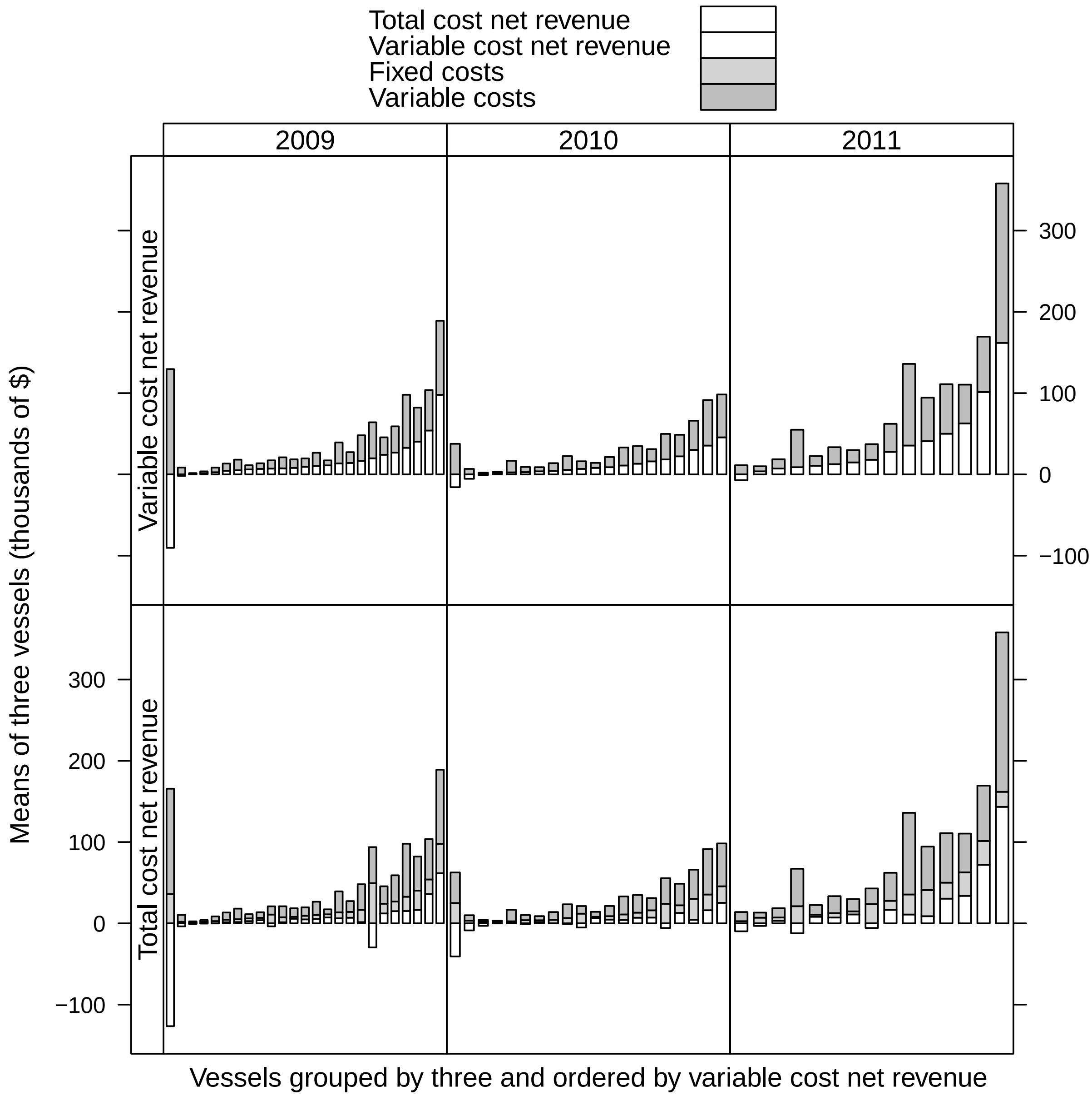

Figure 10.12: Net revenue in the non-whiting, non-DTS trawl with trawl endorsement fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the non-whiting, non-DTS trawl with trawl endorsement fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

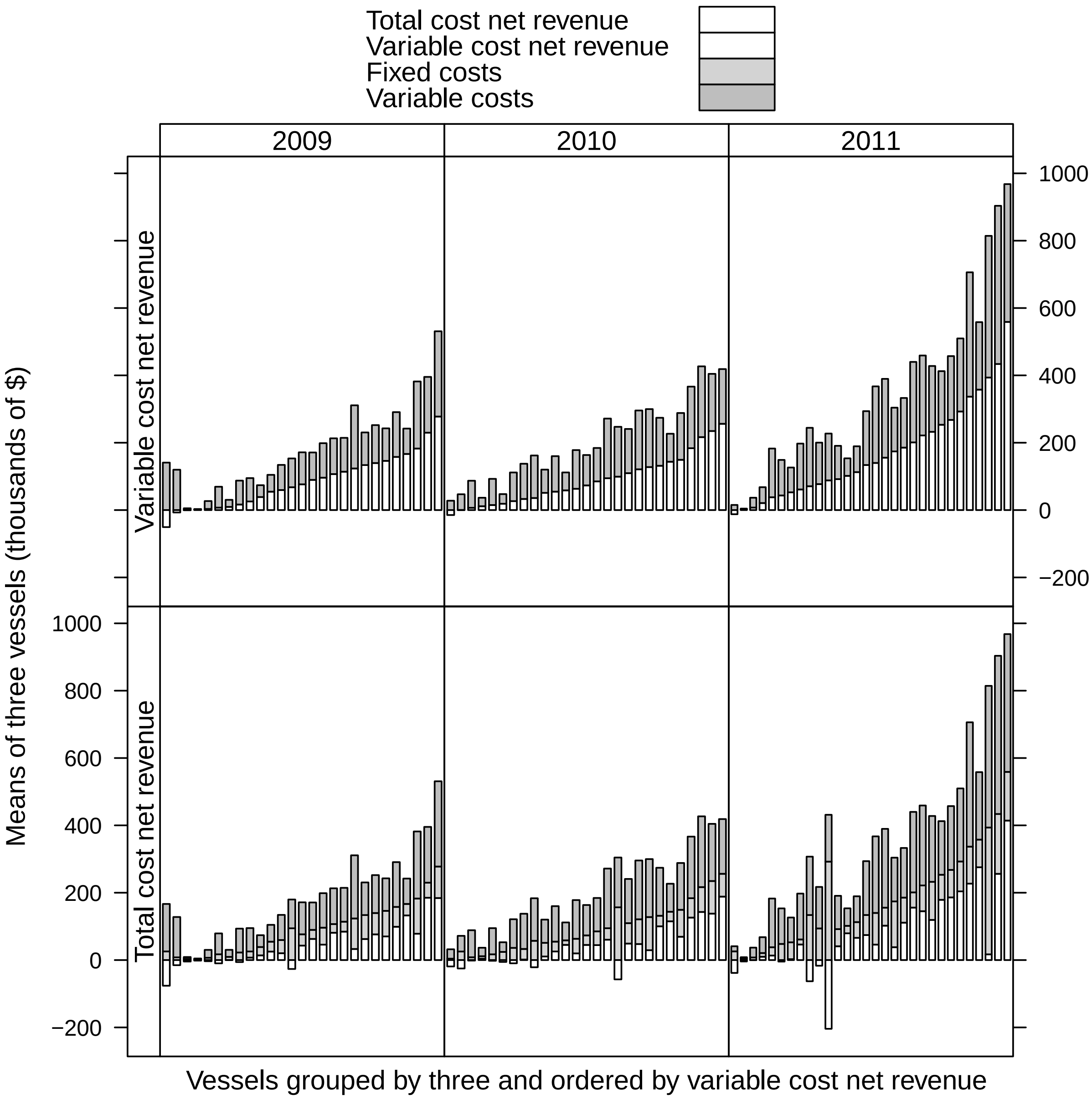

Figure 10.13: Net revenue in the other fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the other fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

11 Crew Share System

The most common system for remunerating crew is the crew share system where crew are paid a percentage of the total revenue earned by the vessel after certain expenses are deducted. Most vessels in the groundfish trawl fishery use this system (Table 11.1).

Table 11.1: Frequency of crew share distributions. Number of entities who used a crew share system, did not use a crew share system, or did not respond to the question. An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Crew share system	2009	2010	2011
YES	127	123	121
NO	5	5	14
No response	1	2	8

Participants were asked to provide the percentage of fishing trips in which the vessel owner served as captain in the West Coast groundfish fishery (Table 11.2). In 2011, 22 participants provided the response "NA". These responses are most commonly a result of ownership of a vessel by an LLC that is not identified with a specific person who could operate the vessel as a captain.

Table 11.2: Percentage of trips with owner operated vessels. Average percentage of trips when the vessel owner served as captain.

Share	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Percentage of trips vessel owner served as captain	34.9	125	33.9	123	38.4	118

Table 11.3: Average crew shares when vessels were owner operated. share paid to captain, crew, vessel, and other on trips when the vessel owner served as captain.

Share	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Captain share	24	41	21	36	23	41
Crew share	24	52	23	52	25	52
Other share	—		—		13	3
Vessel share	59	51	62	51	60	51

Table 11.4: Average crew shares when using a hired captain. Average share paid to captain, crew, vessel, and other on trips when the vessel owner did not serve as captain.

Share	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Captain share	18	94	18	93	18	91
Crew share	22	98	21	96	22	93
Other share	—		—		7	6
Vessel share	60	96	61	94	59	92

Table 11.5: Fixed costs deducted before calculating crew shares. Percent of entities who deducted fixed costs by cost category (N = number of entities that used a crew share system to pay its crew when operating in the West Coast groundfish fisheries during the survey year). An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Expenses category	2009		2010		2011	
	%	N	%	N	%	N
Depreciation	0%	133	0%	130	—	
Lease of vessel	0%	133	1.5%	130	0.7%	143
Moorage	0%	133	0%	130	—	
Onboard equipment repair and maintenance	0%	133	0%	130	2.8%	143
Repair and maintenance on fishing gear	0%	133	0%	130	—	
Repair and maintenance on processing equipment	0%	133	0%	130	—	

Table 11.6: Variable costs deducted before calculating crew shares. Percent of entities who deducted variable costs by cost category (N = number of entities that used a crew share system to pay its crew when operating in the West Coast groundfish fisheries during the survey year). An entity is defined as a unique combination of an owner or lessee and vessel, whereas as vessel refers to all activities related to that vessel, regardless of the number individuals who owned or leased the vessel.

Expenses category	2009		2010		2011	
	%	N	%	N	%	N
Bait	32.3%	133	31.5%	130	37.8%	143
Buy back taxes	—		—		58%	143
Communication	3%	133	2.3%	130	2.8%	143
Fishing association dues	36.8%	133	36.9%	130	32.2%	143
Food	46.6%	133	42.3%	130	51.7%	143
Freight to the vessel on supplies	0%	133	0%	130	0.7%	143
Fuel and lubrication	55.6%	133	57.7%	130	64.3%	143
Ice	47.4%	133	44.6%	130	45.5%	143
Insurance	2.3%	133	1.5%	130	1.4%	143
Licensing fees	—		—		4.2%	143
Limited entry permit	0%	133	0.8%	130	2.1%	143
Observer coverage	14.3%	133	16.9%	130	46.9%	143
Offload fees	24.1%	133	21.5%	130	27.3%	143
Other expenses	15.8%	133	16.2%	130	9.1%	143
Other permits	0%	133	0%	130	0%	143
Other supplies	1.5%	133	2.3%	130	2.1%	143
Quota pounds held at the start of the year	0%	133	0%	130	NaN%	0
Quota pounds purchased or leased during the year	6%	133	4.6%	130	28%	143
Quota shares purchased or amortized during the year	0%	133	0%	130	2.8%	143
Travel	1.5%	133	1.5%	130	5.6%	143
Trucking of fish	3%	133	2.3%	130	3.5%	143

12 Cost, Revenue, and Net Revenue Rates

Table 12.1: West Coast average variable cost and total cost net revenue per West Coast fishing day and per West Coast shoreside or at-sea pound landed. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue on the West Coast. Fixed costs include capitalized expenditures, capital expenses, and other fixed costs. West Coast days include days at sea in any West Coast fishery.

Description	2009	2010	2011
	Mean	Mean	Mean
Revenue per day	$5,488	$6,086	$9,672
Revenue per metric ton landed	$287	$273	$330
Variable cost per day	$2,557	$2,850	$4,185
Variable cost per metric	$134	$128	$143
Variable cost net revenue per day	$2,931	$3,236	$5,486
Variable cost net revenue metric ton	$154	$145	$187
Fixed cost per day	$1,684	$1,587	$2,644
Fixed cost per metric ton	$88	$71	$90
Total cost net revenue per day	$1,247	$1,649	$2,842
Total cost net revenue per metric ton	$65	$74	$97

Appendix A Cost Disaggregation

In order to conduct economic analyses of specific fisheries it is important to have costs broken out by fishery. However, vessels participating in multiple fisheries incur costs that are aggregated across fisheries. These are called joint costs in the economics and accounting literature. They may include fixed costs (e.g., a new engine), or variable costs (e.g., fuel). The former are joined by the nature of the costs, while the latter are joined due to observational limitations. It is difficult to assign fixed costs to a particular fishery because the level of the cost does not vary with vessel participation (at least over the short run).

Some variable costs can be tracked by fishery, but would be costly to do so. For example, although a vessel could theoretically set up a system to track fuel expenditures by fishery, doing so is rare among the EDC catcher vessels. Moreover, some types of fuel use are inherently (by their nature) difficult to allocate, even if they are tracked. An example is a vessel that fishes both on the West Coast and in Alaska. It is not obvious what proportion of the fuel consumed while steaming between the fisheries should be allocated to the West Coast.

Research is currently being conducted at the Northwest Fisheries Science Center to determine the "best" method of cost allocation relative to certain criteria. For the purposes of this report, four different methods were explored: 1) disaggregation by weight of shoreside landings and at-sea deliveries; 2) disaggregation by value of shoreside landings and at-sea deliveries; 3) disaggregation by days at sea; and, 4) disaggregation by a combination of the other three methods by cost category ("mixed method").

Use of these methods requires data from various sources. The total weight and ex-vessel revenue from shoreside landings are obtained from fish ticket data. The total weight of at-sea deliveries is obtained from A-SHOP data, and the ex-vessel revenue from at-sea deliveries in obtained from EDC data. The days at sea are also obtained from EDC data. Landings and days at sea are allocated to specific fisheries using the methods described in Section 3: Vessel Participation on the West Coast and in Alaska.

Alaska landings and revenues obtained from EDC data were appended to the information extracted from the West Coast fish ticket data. This was only done for operators who also operated the vessel on the West Coast. If a vessel only participated in Alaska fisheries, the data were excluded from the analyses. If a vessel fished in Alaska, but the operator of the vessel was different from the operator on the West Coast, the Alaska portion was also excluded.

If the vessel was operated by more than one company during the fiscal year, the range of dates that are used to pull the fish ticket records is adjusted. There are two cases when this would occur: the vessel was leased to a different operator, or the vessel was sold mid-year to another company. In cases where the vessel was sold mid-year, information from the Permit Office must be obtained to determine when the vessel was transferred to a new company. Although both the Coast Guard and the Permit Office track vessel ownership information, we use the Permit Office data as the authoritative source for this information. When the vessel transfers ownership, a new record is made in the Permit Office database and so the dates of operation of the multiple companies can be determined and used as the range of dates for pulling the fish ticket records. Occasionally, the paperwork for vessel sales lags with the change in operation, additional information provided by the participant on the form or other communications is used to adjust the fiscal year used to calculate total revenue to best correspond with the information provided on the form. If the vessel was leased by the owner of the vessel, then the lease dates provided on the EDC form are combined with the fiscal year data to pull the fish ticket records.

Once the total revenues from shoreside landings is calculated, it is then added to the other revenue categories provided on the forms to generate the total revenue. Landings of species associated with zero revenue were excluded entirely from the cost disaggregation analyses.

Listed below are the variables used to disaggregate each cost category for the "mixed" method:

- Costs were disaggregated using ex-vessel revenue for the following cost categories:
  - Capitalized expenditures
  - Crew wages
  - Captain wages
  - Travel
  - Fishery association dues
  - Fees
  - Vessel and on-board equipment.
- Costs were disaggregated using at-sea deliveries and shoreside landings weight for the following cost categories:
  - Bait (only aggregated to non-trawl fisheries)
  - Offload fees
  - Trucking expenses
  - Fishing gear.
- Costs were disaggregated using days at sea for the following cost categories:
  - Food
  - Fuel

- Ice
- Insurance
- Other supplies
- Communications
- Lease of the vessel
- Moorage.

To understand the potential implications of the assumptions associated with the four methods of cost disaggregation, the output of the different methods were examined by looking at the effect on average total cost net revenue on the West Coast. Total cost net revenue by cost disaggregation type are presented in Tables A.1 (cost disaggregation using ex-vessel revenue), Table A.2 (cost disaggregation using at-sea deliveries and shoreside landings),Table A.3 (cost disaggregation using days at sea) and A.4 (cost disaggregation using "mixed method").

Using landings and delivery weight resulted in allocating the largest variable and fixed costs to the West Coast than any other method and therefore the lowest total cost net revenue. The days at sea method resulted in the highest total cost net revenue. Although the different methods resulted in different allocations of costs, figures A.1, A.2, and A.3 show that there were no major differences between the methods.

Table A.1: Net revenue using ex-vessel revenue for cost disaggregation. Total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue for all West Coast operations using ex-vessel revenue to disaggregate costs from other fisheries.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$443,583	130	$486,567	126	$726,096	132
(Variable costs)	($206,797)	130	($228,678)	126	($315,671)	132
Variable cost net revenue	**$236,786**	**130**	**$257,889**	**126**	**$410,424**	**132**
(Fixed costs)	($132,138)	130	($123,514)	126	($194,863)	132
Total cost net revenue	**$104,648**	**130**	**$134,375**	**126**	**$215,562**	**132**

Table A.2: Net revenue using at-sea deliveries and shoreside landings for cost disaggregation. Total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue for all West Coast operations using at-sea deliveries and shoreside landings to disaggregate costs from other fisheries.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$443,583	130	$486,567	126	$726,096	132
(Variable costs)	($213,006)	130	($236,884)	126	($325,704)	132
Variable cost net revenue	**$230,577**	**130**	**$249,683**	**126**	**$400,392**	**132**
(Fixed costs)	($149,875)	130	($135,220)	126	($206,579)	132
Total cost net revenue	**$80,702**	**130**	**$114,462**	**126**	**$193,812**	**132**

Table A.3: Net revenue using days at sea for cost disaggregation. Total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue for all West Coast operations using days at sea to disaggregate costs from other fisheries.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$443,583	130	$486,567	126	$726,096	132
(Variable costs)	($205,743)	130	($227,443)	126	($310,256)	132
Variable cost net revenue	**$237,839**	**130**	**$259,124**	**126**	**$415,839**	**132**
(Fixed costs)	($129,862)	130	($122,794)	126	($189,186)	132
Total cost net revenue	**$107,978**	**130**	**$136,330**	**126**	**$226,654**	**132**

Table A.4: Net revenue using the mixed method for cost disaggregation. Total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue for all West Coast operations using the mixed method to disaggregate costs from other fisheries.

	2009		2010		2011	
	Mean	N	Mean	N	Mean	N
Revenue	$443,583	130	$486,567	126	$726,096	132
(Variable costs)	($206,668)	130	($227,833)	126	($314,216)	132
Variable cost net revenue	**$236,915**	**130**	**$258,733**	**126**	**$411,880**	**132**
(Fixed costs)	($136,151)	130	($126,897)	126	($198,505)	132
Total cost net revenue	**$100,764**	**130**	**$131,836**	**126**	**$213,374**	**132**

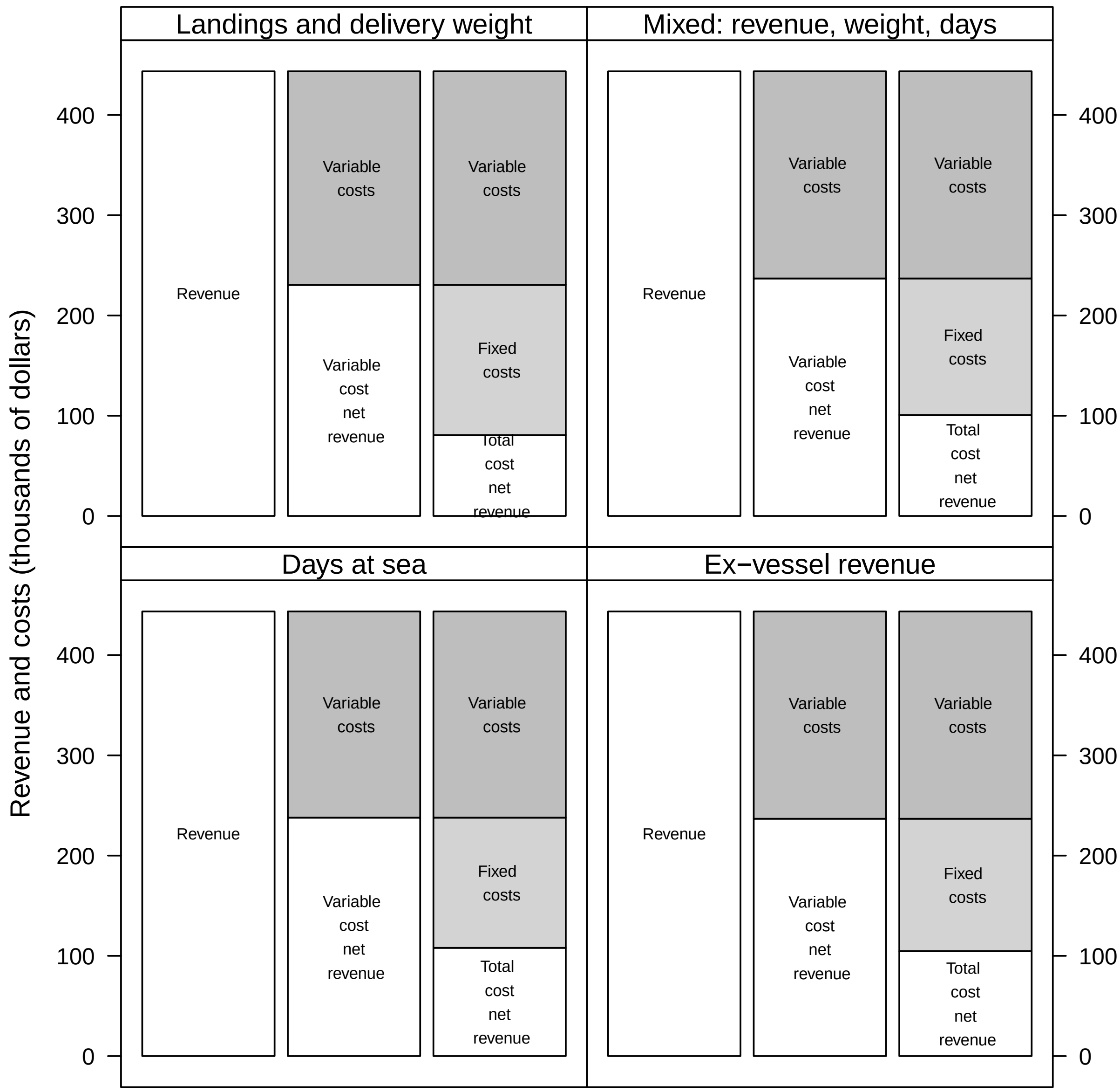

Figure A.1: Sensitivity analysis 2009 cost disaggregation methods. Sensitivity analysis for 2009 cost data of four different cost disaggregation methods in terms of variable costs, fixed costs, variable cost net revenue, and total cost net revenue. The three methods are disaggregation by landings and delivery weight, days at sea, ex-vessel revenue, and "mixed" where costs are disaggregated by one of the three methods depending on the type of cost.

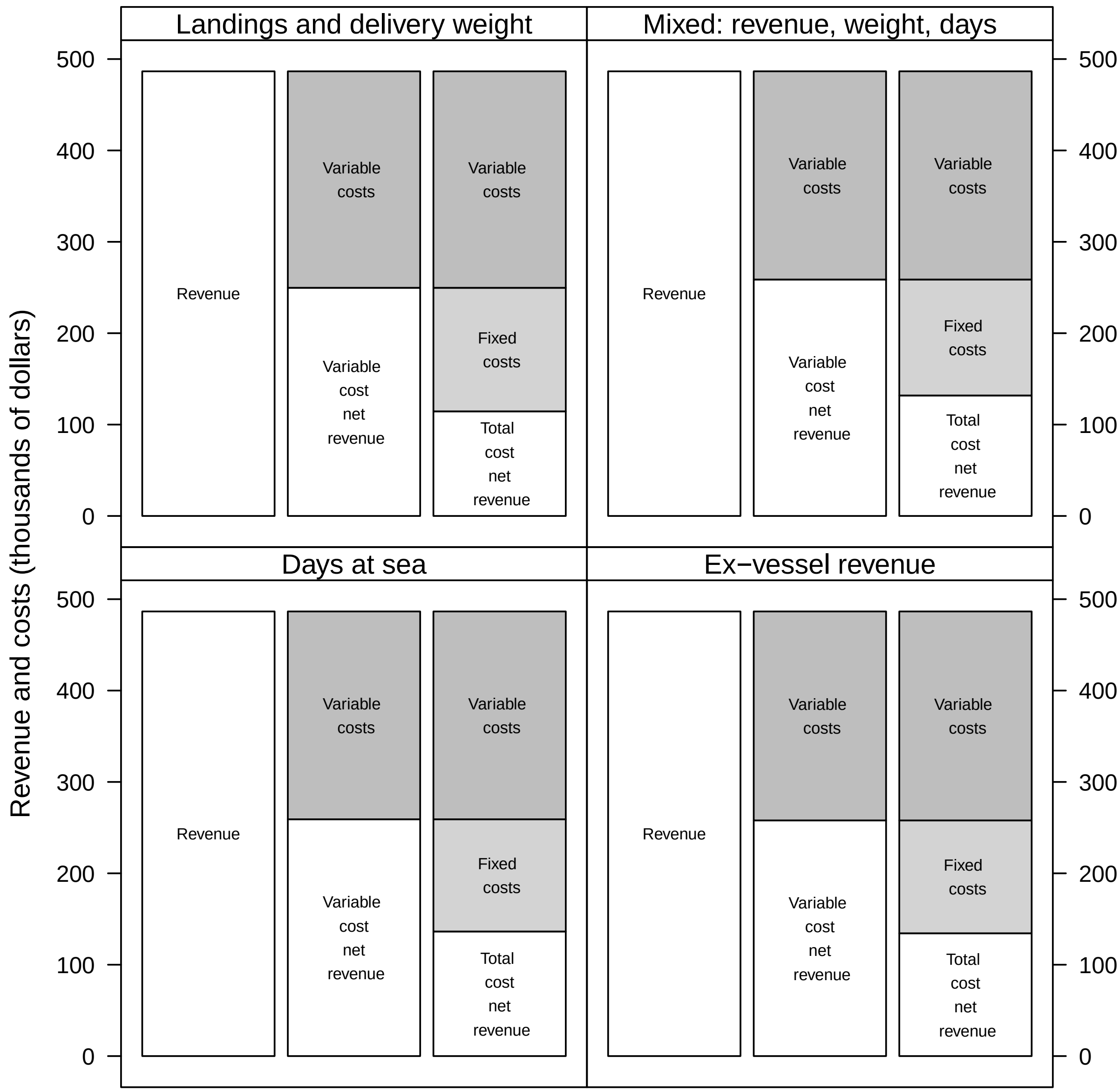

Figure A.2: Sensitivity analysis 2010 cost disaggregation methods. Sensitivity analysis for 2010 cost data of four different cost disaggregation methods in terms of variable costs, fixed costs, variable cost net revenue, and total cost net revenue. The three methods are disaggregation by landings and delivery weight, days at sea, ex-vessel revenue, and "mixed" where costs are disaggregated by one of the three methods depending on the type of cost.

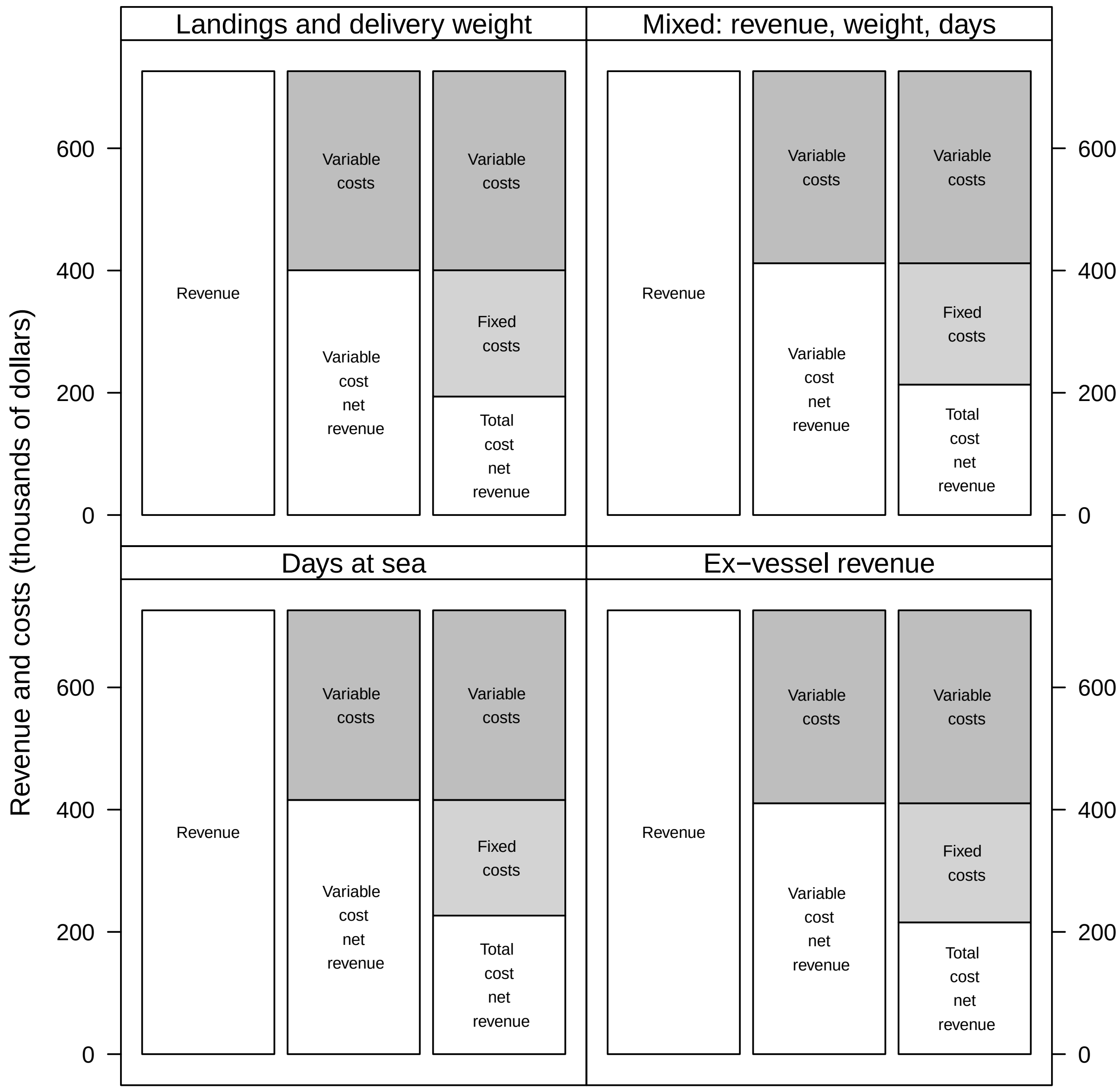

Figure A.3: Sensitivity analysis 2011 cost disaggregation methods. Sensitivity analysis for 2011 cost data of four different cost disaggregation methods in terms of variable costs, fixed costs, variable cost net revenue, and total cost net revenue. The three methods are disaggregation by landings and delivery weight, days at sea, ex-vessel revenue, and "mixed" where costs are disaggregated by one of the three methods depending on the type of cost.

Economic Data Collection Program

Catcher-Processor Report

Draft Report for PFMC Review

Do Not Cite

Northwest Fisheries Science Center[1]

May 22, 2013

[1]For questions or comments, please contact the EDC Program at nwfsc.edc@noaa.gov.

Contents

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Summary

This report summarizes information collected from the West Coast groundfish trawl catcher-processor fleet as a part of the Economic Data Collection (EDC) program, which was implemented to monitor the economic effects of the 2011 transition of the West Coast groundfish trawl fishery to a catch share program. The catch share program consists of cooperative programs for the at-sea mothership and catcher-processor fleets, and an individual fishing quota (IFQ) program for the shorebased trawl fleet. Annual EDC submissions are required from all fishery participants. The catcher-processor form is available online[1]. This catcher-processor report (and its companion reports covering the other sectors) is the first in what is expected to be an annual series of reports. EDC economists will expand and refine the scope and methods used with each new annual publication.

The report covers the years 2009 to 2011. It contains information about annual participation by catcher-processors in the West Coast and Alaska groundfish trawl fisheries, as well as the physical characteristics, fuel use, and crew size of catcher-processor vessels participating in the West Coast groundfish trawl fisheries. Harvest quantity and the ports of delivery for fishing in Alaska and the West Coast are provided for vessels participating in the West Coast groundfish trawl fisheries. The report also contains variable and fixed cost information, production, revenues, and calculated net revenue from West Coast harvest. Finally, a breakdown of costs, revenue, and net revenue per day at sea, per metric ton of production, and per metric ton of harvest provide the basis for a simple metrics of the economic performance of the catcher-processor fleet.

[1] http://www.nwfsc.noaa.gov/research/divisions/fram/economic_data.cfm

1 Introduction

1.1 Background

In January 2011, the West Coast groundfish trawl fishery transitioned to a catch share program. The catch share program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet, and cooperative programs for the at-sea mothership and catcher-processor fleets. The Economic Data Collection (EDC) program[1] was implemented as part of these new regulations to monitor the economic effects of the catch share program. Annual economic data submissions are required from all fishery participants: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors §50 CFR 660.114.

The catcher-processor fleet on the West Coast has been a cooperative since 1997, when the Pacific Whiting Conservation Cooperative was formed. The Cooperative consists of three companies and all catcher-processor vessels that participate in the Pacific whiting fishery on the West Coast. While the 2011 catch share program changed the structure of the whiting shoreside and mothership fisheries, the catcher-processor fishery has continued to operate as a single co-op.

This draft report summarizes the 2009-11 EDC catcher-processor survey data. The EDC Program has enhanced the quantity and quality of economic information available for analysis and the management of the West Coast groundfish trawl fishery. While costs and earnings data are available for shorebased catcher vessels starting in 2004[2], this is the first data collection from the catcher-processor fleet.

In addition to the catcher-processor report, there are four companion reports:

- Economic Data Collection Program, Administration and Operations Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Mothership Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

[1] Additional information on the EDC Program, including the EDC data collection forms can be found at www.nwfsc.noaa.gov/edc

[2] Lian, C.E. 2010. West Coast limited entry groundfish trawl costs and earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p.

- Economic Data Collection Program, Catcher Vessel Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, First Receiver and Shorebased Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

The Administration and Operations Report describes the EDC Program administration and fielding of the surveys, the EDC forms, data quality controls and quality checks and data processing, and safeguarding confidential information. The other EDC reports provide basic data summaries of the catcher vessel, mothership, and first receiver and shorebased processor forms.

This catcher-processor report and other reports, listed above, comprise the first of what is expected to be an annual series of reports. It is envisioned that over time, the scope of these reports will expand, and the methods used will be refined with each annual publication. As such, the data summaries and analyses may change in subsequent years as improvements are implemented. Future reports will contain additional summaries that describe the variation of the data, either numerically or graphically. They are not contained in this report due to time constraints.

1.2 Purpose of the report

This report, like the other three EDC data summary reports, has multiple objectives. The first is to provide basic economic data summaries that can be used for a variety of purposes associated with fishery management. Since much of the data collected are confidential under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, the data are summarized as averages or totals for each question on the EDC forms. Thus summarized, the reports make the data available to the public for both research and informational purposes.

Second, the data summary reports provide information about the performance of the catch share program. This includes information that can be used to monitor whether and to what degree the goals of the program are being met. It is expected that additional modeling will provide increased detail about program impacts. These reports will serve as the basis for the 5-year review of the catch share program that is mandated in the MSA, as well as the NMFS National Catch Shares Performance Indicators. Currently, with just a single year of catch share EDC data, it may be difficult to draw firm conclusions about the performance of the program. In addition, the catch share program may have a transitional period in the first few years as participants learn about the system and develop new business strategies.

Third, the reports either provide or serve as the basis for economic models that will be used as part of the Pacific Fishery Management Council's (PFMC) biennial specification process for groundfish management. These models include the IO-PAC model[3], as well as estimates of

[3]Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

revenue, costs, and net revenue.

Lastly, and perhaps most importantly, the data reports are expected to provide a useful catalyst for feedback on the data collected and its analysis.

1.3 Catcher-processor form administration

Completion of EDC forms is mandatory for participants in the catch share program. Survey participants are identified using contact information provided by the Northwest Regional Office Permit Office. The regulations for defining who is required to complete an EDC form differs between 2009 and 2010 data collection and all annual/ongoing data collections for 2011 onward. For the 2009-2010 period, all owners, lessees, and charterers of a catcher processor vessel that harvested whiting in 2009 or 2010 as recorded in NMFS' NORPAC database §660.114(b)(3)(i) are required to complete an EDC form. For 2011 and beyond, all owners, lessees, and charterers of a catcher processor vessel registered to a C/P-endorsed limited entry trawl permit at any time are required to complete an EDC form §660.114(b)(3)(ii). For permit owners, a C/P-endorsed limited entry trawl permit application will not be considered complete until the required EDC form for the permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i). For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC form for that owner for that vessel is submitted, as specified, at §660.25(b)(4)(v). For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC form for their operation of that vessel is submitted.

A calendar year is used to determine which vessels meet the criteria. For example, in 2012 data were collected from all owners, lessees, and charters of a catcher-processor registered to a limited entry trawl permit with a C/P endorsement during 2011. The forms are fielded on this schedule in order to allow participants the time necessary to complete their taxes, which may contain some information that is required on the EDC forms.

If a form has missing information, or the information provided on the form is believed to be incorrect, EDC Program staff will attempt to contact the participant to correct the information. On occasion, the participant cannot be reached or the participant cannot provide the missing information. Missing or inaccurate data are treated on a case-by-case basis during analysis as documented in the Administration and Operations Report. Data are validated and verified with external data sources whenever possible. These data sources include the Permit Office and the At-Sea Hake Observer Program database.

1.4 About the survey participants

One distinguishing factor amongst the vessels that affects interpretation of EDC data is whether the vessel fished in Alaska, the West Coast, or Alaska and the West Coast. Although the questions on the EDC form ask about fisheries on the West Coast, Alaska, and other fisheries, the catcher-processor vessels in the survey population do not fish anywhere other than the West Coast and Alaska. For vessels that participated in the tribal sector of the West Coast at-sea hake fishery, West Coast costs, days at sea, fuel use, and production weight and value have been adjusted to reflect only non-tribal catcher-processor sector activities.

1.5 Understanding the report

The data provided in the summary tables throughout the report are for all vessels that fished on the West Coast during the survey year, unless otherwise noted.

All data submitted via the EDC Program are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) and under NOAA Administrative Order 216-100. In order to protect these data, a rule of three and a rule of 90-10 are implemented. The rule of three requires a response from at least three companies in order to show a summary statistic. The 90-10 rule requires that no single company's value should comprise over 90 percent of the value displayed. In the case of the West Coast whiting catcher-processor fishery, there are only three companies and therefore statistics are only shown in the tables if there was at least one vessel from each catcher-processor company reporting a positive value. The tables show a '***' for data points where there were less than three companies reporting the information, and/or if one company's responses accounted for greater than 90 percent of the average value. Zeroes are shown if all entities reported zeroes. More information about how confidential data are protected in the EDC Program can be found in the Administration and Operations Report.

Although participants are identified on a calendar year basis, they complete the form using information based on the fiscal year of the entity. Currently data are presented for survey year, and therefore data assigned to a survey year may not overlap completely with the calendar year. Information obtained from outside of the EDC Program is adjusted to match the fiscal year provided on each form. For the three years of data collected from catcher processors, all catcher-processors used the calendar year for the fiscal year.

The form had very few changes between the 2009-2010 data collection, and the 2011 collection. The 2009 and 2010 EDC catcher-processor forms asked if the participant harvested or processed any fish during that calendar year, and those who answered "No" were not required to respond to any further questions. This option disappeared on the 2011 form and every participant was required to complete the form in its entirety. The only other change to the forms from 2009-2010 to 2011 pertained to offload locations, with "Tacoma" substituted for "Westport, Hoquiam" in response to input on the 2009 and 2010 surveys.

2 Vessel Participation on the West Coast and in Alaska

The catcher-processor fleet participates in fisheries on the West Coast and Alaska. Table 2.1 provides the average days at sea by activity. Participants are instructed to count partial days as full days when recording days at sea on the forms. In 2011, the vessels spent less time on average off-loading and steaming on the West Coast than in 2009 and 2010, and more days fishing in Alaska in 2011.

Table 2.1: Average days at-sea. Average days at sea by activity in West Coast and Alaska activities for catcher-processor vessels (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Fishing and processing West Coast whiting fishery	36 (5)	52 (6)	42 (9)
Off-loading in the West Coast whiting fishery	***	4 (5)	3 (9)
Steaming in the West Coast whiting fishery	6 (5)	11 (6)	5 (9)
Steaming between West Coast and Alaska	***	23 (6)	19 (9)
Fishing in Alaska	***	111 (6)	190 (9)

Table 2.2 presents the median number of one way trips vessels made steaming between Alaska and the West Coast that year. In 2009, not all companies reported steaming trips and thus to preserve confidentiality we cannot report a value for that year.

Table 2.2: One-way trips steaming between West Coast and Alaska. Median number of one-way trips between the West Coast and Alaska.

	2009 (N)	2010 (N)	2011 (N)
One-way trips to Alaska	***	4 (6)	4 (9)

Table 2.3: Number of vessels that fished on the West Coast and Alaska. The value for 2009 is suppressed because not all companies had vessels that fished in Alaska in 2009.

Description	2009	2010	2011
Number of vessels that fished and processed on the West Coast	5	6	9
Number of vessels that fished and processed in Alaska	*	6	9

3 Delivery Ports

Table 3.1 lists the number of vessels delivering to each port. Some vessels delivered to more than one port in a survey year. This frequency table summarizes responses to the question on the EDC that asks for the percentage of all West-Coast whiting products off-loaded from the catcher-processor vessel at each major West Coast port.

Table 3.1: Off-loading. Total number of vessels that off-loaded in each port.

Location	2009	2010	2011
Off-load in Blaine/Bellingham	0	2	4
Off-load in Seattle	3	3	2
Off-load in Tacoma	2	3	3

4 Vessel Physical Characteristics

Physical vessel characteristics are shown below in Table 4.1. Survey participants were asked to provide basic information about the vessel and its physical characteristics, including market value, replacement value, vessel length, horsepower of main engines, and fuel capacity from the most recent marine survey. Marine surveys are done on a regular basis and are often required for for insurance, financing, and other purposes.

Table 4.1: Average vessel characteristics.

Description	2009 (N)	2010 (N)	2011 (N)
Market value ($)	59,706,000 (5)	57,583,333 (6)	55,181,111 (9)
Replacement value ($)	92,000,000 (5)	86,783,333 (6)	85,944,444 (9)
Length (feet)	301 (5)	281 (6)	304 (9)
Horsepower	6,600 (5)	6,433 (6)	6,800 (9)
Fuel capacity (gallons)	265,884 (5)	212,670 (6)	277,936 (9)

The participants provide information about whether the vessel was hauled out (vessel was removed from the water for maintenance and repairs). Each year about half of all active fishing vessels are hauled out. The information shown below in Table 4.2 provides context that may be used to explain major costs associated with vessel repair and maintenance.

Table 4.2: Haul outs. Number of vessels that were hauled out during their fiscal year.

Hauled Out	2009	2010	2011
Yes	2	3	4
No	3	3	5

5 Vessel Fuel Use and Crew Size

5.1 Fuel use

Table 5.1 contains the vessels' average fuel use per day, for propulsion or other uses, when engaged in West Coast activities. The information in the table below represents the average of the average fuel use provided by participants. As stated for Table 2.3, not all companies had vessels that steamed between the West Coast and Alaska in 2009, and thus this value is suppressed to maintain confidentiality.

Table 5.1: Daily fuel use. Average daily fuel use by activity (gallons per day) (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Fishing, processing, and steaming in the West Coast whiting fishery	7,747 (5)	7,229 (6)	7,750 (9)
Steaming between West Coast and Alaska	***	5,503 (6)	6,242 (9)

In 2011, the average total fuel used by the vessel during the survey year for propulsion or other use in the West Coast whiting fishery was less than in 2010 or 2009 (Table 5.2) . This total excludes fuel used for steaming between the West Coast and Alaska.

Table 5.2: Average total fuel use. Average total fuel use (gallons) per entity (N = number of vessels with non-zero, non-NA responses)

Description	2009 (N)	2010 (N)	2011 (N)
Diesel	362,185 (5)	336,836 (6)	327,614 (9)
Fish oil	***	***	***

5.2 Crew

Table 5.3 presents the average number of processing and non-processing crewmembers when the vessel was operating in the West Coast whiting fishery during the survey year. Processing crew includes line workers, fishmeal crew, quality control, technicians, cleanup, factory managers, combis, and mechanics who work on processing equipment. Non-processing crew includes the captain, deckhands, wheelhouse, galley, and engineers.

Table 5.3: Average crew size. Average size of non-processing crew and processing crew (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Non-processing	24 (5)	21 (6)	32 (9)
Processing	88 (5)	91 (6)	83 (9)

6 Whiting Harvest

Pacific whiting is managed through a bilateral agreement between the United States and Canada, known as the Pacific Whiting Treaty. The agreement allocates a percentage of the harvest quota to U.S. and Canadian fishermen. Once the U.S. allocation has been determined, it is then allocated between catcher-processor, mothership, and shoreside sectors. The annual allocations to the catcher-processor sector (Table 6.1) are taken from the annual *Pacific Whiting Fishery Summary* provided by the Northwest Regional Office[1].

The West Coast data for the catcher-processor sector annual whiting fish purchases in Table 6.1 are provided by the A-SHOP through the Pacific States Information Network (PacFIN) database. The values for average vessel harvest and total fleet harvest in all fisheries (including the West Coast and Alaska) are from a question on the EDC survey that asks participants to provide the total round weight of all fish harvested by the vessel in all fisheries during the survey year.

Table 6.1: Annual catcher-processor allocation, average West Coast whiting harvest per vessel and total West Coast and Alaska harvest in metric tons (N=number of vessels).

Description	2009 (N)	2010 (N)	2011 (N)
Total catcher-processor West Coast whiting allocation	35,376	53,379	75,138
Average West Coast whiting catch by vessel (A-SHOP)	6,910 (5)	9,047 (6)	7,964 (9)
Total West Coast whiting catcher-processor fleet catch (A-SHOP)	34,552 (5)	54,285 (6)	71,679 (9)
Total West Coast and Alaska catcher-processor fleet catch	126,671 (5)	199,475 (6)	453,470 (9)
Average West Coast and Alaska catch by vessel	25,334 (5)	33,246 (6)	50,386 (9)

[1] http://161.55.131.129/Groundfish-Halibut/Groundfish-Fishery-Management/Whiting-Management/2011/upload/2011-summary.pdf

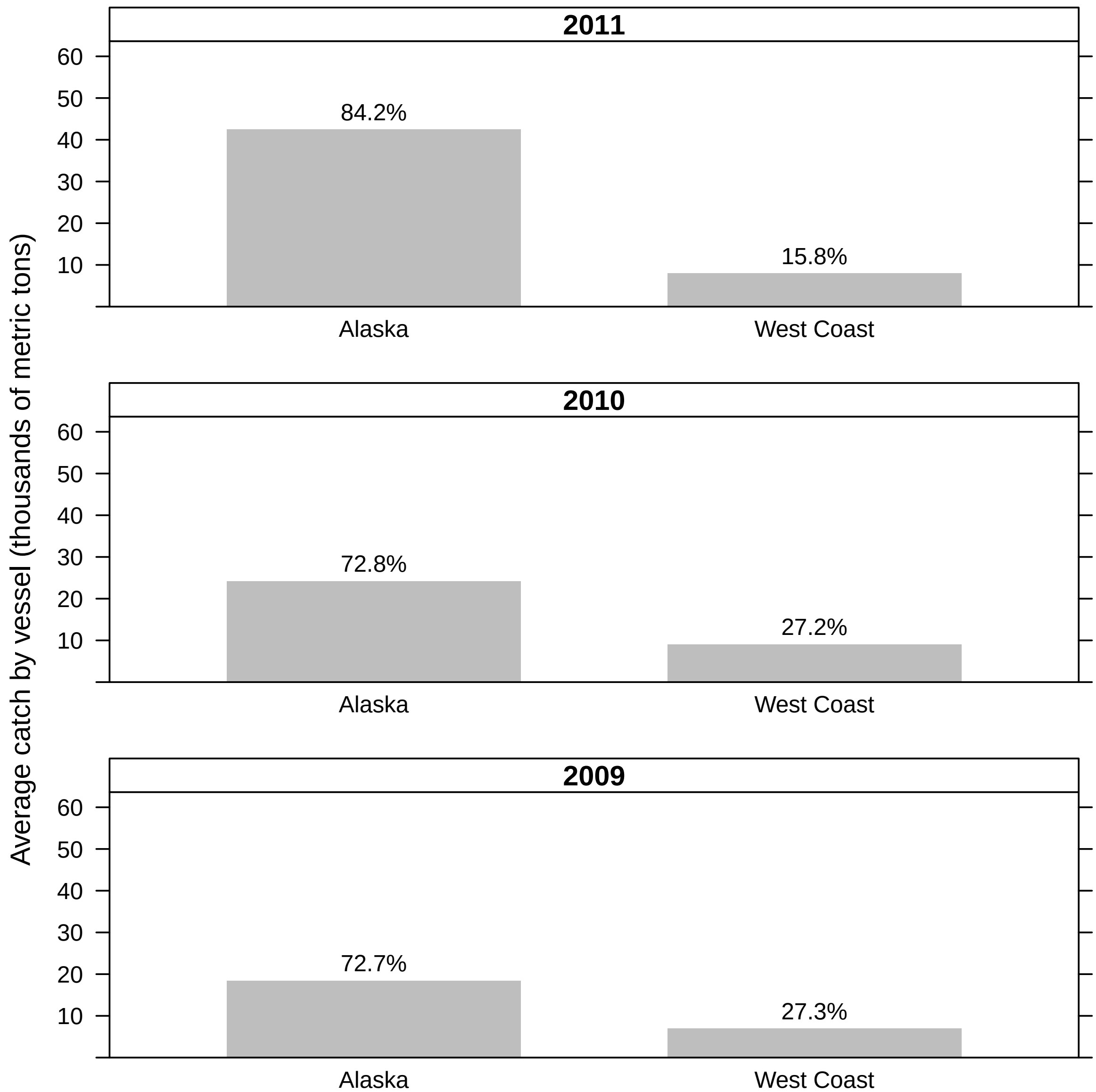

Figure 6.1: Average annual harvest on the West Coast and Alaska. Average annual harvest (thousands of metric tons) from 2009 to 2011 on the West Coast and in Alaska. Percentages above each bar indicate the portion of the total harvest caught in that fishery.

7 Revenue

The EDC forms ask about four forms of revenue: revenue from production of seafood products, revenue from sale or lease of West Coast catcher-processor endorsed permits, revenue from the sale or lease of co-op shares, and revenue from lease or bareboat charter of the vessel. All vessels that fished on the West Coast reported production revenue, but there were no vessels that reported revenue from the other three categories. It is possible that vessels may have made end-of-season informal arrangements regarding leftover quota; however, this type of transfer is not captured by the EDC form.

Tables 7.1 and 7.2 provide summary information on annual production in the West Coast whiting catcher-processor sector. Participants provide total weight of production and value of production by major product categories. These values include any post-season adjustments for products produced during the survey year. Not included in the value of production are any additional payments received to cover shipping, handling, or storage costs associated with the sale beyond the free-on-board (buyer assumes responsibility and liability for the product and pays shipping costs) port of discharge. The revenue only includes fish caught and processed on the West Coast.

Table 7.1: Whiting production weight. Average production weight (metric tons) for whiting (N = number of vessels with non-zero, non-NA responses).

Product Category	2009 MT (N)	2010 MT (N)	2011 MT (N)
Fillets	1,122 (5)	987 (6)	1,130 (9)
Fishmeal	273 (3)	249 (3)	258 (6)
Fish oil	***	65 (5)	38 (7)
Headed and gutted	0 (0)	***	***
Minced	247 (4)	341 (4)	263 (7)
Other	***	***	***
Round	0 (0)	0 (0)	0 (0)
Roe	0 (0)	***	0 (0)
Stomachs	0 (0)	0 (0)	0 (0)
Surimi	953 (5)	1,621 (6)	975 (9)
Average vessel total: all products	2,648 (5)	3,310 (6)	2,722 (9)

Table 7.2: Whiting production value. Average production value ($) for whiting (N = number of vessels with non-zero, non-NA responses).

Product Category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fillets	3,540,092 (5)	3,001,928 (6)	3,141,512 (9)
Fishmeal	401,632 (3)	464,326 (3)	446,899 (6)
Fish oil	***	56,038 (5)	48,632 (7)
Headed and gutted	0 (0)	***	***
Minced	466,712 (4)	705,643 (4)	458,764 (7)
Other	***	***	***
Round	0 (0)	0 (0)	0 (0)
Roe	0 (0)	***	0 (0)
Stomachs	0 (0)	0 (0)	0 (0)
Surimi	1,985,758 (5)	4,761,903 (6)	2,417,943 (9)
Average vessel total: all products	6,502,348 (5)	9,059,110 (6)	6,601,671 (9)

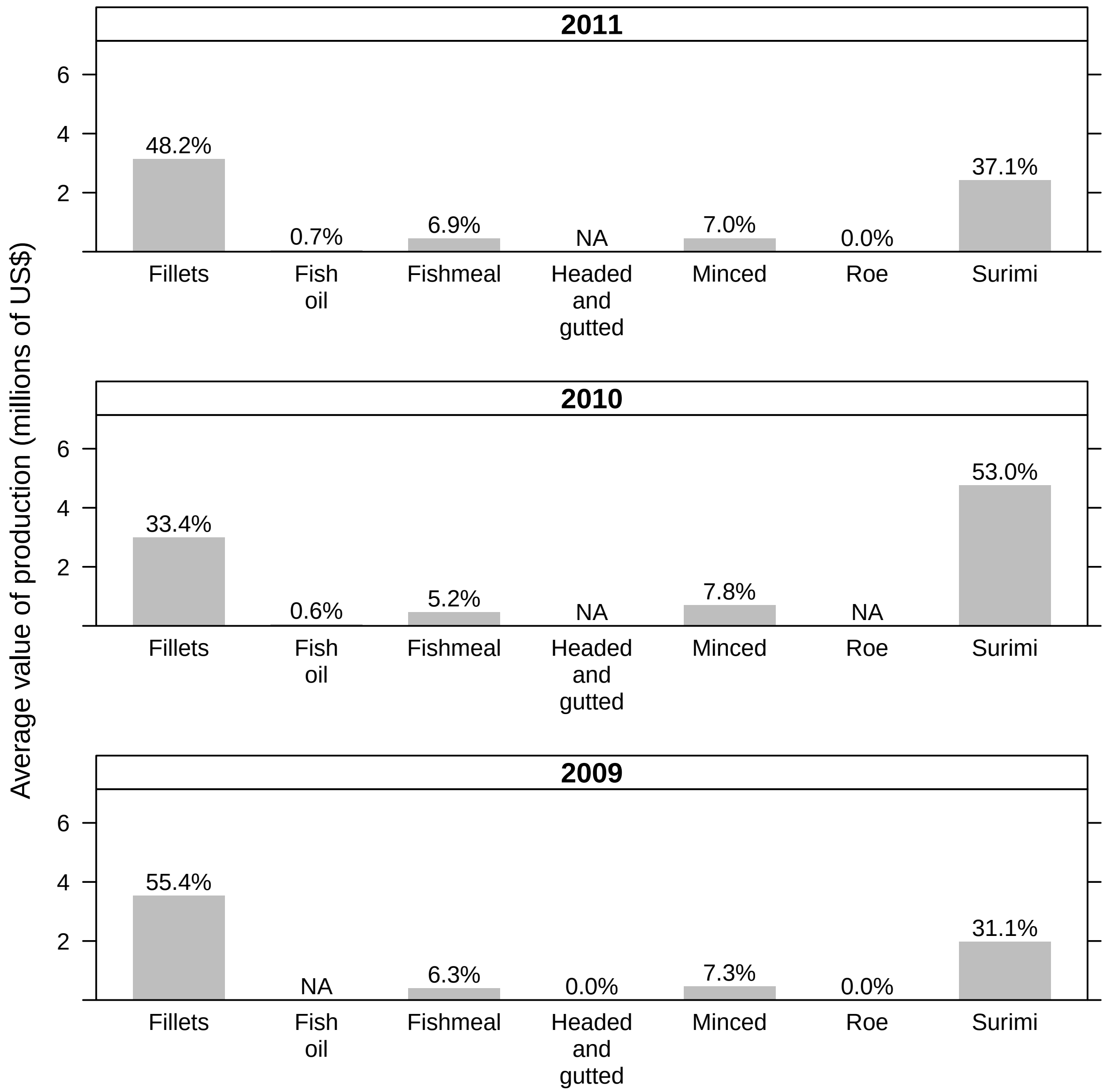

Figure 7.1: Production value by product type and year. Average whiting production value by product type and year. Confidential data have been suppressed and replaced with "NA", product categories where production value was reported as 0 for all vessels for all years are not included. The percentage of each product type of all production is listed on the top of each bar.

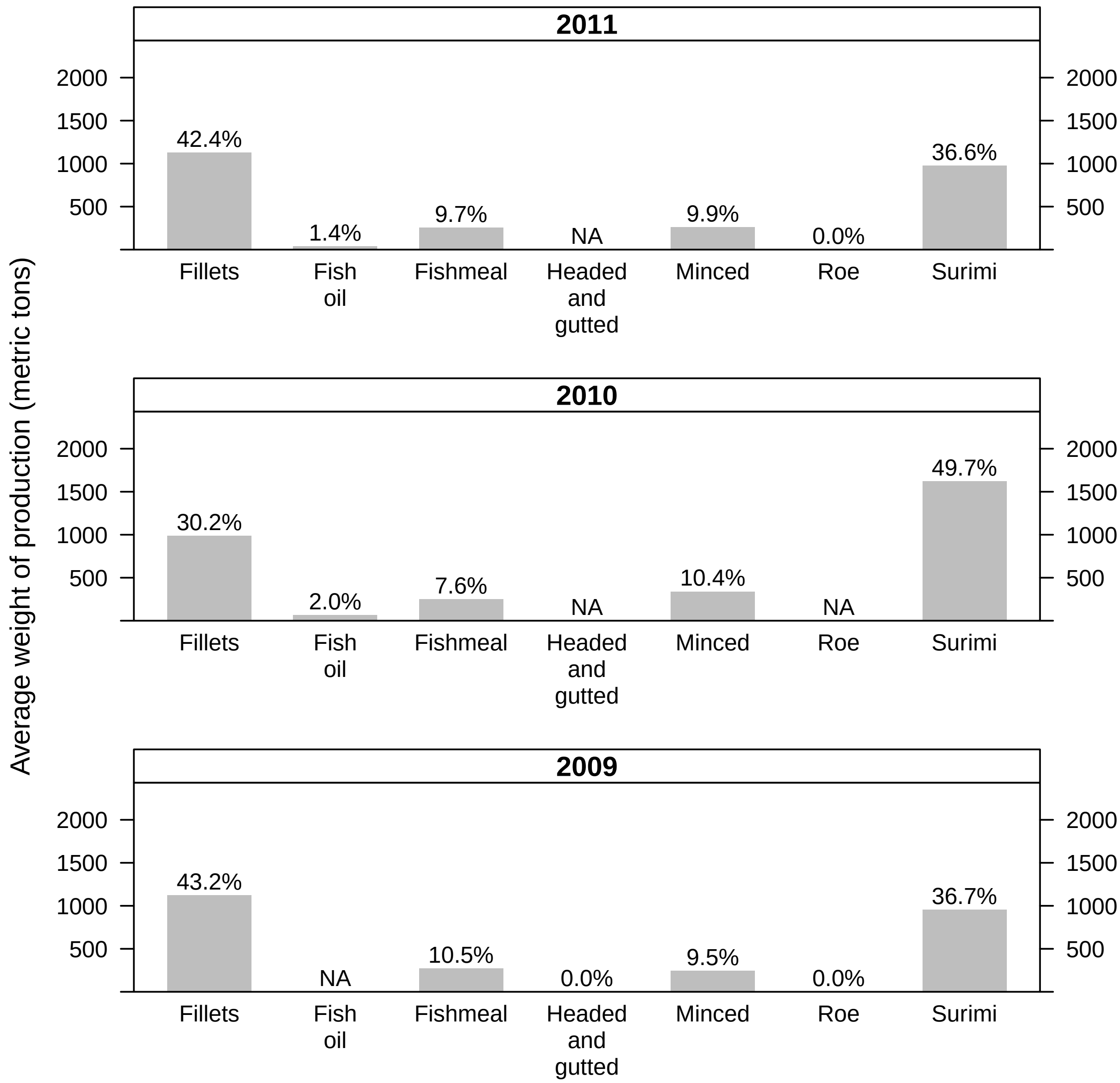

Figure 7.2: Production weight by product type and year. Average whiting production value by product type and year. Confidential data have been suppressed and replaced with "NA", product categories where production value was reported as 0 for all vessels for all years are not included. The percentage of each product type of all production is listed on the top of each bar.

8 Costs

This section of the report describes the cost data that are collected on the EDC catcher-processor form. It reports variable costs, fixed costs, and total costs, and how those costs are disaggregated to estimate the proportion of costs attributed to West Coast fisheries.

For the purposes of the EDC, costs are divided into two categories: variable costs and fixed costs. Variable costs vary with the level of fishery participation, and generally include items such as fuel and crew payments. Fixed costs do not vary with the level of fishery participation, and generally include items such as vessel capital improvements. The designation of a cost as variable or fixed depends on many factors, including the relevant time horizon and use of the data. While some costs would clearly be considered fixed (e.g., the purchase of a new engine), others are more difficult to categorize. For the purposes of this report, we consider the costs listed in Tables 8.2, 8.3 and 8.4 to be fixed, and the costs listed in Table 8.1 to be variable. The EDC Program will continue to explore, and possibly improve, the categorization of these costs.

The cost section of the EDC form collects both "capitalized expenditures" and "expenses" for vessel improvements and maintenance, fishing gear, and processing equipment. This is because for tax accounting purposes, certain costs may be treated as either capitalized or expensed. Capitalized expenditures are depreciated over a number of years. Expensed items are fully deducted as a cost for the year in which they occur. In an effort to reduce the reporting burden and errors, these data are collected as they are reported in the businesses' accounting systems.

In order to conduct economic analyses of specific fisheries it is important to have costs broken out by fishery. For some costs, it may be feasible for participants to break out or track costs at the fishery level. However, for most costs this is impossible. During the EDC form development process, a key issue was the determination of which costs could reasonably be broken out by fishery or groups of fisheries. Each cost item is assigned to one or more categories based on how it is commonly tracked by industry members: 1) used on West Coast fisheries only (West Coast Only); 2) used on the West Coast and in other fisheries (Shared); and 3) used in all fisheries (All) regardless of whether they are used on the West Coast.

Some costs that are required for economic analysis are not asked for on the EDC forms because they are available through other sources, or can be calculated through the At-Sea Hake Observer Program or Northwest Regional Permit Office data.

Finally, there are a variety of costs that are associated with running a catcher-processor that are not requested on the form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than fishing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, vehicles, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture costs that are directly related to vessel maintenance and fishing operations, and not costs that are related to activities or equipment off the vessel. For these reasons, the EDC aggregated measures of costs (variable costs, fixed costs, and total costs) underestimate the true costs of operating a business.

8.1 Variable costs

Variable costs were collected for all West Coast activities. Unlike fixed costs, variable costs are directly related to fishing operations, and therefore it is possible for vessels to separate expenses for activities on the West Coast from other activities. Average processing crew expenses fell by about twenty percent from 2009 to 2011, while non-processing crew expenses increased during the same period by about thirty-five percent. Total expenses on fuel increased by more than sixty percent from 2009 to 2011 (Table 8.1).

Table 8.1: Variable expenses. Average variable expenses on the West Coast for EDC vessels ($) (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Co-op membership fees	20,016 (5)	27,271 (6)	16,845 (9)
Communication	15,896 (5)	21,514 (6)	16,765 (9)
Food	88,372 (5)	108,934 (6)	108,896 (9)
Freight	***	***	15,843 (7)
Fuel and lubrication	758,126 (5)	862,106 (6)	1,225,046 (9)
Marine Stewardship Council fees	***	***	***
Non-fish ingredients (additives)	217,929 (5)	297,747 (6)	142,759 (9)
Non-processing crew wages	314,131 (5)	383,442 (6)	426,262 (9)
Observers	31,353 (5)	36,923 (6)	35,551 (9)
Offloading	***	***	***
On-board cargo/product insurance	***	***	13,087 (9)
Packing materials	204,837 (5)	232,183 (6)	241,636 (9)
Processing crew wages	1,140,442 (5)	1,420,313 (6)	908,419 (9)
Sea State data monitoring	3,701 (5)	3,982 (6)	4,672 (7)
Supplies	***	***	7,899 (9)
Travel	***	20,917 (5)	25,974 (7)

8.2 Fixed costs

8.2.1 Costs on vessel and on-board equipment, fishing gear, and processing equipment

Table 8.2 presents average annual capitalized expenditures. Survey participants are asked to provide capitalized expenditures for the survey year associated with the following categories:

- New and used vessel and on-board equipment: excludes processing equipment and fishing gear, includes all electronics, safety equipment, and machinery not used to harvest or process fish
- Processing Equipment: excludes all equipment, machines, and buildings based primarily

on shore, excludes any processing equipment that is not used at least partially in the West Coast whiting fishery, and includes on-board freezers, storage equipment, packing equipment, conveyors, and on-board cargo handling equipment

- Fishing gear: Includes nets, cables, doors, and fishing machinery used in the West Coast whiting fishery, excludes any fishing gear that is not used at least partially in the West Coast whiting fishery

Table 8.2: Capitalized expenditures on vessel and on-board equipment, fishing gear, and processing equipment. Average capitalized expenditures ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of vessels with non-zero, non-NA responses). Note that some capitalized expenditures were requested for all fisheries the vessel participates in (West Coast, Alaska, and other) and others are for West Coast Fisheries only (Washington, Oregon, and California).

Expenditure category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fishing gear shared between the West Coast and other fisheries	96,875 (5)	***	251,090 (6)
Fishing gear used only on the West Coast	***	***	0 (0)
Vessel and on-board equipment	1,913,124 (5)	962,737 (6)	2,023,117 (9)
Processing equipment shared between the West Coast and other fisheries	***	***	***
Processing equipment used only on the West Coast	0 (0)	***	0 (0)

Table 8.3: Expenses on vessel and on-board equipment, fishing gear, and processing equipment. Average expenses ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of vessels with non-zero, non-NA responses). Note that some expenses were requested for all fisheries the vessel participates in (West Coast, Alaska, and other) and others are for West Coast Fisheries only (Washington, Oregon, and California).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fishing gear repair and maintenance shared between the West Coast and other fisheries	280,297 (5)	201,289 (6)	360,357 (9)
Fishing gear repair and maintenance on the West Coast	***	41,741 (5)	33,607 (7)
Vessel and on-board equipment	1,160,418 (5)	1,203,127 (6)	1,677,263 (9)
Processing equipment shared between the West Coast and Alaska	875,899 (5)	711,998 (6)	752,766 (9)

8.2.2 Other fixed costs

Table 8.4: Other fixed expenses. Average fixed expenses ($) on all other categories (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)	890,246 (5)	833,454 (6)	901,322 (9)
Moorage	184,240 (5)	228,764 (6)	155,201 (9)
Lease of vessel	0 (0)	0 (0)	0 (0)

Table 8.5: Depreciation. Average depreciation taken during survey year. (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Depreciation	2,694,639 (5)	2,317,669 (6)	3,077,619 (9)

8.3 Fixed costs on the West Coast

As described above, not all costs reported on the EDC forms are for West Coast only operations. Therefore, cost disaggregation was required both to estimate total costs and total cost net revenue on the West Coast. Estimates of West Coast only costs are calculated using a ratio of pounds caught on the West Coast to pounds caught in all fisheries, including Alaska, Tribal, and any other fisheries, which provides an estimate of the proportion of the vessel costs attributed to the West Coast for costs that are shared. This approximation for the proportion of shared spending on the West Coast is then summed with the West Coast Only spending categories to provide a total estimate for annual West Coast Only spending (Table 8.8).

$$C_n^{WC} = EX_n^{WC} + C_n^{SHD} \times \frac{WT_n^{WC}}{WT_n^{TOT}}, \tag{8.1}$$

where C_n^{WC} is the annual expenses associated with the West Coast for each vessel n, EX_n^{WC} are the West Coast only expenses (as reported on the EDC forms), and C_n^{SHD} are the costs that were shared between the West Coast and Alaska (as reported by the vessels on the EDC forms). The ratio of WT_n^{WC} (total purchases of fish on the West Coast) to WT_n^{TOT} (total purchases in all fisheries) are used to apportion the EX_n^{SHD} between the West Coast and other fisheries. The shared expenses include both the "Shared" and "All" costs described above. The annual expenses on the West Coast are calculated for each survey year.

8.3.1 Costs on vessel and on-board equipment, fishing gear, and processing equipment on the West Coast only

Table 8.6: West Coast fixed costs on vessel and on-board equipment, fishing gear, and processing equipment. Capitalized expenditures and expenses on vessel and on-board equipment, fishing gear, and processing equipment on the West Coast (N = number of vessels with non-zero, non-NA responses).

Cost category	2009 $ (N)	2010 $ (N)	2011 $ (N)
West Coast costs on fishing gear	111,923 (5)	140,977 (6)	93,529 (9)
West Coast costs on on-board and vessel equipment	85,058 (5)	116,742 (6)	81,207 (9)
West Coast costs on processing equipment	683,790 (5)	297,794 (6)	183,549 (9)

8.3.2 Other fixed costs on the West Coast only

Table 8.7: West Coast costs on insurance, moorage, and leasing. (N = number of vessels with non-zero, non-NA responses).

Cost category	2009 $ (N)	2010 $ (N)	2011 $ (N)
West Coast portion of insurance expenses	239,770 (5)	266,940 (6)	142,062 (9)
West Coast portion of moorage expenses	55,166 (5)	68,926 (6)	25,773 (9)

8.3.3 Summary of West Coast costs

Table 8.8: Summary of costs on the West Coast. Average costs on vessel and on-board equipment, fishing gear, and processing equipment, other fixed costs, and all variable costs on the West Coast (N = number of vessels with non-zero, non-NA responses).

Description	2009 $ (N)	2010 $ (N)	2011 $ (N)
Total costs on vessel and on-board equipment, fishing gear, and processing equipment	1,080,915 (5)	727,045 (6)	401,844 (9)
Total other costs	4,465,721 (5)	5,293,487 (6)	4,314,462 (9)
Total costs	5,546,636 (5)	6,020,532 (6)	4,716,306 (9)

8.3.4 Quota and permit costs on the West Coast

The EDC form requests information on quota and permit expenses. No vessels reported lease or purchase of permits; however, vessels may have made end-of season informal arrangements regarding leftover quota. This type of transfer is not captured by the EDC form.

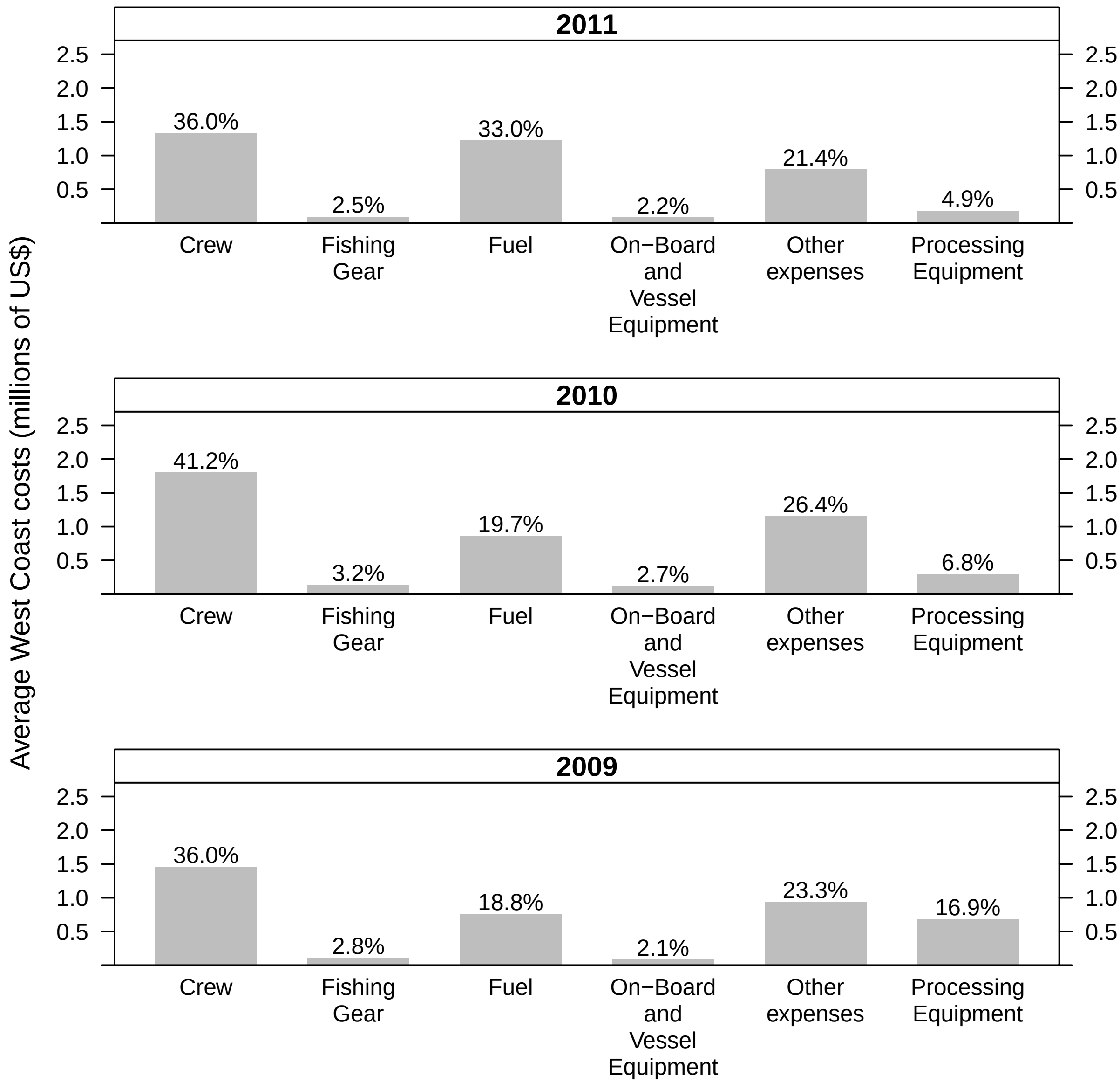

Figure 8.1: Average costs by category on the West Coast. Average costs by category on the West Coast including capitalized expenditures and annual expenses (millions of dollars). Crew includes both processing and non-processing crew expenses shown in Table 8.1. The "Other" category includes expenses on additives, communication, fees, insurance, freight, moorage, observers, offloading, supplies, packing, travel, and Sea-State monitoring. Percentages above each bar indicate the portion the category makes up of total West Coast costs.

9 Net Revenue and Economic Profit

Net returns from operating a vessel are presented in this section. The level of net returns not only indicates whether a vessel is a viable ongoing business, but also the size of net benefit that is created from society's perspective. Two different measures of net returns are examined. They differ in the types of costs that are taken into account, and therefore, their interpretation and use. The first is a monetary, financial measure that attempts to track a vessel's net cash flow, which we call *net revenue*. It is calculated as revenue minus monetary costs. The only costs that are accounted for are those that are actually paid or associated with a financial transaction. The second measure attempts to track the broader economic performance of a vessel and includes all costs regardless of whether there is a cash or financial transaction. Costs are measured by their true resource costs, which may or may not be equal to monetary outlays. This measure is called *economic profit*[1]. The distinction between the two measures is probably most easily understood through a few examples relevant to fisheries.

Labor costs for the net revenue measure are the total payments to the crew and captain. If work is performed that is not paid for, then it is not included as a cost. This commonly occurs in commercial fishing when the owner of a vessel is also the captain, but does not does not draw a captain's wage. In this case, the net revenue is higher than it would be if the captain drew a wage or hired a captain. In the end, the vessel owner-captain is not necessarily any worse off since s/he is the residual claimant to the net revenue. However, the net revenue would be higher than a comparable vessel that hired a captain[2]. Economic profit, on the other hand, accounts for the cost associated with an owner's time that is used as a captain. This is called an opportunity cost in the economics literature[3], and is typically approximated by the wage of a comparably productive captain[4].

A second example of the difference between net revenue and economic profit is the treatment of vessel capital costs. Again, net revenue only includes costs that are actually paid, which includes items such as vessel repair, maintenance, and upgrades. Economic profit would also include the opportunity cost of owning the vessel, a capital asset. By owning a vessel, the owner foregoes other investment opportunities that would provide a rate of return. This is called the

[1] Whitmarsh D., James C., Pickering H., Neiland A. 2000. The profitability of marine commercial fisheries: a review of economic information needs with particular reference to the UK. Marine Policy, Vol. 24(3), pp. 257-263

[2] The same would also be true when a vessel owner does not receive a wage for work performed to repair or maintain a vessel or gear.

[3] See Boardman, Anthony, David Greenberg, and Aidan Vining. Cost-Benefit Analysis: Concepts and Practice, Prentice Hall, NJ. 2000. pp. 31-32.

[4] A more accurate measure would be the owner-captain's most valued wage off the vessel

opportunity cost of capital, and is typically approximated by the market rate of return associated with businesses of comparable risk, multiplied by the market value of the vessel.

Both net revenue and economic profit are useful measures for fishery management. Net revenue attempts to measure the annual financial well-being of vessel operations. It can be used to determine if there is a monetary gain or loss, or how changes in fishery management may affect the level of monetary gain or loss. Economic profit is a better indicator of the long-term viability of fishery operations since it includes all costs, and values the costs at their opportunity cost. It can be used to estimate whether there are incentives or disincentives to invest in capital, or enter and leave the fishery. It is also a better measure of the net benefit of the fishery to the nation.

Calculations of net revenue are included in this draft report. The cost categories used in net revenue, based on those reported in the EDC forms, are discussed below. Currently, calculations of economic profit are beyond the scope of the report. Economic profit relies on opportunity costs, which may be different from some of the costs reported on the EDC forms, so additional methods and analyses are required. The EDC Program economists will continue to work on developing measures of economic profit so that it may be included in future reports.

9.1 Net revenue

Net revenue is calculated two ways: using only variable costs, and using variable costs plus fixed costs (total costs)[5]. The first calculation is called *variable cost net revenue*, while the second is called *total cost net revenue*. Variable cost net revenue is useful to examine changes in fishery operations that are not so great as to affect fixed costs. For example, the cost of fishing/processing an additional day, or catching/processing an additional metric ton of fish, is better represented by only considering variable costs. Total cost net revenue is usually a better summary measure of financial gain or loss for an entire year, season, or fishery.

There are several caveats associated with the net revenue calculations in this report. As noted in the Section 8, there are a variety of costs that are associated with running a vessel that are not requested by the EDC form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than fishing/processing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, vehicles, and transport trucks, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture costs that are only directly related to vessel maintenance and fishing/processing operations, and not costs that are related to activities or equipment off the vessel. Therefore, the EDC calculated net revenue is an underestimate of the true net revenue. The difference is likely much greater for total cost net revenue than variable cost net revenue since most of the excluded costs are fixed costs.

[5] See Section 8 for a more complete discussion of variable and fixed costs used in this report

Another caveat is that the EDC forms do not collect information about income taxes or financing costs. This has several implications. The first is that these costs are not included in the net revenue calculations. Therefore, net revenue is greater than it would be otherwise. The second is that in lieu of financing information (principal and interest payments), EDC total cost net revenue uses the total costs associated with vessel and gear purchases, repair, maintenance and improvements. For example, if a new engine is purchased, the total cost of the engine is used, even though the actual cash outlay, if it were financed, would only be the principal and interest payments made that year. It is likely that many larger capital costs, and perhaps some operating costs, are financed. This would mean that the actual cash outlays in a particular year for those items would be less than what is used in the EDC for the net revenue calculation. Over time, this may balance out to some degree because previously financed or purchased capital and equipment are also not included, except for the year in which they are purchased[6]. Moreover, total cost net revenue is expected to be representative of actual total cost net revenue only when averaged over many years and across vessels because relatively large capital costs occur periodically.

9.1.1 Net revenue for all West Coast fishing activities

Average net revenue is calculated for all activities on the West Coast. West Coast revenue only includes revenue from production of fish. The variable and fixed costs do not include costs related to acquiring limited entry permits, quota shares, or quota pounds.

$$\text{Variable cost net revenue} = \text{West Coast revenue} - \text{West Coast variable costs}$$

$$\text{Total cost net revenue} = \text{West Coast revenue} - (\text{West Coast variable costs} + \text{West Coast fixed costs})$$

[6] At best it is just a partial balancing out because the interest payments are not accounted in the EDC data.

Table 9.1: West Coast variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue on the West Coast (N = number of vessels). Fixed costs include capitalized expenditures and expenses on vessel and on-board equipment, fishing gear, and processing equipment and other fixed costs (N = number of EDC vessels with non-zero, non-NA responses).

Description	2009 $ (N)	2010 $ (N)	2011 $ (N)
Revenue	6,502,348 (5)	9,059,110 (6)	6,601,671 (9)
(Variable costs)	2,913,037 (5)	3,545,239 (6)	3,227,204 (9)
Variable cost net revenue	**3,589,311 (5)**	**5,513,871 (6)**	**3,374,466 (9)**
(Fixed costs)	1,090,649 (5)	753,658 (6)	444,913 (9)
Total cost net revenue	**2,520,528 (5)**	**4,770,114 (6)**	**2,941,876 (9)**

10 Cost, Revenue, Net Revenue, and Product Recovery Rates

Table 10.1 provides a breakdown of the revenue, variable cost, variable cost net revenue, total cost, and total cost net revenue by days at sea (West Coast processing and steaming), metric ton of fish produced, and metric ton of fish harvested

The product recovery rate for the catcher-processor whiting sector (Table 10.2) is

$$\frac{\sum_{n=1}^{N} WT_n^{fishoutputs}}{\sum_{n=1}^{N} WT_n^{fishinputs}}$$

where N is the total number of catcher-processors that harvested fish on the West Coast, $\sum_{n=1}^{N} WT_n^{fishoutputs}$ is the total weight of fish harvested and $\sum_{n=1}^{N} WT_n^{fishinputs}$ is the total weight of production for all catcher processors. The product recovery rate is calculated for each survey year.

Table 10.1: Revenue, cost, and net revenue rates.

Description	2009 (N)	2010 (N)	2011 (N)
Revenue per day (West Coast fishing, processing, and steaming day)	119,970 (5)	120,788 (6)	109,018 (9)
Revenue per metric ton produced	2,456 (5)	2,737 (6)	2,425 (9)
Variable cost per day (West Coast fishing, processing, and steaming day)	53,746 (5)	47,270 (6)	53,293 (9)
Variable cost per metric ton produced	1,100 (5)	1,071 (6)	1,185 (9)
Variable cost net revenue per day (West Coast fishing, processing, and steaming day)	66,223 (5)	73,518 (6)	55,725 (9)
Variable cost net revenue per metric ton produced	1,355 (5)	1,666 (6)	1,240 (9)
Variable cost net revenue per metric ton harvested	519 (5)	609 (6)	424 (9)
Fixed cost per day (West Coast fishing, processing, and steaming day)	20,123 (5)	10,049 (6)	7,347 (9)
Fixed cost per metric ton produced	412 (5)	228 (6)	163 (9)
Total cost net revenue per day (West Coast fishing, processing, and steaming day)	46,504 (5)	63,602 (6)	48,581 (9)
Total cost net revenue per metric ton produced	952 (5)	1,441 (6)	1,081 (9)
Total cost net revenue per metric ton harvested	365 (5)	527 (6)	369 (9)

Table 10.2: Product recovery rate. The product recovery rate (total weight of production divided by total weight of fish purchases) for catcher-processors on the West Coast (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Product recovery rate	0.38 (5)	0.37 (6)	0.34 (9)

Economic Data Collection Program

Mothership Report

Draft Report for PFMC Review

Do Not Cite

Northwest Fisheries Science Center[1]

May 23, 2013

[1]For questions or comments, please contact the EDC Program at nwfsc.edc@noaa.gov.

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Summary

This report summarizes information collected from the West Coast groundfish mothership fleet as a part of the Economic Data Collection (EDC) Program, which was implemented to monitor the economic effects of the 2011 transition of the West Coast groundfish trawl fishery to a catch share program. The catch share program consists of cooperative programs for the at-sea mothership and catcher-processor fleets, and an individual fishing quota (IFQ) program for the shorebased trawl fleet. Annual EDC submissions are required from all fishery participants. The mothership form is available online[1]. This mothership report (and its companion reports covering the other sectors) is the first in what is expected to be an annual series of reports. EDC economists will expand and refine the scope and methods used with each new annual publication.

The report covers the years 2009 to 2011. It contains information about annual participation by motherships in the West Coast and Alaska groundfish trawl fisheries, as well as the physical characteristics, fuel use, and crew size of mothership vessels participating in the West Coast groundfish trawl fisheries. Fish purchase quantity and cost and the ports of delivery for processing in Alaska and the West Coast are provided for vessels participating in the West Coast groundfish trawl fisheries. The report also contains variable and fixed cost information, production, revenues, and calculated net revenue from West Coast fish purchases. Finally, a breakdown of costs, revenue, and net revenue per day at sea, per metric ton of production, and per metric ton purchased provide basic metrics of the economic performance of the mothership fleet.

[1] http://www.nwfsc.noaa.gov/research/divisions/fram/economic_data.cfm

1 Introduction

1.1 Background

In January 2011, the West Coast groundfish trawl fishery transitioned to a catch share program. The catch share program consists of an individual fishing quota (IFQ) program for the shorebased trawl fleet, and cooperative programs for the at-sea mothership and catcher-processor fleets. The Economic Data Collection (EDC) Program[1] was implemented as part of these new regulations to monitor the economic effects of the catch share program. Annual economic data submissions are required from all fishery participants: catcher vessels, motherships, catcher-processors, and first receivers and shorebased processors §50 CFR 660.114. Baseline, pre-catch share data, was submitted in 2011 for the 2009 and 2010 operating years. Data for the first year the fishery operated under the catch share program (2011), was submitted in 2012.

This draft report summarizes the 2009-11 EDC mothership survey data. The EDC Program has enhanced the quantity and quality of economic information available for analysis and the management of the West Coast groundfish trawl fishery. While cost earnings data are available for shorebased catcher vessels starting in 2004[2], this is the first data collection from the mothership fleet.

In addition to the mothership report, there are four companion reports:

- Economic Data Collection Program, Administration and Operations Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Catcher-Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, Catcher Vessel Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)
- Economic Data Collection Program, First Receiver and Shorebased Processor Report, Draft Report for the SSC Economic Subcommittee Review (March 2013)

[1] Additional information on the EDC Program, including the EDC data collection forms can be found at www.nwfsc.noaa.gov/edc

[2] Lian, C.E. 2010. West Coast limited entry groundfish trawl cost earnings survey protocols and results for 2004. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-107, 35 p.

The Administration and Operations Report describes the EDC Program administration and fielding of the surveys, the EDC forms, data QA/QC and data processing, and safeguarding confidential information. The other EDC reports provide basic data summaries of the catcher vessel, catcher-processor, and first receiver and shorebased processor forms.

This mothership report and other reports, listed above, comprise the first of what is expected to be an annual series of reports. It is envisioned that over time, the scope of these reports will expand, and the methods used will be refined with each annual publication. As such, the data summaries and analyses may change in subsequent years as improvements are implemented. Future reports will contain additional summaries that describe the variation of the data, either numerically or graphically. They are not contained in this report due to time constraints.

1.2 Purpose of the report

This report, as well as the other three EDC data summary reports have multiple objectives. The first is to provide basic economic data summaries that can be used for a variety of purposes associated with fishery management. Since much of the data collected are confidential under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 2007, the data are summarized as averages or totals for each question on the EDC forms. Thus summarized, the reports make the data available to the public for both research and informational purposes.

Second, the data summary reports provide information about the performance of the catch share program. This includes information that can be used to monitor whether and to what degree the goals of the program are being met. It is expected that additional modeling will provide increased detail about program impacts. These reports will serve as the basis for the 5-year review of the catch share program that is mandated in the MSA, as well as the NMFS National Catch Shares Performance Indicators. Currently, with just a single year of catch share EDC data, it may be difficult to draw firm conclusions about the performance of the program. In addition, the catch share program may have a transitional period in the first few years as participants learn about the system and develop new business strategies.

Third, the reports either provide or serve as the basis for economic models that will be used as part of the Pacific Fishery Management Council's (PFMC) biennial specification process for groundfish management. These models include the IO-PAC model[3], as well as estimates of revenue, costs, and net revenue.

Lastly, and perhaps most importantly, the data reports are expected to provide a useful catalyst for feedback on the data collected and its analysis.

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[3]Leonard, J., and P. Watson. 2011. Description of the input-output model for Pacific Coast fisheries. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-111, 64 p.

1.3 Mothership form administration

Completion of EDC forms is mandatory for participants in the catch share program. Survey participants are identified using contact information provided by the Northwest Regional Office Permit Office. The regulations for defining who is required to complete an EDC form differs between the baseline data collection (2009 and 2010) and all annual/ongoing data collections for 2011 onward. For the baseline period, all owners, lessees, and charterers of a mothership vessel that received whiting in 2009 or 2010 as recorded in NMFS' NORPAC database §660.114(b)(3)(i). For 2011 and beyond, all owners, lessees, and charterers of a mothership vessel registered to a mothership permit at any time are required to complete an EDC form §660.114(b)(3)(ii). For permit owner, an MS permit application will not be considered complete until the required EDC form for that permit owner associated with that permit is submitted, as specified at §660.25(b)(4)(i). For a vessel owner, participation in the groundfish fishery (including, but not limited to, changes in vessel registration) will not be authorized until the required EDC form for that owner for that vessel is submitted, as specified, in part, at §660.25(b)(4)(v). For a vessel lessee or charterer, participation in the groundfish fishery will not be authorized, until the required EDC form for their operation of that vessel is submitted.

A calendar year is used to determine which vessels meet the criteria. For example, in 2012 data were collected from all owners, lessees, and charters of a mothership registered to a limited entry trawl permit during 2011. The forms are fielded on this schedule in order to allow participants the time necessary to complete their taxes, which may contain some information that is required on the EDC forms.

If a form has missing information, or the information provided on the form is believed to be incorrect, EDC Program staff attempt to contact the participant to correct the information. On occasion, the participant cannot be reached or the participant cannot provide the missing information. In these cases, the missing or inaccurate data are treated on a case-by-case basis during analysis as documented in the Administration and Operations Report. Data are validated and verified with external data sources whenever possible. These data sources include the Northwest Regional Permit Office and the At-Sea Hake Observer (A-SHOP) program.

1.4 About the survey participants

One distinguishing factor among the vessels that affects interpretation of EDC data is whether the vessel received fish in Alaska, the West Coast, or Alaska and the West Coast. Although the questions on the EDC form ask about fisheries on the West Coast, Alaska, and other fisheries, the mothership vessels in the survey population do not fish anywhere other than the West Coast and Alaska. For vessels that participated in the tribal sector of the West Coast at-sea hake fishery, West Coast costs, days at sea, fuel use, and production weight and value have been adjusted to reflect only non-tribal mothership sector activities.

1.5 Understanding the report

The data provided in the summary tables throughout the report are for all vessels that processed on the West Coast during the survey year, unless otherwise noted.

All data submitted via the EDC Program are confidential under 402(b) of the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) and under NOAA Administrative Order 216-100. In order to protect these data, a rule of three and a rule of 90-10 are implemented. The rule of three requires a response from at least three companies in order to show a summary statistic. The 90-10 rule requires that no single company's value should comprise over 90 percent of the value of the value displayed. The tables show a '***' for data points where there were less than three companies reporting the information, and/or if one company's responses accounted for greater than 90 percent of the average value. Zeroes are shown if all entities only reported zeroes. More information about how confidential data are protected in the EDC Program can be found in the Administration and Operations Report.

Although participants are identified on a calendar year basis, they complete the form using information based on the fiscal year of the entity. Currently data are presented for survey year, and therefore data assigned to a survey year may not overlap completely with the calendar year. Information obtained from outside of the EDC Program is adjusted to match the fiscal year provided on each form.

The form had very few changes between the baseline data collection in 2009-2010, and the 2011 collection. The 2009 and 2010 EDC mothership forms asked if the participant received or processed any fish during that calendar year, and those who answered "No" were not required to respond to any further questions. This option disappeared on the 2011 form and every participant was required to complete the form in its entirety. The only other change to the forms from 2009-2010 to 2011 pertained to offload locations, with "Tacoma" substituted for "Westport, Hoquiam" in response to input on the 2009 and 2010 surveys.

For each value displayed in the summary data tables, N is displayed. In most cases, N represents the number of responses to the question that are not "NA" and not zero, unless noted otherwise.

2 Vessel Participation on the West Coast and in Alaska

The mothership fleet participates in fisheries on the West Coast and Alaska. Table 2.1 provides the average days at sea by activity listed. Participants are instructed to count partial days as full days when recording days at sea on the forms. In 2011, the vessels spent on average, less time off-loading and steaming on the West Coast than in 2009 and 2010, and more days processing on average in Alaska in 2011 than during the baseline period.

Table 2.1: Average days at sea. Average days at sea by activity in West Coast and Alaska activities for mothership vessels (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Processing in Alaska	117 (6)	99 (7)	147 (8)
Processing in the West Coast whiting fishery	19 (6)	25 (8)	35 (6)
Steaming in the West Coast whiting fishery	3 (6)	5 (8)	4 (6)
Steaming between West Coast and Alaska	24 (6)	19 (7)	18 (8)
Off-loading in the West Coast whiting fishery	3 (6)	4 (8)	5 (6)

Table 2.2 presents the average number of one-way trips vessels made steaming between Alaska and the West Coast that year. The median number of steaming trips motherships take to Alaska appears to remain constant through the three survey years.

Table 2.2: Average one-way trips steaming between West Coast and Alaska. Median number of one-way trips between the West Coast and Alaska.

	2009 (N)	2010 (N)	2011 (N)
One-way trips to Alaska	4 (6)	4 (7)	4 (8)

Table 2.3: Number of vessels that processed on the West Coast and Alaska.

Description	2009	2010	2011
Number of vessels that processed on the West Coast	6	7	8
Number of vessels that processed in Alaska	6	8	6

3 Delivery Ports

Table 3.1 lists the number of vessels delivering to each port. Some vessels delivered to more than one port in a survey year. This frequency table summarizes responses to the question on the EDC that asks for the percentage of all West-Coast whiting products off-loaded from the mothership vessel at each major West Coast port.

Table 3.1: Off-loading. Total number of vessels that off-loaded in each port.

Location	2009	2010	2011
Off-load in Blaine/Bellingham	1	3	3
Off-load in Seattle	5	5	2
Off-load in Tacoma	2	3	1

4 Vessel Physical Characteristics

Physical vessel characteristics are shown below in Table 4.1. Survey participants were asked to provide basic information about the vessel and its physical characteristics, including market value, replacement value, vessel length, horsepower of main engines, and fuel capacity from the most recent marine survey. Marine surveys are done on a regular basis and are often required for insurance, financing, and other purposes.

Table 4.1: Average vessel characteristics. Average market value, replacement value, horsepower, fuel capacity and length (N = number of EDC vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Market Value ($)	54,500,000 (4)	57,700,000 (6)	51,016,667 (6)
Replacement Value ($)	107,500,000 (4)	100,000,000 (6)	96,416,667 (6)
Length (feet)	360 (6)	338 (8)	346 (8)
Horsepower	8,525 (6)	7,794 (8)	7,564 (8)
Fuel Capacity (gallons)	397,721 (6)	342,291 (8)	355,071 (8)

The participants provide information about whether the vessel was hauled out. The information shown below in Table 4.2 about how many vessels in the fleet are hauled out in that survey year provides context that may be used to explain major costs associated with vessel repair and maintenance.

Table 4.2: Haul outs. Number of vessels that were hauled out during their fiscal year.

Response	2009	2010	2011
Yes	2	3	2
No	4	5	6

5 Vessel Fuel Use and Crew Size

5.1 Fuel use

Table 5.1: Daily fuel use. Average daily fuel use by activity (gallons per day) (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Processing and steaming in the West Coast whiting fishery	6,763 (6)	5,876 (8)	5,105 (7)
Steaming between West Coast and Alaska	6,917 (6)	5,099 (8)	5,312 (8)

In 2011, the average total fuel used by the vessel during the survey year for propulsion or other use in the West Coast whiting fishery was less than in 2010 or 2009 (Table 5.2) . This total excludes fuel used for steaming between the West Coast and Alaska. The increase from 2011 is likely due to the increase in the number of days at sea processing on the West Coast, see Table 2.1.

Table 5.2: Average total fuel use. Average total fuel use (gallons) per entity (N = number of vessels with non-zero, non-NA responses)

Description	2009 (N)	2010 (N)	2011 (N)
Diesel	118,007 (6)	141,900 (8)	193,220 (6)
Fish oil	***	***	***

5.2 Crew size

Participants provide the total number processing and non-processing crew members when the vessel was operating in the West Coast whiting fishery during the survey year (Table 5.3). Processing crew includes line workers, fishmeal crew, quality control, technicians, cleanup, factory managers, combis, and mechanics who work on processing equipment. Non-processing crew includes the captain, deckhands, wheelhouse, galley, and engineers. The number of processing crew appears to have declined from 2009 through 2010 and 2011, while the non-processing crew size appears more stable throughout the survey years.

Table 5.3: Average crew size. Average size of non-processing crew and processing crew (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Non-processing	35 (6)	31 (8)	32 (6)
Processing	90 (6)	88 (8)	71 (6)

The average fuel use per day on the West Coast decreased slightly from 2009 to 2011 (Table 5.1). This total includes both propulsion and other uses, when engaged in West Coast activities. The other uses referred to on the form may include non-propulsion fuel uses, such as diesel or fish oil used to run fishmeal plants, vessel generators, or power processing equipment. The information in the table below represents the average of the average fuel use provided by participants.

6 Whiting Purchases

Pacific whiting is managed through a bilateral agreement between the United States and Canada, known as the Pacific Whiting Treaty. The agreement allocates a percentage of the harvest quota to U.S. and Canadian fishermen. Once the U.S. allocation has been determined, it is then allocated between catcher-processor, mothership, and shoreside sectors. Between 2009 and 2011, the total allocation to the mothership more than doubled from 24,034 metric tons for the sector in 2009 to 53,039 metric tons in 2011 (Table 6.1)[1].

The West Coast data for the mothership sector annual whiting fish purchases in Table 6.1 are provided by the A-SHOP through the Pacific States Information Network (PacFIN) database. The values for average vessel fish purchases and total fish purchases in all fisheries (including the West Coast and Alaska) are from a question on the EDC survey that asks participants to provide the total round weight of all fish processed on the vessel in all fisheries during the survey year.

[1] *Pacific Whiting Fishery Summary* provided by the Northwest Regional Office: http://161.55.131.129/Groundfish-Halibut/Groundfish-Fishery-Management/Whiting-Management/2011/upload/2011-summary.pdf

Table 6.1: Annual mothership allocation, average West Coast whiting purchases per vessel and total West Coast and Alaska fish purchases (metric tons).

Description	2009 (N)	2010 (N)	2011 (N)
Total mothership West Coast whiting allocation	24,034	37,679	53,039
Average West Coast whiting purchases by vessel (A-SHOP)	4,049 (6)	4,492 (8)	7,190 (6)
Total West Coast whiting mothership fleet purchases (A-SHOP)	24,297 (6)	35,935 (8)	50,331 (6)
Total West Coast and Alaska mothership fleet purchases	200,395 (6)	222,705 (8)	240,934 (6)
Average West Coast and Alaska purchases by vessel	33,399 (6)	27,838 (8)	34,419 (7)

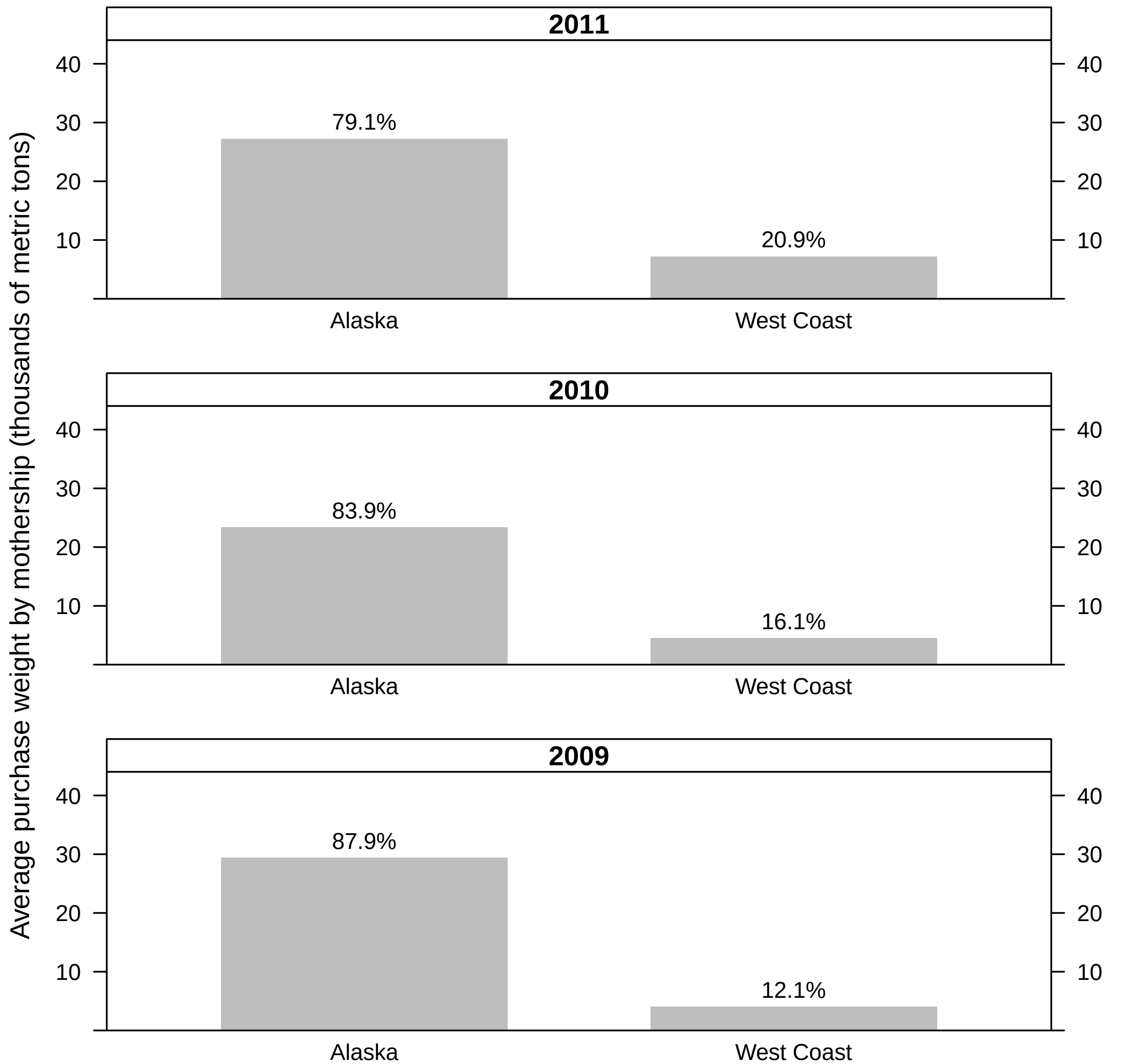


Figure 6.1: Average annual purchases on the West Coast and Alaska. Average annual purchases (thousands of metric tons) from 2009 to 2011 on the West Coast and in Alaska. Percentages above each bar indicate the portion of the total purchases in that fishery.

7 Revenue

The EDC forms ask about three forms of revenue: revenue from production of seafood products, revenue from sale or lease of West Coast whiting mothership permits, and revenue from lease or bareboat charter of the vessel. All vessels that processed fish on the West Coast reported production revenue, but there were no vessels that reported revenue from permits or lease/charter. It is possible that vessels may have made end-of-season informal arrangements regarding leftover quota; however, this type of transfer is not captured by the EDC form.

Tables 7.1 and 7.2 provide summary information on annual production in the mothership West Coast whiting sector. Participants provide total weight of production and value of production by major product categories. These values include any post-season adjustments for products produced during the survey year. Not included in the value of production are any additional payments received to cover shipping, handling, or storage costs associated with the sale beyond the free-on-board (buyer assumes responsibility and liability for the product and pays shipping costs) port of discharge. The revenue only includes fish processed on the West Coast.

Table 7.1: Whiting production weight. Average production weight (metric tons) for whiting (N = number of vessels with non-zero, non-NA responses).

Product Category	2009 MT (N)	2010 MT (N)	2011 MT (N)
Fillets	325 (4)	247 (4)	139 (4)
Fishmeal	156 (5)	160 (5)	216 (4)
Fish oil	***	***	***
Headed and gutted	***	347 (4)	386 (3)
Minced	249 (4)	233 (4)	252 (4)
Other	***	***	***
Round	0 (0)	***	***
Roe	0 (0)	***	0 (0)
Stomachs	0 (0)	0 (0)	0 (0)
Surimi	388 (5)	839 (8)	1,047 (5)
Average vessel total	1,650 (6)	1,881 (8)	2,330 (6)

Table 7.2: Whiting production value. Average production value ($) for whiting (N = number of vessels with non-zero, non-NA responses).

Product Category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fillets	1,056,422 (4)	704,259 (4)	369,641 (4)
Fishmeal	225,287 (5)	303,913 (5)	360,994 (4)
Fish oil	0 (0)	***	***
Headed and gutted	***	564,395 (4)	692,760 (3)
Minced	477,987 (4)	473,463 (4)	394,001 (4)
Other	***	***	***
Round	0 (0)	***	***
Roe	0 (0)	***	0 (0)
Stomachs	0 (0)	0 (0)	0 (0)
Surimi	1,179,759 (5)	2,538,276 (8)	2,993,931 (5)
Average vessel total	3,673,561 (6)	4,640,531 (8)	5,113,203 (6)

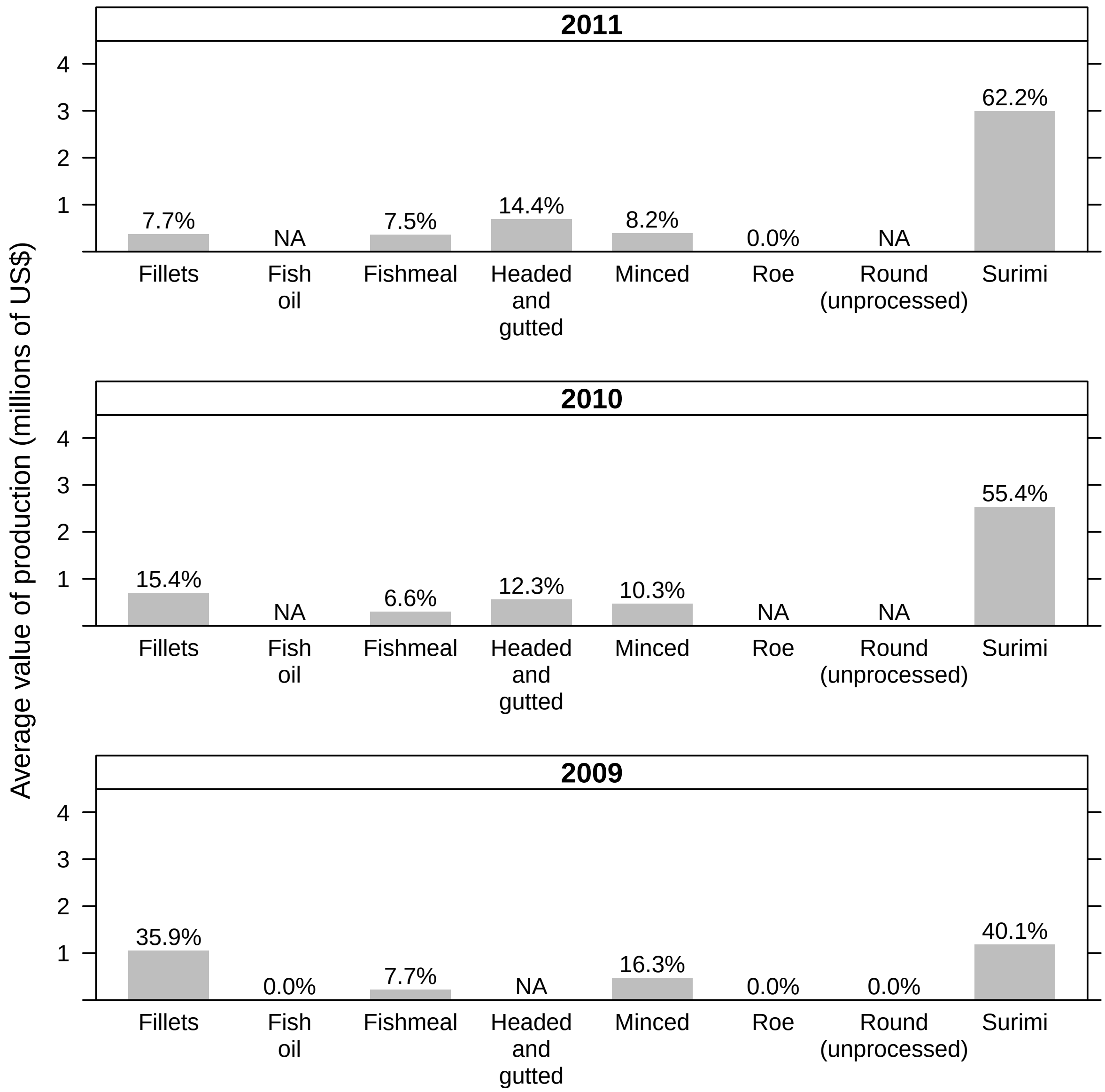


Figure 7.1: Production value by product type and year. Average whiting production value by product type and year. Confidential data have been suppressed and replaced with "NA", product categories where production value was reported as 0 for all vessels for all years are not included. The percentage of each product type of all production is listed on the top of each bar.

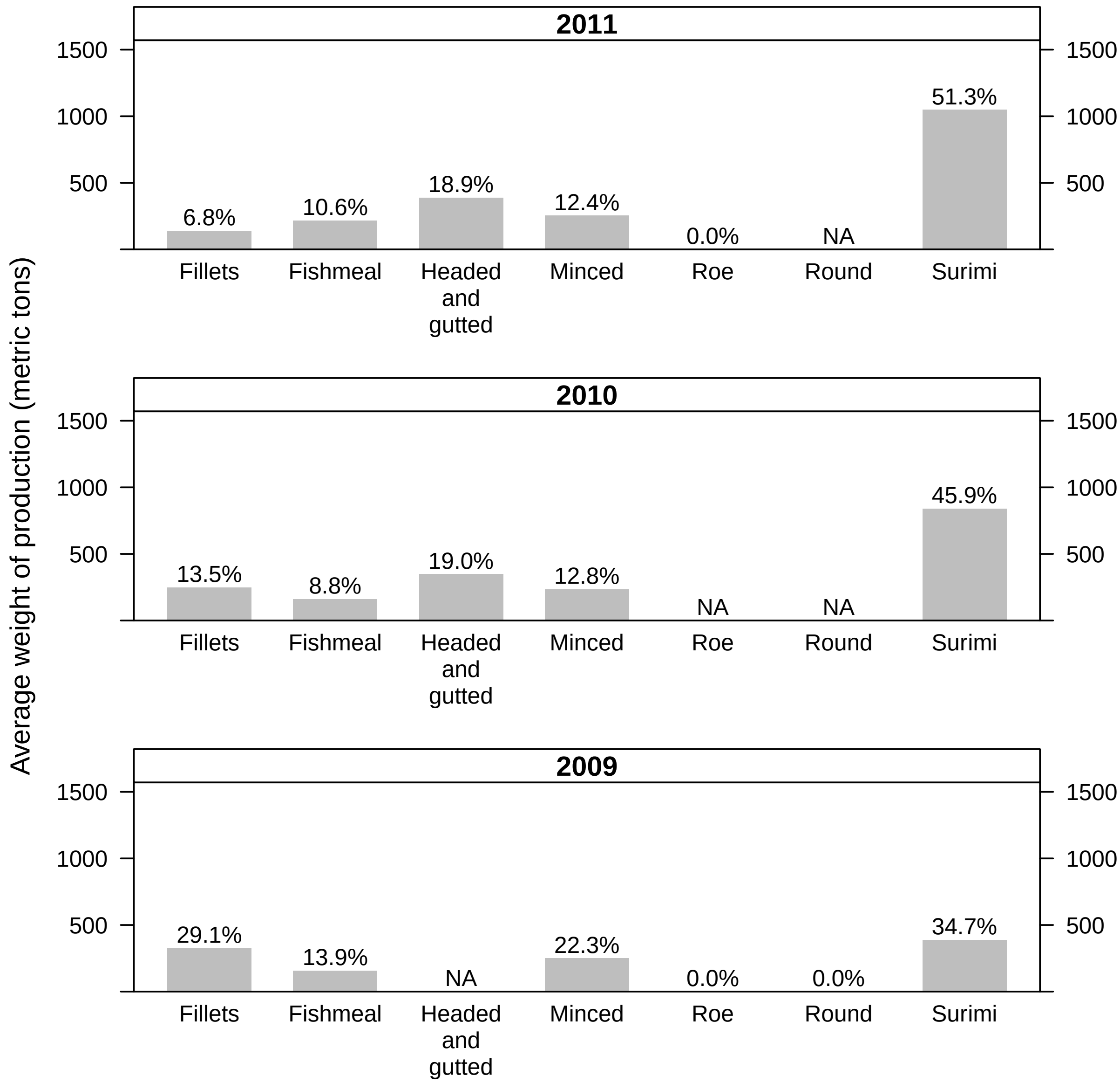


Figure 7.2: Production weight by product type and year. Average whiting production weight by product type and year. Confidential data have been suppressed and replaced with "NA", product categories where production value was reported as 0 for all vessels for all years are not included. The percentage of each product type of all production is listed on the top of each bar.

8 Costs

This section of the report describes the cost data that are collected on the EDC mothership form. It reports variable costs, fixed costs, and total costs, and how those costs are disaggregated to estimate the proportion of costs attributed to West Coast fisheries.

For the purposes of the EDC, costs are divided into two categories, variable costs and fixed costs. Variable costs vary with the level of fishery participation, and generally include items such as fuel and crew payments. Fixed costs do not vary with the level of fishery participation, and generally include items such as vessel capital improvements. The designation of a cost as variable or fixed depends on many factors, including the relevant time horizon and use of the data. While some costs would clearly be considered fixed (e.g., the purchase of a new engine), others are more difficult to categorize as fixed, versus variable. For the purposes of this report, we consider the costs listed in Tables 8.2, 8.3 and 8.4 to be fixed, and the costs listed in Table 8.1 to be variable. The EDC Program will continue to explore, and possibly improve, the categorization of these costs.

The cost section of the EDC form collects both "capitalized expenditures" and "expenses" for vessel improvements and maintenance, fishing gear, and processing equipment. This is because certain costs may be treated for tax accounting purposes as either capitalized or expensed. Capitalized expenditures are depreciated over a number of years. Expensed items are fully deducted as a cost for the year in which they occur. In an effort to reduce the reporting burden and errors, these data are collected as they are reported in the businesses' accounting systems.

In order to conduct economic analyses of specific fisheries it is important to have costs broken out by fishery, i.e. West Coast whiting or processing in Alaska. For some costs, it may be feasible for participants to break out or track costs at the fishery level. However, for most costs this is impossible, or would require additional burden to do so. During the EDC form development process, a key issue was the determination of which costs could reasonably be broken out by fishery. Each cost item is assigned to one or more category based on how they are commonly tracked by industry members: 1) used on West Coast fisheries only (West Coast Only); 2) used on the West Coast and in other fisheries (Shared); and 3) used in all fisheries (All) regardless of whether they are used on the West Coast.

Finally, there are a variety of costs that are associated with running a mothership that are not requested on the form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than processing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, pickup trucks, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture costs that are directly related to vessel maintenance and processing operations, and not costs that are related to activities or equipment off the vessel. For these reasons, the EDC aggregated measures of costs (variable costs, fixed costs, and total costs) underestimate the true costs of operating a business.

8.1 Variable Costs

Variable costs were collected for all West Coast activities. Unlike fixed costs, variable costs are directly related to processing operations, and therefore it was possible for vessels to separate expenses for activities on the West Coast from other activities. Processing crew wages made up the largest portion of variable costs in 2009 and 2010, however in 2011, expenses on fuel and lubrication nearly doubled from 2009 and 2010, and surpassed processing crew wages as the largest portion of variable costs (Table 8.1). The next largest variable costs in 2011 on the West Coast were non-processing crew wages, non-fish ingredients (additives), and packing materials.

Table 8.1: Variable expenses. Average variable expenses on the West Coast for EDC vessels ($) (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Co-op membership fees	0 (0)	0 (0)	4,773 (3)
Communication	6,183 (6)	5,598 (8)	13,282 (6)
Fishing gear repair and maintenance	***	***	25,351 (4)
Food	44,281 (5)	47,713 (8)	90,159 (6)
Freight	***	9,397 (5)	13,420 (3)
Fuel and lubrication	330,094 (6)	380,084 (8)	715,474 (6)
Non-fish ingredients (additives)	43,637 (5)	138,796 (8)	223,126 (5)
Non-processing crew wages	395,978 (6)	365,546 (8)	425,924 (6)
Observers	18,937 (6)	18,416 (8)	23,981 (6)
Offloading	34,907 (6)	32,150 (6)	22,262 (5)
On-board cargo/product insurance	11,893 (5)	10,518 (7)	***
Packing materials	94,824 (6)	107,813 (8)	154,550 (6)
Processing crew wages	450,248 (6)	626,179 (8)	595,093 (6)
Supplies	***	27,884 (5)	19,380 (4)
Travel	12,168 (4)	7,547 (7)	20,224 (5)

8.2 Fixed costs

8.2.1 Costs on vessel and on-board equipment, fishing gear, and processing equipment

Table 8.2 presents average annual capitalized expenditures. Survey participants are asked to provide capitalized expenditures for the survey year associated with the following categories:

- New and used vessel and on-board equipment: excludes processing equipment and fishing gear, includes all electronics, safety equipment, and machinery not used to process fish
- Processing Equipment: excludes all equipment, machines, and buildings based primarily on shore, excludes any processing equipment that is not used at least partially in the West Coast whiting fishery, and includes on-board freezers, storage equipment, packing

equipment, conveyors, and on-board cargo handling equipment

- Fishing gear: Includes nets, cables, doors, and fishing machinery used in the West Coast whiting fishery, excludes any fishing gear that is not used at least partially in the West Coast whiting fishery

Table 8.2: Capitalized expenditures on vessel and on-board equipment, fishing gear, and processing equipment. Average capitalized expenditures ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of vessels with non-zero, non-NA responses). Note that some capitalized expenditures were requested for all fisheries the vessel participates in (West Coast, Alaska, and other) and others are for West Coast Fisheries only (Washington, Oregon, and California).

Expenditure category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fishing gear shared between the West Coast and other fisheries	230,702 (5)	***	711,220 (6)
Fishing gear used only on the West Coast	***	***	0 (0)
Vessel and on-board equipment	1,477,668 (5)	846,126 (8)	1,089,892 (8)
Processing equipment shared between the West Coast and other fisheries	2,687,834 (5)	817,710 (7)	175,503 (5)
Processing equipment used only on the West Coast	0 (0)	***	0 (0)

Table 8.3: Expenses on vessel and on-board equipment, fishing gear, and processing equipment. Average expenses ($) on vessel and on-board equipment, fishing gear, and processing equipment (N = number of vessels with non-zero, non-NA responses). Note that some expenses were requested for all fisheries the vessel participates in (West Coast, Alaska, and other) and others are for West Coast Fisheries only (Washington, Oregon, and California).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fishing gear repair and maintenance shared between the West Coast and other fisheries	285,637 (4)	196,689 (6)	163,766 (8)
Fishing gear repair and maintenance on the West Coast	***	***	25,351 (4)
Vessel and on-board equipment	1,693,868 (6)	1,344,278 (8)	1,133,014 (8)
Processing equipment shared between the West Coast and Alaska	344,358 (4)	441,818 (6)	276,708 (8)

8.2.2 Other fixed costs

Table 8.4: Other fixed expenses. Average fixed expenses ($) on all other categories (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Insurance premium payments (hull and machinery, protection and indemnity, and pollution insurance)	1,200,878 (6)	1,045,572 (8)	905,653 (8)
Moorage	388,929 (6)	332,542 (8)	207,233 (8)
Lease of vessel	***	0 (0)	***

Table 8.5: Depreciation. Average depreciation taken during survey year. (N = number of vessels with non-zero, non-NA responses).

Expense category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Depreciation	2,285,967 (6)	2,251,126 (8)	2,079,527 (8)

8.3 Fixed costs on the West Coast

As described above, not all costs reported on the EDC forms are for West Coast only operations. Therefore, cost disaggregation was required both to estimate total costs and total cost net revenue on the West Coast. Estimates of West Coast only costs are calculated using a ratio of pounds purchased on the West Coast to pounds purchased in all fisheries, including Alaska, Tribal, and any other fisheries, which provides an estimate of the proportion of the vessel costs attributed to the West Coast for costs that are shared. This approximation for the proportion of shared spending on the West Coast is then summed with the West Coast Only spending categories to provide a total estimate for annual West Coast Only spending (Table 8.9).

$$C_n^{WC} = EX_n^{WC} + C_n^{SHD} \times \frac{WT_n^{WC}}{WT_n^{TOT}}, \tag{8.1}$$

where C_n^{WC} is the annual expenses associated with the West Coast for each vessel n, EX_n^{WC} are the West Coast only expenses (as reported on the EDC forms), and C_n^{SHD} are the costs that were shared between the West Coast and Alaska (as reported by the vessels on the EDC forms). The ratio of WT_n^{WC} (total purchases of fish on the West Coast) to WT_n^{TOT} (total purchases in all fisheries) are used to apportion the EX_n^{SHD} between the West Coast and other fisheries. The shared expenses include both the "Shared" and "All" costs described above. The annual expenses on the West Coast are calculated for each survey year.

8.3.1 Costs on vessel and on-board equipment, fishing gear, and processing equipment on the West Coast

Table 8.6: West Coast costs on vessel and on-board equipment, fishing gear, and processing equipment. Average costs on vessel and on-board equipment, fishing gear, and processing equipment vessel and on-board equipment, fishing gear, and processing equipment on the West Coast (N = number of vessels with non-zero, non-NA responses).

Cost category	2009 $ (N)	2010 $ (N)	2011 $ (N)
Fishing gear	46,509 (6)	73,279 (8)	184,339 (6)
On-board and vessel equipment	41,243 (6)	62,632 (8)	174,753 (6)
Processing equipment	282,654 (6)	298,874 (8)	54,962 (6)

8.3.2 Other fixed costs on the West Coast

Table 8.7: West Coast costs on insurance, moorage, and leasing. (N = number of vessels with non-zero, non-NA responses).

Cost category	2009 $ (N)	2010 $ (N)	2011 $ (N)
West Coast portion of insurance expenses	152,493 (6)	163,832 (8)	166,077 (6)
West Coast portion of moorage expenses	48,587 (6)	44,647 (8)	46,231 (6)

8.3.3 Quota and permit costs on the West Coast

The EDC form requests information on quota and permit expenses. No vessels reported lease or purchase of permits; however, vessels may have made end-of season informal arrangements regarding leftover quota. This type of transfer is not captured by the EDC form.

8.4 Fish purchases

The mothership form includes a question about the purchase of whiting and "Other" fish during the year. This information, along with a calculation of the average annual price is presented in Table 8.8. The average price for the season is calculated using the total reported revenue divided by the total reported purchase weight for each vessel for that survey year.

Table 8.8: Whiting purchases. Average fish cost per pound ($/lb), value of whiting purchases ($), and weight of whiting purchases (MT).

	2009 (N)	2010 (N)	2011 (N)
Cost ($/metric ton)	166.224 (6)	0.103 (8)	0.105 (6)
Value of whiting purchases ($)	747,115 (6)	1,204,631 (8)	1,434,138 (6)
Weight of whiting purchaes (metric tons)	4,389 (6)	5,437 (8)	6,322 (6)

8.4.1 Summary of West Coast costs

Table 8.9: Summary of costs on the West Coast. Average costs on vessel and on-board equipment, fishing gear, and processing equipment, other fixed costs, variable costs, and costs of fish purchases on the West Coast (N = number of vessels with non-zero, non-NA responses).

Description	2009 $ (N)	2010 $ (N)	2011 $ (N)
Cost of whiting purchased	747,115 (6)	1,204,631 (8)	1,434,138 (6)
West Coast capitalized expenditures on vessel and on-board equipment, fishing gear, and processing equipment	451,179 (6)	453,002 (8)	489,520 (6)
West Coast expenses	2,258,026 (6)	2,711,598 (8)	3,304,710 (6)

9 Net Revenue and Economic Profit

Net returns from operating a vessel are presented in this section. The level of net returns not only indicates whether a vessel is a viable ongoing business, but also the size of net benefit that is created from society's perspective. Two different measures of net returns are examined. They differ in the types of costs that are taken into account, and therefore, their interpretation and use. The first is a monetary, financial measure that attempts to track a vessel's net cash flow, which we call *net revenue*. It is calculated as revenue minus monetary costs. The only costs that are accounted for are those that are actually paid or associated with a financial transaction. The second measure attempts to track the broader economic performance of a vessel and includes all costs regardless of whether there is a cash or financial transaction. Costs are measured by their true resource costs, which may or may not be equal to monetary outlays. This measure is called *economic profit*[1]. The distinction between the two measures is probably most easily understood through a few examples relevant to fisheries.

Labor costs for the net revenue measure are the total payments to the crew and captain. If work is performed that is not paid for, then it is not included as a cost. This commonly occurs in commercial fishing when the owner of a vessel is also the captain, but does not does not draw a captain's wage. In this case, the net revenue is higher than it would be if the captain drew a wage or hired a captain. In the end, the vessel owner-captain is not necessarily any worse off since s/he is the residual claimant to the net revenue. However, the net revenue would be higher than a comparable vessel that hired a captain[2]. Economic profit, on the other hand, accounts for the cost associated with an owner's time that is used as a captain. This is called an opportunity cost in the economics literature[3], and is typically approximated by the wage of a comparably productive captain[4].

A second example of the difference between net revenue and economic profit is the treatment of vessel capital costs. Again, net revenue only includes costs that are actually paid, which includes items such as vessel repair, maintenance, and upgrades. Economic profit would also include the opportunity cost of owning the vessel, a capital asset. By owning a vessel, the owner foregoes other investment opportunities that would provide a rate of return. This is called the

[1] Whitmarsh D., James C., Pickering H., Neiland A. 2000. The profitability of marine commercial fisheries: a review of economic information needs with particular reference to the UK. Marine Policy, Vol. 24(3), pp. 257-263

[2] The same would also be true when a vessel owner does not receive a wage for work performed to repair or maintain a vessel or gear.

[3] See Boardman, Anthony, David Greenberg, and Aidan Vining. Cost-Benefit Analysis: Concepts and Practice, Prentice Hall, NJ. 2000. pp. 31-32.

[4] A more accurate measure would be the owner-captain's most valued wage off the vessel.

opportunity cost of capital, and is typically approximated by the market rate of return associated with businesses of comparable risk, multiplied by the market value of the vessel.

Both net revenue and economic profit are useful measures for fishery management. Net revenue attempts to measure the annual financial well-being of vessel operations. It can be used to determine if there is a monetary gain or loss, or how changes in fishery management may affect the level of monetary gain or loss. Economic profit is a better indicator of the long-term viability of fishery operations since it includes all costs, and values the costs at their opportunity cost. It can be used to estimate whether there are incentives or disincentives to invest in capital, or enter and leave the fishery. It is also a better measure of the net benefit of the fishery to the nation.

Calculations of net revenue are included in this draft report. The cost categories used in net revenue, based on those reported in the EDC forms, are discussed below. Currently, calculations of economic profit are beyond the scope of the report. Economic profit relies on opportunity costs, which may be different from some of the costs reported on the EDC forms, so additional methods and analyses are required. The EDC Program economists will continue to work on developing measures of economic profit so that it may be included in future reports.

9.1 Net revenue

Net revenue is calculated two ways: using only variable costs, and using variable costs plus fixed costs (total costs)[5]. The first calculation is called *variable cost net revenue*, while the second is called *total cost net revenue*. Variable cost net revenue is useful to examine changes in fishery operations that are not so great as to affect fixed costs. For example, the cost of processing an additional day, or processing an additional metric ton of fish, is better represented by only considering variable costs. Total cost net revenue is usually a better summary measure of financial gain or loss for an entire year, season, or fishery.

There are several caveats associated with the net revenue calculations in this report. As noted in the Section 8, there are a variety of costs that are associated with running a vessel that are not requested by the EDC form because it is difficult to determine the share of the cost associated with the vessel. These costs include items that can be used for activities other than processing, or are too difficult to allocate to a particular vessel in a multi-vessel company. These expenses include office space, vehicles and transport trucks, storage of equipment, professional fees, and marketing. In general, the EDC forms attempt to capture only costs that are directly related to vessel maintenance and processing operations, and not costs that are related to activities or equipment off the vessel. Therefore, the EDC calculated net revenue is an underestimate of the true net revenue. The difference is likely much greater for total cost net revenue than variable cost net revenue since most of the excluded costs are fixed costs.

Another caveat is that the EDC forms do not collect information about income taxes or financing costs. This has several implications. The first is that these costs are not included in

[5] See Section 8 for a more complete discussion of variable and fixed costs used in this report

the net revenue calculations. Therefore, net revenue is greater than it would be otherwise. The second is that in lieu of financing information (principal and interest payments), EDC total cost net revenue uses the total costs associated with vessel and gear purchases, repair, maintenance and improvements. For example, if a new engine is purchased, the total cost of the engine is used, even though the actual cash outlay, if it were financed, would only be the principal and interest payments made that year. It is likely that many larger capital costs, and perhaps some operating costs, are financed. This would mean that the actual cash outlays in a particular year for those items would be less than what is used in the EDC for the net revenue calculation. Over time, this may balance out to some degree because previously financed or purchased capital and equipment are also not included, except for the year in which they are purchased[6]. Moreover, total cost net revenue is expected to be representative of actual total cost net revenue only when averaged over many years and across vessels because relatively large capital costs occur periodically.

9.1.1 Net revenue for all West Coast fishing activities

Average net revenue is calculated for all activities on the West Coast. West Coast revenue only includes revenue from production of fish. The variable and fixed costs do not include costs related to acquiring limited entry permits, quota shares, or quota pounds.

$$\text{Variable cost net revenue} = \text{West Coast revenue} - \text{West Coast variable costs}$$

$$\text{Total cost net revenue} = \text{West Coast revenue} - (\text{West Coast variable costs} + \text{West Coast fixed costs})$$

Table 9.1: West Coast variable cost and total cost net revenue. Average total revenue, variable costs, variable cost net revenue, fixed costs, and total cost net revenue on the West Coast (N = number of vessels). Fixed costs include capitalized expenditures and expenses on vessel and on-board equipment, fishing gear, and processing equipment and other fixed costs (N = number of EDC vessels with non-zero, non-NA responses).

Description	2009 $ (N)	2010 $ (N)	2011 $ (N)
Revenue	3,673,561 (6)	4,640,531 (8)	5,113,203 (6)
(Variable costs)	2,228,840 (6)	2,996,768 (8)	3,800,777 (6)
Variable cost net revenue	**1,444,721 (6)**	**1,643,763 (8)**	**1,312,426 (6)**
(Fixed costs)	568,902 (6)	551,691 (8)	453,237 (6)
Total cost net revenue	**879,419 (6)**	**1,101,469 (8)**	**868,774 (6)**

[6] At best it is just a partial balancing out because the interest payments are not accounted in the EDC data.

10 Cost, Revenue, Net Revenue, Markup, and Product Recovery Rates

Table 10.1 provides a breakdown of the revenue, variable cost, variable cost net revenue, total cost, and total cost net revenue by days at sea (West Coast processing and steaming), metric ton of fish produced, and metric ton of fish purchased. Although total revenue in the fishery increased slightly from 2010 to 2011, from $5.3 million to $5.5 million (Table 7.1), the average total revenue per day decreased from $105 thousand per day to $93 thousand per day (Table 10.1).

Table 10.1: Revenue, cost, and net revenue rates.

Description	2009 $ (N)	2010 $ (N)	2011 $ (N)
Revenue per day (West Coast processing and steaming)	86,099 (6)	104,238 (8)	95,853 (6)
Revenue per metric ton produced	2,226 (6)	2,467 (8)	2,194 (6)
Variable cost per day (West Coast processing and steaming)	13,334 (6)	12,392 (8)	8,496 (6)
Variable cost per metric ton produced	345 (6)	293 (8)	195 (6)
Variable cost net revenue per day (West Coast processing, and steaming)	33,861 (6)	36,923 (8)	24,603 (6)
Variable cost net revenue per metric ton produced	876 (6)	874 (8)	563 (6)
Variable cost net revenue per metric ton purchased	357 (6)	366 (8)	183 (6)
Total cost per day (West Coast processing, and steaming)	81,008 (6)	98,144 (8)	98,011 (6)
Total cost per metric ton produced	2,095 (6)	2,322 (8)	2,244 (6)
Total cost net revenue per day (West Coast processing, and steaming)	20,611 (6)	24,742 (8)	16,286 (6)
Total cost net revenue per metric ton produced	533 (6)	585 (8)	373 (6)
Total cost net revenue per metric ton purchased	217 (6)	245 (8)	121 (6)

The markup for the mothership whiting sector (Table 10.2) is

$$\frac{\sum_{n=1}^{N} R_n}{\sum_{n=1}^{N} C_n}$$

where N is the total number of motherships that processed on the West Coast, R_n is the value of production by mothership vessel, and C_n is the cost of fish purchases by mothership vessel. The markup is calculated for each survey year.

The product recovery rate for the mothership whiting sector (Table 10.2) is

$$\frac{\sum_{n=1}^{N} WT_n^{fishoutputs}}{\sum_{n=1}^{N} WT_n^{fishinputs}}$$

where N is the total number of motherships that purchased fish on the West Coast, $WT_n^{fishoutputs}$ is the weight of fish produced by mothership vessel and $WT_n^{fishinputs}$ is the weight of fish purchases from catcher vessels by mothership vessel. The product recovery rate is calculated for each survey year.

Table 10.2: Markup and product recovery rate. The markup (total value of production divided by total cost of fish purchases) and product recovery rate (total weight of production divided by total weight of fish purchases) for mothership whiting vessels on the West Coast (N = number of vessels with non-zero, non-NA responses).

Description	2009 (N)	2010 (N)	2011 (N)
Markup	4.917 (6)	3.852 (8)	3.565 (6)
Product Recovery Rate	0.407 (6)	0.419 (8)	0.324 (6)

Agenda Item F.2.b
Supplemental NWFSC PowerPoint
June 2013

NOAA FISHERIES
NWFSC

Economic Data Collection (EDC) Program

Presentation to the PFMC

June 2013

Todd Lee and Erin Steiner
NWFSC, Seattle, WA

What is the EDC Program?

- Many people involved (NWFSC, NWR, Enforcement, GC, PSMFC, PFMC, States, Participants, Associations).
- 4 annual data collections
- 4 survey instruments
- 4 data sets
- 2 databases
- 245 participants
- 63,039 non-null, non-zero data points
- 3 years of data
- 1,935 phone calls and emails to date

Background

- Mandatory Economic Data Collection was initiated as part of the West Coast groundfish catch share program
- Baseline data from 2009 and 2010 (collected in Sept 2011)
- Catch share data collection began in Sept 2012 with 2011 data
- Data from:
  - Catcher vessels (previous cost-earnings surveys)
  - Catcher-processors
  - Motherships
  - First receivers and shorebased processors

See matrix on page 42 of O&A Report

Purpose of EDC Program

- Provide economic data that can be used to assess the catch share program
  - Information to the Council, NOAA, participants, NGOs, scientists, and the public
  - MSA requirement of 5 year review, and subsequent reviews
  - NOAA Fisheries catch share performance metrics
- Biennial PFMC Groundfish Specification Process
- Analysis of other FMP amendments

Purpose of Annual EDC Reports

- Solicit feedback from PFMC, other EDC information users, and participants
- Document EDC methods
- Summarize confidential data to provide basic economic information (wide variety of uses)
- Provide economic analysis of catch share fishery
  - Economic performance measures
  - Regional economic impact analysis
- Basis for MSA mandated review
- Expand analysis and scope each year

EDC Program Design

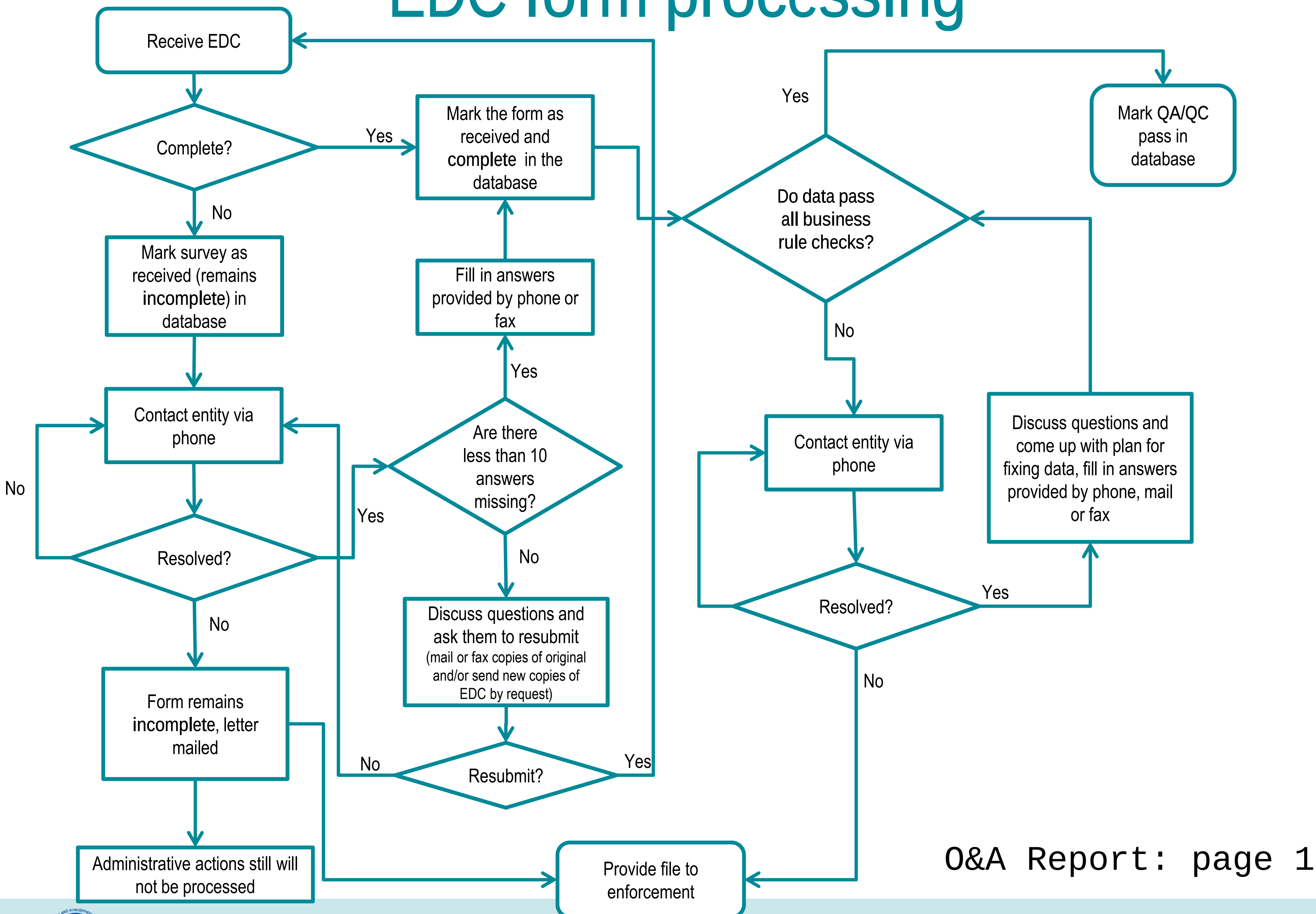
- Meetings with industry members and representatives and input through Council process
- Collect information on all fisheries
  - Spillover effects
  - Accounting/tracking multiple fisheries complicates separation on forms
  - In general, variable costs (West Coast) and fixed costs (all fisheries)

Cost Disaggregation

We are interested in West Coast and fishery level economic measures

- Need to disaggregate AK and West Coast costs
- Need to disaggregate tribal activities from Mothership sector
- Need to disaggregate specific fisheries from the West Coast level costs

EDC form processing



O&A Report: page 19

NOAA FISHERIES

Protecting Confidential Information

- All data are stored on secure servers
- All paper copies of forms are stored in locked filing cabinets
- Data are only mailed or faxed to address provided on form unless participant gives explicit permission
- Data summary rules
  - Rule of 3
  - 90-10 rule

Types of Information Collected

Vessels - Types of Data Collected

- Vessel physical characteristics (value, length, fuel capacity, and horsepower)
- Vessel operating information by fishery (days at sea, crew size, fuel use, and speed)
- Revenue source not in PacFIN
- Costs (variable, fixed, and permit and quota sales and leases)
- Crew and captain payment information
- Processing and non-processing crew wages

CV Report: page 17

FR and SBP - Types of Data Collected

- Facility value
- Employment by month (production and non-production employees)
- Costs (variable and fixed)
- Fish purchases by species and fishery
- Revenue by species and product type

Response Rates

		2009	2010	2011
Catcher Vessel	Received (%)	92%	92%	95%
	Total Forms (N)	168	165	176
Catcher-processor	Received (%)	100%	100%	100%
	Total Forms (N)	7	8	10
Mothership	Received (%)	100%	100%	100%
	Total Forms (N)	6	8	8
First receiver / shorebased processor	Received (%)	67%	78%	96%
	Total Forms (N)	55	58	52

Measures of Net Revenue

PFMC Goal of Catch Share Program

Create and implement a capacity rationalization plan that increases net economic benefits, creates individual economic stability, provides for full utilization of the trawl sector allocation, considers environmental impacts, and achieves individual accountability of catch and bycatch.

Net Revenue

- Measure of economic performance
- Financial measure based on cash flow
- Net Revenue = Monetary Revenue − Monetary Cost
- Attempts to measure annual financial well-being of a business
- Variable Cost Net Revenue and Total Cost Net Revenue
  - Useful to have measures based on variable cost and total costs (variable + fixed)
  - Distinction based on several factors (timeframe, use)

Variable Cost Net Revenue (CV Example)

- VCNR = Revenue – Variable Costs
- Variable costs
  - Wages
  - Fuel
  - Travel
  - Observer fees
  - Fishing association dues and commission costs
  - State licensing and federal fees
  - Food
  - Ice
  - Bait
  - Off-load expenses
  - Freight
  - Other supplies
  - Communications
  - Trucking of fish

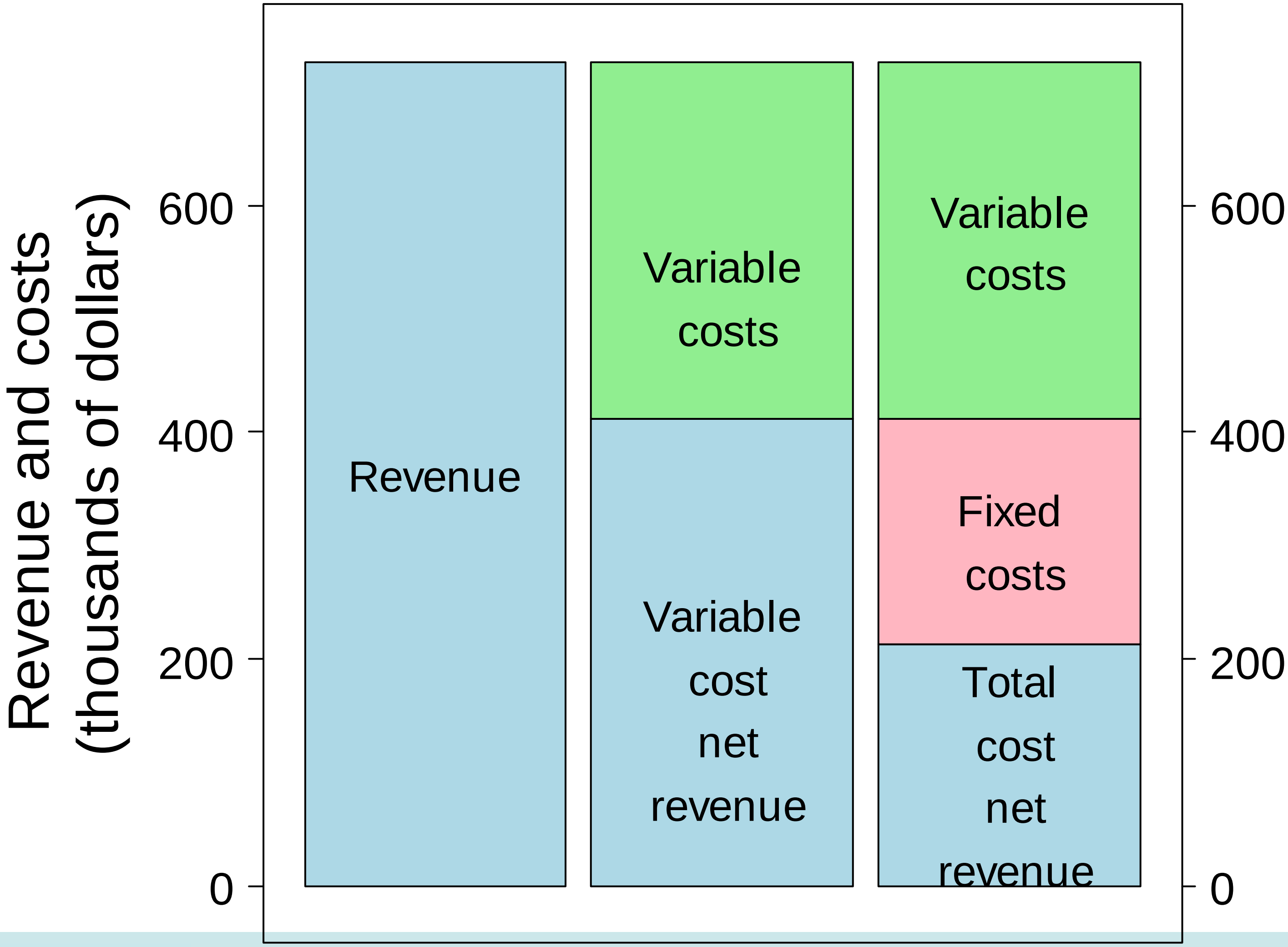
Total Cost Net Revenue (CV Example)

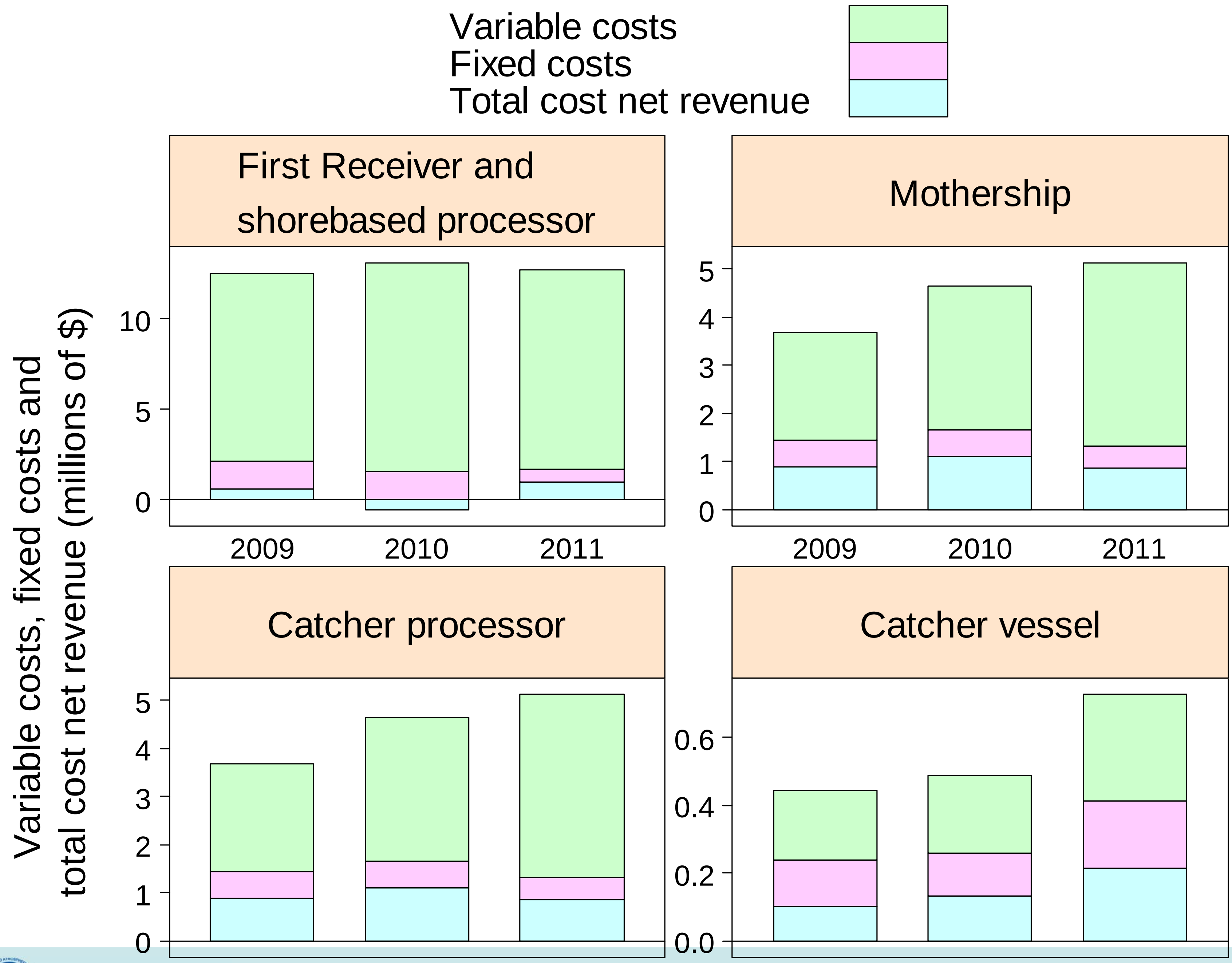
- TCNR = Revenue – Variable Costs – Fixed Costs
- Fixed costs
  - Capitalized Expenditures (all charged to year of occurrence)
    - On-board and vessel equipment
    - Fishing gear
    - Processing equipment
  - Expenses
    - On-board and vessel equipment
    - Fishing gear
    - Processing equipment
    - Insurance
    - Moorage
    - Lease or bareboat charter of vessel

Not All Monetary Costs Are Collected

- Office space and equipment
- Storage space (gear)
- Vehicles
- Professional fees and marketing
- Principal and interest
- Some taxes

Variable and total cost net revenue (2011 - All West Coast)





Variable costs
Fixed costs
Total cost net revenue
First Receiver and shorebased processor
Mothership
Catcher processor
Catcher vessel
Variable costs, fixed costs and total cost net revenue (millions of $)
0
5
10
1
2
3
4
0.0
0.2
0.4
0.6
2009
2010
2011

CV Examples of Net Revenue by fishery

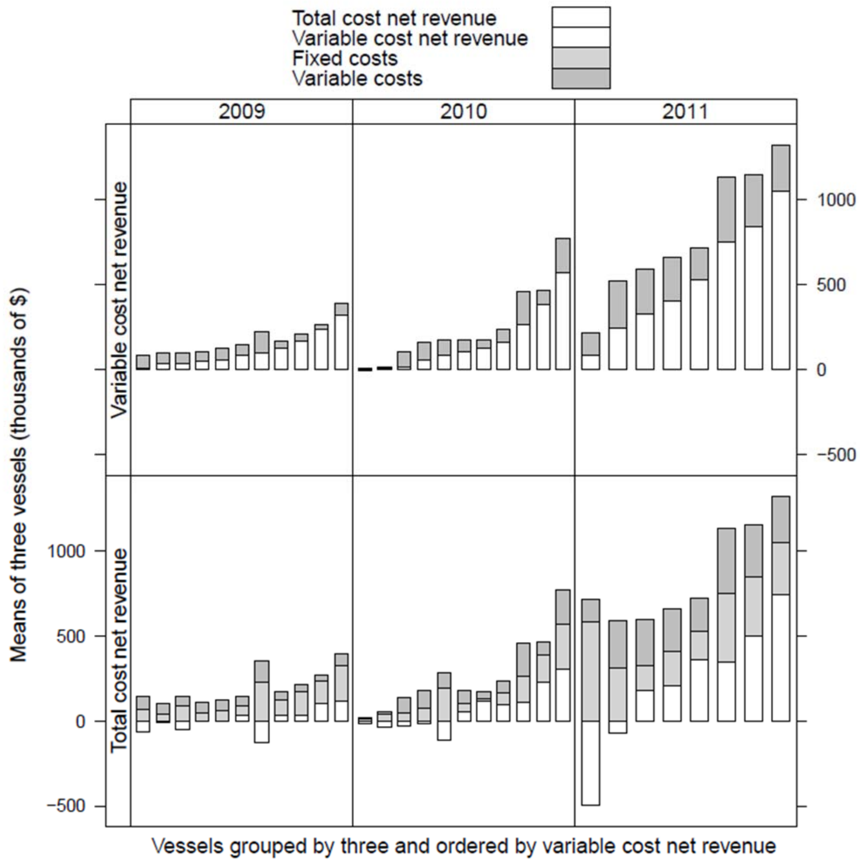


Figure 10.9: Net revenue in the shoreside Pacific whiting fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the shoreside Pacific whiting fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

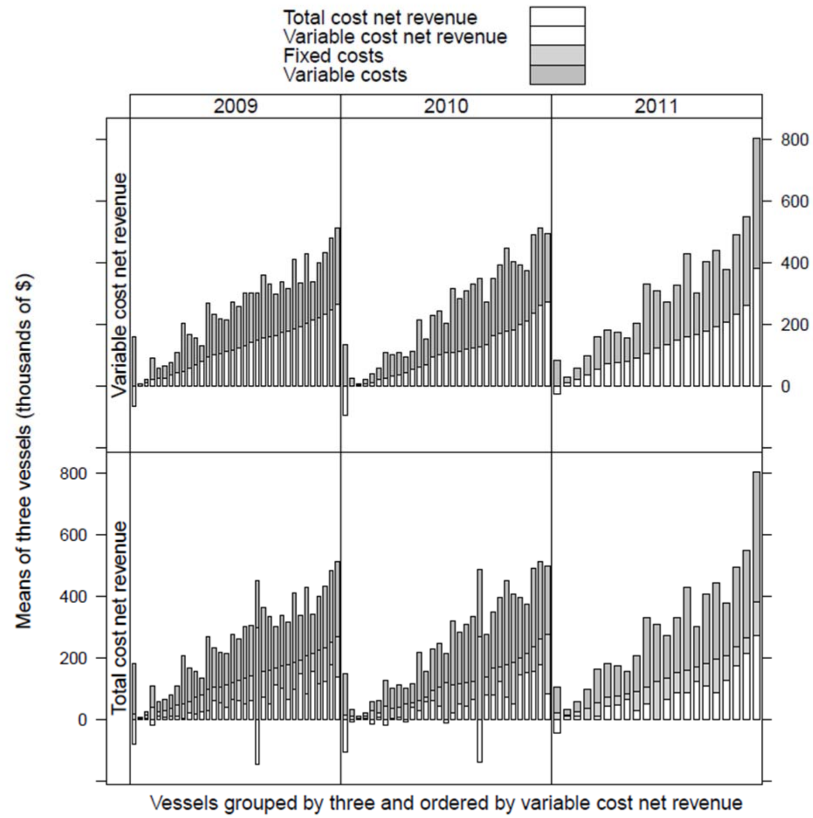


Figure 10.10: Net revenue in the DTS trawl with trawl endorsement fishery by vessels groups. Revenue, fixed costs, variable costs, variable cost net revenue, and total cost net revenue in the DTS trawl with trawl endorsement fishery. To protect confidentiality, vessels were sorted by revenue and means were calculated on groups of three vessels.

CV Report: page 94, 95

Rates (CV Example)

Description	2009	2010	2011
	Mean	Mean	Mean
Revenue per day	$5,488	$6,086	$9,672
Revenue per metric ton landed	$287	$273	$330
Variable cost per day	$2,557	$2,850	$4,185
Variable cost per metric	$134	$128	$143
Variable cost net revenue per day	$2,931	$3,236	$5,486
Variable cost net revenue metric ton	$154	$145	$187
Fixed cost per day	$1,684	$1,587	$2,644
Fixed cost per metric ton	$88	$71	$90
Total cost net revenue per day	$1,247	$1,649	$2,842
Total cost net revenue per metric ton	$65	$74	$97

CV Report: page 104

Fishery Definitions

- At-sea whiting – all deliveries recorded by A-SHOP in NORPAC database
- All trips where the maximum revenue came from:
  - Shoreside Pacific whiting – shoreside landings of whiting
  - DTS trawl – aggregate of dover, thornyheads, sablefish, and blackgill rockfish with trawl gear
  - Non-whiting/non-DST trawl – groundfish other than whiting and DTS
  - Groundfish fixed gear with trawl endorsement – groundfish while using fixed gear with a trawl permit
  - Crab
  - Shrimp
  - Other – includes salmon, halibut, tuna, and groundfish fixed gear with fixed gear endorsement

Economic Profit – Future Work

- Economic measure based on “true” benefits and costs. Attempts to measure net benefit to society
- Economic Profit = Revenue – Opportunity costs
- Opportunity Costs
  - May or may not differ from monetary costs
  - Labor
  - Capital
  - Quota
  - Economic rate of return
- Variable Economic Profit and Total Economic Profit

Biennial Specification Process

EDC Data in the Biennial Specification Process

- IO-PAC
- Non-PacFIN revenue
- Costs
- Net Revenue projections

- Note: LE fixed gear and open access economic data from voluntary cost-earnings surveys

Moving Forward

- Feedback on the reports and analysis
- Would the PFMC like to see the reports annually as part of the Council process?

Thanks to:

- Industry members and associations
- Northwest Regional Office
- Northwest Fisheries Science Center
- Office of Law Enforcement
- Office of General Council
- States
- PSMFC

Science, Service, Stewardship

Pacific Coast Catch Share Social Study

Suzanne M. Russell
Social Scientist, NOAA Fisheries,
NWFSC, Seattle, WA

June 20, 2013

NOAA FISHERIES SERVICE

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Goal

To measure social & cultural changes on the industry & related communities due to the catch shares program.

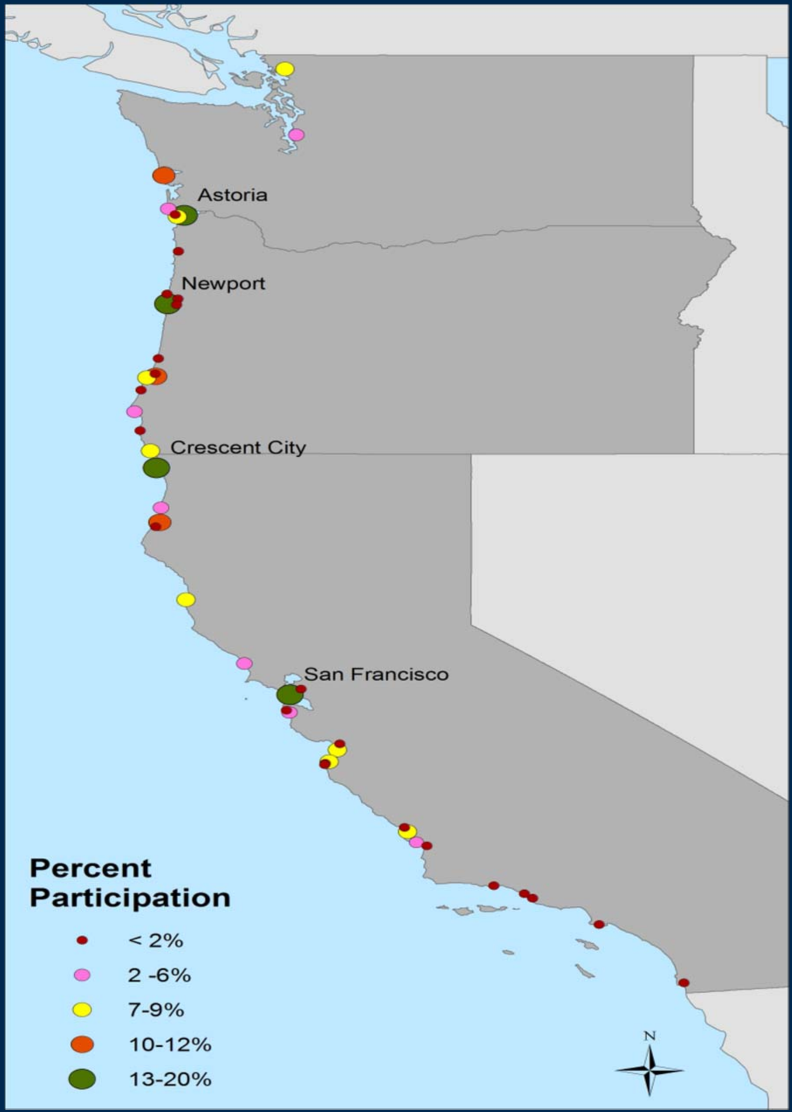
Participants

Anyone connected directly or indirectly to the trawl fishery.

Data Collection

	2010	2012
Surveys	240	~262
Interviews	226	~255

Geographic Distribution of 2010 Study Participants



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Survey Forms

- Demographic
  - Age, education, residence, etc.
- Individual Participation
  - Role, job history, satisfaction, etc.
- Connections (Social Networks)
  - Communication sources, suppliers, etc.
- Quota (Catch Share) Perspectives
  - How well informed, support/not support catch shares, etc.
- Fishermen
  - Species fished, gears utilized, relationships in fishery, etc.
- Processors
  - Species processed, product transportation, marketing range etc.
- 2012: Quota Allocation Recipients
  - QP transfer activity, reasons for transfers, outcomes of transfers. etc.

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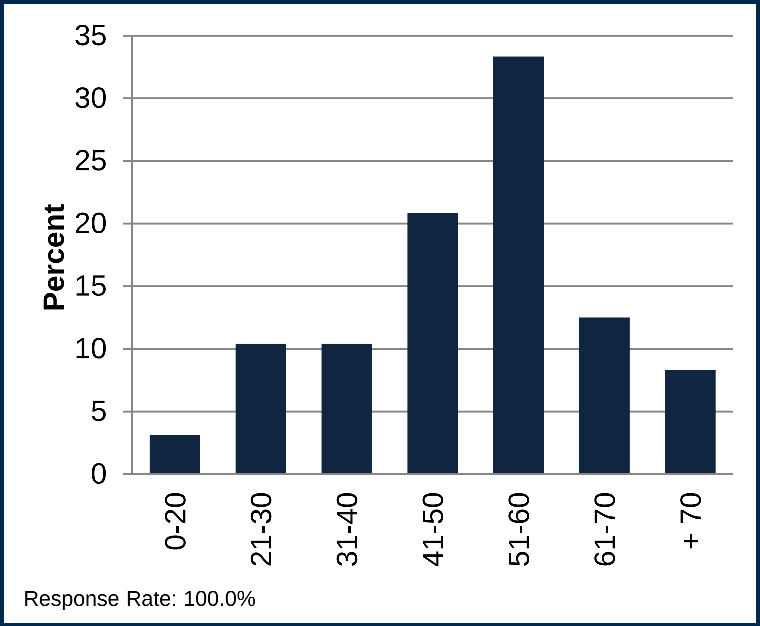
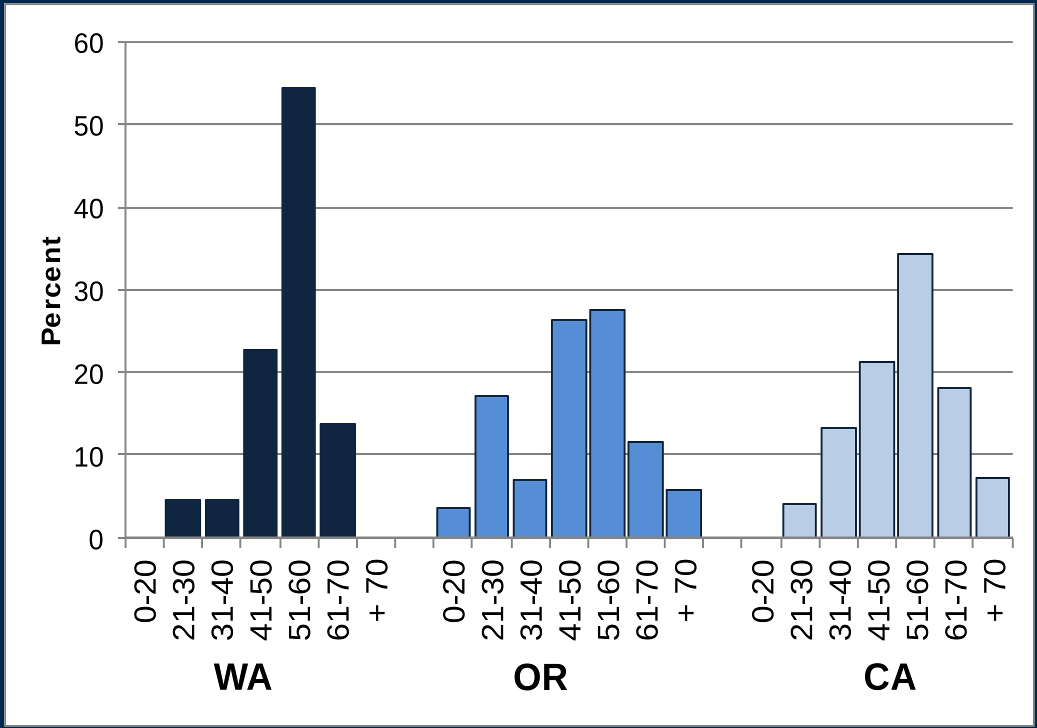
Preliminary Results Example

Age Distribution Results (2010)





Trawl Harvesters
54.2% Over 50 years old

All Participants by State
Over 50 years old:
WA 68.2%, OR 44.8%, CA 59.6%

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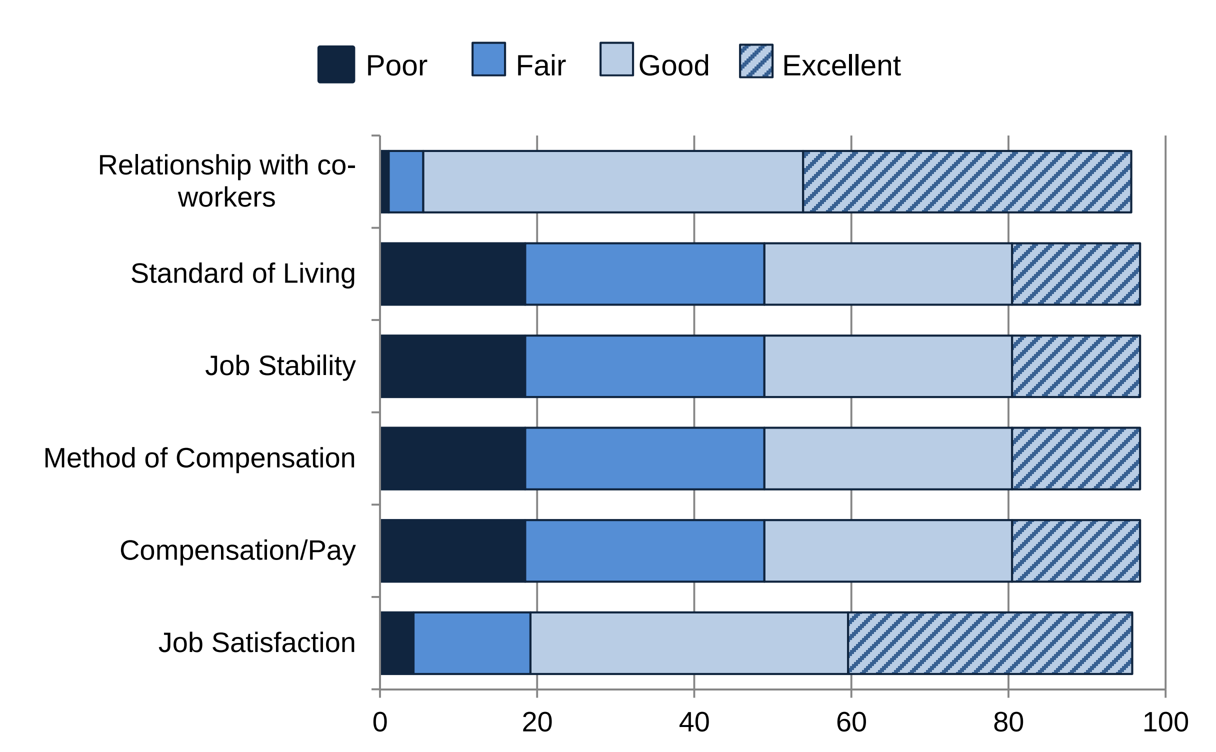
Preliminary Results Example

Harvester Satisfaction Results (2010)



Greatest satisfaction: Relationship with co-workers
Least satisfaction: Standard of Living/Job Stability/Compensation

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Research Status

2010 Research

- Data analysis is approaching its conclusion
- Report expected to be completed by end of 2013
- Will be widely distributed upon completion

2012 Research

- Data collection concluded
- Analysis to commence in 2013

Comparative analysis between 2010 & 2012

For more information Contact: Suzanne Russell
suzanne.russell@noaa.gov, 206-860-3274
http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/humandim/groundfish-study.cfm

GROUNDFISH ADVISORY SUBPANEL REPORT ON THE STATUS OF THE RATIONALIZED TRAWL FISHERY

The Groundfish Advisory Subpanel (GAP) heard a report from Dr. Todd Lee and Ms. Erin Steiner on the Economic Data Collection Program and the first three years of data. At the outset, the GAP wishes to thank Dr. Lee and Ms. Steiner for producing the report.

Overall, the GAP believes that the report will serve as a useful indicator of trawl fishery trends and the relative success of the groundfish catch share program, and the 2011 fishing year. However, at this point we have only one year of data from the catch share program, and that fishing year may have been somewhat anomalous due to, among other things, particularly strong shrimp and crab seasons, record black cod prices, and a large whiting annual catch limit.

The GAP cautions against using the information in the report to make specific judgments about the profitability of the various fishing sectors. Rather, as noted above, it is the general up or down trend and the comparison between revenue pre- and post-catch share which is critical to judging the success of the program. The GAP highlights, as does the report itself, that cost information is incomplete and the GAP is concerned that the report will be used to paint a misleading picture about the profitability of the various fishing and processing sectors. It appears that may already be occurring, based on comments in the briefing book.

The GAP notes that the kind of detailed economic data in the report has long been absent from the fisheries management process, and recommends considering the collection of economic information from all fishery sectors. More detailed economic data could prove particularly useful when considering rebuilding plans and justifying deviations from the requirement to rebuild species as quickly as possible. To date, economic impacts and benefits have been measured by ex-vessel price, which is largely inadequate.

Some members of the GAP expressed interest in reducing the frequency of collection from annually to a longer interval (perhaps every three years) after an initial period of yearly collection through the five-year review.

Several members also noted that the form itself was much more time-consuming than estimated by the agency. While noting its importance, they wished to highlight how onerous the process is.

The GAP also heard a brief report on the socioeconomic survey. The GAP thanks Ms. Suzanne Russell for compiling the survey, and expressed interest in seeing more up to date information. The GAP notes that the terminology is inconsistent between the economic data collection report and the socioeconomic survey, and recommends using identical language in the future so that meaningful inferences and comparisons can be made. For example, the definitions of first receivers/processors are inconsistent between the two surveys.

PFMC
06/21/13

Agenda Item F.2.c
Supplemental GMT Report
June 2013

GROUNDFISH MANAGEMENT TEAM REPORT ON THE ECONOMIC DATA COLLECTION PROGRAM

The Groundfish Management Team (GMT) received a presentation on the Economic Data Collection Program (ECDP) from Dr. Todd Lee and Erin Steiner. The GMT would like to thank both for describing the methods and providing some preliminary results for that program. We would also like to emphasize the usefulness and timeliness of this information for managing west coast groundfish fisheries (e.g., for developing the 2015-2016 Harvest Specifications and Management Measures and for evaluating electronic monitoring).

The GMT had some discussion regarding the fishery categories currently defined by the ECDP. Currently, the ECDP is summarizing data for the following fisheries: (1) at-sea whiting, (2) shoreside whiting, (3) Dover, thornyhead, sablefish (DTS) trawl, (4) non-whiting, non-DTS trawl, (5) groundfish while using fixed gear with a trawl permit (gear switching), (6) crab, (7) shrimp, and (8) other, which includes salmon, halibut, tuna, and groundfish fixed gear with a fixed gear endorsement.

The GMT recommended that at least one additional category and definition be provided for the shoreside non-whiting, non-DTS trawl. One recommendation is to add a non-whiting midwater trawl category. In addition, there are some who suggest the “non-whiting, non-DTS trawl” category be divided into “nearshore flatfish trawl” and “bottom rockfish” trawl. The GMT notes, however, that confidentiality provisions may prohibit summarizing data using categories at this level of resolution.

The GMT would like to continue communication with the Dr. Lee and Ms. Steiner as the categories and definitions are further developed.

GMT Recommendations:

- **Add a new trawl category: non-whiting midwater trawl.**
- **Continue GMT involvement and communication to help refine fishery categories and definitions.**

PFMC
06/20/13

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STATUS OF THE RATIONALIZED TRAWL FISHERY

The Scientific and Statistical Committee (SSC) received a presentation by Dr. Todd Lee and Ms. Erin Steiner, National Marine Fisheries Service Northwest Fisheries Science Center (NWFSC) regarding the mandatory Economic Data Collection (EDC) program for participants in the groundfish catch shares program. The EDC was reviewed by the Economics and Groundfish Subcommittees on April 7, 2013 in Portland.

The EDC program provides comprehensive economic data for shorebased catcher vessels which was previously collected through voluntary cost-earnings surveys and new, previously unavailable data for motherships, catcher vessels delivering to motherships, catcher processors, and first receivers/shorebased processors. The EDC achieved a 94 percent response rate in 2011; survey data are subject to double-key entry and other data validation methods. The data represent best available science and are directly relevant to evaluating the economic performance of the catch share program and for analyzing management alternatives considered in the Specs process.

Dr. Lee briefed the SSC regarding the Pacific Coast Groundfish Trawl Social Study, a study conducted separately from the EDC by NWFSC social scientist Ms. Suzanne Russell. This study involved voluntary surveys and interviews of groundfish fishery participants in 2010 and 2012 and may be a good source of information regarding the short-term social impacts of the catch share program. The SSC would like to review this study as a potential source of information for the five-year review of the catch share program.

PFMC

06/21/13

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Email: hansradtke@peak.org

March 30, 2013

Mr. Dan Wolford, Chair
Pacific Fishery Management Council
7700 NE Ambassador Pl, Suite 101
Portland, OR 97220

via email: pfmc.comments@noaa.gov

Dear Mr. Wolford and Council Members,

At the September 2012 and March 2013 Council meetings, discussion took place and testimony was heard from the Midwater Trawlers Cooperative to support HR 6362 legislation for refinancing the West Coast groundfish trawl fishery's buyback program's loan. The same industry request was made at a U.S. Representative Kurt Schrader town hall meeting March 21, 2013 in Newport, Oregon by the Midwater Trawlers Cooperative (see Newport News Times March 26, 2013 edition). Following directions from the Council, Executive Director Don McIsaac has written a letter in support of the proposed legislation. The principle support issue the Council asked to be addressed in the letter was to limit the loan payment terms to be a maximum of three percent groundfish fishery ex-vessel value instead of the current payment terms for five percent ex-vessel value. In parallel, the Council has asked NMFS to integrate the loan buyback payment requirements into the trawl rationalization program's cost recovery fee program.

Following the industry inspired buyback program of 2003, the Council has adopted the trawl rationalization program implemented in 2011. This individual quota share (QS), program was designed to make the industry more efficient. Early successes for this objective look promising with fewer vessels participating and discard mortality being reduced. The real efficiency progress will be the result of QS consolidations. The QS permanent transfers through purchases by willing sellers and buyers was to occur starting this year, but delays in developing and approving trailing amendments have pushed this feature out at least another year.

This catch-share program has created an immediate private capital windfall. QS transfer purchase amounts when they ensue in the future will be revealing as to the actual asset value. However, initial lease payments for quota pounds and theoretical calculations show the value is considerable. While other world catch-share programs require 100 percent funding by industry of science and management of fisheries, U.S. program objectives at least recognize that catch-share programs can be assessed for some of the management and research costs.

Being an economist, I am enthused that submitting economic behavior data (titled the Economic Data Collection or EDC program) is a mandatory requirement for catch-share program participating vessels and processors. The data should provide accurate (although submittals are not being audited) information for showing whether catch-share program objectives are being satisfied. Economists will also be able to use the EDC information to show indirect economic effects of this program's consistencies with MSA economic related national standards (economic impacts to communities, social welfare, fairness/equity, etc.).

It is coincident that the Council is wrestling with industry financial means (i.e. ability to absorb buyback program, cost recovery fees, and observer costs) while the SSC April 2013 meeting will be reviewing before-and-after catch-share program factual industry budgets. The Northwest Fisheries Science Center (NFSC) is using the first two years of EDC data to update their IO-Pac economic effects model. I am attaching to this letter Table 7 from Council April 2013 briefing book material for the SSC meeting. The table summarizes proprietorship gross profit for the several vessel types that participate in the onshore and offshore groundfish fishery. For example, the whiting trawlers vessel type has an annual 27.7 percent revenue return to proprietor. The calculation method for this statistic is the same as the above mentioned caps on cost recovery and buyback loan payment, i.e. it is the percent of ex-vessel revenue for the vessel type. Although vessels usually have a portfolio of fishery derived revenues, this particular vessel class revenue is dominated by the trawl groundfish fishery. Economists have methods to decompose a vessel operations fixed and variable costs into single fisheries if that information is warranted.

I am writing this letter to suggest that the above described Council and SSC agenda items be made coherent with each other. If the information used in the IO-Pac model is representative for revenue and cost flows of the trawl fishery vessel participants, then it would be apparent that the profit margins (proprietary income) are adequate to repay the buyback loan and ongoing management costs. The SSC could be tasked with providing advice not only on the adequacy of the economic effects model, but also on the industry cost absorption ability.

Thank you for your consideration,

Hans Radtke

Hans D. Radtke, Ph.D.
Encl.
cc: Rep. Kurt Schrader

Table 7. Percentage distribution of commercial fishing production functions by expenditure categories.

Expenditure categories (table continued horizontally below)	**Catcher processor**	**Mother-ship**	**Alaska**	**Pacific whiting trawler**	**Large groundfish trawler**	**Small groundfish trawler**	**Sablefish fixed gear**	**Other groundfish fixed gear**	**Migratory liner**	**Pelagic netter**
Captain	—	—	13.4	12.3	17.5	17.5	21.6	18.3	16.6	16.6
Crew	—	—	19.6	17.8	21.6	21.6	23.7	21.5	18.1	18.1
Fuel, lubricants	—	—	13.2	12.8	16.8	16.8	7.4	7.5	8.3	8.3
Food, crew provisions	—	—	1.4	1.6	1.5	1.5	2.0	1.9	1.2	1.2
Ice	—	—	0.1	0.8	1.4	1.4	1.2	1.1	0.7	0.7
Bait	—	—	0.8	1.0	0.8	0.8	4.4	4.3	2.8	2.8
Repair and maintenance: vessel, gear, equipment	—	—	8.7	11.3	14.3	14.3	10.7	12.4	10.4	10.4
Insurance	—	—	3.2	5.4	4.6	4.6	2.8	5.9	3.6	3.6
Interest and financial services	—	—	0.4	1.7	1.1	1.1	2.1	1.8	1.1	1.1
Purchases of permits	—	—	1.7	0.1	0.5	0.5	0.5	2.6	0.9	0.9
Leasing of permits	—	—	0.6	0.0	0.5	0.5	2.1	0.2	0.5	0.5
Moorage	—	—	0.8	0.7	0.7	0.7	2.4	1.6	1.2	1.2
Landings taxes	—	—	0.7	4.3	4.4	4.4	0.1	0.0	1.1	1.1
Enforcement	—	—	0.5	1.1	0.4	0.4	1.1	0.7	0.4	0.4
Dues	—	—	0.1	0.3	0.9	0.9	0.3	0.0	0.3	0.3
Freight Supplies	—	—	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.1
Offloading	—	—	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.2
Trucking	—	—	0.0	0.0	0.0	0.0	0.0	1.1	0.2	0.2
Other miscellaneous	—	—	1.1	1.1	2.8	2.8	2.4	6.7	4.7	4.7
Proprietary income	—	—	33.6	27.7	10.2	10.2	15.0	10.8	27.5	27.5
Total (%)			**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 7 continued horizontally. Percentage distribution of commercial fishing production functions by expenditure categories

Expenditure categories (column list repeated from above)	**Migratory netter**	**Shrimper**	**Crabber**	**Salmon troller**	**Salmon netter**	**Other netter**	**Lobster**	**Diver**	**Other >15,000**	**Other <15,000**
Captain	16.6	20.8	21.4	7.5	19.0	16.6	16.6	16.6	16.6	17.9
Crew	18.1	17.7	21.6	17.2	8.2	18.1	18.1	18.1	18.1	13.3
Fuel, lubricants	8.3	2.3	6.9	9.9	1.4	8.3	8.3	8.3	8.3	17.6
Food, crew provisions	1.2	13.4	1.1	3.0	4.3	1.2	1.2	1.2	1.2	3.6
Ice	0.7	1.2	0.4	0.3	0.0	0.7	0.7	0.7	0.7	1.0
Bait	2.8	2.2	4.4	0.2	0.0	2.8	2.8	2.8	2.8	2.7
Repair and maintenance: vessel, gear, and equipment	10.4	7.5	11.3	15.6	17.7	10.4	10.4	10.4	10.4	27.0
Insurance	3.6	4.4	4.2	5.0	2.2	3.6	3.6	3.6	3.6	4.7
Interest and financial services	1.1	0.0	1.0	3.1	0.0	1.1	1.1	1.1	1.1	0.6
Purchases of permits	0.9	0.0	1.2	3.2	0.2	0.9	0.9	0.9	0.9	5.9
Leasing of permits	0.5	0.0	0.4	0.3	0.3	0.5	0.5	0.5	0.5	0.3
Moorage	1.2	3.0	1.2	3.2	0.8	1.2	1.2	1.2	1.2	8.4
Landings taxes	1.1	1.2	0.1	0.0	1.0	1.1	1.1	1.1	1.1	0.0
Enforcement	0.4	0.3	0.1	0.3	0.0	0.4	0.4	0.4	0.4	0.7
Dues	0.3	0.2	0.2	0.8	0.5	0.3	0.3	0.3	0.3	0.8
Freight Supplies	0.1	0.4	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0
Offloading	0.2	0.5	0.4	0.0	0.5	0.2	0.2	0.2	0.2	0.1
Trucking	0.2	0.0	0.2	0.6	1.7	0.2	0.2	0.2	0.2	1.1
Other miscellaneous	4.7	0.4	8.2	10.7	3.3	4.7	4.7	4.7	4.7	6.5
Proprietary income	27.5	24.4	15.6	19.1	38.9	27.5	27.5	27.5	27.5	-12.1
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**.100.0**	**100.0**	**100.0**	**100.0**

*Percentages not shown due to confidentiality restrictions

MID-WATER RECREATIONAL FISHERY

The Council is considering whether to develop a mid-water recreational fishery to provide increased access to healthy pelagic groundfish while minimizing overfished species bycatch. In recent years exempted fishing permits (EFPs) have been recommended by the Council and issued by National Marine Fisheries Service (NMFS) to explore the feasibility of such a fishery. Under this agenda item, the Council is scheduled to discuss whether the data collected under the EFPs are sufficient to inform the development of regulations and the projected impacts to overfished species.

A proposal to develop a mid-water recreational fishery in Oregon, similar to the Oregon Recreational Fishing Alliance EFPs conducted in 2009 and 2011, was received for Council consideration (Agenda Item F.3.c, Holloway Proposal). The applicant recommends modifying the regulations to provide access to fishing grounds in Oregon seaward of 40 fathoms (fm) from April 1 to September 30, a time when fishing is only permitted shoreward of 30 fm under current regulations. Under the proposal, regulations would also define the gear configuration required in the area, which is intended to keep the terminal gear off the seafloor.

The Council should review the data collected under past EFPs and consider whether it is sufficient for promulgating regulations and understanding the impacts of the action. Additionally, the Council should recommend whether a mid-water recreational fishery is desired coastwide, or only in Oregon.

Council Task:

1. **Provide guidance on the development of a mid-water recreational fishery including whether regulations should be coastwide or Oregon only.**

Reference Materials:

1. Agenda Item F.3.b, ODFW Letter: ODFW Letter of Support.
2. Agenda Item F.3.c, Holloway Proposal: Recreational Midwater Rockfish Fishery.

Agenda Order:

a. Agenda Item Overview — Kelly Ames
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Provide Guidance on Further Consideration of a Mid-Water Sport Fishery regulations

PFMC
05/30/13

Oregon
John A. Kitzhaber, MD, Governor

Department of Fish and Wildlife
Marine Resources Program
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Newport, OR 97365
(541) 867-4741
Fax: (541) 867-0311
www.dfw.state.or.us

Mr. Dan Wolford
Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

May 28, 2013

~~Mr. Wolford~~ Dan,

The Oregon Department of Fish and Wildlife (ODFW) supports further analysis of the viability of a recreational mid-water groundfish fishery, as proposed by John Holloway. The proposal is a culmination of industry-government collaboration informed by data collected using a federal exempted fishing permit.

It has been demonstrated in communities coastwide that cushioning the economic blow of a failure in other fisheries by absorbing displaced effort is greatly needed. Both the salmon and groundfish fisheries are vulnerable to downswings or closures, and there are many examples of coastal economies suffering as a result. For example, Winchester Bay was once a thriving charter port with 13 charter vessels, but now only two remain due to the crash of the coho salmon fishery in the 1990's and closure of local reefs to groundfish fishing due to implementation of rockfish conservation areas in the 2000's. Had substitute fisheries existed, such as the proposed recreational mid-water groundfish fishery, the outcome may have been different.

Collaboration between industry members and state and federal agencies has proven valuable. The recreational fleet has a long history of developing innovative methods to increase economic efficiency and reduce bycatch. Support from the National Marine Fisheries Service (NMFS), Pacific Fishery Management Council (PFMC), and the states have allowed many of these innovations to come to fruition. Recent collaborations have yielded methods to target underutilized stocks while maintaining impacts to species of concern at acceptable levels. Timely and thorough analysis by the management partners is essential to implementing creative solutions likely to yield both economic and conservation benefits.

Development of a mid-water fishery may aide in the enhancement and stabilization of coastal economies. Further investigation of this fishery's potential is warranted and may provide angling opportunities that have not been available for some time.

Sincerely,

Gway R. Kirchner

Gway Kirchner
Fishery Management Section Manager, ODFW

Cc: Frank Lockhart, NMFS
Michele Culver, WDFW
Joanna Grebel, CDFW
Phil Anderson, WDFW
Marci Yaremko, CDFW

ENFORCEMENT CONSULTANTS REPORT ON RECREATIONAL MID-WATER ROCKFISH FISHERY

The Enforcement Consultants (EC) has reviewed the Recreational Mid-Water Rockfish Fishery proposal for Oregon and offers the following comments related to the suggested management measures:

Area Allowance: The proposal recommends that a Mid-Water fishery with gear restrictions be open seaward of 40 fathoms, creating a 10 fathom buffer between this fishery and the current recreational groundfish fishery, which is restricted to angling shoreward of the 30 fathom line. The EC appreciates and supports such a buffer. The 30 and 40 fathom lines are well-known to Oregon enforcement and are delineated on current navigational equipment.

Bag limits: The EC supports a consistent bag limit between this proposed fishery and the current Oregon recreational groundfish fishery that occurs inside 30 fathoms. A different bag limit would create loopholes for enforcement, potentially compromising the integrity of recreational groundfish management.

Gear Requirements: The gear requirements outlined in this proposal were vetted through the Exempted Fishing Permit (EFP) process, including comment by the EC requesting a measureable leader length. Enforcement had no issues inspecting the gear requirements during the EFP's operational time period. History has shown that the recreational angler can have difficulty adapting to new gear restrictions, leading to a spike in enforcement actions. To counter this possibility, the EC recommends a high level of public outreach and education should this proposal move forward.

The EC also notes that while this fishery appears viable in Oregon, further analysis by the EC may be necessary prior to implementation in other states.

PFMC
06/21/13

Agenda Item F.3.b
Supplemental GAP Report
June 2013

GROUNDFISH ADVISORY PANEL REPORT ON MID-WATER RECREATIONAL FISHERY

The Groundfish Advisory Subpanel (GAP) reviewed the Mid-Water Recreational Fishery proposal outlined in “Agenda Item F.3.c, Holloway Proposal, June 2013.” Ms. Gretchen Hanshew of the GMT was present to express the views of the GMT and answer technical questions.

The GAP unanimously supports moving the Mid-water recreational fishery into regulation with the following comments:

- While this proposal should be put into regulation in Oregon as soon as possible, the option should be available to California and Washington if so desired. Future inclusion of California and Washington would be subject to further discussion contingent upon successful implementation in Oregon.

- The proposal has been on the table for several years now and should be put into regulation as soon as possible, preferably through a regulatory amendment.

- The fishery needs to be adequately monitored in order to ensure compliance with new and existing regulations and to avoid exceeding harvest guidelines on overfished species, particularly Yelloweye and Canary rockfish. The GAP notes that existing state and Federal enforcement efforts in the recreational fishery do a good job of ensuring regulatory compliance.

- Barotrauma recompression devices should be required to be carried on vessels engaged in the fishery for use in the event of encounters with rockfish species that are required to be released. That gear should be readily available to be deployed.

PFMC
06/21/13

GROUNDFISH MANAGEMENT TEAM REPORT ON THE
MID-WATER SPORT FISHERY

The Groundfish Management Team (GMT) reviewed the Mr. John Holloway proposal (Agenda Item F.3.c) and the Oregon Department of Fish and Wildlife letter (Agenda Item F.3.b). The GMT would like to thank Mr. Holloway for meeting with the team and answering our questions.

The GMT attempted to focus our comments in this report on the Council action listed in the situation summary: *Provide guidance on the development of a mid-water recreational fishery including whether regulations should be coastwide or Oregon only.* The GMT is not providing comments on the technical merits of the proposal itself, or the proposed fishery, in this report.

Is there enough information to proceed with the scoping of a mid-water recreational fishery?

Mr. Holloway's proposal relies on information collected during an exempted fishing permit (EFP) in 2009 and 2011. The primary purpose of the EFP was to test gear designed to avoid yelloweye rockfish. All trips occurred on observed charter vessels in Oregon, with full retention of all rockfish caught. Under the EFP, several trips occurred within the Stonewall Bank Yelloweye Rockfish Conservation Area (YRCA), a known yelloweye rockfish hot spot, with minimal yelloweye rockfish encounters. In the two years combined, there was a total of 0.004 mt (or 4 kg) of yelloweye rockfish out of the 5.2 mt of total rockfish caught under the EFPs. In contrast, there was 1.0 mt of canary rockfish caught.

The GMT sees the potential benefit of implementing this proposal into regulation. Although it's difficult to estimate how many recreational anglers might participate in this fishery, adding new fishing opportunities in deeper water might take pressure off nearshore areas, and potentially vulnerable nearshore species, that are impacted under current regulations.

If there is enough information to proceed, should the mid-water recreational fishery be just in Oregon, or include other areas?

The EFP was conducted onboard observed charter vessels off of Oregon. Thirty two of the thirty four trips occurred out of Newport, Depoe Bay, and Garibaldi. Only two of the trips occurred out of ports south of Newport therefore, there is limited information from southern Oregon. There was an EFP using similar gear off of California that targeted chilipepper rockfish; however it was conducted in deeper water than what will likely be fished under this proposed fishery. The GMT is not aware of a similar EFP or any other research of this type off of Washington. Therefore there are no data to inform potential impacts to target and overfished species outside of Oregon.

The EFP was conducted on observed charter vessels; no private vessels participated in the EFP. Therefore, there is no direct information to predict impacts to target and overfished species for private vessels. It is also difficult to predict the effort that might result from this fishery. Part of the EFP was a bag limit of 15 rockfish, versus the seven rockfish bag limit in state regulations at the time of the EFP. All rockfish were required to be retained during the EFP, including canary and yelloweye rockfish. If this proposal were to be implemented, all regulations, other than the allowable depth, would be the same as the regular recreational fishery. This may not provide the same incentives as the EFP.

When considering whether or not the fishery could be expanded to other areas, the GMT discussed the difficulty with examining this proposal as a stand-alone management measure outside of analysis of other management measure analysis that will occur under the 2015-2016 biennial harvest specification and management measure analysis. The GMT discussed the benefits of a stepwise approach that would allow the proposal to be implemented in Oregon where there may be stakeholder interest, with the opportunity to consider expansion into other areas at a later time after more information becomes available.

Additional consideration

The GMT also discussed ideas for implementing the proposal in a way that addresses concerns with monitoring and reporting under a management structure outside of the requirements of the EFP. One idea was to allow the fishery for charter vessels only where onboard observers could track discards. The GMT also discussed the possibility of short openers, perhaps two-weeks at a time, where catch information could be synthesized prior to the next two-week opening. Something like this could prevent the overfished species harvest guidelines, like canary and yelloweye rockfish, from being exceeded if bycatch in the new fishery is much higher than observed during the EFP. However, these concepts would add a layer of management, regulatory, and enforcement complexities that may outweigh the benefits of the fishery.

The GMT believes there is enough information to continue the scoping process, if the Council chooses.

PFMC
06/21/13

Recreational Midwater Rockfish Fishery

Application to
National Marine Fisheries Service

A. Date of application

May 28, 2013

B. Applicant

Recreational Fishing Alliance, Oregon Chapter
Contact:
John Holloway
6823 SW Burlingame Ave.
Portland, OR 97219
(503) 201-3861

C. Statement of need and goals

Applicant is proposing that a midwater fishery be implemented in regulation to target abundant species using special gear in order to avoid and/or minimize impacts on species of concern. Recreational fishing depth and area closures are presently the most constraining in history. This is due primarily to one species, yelloweye rockfish. These closures apply to the entire water column for most groundfish FMP species. Yelloweye reside near the bottom in select habitats. Midwater species exist in relative abundance, yet are inaccessible. It has been shown that special gear can be developed which can provide access to midwater species without causing any additional impacts to yelloweye rockfish. Bottom habitat is all that needs protection from hooking impacts. This could provide increased opportunity for recreational fisheries and relieve fishing pressure on nearshore species. Increased opportunity is something that has been lacking for many years of incremental constraints on all fisheries.

E. Results from test fishery conducted in 2009 and 2011

Two years of federal Exempted Fishing Permit activities were recently completed. A total of thirty four fishing trips were conducted using Oregon charter vessels. All trips carried federal observers on board. Full catch accounting was documented for each trip. Participating anglers were normal charter customers. No angler selection was made. Fishing area selection was entirely based on target species with no regard for avoiding species of concern. Several trips were conducted within a federally documented yelloweye rockfish conservation area near Newport, Oregon. The primary purpose of this experiment was to avoid yelloweye rockfish. A total of two yelloweye rockfish were caught from a total of over five metric tons of rockfish landed. This is an impact rate of 0.08%. It is believed that the low impact rate on yelloweye justifies a broader application to regulation.

F. Previous Council discussion.

Discussion of this proposal by Council membership began informally in November 2011. Formal discussion took place at the Sept 2012 PFMC meeting in Boise, ID. The following discussion is from the minutes of that meeting (http://www.pcouncil.org/wp-content/uploads/FINAL_Sept_2012_Minutes.pdf) page 34, agenda item G.6:

> "Mr. S. Williams asked if NMFS was comfortable with initiating the recreational mid-water fishery issue in June 2013. Mr. Lockhart replied yes, depending on how the issue integrates with the biennial groundfish regulation specification process.
>
> Mr. S. Williams asked if it was possible to address the recreational mid-water fishery issue outside the specification process. Mr. Lockhart replied yes.
>
> Mr. Williams recommended putting the recreational mid-water fishery issue on the June 2013 agenda. "

Additional public comment was submitted by John Holloway at the November 2012 PFMC meeting, agenda item F.4.c (http://www.pcouncil.org/wp-content/uploads/F4c_PC_NOV2012BB.pdf)

G. Suggested management measures for Oregon:

Season open dates.

a) This fishery would open April 1st and close on Sept. 30th.

This open period would occur when groundfish is normally constrained by depth (currently open shoreward of 30 fathoms during this period}.

Area allowance.

a) The fishery would be open seaward of 40 fathoms only, between Washington and California border. This would coincide with the halibut nearshore depth limit (already defined by rule). It would allow a 10 fathom buffer from the normal groundfish limit (30 fathoms), reducing enforcement requirements to determine precise fishing location.

Bag limits.

a) Bag limits shall coincide with current state regulation, seven rockfish plus two lingcod.

b) Federal bag limits are higher and future adjustments could be made if accountability and enforcement requirements are satisfied

Gear requirements.

a) Gear shall be what exists in current groundfish regulations with the following additions: Hooking gear shall be a minimum of 30 feet above a sinker on a long leader. No maximum distance. A float shall be attached no more than 6 inches below the lowest hook. The float must be solid construction. None may be hollow. The float must have sufficient buoyancy to float all gear and line with the sinker removed.

H. Discussion.

Season open dates. These dates can be adjusted to meet various requirements. Short openings followed by catch accounting to determine inseason impacts are one example.

Area allowance. Area can be adjusted for management or enforcement requirements. The target species, yellowtail rockfish, are not generally found in abundance shoreward of 30 fathoms. It is not recommended to allow fishing in the Yelloweye Rockfish Conservation Area for enforcement reasons, even though EFP fishing in that area had minimal impacts on rebuilding species.

Rebuilding species impacts. Canary and yelloweye rockfish are the two species of intended avoidance.

Yelloweye rockfish were impacted at a rate of 0.08% in the EFP fishery. That is 4 kg yelloweye (2 fish) per 5163 kg rockfish landed. This is very close to total avoidance even within the YRCA where none were caught.

Canary rockfish were impacted at a rate of 20% in the EFP fishery. This impact rate is 1015 kg canary to 5163 kg total. It may be interesting to note that 743 kg of canary rockfish were landed by one vessel during six trips of 34. This is 73% of total. It was reported that this vessel was targeting canary due to the full retention allowance of the EFP. It is not being suggested that the canary impacts be adjusted downward. It is being suggested that this magnitude will likely be at the high end of what might be expected should this fishery go into regulation, especially with no retention. The current harvest guideline for canary rockfish has not been fully utilized recently by the Oregon recreational sector. The impacts as of October 28, 2012 were 53% of the harvest guideline of 7.0 metric tons.

John Holloway
RFA-Oregon

Attachment 1

Oregon Recreational Yellowtail Rockfish EFP

2009 & 2011 Combined Final Report
October 19, 2011

The 2009 and 2011 Oregon yellowtail rockfish EFP activities have been completed. Total trips for both years were thirty four.

The results are in excess of expectations. The purpose of this EFP is to avoid or minimize bycatch of prohibited species while targeting abundant offshore midwater stocks. The total impact on yelloweye rockfish was two fish (4 kg rounded) from a total of over 5.163 metric tons of rockfish landed. The other, canary rockfish are being impacted at rates well below that using common bottom gear. The overall EFP impact rate for canary rockfish is at 33% of yellowtail rockfish by weight. It is approximately 20% of all rockfish landed. The impact rate for canary to yellowtail was 113% by weight during the period 1993-1999 (ODFW) using traditional bottom gear when all depth access was open full season.

Following is the catch accounting for both years:

		weight in kg			by number
	Yellowtail	Widow	Canary	Yelloweye	Other Rkfsh
All Trips Total 2009	1657	266	129	0	31
All Trips Total 2011	1421	800	886	4	115
Totals	3078	1066	1015	4	146

Total all fish except 'other' (kg) 5163

The level of participating angler expertise encompasses the full range. Novice and expert anglers participated in this EFP. Angler selection was on a first come first served basis. No expertise selection took place. While the charter operators are considered to be experts, no area selection took place to avoid known concentrations of canary or yelloweye rockfish. Higher canary impacts were encountered while intentionally fishing an area of high relief (pinnacles) near Depoe Bay, Oregon while yelloweye encounters remained virtually unchanged. The only area selection used was based on known concentrations of yellowtail rockfish without regard to any other species. Some trips took place within a federally recognized Yelloweye Rockfish Conservation Area.

A survey of angler intent was conducted and is summarized in Attachment 1. A majority indicated that they would participate in this fishery if it were put into regulation in both the charter and private sportboat level. Although 15 fish bag limit was preferred, a lower number would be acceptable down to a level of seven fish or greater.

John Holloway
RFA-OR

Oregon Recreational Yellowtail Rockfish EFP
2009 & 2011 Combined Final Report
Attachment 1

The number of responses to each answer is indicated in brackets.
A total of 299 anglers responded to the questionnaire.

Oregon Yellowtail EFP Angler Questionnaire

The National Marine Fisheries Service, the issuing agency of the permits for this experiment is asking for participant feedback. Your help is greatly appreciated and will be a factor in determining whether this fishery will become available to all recreational anglers. Please answer all questions that apply to your experience today. Please check all that apply.

1. For what of any of the following reasons did you choose to participate in this trip today?

[207] 15 rockfish bag limit

[155] A chance to participate in an experiment

[97] A desire to fish further offshore

2. Is there a bag limit size that would cause you not to participate?

[192] Six fish or less

[56] Seven to ten fish

[65] Eleven to fourteen fish

3. If this fishery were adopted as a recreational fishery open to all, with an acceptable bag limit, how likely would you be to participate in the future?

[217] Very likely

[51] Somewhat likely

[26] Occasionally, no more than other trips

[8] Not likely

4. If you fish aboard your own or another's private sport boat how likely would you be to participate if this were available to all?

[178] Very likely

[59] Somewhat likely

[35] Occasionally, no more than other trips

[29] Not likely

Attachment 2

Oregon Recreational Yellowtail Rockfish EFP

2009 Activities Report
April 24, 2010

The Oregon yellowtail rockfish EFP officially got underway on June 21, 2009 with a trip by the charter vessel Norwester. During 2009 thirteen trips were completed. All have been monitored and recorded by on board PSMFC observers. The EFP was originally planned for thirty trips. The reduced number was due to a later than planned startup and minimal participation in the south coast sector. This EFP is currently in process for renewal for 2010. If permits are received soon a full schedule is anticipated for 2010.

The results to date are in excess of expectations. The purpose of this EFP is to avoid or minimize bycatch of prohibited species while targeting abundant offshore midwater stocks. To date the most constraining species, yelloweye rockfish, is yet to be encountered using this EFP gear. The other, canary rockfish, are being impacted at rates well below that using common bottom gear. The EFP impact rate for canary rockfish is at 8% of yellowtail rockfish by weight. It is approximately 6% of all rockfish landed. The impact rate for canary to yellowtail was 113% by weight during the period 1993-1999 (ODFW) using traditional bottom gear when all depth access was open full season.

Following is the catch accounting for 2009:

Oregon Yellowtail EFP Trip Report 9/18/09

				weight in kg			**by number**
Trip Date	**Vessel Name**	**# of Anglers**	**Yellowtail**	**Widow**	**Canary**	**Yelloweye**	**Other Rkfsh**
6/21/2009	Norwester	10	157	0	8	0	0
7/17/2009	Miss Raven	12	128	46	2	0	8
7/19/2009	D & D	11	100	54	13	0	0
7/20/2009	Umatilla II	8	112	14	0	0	1
7/25/2009	Miss Raven	11	167	4	0	0	4
7/28/2009	Norwester	9	130	4	13	0	3
8/2/2009	Miss Raven	11	125	43	0	0	0
8/11/2009	D & D	11	147	17	13	0	0
8/16/2009	Umatilla II	12	128	37	0	0	6
8/21/2009	Prowler	11	62	0	32	0	5
8/23/2009	D & D	9	131	9	8	0	0
9/4/2009	Norwester	12	161	4	40	0	0
9/13/2009	Umatilla II	10	109	34	0	0	4
All Trips Total		137	1657	266	129	0	31
EFP Species Caps (kg)				3000	2600	200	

The level of participating angler expertise encompasses the full range. Novice and expert anglers participated in this EFP. Angler selection was on a first come first served basis. No expertise selection took place. While the charter operators are considered to be experts, no area selection took place to avoid known concentrations of canary or yelloweye rockfish. The only area selection used was based on known concentrations of yellowtail rockfish without regard to any other species. Some trips took place within a federally recognized Yelloweye Rockfish Conservation Area.

John Holloway
RFA-OR

Attachment 3

Oregon Recreational Yellowtail Rockfish EFP

2011 Activities Final Report
October 19, 2011

The 2010-2011 Oregon yellowtail rockfish EFP officially got underway on April 17, 2011 with a trip by the charter vessel Norwester. During 2011 twenty one trips were completed. This is the second year of this EFP with the first taking place in 2009.

The results for 2011 are in excess of expectations. The purpose of this EFP is to avoid or minimize bycatch of prohibited species while targeting abundant offshore midwater stocks. The total impact on yelloweye rockfish was two fish (4 kg rounded) from a total of over 3 metric tons of rockfish landed. The other, canary rockfish are being impacted at rates well below that using common bottom gear. The 2011 EFP impact rate for canary rockfish is at 62% of yellowtail rockfish by weight. It is approximately 28% of all rockfish landed. The impact rate for canary to yellowtail was 113% by weight during the period 1993-1999 (ODFW) using traditional bottom gear when all depth access was open full season.

Following is the catch accounting for 2011:

Oregon Yellowtail EFP Trips Report 9/1/2011

			weight in kg				by number
Trip Date	**Vessel Name**	**# of Anglers**	**Yellowtail**	**Widow**	**Canary**	**Yelloweye**	**Other Rkfsh**
04/17/11	Norwester	12	78	89	5	0	0
05/15/11	Miss Raven	9	93	27	8	0	9
05/15/11	D & D	11	84	71	3	0	0
05/22/11	Miss Raven	10	29	88	5	2	15
05/29/11	Miss Raven	7	3	52	2	0	38
05/31/11	Norwester	9	97	30	13	0	0
06/05/11	Miss Raven	13	37	108	5	0	30
06/12/11	Miss Raven	9	40	65	6	0	15
06/20/11	Samson	12	136	2	79	0	0
06/22/11	Miss Raven	12	7	75	0	0	1
06/27/11	Samson	12	98	0	137	2	0
06/28/11	D & D	9	118	7	30	0	0
07/02/11	Miss Raven	11	5	51	2	0	2
07/04/11	Samson	11	73	3	76	0	2
07/26/11	D & D	11	161	11	6	0	0
07/27/11	Miss Raven	11	3	43	3	0	3
08/12/11	Miss Raven	11	61	7	55	0	0
08/23/11	Samson	13	82	0	190	0	0
08/24/11	Norwester	11	86	71	0	0	0
08/26/11	Samson	13	69	0	160	0	0
08/31/11	Samson	8	61	0	101	0	0
All Trips Total		225	1,421	800	886	4	115
EFP Species Caps (kg)			10,000	3000	1000	100	

The level of participating angler expertise encompasses the full range. Novice and expert anglers participated in this EFP. Angler selection was on a first come first served basis. No expertise selection took place. While the charter operators are considered to be experts, no area selection took place to avoid known concentrations of canary or yelloweye rockfish. Higher canary impacts were encountered while intentionally fishing an area of high relief (pinnacles) near Depoe Bay, Oregon while yelloweye encounters remained virtually unchanged. The only area selection used was based on known concentrations of yellowtail rockfish without regard to any other species. Some trips took place within a federally recognized Yelloweye Rockfish Conservation Area.

John Holloway
RFA-OR

SEABIRD AVOIDANCE REGULATIONS

The U.S. Fish and Wildlife Service (USFWS) published a biological opinion considering the effects of west coast groundfish fisheries to Endangered Species Act (ESA) listed marine species, including seabirds (see http://tinyurl.com/nl4ye3u**)**. The opinion includes reasonable and prudent measures (RPMs), terms and conditions, and conservation recommendations[1] to minimize take of seabirds, particularly the endangered short-tailed albatross. The RPMs stipulate that the National Marine Fisheries Service (NMFS) shall 1) minimize the risk of short-tailed albatross interactions with commercial hook and line gear, 2) establish a work group as an advisory body to NMFS and USFWS for the purposes of reducing risk to short-tailed albatross (and other ESA-listed species), 3) monitor and report all observed, reported, and estimated short-tailed albatross take as well as report on the efficacy of avoidance and minimization measures, and 4) facilitate the salvage of short-tailed albatross carcasses taken by longline gear.

The NMFS prepared a preliminary draft Environmental Assessment (EA) and associated draft regulations (see Appendix A of the EA), in response to the RPMs, for Council consideration under this agenda item (Agenda Item F.4.b, Preliminary Draft EA). The ESA Work Group, which is proposed as a Council advisory body, is scheduled for Council discussion under Agenda Item C.6 Membership Appointments and Council Operating Procedures.

The action alternative detailed in the EA would establish regulations requiring streamer lines for commercial longline vessels 55 feet or greater in length to reduce the incidental take of seabirds, while maintaining the voluntary program for smaller vessels. Proposed regulations would modify offal discharge, to the extent practicable, in a manner that should minimize seabird interactions. Procedures for reporting and salvaging short-tailed albatross carcasses taken by longline gear are also proposed. Overall, the proposed regulations are intended to be similar to the Alaska streamer line regulations for Federal waters. The Council should review the draft preliminary EA and regulations, provide guidance, and select a preliminary preferred alternative for public review.

Council Action:

1. Review and provide guidance on the draft preliminary EA.
2. Adopt a preliminary preferred alternative for public review.

Reference Materials:

1. Agenda Item F.4.b, Preliminary Draft EA: Measures to Minimize Take of Short-tailed Albatross in the Pacific Coast Groundfish Fisheries.

[1] Reasonable and prudent measures are non-discretionary measures to minimize the amount or extent of incidental take. Terms and conditions are non-discretionary terms to implement the reasonable and prudent measures. Conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects on listed species or critical habitat or regarding the development of information.

Agenda Order:

a. Agenda Item Overview Kelly Ames
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action**: Adopt Preliminary Seabird Avoidance Regulations in Groundfish Fisheries for Public Review

PFMC
05/28/13

MEASURES TO MINIMIZE TAKE OF SHORT-TAILED ALBATROSS IN THE PACIFIC COAST GROUNDFISH FISHERIES Including the ENVIRONMENTAL ASSESSMENT (EA) AND INITIAL REGULATORY FLEXIBILITY ANALYSIS (IRFA)

Preliminary DRAFT

Lead Agency	National Oceanic and Atmospheric Administration National Marine Fisheries Service Northwest Regional Office Seattle, Washington
Responsible Official	William Stelle, Jr. Regional Administrator Northwest Regional Office

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• 1.0 INTRODUCTION

This Environmental Assessment (EA) analyzes the implementation of a Seabird Avoidance Program in the Pacific Coast Groundfish Fishery. It specifically addresses proposed regulations to minimize the take of ESA-listed short-tailed albatross (*Phoebastria albatrus*). The proposed provisions are pursuant to a U.S. Fish and Wildlife Service Biological Opinion (B.O.) that requires NMFS to implement regulations mandating the use of seabird avoidance measures by vessels greater than or equal to 55 feet length overall (LOA) using bottom longline gear to harvest groundfish. The seabird avoidance measures are modeled after a similar regulatory program in effect for the Alaskan groundfish fishery.

1.1 PURPOSE AND NEED FOR ACTION

The purpose of the proposed action is to reduce interactions between seabirds and groundfish longline gear. Many seabirds attack baited hooks as the longline is being set and become lethally hooked and drowned (USFWS 2008, p. 20). The proposed action would amend the regulations governing the Pacific Coast groundfish fishery to require seabird avoidance measures – specifically the use of streamer lines and related provisions currently mandated in the Alaskan groundfish fishery – by vessels 55 ft LOA or greater in the bottom longline fishery.

The proposed action is needed to minimize takes of endangered short-tailed albatross and comply with a 2012 B.O. issued by the U.S. Fish and Wildlife Service. The 2012 B.O. evaluated the risks of continued operation of the Pacific Coast groundfish fishery on ESA-listed seabirds, including short-tailed albatross. The 2012 B.O. included a Term and Condition requiring NMFS to promulgate regulations mandating the use of streamer lines by longline vessels 55 feet LOA or greater, patterned on the Alaska streamer line regulations. Accordingly, for the fishery to be exempt from the ESA Section 9 restrictions regarding take of a listed species, streamer line regulations must be in effect by November 21, 2014. The 2012 B.O. anticipates the yearly average take of one short-tailed albatross killed from longline hooks or trawl cables. As the short-tailed albatross population is expanding, it is expected to result in more interactions with the Pacific Coast Groundfish Fisheries. This action would implement one of the terms and conditions of the 2012 B.O. and reduce the risk of exceeding the take limits of short-tailed albatross, which in turn would reduce the risk of economic harm to the fishing industry that could result from the incidental take limit being exceeded.

1.2 PROPOSED ACTION

The proposed action would require streamer lines, sometimes referred to as tori or bird-scaring lines, to be deployed as the longline gear is being set. A streamer line effectively fences off the longline from seabird interactions. The streamer line is a line (typically 50-fathom or 90-meter) that extends from a high point near the stern of the vessel to a drogue (usually a buoy with a weight). As the vessel moves forward the drogue creates tension in the line producing a span from the stern where the streamer line is aloft. The aloft section includes streamers made of UV protected, brightly colored tubing spaced every 16 feet (5 meters). Streamers must be heavy enough to maintain a near-vertical fence in moderate to high winds. Individual streamers should extend to the water, to prevent aggressive birds from getting to the groundline. When deployed in pairs – one from each side of the stern – streamer lines create a moving fence around the sinking groundline reducing or eliminating bird interactions (see Figure 1) (Melvin 2000). Streamer lines have been effective at reducing seabird bycatch in fisheries throughout the world including Alaskan fisheries that are similar to West Coast groundfish fisheries (USFWS 2008; Ed Melvin, personal communication; Bob Alverson, personal communication).

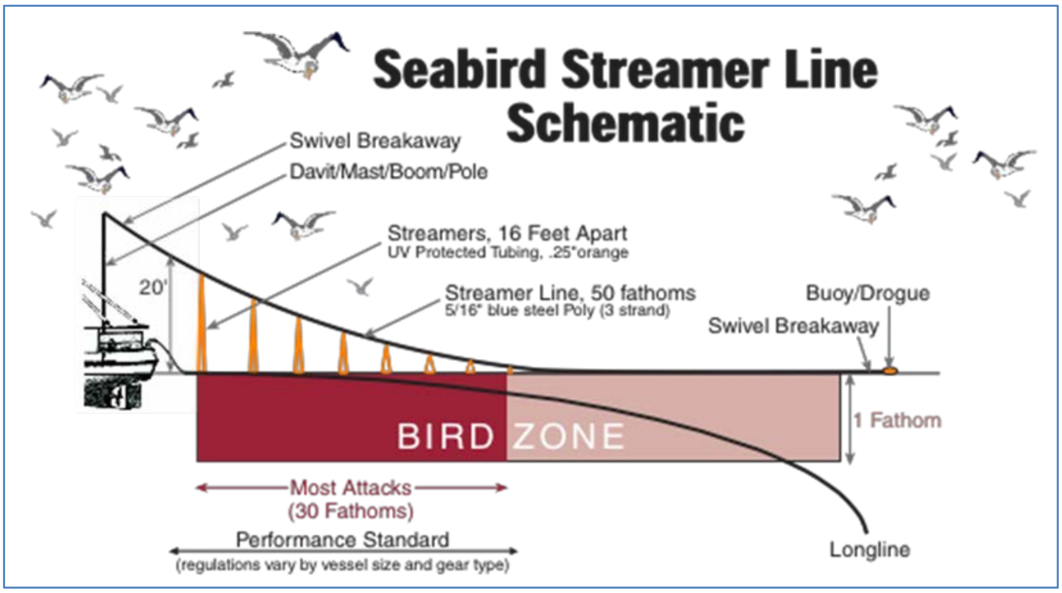

Figure 1: Schematic of streamer lines to reduce seabird bycatch (modified from Melvin 2000).

1.3 Action Area

The action area is the area off the Pacific coast where West Coast groundfish vessels using bottom longline gear operate, defined by regulation at 50 CFR 660.11 subpart C as: "the Exclusive Economic Zone off the coasts of Washington, Oregon, and California between 3 and 200 nm offshore, and bounded on the north by the Provisional International Boundary between the U.S. and Canada, and bounded on the south by the International Boundary between the U.S. and Mexico (see Figure 2). The inner boundary of the fishery management area is a line coterminous with the seaward boundaries of the States of Washington, Oregon, and California (the "3-mile limit"). The outer boundary of the fishery management area is a line drawn in such a manner that each point on it is 200 nm from the baseline from which the territorial sea is measured, or is a provisional or permanent international boundary between the U.S. and Canada or Mexico."

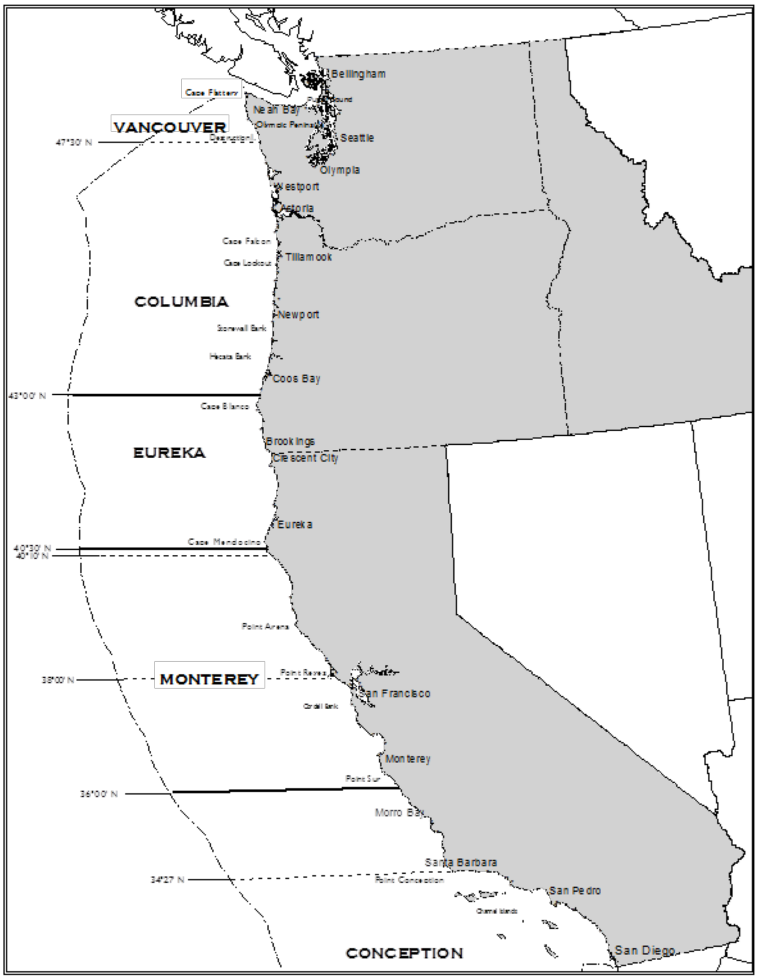

Figure 2: The action area, showing major coastal communities and groundfish management areas.

1.4 BACKGROUND OF RELATED NON-REGULATORY ACTIONS

In addition to the regulatory action analyzed in this EA, NMFS has worked in collaboration with academia, NGOs, the fishing industry, coastal tribes, and Washington Sea Grant to develop a multi-dimensional seabird conservation initiative for the West Coast groundfish fishery. The initiative includes research, industry outreach, and subsidies to encourage voluntary use of the seabird avoidance measures described below. The initiative was catalyzed in 2011 by the take of a short-tailed albatross in the groundfish longline fishery off Oregon (see Section 3.1).

1.4.1 Research

Washington Sea Grant and Oregon State University are leading a research program in collaboration with the fishing industry to develop effective and practical tools to reduce the mortality of albatrosses and other seabirds in the West Coast longline fishery targeting sablefish. Industry partners currently include the Fishing Vessel Owners Association, Washington coastal tribes, and others. NMFS, the Packard Foundation, and the National Fish and Wildlife Foundation are funding this project. A specific goal is to develop streamer lines suited to the diversity of longline gear used in this fishery and to promote their voluntary use.

At the conclusion of this research effort, recommendations for seabird bycatch avoidance will be provided to the Pacific Fishery Management Council for its consideration based on results and consultation with the fishing industry and other stakeholders. Research protocol is provided in Appendix C. The research program is pursuant to the 2012 B.O. requirement for an adaptive management process to revise the regulatory provisions considered in this EA as needed. The B.O. provides:

> "*It is expected that new information and research shall reveal new or improved methods of reducing bycatch of short-tailed albatross that are safe and effective for the Fishery to use . . . (*USFWS 2012, p. 35*)"*

1.4.2 Industry Outreach

The purpose of the outreach program is to raise awareness of the need for albatross bycatch mitigation, share solutions developed for Alaskan fisheries and other demersal fisheries around the world, encourage voluntary use of streamer lines, and foster innovation. The project is:

- developing and distributing outreach materials on seabird bycatch prevention strategies;
- raising industry awareness on the availability of free streamer lines;
- serving as the point of contact on technical aspects of seabird bycatch mitigation measures to stakeholders; and,
- conducting targeted outreach to fishery stakeholders.

Appendix B contains a 2011 outreach summary.

1.4.3 Subsidy

NMFS has provided funding to the Pacific States Marine Fisheries Commission (PSMFC) to build (or procure) streamer lines and distribute them free of charge to any bottom longline vessel fishing on the West Coast. The program has resulted in the distribution of 221 streamer lines since 2009 that have been deployed on a voluntary basis. It is expected that the outreach efforts described above will result in increased interest by the fleet and the distribution of additional free streamer lines.

• 2.0 ALTERNATIVES

This section presents alternatives for analysis as well as a summary of NMFS' scoping process, including alternatives that were considered but rejected from further analysis.

2.1 ALTERNATIVE 1 – NO ACTION

The No Action alternative would maintain the current regulations that do not include seabird avoidance measures. The non-regulatory actions described in Section 1.4 would continue as long as funding is available.

2.2 ALTERNATIVE 2 – REGULATORY SEABIRD AVOIDANCE PROGRAM

Alternative 2 would amend the regulations governing the Pacific Coast groundfish fishery to require seabird avoidance measures – specifically the use of streamer lines and related provisions currently mandated in the Alaskan groundfish fishery (50 CFR 679.24(e)) – by vessels 55 ft LOA or greater using bottom longline gear pursuant to the Pacific Coast Groundfish Fishery Management Plan (FMP). In sum, the regulation would:

- Require the use of streamer lines in the commercial longline fishery of the Pacific Coast Groundfish Fishery for non-tribal vessels 55 feet in length or greater;
- Require vessels to deploy one or two streamer lines depending on the type of longline gear being set;
- Require that streamer lines meet technical specifications and be available for inspection;
- Allow for a rough weather exemption from using streamer lines for safety purposes; and,
- Require that vessels take additional measures to avoid seabird interactions including:
    - Ensuring that baited hooks sink quickly; and,
    - Discharging offal in a manner that distracts birds from hooks.

Details associated with Alternative 2 are presented as draft regulatory language in Appendix A.

The non-regulatory actions described in Section 1.4 would continue as long as funding is available.

2.3 SCOPING SUMMARY

Pursuant to the NMFS Policy Directive 30-131, NMFS convened an Internal Scoping Meeting with subject matter experts to scope alternatives, identify issues or resources for analysis, and make preliminary determinations regarding the context and intensity of likely effects of the proposed action on the human environment.

2.3.1 Alternatives Considered but Rejected from Further Analysis

An alternative to require seabird avoidance measures on all vessels using longline gear was considered during scoping and rejected from further analysis due to ongoing research that makes such an alternative premature. As described in Section 1.4, Washington Sea Grant is conducting research to develop streamer lines suited to the diversity of longline gear used in the Pacific Coast Groundfish Fishery. While the research may influence streamer line design for all vessel sizes, smaller vessels may be subject to risk of safety problems arising from the streamer lines becoming entangled during gear-setting (Guy 2013, pers comm). Designing safe gear for smaller vessels is a priority of the research. Pending the completion of that research, it would be premature to consider reglations on vessels smaller than 55 ft LOA. Alternatives to pattern seabird avoidance measures on other fishery management programs (e.g., Hawaii longline) were considered and rejected for further analysis because the B.O. specifically requires the measures to be patterned after the program for the Alaskan groundfish fishery.

• 3.0 AFFECTED ENVIRONMENT

This section describes the affected environment of those resources directly associated with implementation of the proposed action.

3.1 SEABIRDS

3.1.1 ESA-Listed Seabirds[1]

ESA-listed endangered seabirds in the project area include short-tailed albatross (*Genus species name*), California least tern (*Sterna antillarum browni*), and Marbled murrelet (*Brachyramphus marmoratus*), but of those, only short-tailed albatross is known to interact with the groundfish fishery (USFWS 2011). For that reason, the remainder of this discussion is devoted to short-tailed albatross.

Short-tailed albatrosses are large, pelagic seabirds with long, narrow wings adapted for soaring just above the water surface. Short-tailed albatross are central place foragers and bring food back to nestlings after surface feeding on primarily squid (especially the Japanese common squid [*Todarodes pacificus*]), shrimp, fish (including bonitos [*Sarda* sp.], flying fishes [Exocoetidae] and sardines [Clupeidae]), flying fish eggs, and other crustaceans (Hasegawa and DeGange 1982, Tickell 1975, Tickell 2000). There is little information on non-breeding diet, but it is thought that squids, crustaceans, and fishes are important prey (Hasegawa and DeGange 1982).

Marine Range
At-sea sightings since the 1940s indicate that short-tailed albatross are distributed widely throughout their historic foraging range in the temperate and subarctic North Pacific Ocean (Sanger 1972). While observations are concentrated along the edge of the continental shelf, in the northern Gulf of Alaska, Aleutian Islands, and Bering Sea (McDermond and Morgan 1993, Sherburne 1993), individual short-tailed albatross have been recorded along the West Coast of North America and as far south as the Baja Peninsula, Mexico (Palmer 1962).

From December through April, short-tailed albatross foraging is primarily concentrated near the breeding colonies, although individual trips may extend hundreds of miles or more from the colony sites. During the non-breeding season, short-tailed albatross range along the Pacific Rim from southern Japan to northern California, primarily along continental shelf margins. Post-breeding birds either disperse rapidly north to the western Aleutian Islands or stay within the coastal waters of northern Japan and the Kuril Islands throughout the summer, moving in early September into the western Aleutian Islands; once in the Aleutians, most birds travel east toward the Gulf of Alaska (Suryan et al. 2006).

[1] This section adapted from NWFSC 2011.

Juveniles and sub-adults are prevalent off the West Coasts of Canada and the U.S. (Environment Canada 2008). In late September, large flocks of short-tailed albatross have been observed over the Bering Sea canyons (Piatt et al. 2006); these are the only known concentrations of this species away from their breeding islands. Short-tailed albatross forage extensively along continental shelf margins, spending the majority of time within national EEZs, particularly the U.S. (off Alaska), Russia, and Japan, rather than over international waters (Suryan et al. 2007a, Suryan et al. 2007b).

Critical habitat

Critical habitat has not been designated for this species. In the 2000 final listing rule, the USFWS determined that designation of critical habitat was not prudent, due to the lack of habitat-related threats to the species, the lack of specific areas in U.S. jurisdiction that could be identified as meeting the definition of Critical Habitat, and the lack of recognition or educational benefits accruing to the American people as a result of such designation (65 FR 147:46651-46653).

Status

The short-tailed albatross was originally listed as endangered in 1970. Due to an administrative error, the species was listed as endangered throughout its range except within the United States (50 CFR 17.11). The error was corrected on 31 July 2000, when the U.S. Fish and Wildlife Service published a final rule listing the short-tailed albatross as endangered under the ESA
throughout its range, including the United States (65 FR 147:46643-46654). The Short-Tailed Albatross Recovery Plan was finalized in 2008 (USFWS 2008).

Abundance and trend

As of spring 2011, the global population estimate of short-tailed albatross was 3,463 individuals (P. Sievert and H. Hasegawa, unpubl. data). Pre-exploitation global population estimates of short-tailed albatross are not known, but Dr. Hiroshi Hasegawa estimated there were at least 300,000 breeding pairs on Torishima Island alone (cited in USFWS 2008). From 1881 to 1903, an estimated five million short-tailed albatross were harvested from the breeding colony on Torishima Island, and they were harvested into the 1930s (except for a few years following a 1903 volcanic eruption); by 1949, there were no short-tailed albatross breeding at any of the historically-known breeding sites, including Torishima Island, and the species was thought to be extinct (Austin 1949) however a small number of birds are thought to have been at sea that later returned to re-populate Torishima Island.

Threats (from Recovery Plan (USFWS 2008) or Listing documents)

Short-tailed albatross face significant threats on breeding colonies and at sea. The major threat of over-exploitation that led to the species' original endangered status no longer occurs. Current threats listed in the Recovery Plan include catastrophic events, such as a volcanic eruption on the main breeding site on Torishima Island. Other catastrophic events, particularly monsoons, can also threaten habitat and nesting success. Past volcanic activity has restricted breeding to sparsely vegetated and steep slopes of loose volcanic soil, and monsoon rains result in frequent mudslides and severe erosion, which can reduce habitat, destroy nests, and reduce breeding success. Global threats may also include indirect adverse effects related to climate change and oceanic regime shifts.

While known and potential threats from commercial fishing include U.S. and international demersal longline, pelagic longline, gillnet, jig/troll, and trawl fisheries, short-tailed albatross populations are not declining due to seabird bycatch in commercial fisheries (USFWS 2008). Other threats include contamination from organochlorines, pesticides, metals, and oil, and consumption of plastics. There has been an observed increase in the occurrence of plastics in birds on Torishima Island over the last decade, but the effect on survival and population growth is not known (USFWS 2008).

Past Fishery Impacts
There have been 16 reported lethal takes of short-tailed albatross in commercial fisheries since 1983; mostly in hook-and-line fisheries. The most recent reports—two takes in the Alaskan cod longline fishery and one take in the West Coast sablefish longline fishery—were the first reported in U.S. fisheries since 1998.

California, Oregon, Washington One known lethal take of short-tailed albatross has been reported off the West Coast of the continental U.S. In April 2011, a single short-tailed albatross juvenile was reported caught by longline gear in the limited entry sablefish fishery approximately 65 kilometers off the Oregon coast (WCGOP, unpubl. data).

Japan, Russia There is virtually no seabird bycatch information reported from Japanese fisheries, although it is likely that take has occurred in pelagic fisheries off Japan. During brood rearing, adults forage for food off the east coast of Honshu, and individuals on Torishima Island have been observed with fishhooks in their mouths of the same type used in Japanese commercial fisheries (USFWS 2008). There is also inadequate seabird bycatch information from Russian fisheries, although demersal longline fisheries in the Russian EEZ are a known threat to short-tailed albatross (USFWS 2008), and short-tailed albatross have been taken in driftnet fisheries that still operate in the Russian EEZ.

Alaska and Hawaii No known takes of short-tailed albatross have been reported in domestic pelagic longline fisheries in the North Pacific. Demersal longline fisheries in the U.S. EEZ off Alaska (Bering Sea/Aleutian Islands area and Gulf of Alaska) are a known threat to short-tailed albatross, with almost all known takes occurring in demersal longline groundfish fisheries; no takes have been reported in groundfish trawl or pot fisheries. Two separate analyses for the demersal groundfish longline fisheries have estimated that, on average, one short-tailed albatross is taken in the Bering Sea hook-and line fishery each year (Stehn et al. 2001), and mitigation measures have likely reduced this rate since those estimates were developed. U.S.-based pelagic longline swordfish and tuna fisheries in the vicinity of the Hawaiian Islands have the potential to affect short-tailed albatross; overall seabird (and albatross) bycatch rates have declined in Hawaii's pelagic longline fishery since bycatch reduction regulations were promulgated (Gilman and Kobayashi 2005, NMFS 2011). A recent analysis of the continued operation of the Hawaii-based pelagic longline fisheries (NMFS 2011) calculated rates of incidental take of short-tailed albatross of one per year for both the shallow-set longline and deep-set longline fisheries. The rate of incidental takes of seabirds in general and albatross in particular has declined markedly in Alaskan demersal longline fisheries since bycatch reduction regulations were instituted (USFWS 2008).

3.1.2 Other Seabirds[2]

The US West Coast supports a diversity of seabird species, which exhibit a wide range of life history characteristics. Seabirds for which takes have been documented in the West Coast groundfish fishery include species that breed locally such as Brandt's cormorant, brown pelican, common murre, Leach's strom petrel and the western gull. Takes have also been documented for seabird species that pass through the California Current system during migration or foraging periods, but breed elsewhere such as the black-footed albatross, northern fulmar and the sooty shearwater.

All of the California Current system seabirds (breeding or transitory) are highly mobile and require an abundant food source to support their high metabolic rates (Ainley et al. 2005). Because of these shared characteristics, the abundance of most seabird species along the US West Coast is influenced by the same physical and biological factors, e.g., oceanic productivity and prey availability (Tyler et al. 1993, Ainley et al. 2005). Specifically, the seasonal and latitudinal distribution of seabirds is defined by the intensity of coastal upwelling, which delivers nutrient rich water and supports greater prey biomass in surface waters accessible to seabirds (Tyler et al. 1983). On the US West Coast, upwelling is most intense south of Cape Blanco, OR (42° 50' N latitude) (Bakun et al. 1974, Barth et al. 2000), which supports a large percentage of the nesting sites of locally breeding seabirds (Tyler et al. 1993). The location of stable nesting sites reflects oceanographic conditions that support long-term food availability (Tyler et al. 1993). Transient species to the California Current system are also most abundant in areas of strong upwelling intensity and high productivity (Briggs and Chu 1986, Hyrenbach et al. 2002).

In addition to varying by latitude, both coastal upwelling and the distribution of seabirds also vary by season. Three distinct oceanic seasons have traditionally been defined for the US West Coast: the Upwelling, Oceanic, and Davidson Current seasons (Ford et al. 2004). The Upwelling season coincides with late spring and summer, when northerly winds transport surface waters southward and away from the coast. The distribution of breeding species in summer largely reflects the location of nesting colonies, which are most prevalent adjacent to the central and northern portion of the California Current system (Tyler et al. 1993, Ford et al. 2004). However, during this time, breeders are outnumbered by visiting species, which are attracted by greater oceanic productivity and prey abundance associated with upwelling. Commonly observed visiting species in summer include the sooty shearwater (*Puffinus griseus*), Northern fulmar *(Fulmarus glacialis*), and black-footed albatross (*Phoebastria nigripes*) (Tyler et al. 1993). In the fall (Oceanic season), northerly winds and upwelling intensity decrease, and sea surface temperature reaches its annual maximum. Several species that nest farther south in Mexico and southern California move northward, including the brown pelican (*Pelecanus occidentalis*) and storm-petrels. As winter approaches, these species again return south and breeders from boreal nesting colonies become more abundant, particularly off of California (Tyler et al. 1993). The winter months along the West Coast are characterized by warmer water delivered by the Davidson Current and reduced levels of primary production (Davidson Current season). Seabird abundance during this time is generally low (Tyler et al. 1993).

[2] This section adapted from Jannot et al. 2011.

3.2 Socioeconomic Affected Environment

Of the many types of fishing gear used in the groundfish fishery, only vessels that use fixed gear, specifically bottom longline, will be affected by the proposed action. There are three major sectors in the fixed gear groundfish fishery that would be affected: the LE sablefish endorsed sector, the LE non-sablefish-endorsed sector, and the Federal open access sector. In addition, a new sector has emerged since the implementation of the ITQ program that allows trawlers to "gear switch" and harvest their trawl quota with longline gear (50 CFR 660.140(k)).

3.2.1 Affected Sectors

Limited Entry Sablefish Primary Tier-Endorsed Fixed Gear

Vessels participating in the LE sablefish-endorsed sector range in size from 33 to 95 feet and operate north of 36-degrees N. latitude. Fishing generally occurs in depths greater than 80 fathoms. Nearly all of the vessels participating in this sector deliver their iced catch to shoreside processors. Catch in the LE sablefish-endorsed fishery is composed mostly of sablefish, with bycatch primarily composed of spiny dogfish shark, Pacific halibut, rockfish species, and skates. LE sablefish-endorsed permits provide the permit holder with an annual share of the sablefish catch. Sablefish-endorsed permits are assigned to Tier 1, 2, or 3. Each Tier 1 permit receives 1.4% of the primary-season sablefish allocation, with Tiers 2 and 3 receiving 0.64% and 0.36%, respectively. Each year, these shares are translated into amounts of catch (in pounds), or "tier limits", which could be caught during the primary fishery. Regulations allow for up to three LE sablefish-endorsed permits to be 'stacked' on a single vessel. Permit stacking was implemented to increase the economic efficiency of the fleet and promote fleet capacity reduction. Stacking more than one sablefish-endorsed permit on a vessel allows the vessel to land sablefish up to the sum of the associated tier limits. However, permit stacking does not convey additive landing limits for any other species. LE sablefish-endorsed primary season fishing currently takes place over a seven-month period from April 1 to October 31. The seven-month season was first implemented in 2002. Permit holders land their tier limits at any time during the seven-month season. Once the primary season opens, all sablefish landed by a sablefish-endorsed permit is counted toward attainment of its tier limit. Vessels that have LE sablefish-endorsed permits can fish in the LE non-sablefish-endorsed fishery under trip limits once their quota of primary season sablefish has been caught or when the primary season is closed, from November 1 through March 31.

Limited Entry Non-Sablefish-Endorsed Fixed Gear

The LE non-sablefish-endorsed fixed gear sector occurs coastwide but operates primarily out of southern California ports. The fishery operates year-round, but the majority of fishing activity occurs during the summer months when weather conditions improve. Vessels in the LE non-sablefish-endorsed sector range in size from 17 to 60 feet, with an average length of 34 feet. Vessels catch a variety of groundfish species, including thornyheads, sablefish, rockfish, and flatfish. The fleet typically operates in depths greater than 80 fathoms. Nearly all of the vessels participating in this fishery deliver their iced catch to fresh fish markets. LE non-sablefish-endorsed fixed gear permits are subject to daily and weekly trip limits for sablefish, thornyheads, and other groundfish species.

Gear Switching

Under the trawl rationalization program, vessels are no longer restricted to a specific gear type. Vessels that were previously limited to trawl gear may now opt to use non-trawl gear. As with other elements of the trawl rationalization program, it is unknown how this will influence fishing effort profiles. Market analysis suggests it may be economically beneficial for some fishermen to harvest sablefish by bottom-longline instead of trawl; however, it is not yet known if this will occur or, if it does, the magnitude of change. As mentioned above, starry flounder, "other flatfish," and chilipepper rockfish south of 40º10'N latitude have been allocated to nontrawl fisheries in excess of historical amounts. Similar to sablefish, it is not possible to determine if this will result in a net increase in non-trawl effort. NMFS is actively monitoring changes in the fishery that result from the trawl rationalization program.

Open Access Fixed Gear

As the open access sector of the fixed gear groundfish fishery does not require Federal or state permits (state requirements for commercial fishing licenses notwithstanding), characterizing the participants can be difficult. Vessels range in size from 10 to 97 feet, with an average length of 33 feet. Vessels catch a variety of groundfish species, including sablefish, spiny dogfish, and skates. Vessels operate out of all three coastal states and generally fish in waters shoreward of 30 fathoms or seaward of 100 fathoms. Open access fixed gear vessels are subject to daily and weekly trip limits for sablefish, spiny dogfish shark, and other groundfish species. Flatfish species—including dover sole, arrowtooth flounder, petrale sole, English sole, starry flounder, and all other flatfish—are managed as a single group for the open access fishery.

3.3 Safety-at-Sea

The deployment of streamer lines raises potential safety issues. For example, lines may become entangled during the setting of the longline and create a safety hazard. There are not data available to quantify the frequency of safety issues related to the deployment of streamer lines; however, industry experts with experience in the Alaskan groundfish fisheries suggest safety issues are rare there because of long-term experience using streamer lines and a regulatory exemption from using streamer lines in rough weather. Further, low-tensile strength "break-aways" are sewn into streamer lines so that if entanglements occur, the line breaks without creating a safety hazard such as entanglement in the prop (Guy 2013; pers comm). NMFS' funded outreach is expected to reduce the risk of safety hazards by teaching fishermen safe deployment techniques.

3.3.1 Comparison of the Safety-at-Sea Consequences of the Alternatives

Safety-at-sea issues are present under either alternative because NMFS is encouraging the voluntary use of streamer lines that may become a hazard through entanglement. Alternative 2 has a higher risk of safety hazards due to the regulatory requirement for vessels 55 ft LOA and larger. For both alternatives, there are mitigating factors, including outreach on the safe use of streamer lines and the use of low-tensile strength "break-aways." Further, the incidence of entanglements is expected to be reduced over time as the fleet gains experience. Risks associated with Alternative 2 are mitigated by a rough weather exemption in which the requirement to deploy streamer lines is held in abeyance whenever winds exceed 45 knots (storm or Beaufort 9 conditions).

• 4.0 ENVIRONMENTAL CONSEQUENCES

The proposed action would have a negligible influence on normal fishing operations. For example, the proposed action would not affect when, where, or to what degree a fishermen will fish and therefore, impacts would not be expected on the following resources or issues: groundfish (including overfished species), non-groundfish, listed species with the exception of short-tailed albatross, non-listed species with the exception of seabirds, the marine ecosystem, habitat, tourism and recreation, environmental justice, human health, cultural resources, and climate change. The full range of environmental consequences associated with normal fishing operations are fully considered in and hereby tiers off the following EIS: Proposed Harvest Specifications and Management Measures for the 2013-2014 Pacific Coast Groundfish Fishery and Amendment 21-2 to the Pacific Coast Fishery Management Plan, Final Environmental Impact Statement (PFMC and NMFS 2012). Issues directly associated with implementation of the proposed action and therefore considered in the following analyses are: (a) seabirds; (b) cost to vessels of procuring streamer lines; and, (c) safety issues associated with deploying streamer lines.

4.1 SEABIRD RESOURCES

4.1.1 ESA-Listed Seabirds

Impact of West Coast Groundfish fisheries on population growth rate

Based on the information summarized above, West Coast groundfish fisheries are imposing some additional (non-natural) mortality on short-tailed albatross. The number of takes per year is very likely higher than the number of takes observed (one lethal take over the period of 2002–2011), and based on the black-footed albatross mortality rate, is probably ~1/year and unlikely to be >2/year. On its own, this level of mortality is very small compared to the annual growth rate of the population (~6.5%; currently >200 birds/year). Even when combined with known mortality from other fisheries on a global scale, there is no reason to change the conclusion from the USFWS Recovery Plan that mortality from fishing is not a significant impediment to the growth and recovery of the species (USFWS 2008). Analyses of the impacts of Alaskan trawl mortality on the Torishima Island short-tailed albatross population suggest that trawl-related bycatch exceeding the current expected incidental take in that fishery (two takes in any 5-year period) by even a factor of 10 would have little impact on when the species' proposed recovery goals are achieved (Zador et al. 2008). NMFS'

Biological Assessment quantifies the level of mortality in another set of fisheries, but does not change the basic conclusion that, at present, the level of estimated fishing mortality is small compared to the annual growth rate of the population. Use of mitigation measures, such as streamer lines or integrated weighted lines like those employed in Alaskan fisheries, would be expected to reduce take even further (NWFSC 2011; USFWS 2008; and, WA Sea Grant 2011).

Comparison of the Alternatives

Neither alternative will result in significant impacts to short-tailed albatross; both alternatives are expected to reduce take due to voluntary use of seabird avoidance devices; and, implementation of a regulatory requirement for vessels 55 ft LOA or larger to follow seabird avoidance measures under alternative 2 is expected to reduce take of short-tailed albatross more than no-action.

USFWS concluded that take levels associated with the no-action alternative are not likely to result in jeopardy to short-tailed albatross and provided for an average incidental take of one bird per year (USFWS 2011). As described above, alternative 1 is not significantly impeding a relatively robust recovery rate.

Both alternatives include outreach and subsidies to encourage voluntary use of streamer lines as described in section 1.4. As such, fishery interactions with short-tailed albatross will be less likely to result in lethal hooking events as the use of streamer lines is likely to increase under either alternative. As of 2011, 221 streamer lines were distributed free of charge to West Coast longline vessels at the vessels request for voluntary use. However, it is not possible at this time to quantify how many vessels will voluntarily deploy streamer lines or how effective the streamer lines will be at reducing short-tail albatross mortality. Alternative 2 would hedge against low voluntary compliance by ensuring that, at a minimum, large vessels use streamer lines and associated seabird avoidance measures. In addition, research on the practical application of streamer lines may result in a re-design of streamer lines to be more appropriate for the West Coast longline fleet. Over time, this could result in increased voluntary deployment under either alternative.

4.1.2 Other Seabirds

In 2009, northern fulmars comprised the largest proportion of seabird bycatch in West Coast groundfish fisheries, followed by unspecified tubenoses and unspecified alcids. Bycatch estimates for 2009 could not be provided for cormorants, gulls, or murres because CVs exceeded 80%. Shearwaters, gulls, and cormorants were commonly observed seabird bycatch from 2002-2008. Seabird bycatch was most common from April through October, which coincides with the limited entry fixed gear sablefish endorsed season. Although bycatch rates for most seabird species were highest in association with longline gear, common murres, cormorants, and storm petrels were also caught by trawl gear.

In 2009, there were no observed takes of black-footed albatross in West Coast groundfish fisheries. There was a single opportunistic take of black-footed albatross in the at-sea hake fishery in 2009. During 2002-2008, seabird bycatch estimates were greatest for the black-footed albatross, which was primarily caught by longlines in the limited entry sablefish endorsed (primary) sector from May through October. Black-footed albatross bycatch exhibited an increasing trend from 2002 to 2007, followed by a slight reduction in 2008. Takes for this species occur on approximately 2.6% of observed sablefish longline trips, with 1-2 birds typically caught at a time. Bycatch estimates could not be provided for several species in 2006 and 2007 because of high CV values. Annual coverage in the limited entry sablefish primary sector was close to 24% in both of these years, and the total number of takes in this sector was 13 and 48, respectively. However, bycatch events of black-footed albatross in 2006 and 2007 were unusual in that they were concentrated on consecutive sets within the same trip. For instance, one observed vessel caught 32 individuals across several sets off the coast of southern Oregon, representing 2/3 of the total number of observed takes for that year. This resulted in high variance among takes from one trip to the next and produced bycatch estimates with CVs as high as 96%.

Comparison of the Alternatives
Both alternatives are expected to reduce seabird mortality due to voluntary use of seabird avoidance devices; and, implementation of a regulatory requirement for vessels 55 ft LOA or larger to follow seabird avoidance measures under alternative 2 is expected to reduce seabird mortality more than no-action.

Both alternatives include outreach and subsidies to encourage voluntary use of streamer lines as described in Section 1.4. As such, fishery interactions with seabirds will be less likely to result in lethal hooking events as the use of streamer lines increases under either alternative. However, it is not possible at this time to quantify how many vessels will voluntarily deploy streamer lines or how effective the streamer lines will be at reducing short-tail albatross mortality. Alternative 2 would hedge against low voluntary compliance by ensuring that, at a minimum, large vessels use streamer lines and associated seabird avoidance measures. In addition, research on the practical application of streamer lines may result in a re-design of streamer lines to be more appropriate for the West Coast longline fleet. Over time, this may result in increased voluntary deployment under either alternative.

4.2 Socioeconomic Resources

4.2.1 Fishing Industry

The number of vessels that would be affected by the proposed action changes from year to year. There were 227 LE fixed gear permits in 2009. LE fixed gear permits are either sablefish-endorsed or non-sablefish-endorsed. In addition, all LE fixed gear permits have gear endorsements (longline, pot/trap, or both). Of the 227 LE fixed gear permits in 2009, 164 had sablefish-endorsements. Of these, 132 were associated with longline gear, 32 were 8 associated with pot/trap gear, and 4 were associated with both longline and pot/trap gear. The remaining 63 limited entry non-sablefish-endorsed permits were all associated with longline gear. The open access fixed gear sector does not require Federal or state permits. Therefore, the total number of participants varies widely from year to year. Open access vessels can use any type of hook-and-line or pot/trap gear, including longline, fishing pole, and vertical longline.

A reasonable approximation of affected vessels is the total number of vessels 55 ft LOA or greater that deployed longline gear in 2011. Out of 408 total vessels deploying longline gear, 43 or 10.3% met the length requirement. Table 3.1 shows a break-down by state.

Table 3.1: Affected Universe of Vessels (Source: Pacific Fishery Management Council, September 2012 Groundfish Management Team report)

State	Longline Vessels 55 ft LOA or larger
Washington	18
Oregon	12
California	13
	Total=43 (10.3% of total longline vessels)

Cost of Streamer Lines
As described in Section 1.4, direct cost of the proposed action to industry is zero for as long as NMFS continues to fund the subsidy and free lines are available. Under current funding, the subsidy is expected to last a minimum of 2-3 years but it probably will continue into the foreseeable future. In the event that NMFS discontinued the subsidy, the affected industry would be required to build or purchase streamer lines. Estimates for the cost of streamer lines range from $100-$150 each ($200-300/pair) (Melvin pers comm & Colpo pers comm).

Comparison of the Alternatives
Direct costs associated with the alternatives are limited to the costs of streamer lines, which for the foreseeable future, is subsidized by NMFS. Therefore, direct costs are zero under either alternative. If in the future, NMFS discontinues the subsidy, alternative 1 would still be a zero cost however alternative 2 would impose a $100-300 cost each time the vessel needs to purchase streamer lines. For purposes of this analysis, we assume the vessel would need to purchase streamer lines once/year thereby imposing a direct cost of $100-300 per vessel per year under alternative 2.

4.2.2 Human Safety

The deployment of streamer lines raises potential safety issues. For example, lines may become entangled during the setting of the longline and create a safety hazard. There are not data available to quantify the frequency of safety issues related to the deployment of streamer lines; however, industry experts with experience in the Alaskan groundfish fisheries suggest safety issues are rare there because of long-term experience using streamer lines and a regulatory exemption from using streamer lines in rough weather. Further, low-tensile strength "break-aways" are sewn into streamer lines so that if entanglements occur, the line breaks without creating a safety hazard such as entanglement in the prop (Guy 2013; pers comm). NMFS' funded outreach is expected to reduce the risk of safety hazards by teaching fishermen safe deployment techniques.

Comparison of the Alternatives
Safety-at-sea issues are present under either alternative because NMFS is encouraging the voluntary use of streamer lines that may become a hazard through entanglement. Alternative 2 has a higher risk of safety hazards due to the regulatory requirement for vessels 55 ft LOA and larger. For both alternatives, there are mitigating factors, including outreach on the safe use of streamer lines and the use of low-tensile strength "break-aways." Further, the incidence of entanglements is expected to be reduced over time as the fleet gains experience.

Risks associated with Alternative 2 are mitigated by a rough weather exemption in which the requirement to deploy streamer lines is held in abeyance whenever winds exceed 45 knots (storm or Beaufort 9 conditions).

4.3 Cumulative Effects

To be Completed

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• APPENDIX A –DRAFT REGULATION

NMFS proposes to amend 50 CFR part 660 as follows:

PART 660 – FISHERIES OFF WEST COAST STATES AND IN THE WESTERN PACIFIC

1. The authority citation for part 660 continues to read as follows:
Authority: 16 U.S.C. 1801 *et seq*. and 16 U.S.C. 773 *et seq*.

2. In § 660.11, add the definition for "seabird" in alphabetical order and add new paragraph (6)(v) to the definition of "fishing gear" to read as follows:

§ 660.11 General definitions
* * * * *

Seabird means those bird species that habitually obtain their food from the sea below the low water mark.

* * * * *

Fishing gear * * *

(6) * * *

(i)(A) Snap gear means a type of bottom longline gear where the hook and gangion are attached to the groundline using a mechanical fastener or snap.

* * * * *

3. In §660.12, paragraph (a)(15) is added to read as follows:

§ 660.12 General groundfish prohibitions.

In addition to the general prohibitions specified in § 600.725 of this chapter, it is unlawful for any person to:

(a) * * *
(15) Fail to comply with the requirements of the Seabird Avoidance Program described in §660.61 when commercial fishing for groundfish using bottom longline gear.

4. § 660.61 is added to read as follows:
§ 660.61 Seabird Avoidance Program

This section contains the requirements of the Seabird Avoidance Program.

a. Purpose. The purpose of the Seabird Avoidance Program is to minimize interactions between fishing gear and seabird species, including short-tailed albatross (*Phoebastria albatrus*).

b. Applicability. The requirements specified in paragraph (c) of this section apply to the following fishing vessels:

1. Vessels greater than or equal to 55 ft (16.8 m) LOA engaged in commercial fishing for groundfish with bottom longline gear pursuant to the gear switching provisions of the Limited Entry Trawl Fishery, Shoreside IFQ Program as specified in §660.140(k) or pursuant to Subparts E or F of this Part, except as provided in paragraph (b)(2) of this section.

2. Exemptions: The requirements specified in paragraph (c) of this section do not apply to Pacific Coast treaty Indian fisheries, as described at §660.50, or to anglers engaged in recreational fishing for groundfish, as described in Subpart G of this Part.

c. Seabird Avoidance Requirements

1. General Requirements: The operator of a vessel described in 660.61(b)(1), must:

   i. Gear onboard. Have onboard the vessel seabird avoidance gear as specified in paragraph (c)(2) of this section;

   ii. Gear inspection. Upon request by an authorized officer or observer, make the seabird avoidance gear available for inspection;

   iii. Gear use. Use seabird avoidance gear as specified in paragraph (c)(2) of this section that meets the standards specified in paragraph (c)(3) of this section while hook-and-line gear is being deployed.

   iv. Sink baited hooks**.** Ensure that baited hooks sink as soon as they are put in the water.

   v. Offal discharge.

      A. If offal is discharged while gear is being set or hauled, discharge offal in a manner that distracts seabirds from baited hooks, to the extent practicable. The discharge site must be either aft of the hauling station or on the opposite side of the vessel from the hauling station.

      B. Remove hooks from any offal prior to discharging the offal.

C. Eliminate directed discharge through chutes or pipes of residual bait or offal from the stern of the vessel while setting gear. This does not include baits falling off the hook or offal discharges from other locations that parallel the gear and subsequently drift into the wake zone well aft of the vessel.

D. For vessels not deploying gear from the stern, eliminate directed discharge of residual bait or offal over sinking hook-and-line gear while gear is being deployed.

vi. Handling of hooked short-tailed albatross.

A. Safe release of live short-tailed albatross. . Make every reasonable effort to ensure short-tailed albatross brought on board alive are released alive and that, wherever possible, hooks are removed without jeopardizing the life of the bird(s). If the vessel operator determines, based on personal judgment, that an injured bird is likely to die upon release, the vessel operator is encouraged to seek veterinary care in port. Final disposition of an injured bird will be with a Wildlife Rehabilitator. If needed, phone the U.S. Fish and Wildlife Service at 503-231-6179 to assist in locating a qualified Wildlife Rehabilitator to care for the short-tailed albatross.

B. Dead short-tailed albatross must be kept as cold as practicable while the vessel is at sea and frozen as soon as practicable upon return to port. Carcasses must be labeled with the name of vessel, location of hooking in latitude and longitude, and the number and color of any leg band if present on the bird. Leg bands must be left attached to the bird. Phone the U.S. Fish and Wildlife Service at 503-231-6179 to arrange for the disposition of dead short-tailed albatross.

C. All hooked short-tailed albatross must be reported to U.S. Fish and Wildlife Service Law Enforcement by the vessel operator by phoning 360-753-7764 (WA) 503-682-6131 (OR) or 916-414-6660 (CA). as soon as practicable upon the vessel's returning to port.

D. If a NMFS-certified fisheries observer is on board at the time of a hooking event, the observer shall be responsible for the disposition of dead, injured, or sick short-tailed albatross and reporting requirements to U.S.

Fish and Wildlife Service Law Enforcement . Otherwise, the vessel operator shall be responsible.

2. Gear Requirements. The operator of a vessel identified in paragraph (b)(1) of this section must comply with the following gear requirements:
   i. Snap gear. Vessels using snap gear as defined at §660.11 must deploy a minimum of a single streamer line in accordance with the requirements of paragraphs (c)(3)(i)-(ii) of this section, except as provided in paragraph (c)(2)(iii)(A) of this section.
   ii. Other than snap gear. Vessels not using snap gear must deploy a minimum of one pair of streamer lines in accordance with the requirements of paragraphs (c)(3)(i) and (c)(3)(iii) of this section, except as provided in paragraph (c)(2)(iii)(B) of this section.
   iii. Weather Safety Exception.
      A. The use of streamer lines is discretionary for vessels using snap gear when wind speeds exceed 45 knots (storm or Beaufort 9 conditions).
      B. When wind speeds exceed 30 knots (near gale or Beaufort 7 conditions) but are less than or equal to 45 knots, vessels not using snap gear must deploy from the windward side of the vessel a single streamer line meeting the standards of paragraphs (c)(3)(i) and (c)(3)(iii)(A)-(C) of this section. The use of streamer lines by such vessels is discretionary when wind speeds exceed 45 knots.
3. Gear performance and material standards:
   i. Material standards for all streamer lines. All streamer lines must:
      A. Have streamers spaced a maximum of every 16.4 ft (5 m);
      B. Have individual streamers that hang attached to the mainline to 9.8 in (0.25 m) above the waterline in the absence of wind.
      C. Have streamers constructed of material that is brightly colored, UV-protected plastic tubing or 3/8 inch polyester line or material of an equivalent density.
   ii. Snap gear streamer standards. For vessels using snap gear, a streamer line must:
      A. Be a minimum length of 147.6 ft (45 m).
      B. Be deployed so that streamers are in the air a minimum of 65.6 ft (20 m) aft of the stern and within 6.6 ft (2 m)

horizontally of the point where the main groundline enters the water before the first hook is set.

iii. Standards for gear other than snap gear. Vessels not using snap gear must use paired streamer lines meeting the following requirements:

A. Streamer lines must be a minimum length of 300 feet (91.4 m);

B. Streamer lines must be deployed so that streamers are in the air a minimum of 131.2 ft (40m) aft of the stern for vessels under 100 ft (30.5 m) LOA and 196.9 ft (60m) aft of the stern for vessels 100 ft (30.5 m) or over.

C. At least one streamer line must be deployed in accordance with paragraph (c)(3)(iii)(B) before the first hook is set and a second streamer line must be deployed within 90 seconds thereafter.

D. For vessels deploying hook-and-line gear from the stern, the streamer lines must be deployed from the stern, one on each side of the main groundline.

E. For vessels deploying hook-and-line gear from the side, the streamer lines must be deployed from the stern, one over the main groundline and the other on one side of the main groundline.

5. In § 660.140, paragraph (k)(1)(viii) is added to read as follows:

§ 660.140 Shoreside IFQ Program

* * * * *

(k) * * *

(1) * * *

(iv) The vessel must comply with prohibitions applicable to limited entry fixed gear fishery as specified at § 660.212, gear restrictions applicable to limited entry fixed gear as specified in §§ 660.219 and 660.230(b), and management measures specified in § 660.230(d), including restrictions on the fixed gear allowed onboard, its usage, and applicable fixed gear groundfish conservation area restrictions, except that the vessel will not be subject to limited entry fixed gear trip limits when fishing in the Shorebased IFQ Program. Vessels using bottom longline gear as defined at §660.11 are subject to the requirements of the Seabird Avoidance Program described in §660.61.

6. In § 660.230, paragraph (b)(5) is added to read as follows:

§ 660.230 Fixed gear fishery-management measures.

* * * * *

(b) * * *

(5) Vessels fishing with bottom longline gear as defined at §660.11 are subject to the requirements of the Seabird Avoidance Program described in §660.61.

* * * * *

7. In § 660.330, paragraph (b)(2)(i) is revised to read as follows:

§ 660.330 Open access fishery-management measures.

* * * * *

(b) * * *

(2) * * *

(i) <u>Fixed gear</u> (longline, trap or pot, set net and stationary hook-and-line gear, including commercial vertical hook-and-line gear) must be attended at least once every 7 days. Vessels fishing with bottom longline gear as defined at §660.11 are subject to the requirements of the Seabird Avoidance Program described in §660.61.

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• APPENDIX B – OUTREACH REPORT

Bringing albatross conservation to West Coast groundfish fisheries: progress on outreach efforts in the longline fleet.

Washington Sea Grant, University of Washington

24 August 2011

Introduction

The recent take of a short-tailed albatross in the West Coast Groundfish Fishery has focused attention on seabird conservation efforts. Alaska has a long history with seabird mitigation, and approaches pioneered in Alaska are currently being adapted to the West Coast. A brief history of bycatch mitigation research and a summary of conservation efforts occurring throughout the west coast are provided below.

Alaska Mitigation and Outreach

In 1999 and 2000, Washington Sea Grant (WSG) led a research program in collaboration with industry, National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS) testing a host of seabird bycatch mitigation measures in the Alaska longline fisheries. The streamer line, sometime referred to as tori line or bird scaring line, was shown to be the most effective mitigation measure trialed; it reduced the mortalities of surface foraging seabirds such as albatrosses by 100% when used in pairs bracketing the sinking longline and by 96% when used singly (Melvin et al. 2001). The streamer lines used in Alaska fisheries consist of a 90 m line that runs from a high point at the stern to device that creates drag at its terminus (Melvin 2000, Figure 5). As the vessel moves forward the drag acts to suspend a section of line in the air. Brightly colored streamers hang from the aerial extent and scare birds from sinking baits.

Based on the results of WSG's research, streamer lines with performance and material standards were adopted almost immediately by the Alaska industry two years prior to seabird avoidance regulation changes. Through 2006 (the most current summary of observer data available) seabird bycatch rates in the Alaska longline fisheries were reduced by 78% from pre-research levels (9,000 to 26,000 birds/year; Fitzgerald et al. 2008, Figure 1). With funding from the USFWS and NMFS, streamer lines designed by WSG and built and distributed though the Pacific States Marine Fisheries Commissions, have been made available to the Alaska longline fleet since 1999. After 12 years with no short-tailed albatross takes in the Alaska longline fisheries, two were taken in the Bering Sea in 2010. During this time period the short-tailed albatross population doubled. Incidental take statement limits specified in the ESA Biological Opinion have not been exceeded to date for either the Alaskan groundfish or Pacific halibut longline fisheries (USFWS 2003).

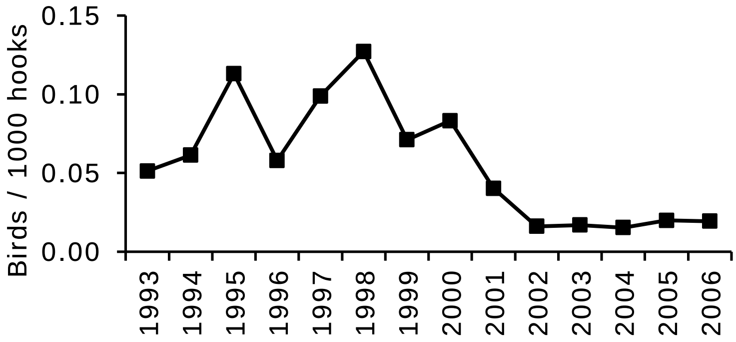

Figure 1. The seabird bycatch rate in the Alaska longline groundfish fishery. Seabird mortality rate has decreased by 78% and albatross mortality has been reduced by 88% since streamer lines were introduced in 1999 – 2000 (Based on Fitzgerald et al. 2008).

Further research in 2002 clarified appropriate streamer line configuration for smaller vessels and for vessels using snap-on gear (Melvin and Wainstein, 2006). Data from seabird surveys designed by WSG and carried out by NMFS and the International Halibut Commission from 2004 to 2006 showed that seabird bycatch mitigation was unnecessary in Alaskan inside waters of Southeast Alaska, Prince William Sound and Cook Inlet (Melvin et al 2006). Alaska seabird bycatch regulations were changed again in 2008 to reflect these new findings.

WSG led research continued in 2005 developing and testing integrated weight longlines as a means to further reduce seabird mortality for the Bering Sea cod freezer-longline vessels (Dietrich et al. 2009). Additional studies developed and tested methods to prevent seabird strikes and related mortality with trawl cables on pollock catcher processors in the Bering Sea (Melvin et al. 2011).

West Coast Outreach

In 2008, West Coast Groundfish Observer Program (WCGOP) data showed black-footed albatross were incidentally killed in the West Coast groundfish fisheries (NWFSC 2008). At this time, use of seabird bycatch mitigation in the fishery was rare and awareness of seabird bycatch issues among industry stakeholders was low. Growing conservation concern for black-footed albatross, and a recent increase in sightings of the ESA listed short-tailed albatross, highlighted the need for a proactive course of action. In response, WSG published a press release and distributed informational pamphlets to stakeholders along the west coast from Neah Bay, WA to Morro Bay, CA to raise awareness of the need for albatross conservation and to inform fishermen of the success of streamer lines at reducing seabird bycatch in similar Alaskan fisheries. In August 2008, the Fishing Vessel Owner's Association (FVOA) in a letter to its membership recommended they voluntarily use streamer lines in accordance with Alaskan regulations when fishing in West Coast waters.

The WCGOP bycatch data and fishery/seabird overlap analysis (Guy et al. In Prep.) suggested that outreach efforts should focus on the fixed gear sablefish fishery. The west coast hook and line fleet consists of approximately 300 vessels. WCGOP observers began documenting the use and characteristics of seabird avoidance gear starting in 2009. In addition, the WCGOP compiled a photographic library of over 243 vessels coast wide. WSG analyzed these photographs and determined that 84% of West Coast longline vessels have the infrastructure (mast or poles) necessary for deploying streamer lines.

Streamer Line distribution

In a 2009-2011 pilot project, WSG facilitated the extension of free streamer line program in Alaska to the West Coast longline fleet. WSG conducted visits to major Washington and Oregon ports in partnership with Englund Marine and Industrial Supply to raise awareness and promote voluntary use of streamer lines. Streamer lines and best-practice information were delivered to volunteer fisherman in Neah Bay, La Push, Westport, Ilwaco, Astoria, Newport, Charleston, and Port Orford. Additionally, streamer lines were made available at the ports of Eureka, Crescent City and Fort Bragg via Englund Marine and Industrial Supply's network of stores and partners. As of July 2011, 221 Alaskan-style streamer lines have been distributed to federal and tribal longline vessels (Table 1).

Table 1. The number of steamer lines distributed to West Coast longline vessels. Some vessels use more than one streamer line so the total number of vessels equipped with steamer lines is unknown.

Year	Federal	Tribal	Grand Total
2009	52	115	167
2010	52		52
2011	2		2
Grand Total	106	115	221

The infrastructure to provide free streamer lines to the WC longline vessels is in place. Based on feedback from volunteers and experiences in other fisheries, WSG developed an Alaska-style streamer line that is designed to improve performance for the West Coast fleet. Design changes included using lighter materials to reduce weight and thus increase aerial extent, and substituting material and hardware to reduce streamers tangling.

Funding

Funding for this project was provided by the Northwest Science Center, the Northwest Region, Pacific States Marine Fisheries Commission and Washington Sea Grant.

Contacts

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• APPENDIX C – RESEARCH PROTOCOL

Reducing the Mortality of Albatrosses and Other Seabirds in the West Coast Longline Fishery for Sablefish

Washington Sea Grant and Oregon State University

Program Description
Washington Sea Grant and Oregon State University are leading a research program, funded by NOAA Fisheries, the Packard Foundation, and the National Fish and Wildlife Foundation and in collaboration with fishing industry, to develop practical and safe tools to reduce seabird bycatch in west coast longline fisheries. Industry partners currently include the Fishing Vessel Owners Association, Washington coastal tribes, and others. A specific objective is to develop streamer line designs and configurations that are best suited to the diversity of longline gear used in this fishery and to promote their voluntary use. Results will be used to develop recommendations on effective and practical seabird bycatch mitigation options for the sablefish longline fleet in collaboration with stakeholders for possible Council action.

Mitigation Treatments
We will evaluate the performance of two streamer lines treatments, one vs. two streamer lines, to a control of no streamer lines across the variety of longline gears used by the west coast sablefish fleet (snap-on, tubs, skate-bottom, auto-bait…etc.) in the course of production fishing. Host vessels will be partially compensated for participation to offset increased costs (insurance, food and possible bait loss) and to provide an incentive. Streamer line configuration – aerial extent, height of attachment, towed device, and number and type of streamers – will be manipulated as needed to match streamer lines to specific longline gears. To start streamer lines will be those designed by Washington Sea Grant and currently being made available to the West Coast fleet via PSMFC with funding from NOAA Fisheries (Figure 1). We will also explore increasing the sinking speed of longlines by manipulating line weights and/or floats as necessary.

Experimental Design
Longline sets will be made during daylight hours to allow researchers to monitor seabird behavior in response to the mitigation treatments (one vs. two vs. none streamer lines). To reduce bias due to environmental factors, treatments will be deployed in a random sequence within day and from day to day within a give fishing trip. The host captain, in consultation with researchers, will determine the number of hooks per set, and the number of sets per day. If a short-tailed albatross is observed interacting, or about to interact with longline gear, we will maximize protection of baited hooks by immediately deploying two streamer lines (if the vessel has the capacity) or terminate/relocate fishing operations.

Fishery researchers will collect data on seabird attacks on baited hooks and seabird numbers during each set. A primary "attack" is any unambiguous attempt by a bird to take bait off a hook – typically a dive or plunge directly over a sinking hook. A secondary attack is another bird or a group of birds attempting to steal a bait or baited hook at the surface from a bird that made a primary attack. The number of attacks will be recorded for the duration of each research set, or for a minimum of 15 minutes depending on the number of hooks deployed in a given set. Researchers will record the number of attacks occurring within 100 m of the stern in 10-m increments and lateral position relative to streamer lines (to port or starboard of a single streamer lines or within or to port or starboard of two streamer liens). Markers inserted into the streamer lines or a measuring line (with no streamer line controls), will serve as reference points to judge distance. Immediately prior to and following each attack rate observation, researchers will record the number of seabirds (on the water and in the air) by species in a 100 m hemisphere centered at the midpoint of the stern. Data will also be collected on the performance of streamer lines (aerial extent and design variants), the physical environment (wind speed, wind direction, swell height, cloud cover) and vessel operations (speed in knots, bait type and quality, presence of weights or floats; etc.)

During each haul, researchers will record the catch of all seabirds (expected to be rare) and fishes to species or species group for a minimum of 50% of the haul. To the extent possible, we will track the catch of fish and birds relative to weights and floats along the groundline. Special attention will be paid to quantifying the number of fish damaged by hagfish depredation relative to the proximity of weights and floats. Researchers will also estimate the number of seabirds within 50 m of the hauling station by species and the presence or absence of discards associated with fish processing (heading and gutting).

Wildlife Computer MK9s time-depth-recorders will be used to determine the sink rate of longlines and to the extent possible the position of longlines on the sea floor. Sink rates will be used to estimate the distance astern that longline sink beyond the benchmark depth of 2 m, our assumed diving depth of North Pacific albatrosses. This sinking distance will be compared to attack rate by distance data for each streamer line treatment to inform streamer line design and configuration. Bottle lines, 750 ml plastic bottles attached to a 2-m length of gangion will also be used to demonstrate to crew where lines sink beyond 2 m.

As fishing locations and catch data are confidential, they will not be shared or graphically represented only in an aggregated form.

Analysis

Because seabird bycatch events are rare in west coast longline fisheries, we will evaluate mitigation strategies based on multiple metrics:

- Intensity and location of seabird attacks on baited hooks during the set;
- Catch rates of target and non-target species;
- Depredation damage to target species;
- Streamer line(s) configuration, performance, and alignment with fishing gear sink profiles;
- Compatibility with safe and efficient fishing operations as evaluated by the captain and crew.

Data on gear sink rates, bird attack rates as a function of distance astern, bird abundance and bird catch rates (to the extent it is available) will be used to inform streamer line configurations necessary to protect birds for each gear type. Generalized linear modeling techniques will be used to evaluate seabird bycatch, fish catch rates (target and non-target), and attack rates as a function of mitigation treatments and other relevant environmental and operation factors. To the extent possible we will also evaluate the relationships among seabird abundance, attack rates and bycatch rates.

Agenda Item F.4.b
Supplemental EC Report
June 2013

ENFORCEMENT CONSULTANTS REPORT ON SEABIRD AVOIDANCE REGULATIONS

The Enforcement Consultants (EC) have reviewed the Preliminary Draft Environmental Assessment, specifically, Appendix A pertaining to the Draft Seabird Avoidance Regulations. The EC generally supports the draft regulations, as nearly identical regulations have proven to be effective in Alaska fisheries. However, the EC has one recommendation, which is to ensure that measurements used within the regulations be conveyed consistently in feet, rounded to the nearest foot. The draft regulations use meters converted into feet, or vice versa, with conversions often resulting in fractions of feet or meters. This has the potential to result in confusion by both harvesters and enforcement officers. The EC believes slight alterations to the measurements to round them to the nearest foot would not have an adverse impact on the intent of the regulations.

PFMC
06/21/13

GROUNDFISH ADVISORY SUBPANEL REPORT ON SEABIRD AVOIDANCE REGULATIONS

The Groundfish Advisory Subpanel (GAP) received a presentation on the preliminary Draft Environmental Assessment (EA) for measures to minimize the take of short-tailed albatross in the Pacific Coast Groundfish fisheries from Ms. Gretchen Hanshew. The Draft EA provides two options, status quo and alternative 2.2, which is similar to seabird avoidance restrictions adopted by the North Pacific Fishery Management Council. The proposed restrictions would affect longline vessels 55 feet and longer off California, Oregon and Washington. The GAP recommends adoption of alternative 2.2. The GAP had the following suggested changes.

1. On page 24 of the Council handout, which is titled, Appendix A-Draft Regulations, under, C. Seabird Avoidance requirements, part iv says, “Ensure that baited hooks sink as soon as possible as they are put in the water.” The GAP suggest that the wording be, “ensure that baited hooks are submerged by the time the gear gets to the end of the tori line.”

Explanation for the change in wording. The sablefish fishery off California, Oregon and Washington at times uses floats on the gear to avoid “slime eel” depredation. Therefore, baits leaving the stern of the vessel may not sink immediately, but should be at the appropriate depth by the time the gear passes the end of the tori line.

2. Due to the many designs of fishing vessels the GAP recommends that the regulations provide a process on a case by case basis by which a operator can request a variance in design and or deployment of the bird avoidance gear in order to address safety concerns or to meet the intent of the regulation. The GAP believes the strict 300 foot length of the tori lines may not work for all vessel designs.

Finally, the GAP was informed that the draft regulations in the EA are consistent with Alaska region regulations. However, it appears to the GAP that regulatory language in the draft EA does not appear in Alaska Regional regulations. For example, regulations requiring specific vessel operator action for the handling of hooked albatross (page 25 of the draft EA) do not appear consistent with Alaska regulations. The GAP request clarification about how regulations in the draft EA differ from the Alaska region and where different, explain what is the rationale for the difference.

PFMC
06/21/13

Agenda Item F.4.b
Supplemental GMT Report
June 2013

GROUNDFISH MANAGEMENT TEAM REPORT ON SEABIRD AVOIDANCE REGULATIONS

The Groundfish Management Team (GMT) reviewed the Preliminary Draft Environmental Assessment (EA) Measures to Minimize Take of Short-tailed Albatross in the Pacific Coast Groundfish Fishery (Agenda Item F.4.b, Preliminary Draft EA), including draft regulations, and offers the following comments.

The GMT identified a few potential items that may warrant further considerations be incorporated into the Preliminary Draft EA and/or may also warrant revisions to the draft regulations.

Longline Gear Descriptions

The Preliminary Draft EA contains a comprehensive description of the longline fisheries that would be affected by the new streamer line regulations; however, additional information about the specific types of gear configurations and deployment methods that are used in the Pacific coast groundfish fishery would be very helpful to fully explore the feasibility of the draft regulations, to be most effective at avoiding seabird interactions. For example, some longline vessels deploy weighted skates, but some vessels use lines with floats to avoid hagfish. The GMT noted that, under the proposed regulations, both of these types of longline gear would be legal but would have quite different levels of compliance with the proposed requirement to "ensure that baited hooks sink as soon as they are put in the water." This example illustrates how incorporating additional information about the specific types of gear configurations and deployment methods that are used in the Pacific coast groundfish fishery may uncover other issues that could change the relative effectiveness of the proposed regulations. In this specific example, the EA could explore whether or not lines with floats should be prohibited to allow baited hooks to sink more quickly or if some other specific gear requirements should be considered to meet the reasonable and prudent measures, terms and conditions, and conservation recommendations described in the Biological Opinion.

In addition to industry representatives, Sea Grant may be a good source to get more specific information about the types of gear configurations and deployment methods that are used in the Pacific coast groundfish fishery, since they have been investigating regional gear type issues.

The GMT recommends that NMFS work with industry, Sea Grant and others to incorporate additional information regarding the specific types of gear configurations and deployment methods that are used in the Pacific coast groundfish fishery into the Draft EA.

Weather Safety Exemption

The GMT reviewed the regulations that would exempt fishing vessels from requirements to use streamer lines under certain foul weather conditions, specifically if winds are greater than 45 knots (Beaufort 9 conditions). The GMT hypothesized that it is unlikely that there is much fishing effort that occurs in these storm conditions off the West Coast because of the highly exposed outer coast fishing grounds (compared to some fishing grounds in the lee of some of Alaska's Islands). Information in the observer database could provide information on the magnitude of fishing effort that has occurred under these types of storm conditions. The GMT recommends considering an additional alternative that does not have a weather safety exemption, and would instead prohibit longline gear from being deployed under any circumstances without meeting the applicable streamer line requirements. The weather safety exemption may not be necessary, as written, because it is unlikely any fishing would occur at all in those types of foul weather conditions off Washington, Oregon, or California.

The GMT recommends a new alternative (Alternative 3) that is the same as Alternative 2, but removes the weather safety exemption.

The draft regulations, as written, may require more specificity regarding how, where, and when weather conditions would be measured and applied to allow the weather safety exemption. The GMT was also curious how and when the Alaska Region measures the Beaufort conditions to know when to apply a weather safety exception that is in their streamer line regulations. It is possible that their method would be applicable to the west coast fishery, but without seeing more detail, a determination cannot be made. **The GMT recommends additional information regarding how and when to apply the weather safety exemption be added to the Draft EA under Alternative 2.**

Voluntary Use of Streamer Lines

The GMT noted that 221 streamer lines have been distributed to the longline fleet for voluntary use, and suggests exploring available information to see how many longline vessels have been using streamer lines. Information on the number of vessels that voluntarily use streamer lines may be available from Sea Grant, and some information may also be available from observations made in the West Coast Groundfish Observer Program. **The GMT recommends a review of available information to see how many vessels in the groundfish fishery voluntarily use streamer lines, and for that information to be presented in the EA.**

Research and Vessels Smaller than 55 Feet

The GMT expressed support of research efforts to inform measures for seabird avoidance that are designed for vessels less than 55 ft long, with voluntary use of streamer lines being encouraged in the interim. The new ESA Workgroup, being considered under Agenda Item C.6 could be a possible avenue for the results of ongoing research to come forward to modify or implement new regulations to protect seabirds.

GMT Recommendations:

1. **NMFS work with industry, Sea Grant and others to incorporate additional information regarding the specific types of gear configurations and deployment methods that are used in the Pacific coast groundfish fishery into the Draft EA.**
2. **Add a new alternative (Alternative 3) that is the same as Alternative 2, but removes the weather safety exemption.**
3. **Additional information regarding how and when to apply the weather safety exemption be added to the Draft EA under Alternative 2.**
4. **A review of available information to see how many vessels in the groundfish fishery voluntarily use streamer lines, and for that information to be presented in the EA.**

PFMC
06/21/13

Agenda Item F.5
Situation Summary
June 2013

APPROVE STOCK ASSESSMENTS

The Pacific Fishery Management Council (Council) process for setting groundfish harvest levels and other specifications depends on periodic assessments of the status of groundfish stocks and a report from an established assessment review body or, in the Council parlance, a Stock Assessment Review (STAR) Panel. The Scientific and Statistical Committee (SSC) reviews this information and makes a recommendation relative to the standards of 1) the best available science, and 2) soundness for use in groundfish fishery management decision-making by the Council. The Council then approves the new assessments and relevant analyses used to set groundfish harvest levels and other specifications for the following biennial management period.

Nine groundfish species (brown rockfish, China rockfish, copper rockfish, English sole, sharpchin rockfish, stripetail rockfish, rex sole, vermilion rockfish, and yellowtail rockfish) were recommended for assessment this year using a new data-moderate assessment framework recommended by the SSC and adopted by the Council. Data-moderate assessments are more data-limited than full assessments, with inclusion of historical catches and abundance indices allowed, but not age or length composition data. Data-moderate assessments are designed to provide more information than data-poor situations, where catch-only methods are used only to determine overfishing limits for stocks with information that falls far below what is necessary to conduct a full assessment. One of the benefits of creating the new category of data-moderate stock assessments is that it provides for the expeditious review of more stock assessments. The executive summary of the data-moderate assessments document is provided in Attachment 1 and **the assessment in its entirety is available on the June 2013 briefing book CD and website (electronic only).** The report of the April 2013 stock assessment review (STAR) Panel that reviewed the data-moderate assessments is provided in Attachment 2. It is noted that the STAR Panel only had time to review assessments for eight of the nine species, so the data-moderate assessment document does not include an assessment of vermilion rockfish (or yellowtail rockfish south of 40º10’ N lat.). The established process for data-moderate assessments also requires the SSC to review the available compositional data for data-moderate stocks and to recommend whether future full assessments can potentially be conducted. The compositional data for the nine data-moderate species available by the briefing book deadline is provided in Attachment 3.

Two groundfish species (darkblotched rockfish and petrale sole) were assessed this year with full assessments and reviewed by a STAR Panel in May. The executive summaries of the darkblotched and petrale assessments are provided in Attachments 4 and 6, respectively and **the assessments in their entirety are available on the June 2013 briefing book CD and website (electronic only).** The STAR Panel reports for the darkblotched and petrale assessment reviews are provided in Attachments 5 and 7, respectively.

Members of the Groundfish Subcommittee of the SSC, the Groundfish Management Team (GMT), and Groundfish Advisory Subpanel (GAP) are scheduled to review one updated assessment and three catch reports immediately before the June Council meeting on Tuesday, June 18 (see SSC Groundfish Subcommittee Agenda). The Executive Summary of the updated bocaccio assessment is provided as Agenda Item F.5.a, Attachment 8 and **the assessment in its entirety is available on the June 2013 briefing book CD and website (electronic only).** The canary rockfish, Pacific ocean perch, and yelloweye catch reports are provided in Attachments 9-11.

The Council should consider the assessments and catch reports, as well as the advice of the SSC, other advisory bodies, and the public before adopting the new stock assessments and catch reports for use in groundfish management in 2015 and beyond.

Council Action:

Adopt the stock assessments (data-moderate, full, and updated assessments) and catch reports recommended by the SSC.

Reference Materials:

1. Agenda Item F.5.a, Attachment 1: Data-moderate stock assessments for brown, China, copper, sharpchin, stripetail, and yellowtail rockfishes and English and rex soles in 2013.
2. Agenda Item F.5.a, Attachment 2: Pacific Coast Groundfish Stock Assessment Review (STAR) Panel Report for Data-Moderate Assessments.
3. Agenda Item F.5.a, Attachment 3: Available Age and Length Composition Data for the Nine Data-Moderate Stocks Undergoing Assessment in 2013.
4. Agenda Item F.5.a, Attachment 4: Status of the darkblotched rockfish resource off the continental U.S. Pacific Coast in 2013.
5. Agenda Item F.5.a, Attachment 5: Darkblotched Rockfish Stock Assessment Review (STAR) Panel Report.
6. Agenda Item F.5.a, Attachment 6: Status of the U.S. Petrale Sole Resource in 2012.
7. Agenda Item F.5.a, Attachment 7: Petrale Sole Stock Assessment Review (STAR) Panel Report.
8. Agenda Item F.5.a, Attachment 8: Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas as evaluated for 2013.
9. Agenda Item F.5.a, Attachment 9: Canary Rockfish Catch Report for 2011-12.
10. Agenda Item F.5.a, Attachment 10: Pacific Ocean Perch Catch Report for 2011-12.
11. Agenda Item F.5.a, Attachment 11: Yelloweye Rockfish Catch Report for 2011-12.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Adopt Final Data Moderate Stock Assessments, the Petrale Sole Stock Assessment, the Darkblotched Rockfish Stock Assessment, the Bocaccio Update Assessment, and Catch Reports for Canary, Pacific Ocean Perch, and Yelloweye Rockfish

PFMC
05/30/13

Agenda Item F.5.a
Attachment 1 (Entire Document Electronic Only)
June 2013

Data-moderate stock assessments for brown, China, copper, sharpchin, stripetail, and yellowtail rockfishes and English and rex soles in 2013

by

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May 2013

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Executive Summary

Stocks

The catch and index only stock assessment methods (XDB-SRA and exSSS) were applied to eight species of groundfishes. Six were rockfishes (three nearshore and three shelf and/or slope species) and two flatfishes. Two of the nearshore rockfishes (China and copper) defined and assessed stocks in two areas, the former north and south of Cape Mendocino, CA and the latter north and south of Point Conception, CA. Yellowtail rockfish was also considered as two stocks north and south of Cape Mendocino, but only the northern stock was assessed. The remaining rockfishes and two flatfishes were treated as coastwide stocks.

Derived outputs

All stocks were found to be above the biomass limit reference points. No stocks were therefore found to be overfished, but at least one (China rockfish north) is below the target reference point. Overfishing may also be occurring in that stock. Estimated population biomass of the nearshore rockfishes with assessments using fishery-dependent data demonstrated less uncertainty than the shelf and slope species with assessments using fishery-independent survey data. Overall exploitation rates were smaller than that estimated by F_{MSY}. Given the high stock status of the shelf-slope species, the estimated OFLs are high and well above average catch over the last 3 years.

Table ES1. Derived outputs for each assessed stock. Central tendency is reported as the mode in the top table and the median in the bottom. Numbers in the parentheses is the range of the 95% credibility interval.

			Derived Outputs: Scale and Status			
Model	Group	Stock	SB_0	SB_{2013}	SB_{2013}/SB_0	SB_{MSY}
XDB-SRA	Rockfishes	Brown rockfish	1788 (980 - 3813)	724 (332 - 2397)	0.4 (0.22 - 0.78)	689 (394 - 1456)
XDB-SRA	Rockfishes	China rockfish (N)	246 (124 - 536)	88 (26 - 363)	0.33 (0.14 - 0.75)	93 (44 - 211)
XDB-SRA	Rockfishes	China rockfish (S)	444 (239 - 3041)	293 (142 - 2629)	0.72 (0.41 - 0.95)	209 (101 - 961)
XDB-SRA	Rockfishes	Copper rockfish (N)	1697 (1095 - 2805)	788 (403 - 1741)	0.42 (0.25 - 0.86)	665 (370 - 1190)
XDB-SRA	Rockfishes	Copper rockfish (S)	1097 (604 - 5025)	858 (418 - 4281)	0.84 (0.49 - 0.99)	529 (249 - 1811)
exSSS AIS	Rockfishes	Sharpchin	6847 (2437-24742)	3291 (1456-21157)	0.73 (0.31-0.91)	1944 (634-6509)
exSSS AIS	Rockfishes	Yellowtail (N)	68887 (19363-277492)	38168 (12184-221920)	0.69 (0.35-0.90)	19020 (4617-70550)
exSSS AIS	Flatfishes	English sole	28731 (11757-94321)	24410 (10444-89100)	0.88 (0.77-0.96)	4898 (1019-18983)
exSSS AIS	Flatfishes	Rex sole	2406 (731-15814)	1683 (602-13150)	0.80 (0.64-0.93)	560 (255-3418)

			Derived Outputs: Fishing and Removals			
Model	Group	Stock	F_{2012}/F_{MSY}	MSY	OFL_{2015}	OFL_{2016}
XDB-SRA	Rockfishes	Brown rockfish	0.58 (0.2 - 1.1)	156 (118 - 212)	172 (92 - 464)	176 (93 - 467)
XDB-SRA	Rockfishes	China rockfish (N)	1.9 (0.4 - 8.43)	10 (3 - 22)	8 (1 - 42)	8 (1 - 42)
XDB-SRA	Rockfishes	China rockfish (S)	0.28 (0.06 - 0.59)	33 (21 - 70)	50 (24 - 237)	51 (25 - 237)
XDB-SRA	Rockfishes	Copper rockfish (N)	0.33 (0.15 - 0.71)	117 (80 - 163)	149 (69 - 316)	154 (71 - 320)
XDB-SRA	Rockfishes	Copper rockfish (S)	0.33 (0.11 - 0.79)	92 (50 - 189)	154 (67 - 475)	154 (67 - 476)
exSSS AIS	Rockfishes	Sharpchin	0.02	320 (154-883)	416 (130-1474)	404 (132-1397)
exSSS AIS	Rockfishes	Yellowtail (N)	0.14	5728 (3295-14517)	7218 (2646-23903)	6949 (2679-22724)
exSSS AIS	Flatfishes	English sole	0.02	4072 (3210-11847)	10792 (7138-32391	7890 (4921-23317)
exSSS AIS	Flatfishes	Rex sole	0.07	1676 (1230-3622)	5764 (3089-16500)	3956 (2479-10253)

Decision tables

Forecasts for each stock are based on a 12-year outlook predicated one of two control rules: 1) constant catch based on the average of the last three years or landings and 2) catch based on the P* OFL buffer and the “40-10” ABC control rule. The later has three catch scenarios based on the forecasted results of the three states of nature. These states of nature capture different states in depletion by taking the median value of starting depletion and resultant median forecasted catch under control rule 2 above and the base case model for the following portions of the posterior depletion distribution: 1) bottom quartile of starting depletion values, 2) interquartile of the starting depletion, and 3) upper quartile of the starting depletion. Thus 25% of the distribution is in each of the lower and upper states of nature, with 50% contained in the middle state. A total of three models were therefore run with the three different catch scenarios based on control rule #2, then each state of nature (posterior density quartiles) was summarized by the median value of the draws contained in that state of nature. Each forecast assumes full attainment of the prescribed catch and no implementation error.

Nearshore rockfishes

Decision tables for the nearshore rockfish stock assessments are given in Tables ES2 through ES6. Results for China rockfish (north) and brown rockfish (coastwide) include the probability that spawning biomass is below the minimum stock size threshold (MSST) of $0.25B_0$. This information is not presented for the other stocks, because the probabilities of becoming overfished were less than 1% for all three catch scenarios under the base-case model.

Table ES 2. Decision table for brown rockfish (coastwide). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. "Overfished" is the probability of being below the MSST. Estimated MSY is 156 mt/year.

			STATE OF NATURE: DEPLETION IN 2013								
			Lower Quartile			Interquartile Range			Upper Quartile		
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Recent Catch	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	101.5	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	101.5	521	0.31	13%	789	0.46	0%	1249	0.67	0%
	2017	101.5	534	0.32	9%	807	0.47	0%	1264	0.68	0%
	2018	101.5	547	0.32	8%	824	0.48	0%	1280	0.69	0%
	2019	101.5	561	0.33	6%	842	0.49	0%	1295	0.70	0%
	2020	101.5	576	0.34	5%	861	0.50	0%	1309	0.71	0%
	2021	101.5	590	0.34	4%	877	0.51	0%	1323	0.72	0%
	2022	101.5	605	0.35	3%	894	0.52	0%	1340	0.73	0%
	2023	101.5	620	0.36	3%	912	0.53	0%	1353	0.74	0%
	2024	101.5	634	0.36	3%	927	0.53	0%	1366	0.74	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Low ABC	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	103	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	107	520	0.31	15%	788	0.45	0%	1249	0.67	0%
	2017	111	531	0.32	13%	803	0.46	0%	1260	0.68	0%
	2018	114	539	0.32	12%	816	0.47	0%	1272	0.69	0%
	2019	117	548	0.32	11%	829	0.48	0%	1282	0.70	0%
	2020	119	557	0.33	11%	841	0.49	0%	1290	0.70	0%
	2021	121	566	0.33	10%	851	0.49	0%	1297	0.71	0%
	2022	123	572	0.33	11%	860	0.50	0%	1305	0.71	0%
	2023	125	579	0.33	11%	870	0.50	0%	1312	0.72	0%
	2024	126	586	0.34	11%	878	0.51	0%	1316	0.72	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Median ABC	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	154	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	153	494	0.29	21%	762	0.44	0%	1223	0.65	0%
	2017	152	485	0.29	25%	757	0.44	0%	1215	0.65	0%
	2018	153	480	0.29	27%	756	0.44	0%	1212	0.65	0%
	2019	154	476	0.28	28%	757	0.44	0%	1208	0.66	0%
	2020	154	471	0.28	31%	756	0.44	0%	1204	0.66	0%
	2021	155	466	0.28	33%	754	0.44	0%	1201	0.66	0%
	2022	155	461	0.27	36%	754	0.44	0%	1203	0.66	0%
	2023	155	459	0.27	38%	751	0.44	0%	1201	0.66	0%
	2024	154	454	0.26	41%	750	0.44	0%	1198	0.66	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: High ABC	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	222	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	214	460	0.27	33%	728	0.42	0%	1189	0.63	0%
	2017	209	425	0.25	47%	697	0.40	0%	1154	0.62	0%
	2018	205	399	0.24	59%	675	0.39	0%	1130	0.61	0%
	2019	202	380	0.23	67%	661	0.38	0%	1110	0.60	0%
	2020	200	360	0.22	78%	643	0.37	0%	1092	0.59	0%
	2021	198	336	0.20	89%	626	0.36	1%	1074	0.59	0%
	2022	196	314	0.19	96%	610	0.35	3%	1059	0.58	0%
	2023	194	294	0.18	99%	594	0.34	7%	1049	0.58	0%
	2024	193	273	0.16	99%	579	0.33	12%	1036	0.57	0%

Table ES3. Decision table for China rockfish (north of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass, "Depl" is median depletion, and "Overfished" is the probability of being below the MSST. Estimated MSY is 10 mt/year.

			STATE OF NATURE: DEPLETION IN 2013								
			Lower Quartile			Interquartile Range			Upper Quartile		
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Recent Catch	2013	15.1	46	0.22	70%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	83%	89	0.38	0%	183	0.59	0%
	2015	15.1	39	0.19	95%	87	0.37	0%	182	0.59	0%
	2016	15.1	36	0.17	99%	84	0.36	3%	181	0.58	0%
	2017	15.1	33	0.16	100%	82	0.35	9%	179	0.58	0%
	2018	15.1	29	0.14	100%	79	0.34	13%	178	0.58	0%
	2019	15.1	26	0.12	100%	77	0.33	18%	176	0.58	0%
	2020	15.1	22	0.10	100%	75	0.32	24%	175	0.58	0%
	2021	15.1	18	0.08	100%	72	0.31	29%	174	0.58	0%
	2022	15.1	14	0.06	100%	70	0.30	33%	172	0.57	0%
	2023	15.1	10	0.04	100%	67	0.29	37%	172	0.57	0%
	2024	15.1	5	0.02	100%	65	0.28	41%	171	0.57	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Low ABC	2013	15.1	46	0.2	72%	91	0.4	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	1.9	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	2.3	42	0.21	83%	91	0.38	0%	188	0.61	0%
	2017	2.5	45	0.22	73%	95	0.40	0%	191	0.63	0%
	2018	2.8	48	0.22	67%	98	0.41	0%	196	0.65	0%
	2019	2.9	49	0.23	63%	101	0.42	0%	200	0.67	0%
	2020	3.0	50	0.23	60%	103	0.43	0%	203	0.68	0%
	2021	3.1	52	0.24	57%	105	0.44	0%	206	0.70	0%
	2022	3.2	53	0.24	54%	108	0.45	0%	210	0.71	0%
	2023	3.3	54	0.25	52%	110	0.46	0%	212	0.72	0%
	2024	3.4	55	0.25	50%	112	0.47	0%	215	0.73	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Median ABC	2013	15.1	46	0.22	72%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	7.5	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	7.7	40	0.19	93%	88	0.37	0%	185	0.60	0%
	2017	7.9	40	0.19	91%	89	0.38	1%	186	0.61	0%
	2018	8.0	40	0.19	90%	90	0.38	1%	188	0.62	0%
	2019	8.0	39	0.18	90%	91	0.38	2%	190	0.63	0%
	2020	8.0	38	0.18	90%	91	0.38	3%	192	0.64	0%
	2021	8.1	38	0.17	90%	91	0.39	4%	193	0.65	0%
	2022	8.2	37	0.17	90%	92	0.39	5%	194	0.66	0%
	2023	8.2	36	0.16	90%	92	0.39	6%	195	0.66	0%
	2024	8.3	34	0.16	89%	92	0.39	7%	196	0.67	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: High ABC	2013	15.1	46	0.22	72%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	18.4	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	18.1	34	0.17	100%	83	0.35	7%	180	0.58	0%
	2017	17.9	30	0.14	100%	79	0.33	15%	176	0.57	0%
	2018	17.8	25	0.12	100%	75	0.32	23%	174	0.56	0%
	2019	17.6	21	0.10	100%	72	0.30	30%	171	0.56	0%
	2020	17.5	16	0.07	100%	68	0.29	36%	169	0.55	0%
	2021	17.4	11	0.05	100%	65	0.28	41%	167	0.55	0%
	2022	17.2	6	0.03	100%	62	0.26	46%	165	0.54	0%
	2023	17.1	tr	tr	100%	58	0.25	51%	163	0.54	0%
	2024	17.0	tr	tr	98%	55	0.23	55%	161	0.53	0%

Table ES4. Decision table for China rockfish (south of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 33 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	16	224	0.53	311	0.70	410	0.87
	2016	16	228	0.54	316	0.71	415	0.88
	2017	16	233	0.55	320	0.73	417	0.89
	2018	16	237	0.56	325	0.74	419	0.89
	2019	16	241	0.57	329	0.74	421	0.90
	2020	16	244	0.57	333	0.75	421	0.90
	2021	16	248	0.58	336	0.76	422	0.90
	2022	16	251	0.59	340	0.77	423	0.90
	2023	16	255	0.60	343	0.77	423	0.90
	2024	16	259	0.61	345	0.78	423	0.90
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	34	224	0.53	311	0.70	410	0.87
	2016	34	219	0.52	307	0.69	406	0.86
	2017	33	215	0.51	303	0.69	400	0.85
	2018	33	212	0.50	300	0.68	395	0.84
	2019	32	210	0.50	297	0.67	389	0.82
	2020	32	207	0.50	295	0.67	382	0.81
	2021	32	205	0.49	294	0.66	379	0.81
	2022	32	203	0.49	292	0.66	375	0.80
	2023	31	201	0.48	290	0.66	372	0.80
	2024	31	198	0.48	289	0.65	371	0.80
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	45	224	0.53	311	0.70	410	0.87
	2016	43	214	0.51	301	0.68	401	0.85
	2017	42	205	0.49	293	0.66	390	0.83
	2018	41	198	0.47	286	0.65	381	0.81
	2019	40	192	0.46	280	0.63	372	0.79
	2020	39	187	0.45	276	0.62	362	0.77
	2021	38	182	0.44	271	0.61	356	0.77
	2022	38	178	0.43	268	0.61	351	0.76
	2023	37	174	0.42	264	0.60	348	0.75
	2024	37	170	0.41	261	0.59	346	0.75
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	58	224	0.53	311	0.70	410	0.87
	2016	55	207	0.49	295	0.67	394	0.84
	2017	52	193	0.46	281	0.64	378	0.80
	2018	49	182	0.43	269	0.61	364	0.77
	2019	47	173	0.41	261	0.59	352	0.75
	2020	46	164	0.40	253	0.57	340	0.73
	2021	45	158	0.38	247	0.56	332	0.72
	2022	44	152	0.37	241	0.54	326	0.71
	2023	43	146	0.35	236	0.53	322	0.70
	2024	43	140	0.34	231	0.52	319	0.69

Table ES5. Decision table for copper rockfish (north of 34° 27′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 117 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	38	598	0.35	845	0.50	1196	0.73
	2016	38	618	0.36	870	0.52	1226	0.75
	2017	38	637	0.37	895	0.53	1249	0.76
	2018	38	658	0.38	920	0.55	1275	0.78
	2019	38	678	0.39	947	0.56	1298	0.80
	2020	38	698	0.40	973	0.58	1318	0.81
	2021	38	717	0.42	997	0.59	1336	0.83
	2022	38	739	0.43	1022	0.61	1354	0.84
	2023	38	759	0.44	1047	0.62	1368	0.85
	2024	38	780	0.45	1071	0.64	1381	0.86
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	87	598	0.35	845	0.50	1196	0.73
	2016	86	593	0.35	846	0.50	1201	0.73
	2017	86	591	0.34	848	0.51	1203	0.73
	2018	87	593	0.34	854	0.51	1209	0.74
	2019	87	594	0.34	863	0.51	1213	0.75
	2020	88	597	0.35	871	0.52	1218	0.75
	2021	89	601	0.35	880	0.52	1217	0.76
	2022	90	604	0.35	887	0.53	1220	0.76
	2023	90	607	0.35	892	0.53	1220	0.76
	2024	91	610	0.35	898	0.54	1220	0.77
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	134	598	0.35	845	0.50	1196	0.73
	2016	131	570	0.33	822	0.49	1178	0.72
	2017	128	548	0.32	805	0.48	1159	0.71
	2018	126	531	0.31	794	0.47	1148	0.70
	2019	126	518	0.30	787	0.47	1137	0.70
	2020	125	510	0.30	781	0.47	1126	0.70
	2021	125	504	0.29	780	0.47	1119	0.69
	2022	125	496	0.29	777	0.46	1109	0.69
	2023	124	488	0.28	772	0.46	1105	0.69
	2024	123	479	0.28	767	0.46	1100	0.69
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	198	598	0.35	845	0.50	1196	0.73
	2016	188	538	0.31	790	0.47	1146	0.69
	2017	181	490	0.29	747	0.45	1101	0.67
	2018	175	452	0.26	715	0.43	1068	0.65
	2019	171	424	0.25	689	0.41	1040	0.64
	2020	167	400	0.23	670	0.40	1016	0.63
	2021	164	384	0.22	657	0.39	994	0.62
	2022	162	365	0.21	643	0.39	979	0.61
	2023	160	343	0.20	628	0.38	966	0.60
	2024	158	321	0.19	611	0.37	956	0.60

Table ES6. Decision table for copper rockfish (south of 34° 27′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 92 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	40	670	0.63	918	0.81	963	0.94
	2016	40	677	0.64	926	0.82	952	0.93
	2017	40	685	0.64	932	0.83	943	0.92
	2018	40	694	0.65	939	0.83	932	0.92
	2019	40	704	0.66	944	0.84	926	0.92
	2020	40	713	0.66	949	0.84	924	0.91
	2021	40	720	0.67	953	0.85	922	0.91
	2022	40	732	0.67	956	0.85	923	0.91
	2023	40	738	0.68	960	0.85	924	0.91
	2024	40	745	0.68	963	0.85	924	0.91
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	100	670	0.63	918	0.81	963	0.94
	2016	96	647	0.61	896	0.80	922	0.90
	2017	94	629	0.60	876	0.78	887	0.88
	2018	92	616	0.58	860	0.76	854	0.85
	2019	91	605	0.57	847	0.75	831	0.82
	2020	89	596	0.57	836	0.74	811	0.80
	2021	88	591	0.56	826	0.73	793	0.78
	2022	87	584	0.55	817	0.72	785	0.77
	2023	86	577	0.55	809	0.71	780	0.77
	2024	85	572	0.54	803	0.71	781	0.77
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	144	670	0.63	918	0.81	962	0.94
	2016	136	625	0.59	874	0.78	900	0.88
	2017	129	590	0.56	836	0.74	847	0.84
	2018	123	563	0.54	806	0.71	800	0.79
	2019	118	541	0.51	782	0.69	767	0.76
	2020	114	523	0.50	764	0.67	737	0.73
	2021	111	510	0.49	747	0.66	717	0.71
	2022	109	499	0.48	734	0.65	706	0.69
	2023	107	487	0.47	723	0.64	700	0.69
	2024	105	473	0.45	712	0.63	699	0.69
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	162	670	0.63	918	0.81	962	0.94
	2016	147	616	0.58	865	0.77	891	0.87
	2017	134	576	0.55	822	0.73	833	0.82
	2018	125	547	0.52	790	0.70	784	0.78
	2019	118	527	0.50	767	0.68	752	0.74
	2020	113	509	0.49	749	0.66	722	0.72
	2021	110	499	0.48	735	0.65	705	0.70
	2022	108	488	0.46	724	0.64	696	0.69
	2023	108	475	0.45	713	0.63	693	0.68
	2024	108	461	0.44	702	0.62	691	0.68

Shelf-slope stocks

Results for the shelf-slope fishery-independent stock assessments area provided in ES7 through ES10. The average catch scenarios increase the stock biomass, and thus status, of all stocks in all states of nature. The high catch scenarios drop stock status below the target reference point in the base depletion state of nature by the end of the 12 year forecast in all four stocks. The rockfishes also drop below the limit reference point in the low depletion state of nature under the high catch scenario.

Table ES7. Decision table for sharpchin rockfish. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 320 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	195	3,485	51.5%	5,798	71.8%	7,904	86.3%
	2016	195	3,476	51.2%	5,791	71.6%	7,894	85.8%
	2017	194	3,469	50.9%	5,779	71.3%	7,881	85.4%
	2018	194	3,447	50.7%	5,762	71.1%	7,867	85.0%
	2019	193	3,440	50.4%	5,752	70.9%	7,852	84.8%
	2020	192	3,431	50.1%	5,743	70.6%	7,831	84.5%
	2021	191	3,426	49.9%	5,724	70.4%	7,798	84.2%
	2022	190	3,418	49.7%	5,705	70.2%	7,769	84.1%
	2023	189	3,401	49.5%	5,685	69.9%	7,744	83.8%
	2024	189	3,395	49.3%	5,667	69.8%	7,721	83.6%
Medium Catches	2015	382	3,371	51.1%	5,628	71.2%	7,561	86.0%
	2016	372	3,393	50.6%	5,531	69.5%	7,216	82.2%
	2017	363	3,394	50.1%	5,426	67.8%	6,908	78.4%
	2018	354	3,380	49.6%	5,300	66.1%	6,570	75.2%
	2019	347	3,377	49.2%	5,177	64.3%	6,313	72.5%
	2020	339	3,365	49.0%	5,091	62.7%	6,094	69.9%
	2021	334	3,363	48.6%	4,984	61.5%	5,895	67.5%
	2022	328	3,347	48.5%	4,933	60.4%	5,720	65.4%
	2023	322	3,321	48.3%	4,840	59.4%	5,561	63.8%
	2024	317	3,336	48.2%	4,770	58.5%	5,419	62.2%
High Catches	2015	750	3,343	50.6%	5,688	71.7%	7,863	86.0%
	2016	730	2,964	44.1%	5,338	66.4%	7,567	82.3%
	2017	703	2,594	38.6%	4,999	61.8%	7,310	87.7%
	2018	674	2,257	33.6%	4,643	57.2%	7,040	75.7%
	2019	650	1,953	28.9%	4,300	53.3%	6,791	73.1%
	2020	625	1,684	24.7%	4,001	49.6%	6,498	70.5%
	2021	612	1,392	20.8%	3,691	46.7%	6,215	68.6%
	2022	591	1,190	17.1%	3,479	43.6%	6,055	66.7%
	2023	575	980	13.9%	3,266	41.0%	5,935	65.0%
	2024	563	756	10.9%	3,095	38.6%	5,816	63.5%
Average Catches	2015	5	3,485	50.6%	5,664	72.0%	7,573	86.4%
	2016	5	3,602	51.9%	5,786	73.4%	7,643	87.4%
	2017	5	3,725	53.7%	5,895	74.7%	7,708	88.2%
	2018	5	3,826	54.9%	6,020	75.9%	7,768	89.0%
	2019	5	3,938	56.3%	6,121	77.0%	7,828	89.7%
	2020	5	4,042	57.7%	6,227	78.3%	7,888	90.3%
	2021	5	4,135	59.0%	6,327	79.3%	7,944	91.1%
	2022	5	4,260	60.4%	6,420	80.3%	7,998	91.6%
	2023	5	4,318	61.6%	6,510	81.2%	8,048	92.2%
	2024	5	4,418	62.6%	6,599	82.2%	8,096	92.8%

Table ES8. Decision table for yellowtail rockfish (north of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. “Spawning Biomass” is median female spawning stock biomass. “Depletion” is median depletion. Estimated MSY is 5728 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
	2015	3,936	43,502	52.8%	56,604	68.9%	62,979	83.4%
	2016	3,912	43,108	52.4%	56,063	68.3%	62,573	82.7%
	2017	3,879	42,738	52.0%	55,772	67.9%	62,187	81.9%
	2018	3,844	42,434	51.7%	55,468	67.4%	61,835	81.2%
Low Catches	2019	3,818	42,206	51.3%	55,027	66.7%	61,524	80.6%
	2020	3,797	41,976	50.9%	54,624	66.4%	61,253	79.9%
	2021	3,777	41,749	50.6%	54,269	66.0%	61,019	79.6%
	2022	3,759	41,547	50.4%	53,958	65.7%	60,818	79.3%
	2023	3,744	41,393	50.1%	53,684	65.3%	60,644	79.0%
	2024	3,730	41,129	50.0%	53,444	64.9%	60,491	78.8%
		6,497	43,502	52.4%	54,304	69.3%	60,039	83.3%
	2016	6,312	43,252	52.1%	52,730	66.8%	55,750	87.0%
	2017	6,126	43,044	51.6%	51,060	64.6%	52,853	73.9%
	2018	5,962	42,955	51.1%	49,531	62.7%	50,294	70.5%
Medium Catches	2019	5,798	42,673	50.7%	48,227	61.0%	48,062	67.2%
	2020	5,638	42,597	50.4%	47,111	49.4%	46,136	64.4%
	2021	5,523	42,567	50.0%	46,260	58.2%	44,484	62.3%
	2022	5,417	42,547	49.9%	45,421	57.1%	43,067	60.5%
	2023	5,324	42,842	49.7%	44,594	56.2%	41,784	59.9%
	2024	5,251	42,899	49.4%	43,788	55.4%	40,810	57.6%
	2015	11,666	44,076	52.6%	54,174	69.4%	63,587	83.7%
	2016	11,148	39,125	46.6%	49,654	63.4%	60,602	78.9%
	2017	10,530	34,591	41.3%	45,256	58.0%	57,730	75.1%
	2018	10,032	30,672	36.4%	41,696	53.4%	55,222	71.7%
High Catches	2019	9,675	26,968	31.9%	38,467	49.6%	53,091	68.6%
	2020	9,333	23,925	28.2%	35,708	46.2%	51,319	66.1%
	2021	9,052	20,975	25.1%	33,481	43.0%	49,975	63.9%
	2022	8,830	18,205	22.3%	31,248	40.4%	48,657	62.2%
	2023	8,547	15,740	19.5%	29,253	38.2%	47,106	60.6%
	2024	8,311	13,900	17.0%	27,694	36.4%	46,200	59.3%
	2015	1,376	45,023	52.7%	54,405	69.6%	61,190	83.7%
	2016	1,376	46,290	54.1%	55,352	70.7%	61,802	84.4%
	2017	1,376	47,532	55.4%	56,136	72.0%	62,370	84.9%
	2018	1,376	48,447	56.5%	56,980	72.9%	62,899	85.5%
Average Catches	2019	1,376	49,334	57.7%	57,758	73.7%	63,390	86.1%
	2020	1,376	50,528	59.0%	58,506	74.6%	63,845	86.5%
	2021	1,376	51,821	59.9%	59,109	75.5%	64,267	86.9%
	2022	1,376	52,752	61.0%	59,675	76.2%	64,658	87.3%
	2023	1,376	53,532	62.1%	60,139	77.0%	65,020	87.6%
	2024	1,376	54,297	63.1%	60,643	77.7%	65,355	87.9%

Table ES9. Decision table for English sole. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 4072 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	8,909	33,061	86.2%	24,798	90.7%	24,306	94.0%
	2016	7,247	26,491	67.9%	18,414	67.2%	18,274	71.1%
	2017	6,146	21,871	56.6%	14,277	52.0%	14,593	56.8%
	2018	5,379	18,728	48.7%	11,709	42.6%	12,608	48.6%
	2019	4,858	16,631	43.3%	10,061	37.1%	11,880	44.2%
	2020	4,529	15,286	39.7%	9,293	34.0%	11,515	43.0%
	2021	4,305	14,401	97.2%	8,908	32.3%	11,386	42.1%
	2022	4,151	13,766	35.5%	8,606	31.3%	11,128	41.4%
	2023	4,018	13,279	34.3%	8,424	30.7%	11,077	41.8%
	2024	3,939	12,947	33.4%	8,319	30.2%	10,982	42.0%
Medium Catches	2015	9,452	33,131	86.2%	24,735	90.7%	24,844	94.1%
	2016	4,098	26,338	67.7%	18,131	65.7%	16,751	63.2%
	2017	5,733	61,662	55.5%	14,115	50.8%	12,720	47.3%
	2018	4,972	18,441	47.3%	11,791	42.4%	10,602	39.6%
	2019	4,574	16,343	42.0%	10,538	37.9%	9,587	36.0%
	2020	4,332	14,991	38.6%	9,810	65.4%	9,065	34.3%
	2021	4,184	41,092	36.4%	9,401	34.0%	8,727	33.2%
	2022	4,073	13,465	34.8%	9,096	33.1%	8,490	32.6%
	2023	3,992	13,008	33.7%	8,916	32.4%	8,428	32.1%
	2024	3,922	12,662	33.0%	8,768	31.9%	8,340	31.7%
High Catches	2015	11,901	32,854	86.3%	25,220	90.6%	25,473	94.1%
	2016	2,368	23,791	61.8%	16,600	59.1%	17,158	63.6%
	2017	6,790	23,311	60.9%	16,346	58.2%	17,307	63.7%
	2018	5,975	19,630	51.5%	13,092	46.5%	14,308	53.7%
	2019	5,691	16,975	44.7%	10,874	38.8%	12,784	47.7%
	2020	5,446	14,926	39.1%	9,324	33.2%	11,642	43.0%
	2021	5,258	13,185	34.9%	8,098	29.1%	10,594	40.1%
	2022	5,106	12,087	31.5%	7,196	26.3%	10,178	38.2%
	2023	5,007	11,004	28.6%	6,557	24.3%	9,903	36.7%
	2024	4,960	10,260	26.4%	6,114	22.6%	9,600	36.2%
Average Catches	2015	224	33,061	85.9%	25,473	90.7%	25,687	94.0%
	2016	224	33,694	87.3%	24,996	91.8%	25,853	94.6%
	2017	224	34,117	88.5%	25,186	92.6%	25,981	95.1%
	2018	224	34,518	89.6%	25,377	93.3%	26,078	95.4%
	2019	224	34,916	90.6%	25,522	93.8%	26,153	95.7%
	2020	224	35,358	91.4%	25,635	94.3%	26,210	96.0%
	2021	224	35,746	92.1%	25,725	94.6%	26,253	96.0%
	2022	224	36,087	82.6%	25,798	94.9%	26,286	96.3%
	2023	224	36,387	93.2%	25,857	95.1%	26,312	96.4%
	2024	224	36,651	93.6%	25,904	95.3%	26,332	96.6%

Table ES10. Decision table for rex sole. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 1676 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	3,085	3,772	72.9%	3,377	80.7%	4,396	89.7%
	2016	2,541	3,113	59.4%	2,837	68.8%	3,989	81.4%
	2017	2,174	2,568	50.6%	2,490	60.8%	3,742	76.1%
	2018	1,909	2,237	44.8%	2,262	55.7%	3,560	72.9%
	2019	1,753	2,102	41.1%	2,137	52.6%	3,448	71.0%
	2020	1,652	2,022	38.7%	2,031	50.6%	3,380	70.3%
	2021	1,590	1,970	36.9%	1,986	49.3%	3,339	69.7%
	2022	1,544	1,928	35.8%	1,939	48.5%	3,313	69.4%
	2023	1,510	1,887	35.2%	1,924	48.1%	3,297	69.2%
	2024	1,485	1,857	34.6%	1,917	47.9%	3,287	69.1%
Medium Catches	2015	4,395	3,788	73.4%	3,073	81.1%	4,076	89.5%
	2016	3,342	3,023	59.5%	2,382	62.0%	2,937	64.7%
	2017	2,701	2,569	50.4%	1,938	50.3%	2,313	50.7%
	2018	2,308	2,279	44.3%	1,662	43.4%	1,963	43.3%
	2019	2,067	2,086	40.5%	1,511	39.4%	1,765	39.2%
	2020	1,926	1,940	38.1%	1,421	37.1%	1,663	36.9%
	2021	1,839	1,859	36.5%	1,371	35.7%	1,602	35.7%
	2022	1,778	1,812	35.6%	1,335	34.8%	1,562	34.9%
	2023	1,738	1,784	34.9%	1,305	34.2%	1,517	34.3%
	2024	1,711	1,764	34.4%	1,283	33.8%	1,496	33.8%
High Catches	2015	7,895	3,720	73.4%	3,073	81.1%	4,093	89.5%
	2016	5,315	1,684	34.1%	1,717	44.9%	2,866	64.7%
	2017	4,116	928	20.3%	973	27.4%	2,208	51.6%
	2018	3,382	732	15.8%	731	21.0%	1,927	44.8%
	2019	1,947	685	14.0%	655	18.9%	1,726	41.2%
	2020	2,722	657	13.6%	641	18.7%	1,791	42.3%
	2021	2,547	629	13.1%	605	17.5%	1,697	40.7%
	2022	2,470	607	12.4%	571	16.4%	1,663	40.0%
	2023	2,387	594	11.9%	552	15.6%	1,612	39.5%
	2024	2,344	578	11.6%	542	15.2%	1,579	38.9%
Average Catches	2015	455	3,687	73.2%	3,158	81.0%	3,686	89.9%
	2016	455	3,761	74.4%	3,191	81.9%	3,707	90.3%
	2017	455	3,824	75.4%	3,220	82.6%	3,723	90.6%
	2018	455	3,874	76.3%	3,245	83.2%	3,737	90.9%
	2019	455	3,919	77.2%	3,266	83.7%	3,747	91.1%
	2020	455	3,959	77.9%	3,285	84.2%	3,757	91.3%
	2021	455	3,993	78.4%	3,301	84.6%	3,765	91.6%
	2022	455	4,022	78.9%	3,315	84.9%	3,771	91.7%
	2023	455	4,047	79.4%	330	85.2%	3,777	91.9%
	2024	455	4,067	79.8%	3,340	85.5%	3,782	92.0%

1 Introduction

The following work is the first to apply category 2 stock assessments to nine west coast groundfishes: brown rockfish (*Sebastes auriculatus*), China rockfish (*Sebastes nebulosus*), copper rockfish(*Sebastes caurinus*), sharpchin rockfish (*Sebastes zacentrus*), stripetail rockfish (*Sebastes saxicola*), yellowtail rockfish (*Sebastes flavidus*); English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*). Two of the species (English sole and yellowtail rockfish) have previous Council-approved, but currently outdated, assessments. The remaining species previously only had category 3 (catch-only) assessment estimates of OFL.

There was insufficient time during the review to evaluate all the assessments originally requested by the Council. Assessments for vermilion/sunset rockfishes (*Sebastes miniatus* and *Sebastes crocotulus*) and yellowtail rockfish (south of 40° 10′ N. latitude) were not presented by the STAT.

1.1 Biology, Ecology, and Life History

The following are brief descriptions of pertinent biological and ecological considerations for each stock, presenting by ecological and taxonomic groups.

1.1.1 Nearshore rockfishes

The following three species are currently managed in the minor nearshore rockfish stock complex:

Brown rockfish (*Sebastes auriculatus*) is a medium-sized, commercially (mainly in the live-fish fishery) and recreationally important nearshore rockfish ranging from Baja Mexico to southeast Alaska, though core abundance within PFMC-managed waters is south of Cape Mendocino. Brown rockfish are associated with rocky reefs and show distinct genetic differentiation by distance in coastal populations off California (Buonaccorsi et al. 2005), though no distinct break is obvious to define substocks. Life history information is not spatially resolved. While coastwide populations may be subject to localized depletion because of reef-specific associations and small home ranges, no subpopulations have been distinguished. Brown rockfish is therefore initially explored as one coastwide population for the purpose of this assessment. Brown rockfish has a notably elevated vulnerability to overfishing (V = 1.99; Cope et al. 2011) and is listed on NOAA's Fishery Stock Sustainability Index (FSSI) (include reference web link?). Brown rockfish have been aged to 34 years (Love et. al 2002; Table 1). No stock assessment has previously been conducted for brown rockfish.

China rockfish (*Sebastes nebulosus*) is a medium-sized, commercially (mainly in the live-fish fishery) and recreationally prized deeper-dwelling nearshore rockfish ranging from southern California, north to the Gulf of Alaska. Core abundance is found from northern California to southern British Columbia, Canada. Individuals tend to be solitary and usually found in rock habitats. Limited information is available on stock structure or life history, though additional considerations are given in the modeling section for consider separate stocks north and south of Cape Mendocino. China rockfish have been aged to almost 80 years old (Table 1), one the oldest aged rockfishes with common occurrences below 100m. China rockfish vulnerability to overfishing is one of the highest recorded (V = 2.23) for west coast groundfishes. No stock assessment has previously been conducted for China rockfish. China rockfish is not listed on the FSSI.

Copper rockfish (*Sebastes caurinus*) is a medium to large sized nearshore rockfish found from Mexico to Alaska. The core range is comparatively large, from northern Baja Mexico to the Gulf of Alaska, as well as in Puget Sound. They occur mostly on low relief or sand-rock interfaces. Copper rockfish have historically been a part of both commercial (mainly in the live-fish fishery) and recreational fisheries throughout its range. Genetic work has revealed significant differences between Puget Sound and coastal stocks, but not among the coastal stocks (Buonaccorsi et al. 2002). Though genetic or ecological evidence is lacking for defining population structure, model fit considerations are described in the model results section that support stock distinction north and south of Point Conception. Copper rockfish live at least 50 years (Table 1) and have the highest vulnerability (V=2.27) of any west coast groundfishes. No stock assessment has previously been conducted for copper rockfish. Copper rockfish is not listed on the FSSI.

1.1.2 Shelf rockfishes

The following three species have been managed in either the minor slope rockfish stock complex (sharpchin, stripetail and yellowtail (south of 40°10' N lat.) rockfish or as with its own quota (yellowtail rockfish north of 40°10' N lat.):

Sharpchin rockfish (*Sebastes zacentrus*) is a smaller-sized rockfish that inhabits waters up to 500 m, typically over muddy-rock habitats and range from Southern California to Alaska, though core range is northern California to Alaska in waters up to 300 m (Figure 1 &Figure 2). Sharpchin are not a major commercial target, though they are taken in large numbers and commonly seen in trawls that target Pacific ocean perch. They are not a major component of any recreational fisheries. There is no indication of population structure in sharpchin rockfish, so one coastwide stock is assumed for assessment purposes. Sharpchin rockfishes live to at least 58 years (Table 1) and have high vulnerability (V = 2.05) to overfishing. No stock assessment has previously been conducted for stripetail rockfish. Sharpchin rockfish is not listed on the FSSI.

Stripetail rockfish (*Sebastes saxicola*) is a smaller-sized rockfish differing from sharpchin in that its range is more southerly (Mexico to Alaska, but mostly from southern California to British Columbia) and core depths a bit shallower (down to 200 m; Figure 3 & Figure 4). They tend to be found on sandy-rock bottoms in high numbers, co-occurring with the ubiquitous greenstriped rockfish (Cope and Haltuch 2012). Though found in trawl fisheries, they are neither a target of commercial or recreational fisheries. They also are not as long-lived (at least 38 years old; Table 1) as sharpchin, thus are considered only moderately vulnerable to overfishing (V = 1.80). No stock assessment has previously been conducted for stripetail rockfish. Stripetail rockfish is not listed on the FSSI.

Yellowtail rockfish (*Sebastes flavidus*) is a mid-water to high-relief dwelling rockfish distributed from northern California to the Aleutian Islands. Core distribution is central California to Alaska (Figure 5 and Figure 6). Yellowtail rockfish are common in both commercial and recreational fisheries throughout its range and commonly occur with canary and widow rockfishes (Cope and Haltuch 2012). Despite historically large removals and its popularity in commercial and recreational fisheries, its association with those highly regulated species has greatly decreased removals over the last decade. Due to this low susceptibility to fisheries removals, the vulnerability to overfishing of yellowtail rockfish is relatively low (V = 1.88), though the productivity of this species is also relatively low, including a longevity to almost 70 years (Table 1). A previous assessment conducted for yellowtail rockfish (Wallace and Lai 2004) separated stocks at Cape Mendocino and only conducted an assessment for the northern stock. That stock was estimated to be above the relative spawning biomass reference point of 40% of unfished levels. Hess et al. (2011) described a strong break in the genetic structure of yellowtail rockfish at Cape Mendocino, supporting the stock structure assumed in the previous assessment. That same structure is maintained in this assessment, with the southern stock having no prior assessment. Due to time constraints on model development and review, the attempt at assessing the southern stock of yellowtail is not included in this document, thus results are only presented for yellowtail north. Yellowtail rockfish is listed on the FSSI.

1.1.3 Flatfishes

English sole (*Parophrys vetulus*) is a medium-sized wide ranging and common flatfish species from Baja California to Alaska (Figure 7 and Figure 8). English sole are most common in depths less than 200m, though they can be found down to 550m. English sole have a long history of commercial removals, almost exclusively in trawl fisheries, with records dating back into the late 1800s. Peaks in catches occurred post-World War II, but catches were relatively high from 1920-1980. Since then, catches have greatly significantly declined and are currently at historic lows. This landings history, coupled with fairly high productivity and relatively low maximum ages (20+ years old; Table 1), determines a vulnerability to overfishing as one of the lowest of the groundfishes (V = 1.19). The English sole stock was last assessed in 2007 and found to be well above the initial spawning biomass estimate and was at or above the target biomass since 2000. English sole is listed on the FSSI.

Rex sole (*Glyptocephalus zachirus*) is a medium sized, moderately long-lived (up to almost 30 years; Table 1) right-eyed flatfish ranging widely in distribution from central Baja California to the Aleutian Islands (Figure 9 and Figure 10). They are common in a large part of their recorded range, from southern California to the Aleutian Islands. They are also distributed in deeper depths, commonly found in waters up to at least 500 m and range down to more than 1100 m. Rex sole are a very commonly occurring species in the fishery-independent trawl surveys, and thus are very accessible to trawl fisheries. Targeting for rex sole in commercial fisheries has varied over the years, with major removals occurring in the mid-20th century to provide feed for mink farms. They have not been targeted heavily in the last few decades, thus their vulnerability to overfishing is believe to be low (V = 1.28). Rex sole is listed on the FSSI and does not have a previously conducted stock assessment.

2 Assessment

2.1 Data and Inputs

2.1.1 Removal histories

Annual estimates of commercial and recreational landings by species, year, and coastal region were compiled for each species. Catches from U.S. waters were partitioned into three regions, divided at Point Conception and Cape Mendocino which are widely recognized as major biogeographic boundaries along the US west coast (Figure 11): “Southern” (US-Mexico border to Point Conception), “Central” (Point Conception to Cape Mendocino), and “Northern” (Cape Mendocino to the US-Canada border). The Northern region is equivalent to the Eureka, Columbia, and Vancouver INPFC areas. The Southern and Central regions are divided at Point Conception (34° 27’ N. latitude), rather than the northern boundary of the INPFC “Conception” area (36° N. latitude).

2.1.2 Catch data were compiled from a variety of sources (Removals

Table 2). Notable gaps in the catch reconstructions are recreational removals prior to 1980 in Oregon and prior to 1967 in Washington. In terms of total cumulative landings and discard, the species rank (in descending order) as follows: English sole, yellowtail rockfish, rex sole, sharpchin rockfish, copper rockfish, brown rockfish, stripetail rockfish, China rockfish.

2.1.3 Catch data sources

2.1.3.1 PacFIN

The primary source for commercial landings data between Cape Mendocino and the US-Canadian border was the Pacific Fisheries Information Network (PacFIN, pacfin.psmfc.org). We queried PacFIN using INPFC-based area stratification to obtain groundfish landings from 1981-2012. Landings reported from “nominal” market categories were pooled with corresponding categories.

2.1.3.2 CALCOM

The CALCOM database was the source for California’s commercial landings estimates for the area south of Cape Mendocino from 1969 – 2012, and the area between Cape Mendocino and the CA-OR border from 1969-1980. Since multiple species are often landed within a single market category, it is necessary to “expand” landings estimates from fish tickets using species composition data obtained by port samplers. CALCOM is the source of these “expanded” landings for California, and generates estimates of species compositions and catch by year, quarter, market category, gear group, port complex, and fishery condition (i.e. live / nonlive). Expanded species compositions are uploaded to PacFIN on a monthly basis, where they are applied to landings by market category from fish ticket data. A final “annual expansion” is uploaded to PacFIN when all landing receipts for a given year have been submitted. Pearson et al. (2008) describe the reliability of commercial groundfish landings in California from 1969-2006.

2.1.3.3 RecFIN

Annual estimates of total recreational catch (landings and discard) for California and Oregon were obtained from the Recreational Fisheries Information Network website (RecFIN; www.recfin.org) for the period 1980-2011. Estimates for 2012 were provided by the states’ Groundfish Management Team representatives. For these states, total recreational catch was assumed equal to the combined weight of catch types A and B1 (sampler-examined catch, and angler-reported catch and discard). Sampling for RecFIN did not occur from 1990-1992 due to lack of funding. Northern California party boat data from 1993-1995 are also not available from RecFIN. We estimated total recreational catch by state and species for the years 1990-1992 using a linear interpolation. Prior to 2004, recreational catch between Cape Mendocino and the CA-OR border was estimated by calculating the percentage of A+B1 catch in CRFS District 6 relative to A+B1 catch in CRFS Districts 3 through 6 from 2004-2011. The percentages were 1%, 7%, and 6.5% for brown rockfish, china rockfish, and copper rockfish, respectively.

2.1.3.4 NORPAC

Estimated bycatch of groundfish species from the at-sea whiting fleet is available for the years 1991-2012 from the NORPAC database. We queried NORPAC data (accessible through PacFIN) for estimates of total bycatch weight by species, area, and year. Annual estimates of total bycatch by species from this fishery were included in our catch reconstructions without modification.

2.1.3.5 Foreign fleets (Rogers 2003)

Foreign fleets caught substantial amounts of groundfish off the west coast of the United States in 1965-1976. Rogers (2003) described these fisheries in detail and developed a standardized method for estimating rockfish catch during this time period by nation, area, and year. We include Rogers’ catch estimates in our analysis without modification

2.1.3.6 California Historical Catch Reconstructions (Commercial and Recreational)

Ralston et al. (2010) describe a reconstruction of California’s commercial landings prior to 1969 and recreational landings prior to 1981. We queried the database maintained by the SWFSC Fisheries Ecology Division for commercial groundfish landings from 1916-1969 and recreational rockfish catch (landings + discard) from 1928-1980.

2.1.3.7 Oregon Commercial Catch Reconstructions

Historical landings from Oregon's commercial fisheries were provided by V. Gertseva (NMFS, pers. comm.). Landings estimates were stratified by year, species, and gear (trawl vs. non-trawl), but gear types were aggregated for this analysis.

2.1.3.8 English sole stock assessment (Stewart 2007)

Estimates of total catch (landings plus discard) of English sole were taken from the 2007 stock assessment, which estimated discards within the assessment model (Stock Synthesis).

2.1.3.9 WA commercial trawl records (Tagart 1985)

Estimates of trawl-caught rockfish in Washington by year, species, PMFC area, and reporting agency (CDFG, ODFW, WDFW, and DFO Canada) for the years 1963-1980 were obtained from Tagart (1985). We calculated species compositions from the 1969-1976 data (prior to the development of the widow rockfish fishery) and applied them to Tagart's aggregated rockfish landings from 1963-1968.

2.1.3.10 Pacific Marine Fisheries Commission (PMFC) Data Series, 1956-1980

The PMFC compiled commercial catch statistics by market category, year, month, area, and agency beginning in 1956. Landings estimates were limited to trawl gear prior to 1971 (Lynde, 1986). These data are commonly referred to as the "Data Series" and were digitized and made available by the Northwest Fisheries Science Center (NWFSC) of the National Marine Fisheries Service (NMFS). Landings in the Data Series are stratified by area where caught, as opposed to landing location. The Data Series is described in detail by Lynde (1986).

2.1.3.11 Pacific Fisherman Yearbooks

Pacific Fisherman yearbooks provide a record of total rockfish landings in Washington from the 1930s to 1956 (Anonymous, 1947, 1957; as cited in Stewart, 2007). Reported rockfish catch is partitioned into POP and other rockfish categories after 1952. Stewart (2007) found this source to be similar to catch reported in the Current Fishery Statistics series published by the Fish and Wildlife Service (see multiple citations in Stewart, 2007), with the exception of one year (1945) in which the Pacific Fisherman data estimated 7,300 mt and the Fish and Wildlife Service data showed 11,552 mt. We retained the estimate from the Pacific Fisherman yearbooks to maintain consistency with the remainder of the time series. The Pacific Fisherman data include landings originating from Canadian waters. To estimate yield available from U.S. stocks (assuming they are independent) it is necessary to identify the fraction of catch originating in U.S. waters. Alverson (1957) reports the fraction of landed rockfish that originated from U.S. waters during 1953 (14.9% for other rockfish and 9.7% for POP). We applied these proportions to the Pacific Fisherman landings to get Washington landings from U.S. waters. For years reporting only total rockfish, we used the average proportion. We then applied the 1969-1976 species composition data from Tagart (1985) to our estimates of total rockfish caught in U.S. waters off Washington to estimate rockfish landings by species from 1942-1955, as these composition data are the best available information at this time. As with the PFMC Data Series, this application of the Tagart composition data makes a strong assumption that rockfish species compositions do not vary over time. In summary, estimates of total rockfish landings in Washington for years prior to 1981 are derived from 4 sources: Pacific Fisherman yearbooks, PMFC Data Series Reports, Alverson (1957) and Tagart (1985).

2.1.3.12 Wallace and Lai (2005)

Landings of yellowtail rockfish north of Cape Menodocino (1967-2004) were estimated for the 2005 stock assessment (Wallace and Lai, 2005). The authors also obtained estimates of yellowtail caught in US waters but landed in Canada. These foreign landings were added to the recently reconstructed landings for yellowtail rockfish.

2.1.3.13 CDFG Fish Bulletin #74

Landings of rex sole from 1916-1930 were reconstructed from total sole landings reported in CDFG Fish Bulletin 74 (1949). The Bulletin reports 5.1% as the approximate proportion of rex sole in total sole landings observed in 1947, and this percentage was assumed constant for the years 1916-1930.

2.1.3.14 Washington Recreational Removals

Washington Department of Fish and Wildlife (Tsou, pers. comm.) supplied total numbers of recreationally-landed and released fishes in coastal waters from 1975-2012, 3 of which are rockfishes being considered in these assessments (China, copper, and yellowtail rockfishes). The years 1987-1989 were missing, so stock-specific linear interpolation of landings were made using 1986 and 1990 landings as endpoints. The number of fish released was not recorded prior to 2002. The years 1995-2002 had the same rockfish bag limits, so the ratio of released to landed fish in 2002 was multiplied by the landing in years 1995-2001. No information on releases are available for the years 1975-1994 when no bag limits were in effect, so a value of 0.5 times the 2002 release ratio was assumed. There was an isolated report of landings in 1967 (Buckley et al. 1967). Missing years from 1975-1960 (1960 catch was assumed to be 0) were therefore interpolated through the 1967 value, with discards assumed as in the years 1975-1994. Finally, no information on mortality of released fishes was available, so the bracketing scenarios of 0% and 100% mortality were assumed, with the latter chosen as the base case and the former as a sensitivity run.

Removals were recorded as numbers of fish, but biomass is preferred in the assessment models. Length compositions of catch from 1997-2012 were converted to weight compositions using length-weight relationships (Table 1). Weights were then averaged over all years. Each year of assumed numbers removed was then multiplied by the average weight to get the final removals in metric tons.

2.1.3.15 Discard Estimates

Discard from recreational fisheries (apart from WA, described above) was included in the downloaded RecFIN estimates (catch type A+B1) and the CA recreational catch reconstruction (Ralston et al. 2010).

Following Dick and MacCall (2010) discard ratios (discard/retained) for commercial fisheries were calculated from WCGOP annual reports (NWFSC, 2008, 2009; their Table 3a) as the ratio of discarded catch in 2008-09 to retained catch in 2008-2009. When species-specific rates were not available, estimates were derived from aggregated categories (e.g. shelf rockfish). Data from Pikitch et al. (1988) were used to develop point estimates of discard in 1986 for rex sole and sharpchin rockfish, with years in between estimated using linear interpolation to the NWFSC values. Historical discard ratios were assumed to be equal to the earliest available source of discard information for that species. The estimated discard rates were constant over all years for brown, china, copper, and stripetail rockfishes (11%, 13%, 13%, and 44%, respectively). Harry (1956) observed nearly 100% discard of rex sole in the Oregon otter trawl fishery around 1950. In California, rex sole ranked third (slightly over 5%) among sole species in the 1947 trawler catch (CDFG Fish Bulletin No. 74). Historical discard rates are therefore a source of uncertainty in removals, and appear to vary by region. For the base model, we assume a 1:1 ratio of discard to retained fish for rex sole in years prior to 1950. Total removals for English sole (including discards) were taken from the 2007 update assessment, with an assumed discard rate of 33% for years after 2006 (based on WCGOP annual reports). Time varying estimates of discard rates for rex sole, sharpchin rockfish, and yellowtail rockfish (north of Cape Mendocino) are shown in Figure 12.

2.1.4 Species removals by fishery and region, and data source

2.1.4.1 Brown rockfish

Coast wide, recreational fishing has accounted for approximately 56% of cumulative historical removals for brown rockfish (44% commercial). The percentages of total catch in the northern, central, and southern regions are 1%, 80%, and 18%, respectively (Table 3 and Table 4; Figure 13).

2.1.4.2 China rockfish

Coast wide, recreational fishing has accounted for approximately 64% of cumulative historical removals for china rockfish (36% commercial). The percentages of total catch in the northern, central, and southern regions are 21%, 73%, and 5%, respectively (Table 5 and Table 6; Figure 14)

2.1.4.3 Copper rockfish

Coast wide, recreational fishing has accounted for approximately 86% of cumulative historical removals for copper rockfish (14% commercial). The percentages of total catch in the northern, central, and southern regions are 4%, 63%, and 33%, respectively (Table 7 and Table 8; Figure 15).

2.1.4.4 Sharpchin rockfish

Landings of sharpchin rockfish are almost entirely from commercial sources (negligible recreational landings relative to commercial landings). The percentages of total catch in the northern, central, and southern regions are 97%, 3%, and 0%, respectively (Table 9 and Table 10; Figure 16).

2.1.4.5 Stripetail rockfish

Landings of stripetail rockfish are almost entirely from commercial sources (negligible recreational landings relative to commercial landings). The percentages of total catch in the northern, central, and southern regions are 60%, 40%, and 0%, respectively (Table 11 and Table 12; Figure 17).

2.1.4.6 Yellowtail rockfish

Coast wide, recreational fishing has accounted for approximately 5% of cumulative historical removals for yellowtail rockfish (95% commercial). The percentages of total catch in the northern, central, and southern regions are 84%, 15%, and 1%, respectively (Table 13 and Table 14; Figure 18). A linear ramp in catch was assumed from 0 mt in 1900 to 529 mt in 1916.

2.1.4.7 English sole

Landings of English sole are almost entirely from commercial sources (negligible recreational landings relative to commercial landings). Model-estimated discards from the 2007 assessment were not reported by our regional definitions, so we illustrate the relative magnitude of landings by region based on an assumed constant 33% discard rate. The percentages of total catch in the northern and combined central/southern regions are 50% and 50%, respectively (Figure 19). This assessment uses the same coastwide removals (including discard) as the 2007 assessment (Stewart, 2007), with PacFIN and CALCOM estimates for years after 2006 and an assumed 33% discard rate (Table 15 and Table 16).

2.1.4.8 Rex sole

Landings of rex sole are almost entirely from commercial sources (negligible recreational landings relative to commercial landings). The percentages of total catch in the northern, central, and southern regions are 69%, 30%, and <1%, respectively (Table 17 and Table 18; Figure 20)

2.1.5 Fishery-independent surveys

2.1.5.1 Survey types

There are two main fishery-independent trawl surveys used in most west coast groundfish assessments (Table 19): 1) The Alaska Fisheries Science Center (AFSC) Triennial shelf survey (1977-2004) and the annual Northwest Fisheries Science Center (NWFSC) shelf-slope trawl survey (2003-present). Though each survey uses trawl gear to sample groundfishes, the gear specifications, latitudinal and depth distributions, and survey design differs (Cope and Haltuch 2012).

The latitudinal distributions of the Triennial Surveys are shown in Table 20. The data set has been trimmed to exclude tows taken south of Pt. Conception (ca. 34.5º N lat.) and in Canada (ca. 48.5º N lat.). The southernmost latitude bin was not sampled in 1980, 1983, and 1986. The depth distributions of the Triennial Surveys are shown in (Table 21). The 1977 survey did not sample depths shallower than 95m, and the 1980-1992 surveys did not sample depths greater than about 350m. The temporal distributions of the Triennial Surveys are shown in Table 22. Beginning in 1995, surveys began and ended about 5 weeks earlier than previous surveys.

The Triennial survey used set line transects with randomly placed trawls as the survey was conducted. In addition, changes in timing and coverage of the triennial survey pre- and post-1995 have made it common practice to break that survey into two time periods. We have used this approach in these assessments as well, resulting in two separate indices for the Triennial survey: Triennial-early including 1980-1992; and Triennial-late including 1995-2004. The first year of the triennial survey (1977) has also typically been dropped because of differences in depth coverage (i.e., shallower depths were excluded) versus other years in the survey. All water hauls and foreign catch are traditionally removed from these data sets. Base case models assume these common practices in subsequent data preparation and development of abundance indices.

The NWFSC shelf-slope survey, also known informally as the combo survey, has surveyed deeper waters with greater latitudinal range, and employs a stratified random design. <<include additional information on this survey like the latitudinal distribution, sampling depths, and temporal distribution>> or at least reference where this information can be found.

A third survey, the AFSC slope survey (1997-2001) was also considered, but either the frequency of occurrence of most species was too low or resultant indices were deemed insufficiently informative (see explanation below). Therefore, all subsequent results are reported for only the AFSC triennial and NWFSC annual shelf-slope surveys.

2.1.5.2 GLMM analysis

Delta-Generalized Linear Mixed Models (delta-GLMMs) were used rather than assuming design-based expanded swept-area estimates of abundance. Delta-GLMMs are preferred because they model both probability of positives and the magnitude of positive tows and allows for different factors such as vessel and strata effects to be considered in a holistic modeling environment that propagates the uncertainty though all considered processes. An updated Bayesian implementation of this approach was used (Thorson and Ward in press). Lognormal and gamma errors structures were considered for the positive tows, including the option to model extreme catch events (ECEs), defined as hauls with extraordinarily large catches, as a mixture distribution (Thorson et al. 2011). There were therefore four total positive tow error structures considered: gamma or lognormal with or without ECEs mixture distributions. Model convergence was evaluated using the effective sample size of all estimated parameters (typically >500 of more than 1000 kept samples would indicate convergence), while model goodness-of-fit was evaluated using Bayesian Q-Q plots. The resultant coefficient of variations (CVs) of each model were also considered when determining viable indices (i.e., CVs consistently >2 in each year were deemed uninformative and not used). Much discussion was given to the appropriate way to select among model error and whether or not to model extreme catch events. The STAR panel felt there was insufficient information to select the ECE models, so they were not considered in final model selection. Deviance was ultimately used to choose between the lognormal and gamma, though more research into improved model selection criteria for these GLMM models is needed.

Stratification for each survey was determined by considering first the design-based strata, then any additional strata that gives at least 5 positive occurrences for each strata. Design strata can be broken up into finer strata, but combining strata of differential sampling effort could create bias, thus combining strata was limited to cases where additional samples could be added with small increases in depth beyond a certain strata boundary. Design depth strata considered were 55-183 m,183-366 m, and 366-500m; and 55-183 m, 183-549m, and 549-1280m for the AFCS triennial and NWFSC annual surveys, respectively. There were no specific latitudinal design strata for the AFSC triennial survey, but the NWFSC had one latitudinal effort break at 34.5º N lat. (near Pt. Conception). Only five stocks (Sharpchin, stripetail and yellowtail rockfish north; English and rex soles) demonstrated adequate frequencies of occurrence (> 10% per year) to be considered for index development (Table 23). Final design strata used in the GLMMs for those stocks are shown in Figure 21 to Figure 25. Year-strata effects were assumed fixed with no interactions for both the binomial and positives models. The Triennial Survey assumes no vessel effects, while the NWFSC annual survey assumed random vessel effects.

Model comparisons and selection are given in Table 24. Lognormal error structure was chosen over gamma in most instances based on the deviance criterion. The suggestion to use a combined triennial survey with lognormal error structure for yellowtail rockfish north was made late in the STAR panel review, so no gamma model is provided for comparison. All chosen models demonstrated good effective sample sizes and acceptable Q-Q plots (Figure 26 to Figure 28). Final index time series used in the base case models are given in Table 25.

2.1.5.3 Power plant impingement indices

The power plant impingement index represents data collected from coastal cooling water intakes at five Southern California electrical generating stations from 1972 through 2011 (and ongoing). These data have been previously described and published by Love et al. (1998) and Miller et al (2009) with respect to trends in abundance of *Sebastes* species and queenfish (*Seriphus politus*), respectively, as well as in Field et al. (2010) with respect to the development of a recruitment (age-0 abundance) estimate for bocaccio rockfish. The latter index was estimated to be the best performing of four potential pre-recruit indices for this species, and is currently included in the most recent bocaccio update (Field 2011). The dataset includes observations on as many as 1.8 million fish encountered in three basic types of power plant impingement surveys (E. Miller unpublished data.). Of the three principle “types” of data, the most reliable data are the “heat treatment” data, in which a known volume of water is treated at high temperatures to kill off biofouling organisms, and all fishes are subsequently enumerated. Fish are identified to the lowest possible taxon, and a total weight and standardized length measurements are obtained for all species, although such data is not as complete in some of the early years. The frequency of all of these sampling methods is irregular, as a result of changes in operating schedules, regulatory requirements, energy demands and changes in ownership over time. However, the time series is extensive, sampling is distributed relatively evenly across all months as well, and has continued to show considerable promise as a relative abundance index.

Data from over 1700 heat treatments, from five different power stations (e.g., locations) are currently available (data from one additional plant may become available in the near future, as may data from other operations). Table 27 shows the number of heat treatment per station samples for the five power plants currently available by year. Table 28 shows the number of positive occurrences by species from the dataset in Table 27, for five of the more abundant rockfish species; bocaccio, brown, grass, olive and vermilion (*Sebastes paucispinis, S. auriculatus, S. rastrelliger, S. serranoides* and *S. miniatus*). Data on many other *Sebastes* species is present, but likely to be too sparse to be informative, although there is considerable data for California scorpionfish (*Scorpaena guttata*). Note that size data (mean weight and length) are available for most species in many of the most recent years. These data indicate that while some species are present almost exclusively as young-of-the-year (YOY), others, including brown rockfish and grass rockfish, are encountered as both YOY, settled juveniles, and subadults (infrequently to mature adult sizes), with suggestions of strong cohorts in some of the size data.

Abundance indices were developed using a Delta-GLM (generalized linear model) approach, based on R code developed by E.J. Dick, and consistent with approaches used to develop indices of relative abundance for past stock assessments as well as other types of survey data used in the data-moderate models. Year effects are independently estimated covariates which reflect a relative index of abundance for each year, error estimates for these parameters are developed with a jackknife routine. Seasonal effects were also included, and power station (location) effects were modeled to represent what seem to be fairly substantial differences in catchability by power plant. A preliminary index of brown rockfish (Figure 29) was developed based on the number of encountered animals, and suggests patterns that are consistent with those under development from recreational CPUE data. However, as the average size appears to vary substantially from year to year, with some suggestion of cohorts moving through the sampling frame, an index based on the total biomass of encountered animals may be more appropriate.

2.1.6 Fishery-dependent indices

2.1.6.1 Trip-based Recreational CPUE

From 1980 to 2003 the MRFSS program sampled landings at dockside (called an "intercept") upon termination of recreational fishing trips. Data were not collected from 1990-1992 due to lack of funding, and the time series is truncated at 2003 due to regulatory changes. The major advantages of this time series are its length (24-year span) and spatial coverage (U.S.-Mexico border to OR-WA border). Although the program sampled various fishing modes, only the party and charter boat (a.k.a. commercial passenger fishing vessel) samples are used in the present analyses due to their relatively large and diverse catches.

The raw data are available from RecFIN (http://www.recfin.org/), and are aggregated by YEAR and bi-monthly sampling period (called a WAVE). The relevant data type (dockside sampler-examined catch, or "Type 3" records in RecFIN) includes catch and effort information aggregated by trip. The catch represents retained fish, effort is angler-reported, and location information includes intercept site (reduced to COUNTY) and distance from shore (AREA_X, a binary variable indicating inside/outside 3 miles). A summary of sample sizes by YEAR and COUNTY is given in Table 29.

Data preparation
Each entry in the RecFIN Type 3 database corresponds to a single fish examined by a sampler at a particular survey site. Since only a subset of the catch may be sampled, each record also identifies the total number of that species possessed by the group of anglers being interviewed. The number of anglers and the hours fished are also recorded. Unfortunately the Type 3 data do not indicate which records belong to the same boating trip. Because our aim is to obtain a measure of catch per unit effort, it is necessary to separate the records into individual trips. For this reason trips must be inferred from the RecFIN data. This is a lengthy process, and is outlined in Appendix RecFIN A. After applying the trip identification algorithm, an estimated 12222 trips were available for analysis. The total number of sampled trips per year varies from 274 to 1064, and the number of samples per county varies from 2 to 2301 (Table 29). For each of the recreationally important rockfish species scheduled for data-moderate assessments in 2013 (yellowtail, brown, copper, and China rockfishes) we calculated the total number observed in sampler-examined trips by YEAR and COUNTY and the corresponding number of positive trips. As an alternative coarser geographic descriptor, we aggregated COUNTY into REGION, which had three values, Mexico to Pt. Conception (SOUTH), Pt. Conception to Cape Mendocino (CENTRAL), and Cape Mendocino to Astoria at the OR/WA border (NORTH). Note that the regional break at Cape Mendocino is different than the CA/OR break in the original RecFIN data.

To identify trips as effective effort for a given target species, we apply the binary regression approach of Stephens and MacCall (2003). Based on presence/absence of species co-occurring with the target species, this method generates a probability of observing the target species in a given trip. We wish to exclude trips with a low probability of observing the target. Stephens and MacCall suggested a threshold probability that balances the false positives and false negatives. Using this criterion, most trips not exceeding the threshold probability would not catch the target species, but since some trips reflect a mixture of targets, a subset of trips in which the target was reported are also excluded from the data set ("false positives"). Whereas Stephens and MacCall used a logistic regression, we examine a suite of transformations including logit, probit, complementary log-log (cloglog) and complementary log-log, modeling absences (cloglogABSENCE). In most cases the latter was the preferred transformation.

RecFIN-based Indexes (1980-2003) RecFIN
Annual abundance indices are estimated using the delta-GLM approach (Lo et al., 1992; Stefansson, 1996). Explanatory variables available in the Type 3 data are YEAR, WAVE (2-month period), COUNTY or REGION, and AREA_X (distance from shore). The distance from shore is a binary categorical variable, which indicates whether the majority of effort was within or beyond 3 miles of shore.

Once the trip data are filtered according to the Stephens-MacCall method, we determine the best link function for the binomial portion of the model and the best probability model (density function) for the positive portion of the model. The link functions we considered were logit, probit, cloglog, and cloglogABSENCE. The probability distributions we considered for the positive model were the gamma and the lognormal distributions. For each link function we fit a binomial GLM to the data and used AIC as a model selection criterion. Similarly, for each positive probability model we fit a GLM and use AIC to determine the relative goodness of fit.

Once a link function and probability model have been selected, further model selection analysis is performed to determine which explanatory variables to use. Because we ultimately seek a yearly CPUE index, we force YEAR to be a variable in the model. We use BIC as a model selection criterion, testing for interactions with YEAR effects. By the BIC criterion, all interaction terms were dropped in every RecFIN index.

Brown rockfish (central area)
The RecFIN (dockside sampling) 1980 to 2003 data for the central areas (Pt. Conception to Cape Mendocino) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

[The pre-STAR draft included information about a coast-wide index for brown rockfish. Details regarding the central area index (filtering, model selection, etc.) will be included in the final draft. Index values and CVs used in the base model are presented in Table 30. The index is shown in Figure 30.]

Brown rockfish (southern area)
The RecFIN (dockside sampling) 1980 to 2003 data for the southern area (Pt. Conception to the U.S.-Mexico border) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

[The pre-STAR draft included information about a coast-wide index for brown rockfish. Details regarding the southern index (filtering, model selection, etc.) will be included in the final draft. Index values and CVs used in the base model are presented in Table 31. The index is shown in Figure 31.]

China rockfish (northern area)

The RecFIN (dockside sampling) 1980 to 2003 data for the northern area (Cape Mendocino to Astoria) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

[The pre-STAR draft included information about a coast-wide index for China rockfish. Details regarding the northern index (filtering, model selection, etc.) will be included in the final draft. Index values and CVs used in the base model are presented in Table 32. The index is shown in Figure 32.]

China rockfish (central area)

The RecFIN (dockside sampling) 1980 to 2003 data for the central area (Pt. Conception to Cape Mendocino) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

[The pre-STAR draft included information about a coast-wide index for China rockfish. Details regarding the central index (filtering, model selection, etc.) will be included in the final draft. Index values and CVs used in the base model are presented in Table 33. The index is shown in Figure 33.]

Copper rockfish (south area)
The RecFIN (dockside sampling) 1980 to 2003 data for the southern area (Mexico to Pt. Conception) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

Species Filtering: The initial data set (N = 7469, pos = 517) was filtered using a binomial GLM with presence-absence of other commonly occurring species as indicator variables. Alternative transforms and their AIC values were logit (2423), probit (2394) and cloglogAbsence (2369), giving strong support for the latter. The species coefficients are shown in Figure 34 and Figure 35. The 522 records with the highest fitted probabilities were retained (the probability threshold was 0.322).

Delta-GLM: The selected data (N = 522, pos = 275) contained YEAR and three possible additional effects, WAVE (6 two-month bins), COUNTY (5 levels), and AREA_X (2 levels), which was a binary indicator of inside/outside three miles from shore. Abundance was measured as catch per angler hour, and the positive model was weighted by angler hours. The distribution for positives was lognormal (which was strongly favored over gamma by a deltaAIC of 45). The binary model used a logit transformation which was indistinguishable from the alternatives. In both submodels, stepwise BIC removed all interaction terms and then removed fixed effects leaving only YEAR and COUNTY (Table 34). The YEAR effects are shown in Figure 36.

Copper rockfish (north-central area)
The RecFIN (dockside sampling) 1980 to 2003 data for the North and Central areas (Pt. Conception to Astoria) were subsetted by Stephens-MacCall species filtering, and were then used in a delta-GLM.

Species Filtering: The initial data set (N = 4291, pos = 833) was filtered using a binomial GLM with presence-absence of other commonly occurring species as indicator variables. Alternative transforms and their AIC values were logit (3141), probit (3133) and cloglogAbsence (3126), giving strong support for the latter. The species coefficients are shown in Figure 37. The 841 records with the highest fitted probabilities were retained (the probability threshold was 0.360).

Delta-GLM: The selected data (N = 841, pos = 476) contained YEAR and three possible additional effects, WAVE (6 two-month bins), COUNTY (14 levels) or broader REGION (2 levels), and AREA_X (2 levels) which was a binary indicator of inside/outside three miles from shore. Abundance was measured as catch per angler hour, and the positive model was weighted by angler hours. The distribution for positives was lognormal (which was strongly favored over gamma by a deltaAIC of 63). The binary model used a logit transformation which was indistinguishable from the alternatives. In the positive submodel, stepwise BIC removed all interaction terms and then removed fixed effects leaving only YEAR and REGION (which was favored over COUNTY). The binomial portion removed all effects, leaving only YEAR (Table 35). The YEAR effects are shown in Figure 38.

2.1.6.2 Observer-based Recreational CPUE from CPFVs

Central California Observer Indexes (1988-1998+) CenCalOBS
Historical CPFV observer data from 1988 to 1998 for the Central California area (Pt. Conception to Cape Mendocino) were combined with data from two ongoing onboard observer programs: CDFW (1999-2011), and CalPoly (2003-2011). Data from CDFW and CalPoly were formatted to match the historical format (catch and effort for drifts were aggregated within a site and trip).

Prior to any analyses, a preliminary data filter was applied. Trips and drifts meeting the following criteria were excluded from analyses:

- Trips in which 70% or more of the observed catch composition was not bottomfish (CDFW data only)

Drifts meeting the following criteria were excluded from analyses:

- Drifts in San Francisco Bay (Golden Gate Bridge was used as the border)
- Drifts missing both starting and ending location (latitude/longitude) (CalPoly and CDFW data only)

- Drifts identified as having possible erroneous location or time data (CalPoly and CDFW data only)

Fishing time was limited to include 95% of the data to remove potential outliers for the CDFW and CalPoly data. Fishing time outliers were not removed from the historical data because fishing time was aggregated over multiple drifts at a specific location. Remaining drifts were between 5 and 69 minutes for the CDFW data and between 4 and 54 minutes for the CalPoly data. The number of observed anglers was limited to include 95% of the CDFW data, resulting in observed anglers between 4 and 19 persons.

Fishing locations in the historical database are assigned to fishing sites, defined by CDFW's historical onboard observer database (pers. comm., Deb Wilson-Vandenberg, CDFW). A site is established the first time it is visited and that site is recorded as a fishing location for all future trips fishing at the same location. For this analysis, fishing sites were bounded by creating Thiessan polygons over the observed range.

For each species, the following methods were applied to identify regions of suitable habitat (region), and to determine the number of drifts to include in the analysis. The drift-specific locations from the CDFW and CalPoly data were used to define the suitable habitat. The locations of positive encounters were mapped, using the drift starting locations. Regions were defined by creating detailed hulls (similar to an alpha hull) with a 0.01 decimal degree buffer around a location or cluster of locations (Data East 2003). Any portion of a region that intersected with land was removed. As an example of the buffers, a region with only one positive encounter has an ellipsoid area of 3.22km^2. Each drift (including both positive and zero-catch) was assigned to the region with which it intersected. Drifts that did not intersect with a region were considered structural zeroes, i.e., outside of the species habitat, and excluded from the analyses. The regions of suitable habitat were then assigned to the intersecting historical fishing sites (Thiessan polygons). If a fishing site included suitable habitat from more than one region, the regions were combined and the area within the fishing sites were summed. This aggregation allows area-weighted indices to be calculated at the level of fishing site or region. All historical data (positive and zero-catch site visits) occurring within a fishing site of suitable habitat were retained for analyses. Site visits from the historical data that occurred in a polygon identified as having no suitable habitat were excluded from the analyses.

Drifts from the same trip (for CalPoly and CDFW data) occurring within the same fishing site were collapsed to maintain consistency with the historical data. CPUE was calculated as $\sum catch \; / \; \sum effort$ for a site visit within a trip. For all species, catch included both observed retained and discarded fish. An average depth was calculated as the average of the average depth over all collapsed drifts.

For each species, data were filtered to exclude Thiessan polygons that did not consistently produce catch of the species of interest (i.e., having fewer than 5 years with positive observations).

<u>Brown rockfish</u>
Onboard CPFV Data: Prior to filtering, the combined set of historical and current CDFW onboard samples and the CalPoly samples (N = 5176 ; pos = 1525) contained 33 regions identified as suitable brown rockfish habitat. Only one positive observation occurred deeper than 40 fathoms, so only records with an average depth less than 40 fathoms were retained. Data for the year 2000 was excluded due to small sample size (22 observations total, 9 positive).

Testing for differences in CPUE trend among regions: Although 14 regions had at least 5 years of positive observations for brown rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 2 'super regions' (north and south of Monterey, CA). The interaction between YEAR and REGION was not retained by stepwise BIC in either the lognormal or binomial submodels.

Delta-GLM: The selected data (N = 2158 ; pos = 1159) contained categorical variables for YEAR (23 levels) and two possible additional effects, MONTH (12 levels), REGION (2 levels), and 10-fathom depth bins ("DEP10", 4 levels). The distribution for positives was lognormal (which was favored over gamma by a deltaAIC of 10.7). The final positive and binomial models for the index retained YEAR, DEP10, and REGION effects (Table 36; Figure 39).

China rockfish
Onboard CPFV Data: Prior to filtering, the combined set of historical and current CDFW onboard samples and the CalPoly samples (N = 6904 ; pos = 1585) contained 34 regions identified as suitable china rockfish habitat. China rockfish is a shallow, nearshore species, and only records with an average depth less than 50 fathoms were retained. Data for the year 2000 was excluded due to small sample size.

Testing for differences in CPUE trend among regions: Although 18 regions had at least 5 years of positive observations for brown rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 3 'super regions' (north of San Francisco, Half Moon Bay to Santa Cruz, and from Monterey to Morro Bay). The interaction between YEAR and REGION was retained by stepwise AIC in the lognormal, but not the binomial, submodel. To develop an index for Central California that integrated across area-specific trends in abundance, we developed an area-weighted index using coefficients from the Year/Region interaction terms multiplied by area estimates for each region. The trend in year effects from the area-weighted index was similar to the main effects model (selected as the best model by BIC; Figure 40). The interaction between YEAR and REGION was not retained by stepwise BIC in either the lognormal or binomial submodels.

Delta-GLM: The selected data (N = 3741 ; pos = 1162) contained categorical variables for YEAR (23 levels) and two possible additional effects, MONTH (12 levels), REGION (3 levels), and 10-fathom depth bins ("DEP10", 5 levels). The distribution for positives was lognormal (which was favored over gamma by a deltaAIC of 132). The final positive and binomial models for the index retained YEAR, DEP10, and REGION effects. The YEAR effects are shown in Table 37 and
Figure **41**.

Copper rockfish
Onboard CPFV Data: Prior to filtering, the combined set of historical and current CDFW onboard samples and the CalPoly samples (N = 7727 ; pos = 2615) contained 38 regions identified as suitable copper rockfish habitat. Records with an average depth deeper than 60 fathoms were discarded due to the small number of positives. Data for the year 2000 was excluded due to small sample size.

Testing for differences in CPUE trend among regions: Although 21 regions had at least 5 years of positive observations for copper rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 4 'super regions' (roughly Point Arguello to Point Lopez, the Monterey/Carmel area, Santa Cruz to Half Moon Bay, and the Farallon Islands to Point Reyes). The interaction between YEAR and REGION was not retained by stepwise BIC in either the lognormal or binomial submodels.

Delta-GLM: The selected data (N = 5024 ; pos = 2079) contained categorical variables for YEAR (23 levels) and two possible additional effects, MONTH (12 levels), REGION (4 levels), and 10-fathom depth bins ("DEP10", 6 levels). The distribution for positives was lognormal (which was favored over gamma by a deltaAIC of 217). The final positive and binomial models for the index retained YEAR, DEP10, and REGION effects. The YEAR effects are shown in Table 38 and Figure 42. Copper rockfish has a slightly deeper distribution compared to other "nearshore" rockfish (e.g. China), so the index was calculated from data excluding regulatory periods and locations with 20-fathom depth restrictions. The difference in year effects was minimal (
Figure **43**).

Southern California Observer Indexes (1999-2011) SoCalOBS

Data for the southern California indices are from the California Department of Fish and Wildlife (CDFW) Onboard Observer Program (1999-2011) (Reilly et al. 1998). Data were analyzed at the drift level and catch was taken to be the sum of observed retained and discarded fish.

Prior to any analyses, a preliminary data filter was applied. Trips and drifts meeting the following criteria were excluded from analyses:

- Trips outside U.S. waters
- Trips in which 70% or more of the observed catch composition was not bottomfish

Drifts meeting the following criteria were excluded from analyses:

- Drifts deeper than 60 fathoms (due to depth regulations)
- Drifts in conservation areas, i.e., Cowcod Conservation Areas and MPAs, established prior to 2012 and prohibit the take of rockfish
- Drifts in San Diego Harbor
- Drifts missing both starting and ending location (latitude/longitude)
- Drifts identified as having possible erroneous location or time data.

Fishing time and number of observed anglers were limited to include 95% of the data to remove potential outliers. Remaining drifts were between 5 and 119 minutes and observed anglers between 4 and 19 persons.

For each species, the following methods were applied to identify regions of suitable habitat, and to determine the number of drifts to include in the analysis. The locations of positive encounters were mapped, using the drift starting locations. Regions of suitable habitat were defined by creating detailed hulls (similar to an alpha hull) with a 0.01 decimal degree buffer around a location or cluster of locations (Data East 2003). Any portion of a region that intersected with land was removed. As an example of the buffers, a region with only one positive encounter has an ellipsoid area of 3.22km^2. Each drift (both positive and zero-catch) was assigned to the region with which it intersected. Drifts that did not intersect with a region were considered structural zeroes, i.e., outside of the species habitat, and not used in analyses. For each species, data were filtered to exclude regions that did not consistently produce catch of the species of interest (i.e., having fewer than 5 years with positive observations).

Brown rockfish

ODFW Onboard Data: The data pre-region filtered (N = 11906; pos = 1126) contained 65 regions identified as suitable brown rockfish habitat.

Preliminary data analysis: Brown rockfish were never observed deeper than 40 fathoms, and observations deeper than 40 fathoms were excluded from the analysis. Depth was collapsed to two 15-fathom depth bins to increase sample sizes within depth bins.

Testing for differences in CPUE trend among regions: Although 17 regions (75% of the total km^2 defined as suitable habitat) had at least 5 years of positive observations for brown rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 2 'super regions,' 1) north of San Pedro, and 2) south of San Pedro. Trends in average CPUE in each super region suggested a potential difference among regions that was supported by stepwise AIC model selection (for the binomial GLM only). The main-effects model has more pronounced peak relative abundance than the area-weighted model, but both exhibit the same increase in relative abundance (Figure 44). The areas are weighed fairly evenly (44% North of San Pedro and 56% South of San Pedro), but the temporal trends between the regions do differ (

Figure **45**). The main-effects model was retained for the index.

Delta-GLM: The selected data (N = 9036 ; pos = 999) contained categorical variables for YEAR (11 levels) and two possible additional effects, MONTH (12 levels), REGION (2 levels), and 15-fathom depth bins ("DEP15", 2 levels). The distribution for positives was lognormal (which was strongly favored over gamma by a deltaAIC of 158). The binary model used a logit transformation which was which was indistinguishable from the alternatives. In both submodels, stepwise BIC removed all interaction terms. The final positive without interactions retained YEAR, DEP10, and REGION, and MONTH, and the binomial portion retained YEAR, REGION, and MONTH (Table 39). The YEAR effects are shown in Figure 46.

Copper rockfish (south area)

ODFW Onboard Data: The data pre-region filtered (N = 12580; pos = 1471) contained 84 regions identified as suitable copper rockfish habitat.

Preliminary data analysis: Depth was collapsed to four 15-fathom depth bins to increase sample sizes within depth bins.

Testing for differences in CPUE trend among regions: Although 19 regions (68% of the total km^2 defined as suitable habitat) had at least 5 years of positive observations for copper rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 2 'super regions,' 1) Coastal, and 2) Channel Islands. Trends in average CPUE in each super region suggested a potential difference among regions that was supported by stepwise AIC model selection (for both the positive and binomial GLMs). The main-effects model has more pronounced peak relative abundance than the area-weighted model, but both exhibit the same increase in relative abundance (Figure 47). The coastal areas accounted for 65% of the total copper rockfish "suitable habitat," with the other 35% from the Channel Islands (Figure 47). The main-effects model was retained for the index.

Delta-GLM: The selected data (N = 9378; pos = 1271) contained categorical variables for YEAR (11 levels) and two possible additional effects, MONTH (12 levels), REGION (2 levels), and 15-

fathom depth bins ("DEP15", 4 levels). The distribution for positives was lognormal (which was strongly favored over gamma by a deltaAIC of 161.4). The binary model used a logit transformation which was which was indistinguishable from the alternatives. In both submodels, stepwise BIC removed all interaction terms. The positive and binomial models without interactions retained YEAR, REGION, MONTH, and DEP15 (Table 40). The YEAR effects are shown in Figure 48.

Northern CA and OR Indexes (2001-2012) NoCalOROBS
Data were combined from the Oregon Department of Fish and Wildlife (ODFW) Observer Program (2001, 2003-2012) (Monk et al. in prep) and the California Department of Fish and Wildlife (CDFW) Observer Program (1999-2011) (Reilly et al. 1998). Data were analyzed at the drift level and catch was taken to be the sum of observed retained and discarded fish.

Prior to any analyses, a preliminary data filter was applied. Trips and drifts meeting the following criteria were excluded from analyses:

Northern California trips in which 70% or more of the observed catch composition was not bottomfish

- ODFW halibut-targeted trips were excluded.

Drifts meeting the following criteria were excluded from analyses:

- Drifts deeper than 40 fathoms (due to depth regulations)
- Drifts within the current Stonewall Bank Yelloweye Rockfish Conservation
- Drifts within Arcata Bay, Humboldt Bay, or South Bay near Eureka, CA
- Drifts missing both starting and ending location (latitude/longitude)
- Drifts identified as having possible erroneous location or time data

Fishing time was limited to include 95% of the data to remove potential outliers. In Oregon, drifts with fishing times between 3 and 34 minutes were retained. In northern California, drifts with fishing times between 2 and 46 minutes were retained. The number of observed anglers from the northern California was also limited to include 95% of the data, resulting in observed anglers between 4 and 19 persons.

For each species, the following methods were applied to identify regions of suitable habitat, and to determine the number of drifts to include in the analysis. The locations of positive encounters were mapped, using the drift starting locations. Regions of suitable habitat were defined by creating detailed hulls (similar to an alpha hull) with a 0.01 decimal degree buffer around a location or cluster of locations (Data East 2003). Any portion of a region that intersected with land was removed. As an example of the buffers, a region with only one positive encounter has an ellipsoid area of 3.22km^2. Each drift (both positive and zero-catch) was assigned to the region with which it intersected. Drifts that did not intersect with a region were considered structural zeroes, i.e., outside of the species habitat, and not used in analyses. For each species, data were filtered to exclude regions that did not consistently produce catch of the species of interest (i.e., having fewer than 5 years with positive observations).

For each species, data were filtered to exclude regions that did not consistently produce catch of the species of interest (i.e., having fewer than 5 years with positive observations). This filter excluded all drifts from northern California (north of 40°10' N lat.) for all species. The indices for the northern region represent only data from the ODFW Observer Program. The data from northern California were too sparse to include in the analyses.

China rockfish (north region)
ODFW Onboard Data: The data pre-region filtered (N = 8105; pos = 241) contained 22 regions identified as suitable China rockfish habitat.

Preliminary data analysis: China rockfish were never observed deeper than 30 fathoms, observations deeper than 30 fathoms were excluded from the analysis. Data by month was too sparse for the analysis, and month was collapsed to "WAVE", e.g., March-April = 2.

Testing for differences in CPUE trend among regions: Although 8 regions (71% of the total km^2 defined as suitable habitat) had at least 5 years of positive observations for China rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 2 'super regions,' 1) Northern Oregon (Tillamook and Lincoln Counties), and 2) Southern Oregon (Coos and Curry Counties). Trends in average CPUE in each super region suggested a potential difference among regions that was supported by stepwise AIC model selection (for both the positive and binomial GLMs; Figure 49). However, development of the area-weighted index resulted in little change over the main-effects model, and the main effects model was retained for the index.

Delta-GLM: The selected data(N = 7043; pos = 198) contained categorical variables for YEAR (11 levels) and two possible additional effects, WAVE (4 levels), REGION (2 levels), and 10-fathom depth bins ("DEP10", 3 levels). The distribution for positives was lognormal (which was favored over gamma by a deltaAIC of 18.38). The binary model used a logit transformation which was which was indistinguishable from the alternatives. In both submodels, stepwise BIC removed all interaction terms. The final positive model without interactions retained YEAR, WAVE, and REGION, and the binomial portion retained only YEAR (Table 41). The YEAR effects are shown in Figure 50.

Copper rockfish (north region)
ODFW Onboard Data: The data pre-region filtered (N = 7550; pos = 185) contained 21 regions identified as suitable copper rockfish habitat.

Preliminary data analysis: Copper rockfish were never observed deeper than 30 fathoms, observations deeper than 30 fathoms were excluded from the analysis. Depth was collapsed into two 15-fathom depth bins ("DEP15"). Data by month was too sparse for the analysis, and month was collapsed to "WAVE", e.g., March-April = 2.

Testing for differences in CPUE trend among regions: Although 5 regions (61% of the total km^2 defined as suitable habitat) had at least 5 years of positive observations for China rockfish, sampling coverage was insufficient to test for difference in CPUE trends among regions (i.e., an interaction between YEAR and REGION variables). To examine spatial differences in CPUE trends, regions were aggregated into 2 'super regions,' 1) Northern Oregon (Lincoln County), and 2) Southern Oregon (Coos County). Trends in average CPUE in each super region suggested a potential difference among regions that was supported by stepwise AIC model selection (for the positive GLM only). The development of the area-weighted index differentiates from the main-effects model in 2001 and 2007 (Figure 51). The area-weighted model can be run as a sensitivity analysis, and the main-effects model is used in the base case model for copper rockfish.

Delta-GLM: The selected data (N = 5786; pos = 145) contained categorical variables for YEAR (11 levels) and two possible additional effects, WAVE (4 levels), REGION (2 levels), and 15-

fathom depth bins ("DEP15", 2 levels). The distribution for positives was lognormal (which was favored over gamma by a deltaAIC of 5.78). The binary model used a logit transformation which was which was indistinguishable from the alternatives. In both submodels, stepwise BIC removed all interaction terms. The positive model retained YEAR and REGION, and the binomial portion retained only YEAR, DEP10, and REGION (Table 42). The YEAR effects are shown in Figure 52.

2.2 History of Modeling Approaches Used for this Stock

2.2.1 Previous assessments

Yellowtail north and English sole had previous full (category 1) stock assessments performed, which included indices of abundance, length/age compositions and recruitment estimation. Yellowtail rockfish and English sole have a long history of management being informed by fisheries models, dating back to the early 1980s. The last assessment for yellowtail was performed in 2004 using an age-structured model written in AD Model Builder, but not Stock Synthesis. The most recent English sole assessment was conducted in 2007 using Stock Synthesis 2. The remaining species have no prior category 1 assessments.

Dick and MacCall (2010) estimated overfishing levels (OFLs) for brown, china, copper, yellowtail (south of 40° 10′ N. latitude), sharpchin, and stripetail rockfishes as well as for rex sole using Depletion-Based Stock Reduction Analysis. These OFLs were adopted for the PFMC's 2011-12 and 2013-14 management cycles, as components of the stock complex OFLs associated with each species.

2.3 Model Description

Two assessments models (Extended Depletion-Based Stock Reduction Analysis and extended Simple Stock Synthesis) are applied to the removal and index data available for each stock. Both methods were approved in 2012 by a methodology review panel[1] as appropriate for estimating status and OFLs. Initial model exploration included running both modeling approaches for each stock, but resource limitations during the STAR panel necessitated the following division of labor between the two approaches: Assessments of nearshore rockfishes (3 species) relying on fishery-dependent recreational-based indices were done using XDB-SRA; shelf-slope species (4 species) using fishery-independent trawl surveys were done using exSSS.

2.3.1 Bayesian Stock Reduction Analysis (Extended Depletion-Based Stock Reduction Analysis, XDB-SRA)

Depletion-Based Stock Reduction Analysis (DB-SRA; Dick and MacCall, 2010) is a non-age-structured catch-based yield estimator currently used by the PFMC to estimate sustainable yields for "data-poor" stocks. The method generates prior predictive distributions of OFL and other quantities of interest to management (e.g., MSY and unfished biomass) based on a population dynamics model, annual catches, age at maturity, and prior distributions for stock status, natural mortality, and the ratios F_{MSY} / M and B_{MSY} / B_0. For the assessments of "data-moderate" stocks, we developed a simple Bayesian extension of DB-SRA, in which the prior distributions are updated by specification of likelihood functions for the abundance indices, generating posterior distributions for quantities such as stock status, biomass, and sustainable yield (OFL).

[1] Assessment Methods for Data-Moderate Stocks: Report of the Methodology Review Panel Meeting http://www.pcouncil.org/wp-content/uploads/H3a_ATT1_DATA_MOD_RPT_SEP2012BB.pdf

2.3.1.1 Population Dynamics Model

We revise the dynamics equation used by Dick and MacCall (2011) to better approximate a time lag in recruitment, rather than a lag in net production. Biomass in each year is defined as

$$B_t = B_{t-1} + P(B_{t-a}) - C_{t-1} + (1 - e^{-M})(B_{t-a} - B_{t-1}) \quad (1)$$

where B_t represents mature and vulnerable biomass at time *t* and C_t represents catch at time *t*. All sources of catch within an assessment were combined into one fleet, with assumed 'knife-edge' selectivity set equal to age at maturity. P is a latent production function based on biomass a years earlier, where a is the age that a fish matures and becomes vulnerable to the fishery. Following Dick and MacCall (2011), we use a hybrid production function based on the Pella-Tomlinson-Fletcher (PTF) and Graham-Schaefer models. The last term in equation (1) adjusts the natural mortality component of net production to reflect biomass at time B_{t-1} rather than B_{t-a} (Aalto et al., in prep.). If, for example, B_{t-a} is larger than B_{t-1}, a model without this correction factor would underestimate production, and vice versa. Note that the correction term disappears when lag times for recruitment and survival are the same.

2.3.1.2 Likelihood components

For each abundance index, *I*, we assume a normal likelihood function for log-scale biomass and index values, scaled by a catchability coefficient, q.

$$l(B, q, a; I) = \prod_{i=1}^{n} N(log(I_i/q); log(B_i), v_i + a). \quad (2)$$

The variance of the normal likelihood is composed of an annual variance component, v_i (estimated external to the model and assumed known for the i^{th} year), and an additive variance term, *a*, that is common to all years and estimated in the model.

2.3.1.3 Prior Distributions

Relative Depletion (Δ): Since Δ (= $1-B_t/B_0$) is constrained to be between 0 and 1, we use a truncated beta distribution as a prior. The distribution was truncated below 0.01 and above 0.99 to exclude improbable values of stock status.

The 2012 STAR Panel recommended using PSA vulnerability scores (Cope et al. 2011) to establish depletion priors for data-moderate assessments. Unfortunately, no quantitative information was captured in the Panel Report, so the analysis had to be reconstructed. The PSA scores reflecting pre-2000 fishery management were provided by John DeVore (pers comm) and corresponding depletion was the relative abundance in 2000. Pacific hake was deleted from the data set, giving N=31 cases (Figure 53).

The STAR Panel recommended using three bins, but their specifications were not recorded. The vertical lines in Figure 53 show bin boundaries at vulnerability scores of 1.87 and 2.33. Depletion priors were calculated for the left "Low V" bin, the central "Middle V" bin, and an "Uninformative" case reflecting the entire data set. Means and standard deviations were used to specify the priors as beta distributions (Figure 54). Except for English sole and yellowtail rockfish, we do not have pre-2000 PSA vulnerability scores for the data-moderate species under present consideration, and use scores reported by Cope et al. (2011). Brown rockfish (1.99), China Rockfish (2.23), and copper rockfish (2.27) fell in the "Middle V" bin.

Natural mortality rate (M): For species that have not been previously assessed, we assumed a lognormal distribution with arithmetic mean derived from Hoenig's equation for total mortality, *Z*.

$$log(Z) = 1.710 - 1.084 \times log(A_{max}). \qquad (3)$$

The arithmetic mean for M was bias-corrected using a log-scale standard deviation 0.4. Uncertainty for this parameter was informed by Hoenig's regression data.

B_{MSY}/B_0: We assume a truncated beta distribution for this parameter with bounds 0.05 and 0.95, chosen to exclude unrealistic parameter values. The mean of the prior distribution was 0.4 for rockfish, with a standard deviation of 0.15. This prior is centered on the PFMC proxy for rockfish, and acknowledges considerable uncertainty in this quantity.

F_{MSY}/M: We assume a lognormal distribution, with arithmetic mean 0.97 and log-scale standard deviation 0.46. These parameter values are based on the work of Zhou et al. (2012) who conducted a meta-analysis of the ratio Fmsy/M for 245 stocks. Specifically, we used the prior for teleosts (n=88 species) and approximated the log-scale standard deviation of the prior by multiplying the reported standard error by the square root of the sample size.

Additive variance (a): A uniform distribution was chosen as a prior for this parameter. The range for each index was chosen through visual inspection of preliminary importance sampling results and confirmation that posterior draws were not truncated.

Catchability (q): Catchability coefficients were not estimated. The likelihood was derived by integrating over *log*(*q*) with a diffuse, improper prior (uniform from $-\infty$ to $+\infty$).

2.3.1.4 Monte Carlo Simulation of Posterior Distributions

Starting from DB-SRA results (i.e., prior predictive distributions), Sampling Importance Resampling (SIR; Rubin, 1988) is easily implemented by calculating the likelihood associated with each parameter vector, followed by resampling from the prior distributions using the likelihoods as weights.

When SIR was found to be computationally inefficient, we generated results based on an Adaptive Importance Sampling (AIS) algorithm (see Kinas (1996) for details). We use the routine described by West (1993) for reducing the mixture, although in place of simple Euclidean distance we use standardized Euclidean distance to determine the nearest neighboring points (the standardized distances are not sensitive to differences in magnitude among parameters). During each iteration, we draw approximately 2000 points from the current envelope and then reduce the mixture to 500 components. A multivariate normal kernel is employed, and we follow the guidelines discussed by West (1993) for choosing the smoothing parameter.

2.3.1.5 Convergence Criteria

For SIR runs, we examined the maximum value of the importance sampling weights to determine if a large number of posterior draws were based on a single run. Runs with maximum weights less than 0.01 showed little change in posterior distributions under further sampling. For AIS runs, a measure of entropy relative to uniformity of the weights (West, 1993) was also monitored. The adaptive algorithm was stopped if the entropy criterion reached a threshold value of 0.92.

2.3.2 Extended Simple Stock Synthesis (exSSS)

2.3.2.1 Model

Stock Synthesis (SS; Methot and Wetzel 2013) is a flexible age-structured likelihood-based modeling environment used for most west coast groundfish stock assessments. Cope (2013) demonstrated that its flexibility includes application of category 3 (catch-only) models, an approach termed Simple Stock Synthesis (SSS). Extended SSS is intended to be a bridge between SSS and SS by adding indices of abundance to SSS, thus allowing categories 1-3 assessments to be developed and conducted on a common modeling platform. Cope[2] demonstrated the ability of exSSS to adequately replicate full assessments, and the approach was reviewed by a STAR panel and SCC, both of which recommended its application to data-moderate stocks.

The population model underlying exSSS is sex- and age-structured with a Beverton-Holt stock-recruitment relationship, though recruitment is assumed deterministic. There are four estimated parameters: Male and female natural mortality (*M*), steepness (*h*), and the log-value of initial recruitment (lnR_0). The *M* prior is assumed lognormal distributed with mean values provided in Table 1 and a standard deviation of 0.4 (same assumptions used in DB-SRA and SSS). Steepness for rockfishes assumes a beta distribution, with parameters based on an update of the Dorn rockfish prior (commonly used in past west coast rockfish assessments) conducted by J. Thorson (pers. comm.) which was reviewed and accepted by the SSC ($\mu = 0.779$; $\sigma = 0.152$). The prior used for the flatfishes was the Myers et al. (1999) normally distributed steepness meta-analysis for flatfishes ($\mu = 0.8$; $\sigma = 0.093$), also commonly applied to west coast rockfishes. Sensitivity to choice of *M* and rockfish *h* was explored using the Hamel prior for *M* (Table 43; Hamel, pers. comm.) and the old Dorn rockfish *h* prior, respectively. In addition, a likelihood profile on *h* is provided to explore the sensitivity of *M* and derived quantities to the assumed fixed value of *h*. Additional fixed model parameterizations include sex-specific growth, length weight relationships, and maturity-at length (Table 1). Selectivities of fishery and abundance indices are assumed equal to maturity in all cases. Additional variance estimation on abundance indices was also considered. Major likelihood components therefore include fits to the abundance indices and any penalties on priors. Sensitivities of derived quantities to the inclusion of indices of abundance were also explored.

2.3.2.2 Model uncertainty in exSSS

Uncertainty is estimated and compared in three ways: 1) asymptotic variance, 2) Markov Chain Monte Carlo (MCMC), and 3) Adaptive Importance Sampling (AIS). The asymptotic variance is calculated when using SS models and thus simple to obtain, but may underestimate uncertainty (Stewart et al. 2013), thus the need for other methods. For MCMC, a 2,200,000 chain is run (-MCMC 2200000) for each species, with the first 200,000 iterations (-mcscale 200000) undergoing a rescaling of the covariance matrix until a desirable acceptance rate is achieved, and every 2,000th iteration being retained (-mcsave 2000). The first 99 iterations are then removed to leave 1000 draws for the posterior. In past applications of exSSS, converged MCMC models were not always available, thus AIS was also considered as an alternative way to characterized uncertainty. The application to exSSS is described below.

2.3.2.3 Adaptive Importance Sampling (AIS*)*

Sampling importance resampling (SIR) (Ruben 1987, 1988), which samples parameter vectors from a prior distribution taken from a sampling envelope has been applied in fishery stock assessment for parameter estimation (e.g., Punt 1993; McAllister et al. 1994, Kinas 1996). However, an AIS approach that updates the sampling envelope based upon iterative SIR draws

[2] Cope, J.M. 2012. Extending catch-only Stock Synthesis models to include indices of abundance. Report provided for the Assessment Methods for Data-Moderate Stocks Review Panel. 26-29 June 2012, Seattle, WA.

can be beneficial when the best sampling envelope is unknown or not well understood a priori due to correlation among parameters.

To create initial population trajectories, 2000 (N_{init}) Monte Carlo draws from each of the three prior distributions initial parameter draws are fixed in the model where exSSS estimates a *ln(R₀)* value which results in population that meets the fixed final depletion value, based on the other fixed model parameters. The survey likelihood value from each trajectory given the data is recorded as a measure of the fit of the expected model values to the observed data calculated as:

$$L_i\left(\theta_i \mid data\right) = \sum_{t=1}^{N_t} \frac{\left(\ln\left(I_t\right) - \ln\left(\hat{q}_i B_{t,i}\right)\right)^2}{2\sigma^2} \tag{0.0}$$

where $\hat{I}_t$ is the observed abundance value in year t, $B_{t,i}$ is the estimated biomass in year t for the i[th] trajectory, and $\hat{q}_i$ is the catchability coefficient for the ith trajectory, and σ is the variance.

The likelihood of the i[th] trajectory given the data is combined with the prior and posterior probability of the parameter values to calculate the sampling envelope weights:

$$w_i = \frac{L_i\left(\theta_i \mid data\right) P_i}{Pr_i} \tag{0.0}$$

where P_i is the prior probability for the drawn parameter set and Pr_i posterior probability of the drawn parameter set. In the first iteration of the AIS the prior and posterior distribution are equal and hence cancel each from the numerator and the denominator of equation 1.2. A sample with replacement of size 0.25 N_{init} with probability equal to the weights composes the SIR draw which results in a new proposed posterior distribution. The mean and covariance values of the SIR drawn parameters are calculated and a student's multivariate t-distribution is applied to regenerate parameter vectors of sample size equal to N_{init}. The new parameter distributions are then applied to exSSS to create new population trajectories which complete the steps.

This iterative process continues until a pre-specified entropy criterion is met. Entropy is a measure of uniformity about the sample weights with values ranging between 0 and 1. As the importance sample function closes in the target distribution the value of entropy will approach 1, which indicates a perfectly uniform distribution with each weight being equal to 1/N. Entropy was calculated as:

$$e = -\sum_{i=1}^{n} w_i \frac{\log\left(w_i\right)}{\log\left(N\right)} \tag{0.0}$$

The AIS continued until an entropy criterion of 0.92 was reached (point of convergence). Model testing demonstrated that entropy = 0.92 was a point where there was limited change in the posterior distributions. Once model convergence was reached a final large SIR of 6,000 samples were drawn from the distribution of parameters that met the entropy criterion. The final large SIR sample of parameter vectors, the final posterior distributions, is then applied by exSSS to create a distribution of final trajectories with estimated biomasses and OFLs.

2.4 Response to STAR Panel Recommendations

There are no formal STAR panel recommendations to address for the new applications of category 2 assessments to these stocks.

2.5 Base-Models, Uncertainty and Sensitivity Analyses

2.5.1 XDB-SRA assessments (Fishery-dependent indices only)

2.5.1.1 Brown rockfish

Scope of the assessment: the post-STAR panel XDB-SRA base model for brown rockfish incorporates coast-wide estimates of total removals (landings + discard). Landings north of Cape Mendocino are a small fraction (approximately 1%) of the cumulative coastwide historical landings (brown rockfish is uncommon in the northern region) and we have no trend indices for Oregon or Washington. We assume that trends north of Cape Mendocino do not differ from the southern portion of the population and we include landings from north of Mendocino to provide a basis for a coast-wide OFL.

Stock status and biomass trends: For comparative purposes, we report nominal female spawning biomass (hereafter 'spawning biomass') as half total adult biomass. The model for brown rockfish suggests the stock is near target biomass (Table 44; Figure 55). The posterior distribution for spawning biomass in 2013, as a percentage of unfished biomass (aka "depletion"), has a mode at 40%, with 2.5 and 97.5 percentiles of 22% and 78% of unfished biomass (Table 44). Median spawning biomass in 2013 is 724 mt, and median unfished spawning biomass was 1788 mt. Median spawning biomass declined rapidly during the 1970s and 1980s, but has shown an increasing trend since the mid-1990s (Table 45; Figure 55).

Yield estimates: The XDB-SRA base model estimates that median MSY for brown rockfish is 156 mt per year, and the fishing mortality rate in 2012 was 58% of F_{MSY}. The posterior medians for OFL in 2015 and 2016 were 172 and 176 mt, respectively (Table 44). These OFL estimates assume removals of 101.5 mt per year from 2013-2015 (Table 46).

Model Convergence: The SIR algorithm initially drew 500000 parameter vectors from the joint prior distribution, then resampled 15000 draws from the prior using likelihood weights to obtain the joint posterior distribution. Convergence of the SIR algorithm was evaluated by calculating the maximum resampling weight (0.001), which was well below the assumed convergence threshold (0.01).

Fit to indices of abundance: The indices used in the XDB-SRA model are 1) the onboard CPFV observer index for Central California (1988-2011), 2) a Southern California onboard CPFV observer index (1999-2011), 3) a RecFIN dockside CPFV observer index for Central California (1980-2003), and 4) a RecFIN dockside CPFV observer index for Southern California (1980-2003). Comparison of relative abundance time series, rescaled by the model-estimated catchability coefficients (i.e. in biomass units), suggests reasonable links between indices within the model (Figure 56). The model is better able to capture trends in the Central California time series, underestimating increases in abundance during the early 2000s apparent in the Southern California indices (Figure 57). For this reason, sensitivity analyses based on regional models were considered, but ultimately rejected in favor of a coastwide model. See "Sensitivity Analyses" (below).

Parameter estimates: All catchability coefficients were integrated over a diffuse prior to reduce model dimension (Table 46). Additive variance parameters were estimated for all four indices, the largest of which had a median of 0.8 (the southern California onboard CPFV observer index).

The large amount of variance reflects the poor fit to this index, relative to the other indices. The posterior distributions for F_{MSY}/M shifted toward slightly larger values, and B_{MSY}/B_0 shifted only slightly but showed little support for values in the tails of the prior. Relative to the prior, the posterior distribution for delta in the year 2000 was much more precise, with a median of 0.70 ("depletion" = 0.30).

Comparison to Catch-Based Model (DB-SRA): Outputs from the DB-SRA model for brown rockfish are essentially prior predictive distributions from the XDB-SRA base model. Assuming constant catches of 101.5 mt per year, the median OFL estimates for 2015-16 from DB-SRA are 185 mt and 189 mt, respectively, compared to 172 mt and 176 mt from XDB-SRA (Table 44).

Sensitivity Analyses: Regional models for brown rockfish (north and south of Point Conception) were evaluated by the STAR Panel in response to the poor fit to abundance indices for southern California. The posterior distribution for Fmsy/M in the southern model favored unrealistically large values for a rockfish. However, this result is not unexpected when fitting a model with deterministic recruitment to a rapidly increasing abundance trend (possibly driven by recent strong recruitments). Given the unlikely differences in estimated productivity for this species between the two regions, the Panel recommended that the OFL be based on the coast-wide model, and partitioned between the regions based on regional biomass estimates. The panel requested that RecFIN dockside indices be developed for each region separately. Other sensitivity analyses considered by the panel included the effect of diffuse and informative priors on Fmsy/M and Bmsy/B0, and model results based on fits to individual indices (Table 47).

2.5.1.2 China rockfish

The STAR panel favored regional models for China rockfish over a coast-wide model. This decision was based on improved fits to the indices, evidence of regional differences in biomass and exploitation trends, and plausible productivity parameters in both regional models.

China rockfish, north of 40° 10′ N. latitude
Scope of the assessment: The post-STAR panel XDB-SRA base model for China rockfish (north of 40° 10′ N. latitude) incorporates total removals (landings + discard) between approximately Cape Mendocino, CA and the U.S.-Canada border. Although often considered to have a northern distribution along the U.S. west coast, cumulative historical removals of China rockfish north of Cape Mendocino are less than one-third of the removals from central California (Figure 14). No trend information is currently available for waters off Washington. The model assumes trends in abundance off northern California and Oregon are representative of Washington.

Stock status and biomass trends: The model for northern China rockfish suggests the stock is below target biomass but above the MSST (Table 44; Figure 58). The posterior distribution for spawning biomass in 2013, as a percentage of unfished biomass (aka "depletion"), has a mode at 33%, with 2.5 and 97.5 percentiles of 14% and 75% of unfished biomass (Table 44). Median spawning biomass in 2013 is 88 mt, and median unfished spawning biomass was 246 mt. Median spawning biomass has declined consistently since the 1980s (Table 48; Figure 58).

Yield estimates: The XDB-SRA base model estimates that median MSY for northern China rockfish is 10 mt per year, and the fishing mortality rate in 2012 was 190% of F_{MSY}. The posterior medians for OFL in 2015 and 2016 were both 8 mt, respectively (Table 44). These OFL estimates assume removals of 15.2 mt per year from 2013-2015 (Table 49).

Model Convergence: The SIR algorithm initially drew 300000 parameter vectors from the joint prior distribution, then resampled 15000 draws from the prior using likelihood weights to obtain the joint posterior distribution. Convergence of the SIR algorithm was evaluated by calculating the maximum resampling weight (0.0005), which was well below the assumed convergence threshold (0.01).

Fit to indices of abundance: The indices used in the XDB-SRA model are 1) RecFIN dockside CPFV observer index for Northern California and Oregon (1980-2003) and 2) an Oregon onboard CPFV observer index (2001-2012) (Figure 59). Comparison of relative abundance time series, rescaled by the model-estimated catchability coefficients (i.e. in biomass units), suggests reasonable links between indices within the model (Figure 60).

Parameter estimates: All catchability coefficients were integrated over a diffuse prior to reduce model dimension (Table 49). Additive variance parameters were estimated for both indices, although neither was large relative to the input variances (Figure 59). The posterior distributions showed little updating relative to the priors, with the exception of delta (in the year 2000). The post-model, pre-data distribution contained very little support for low biomass estimates (<30% of unfished) in 2000. The posterior distribution for delta in 2000 was similar, but slightly more precise, with a median of 0.46 ("depletion" = 0.64).

Comparison to Catch-Based Model (DB-SRA): Outputs from the DB-SRA model are essentially prior predictive distributions from the XDB-SRA base model. Assuming constant catches of 15.2 mt per year, the median OFL estimates for 2015-16 from DB-SRA are 7 mt and 7 mt, respectively, compared to 8 mt and 8 mt from XDB-SRA (Table 44).

Sensitivity Analyses: Preliminary analyses considered by the panel examined the effect of diffuse and informative priors on Fmsy/M and Bmsy/B0, and changes in outputs based on fits to individual indices (Table 50). The effect of informed vs. diffuse productivity priors was minimal, with a 1% in depletion and 1 mt change in OFL (about 15%, given the small yields). The separate fits to the two indices produced a slightly larger difference in 2013 depletion (neither below the MSST), but both data sets estimated F_{2012}/F_{MSY} well over 1, suggesting that although the stock is not overfished, it is likely that overfishing is occurring.

China rockfish, south of 40° 10′ N. latitude

Scope of the assessment: The post-STAR panel XDB-SRA base model for China rockfish (south of 40° 10′ N. latitude) incorporates total removals (landings + discard) between approximately Cape Mendocino, CA and the U.S.-Mexico border, although few China rockfish have been landed south of Point Conception in recent decades (Figure 14). The assumption of an isolated stock remains untested (see Research Needs section).

Stock status and biomass trends: The model for central/southern China rockfish suggests the stock is above target biomass with high probability (Table 44; Figure 61). The posterior distribution for spawning biomass in 2013, as a percentage of unfished biomass (aka "depletion"), has a mode at 72%, with 2.5 and 97.5 percentiles of 41% and 95% of unfished biomass (Table 44). Median spawning biomass in 2013 is 293 mt, and median unfished spawning biomass was 444 mt. Median spawning biomass has increased steadily since the late 1990s (Table 51; Figure 61).

Yield estimates: The XDB-SRA base model estimates that median MSY for central/southern China rockfish is 33 mt per year, and the fishing mortality rate in 2012 was 28% of F_{MSY}. The posterior medians for OFL in 2015 and 2016 were 50 and 51 mt, respectively (Table 44). These OFL estimates assume removals of 40 mt per year from 2013-2015 (Table 52).

Model Convergence: The AIS algorithm was set to an initial sample size of 7500, a working sample of 3000 (with mixture reduction to 500 points at each step), and a final AIS sample of 15000. The model converged to an acceptable entropy score (0.96) and maximum importance weight (0.004).

Fit to indices of abundance: The indices used in the XDB-SRA model for central/southern China rockfish are 1) RecFIN dockside CPFV observer index for central and southern California (1980-2003) and 2) a central California onboard CPFV observer index (1988-2011). Comparison of relative abundance time series, rescaled by the model-estimated catchability coefficients (i.e. in biomass units), suggests reasonable links between indices within the model (Figure 62).

Parameter estimates: All catchability coefficients were integrated over a diffuse prior to reduce model dimension (Table 52). Additive variance parameters were estimated for both indices, although neither was large relative to the input variances (Figure 62). The posterior distributions for FMSY/M and BMSY/B0 were both shifted to the right of their respective prior densities. Delta (in the year 2000) was slightly updated by the post-model, pre-data distribution, but the continued shift in the posterior distribution suggests the data support a less-depleted stock, with a median of 0.50 (Figure 63).

Comparison to Catch-Based Model (DB-SRA): Outputs from the DB-SRA model are essentially prior predictive distributions from the XDB-SRA base model. Assuming constant catches of 16.1mt per year, the median OFL estimates for 2015-16 from DB-SRA are both 20 mt, compared to 50 mt and 51 mt from XDB-SRA (Table 44). The difference between the two models is the higher productivity of XDB-SRA's updated posterior parameter distributions, relative to the prior predictive distributions.

Sensitivity Analyses: Diffuse priors on Fmsy/M and Bmsy/B0 resulted in a smaller, more productive stock relative to the original DB-SRA priors. Separate fits to the two indices produced a 14% difference in median 2013 depletion, but both data sets estimated F_{2012}/F_{MSY} well below 1 and 2013 biomass above target (Table 53).

2.5.1.3 Copper rockfish

Copper rockfish, north of 34°27′N. latitude

Scope of the assessment: the post-STAR panel XDB-SRA base model for central/northern copper rockfish incorporates total removals (landings + discard) between Point Conception and the U.S.-Canada border. No trend information is currently available for waters off Washington. The model assumes trends in abundance off central/northern California and Oregon are representative of Washington.

Stock status and biomass trends: The model for central/northern copper rockfish suggests the stock is near target biomass (Table 44; Figure 64). The posterior distribution for spawning biomass in 2013, as a percentage of unfished biomass (aka "depletion"), has a mode at 42%, with 2.5 and 97.5 percentiles of 25% and 86% of unfished biomass (Table 44). Median spawning biomass in 2013 is 788 mt, and median unfished spawning biomass was 1697 mt. According to the model, median spawning biomass has been increasing steadily since the late-1990s (Table 54, Figure 64).

Yield estimates: The XDB-SRA base model estimates that median MSY for central/northern copper rockfish is 117 mt per year, and the fishing mortality rate in 2012 was 33% of F_{MSY}. The posterior medians for OFL in 2015 and 2016 were 149 and 154 mt, respectively (Table 44). These OFL estimates assume removals of 38.2 mt per year from 2013-2015 (Table 55).

Model Convergence: The SIR algorithm initially drew 300000 parameter vectors from the joint prior distribution, then resampled 15000 draws from the prior using likelihood weights to obtain the joint posterior distribution. Convergence of the SIR algorithm was evaluated by calculating the maximum resampling weight (0.001), which was well below the assumed convergence threshold (0.01).

Fit to indices of abundance: The indices used in the XDB-SRA model are 1) the onboard CPFV observer index for Central California (1988-2011), 2) a RecFIN dockside CPFV observer index for Central California and Oregon (1980-2003), and 3) an onboard CPFV observer index for Oregon (2001-2012). Comparison of relative abundance time series, rescaled by the model-estimated catchability coefficients (i.e. in biomass units), suggests reasonable links between indices within the model (Figure 65). The model is better able to capture trends in the two onboard observer time series, with the dockside RecFIN index showing a decline after 2000 that is not captured by the model (Figure 66, index 2). This lack of fit is reflected in the slightly higher additive variance estimate for the dockside index.

Parameter estimates: All catchability coefficients were integrated over a diffuse prior to reduce model dimension (Table 55). The posterior distribution for F_{MSY}/M shifted toward slightly larger values, but the distributions for M and B_{MSY}/B_0 shifted only slightly (Figure 66). Relative to the prior, the posterior distribution for delta in the year 2000 was much more precise, with a median of 0.72 ("depletion" = 0.28). The posterior updating of delta is data-driven, as there is little change between the prior and the post-model, pre-data distribution.

Comparison to Catch-Based Model (DB-SRA): Assuming constant catches of 38.2 mt per year, the median OFL estimates for 2015-16 from DB-SRA are 118 mt and 121 mt, respectively, compared to 149 mt and 154 mt from XDB-SRA (Table 44).

Sensitivity Analyses: Regional models for central/northern copper rockfish were developed during the STAR Panel in response to the poor fit to abundance indices for southern California. Sensitivity analyses based on the original coastwide model that were presented to the Panel are provided here for completeness (Table 56).

Copper rockfish, south of 34° 27′ N. latitude

Scope of the assessment: The post-STAR panel XDB-SRA base model for southern copper rockfish (south of 34° 27′ N. latitude) incorporates total removals (landings + discard) between approximately the U.S.-Mexico border and Point Conception.

Stock status and biomass trends: The model for southern copper rockfish suggests the stock is above target biomass with high probability (Table 44; Figure 67). The posterior distribution for spawning biomass in 2013, as a percentage of unfished biomass (aka "depletion"), has a mode at 84%, with 2.5 and 97.5 percentiles of 49% and 99% of unfished biomass (Table 44). Median spawning biomass in 2013 is 858 mt, and median unfished spawning biomass was 1097 mt. According to the model, median spawning biomass has increased steadily since the late 1980s (Table 57, Figure 67).

Yield estimates: The XDB-SRA base model estimates that median MSY for southern copper rockfish is 92 mt per year, and the fishing mortality rate in 2012 was 33% of F_{MSY}. The posterior medians for OFL in 2015 and 2016 were both 154 mt (Table 44). These OFL estimates assume removals of 40 mt per year from 2013-2015 (Table 58).

Model Convergence: The AIS algorithm was set to an initial sample size of 7500, a working sample of 3000 (with mixture reduction to 500 points at each step), and a final AIS sample of 15000. The model converged to an acceptable entropy score (0.95) and maximum importance weight (0.002).

Fit to indices of abundance: The indices used in the XDB-SRA model for southern copper rockfish are 1) a southern California onboard CPFV observer index (1999-2011) and 2) RecFIN dockside CPFV observer index for southern California (1980-2003) (Figure 68). Similar to brown rockfish, the deterministic model had difficulty matching the rate of increase suggested by the onboard observer index. Comparison of relative abundance time series, rescaled by the model-estimated catchability coefficients (i.e. in biomass units), suggests reasonable links between indices within the model (Figure 69).

Parameter estimates: All catchability coefficients were integrated over a diffuse prior to reduce model dimension (Table 58). Additive variance was estimated for both indices, but was close to zero for the RecFIN index (Figure 68). The posterior distributions for FMSY/M and BMSY/B0, but not M, were shifted to the right of their respective prior densities. Delta (in the year 2000) was only slightly updated by the model, but the continued shift in the posterior distribution suggests the data support a less-depleted stock, with a median of 0.43.

Comparison to Catch-Based Model (DB-SRA): Outputs from the DB-SRA model are essentially prior predictive distributions from the XDB-SRA base model. Assuming constant catches of 16.1mt per year, the median OFL estimates for 2015-16 from DB-SRA are around 65 mt, compared to 154 mt from XDB-SRA (Table 44). The difference between the two models is the higher productivity of XDB-SRA's updated posterior parameter distributions, relative to the prior predictive distributions.

2.5.2 exSSS assessments (Fishery-independent indices only)

2.5.2.1 Sharpchin rockfish

Model: The base case model was structured as a coastwide model with two triennial survey time series (pre- and post- 1995) and one annual survey time series. The model fits all points in each of the three fishery-independent abundance indices (Figure 70) with no additional variance added to the indices (early Triennial: 0.00; late Triennial: 0.00; NWFSC: 0.00; Table 59). The median posterior value of q for both triennial surveys were 0.53 and 1.35 for the early and late time periods, respectively, but the NWFSC survey was almost 7, an unlikely number for a rockfish (Table 59; Figure 71). Sensitivity to including that survey is reported below. The AIS entropy criterion quickly met the convergence criterion (Figure 72). Priors for both the steepness and stock status were updated (slightly downward and upward, respectively) by inclusion of the index data (Figure 73). Pairs plots for all parameters are provide in Figure 74 and show low correlation or bounding in the parameter draws.

Derived model outputs: Model outputs for stock status and spawning biomass are reported in Table 60. Estimates of spawning biomass (Figure 75) and stock status (Figure 76) were different for the MLE and AIS exSSS estimates. The mode of the posterior for stock status was estimated at 73%, well above target the reference level (Table 60; Figure 77). The peak of the posterior estimates of F_{MSY}/M is >1 (Figure 78), not surprising for high steepness values (posterior median = 0.77). OFLs for 2015 and 2016 are provided in Figure 79. Estimates of population scale (biomass) and status for the catch-only SSS model were lower and less optimistic with lower levels of uncertainty than the exSSS model (Table 60; Figure 80).

Sensitivities: Model results demonstrated sensitivity to the inclusion of abundance indices (Table 61). Using only the short Triennial late survey produced smaller biomasses and a more depleted stock, though still well above the target level. The NWFSC survey by itself was uninformative and would not produce a converged model. Taking the NWFSC out to avoid the questionably high q, but leaving both Triennial surveys in produced a smaller biomass and subsequently smaller OFLs, with a slightly more depleted stock. The use of the Hamel *M* prior produced a slightly less depleted stock and higher OFLs, while use of the old rockfish steepness prior produced a slightly more depleted stock and lower OFLs.

Steepness profile: Derived outputs were sensitivity to the steepness value (Figure 81). Higher steepness values generally corresponded to increased initial and current spawning biomass, the latter at a higher right, causing stock status to increase towards 1. Comparison to the prior values of F_{MSY}/M and B_{MSY}/B_0 used in XDB-SRA demonstrate that the prior and estimated *h* values from exSSS assume a much higher productivity for sharpchin rockfish than would be assumed in XDB-SRA (Figure 82).

2.5.2.2 Yellowtail rockfish (North of 40° 10' N. lat.)

Model: The base case model was structured as a coastwide model with a combined triennial survey time series and one annual survey time series. All fishery-dependent (Hake bycatch, commercial CPUE and recreational based indices) were not included as recommended by the STAR panel. The model fits all points in each of the two fishery-independent abundance indices (Figure 83) with higher additional variance added to the triennial survey (Table 59; Figure 84). The median posterior value of q for the triennial and annual surveys were 0.54 (very similar to sharpchin rockfish) and 0.22 (Table 59; Figure 85). The AIS entropy criterion quickly met the convergence criterion (Figure 72). Priors for both the steepness and stock status were updated (slightly downward and upward, respectively) by inclusion of the index data (Figure 86). Pairs plots for all parameters are provide in Figure 87 and show low correlation or bounding in the parameter draws.

Derived model outputs: Model outputs for stock status and spawning biomass are reported in Table 60. Estimates of spawning biomass (Figure 88) and stock status (Figure 89) were notably different for the MLE and AIS exSSS estimates, with the MLE showing higher biomass and a less depletion stock. The mode of the posterior for stock status was estimated at 69%, well above target the reference level (Table 60; Figure 90). Current estimates of spawning biomass are comparable to past assessments (Figure 91). The peak of the posterior estimates of F_{MSY}/M is >1 (Figure 92), not surprising for high steepness values (posterior median = 0.79). OFLs for 2015 and 2016 are provided in Figure 93. Estimates of population scale (biomass) and status for the catch-only SSS model were lower and less optimistic with lower levels of uncertainty in spawning biomass than the exSSS model (Table 60; Figure 94).

Sensitivities: Model results demonstrated sensitivity to the inclusion of abundance indices (Table 62). Removing the annual survey and using only the triennial surveys, combined or separated, produced smaller biomasses and a more depleted stock, though still well above the target level in all cases. The annual NWFSC survey by itself indicated much higher biomasses and a high measure of stock status. The use of the Hamel *M* prior produced a slightly less depleted stock and higher OFLs, while use of the old rockfish steepness prior produced a slightly more depleted stock and lower OFLs.

Steepness profile: Derived outputs were moderately sensitivity to the assumed steepness value (Figure 95). Only the lower steepness values produced noticeable changes in biomass and stock status. Comparison to the prior values of F_{MSY}/M and B_{MSY}/B_0 used in XDB-SRA demonstrate that the prior and estimated *h* values from exSSS assume a much higher productivity for yellowtail rockfish than would be assumed in XDB-SRA (Figure 96).

2.5.2.3 English sole

Model: The base case model was structured as a coastwide model with two triennial survey time series (pre- and post- 1995) and one annual survey time series. The model fits all points in each of the three fishery-independent abundance indices (Figure 97) with higher additional variance added to the NWFSC annual survey (Table 59; Figure 98). The median posterior value of q for each survey was >1, with the triennial survey being higher than the NWFSC annual survey (Table 59; Figure 99). Values of q > 1 are not unexpected for flatfishes (Bryan et al. in review; STAR Panel report of 2013 petrale sole). The AIS entropy criterion quickly met the convergence criterion (Figure 72). Priors for both the steepness and stock status were updated (slightly upward and downward, respectively) by inclusion of the index data (Figure 100). Pairs plots for all parameters are provide in Figure 101 and show low correlation and only slight bounding in the parameter draws.

Derived model outputs: Model outputs for stock status and spawning biomass are reported in Table 60. Estimates of spawning biomass (Figure 102) were different than that estimated from the MLE (higher relative to the AIS values), but stock status (Figure 103) was similar between MLE and AIS exSSS estimates. The mode of the posterior for stock status was estimated at 88%, well above target the reference level (Table 60; Figure 104). The exSSS model is comparable to the 2007 English sole assessment, with the uncertainty level encompassing the probable biomass and depletion levels of the former assessment (Figure 105). The peak of the posterior estimates of F_{MSY}/M is >>1 (Figure 106). OFLs for 2015 and 2016 are provided in Figure 107. Estimates of population scale (biomass) and status for the catch-only SSS model are very similar to the exSSS model, with more uncertainty in the SSS model (Table 60; Figure 108).

Sensitivities: Model results were robust to most sensitivity runs explored (Table 63). Stock status was most sensitive when the model used the late triennial time series only. The scale of the population biomass was most sensitive to when only using either the late triennial or the NWFSC annual survey. The use of the Hamel *M* prior produced lower biomass and OFL estimates.

Steepness profile: Derived outputs were sensitivity to the steepness value (Figure 109). Higher steepness values generally corresponded to decreased initial and current spawning biomass, though depletion was robust to all but the lowest steepness values. Comparison to the prior values of F_{MSY}/M and B_{MSY}/B_0 used in XDB-SRA demonstrate that the prior and estimated *h* values from exSSS assume a higher productivity for English sole than would be assumed in XDB-SRA (Figure 110).

2.5.2.4 Rex sole

Model: The base case model was structured as a coastwide model with two triennial survey time series (pre- and post- 1995) and one annual survey time series. The model fits all points in each of the three fishery-independent abundance indices (Figure 111) with higher additional variance added to the early triennial survey (Table 59; Figure 112). The median posterior value of q for each survey was >1, with the triennial survey being higher than the NWFSC annual survey (Table

59; Figure 113). Values of q > 1 are not unexpected for flatfishes (Bryan et al. in review; STAR Panel report of 2013 petrale sole), though such high values are questionable. The AIS entropy criterion quickly met the convergence criterion (Figure 72). Priors for both the steepness and stock status were updated (slightly upward and downward, respectively) by inclusion of the index data (Figure 114). Pairs plots for all parameters are provide in Figure 115 and show low correlation and only slight bounding in the parameter draws.

Derived model outputs: Model outputs for stock status and spawning biomass are reported in Table 60. Estimates of spawning biomass (Figure 116) were different than that estimated from the MLE (higher relative to the AIS values), but stock status (Figure 117) was similar between MLE and AIS exSSS estimates. The mode of the posterior for stock status was estimated at 80%, well above target the reference level (Table 60; Figure 118). The peak of the posterior estimates of F_{MSY}/M is >>1 (Figure 119). OFLs for 2015 and 2016 are provided in Figure 120. Estimates of population scale (biomass) and status for the catch-only SSS model are very similar to the exSSS model, with more uncertainty in the SSS model (Table 60; Figure 121).

Sensitivities: Model results were sensitive to many of the sensitivity runs explored (Table 64). Stock status was least sensitive, only showing sensitivity when the model used the late triennial time series only. The scale of the population biomass was very sensitive to most explored model configurations.

Steepness profile: Derived outputs were sensitivity to the steepness value (Figure 122). Higher steepness values generally corresponded to changing initial and current spawning biomass, though depletion was robust to most steepness values. Comparison to the prior values of F_{MSY}/M and B_{MSY}/B_0 used in XDB-SRA demonstrate that the prior and estimated h values from exSSS assume a higher productivity for English sole than would be assumed in XDB-SRA (Figure 123).

The scale of the population proved to be highly uncertain, both in absolute measures and relative sensitivities, making the results of these models uninformative to scale, and thus to resultant catch estimates (i.e., OFLs).

2.5.3 Status only assessment

2.5.3.1 Stripetail rockfish

Assessments for stripetail rockfish immediately proved to be highly uninformative as to the scale of the population. Instead of abandoning this assessment all together, the STAT explored stock status across the uncertainty in population scale. Both XDB-SRA and exSSS were used in the explorations. For the exSSS model, profiles over the initial recruitment (R_0) were considered for lnR_0 values from 6 to 20 (Figure 124). Stock status (depletion) remained above the target for values of lnR_0 >7. Values below that level had –log likelihood values significantly different from the lowest value. It was near virgin levels for values of lnR_0 >10. The results strongly indicate that the index data inform the status to be well above the target level, though the scale of the population is greatly unknown.

An analogous profile over alternative population sizes was done using XDB-SRA, in this case scanning over alternative values of the catchability coefficient (q) for the two trawl surveys (both were assumed to have the same q). The surveys were originally designed to have a catchability coefficient of approximately 1 (ln(q)=0). The posterior distributions from the XDB-SRA model reflect the priors, and are not significantly updated by the data. Table 65 shows the results for values of ln(q) ranging from -1 to 1.5. Corresponding estimates of relative abundances (a.k.a. depletions) were near unfished levels over most of this range, and only begin to decline as q approaches implausibly high values (ln(q)=1.5; q=4.5). Current fishing intensity is estimated to be negligibly small in all cases. The STAR Panel was unwilling to accept a prior probability distribution of q, so no formal quantitative estimates of productivity are presented. On a very approximate scale, MSY appears to be on the order of a few hundred tons, but because relative abundance is high, current OFL estimates approach 1000 tons.

3 Harvest Projections and Decision Tables (Groundfish Only)

Forecasts for each stock are based on a 12-year outlook predicated one of two control rules: 1) constant catch based on the average of the last three years or landings and 2) catch based on the P* OFL buffer and the "40-10" ABC control rule. The later has three catch scenarios based on the forecasted results of the three states of nature. These states of nature capture different states in depletion by taking the median value of starting depletion and resultant median forecasted catch under control rule 2 above and the base case model for the following portions of the posterior depletion distribution: 1) bottom quartile of starting depletion values, 2) interquartile of the starting depletion, and 3) upper quartile of the starting depletion. Thus 25% of the distribution is in each of the lower and upper states of nature, with 50% contained in the middle state. A total of three models were therefore run with the three different catch scenarios based on control rule #2, then each state of nature (posterior density quartiles) was summarized by the median value of the draws contained in that state of nature. Each forecast assumes full attainment of the prescribed catch and no implementation error.

Decision tables for the nearshore rockfish stock assessments are given in Table 66 through Table 70. Results for China rockfish (north) and brown rockfish (coastwide) include the probability that spawning biomass is below the minimum stock size threshold (MSST) of 0.25B0. This information is not presented for the other stocks, because the probabilities of becoming overfished were less than 1% for all three catch scenarios under the base-case model.

Results for the shelf-slope fishery-independent stock assessments area provided in Table 71 through Table 74. The average catch scenarios increase the stock biomass, and thus status, of all stocks in all states of nature. The high catch scenarios drop stock status below the target reference point in the base depletion state of nature by the end of the 12 year forecast in all four stocks. The rockfishes also drop below the limit reference point in the low depletion state of nature under the high catch scenario.

4 Research Needs

The following list contains research recommendations to further improve the application of catch and index only stock assessments:

1. Continued research on the uncertainty in the catch histories of all groundfishes. Catch is a critical component of these and all stock assessments, especially when attempting to define population scale. Reconstructions of historical catches are still needed for certain areas, time periods, and fisheries. Currently, reconstructed catches are available for California's commercial and recreational fisheries extending back to 1916 and 1928, respectively (Ralston et al. 2010). Oregon has completed a reconstruction for its commercial catch since 1876 (V. Gertseva, NMFS; pers. comm.), but recreational catch prior to 1980 is assumed to be zero in this analysis. Recreational catch in Washington was reconstructed to 1975 for these assessments, and interpolated back to 1960. A thorough reconstruction of historical commercial catches (prior to 1981) is urgently needed for Washington. Estimates of uncertainty in historical catch reconstructions are needed for all states. Reconstructed catches tend to be most precise for common species, and progressively less precise as species become uncommon. Because data-poor and

data-moderate assessments focus on the less common species, quantification of the precision of catch reconstructions is especially important to these assessments.

2. Model selection criteria for the GLMM model, including insight when to consider the ECE models. The lognormal model frequently showed different time series behavior than the gamma and ECE models, the latter of which usually gave consistent results. The ability to determine whether lognormal or gamma is most appropriate, as well as understanding when the ECE approach should be considered will help formulate the best index treatment.
3. Further consideration as to when it is appropriate to split or maintain the full time series for the Triennial survey. While this proved of little sensitivity in these examples, it could be important in some instances.
4. The NWFSC survey showed poor behavior or limited information for all stocks. Understanding why this may be (including the residual patterns) will help diagnose its use as a data input for catch and index only models.
5. Further understanding of reasonable or probable catchability (q) values will enhance the interpretation of scale, a generally weakly informed output of these catch and index-only models that are dependent on trawl surveys. We already have an extensive collection of estimated q values from data-rich assessments, assuring feasibility. Priors on q would be useful in several respects:
    a. Priors could be used to link the time series of triennial and NWFSC survey abundance estimates, greatly enhancing their information content.
    b. For lightly-fished species such as stripetail rockfish, a prior distribution of q would allow quantitative estimation of ABC and OFL so that management can make informed decisions regarding fishery development and conservation. Values of ABC and OFL should not require experience from an intense historical fishery to be quantitatively acceptable.
    c. Improved understanding of multispecies patterns in survey q could be useful for evaluating survey performance and diagnosis (see recommendation #4).
6. More direct attempts to compare XDB-SRA and exSSS models to understand why they may give different results. Reconciling the use of different productivity assumptions (i.e., priors) in XDB-SRA and exSSS is a major part of this work. Progress was made during the STAR panel, but much more work is needed.
7. Given the success of the efforts reported herein, more attempts at data-moderate assessment are anticipated. Further development of exSSS and XDB-SRA capabilities and speed of execution would be beneficial. One useful area of development is quantitative treatment of historical catch imprecision (see recommendation #1). Further technical details are not described here.
8. Single-species stock assessment models are still unable to address systematic changes in productivity due to external factors such as inter-species relationships and low-frequency aspects of climate change. Relatively simple data-moderate models may provide tractable linkages to ecosystem models, and are relatively easy to modify to reflect ecosystem forces.
9. Exploration of trans-boundary assessments with Canada should be initiated, and would benefit all parties. This also requires development of data inputs including historical catch reconstructions. Due to their transparency, data-moderate assessments may play an especially useful role in promoting trans-boundary fishery science.

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7 Tables

7.1 Model data and inputs

7.1.1 Life histories

Table 1. Life history values for each stock used in either the xDB-SRA or exSSS models. A_{MAX}: longevity; L_{MAX}: maximum length; M: natural mortality rate; L_1: length at age 1; L_∞: asymptotic length; k: von Bertalanffy growth coefficient; CV_x: CV at L_1 or L_∞; a,b: weight-length parameters; $L_{50\%}$: length at 50% maturity; slope: slope of maturity curve; A_{MAT}: age at maturity.

						Growth										Weight (g) -length (cm) relationship				Maturity		
						Female										Female		Male		Length		Age
Scientific name	Common Name	Species code	A_{MAX}	L_{MAX}	M	L_1	L_∞	k	CV_1	CV_∞	L_1	L_∞	k	CV_1	CV_∞	a	b	a	b	$L_{50\%}$	slope	A_{MAT}
Sebastes auriculatus	Brown rockfish	BRWN	34	56	0.14	11.29	51.40	0.16	0.10	0.10	11.29	51.40	0.16	0.10	0.10	1.37E-05	3.03	9.59E-06	3.15	26	-2.29	4
Sebastes nebulosus	China rockfish	CHNA	79	45	0.06	5.32	37.30	0.19	0.10	0.10	7.79	37.50	0.19	0.10	0.10	6.64E-06	3.21	8.79E-06	3.15	27	-5.53	5
Sebastes caurinus	Copper rockfish	COPP	50	66	0.09	14.48	57.20	0.13	0.10	0.10	9.42	51.70	0.22	0.10	0.10	9.39E-06	3.18	1.36E-05	3.08	34	-1.33	6
Sebastes zacentrus	Sharpchin rockfish	SHRP	58	49	0.08	8.25	33.21	0.17	0.10	0.10	8.23	26.98	0.20	0.10	0.10	8.27E-06	3.16	9.10E-06	3.13	22	-5.01	6
Sebastes saxicola	Stripetail rockfish	STRK	38	41	0.12	9.47	33.05	0.06	0.10	0.10	10.37	17.38	0.19	0.10	0.10	1.68E-05	2.95	2.98E-05	2.72	17	-2.30	4
Sebastes flavidus	Yellowtail rockfish (N)	YTRK_N	64	66	0.11	13.44	52.21	0.17	0.10	0.10	19.04	47.57	0.19	0.10	0.10	1.32E-05	3.03	1.24E-05	3.06	37	-0.47	10
Parophrys vetulus	English sole	ENGL	23	61	0.26	17.34	40.56	0.36	0.10	0.10	17.34	23.98	0.48	0.18	0.18	8.21E-06	3.02	1.04E-05	2.94	31	-0.61	4
Glyptocephalus zachirus	Rex sole	REX	29	61	0.20	13.45	41.82	0.39	0.10	0.10	13.45	41.82	0.39	0.10	0.10	3.02E-06	3.21	2.67E-06	3.25	35	-0.39	4

Sources: Washington 1978; Hoenig 1983; Lea et al. 1999; Shaw 1999; Love et al. 2002; Abookire 2005; Stewart 2007; Dick and MacCall 2010; Love et al. 2011; NWFSC trawl survey; NWFSC hook and line survey (M. Head, pers. comm.)

7.1.2 Removals

Table 2. Sources of removal data used in the data-moderate assessments.

Source Name	Time Period	Spatial Coverage
PacFIN	1981-2012	Cape Mendocino – Canadian border
CALCOM	1969-2012	California (1969-1980); Mexican border – Cape Mendocino (1981-2012)
RecFIN	1980-2012	Mexican border – OR/WA border
NORPAC	1990-2012	Cape Mendocino – Canadian border
Rogers (2003)	1966-1976	Pt. Conception – Canadian border
California Commercial Catch Reconstruction	1916-1968	California
California Recreational Catch Reconstruction	1928-1979	California
Oregon Commercial Catch Reconstruction	1892-1980	Oregon
Stewart (2007; English sole assessment)	1876-2006	Mexican border – Canadian border
Tagart (1985)	1963-1980	Washington
PMFC Data Series	1956-1980	Washington
Pacific Fisherman Yearbooks	1942-1955	Washington
Wallace and Lai (2005; Yellowtail rockfish assessment)	1967-2004	Cape Mendocino – Canadian border
CDFG Fish Bulletin #74	1916-1930	California
WA Recreational	1967, 1975-2012	Washington

Table 3. Removals (mt) of brown rockfish (*Sebastes auriculatus*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.02	9.18	0.00	9.20	1966	24.63	108.24	3.37	136.25
1917	0.03	14.26	0.00	14.30	1967	36.35	108.90	5.05	150.30
1918	0.03	16.69	0.00	16.72	1968	45.74	107.70	2.91	156.35
1919	0.02	11.61	0.00	11.63	1969	19.17	105.47	2.29	126.93
1920	0.02	11.84	0.00	11.86	1970	28.08	129.11	4.27	161.46
1921	0.02	9.78	0.00	9.79	1971	28.29	128.55	4.32	161.16
1922	0.02	8.41	0.00	8.42	1972	38.41	172.05	2.28	212.74
1923	0.02	9.08	0.00	9.11	1973	45.04	262.07	3.29	310.41
1924	0.03	5.23	0.00	5.25	1974	59.77	297.96	2.24	359.97
1925	0.03	7.53	0.00	7.56	1975	67.91	244.70	1.13	313.74
1926	0.04	9.58	0.00	9.62	1976	51.88	279.30	3.27	334.44
1927	0.03	4.25	0.00	4.28	1977	46.83	237.85	0.12	284.80
1928	0.05	5.69	0.00	5.75	1978	45.44	157.03	0.24	202.71
1929	0.08	5.33	0.02	5.42	1979	61.98	134.08	0.21	196.28
1930	0.10	10.35	0.02	10.47	1980	105.76	306.36	0.68	412.80
1931	0.15	13.63	0.03	13.81	1981	44.94	93.45	2.77	141.17
1932	0.13	14.18	0.03	14.33	1982	75.85	166.35	18.19	260.39
1933	0.18	15.56	0.04	15.78	1983	41.89	96.68	1.04	139.61
1934	0.18	11.02	0.04	11.24	1984	84.12	152.17	0.85	237.14
1935	0.20	14.20	0.04	14.45	1985	89.20	126.71	1.68	217.60
1936	0.20	14.76	0.04	15.01	1986	94.06	166.79	6.25	267.10
1937	0.19	16.76	0.06	17.02	1987	80.78	108.61	0.88	190.27
1938	0.55	17.70	0.07	18.32	1988	70.86	244.73	3.49	319.08
1939	1.06	19.00	0.07	20.14	1989	53.79	139.75	19.77	213.30
1940	0.42	21.81	0.08	22.31	1990	42.76	125.24	5.09	173.08
1941	0.55	21.43	0.07	22.05	1991	30.11	139.36	0.92	170.39
1942	0.08	6.58	0.04	6.70	1992	16.58	124.63	0.85	142.07
1943	0.10	8.59	0.05	8.74	1993	4.08	132.52	1.22	137.82
1944	0.08	5.36	0.15	5.59	1994	16.36	59.48	0.27	76.11
1945	0.11	11.75	0.37	12.23	1995	13.83	62.26	0.49	76.58
1946	0.19	22.47	0.34	23.00	1996	15.24	91.09	0.50	106.84
1947	0.76	13.18	0.10	14.04	1997	11.67	141.42	1.19	154.28
1948	1.39	20.94	0.19	22.52	1998	3.23	92.98	2.11	98.32
1949	2.04	27.62	0.15	29.81	1999	9.71	114.55	1.51	125.77
1950	2.36	27.75	0.13	30.24	2000	7.29	93.37	0.71	101.36
1951	2.15	43.69	0.23	46.07	2001	10.24	138.54	2.62	151.41
1952	3.00	43.44	0.20	46.64	2002	11.81	80.03	2.58	94.42
1953	2.79	34.16	0.17	37.12	2003	13.85	153.53	1.91	169.29
1954	7.57	43.16	0.13	50.86	2004	7.64	49.71	0.83	58.17
1955	12.64	86.38	0.17	99.19	2005	14.78	84.43	1.20	100.40
1956	14.22	91.89	0.17	106.28	2006	9.04	78.65	1.45	89.15
1957	11.86	96.55	0.23	108.64	2007	7.99	67.11	1.04	76.14
1958	11.02	118.11	0.22	129.36	2008	7.70	63.65	1.23	72.58
1959	8.08	82.74	0.15	90.97	2009	7.16	77.00	0.71	84.87
1960	14.12	92.12	0.10	106.34	2010	9.77	86.10	1.10	96.97
1961	21.54	63.64	0.09	85.27	2011	21.64	90.45	0.60	112.69
1962	12.66	79.47	0.05	92.18	2012	15.10	78.81	0.80	94.71
1963	15.25	101.05	0.13	116.42	***2013***				***101.45***
1964	10.73	83.35	0.16	94.24	***2014***				***101.45***
1965	17.00	102.28	0.32	119.61	***2015***				***101.45***

Table 4. Removals (mt) of brown rockfish (*Sebastes auriculatus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1916				8.71				0.49	9.20
1917				13.53				0.76	14.30
1918				15.83				0.89	16.72
1919				11.01				0.62	11.63
1920				11.23				0.63	11.86
1921				9.27				0.52	9.79
1922				7.97				0.45	8.42
1923				8.62				0.49	9.11
1924				4.97				0.28	5.25
1925				7.16				0.40	7.56
1926				9.11				0.51	9.62
1927				4.05				0.23	4.28
1928		1.12		4.38				0.25	5.75
1929		2.23		3.02				0.17	5.42
1930		2.58		7.46				0.42	10.47
1931		3.45		9.81				0.55	13.81
1932		4.31		9.49				0.53	14.33
1933		5.17		10.04				0.57	15.78
1934		6.03		4.94				0.28	11.24
1935		6.89		7.15				0.40	14.45
1936		7.73		6.89		0.00		0.39	15.01
1937		9.11		7.47		0.01		0.42	17.02
1938		9.03		8.78		0.01		0.50	18.32
1939		7.92		11.56		0.01		0.65	20.14
1940		11.21		10.49		0.02		0.59	22.31
1941		10.36		11.05		0.01		0.62	22.05
1942		5.51		1.12		0.01		0.06	6.70
1943		5.27		3.28		0.01		0.19	8.74
1944		4.32		1.18		0.02		0.07	5.59
1945		5.76		6.10		0.02		0.34	12.23
1946		9.92		12.35		0.02		0.70	23.00
1947		8.31		5.41		0.01		0.31	14.04
1948		16.77		5.42		0.02		0.31	22.52
1949		21.66		7.70		0.02		0.43	29.81
1950		26.56		3.48		0.01		0.20	30.24
1951		31.79		13.51		0.01		0.76	46.07
1952		28.10		17.54		0.01		0.99	46.64
1953		24.70		11.76		0.00		0.66	37.12
1954		34.30		15.67		0.00		0.88	50.86
1955		45.04		51.26		0.01		2.89	99.19
1956		48.33		54.85		0.00		3.09	106.28
1957		40.90		64.12		0.01		3.61	108.64
1958		68.54		57.58		0.00		3.24	129.36
1959		50.72		38.10		0.00		2.15	90.97
1960		42.44		60.49		0.00		3.41	106.34
1961		32.51		49.93		0.01		2.81	85.27
1962		37.76		51.51		0.00		2.90	92.18
1963		47.28		65.45		0.01		3.69	116.42
1964		40.38		50.98		0.00		2.87	94.24
1965		60.48		55.96		0.02		3.15	119.61

Table 4 (Continued). Removals (mt) of brown rockfish (*Sebastes auriculatus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1966		74.86		52.11		0.01	6.00	3.27	136.25
1967		75.32		59.96		0.03	11.00	4.00	150.30
1968		79.65		68.58		0.03	4.00	4.09	156.35
1969		76.69	45.51			0.05	2.00	2.68	126.93
1970		98.96	55.14			0.02	4.00	3.33	161.46
1971		88.74	64.50			0.05	4.00	3.86	161.16
1972		116.07	88.45			0.07	3.00	5.15	212.74
1973		127.95	149.65			0.08	23.00	9.73	310.41
1974		143.22	144.10			0.10	61.00	11.56	359.97
1975		147.26	142.56			0.05	15.00	8.88	313.74
1976		132.43	173.17			0.07	18.00	10.77	334.44
1977		129.03	147.38			0.08		8.31	284.80
1978		116.26	81.75			0.10		4.61	202.71
1979		129.41	63.24			0.06		3.57	196.28
1980	167.16		232.49			0.06		13.10	412.80
1981	73.94		61.30		2.34			3.58	141.17
1982	99.82		135.03		16.98			8.56	260.39
1983	109.14		28.51		0.34			1.62	139.61
1984	159.43		73.56		0.00			4.14	237.14
1985	202.43		13.86		0.50			0.81	217.60
1986	197.22		61.21		4.94			3.73	267.10
1987	160.26		28.33		0.09			1.60	190.27
1988	263.54		51.12		1.46			2.96	319.08
1989	129.53		61.31		17.99			4.47	213.30
1990	113.82		51.97		4.13			3.16	173.08
1991	98.11		68.22		0.22			3.85	170.39
1992	82.39		56.31		0.18			3.18	142.07
1993	66.68		66.79		0.56			3.79	137.82
1994	28.75		44.71		0.12			2.53	76.11
1995	38.64		35.70		0.23			2.02	76.58
1996	42.45		60.75		0.21			3.43	106.84
1997	55.33		92.97		0.71			5.28	154.28
1998	39.94		53.63		1.64			3.11	98.32
1999	64.49		57.18		0.84			3.27	125.77
2000	57.85		41.00		0.19			2.32	101.36
2001	110.70		37.77		0.76			2.17	151.41
2002	65.13		25.82		1.90			1.56	94.42
2003	148.10		19.60		0.47			1.13	169.29
2004	32.11		24.00		0.67			1.39	58.17
2005	76.81		21.46		0.88			1.26	100.40
2006	67.31		20.01		0.66			1.16	89.15
2007	52.82		21.70		0.37			1.24	76.14
2008	46.95		23.81		0.45			1.37	72.58
2009	58.83		24.47		0.18			1.39	84.87
2010	68.79		26.55		0.12			1.50	96.97
2011	82.22		28.80		0.04			1.62	112.69
2012	70.30		22.86		0.25			1.30	94.71
2013									***101.45***
2014									***101.45***
2015									***101.45***

Table 5. Removals (mt) of china rockfish (*Sebastes nebulosus*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.03	6.50	0.00	6.53	1966	0.81	18.13	0.94	19.88
1917	0.05	10.09	0.00	10.15	1967	1.20	23.15	1.40	25.75
1918	0.05	11.81	0.01	11.86	1968	1.50	19.65	1.52	22.67
1919	0.03	8.22	0.00	8.25	1969	1.49	21.70	2.47	25.65
1920	0.03	8.38	0.00	8.41	1970	2.28	35.06	2.04	39.37
1921	0.03	6.92	0.01	6.95	1971	2.28	24.83	2.96	30.07
1922	0.03	5.95	0.00	5.98	1972	3.17	36.03	3.50	42.70
1923	0.03	6.43	0.00	6.47	1973	3.92	46.36	3.75	54.03
1924	0.05	3.70	0.01	3.75	1974	4.88	44.66	4.46	54.00
1925	0.05	4.62	0.01	4.68	1975	5.02	43.02	3.52	51.56
1926	0.06	7.48	0.01	7.55	1976	4.16	47.95	3.01	55.12
1927	0.05	6.36	0.01	6.42	1977	3.97	43.86	3.23	51.05
1928	0.04	8.11	0.01	8.17	1978	3.90	29.41	4.57	37.88
1929	0.05	7.20	0.08	7.32	1979	5.62	38.87	3.40	47.88
1930	0.05	9.99	0.13	10.16	1980	15.53	42.47	10.73	68.73
1931	0.09	5.05	0.06	5.20	1981	4.89	30.77	16.32	51.97
1932	0.01	11.47	0.03	11.51	1982	6.49	38.88	18.37	63.73
1933	0.02	5.47	0.09	5.58	1983	5.66	17.95	2.83	26.44
1934	0.01	10.06	0.76	10.83	1984	3.61	20.65	6.15	30.41
1935	0.01	9.50	0.63	10.14	1985	4.74	24.41	8.90	38.04
1936	0.01	9.84	1.01	10.86	1986	9.88	32.30	5.49	47.67
1937	0.01	9.58	0.80	10.40	1987	6.92	49.82	12.72	69.47
1938	0.01	7.70	2.56	10.27	1988	4.66	36.60	11.45	52.71
1939	0.01	5.40	4.74	10.15	1989	7.45	29.33	12.55	49.33
1940	0.01	5.54	2.99	8.54	1990	5.71	29.57	15.87	51.15
1941	0.01	5.07	0.99	6.07	1991	5.30	34.04	11.63	50.97
1942	0.00	2.83	0.84	3.67	1992	1.96	45.97	17.41	65.34
1943	0.01	3.83	0.39	4.24	1993	0.13	40.40	13.78	54.31
1944	0.00	2.14	0.43	2.58	1994	0.21	60.53	18.72	79.46
1945	0.00	2.75	0.48	3.23	1995	0.00	45.67	18.79	64.46
1946	0.01	5.29	0.57	5.86	1996	0.02	32.96	16.70	49.68
1947	0.04	4.53	0.25	4.82	1997	0.03	38.62	22.35	60.99
1948	0.05	9.36	0.44	9.85	1998	0.00	18.68	27.47	46.15
1949	0.06	12.33	0.40	12.80	1999	0.48	20.21	35.85	56.54
1950	0.07	11.25	0.25	11.58	2000	0.00	20.08	22.23	42.31
1951	0.32	13.55	0.23	14.10	2001	0.00	18.70	28.09	46.79
1952	0.25	11.89	0.27	12.42	2002	0.00	17.79	28.82	46.61
1953	0.09	10.52	0.11	10.72	2003	0.00	17.58	16.47	34.05
1954	0.20	10.88	0.10	11.18	2004	0.06	9.85	11.98	21.89
1955	0.35	12.33	0.20	12.88	2005	0.19	15.68	9.41	25.28
1956	0.41	13.58	0.13	14.12	2006	0.01	12.80	11.07	23.88
1957	0.24	13.99	0.29	14.52	2007	0.00	13.54	15.36	28.89
1958	0.17	22.62	0.08	22.86	2008	0.00	15.31	16.27	31.58
1959	0.10	18.03	0.10	18.24	2009	0.00	20.27	15.09	35.36
1960	0.10	14.99	0.09	15.19	2010	0.03	18.85	11.82	30.70
1961	0.12	14.60	0.26	14.98	2011	0.00	15.72	16.37	32.10
1962	0.11	12.47	0.30	12.88	2012	0.11	13.50	17.27	30.88
1963	0.12	15.85	0.46	16.43	***2013***				***31.23***
1964	0.16	9.95	0.51	10.62	***2014***				***31.23***
1965	0.41	16.64	0.92	17.97	***2015***				***31.23***

Table 6. Removals (mt) of china rockfish (*Sebastes nebulosus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1916				6.13		0.00		0.40	6.53
1917				9.52		0.00		0.62	10.15
1918				11.13		0.00		0.72	11.86
1919				7.74		0.00		0.50	8.25
1920				7.90		0.00		0.51	8.41
1921				6.52		0.00		0.42	6.95
1922				5.61		0.00		0.37	5.98
1923				6.07		0.00		0.39	6.47
1924				3.51		0.00		0.23	3.75
1925				4.39		0.00		0.29	4.68
1926				7.09		0.00		0.46	7.55
1927				6.02		0.00		0.39	6.42
1928		0.42		7.27		0.01		0.47	8.17
1929		0.84		6.02		0.07		0.40	7.32
1930		0.96		8.53		0.11		0.56	10.16
1931		1.28		3.63		0.06		0.24	5.20
1932		1.60		9.30		0.00		0.61	11.51
1933		1.92		3.42		0.01		0.22	5.58
1934		2.24		8.04		0.02		0.52	10.83
1935		2.56		7.10		0.00		0.46	10.14
1936		2.88		7.42		0.07		0.49	10.86
1937		3.42		6.36		0.19		0.43	10.40
1938		3.36		6.27		0.22		0.42	10.27
1939		2.94		6.51		0.26		0.44	10.15
1940		4.23		3.73		0.32		0.26	8.54
1941		3.91		1.81		0.22		0.13	6.07
1942		2.08		1.22		0.27		0.10	3.67
1943		1.99		1.76		0.35		0.14	4.24
1944		1.63		0.49		0.40		0.06	2.58
1945		2.17		0.56		0.44		0.06	3.23
1946		3.74		1.51		0.48		0.13	5.86
1947		2.98		1.57		0.16		0.11	4.82
1948		5.95		3.34		0.32		0.24	9.85
1949		7.70		4.44		0.34		0.31	12.80
1950		9.39		1.93		0.13		0.13	11.58
1951		11.01		2.79		0.11		0.19	14.10
1952		9.60		2.42		0.22		0.17	12.42
1953		8.20		2.29		0.08		0.15	10.72
1954		10.29		0.79		0.05		0.05	11.18
1955		12.38		0.34		0.14		0.03	12.88
1956		13.84		0.20		0.07		0.02	14.12
1957		13.80		0.53		0.15		0.04	14.52
1958		22.58		0.25		0.02		0.02	22.86
1959		17.50		0.64		0.05		0.04	18.24
1960		14.59		0.50		0.06	0.00	0.04	15.19
1961		12.71		1.92		0.11	0.11	0.13	14.98
1962		11.92		0.63		0.06	0.22	0.05	12.88
1963		14.91		1.01		0.11	0.33	0.07	16.43
1964		10.10		0.03		0.05	0.44	0.01	10.62
1965		16.55		0.50		0.31	0.55	0.05	17.97

Table 6 (Continued). Removals (mt) of china rockfish (*Sebastes nebulosus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1966		18.63		0.36		0.19	0.66	0.04	19.88
1967		24.20		0.18		0.55	0.77	0.05	25.75
1968		21.16		0.01		0.53	0.94	0.03	22.67
1969		18.05	5.07			1.03	1.11	0.40	25.65
1970		30.37	6.77			0.48	1.28	0.47	39.37
1971		22.31	4.84			1.09	1.45	0.39	30.07
1972		31.42	7.66			1.40	1.61	0.59	42.70
1973		34.73	14.93			1.52	1.78	1.07	54.03
1974		39.38	9.96			1.94	1.95	0.77	54.00
1975		38.04	9.70			1.01	2.12	0.70	51.56
1976		41.12	10.75			1.35	1.12	0.79	55.12
1977		37.22	10.40			1.80	0.84	0.79	51.05
1978		29.43	3.81			1.97	2.30	0.38	37.88
1979		33.49	10.40			1.43	1.79	0.77	47.88
1980	36.57		27.47			1.28	1.54	1.87	68.73
1981	27.30		19.28		2.55		1.41	1.42	51.97
1982	43.92		14.80		0.01		4.05	0.96	63.73
1983	16.91		7.26		0.00		1.80	0.47	26.44
1984	18.07		9.68		0.00		2.03	0.63	30.41
1985	32.79		3.04		0.00		2.01	0.20	38.04
1986	42.58		2.55		0.00		2.36	0.17	47.67
1987	60.04		6.01		0.00		3.03	0.39	69.47
1988	39.62		8.48		0.34		3.69	0.57	52.71
1989	38.20		6.27		0.09		4.36	0.41	49.33
1990	36.68		6.28		2.58		5.02	0.58	51.15
1991	35.16		11.51		0.64		2.87	0.79	50.97
1992	33.64		20.99		4.33		4.72	1.65	65.34
1993	32.13		15.46		1.67		3.93	1.11	54.31
1994	32.27		33.81		7.81		2.86	2.71	79.46
1995	24.47		24.08		10.89		2.75	2.27	64.46
1996	21.82		14.99		9.40		1.88	1.59	49.68
1997	12.11		29.94		14.26		1.81	2.87	60.99
1998	10.92		11.05		20.78		1.33	2.07	46.15
1999	21.43		6.15		25.30		1.62	2.05	56.54
2000	21.94		2.97		14.33		1.94	1.13	42.31
2001	19.11		3.21		20.57		2.36	1.55	46.79
2002	18.62		2.80		21.82		1.77	1.60	46.61
2003	19.97		0.99		10.61		1.73	0.75	34.05
2004	10.36		1.98		7.28		1.67	0.60	21.89
2005	15.96		2.33		4.56		1.98	0.45	25.28
2006	13.92		2.02		5.62		1.83	0.50	23.88
2007	15.79		2.21		8.01		2.23	0.66	28.89
2008	16.67		2.34		9.40		2.40	0.76	31.58
2009	22.03		1.97		8.53		2.14	0.68	35.36
2010	20.40		1.81		5.15		2.89	0.45	30.70
2011	18.72		1.55		8.42		2.76	0.65	32.10
2012	17.50		1.12		9.13		2.46	0.67	30.88
2013									***31.23***
2014									***31.23***
2015									***31.23***

Table 7. Removals (mt) of copper rockfish (*Sebastes caurinus*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.12	4.00	0.10	4.23	1966	43.78	120.95	0.91	165.64
1917	0.20	6.25	0.20	6.65	1967	50.70	128.07	1.65	180.42
1918	0.18	7.31	0.45	7.94	1968	59.27	135.68	1.56	196.51
1919	0.11	4.97	0.11	5.19	1969	46.97	144.83	2.84	194.64
1920	0.12	5.10	0.15	5.36	1970	69.55	180.39	2.02	251.96
1921	0.10	4.25	0.22	4.58	1971	66.84	168.05	3.12	238.01
1922	0.10	3.67	0.17	3.94	1972	92.20	214.11	3.61	309.93
1923	0.14	3.97	0.06	4.17	1973	111.48	245.26	3.70	360.45
1924	0.18	2.51	0.15	2.85	1974	138.15	269.37	4.51	412.03
1925	0.20	3.52	0.46	4.18	1975	142.16	267.14	3.01	412.32
1926	0.25	4.61	0.46	5.32	1976	116.95	295.33	3.62	415.90
1927	0.21	2.92	0.86	3.98	1977	109.06	304.92	3.60	417.57
1928	0.20	4.60	0.76	5.56	1978	108.06	280.99	3.40	392.45
1929	0.23	5.58	0.80	6.61	1979	151.84	292.28	3.14	447.26
1930	0.26	8.02	1.25	9.54	1980	363.87	107.98	7.71	479.57
1931	0.26	9.84	1.59	11.69	1981	120.36	371.76	29.45	521.57
1932	0.34	10.80	1.14	12.28	1982	224.68	199.13	16.65	440.46
1933	0.20	11.41	0.89	12.50	1983	117.25	150.61	21.00	288.86
1934	0.31	11.35	0.82	12.47	1984	131.32	122.17	33.53	287.02
1935	0.60	14.11	1.44	16.16	1985	167.22	146.99	11.95	326.16
1936	0.44	14.89	1.47	16.80	1986	141.64	113.15	9.62	264.41
1937	1.22	18.01	1.22	20.45	1987	16.16	89.45	10.29	115.90
1938	0.72	16.76	1.62	19.10	1988	74.72	85.11	10.95	170.78
1939	0.50	14.89	1.64	17.03	1989	71.56	91.01	15.73	178.30
1940	0.54	20.36	0.97	21.86	1990	57.64	89.21	28.92	175.77
1941	0.61	19.20	1.23	21.04	1991	50.92	108.68	17.98	177.58
1942	0.14	8.75	1.31	10.20	1992	32.61	128.58	21.76	182.95
1943	0.20	9.31	1.71	11.22	1993	19.93	134.74	14.76	169.43
1944	0.09	9.50	6.10	15.69	1994	62.78	71.37	11.81	145.96
1945	0.17	14.51	16.34	31.02	1995	50.96	48.50	21.93	121.39
1946	0.21	25.33	14.09	39.62	1996	97.99	73.55	15.44	186.98
1947	0.75	15.58	3.21	19.53	1997	43.87	68.50	20.99	133.36
1948	1.78	26.39	6.26	34.43	1998	55.68	40.22	20.50	116.40
1949	2.33	32.43	2.28	37.04	1999	62.41	33.19	20.17	115.77
1950	3.16	38.33	1.28	42.77	2000	27.38	26.93	12.16	66.46
1951	5.91	52.79	1.60	60.31	2001	20.63	20.94	12.95	54.51
1952	4.50	43.86	1.69	50.05	2002	14.57	14.28	12.15	41.00
1953	4.13	35.35	1.15	40.63	2003	17.04	20.48	7.72	45.23
1954	8.57	44.97	2.22	55.76	2004	16.33	15.71	7.26	39.30
1955	16.72	52.20	0.47	69.40	2005	30.21	31.49	9.67	71.36
1956	18.31	59.85	0.50	78.67	2006	13.48	33.56	9.55	56.59
1957	10.83	57.86	0.79	69.48	2007	30.21	35.44	13.09	78.73
1958	10.88	98.74	0.72	110.35	2008	26.47	27.35	11.47	65.29
1959	5.92	80.12	0.48	86.52	2009	25.08	36.55	9.07	70.70
1960	6.79	68.40	0.31	75.50	2010	23.78	25.09	9.25	58.13
1961	9.69	51.13	0.40	61.23	2011	44.89	23.88	11.63	80.39
1962	6.58	63.59	0.38	70.55	2012	50.20	32.20	12.58	94.99
1963	7.03	79.09	0.75	86.88	***2013***				***77.83***
1964	11.78	70.60	0.58	82.97	***2014***				***77.83***
1965	17.38	104.37	1.42	123.17	***2015***				***77.83***

Table 8. Removals (mt) of copper rockfish (*Sebastes caurinus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1916				3.97		0.01		0.26	4.23
1917				6.24		0.01		0.41	6.65
1918				7.45		0.01		0.49	7.94
1919				4.87		0.01		0.32	5.19
1920				5.03		0.01		0.33	5.36
1921				4.29		0.01		0.28	4.58
1922				3.69		0.01		0.24	3.94
1923				3.90		0.01		0.25	4.17
1924				2.66		0.01		0.17	2.85
1925				3.92		0.01		0.26	4.18
1926				4.98		0.01		0.32	5.32
1927				3.73		0.01		0.24	3.98
1928		1.60		3.69		0.02		0.24	5.56
1929		3.21		3.11		0.09		0.21	6.61
1930		3.70		5.34		0.13		0.36	9.54
1931		4.94		6.27		0.07		0.41	11.69
1932		6.17		5.73		0.01		0.37	12.28
1933		7.41		4.76		0.02		0.31	12.50
1934		8.64		3.57		0.03		0.23	12.47
1935		9.87		5.89		0.01		0.38	16.16
1936		11.08		5.28		0.09		0.35	16.80
1937		13.17		6.61		0.23		0.44	20.45
1938		12.96		5.51		0.26		0.38	19.10
1939		11.34		5.05		0.29		0.35	17.03
1940		16.15		5.00		0.37		0.35	21.86
1941		14.92		5.46		0.27		0.37	21.04
1942		7.93		1.79		0.34		0.14	10.20
1943		7.58		2.92		0.50		0.22	11.22
1944		6.23		8.43		0.46		0.58	15.69
1945		8.30		20.83		0.49		1.39	31.02
1946		14.29		23.25		0.54		1.55	39.62
1947		11.89		6.99		0.18		0.47	19.53
1948		24.02		9.40		0.37		0.64	34.43
1949		31.07		5.22		0.38		0.36	37.04
1950		38.13		4.21		0.15		0.28	42.77
1951		47.22		12.16		0.13		0.80	60.31
1952		42.15		7.17		0.25		0.48	50.05
1953		37.03		3.29		0.09		0.22	40.63
1954		49.80		5.53		0.06		0.36	55.76
1955		66.15		2.89		0.16		0.20	69.40
1956		73.31		4.95		0.08		0.33	78.67
1957		63.06		5.86		0.17		0.39	69.48
1958		102.76		7.11		0.02		0.46	110.35
1959		78.21		7.75		0.06		0.51	86.52
1960		64.31		10.44		0.07	0.00	0.68	75.50
1961		50.89		9.51		0.13	0.07	0.63	61.23
1962		63.50		6.42		0.08	0.13	0.42	70.55
1963		78.89		7.18		0.12	0.20	0.48	86.88
1964		77.65		4.70		0.04	0.27	0.31	82.97
1965		116.30		5.79		0.34	0.34	0.40	123.17

Table 8 (Continued). Removals (mt) of copper rockfish (*Sebastes caurinus*) by year and data source.

Year	RecFIN	CA Recreational Reconstruction	CALCOM	CA Commercial Reconstruction	PacFIN	OR Commercial Reconstruction	Foreign Fisheries	Commercial Discard	Total
1966		158.18		6.41		0.22	0.40	0.43	165.64
1967		170.13		8.61		0.62	0.47	0.60	180.42
1968		190.42		4.66		0.58	0.50	0.34	196.51
1969		190.05	2.66			1.15	0.53	0.25	194.64
1970		248.03	2.63			0.53	0.56	0.21	251.96
1971		231.17	4.66			1.20	0.59	0.38	238.01
1972		300.04	7.14			1.56	0.63	0.57	309.93
1973		350.52	7.04			1.68	0.66	0.57	360.45
1974		392.04	16.00			2.12	0.69	1.18	412.03
1975		400.14	9.65			1.11	0.72	0.70	412.32
1976		395.44	17.37			1.49	0.37	1.23	415.90
1977		399.16	15.47			1.80	0.02	1.12	417.57
1978		384.26	5.03			2.18	0.50	0.47	392.45
1979		436.82	7.44			1.57	0.85	0.59	447.26
1980	432.31		42.71			1.40	0.28	2.87	479.57
1981	506.40		13.04		0.00		1.28	0.85	521.57
1982	419.17		16.58		2.13		1.37	1.22	440.46
1983	213.54		57.17		12.96		0.63	4.56	288.86
1984	238.17		30.30		14.33		1.32	2.90	287.02
1985	294.56		28.62		0.05		1.06	1.86	326.16
1986	248.09		14.02		0.00		1.40	0.91	264.41
1987	96.26		16.84		0.09		1.61	1.10	115.90
1988	144.86		22.11		0.51		1.83	1.47	170.78
1989	137.40		31.57		4.91		2.05	2.37	178.30
1990	125.74		27.70		17.14		2.27	2.92	175.77
1991	114.09		50.57		7.63		1.50	3.79	177.58
1992	102.44		62.96		9.95		2.86	4.74	182.95
1993	90.78		67.73		4.12		2.12	4.67	169.43
1994	103.09		34.72		4.28		1.33	2.54	145.96
1995	41.59		57.04		16.03		1.98	4.75	121.39
1996	93.14		77.11		8.75		2.39	5.59	186.98
1997	44.28		69.46		12.06		2.25	5.30	133.36
1998	46.96		50.90		12.13		2.32	4.10	116.40
1999	75.58		25.17		10.48		2.21	2.32	115.77
2000	50.75		8.89		3.54		2.48	0.81	66.46
2001	36.25		8.17		6.61		2.53	0.96	54.51
2002	26.05		6.66		5.82		1.66	0.81	41.00
2003	39.62		1.63		1.84		1.91	0.23	45.23
2004	31.21		3.87		1.83		2.03	0.37	39.30
2005	62.28		3.25		2.51		2.95	0.37	71.36
2006	49.98		2.26		2.12		1.94	0.29	56.59
2007	70.59		2.61		3.15		2.00	0.37	78.73
2008	55.83		3.00		3.68		2.34	0.43	65.29
2009	62.57		3.89		1.79		2.09	0.37	70.70
2010	52.28		2.68		1.07		1.85	0.24	58.13
2011	72.85		3.12		1.61		2.51	0.31	80.39
2012	87.10		3.75		2.15		1.60	0.38	94.99
2013									***77.83***
2014									***77.83***
2015									***77.83***

Table 9. Removals (mt) of sharpchin rockfish (*Sebastes zacentrus*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.00	0.02	0.00	0.02	1966	0.00	0.14	891.48	891.62
1917	0.00	0.03	0.00	0.03	1967	0.00	0.13	510.79	510.92
1918	0.00	0.03	0.00	0.03	1968	0.00	0.11	298.87	298.99
1919	0.00	0.02	0.00	0.02	1969	0.00	0.19	32.77	32.97
1920	0.00	0.02	0.00	0.02	1970	0.00	0.28	46.46	46.74
1921	0.00	0.02	0.00	0.02	1971	0.00	0.23	67.23	67.46
1922	0.00	0.02	0.00	0.02	1972	0.00	0.37	44.45	44.82
1923	0.00	0.02	0.00	0.02	1973	0.00	2.40	68.55	70.95
1924	0.00	0.01	0.00	0.01	1974	0.00	2.71	40.22	42.93
1925	0.00	0.01	0.00	0.01	1975	0.00	3.03	43.27	46.30
1926	0.00	0.03	0.00	0.03	1976	0.00	3.18	33.75	36.93
1927	0.00	0.04	0.00	0.04	1977	0.00	1.12	11.47	12.59
1928	0.00	0.06	0.00	0.06	1978	0.00	0.07	179.87	179.94
1929	0.00	0.06	0.02	0.07	1979	0.00	3.59	184.26	187.85
1930	0.00	0.06	0.01	0.07	1980	0.00	0.00	176.32	176.32
1931	0.00	0.02	0.03	0.05	1981	0.00	0.00	27.70	27.70
1932	0.00	0.03	0.02	0.05	1982	0.00	0.00	25.93	25.93
1933	0.00	0.04	0.04	0.08	1983	0.00	1.39	494.09	495.48
1934	0.00	0.05	0.03	0.08	1984	0.00	3.91	171.81	175.72
1935	0.00	0.05	0.03	0.08	1985	0.00	10.91	624.42	635.33
1936	0.00	0.06	0.02	0.07	1986	0.00	1.93	432.46	434.39
1937	0.00	0.05	0.04	0.09	1987	0.00	0.13	418.29	418.42
1938	0.00	0.06	0.05	0.11	1988	0.00	0.00	867.83	867.83
1939	0.00	0.06	0.10	0.16	1989	0.00	8.57	913.37	921.93
1940	0.00	0.08	0.35	0.42	1990	0.00	31.65	672.74	704.40
1941	0.00	0.13	0.56	0.69	1991	0.00	17.46	438.01	455.47
1942	0.00	0.04	1.01	1.04	1992	0.09	19.63	379.91	399.62
1943	0.00	0.06	3.54	3.60	1993	0.05	9.11	743.94	753.10
1944	0.00	0.08	5.69	5.78	1994	0.00	32.86	797.44	830.30
1945	0.00	0.14	10.56	10.69	1995	0.00	11.07	439.66	450.73
1946	0.00	0.32	6.84	7.16	1996	0.00	37.98	388.98	426.96
1947	0.00	0.15	4.23	4.38	1997	0.00	181.91	462.55	644.46
1948	0.00	0.24	4.28	4.51	1998	0.00	17.04	182.59	199.63
1949	0.00	0.13	5.10	5.23	1999	0.00	0.96	92.89	93.85
1950	0.00	0.17	5.80	5.97	2000	0.00	0.70	17.48	18.18
1951	0.00	0.36	5.70	6.06	2001	0.00	0.08	13.45	13.53
1952	0.00	0.38	10.02	10.40	2002	0.00	0.43	9.09	9.52
1953	0.00	0.33	6.75	7.07	2003	0.00	0.00	8.01	8.01
1954	0.00	0.22	10.14	10.37	2004	0.00	0.00	38.18	38.18
1955	0.00	0.15	7.62	7.77	2005	0.00	0.00	5.75	5.75
1956	0.00	0.33	12.83	13.16	2006	0.00	0.00	0.26	0.26
1957	0.00	0.32	11.97	12.30	2007	0.00	0.00	3.84	3.84
1958	0.00	0.31	10.73	11.04	2008	0.00	0.00	1.84	1.84
1959	0.00	0.28	9.58	9.85	2009	0.00	0.00	2.04	2.04
1960	0.00	0.26	12.37	12.63	2010	0.00	0.00	0.57	0.57
1961	0.00	0.14	14.54	14.68	2011	0.00	0.00	0.78	0.78
1962	0.00	0.15	18.62	18.77	2012	0.00	0.00	13.69	13.69
1963	0.00	0.18	23.70	23.88	***2013***				***5.01***
1964	0.00	0.10	21.21	21.31	***2014***				***5.01***
1965	0.00	0.10	19.93	20.03	***2015***				***5.01***

Table 10. Removals (mt) of sharpchin rockfish (*Sebastes zacentrus*) by year and data source.

Year	CA Commercial Reconstruction	CALCOM	OR Commercial Reconstruction	PacFIN	Tagart	Pac. Fisherman and PMFC Data Series	NORPAC	Foreign Fisheries	Commercial Discard	Total
1916	0.01		0.00						0.01	0.02
1917	0.01		0.00						0.01	0.03
1918	0.02		0.00						0.02	0.03
1919	0.01		0.00						0.01	0.02
1920	0.01		0.00						0.01	0.02
1921	0.01		0.00						0.01	0.02
1922	0.01		0.00						0.01	0.02
1923	0.01		0.00						0.01	0.02
1924	0.00		0.00						0.01	0.01
1925	0.00		0.00						0.00	0.01
1926	0.01		0.00						0.01	0.03
1927	0.02		0.00						0.02	0.04
1928	0.03		0.00						0.03	0.06
1929	0.03		0.00						0.04	0.07
1930	0.03		0.00						0.04	0.07
1931	0.02		0.00						0.02	0.05
1932	0.02		0.00						0.03	0.05
1933	0.04		0.00						0.04	0.08
1934	0.04		0.00						0.04	0.08
1935	0.04		0.00						0.04	0.08
1936	0.03		0.00						0.04	0.07
1937	0.04		0.00						0.05	0.09
1938	0.05		0.00						0.06	0.11
1939	0.07		0.01						0.08	0.16
1940	0.08		0.12						0.22	0.42
1941	0.13		0.19						0.36	0.69
1942	0.05		0.36			0.09			0.55	1.04
1943	0.08		1.24			0.38			1.89	3.60
1944	0.13		2.17			0.44			3.04	5.78
1945	0.33		3.36			1.38			5.62	10.69
1946	0.41		2.12			0.86			3.77	7.16
1947	0.20		1.36			0.52			2.31	4.38
1948	0.31		0.95			0.88			2.37	4.51
1949	0.16		1.24			1.08			2.75	5.23
1950	0.14		1.64			1.05			3.14	5.97
1951	0.28		1.74			0.85			3.19	6.06
1952	0.27		3.38			1.29			5.47	10.40
1953	0.24		2.18			0.93			3.72	7.07
1954	0.13		3.03			1.76			5.45	10.37
1955	0.10		2.41			1.18			4.09	7.77
1956	0.18		3.90			2.16			6.92	13.16
1957	0.19		3.89			1.75			6.47	12.30
1958	0.20		3.04			2.00			5.81	11.04
1959	0.18		2.21			2.28			5.18	9.85
1960	0.21		3.02			2.75			6.64	12.63
1961	0.09		3.89			2.98			7.72	14.68
1962	0.08		4.80			4.01			9.87	18.77
1963	0.11		8.63		2.58				12.56	23.88
1964	0.06		7.48		2.57				11.21	21.31
1965	0.08		7.18		2.24				10.53	20.03

Table 10 (Continued). Removals (mt) of sharpchin rockfish (*Sebastes zacentrus*) by year and data source.

Year	CA Commercial Reconstruction	CALCOM	OR Commercial Reconstruction	PacFIN	Tagart	Pac. Fisherman and PMFC Data Series	NORPAC	Foreign Fisheries	Commercial Discard	Total
1966	0.08		14.92		2.70			405.00	468.92	891.62
1967	0.08		9.13					233.00	268.70	510.92
1968	0.08		3.66					138.00	157.24	298.99
1969		0.09	0.14		0.40			15.00	17.34	32.97
1970		0.13	1.83		4.20			16.00	24.58	46.74
1971		0.11	11.57		6.30			14.00	35.48	67.46
1972		0.18	3.17		5.90			12.00	23.57	44.82
1973		0.14	1.90		0.60			31.00	37.32	70.95
1974		0.29	4.17		0.90			15.00	22.58	42.93
1975		0.43	6.51					15.00	24.35	46.30
1976		0.51	7.10		0.90			9.00	19.42	36.93
1977		0.53	3.34		2.10				6.62	12.59
1978		0.03	33.57		51.70				94.63	179.94
1979		1.70	57.95		29.40				98.79	187.85
1980		0.00	53.69		29.90				92.73	176.32
1981		0.00		13.13					14.57	27.70
1982		0.00		12.29					13.64	25.93
1983		0.66		234.24					260.58	495.48
1984		1.85		81.45					92.41	175.72
1985		5.17		296.02					334.13	635.33
1986		0.91		205.02					228.45	434.39
1987		0.06		200.98					217.38	418.42
1988		0.00		422.67					445.16	867.83
1989		4.23		451.02					466.68	921.93
1990		15.85		336.87			0.00		351.68	704.40
1991		8.87		222.40			0.05		224.15	455.47
1992		10.16		185.74			10.00		193.72	399.62
1993		4.79		388.92			0.00		359.38	753.10
1994		17.43		423.07			0.03		389.76	830.30
1995		5.96		236.76			0.04		207.97	450.73
1996		20.77		212.70			0.02		193.47	426.96
1997		101.03		256.89			0.01		286.53	644.46
1998		9.62		102.95			0.07		87.00	199.63
1999		0.55		53.22			0.03		40.05	93.85
2000		0.41		10.16			0.02		7.59	18.18
2001		0.05		5.90			2.06		5.52	13.53
2002		0.26		5.40			0.07		3.78	9.52
2003		0.00		3.79			1.12		3.10	8.01
2004		0.00		23.79			0.01		14.38	38.18
2005		0.00		3.63			0.02		2.10	5.75
2006		0.00		0.14			0.03		0.09	0.26
2007		0.00		1.74			0.79		1.31	3.84
2008		0.00		1.23			0.00		0.61	1.84
2009		0.00		1.37			0.00		0.67	2.04
2010		0.00		0.38			0.00		0.19	0.57
2011		0.00		0.52			0.01		0.26	0.78
2012		0.00		9.17			0.00		4.51	13.69
2013										***5.01***
2014										***5.01***
2015										***5.01***

Table 11. Removals (mt) of stripetail rockfish (*Sebastes saxicola*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.00	7.70	0.15	7.85	1966	0.01	18.40	78.25	96.66
1917	0.00	12.17	0.29	12.46	1967	0.02	11.68	62.12	73.83
1918	0.00	12.23	0.58	12.81	1968	0.01	11.59	127.15	138.75
1919	0.00	8.14	0.13	8.27	1969	0.00	10.67	34.17	44.84
1920	0.00	8.51	0.18	8.69	1970	0.00	14.99	39.68	54.67
1921	0.00	7.11	0.27	7.38	1971	0.00	11.45	55.99	67.44
1922	0.00	6.57	0.22	6.79	1972	0.00	19.83	66.92	86.75
1923	0.00	8.16	0.08	8.24	1973	0.00	51.02	229.59	280.62
1924	0.00	8.00	0.38	8.38	1974	0.00	59.49	50.08	109.58
1925	0.00	8.42	1.09	9.51	1975	0.00	61.65	77.14	138.79
1926	0.00	11.95	0.85	12.80	1976	0.00	64.88	47.50	112.38
1927	0.00	9.34	1.43	10.77	1977	0.00	42.91	6.20	49.10
1928	0.00	9.68	0.87	10.56	1978	0.00	17.39	7.71	25.10
1929	0.00	6.14	4.25	10.39	1979	0.00	47.21	17.09	64.30
1930	0.00	8.37	3.39	11.76	1980	0.00	61.54	5.92	67.47
1931	0.00	6.32	7.27	13.59	1981	0.00	35.49	0.37	35.85
1932	0.00	4.80	3.95	8.75	1982	0.00	25.36	17.78	43.14
1933	0.00	3.93	3.35	7.28	1983	0.00	3.60	35.22	38.81
1934	0.00	4.22	3.10	7.32	1984	0.00	6.85	25.43	32.28
1935	0.00	4.00	4.34	8.34	1985	0.00	16.25	40.30	56.55
1936	0.00	4.00	1.67	5.67	1986	0.00	10.95	12.11	23.06
1937	0.00	3.40	2.11	5.51	1987	0.00	16.75	16.11	32.85
1938	0.00	3.10	2.49	5.59	1988	0.00	10.90	15.77	26.68
1939	0.00	2.95	3.85	6.80	1989	0.00	10.73	23.07	33.81
1940	0.00	2.28	3.47	5.75	1990	0.00	7.22	33.48	40.71
1941	0.00	2.33	2.93	5.26	1991	0.00	11.07	59.99	71.05
1942	0.00	0.79	1.27	2.07	1992	0.00	2.40	11.51	13.90
1943	0.00	0.96	2.38	3.34	1993	0.00	19.33	39.49	58.82
1944	0.00	2.37	6.26	8.63	1994	0.00	30.63	109.98	140.61
1945	0.00	3.40	15.81	19.22	1995	0.00	46.78	20.46	67.24
1946	0.00	6.04	12.52	18.56	1996	0.00	6.78	19.31	26.10
1947	0.00	3.40	8.83	12.23	1997	0.00	12.79	25.26	38.04
1948	0.00	3.42	10.33	13.75	1998	0.00	34.01	28.49	62.50
1949	0.00	7.43	15.83	23.26	1999	0.00	6.40	27.05	33.45
1950	0.00	11.28	14.96	26.24	2000	0.01	1.27	7.77	9.05
1951	0.00	20.62	12.46	33.08	2001	0.00	0.54	18.86	19.40
1952	0.00	18.69	8.69	27.38	2002	0.00	0.32	6.50	6.82
1953	0.00	20.90	8.09	28.99	2003	0.00	0.05	2.87	2.91
1954	0.00	17.94	20.77	38.71	2004	0.00	0.14	3.26	3.40
1955	0.00	9.78	20.23	30.02	2005	0.00	0.31	6.02	6.33
1956	0.00	15.61	32.70	48.32	2006	0.00	0.00	7.26	7.26
1957	0.01	13.49	17.85	31.35	2007	0.00	0.00	8.21	8.22
1958	0.01	21.77	8.07	29.85	2008	0.00	0.00	8.63	8.63
1959	0.01	21.36	6.67	28.04	2009	0.00	0.00	3.19	3.19
1960	0.01	13.76	12.22	25.99	2010	0.00	0.00	1.84	1.84
1961	0.01	12.82	9.78	22.61	2011	0.00	0.00	3.83	3.83
1962	0.01	13.11	10.04	23.17	2012	0.00	0.29	4.16	4.45
1963	0.01	13.16	7.87	21.04	***2013***				***3.37***
1964	0.00	10.48	11.15	21.63	***2014***				***3.37***
1965	0.01	10.25	17.79	28.05	***2015***				***3.37***

Table 12. Removals (mt) of stripetail rockfish (*Sebastes saxicola*) by year and data source.

Year	CA Commercial Reconstruction	CALCOM	OR Commercial Reconstruction	PacFIN	Tagart	Foreign Fisheries	Commercial Discard	Total
1916	6.42						1.43	7.85
1917	10.18						2.27	12.46
1918	10.47						2.34	12.81
1919	6.76						1.51	8.27
1920	7.10						1.59	8.69
1921	6.03						1.35	7.38
1922	5.55						1.24	6.79
1923	6.73						1.50	8.24
1924	6.85						1.53	8.38
1925	7.78						1.74	9.51
1926	10.46						2.34	12.80
1927	8.80						1.97	10.77
1928	8.63						1.93	10.56
1929	8.49						1.90	10.39
1930	9.62						2.15	11.76
1931	11.11						2.48	13.59
1932	7.15						1.60	8.75
1933	5.95						1.33	7.28
1934	5.99						1.34	7.32
1935	6.81						1.52	8.34
1936	4.63						1.03	5.67
1937	4.51						1.01	5.51
1938	4.57						1.02	5.59
1939	5.56						1.24	6.80
1940	4.70						1.05	5.75
1941	4.30						0.96	5.26
1942	1.66		0.03				0.38	2.07
1943	2.48		0.25				0.61	3.34
1944	6.63		0.43				1.58	8.63
1945	15.66		0.05				3.51	19.22
1946	14.97		0.21				3.39	18.56
1947	9.38		0.61				2.23	12.23
1948	8.68		2.56				2.51	13.75
1949	16.27		2.74				4.25	23.26
1950	20.01		1.44				4.79	26.24
1951	24.63		2.41				6.04	33.08
1952	18.95		3.43				5.00	27.38
1953	21.85		1.85				5.29	28.99
1954	21.05		10.60				7.07	38.71
1955	14.87		9.67				5.48	30.02
1956	15.94		23.56				8.82	48.32
1957	13.72		11.90				5.72	31.35
1958	21.37		3.03				5.45	29.85
1959	20.10		2.82				5.12	28.04
1960	13.70		7.54				4.74	25.99
1961	12.02		6.47				4.13	22.61
1962	12.17		6.77				4.23	23.17
1963	13.43		3.77				3.84	21.04
1964	10.15		7.53				3.95	21.63
1965	11.94		10.99				5.12	28.05

Table 12 (Continued). Removals (mt) of stripetail rockfish (*Sebastes saxicola*) by year and data source.

Year	CA Commercial Reconstruction	CALCOM	OR Commercial Reconstruction	PacFIN	Tagart	Foreign Fisheries	Commercial Discard	Total
1966	10.41		12.60			56.00	17.65	96.66
1967	13.32		15.02			32.00	13.48	73.83
1968	11.64		2.79			99.00	25.33	138.75
1969		10.28	2.38			24.00	8.19	44.84
1970		13.85	1.84			29.00	9.98	54.67
1971		11.96	21.17			22.00	12.31	67.44
1972		18.28	17.63			35.00	15.84	86.75
1973		22.04	2.35			205.00	51.23	280.62
1974		25.48	4.09			60.00	20.00	109.58
1975		32.82	1.64			79.00	25.34	138.79
1976		36.74	0.12			55.00	20.51	112.38
1977		37.78	0.66		1.70		8.96	49.10
1978		16.15	4.17		0.20		4.58	25.10
1979		45.34	6.92		0.30		11.74	64.30
1980		52.66	2.49				12.32	67.47
1981		29.01		0.30			6.55	35.85
1982		20.73		14.54			7.88	43.14
1983		2.94		28.79			7.09	38.81
1984		5.60		20.79			5.89	32.28
1985		13.28		32.94			10.32	56.55
1986		8.95		9.90			4.21	23.06
1987		13.69		13.17			6.00	32.85
1988		8.91		12.89			4.87	26.68
1989		8.77		18.86			6.17	33.81
1990		5.91		27.37			7.43	40.71
1991		9.05		49.04			12.97	71.05
1992		1.96		9.41			2.54	13.90
1993		15.80		32.28			10.74	58.82
1994		25.04		89.90			25.67	140.61
1995		38.24		16.72			12.27	67.24
1996		5.54		15.79			4.76	26.10
1997		10.45		20.65			6.95	38.04
1998		27.80		23.29			11.41	62.50
1999		5.23		22.11			6.11	33.45
2000		1.04		6.35			1.65	9.05
2001		0.44		15.42			3.54	19.40
2002		0.26		5.31			1.25	6.82
2003		0.04		2.34			0.53	2.91
2004		0.11		2.67			0.62	3.40
2005		0.25		4.92			1.16	6.33
2006		0.00		5.93			1.32	7.26
2007		0.00		6.71			1.50	8.22
2008		0.00		7.06			1.58	8.63
2009		0.00		2.60			0.58	3.19
2010		0.00		1.50			0.34	1.84
2011		0.00		3.13			0.70	3.83
2012		0.23		3.40			0.81	4.45
2013								***3.37***
2014								***3.37***
2015								***3.37***

Table 13. Removals (mt) of yellowtail rockfish (*Sebastes flavidus*) by year and region. Only removals for northern California, Oregon, and Washington ("No. CA / OR / WA") were included in the assessment of the northern stock. Catch prior to 1916 (not shown) averaged <1mt yr^{-1}.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	2.61	526.48	3.04	532.12	1966	5.71	320.66	4896.57	5222.94
1917	4.21	818.42	5.01	827.64	1967	8.94	317.50	3016.48	3342.93
1918	3.84	957.57	10.29	971.69	1968	10.06	275.44	3321.47	3606.97
1919	2.29	663.84	3.31	669.44	1969	37.32	194.61	3821.11	4053.03
1920	2.49	677.46	4.11	684.07	1970	26.22	226.47	2215.58	2468.27
1921	2.18	560.26	5.59	568.03	1971	33.18	256.99	1674.71	1964.88
1922	2.14	482.10	4.56	488.80	1972	47.10	342.40	2533.20	2922.70
1923	2.87	521.01	2.47	526.35	1973	53.63	564.94	2347.89	2966.46
1924	3.85	304.79	4.33	312.97	1974	60.06	687.61	1702.74	2450.41
1925	4.22	391.33	10.79	406.34	1975	54.73	730.51	1428.23	2213.46
1926	5.24	604.38	10.72	620.34	1976	60.88	519.57	4324.37	4904.82
1927	4.35	489.66	18.98	512.98	1977	68.31	525.74	5087.00	5681.05
1928	3.71	575.73	17.71	597.15	1978	69.40	360.81	8282.49	8712.70
1929	3.76	486.22	26.03	516.00	1979	95.54	430.50	8047.55	8573.59
1930	3.84	709.40	36.92	750.15	1980	111.20	410.83	7889.59	8411.62
1931	1.26	646.46	41.93	689.66	1981	104.00	736.43	9298.11	10138.54
1932	6.54	517.67	27.92	552.13	1982	157.37	1392.66	9799.27	11349.30
1933	1.02	332.42	25.96	359.39	1983	90.01	1508.64	8931.04	10529.69
1934	3.47	372.99	22.91	399.37	1984	138.32	1689.13	5521.20	7348.65
1935	4.00	449.44	34.89	488.33	1985	183.34	895.84	3769.61	4848.79
1936	4.69	555.50	40.03	600.22	1986	152.17	735.04	5397.86	6285.06
1937	2.84	503.56	48.18	554.59	1987	15.96	766.93	5268.11	6051.00
1938	1.61	404.12	55.26	461.00	1988	61.07	391.19	6956.76	7409.02
1939	1.54	287.25	62.70	351.49	1989	98.27	1095.50	6181.38	7375.15
1940	1.87	445.36	140.32	587.55	1990	60.75	1031.22	5237.92	6329.88
1941	2.02	442.14	188.62	632.78	1991	39.27	444.33	5285.16	5768.77
1942	0.93	145.02	341.40	487.35	1992	37.50	645.38	8376.06	9058.94
1943	0.73	176.69	1116.69	1294.11	1993	22.84	275.91	7708.45	8007.20
1944	0.58	205.44	1936.51	2142.53	1994	9.23	278.20	7584.35	7871.78
1945	1.08	336.43	3390.80	3728.31	1995	24.19	217.57	6857.31	7099.07
1946	1.27	456.51	2201.01	2658.79	1996	6.10	232.64	8673.57	8912.31
1947	0.82	361.36	1209.00	1571.18	1997	16.20	734.14	3151.10	3901.44
1948	1.11	367.02	1076.04	1444.17	1998	9.09	433.12	4214.20	4656.41
1949	1.29	342.91	951.84	1296.04	1999	10.08	237.82	4816.41	5064.32
1950	1.79	489.33	961.39	1452.51	2000	0.53	160.75	5011.83	5173.11
1951	2.37	480.88	855.03	1338.28	2001	0.28	57.43	3387.20	3444.91
1952	2.34	378.51	1008.62	1389.46	2002	0.12	26.43	2452.14	2478.69
1953	1.13	196.98	796.00	994.12	2003	0.07	19.47	1490.02	1509.55
1954	2.01	251.50	1147.37	1400.88	2004	0.67	12.74	1750.19	1763.60
1955	2.69	265.29	975.55	1243.53	2005	1.76	23.57	966.08	991.40
1956	3.82	482.76	1475.46	1962.03	2006	1.69	22.49	510.82	535.00
1957	4.41	495.94	1610.52	2110.88	2007	1.87	57.95	405.36	465.18
1958	5.10	807.10	1434.98	2247.17	2008	4.21	17.82	511.05	533.08
1959	11.31	668.10	1588.92	2268.34	2009	0.89	48.24	817.39	866.51
1960	4.42	388.35	1994.72	2387.48	2010	1.01	23.97	1026.61	1051.58
1961	5.33	284.58	1963.13	2253.04	2011	0.62	45.29	1456.02	1501.93
1962	4.26	237.63	2447.96	2689.85	2012	2.42	52.30	1646.36	1701.08
1963	3.90	203.58	1900.84	2108.32	***2013***			***1376.33***	
1964	2.74	138.02	1598.46	1739.22	***2014***			***1376.33***	
1965	5.55	199.76	1573.93	1779.25	***2015***			***1376.33***	

Table 14. Removals (mt) of yellowtail rockfish (*Sebastes flavidus*) north of Cape Mendocino, by year and data source. Catch prior to 1916 (not shown) averaged <1mt yr^{-1}.

Year	OR Commercial Reconstruction	PacFIN	Tagart	Pac. Fisherman and PMFC Data	Wallace and Lai	Foreign Fisheries	NORPAC	CALCOM	CA Commercial Reconstruction	CA Recreational Reconstruction	RecFIN	WA Recreational	Commercial Discard	Total
1916	1.00								1.90				0.14	3.04
1917	1.05								3.74				0.23	5.01
1918	1.10								8.72				0.47	10.29
1919	1.15								2.00				0.15	3.31
1920	1.20								2.72				0.19	4.11
1921	1.26								4.08				0.25	5.59
1922	1.31								3.04				0.21	4.56
1923	1.36								1.00				0.11	2.47
1924	1.41								2.73				0.20	4.33
1925	1.46								8.84				0.49	10.79
1926	1.51								8.72				0.49	10.72
1927	1.56								16.55				0.86	18.98
1928	2.61								14.28	0.02			0.80	17.71
1929	9.13								15.68	0.03			1.18	26.03
1930	12.48								22.73	0.04			1.67	36.92
1931	7.14								32.84	0.05			1.90	41.93
1932	1.81								24.79	0.07			1.26	27.92
1933	2.88								21.84	0.08			1.17	25.96
1934	3.12								18.67	0.09			1.03	22.91
1935	2.03								31.18	0.11			1.58	34.89
1936	10.08								28.02	0.12			1.81	40.03
1937	23.00								22.87	0.14			2.18	48.18
1938	22.93								29.69	0.14			2.50	55.26
1939	28.53								31.21	0.12			2.84	62.70
1940	119.04								14.75	0.17			6.35	140.32
1941	159.22								20.69	0.16			8.55	188.62
1942	282.71			26.21					16.92	0.09			15.48	341.40
1943	924.12			113.11					28.74	0.08			50.63	1116.69
1944	1572.57			130.03					146.04	0.07			87.81	1936.51
1945	2420.25			407.74					408.98	0.09			153.76	3390.80
1946	1507.08			255.74					338.25	0.15			99.80	2201.01
1947	916.75			152.63					84.67	0.12			54.82	1209.00
1948	627.00			260.00					140.01	0.24			48.78	1076.04
1949	541.10			319.49					47.79	0.32			43.15	951.84
1950	581.15			309.35					26.93	0.38			43.58	961.39
1951	512.86			251.82					51.16	0.44			38.75	855.03
1952	537.31			380.29					44.92	0.38			45.72	1008.62
1953	444.58			276.16					38.86	0.33			36.08	796.00
1954	530.71			519.48					44.77	0.41			52.01	1147.37
1955	568.14			348.64					14.07	0.48			44.22	975.55
1956	755.16			639.14					13.74	0.54			66.88	1475.46
1957	996.71			519.10					21.09	0.62			73.00	1610.52
1958	751.99			590.51					26.89	0.54			65.05	1434.98
1959	824.58			673.38					18.48	0.45			72.03	1588.92
1960	1075.78			814.22					13.99	0.28			90.44	1994.72
1961	977.46			882.25					9.05	0.23		5.37	88.77	1963.13
1962	1131.41			1186.28					8.90	0.11		10.74	110.51	2447.96
1963	960.83		816.53						21.83	0.08		16.12	85.46	1900.84
1964	687.66		792.17						25.55	0.09		21.49	71.51	1598.46
1965	675.10		779.10						22.57	0.16		26.86	70.15	1573.93

Table 14 (Continued). Removals (mt) of yellowtail rockfish (*Sebastes flavidus*) north of Cape Mendocino, by year and data source. Catch prior to 1916 (not shown) averaged <1mt yr^{-1}.

Year	OR Commercial Reconstruction	PacFIN	Tagart	Pac. Fisherman and PMFC Data	Wallace and Lai	Foreign Fisheries	NORPAC	CALCOM	CA Commercial Reconstruction	CA Recreational Reconstruction	RecFIN	WA Recreational	Commercial Discard	Total
1966	818.87		968.40			2845.00			11.45	0.04		32.23	220.58	4896.57
1967	835.23		34.70		1.40	1956.00			16.31	0.16		37.61	135.07	3016.48
1968	981.83		951.50		0.00	1187.00			17.63	0.09		34.36	149.05	3321.47
1969	1378.58		1372.60		21.70	786.00		58.95		0.31		31.12	171.85	3821.11
1970	521.79		464.80		10.20	1031.00		60.66		0.06		27.87	99.20	2215.58
1971	674.15		365.10		9.70	434.00		92.23		0.08		24.63	74.82	1674.71
1972	1113.73		456.90		11.30	716.00		99.77		0.21		21.39	113.89	2533.20
1973	1071.76		275.90		20.50	770.00		85.82		0.12		18.14	105.64	2347.89
1974	780.20		50.20		16.90	654.00		109.94		0.07		14.90	76.53	1702.74
1975	707.49		330.30		5.60	222.00		86.92		0.03		11.65	64.23	1428.23
1976	1338.84		2363.80		63.70	235.00		111.59		0.04		16.03	195.36	4324.37
1977	1513.10		2955.50		269.50			111.06		0.06		7.45	230.33	5087.00
1978	2221.52		5191.00		184.90			297.22		0.47		12.38	375.00	8282.49
1979	2061.90		5311.80		237.00			67.53		0.53		4.07	364.72	8047.55
1980	3048.51		4235.50		181.30			37.46			27.54	2.89	356.38	7889.59
1981		8722.79			141.60						8.65	4.02	421.06	9298.11
1982		8902.01			434.80						17.24	1.72	443.50	9799.27
1983		8145.19			363.60						15.32	2.77	404.17	8931.04
1984		4866.72			369.80						32.51	3.43	248.73	5521.20
1985		3037.51			358.70						45.80	4.95	322.64	3769.61
1986		4167.96			740.90						13.59	9.06	466.34	5397.86
1987		3956.79			830.70						14.59	11.21	454.81	5268.11
1988		5669.20			663.90						8.64	13.37	601.64	6956.76
1989		4553.33			1050.00						30.22	15.52	532.32	6181.38
1990		4195.53			566.60		2.60				2.86	17.68	452.65	5237.92
1991		3574.14			863.40		354.75				2.26	35.35	455.27	5285.16
1992		5494.09			1463.00		662.35				1.05	31.73	723.85	8376.06
1993		5010.89			1612.50		307.32				77.67	41.66	658.42	7708.45
1994		5174.43			1142.80		566.33				28.87	17.98	653.94	7584.35
1995		4664.64			781.00		779.28				25.72	15.31	591.37	6857.31
1996		5159.88			2013.40		710.07				20.63	20.68	748.92	8673.57
1997		1825.46			583.70		418.53				33.38	21.40	268.63	3151.10
1998		2467.05			763.90		555.66				36.13	31.73	359.73	4214.20
1999		2226.47			977.00		1161.80				24.88	11.56	414.70	4816.41
2000		2830.07			1082.10		636.28				18.12	13.16	432.10	5011.83
2001		1883.47			976.40		209.82				17.22	8.68	291.62	3387.20
2002		1017.57			1007.70		193.60				19.27	3.20	210.79	2452.14
2003		413.54			887.90		35.30				15.80	10.49	126.99	1490.02
2004		567.58			958.50		43.31				11.69	20.02	149.09	1750.19
2005		746.50					108.38				12.54	17.45	81.21	966.08
2006		338.83					108.95				8.79	11.71	42.54	510.82
2007		274.34					77.21				6.96	13.45	33.40	405.36
2008		272.77					173.56				5.48	16.85	42.40	511.05
2009		536.08					177.54				10.26	25.71	67.79	817.39
2010		748.57					149.75				7.92	35.02	85.34	1026.61
2011		1181.03					101.11				12.40	39.67	121.80	1456.02
2012		1433.21					41.32				14.68	17.07	140.08	1646.36
2013														***1376.33***
2014														***1376.33***
2015														***1376.33***

Table 15. Removals (mt) of English sole (*Parophrys vetulus*) by year and region.

Year	Southern & Central California	No. CA / OR / WA	Discard (Coastwide)	Total	Year	Southern & Central California	No. CA / OR / WA	Discard (Coastwide)	Total
1876	1.0	0.0	0	1.0	1946	717.1	3544.0	737	4998.1
1877	1.2	0.0	0	1.2	1947	776.1	2055.9	502	3334.0
1878	1.4	0.0	0	1.4	1948	1208.5	4008.5	814	6030.9
1879	1.7	0.0	0	1.7	1949	1092.5	1977.5	476	3546.0
1880	2.1	0.0	0	2.1	1950	1606.8	3311.3	755	5673.1
1881	2.5	0.0	0	2.5	1951	947.1	2558.2	684	4189.4
1882	3.0	0.0	0	3.0	1952	736.1	2324.9	763	3824.0
1883	3.6	0.0	1	4.6	1953	680.8	1589.8	640	2910.6
1884	4.3	0.0	1	5.3	1954	750.4	1321.1	552	2623.5
1885	5.2	0.0	1	6.2	1955	837.2	1438.8	553	2829.0
1886	6.2	0.0	1	7.2	1956	1285.0	1783.0	719	3787.0
1887	7.4	0.0	1	8.4	1957	1390.0	2190.0	856	4436.0
1888	8.9	0.0	1	9.9	1958	1132.0	3225.0	1163	5520.0
1889	10.7	0.0	2	12.7	1959	808.0	3350.0	1269	5427.0
1890	12.8	0.0	2	14.8	1960	594.0	2829.0	915	4338.0
1891	15.4	0.0	2	17.4	1961	1082.0	2301.0	805	4188.0
1892	18.5	0.0	3	21.5	1962	1436.0	2185.0	875	4496.0
1893	22.2	0.0	3	25.2	1963	1367.0	2230.0	892	4489.0
1894	26.6	0.0	4	30.6	1964	1453.0	2085.0	1204	4742.0
1895	31.9	0.0	5	36.9	1965	1696.0	2187.0	1160	5043.0
1896	38.3	0.0	5	43.3	1966	1470.0	3068.0	984	5522.0
1897	46.0	0.0	7	53.0	1967	1540.0	2786.0	866	5192.0
1898	55.2	0.0	8	63.2	1968	1339.0	3200.0	929	5468.0
1899	66.2	0.0	9	75.2	1969	1012.0	2049.0	727	3788.0
1900	79.5	0.0	11	90.5	1970	902.0	1593.0	607	3102.0
1901	95.4	0.0	14	109.4	1971	909.0	1383.0	559	2851.0
1902	114.5	0.0	16	130.5	1972	793.0	1850.0	657	3300.0
1903	137.4	0.0	20	157.4	1973	836.0	2134.0	803	3773.0
1904	164.8	0.0	24	188.8	1974	1012.0	1934.0	912	3858.0
1905	197.8	0.0	28	225.8	1975	1227.0	2267.0	1085	4579.0
1906	237.4	0.0	34	271.4	1976	1143.0	3323.0	1289	5755.0
1907	284.9	0.0	41	325.9	1977	927.0	1940.0	868	3735.0
1908	341.8	0.0	49	390.8	1978	1070.0	2393.0	1048	4511.0
1909	410.2	0.0	59	469.2	1979	1115.0	2516.0	1079	4710.0
1910	492.2	0.0	72	564.2	1980	1362.0	1851.0	930	4143.0
1911	590.7	0.0	86	676.7	1981	1135.0	1578.8	1155	3868.8
1912	708.8	0.0	104	812.8	1982	1006.1	1786.5	1171	3963.6
1913	850.6	0.0	126	976.6	1983	640.8	1714.6	973	3328.4
1914	1020.7	0.0	152	1172.7	1984	529.6	1191.7	832	2553.3
1915	1224.8	0.0	184	1408.8	1985	693.9	1236.0	1064	2993.9
1916	2454.1	0.0	372	2826.1	1986	755.5	1279.8	1138	3173.3
1917	3343.1	0.0	522	3865.1	1987	746.9	1721.1	1536	4004.0
1918	2691.7	0.0	440	3131.7	1988	704.4	1396.2	1367	3467.6
1919	2117.6	0.0	357	2474.6	1989	768.3	1643.9	1390	3802.2
1920	1463.8	0.0	251	1714.8	1990	712.5	1198.9	1015	2926.4
1921	1865.6	0.0	318	2183.6	1991	691.7	1492.4	1170	3354.1
1922	2697.7	0.0	461	3158.7	1992	487.2	1134.7	952	2573.9
1923	2714.1	0.0	472	3186.1	1993	395.1	1205.4	980	2580.4
1924	3491.0	0.0	619	4110.0	1994	370.8	751.2	718	1840.0
1925	3393.3	0.0	625	4018.3	1995	414.6	711.9	646	1772.4
1926	3246.5	0.0	618	3864.5	1996	436.9	717.6	421	1575.5
1927	3923.2	0.0	767	4690.2	1997	468.6	1037.9	505	2011.5
1928	3442.0	0.0	701	4143.0	1998	228.6	909.7	420	1558.3
1929	3975.7	2.6	832	4810.3	1999	227.3	684.8	392	1304.1
1930	3065.2	0.8	666	3732.0	2000	181.5	579.1	327	1087.7
1931	1579.8	0.9	347	1927.7	2001	199.1	790.8	421	1410.9
1932	2919.2	5.8	615	3540.1	2002	101.7	1066.0	529	1696.6
1933	2762.1	4.0	580	3346.0	2003	116.8	677.4	338	1132.1
1934	2350.1	2.4	493	2845.5	2004	98.9	852.7	302	1253.6
1935	2666.8	5.2	554	3226.0	2005	69.4	854.9	227	1151.4
1936	2801.0	18.3	585	3404.3	2006	58.0	849.2	192	1099.2
1937	2547.4	69.3	543	3159.7	2007	63.2	613.6	112.6	789.4
1938	1076.2	1070.3	397	2543.6	2008	70.5	289.7	59.9	420.1
1939	1350.6	1176.2	464	2990.8	2009	39.3	317.0	59.3	415.5
1940	1168.9	1404.8	464	3037.8	2010	21.6	199.7	36.8	258.1
1941	807.9	1053.6	340	2201.5	2011	17.8	152.1	28.3	198.1
1942	162.9	1600.1	301	2064.0	2012	18.4	166.8	30.8	216.1
1943	381.6	2697.1	559	3637.7	***2013***				***224.1***
1944	429.1	1350.4	362	2141.5	***2014***				***224.1***
1945	411.6	1170.4	305	1887.0	***2015***				***224.1***

Table 16. Removals (mt) of English sole (*Parophrys vetulus*) by year and data source.

Year	Stewart	CALCOM	PacFIN	Discard	Total
1876	1			0	1
1877	1			0	1
1878	1			0	1
1879	2			0	2
1880	2			0	2
1881	2			0	2
1882	3			0	3
1883	4			1	5
1884	4			1	5
1885	5			1	6
1886	6			1	7
1887	7			1	8
1888	9			1	10
1889	11			2	13
1890	13			2	15
1891	15			2	17
1892	18			3	21
1893	22			3	25
1894	27			4	31
1895	32			5	37
1896	38			5	43
1897	46			7	53
1898	55			8	63
1899	66			9	75
1900	79			11	90
1901	95			14	109
1902	114			16	130
1903	137			20	157
1904	165			24	189
1905	198			28	226
1906	237			34	271
1907	285			41	326
1908	342			49	391
1909	410			59	469
1910	492			72	564
1911	591			86	677
1912	709			104	813
1913	851			126	977
1914	1021			152	1173
1915	1225			184	1409
1916	2454			372	2826
1917	3343			522	3865
1918	2692			440	3132
1919	2118			357	2475
1920	1464			251	1715
1921	1866			318	2184
1922	2698			461	3159
1923	2714			472	3186
1924	3491			619	4110
1925	3393			625	4018
1926	3247			618	3865
1927	3923			767	4690
1928	3442			701	4143
1929	3979			832	4811
1930	3066			666	3732
1931	1581			347	1928
1932	2925			615	3540
1933	2766			580	3346
1934	2352			493	2845
1935	2672			554	3226
1936	2819			585	3404
1937	2616			543	3159
1938	2146			397	2543
1939	2527			464	2991
1940	2574			464	3038
1941	1862			340	2202
1942	1763			301	2064
1943	3079			559	3638
1944	1779			362	2141
1945	1582			305	1887

Table 16 (Continued). Removals (mt) of English sole (*Parophrys vetulus*) by year and data source.

Year	Stewart	CALCOM	PacFIN	Discard	Total
1946	4261			737	4998
1947	2832			502	3334
1948	5216			814	6030
1949	3070			476	3546
1950	4918			755	5673
1951	3505			684	4189
1952	3061			763	3824
1953	2271			640	2911
1954	2071			552	2623
1955	2276			553	2829
1956	3068			719	3787
1957	3580			856	4436
1958	4357			1163	5520
1959	4158			1269	5427
1960	3423			915	4338
1961	3383			805	4188
1962	3621			875	4496
1963	3597			892	4489
1964	3538			1204	4742
1965	3883			1160	5043
1966	4538			984	5522
1967	4326			866	5192
1968	4539			929	5468
1969	3061			727	3788
1970	2495			607	3102
1971	2292			559	2851
1972	2643			657	3300
1973	2970			803	3773
1974	2946			912	3858
1975	3494			1085	4579
1976	4466			1289	5755
1977	2867			868	3735
1978	3463			1048	4511
1979	3631			1079	4710
1980	3213			930	4143
1981	2625			1155	3780
1982	2662			1171	3833
1983	2118			973	3091
1984	1626			832	2458
1985	1891			1064	2955
1986	2015			1138	3153
1987	2443			1536	3979
1988	2055			1367	3422
1989	2390			1390	3780
1990	1892			1015	2907
1991	2169			1170	3339
1992	1604			952	2556
1993	1554			980	2534
1994	1100			718	1818
1995	1116			646	1762
1996	1119			421	1540
1997	1406			505	1911
1998	1021			420	1441
1999	853			392	1245
2000	734			327	1061
2001	942			421	1363
2002	1154			529	1683
2003	787			338	1125
2004	916			302	1218
2005	888			227	1115
2006	886			192	1078
2007		63.2	613.6	112.6	789.4
2008		70.5	289.7	59.9	420.1
2009		39.3	317.0	59.3	415.5
2010		21.6	199.7	36.8	258.1
2011		17.8	152.1	28.3	198.1
2012		18.4	166.8	30.8	216.1
2013					***224.1***
2014					***224.1***
2015					***224.1***

Table 17. Removals (mt) of rex sole (*Glyptocephalus zachirus*) by year and region.

Year	Southern California	Central California	No. CA / OR / WA	Total	Year	Southern California	Central California	No. CA / OR / WA	Total
1916	0.00	131.45	90.86	222.31	1966	21.08	588.54	1637.70	2247.33
1917	0.00	179.08	123.77	302.85	1967	22.41	703.79	1513.90	2240.10
1918	0.00	144.19	99.66	243.84	1968	23.33	645.20	1422.42	2090.95
1919	0.00	113.43	78.40	191.83	1969	29.34	320.55	2072.48	2422.36
1920	0.00	78.41	54.19	132.60	1970	16.69	373.42	1562.92	1953.04
1921	0.00	99.93	69.07	169.00	1971	18.65	345.80	1218.26	1582.71
1922	0.00	144.51	99.88	244.38	1972	29.06	308.54	1636.56	1974.16
1923	0.00	145.38	100.48	245.86	1973	20.25	266.84	1641.36	1928.45
1924	0.00	181.27	125.29	306.56	1974	22.40	277.29	1622.48	1922.17
1925	0.00	179.78	124.26	304.03	1975	10.50	428.07	1450.87	1889.44
1926	0.00	177.47	122.66	300.12	1976	12.92	624.60	1488.09	2125.62
1927	0.00	215.01	148.61	363.62	1977	8.98	403.16	1352.12	1764.26
1928	0.00	210.95	145.80	356.74	1978	4.05	424.78	1661.76	2090.59
1929	0.00	240.18	166.01	406.19	1979	3.95	452.43	2216.61	2672.99
1930	0.00	224.13	154.91	379.03	1980	0.23	513.05	1561.37	2074.65
1931	0.00	283.97	281.60	565.57	1981	1.54	398.30	1633.42	2033.25
1932	0.00	226.61	152.10	378.71	1982	1.54	454.64	1830.82	2287.01
1933	0.11	260.30	100.15	360.56	1983	5.63	459.79	1432.62	1898.05
1934	0.09	348.32	107.13	455.53	1984	2.62	348.62	1302.66	1653.90
1935	0.39	378.08	51.64	430.11	1985	0.85	652.62	1184.64	1838.11
1936	0.00	276.59	75.64	352.23	1986	1.59	624.91	915.48	1541.98
1937	0.00	172.33	141.90	314.23	1987	3.82	607.61	914.82	1526.25
1938	0.00	231.46	149.36	380.82	1988	2.82	681.69	917.16	1601.68
1939	0.00	290.59	185.44	476.03	1989	4.58	676.53	759.91	1441.02
1940	0.00	248.57	194.45	443.02	1990	0.15	489.60	620.98	1110.73
1941	0.01	155.78	143.62	299.41	1991	0.00	582.36	864.99	1447.34
1942	0.00	77.57	197.46	275.03	1992	0.18	400.32	678.30	1078.80
1943	0.00	124.05	591.14	715.18	1993	0.05	392.92	566.49	959.46
1944	0.00	96.86	284.72	381.58	1994	0.22	524.65	494.32	1019.19
1945	0.67	142.75	205.74	349.17	1995	2.29	601.75	507.77	1111.80
1946	0.00	176.25	256.13	432.39	1996	0.60	434.16	579.91	1014.67
1947	0.10	253.17	366.40	619.67	1997	0.57	356.21	605.99	962.78
1948	9.64	283.65	558.88	852.17	1998	0.83	196.45	549.39	746.67
1949	17.34	410.01	540.14	967.48	1999	0.20	178.81	508.06	687.06
1950	0.53	483.65	438.70	922.87	2000	0.10	148.60	478.03	626.73
1951	0.85	521.94	450.55	973.34	2001	0.42	114.25	546.84	661.50
1952	2.54	573.45	555.26	1131.25	2002	0.64	132.72	554.42	687.79
1953	1.29	431.09	996.85	1429.24	2003	0.07	162.97	512.09	675.13
1954	5.48	552.48	950.04	1507.99	2004	0.14	150.53	460.84	611.50
1955	0.47	483.67	1495.40	1979.55	2005	0.02	133.26	528.30	661.58
1956	2.75	548.00	1809.25	2360.00	2006	0.03	77.04	545.22	622.29
1957	6.25	523.54	1607.61	2137.40	2007	0.03	56.37	566.65	623.05
1958	8.91	615.08	1562.20	2186.19	2008	0.06	49.51	545.03	594.60
1959	9.22	578.99	1444.78	2032.99	2009	0.02	39.14	570.17	609.32
1960	9.70	472.55	1444.77	1927.01	2010	0.17	21.26	493.33	514.77
1961	34.43	480.55	1486.90	2001.88	2011	0.97	18.49	407.45	426.91
1962	47.78	577.44	1658.37	2283.60	2012	0.33	12.68	409.44	422.45
1963	52.45	659.58	1778.72	2490.74	***2013***				***454.71***
1964	14.92	588.77	1262.33	1866.01	***2014***				***454.71***
1965	30.22	623.29	1147.70	1801.20	***2015***				***454.71***

Table 18. Removals (mt) of rex sole (*Glyptocephalus zachirus*) by year and data source.

Year	OR Commercial Reconstruction	PacFIN	CALCOM	CA Commercial Reconstruction	CDFG Fish Bulletin No. 74	PMFC Data Series	NORPAC	Commercial Discard	Total
1916					148.2			74.1	222.3
1917					201.9			100.9	302.8
1918					162.6			81.3	243.8
1919					127.9			63.9	191.8
1920					88.4			44.2	132.6
1921					112.7			56.3	169.0
1922					162.9			81.5	244.4
1923					163.9			82.0	245.9
1924					204.4			102.2	306.6
1925					202.7			101.3	304.0
1926					200.1			100.0	300.1
1927					242.4			121.2	363.6
1928					237.8			118.9	356.7
1929					270.8			135.4	406.2
1930					252.7			126.3	379.0
1931				377.0				188.5	565.6
1932	0.5			252.0				126.2	378.7
1933	0.2			240.2				120.2	360.6
1934	0.1			303.6				151.8	455.5
1935	0.2			286.5				143.4	430.1
1936	0.9			233.9				117.4	352.2
1937	4.7			204.8				104.7	314.2
1938	0.1			253.8				126.9	380.8
1939	14.6			302.8				158.7	476.0
1940	26.2			269.1				147.7	443.0
1941	31.3			168.3				99.8	299.4
1942	7.6			175.8				91.7	275.0
1943	252.0			224.8				238.4	715.2
1944	66.9			187.5				127.2	381.6
1945	32.2			200.6				116.4	349.2
1946	29.5			258.7				144.1	432.4
1947	30.7			382.4				206.6	619.7
1948	164.9			403.2				284.1	852.2
1949	206.8			438.2				322.5	967.5
1950	151.1			464.1				307.6	922.9
1951	197.5			454.0				321.8	973.3
1952	228.8			531.5				370.9	1131.2
1953	508.0			456.7				464.6	1429.2
1954	507.2			514.8				486.0	1508.0
1955	862.2			485.0				632.4	1979.6
1956	804.3			514.9		293.6		747.2	2360.0
1957	730.4			556.9		179.5		670.6	2137.4
1958	874.5			626.7		5.5		679.6	2186.2
1959	666.5			632.7		107.8		626.0	2033.0
1960	720.1			489.3		130.0		587.7	1927.0
1961	745.4			526.8		125.1		604.6	2001.9
1962	918.5			626.4		55.9		682.8	2283.6
1963	1028.3			696.6		28.6		737.2	2490.7
1964	687.0			632.4		0.0		546.6	1866.0
1965	514.7			671.3		93.2		522.1	1801.2

Table 18 (Continued). Removals (mt) of rex sole (*Glyptocephalus zachirus*) by year and data source.

Year	OR Commercial Reconstruction	PacFIN	CALCOM	CA Commercial Reconstruction	CDFG Fish Bulletin No. 74	PMFC Data Series	NORPAC	Commercial Discard	Total
1966	873.1			729.7		0.0		644.5	2247.3
1967	810.7			794.0		0.0		635.4	2240.1
1968	642.7			861.7		0.0		586.5	2090.9
1969	726.0		1024.6			0.0		671.8	2422.4
1970	621.7		789.9			6.1		535.3	1953.0
1971	510.1		643.9			0.0		428.7	1582.7
1972	649.6		753.7			42.6		528.3	1974.2
1973	615.1		718.8			84.8		509.7	1928.5
1974	621.6		626.7			172.2		501.6	1922.2
1975	494.5		746.8			161.4		486.7	1889.4
1976	512.3		913.0			160.0		540.4	2125.6
1977	452.2		702.2			167.4		442.5	1764.3
1978	653.8		697.6			222.1		517.1	2090.6
1979	746.5		868.5			406.1		651.9	2673.0
1980	541.4		861.6			173.0		498.7	2074.7
1981		1246.6	305.2					481.5	2033.3
1982		1403.8	349.8					533.4	2287.0
1983		1103.7	358.6					435.8	1898.0
1984		1008.3	271.9					373.7	1653.9
1985		921.3	508.2					408.6	1838.1
1986		715.4	489.6					337.0	1542.0
1987		719.8	481.1					325.4	1526.2
1988		726.7	542.3					332.7	1601.7
1989		606.3	543.4					291.3	1441.0
1990		486.9	393.5				12.0	218.3	1110.7
1991		699.9	471.2				0.0	276.3	1447.3
1992		551.3	326.4				1.4	199.7	1078.8
1993		464.9	322.5				0.0	172.0	959.5
1994		408.4	433.9				0.3	176.6	1019.2
1995		422.5	503.0				0.4	186.0	1111.8
1996		486.4	364.7				0.0	163.5	1014.7
1997		512.1	301.5				0.0	149.2	962.8
1998		467.5	168.0				0.2	111.0	746.7
1999		435.8	153.5				0.0	97.7	687.1
2000		409.3	128.5				3.8	85.1	626.7
2001		461.8	99.9				14.4	85.5	661.5
2002		477.8	117.0				8.7	84.2	687.8
2003		452.0	144.2				0.8	78.1	675.1
2004		410.4	134.3				0.3	66.5	611.5
2005		472.4	119.7				2.2	67.3	661.6
2006		493.3	69.8				0.3	58.9	622.3
2007		516.9	51.5				0.2	54.5	623.0
2008		501.1	45.6				0.3	47.6	594.6
2009		524.1	36.0				0.4	48.8	609.3
2010		443.4	19.7				10.4	41.2	514.8
2011		371.1	17.9				3.8	34.2	426.9
2012		373.9	12.0				2.8	33.8	422.4
2013									***454.71***
2014									***454.71***
2015									***454.71***

Table 19. Sources of abundance information by species, region and time.

Species			Brown Rockfish	China Rockfish	Copper Rockfish	Copper Rockfish	Copper Rockfish	English Sole	Rex Sole	Sharpchin Rockfish	Stripetail Rockfish	Vermilion Rockfish	Vermilion Rockfish	Yellowtail Rockfish	Yellowtail Rockfish
Species Abbreviation			BRWN	CHNA	COPP	COPP	COPP	EGLS	REX	SHRP	STRK	VERM	VERM	YTRK	YTRK
Area				CEN-NO	SOUTH	CEN-NO	ALL	CEN-NO	CEN-NO	CEN-NO	CEN-NO	SOUTH	CEN	CEN	NORTH
Source	Model	Survey													
Trawl Surveys	GLMM	Triennial early						80-92	80-92	80-92	80-92				80-92
		Triennial late						95-04	95-04	95-04	95-04				95-04
		NWFSC						03-12	03-12	03-12	03-12				03-12
	GLM-stratified	Triennial						77-04	77-04	77-04	77-04			77-04	77-04
		NWFSC												03-12	
Hook and Line Survey		H&L										04-12			
Recreational CPUE															
		RecFIN	80-03	80-03	80-03	80-03	80-03					80-03	80-03	80-03	80-03
		CenCalOBS	88-??	88-??		88-??							88-??	88-??	
		SoCalOBS	99-11		99-11							99-11			
		NoCalOROBS	01-12	01-12		01-12							01-12	01-12	01-12

Table 20. Number of tows in the Triennial Survey by year and latitude. Columns: southern boundaries of 2-degree bins.

				CA/OR		OR/WA		
Pt. Conception			Cape Mendocino				Canada	
Latitude:	L34	L36	L38	L40	L42	L44	L46	Total
1977	109	51	100	20	47	118	126	571
1980		23	26	19	71	61	101	301
1983		30	36	30	108	99	176	479
1986		29	41	25	46	79	263	483
1989	30	69	47	33	41	107	113	440
1992	18	55	44	36	48	113	107	421
1995	43	49	60	43	56	102	84	437
1998	46	54	62	50	64	103	89	468
2001	47	53	62	47	66	103	86	464
2004	22	42	44	44	57	83	76	368
Total	315	455	522	347	604	968	1221	4432

Table 21. Number of tows in the Triennial Survey by year and depth. Columns: shallow boundaries.

Depth(m):	D50	D95	D125	D150	D200	D250	D300	D350	D400	D450	Total
1977		101	59	74	89	48	80	44	68	8	571
1980	83	54	45	62	29	15	12	1			301
1983	121	107	68	72	59	29	18	5			479
1986	114	144	89	91	22	10	12	1			483
1989	120	104	72	79	29	18	15	3			440
1992	114	114	69	60	34	13	16	1			421
1995	87	80	54	50	47	17	19	36	28	19	437
1998	96	92	57	50	46	18	22	28	35	24	468
2001	91	95	54	46	47	17	24	27	40	23	464
2004	78	61	47	45	35	22	16	12	38	14	368
Total	904	952	614	629	437	207	234	158	209	88	4432

Table 22. Temporal distribution of Triennial Surveys. The three time period groups are used in the stratified GLM analyses. Columns: first day of 10-day Julian date bins.

TIMEP:	EARLY			COMMON					LATE				
Date:	150	160	170	180	190	200	210	220	230	240	250	260	Total
1977				26	83	44	124	34	36	96	73	55	571
1980					50	19	56	47	55	45	29		301
1983				2	54	86	64	71	98	45	22	37	479
1986					32	55	67	98	98	52	62	19	483
1989					22	70	73	88	92	95			440
1992					15	36	37	40	53	145	74	21	421
1995	10	42	63	80	68	106	37	31					437
1998	28	99	91	90	94	49	17						468
2001	26	90	49	41	58	97	75	28					464
2004	78	57	71	74	49	39							368
Total	142	288	274	313	525	601	550	437	432	478	260	132	4432

Table 23. The total frequency of occurrence by survey and year of each species considered in the category 2 stock assessments.

A) AFSC triennial shelf

Group	Species	1977	1980	1983	1986	1989	1992	1995	1998	2001	2004
Rockfishes	Brown	0%	1%	1%	2%	2%	1%	1%	0%	0%	1%
	China	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Copper	0%	0%	1%	0%	3%	1%	1%	1%	1%	0%
	Sharpchin	13%	15%	19%	20%	19%	16%	11%	11%	10%	14%
	Stripetail	29%	21%	20%	19%	33%	19%	36%	26%	24%	31%
	Yellowtail	17%	26%	36%	32%	13%	15%	13%	21%	10%	14%
Flatfishes	English sole	28%	55%	65%	75%	67%	63%	58%	69%	62%	67%
	Rex sole	89%	90%	93%	102%	98%	83%	95%	96%	97%	97%

B) AFSC triennial slope

Group	Species	1997	1999	2000	2001
Rockfishes	Brown	0%	0%	0%	0%
	China	0%	0%	0%	0%
	Copper	0%	0%	0%	0%
	Sharpchin	12%	11%	8%	9%
	Stripetail	11%	10%	9%	10%
	Yellowtail	1%	2%	0%	0%
Flatfishes	English sole	12%	14%	11%	9%
	Rex sole	42%	40%	40%	38%

C) NWFSC annual shelf-slope

Group	Species	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rockfishes	Brown	1%	1%	1%	1%	0%	0%	0%	0%	1%	1%
	China	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Copper	1%	1%	1%	0%	1%	2%	1%	1%	1%	3%
	Sharpchin	21%	25%	22%	21%	20%	18%	22%	23%	23%	21%
	Stripetail	10%	7%	5%	7%	5%	4%	6%	6%	7%	6%
	Yellowtail	6%	6%	7%	6%	7%	5%	6%	7%	7%	7%
Flatfishes	English sole	41%	46%	45%	36%	35%	35%	36%	40%	43%	43%
	Rex sole	65%	66%	67%	62%	62%	59%	58%	62%	62%	62%

Table 24. Deviance values for each of the four error structures explored for each stock and survey. Bold values are models with lowest deviance.

		Model	
Survey	Species	Gamma	Lognormal
Triennial- early	Sharpchin rockfish	5124	**4277**
	Stripetail rockfish	4998	**4715**
	Yellowtail rockfish (N)	6765	**5642**
	English sole	12176	**11366**
	Rex sole	14725	**13757**
Triennial- late	Sharpchin rockfish	2288	**2144**
	Stripetail rockfish	5063	**4861**
	Yellowtail rockfish (N)	3119	**3002**
	English sole	9626	**9678**
	Rex sole	**14206**	14449
Triennial combined	Yellowtail rockfish (N)	NA	9683
NWFSC combo	Sharpchin rockfish	9585	**9248**
	Stripetail rockfish	4126	**4004**
	Yellowtail rockfish (N)	4825	**4701**
	English sole	20857	**20807**
	Rex sole	**29396**	29776

Table 25. Final design and model (GLMM)-based survey abundance indices for each survey and stock. Yellowtail rockfish (N) treat the triennial survey as one time series.

		Species														
		Sharpchin rockfish			Stripetail rockfish			Yellowtail rockfish (N)			English sole			Rex sole		
Survey	Year	Design	$GLMM_{med}$	CV	Design	$GLMM_{med}$	CV	Design	$GLMM_{med}$	CV	Design	$GLMM_{med}$	CV	Design	$GLMM_{med}$	CV
Triennial- Early	1980	4700	15612	0.49	24852	33906	0.45	10590	8962	0.33	4203	4621	0.18	6580	6375	0.18
	1983	16192	15974	0.39	7889	9707	0.36	18309	13131	0.19	8369	9250	0.14	13755	13553	0.13
	1986	7499	9735	0.46	7100	17386	0.52	15848	9855	0.28	9543	10549	0.13	15373	16412	0.24
	1989	4688	10330	0.41	10551	14952	0.35	22500	6540	0.29	11949	11490	0.11	16093	16747	0.11
	1992	16428	11786	0.41	7743	13746	0.43	10835	8630	0.27	10550	10292	0.12	14559	16081	0.10
Triennial- Late	1995	5056	5279	0.44	24285	26132	0.32	2713	2924	0.30	10225	11072	0.11	18373	18876	0.08
	1998	3714	3778	0.47	10372	11471	0.35	25545	21151	0.31	15211	14939	0.09	27979	30002	0.09
	2001	5716	3236	0.47	13550	14829	0.34	4414	5022	0.32	16414	17186	0.10	33135	34071	0.08
	2004	2935	6079	0.44	23448	25580	0.33	15232	17350	0.85	37733	34862	0.10	58815	61111	0.09
NWFSC	2003	19398	27362	0.39	164031	105706	0.48	26478	21205	0.47	38697	40260	0.14	56948	58250	0.09
	2004	28373	57970	0.62	21541	20414	0.51	16232	19239	0.55	46476	40948	0.13	54930	57759	0.12
	2005	28254	33980	0.38	21791	13061	0.50	21392	23343	0.43	33160	31870	0.12	51253	52654	0.09
	2006	13559	25856	0.43	5497	15287	0.96	9653	9036	0.47	20985	19478	0.13	48839	50359	0.10
	2007	14136	20347	0.44	2435	10176	0.59	25042	16089	0.44	17803	17713	0.13	45310	49885	0.10
	2008	20765	31124	0.43	3652	33992	0.93	12476	14247	0.47	14895	15061	0.12	35155	37580	0.09
	2009	18634	35855	0.31	7813	3452	0.62	9051	7320	0.47	16484	17286	0.13	35353	36509	0.10
	2010	8639	22998	0.32	782	3540	0.51	28723	37589	0.42	18387	18451	0.13	38564	40698	0.09
	2011	15304	40690	0.33	33482	17191	0.49	30516	25480	0.42	18554	20842	0.12	41530	44484	0.09
	2012	18722	27937	0.39	20594	18651	0.55	38715	14678	0.44	21296	20399	0.13	44622	47233	0.11

Table 26. Posterior median index values (MCMC) (back-transformed model predictions) for 2004–2012 and their associated posterior log-SD. Also presented for comparison are the year coefficients and standard errors directly from the GLM. Note that coefficients are on the scale of the linear predictors and are not directly comparable to the indices.

	2004	**2005**	**2006**	**2007**	**2008**
Posterior median index	0.1237	0.1441	0.1292	0.1315	0.0869
Posterior log-SD	0.0708	0.0692	0.0671	0.0521	0.0540
GLM year coefficient	0.00	0.1579	0.0478	0.0621	-0.3516
Coefficient SE	0.00	0.0862	0.1021	0.1011	0.0901

	2009	**2010**	**2011**	**2012**
Posterior median index	0.1175	0.1171	0.1581	0.1701
Posterior log-SD	0.0519	0.0501	0.0436	0.0512
GLM year coefficient	-0.0466	-0.0509	0.2475	0.3240
Coefficient SE	0.1034	0.0994	0.0899	0.1047

Table 27. Number of heat treatment samples by power station, over time. Plant acronyms are OBGS = Ormond Beach (Ventura), ESGS = El Segundo, RBGS = Redondo Beach, HBGS = Huntington Beach, SONGS = San Onofre Nuclear (San Clemente).

year	ESGS	HBGS	OBGS	RBGS	SONGS	ALL
1972	17	14			7	38
1973	14	13			8	35
1974	19	13		3	8	43
1975	21	12	4	5		42
1976	20	9	8	18	6	61
1977	21	10	9	3	7	50
1978	12	11	1	8	7	39
1979	16	10	11	12	6	55
1980	13	10	10	12	2	47
1981	14	11	9	10	4	48
1982	15	7	6	13	2	43
1983	10	7	6	12	9	44
1984	6	7	5	10	11	39
1985	12	7	6	13	15	53
1986	9	8	6	17	14	54
1987	9	5	7	9	18	48
1988	6	7	6	8	18	45
1989	3	6	7	7	18	41
1990	7	6	8	9	17	47
1991	5	3	6	8	22	44
1992	9	5	12	9	25	60
1993	5	8	6	10	18	47
1994	8	8	8	11	17	52
1995	5	6	5	8	15	39
1996	5	8	8	12	21	54
1997	9	7	5	12	13	46
1998	3	4	5	8	24	44
1999	3		7	2	19	31
2000	11	1	6	5	20	43
2001	4	3	7	20	18	52
2002	5	7	5	6	22	45
2003	4	7	4	2	20	37
2004	3	7	2	4	18	34
2005	2	4	1	4	24	35
2006	4	5		2	15	26
2007	3	5		1	25	34
2008	3	7		1	22	33
2009	2	3			22	27
2010	2	8			18	28
2011		5		1	25	31

Table 28. Number of samples positive for five of the most frequently occurring rockfish species

year	bocaccio	brown	grass	olive	vermilion
1972	23	8	13	20	
1973	17	6	25	12	
1974	18	14	20	26	
1975	27	35	18	33	
1976	12	31	19	26	
1977	17	32	18	29	
1978	18	17	21	20	
1979	18	34	17	32	
1980	12	32	19	20	
1981	5	22	17	5	
1982	3	21	13	2	
1983		24	15	2	
1984	4	11	8	2	
1985	7	30	17	6	
1986	5	20	8	9	
1987		13	15	8	
1988	16	12	11	5	
1989	7	15	16	8	
1990	3	11	11	3	
1991	13	17	17	2	
1992	6	23	7	9	
1993	1	12	8	2	
1994		14	10	4	
1995	4	8	2	1	1
1996	4	13	4	1	
1997	2	6	1		
1998		4	2	1	
1999	10	5	1	1	8
2000	7	14	4	3	5
2001	2	11	4	2	
2002	8	9	4	1	2
2003	12	17	3	4	5
2004	4	12	4	3	2
2005	13	14	6		2
2006		13	4		4
2007	5	13	4		7
2008	5	13	4		8
2009	8	14	6		8
2010	14	8	9	1	5
2011	3	12	7	1	4

Table 29. Sample sizes (trips) by YEAR, COUNTY and REGION. The shaded cells (Central, 1997-98) are unreliable and are not used.

			SOUTH								CENTRAL					CA/OR					NORTH				
COUNTY:	SAN DIEGO	ORANGE	LOS ANGELES	VENTURA	SANTA BARBARA	SAN LUIS OBISPO	MONTEREY	SANTA CRUZ	SAN MATEO	SAN FRANCISCO	ALAMEDA	CONTRA COSTA	MARIN	SONOMA	MENDOCINO	HUMBOLDT	DEL NORTE	CURRY	COOS	DOUGLAS	LANE	LINCOLN	TILLAMOOK	CLATSOP	
YEAR/FIPS	**73**	**59**	**37**	**111**	**83**	**79**	**53**	**87**	**81**	**75**	**1**	**13**	**41**	**97**	**45**	**23**	**15**	**15**	**11**	**19**	**39**	**41**	**57**	**7**	Total
1980	40	70	36	130	85	21	75	1	11				6	6	17			3	3			47	5		556
1981	78	144	65	98	85	10	23	2	13	3	1		8	13	7		1		2			37	1		591
1982	242	284	157	65	57	6	30	5	12		1		4	7	21	1		2	1			44	2		941
1983	276	219	257	83	57	7	39	12	9				3	4	15			4				32	6		1023
1984	173	207	254	103	28	32	103	41	7		6		7	7	12			4	19	8		32	19	2	1064
1985	198	170	156	74	26	57	152	43	35		11	4	5	21	19		2	6	17	4		32	13		1045
1986	83	156	197	80	25	58	85	34	16			8	6	11	10			5	14	4	1	25	11		829
1987	22	44	63	5	9	16	15		20		15	9	10	26	5	1	1	4	4			40	5		314
1988	22	33	85	79	16	28	28	6	25	2	12		9	27	1	1	2	4	5	5		66	9		465
1989	20	16	80	20		10	4	7	21		2	5	3		4	1		2	10			69			274
1993	50	126	219	37	33	14												10	16	2		100	7	1	615
1994	136	47	113	46	9	20												16	16	1	1	70	15		490
1995	31	19	32	19	7	17	10	5	8				5	5	6	5	1	17	25			72	7		291
1996	33	37	40	30	5	42	38	12	27		8		5	22	6	8	2	9	13			70	9		416
1997	28	19	32	15	1	58	34	15	23		12	6		45		1		20	19			82	17		427
1998	61	30	60	28	9	52	32	20	25	5	25		39	65	6	2		11	20	1		88	26		605
1999	56	35	81	36	7	24	27	19	42	2	23		11	23	5	2		14	17			99	24	1	548
2000	43	31	77	18	5	13	6	12	14	1	7		12	10	3			8	4			53	21		338
2001	35	28	59	21	6	8	10	14	27	7	7		10	5	7	10	1	5	8			47	15		330
2002	76	54	103	40	7	18	14	19	35	8	21		8	15	9			6	11	3		77	10	3	537
2003	78	65	135	42	7	21	25	19	25	7	20		14	16	10	20	3	3				12	1		523
Grand Total	1781	1834	2301	1069	484	532	750	286	395	35	171	32	165	328	163	52	13	153	224	28	2	1194	223	7	12222

Table 30. Least square means of GLM for brown rockfish, central area (RecFIN).

YEAR	Index	CV	YEAR	Index	CV
1980	0.1934	0.3904	1993	0.1453	0.7271
1981	0.0992	0.5265	1994	0.0364	0.8266
1983	1.0230	0.5901	1996	0.0848	0.2521
1984	0.1229	0.5696	1999	0.1369	0.5163
1985	0.1422	0.2374	2000	0.0957	0.4364
1986	0.3906	0.3029	2001	0.1154	0.2450
1987	0.2480	0.5568	2002	0.0620	0.2173
1988	0.3327	0.9358	2003	0.1604	0.2767
1989	0.0476	0.5289			

Table 31. Least square means of GLM for brown rockfish, southern area (RecFIN).

YEAR	Index	CV	YEAR	Index	CV
1980	0.0201	0.5233	1994	0.0128	0.8015
1981	0.0218	0.9573	1996	0.0039	0.7178
1982	0.0353	0.9598	1998	0.0079	0.4538
1983	0.0106	0.5297	1999	0.0192	0.5172
1984	0.0167	0.4477	2000	0.0221	0.6067
1985	0.0096	0.4137	2001	0.0448	0.5027
1986	0.0023	0.6843	2002	0.0192	0.4162
1988	0.0067	0.4893	2003	0.0302	0.5446

Table 32. Least square means of GLM for China rockfish, northern area (RecFIN).

YEAR	Index	CV	YEAR	Index	CV
1980	0.1014	0.515	1993	0.0437	0.3
1981	0.059	0.263	1994	0.0404	0.257
1982	0.0441	0.642	1995	0.0252	0.291
1983	0.0193	0.65	1996	0.0244	0.332
1984	0.0192	0.366	1997	0.0374	0.245
1985	0.06	0.373	1998	0.0277	0.222
1986	0.0242	0.533	1999	0.0423	0.179
1987	0.0684	0.47	2000	0.0431	0.272
1988	0.0407	0.29	2001	0.0138	0.464
1989	0.031	0.358	2002	0.0156	0.34
			2003	0.0271	0.472

Table 33. Least square means of GLM for China rockfish, central area (RecFIN).

YEAR	Index	CV	YEAR	Index	CV
1980	0.0327	0.404	1993	0.0143	0.630
1981	0.0498	0.748	1994	0.018	0.412
1983	0.0592	0.422	1995	0.1076	0.233
1984	0.0137	0.514	1996	0.0449	0.148
1985	0.0253	0.319	1999	0.0302	0.233
1986	0.0496	0.331	2000	0.0304	0.262
1987	0.0486	0.428	2001	0.0698	0.207
1988	0.0584	0.364	2002	0.0801	0.182
1989	0.0669	0.410	2003	0.0607	0.167

Table 34. Least square means of GLM for copper rockfish, southern area (RecFIN).

YEAR	Index	CV		YEAR	Index	CV
1980	0.084	0.400		1993	0.083	0.568
1981	0.049	0.388		1994	0.084	1.272
1982	0.029	0.684		1995	0.063	0.678
1983	0.111	0.664		1996	0.133	0.332
1984	0.095	0.467		1997	0.077	1.231
1985	0.045	0.444		1998	0.089	0.425
1986	0.083	0.484		1999	0.148	0.259
				2000	0.093	0.482
1988	0.163	0.676		2001	0.087	0.399
				2002	0.074	0.236
				2003	0.161	0.427

Table 35. Least square means of GLM for copper rockfish, north-central area (RecFIN).

YEAR	Index	CV		YEAR	Index	CV
1980	0.034	0.460		1993	0.060	0.286
1981	0.116	0.402		1994	0.060	0.292
1982	0.044	0.475		1995	0.021	0.498
1983	0.111	0.359		1996	0.052	0.126
1984	0.128	0.473		1997	0.048	0.316
1985	0.056	0.347		1998	0.042	0.400
1986	0.098	0.222		1999	0.051	0.154
1987	0.028	1.674		2000	0.050	0.324
1988	0.028	0.371		2001	0.041	0.222
1989	0.089	0.254		2002	0.037	0.310
				2003	0.025	0.211

Table 36. Central California onboard CPFV index for brown rockfish (data from historical and current CDFW sampling programs and CalPoly onboard sampling).

Year	Index	SD.log
1988	0.3424	0.2004
1989	0.3270	0.1804
1990	0.3766	0.3239
1991	0.4119	0.4553
1992	0.2678	0.1866
1993	0.2923	0.2559
1994	0.1912	0.2419
1995	0.3226	0.2386
1996	0.2602	0.2103
1997	0.1565	0.2008
1998	0.3721	0.1662
1999	0.1332	0.5135
2000		
2001	0.2061	0.2515
2002	0.0945	0.3410
2003	0.2814	0.1403
2004	0.3104	0.1298
2005	0.3096	0.1600
2006	0.5117	0.1272
2007	0.4439	0.1408
2008	0.2967	0.2035
2009	0.4162	0.1888
2010	0.3567	0.1168
2011	0.3170	0.1334

Table 37. Central California onboard CPFV index for China rockfish (data from historical and current CDFW sampling programs and CalPoly onboard sampling).

Year	index	log.sd
1988	0.0512	0.1690
1989	0.0520	0.1682
1990	0.1170	0.2245
1991	0.0733	0.2932
1992	0.0409	0.1751
1993	0.0461	0.1860
1994	0.0731	0.1473
1995	0.0456	0.1906
1996	0.0522	0.1574
1997	0.0375	0.1885
1998	0.0186	0.2281
1999	0.0429	0.2935
2000		
2001	0.0328	0.2732
2002	0.0544	0.2677
2003	0.0671	0.1840
2004	0.0594	0.1672
2005	0.0565	0.2367
2006	0.0518	0.2139
2007	0.0737	0.1828
2008	0.0674	0.1927
2009	0.1014	0.1778
2010	0.0878	0.1710
2011	0.0640	0.1658

Table 38. Central California onboard CPFV index for copper rockfish (data from historical and current CDFW sampling programs and CalPoly onboard sampling).

Year	index	log.sd
1988	0.0397	0.1416
1989	0.0597	0.1187
1990	0.0724	0.2005
1991	0.0468	0.2232
1992	0.0686	0.1207
1993	0.0697	0.1254
1994	0.0495	0.1329
1995	0.0603	0.1252
1996	0.0576	0.1208
1997	0.0604	0.1269
1998	0.0552	0.1518
1999	0.0403	0.4086
2000		
2001	0.1001	0.2187
2002	0.0545	0.3742
2003	0.0736	0.1990
2004	0.0939	0.1175
2005	0.1555	0.1235
2006	0.1497	0.1104
2007	0.1309	0.1166
2008	0.0764	0.1636
2009	0.0705	0.1786
2010	0.1370	0.1126
2011	0.1029	0.1239

Table 39. Least square means of. the delta-GLM for brown rockfish, southern area (CDFW Observer Program).

Year	Index	CV
1999	0.0089	0.377
2000	0.0055	0.419
2001	0.0079	0.403
2002	0.0229	0.213
2003	0.0299	0.205
2004	0.0193	0.245
2005	0.0366	0.166
2006	0.0857	0.124
2007	0.0550	0.139
2008	0.0815	0.120
2009	0.0647	0.109
2010	0.0826	0.113
2011	0.0577	0.154

Table 40. Least square means of the delta-GLM for copper rockfish, southern area (CDFW Observer Program).

Year	Index	CV
1999	0.0347	0.205
2000	0.0483	0.280
2001	0.0103	0.387
2002	0.0167	0.258
2003	0.0429	0.183
2004	0.0253	0.197
2005	0.0567	0.164
2006	0.0655	0.128
2007	0.1051	0.105
2008	0.0848	0.098
2009	0.0611	0.121
2010	0.0553	0.110
2011	0.0815	0.096

Table 41. Least square means of the delta-GLM for China rockfish, northern area (ODFW Observer Program).

Year	Index	CV
2001	0.0341	0.241
2002		
2003	0.0306	0.220
2004	0.0205	0.332
2005	0.0154	0.345
2006	0.0189	0.276
2007	0.0369	0.199
2008	0.0178	0.274
2009	0.0300	0.242
2010	0.0081	0.542
2011	0.0236	0.439
2012	0.0334	0.262

Table 42. Least square means of the delta-GLM for copper rockfish, northern area (ODFW Observer Program).

Year	Index	CV
2001	0.0264	0.350
2002		
2003	0.0147	0.369
2004	0.0118	0.423
2005	0.0387	0.308
2006	0.0384	0.261
2007	0.0304	0.237
2008	0.0149	0.324
2009	0.0316	0.290
2010	0.0406	0.304
2011	0.0137	0.513
2012	0.0230	0.365

Table 43. Sex-specific priors for natural mortality (*M*) calculated from Hamel's method and used in exSSS sensitivity runs. *M* is given in normal space, but the prior is lognormal, with SD log the standard deviation in log space.

		Females		Males	
Group	Species	*M*	SD log	*M*	SD log
Rockfishes	Brown	0.17	0.41	0.18	0.41
	China	0.12	0.41	0.12	0.41
	Copper	0.16	0.30	0.14	0.41
	Sharpchin	0.13	0.41	0.14	0.41
	Stripetail	0.17	0.41	0.21	0.41
	Yellowtail N	0.14	0.30	0.11	0.41
Flatfishes	English sole	0.33	0.26	0.41	0.33
	Rex sole	0.31	0.33	0.31	0.33

7.2 Model results

7.2.1 XBD-SRA model estimates

Table 44. Derived quantities from DB-SRA and XDB-SRA for three species of nearshore rockfishes. Parentheses contain the range of the 95% credibility intervals.

	DB-SRA (catch-based) estimates							
Stock	SB_0	SB_{2013}	SB_{2013} / SB_0	SB_{MSY}	F_{2012} / F_{MSY}	MSY	OFL_{2015}	OFL_{2016}
Brown rockfish (Coastwide)	2057 (875 - 5968)	814 (139 - 4177)	0.33 (0.07 - 0.88)	743 (333 - 1953)	0.53 (0.12 - 4.61)	156 (72 - 275)	185 (17 - 749)	189 (14 - 751)
China rockfish (Central & South)	622 (270 - 1721)	207 (28 - 1266)	0.26 (0.06 - 0.85)	226 (100 - 610)	0.7 (0.12 - 6.52)	22 (8 - 48)	20 (2 - 119)	20 (1 - 119)
China rockfish (North)	243 (122 - 691)	77 (18 - 521)	0.15 (0.1 - 0.82)	89 (40 - 264)	2.29 (0.29 - 11.93)	9 (3 - 27)	7 (1 - 57)	7 (1 - 57)
Copper rockfish (Central & North)	2022 (963 - 5456)	798 (86 - 3981)	0.3 (0.05 - 0.92)	756 (338 - 1907)	0.42 (0.09 - 5.08)	106 (41 - 198)	118 (8 - 520)	121 (7 - 523)
Copper rockfish (South)	1119 (585 - 2932)	442 (61 - 2167)	0.43 (0.06 - 0.9)	419 (186 - 1062)	0.82 (0.17 - 7.99)	60 (21 - 116)	64 (4 - 287)	65 (4 - 287)

	XDB-SRA estimates							
Stock	SB_0	SB_{2013}	SB_{2013} / SB_0	SB_{MSY}	F_{2012} / F_{MSY}	MSY	OFL_{2015}	OFL_{2016}
Brown rockfish (Coastwide)	1788 (980 - 3813)	724 (332 - 2397)	0.4 (0.22 - 0.78)	689 (394 - 1456)	0.58 (0.2 - 1.1)	156 (118 - 212)	172 (92 - 464)	176 (93 - 467)
China rockfish (Central & South)	444 (239 - 3041)	293 (142 - 2629)	0.72 (0.41 - 0.95)	209 (101 - 961)	0.28 (0.06 - 0.59)	33 (21 - 70)	50 (24 - 237)	51 (25 - 237)
China rockfish (North)	246 (124 - 536)	88 (26 - 363)	0.33 (0.14 - 0.75)	93 (44 - 211)	1.9 (0.4 - 8.43)	10 (3 - 22)	8 (1 - 42)	8 (1 - 42)
Copper rockfish (Central & North)	1697 (1095 - 2805)	788 (403 - 1741)	0.42 (0.25 - 0.86)	665 (370 - 1190)	0.33 (0.15 - 0.71)	117 (80 - 163)	149 (69 - 316)	154 (71 - 320)
Copper rockfish (South)	1097 (604 - 5025)	858 (418 - 4281)	0.84 (0.49 - 0.99)	529 (249 - 1811)	0.33 (0.11 - 0.79)	92 (50 - 189)	154 (67 - 475)	154 (67 - 476)

7.2.1.1 Brown rockfish

Table 45.Time series from the post-STAR panel XDB-SRA model for brown rockfish. Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, which is specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1916	9.2	3576.0	1788.0	1.000	0.003	0.024
1917	14.3	3566.7	1783.4	0.997	0.004	0.037
1918	16.7	3553.5	1776.7	0.994	0.005	0.044
1919	11.6	3540.2	1770.1	0.990	0.003	0.030
1920	11.9	3532.9	1766.5	0.988	0.003	0.031
1921	9.8	3527.7	1763.8	0.986	0.003	0.026
1922	8.4	3524.5	1762.3	0.985	0.002	0.022
1923	9.1	3523.0	1761.5	0.985	0.003	0.024
1924	5.3	3520.5	1760.2	0.985	0.001	0.014
1925	7.6	3523.8	1761.9	0.986	0.002	0.020
1926	9.6	3524.4	1762.2	0.986	0.003	0.025
1927	4.3	3522.3	1761.2	0.985	0.001	0.011
1928	5.7	3525.3	1762.7	0.986	0.002	0.015
1929	5.4	3527.2	1763.6	0.986	0.002	0.014
1930	10.5	3529.0	1764.5	0.986	0.003	0.027
1931	13.8	3524.5	1762.2	0.985	0.004	0.036
1932	14.3	3518.0	1759.0	0.983	0.004	0.038
1933	15.8	3510.8	1755.4	0.981	0.004	0.042
1934	11.2	3503.1	1751.5	0.979	0.003	0.030
1935	14.4	3501.1	1750.5	0.979	0.004	0.038
1936	15.0	3496.8	1748.4	0.978	0.004	0.040
1937	17.0	3492.7	1746.3	0.977	0.005	0.045
1938	18.3	3486.9	1743.4	0.975	0.005	0.049
1939	20.1	3480.5	1740.2	0.973	0.006	0.054
1940	22.3	3471.9	1735.9	0.971	0.006	0.059
1941	22.0	3462.3	1731.2	0.969	0.006	0.059
1942	6.7	3455.7	1727.8	0.967	0.002	0.018
1943	8.7	3465.0	1732.5	0.969	0.003	0.023
1944	5.6	3471.5	1735.7	0.971	0.002	0.015
1945	12.2	3480.1	1740.1	0.973	0.004	0.033
1946	23.0	3479.6	1739.8	0.973	0.007	0.061
1947	14.0	3469.7	1734.9	0.970	0.004	0.037
1948	22.5	3469.3	1734.7	0.970	0.006	0.060
1949	29.8	3460.1	1730.0	0.968	0.009	0.080
1950	30.2	3443.5	1721.8	0.964	0.009	0.081
1951	46.1	3429.7	1714.9	0.960	0.013	0.124
1952	46.6	3402.0	1701.0	0.952	0.014	0.127
1953	37.1	3377.0	1688.5	0.944	0.011	0.102
1954	50.9	3364.9	1682.5	0.941	0.015	0.140
1955	99.2	3340.8	1670.4	0.935	0.030	0.275
1956	106.3	3271.5	1635.8	0.915	0.032	0.302
1957	108.6	3203.1	1601.6	0.896	0.034	0.316
1958	129.4	3142.7	1571.3	0.879	0.041	0.384
1959	91.0	3068.2	1534.1	0.859	0.030	0.277
1960	106.3	3041.7	1520.8	0.852	0.035	0.326
1961	85.3	3001.9	1500.9	0.842	0.028	0.265
1962	92.2	2988.5	1494.2	0.840	0.031	0.287
1963	116.4	2967.2	1483.6	0.835	0.039	0.363
1964	94.2	2924.9	1462.5	0.824	0.032	0.298

Table 44. (Continued) Time series from the post-STAR panel XDB-SRA model for brown rockfish. Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1965	119.6	2909.1	1454.6	0.820	0.041	0.379
1966	136.2	2867.0	1433.5	0.809	0.048	0.438
1967	150.3	2811.5	1405.7	0.795	0.053	0.492
1968	156.4	2746.9	1373.5	0.778	0.057	0.524
1969	126.9	2689.5	1344.7	0.762	0.047	0.435
1970	161.5	2664.0	1332.0	0.756	0.061	0.558
1971	161.2	2599.7	1299.9	0.740	0.062	0.569
1972	212.7	2547.4	1273.7	0.726	0.084	0.766
1973	310.4	2445.0	1222.5	0.698	0.127	1.166
1974	360.0	2259.3	1129.6	0.646	0.159	1.479
1975	313.7	2048.3	1024.2	0.583	0.153	1.448
1976	334.4	1903.7	951.9	0.542	0.176	1.676
1977	284.8	1750.2	875.1	0.499	0.163	1.562
1978	202.7	1653.1	826.6	0.474	0.123	1.179
1979	196.3	1634.5	817.3	0.472	0.120	1.145
1980	412.8	1609.2	804.6	0.468	0.257	2.419
1981	141.2	1358.1	679.1	0.393	0.104	0.993
1982	260.4	1404.1	702.1	0.408	0.185	1.761
1983	139.6	1321.7	660.9	0.385	0.106	1.001
1984	237.1	1370.0	685.0	0.402	0.173	1.619
1985	217.6	1277.0	638.5	0.375	0.170	1.603
1986	267.1	1225.5	612.7	0.360	0.218	2.049
1987	190.3	1120.8	560.4	0.326	0.170	1.606
1988	319.1	1111.7	555.8	0.327	0.287	2.689
1989	213.3	962.1	481.1	0.281	0.222	2.091
1990	173.1	928.5	464.3	0.272	0.186	1.754
1991	170.4	923.5	461.8	0.269	0.185	1.740
1992	142.1	920.4	460.2	0.269	0.154	1.455
1993	137.8	919.8	459.9	0.267	0.150	1.414
1994	76.1	915.6	457.8	0.265	0.083	0.784
1995	76.6	972.0	486.0	0.284	0.079	0.741
1996	106.8	1023.1	511.6	0.299	0.104	0.982
1997	154.3	1034.4	517.2	0.302	0.149	1.400
1998	98.3	995.8	497.9	0.290	0.099	0.927
1999	125.8	1032.3	516.2	0.301	0.122	1.143
2000	101.4	1043.1	521.5	0.304	0.097	0.908
2001	151.4	1078.2	539.1	0.316	0.140	1.304
2002	94.4	1054.4	527.2	0.307	0.090	0.835
2003	169.3	1098.9	549.4	0.319	0.154	1.434
2004	58.2	1062.0	531.0	0.308	0.055	0.510
2005	100.4	1149.7	574.8	0.335	0.087	0.808
2006	89.2	1178.4	589.2	0.343	0.076	0.700
2007	76.1	1220.5	610.2	0.355	0.062	0.573
2008	72.6	1262.9	631.4	0.368	0.057	0.525
2009	84.9	1319.5	659.8	0.385	0.064	0.585
2010	97.0	1360.3	680.1	0.398	0.071	0.645
2011	112.7	1391.6	695.8	0.407	0.081	0.730
2012	94.7	1408.6	704.3	0.411	0.067	0.604
2013	101.5	1448.9	724.5	0.423	0.070	0.625

Table 46. Percentiles of estimated parameters and derived quantities from the XDB-SRA model for brown rockfish (coastwide). OFL estimates assume projections of constant catch, equal to average catch from 2010-2012.

		Percentile				
Quantity	**Derived or Estimated**	**5%**	**25%**	**50%**	**75%**	**95%**
log q (index 1)	Derived	-9.296	-8.602	-8.197	-7.846	-7.413
log q (index 2)	Derived	-11.563	-10.895	-10.492	-10.145	-9.699
log q (index 3)	Derived	-10.091	-9.403	-9.027	-8.704	-8.298
log q (index 4)	Derived	-12.404	-11.722	-11.347	-11.025	-10.625
log a (index 1)	Estimated	-3.653	-3.025	-2.648	-2.285	-1.803
log a (index 2)	Estimated	-0.991	-0.524	-0.200	0.149	0.675
log a (index 3)	Estimated	-2.338	-1.577	-1.129	-0.708	-0.158
log a (index 4)	Estimated	-2.759	-1.559	-0.973	-0.501	0.103
M	Estimated	0.074	0.105	0.134	0.170	0.245
F_{MSY} / M	Estimated	0.535	0.764	0.954	1.195	1.680
Delta (year: 2000)	Estimated	0.431	0.605	0.696	0.765	0.835
B_{MSY} / B_0	Estimated	0.226	0.319	0.400	0.489	0.611
F_{MSY}	Derived	0.065	0.100	0.129	0.166	0.234
E_{MSY}	Derived	0.060	0.089	0.114	0.142	0.190
MSY	Derived	123.6	142.0	155.9	171.8	200.3
B_{MSY}	Derived	852.3	1117.4	1378.4	1718.3	2499.2
Vulnerable Biomass (1916)	Derived	2130.5	2907.0	3576.0	4391.5	6426.7
Vulnerable Biomass (2013)	Derived	738.6	1088.0	1448.9	2056.9	3691.9
OFL 2013	Derived	97.8	130.9	162.4	208.0	352.6
OFL 2014	Derived	100.2	134.9	167.2	213.5	355.5
OFL 2015	Derived	102.0	138.7	171.7	219.5	358.1

Table 47. Sensitivity analyses for brown rockfish (coast-wide) presented at the STAR Panel. Results are not based on the final (base) model. 'oldBase' uses productivity priors from Dick and MacCall (2010), 'Zhou' uses diffuse priors for Fmsy/M and Bmsy/B0 (see text for details), and runs starting with 'Z-' are the 'Zhou' run fit to single indices of abundance.

Run	SB_0	SB_{2013}	SB_{2013}/SB_0	F_{2012}/F_{MSY}	OFL_{2015}	OFL_{2016}
oldBase	1839.1 (1279.8 - 2853.3)	570.5 (326.9 - 1344.3)	0.32 (0.21 - 0.54)	0.81 (0.45 - 1.3)	123.9 (78.6 - 217.5)	126.2 (79.5 - 221.1)
Zhou	1791.4 (1139.5 - 2853.7)	507.8 (287 - 1312.8)	0.3 (0.17 - 0.57)	0.77 (0.41 - 1.23)	132.8 (84.4 - 236.2)	136.2 (85.5 - 241.6)
Z-CenCalObsOnly	2321.8 (1389 - 5753.4)	1007.1 (381.3 - 4071.1)	0.45 (0.22 - 0.81)	0.57 (0.15 - 1.15)	171.9 (87.5 - 613)	175 (88.2 - 614.7)
Z-SoCalObsOnly	1787.9 (779.2 - 105112)	770.8 (320.8 - 97210.3)	0.53 (0.19 - 0.97)	0.35 (0 - 1.38)	279.4 (71.5 - 13940.9)	286.3 (71.4 - 13044.9)
Z-RecFINONly	2370.8 (1216.8 - 4298.7)	431.2 (146.6 - 1666.2)	0.2 (0.07 - 0.51)	1.4 (0.39 - 5.39)	71 (14.3 - 241.8)	70.7 (11.7 - 246.2)

7.2.1.2 China rockfish

7.2.1.2.1 North of 40° 10′ N. lat.

Table 48. Time series from the post-STAR panel XDB-SRA model for China rockfish (north of 40° 10′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, which is specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1916	0.0	492.1	246.1	1.000	0.000	0.000
1917	0.0	492.1	246.1	1.000	0.000	0.000
1918	0.0	492.1	246.1	1.000	0.000	0.000
1919	0.0	492.1	246.1	1.000	0.000	0.000
1920	0.0	492.1	246.1	1.000	0.000	0.000
1921	0.0	492.1	246.1	1.000	0.000	0.000
1922	0.0	492.1	246.1	1.000	0.000	0.000
1923	0.0	492.1	246.1	1.000	0.000	0.000
1924	0.0	492.1	246.1	1.000	0.000	0.000
1925	0.0	492.1	246.1	1.000	0.000	0.000
1926	0.0	492.1	246.0	1.000	0.000	0.000
1927	0.0	492.1	246.0	1.000	0.000	0.000
1928	0.0	492.1	246.0	1.000	0.000	0.001
1929	0.1	492.1	246.0	1.000	0.000	0.003
1930	0.1	492.0	246.0	1.000	0.000	0.005
1931	0.1	491.9	245.9	0.999	0.000	0.003
1932	0.0	491.8	245.9	0.999	0.000	0.001
1933	0.1	491.8	245.9	0.999	0.000	0.004
1934	0.8	491.7	245.9	0.999	0.002	0.031
1935	0.6	491.0	245.5	0.998	0.001	0.026
1936	1.0	490.4	245.2	0.997	0.002	0.041
1937	0.8	489.5	244.7	0.995	0.002	0.033
1938	2.6	488.8	244.4	0.993	0.005	0.105
1939	4.7	486.3	243.2	0.989	0.010	0.196
1940	3.0	481.8	240.9	0.980	0.006	0.125
1941	1.0	479.3	239.6	0.975	0.002	0.041
1942	0.8	479.1	239.6	0.974	0.002	0.035
1943	0.4	479.0	239.5	0.974	0.001	0.017
1944	0.4	479.5	239.8	0.975	0.001	0.018
1945	0.5	479.8	239.9	0.976	0.001	0.020
1946	0.6	480.0	240.0	0.977	0.001	0.024
1947	0.2	480.2	240.1	0.977	0.001	0.010
1948	0.4	480.7	240.3	0.978	0.001	0.018
1949	0.4	480.7	240.4	0.979	0.001	0.017
1950	0.3	481.0	240.5	0.980	0.001	0.010
1951	0.2	481.2	240.6	0.980	0.000	0.010
1952	0.3	481.7	240.9	0.981	0.001	0.011
1953	0.1	482.1	241.1	0.982	0.000	0.005
1954	0.1	482.5	241.2	0.982	0.000	0.004
1955	0.2	482.8	241.4	0.983	0.000	0.008
1956	0.1	483.0	241.5	0.984	0.000	0.005
1957	0.3	483.2	241.6	0.984	0.001	0.012
1958	0.1	483.2	241.6	0.985	0.000	0.003
1959	0.1	483.5	241.8	0.985	0.000	0.004
1960	0.1	483.8	241.9	0.986	0.000	0.004
1961	0.3	484.0	242.0	0.987	0.001	0.011
1962	0.3	484.0	242.0	0.987	0.001	0.012
1963	0.5	484.1	242.0	0.987	0.001	0.019
1964	0.5	483.9	242.0	0.987	0.001	0.021

Table 47 (Continued). Time series from the post-STAR panel XDB-SRA model for China rockfish (north of 40° 10′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1965	0.9	483.8	241.9	0.987	0.002	0.038
1966	0.9	483.2	241.6	0.986	0.002	0.039
1967	1.4	482.5	241.3	0.985	0.003	0.058
1968	1.5	481.5	240.8	0.983	0.003	0.063
1969	2.5	480.5	240.2	0.980	0.005	0.103
1970	2.0	478.5	239.2	0.976	0.004	0.086
1971	3.0	477.1	238.5	0.973	0.006	0.125
1972	3.5	474.9	237.4	0.968	0.007	0.148
1973	3.8	472.3	236.1	0.962	0.008	0.160
1974	4.5	469.4	234.7	0.956	0.009	0.191
1975	3.5	466.2	233.1	0.949	0.008	0.152
1976	3.0	464.0	232.0	0.945	0.006	0.130
1977	3.2	462.4	231.2	0.942	0.007	0.140
1978	4.6	460.6	230.3	0.939	0.010	0.198
1979	3.4	457.5	228.8	0.934	0.007	0.148
1980	10.7	456.1	228.0	0.931	0.024	0.470
1981	16.3	447.2	223.6	0.913	0.036	0.728
1982	18.4	433.4	216.7	0.884	0.042	0.847
1983	2.8	418.0	209.0	0.852	0.007	0.135
1984	6.2	419.0	209.5	0.855	0.015	0.293
1985	8.9	416.9	208.4	0.851	0.021	0.427
1986	5.5	411.9	206.0	0.842	0.013	0.266
1987	12.7	411.2	205.6	0.841	0.031	0.618
1988	11.5	402.7	201.4	0.824	0.028	0.567
1989	12.6	395.9	197.9	0.812	0.032	0.630
1990	15.9	388.1	194.0	0.797	0.041	0.811
1991	11.6	377.1	188.5	0.776	0.031	0.610
1992	17.4	371.3	185.6	0.766	0.047	0.927
1993	13.8	359.7	179.9	0.743	0.038	0.758
1994	18.7	353.1	176.6	0.730	0.053	1.049
1995	18.8	340.9	170.5	0.706	0.055	1.091
1996	16.7	329.5	164.7	0.683	0.051	1.002
1997	22.3	320.6	160.3	0.666	0.070	1.377
1998	27.5	305.7	152.8	0.637	0.090	1.774
1999	35.9	287.3	143.7	0.598	0.125	2.472
2000	22.2	261.0	130.5	0.542	0.085	1.709
2001	28.1	249.5	124.8	0.520	0.113	2.259
2002	28.8	233.2	116.6	0.485	0.124	2.495
2003	16.5	215.8	107.9	0.449	0.076	1.545
2004	12.0	210.8	105.4	0.442	0.057	1.144
2005	9.4	209.5	104.7	0.442	0.045	0.898
2006	11.1	210.6	105.3	0.447	0.053	1.037
2007	15.4	209.5	104.8	0.447	0.073	1.440
2008	16.3	202.7	101.4	0.434	0.080	1.574
2009	15.1	195.4	97.7	0.420	0.077	1.521
2010	11.8	189.9	95.0	0.410	0.062	1.223
2011	16.4	188.5	94.3	0.408	0.087	1.700
2012	17.3	182.3	91.2	0.397	0.095	1.851
2013	15.2	176.1	88.0	0.383	0.086	1.685

Table 49. Percentiles of estimated parameters and derived quantities from the XDB-SRA model for China rockfish (north of 40° 10′ N. lat.). OFL estimates assume projections of constant catch, equal to average catch from 2010-2012.

		Percentile				
Quantity	**Derived or Estimated**	**5%**	**25%**	**50%**	**75%**	**95%**
log q (index 1)	Derived	-9.961	-9.461	-9.181	-8.933	-8.570
log q (index 2)	Derived	-10.155	-9.510	-9.109	-8.776	-8.323
log a (index 1)	Estimated	-4.812	-3.390	-2.738	-2.193	-1.521
log a (index 2)	Estimated	-3.905	-2.655	-1.994	-1.424	-0.643
M	Estimated	0.029	0.044	0.057	0.074	0.109
F_{MSY} / M	Estimated	0.431	0.679	0.918	1.263	1.964
Delta (year: 2000)	Estimated	0.267	0.385	0.458	0.516	0.583
B_{MSY} / B_0	Estimated	0.198	0.302	0.395	0.490	0.623
F_{MSY}	Derived	0.019	0.035	0.053	0.079	0.138
E_{MSY}	Derived	0.018	0.034	0.051	0.074	0.123
MSY	Derived	3.93	7.02	9.67	12.80	18.82
B_{MSY}	Derived	101.3	145.4	186.1	237.0	356.8
Vulnerable Biomass (1916)	Derived	280.2	394.6	492.1	613.5	907.6
Vulnerable Biomass (2013)	Derived	63.1	118.1	176.1	278.5	551.1
OFL 2013	Derived	2.49	5.28	8.99	15.28	31.99
OFL 2014	Derived	2.22	5.00	8.73	15.10	32.05
OFL 2015	Derived	1.94	4.69	8.48	14.96	32.03

Table 50. Sensitivity analyses for China rockfish (north of 40° 10′ N. lat.) presented at the STAR Panel. Results are not based on the final (base) model. 'oldBase' uses productivity priors from Dick and MacCall (2010), 'Zhou' uses diffuse priors for Fmsy/M and Bmsy/B0 (see text for details), and runs starting with 'Z-' are the 'Zhou' run fit to single indices of abundance.

Run	SB0	SB2013	SB2013/SB0	F2012/FMSY	OFL2015	OFL2016
oldBase	231 (154.9 - 397.2)	80.6 (28.9 - 249.2)	0.36 (0.16 - 0.65)	2.37 (0.75 - 6.98)	6.7 (1.7 - 22.4)	6.4 (1.4 - 22.3)
Zhou	227.4 (131 - 404.2)	80.6 (28.5 - 250.6)	0.37 (0.16 - 0.67)	2.06 (0.57 - 7.53)	7.7 (1.7 - 29.2)	7.4 (1.3 - 29.1)
Z-NorCalORObsOnly	237.1 (128.5 - 533.7)	89.8 (25.7 - 379)	0.4 (0.15 - 0.78)	1.87 (0.41 - 7.13)	8.5 (1.7 - 41.3)	8.3 (1.3 - 41.3)
Z-RecFINOnly	221.7 (133 - 396.5)	66.8 (22.5 - 240.2)	0.32 (0.12 - 0.67)	2.63 (0.6 - 10.02)	5.8 (1 - 27.9)	5.5 (0.7 - 27.7)

7.2.1.2.2 South of 40° 10′ N. lat.

Table 51. Time series from the post-STAR panel XDB-SRA model for China rockfish (south of 40° 10′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, which is specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1916	6.5	887.1	443.6	1.000	0.007	0.092
1917	10.1	880.6	440.3	0.993	0.012	0.144
1918	11.9	870.8	435.4	0.982	0.014	0.171
1919	8.2	860.1	430.0	0.970	0.010	0.120
1920	8.4	853.8	426.9	0.962	0.010	0.124
1921	6.9	847.6	423.8	0.955	0.008	0.103
1922	6.0	843.6	421.8	0.951	0.007	0.089
1923	6.5	841.8	420.9	0.949	0.008	0.096
1924	3.7	841.1	420.5	0.949	0.004	0.056
1925	4.7	842.4	421.2	0.952	0.006	0.070
1926	7.5	844.1	422.0	0.954	0.009	0.112
1927	6.4	842.8	421.4	0.954	0.008	0.095
1928	8.2	843.2	421.6	0.954	0.010	0.121
1929	7.2	841.5	420.8	0.953	0.009	0.108
1930	10.0	841.2	420.6	0.952	0.012	0.149
1931	5.1	837.8	418.9	0.948	0.006	0.077
1932	11.5	839.2	419.6	0.949	0.014	0.171
1933	5.5	833.4	416.7	0.943	0.007	0.083
1934	10.1	834.3	417.2	0.944	0.012	0.151
1935	9.5	830.4	415.2	0.939	0.011	0.144
1936	9.9	827.9	414.0	0.936	0.012	0.149
1937	9.6	824.7	412.4	0.932	0.012	0.146
1938	7.7	822.3	411.2	0.930	0.009	0.118
1939	5.4	822.3	411.2	0.930	0.007	0.083
1940	5.5	824.4	412.2	0.934	0.007	0.084
1941	5.1	826.3	413.1	0.938	0.006	0.077
1942	2.8	828.6	414.3	0.941	0.003	0.043
1943	3.8	833.2	416.6	0.947	0.005	0.057
1944	2.1	837.4	418.7	0.951	0.003	0.032
1945	2.8	842.2	421.1	0.955	0.003	0.041
1946	5.3	846.0	423.0	0.959	0.006	0.078
1947	4.6	847.1	423.6	0.960	0.005	0.067
1948	9.4	848.3	424.2	0.961	0.011	0.138
1949	12.4	843.7	421.8	0.956	0.015	0.183
1950	11.3	836.1	418.1	0.948	0.014	0.169
1951	13.9	829.8	414.9	0.940	0.017	0.209
1952	12.1	821.5	410.8	0.928	0.015	0.185
1953	10.6	815.1	407.5	0.920	0.013	0.163
1954	11.1	811.8	405.9	0.915	0.014	0.171
1955	12.7	808.6	404.3	0.911	0.016	0.197
1956	14.0	803.9	402.0	0.907	0.017	0.218
1957	14.2	799.3	399.6	0.902	0.018	0.224
1958	22.8	795.0	397.5	0.899	0.029	0.359
1959	18.1	783.7	391.9	0.887	0.023	0.291
1960	15.1	777.3	388.7	0.881	0.019	0.244
1961	14.7	774.2	387.1	0.878	0.019	0.239
1962	12.6	772.5	386.3	0.877	0.016	0.204
1963	16.0	773.1	386.5	0.878	0.021	0.259
1964	10.1	770.9	385.4	0.876	0.013	0.164

Table 50 (Continued). Time series from the post-STAR panel XDB-SRA model for China rockfish (south of 40° 10′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1965	17.0	775.0	387.5	0.881	0.022	0.275
1966	18.9	771.5	385.7	0.878	0.025	0.307
1967	24.3	766.4	383.2	0.873	0.032	0.398
1968	21.2	756.1	378.0	0.861	0.028	0.351
1969	23.2	750.3	375.2	0.855	0.031	0.388
1970	37.3	742.1	371.0	0.845	0.050	0.633
1971	27.1	720.8	360.4	0.818	0.038	0.476
1972	39.2	711.6	355.8	0.807	0.055	0.699
1973	50.3	690.8	345.4	0.783	0.073	0.928
1974	49.5	660.7	330.3	0.748	0.075	0.960
1975	48.0	633.9	317.0	0.717	0.076	0.976
1976	52.1	611.1	305.5	0.692	0.085	1.106
1977	47.8	585.0	292.5	0.664	0.082	1.064
1978	33.3	565.7	282.9	0.643	0.059	0.768
1979	44.5	562.0	281.0	0.639	0.079	1.029
1980	58.0	548.6	274.3	0.624	0.106	1.381
1981	35.7	522.4	261.2	0.595	0.068	0.896
1982	45.4	518.8	259.4	0.592	0.087	1.146
1983	23.6	505.6	252.8	0.577	0.047	0.613
1984	24.3	515.8	257.9	0.589	0.047	0.616
1985	29.1	523.7	261.8	0.600	0.056	0.725
1986	42.2	524.9	262.4	0.601	0.080	1.045
1987	56.7	513.0	256.5	0.587	0.111	1.442
1988	41.3	487.4	243.7	0.557	0.085	1.113
1989	36.8	478.6	239.3	0.548	0.077	1.009
1990	35.3	475.2	237.6	0.545	0.074	0.973
1991	39.3	474.4	237.2	0.544	0.083	1.088
1992	47.9	468.1	234.1	0.538	0.102	1.345
1993	40.5	452.8	226.4	0.520	0.090	1.179
1994	60.7	445.8	222.9	0.511	0.136	1.795
1995	45.7	418.5	209.2	0.480	0.109	1.445
1996	33.0	407.7	203.9	0.468	0.081	1.070
1997	38.6	410.7	205.3	0.471	0.094	1.240
1998	18.7	406.8	203.4	0.467	0.046	0.605
1999	20.7	423.3	211.6	0.485	0.049	0.643
2000	20.1	434.5	217.2	0.498	0.046	0.606
2001	18.7	443.0	221.5	0.509	0.042	0.550
2002	17.8	454.8	227.4	0.522	0.039	0.509
2003	17.6	465.7	232.9	0.534	0.038	0.488
2004	9.9	476.8	238.4	0.546	0.021	0.267
2005	15.9	495.3	247.7	0.568	0.032	0.408
2006	12.8	508.3	254.2	0.583	0.025	0.320
2007	13.5	523.5	261.7	0.601	0.026	0.326
2008	15.3	537.2	268.6	0.617	0.028	0.358
2009	20.3	549.7	274.9	0.632	0.037	0.461
2010	18.9	554.6	277.3	0.640	0.034	0.422
2011	15.7	562.4	281.2	0.651	0.028	0.345
2012	13.6	574.0	287.0	0.664	0.024	0.292
2013	16.1	585.7	292.8	0.679	0.027	0.336

Table 52. Percentiles of estimated parameters and derived quantities from the XDB-SRA model for China rockfish (south of 40° 10′ N. lat.). OFL estimates assume projections of constant catch, equal to average catch from 2010-2012.

		Percentile				
Quantity	**Derived or Estimated**	**5%**	**25%**	**50%**	**75%**	**95%**
log q (index 1)	Derived	-11.056	-9.776	-9.253	-8.875	-8.468
log q (index 2)	Derived	-10.810	-9.552	-9.038	-8.663	-8.244
log a (index 1)	Estimated	-2.523	-1.922	-1.530	-1.153	-0.632
log a (index 2)	Estimated	-4.185	-3.289	-2.814	-2.425	-1.914
M	Estimated	0.035	0.050	0.065	0.082	0.118
F_{MSY} / M	Estimated	0.575	0.951	1.304	1.718	2.500
Delta (year: 2000)	Estimated	0.211	0.386	0.502	0.597	0.708
B_{MSY} / B_0	Estimated	0.254	0.378	0.464	0.551	0.683
F_{MSY}	Derived	0.028	0.058	0.088	0.120	0.176
E_{MSY}	Derived	0.027	0.055	0.082	0.109	0.154
MSY	Derived	23.90	29.98	32.99	36.48	51.14
B_{MSY}	Derived	221.9	308.7	417.2	606.8	1318.9
Vulnerable Biomass (1916)	Derived	519.2	688.7	887.1	1298.7	3693.5
Vulnerable Biomass (2013)	Derived	313.1	438.8	585.7	893.0	2818.7
OFL 2013	Derived	26.74	38.20	47.78	61.72	122.23
OFL 2014	Derived	27.18	39.01	48.76	62.39	122.77
OFL 2015	Derived	27.68	39.83	49.73	62.97	123.32

Table 53. Sensitivity analyses for China rockfish (south of 40° 10′ N. lat.) presented at the STAR Panel. Results are not based on the final (base) model. ‘oldBase’ uses productivity priors from Dick and MacCall (2010), ‘Zhou’ uses diffuse priors for Fmsy/M and Bmsy/B0 (see text for details), and runs starting with ‘Z-’ are the ‘Zhou’ run fit to single indices of abundance.

Run	SB_0	SB_{2013}	SB_{2013}/SB_0	F_{2012}/F_{MSY}	OFL_{2015}	OFL_{2016}
oldBase	747.9 (382.9 - 2166.9)	463.2 (202.9 - 1818.8)	0.65 (0.45 - 0.87)	0.29 (0.1 - 0.58)	47.4 (24 - 139.4)	47.9 (24.2 - 139.8)
Zhou	463.9 (264.1 - 2050.1)	310.8 (164.8 - 1666.3)	0.69 (0.45 - 0.93)	0.27 (0.1 - 0.5)	52.5 (28.3 - 142.4)	53.4 (28.8 - 142.7)
Z-CenCalObsOnly	387.5 (240.9 - 1024)	201.8 (114.6 - 663)	0.53 (0.33 - 0.82)	0.34 (0.18 - 0.63)	41.9 (22.9 - 77.8)	43.1 (23.3 - 78.5)
Z-RecFINOnly	1166.4 (463 - 4426.6)	710.4 (230.2 - 3888.4)	0.67 (0.34 - 0.93)	0.27 (0.06 - 1.04)	52.5 (13.4 - 263.8)	52.7 (13.3 - 263.8)

7.2.1.3 Copper rockfish

7.2.1.3.1 North of 34° 27′ N. lat.

Table 54. Time series from the post-STAR panel XDB-SRA model for copper rockfish (north of 34° 27′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, which is specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1916	4.1	3395.0	1697.5	1.000	0.001	0.014
1917	6.4	3390.9	1695.4	0.999	0.002	0.022
1918	7.8	3384.7	1692.3	0.997	0.002	0.027
1919	5.1	3377.5	1688.8	0.995	0.002	0.018
1920	5.2	3373.7	1686.9	0.994	0.002	0.018
1921	4.5	3369.9	1684.9	0.993	0.001	0.016
1922	3.8	3367.2	1683.6	0.992	0.001	0.013
1923	4.0	3365.7	1682.9	0.992	0.001	0.014
1924	2.7	3364.6	1682.3	0.991	0.001	0.009
1925	4.0	3365.0	1682.5	0.992	0.001	0.014
1926	5.1	3364.1	1682.0	0.991	0.002	0.018
1927	3.8	3362.7	1681.3	0.991	0.001	0.013
1928	5.4	3361.7	1680.9	0.991	0.002	0.019
1929	6.4	3360.2	1680.1	0.990	0.002	0.022
1930	9.3	3357.2	1678.6	0.989	0.003	0.032
1931	11.4	3352.0	1676.0	0.988	0.003	0.040
1932	11.9	3344.7	1672.4	0.986	0.004	0.042
1933	12.3	3337.7	1668.9	0.984	0.004	0.043
1934	12.2	3331.3	1665.7	0.982	0.004	0.043
1935	15.6	3324.9	1662.5	0.980	0.005	0.055
1936	16.4	3315.7	1657.9	0.977	0.005	0.058
1937	19.2	3306.5	1653.3	0.974	0.006	0.068
1938	18.4	3295.0	1647.5	0.971	0.006	0.066
1939	16.5	3285.2	1642.6	0.969	0.005	0.059
1940	21.3	3278.5	1639.3	0.967	0.007	0.076
1941	20.4	3267.6	1633.8	0.964	0.006	0.073
1942	10.1	3259.0	1629.5	0.962	0.003	0.036
1943	11.0	3261.8	1630.9	0.963	0.003	0.040
1944	15.6	3262.8	1631.4	0.963	0.005	0.056
1945	30.8	3259.5	1629.8	0.962	0.009	0.111
1946	39.4	3242.3	1621.1	0.957	0.012	0.142
1947	18.8	3218.3	1609.1	0.950	0.006	0.068
1948	32.7	3217.0	1608.5	0.950	0.010	0.119
1949	34.7	3202.6	1601.3	0.945	0.011	0.127
1950	39.6	3186.4	1593.2	0.941	0.012	0.146
1951	54.4	3166.7	1583.4	0.935	0.017	0.202
1952	45.6	3132.7	1566.3	0.925	0.015	0.171
1953	36.5	3110.8	1555.4	0.919	0.012	0.138
1954	47.2	3101.5	1550.8	0.916	0.015	0.179
1955	52.7	3081.9	1540.9	0.910	0.017	0.201
1956	60.4	3057.7	1528.8	0.904	0.020	0.232
1957	58.6	3028.9	1514.5	0.895	0.019	0.227
1958	99.5	3002.7	1501.3	0.889	0.033	0.388
1959	80.6	2940.8	1470.4	0.870	0.027	0.321
1960	68.7	2902.8	1451.4	0.859	0.024	0.277
1961	51.5	2879.2	1439.6	0.853	0.018	0.209
1962	64.0	2875.1	1437.5	0.852	0.022	0.259
1963	79.8	2861.2	1430.6	0.847	0.028	0.325
1964	71.2	2829.1	1414.5	0.839	0.025	0.293

Table 53 (Continued). Time series from the post-STAR panel XDB-SRA model for copper rockfish (north of 34° 27′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1965	105.8	2807.9	1404.0	0.833	0.038	0.437
1966	121.9	2758.3	1379.1	0.818	0.044	0.513
1967	129.7	2695.3	1347.7	0.800	0.048	0.559
1968	137.2	2629.5	1314.7	0.781	0.052	0.607
1969	147.7	2559.5	1279.8	0.761	0.058	0.670
1970	182.4	2483.8	1241.9	0.740	0.073	0.853
1971	171.2	2383.1	1191.5	0.710	0.072	0.836
1972	217.7	2299.5	1149.8	0.686	0.095	1.101
1973	249.0	2177.5	1088.7	0.649	0.114	1.332
1974	273.9	2033.1	1016.6	0.606	0.135	1.572
1975	270.2	1876.7	938.3	0.559	0.144	1.685
1976	298.9	1735.5	867.7	0.517	0.172	2.017
1977	308.5	1572.3	786.1	0.470	0.196	2.300
1978	284.4	1413.2	706.6	0.423	0.201	2.360
1979	295.4	1287.9	644.0	0.387	0.229	2.682
1980	115.7	1157.1	578.6	0.348	0.100	1.170
1981	401.2	1210.3	605.2	0.366	0.331	3.854
1982	215.8	961.8	480.9	0.290	0.224	2.618
1983	171.6	909.5	454.8	0.276	0.189	2.199
1984	155.7	894.0	447.0	0.272	0.174	2.025
1985	158.9	886.3	443.1	0.269	0.179	2.090
1986	122.8	861.2	430.6	0.261	0.143	1.659
1987	99.7	882.2	441.1	0.269	0.113	1.313
1988	96.1	894.5	447.2	0.272	0.107	1.248
1989	106.7	903.3	451.6	0.274	0.118	1.375
1990	118.1	899.2	449.6	0.272	0.131	1.533
1991	126.7	880.8	440.4	0.267	0.144	1.677
1992	150.3	853.5	426.7	0.258	0.176	2.060
1993	149.5	807.4	403.7	0.245	0.185	2.168
1994	83.2	766.7	383.4	0.233	0.108	1.268
1995	70.4	794.6	397.3	0.243	0.089	1.029
1996	89.0	839.1	419.6	0.255	0.106	1.234
1997	89.5	856.7	428.4	0.259	0.104	1.217
1998	60.7	866.5	433.3	0.262	0.070	0.815
1999	53.4	899.2	449.6	0.271	0.059	0.689
2000	39.1	931.5	465.8	0.280	0.042	0.487
2001	33.9	978.2	489.1	0.294	0.035	0.401
2002	26.4	1033.4	516.7	0.311	0.026	0.296
2003	28.2	1093.1	546.5	0.329	0.026	0.298
2004	23.0	1145.6	572.8	0.345	0.020	0.231
2005	41.2	1204.9	602.4	0.362	0.034	0.392
2006	43.1	1243.1	621.5	0.373	0.035	0.398
2007	48.5	1283.0	641.5	0.384	0.038	0.433
2008	38.8	1322.1	661.0	0.396	0.029	0.336
2009	45.6	1374.8	687.4	0.411	0.033	0.379
2010	34.3	1418.2	709.1	0.424	0.024	0.276
2011	35.5	1478.0	739.0	0.441	0.024	0.274
2012	44.8	1531.8	765.9	0.458	0.029	0.332
2013	38.2	1575.0	787.5	0.471	0.024	0.274

Table 55. Percentiles of estimated parameters and derived quantities from the XDB-SRA model for copper rockfish (north of 34° 27′ N. lat.). OFL estimates assume projections of constant catch, equal to average catch from 2010-2012.

		Percentile				
Quantity	**Derived or Estimated**	**5%**	**25%**	**50%**	**75%**	**95%**
log q (index 1)	Derived	-10.299	-9.808	-9.503	-9.221	-8.857
log q (index 2)	Derived	-10.579	-10.072	-9.765	-9.489	-9.127
log q (index 3)	Derived	-11.560	-11.126	-10.836	-10.568	-10.208
log a (index 1)	Estimated	-3.470	-2.960	-2.620	-2.285	-1.787
log a (index 2)	Estimated	-2.576	-1.981	-1.600	-1.226	-0.740
log a (index 3)	Estimated	-3.658	-2.468	-1.867	-1.317	-0.694
M	Estimated	0.051	0.071	0.089	0.113	0.157
F_{MSY} / M	Estimated	0.630	0.882	1.092	1.343	1.783
Delta (year: 2000)	Estimated	0.472	0.635	0.720	0.786	0.850
B_{MSY} / B_0	Estimated	0.229	0.323	0.404	0.489	0.609
F_{MSY}	Derived	0.054	0.080	0.099	0.120	0.160
E_{MSY}	Derived	0.051	0.073	0.090	0.107	0.139
MSY	Derived	85.8	103.3	117.4	132.4	155.1
B_{MSY}	Derived	821.3	1103.9	1330.2	1598.0	2138.1
Vulnerable Biomass (1916)	Derived	2341.9	2941.4	3395.0	3891.6	4937.5
Vulnerable Biomass (2013)	Derived	891.9	1231.9	1575.0	2041.3	2966.3
OFL 2013	Derived	74.3	108.0	139.6	180.9	267.1
OFL 2014	Derived	76.6	112.0	144.3	186.4	271.5
OFL 2015	Derived	79.0	116.1	148.9	192.0	275.7

Table 56. Sensitivity analyses for copper rockfish (preliminary coast-wide model) presented at the STAR Panel. Results are not based on the final (base) model. 'oldBase' uses productivity priors from Dick and MacCall (2010), 'Zhou' uses diffuse priors for Fmsy/M and Bmsy/B0 (see text for details), and runs starting with 'Z-' are the 'Zhou' run fit to single indices of abundance.

Run	SB0	SB2013	SB2013/SB0	F2012/FMSY	OFL2015	OFL2016
oldBase	2677.9 (1994.6 - 3868.9)	1150.8 (733.6 - 2184.5)	0.43 (0.31 - 0.64)	0.52 (0.31 - 0.82)	193.7 (123.4 - 319.1)	199 (126.2 - 323.7)
Zhou	2677.3 (1950.1 - 3902.7)	1202.2 (756.6 - 2253.2)	0.45 (0.3 - 0.73)	0.45 (0.25 - 0.77)	226.6 (134.3 - 388.4)	233.2 (138 - 395.7)
Z-NorCalORObsOnly	3660.1 (2256.9 - 7057.9)	881.1 (187.2 - 4958.9)	0.26 (0.06 - 0.77)	1.23 (0.21 - 6.17)	80.7 (13.8 - 485.3)	81.6 (13 - 487.5)
Z-CenCalObsOnly	2334.6 (1722.1 - 3110.2)	1374.1 (746.3 - 2292.1)	0.59 (0.32 - 0.95)	0.31 (0.17 - 0.58)	327.8 (179.8 - 533.6)	337.1 (185.8 - 535.4)
Z-SoCalObsOnly	2751.7 (1657.7 - 5519.9)	841.2 (247.2 - 3157.9)	0.32 (0.09 - 0.81)	0.68 (0.2 - 2.96)	150 (31.5 - 489.3)	155.3 (31 - 496.1)
Z-RecFINONly	5185.6 (3063.8 - 10457.7)	1975.8 (861.5 - 7046.1)	0.4 (0.23 - 0.72)	0.71 (0.17 - 1.97)	139.8 (49.3 - 606.4)	140.9 (49.1 - 606.2)

7.2.1.3.2 South of 34° 27′ N. lat.

Table 57. Time series from the post-STAR panel XDB-SRA model for copper rockfish (south of 34° 27′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, which is specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1916	0.1	2193.6	1096.8	1.000	0.000	0.001
1917	0.2	2193.5	1096.7	1.000	0.000	0.001
1918	0.2	2193.3	1096.6	1.000	0.000	0.001
1919	0.1	2193.1	1096.6	1.000	0.000	0.001
1920	0.1	2193.1	1096.5	1.000	0.000	0.001
1921	0.1	2193.0	1096.5	1.000	0.000	0.001
1922	0.1	2193.0	1096.5	1.000	0.000	0.001
1923	0.1	2193.0	1096.5	1.000	0.000	0.001
1924	0.2	2193.0	1096.5	1.000	0.000	0.001
1925	0.2	2192.9	1096.4	1.000	0.000	0.001
1926	0.3	2192.8	1096.4	1.000	0.000	0.002
1927	0.2	2192.5	1096.3	1.000	0.000	0.001
1928	0.2	2192.5	1096.2	1.000	0.000	0.001
1929	0.2	2192.4	1096.2	1.000	0.000	0.001
1930	0.3	2192.3	1096.2	1.000	0.000	0.002
1931	0.3	2192.2	1096.1	0.999	0.000	0.002
1932	0.3	2192.1	1096.0	0.999	0.000	0.002
1933	0.2	2191.9	1096.0	0.999	0.000	0.001
1934	0.3	2191.9	1096.0	0.999	0.000	0.002
1935	0.6	2191.8	1095.9	0.999	0.000	0.003
1936	0.4	2191.5	1095.7	0.999	0.000	0.002
1937	1.2	2191.3	1095.7	0.999	0.001	0.006
1938	0.7	2190.4	1095.2	0.999	0.000	0.004
1939	0.5	2190.1	1095.0	0.999	0.000	0.003
1940	0.5	2190.0	1095.0	0.998	0.000	0.003
1941	0.6	2189.9	1094.9	0.998	0.000	0.003
1942	0.1	2189.7	1094.9	0.998	0.000	0.001
1943	0.2	2190.1	1095.0	0.999	0.000	0.001
1944	0.1	2190.4	1095.2	0.999	0.000	0.001
1945	0.2	2190.8	1095.4	0.999	0.000	0.001
1946	0.2	2191.1	1095.6	0.999	0.000	0.001
1947	0.7	2191.4	1095.7	0.999	0.000	0.004
1948	1.8	2191.2	1095.6	0.999	0.001	0.010
1949	2.3	2189.8	1094.9	0.999	0.001	0.012
1950	3.2	2188.0	1094.0	0.998	0.001	0.017
1951	5.9	2185.5	1092.8	0.997	0.003	0.032
1952	4.5	2180.5	1090.3	0.994	0.002	0.024
1953	4.1	2177.4	1088.7	0.993	0.002	0.022
1954	8.6	2174.5	1087.2	0.991	0.004	0.047
1955	16.7	2168.1	1084.1	0.988	0.008	0.091
1956	18.3	2153.9	1077.0	0.982	0.008	0.100
1957	10.8	2139.4	1069.7	0.975	0.005	0.060
1958	10.9	2133.9	1066.9	0.973	0.005	0.060
1959	5.9	2129.3	1064.7	0.971	0.003	0.033
1960	6.8	2132.4	1066.2	0.972	0.003	0.038
1961	9.7	2132.1	1066.1	0.973	0.005	0.053
1962	6.6	2130.7	1065.3	0.973	0.003	0.036
1963	7.0	2133.6	1066.8	0.975	0.003	0.038
1964	11.8	2137.1	1068.5	0.977	0.006	0.065

Table 56 (Continued). Time series from the post-STAR panel XDB-SRA model for copper rockfish (south of 34° 27′ N. lat.). Derived quantities (biomasses, depletion, and exploitation rates) are median values. Catch is total catch (landings + discard). Note that median depletion estimates may differ from the posterior mode, specified as the preferred measure of central tendency in the current Terms of Reference for Groundfish Stock Assessment.

Year	Catch	Vulnerable Biomass	Spawning Biomass	Depletion	Exploitation Rate	Exp. Rate / Emsy
1965	17.4	2136.1	1068.0	0.976	0.008	0.095
1966	43.8	2128.2	1064.1	0.973	0.021	0.241
1967	50.7	2094.6	1047.3	0.959	0.024	0.284
1968	59.3	2057.1	1028.6	0.942	0.029	0.339
1969	47.0	2011.9	1005.9	0.921	0.023	0.275
1970	69.6	1981.7	990.9	0.908	0.035	0.415
1971	66.8	1935.1	967.6	0.885	0.035	0.410
1972	92.2	1895.9	948.0	0.866	0.049	0.579
1973	111.5	1834.3	917.1	0.839	0.061	0.727
1974	138.2	1764.5	882.2	0.806	0.078	0.942
1975	142.2	1674.5	837.3	0.766	0.085	1.029
1976	116.9	1593.0	796.5	0.728	0.073	0.895
1977	109.1	1542.9	771.4	0.707	0.071	0.866
1978	108.1	1507.2	753.6	0.692	0.072	0.879
1979	151.8	1480.8	740.4	0.680	0.103	1.256
1980	363.9	1409.5	704.8	0.650	0.258	3.175
1981	120.4	1137.7	568.9	0.523	0.106	1.338
1982	224.7	1127.8	563.9	0.520	0.199	2.507
1983	117.2	1015.8	507.9	0.468	0.115	1.468
1984	131.3	1021.8	510.9	0.470	0.128	1.632
1985	167.2	1007.3	503.6	0.465	0.166	2.095
1986	141.6	955.5	477.8	0.442	0.148	1.868
1987	16.2	915.0	457.5	0.424	0.018	0.224
1988	74.7	1003.7	501.9	0.463	0.074	0.931
1989	71.6	1012.9	506.4	0.468	0.071	0.882
1990	57.6	1028.8	514.4	0.474	0.056	0.700
1991	50.9	1055.2	527.6	0.485	0.048	0.601
1992	32.6	1080.7	540.4	0.495	0.030	0.375
1993	19.9	1118.6	559.3	0.510	0.018	0.221
1994	62.8	1175.7	587.8	0.536	0.053	0.660
1995	51.0	1186.6	593.3	0.540	0.043	0.530
1996	98.0	1207.9	604.0	0.550	0.081	0.996
1997	43.9	1181.9	590.9	0.538	0.037	0.457
1998	55.7	1213.1	606.6	0.553	0.046	0.561
1999	62.4	1233.9	617.0	0.564	0.051	0.616
2000	27.4	1251.8	625.9	0.572	0.022	0.265
2001	20.6	1303.6	651.8	0.596	0.016	0.189
2002	14.6	1357.0	678.5	0.621	0.011	0.128
2003	17.0	1413.6	706.8	0.646	0.012	0.143
2004	16.3	1465.5	732.7	0.669	0.011	0.131
2005	30.2	1514.8	757.4	0.691	0.020	0.235
2006	13.5	1543.7	771.9	0.706	0.009	0.102
2007	30.2	1591.8	795.9	0.729	0.019	0.220
2008	26.5	1621.8	810.9	0.744	0.016	0.189
2009	25.1	1652.9	826.5	0.760	0.015	0.175
2010	23.8	1683.8	841.9	0.776	0.014	0.162
2011	44.9	1713.7	856.8	0.791	0.026	0.298
2012	50.2	1717.7	858.8	0.797	0.029	0.331
2013	39.6	1717.0	858.5	0.800	0.023	0.260

Table 58. Percentiles of estimated parameters and derived quantities from the XDB-SRA model for copper rockfish (south of 34° 27′ N. lat.). OFL estimates assume projections of constant catch, equal to average catch from 2010-2012.

		Percentile				
Quantity	**Derived or Estimated**	**5%**	**25%**	**50%**	**75%**	**95%**
log q (index 1)	Derived	-11.684	-10.750	-10.358	-10.017	-9.595
log q (index 2)	Derived	-11.021	-9.988	-9.506	-9.100	-8.617
log a (index 1)	Estimated	-2.226	-1.709	-1.350	-0.989	-0.478
log a (index 2)	Estimated	-6.645	-5.572	-4.369	-3.347	-2.550
M	Estimated	0.047	0.069	0.089	0.114	0.164
F_{MSY} / M	Estimated	0.499	0.784	1.040	1.367	1.899
Delta (year: 2000)	Estimated	0.164	0.318	0.428	0.534	0.667
B_{MSY} / B_0	Estimated	0.249	0.391	0.481	0.570	0.680
F_{MSY}	Derived	0.035	0.065	0.094	0.131	0.198
E_{MSY}	Derived	0.033	0.061	0.086	0.116	0.168
MSY	Derived	59.1	80.0	91.7	103.6	147.7
B_{MSY}	Derived	555.7	800.1	1058.4	1467.5	2727.7
Vulnerable Biomass (1916)	Derived	1312.0	1722.5	2193.6	3091.7	6977.0
Vulnerable Biomass (2013)	Derived	934.7	1308.8	1717.0	2400.9	5705.6
OFL 2013	Derived	76.3	118.1	152.1	192.2	359.5
OFL 2014	Derived	77.4	120.0	153.3	192.4	358.1
OFL 2015	Derived	78.1	121.6	154.0	192.4	356.3

7.2.2 exSSS model estimates

Table 59. Catchability coefficient (q) and the added variance values for each survey estimated in the MLE exSSS. X: not an applicable index. NA: not available due to unrealistic models.

		Rockfishes		Flatfishes	
Survey	Parameter	Sharpchin	Yellowtail N	English sole	Rex sole
early Triennial	q	1.35	NA	1.54	10.41
	+ var	NA	NA	0.10	0.14
late Triennial	q	0.53	NA	1.52	6.31
	+ var	NA	NA	0.10	0.07
late Triennial	q	NA	0.54	NA	NA
	+ var	NA	0.24	NA	NA
NWFSC annual	q	6.89	0.22	1.22	1.79
	+ var	NA	0.02	0.29	0.00

Table 60. Results of 5 derived outputs (Spawning biomass in the initial year and (SB_0) in 2013 (SB_{2013}), stock depletion status (SB_{2013}/SB_0), fishing status relative to MSY (F_{2012}/F_{MSY}), and OFLs in 2015 and 2016) for SSS and exSSS models.

			Derived Outputs					
Model	Group	Species	SB_0	SB_{2013}	SB_{2013}/SB_0	F_{2012}/F_{MSY}	OFL_{2015}	OFL_{2016}
exSSS AIS	Rockfishes	Sharpchin	6847 (2437-24742)	3291 (1456-21157)	0.73 (0.31-0.91)	0.02	416 (130-1474)	404 (132-1397)
		Yellowtail (N)	68887 (19363-277492)	38168 (12184-221920)	0.69 (0.35-0.90)	0.14	7218 (2646-23903)	6949 (2679-22724)
	Flatfishes	English sole	28731 (11757-94321)	24410 (10444-89100)	0.88 (0.77-0.96)	0.02	10792 (7138-32391)	7890 (4921-23317)
		Rex sole	2406 (731-15814)	1683 (602-13150)	0.80 (0.64-0.93)	0.07	5764 (3089-16500)	3956 (2479-10253)
SSS	Rockfishes	Sharpchin	6204 (2273-13363)	3774 (1587-9595)	0.64 (0.39-0.87)	0.02 (0.01-0.05)	377 (158-854)	367 (159-806)
		Yellowtail (N)	54823 (10668-148869)	26819 (5673-101254)	0.56 (0.23-0.82)	0.17 (0.07-0.56)	4429 (1737-11083)	4378 (1848-10640)
	Flatfishes	English sole	32846 (7663-109934)	29368 (6562-102956)	0.89 (0.8-0.96)	0.01 (0-0.02)	13005 (6362-37567)	9274 (4149-27476)
		Rex sole	10529 (2009-37874)	7950 (1705-32430)	0.82 (0.66-0.95)	0.07 (0.02-0.11)	5956 (3552-22694)	4682 (2896-17218)

7.2.2.1 Sharpchin rockfish

Table 61. Results of base case and sensitivity runs for sharpchin rockfish using exSSS. * indicate runs that did not converge. Colored cells indicate inclusion in the model run. Gray cells indicate indices wherein additional variance was estimated.

			Sensitivity run						
Model attributes		BC	1	2	3	4	5	5	7
Index	NWFSC								
	Triennial- early								
	Triennial- late								
Parameter treatment	M- Hoenig								
	M-Hamel								
	New h prior								
	Old h prior								
Parameter estimates	M_F	0.08	0.08	*	0.08	0.07	0.06	0.12	0.08
	M_M	0.08	0.08	*	0.08	0.08	0.07	0.13	0.08
	h	0.95	0.95	*	0.95	0.95	0.92	0.95	0.75
	ln(R0)	9.16	8.88	*	8.67	8.19	7.87	9.66	8.84
Derived outputs	SB_0	16208	12210	*	9803	6464	5957	11360	11649
	SB_{2013}	14426	10422	*	8013	4449	3208	10511	9580
	SB_{2013}/SB_0	0.89	0.85	*	0.82	0.69	0.54	0.93	0.82
	F_{2012}/F_{MSY}	0.00	0.00	*	0.00	0.01	0.02	0.00	0.01
	MSY	1004	761	*	616	386	286	1106	550
	OFL_{2015}	1235	905	*	708	390	247	1311	829
	OFL_{2016}	1181	868	*	681	379	244	1221	796

7.2.2.2 Yellowtail rockfish (North of 40° 10′ N. lat.)

Table 62. Results of base case and sensitivity runs for yellowtail rockfish (North of 40° 10' N. lat.) using exSSS. Colored cells indicate inclusion in the model run. Gray cells indicate indices wherein additional variance was estimated.

Model attributes		BC	Sensitivity run 1	2	3	4	5	6	7	8	9
Index	Triennial										
	NWFSC										
	Triennial- early										
	Triennial- late										
Parameter treatment	M- Hoenig										
	M-Hamel										
	New h prior										
	Old h prior										
Parameter estimates	M_F	0.11	0.10	0.11	0.11	0.11	0.11	0.10	0.11	0.13	0.11
	M_M	0.11	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11
	h	0.95	0.94	0.95	0.95	0.95	0.96	0.93	0.95	0.95	0.75
	ln(R0)	10.28	9.82	9.84	11.66	9.82	9.73	10.25	9.80	10.37	10.27
Derived outputs	SB_0	102112	73960	63927	395204	68112	55206	96871	64878	74942	100759
	SB_{2013}	84449	52848	45693	378844	48643	37020	76057	45706	64913	79383
	SB_{2013}/SB_0	0.83	0.71	0.71	0.96	0.71	0.67	0.79	0.70	0.87	0.79
	F_{2012}/F_{MSY}	0.03	0.06	0.05	0.01	0.06	0.06	0.05	0.06	0.03	0.07
	MSY	11172	7318	7146	44268	7220	6348	10154	7005	11775	8233
	OFL_{2015}	12281	7080	7193	56591	6900	5641	9510	6582	15153	11981
	OFL_{2016}	11647	6830	6894	52816	6650	5467	9191	6350	14128	11357

7.2.2.3 English sole

Table 63. Results of base case and sensitivity runs for English sole using exSSS. Colored cells indicate inclusion in the model run. Gray cells indicate indices wherein additional variance was estimated.

Model attributes		BC	Sensitivity run 1	2	3	4	5	6	7
Index	Triennial- early								
	Triennial- late								
	NWFSC								
	Triennial								
Parameter treatment	M- Hoenig								
	M-Hamel								
Parameter	M_F	0.26	0.22	0.27	0.22	0.20	0.21	0.28	0.32
	M_M	0.26	0.05	0.29	0.23	0.25	0.27	0.28	0.40
	h	0.80	0.86	0.89	0.74	0.82	0.88	0.85	0.83
	ln(R0)	11.62	11.08	11.51	11.40	11.50	11.21	11.62	11.91
Derived outputs	SB_0	29349	24625	24714	33666	45715	32891	25567	23263
	SB_{2013}	26152	21679	22096	17437	40943	28014	22922	21252
	SB_{2013}/SB_0	0.89	0.88	0.89	0.52	0.90	0.85	0.90	0.91
	F_{2012}/F_{MSY}	0.02	0.01	0.01	0.04	0.01	0.01	0.01	0.01
	MSY	4136	4763	4143	3590	4885	3943	4146	4259
	OFL_{2015}	12092	10767	10477	8237	14629	10384	11220	11901
	OFL_{2016}	8493	8451	7286	10943	10943	7790	7739	7726

7.2.2.4 Rex sole

Table 64. Results of base case and sensitivity runs for rex sole using exSSS. * indicate runs that did not converge. Colored cells indicate inclusion in the model run. Gray cells indicate indices wherein additional variance was estimated.

Model attributes		BC	Sensitivity run						
			1	2	3	4	5	6	7
Index	Triennial- early								
	Triennial- late								
	NWFSC								
	Triennial								
Parameter treatment	M- Hoenig								
	M-Hamel								
Parameter	M_F	0.20	0.24	0.24	0.20	*	0.24	0.27	0.31
	M_M	0.19	0.20	0.22	0.20	*	0.20	0.24	0.29
	h	0.80	0.90	0.84	0.79	*	0.89	0.91	0.84
	ln(R0)	9.97	9.75	10.20	9.91	*	9.75	10.11	10.28
Derived outputs	SB_0	8162	4196	6403	7364	*	4116	4474	3768
	SB_{2013}	6474	2978	5233	4348	*	2915	3543	2790
	SB_{2013}/SB_0	0.79	0.71	0.82	0.59	*	0.71	0.79	0.74
	F_{2012}/F_{MSY}	0.07	0.09	0.07	0.12	*	0.09	0.07	0.10
	MSY	1956	1581	2107	1699	*	1578	1934	1656
	OFL_{2015}	5609	3262	5056	3600	*	3304	3969	3505
	OFL_{2016}	4259	2614	3949	3017	*	2643	3081	2717

7.2.2.5 Stripetail rockfish

Table 65. XDB-SRA results from a profile over credible values of log(q) for fishery-independent survey indices in the model. Depletion (B2013/B0) and F/Fmsy estimates include median (50%) and 90% interval estimates. MSY and OFL (2015) estimates are median values of the posterior distributions.

	B2013/B0			F/Fmsy			MSY	OFL15
lnq	5%	50%	95%	5%	50%	95%	50%	50%
-1	0.951	0.978	0.999	0.002	0.005	0.014	643	2341
-0.5	0.900	0.965	0.994	0.002	0.006	0.016	445	1590
0	0.872	0.942	0.998	0.003	0.009	0.023	247	845
0.5	0.810	0.909	0.998	0.004	0.011	0.033	162	540
1	0.754	0.894	0.992	0.005	0.014	0.037	132	393
1.5	0.602	0.775	0.991	0.009	0.025	0.073	68	202

7.2.3 Decision tables

Table 66. Decision table for brown rockfish (coastwide). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 156 mt/year.

			STATE OF NATURE: DEPLETION IN 2013								
			Lower Quartile			Interquartile Range			Upper Quartile		
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	101.5	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	101.5	521	0.31	13%	789	0.46	0%	1249	0.67	0%
Mgmt.	2017	101.5	534	0.32	9%	807	0.47	0%	1264	0.68	0%
Action:	2018	101.5	547	0.32	8%	824	0.48	0%	1280	0.69	0%
Recent	2019	101.5	561	0.33	6%	842	0.49	0%	1295	0.70	0%
Catch	2020	101.5	576	0.34	5%	861	0.50	0%	1309	0.71	0%
	2021	101.5	590	0.34	4%	877	0.51	0%	1323	0.72	0%
	2022	101.5	605	0.35	3%	894	0.52	0%	1340	0.73	0%
	2023	101.5	620	0.36	3%	912	0.53	0%	1353	0.74	0%
	2024	101.5	634	0.36	3%	927	0.53	0%	1366	0.74	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	103	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	107	520	0.31	15%	788	0.45	0%	1249	0.67	0%
	2017	111	531	0.32	13%	803	0.46	0%	1260	0.68	0%
Mgmt.	2018	114	539	0.32	12%	816	0.47	0%	1272	0.69	0%
Action:	2019	117	548	0.32	11%	829	0.48	0%	1282	0.70	0%
Low ABC	2020	119	557	0.33	11%	841	0.49	0%	1290	0.70	0%
	2021	121	566	0.33	10%	851	0.49	0%	1297	0.71	0%
	2022	123	572	0.33	11%	860	0.50	0%	1305	0.71	0%
	2023	125	579	0.33	11%	870	0.50	0%	1312	0.72	0%
	2024	126	586	0.34	11%	878	0.51	0%	1316	0.72	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	154	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	153	494	0.29	21%	762	0.44	0%	1223	0.65	0%
Mgmt.	2017	152	485	0.29	25%	757	0.44	0%	1215	0.65	0%
Action:	2018	153	480	0.29	27%	756	0.44	0%	1212	0.65	0%
Median	2019	154	476	0.28	28%	757	0.44	0%	1208	0.66	0%
ABC	2020	154	471	0.28	31%	756	0.44	0%	1204	0.66	0%
	2021	155	466	0.28	33%	754	0.44	0%	1201	0.66	0%
	2022	155	461	0.27	36%	754	0.44	0%	1203	0.66	0%
	2023	155	459	0.27	38%	751	0.44	0%	1201	0.66	0%
	2024	154	454	0.26	41%	750	0.44	0%	1198	0.66	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
	2013	101.5	480	0.29	23%	740	0.42	0%	1193	0.63	0%
	2014	101.5	493	0.30	19%	758	0.43	0%	1212	0.64	0%
	2015	222	506	0.30	17%	774	0.45	0%	1232	0.65	0%
	2016	214	460	0.27	33%	728	0.42	0%	1189	0.63	0%
	2017	209	425	0.25	47%	697	0.40	0%	1154	0.62	0%
Mgmt.	2018	205	399	0.24	59%	675	0.39	0%	1130	0.61	0%
Action:	2019	202	380	0.23	67%	661	0.38	0%	1110	0.60	0%
High ABC	2020	200	360	0.22	78%	643	0.37	0%	1092	0.59	0%
	2021	198	336	0.20	89%	626	0.36	1%	1074	0.59	0%
	2022	196	314	0.19	96%	610	0.35	3%	1059	0.58	0%
	2023	194	294	0.18	99%	594	0.34	7%	1049	0.58	0%
	2024	193	273	0.16	99%	579	0.33	12%	1036	0.57	0%

Table 67. Decision table for China rockfish (north of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass, "Depl" is median depletion, and "Overfished" is the percentage of trajectories below $0.25B_0$. Estimated MSY is 10 mt/year.

			STATE OF NATURE: DEPLETION IN 2013								
			Lower Quartile			Interquartile Range			Upper Quartile		
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Recent Catch	2013	15.1	46	0.22	70%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	83%	89	0.38	0%	183	0.59	0%
	2015	15.1	39	0.19	95%	87	0.37	0%	182	0.59	0%
	2016	15.1	36	0.17	99%	84	0.36	3%	181	0.58	0%
	2017	15.1	33	0.16	100%	82	0.35	9%	179	0.58	0%
	2018	15.1	29	0.14	100%	79	0.34	13%	178	0.58	0%
	2019	15.1	26	0.12	100%	77	0.33	18%	176	0.58	0%
	2020	15.1	22	0.10	100%	75	0.32	24%	175	0.58	0%
	2021	15.1	18	0.08	100%	72	0.31	29%	174	0.58	0%
	2022	15.1	14	0.06	100%	70	0.30	33%	172	0.57	0%
	2023	15.1	10	0.04	100%	67	0.29	37%	172	0.57	0%
	2024	15.1	5	0.02	100%	65	0.28	41%	171	0.57	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Low ABC	2013	15.1	46	0.2	72%	91	0.4	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	1.9	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	2.3	42	0.21	83%	91	0.38	0%	188	0.61	0%
	2017	2.5	45	0.22	73%	95	0.40	0%	191	0.63	0%
	2018	2.8	48	0.22	67%	98	0.41	0%	196	0.65	0%
	2019	2.9	49	0.23	63%	101	0.42	0%	200	0.67	0%
	2020	3.0	50	0.23	60%	103	0.43	0%	203	0.68	0%
	2021	3.1	52	0.24	57%	105	0.44	0%	206	0.70	0%
	2022	3.2	53	0.24	54%	108	0.45	0%	210	0.71	0%
	2023	3.3	54	0.25	52%	110	0.46	0%	212	0.72	0%
	2024	3.4	55	0.25	50%	112	0.47	0%	215	0.73	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: Median ABC	2013	15.1	46	0.22	72%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	7.5	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	7.7	40	0.19	93%	88	0.37	0%	185	0.60	0%
	2017	7.9	40	0.19	91%	89	0.38	1%	186	0.61	0%
	2018	8.0	40	0.19	90%	90	0.38	1%	188	0.62	0%
	2019	8.0	39	0.18	90%	91	0.38	2%	190	0.63	0%
	2020	8.0	38	0.18	90%	91	0.38	3%	192	0.64	0%
	2021	8.1	38	0.17	90%	91	0.39	4%	193	0.65	0%
	2022	8.2	37	0.17	90%	92	0.39	5%	194	0.66	0%
	2023	8.2	36	0.16	90%	92	0.39	6%	195	0.66	0%
	2024	8.3	34	0.16	89%	92	0.39	7%	196	0.67	0%
	Year	Catch	SSB	Depl	Overfished	SSB	Depl	Overfished	SSB	Depl	Overfished
Mgmt. Action: High ABC	2013	15.1	46	0.22	72%	91	0.39	0%	184	0.59	0%
	2014	15.1	42	0.21	85%	89	0.38	0%	183	0.59	0%
	2015	18.4	39	0.19	97%	87	0.37	0%	182	0.59	0%
	2016	18.1	34	0.17	100%	83	0.35	7%	180	0.58	0%
	2017	17.9	30	0.14	100%	79	0.33	15%	176	0.57	0%
	2018	17.8	25	0.12	100%	75	0.32	23%	174	0.56	0%
	2019	17.6	21	0.10	100%	72	0.30	30%	171	0.56	0%
	2020	17.5	16	0.07	100%	68	0.29	36%	169	0.55	0%
	2021	17.4	11	0.05	100%	65	0.28	41%	167	0.55	0%
	2022	17.2	6	0.03	100%	62	0.26	46%	165	0.54	0%
	2023	17.1	tr	tr	100%	58	0.25	51%	163	0.54	0%
	2024	17.0	tr	tr	98%	55	0.23	55%	161	0.53	0%

Table 68. Decision table for China rockfish (south of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 33 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	16	224	0.53	311	0.70	410	0.87
	2016	16	228	0.54	316	0.71	415	0.88
	2017	16	233	0.55	320	0.73	417	0.89
	2018	16	237	0.56	325	0.74	419	0.89
	2019	16	241	0.57	329	0.74	421	0.90
	2020	16	244	0.57	333	0.75	421	0.90
	2021	16	248	0.58	336	0.76	422	0.90
	2022	16	251	0.59	340	0.77	423	0.90
	2023	16	255	0.60	343	0.77	423	0.90
	2024	16	259	0.61	345	0.78	423	0.90
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	34	224	0.53	311	0.70	410	0.87
	2016	34	219	0.52	307	0.69	406	0.86
	2017	33	215	0.51	303	0.69	400	0.85
	2018	33	212	0.50	300	0.68	395	0.84
	2019	32	210	0.50	297	0.67	389	0.82
	2020	32	207	0.50	295	0.67	382	0.81
	2021	32	205	0.49	294	0.66	379	0.81
	2022	32	203	0.49	292	0.66	375	0.80
	2023	31	201	0.48	290	0.66	372	0.80
	2024	31	198	0.48	289	0.65	371	0.80
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	45	224	0.53	311	0.70	410	0.87
	2016	43	214	0.51	301	0.68	401	0.85
	2017	42	205	0.49	293	0.66	390	0.83
	2018	41	198	0.47	286	0.65	381	0.81
	2019	40	192	0.46	280	0.63	372	0.79
	2020	39	187	0.45	276	0.62	362	0.77
	2021	38	182	0.44	271	0.61	356	0.77
	2022	38	178	0.43	268	0.61	351	0.76
	2023	37	174	0.42	264	0.60	348	0.75
	2024	37	170	0.41	261	0.59	346	0.75
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	16	215	0.51	300	0.68	405	0.86
	2014	16	220	0.52	306	0.69	407	0.87
	2015	58	224	0.53	311	0.70	410	0.87
	2016	55	207	0.49	295	0.67	394	0.84
	2017	52	193	0.46	281	0.64	378	0.80
	2018	49	182	0.43	269	0.61	364	0.77
	2019	47	173	0.41	261	0.59	352	0.75
	2020	46	164	0.40	253	0.57	340	0.73
	2021	45	158	0.38	247	0.56	332	0.72
	2022	44	152	0.37	241	0.54	326	0.71
	2023	43	146	0.35	236	0.53	322	0.70
	2024	43	140	0.34	231	0.52	319	0.69

Table 69. Decision table for copper rockfish (north of 34° 27′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 117 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	38	598	0.35	845	0.50	1196	0.73
	2016	38	618	0.36	870	0.52	1226	0.75
	2017	38	637	0.37	895	0.53	1249	0.76
	2018	38	658	0.38	920	0.55	1275	0.78
	2019	38	678	0.39	947	0.56	1298	0.80
	2020	38	698	0.40	973	0.58	1318	0.81
	2021	38	717	0.42	997	0.59	1336	0.83
	2022	38	739	0.43	1022	0.61	1354	0.84
	2023	38	759	0.44	1047	0.62	1368	0.85
	2024	38	780	0.45	1071	0.64	1381	0.86
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	87	598	0.35	845	0.50	1196	0.73
	2016	86	593	0.35	846	0.50	1201	0.73
	2017	86	591	0.34	848	0.51	1203	0.73
	2018	87	593	0.34	854	0.51	1209	0.74
	2019	87	594	0.34	863	0.51	1213	0.75
	2020	88	597	0.35	871	0.52	1218	0.75
	2021	89	601	0.35	880	0.52	1217	0.76
	2022	90	604	0.35	887	0.53	1220	0.76
	2023	90	607	0.35	892	0.53	1220	0.76
	2024	91	610	0.35	898	0.54	1220	0.77
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	134	598	0.35	845	0.50	1196	0.73
	2016	131	570	0.33	822	0.49	1178	0.72
	2017	128	548	0.32	805	0.48	1159	0.71
	2018	126	531	0.31	794	0.47	1148	0.70
	2019	126	518	0.30	787	0.47	1137	0.70
	2020	125	510	0.30	781	0.47	1126	0.70
	2021	125	504	0.29	780	0.47	1119	0.69
	2022	125	496	0.29	777	0.46	1109	0.69
	2023	124	488	0.28	772	0.46	1105	0.69
	2024	123	479	0.28	767	0.46	1100	0.69
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	38	556	0.32	794	0.47	1140	0.69
	2014	38	578	0.34	819	0.49	1169	0.71
	2015	198	598	0.35	845	0.50	1196	0.73
	2016	188	538	0.31	790	0.47	1146	0.69
	2017	181	490	0.29	747	0.45	1101	0.67
	2018	175	452	0.26	715	0.43	1068	0.65
	2019	171	424	0.25	689	0.41	1040	0.64
	2020	167	400	0.23	670	0.40	1016	0.63
	2021	164	384	0.22	657	0.39	994	0.62
	2022	162	365	0.21	643	0.39	979	0.61
	2023	160	343	0.20	628	0.38	966	0.60
	2024	158	321	0.19	611	0.37	956	0.60

Table 70. Decision table for copper rockfish (south of 34° 27′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. SSB is median female spawning stock biomass. "Depl" is median depletion. Estimated MSY is 92 mt/year.

			STATE OF NATURE: DEPLETION IN 2013					
			Lower Quartile		Interquartile Range		Upper Quartile	
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Recent Catch	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	40	670	0.63	918	0.81	963	0.94
	2016	40	677	0.64	926	0.82	952	0.93
	2017	40	685	0.64	932	0.83	943	0.92
	2018	40	694	0.65	939	0.83	932	0.92
	2019	40	704	0.66	944	0.84	926	0.92
	2020	40	713	0.66	949	0.84	924	0.91
	2021	40	720	0.67	953	0.85	922	0.91
	2022	40	732	0.67	956	0.85	923	0.91
	2023	40	738	0.68	960	0.85	924	0.91
	2024	40	745	0.68	963	0.85	924	0.91
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Low ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	100	670	0.63	918	0.81	963	0.94
	2016	96	647	0.61	896	0.80	922	0.90
	2017	94	629	0.60	876	0.78	887	0.88
	2018	92	616	0.58	860	0.76	854	0.85
	2019	91	605	0.57	847	0.75	831	0.82
	2020	89	596	0.57	836	0.74	811	0.80
	2021	88	591	0.56	826	0.73	793	0.78
	2022	87	584	0.55	817	0.72	785	0.77
	2023	86	577	0.55	809	0.71	780	0.77
	2024	85	572	0.54	803	0.71	781	0.77
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: Median ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	144	670	0.63	918	0.81	962	0.94
	2016	136	625	0.59	874	0.78	900	0.88
	2017	129	590	0.56	836	0.74	847	0.84
	2018	123	563	0.54	806	0.71	800	0.79
	2019	118	541	0.51	782	0.69	767	0.76
	2020	114	523	0.50	764	0.67	737	0.73
	2021	111	510	0.49	747	0.66	717	0.71
	2022	109	499	0.48	734	0.65	706	0.69
	2023	107	487	0.47	723	0.64	700	0.69
	2024	105	473	0.45	712	0.63	699	0.69
	Year	Catch	SSB	Depl	SSB	Depl	SSB	Depl
Mgmt. Action: High ABC	2013	40	655	0.61	902	0.80	966	0.94
	2014	40	661	0.62	910	0.81	965	0.94
	2015	162	670	0.63	918	0.81	962	0.94
	2016	147	616	0.58	865	0.77	891	0.87
	2017	134	576	0.55	822	0.73	833	0.82
	2018	125	547	0.52	790	0.70	784	0.78
	2019	118	527	0.50	767	0.68	752	0.74
	2020	113	509	0.49	749	0.66	722	0.72
	2021	110	499	0.48	735	0.65	705	0.70
	2022	108	488	0.46	724	0.64	696	0.69
	2023	108	475	0.45	713	0.63	693	0.68
	2024	108	461	0.44	702	0.62	691	0.68

Table 71. Decision table for sharpchin rockfish. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 320 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	195	3,485	51.5%	5,798	71.8%	7,904	86.3%
	2016	195	3,476	51.2%	5,791	71.6%	7,894	85.8%
	2017	194	3,469	50.9%	5,779	71.3%	7,881	85.4%
	2018	194	3,447	50.7%	5,762	71.1%	7,867	85.0%
	2019	193	3,440	50.4%	5,752	70.9%	7,852	84.8%
	2020	192	3,431	50.1%	5,743	70.6%	7,831	84.5%
	2021	191	3,426	49.9%	5,724	70.4%	7,798	84.2%
	2022	190	3,418	49.7%	5,705	70.2%	7,769	84.1%
	2023	189	3,401	49.5%	5,685	69.9%	7,744	83.8%
	2024	189	3,395	49.3%	5,667	69.8%	7,721	83.6%
Medium Catches	2015	382	3,371	51.1%	5,628	71.2%	7,561	86.0%
	2016	372	3,393	50.6%	5,531	69.5%	7,216	82.2%
	2017	363	3,394	50.1%	5,426	67.8%	6,908	78.4%
	2018	354	3,380	49.6%	5,300	66.1%	6,570	75.2%
	2019	347	3,377	49.2%	5,177	64.3%	6,313	72.5%
	2020	339	3,365	49.0%	5,091	62.7%	6,094	69.9%
	2021	334	3,363	48.6%	4,984	61.5%	5,895	67.5%
	2022	328	3,347	48.5%	4,933	60.4%	5,720	65.4%
	2023	322	3,321	48.3%	4,840	59.4%	5,561	63.8%
	2024	317	3,336	48.2%	4,770	58.5%	5,419	62.2%
High Catches	2015	750	3,343	50.6%	5,688	71.7%	7,863	86.0%
	2016	730	2,964	44.1%	5,338	66.4%	7,567	82.3%
	2017	703	2,594	38.6%	4,999	61.8%	7,310	87.7%
	2018	674	2,257	33.6%	4,643	57.2%	7,040	75.7%
	2019	650	1,953	28.9%	4,300	53.3%	6,791	73.1%
	2020	625	1,684	24.7%	4,001	49.6%	6,498	70.5%
	2021	612	1,392	20.8%	3,691	46.7%	6,215	68.6%
	2022	591	1,190	17.1%	3,479	43.6%	6,055	66.7%
	2023	575	980	13.9%	3,266	41.0%	5,935	65.0%
	2024	563	756	10.9%	3,095	38.6%	5,816	63.5%
Average Catches	2015	5	3,485	50.6%	5,664	72.0%	7,573	86.4%
	2016	5	3,602	51.9%	5,786	73.4%	7,643	87.4%
	2017	5	3,725	53.7%	5,895	74.7%	7,708	88.2%
	2018	5	3,826	54.9%	6,020	75.9%	7,768	89.0%
	2019	5	3,938	56.3%	6,121	77.0%	7,828	89.7%
	2020	5	4,042	57.7%	6,227	78.3%	7,888	90.3%
	2021	5	4,135	59.0%	6,327	79.3%	7,944	91.1%
	2022	5	4,260	60.4%	6,420	80.3%	7,998	91.6%
	2023	5	4,318	61.6%	6,510	81.2%	8,048	92.2%
	2024	5	4,418	62.6%	6,599	82.2%	8,096	92.8%

Table 72. Decision table for yellowtail rockfish (north of 40° 10′ N. latitude). Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 5728 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	3,936	43,502	52.8%	56,604	68.9%	62,979	83.4%
	2016	3,912	43,108	52.4%	56,063	68.3%	62,573	82.7%
	2017	3,879	42,738	52.0%	55,772	67.9%	62,187	81.9%
	2018	3,844	42,434	51.7%	55,468	67.4%	61,835	81.2%
	2019	3,818	42,206	51.3%	55,027	66.7%	61,524	80.6%
	2020	3,797	41,976	50.9%	54,624	66.4%	61,253	79.9%
	2021	3,777	41,749	50.6%	54,269	66.0%	61,019	79.6%
	2022	3,759	41,547	50.4%	53,958	65.7%	60,818	79.3%
	2023	3,744	41,393	50.1%	53,684	65.3%	60,644	79.0%
	2024	3,730	41,129	50.0%	53,444	64.9%	60,491	78.8%
Medium Catches		6,497	43,502	52.4%	54,304	69.3%	60,039	83.3%
	2016	6,312	43,252	52.1%	52,730	66.8%	55,750	87.0%
	2017	6,126	43,044	51.6%	51,060	64.6%	52,853	73.9%
	2018	5,962	42,955	51.1%	49,531	62.7%	50,294	70.5%
	2019	5,798	42,673	50.7%	48,227	61.0%	48,062	67.2%
	2020	5,638	42,597	50.4%	47,111	49.4%	46,136	64.4%
	2021	5,523	42,567	50.0%	46,260	58.2%	44,484	62.3%
	2022	5,417	42,547	49.9%	45,421	57.1%	43,067	60.5%
	2023	5,324	42,842	49.7%	44,594	56.2%	41,784	59.9%
	2024	5,251	42,899	49.4%	43,788	55.4%	40,810	57.6%
High Catches	2015	11,666	44,076	52.6%	54,174	69.4%	63,587	83.7%
	2016	11,148	39,125	46.6%	49,654	63.4%	60,602	78.9%
	2017	10,530	34,591	41.3%	45,256	58.0%	57,730	75.1%
	2018	10,032	30,672	36.4%	41,696	53.4%	55,222	71.7%
	2019	9,675	26,968	31.9%	38,467	49.6%	53,091	68.6%
	2020	9,333	23,925	28.2%	35,708	46.2%	51,319	66.1%
	2021	9,052	20,975	25.1%	33,481	43.0%	49,975	63.9%
	2022	8,830	18,205	22.3%	31,248	40.4%	48,657	62.2%
	2023	8,547	15,740	19.5%	29,253	38.2%	47,106	60.6%
	2024	8,311	13,900	17.0%	27,694	36.4%	46,200	59.3%
Average Catches	2015	1,376	45,023	52.7%	54,405	69.6%	61,190	83.7%
	2016	1,376	46,290	54.1%	55,352	70.7%	61,802	84.4%
	2017	1,376	47,532	55.4%	56,136	72.0%	62,370	84.9%
	2018	1,376	48,447	56.5%	56,980	72.9%	62,899	85.5%
	2019	1,376	49,334	57.7%	57,758	73.7%	63,390	86.1%
	2020	1,376	50,528	59.0%	58,506	74.6%	63,845	86.5%
	2021	1,376	51,821	59.9%	59,109	75.5%	64,267	86.9%
	2022	1,376	52,752	61.0%	59,675	76.2%	64,658	87.3%
	2023	1,376	53,532	62.1%	60,139	77.0%	65,020	87.6%
	2024	1,376	54,297	63.1%	60,643	77.7%	65,355	87.9%

Table 73. Decision table for English sole. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 4072 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	8,909	33,061	86.2%	24,798	90.7%	24,306	94.0%
	2016	7,247	26,491	67.9%	18,414	67.2%	18,274	71.1%
	2017	6,146	21,871	56.6%	14,277	52.0%	14,593	56.8%
	2018	5,379	18,728	48.7%	11,709	42.6%	12,608	48.6%
	2019	4,858	16,631	43.3%	10,061	37.1%	11,880	44.2%
	2020	4,529	15,286	39.7%	9,293	34.0%	11,515	43.0%
	2021	4,305	14,401	97.2%	8,908	32.3%	11,386	42.1%
	2022	4,151	13,766	35.5%	8,606	31.3%	11,128	41.4%
	2023	4,018	13,279	34.3%	8,424	30.7%	11,077	41.8%
	2024	3,939	12,947	33.4%	8,319	30.2%	10,982	42.0%
Medium Catches	2015	9,452	33,131	86.2%	24,735	90.7%	24,844	94.1%
	2016	4,098	26,338	67.7%	18,131	65.7%	16,751	63.2%
	2017	5,733	61,662	55.5%	14,115	50.8%	12,720	47.3%
	2018	4,972	18,441	47.3%	11,791	42.4%	10,602	39.6%
	2019	4,574	16,343	42.0%	10,538	37.9%	9,587	36.0%
	2020	4,332	14,991	38.6%	9,810	65.4%	9,065	34.3%
	2021	4,184	41,092	36.4%	9,401	34.0%	8,727	33.2%
	2022	4,073	13,465	34.8%	9,096	33.1%	8,490	32.6%
	2023	3,992	13,008	33.7%	8,916	32.4%	8,428	32.1%
	2024	3,922	12,662	33.0%	8,768	31.9%	8,340	31.7%
High Catches	2015	11,901	32,854	86.3%	25,220	90.6%	25,473	94.1%
	2016	2,368	23,791	61.8%	16,600	59.1%	17,158	63.6%
	2017	6,790	23,311	60.9%	16,346	58.2%	17,307	63.7%
	2018	5,975	19,630	51.5%	13,092	46.5%	14,308	53.7%
	2019	5,691	16,975	44.7%	10,874	38.8%	12,784	47.7%
	2020	5,446	14,926	39.1%	9,324	33.2%	11,642	43.0%
	2021	5,258	13,185	34.9%	8,098	29.1%	10,594	40.1%
	2022	5,106	12,087	31.5%	7,196	26.3%	10,178	38.2%
	2023	5,007	11,004	28.6%	6,557	24.3%	9,903	36.7%
	2024	4,960	10,260	26.4%	6,114	22.6%	9,600	36.2%
Average Catches	2015	224	33,061	85.9%	25,473	90.7%	25,687	94.0%
	2016	224	33,694	87.3%	24,996	91.8%	25,853	94.6%
	2017	224	34,117	88.5%	25,186	92.6%	25,981	95.1%
	2018	224	34,518	89.6%	25,377	93.3%	26,078	95.4%
	2019	224	34,916	90.6%	25,522	93.8%	26,153	95.7%
	2020	224	35,358	91.4%	25,635	94.3%	26,210	96.0%
	2021	224	35,746	92.1%	25,725	94.6%	26,253	96.0%
	2022	224	36,087	82.6%	25,798	94.9%	26,286	96.3%
	2023	224	36,387	93.2%	25,857	95.1%	26,312	96.4%
	2024	224	36,651	93.6%	25,904	95.3%	26,332	96.6%

Table 74. Decision table for rex sole. Alternative catch streams are median ABC catch projections (mt) with 40-10 adjustment based on quartiles of depletion in 2013. "Spawning Biomass" is median female spawning stock biomass. "Depletion" is median depletion. Estimated MSY is 1676 mt/year.

			State of nature					
			Low		Base		High	
Quantiles			0-0.25		0.25-0.75		0.75-1.0	
	Year	Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catches	2015	3,085	3,772	72.9%	3,377	80.7%	4,396	89.7%
	2016	2,541	3,113	59.4%	2,837	68.8%	3,989	81.4%
	2017	2,174	2,568	50.6%	2,490	60.8%	3,742	76.1%
	2018	1,909	2,237	44.8%	2,262	55.7%	3,560	72.9%
	2019	1,753	2,102	41.1%	2,137	52.6%	3,448	71.0%
	2020	1,652	2,022	38.7%	2,031	50.6%	3,380	70.3%
	2021	1,590	1,970	36.9%	1,986	49.3%	3,339	69.7%
	2022	1,544	1,928	35.8%	1,939	48.5%	3,313	69.4%
	2023	1,510	1,887	35.2%	1,924	48.1%	3,297	69.2%
	2024	1,485	1,857	34.6%	1,917	47.9%	3,287	69.1%
Medium Catches	2015	4,395	3,788	73.4%	3,073	81.1%	4,076	89.5%
	2016	3,342	3,023	59.5%	2,382	62.0%	2,937	64.7%
	2017	2,701	2,569	50.4%	1,938	50.3%	2,313	50.7%
	2018	2,308	2,279	44.3%	1,662	43.4%	1,963	43.3%
	2019	2,067	2,086	40.5%	1,511	39.4%	1,765	39.2%
	2020	1,926	1,940	38.1%	1,421	37.1%	1,663	36.9%
	2021	1,839	1,859	36.5%	1,371	35.7%	1,602	35.7%
	2022	1,778	1,812	35.6%	1,335	34.8%	1,562	34.9%
	2023	1,738	1,784	34.9%	1,305	34.2%	1,517	34.3%
	2024	1,711	1,764	34.4%	1,283	33.8%	1,496	33.8%
High Catches	2015	7,895	3,720	73.4%	3,073	81.1%	4,093	89.5%
	2016	5,315	1,684	34.1%	1,717	44.9%	2,866	64.7%
	2017	4,116	928	20.3%	973	27.4%	2,208	51.6%
	2018	3,382	732	15.8%	731	21.0%	1,927	44.8%
	2019	1,947	685	14.0%	655	18.9%	1,726	41.2%
	2020	2,722	657	13.6%	641	18.7%	1,791	42.3%
	2021	2,547	629	13.1%	605	17.5%	1,697	40.7%
	2022	2,470	607	12.4%	571	16.4%	1,663	40.0%
	2023	2,387	594	11.9%	552	15.6%	1,612	39.5%
	2024	2,344	578	11.6%	542	15.2%	1,579	38.9%
Average Catches	2015	455	3,687	73.2%	3,158	81.0%	3,686	89.9%
	2016	455	3,761	74.4%	3,191	81.9%	3,707	90.3%
	2017	455	3,824	75.4%	3,220	82.6%	3,723	90.6%
	2018	455	3,874	76.3%	3,245	83.2%	3,737	90.9%
	2019	455	3,919	77.2%	3,266	83.7%	3,747	91.1%
	2020	455	3,959	77.9%	3,285	84.2%	3,757	91.3%
	2021	455	3,993	78.4%	3,301	84.6%	3,765	91.6%
	2022	455	4,022	78.9%	3,315	84.9%	3,771	91.7%
	2023	455	4,047	79.4%	330	85.2%	3,777	91.9%
	2024	455	4,067	79.8%	3,340	85.5%	3,782	92.0%

8 Figures

8.1 Catch and Abundance Figures

8.1.1 Distribution maps

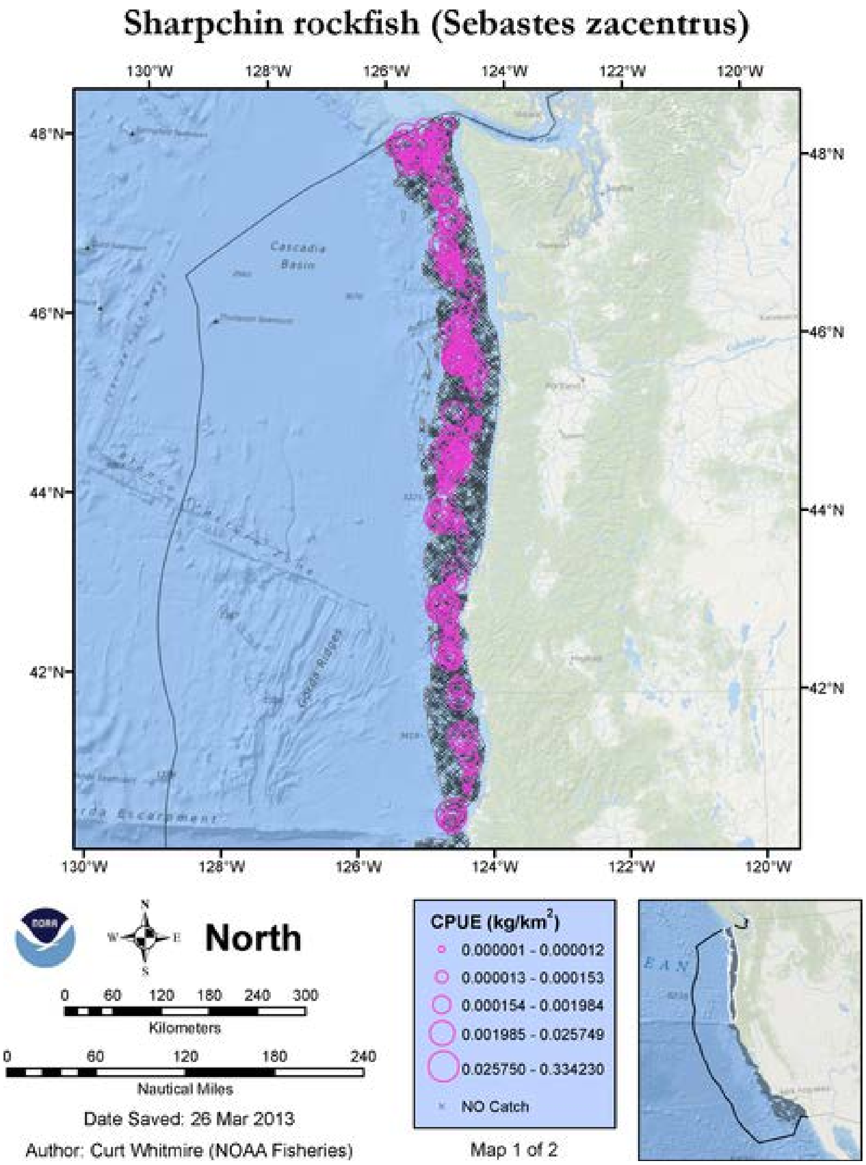


Figure 1. Occurrence and abundance of sharpchin rockfish found in the NWFSC annual survey (2003-2012) north of 40º10' N lat.

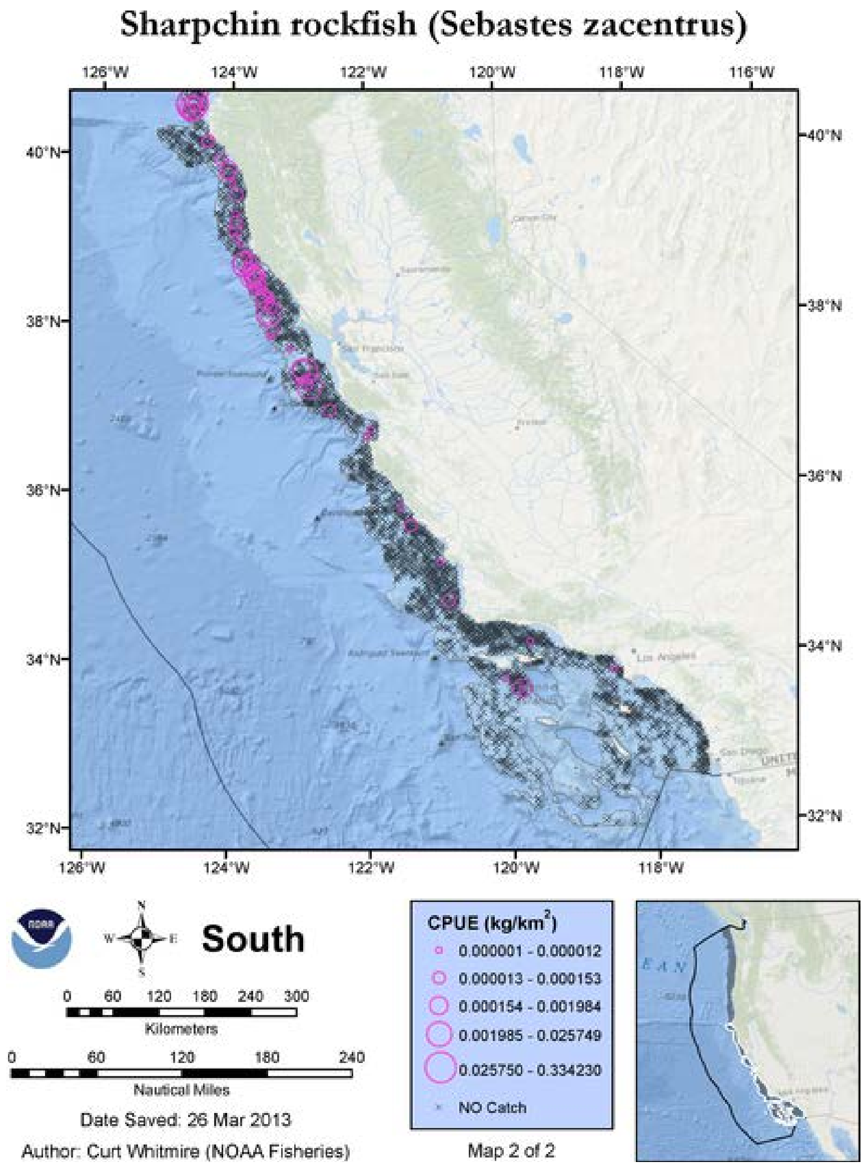


Figure 2. Occurrence and abundance of sharpchin rockfish found in the NWFSC annual survey (2003-2012) south of 40º10’ N lat.

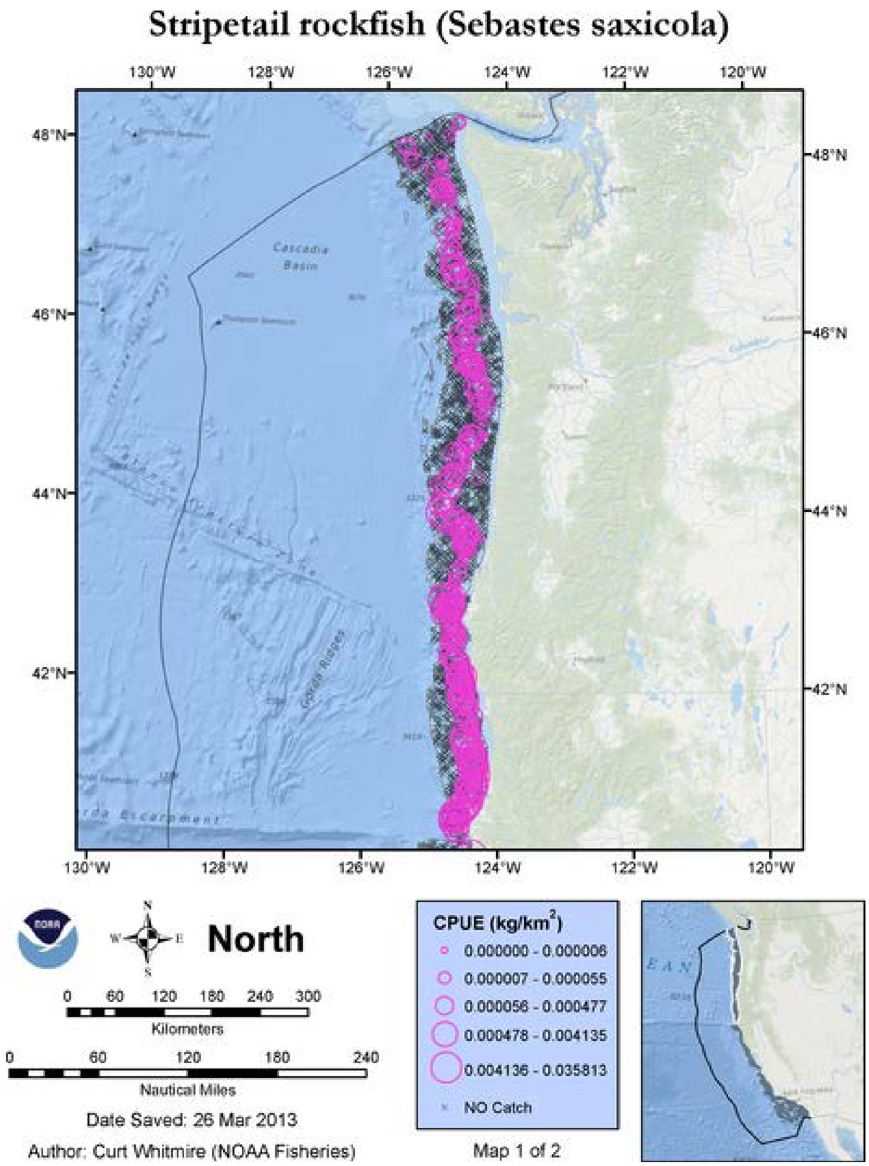


Figure 3. Occurrence and abundance of stripetail rockfish found in the NWFSC annual survey (2003-2012) north of 40º10' N lat.

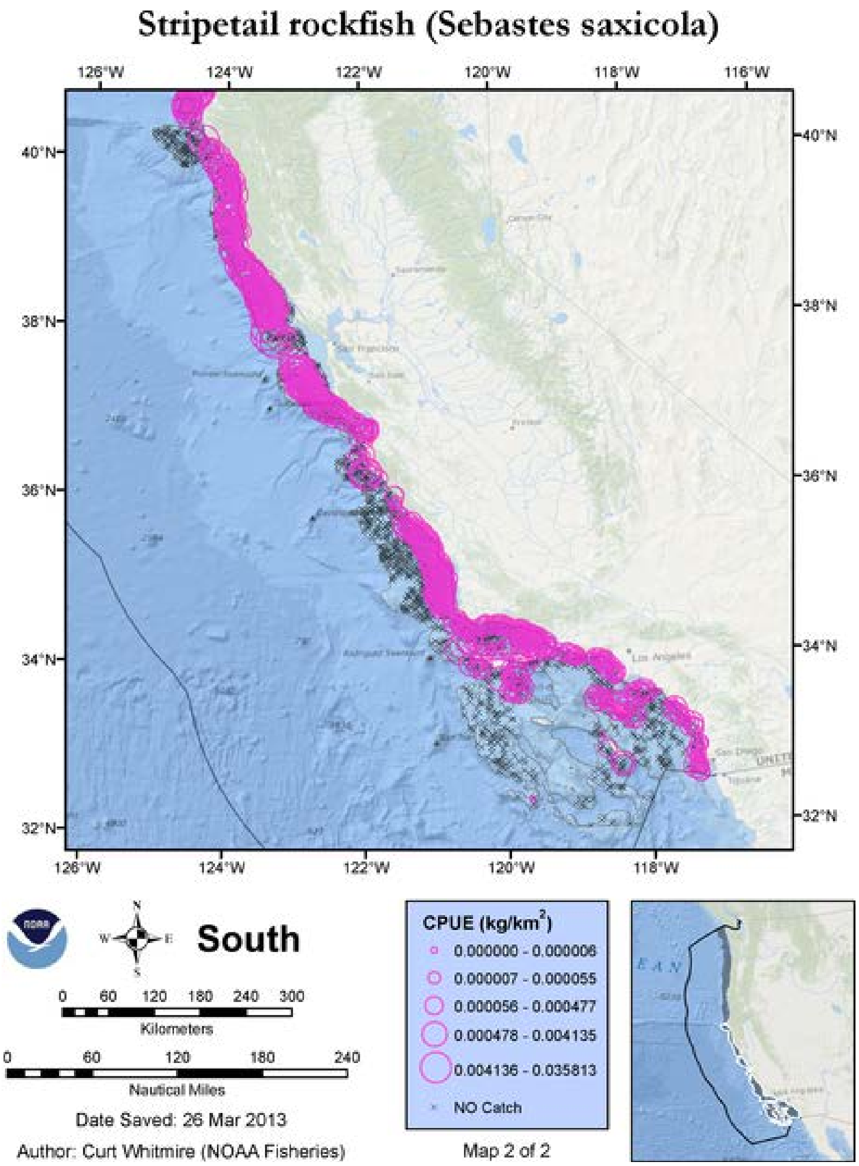


Figure 4. Occurrence and abundance of stripetail rockfish found in the NWFSC annual survey (2003-2012) south of 40º10' N lat.

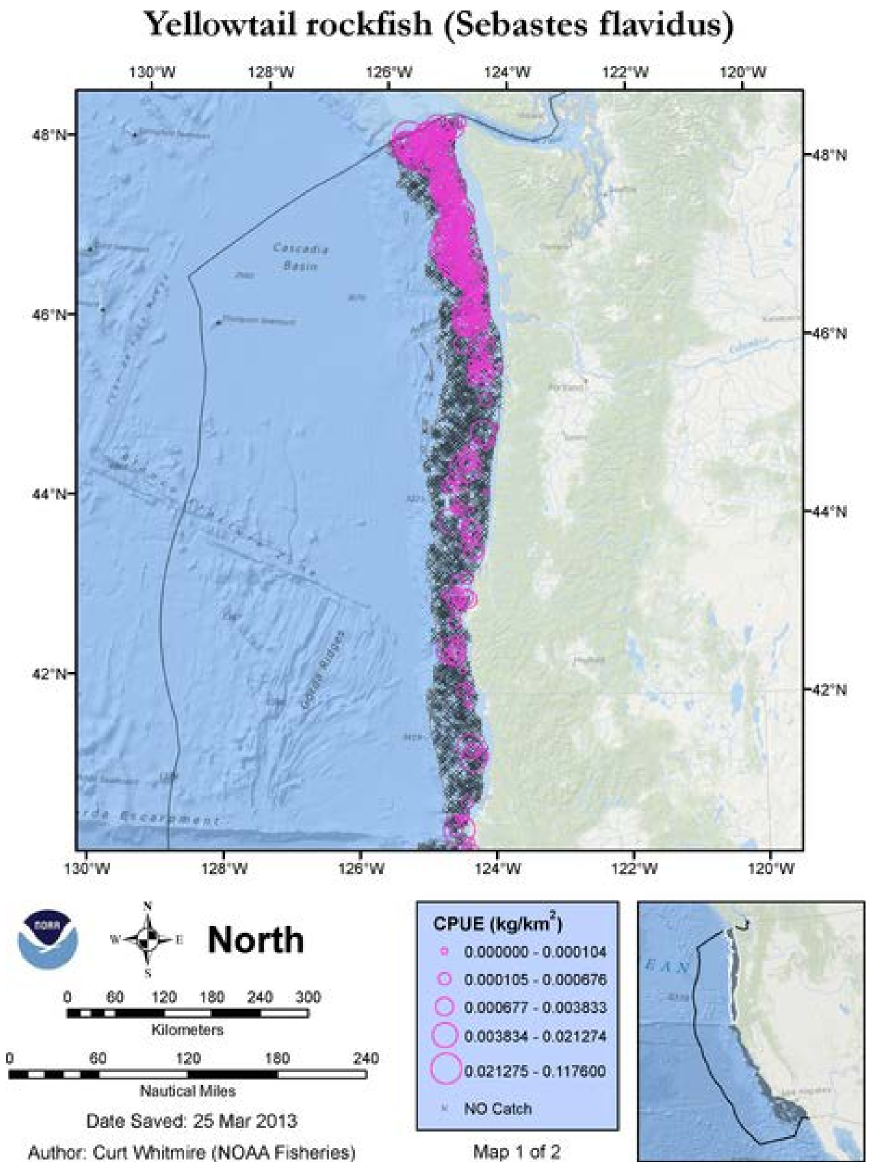


Figure 5. Occurrence and abundance of yellowtail rockfish found in the NWFSC annual survey (2003-2012) north of 40º10' N lat.

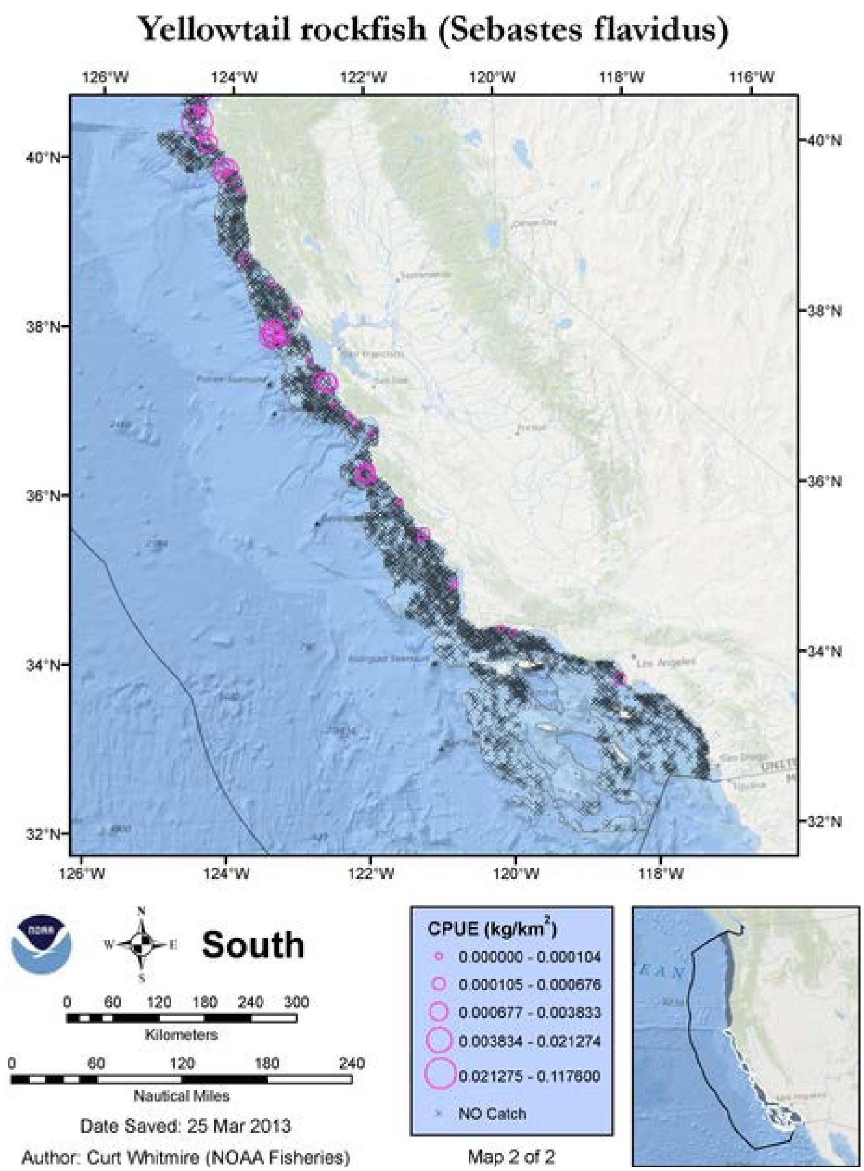


Figure 6. Occurrence and abundance of yellowtail rockfish found in the NWFSC annual survey (2003-2012) south of 40º10' N lat.

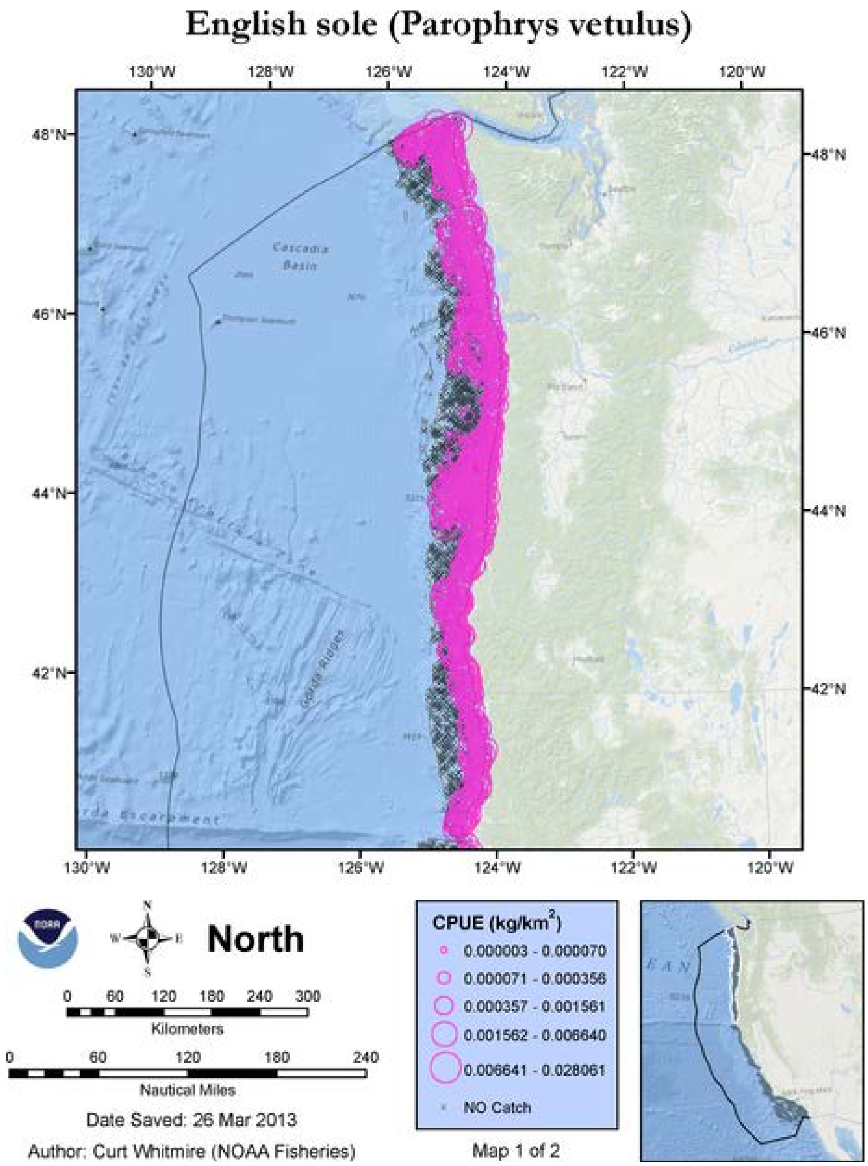


Figure 7. Occurrence and abundance of English sole found in the NWFSC annual survey (2003-2012) north of 40°10' N lat.

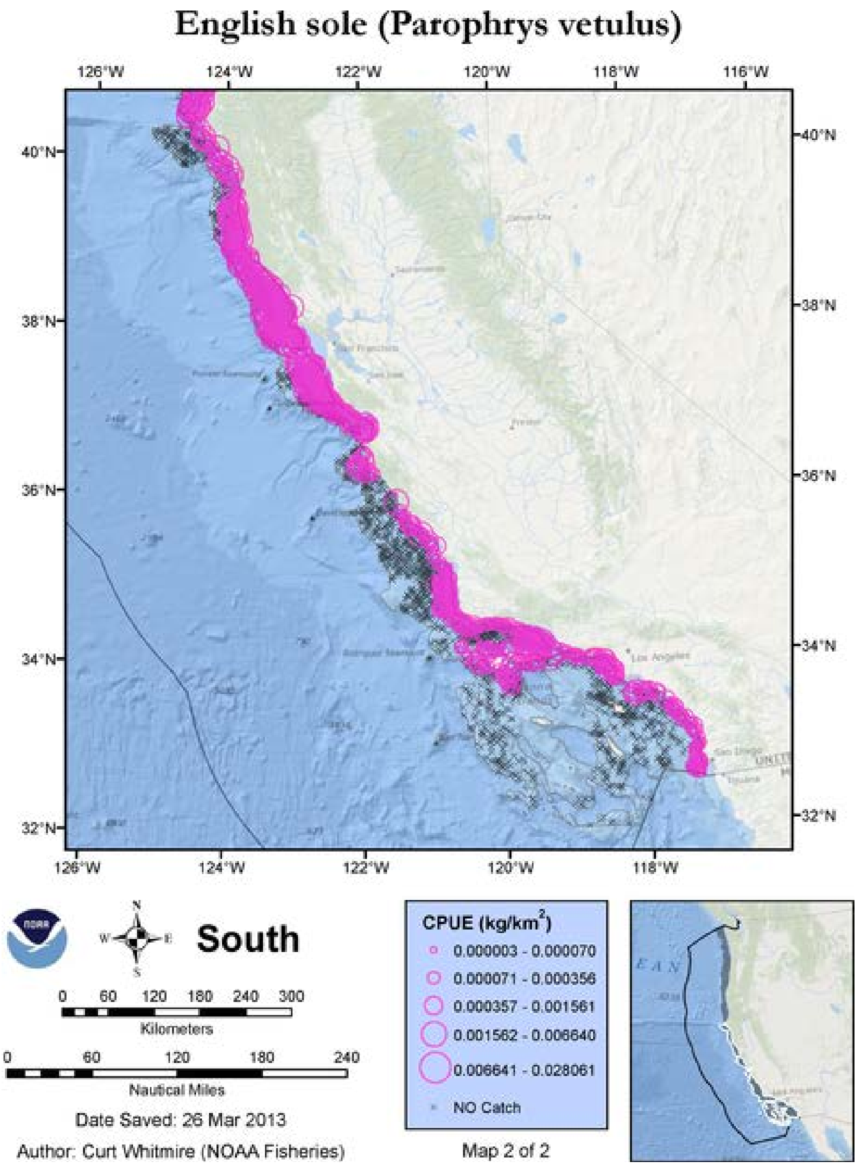


Figure 8. Occurrence and abundance of English sole found in the NWFSC annual survey (2003-2012) south of 40º10' N lat.

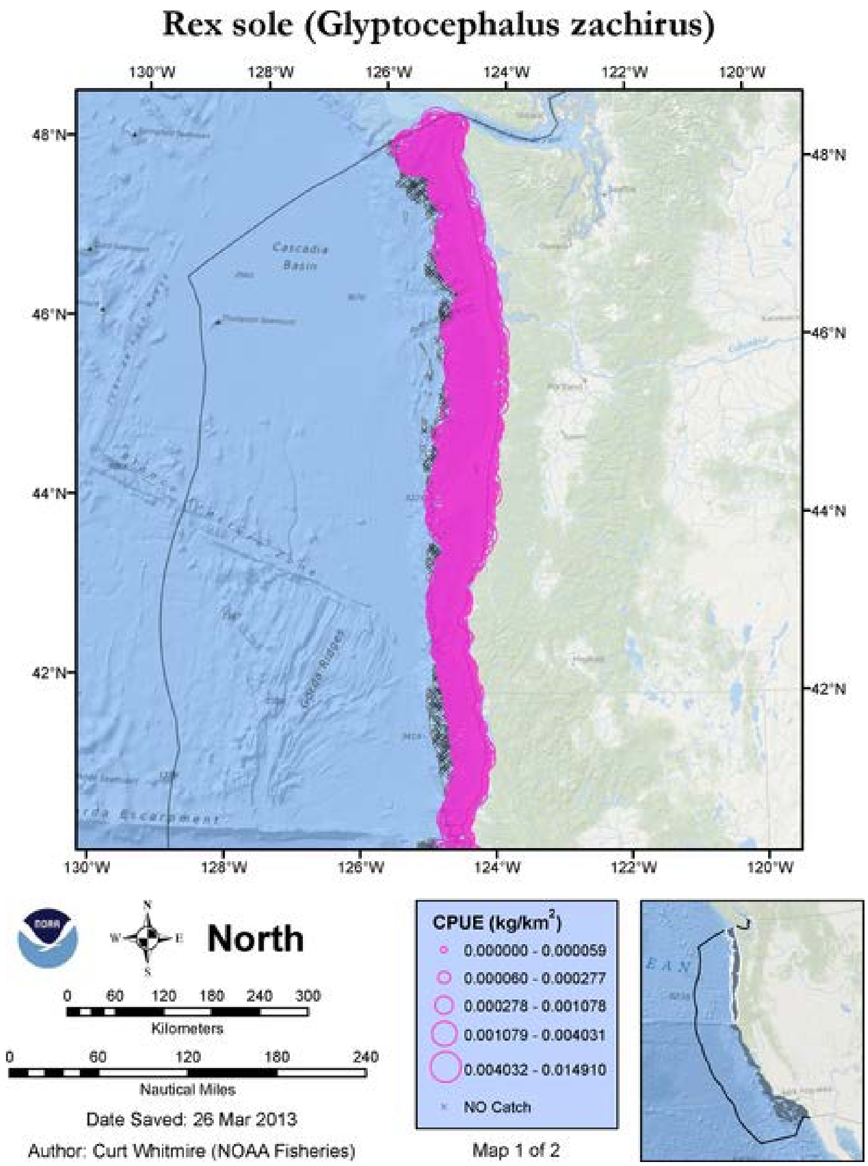


Figure 9. Occurrence and abundance of rex sole found in the NWFSC annual survey (2003-2012) north of 40º10' N lat.

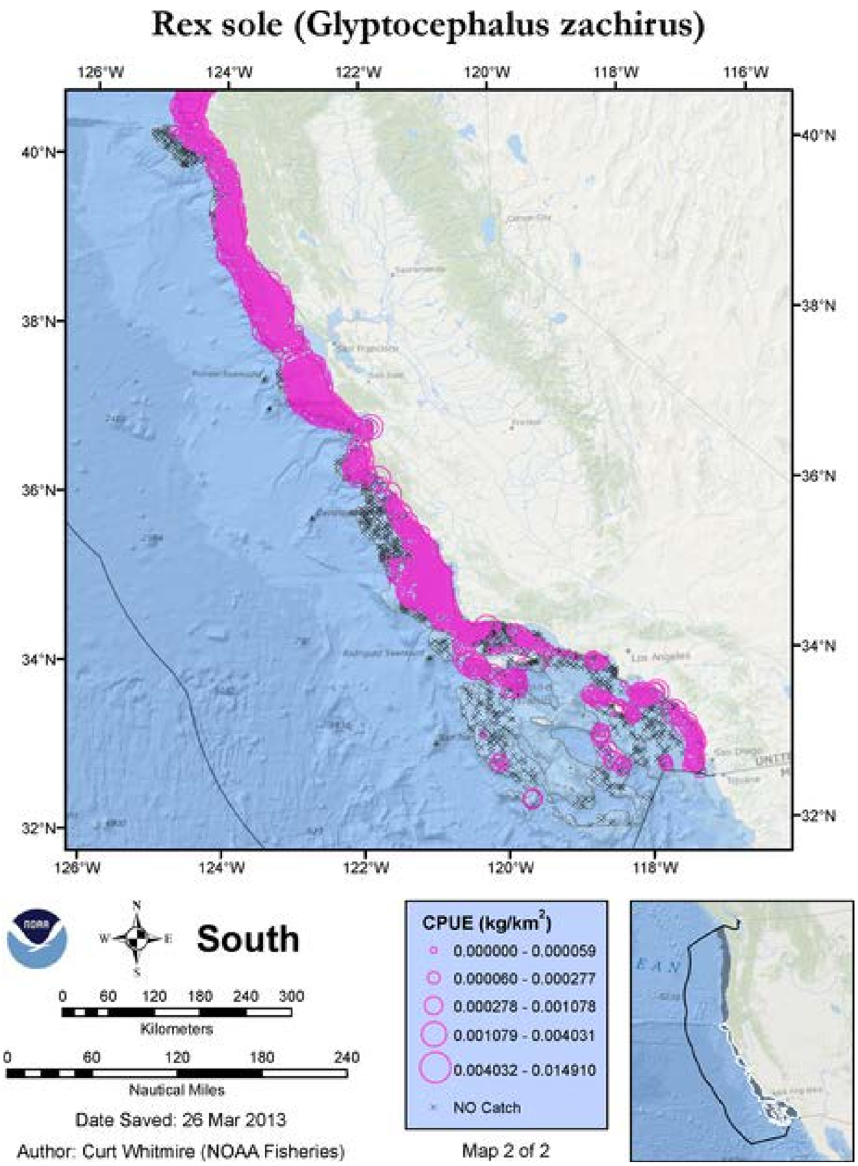


Figure 10. Occurrence and abundance of rex sole found in the NWFSC annual survey (2003-2012) south of 40°10' N lat.

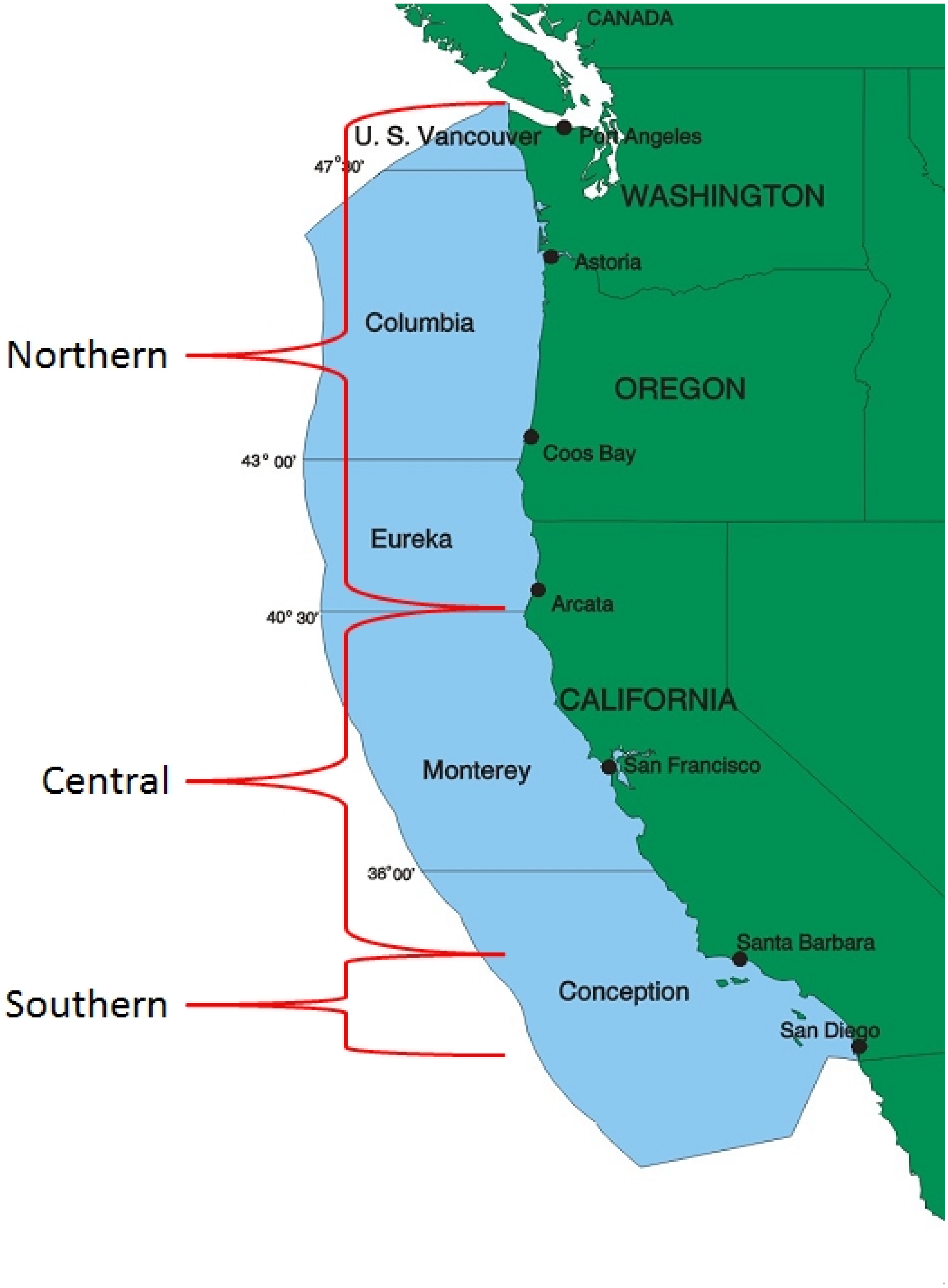


Figure 11. Northern, Central, and Southern regions (red brackets), relative to major INPFC areas (U.S. Vancouver, Columbia, Eureka, Monterey, and Conception). Adapted from Rogers (2003).

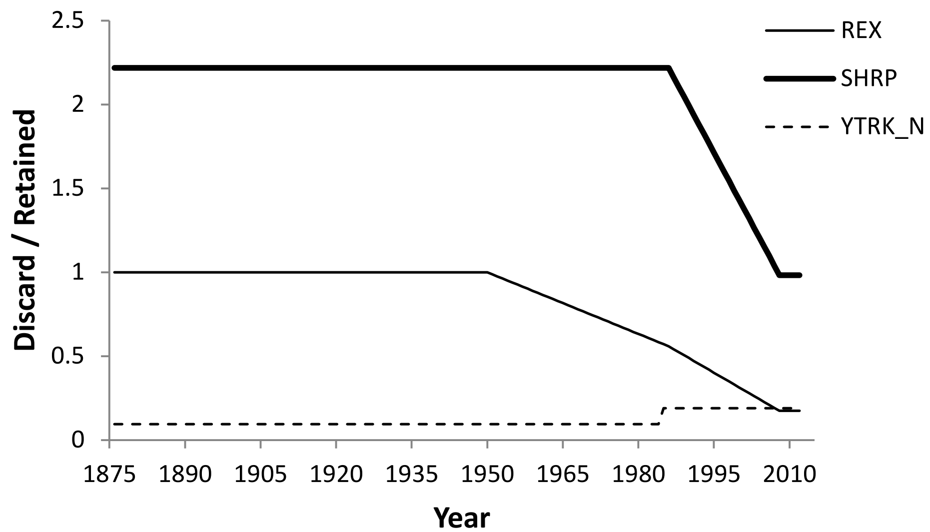


Figure 12. Assumed ratios of discarded catch to retained catch for species with time-varying rates.

8.1.2 Removal histories

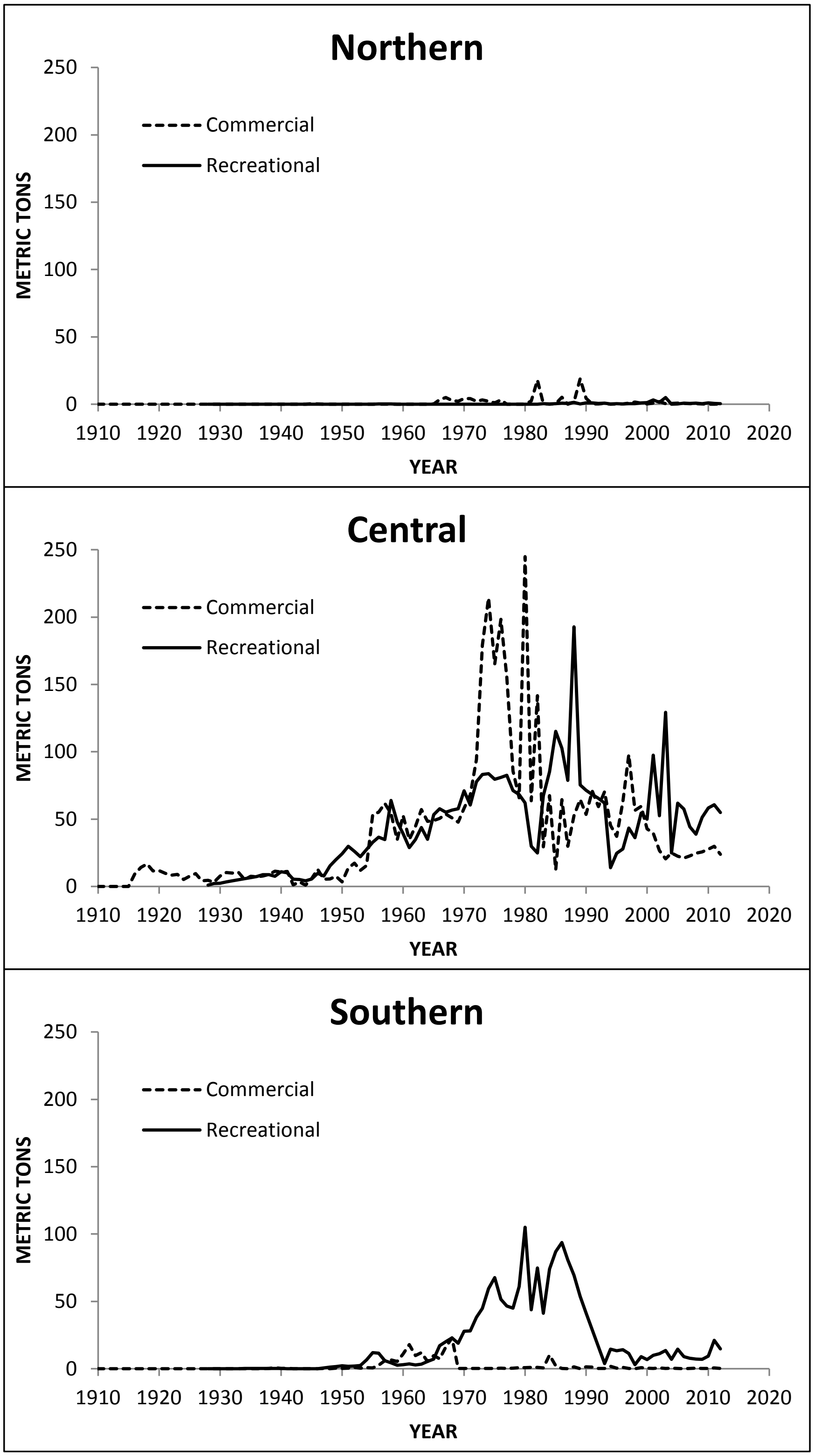


Figure 13. Brown rockfish (*Sebastes auriculatus*) catch by coastal region, year, and fishery. Coastal regions are divided at Point Conception and Cape Mendocino.

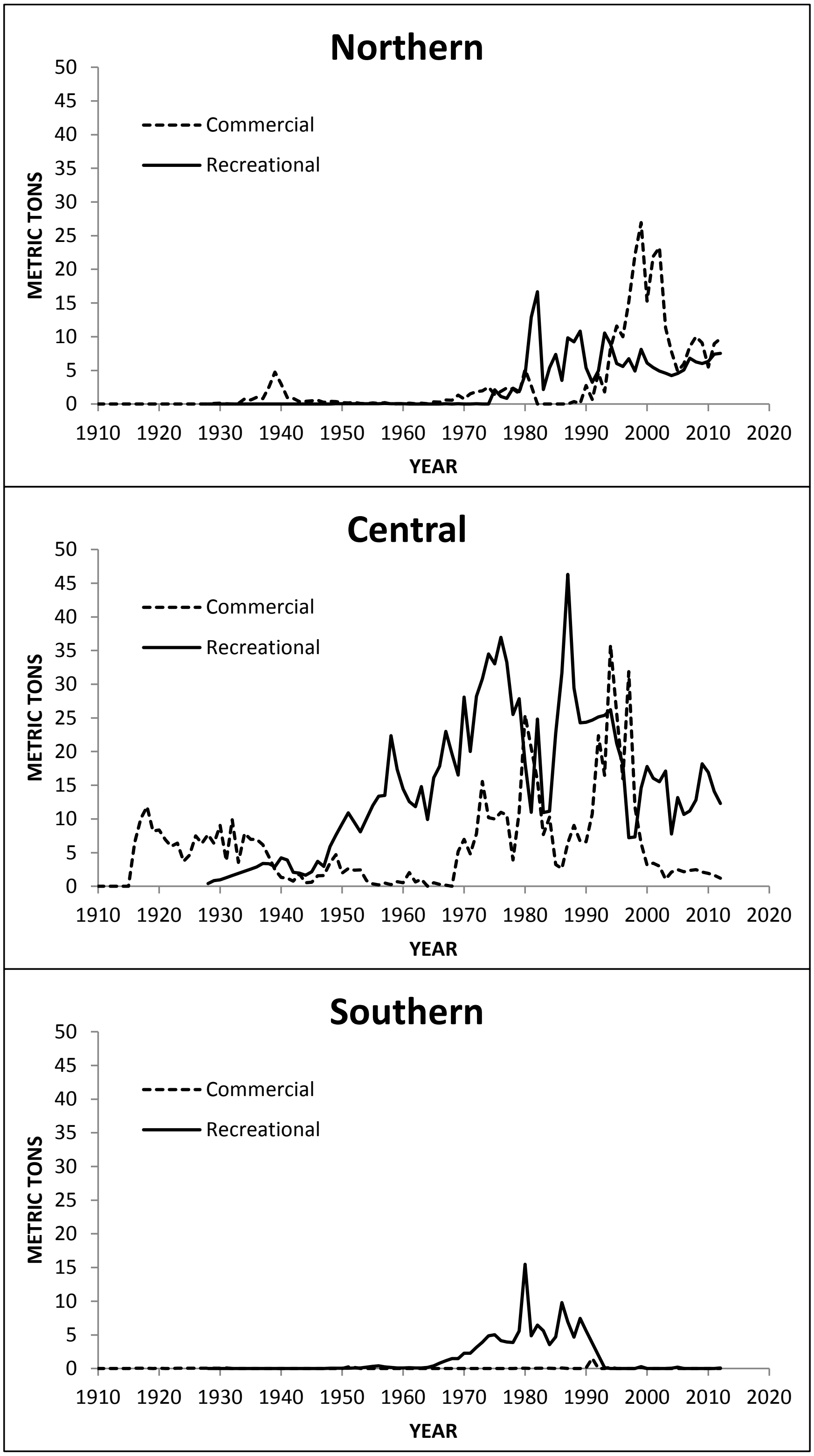


Figure 14. China rockfish (*Sebastes nebulosus*) catch by coastal region, year, and fishery. Coastal regions are divided at Point Conception and Cape Mendocino.

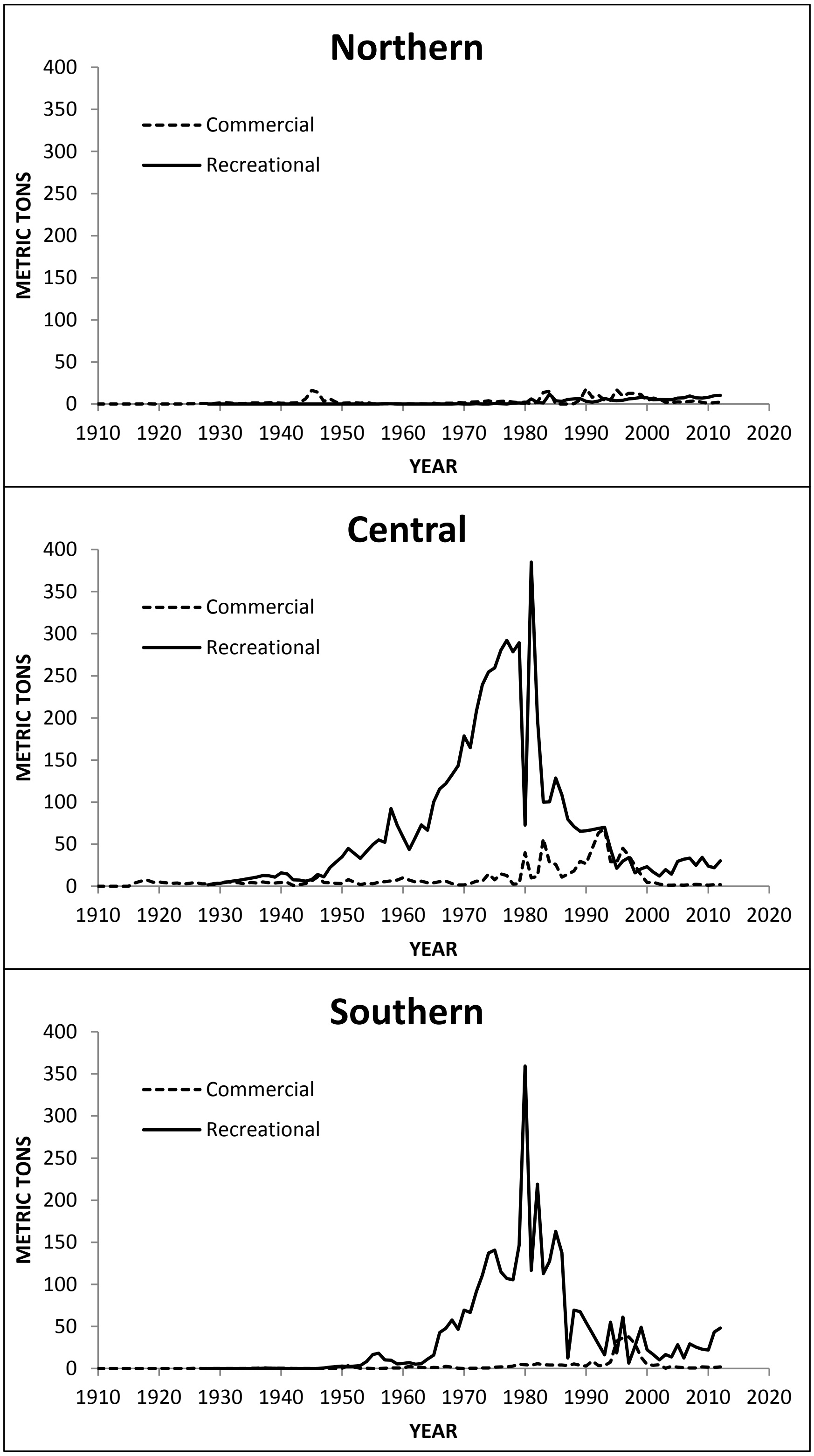


Figure 15. Copper rockfish (*Sebastes caurinus*) catch by coastal region, year, and fishery. Coastal regions are divided at Point Conception and Cape Mendocino.

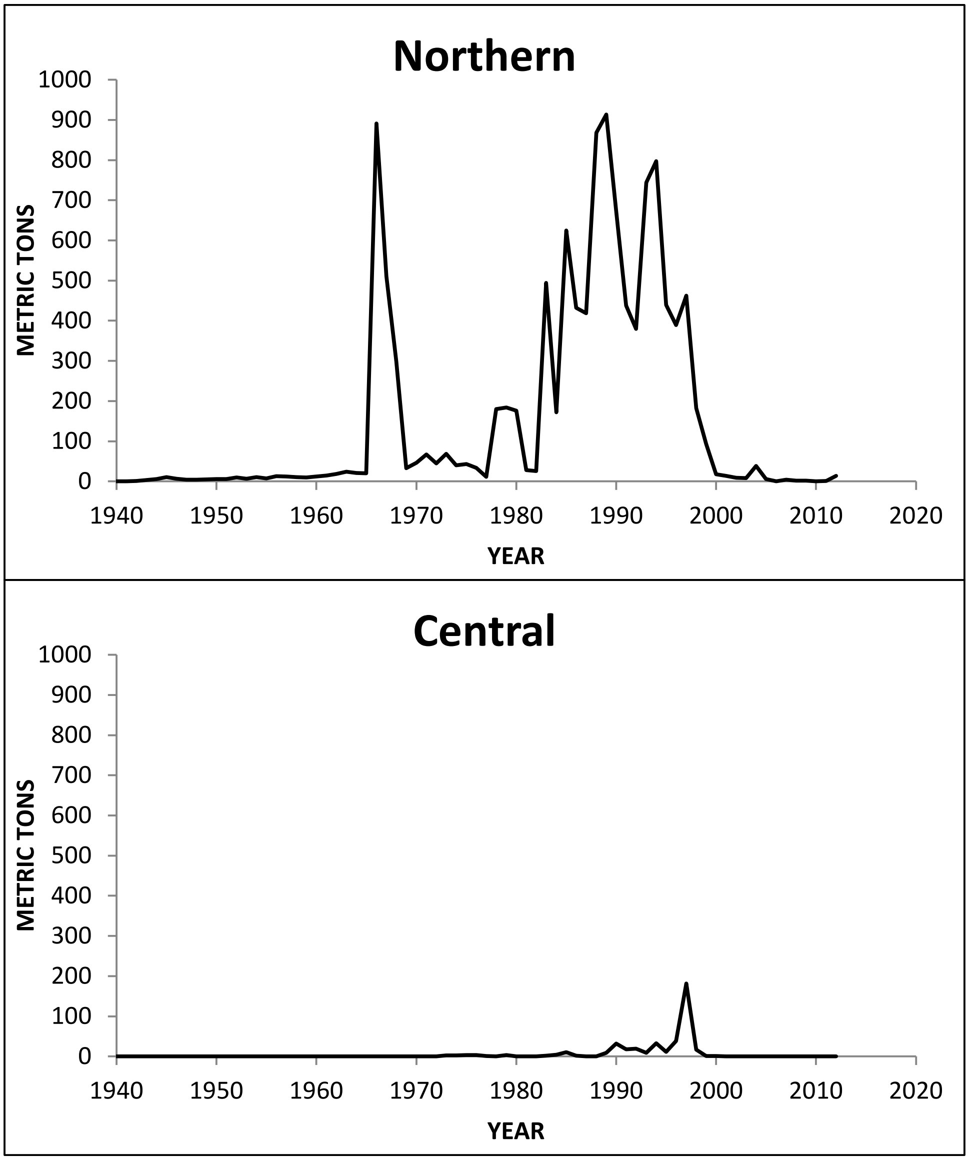


Figure 16. Sharpchin rockfish (*Sebastes zacentrus*) commercial catch by coastal region and year. Recreational catch is negligible. Coastal regions are divided at Cape Mendocino.

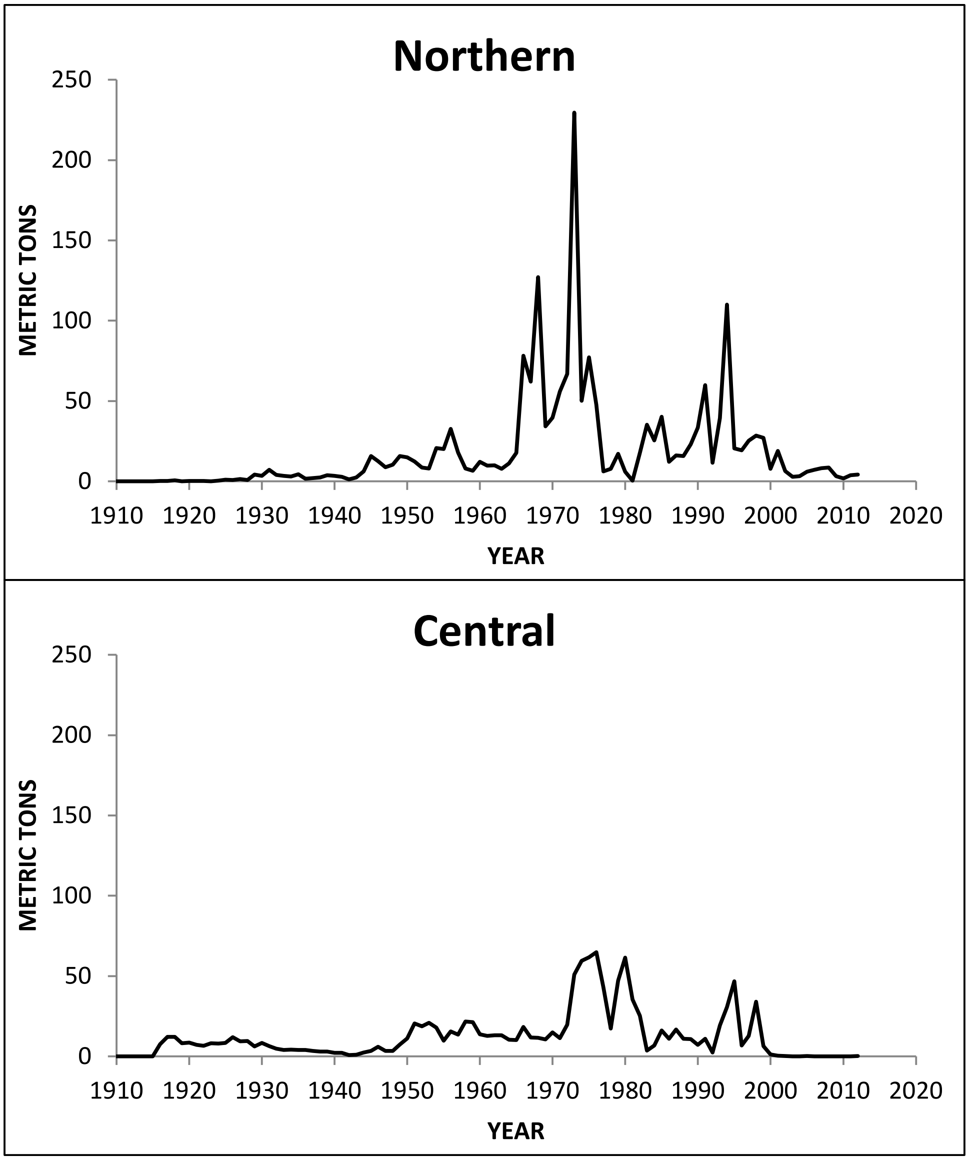


Figure 17. Stripetail rockfish (*Sebastes saxicola*) catch by coastal region, year, and fishery. Coastal regions are divided at Cape Mendocino.

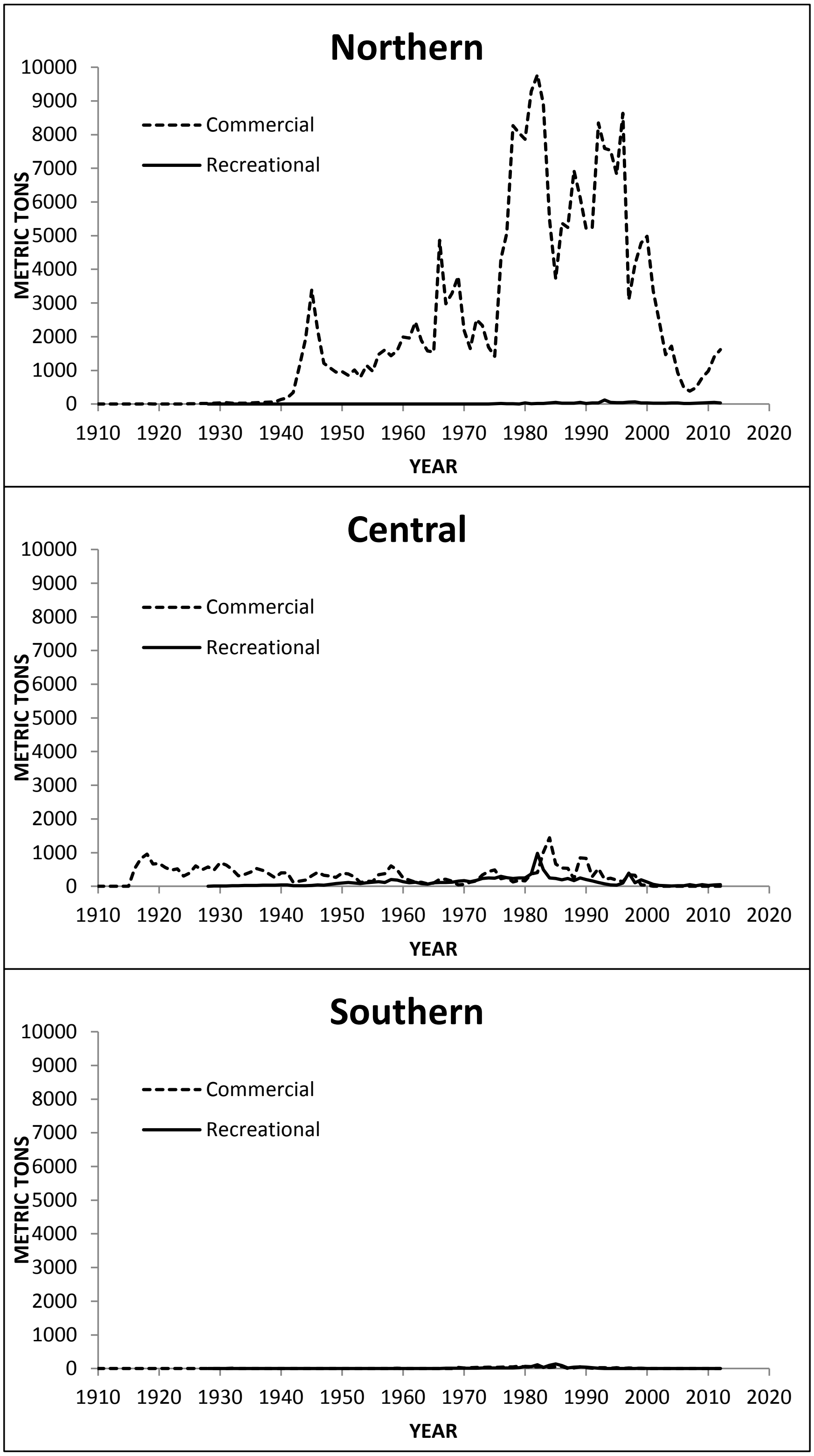


Figure 18. Yellowtail rockfish (*Sebastes flavidus*) catch by coastal region, year, and fishery. Coastal regions are divided at Point Conception and Cape Mendocino.

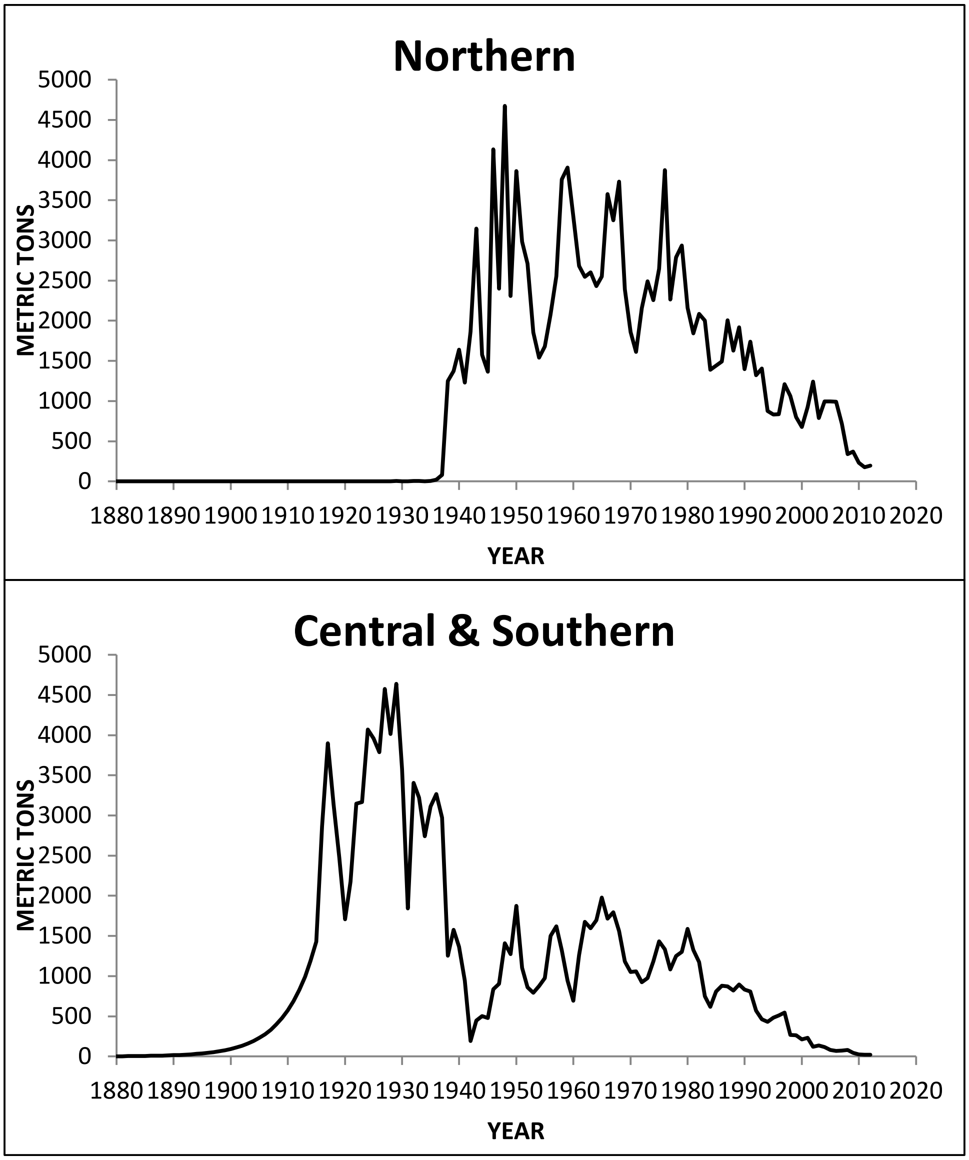


Figure 19. English sole (*Parophrys vetulus*) commercial landings by coastal region and year. Recreational catch is negligible. Commercial catch reconstructions (data prior to 2007) are from Stewart (2007), whose "Southern" area is equivalent to the Central and Southern areas in this assessment.

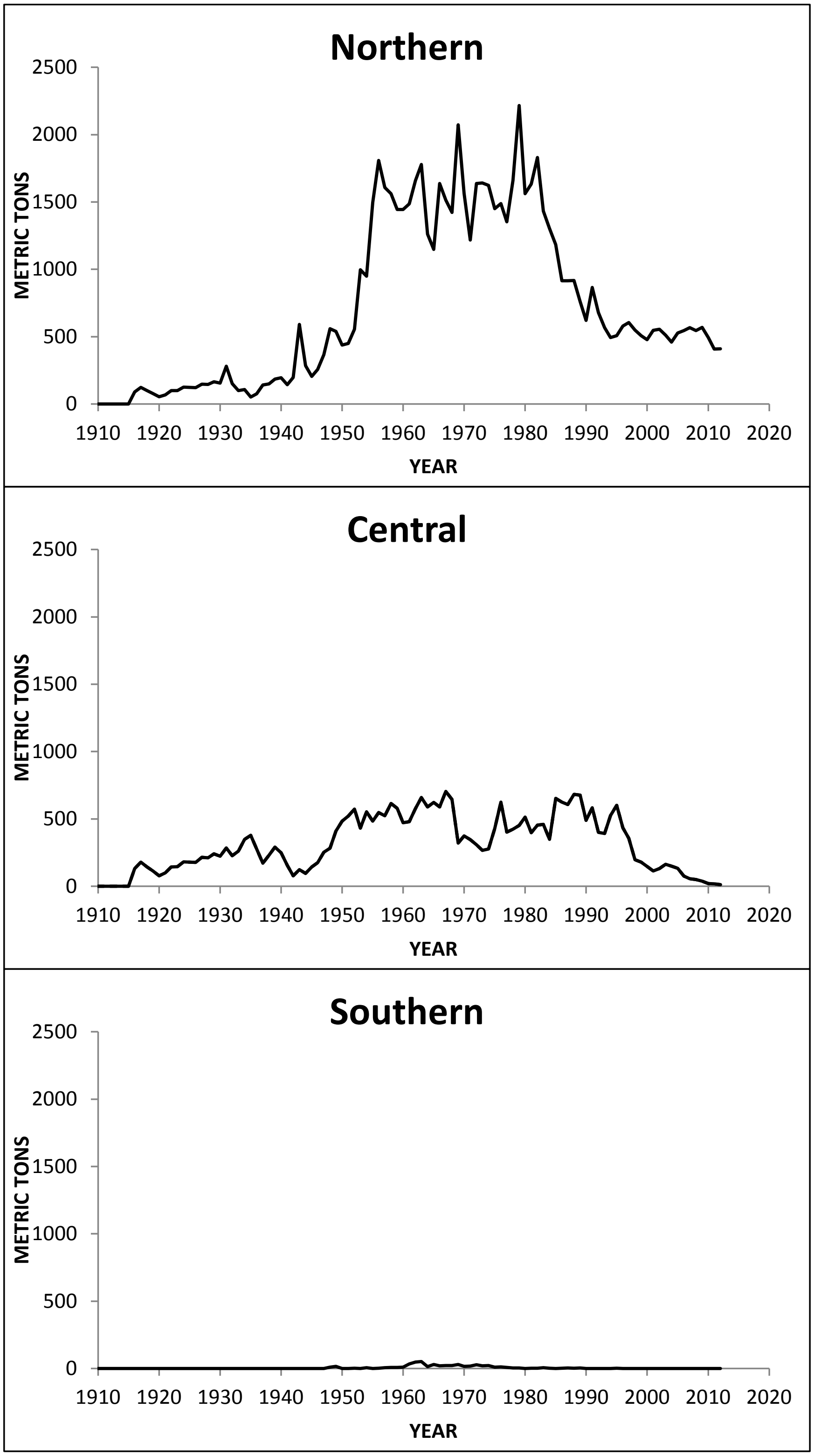


Figure 20. Rex sole (*Glyptocephalus zachirus*) commercial catch by coastal region and year. Recreational catch is negligible. Coastal regions are divided at Point Conception and Cape Mendocino

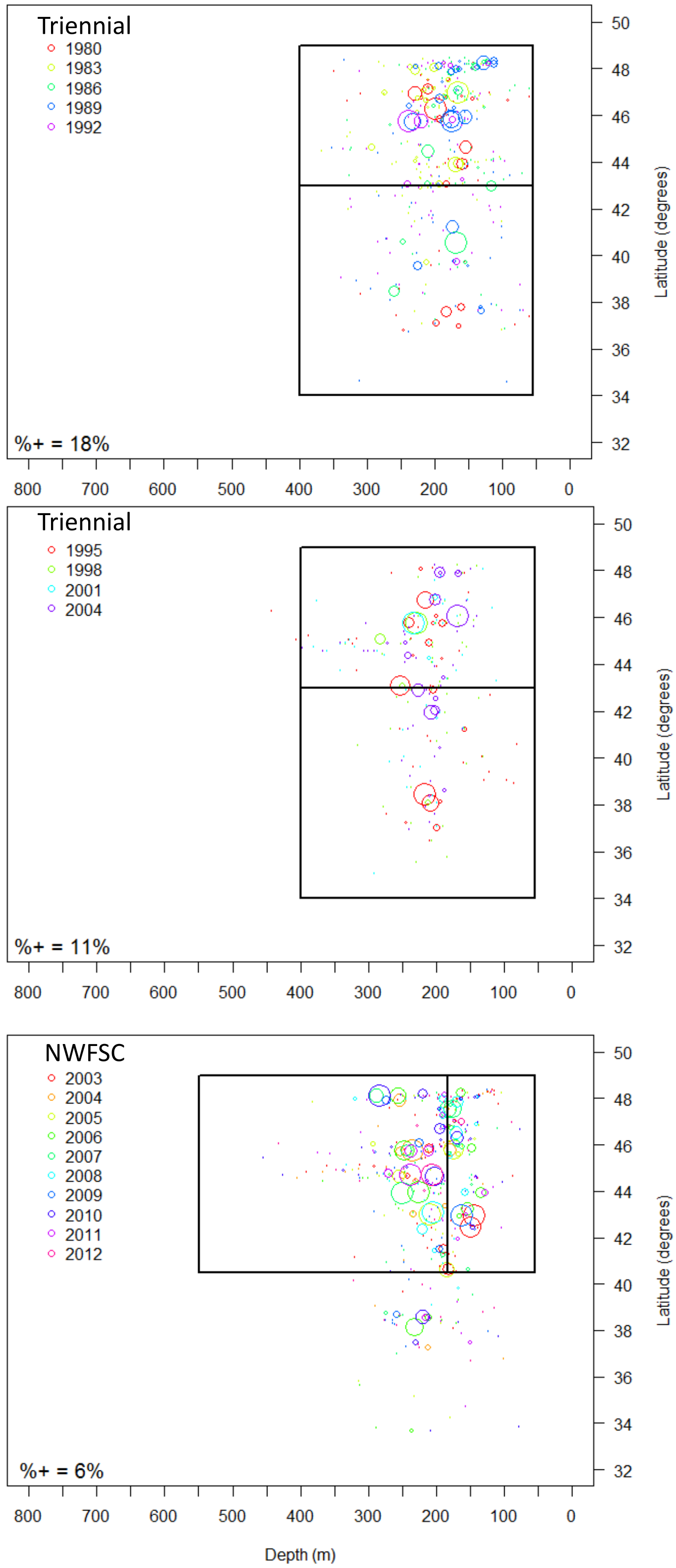


Figure 21. Depth and latitudinal occurrence of sharpchin rockfish in each trawl survey by year. Circle size indicates magnitude of catch. Black lines indicate the strata used in the GLMMs. Number in lower right is the percentage of positive tows.

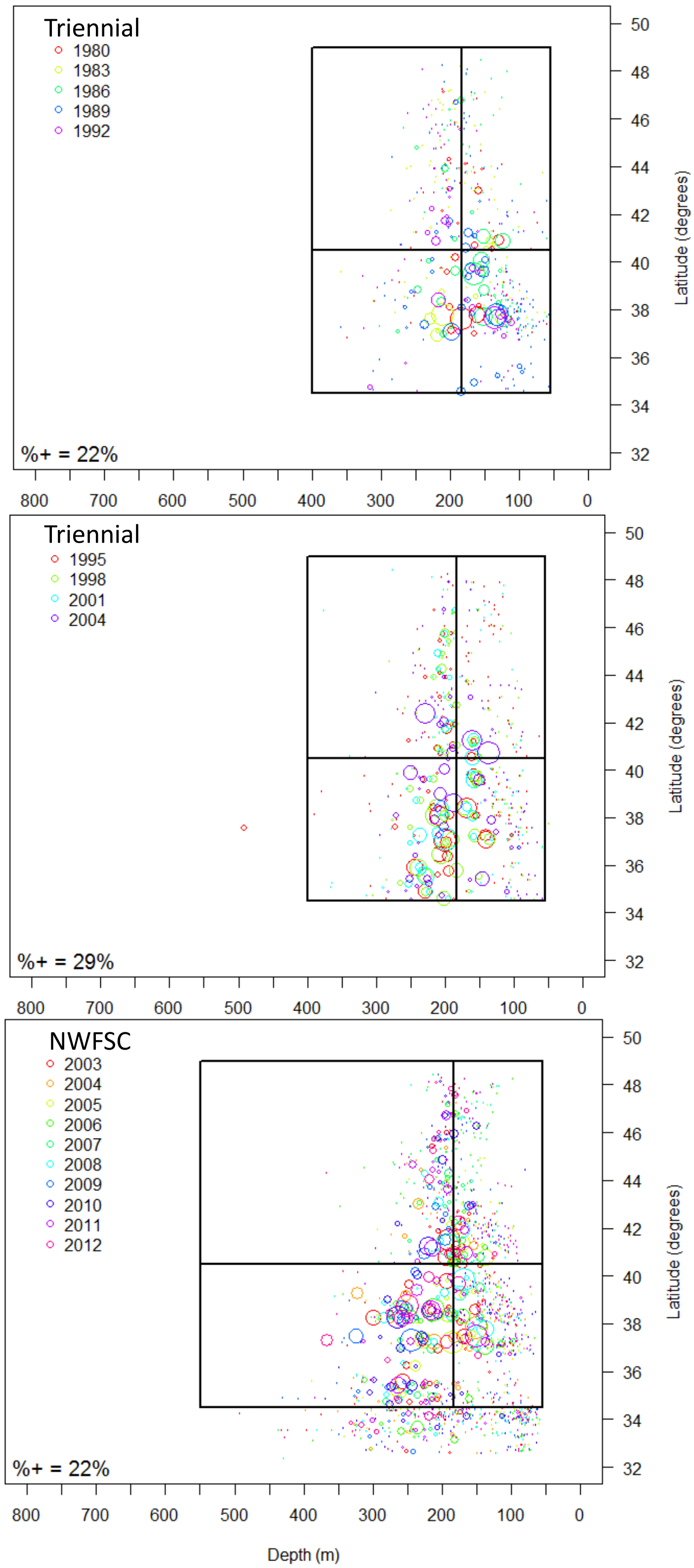


Figure 22. Depth and latitudinal occurrence of stripetail rockfish in each trawl survey by year. Circle size indicates magnitude of catch. Black lines indicate the strata used in the GLMMs. Number in lower right is the percentage of positive tows.

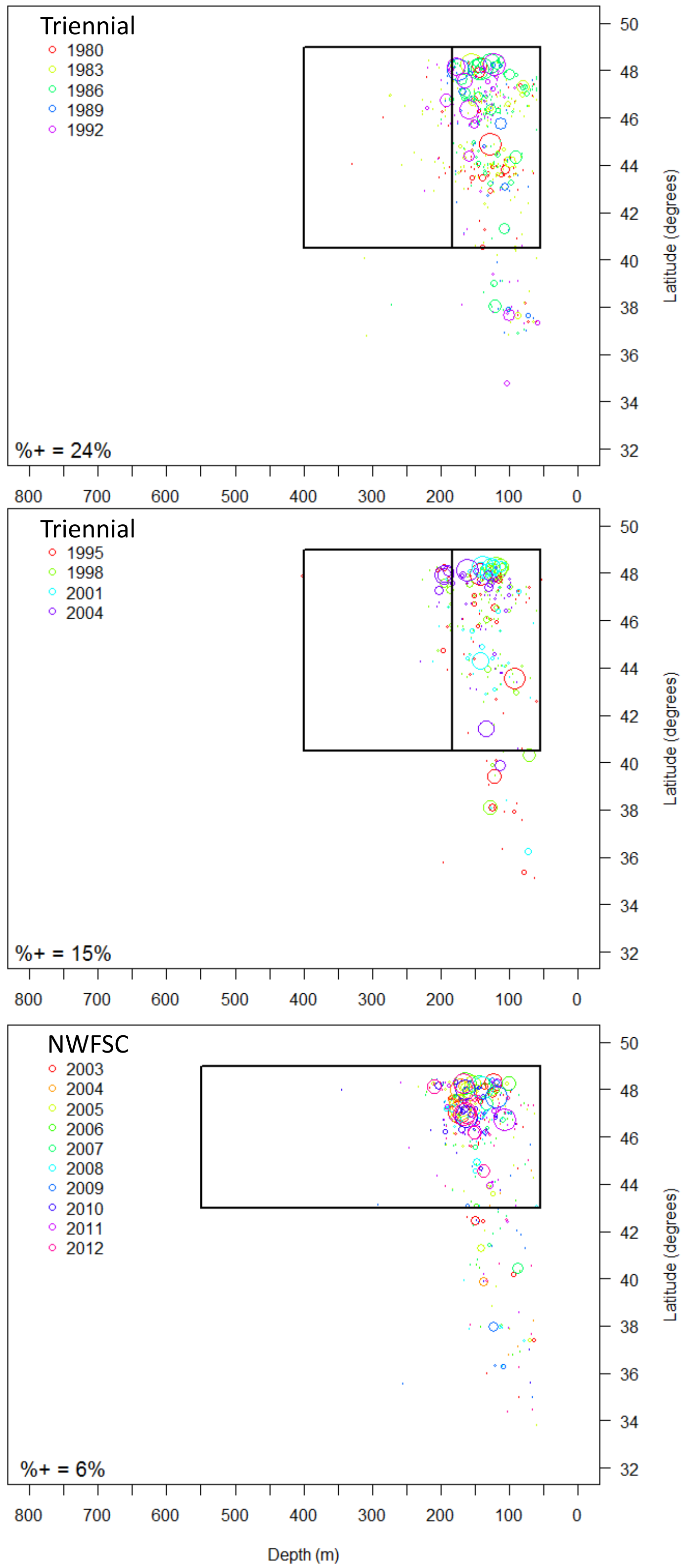


Figure 23. Depth and latitudinal occurrence of yellowtail rockfish (north of 40°10' N lat.) in each trawl survey by year. Circle size indicates magnitude of catch. Black lines indicate the strata used in the GLMMs. Number in lower right is the percentage of positive tows.

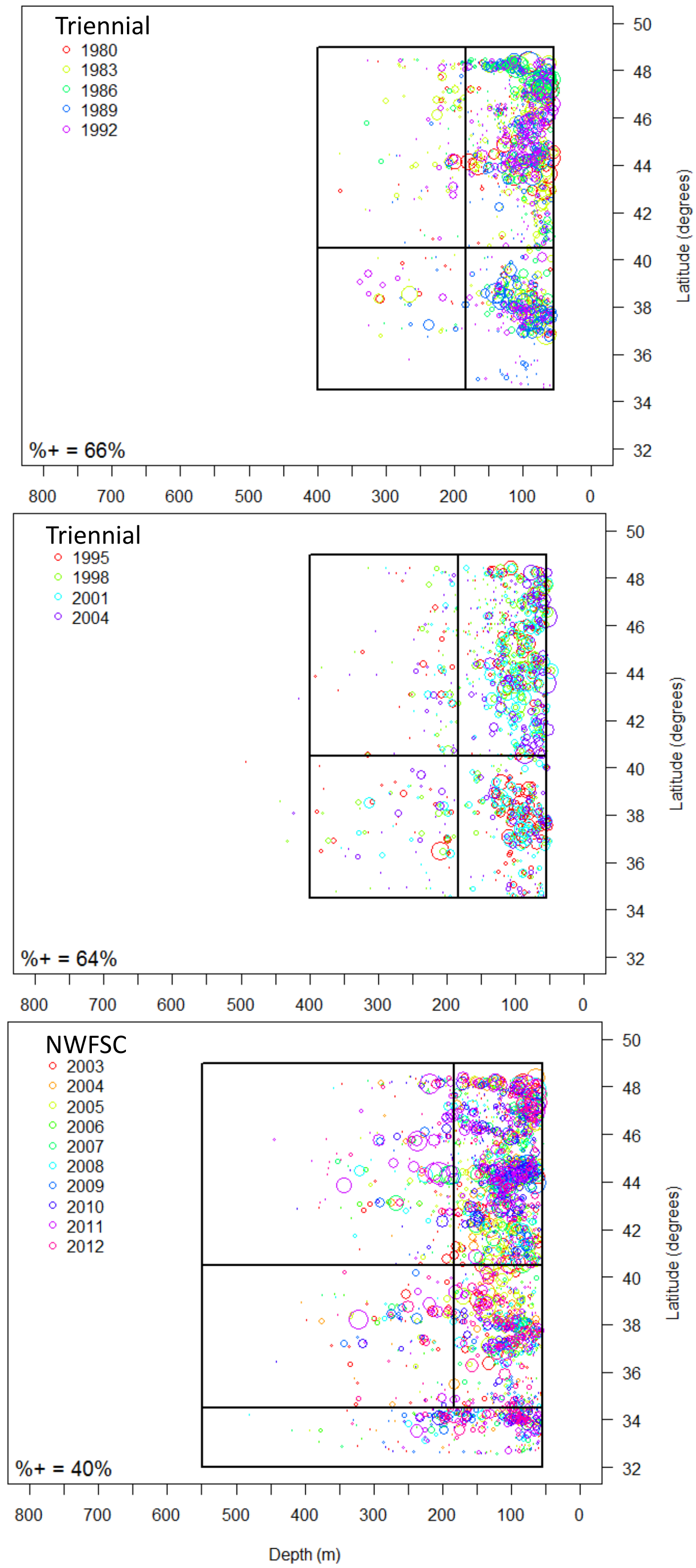


Figure 24. Depth and latitudinal occurrence of English sole in each trawl survey by year. Circle size indicates magnitude of catch. Black lines indicate the strata used in the GLMMs. Number in lower right is the percentage of positive tows.

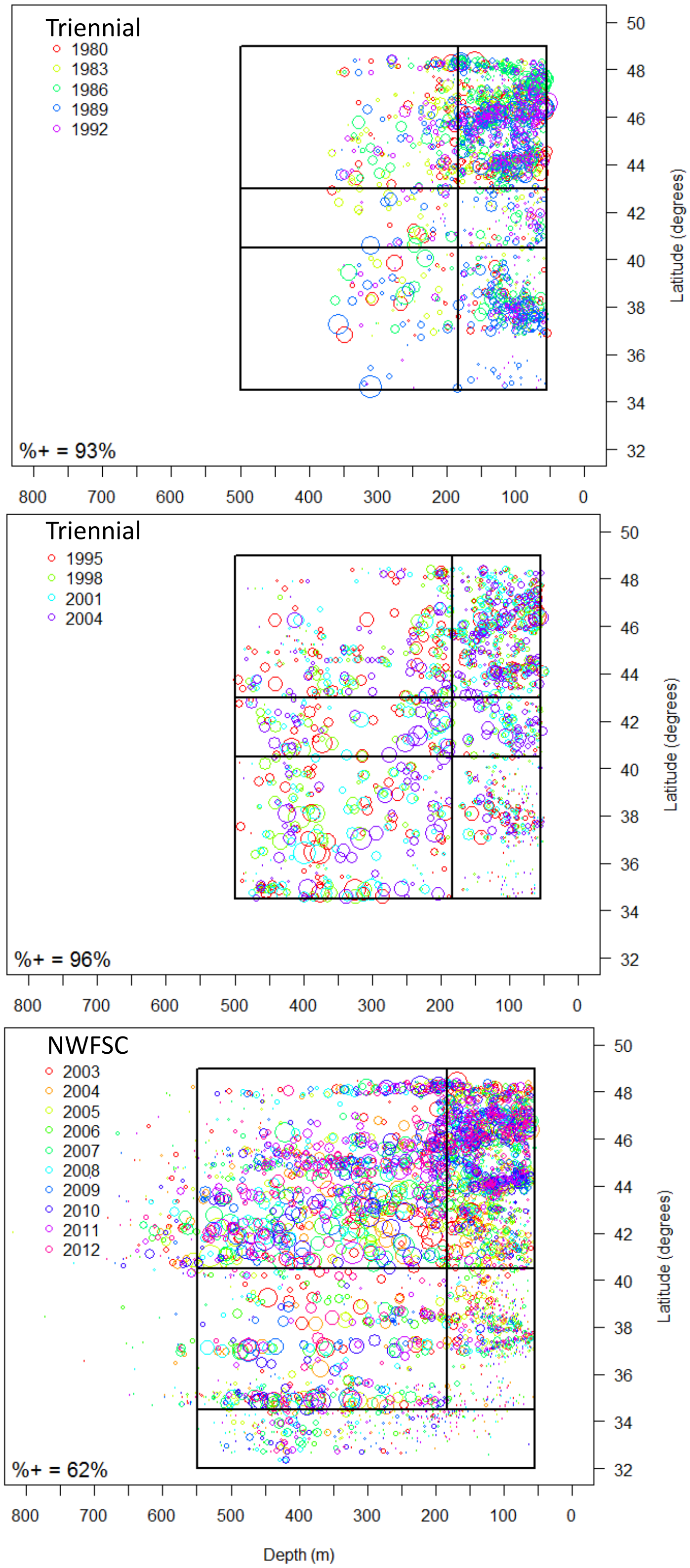


Figure 25. Depth and latitudinal occurrence of rex sole in each trawl survey by year. Circle size indicates magnitude of catch. Black lines indicate the strata used in the GLMMs. Number in lower right is the percentage of positive tows.

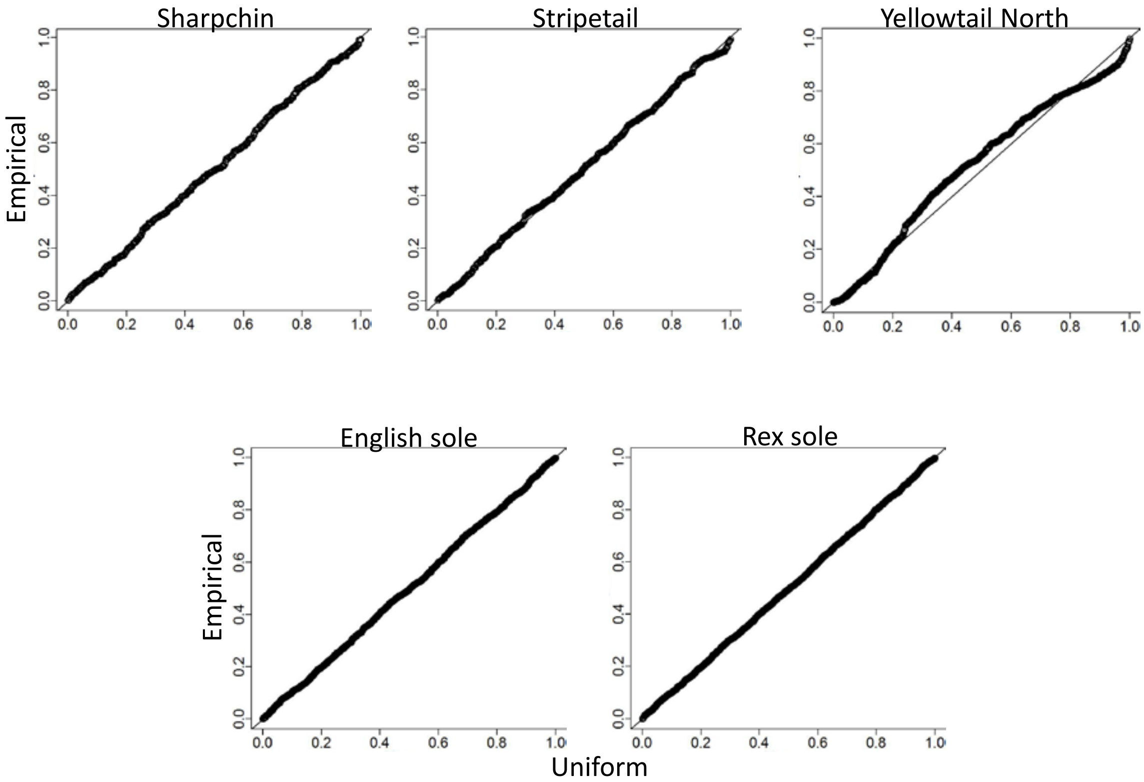


Figure 26. Q-Q plots for the early (1980-1992) AFSC triennial survey series used to diagnose convergence of the Bayesian GLMM model. The yellowtail rockfish (N) plot is for the full time series (1980-2004).

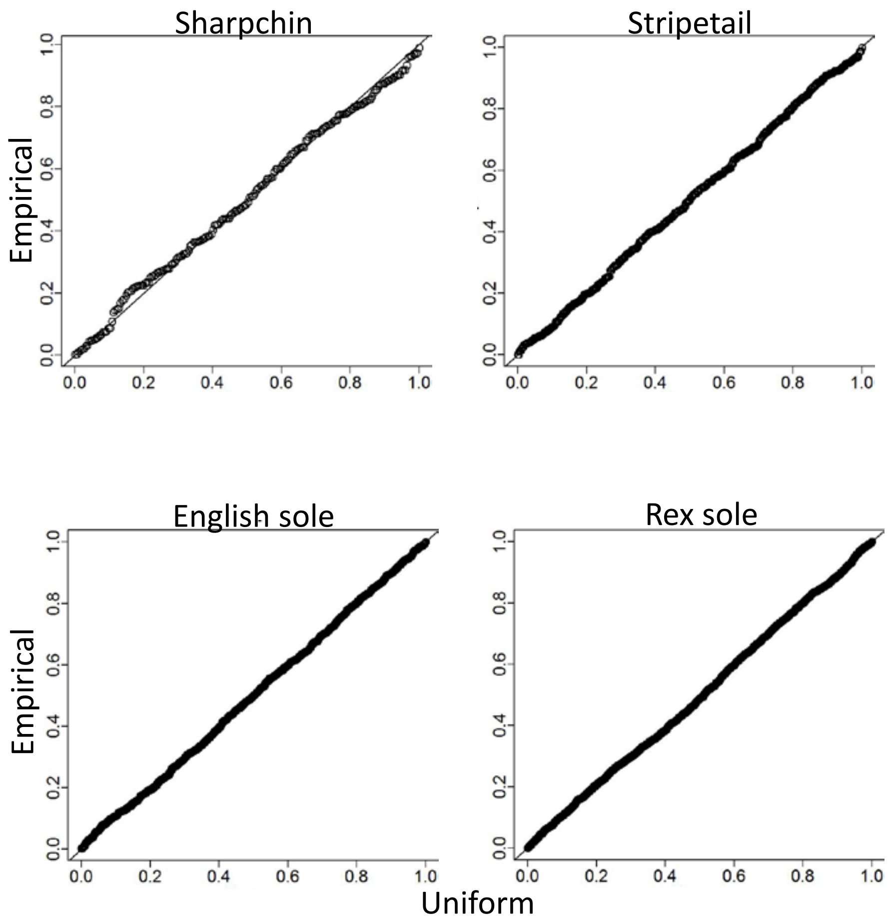


Figure 27. Q-Q plots for the late (1995-2004) AFSC triennial survey series used to diagnose convergence of the Bayesian GLMM model.

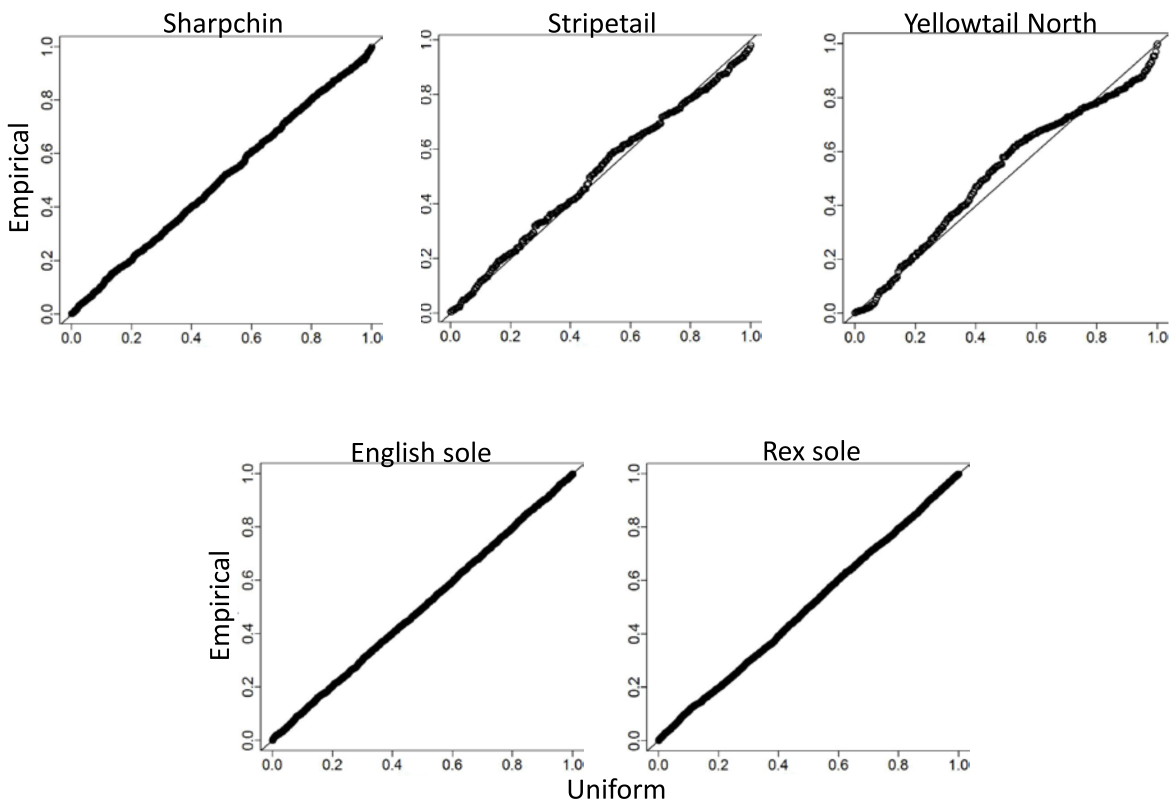


Figure 28. Q-Q plots for the NWFSC annual survey (2003-2012) series used to diagnose convergence of the Bayesian GLMM model.

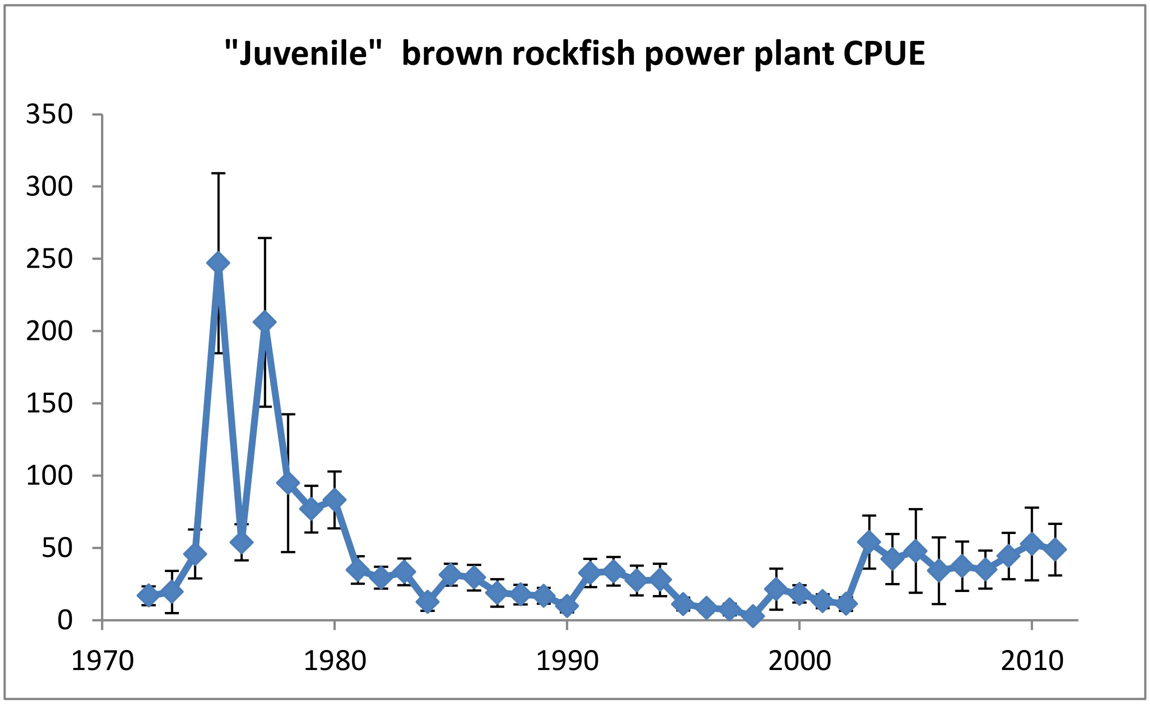


Figure 29. Preliminary index of Brown rockfish (S. auriculatus) based on the number of encountered animals; uncertainty based on a jackknife routine.

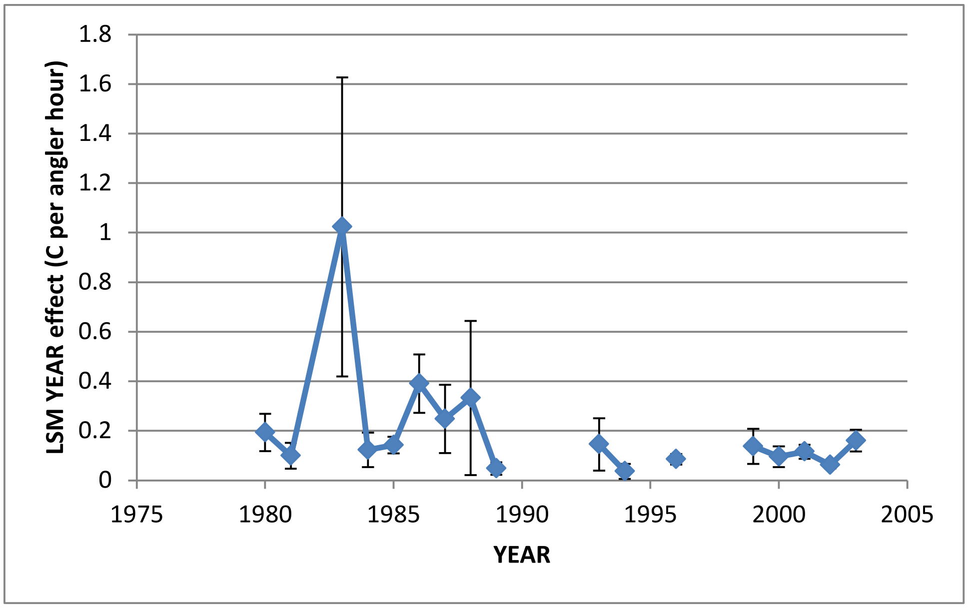


Figure 30. GLM time series of brown rockfish (central area) abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

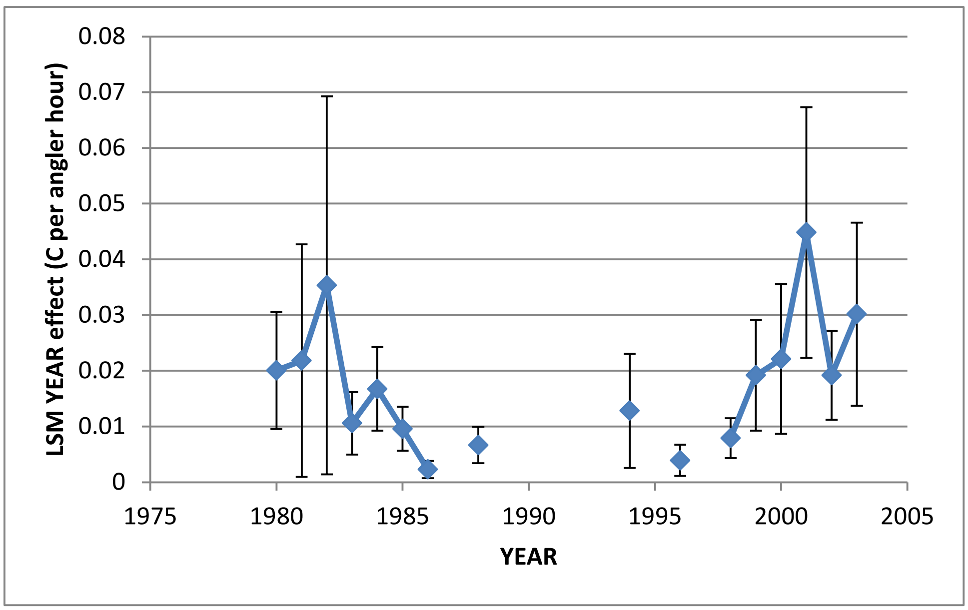


Figure 31. GLM time series of brown rockfish (southern area) abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

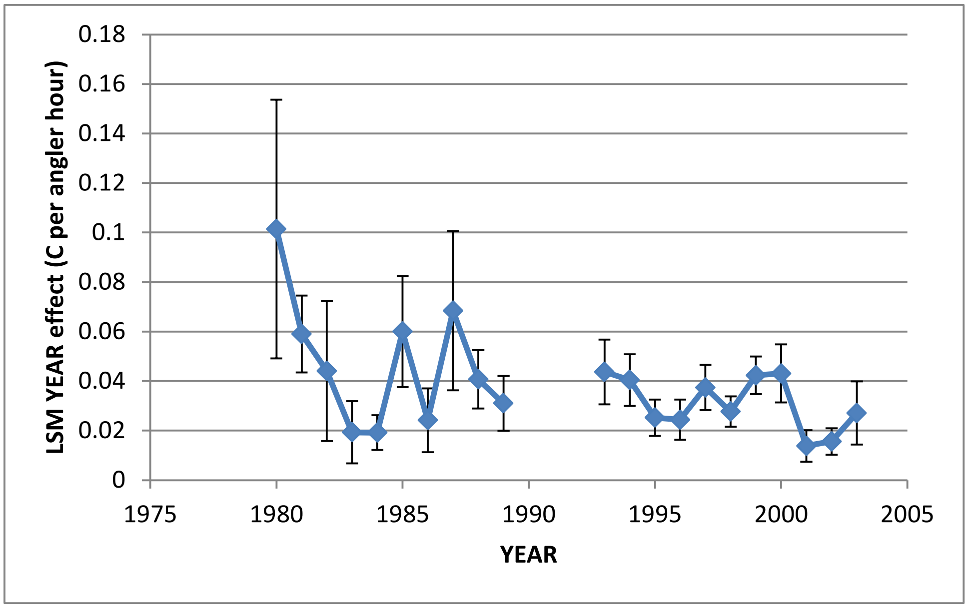


Figure 32. GLM time series of China rockfish (northern area) abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

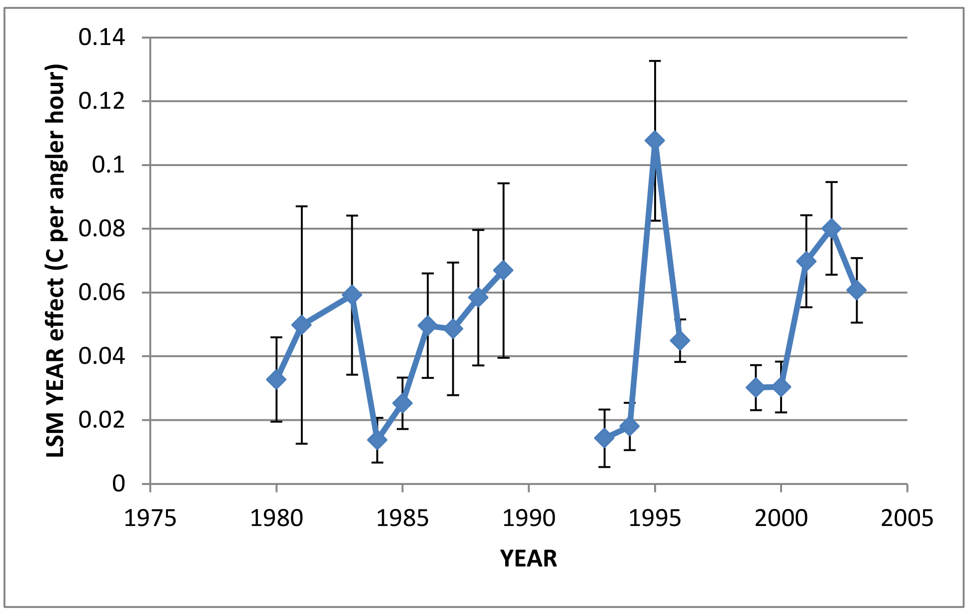


Figure 33. GLM time series of China rockfish (central area) abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

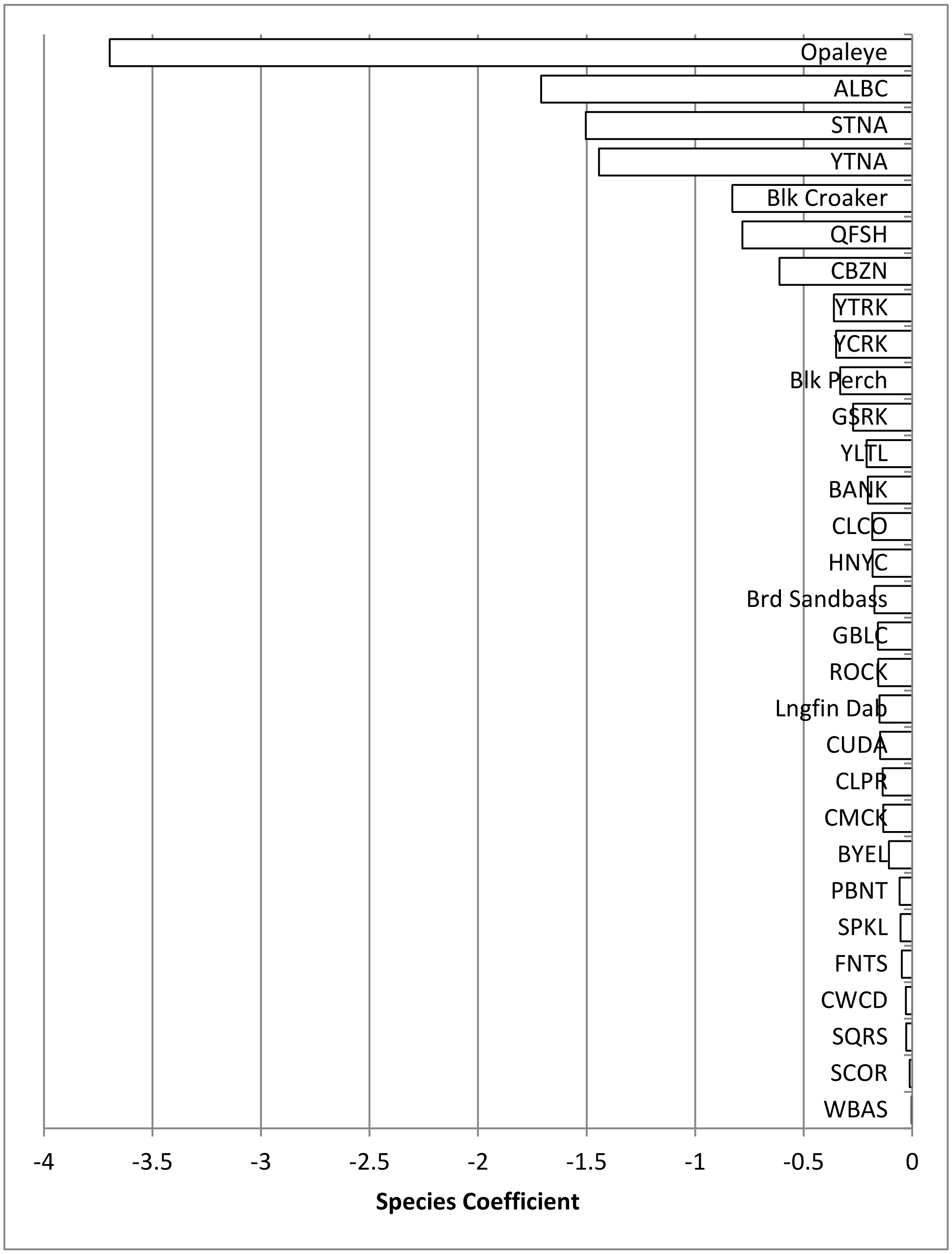


Figure 34. Coefficients estimated by binomial regression for data filtering for copper rockfish south.

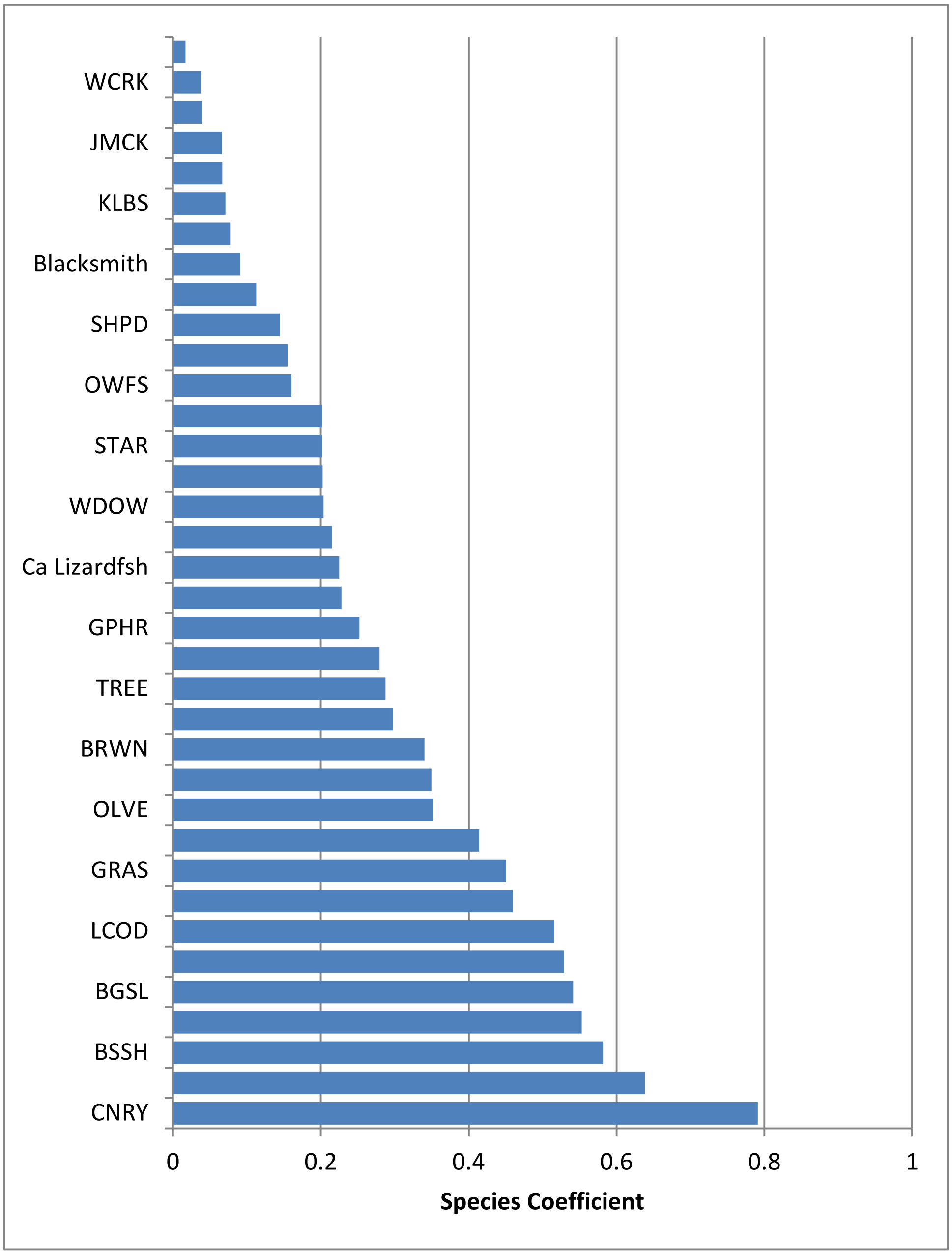


Figure 35. Coefficients estimated by binomial regression for data filtering for copper rockfish south.

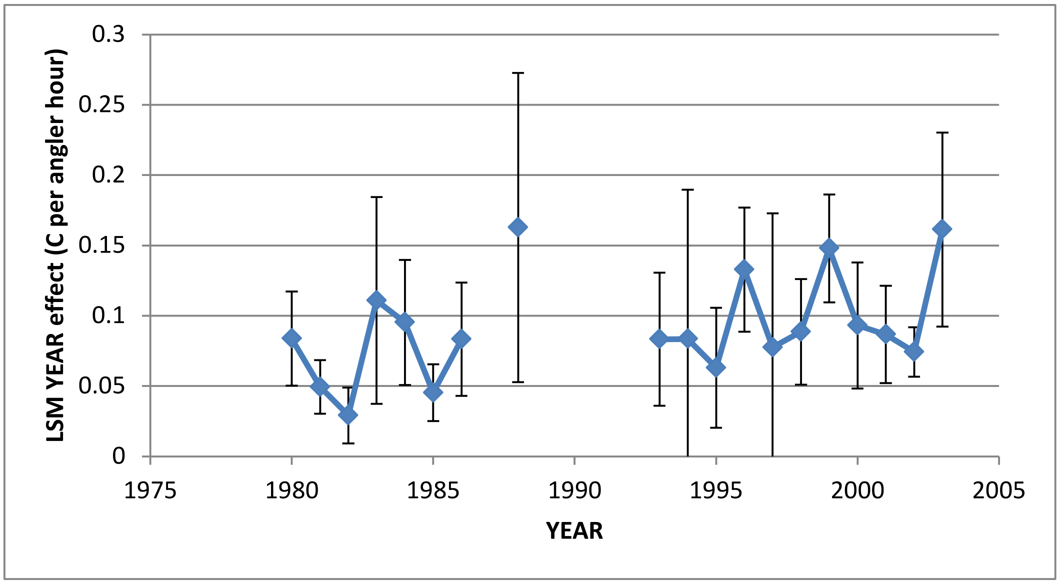


Figure 36. GLM time series of copper rockfish south abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

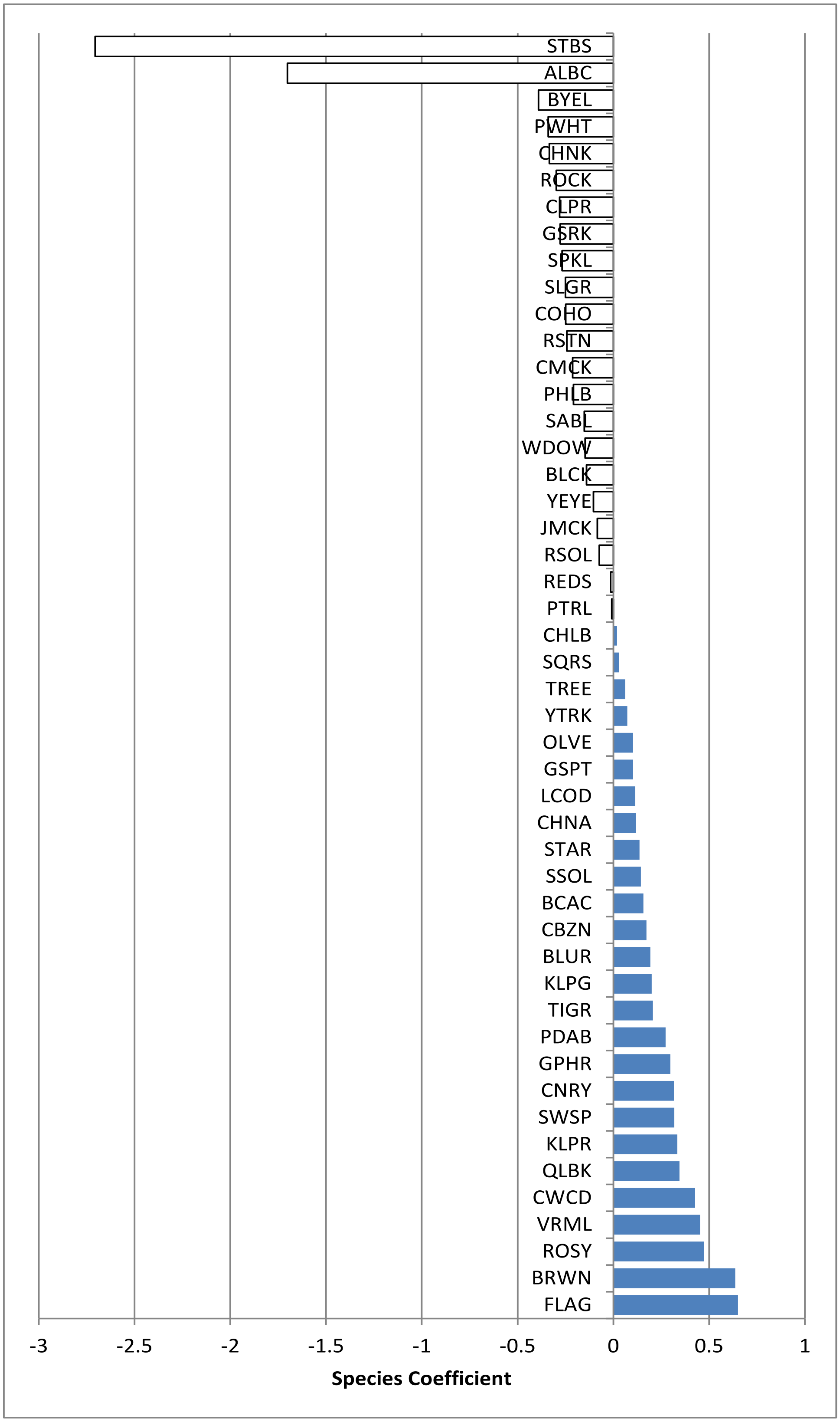


Figure 37. Coefficients estimated by binomial regression for data filtering copper rockfish north/central area.

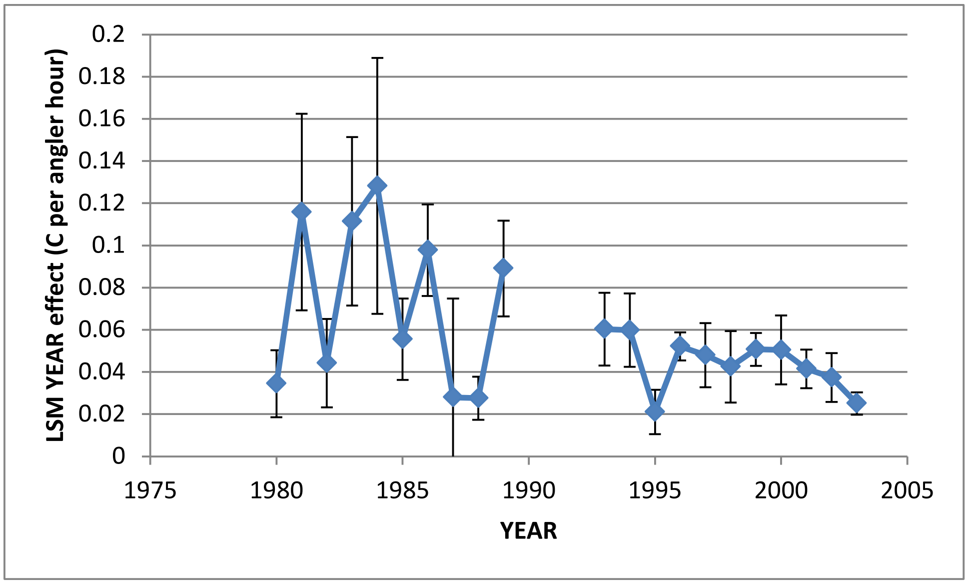


Figure 38. GLM time series of copper rockfish (north/central) abundance indexes from RecFIN sampling. Error bars are 1 standard error from jackknife.

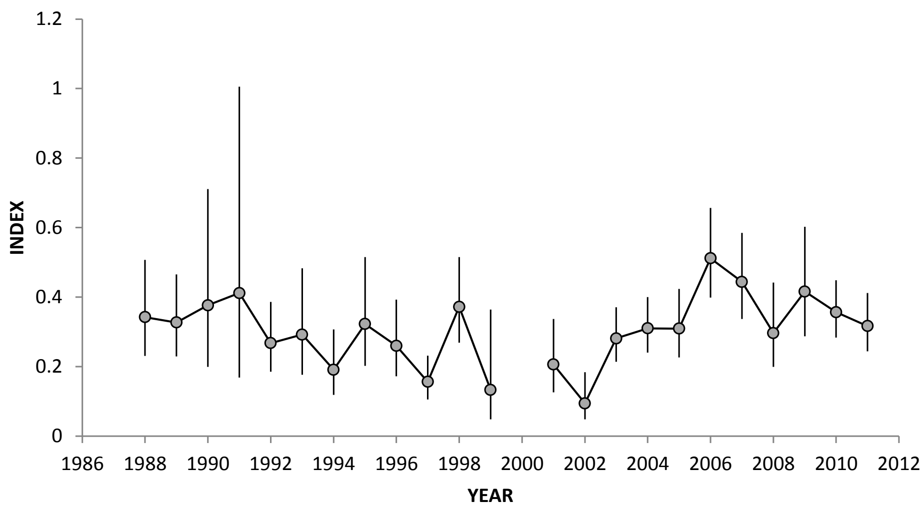


Figure 39. Year effects and 95% lognormal confidence intervals from the Central California onboard CPFV observer index for brown rockfish.

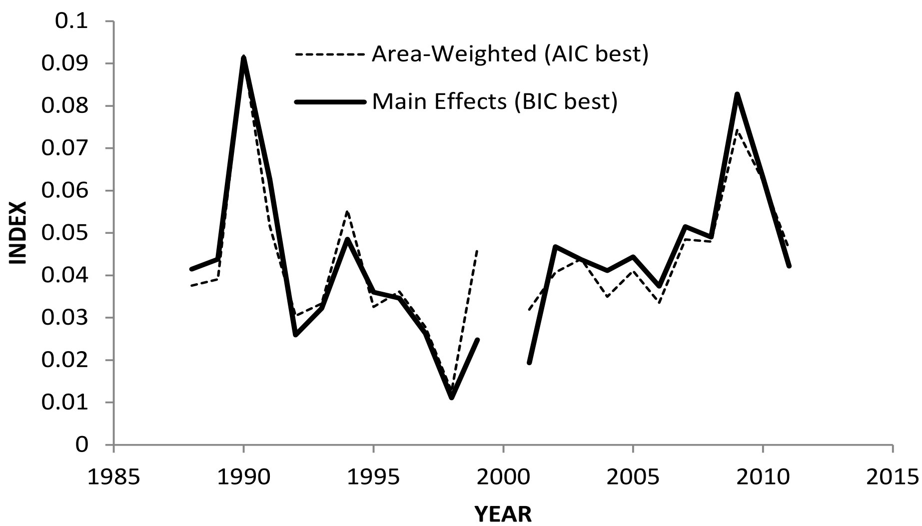


Figure 40. Comparison of area-weighted and "main effects" abundance indices for China rockfish in central California, estimated from onboard CPFV observer data.

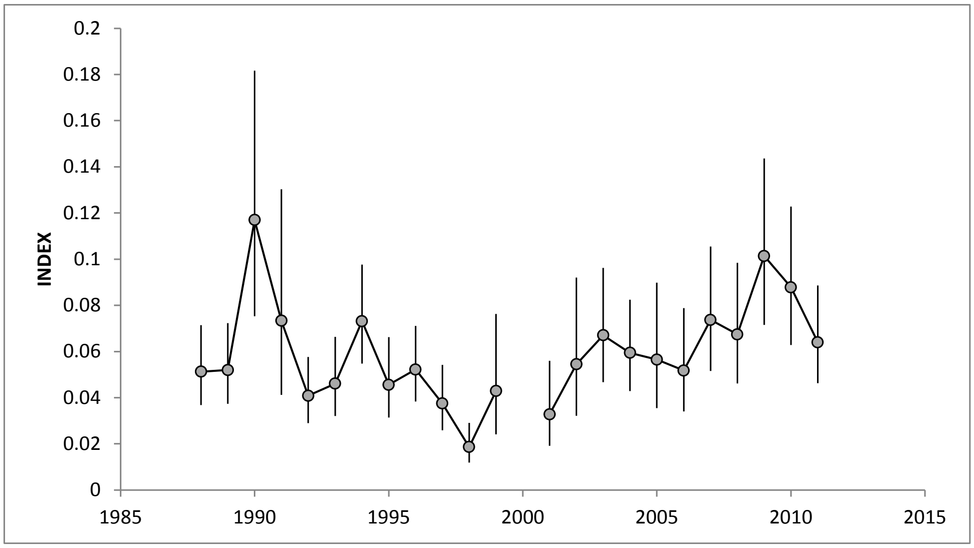


Figure 41. Year effects and 95% lognormal confidence intervals from the Central California onboard CPFV observer index for China rockfish.

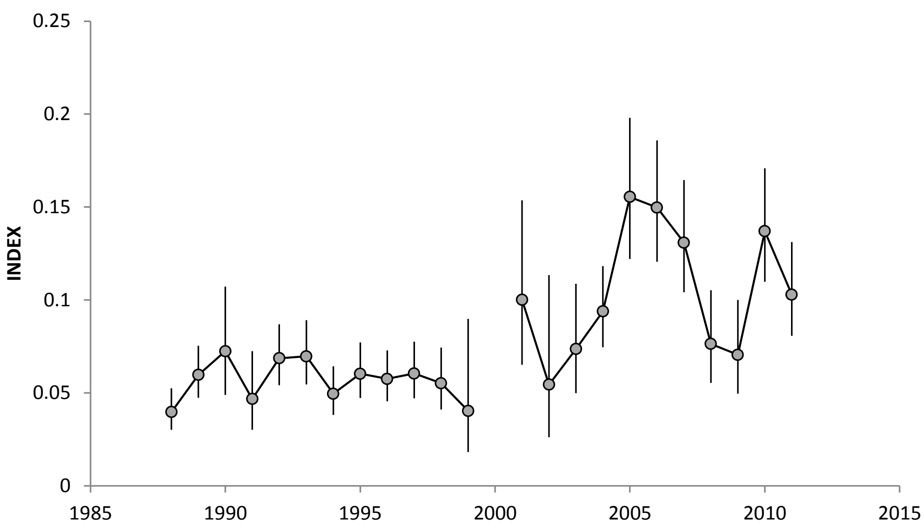


Figure 42. Year effects and 95% lognormal confidence intervals from the Central California onboard CPFV observer index for copper rockfish.

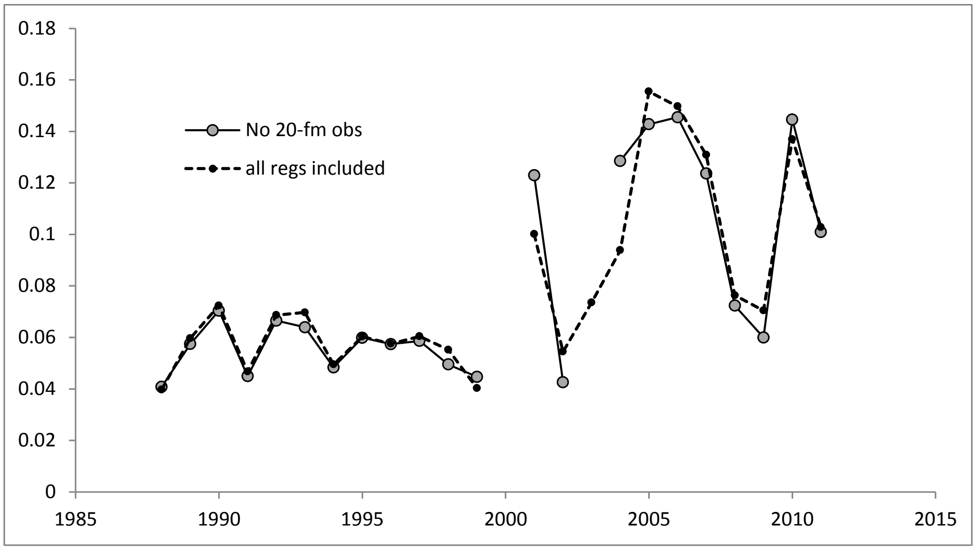


Figure 43. Year effects from the Central California onboard CPFV observer index for Copper rockfish, with a comparison of indices derived using data from all regulatory periods ("all regs included") and data excluding locations and time periods with 20-fathom depth restrictions ("No 20-fm obs").

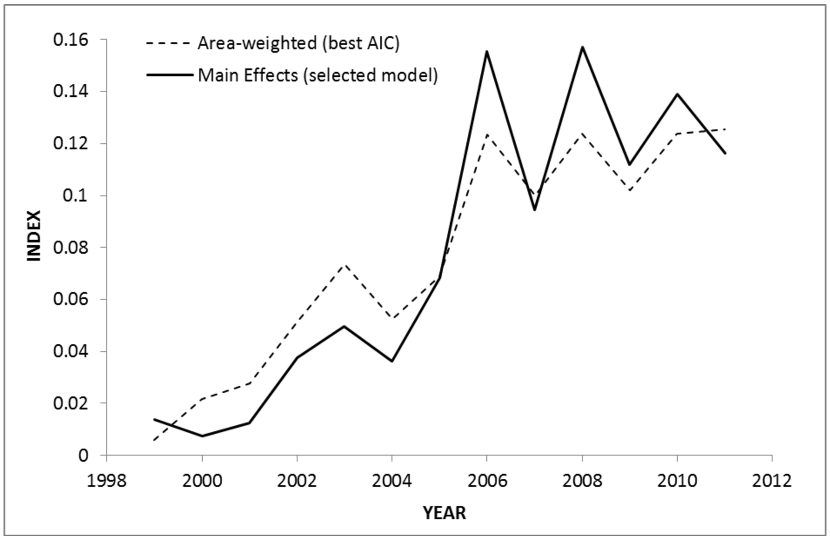


Figure 44. Comparison of indices for Southern California onboard CPFV observer indices for brown rockfish. An area-weighted year/region interaction term (dashed line; selected by AIC) and main-effects model (solid line; selected by AIC without interactions).

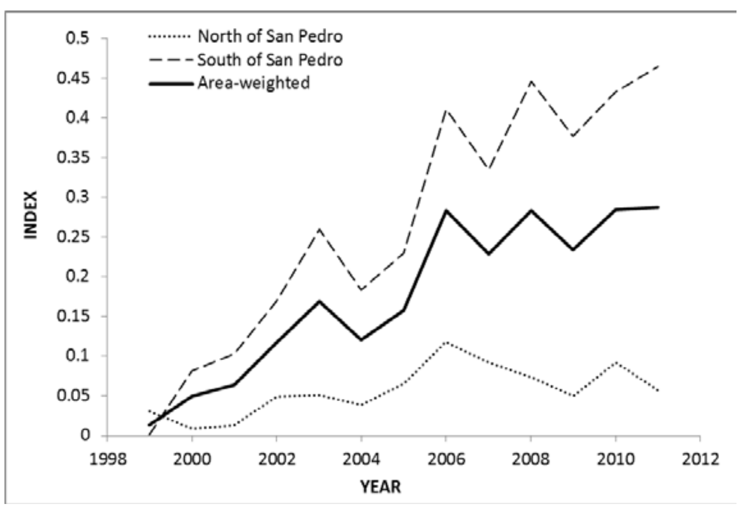


Figure 45. Comparison of indices for Southern California onboard CPFV observer for drifts north of San Pedro (dotted line) and south of San Pedro (dashed line) to the area-weighted index.

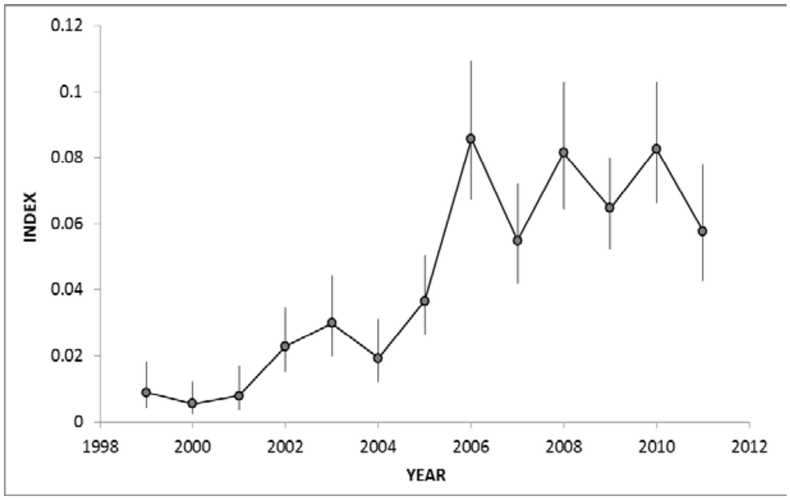


Figure 46.Year effects and 95% lognormal confidence intervals from the Southern California onboard CPFV observer index for brown rockfish.

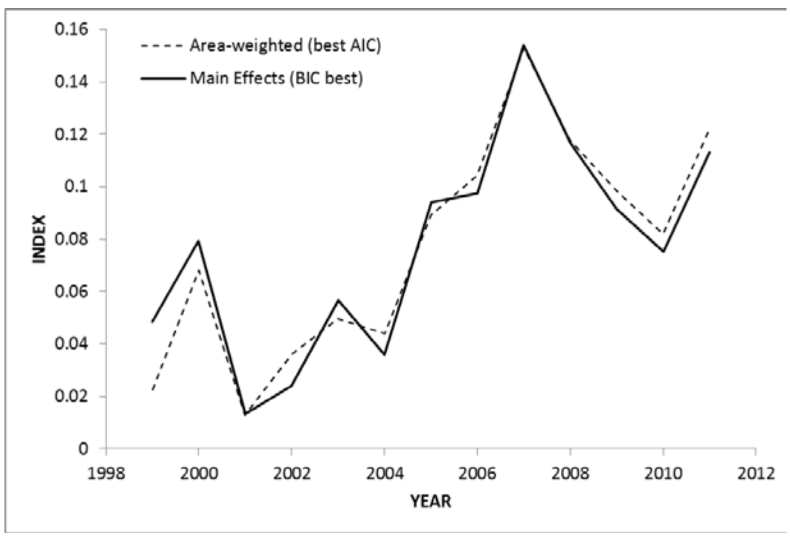


Figure 47. Comparison of indices for Southern California onboard CPFV observer indices for copper rockfish. An area-weighted year/region interaction term (dashed line; selected by AIC) and main-effects model (solid line; selected by BIC without interactions).

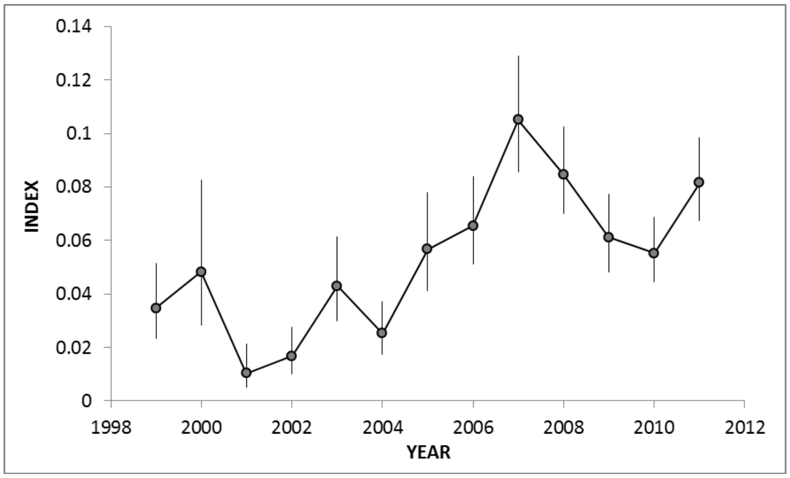


Figure 48. Year effects and 95% lognormal confidence intervals from the Northern California/Oregon onboard CPFV observer index for copper rockfish.

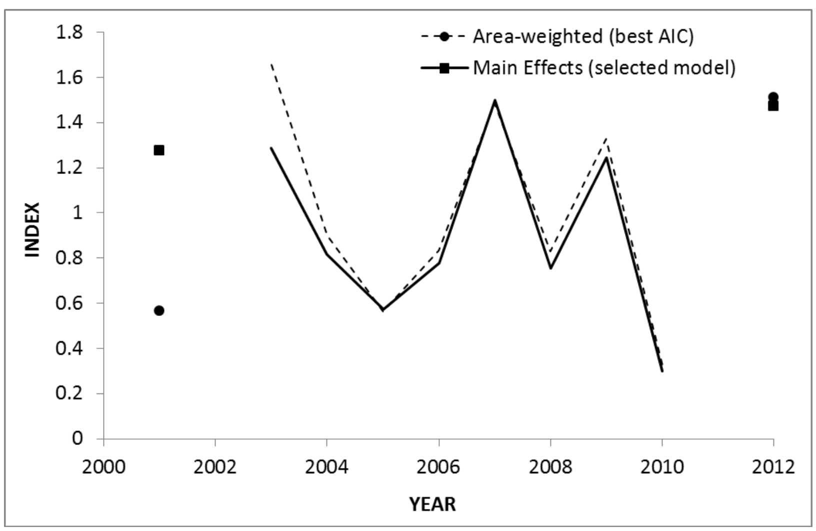


Figure 49. Comparison of indices for the Northern California /Oregon onboard CPFV observer indices for China rockfish. An area-weighted year/region interaction term (dashed line; selected by AIC) and main-effects model (solid line; selected model).

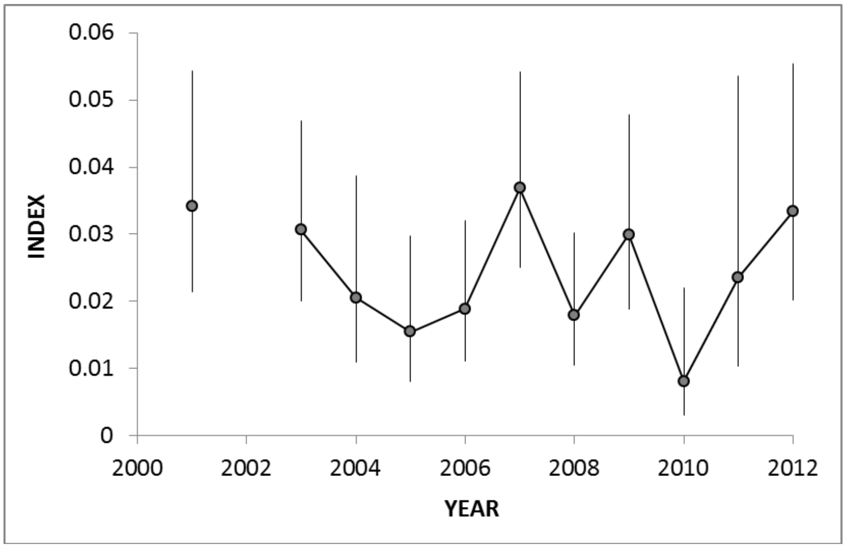


Figure 50. Year effects and 95% lognormal confidence intervals from the Northern California/Oregon onboard CPFV observer index for China rockfish.

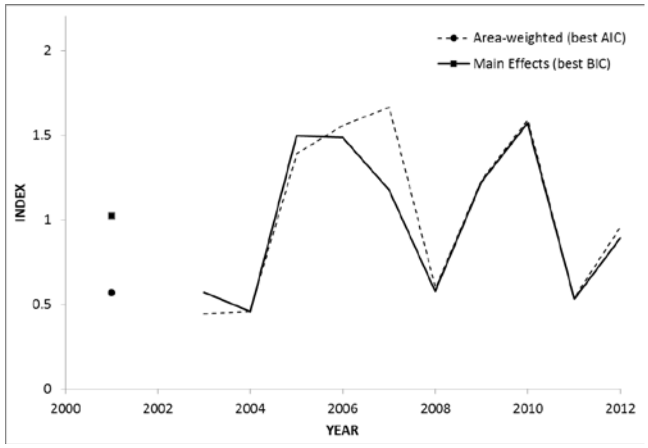


Figure 51. Comparison of indices for the Northern California /Oregon onboard CPFV observer indices for copper rockfish. An area-weighted year/region interaction term (dashed line; selected by AIC) and main-effects model (solid line; selected model).

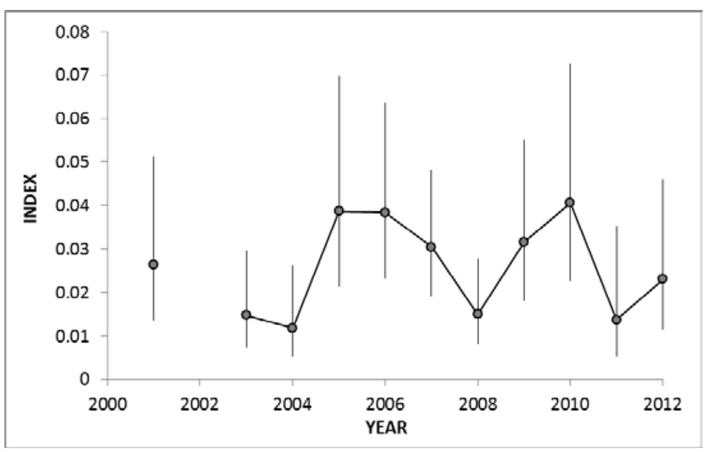


Figure 52. Year effects and 95% lognormal confidence intervals from the Northern California/Oregon onboard CPFV observer index for copper rockfish.

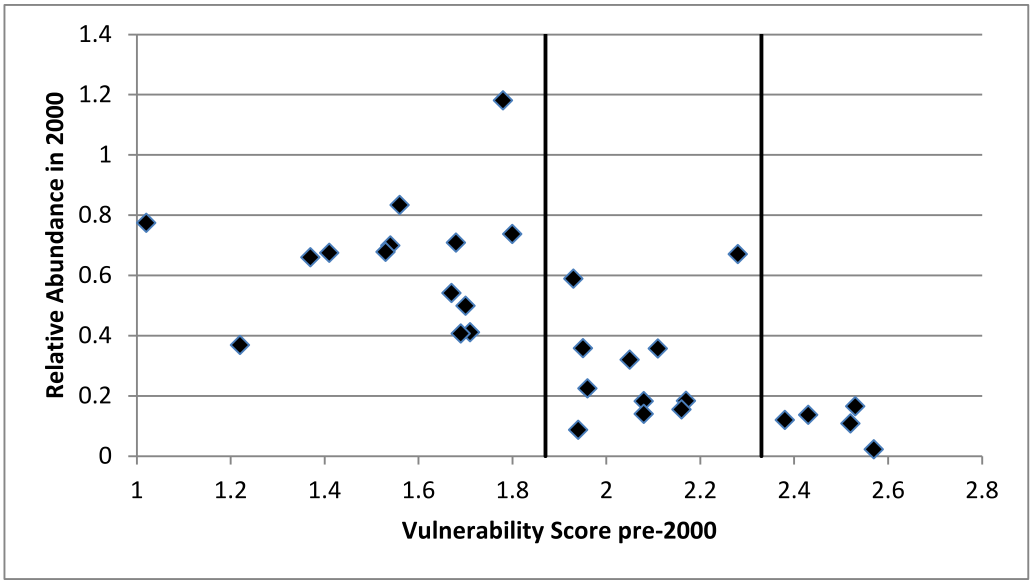


Figure 53. The relationship between relative abundance in 2000 (B2000/Bunfished) and a PSA vulnerability score reflecting pre-2000 fishery management.

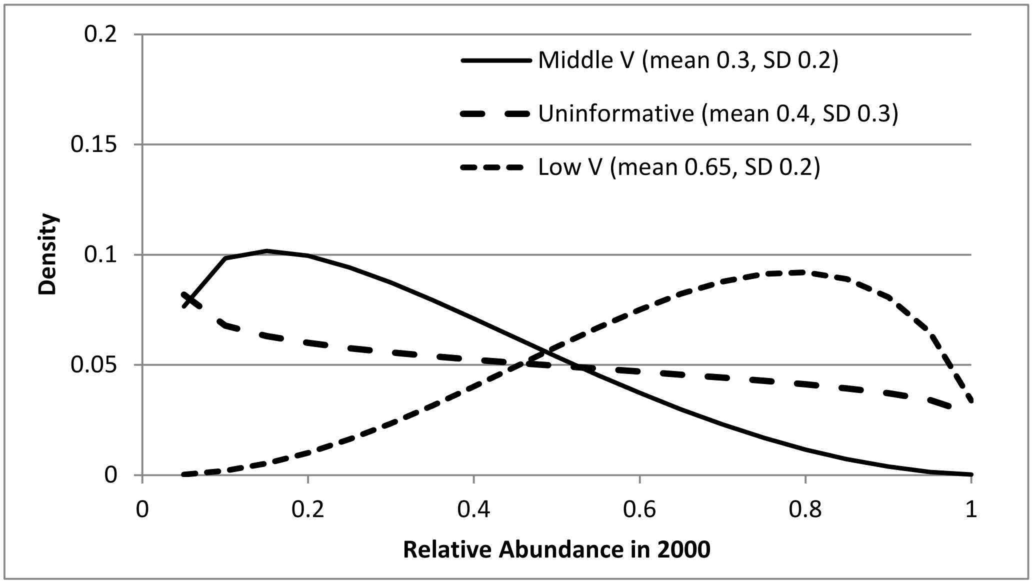


Figure 54. Prior distributions for alternative vulnerability scores.

8.2 Model Results and Diagnostic Figures

8.2.1 Brown rockfish

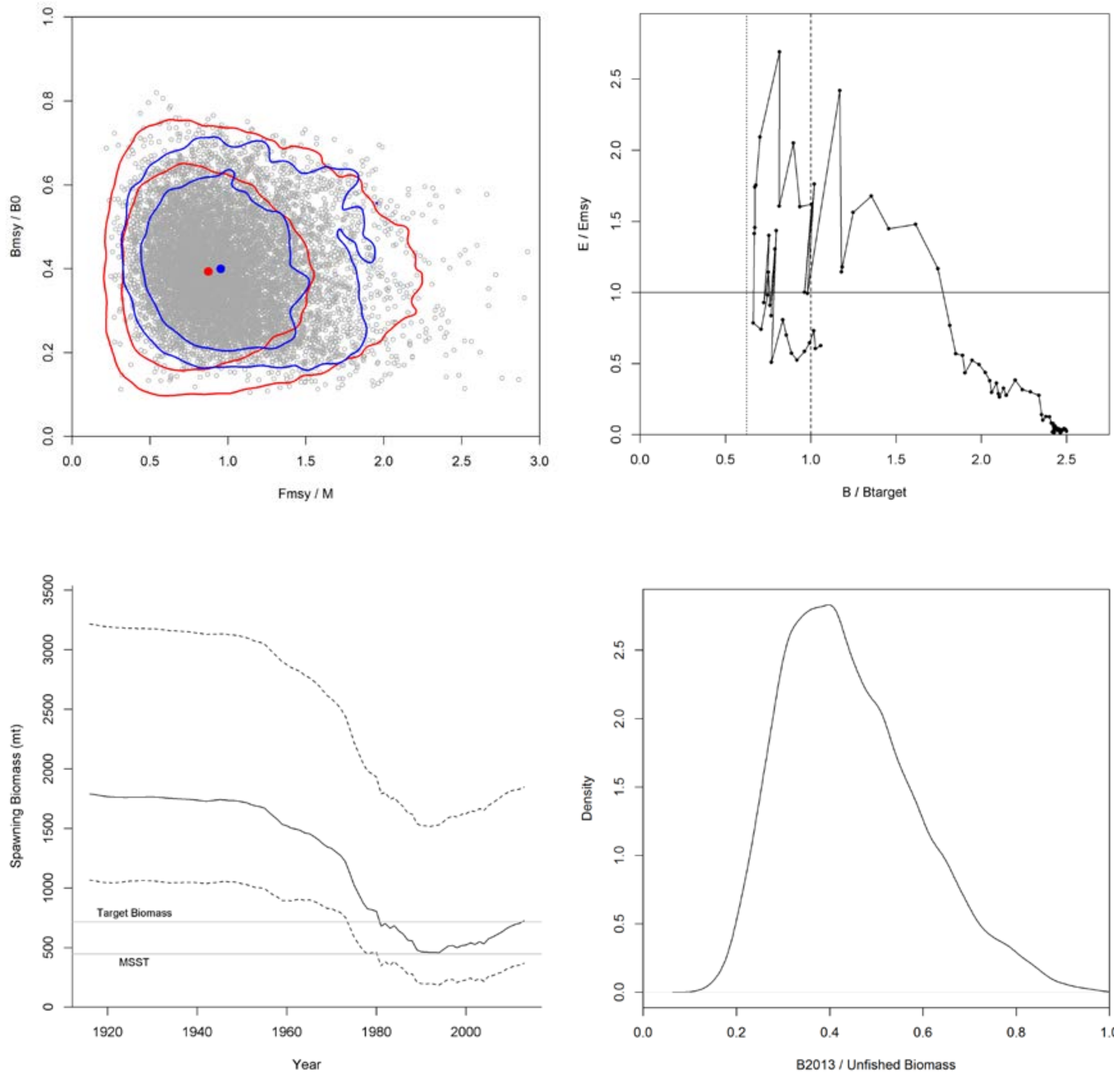


Figure 55. XDB-SRA results for brown rockfish. <u>Upper left</u>: bivariate prior and posterior distributions for Fmsy/M and Bmsy/B0. Red lines are 75% and 95% contours of the prior, blue lines are updated posterior contours. Grey circles are posterior draws, large solid circles are centroids (medians) of the prior and posterior (red and blue, respectively). <u>Upper right</u>: trends in relative exploitation rate and relative biomass. Horizontal solid line is target exploitation rate (model-estimated), vertical lines (dashed and dotted) are target and threshold biomass values, $0.4B_0$ and $0.25B_0$, respectively. <u>Lower left</u>: Median, 5% and 95% quantiles of spawning biomass relative to target and minimum stock size threshold (MSST). <u>Lower right</u>: posterior density of current depletion (biomass in 2013 relative to unfished biomass).

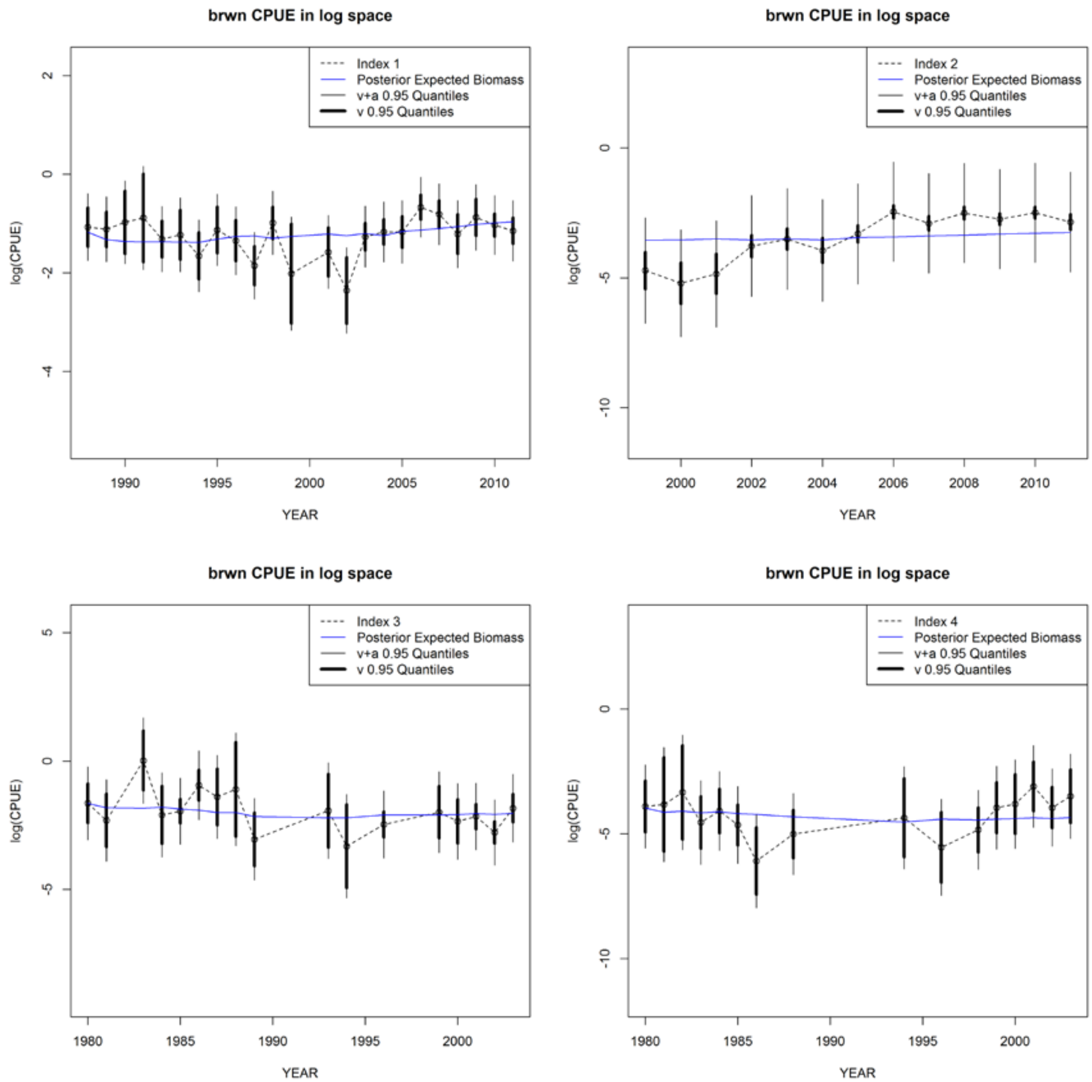


Figure 56. Fits of log-scale indices to XDB-SRA biomass trajectories. Index 1: Central California onboard CPFV observer index. Index 2: Southern California onboard CPFV observer index. Index 3: Central California RecFIN dockside index. Index 4: Southern California RecFIN dockside index. Vertical lines are 95% intervals based on the input variance (thick portion) and combined variance (input plus additive) components (thin portion). Solid blue line is expected (log-scale) biomass.

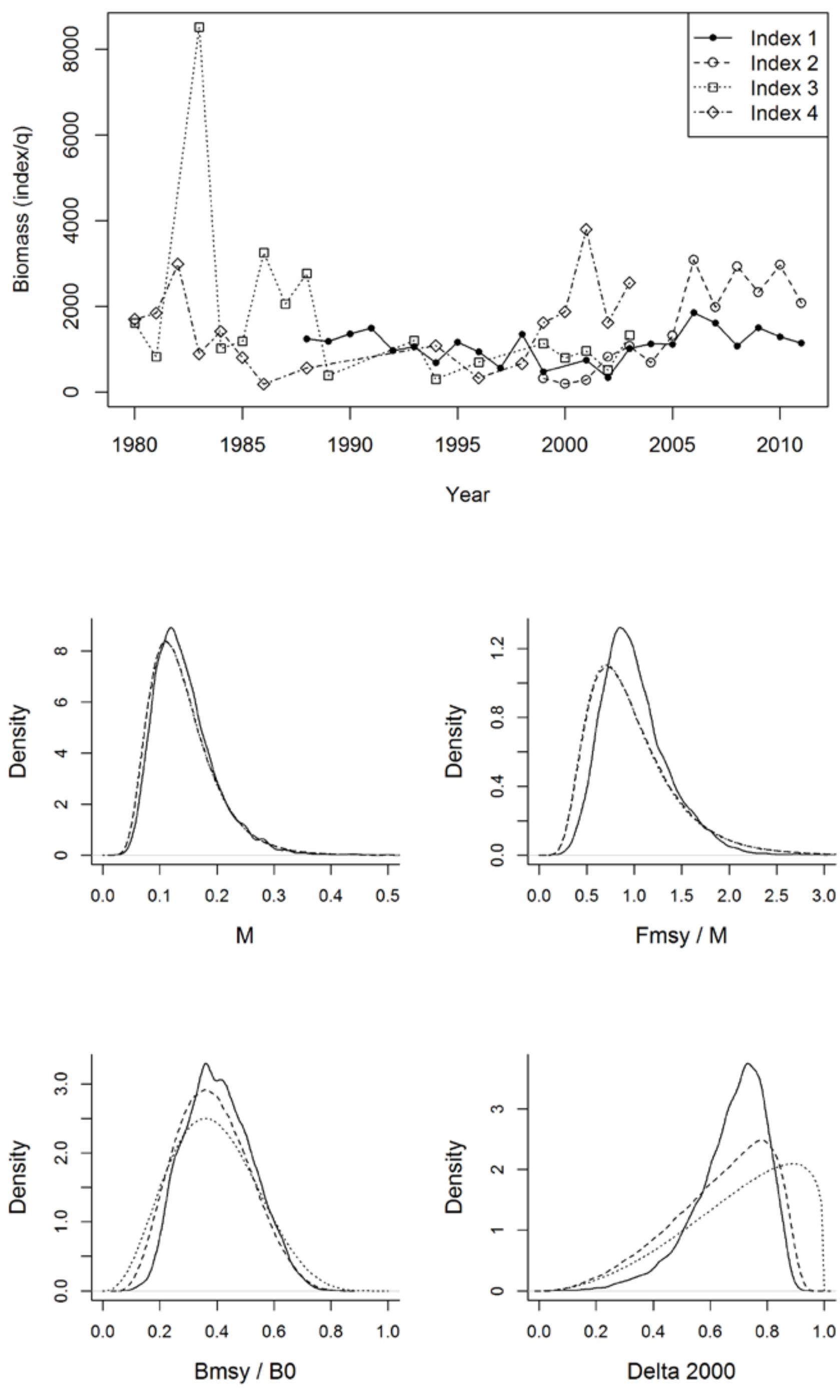


Figure 57. XDB-SRA results for brown rockfish (coastwide). <u>Top panel</u>: indices of abundance rescaled into biomass units (see previous figure for index descriptions). <u>Bottom panels</u>: prior (dotted), post-model pre-data (dashed), and posterior (solid) distributions of XDB-SRA population dynamics parameters.

8.2.2 China rockfish

8.2.2.1 Central and Southern California

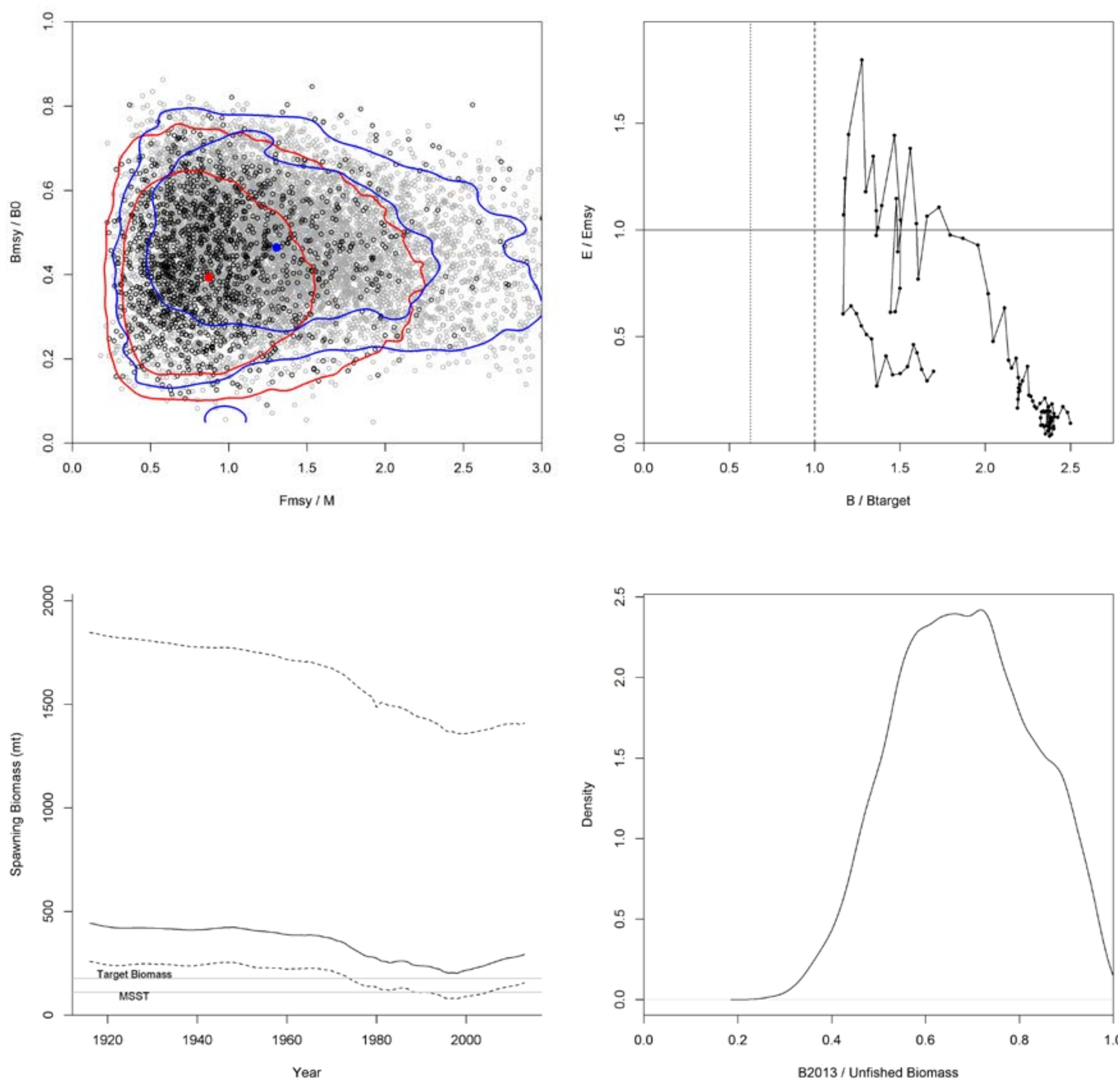


Figure 58. XDB-SRA results for China rockfish (south of 40° 10′ N. lat.). <u>Upper left</u>: bivariate prior and posterior distributions for Fmsy/M and Bmsy/B0. Red lines are 75% and 95% contours of the prior, blue lines are updated posterior contours. Grey circles are posterior draws, black circles represent rejected runs (biomass <0), large solid circles are centroids (medians) of the prior and posterior (red and blue, respectively). <u>Upper right</u>: trends in relative exploitation rate and relative biomass. Horizontal solid line is target exploitation rate (model-estimated), vertical lines (dashed and dotted) are target and threshold biomass values, $0.4B_0$ and $0.25B_0$, respectively. <u>Lower left</u>: Median, 5% and 95% quantiles of spawning biomass relative to target and minimum stock size threshold (MSST). <u>Lower right</u>: posterior density of current depletion (biomass in 2013 relative to unfished biomass).

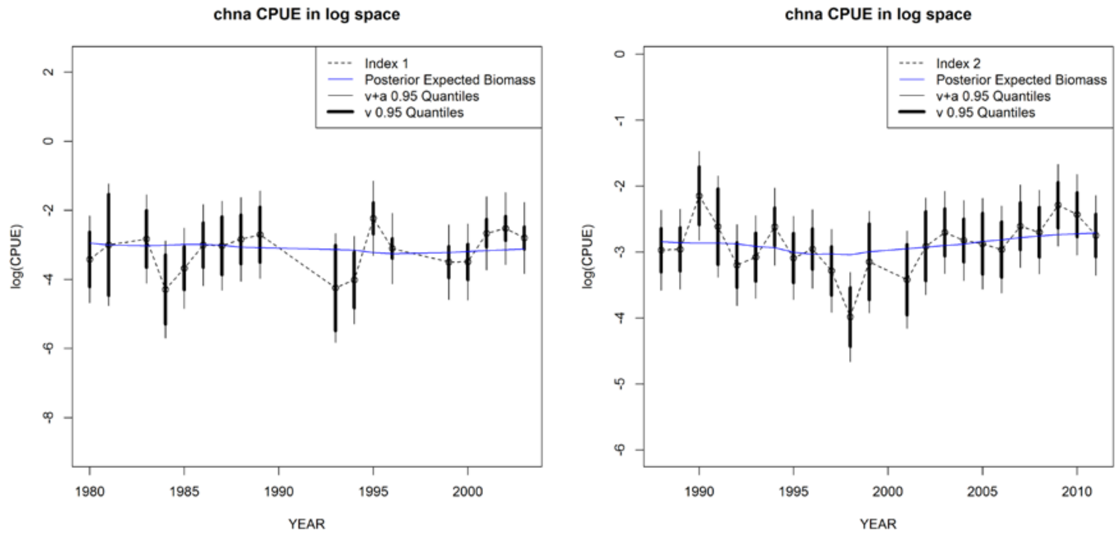


Figure 59. Fits of log-scale indices to XDB-SRA biomass trajectories for China rockfish (south of 40° 10′ N. lat.). Index 1: Central California RecFIN dockside index. Index 2: Central California onboard CPFV observer index. Vertical lines are 95% intervals based on the input variance (thick portion) and combined variance (input plus additive) components (thin portion). Solid blue line is expected log-scale biomass.

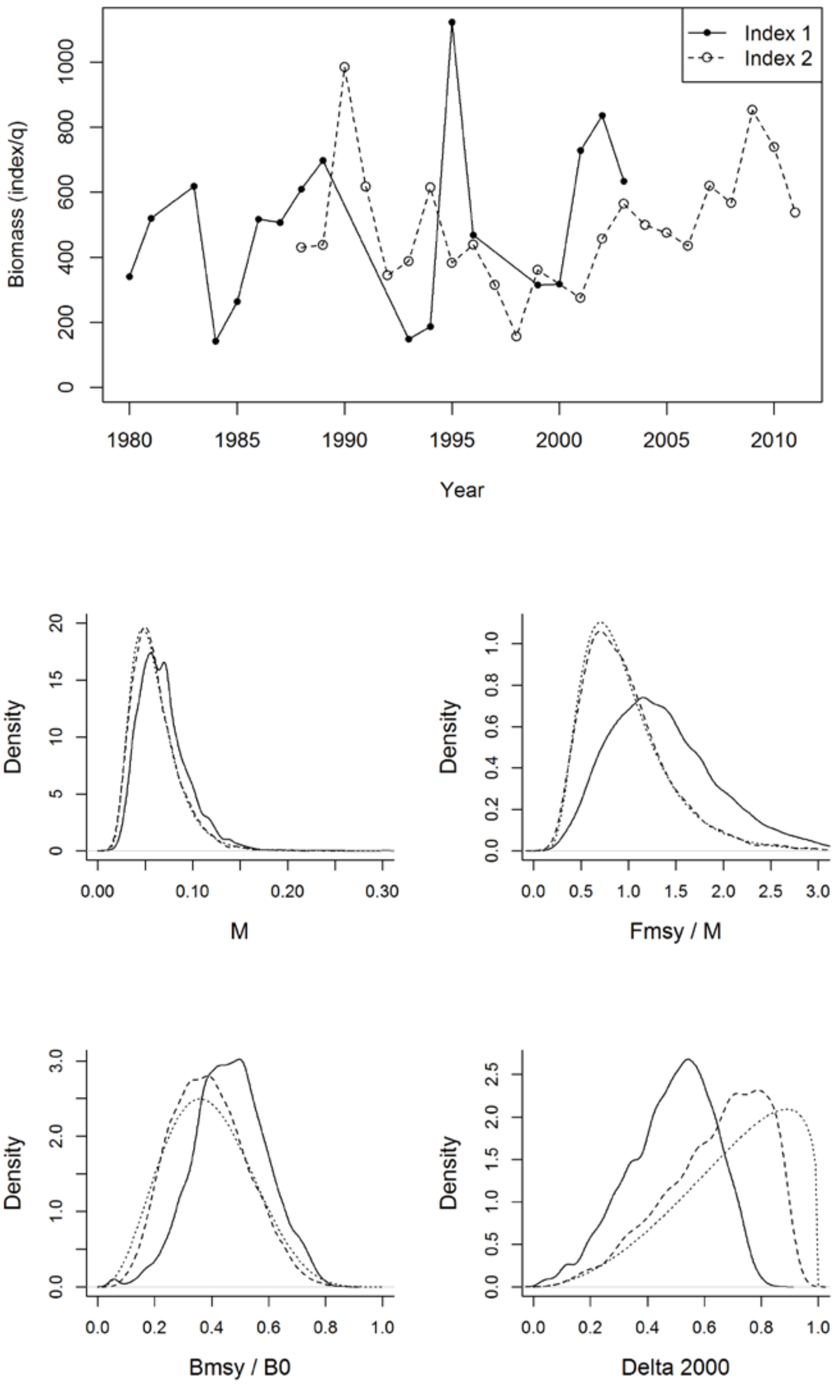


Figure 60. XDB-SRA results for China rockfish (south of 40° 10′ N. lat.). <u>Top panel</u>: indices of abundance rescaled into biomass units (see previous figure for index descriptions). <u>Bottom panels</u>: prior (dotted), post-model pre-data (dashed), and posterior (solid) distributions of XDB-SRA parameters.

8.2.2.2 Northern China Rockfish (N. of 40° 10′ N. lat).

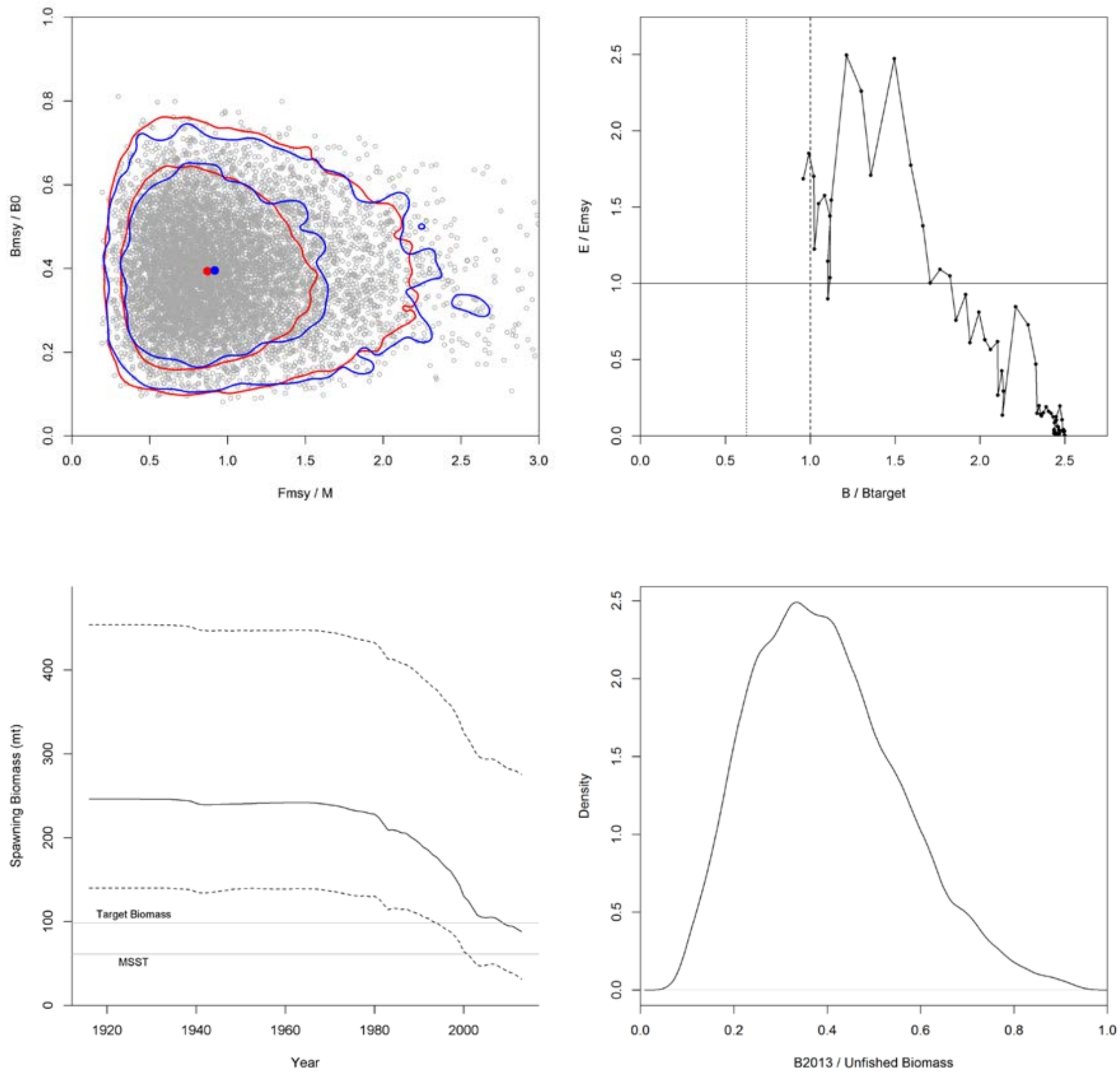


Figure 61. XDB-SRA results for China rockfish (north of 40° 10′ N. lat.). <u>Upper left</u>: bivariate prior and posterior distributions for Fmsy/M and Bmsy/B0. Red lines are 75% and 95% contours of the prior, blue lines are updated posterior contours. Grey circles are posterior draws, black circles represent rejected runs (biomass <0), large solid circles are centroids (medians) of the prior and posterior (red and blue, respectively). <u>Upper right</u>: trends in relative exploitation rate and relative biomass. Horizontal solid line is target exploitation rate (model-estimated), vertical lines (dashed and dotted) are target and threshold biomass values, $0.4B_0$ and $0.25B_0$, respectively. <u>Lower left</u>: Median, 5% and 95% quantiles of spawning biomass relative to target and minimum stock size threshold (MSST). <u>Lower right</u>: posterior density of current depletion (biomass in 2013 relative to unfished biomass).

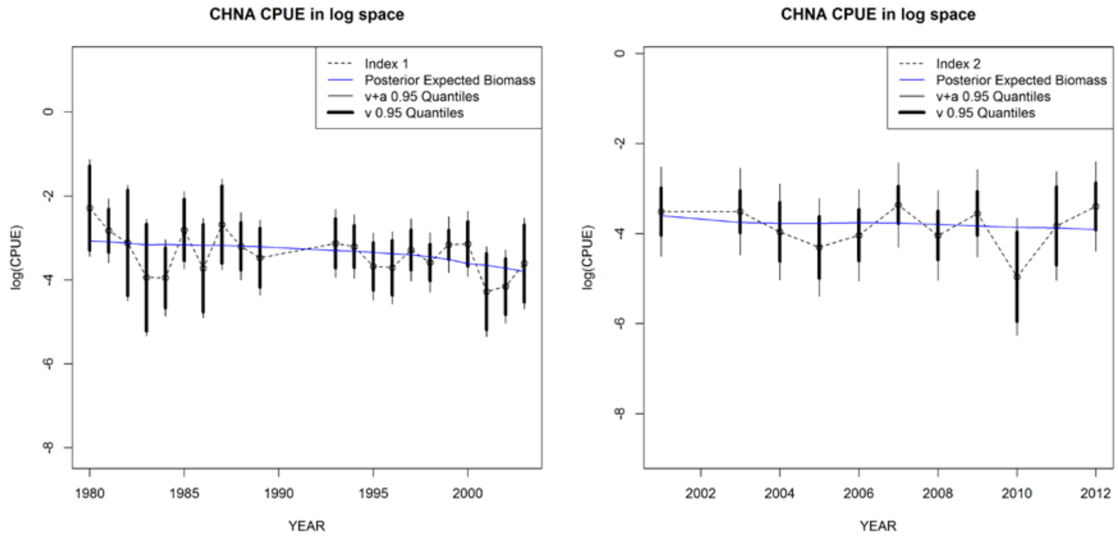


Figure 62. Fits of log-scale indices to XDB-SRA biomass trajectories for China rockfish (north of 40° 10′ N. lat.). <u>Index 1</u>: No. CA / OR RecFIN dockside index. <u>Index 2</u>: Oregon onboard CPFV observer index. Vertical lines are 95% intervals based on the input variance (thick portion) and combined variance (input plus additive) components (thin portion). Solid blue line is expected log-scale biomass.

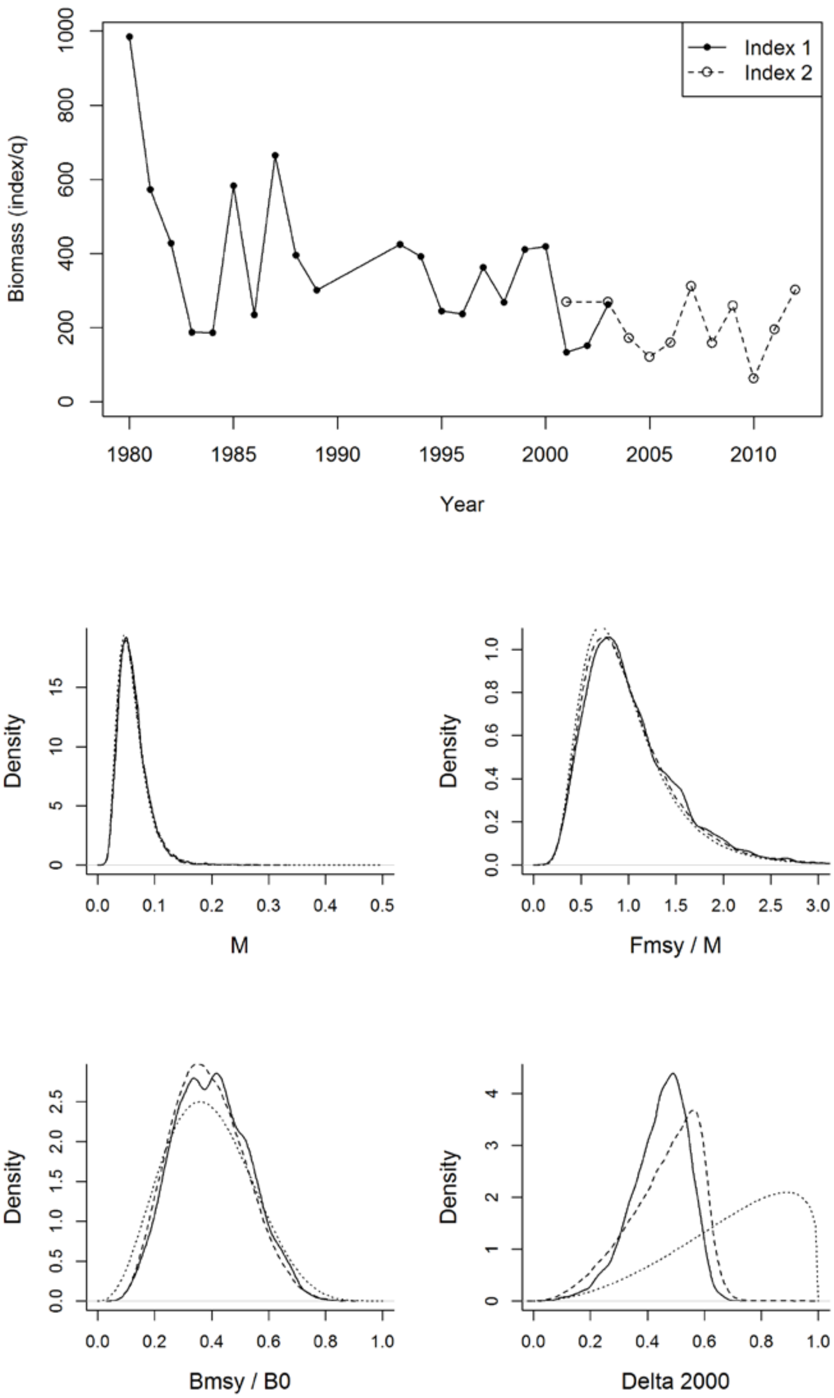


Figure 63. XDB-SRA results for China rockfish (north of 40° 10′ N. lat.). Top panel: indices of abundance rescaled into biomass units (see previous figure for index descriptions). Bottom panels: prior (dotted), post-model pre-data (dashed), and posterior (solid) distributions of XDB-SRA parameters.

8.2.3 Copper rockfish

8.2.3.1 Copper Rockfish North of Point Conception (34° 27′ N. lat.)

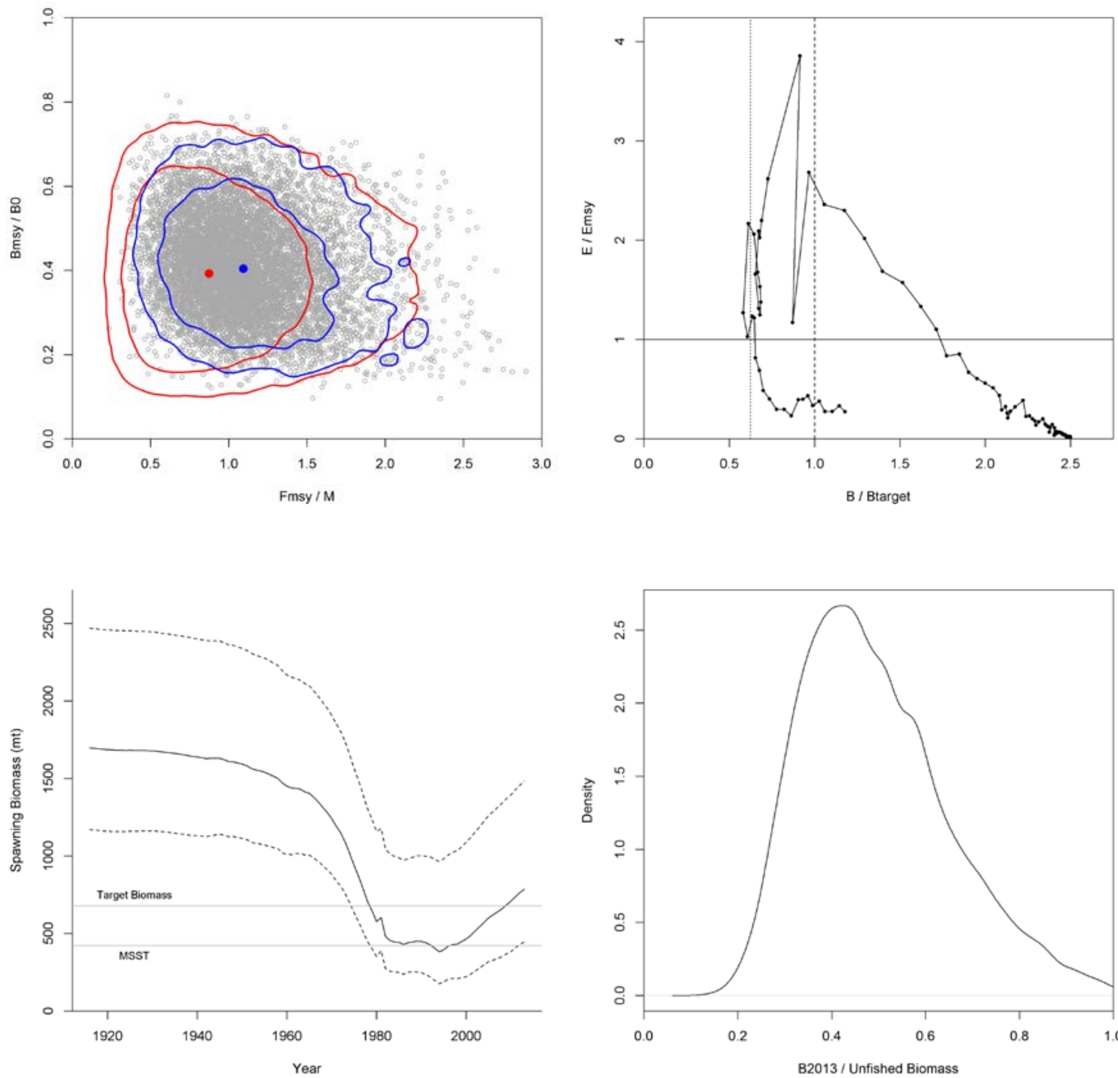


Figure 64. XDB-SRA results for copper rockfish (north of 34° 27′ N. lat.). <u>Upper left</u>: bivariate prior and posterior distributions for Fmsy/M and Bmsy/B0. Red lines are 75% and 95% contours of the prior, blue lines are updated posterior contours. Grey circles are posterior draws, black circles represent rejected runs (biomass <0), large solid circles are centroids (medians) of the prior and posterior (red and blue, respectively). <u>Upper right</u>: trends in relative exploitation rate and relative biomass. Horizontal solid line is target exploitation rate (model-estimated), vertical lines (dashed and dotted) are target and threshold biomass values, $0.4B_0$ and $0.25B_0$, respectively. <u>Lower left</u>: Median, 5% and 95% quantiles of spawning biomass relative to target and minimum stock size threshold (MSST). <u>Lower right</u>: posterior density of current depletion (biomass in 2013 relative to unfished biomass).

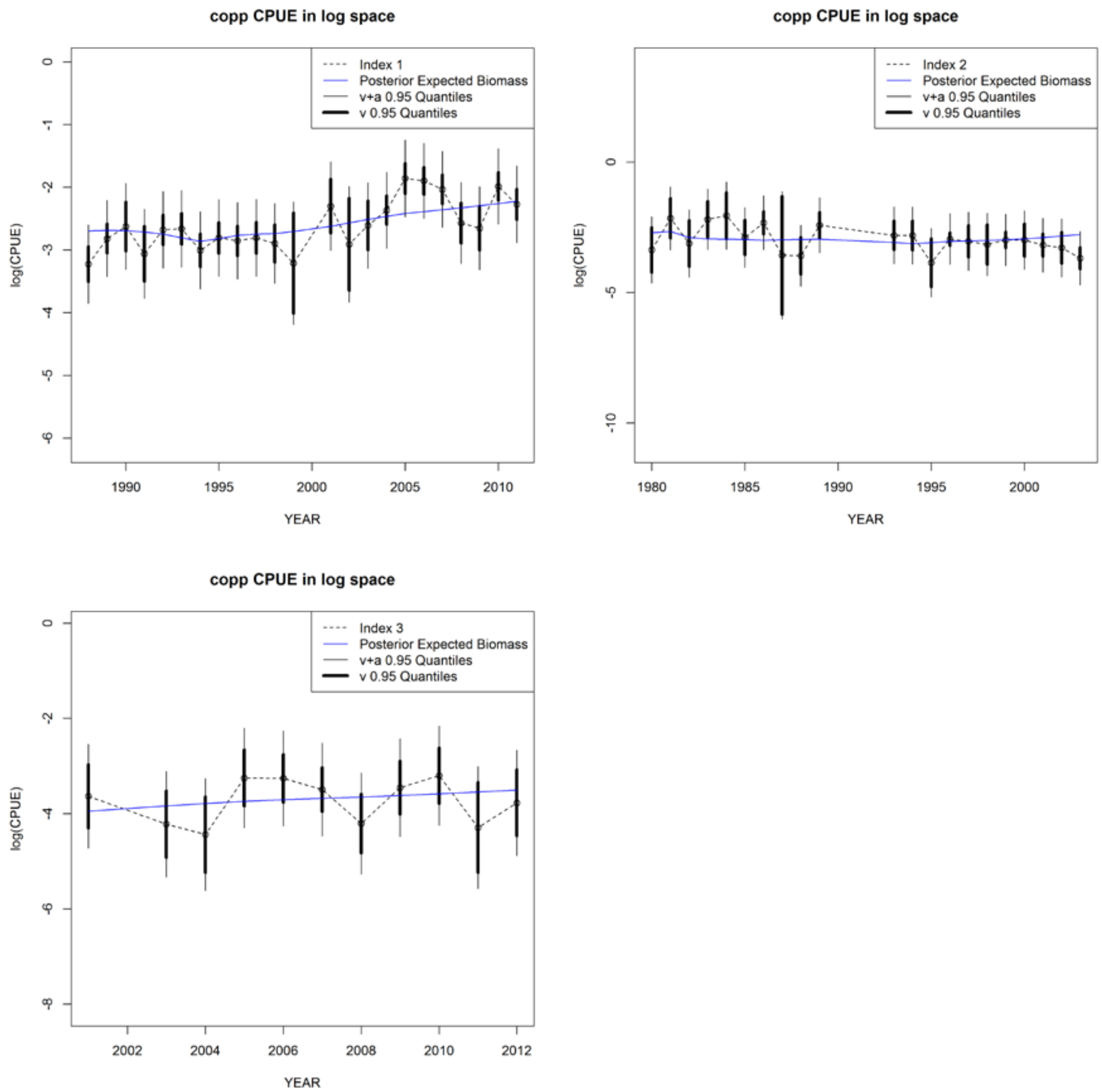


Figure 65. Fits of log-scale indices to XDB-SRA biomass trajectories for copper rockfish (north of 34° 27′ N. lat.). <u>Index 1</u>: Central California onboard CPFV observer index. <u>Index 2</u>: Central/Northern California and Oregon RecFIN dockside index. <u>Index 3</u>: Oregon onboard CPFV observer index. Vertical lines are 95% intervals based on the input variance (thick portion) and combined variance (input plus additive) components (thin portion). Solid blue line is expected log-scale biomass.

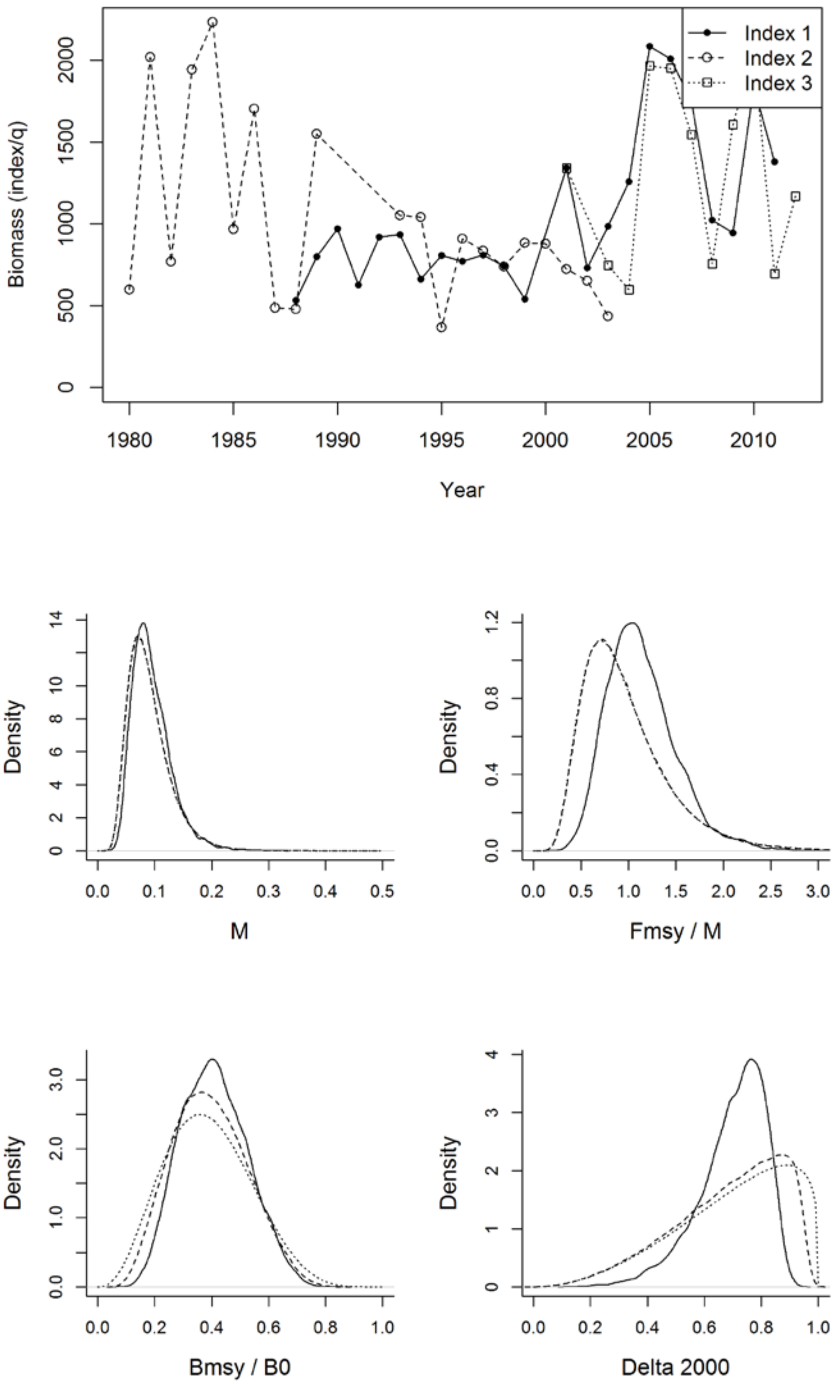


Figure 66. XDB-SRA results for copper rockfish (north of 34° 27′ N. lat.). <u>Top panel</u>: indices of abundance rescaled into biomass units (see previous figure for index descriptions). <u>Bottom panels</u>: prior (dotted), post-model pre-data (dashed), and posterior (solid) distributions of XDB-SRA parameters.

8.2.3.2 Southern Copper Rockfish (S. of 34° 27′ N. lat).

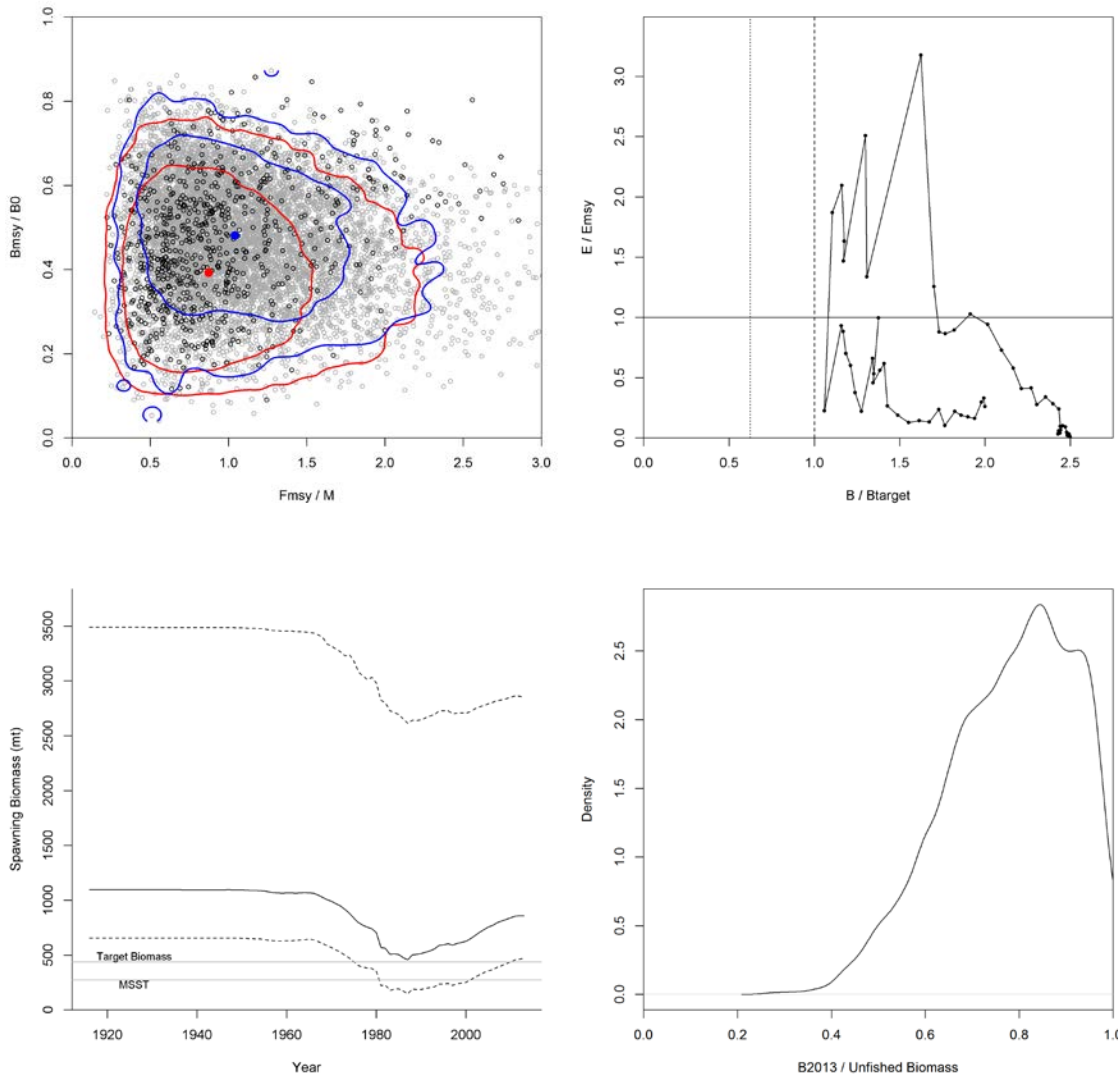


Figure 67. XDB-SRA results for copper rockfish (south of 34° 27′ N. lat.). Upper left: bivariate prior and posterior distributions for Fmsy/M and Bmsy/B0. Red lines are 75% and 95% contours of the prior, blue lines are updated posterior contours. Grey circles are posterior draws, black circles represent rejected runs (biomass <0), large solid circles are centroids (medians) of the prior and posterior (red and blue, respectively). Upper right: trends in relative exploitation rate and relative biomass. Horizontal solid line is target exploitation rate (model-estimated), vertical lines (dashed and dotted) are target and threshold biomass values, $0.4B_0$ and $0.25B_0$, respectively. Lower left: Median, 5% and 95% quantiles of spawning biomass relative to target and minimum stock size threshold (MSST). Lower right: posterior density of current depletion (biomass in 2013 relative to unfished biomass).

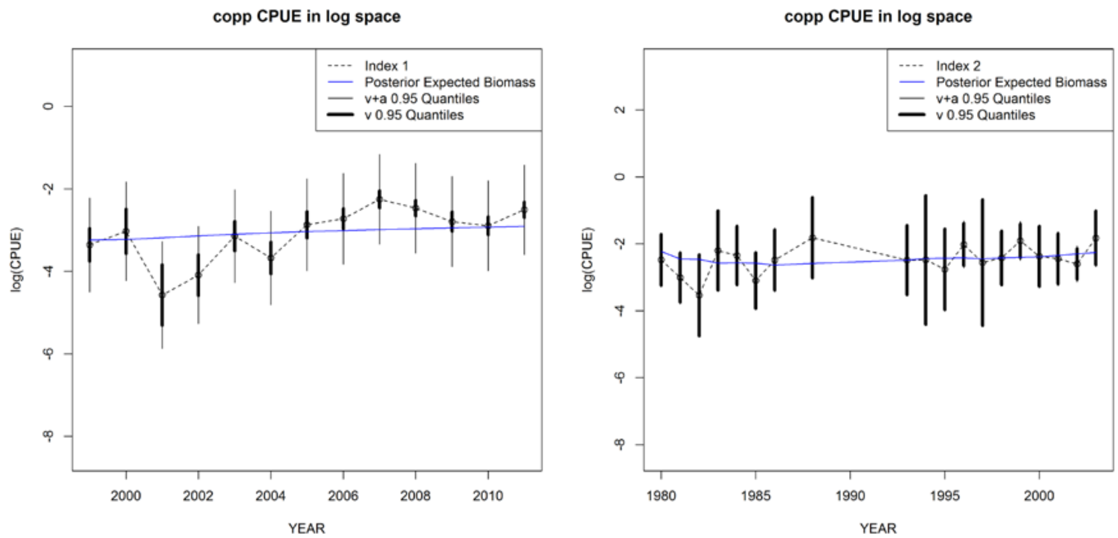


Figure 68. Fits of log-scale indices to XDB-SRA biomass trajectories for copper rockfish (south of 34° 27′ N. lat.). Index 1: Southern California onboard CPFV observer index. Index 2: Southern California RecFIN dockside index. Vertical lines are 95% intervals based on the input variance (thick portion) and combined variance (input plus additive) components (thin portion). Solid blue line is expected log-scale biomass.

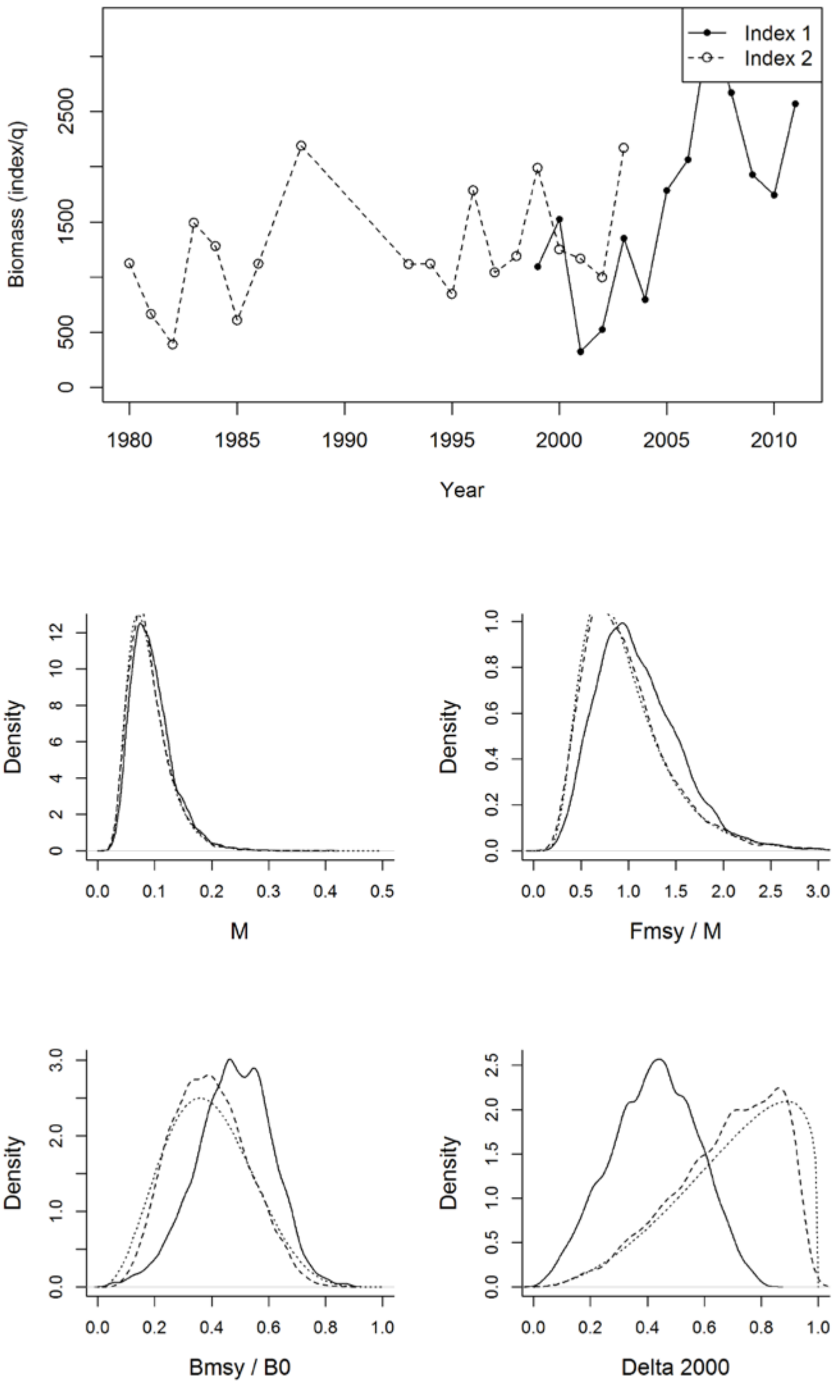


Figure 69. XDB-SRA results for copper rockfish (south of 34° 27′ N. lat.). Top panel: indices of abundance rescaled into biomass units (see previous figure for index descriptions). Bottom panels: prior (dotted), post-model pre-data (dashed), and posterior (solid) distributions of XDB-SRA parameters.

8.2.4 Sharpchin rockfish

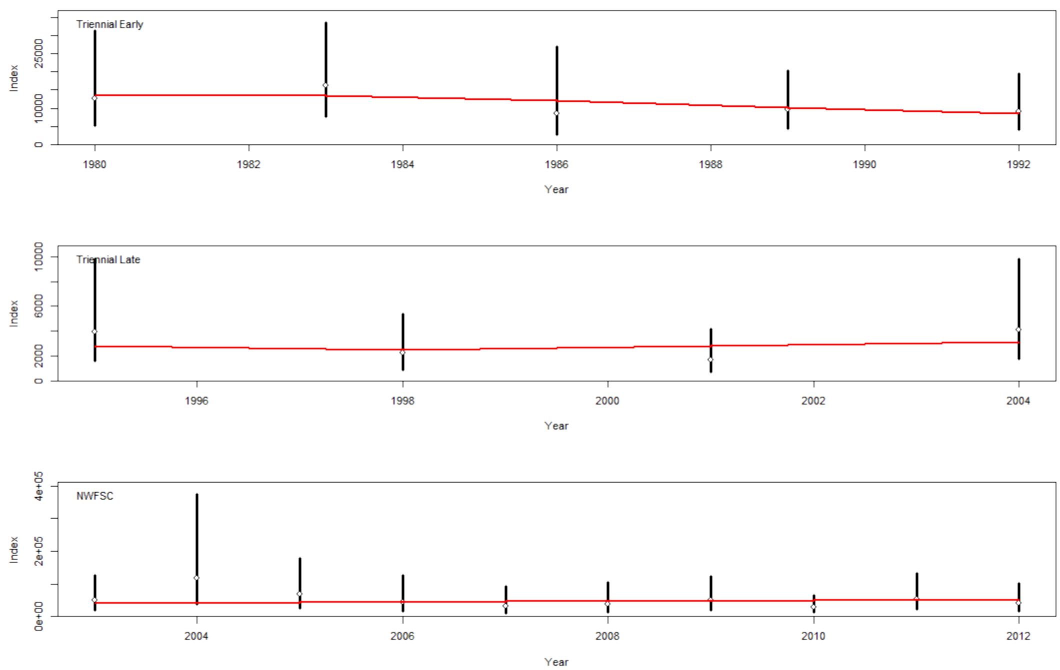


Figure 70. Fits to the three fishery-independent surveys from the exSSS model for sharpchin rockfish. Thick lines are inputted variance; thin lines are estimated added variance.

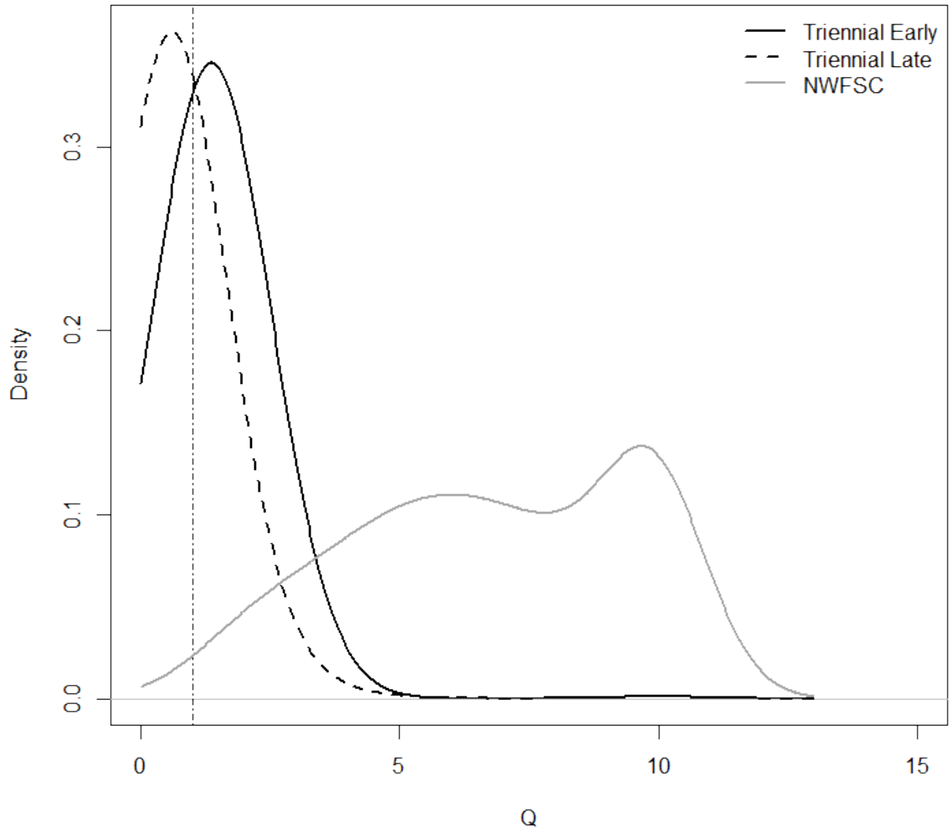


Figure 71. Posterior distribution of the catchability parameters (Q) for each index fit in the exSSS AIS sharpchin rockfish assessment.

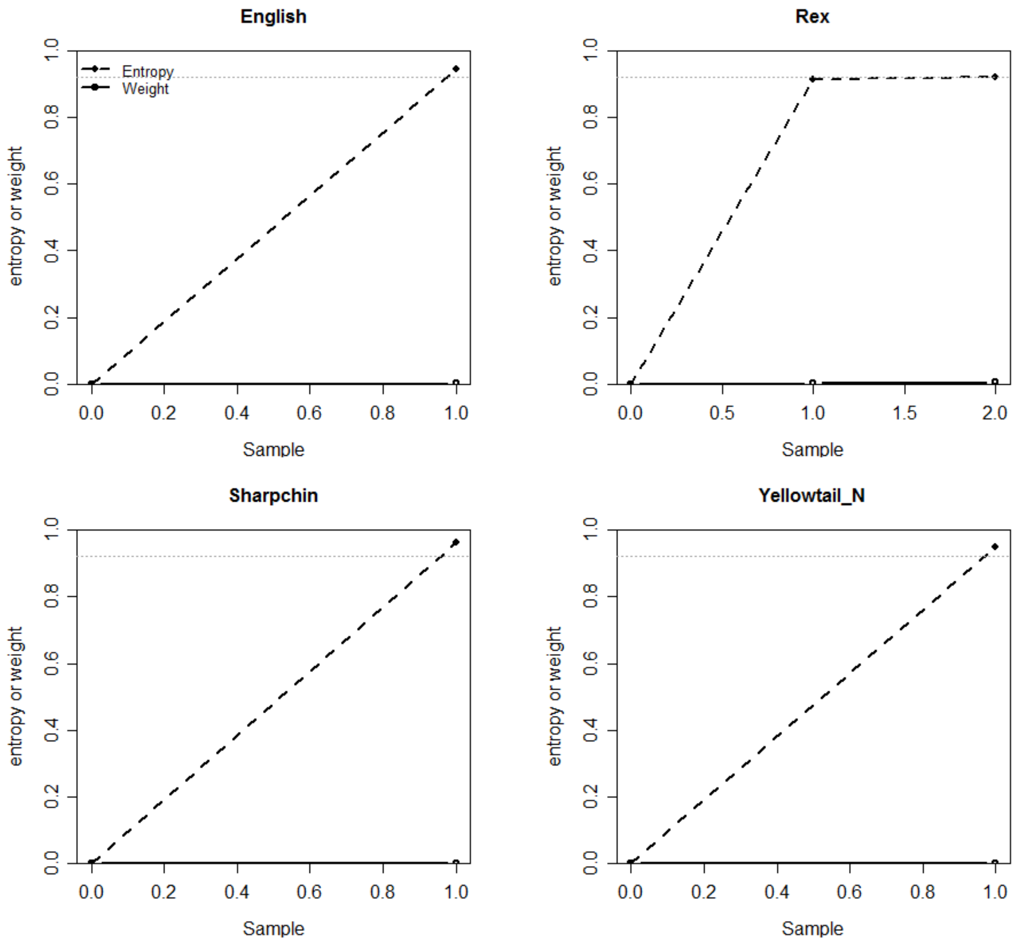


Figure 72. Entropy and model weight values used to determine model convergence in the exSSS AIS models for 4 stocks. Dotted horizontal line is the threshold entropy value of 0.92 indicating convergence.

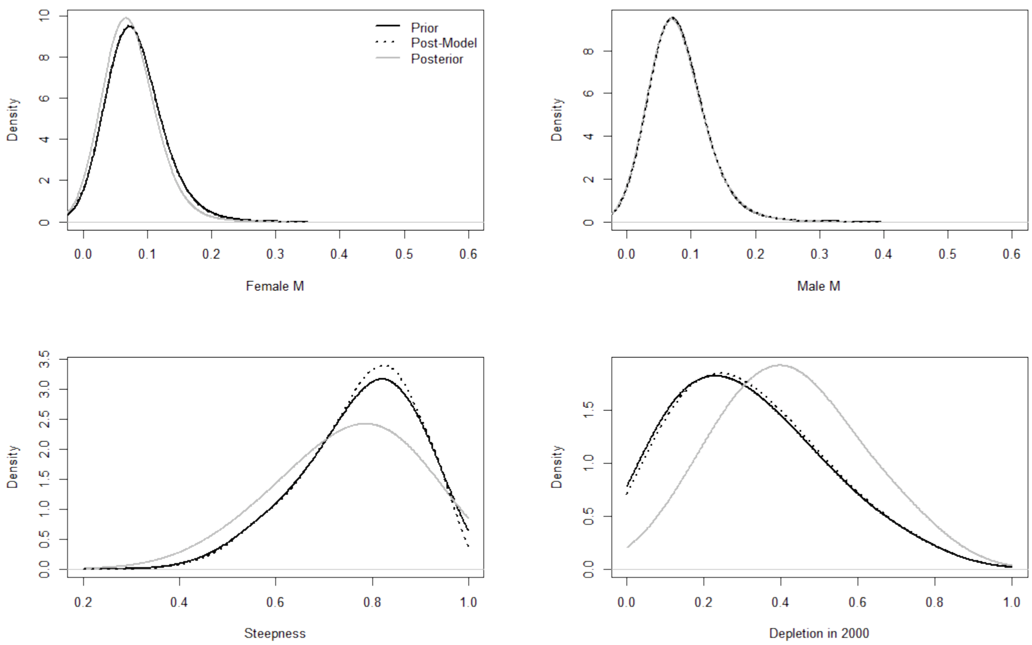


Figure 73. Prior and posterior distributions for each input parameter of the exSSS AIS uncertainty estimation for sharpchin rockfish.

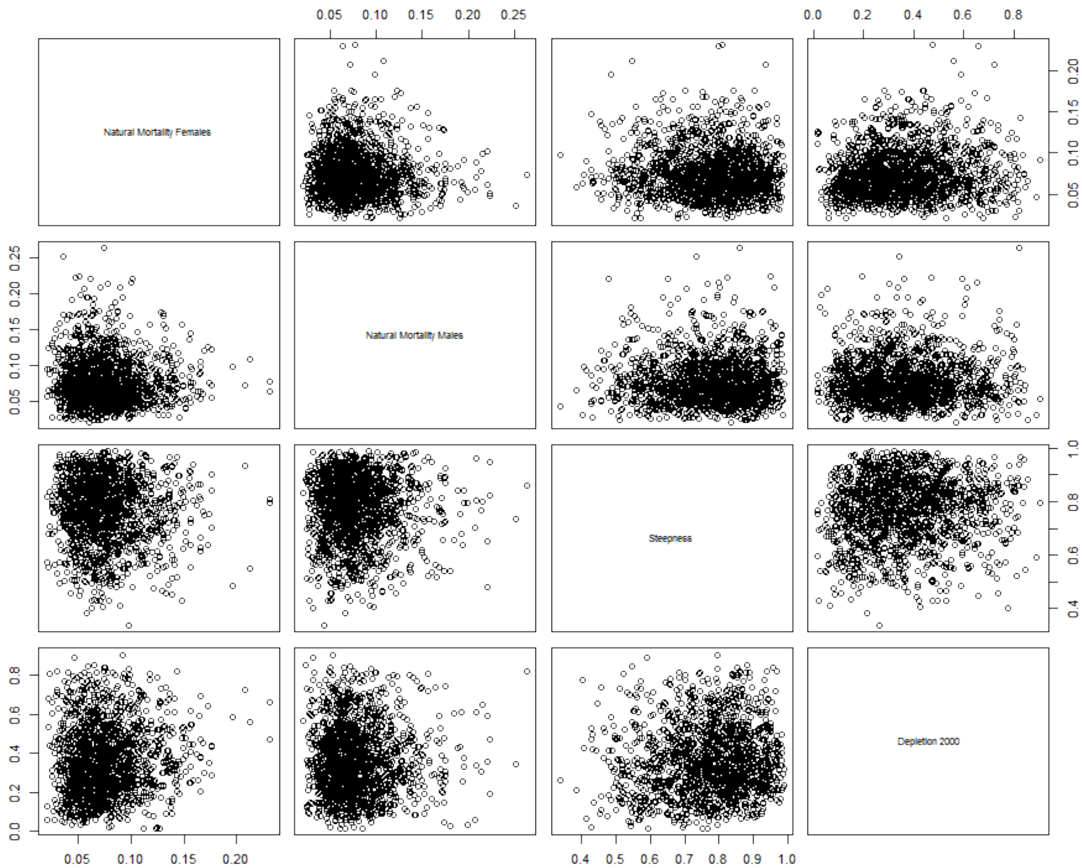


Figure 74. Pairs plots for each parameter in the exSSS AIS treatment of uncertainty for sharpchin rockfish.

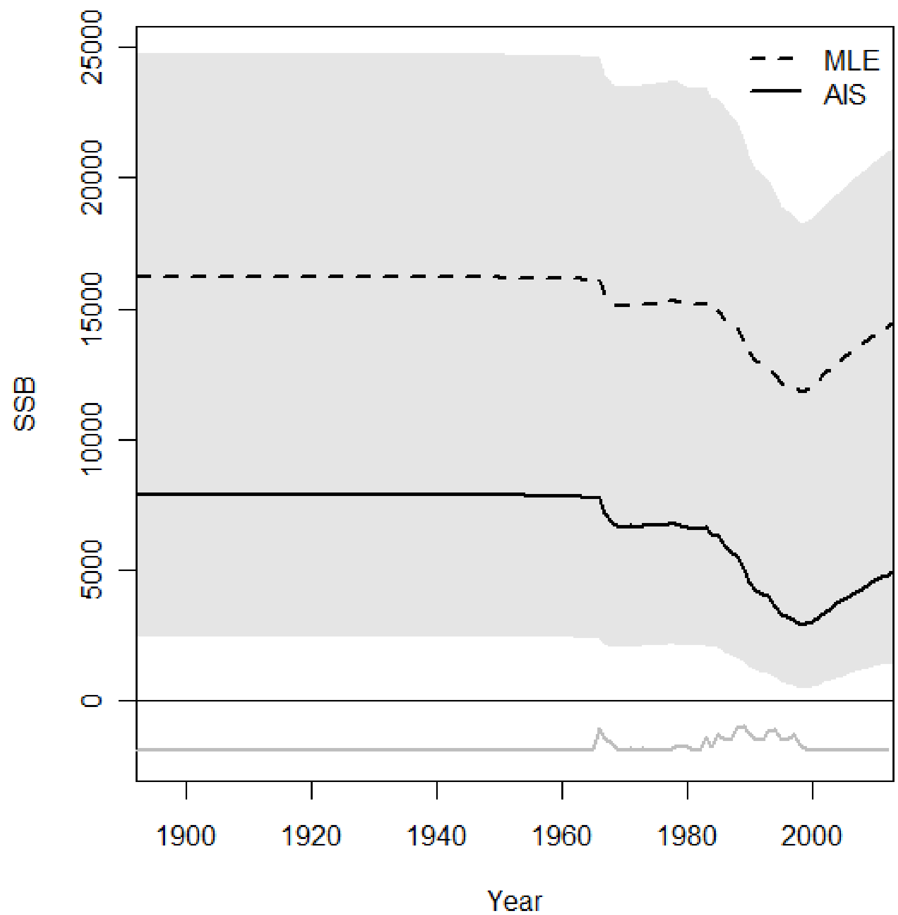


Figure 75. Time series of spawning biomass from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for sharpchin rockfish. Catch history is provided below the 0 line.

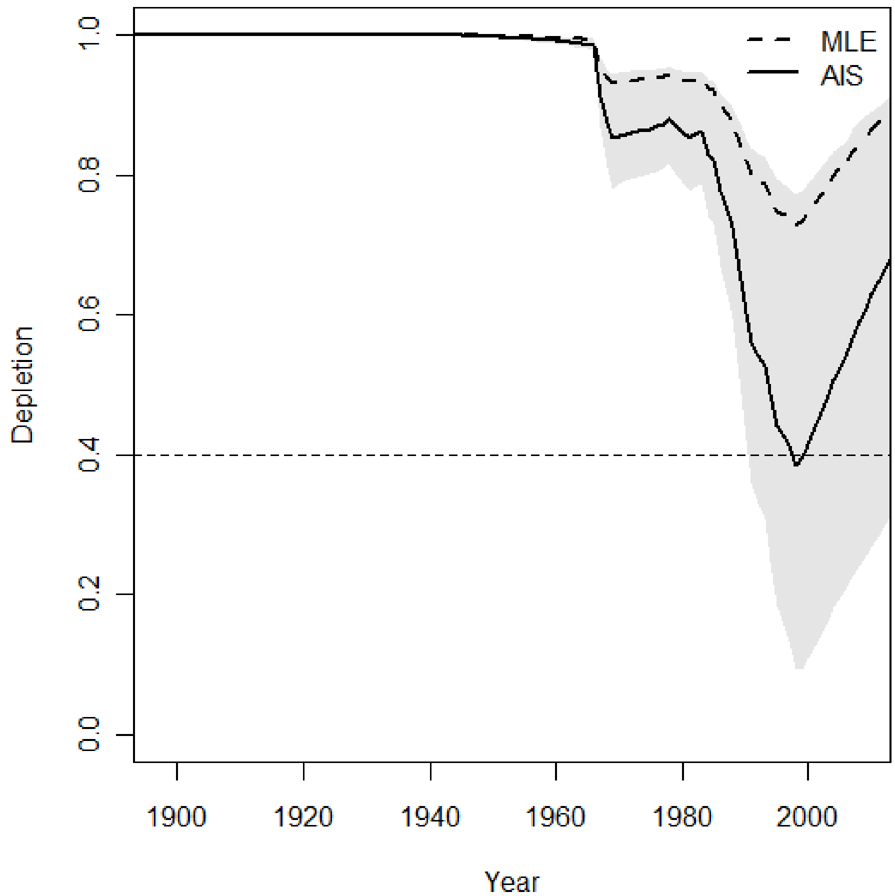


Figure 76. Time series of stock status (depletion) from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for sharpchin rockfish.

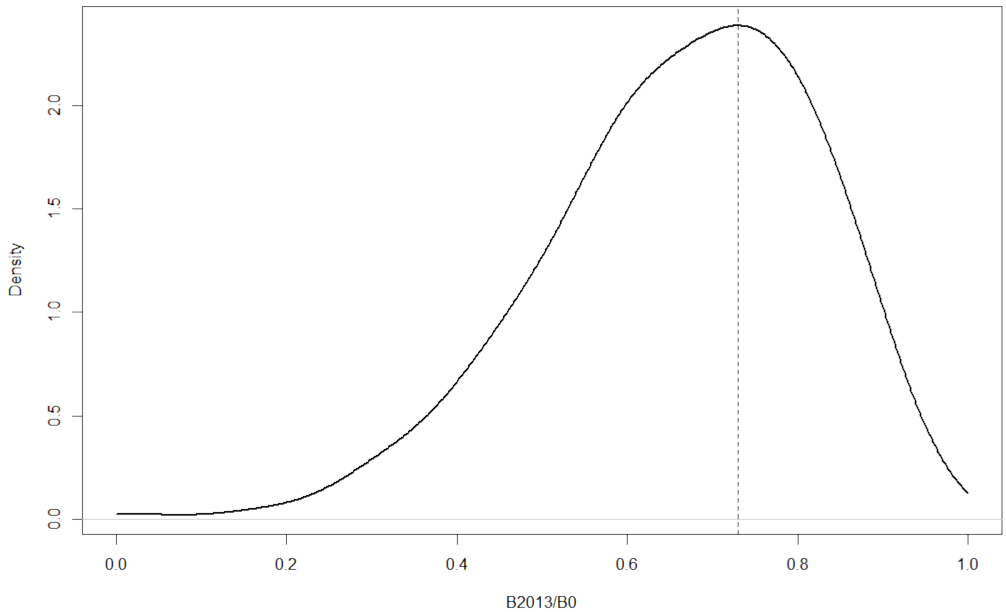


Figure 77. Stock status posterior distribution from the exSSS AIS model for sharpchin rockfish. Mode is indicated by the vertical line.

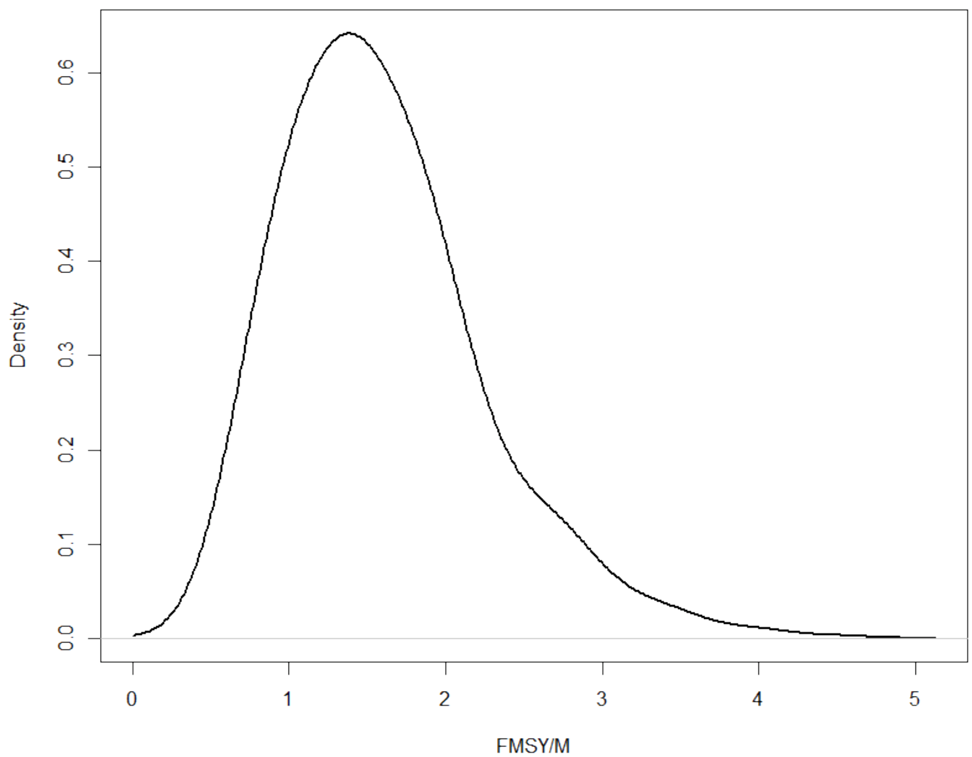


Figure 78. Posterior distribution of F_{MSY}/M from the exSSS AIS model for sharpchin rockfish.

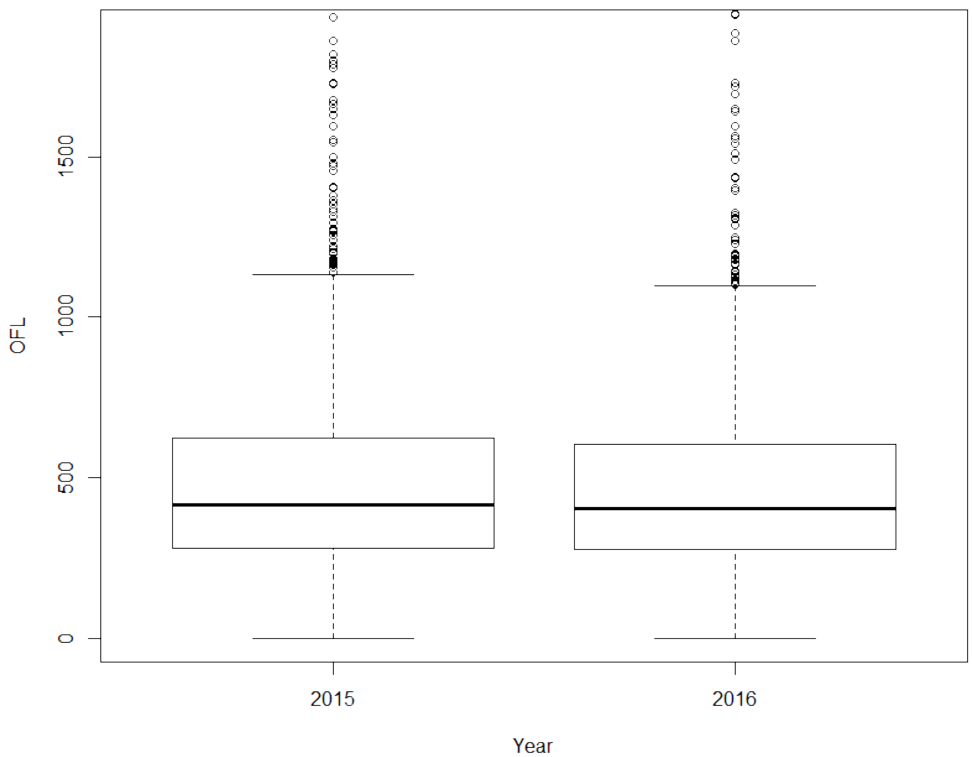


Figure 79. Posterior distribution of OFLs **from the exSSS AIS model for sharpchin rockfish.**

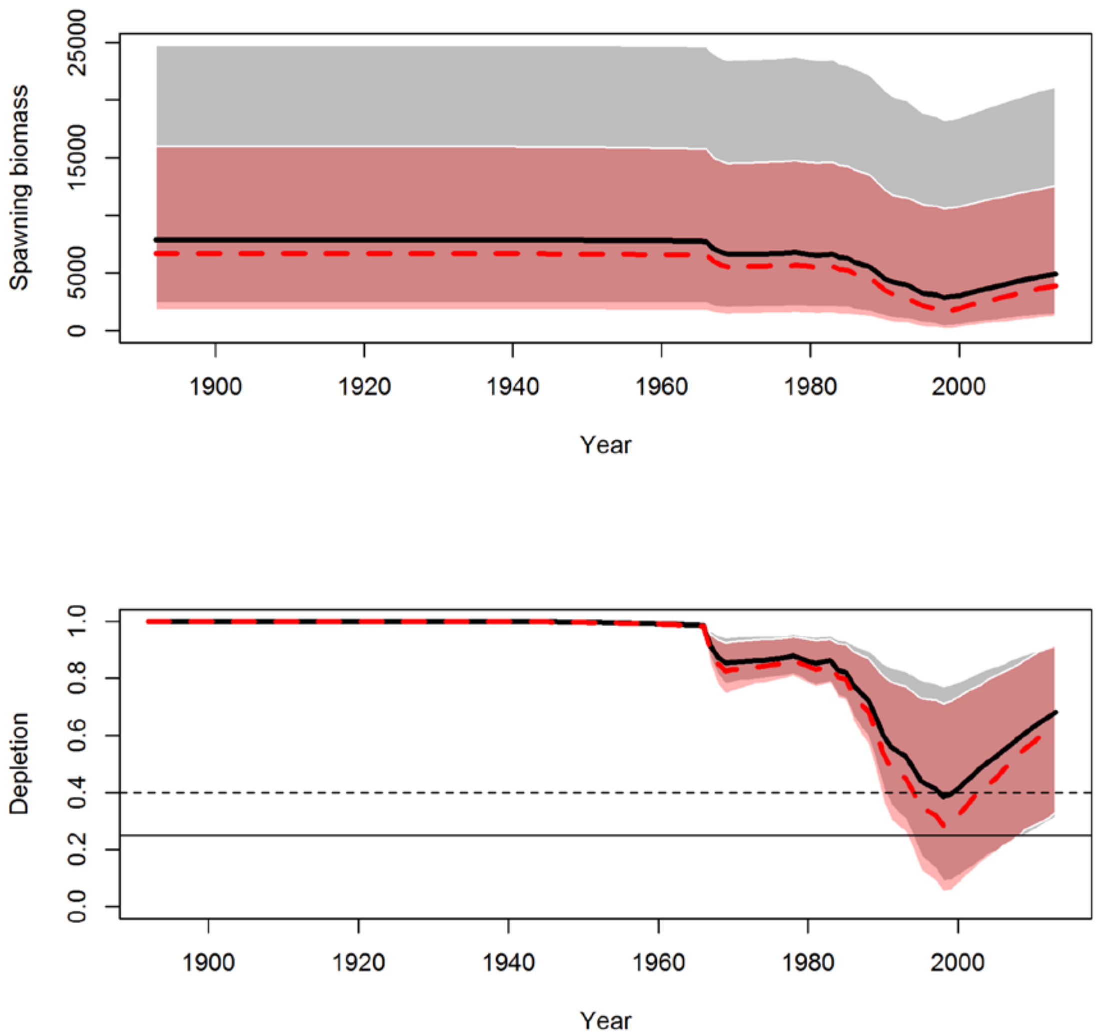


Figure 80. Comparison of the exSSS AIS (black line, gray shaded 95% CI) and catch-only (SSS; red broken line; pink shaded 95% CI) estimates of spawning biomass (upper panel) and stock status (lower panel) for sharpchin rockfish. Darker red shaded area is the overlap of the top models.

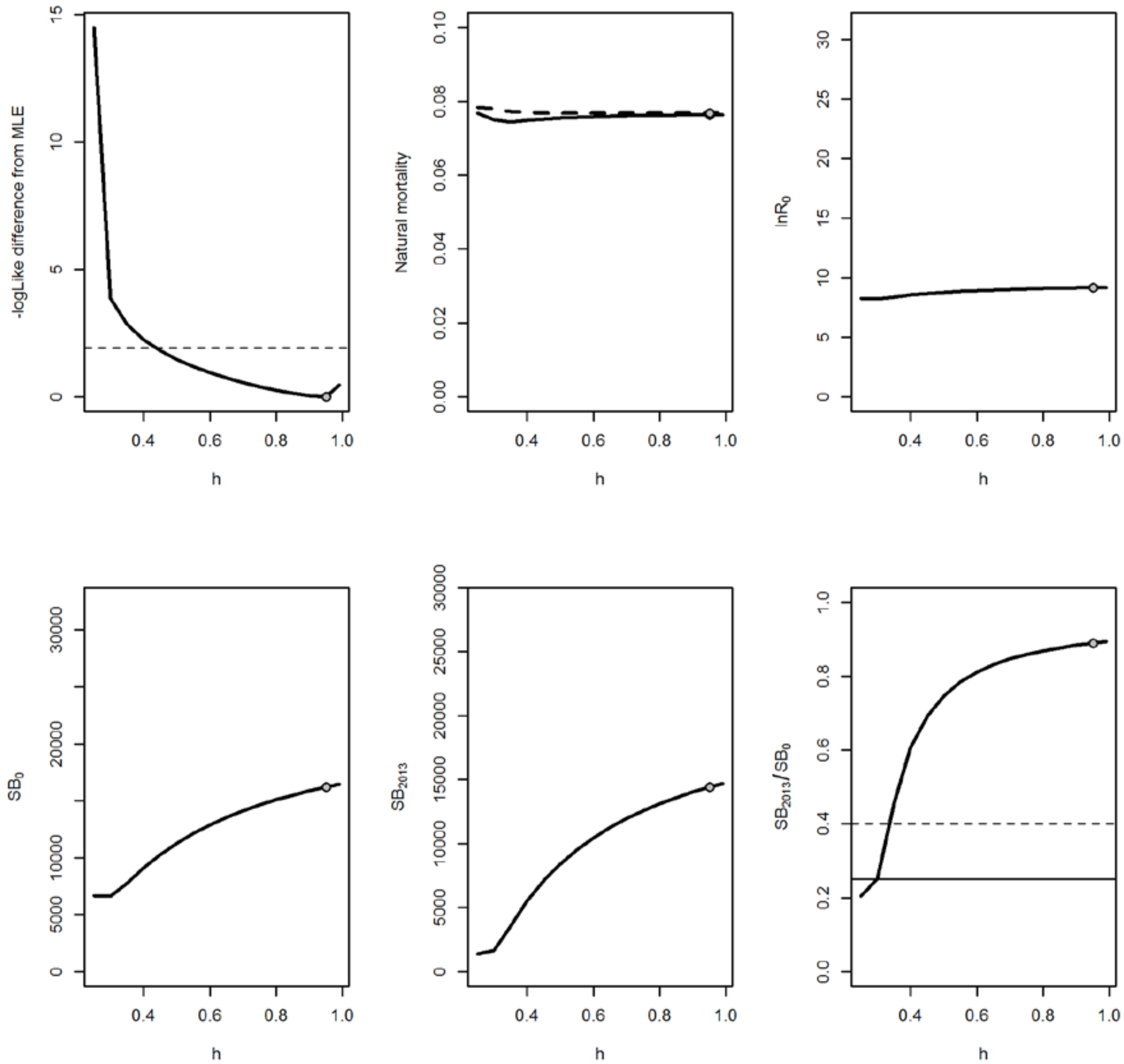
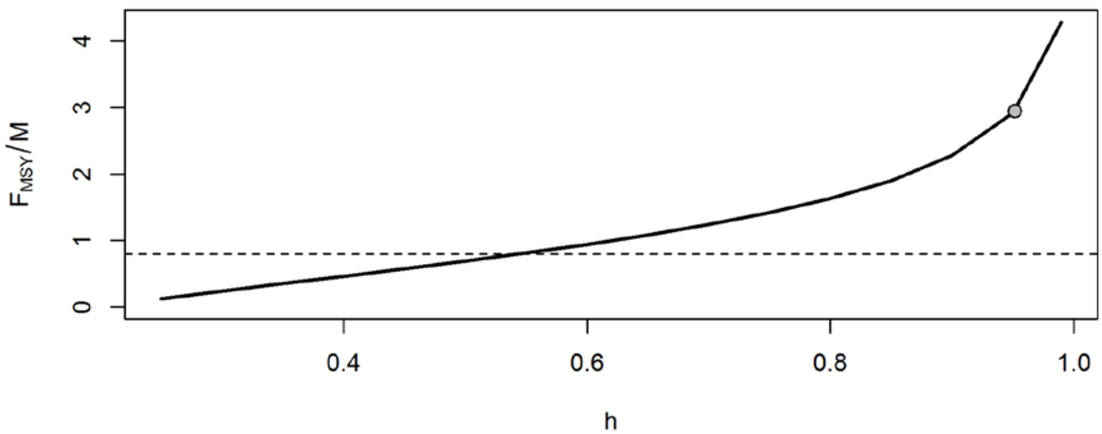


Figure 81. Likelihood profile for steepness (*h*; top left panel) and sensitivity to *h* of estimated (top center and right panels) and derived assessment outputs (bottom panels) for sharpchin rockfish using exSSS. The MLE is indicated by the circle. Top left panel: broken line is 95% interval; Top middle panel: solid and broken lines are the female and male *M* values; Bottom right panel: Solid and broken line are the target and limit biomass reference points.



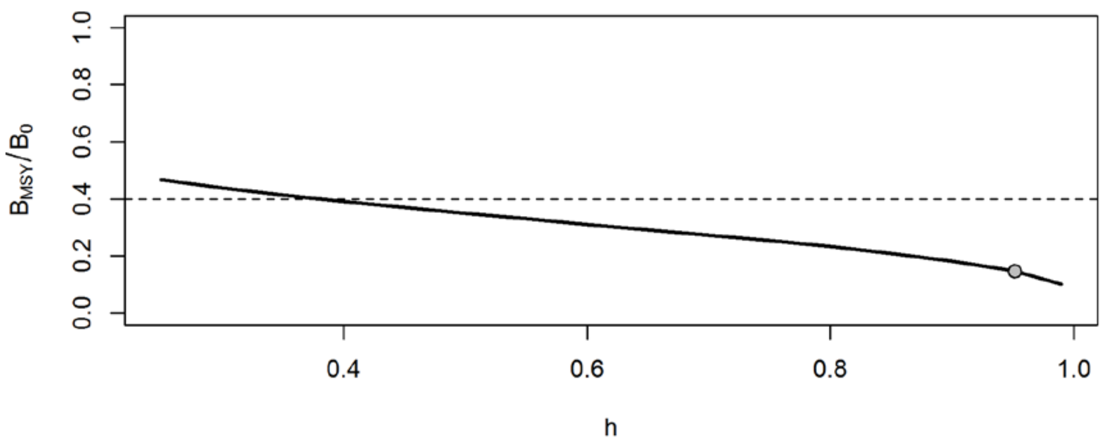


Figure 82. Steepness profile relative to XDB-SRA productivity parameters F_{MSY}/M (top panel) and B_{MSY}/B_0 (bottom panel) for sharpchin rockfish. Circle indicates exSSS MLE estimate. Broken line is the prior mean used in XDB-SRA.

8.2.5 Yellowtail rockfish (North of 40° 10’ N. lat.)

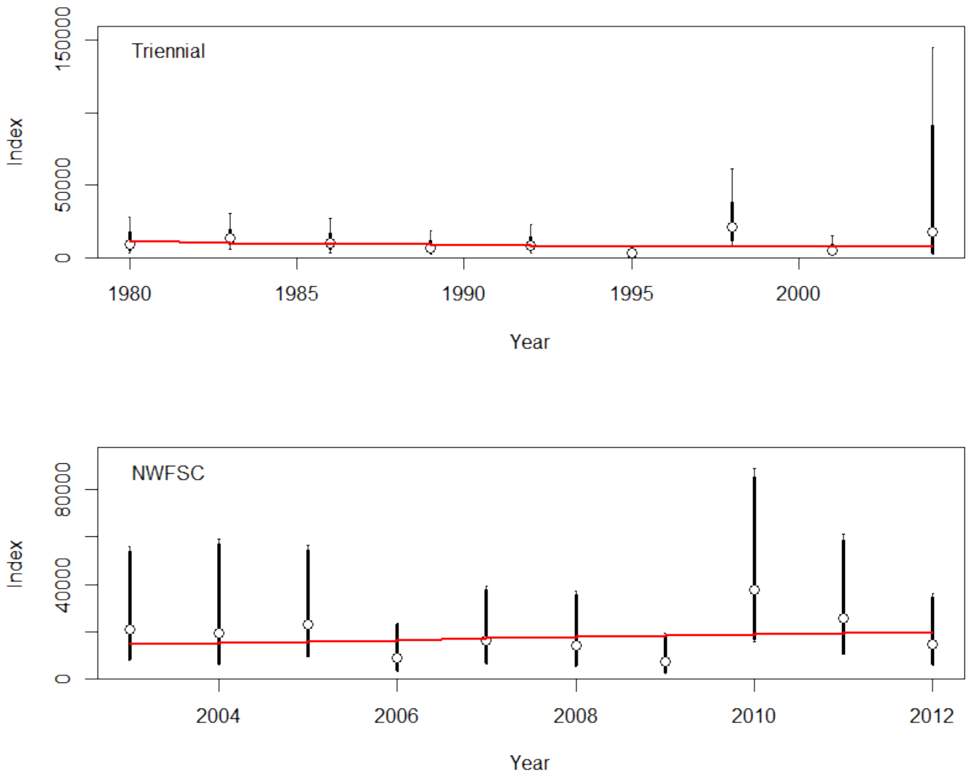


Figure 83. Fits to the three fishery-independent surveys from the exSSS AIS model for yellowtail rockfish (North of 40° 10’ N. lat.). Thick lines are inputted variance; thin lines are estimated added variance.

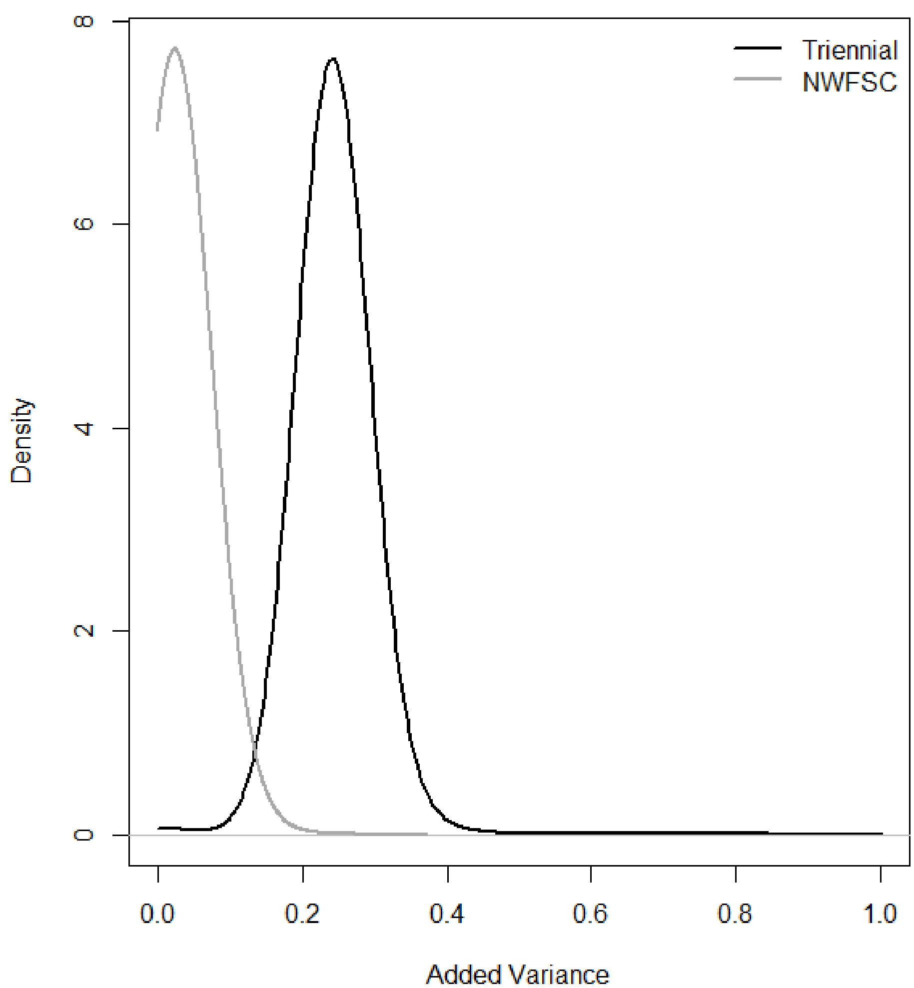


Figure 84. Posterior distribution of the added variance for each index fit in the exSSS AIS yellowtail rockfish (North of 40° 10’ N. lat.) assessment.

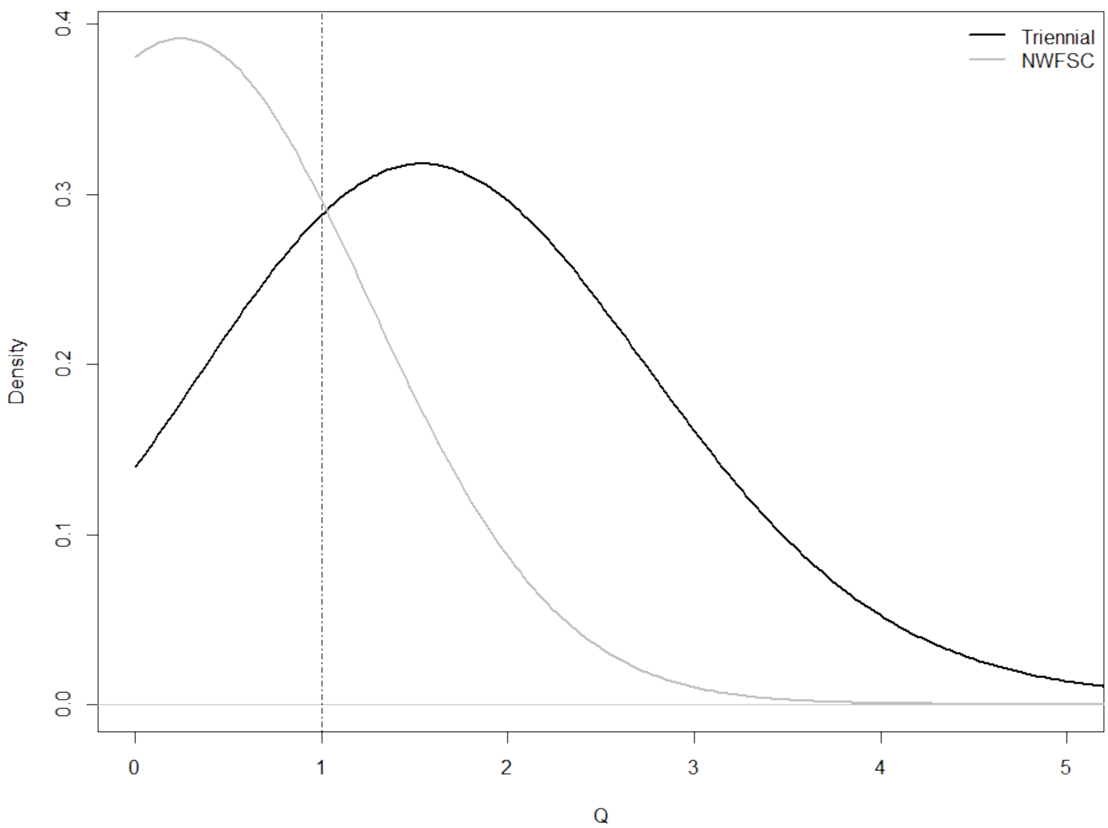


Figure 85. Posterior distribution of the catchability parameters (Q) for each index fit in the exSSS AIS yellowtail rockfish (North of 40° 10' N. lat.) assessment.

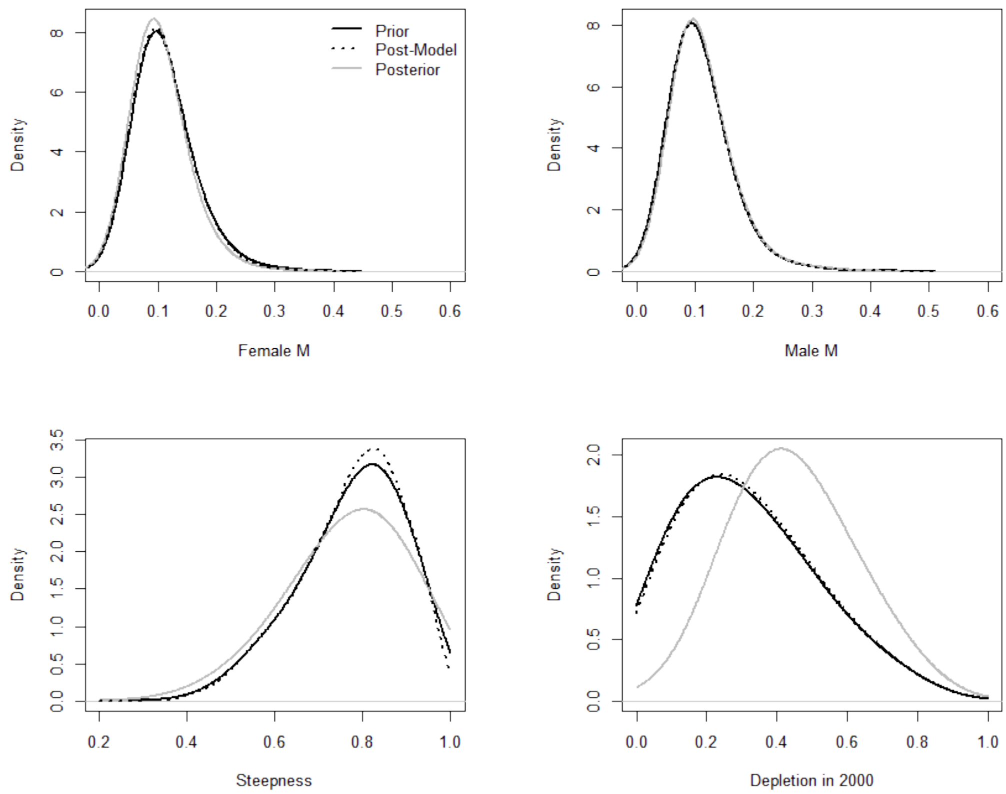


Figure 86. Prior and posterior distributions for each input parameter of the exSSS AIS uncertainty estimation for yellowtail rockfish (North of 40° 10’ N. lat.).

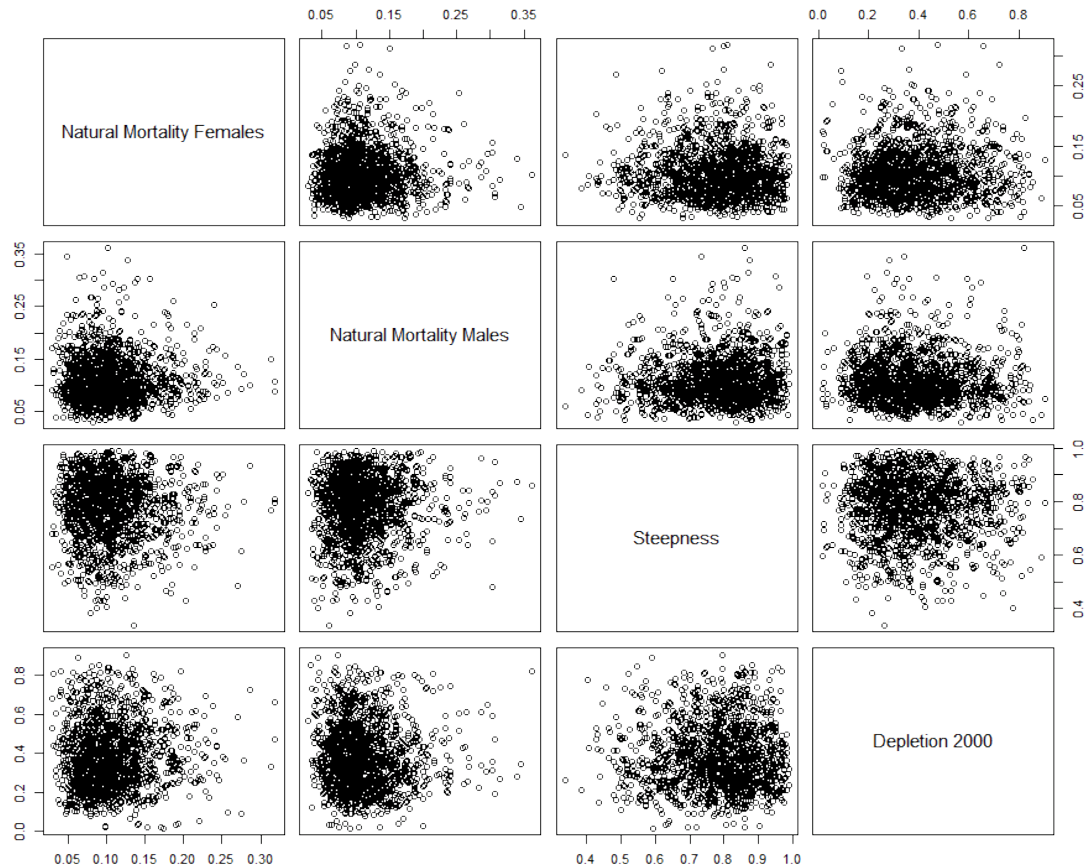


Figure 87. Pairs plots for each parameter in the exSSS AIS treatment of uncertainty for yellowtail rockfish (North of 40° 10' N. lat.).

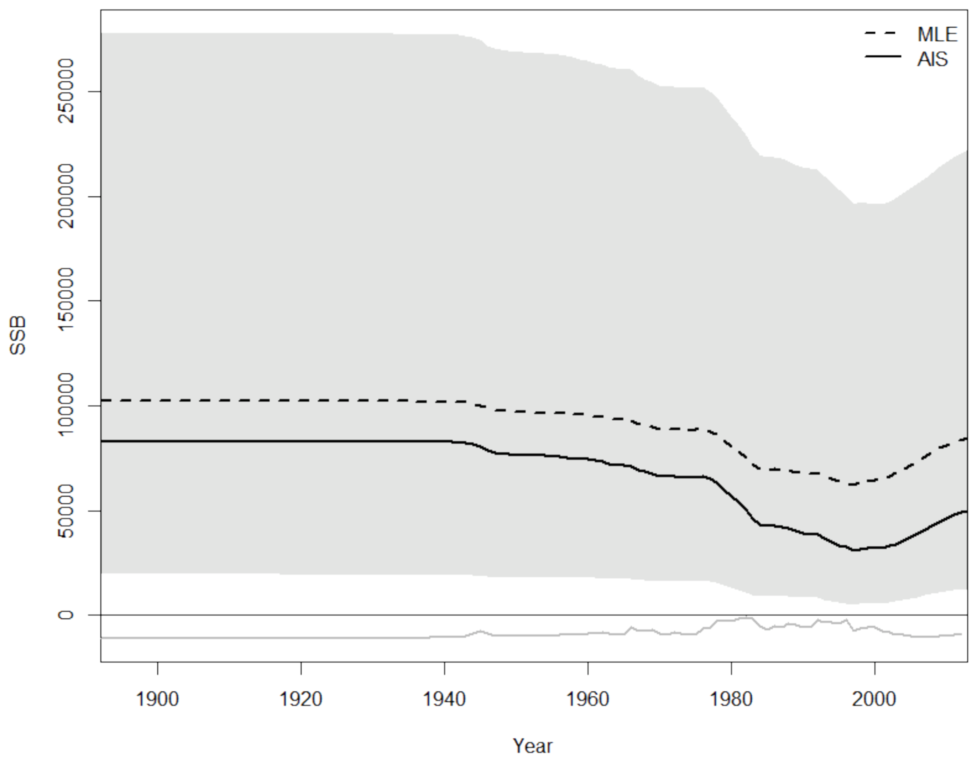


Figure 88. Time series of spawning biomass from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for yellowtail rockfish (North of 40° 10’ N. lat.). Catch history is provided below the 0 line.

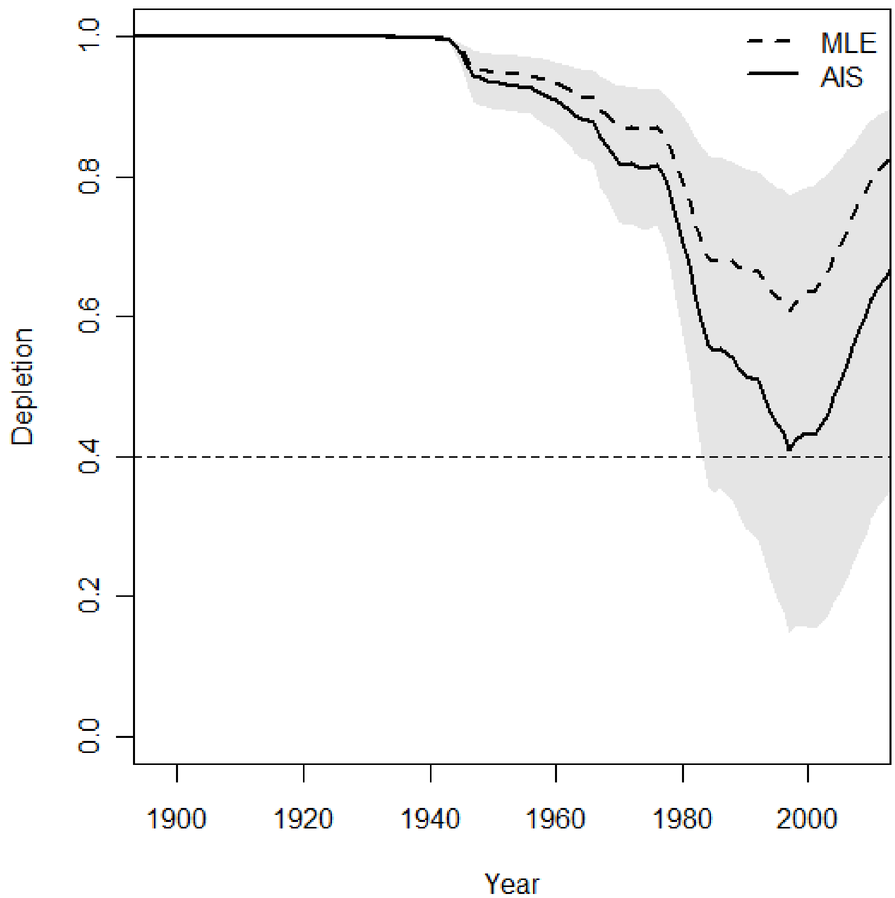


Figure 89. Time series of stock status (depletion) from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for yellowtail rockfish (North of 40° 10’ N. lat.).

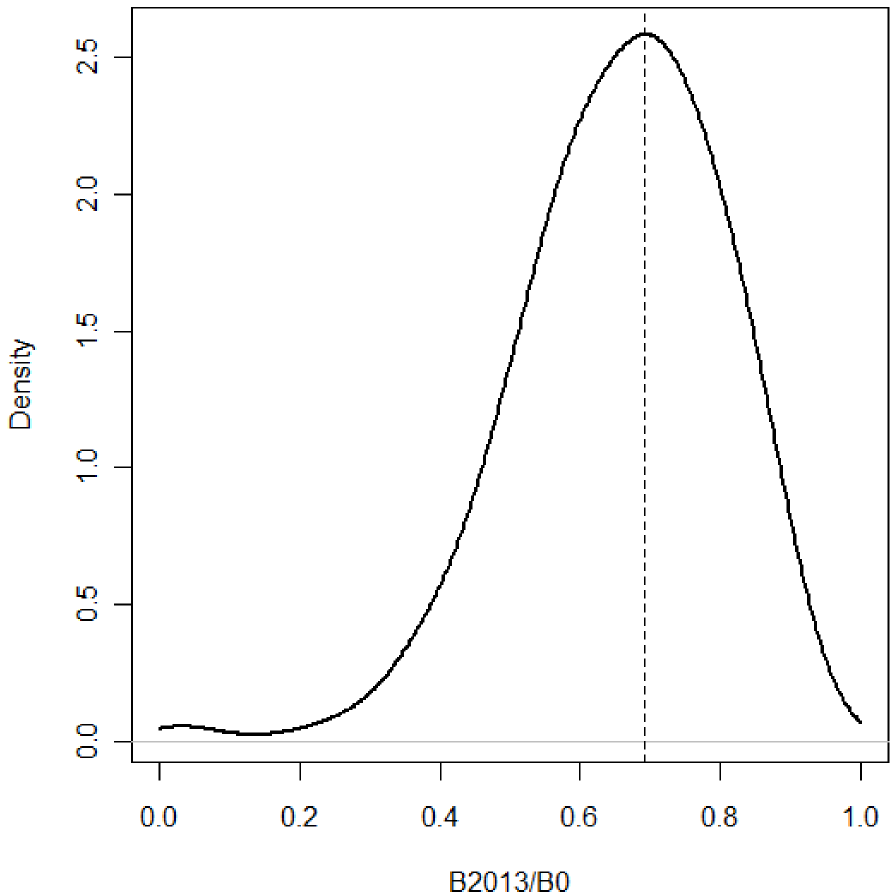


Figure 90. Stock status posterior distribution from the exSSS AIS model for yellowtail rockfish (North of 40° 10’ N. lat.) rockfish. Mode is indicated by the vertical line.

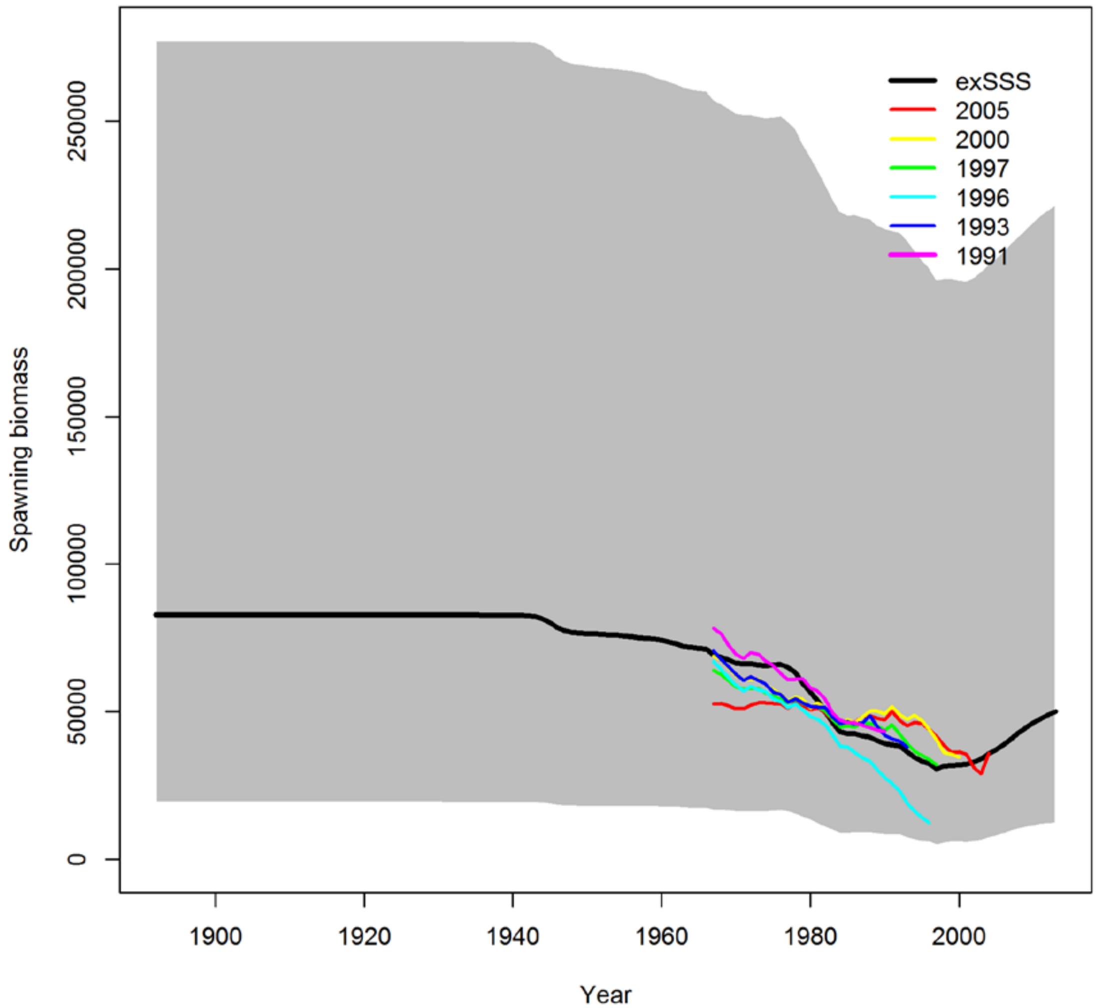


Figure 91. Comparison of exSSS estimated spawning biomass (black line with gray shading indicating the 95% CI) to past stock assessments of the yellowtail rockfish (North of 40° 10' N. lat.).

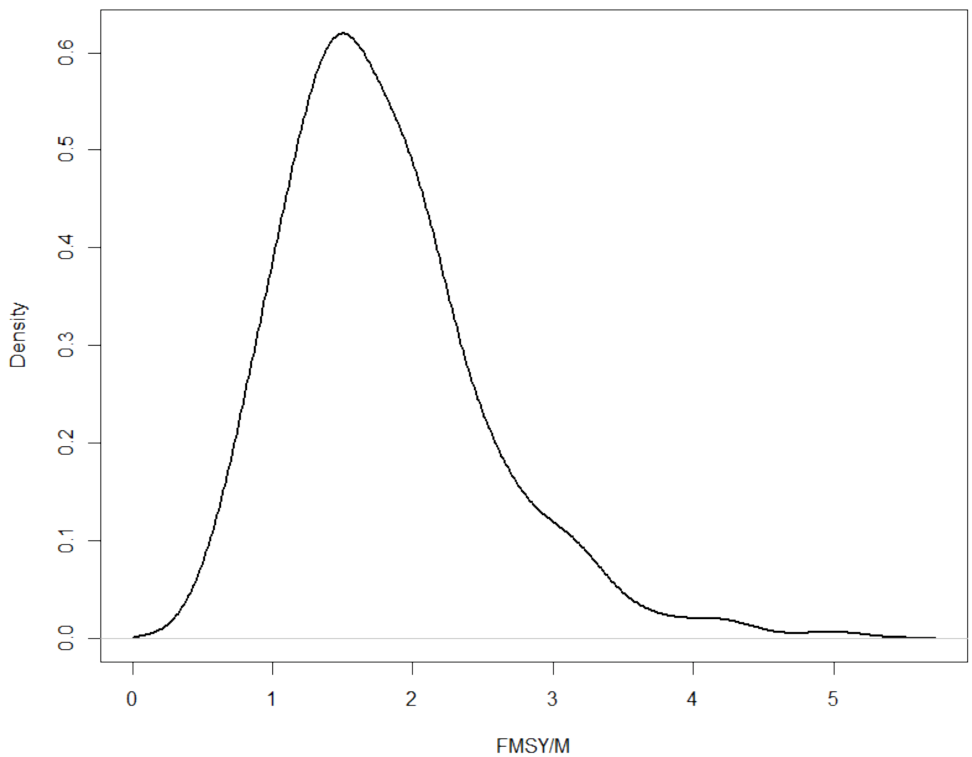


Figure 92. Posterior distribution of F_{MSY}/M from the exSSS AIS model for yellowtail rockfish (North of 40° 10’ N. lat.).

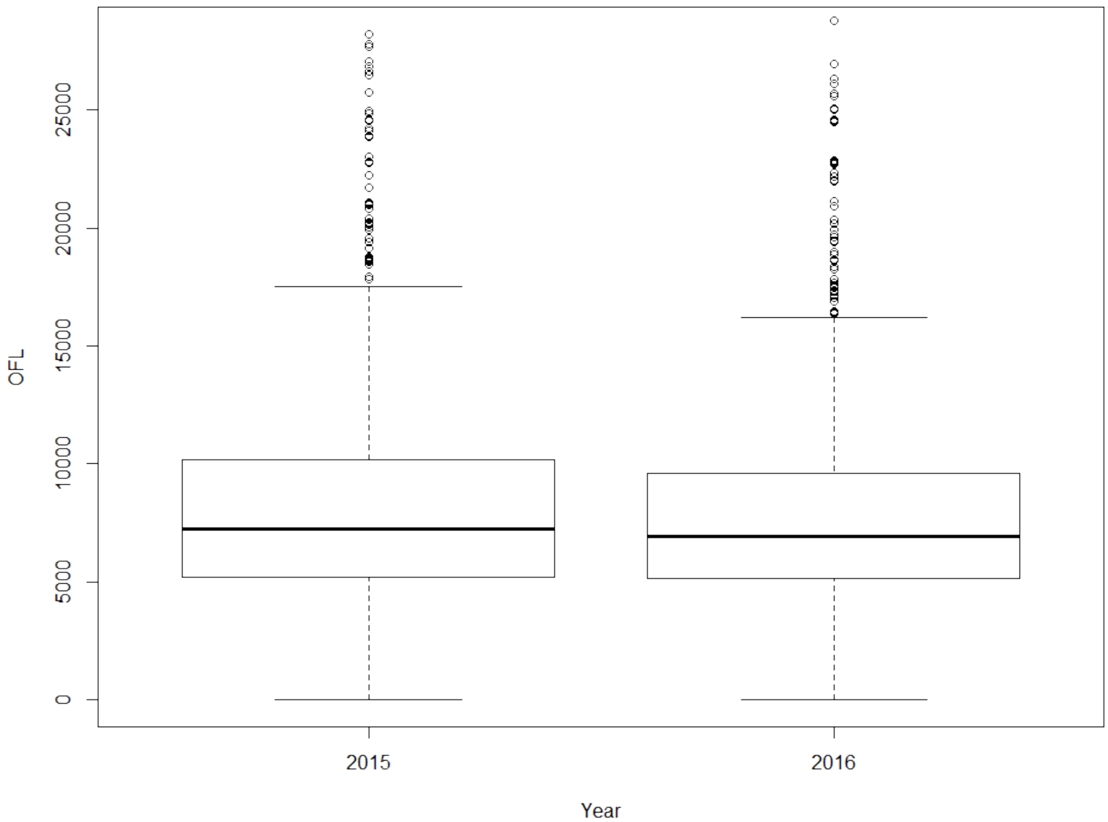


Figure 93. Posterior distribution of OFLs **from the exSSS AIS model for yellowtail rockfish (North of 40° 10' N. lat.).**

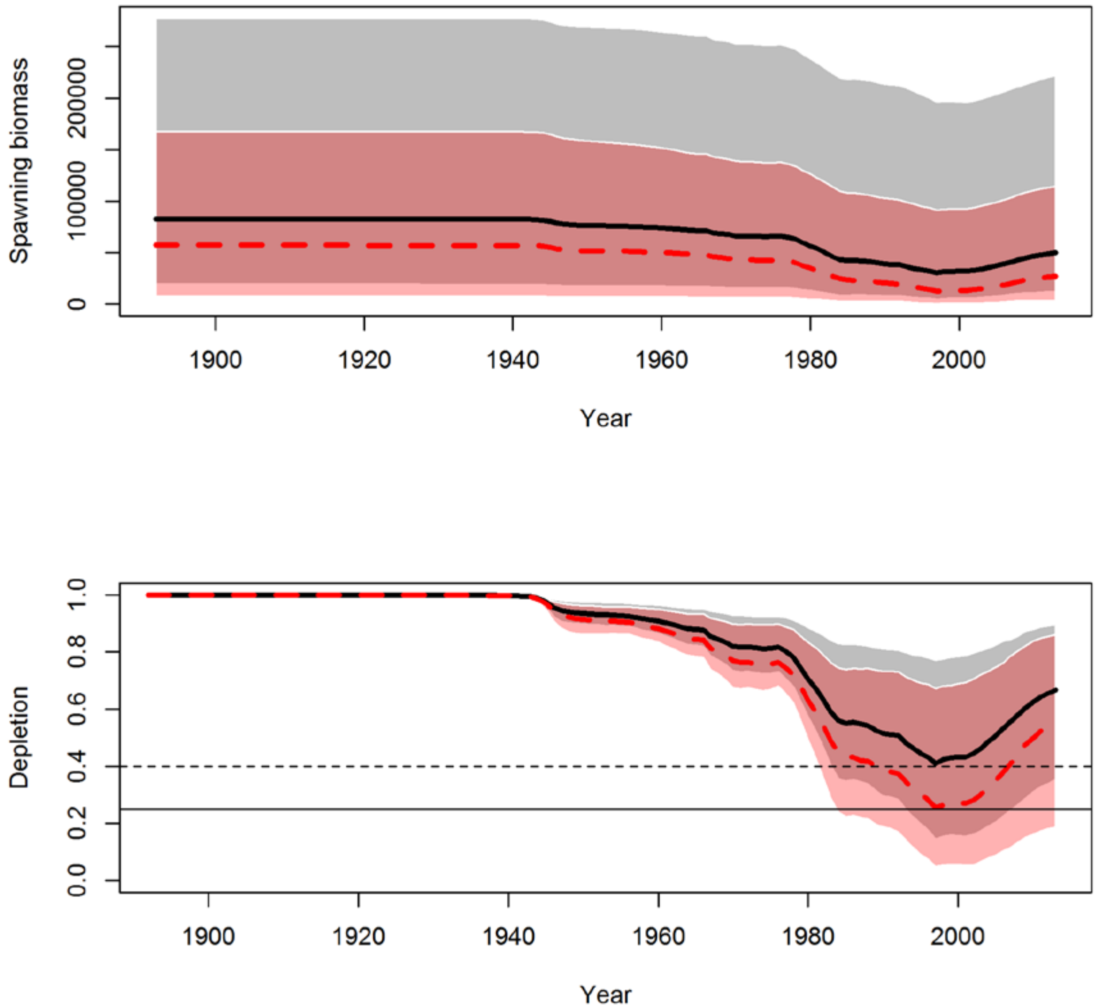


Figure 94. Comparison of the exSSS AIS (black line, gray shaded 95% CI) and catch-only (SSS; red broken line; pink shaded 95% CI) estimates of spawning biomass (upper panel) and stock status (lower panel) for yellowtail rockfish (North of 40° 10' N. lat.). Darker red shaded area is the overlap of the top models.

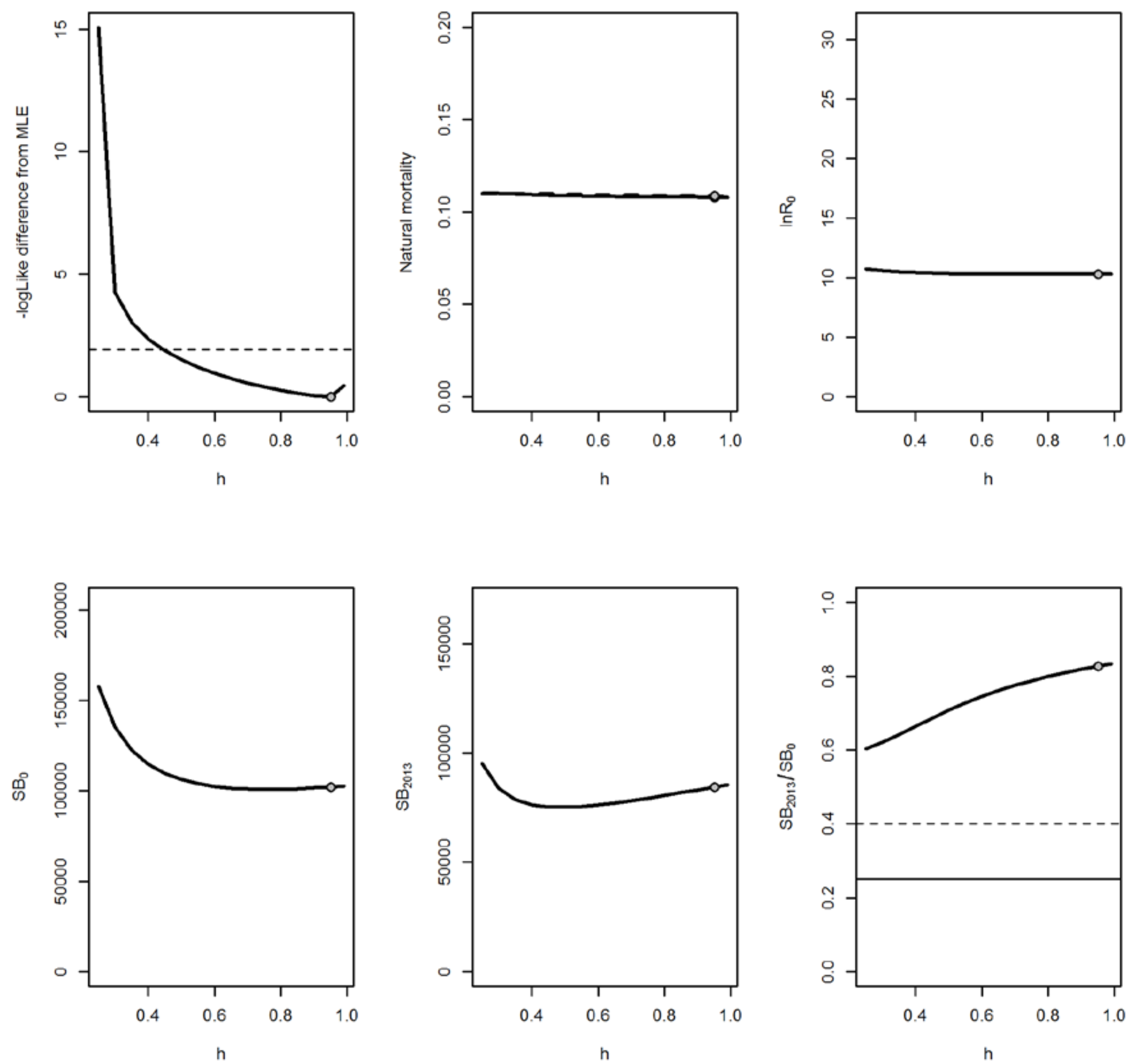


Figure 95. Likelihood profile for steepness (*h*; top left panel) and sensitivity to *h* of estimated (top center and right panels) and derived assessment outputs (bottom panels) for yellowtail rockfish (North of 40° 10' N. lat.) using exSSS. The MLE is indicated by the circle. Top left panel: broken line is 95% interval; Top middle panel: solid and broken lines are the female and male *M* values; Bottom right panel: Solid and broken line are the target and limit biomass reference points.

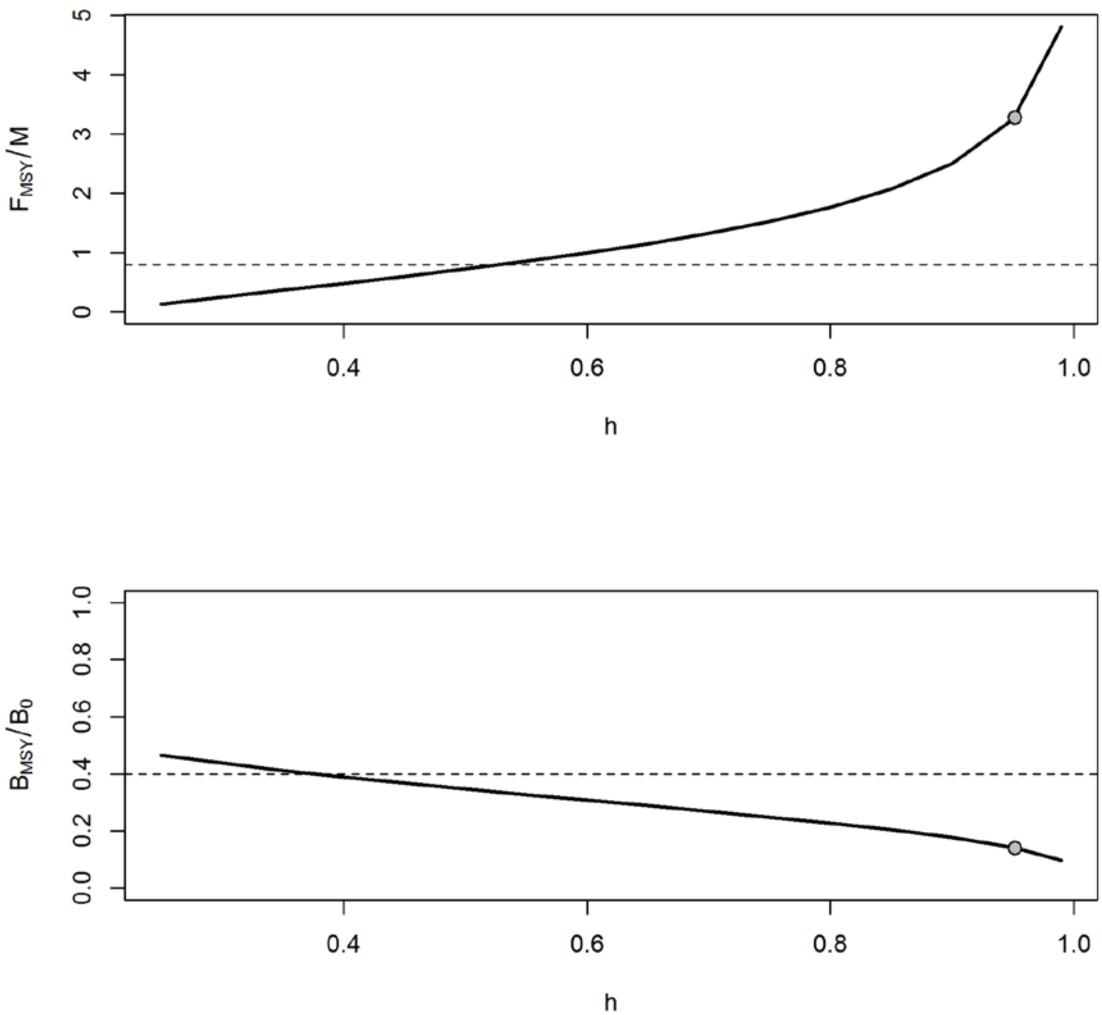


Figure 96. Steepness profile relative to XDB-SRA productivity parameters F_{MSY}/M (top panel) and B_{MSY}/B_0 (bottom panel) for yellowtail rockfish (North of 40° 10' N. lat.). Circle indicates exSSS MLE estimate. Broken line is the prior mean used in XDB-SRA.

8.2.6 English sole

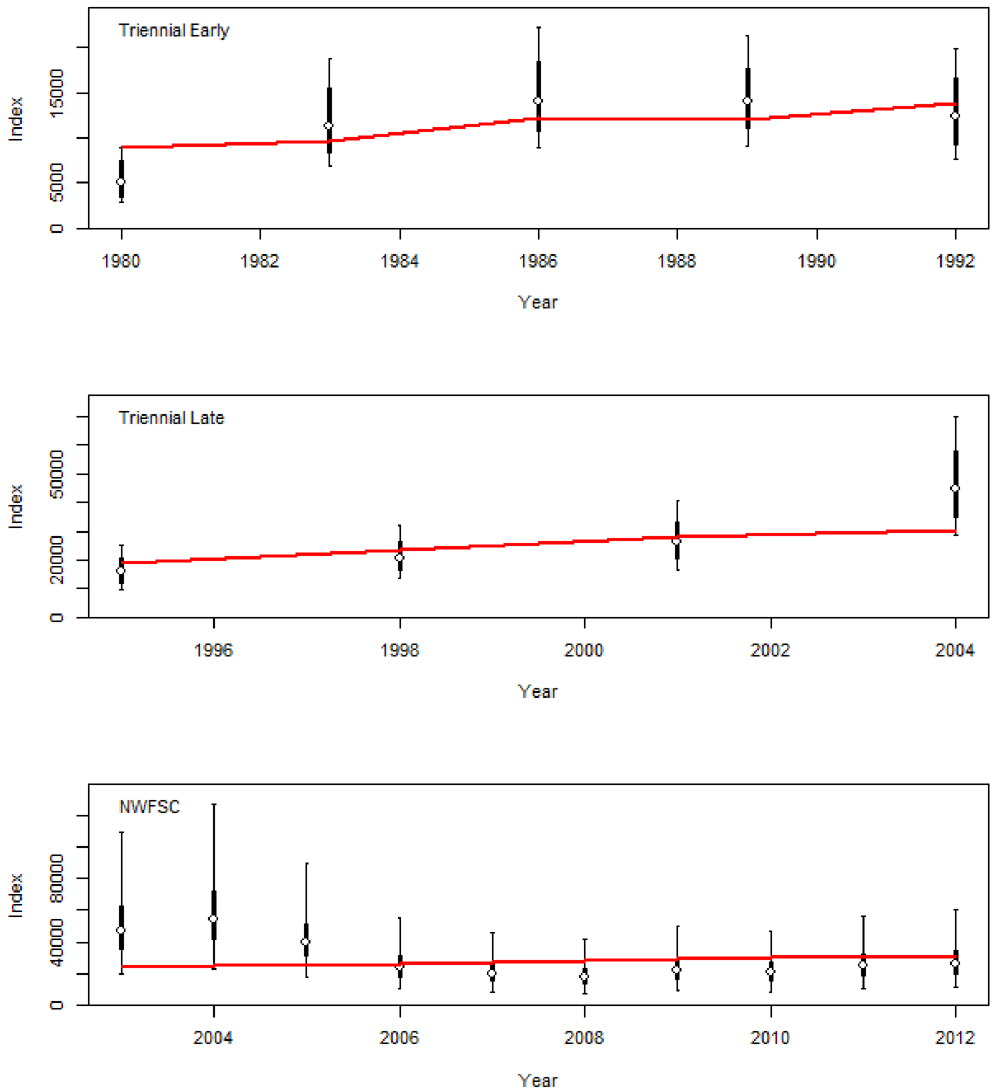


Figure 97. Fits to the three fishery-independent surveys from the exSSS AIS model for English sole. Thick lines are inputted variance; thin lines are estimated added variance.

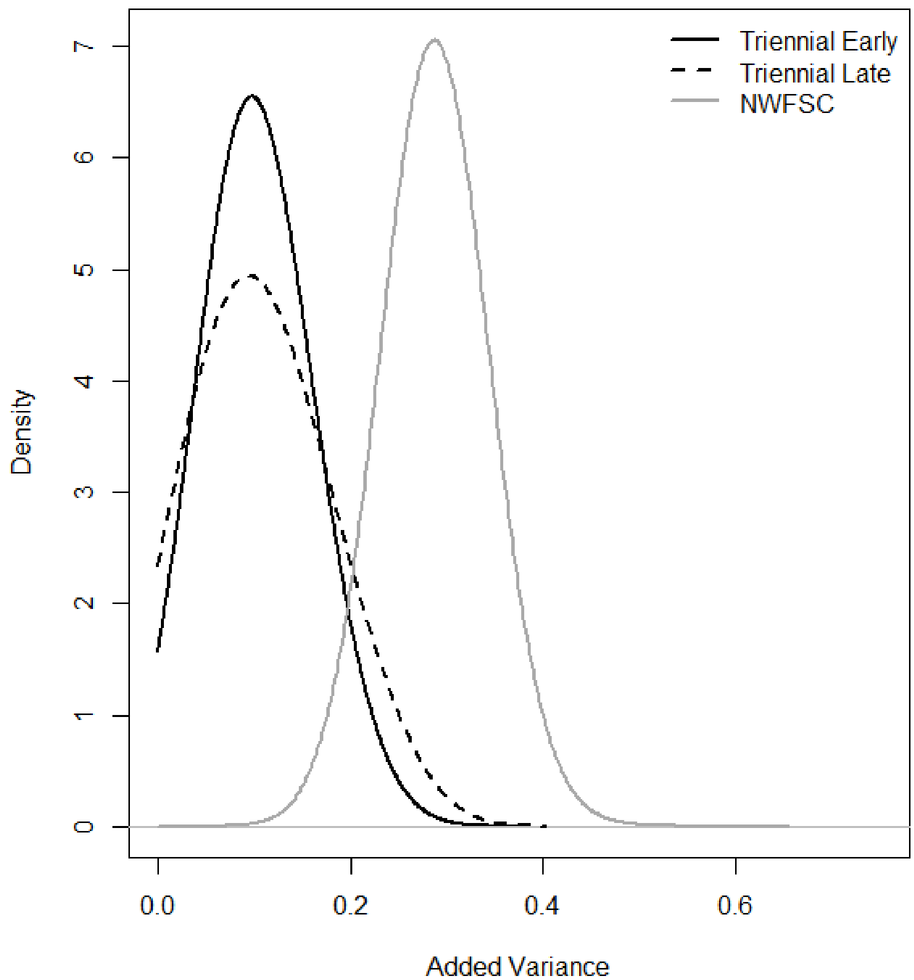


Figure 98. Posterior distribution of the added variance for each index fit in the exSSS AIS English sole assessment.

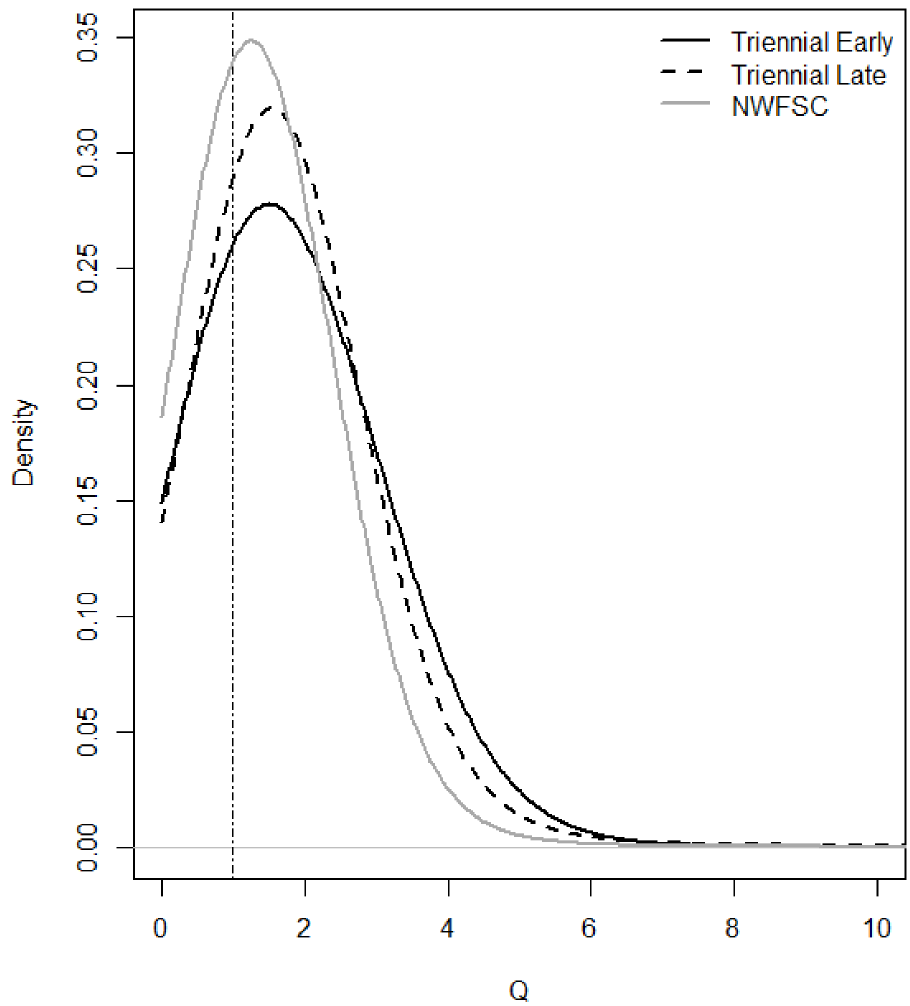


Figure 99. Posterior distribution of the catchability parameters (Q) for each index fit in the exSSS AIS English sole assessment.

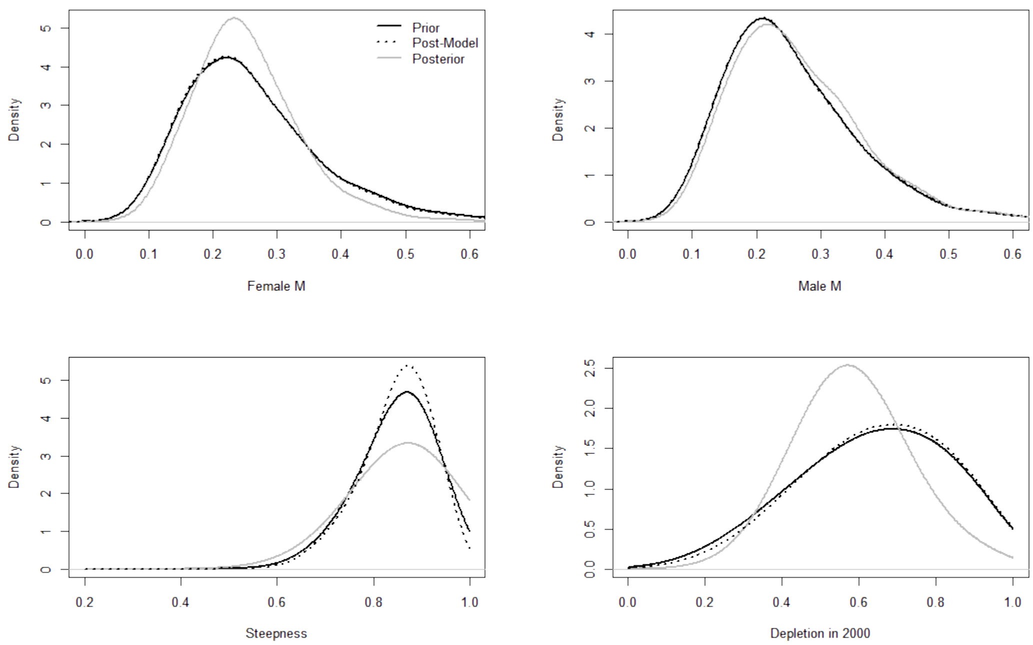


Figure 100. Prior and posterior distributions for each input parameter of the exSSS AIS uncertainty estimation for English sole.

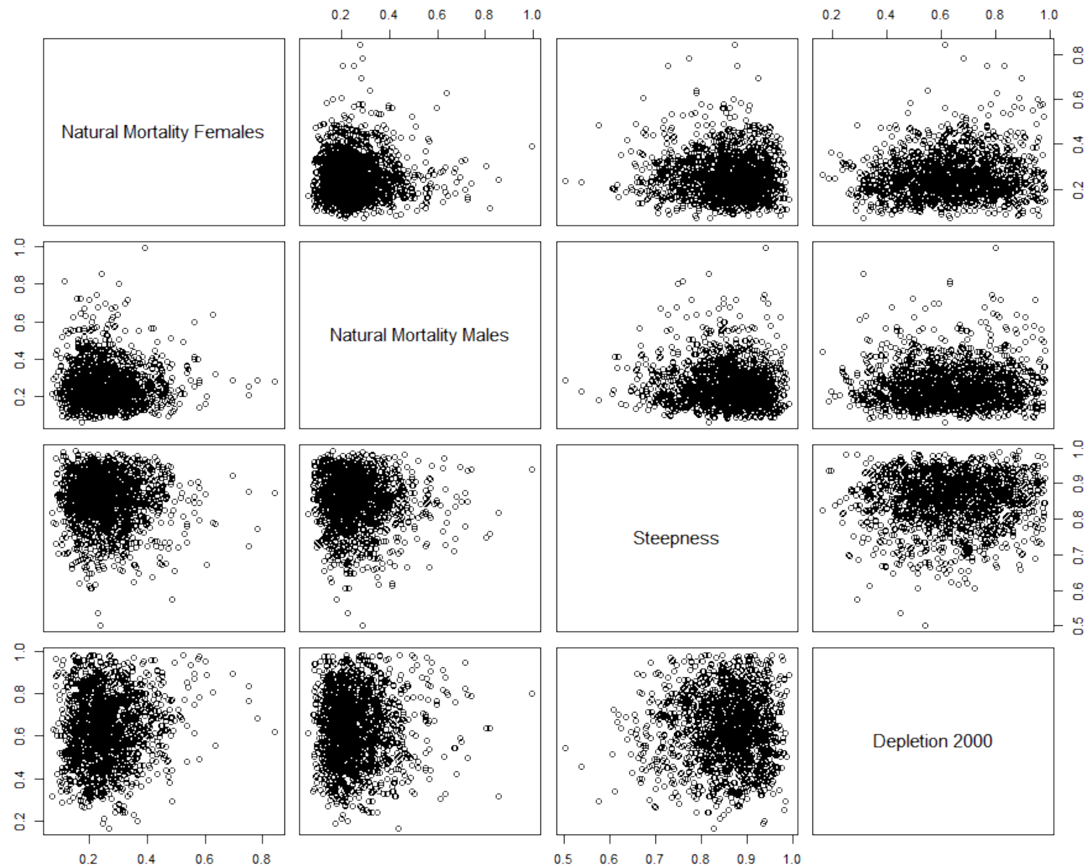


Figure 101. Pairs plots for each parameter in the exSSS AIS treatment of uncertainty for English sole.

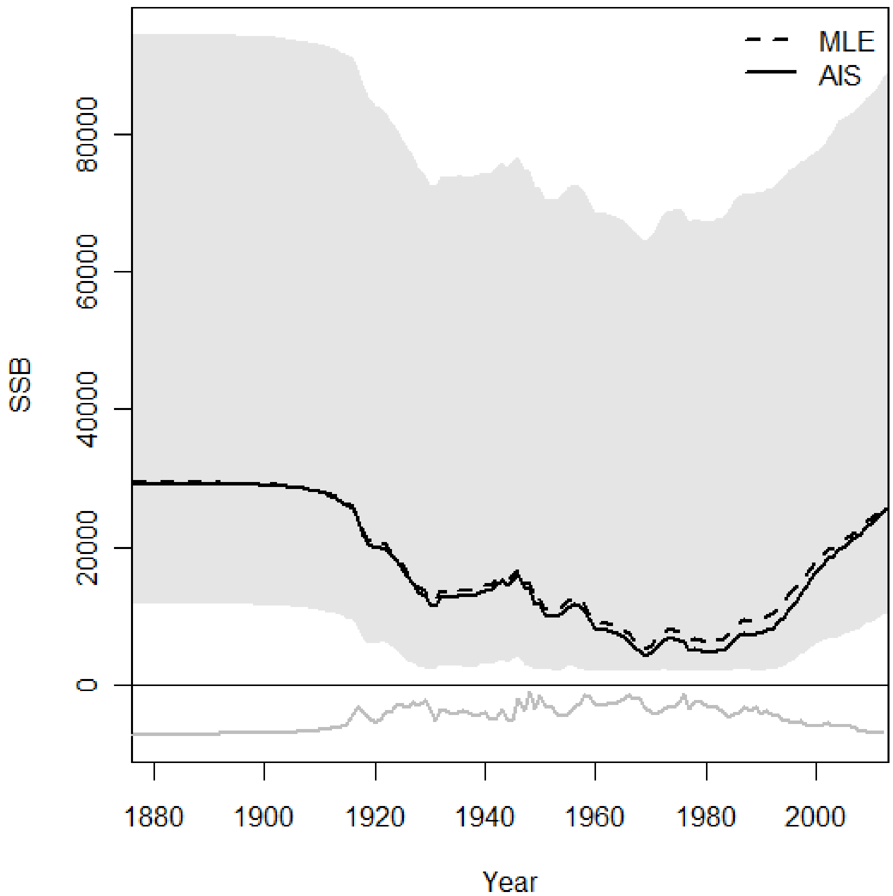


Figure 102. Time series of spawning biomass from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for English sole. Catch history is provided below the 0 line.

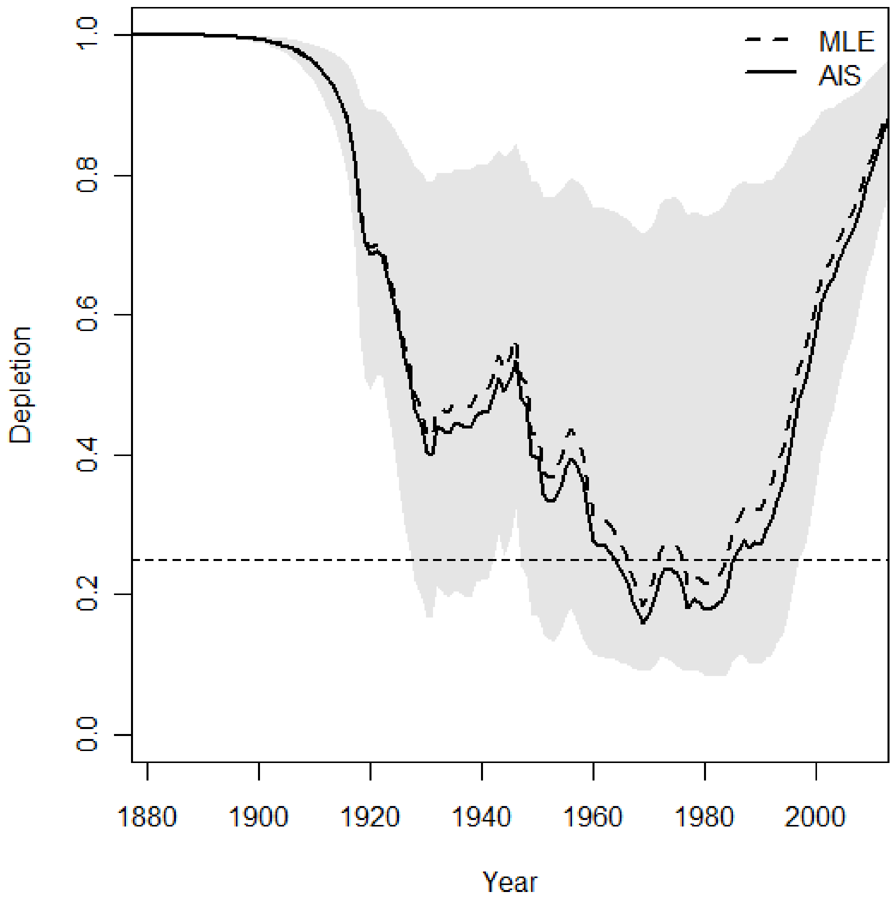


Figure 103. Time series of stock status (depletion) from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for English sole.

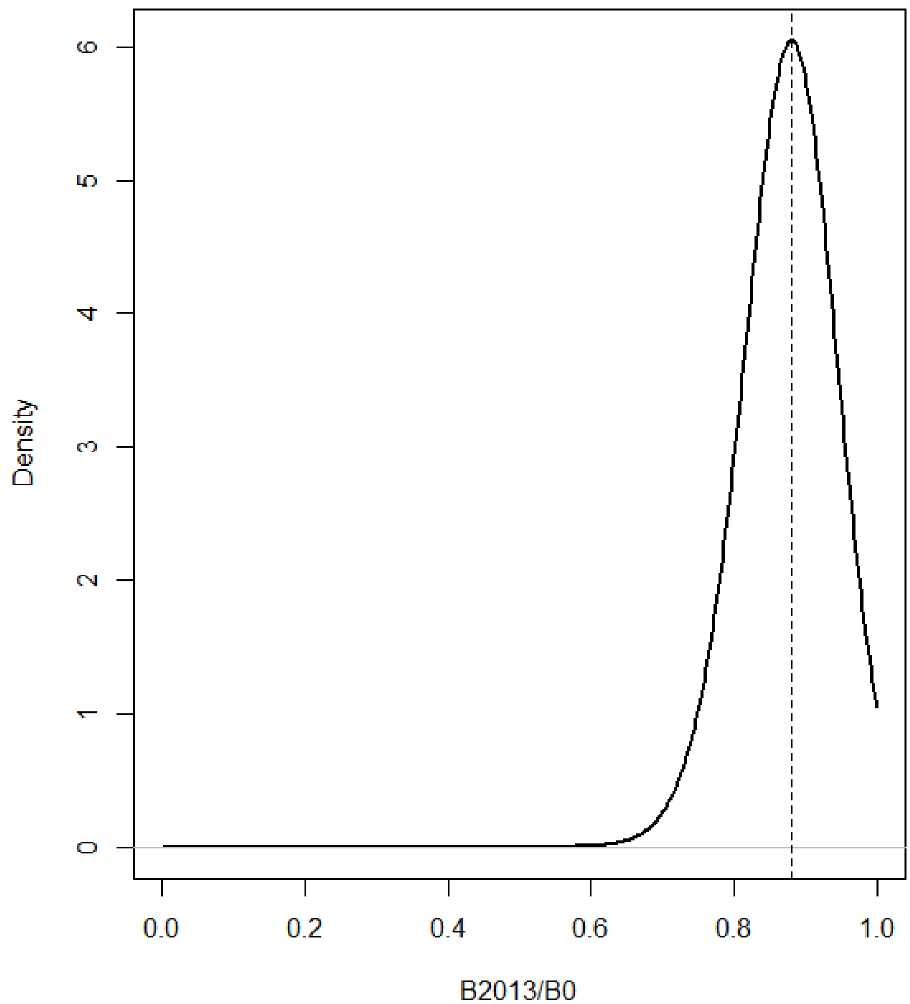


Figure 104. Stock status posterior distribution from the exSSS AIS model for English sole. Mode is indicated by the vertical line.

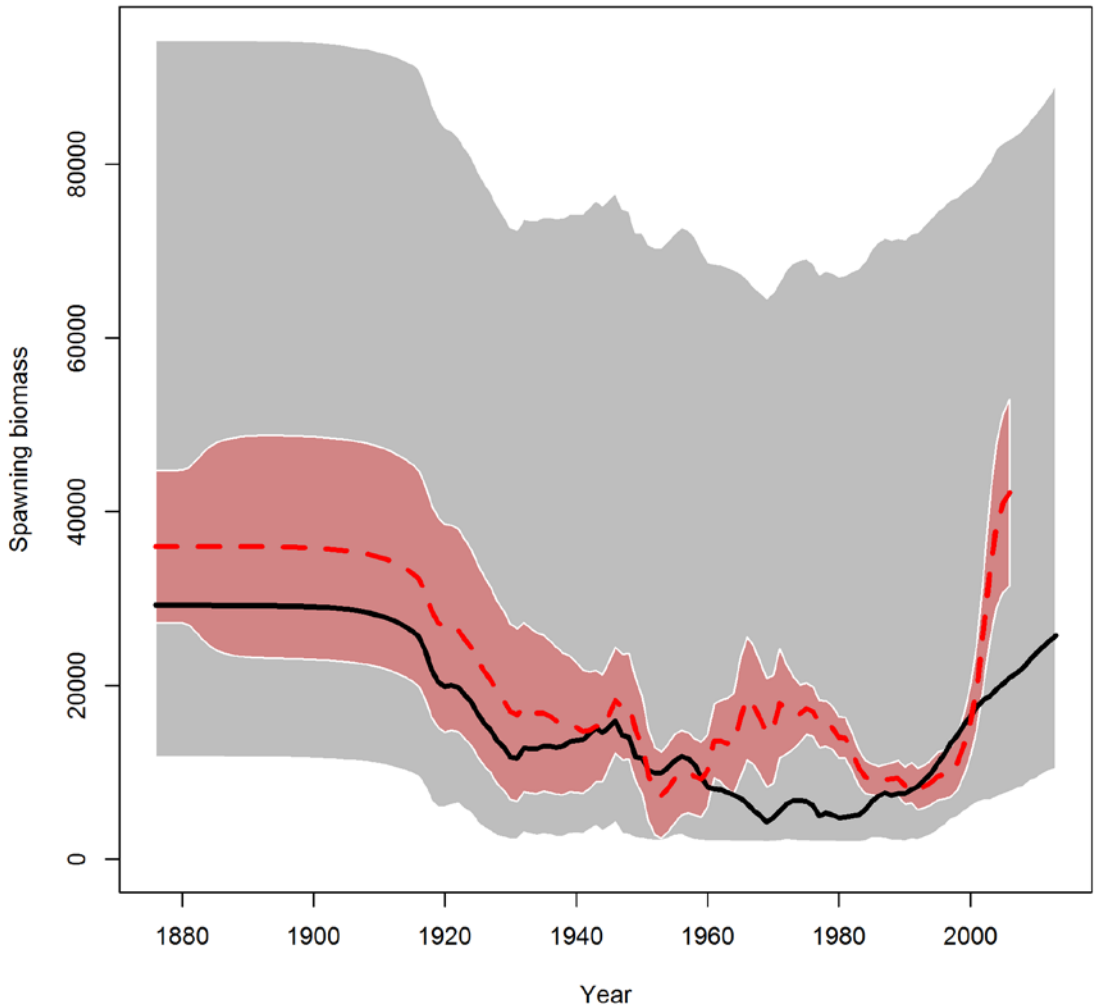


Figure 105. Comparison of the exSSS model (black line with gray shading of 95% CI) to the 2009 full assessment (red broken line with red shading of 95% CI) of English sole.

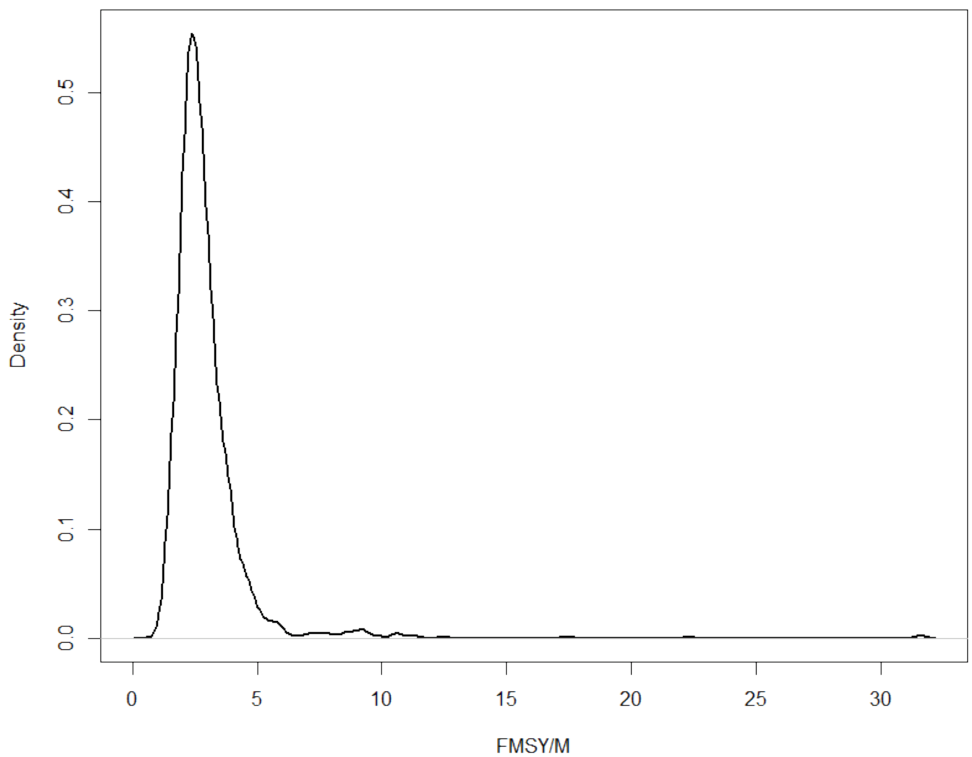


Figure 106. Posterior distribution of F_{MSY}/M from the exSSS AIS model for English sole.

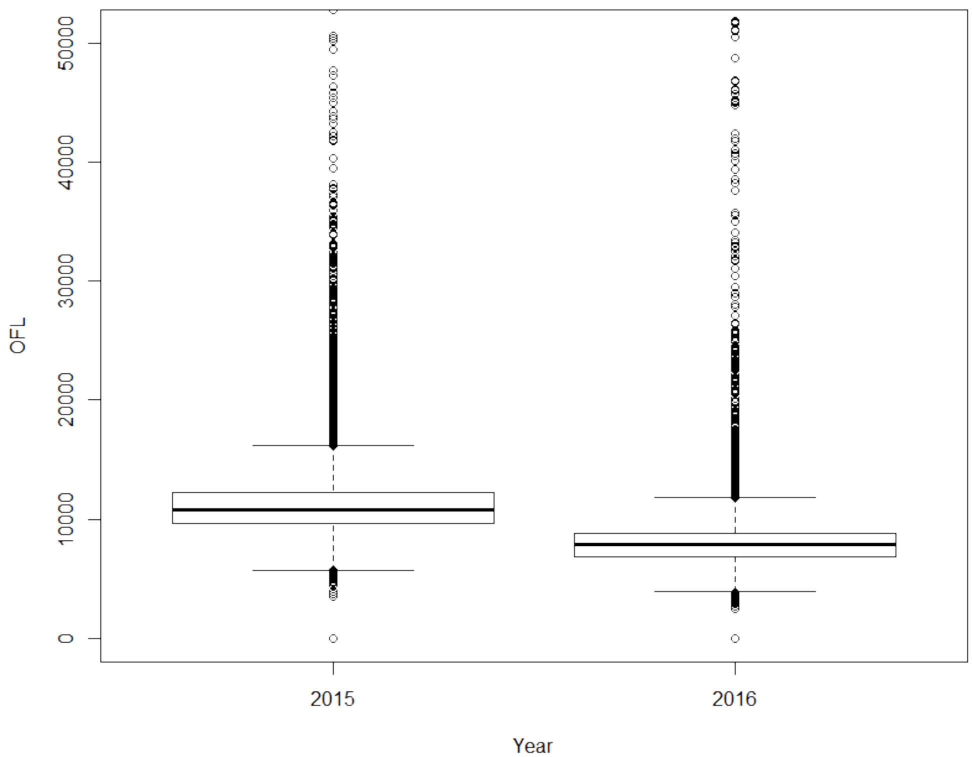


Figure 107. Posterior distribution of OFLs **from the exSSS AIS model for English sole.**

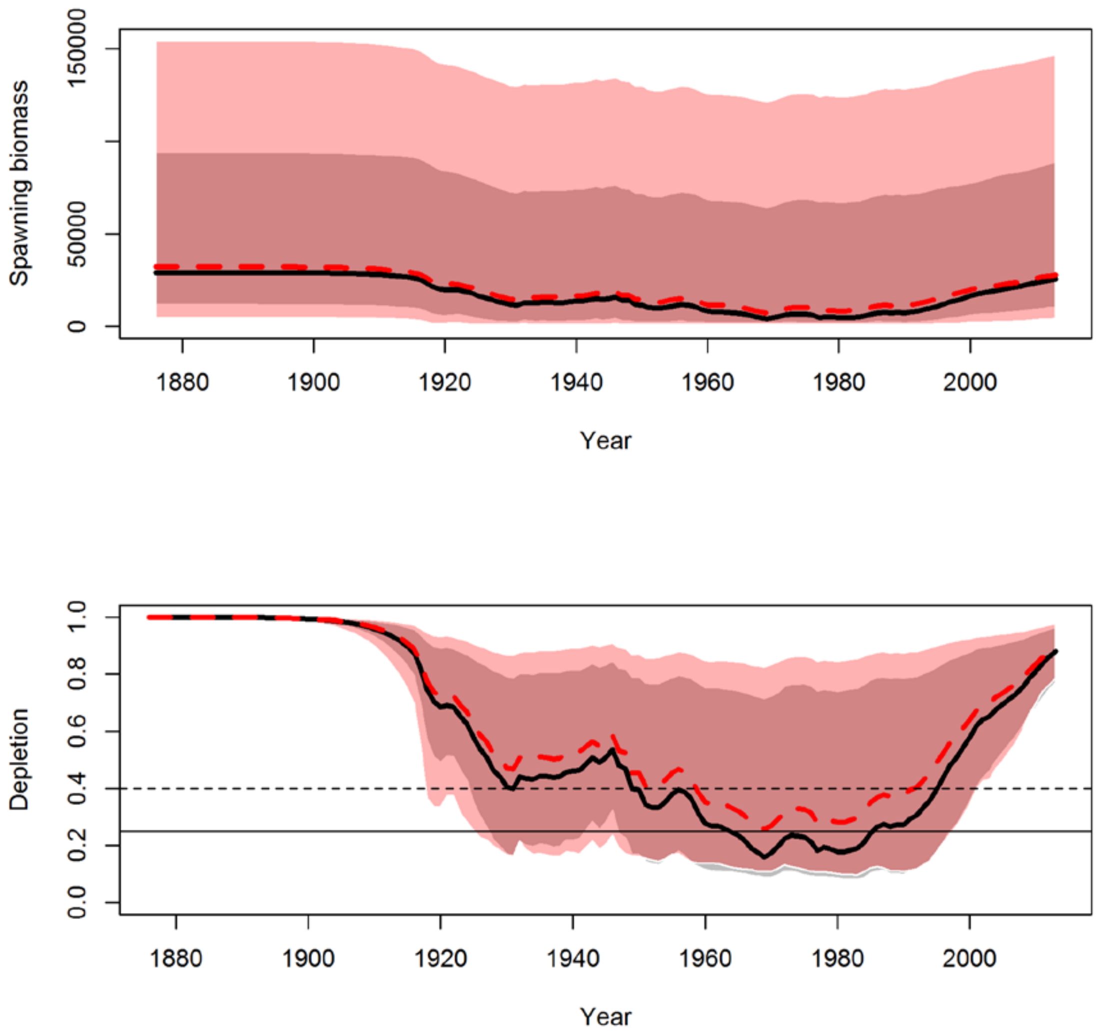


Figure 108. Comparison of the exSSS AIS (black line, gray shaded 95% CI) and catch-only (SSS; red broken line; pink shaded 95% CI) estimates of spawning biomass (upper panel) and stock status (lower panel) for English sole. Darker red shaded area is the overlap of the top models.

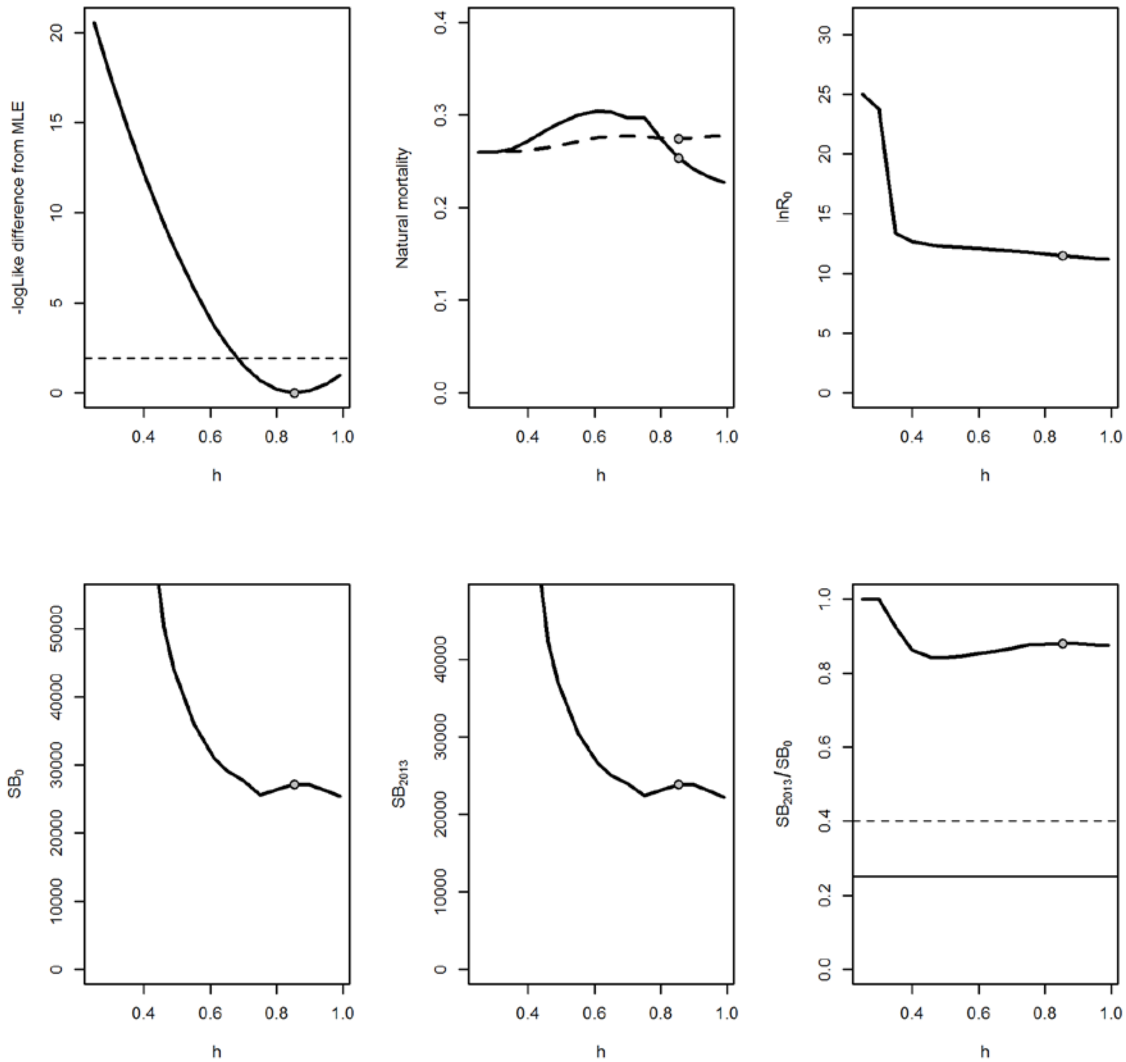


Figure 109. Likelihood profile for steepness (*h*; top left panel) and sensitivity to *h* of estimated (top center and right panels) and derived assessment outputs (bottom panels) for English sole using exSSS. The MLE is indicated by the circle. Top left panel: broken line is 95% interval; Top middle panel: solid and broken lines are the female and male *M* values; Bottom right panel: Solid and broken line are the target and limit biomass reference points.

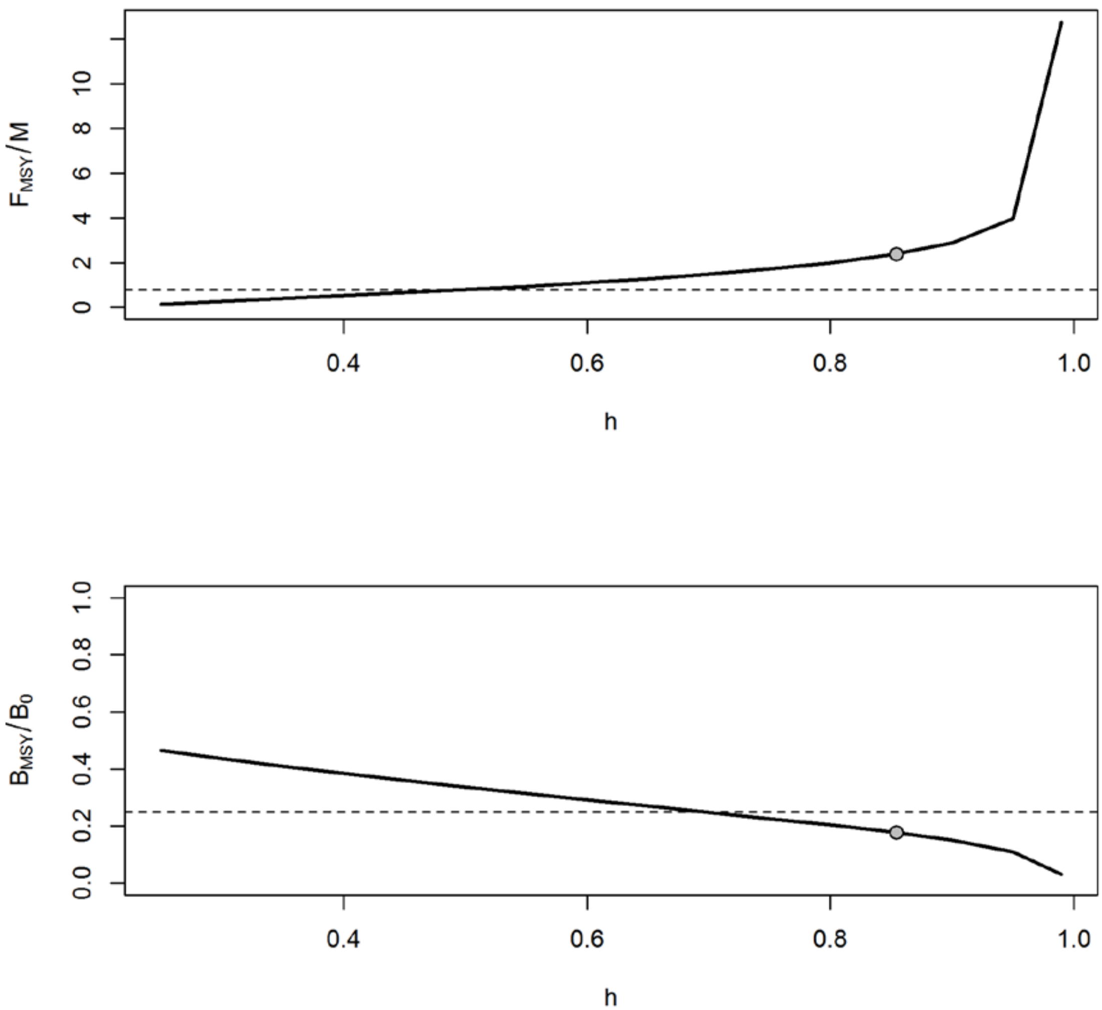


Figure 110. Steepness profile relative to XDB-SRA productivity parameters F_{MSY}/M (top panel) and B_{MSY}/B_0 (bottom panel) for English sole. Circle indicates exSSS MLE estimate. Broken line is the prior mean used in XDB-SRA.

8.2.7 Rex sole

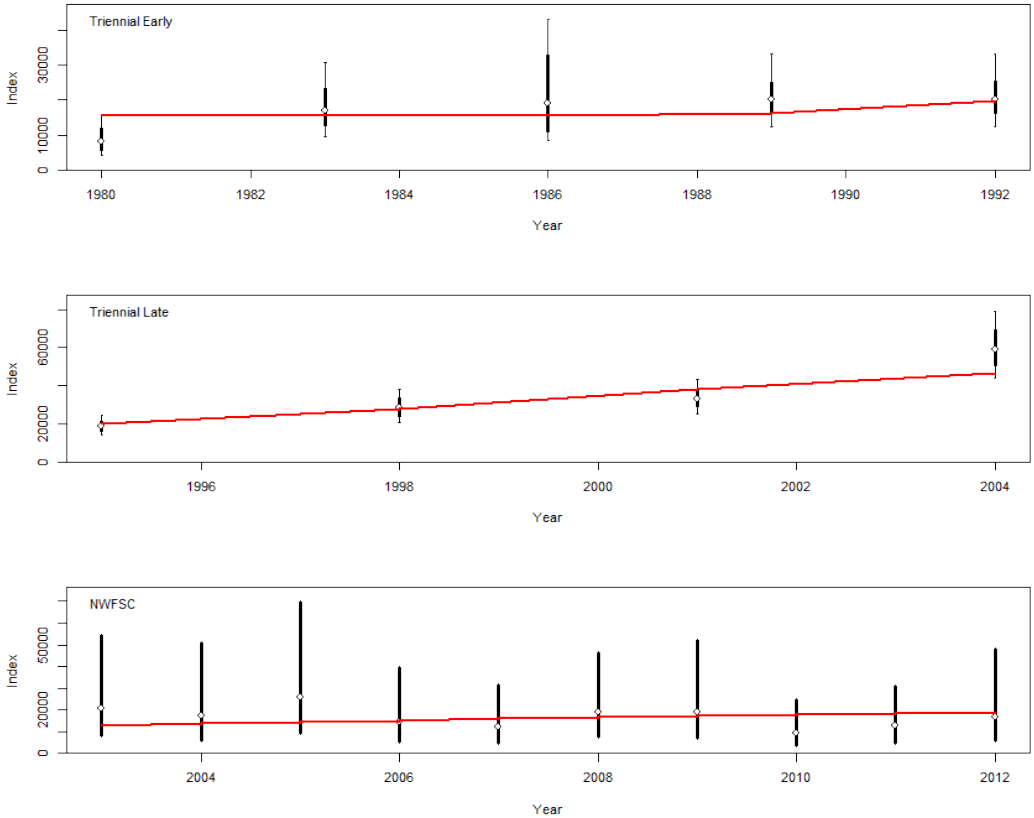


Figure 111. Fits to the three fishery-independent surveys from the exSSS AIS model for rex sole. Thick lines are inputted variance; thin lines are estimated added variance.

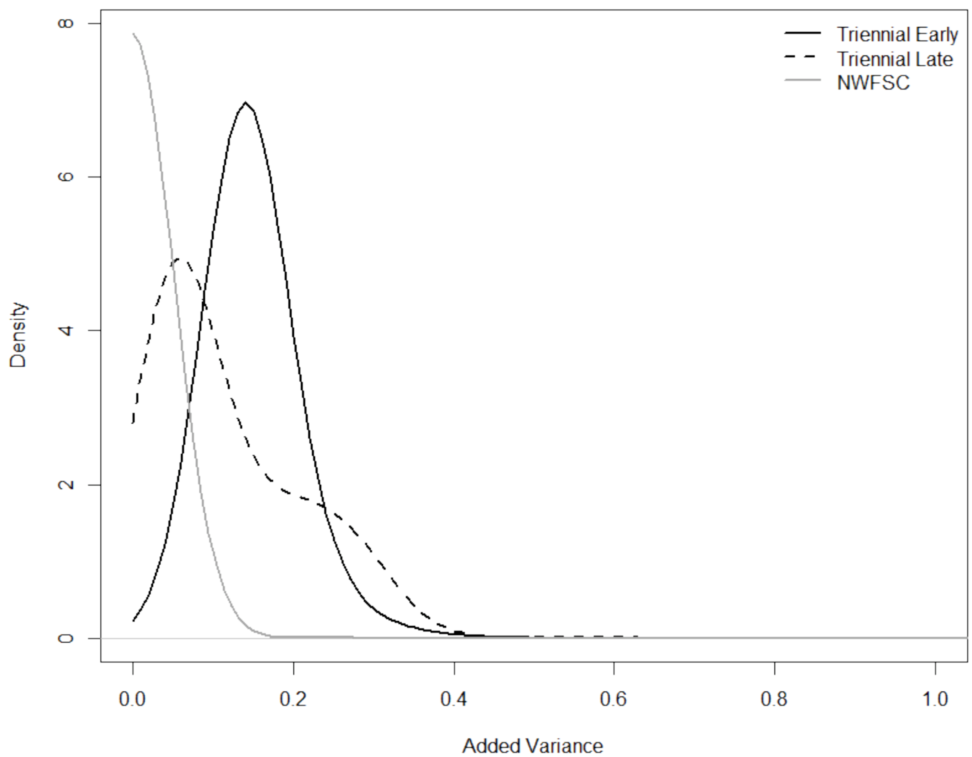


Figure 112. Posterior distribution of the added variance for each index fit in the exSSS AIS rex sole assessment.

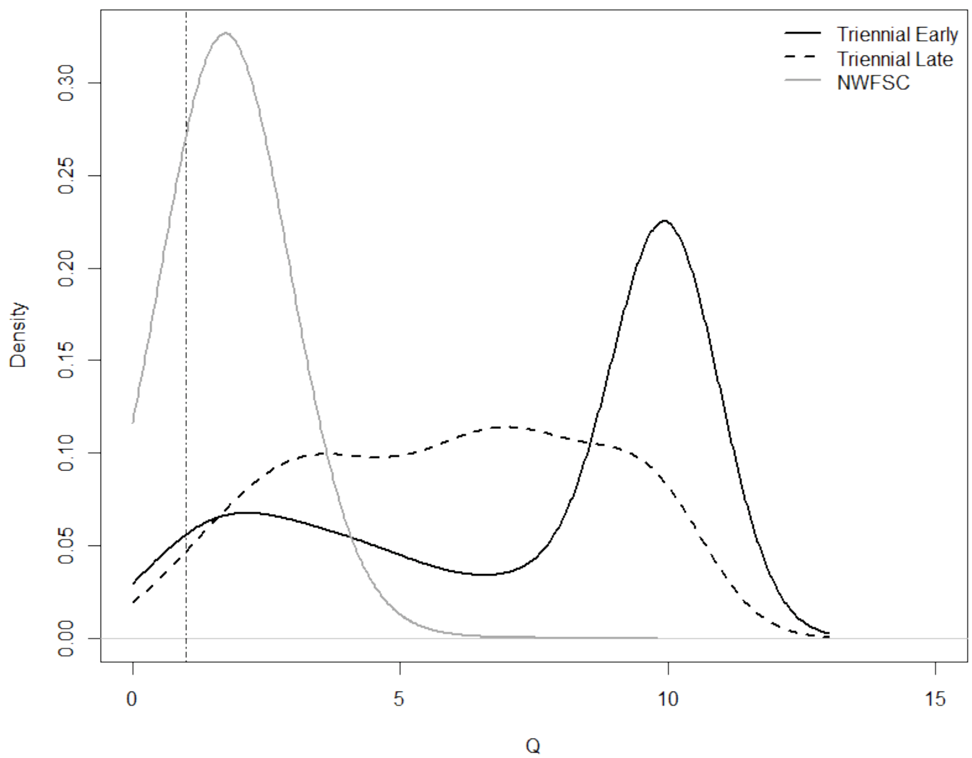


Figure 113. Posterior distribution of the catchability parameters (Q) for each index fit in the exSSS AIS rex sole assessment.

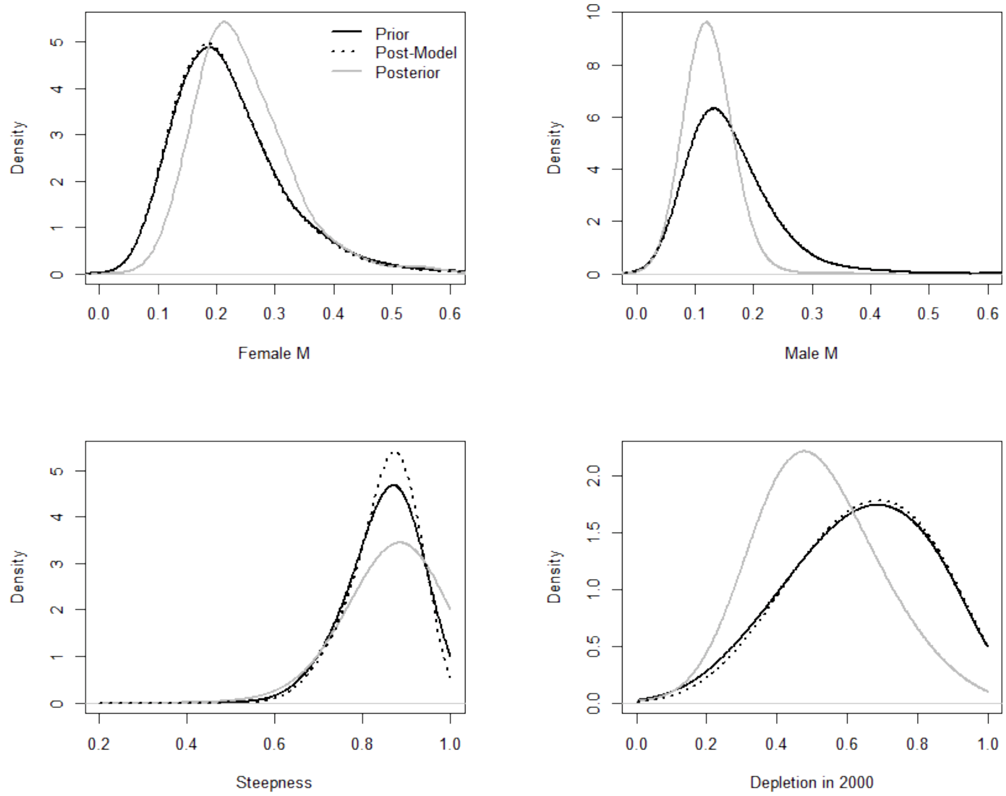


Figure 114. Prior and posterior distributions for each input parameter of the exSSS AIS uncertainty estimation for rex sole.

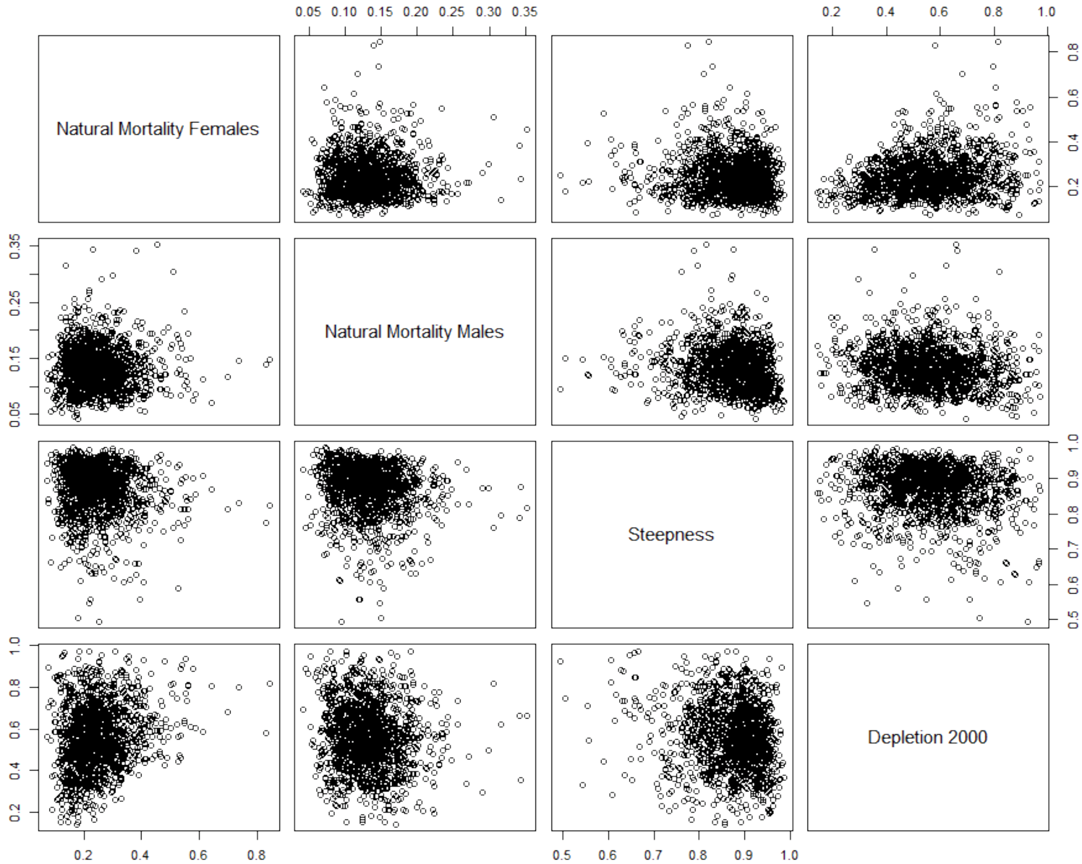


Figure 115. Pairs plots for each parameter in the exSSS AIS treatment of uncertainty for rex sole.

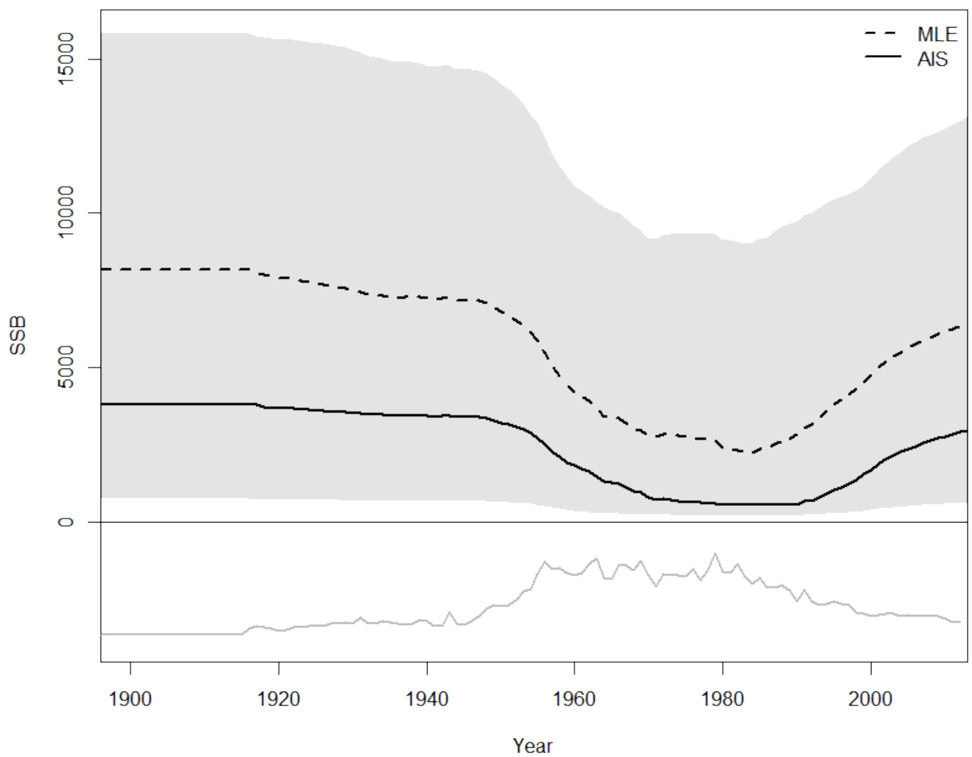


Figure 116. Time series of spawning biomass from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for rex sole. Catch history is provided below the 0 line.

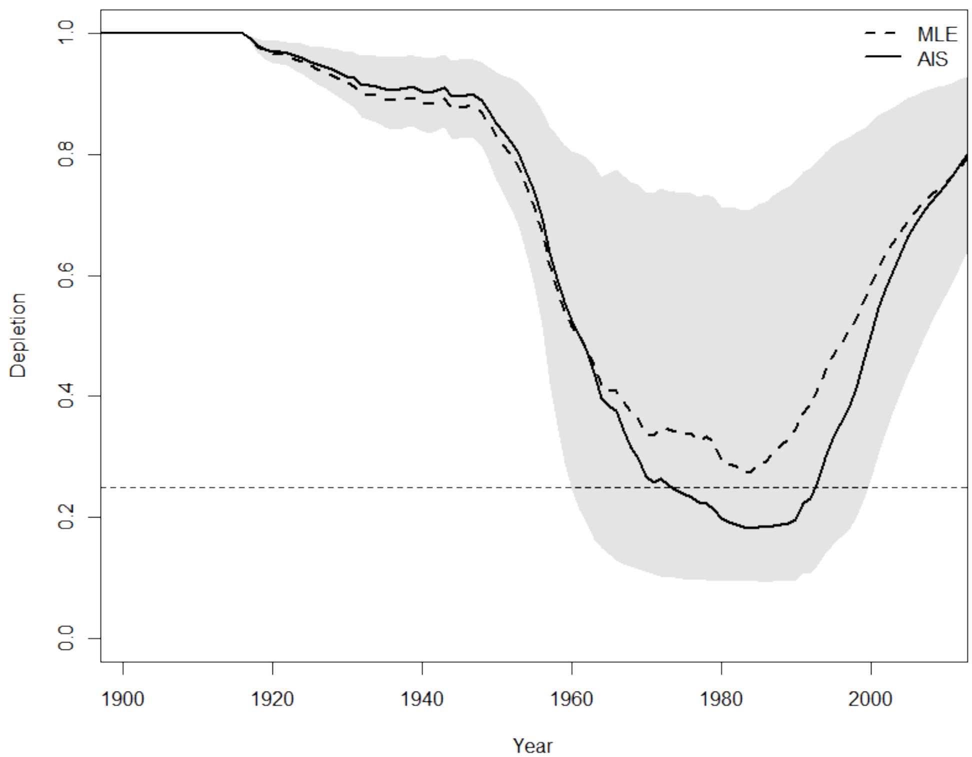


Figure 117. Time series of stock status (depletion) from the exSSS MLE (broken line) and AIS (solid line with gray uncertainty bars) for rex sole.

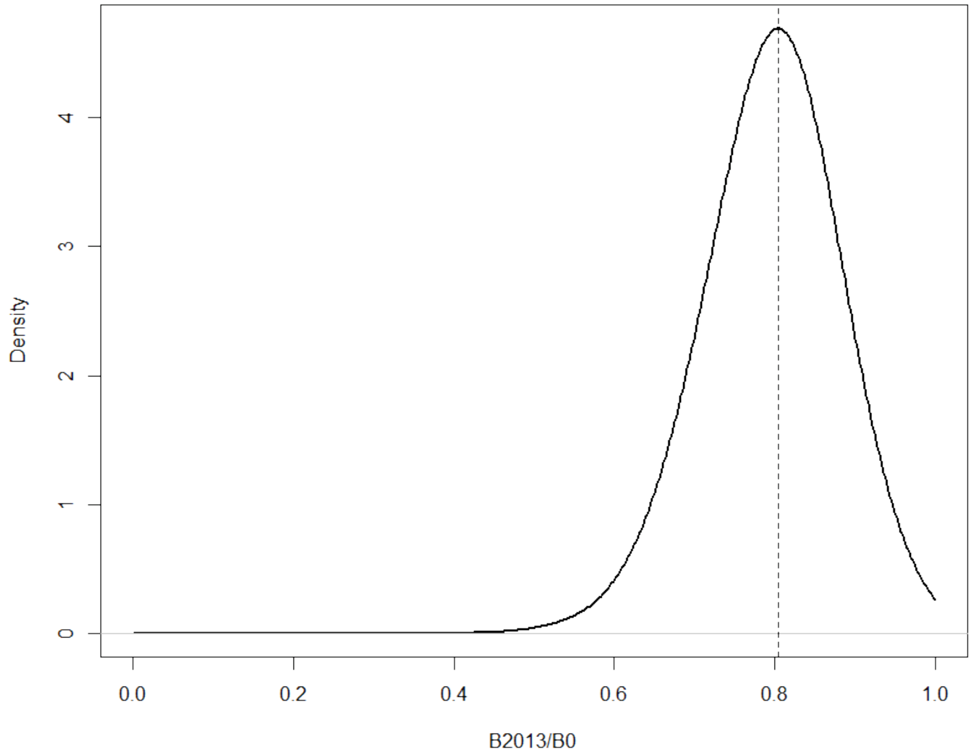


Figure 118. Stock status posterior distribution from the exSSS AIS model for rex sole. Mode is indicated by the vertical line.

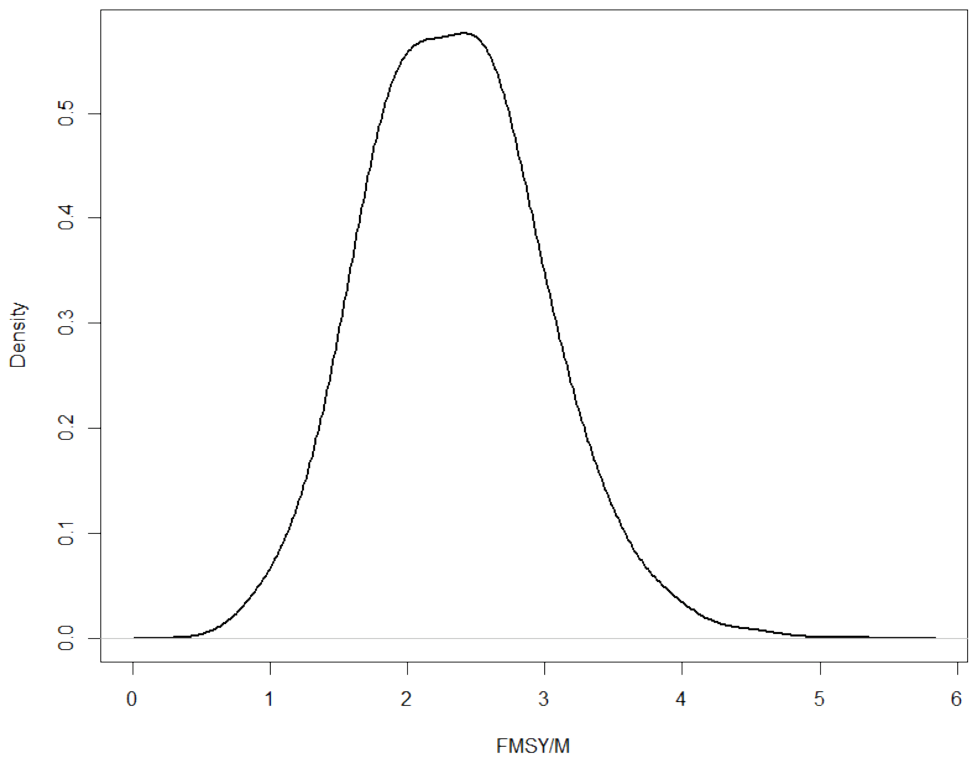


Figure 119. Posterior distribution of F_{MSY}/M from the exSSS AIS model for rex sole.

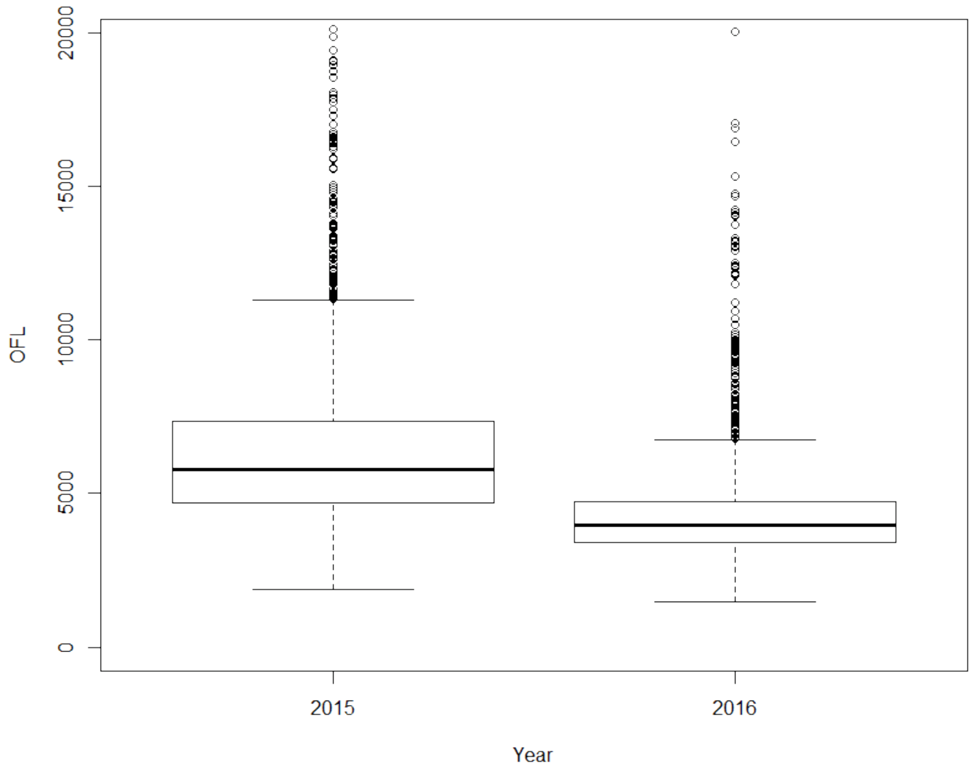


Figure 120. Posterior distribution of OFLs **from the exSSS AIS model for rex sole.**

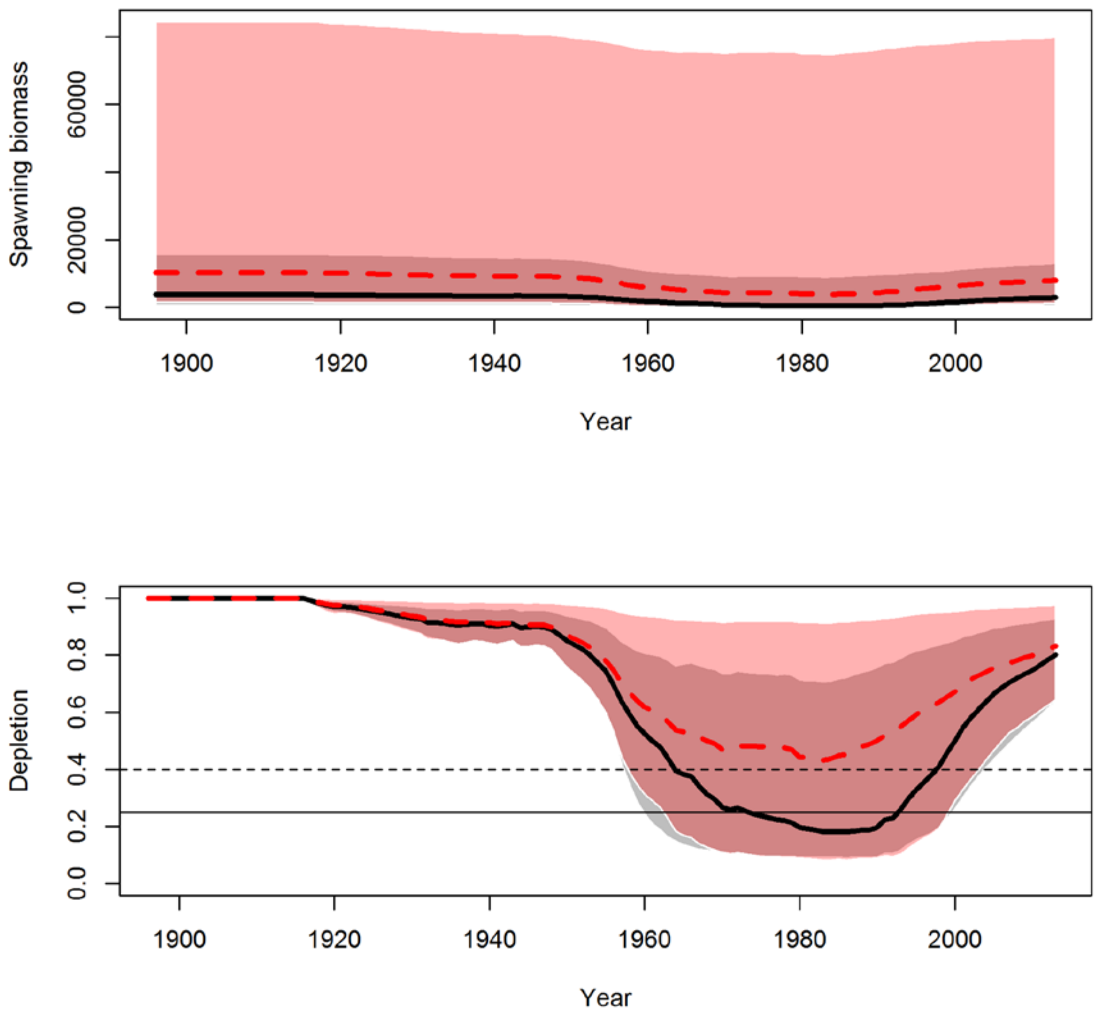


Figure 121. Comparison of the exSSS AIS (black line, gray shaded 95% CI) and catch-only (SSS; red broken line; pink shaded 95% CI) estimates of spawning biomass (upper panel) and stock status (lower panel) for rex sole. Darker red shaded area is the overlap of the top models.

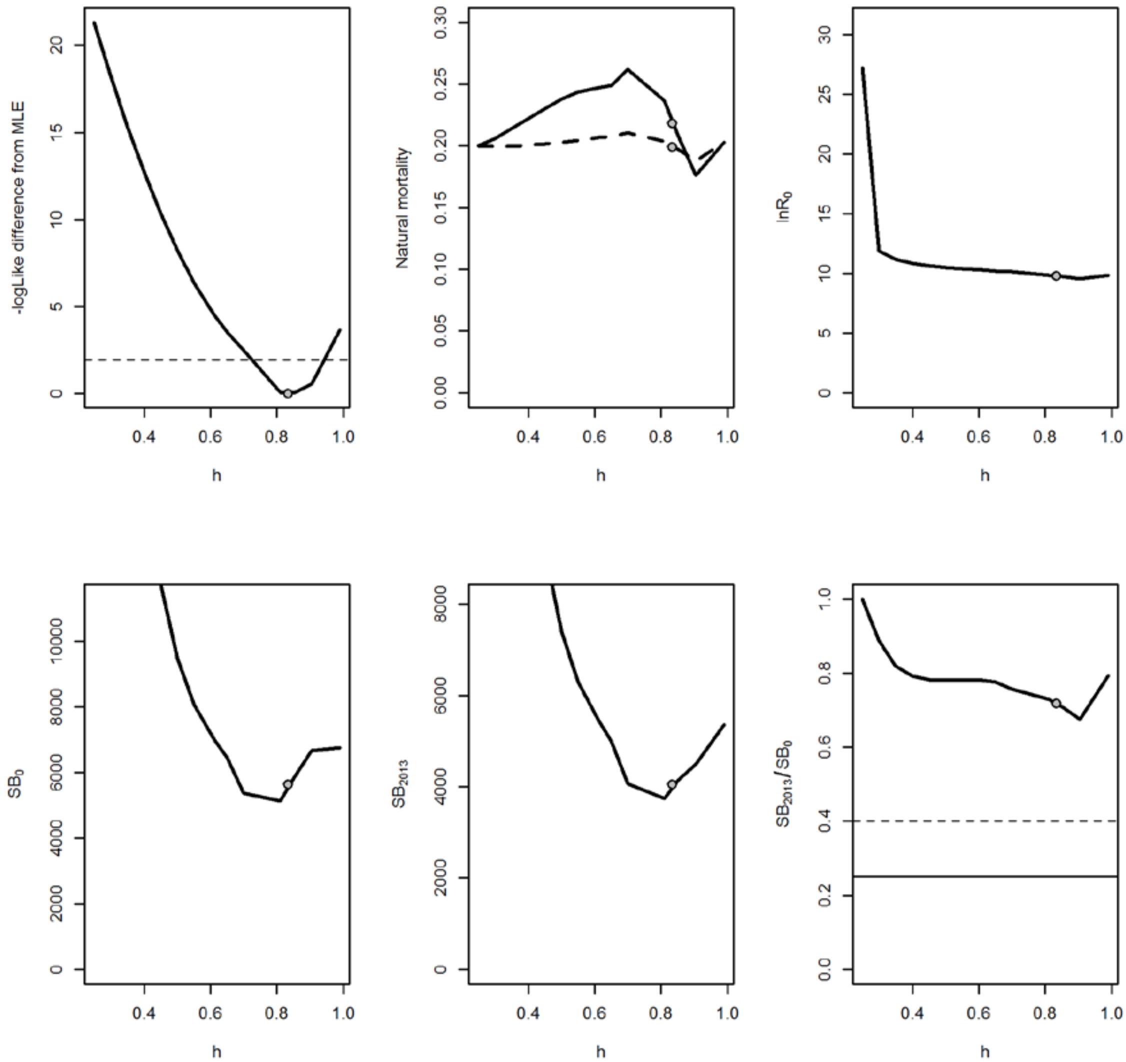


Figure 122. Likelihood profile for steepness (*h*; top left panel) and sensitivity to *h* of estimated (top center and right panels) and derived assessment outputs (bottom panels) for rex sole using exSSS. The MLE is indicated by the circle. Top left panel: broken line is 95% interval; Top middle panel: solid and broken lines are the female and male *M* values; Bottom right panel: Solid and broken line are the target and limit biomass reference points.

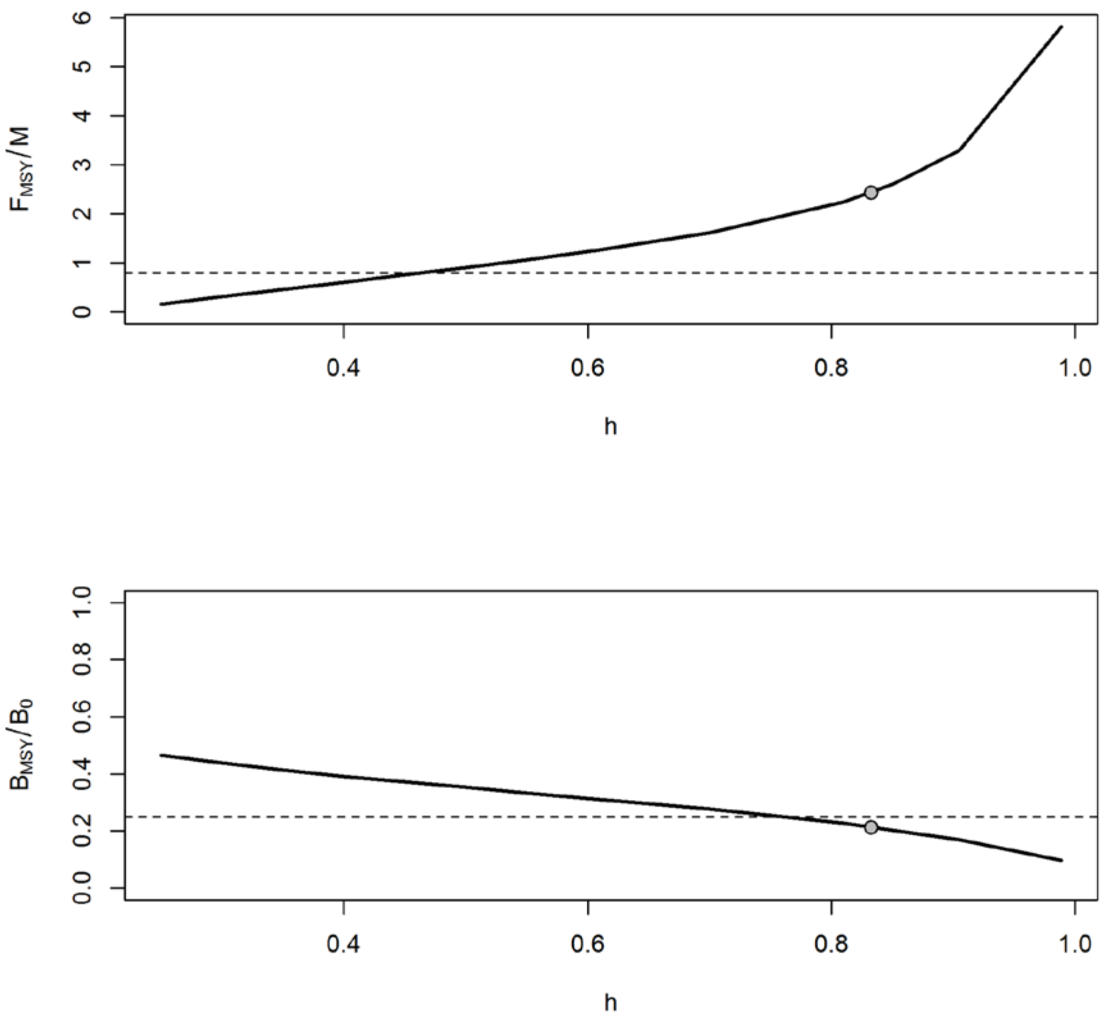


Figure 123. Steepness profile relative to XDB-SRA productivity parameters F_{MSY}/M (top panel) and B_{MSY}/B_0 (bottom panel) for rex sole. Circle indicates exSSS MLE estimate. Broken line is the prior mean used in XDB-SRA.

8.2.8 Stripetail rockfish

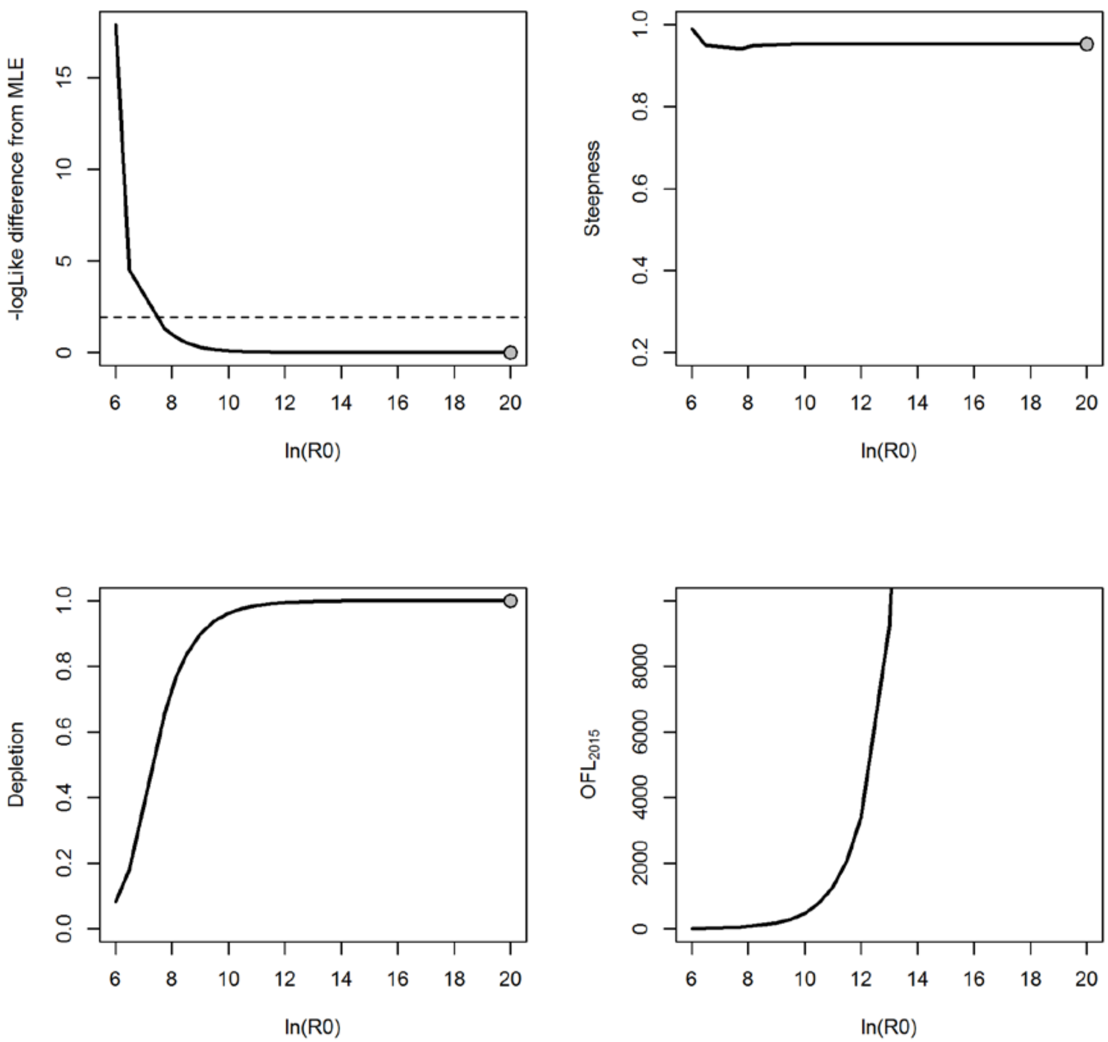


Figure 124. Likelihood, parameter (h), and derived outputs (depletion and OFL_{2015}) profiles over the log of initial recruitment (lnR_0) for the stripetail rockfish.

Appendix

Appendix A. SS Files

Appendix A.1. Sharpchin rockfish

Data file

Global model specifications
1892 # Start year
2012 # End year
1 # Number of seasons/year
12 # Number of months/season
1 # Spawning occurs at beginning of season
1 # Number of fishing fleets
3 # Number of surveys
1 # Number of areas
FISHERY%SURVEY1%SURVEY2%SURVEY3
0.5 0.5 0.5 0.5 # fleet timing_in_season
1 1 1 1 # Area of each fleet
1 # Units for catch by fishing fleet: 1=Biomass(mt),2=Numbers(1000s)
0.01 # SE of log(catch) by fleet for equilibrium and continuous options
2 # Number of genders
58 # Number of ages in population dynamics
Catch section
0 # Initial equilibrium catch (landings + discard) by fishing fleet
121 # Number of lines of catch
Catch Year Season

0.001150487	1892	1
0.001150487	1893	1
0.001150487	1894	1
0.000295835	1895	1
7.12256E-05	1896	1
7.25853E-05	1897	1
4.10928E-05	1898	1
6.94951E-05	1899	1
9.78974E-05	1900	1
0.000126314	1901	1
0.000154716	1902	1
0.000183118	1903	1
0.000211521	1904	1
0.000239937	1905	1
0.000268339	1906	1
0.000296741	1907	1
0.000325157	1908	1
0.00035356	1909	1
0.000381962	1910	1
0.000410364	1911	1
0.000438781	1912	1
0.000467183	1913	1
0.000495585	1914	1
0.000523988	1915	1
0.018731296	1916	1
0.028327536	1917	1
0.033139857	1918	1
0.023600435	1919	1
0.024585622	1920	1
0.019830105	1921	1
0.01794494	1922	1
0.01893014	1923	1
0.010347488	1924	1
0.007505539	1925	1
0.027626414	1926	1
0.043922655	1927	1

0.059811315	1928	1
0.074049115	1929	1
0.067938907	1930	1
0.047493313	1931	1
0.054534866	1932	1
0.083571299	1933	1
0.079491029	1934	1
0.082405376	1935	1
0.074946685	1936	1
0.094108711	1937	1
0.114752532	1938	1
0.161103139	1939	1
0.42489214	1940	1
0.685717911	1941	1
1.043338636	1942	1
3.598970821	1943	1
5.777112792	1944	1
10.6939928	1945	1
7.161619571	1946	1
4.383698696	1947	1
4.512894336	1948	1
5.229668663	1949	1
5.969479224	1950	1
6.06440304	1951	1
10.40211061	1952	1
7.072621356	1953	1
10.36534135	1954	1
7.772092358	1955	1
13.16262469	1956	1
12.29774895	1957	1
11.0445706	1958	1
9.853816807	1959	1
12.63058548	1960	1
14.6787664	1961	1
18.76841144	1962	1
23.87977742	1963	1
21.30568814	1964	1
20.02847431	1965	1
891.6235817	1966	1
510.9169406	1967	1
298.9894879	1968	1
32.96547412	1969	1
46.74018601	1970	1
67.46147099	1971	1
44.82446649	1972	1
70.95380365	1973	1
42.92714017	1974	1
46.2968068	1975	1
36.93121077	1976	1
12.58769187	1977	1
179.9407398	1978	1
187.8498453	1979	1
176.3192986	1980	1
27.70463145	1981	1
25.93266787	1982	1
495.4771827	1983	1
175.7152567	1984	1
635.3283565	1985	1
434.3894091	1986	1
418.4213399	1987	1
867.8299995	1988	1
921.9327553	1989	1
704.3979598	1990	1
455.4709878	1991	1
399.6197281	1992	1
753.0953235	1993	1
830.296212	1994	1
450.7280813	1995	1
426.9589781	1996	1
644.4560797	1997	1

```
199.629736	1998	1
93.84972025	1999	1
18.17774475	2000	1
13.52855594	2001	1
9.518229623	2002	1
8.005632828	2003	1
38.17946805	2004	1
5.748690254	2005	1
0.255711987	2006	1
3.842639735	2007	1
1.839040923	2008	1
2.037965884	2009	1
0.569843338	2010	1
0.783928411	2011	1
13.68731875	2012	1

19 # Number of index observations
# Units: 0=numbers,1=biomass,2=F; Errortype: -1=normal,0=lognormal,>0=T
# Fleet Units Errortype
1 1 0 # fleet 1: FISHERY
2 1 0 # fleet 2: SURVEY
3 1 0 # fleet 2: SURVEY
4 1 0 # fleet 2: SURVEY
#_year seas index obs se(log)
1980	1	2	12581.44	0.462964486	#Tri early
1983	1	2	16110.57	0.374595369
1986	1	2	8634.25	0.580113613
1989	1	2	9519.64	.383331259
1992	1	2	9108.24	0.391341879
1995	1	3	3938.93	0.466238502	#Tri late
1998	1	3	2202.63	0.454324983
2001	1	3	1661.22	0.469075594
2004	1	3	4134.65	0.443822656
2003	1	4	50174.25399	0.471483982	#NWFSC
2004	1	4	117780.528	0.588720526
2005	1	4	68461.82512	0.489966596
2006	1	4	43764.76248	0.539389308
2007	1	4	32385.21202	0.534870966
2008	1	4	36878.05159	0.529974414
2009	1	4	49675.6004	0.464195841
2010	1	4	29165.19996	0.418899015
2011	1	4	53769.16783	0.463277617
2012	1	4	41190.7276	0.457001953

0 #_N_fleets_with_discard
0 #_N_discard_obs
0 #_N_meanbodywt_obs
30 #_DF_meanwt
## Population size structure
1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
# binwidth for population size comp
# minimum size in the population (lower edge of first bin and size at age 0.00)
# maximum size in the population (lower edge of last bin)
-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
22 #_N_LengthBins
2	4	6	8	10	12	14	16	18	20	22	24
	26	28	30	32	34	36	38	40 42  44
0 #_N_Length_obs
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
52 #_N_age_bins
1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15	16	17	18	19	20	21	22	23
	24	25	26	27	28	29	30	31	32	33	34
	35	36	37	38	39	40	41	42	43	44	45
	46	47	48	49	50	51	52
0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
```

0 #_combine males into females at or below this bin number
0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data

999 # End data file

Forecast file

#C growth parameters are estimated
1 #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
0 #_Nblock_Patterns
#_Cond 0 #_blocks_per_pattern
0.5 #_fracfemale
0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#_no additional input for selected M option; read 1P per morph
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1 #_Growth_Age_for_L1
999 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=read fec and wt from wtatage.ss
#_placeholder for empirical age-maturity by growth pattern
0 #_First_Mature_Age
1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0 #_hermaphroditism option: 0=none; 1=age-specific fxn
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound check)
#
#_growth_parms
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
0.001 2 0.077 -2.564 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
1 16.50117351 8.250586756 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
1 66.42 33.21 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.05 0.34 0.17 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0 0 0 # CV_young_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0 0 0 # CV_old_Fem_GP_1
0.001 2 0.077 -2.564 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
1 16.50117351 8.23 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
1 66.42 26.98 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.05 0.34 0.2 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0 0 0 # CV_young_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0 0 0 # CV_old_Fem_GP_1
-3 3 8.27E-06 2.44E-06 -1 0.8 -3 0 0 0 0 0 0 0 # Wtlen_1_Fem
-3 4 3.16 3.34694 -1 0.8 -3 0 0 0 0 0 0 0 # Wtlen_2_Fem
1 1000 22 55 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-3 3 -5.01 -0.25 -1 0.8 -3 0 0 0 0 0 0 0 # Mat_slope_Fem
-3 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eggs/kg_inter_Fem
-3 3 0 0 -1 0.8 -3 0 0 0 0 0 0 0 # Eggs/kg_slope_wt_Fem
-3 3 9.10E-06 2.44E-06 -1 0.8 -3 0 0 0 0 0 0 0 # Wtlen_1_Mal
-3 4 3.13 3.34694 -1 0.8 -3 0 0 0 0 0 0 0 # Wtlen_2_Mal

```
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_GP_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Area_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Seas_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	CohortGrowDev
#_seasonal_effects_on_biology_parms
	0	0	0	0	0	0	0	0	0	0
#_Spawner-Recruitment
3	#_SR_function
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE
1 31 12.32 12.32 -1 10 1  # SR_R0
0.25 0.99 0.779	0.779  2 0.152 3 # SR_steep
0	2	0.01	0.8	-1	0.8	-4	#	SR_sigmaR
-5	5	0.1	0	-1	1	-3	#	SR_envlink
-5	5	0	0	-1	1	-4	#	SR_R1_offset
0	0	0	0	-1	0	-99	#	SR_autocorr
0	#_SR_env_link
0	#_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
0	#do_recdev:	0=none;	1=devvector;	2=simple	deviations
2010	#first	year	of	main	recr_devs;
2010	#last	year	of	main	recr_devs;
-2	#_recdev	phase
1	#	(0/1)	to	read	13	advanced	options
0	#_recdev_early_start	(0=none)
-4	#_recdev_early_phase
-1	#_forecast_recruitment		phase
1	#_lambda	for	fore_recr_like		occurring	before	endyr+1
1990	#_last_early_yr_nobias_adj_in_MPD
1999	#_first_yr_fullbias_adj_in_MPD
2000	#_last_yr_fullbias_adj_in_MPD
2010	#_first_recent_yr_nobias_adj_in_MPD
1.0	#_max_bias_adj_in_MPD
-5	#min	rec_dev
5	#max	rec_dev
0	#_read_recdevs
#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
1 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
0.9 # max F or harvest rate, depends on F_Method
# no additional F input needed for Fmethod 1
# if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read
# if Fmethod=3; read N iterations for tuning for Fmethod 3
#4  # N iterations for tuning F in hybrid method (recommend 3 to 7)
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.01 0 99 -1 # InitF_1FISHERY1
#_Q_setup
 # Q_type options:  <0=mirror, 0=median_float, 1=mean_float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk,
5=mean_unbiased_float_assign_to_parm
 #_Den-dep  env-var  extra_se  Q_type
 0 0 0 0 # 1 FISHERY1
 #ADDS EXTRA SD TO SURVEYS
  0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 3 SURVEY2
 0 0 1 0 # 4 SURVEY3
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
 0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
 0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
 0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
#_size_selex_types
#_Pattern Discard Male Special
 1 0 0 0 # 1 FISHERY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY2
```

1 0 0 0 # 2 SURVEY3
#_age_selex_types
#_Pattern ___ Male Special
10 0 0 0 # 1 FISHERY1
10 0 0 0 # 2 SURVEY1
10 0 0 0 # 2 SURVEY2
10 0 0 0 # 2 SURVEY3
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
0 40 22 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
0 60 0.5877124 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
0 40 22 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_2P_1_SURVEY1
0 60 0.5877124 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_2P_2_SURVEY1
0 40 22 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
0 60 0.5877124 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
0 40 22 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_2P_1_SURVEY1
0 60 0.5877124 6 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_2P_2_SURVEY1
Tag loss and Tag reporting parameters go next
0 # TG_custom: 0=no read; 1=read if tags exist
0 #_Variance_adjustments_to_input_values
1 #_maxlambdaphase
1 #_sd_offset
#
0 # number of changes to make to default Lambdas (default value is 1.0)
15=Tag-comp; 16=Tag-negbin
0 # (0/1) read specs for more stddev reporting

999

Starter file

#C starter comment here
SHRP_data.ss
SHRP_control.ss
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
0 # detailed age-structured reports in REPORT.SSO (0,1)
1 # write detailed checkup.sso file (0,1)
4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce
6 # Turn off estimation for parameters entering after this phase
1 # MCeval burn interval
1 # MCeval thin interval
0.1 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
0 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
1 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
3 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates)
0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file

Forecast file

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing

```
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0
#  2010 2010 2010 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013  #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder:  first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2013 # Rebuilder:  year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F:  1=use first-last alloc year; 2=read seas(row) x fleet(col) below
# Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation  (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
# Conditional input if relative F choice = 2
# Fleet relative F:  rows are seasons, columns are fleets
#_Fleet:  FISHERY
#  1
# max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1
# max totalcatch by area (-1 to have no max); must enter value for each fleet
 -1
# fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0
#_Conditional on >1 allocation group
# allocation fraction for each of: 0 allocation groups
# no allocation groups
2 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch:  2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in
SSV3.20)
# Input fixed catch values
#Year Seas Fleet Catch(or_F)
 2013 1 1 5
 2014 1 1 5
999 # verify end of input
```

Appendix A.2. Stripetail rockfish

<u>Data file</u>

```
# Data-mod 2013: STRIPETAIL ROCKFISH
########################################

### Global model specifications ###
1916        # Start year
2012        # End year
1           # Number of seasons/year
12          # Number of months/season
1           # Spawning occurs at beginning of season
1           # Number of fishing fleets
3           # Number of surveys
1           # Number of areas
FISHERY%SURVEY1%SURVEY2%SURVEY3
0.5 0.5 0.5 0.5 # fleet timing_in_season
1 1 1 1     # Area of each fleet
1           # Units for catch by fishing fleet: 1=Biomass(mt),2=Numbers(1000s)
0.01        # SE of log(catch) by fleet for equilibrium and continuous options
2           # Number of genders
```

38 # Number of ages in population dynamics

Catch section
0 # Initial equilibrium catch (landings + discard) by fishing fleet
97 # Number of lines of catch
Catch Year Season

7.847766604	1916	1.0
12.456103 1917	1.0	
12.80956601	1918	1.0
8.266706276	1919	1.0
8.686200835	1920	1.0
7.380551764	1921	1.0
6.789597127	1922	1.0
8.237297266	1923	1.0
8.379348333	1924	1.0
9.514647101	1925	1.0
12.79846827	1926	1.0
10.76536236	1927	1.0
10.55616997	1928	1.0
10.3885941	1929	1.0
11.76471382	1930	1.0
13.58807244	1931	1.0
8.752232386	1932	1.0
7.277342785	1933	1.0
7.324508178	1934	1.0
8.336622036	1935	1.0
5.668170533	1936	1.0
5.512247291	1937	1.0
5.593815678	1938	1.0
6.803469301	1939	1.0
5.749184033	1940	1.0
5.260328601	1941	1.0
2.065642938	1942	1.0
3.337699465	1943	1.0
8.631083629	1944	1.0
19.21718604	1945	1.0
18.56421431	1946	1.0
12.22990543	1947	1.0
13.74930192	1948	1.0
23.25609657	1949	1.0
26.23633748	1950	1.0
33.07604198	1951	1.0
27.38090045	1952	1.0
28.99024601	1953	1.0
38.71015752	1954	1.0
30.0156969	1955	1.0
48.31658404	1956	1.0
31.34772024	1957	1.0
29.8459613	1958	1.0
28.03771825	1959	1.0
25.9885719	1960	1.0
22.61220825	1961	1.0
23.16546876	1962	1.0
21.04204611	1963	1.0
21.63261218	1964	1.0
28.0481662	1965	1.0
96.65922143	1966	1.0
73.82546581	1967	1.0
138.7526111	1968	1.0
44.84362734	1969	1.0
54.67133211	1970	1.0
67.43755787	1971	1.0
86.75330593	1972	1.0
280.6180397	1973	1.0
109.5771777	1974	1.0
138.7935032	1975	1.0
112.3771617	1976	1.0
49.1044079	1977	1.0
25.10433712	1978	1.0
64.29779351	1979	1.0

67.46562469	1980	1.0
35.85402242	1981	1.0
43.14357267	1982	1.0
38.81323472	1983	1.0
32.27999532	1984	1.0
56.54742267	1985	1.0
23.06332257	1986	1.0
32.85374848	1987	1.0
26.67619172	1988	1.0
33.80815411	1989	1.0
40.70539926	1990	1.0
71.05272323	1991	1.0
13.90491292	1992	1.0
58.82190442	1993	1.0
140.6083616	1994	1.0
67.24009485	1995	1.0
26.09522504	1996	1.0
38.04471623	1997	1.0
62.49803068	1998	1.0
33.45080689	1999	1.0
9.046322481	2000	1.0
19.39662938	2001	1.0
6.820115913	2002	1.0
2.91093711	2003	1.0
3.401457207	2004	1.0
6.33403491	2005	1.0
7.256257079	2006	1.0
8.217321325	2007	1.0
8.632931679	2008	1.0
3.186161056	2009	1.0
1.840005234	2010	1.0
3.829829956	2011	1.0
4.447974053	2012	1.0

19 # Number of index observations
Units: 0=numbers,1=biomass,2=F; Errortype: -1=normal,0=lognormal,>0=T
Fleet Units Errortype
1 1 0 # fleet 1: FISHERY
2 1 0 # fleet 2: SURVEY
3 1 0 # fleet 2: SURVEY
4 1 0 # fleet 2: SURVEY
#_year seas index obs se(log)

1980	1	2	33905.75504	0.453700587	#Tri early
1983	1	2	9706.640967	0.356672026	
1986	1	2	17385.84379	0.519155707	
1989	1	2	14952.04043	0.348535244	
1992	1	2	13745.82105	0.425539977	
1995	1	3	26131.66829	0.322089713	#Tri late
1998	1	3	11470.86613	0.348359624	
2001	1	3	14829.49377	0.336314855	
2004	1	3	25580.18414	0.327940167	
2003	1	4	105706.2531	0.481786923	#NWFSC
2004	1	4	20414.05685	0.506490324	
2005	1	4	13061.25477	0.497711948	
2006	1	4	15287.43463	0.960875857	
2007	1	4	10176.49856	0.593407839	
2008	1	4	33992.37007	0.92573315	
2009	1	4	3452.444848	0.619567676	
2010	1	4	3540.323855	0.505577251	
2011	1	4	17191.3474	0.48520558	
2012	1	4	18650.79603	0.553209108	

0 #_N_fleets_with_discard
0 #_N_discard_obs

0 #_N_meanbodywt_obs
30 #_DF_meanwt

Population size structure
1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector

binwidth for population size comp
minimum size in the population (lower edge of first bin and size at age 0.00)
maximum size in the population (lower edge of last bin)
-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
20 #_N_LengthBins
2 4 6 8 10 12 14 16 18 20 22 24
26 28 30 32 34 36 38 40
0 #_N_Length_obs
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
34 #_N_age_bins
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31 32 33 34
0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
0 #_combine males into females at or below this bin number
0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data
999 # End data file

Forecast file

#C growth parameters are estimated
1 #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
0 #_Nblock_Patterns
#_Cond 0 #_blocks_per_pattern
begin and end years of blocks
#
0.5 #_fracfemale
0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#_no additional input for selected M option; read 1P per morph
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1 #_Growth_Age_for_L1
999 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern
1 #_maturity_option: 1=length logistic
4 #_First_Mature_Age
1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0 #_hermaphroditism option: 0=none; 1=age-specific fxn
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm
bounds; 3=standardw/ no bound check)
#
#_growth_parms
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr
dev_stddev Block Block_Fxn
0.001 2 0.121 -2.112 3 0.4 1 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
1 18.94836209 9.474181043 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
1 66.1 33.05 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.05 0.12 0.06 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0
0 0 # CV_young_Fem_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0
0 0 # CV_old_Fem_GP_1
0.001 2 0.121 -2.112 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Mal_GP_1
1 18.94836209 10.37 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Mal_GP_1
1 66.1 17.38 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Mal_GP_1
0.05 0.12 0.019 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Mal_GP_1
0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0
0 0 # CV_young_Mal_GP_1

0.05 0.2 0.1 0.1 -1 0.8 -3 0 0 0 0 0
0 0 # CV_old_Mal_GP_1
-3 3 1.68E-05 2.44E-06 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_1_Fem
-3 4 2.95 3.34694 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_2_Fem
1 1000 17 3 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-30 3 -2.30 -0.25 -1 0.8 -3 0 0 0 0 0
0 0 # Mat_slope_Fem
-3 3 1 1 -1 0.8 -3 0 0 0 0 0
0 0 # Eggs/kg_inter_Fem
-3 3 0 0 -1 0.8 -3 0 0 0 0 0
0 0 # Eggs/kg_slope_wt_Fem
-3 3 2.98E-05 2.44E-06 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_1_Mal
-3 4 2.72 3.34694 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_2_Mal
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_GP_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_Area_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_Seas_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # CohortGrowDev
#
#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0#_Spawner-Recruitment
3 #_SR_function
#_LO HI INIT PRIOR PR_type SD PHASE
1 31 10 2.3 -1 3 1 #-1 10 1 # SR_R0
0.25 0.99 0.4 0.779 2 0.152 3 # SR_steep # SR_steep
0 2 0.01 0.8 -1 0.8 -4 # SR_sigmaR
-5 5 0.1 0 -1 1 -3 # SR_envlink
-5 5 0 0 -1 1 -4 # SR_R1_offset
0 0 0 0 -1 0 -99 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
0 #do_recdev: 0=none; 1=devvector; 2=simple deviations
2012 # first year of main recr_devs
2012 # last year of main recr_devs
-2 #_recdev phase
1 # (0/1) to read 13 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
-1 #_forecast_recruitment
1 #_lambda for fore_recr_like occurring before endyr+1
1990 #_last_early_yr_nobias_adj_in_MPD
1999 #_first_yr_fullbias_adj_in_MPD
2000 #_last_yr_fullbias_adj_in_MPD
2012 #_first_recent_yr_nobias_adj_in_MPD
1.0 #_max_bias_adj_in_MPD
0 #_period of cycles in recruitment (N parms read below)
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
1 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
0.9 # max F or harvest rate, depends on F_Method
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
0 1 0 0.01 0 99 -1 # InitF_1FISHERY1
#_Q_setup
Q_type options: <0=mirror, 0=median_float, 1=mean_float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk, 5=mean_unbiased_float_assign_to_parm
#_Den-dep env-var extra_se Q_type
0 0 0 0 # 1 FISHERY1

```
# ADDS EXTRA SD TO SURVEYS
0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 3 SURVEY2
 0 0 1 0 # 4 SURVEY3
#
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
#_size_selex_types
#_Pattern Discard Male Special
 1 0 0 0 # 1 FISHERY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
#
#_age_selex_types
#_Pattern ___ Male Special
 10 0 0 0 # 1 FISHERY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
 0 40 17 4 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 1.280191 38 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 17 4 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 1.280191 38 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 17 4 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 1.280191 38 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 17 4 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 1.280191 38 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters
#
0 #_Variance_adjustments_to_input_values
1 #_maxlambdaphase
1 #_sd_offset
#
0 # number of changes to make to default Lambdas (default value is 1.0)
0 # (0/1) read specs for more stddev reporting

999
```

Starter file

```
#C starter comment here
STRK_data.ss
STRK_control.ctl
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
0 # detailed age-structured reports in REPORT.SSO (0,1)
1 # write detailed checkup.sso file (0,1)
4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce
6 # Turn off estimation for parameters entering after this phase
1 # MCeval burn interval
1 # MCeval thin interval
0.1 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
```

0 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
1 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
3 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates)
2 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file

Forecast file

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0
2010 2010 2010 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2013 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY
1
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1
max totalcatch by area (-1 to have no max); must enter value for each fleet
 -1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
2 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
#Year Seas Fleet Catch(or_F)
 2013 1 1 3.4
 2014 1 1 3.4
999 # verify end of input

Appendix A.3. Yellowtail rockfish (North of 40° 10′ N. lat.)

Data file

Data-mod 2013: YELLOWTAIL NORTH ROCKFISH

```
#######################################

### Global model specifications ###
1892	# Start year
2012	# End year
1	# Number of seasons/year
12	# Number of months/season
1	# Spawning occurs at beginning of season
1	# Number of fishing fleets
2	# Number of surveys
1	# Number of areas
FISHERY%Triennial%NWFSC
0.5 0.5 0.5 # fleet timing_in_season
1 1 1	# Area of each fleet
1	# Units for catch by fishing fleet: 1=Biomass(mt),2=Numbers(1000s)
0.01	# SE of log(catch) by fleet for equilibrium and continuous options
2	# Number of genders
64	# Number of ages in population dynamics

### Catch section ###
0  # Initial equilibrium catch (landings + discard) by fishing fleet
121 # Number of lines of catch
# Catch Year Season
2.179923641	1892	1.0
2.179923641	1893	1.0
2.179923641	1894	1.0
0.560555063	1895	1.0
0.134944203	1896	1.0
0.137546252	1897	1.0
0.077851691	1898	1.0
0.131677636	1899	1.0
0.185503581	1900	1.0
0.239319989	1901	1.0
0.293145934	1902	1.0
0.346971879	1903	1.0
0.400797824	1904	1.0
0.454614232	1905	1.0
0.508440177	1906	1.0
0.562266122	1907	1.0
0.61608253	1908	1.0
0.669908475	1909	1.0
0.72373442	1910	1.0
0.777560365	1911	1.0
0.831376773	1912	1.0
0.885202718	1913	1.0
0.939028663	1914	1.0
0.992854608	1915	1.0
3.035198871	1916	1.0
5.013428734	1917	1.0
10.2907837	1918	1.0
3.307769605	1919	1.0
4.113251535	1920	1.0
5.592206255	1921	1.0
4.556611093	1922	1.0
2.467933617	1923	1.0
4.333689409	1924	1.0
10.79270794	1925	1.0
10.72067684	1926	1.0
18.97511125	1927	1.0
17.70551093	1928	1.0
26.02660946	1929	1.0
36.91904695	1930	1.0
41.93393506	1931	1.0
27.92354337	1932	1.0
25.96381366	1933	1.0
22.91444839	1934	1.0
34.89300721	1935	1.0
40.0264671	1936	1.0
48.18266148	1937	1.0
55.26373671	1938	1.0
```

62.69846195	1939	1.0
140.3158232	1940	1.0
188.6193066	1941	1.0
341.3979187	1942	1.0
1116.685285	1943	1.0
1936.512538	1944	1.0
3390.804562	1945	1.0
2201.014236	1946	1.0
1208.997327	1947	1.0
1076.03877	1948	1.0
951.8411821	1949	1.0
961.3926344	1950	1.0
855.0280503	1951	1.0
1008.617746	1952	1.0
796.0048183	1953	1.0
1147.37031	1954	1.0
975.5500468	1955	1.0
1475.458455	1956	1.0
1610.51716	1957	1.0
1434.977317	1958	1.0
1588.919666	1959	1.0
1994.718096	1960	1.0
1963.126365	1961	1.0
2447.958202	1962	1.0
1900.84491	1963	1.0
1598.463435	1964	1.0
1573.934988	1965	1.0
4896.570072	1966	1.0
3016.479951	1967	1.0
3321.470042	1968	1.0
3821.105623	1969	1.0
2215.580474	1970	1.0
1674.707728	1971	1.0
2533.196617	1972	1.0
2347.888846	1973	1.0
1702.736483	1974	1.0
1428.225223	1975	1.0
4324.366471	1976	1.0
5086.99836	1977	1.0
8282.488631	1978	1.0
8047.547628	1979	1.0
7889.58503	1980	1.0
9298.114289	1981	1.0
9799.270236	1982	1.0
8931.041533	1983	1.0
5521.196029	1984	1.0
3769.608425	1985	1.0
5397.855277	1986	1.0
5268.109663	1987	1.0
6956.758651	1988	1.0
6181.381485	1989	1.0
5237.915225	1990	1.0
5285.164195	1991	1.0
8376.061302	1992	1.0
7708.453412	1993	1.0
7584.348398	1994	1.0
6857.312783	1995	1.0
8673.571917	1996	1.0
3151.101658	1997	1.0
4214.202876	1998	1.0
4816.414211	1999	1.0
5011.828389	2000	1.0
3387.202805	2001	1.0
2452.138452	2002	1.0
1490.018131	2003	1.0
1750.188782	2004	1.0
966.080702	2005	1.0
510.8182355	2006	1.0
405.3577101	2007	1.0
511.0469504	2008	1.0

817.3896664	2009	1.0
1026.606114	2010	1.0
1456.016121	2011	1.0
1646.362201	2012	1.0

19 # Number of index observations
Units: 0=numbers,1=biomass,2=F; Errortype: -1=normal,0=lognormal,>0=T
Fleet Units Errortype
1 1 0 # fleet 1: FISHERY
2 1 0 # fleet 2: SURVEY
3 1 0 # fleet 2: SURVEY
#_year seas index obs se(log)

1980	1	2	8962.196869	0.334858607	#Tri
1983	1	2	13130.56899	0.191635919	
1986	1	2	9855.239779	0.278644309	
1989	1	2	6539.568103	0.286905232	
1992	1	2	8630.494905	0.2667461	
1995	1	2	2924.167225	0.303715645	
1998	1	2	21151.41523	0.305317909	
2001	1	2	5021.728611	0.319566943	
2004	1	2	17350.23909	0.845518222	
2003	1	3	21205.26474	0.473755244	#NWFSC
2004	1	3	19239.33425	0.552662098	
2005	1	3	23343.35736	0.43220822	
2006	1	3	9036.145701	0.474465699	
2007	1	3	16088.99761	0.435602184	
2008	1	3	14246.9584	0.470159183	
2009	1	3	7320.101698	0.473810099	
2010	1	3	37589.2747	0.417056884	
2011	1	3	25480.36039	0.424339276	
2012	1	3	14678.0086	0.440904381	

0 #_N_fleets_with_discard
0 #_N_discard_obs

0 #_N_meanbodywt_obs
30 #_DF_meanwt

Population size structure
1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
33 #_N_LengthBins

2	4	6	8	10	12	14	16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60	62	64	66	

0 #_N_Length_obs
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
58 #_N_age_bins

1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15	16	17	18	19	20	21	22	23
	24	25	26	27	28	29	30	31	32	33	34
	35	36	37	38	39	40	41	42	43	44	45
	46	47	48	49	50	51	52	53	54	55	56
	57	58									

0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
0 #_combine males into females at or below this bin number
0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data
999 # End data file

Forecast file

```
#C growth parameters are estimated
1  #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
0 #_Nblock_Patterns
0.5 #_fracfemale
0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
  #_no additional input for selected M option; read 1P per morph
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1	#_Growth_Age_for_L1
999	#_Growth_Age_for_L2	(999	to	use	as	Linf)
0	#_SD_add_to_LAA	(set	to	0.1	for	SS2	V1.x	compatibility)
0	#_CV_Growth_Pattern:	0	CV=f(LAA);	1	CV=F(A);	2	SD=F(LAA);
	3	SD=F(A)
1	#_maturity_option:	1=length	logistic;	2=age	logistic;	3=read	age-maturity	matrix	by
	growth_pattern;	4=read	age-fecundity;	5=read	fec	and	wt	from	wtatage.ss
#_placeholder	for	empirical	age-maturity	by	growth	pattern
0	#_First_Mature_Age
1	#_fecundity	option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0	#_hermaphroditism	option:	0=none;	1=age-specific	fxn
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2	#_env/block/dev_adjust_method	(1=standard;	2=logistic	transform	keeps	in	base	parm
	bounds;	3=standard	w/	no	bound	check)
#
#_growth_parms
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-var	use_dev	dev_minyr	dev_maxyr
	dev_stddev	Block	Block_Fxn
0.001 2 0.11 -2.207 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
1 26.87012886 13.43506443 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
1 104.42 52.21 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.05 0.34 0.17 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_young_Fem_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_old_Fem_GP_1
0.001 2 0.11 -2.207 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Mal_GP_1
1 26.87012886 12.51 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Mal_GP_1
1 104.42 47.57 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Mal_GP_1
0.05 0.34 0.19 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Mal_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_young_Mal_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_old_Mal_GP_1
-3	3	1.32E-05	2.44E-06	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_1_Fem
-3	4	3.03	3.34694	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_2_Fem
1 1000 37  9 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-30	3	-0.47	-0.25	-1	0.8	-3	0	0	0	0	0
	0	0	#	Mat_slope_Fem
-3	3	1	1	-1	0.8	-3	0	0	0	0	0
	0	0	#	Eggs/kg_inter_Fem
-3	3	0	0	-1	0.8	-3	0	0	0	0	0
	0	0	#	Eggs/kg_slope_wt_Fem
-3	3	1.24E-05	2.44E-06	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_1_Mal
-3	4	3.06	3.34694	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_2_Mal
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_GP_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Area_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Seas_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	CohortGrowDev
#
#_seasonal_effects_on_biology_parms
	0	0	0	0	0	0	0	0	0	0
#_Spawner-Recruitment
3	#_SR_function
```

```
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE
1 31 12.2 12.2 -1 10 1  # SR_R0
0.25 0.99 0.779	0.779  2 0.152 3 # SR_steep
0	2	0.01	0.8	-1	0.8	-4	#	SR_sigmaR
-5	5	0.1	0	-1	1	-3	#	SR_envlink
-5	5	0	0	-1	1	-4	#	SR_R1_offset
0	0	0	0	-1	0	-99	#	SR_autocorr
0	#_SR_env_link
0	#_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
0	#do_recdev:	0=none;	1=devvector;	2=simple	deviations
2012	#	first	year	of	main	recr_devs
2012	#	last	year	of	main	recr_devs
-2	#_recdev	phase
1	#	(0/1)	to	read	13	advanced	options
0	#_recdev_early_start	(0=none;	neg	value	makes	relative	to	recdev_start)
-4	#_recdev_early_phase
-1	#_forecast_recruitment
1	#_lambda	for	fore_recr_like	occurring	before	endyr+1
1990	#_last_early_yr_nobias_adj_in_MPD
1999	#_first_yr_fullbias_adj_in_MPD
2000	#_last_yr_fullbias_adj_in_MPD
2012	#_first_recent_yr_nobias_adj_in_MPD
1.0	#_max_bias_adj_in_MPD
0	#_period	of	cycles	in	recruitment	(N	parms	read	below)
-5	#min	rec_dev
5	#max	rec_dev
0	#_read_recdevs
#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
1 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
0.9 # max F or harvest rate, depends on F_Method
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.01 0 99 -1 # InitF_1FISHERY1
#_Q_setup
 # Q_type options:  <0=mirror, 0=median_float, 1=mean_float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk,
5=mean_unbiased_float_assign_to_parm
 #_Den-dep  env-var  extra_se  Q_type
 0 0 0 0 # 1 FISHERY1
 0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 2 SURVEY1
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
 0 5 0 0.1 -1 0.1 1
 0 5 0 0.1 -1 0.1 1
#_size_selex_types
#_Pattern Discard Male Special
 1 0 0 0 # 1 FISHERY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
#_age_selex_types
#_Pattern ___ Male Special
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
 0 40 37 10 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 65 6.264764 64 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 37 10 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 65 6.264764 64 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 37 10 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 65 6.264764 64 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
0 # Tagging flag: 0=none,1=read parameters for tagging
### Likelihood related quantities ###
# variance/sample size adjustment by fleet
0 # Do variance adjustments
1	# Max N lambda phases: read this N values for each item below
1	# SD offset (CPUE, discard, mean body weight, recruitment devs): 0=omit log(s) term, 1=include
```

0 # N changes to default Lambdas = 1.0
0 # extra SD pointer
999 # end of control file

Starter file

#C starter comment here
YTRK_N_data.ss
YTRK_N_control.ss
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
0 # detailed age-structured reports in REPORT.SSO (0,1)
1 # write detailed checkup.sso file (0,1)
4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce
6 # Turn off estimation for parameters entering after this phase
1 # MCeval burn interval
1 # MCeval thin interval
0.1 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
0 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
1 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
3 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates)
0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file

Forecast file

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0
2010 2010 2010 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2013 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4

2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY
1
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1
max totalcatch by area (-1 to have no max); must enter value for each fleet
 -1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
2 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
#Year Seas Fleet Catch(or_F)
 2013 1 1 1376.3
 2014 1 1 1376.3
999 # verify end of input

Appendix A.4. English sole

<u>Data file</u>

Data-mod 2013: ENGLISH SOLE
##
Global model specifications
1876 # Start year
2012 # End year
1 # Number of seasons/year
12 # Number of months/season
1 # Spawning occurs at beginning of season
1 # Number of fishing fleets
3 # Number of surveys
1 # Number of areas
FISHERY%SURVEY1%SURVEY2%SURVEY3
0.5417 0.5417 0.5417 0.5417 #fleet timing_in_season
1 1 1 1 # Area of each fleet
1 # Units for catch by fishing fleet: 1=Biomass(mt),2=Numbers(1000s)
0.01 # SE of log(catch) by fleet for equilibrium and continuous options
2 # Number of genders
30 # Number of ages in population dynamics
Catch section
0 # Initial equilibrium catch (landings + discard) by fishing fleet
137 # Number of lines of catch
Catch Year Season
1 1876 1
1 1877 1
1 1878 1
2 1879 1
2 1880 1
2 1881 1
3 1882 1
5 1883 1
5 1884 1
6 1885 1
7 1886 1
8 1887 1
10 1888 1
13 1889 1
15 1890 1
17 1891 1
21 1892 1
25 1893 1
31 1894 1
37 1895 1
43 1896 1

53	1897	1
63	1898	1
75	1899	1
90	1900	1
109	1901	1
130	1902	1
157	1903	1
189	1904	1
226	1905	1
271	1906	1
326	1907	1
391	1908	1
469	1909	1
564	1910	1
677	1911	1
813	1912	1
977	1913	1
1173	1914	1
1409	1915	1
2826	1916	1
3865	1917	1
3132	1918	1
2475	1919	1
1715	1920	1
2184	1921	1
3159	1922	1
3186	1923	1
4110	1924	1
4018	1925	1
3865	1926	1
4690	1927	1
4143	1928	1
4811	1929	1
3732	1930	1
1928	1931	1
3540	1932	1
3346	1933	1
2845	1934	1
3226	1935	1
3404	1936	1
3159	1937	1
2543	1938	1
2991	1939	1
3038	1940	1
2202	1941	1
2064	1942	1
3638	1943	1
2141	1944	1
1887	1945	1
4998	1946	1
3334	1947	1
6030	1948	1
3546	1949	1
5673	1950	1
4189	1951	1
3824	1952	1
2911	1953	1
2623	1954	1
2829	1955	1
3787	1956	1
4436	1957	1
5520	1958	1
5427	1959	1
4338	1960	1
4188	1961	1
4496	1962	1
4489	1963	1
4742	1964	1
5043	1965	1
5522	1966	1

```
5192	1967	1
5468	1968	1
3788	1969	1
3102	1970	1
2851	1971	1
3300	1972	1
3773	1973	1
3858	1974	1
4579	1975	1
5755	1976	1
3735	1977	1
4511	1978	1
4710	1979	1
4143	1980	1
3780	1981	1
3833	1982	1
3091	1983	1
2458	1984	1
2955	1985	1
3153	1986	1
3979	1987	1
3422	1988	1
3780	1989	1
2907	1990	1
3339	1991	1
2556	1992	1
2534	1993	1
1818	1994	1
1762	1995	1
1540	1996	1
1911	1997	1
1441	1998	1
1245	1999	1
1061	2000	1
1363	2001	1
1683	2002	1
1125	2003	1
1218	2004	1
1115	2005	1
1078	2006	1
789.4	2007	1
420.1	2008	1
415.5	2009	1
258.1	2010	1
198.1	2011	1
216.1	2012	1

19 # Number of index observations
# Units: 0=numbers,1=biomass,2=F; Errortype: -1=normal,0=lognormal,>0=T
# Fleet Units Errortype
1 1 0 # fleet 1: FISHERY
2 1 0 # fleet 2: SURVEY
3 1 0 # fleet 2: SURVEY
4 1 0 # fleet 2: SURVEY
#_year seas index obs se(log)
1980	1	2  5068.04	0.191990701	#Tri early
1983	1	2  11352.60	0.5#0.157586493
1986	1	2  14077.63	0.136826903
1989	1	2  13993.23	0.118986159
1992	1	2  12412.52	0.144787134
1995	1	3  15671.87	0.139753547	#Tri late
1998	1	3  20768.12	0.118109976
2001	1	3  26072.37	0.123467305
2004	1	3  44845.17	0.128683219
2003	1	4  47397.74071	0.14066723	#NWFSC
2004	1	4  54628.85833	0.141405536
2005	1	4  40089.20896	0.125322389
2006	1	4  23917.21089	0.138389159
2007	1	4  20615.2281	0.126679898
2008	1	4  18167.64655	0.133558888
```

```
2009	1	4 21878.99142	0.139215613
2010	1	4 20955.23688	0.129787034
2011	1	4 24911.2161	0.129060731
2012	1	4 26682.23605	0.135269391

0 #_N_fleets_with_discard
0 #_N_discard_obs
0 #_N_meanbodywt_obs
30 #_DF_meanwt
## Population size structure
1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
23 #_N_LengthBins
2	4	6	8	10	12	14	16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
0 #_N_Length_obs
27 #_N_age_bins
1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15	16	17	18	19	20	21	22 23 24 25 26 27
0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
0 #_combine males into females at or below this bin number
0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data
999 # End data file
```

Forecast file

```
#C growth parameters are estimated
#_data_and_control_files: simple.dat // simple.ctl
#_SS-V3.10b-safe;_02/24/2010;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMB
1  #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
0 #_Nblock_Patterns
#_Cond 0 #_blocks_per_pattern
# begin and end years of blocks
#
0.5 #_fracfemale
0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
  #_no additional input for selected M option; read 1P per morph
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
2	#_Growth_Age_for_L1
20	#_Growth_Age_for_L2	(999	to	use	as	Linf)
0	#_SD_add_to_LAA	(set	to	0.1	for	SS2	V1.x	compatibility)
0	#_CV_Growth_Pattern
1	#_maturity_option:	1=length	logistic
0	#_First_Mature_Age
1	#_fecundity	option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0	#_hermaphroditism	option:	0=none;	1=age-specific	fxn
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2	#_env/block/dev_adjust_method
#_growth_parms
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-var	use_dev	dev_minyr dev_maxyr
	dev_stddev		Block	Block_Fxn
0.001 2 0.26	-1.347	3	0.4	2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
5	25	17.3386	16.37	0	50	-2	0	0	0	0	0
	0	0	#	L_at_Amin_Fem_GP_1
25	55	40.5617	39.814	0	50	-2 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.01	1.5	0.357007	0.39273	0	50	-2	0	0	0	0	0
	0	0	#	VonBert_K_Fem_GP_1
0.01	0.9	0.102856	0.10145	0	50	-2	0	0	0	0	0
	0	0	#	CV_young_Fem_GP_1
```

0.01 0.9 0.102856 0.10145 0 50 -2 0 0 0 0 0
0 0 # CV_young_Fem_GP_1

0.001 2 0.26 -1.347 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
5 25 17.3386 16.37 0 50 -2 0 0 0 0 0
0 0 # L_at_Amin_Fem_GP_1
25 55 23.9845115903962 39.814 0 50 -2 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.01 1.5 0.480107669127594 0.39273 0 50 -2 0 0 0 0
0 0 0 # VonBert_K_Fem_GP_1
0.01 0.9 0.178 0.10145 0 50 -2 0 0 0 0 0
0 0 # CV_young_Fem_GP_1
0.01 0.9 0.178 0.10145 0 50 -2 0 0 0 0 0
0 0 # CV_young_Fem_GP_1

-3 3 0.00000821 0.00000547424 -1 0.8 -3 0 0 0 0
0 0 0 # Wtlen_1_Fem
-3 4 3.0226 3.03 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_2_Fem
0 50 31 25 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-1 1 -0.6104999 -0.5 -1 0.8 -3 0 0 0 0 0
0 0 # Mat_slope_Fem
-3 3 1 1 -1 0.8 -3 0 0 0 0 0
0 0 # Eggs/kg_inter_Fem
-3 3 0 0 -1 0.8 -3 0 0 0 0 0
0 0 # Eggs/kg_slope_wt_Fem
-3 3 0.00000267 1.55E-05 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_1_Mal
-3 4 3.25 3.03 -1 0.8 -3 0 0 0 0 0
0 0 # Wtlen_2_Mal
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_GP_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_Area_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # RecrDist_Seas_1
0 0 0 0 -1 0 -4 0 0 0 0 0
0 0 # CohortGrowDev
#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0
#_Spawner-Recruitment
3 #_SR_function
#_LO HI INIT PRIOR PR_type SD PHASE
1 31 10 10 -1 10 1 # SR_R0
0.25 0.99 0.85 0.8 0 0.093 3 # SR_steep
0 2 0.01 0.8 -1 0.8 -4 # SR_sigmaR
-5 5 0.1 0 -1 1 -3 # SR_envlink
-5 5 0 0 -1 1 -4 # SR_R1_offset
0 0 0 0 -1 0 -99 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
0 #do_recdev: 0=none; 1=devvector; 2=simple deviations
2010 # first year of main recr_devs
2010 # last year of main recr_devs
-2 #_recdev phase
1 # (0/1) to read 13 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
-1 #_forecast_recruitment
1 #_lambda for fore_recr_like occurring before endyr+1
1990 #_last_early_yr_nobias_adj_in_MPD
1999 #_first_yr_fullbias_adj_in_MPD
2000 #_last_yr_fullbias_adj_in_MPD
2010 #_first_recent_yr_nobias_adj_in_MPD
1.0 #_max_bias_adj_in_MPD
0 #_period of cycles in recruitment (N parms read below)
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#
#Fishing Mortality info

```
0.3 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
1 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
0.9 # max F or harvest rate, depends on F_Method
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.01 0 99 -1 # InitF_1FISHERY1
#_Q_setup
 # A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk); E:0=num/1=bio/2=F, F:-
1=norm/0=lognorm/>0=T
 #_A  B  C  D  E  F
 0 0 0 0 # 1 FISHERY1
 0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 2 SURVEY1
#
#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
0 1000 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 1000 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 1000 0.01 0.01 0 99 1 # InitF_1FISHERY1
#_size_selex_types
#_Pattern Discard Male Special
 1 0 0 0 # 1 FISHERY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
#
#_age_selex_types
#_Pattern ___ Male Special
 10 0 0 0 # 1 FISHERY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
 0 40 31 83 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 80 4.822997 30 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 31 83 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 80 4.822997 30 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 31 83 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 80 4.822997 30 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 31 83 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 80 4.822997 30 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters
#
0 #_Variance_adjustments_to_input_values
1 #_maxlambdaphase
1 #_sd_offset
0 # number of changes to make to default Lambdas (default value is 1.0)
0 # (0/1) read specs for more stddev reporting
999
```

Starter file

```
ENGL_data.ss #_datfile
ENGL_control.ss #_datfile
#control_modified.ss #_ctlfile
0 #_init_values_src
0 #_run_display_detail
0 #_detailed_age_structure
1 #_checkup
4 #_parmtrace
1 #_cumreport
1 #_prior_like
1 #_soft_bounds
1 #_N_bootstraps
6 #_last_estimation_phase
```

1 #_MCMCburn
1 #_MCMCthin
0.5 #_jitter_fraction
-1 #_minyr_sdreport
-2 #_maxyr_sdreport
0 #_N_STD_yrs
1e-04 #_converge_criterion
0 #_retro_yr
0 #_min_age_summary_bio
1 #_depl_basis
1 #_depl_denom_frac
1 #_SPR_basis
3 #_F_report_units
0 #_F_report_basis
#
999

Forecast file

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.25 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0
2010 2010 2010 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.25 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0.05 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2013 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY
1
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1
max totalcatch by area (-1 to have no max); must enter value for each fleet
 -1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
2 # Number of forecast catch levels to input (else calc catch from forecast F)
3 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
#Year Seas Fleet Catch(or_F)

```
 2013 1 1 224.1
 2014 1 1 224.1
999 # verify end of input
```

Appendix A.5. Rex sole

Data file

```
# Data-mod 2013: REX SOLE
########################################
### Global model specifications ###
1896        # Start year
2012        # End year
1           # Number of seasons/year
12          # Number of months/season
1           # Spawning occurs at beginning of season
1           # Number of fishing fleets
3           # Number of surveys
1           # Number of areas
FISHERY%SURVEY1%SURVEY2%SURVEY3
0.5 0.5 0.5 0.5 # fleet timing_in_season
1 1 1 1     # Area of each fleet
1           # Units for catch by fishing fleet: 1=Biomass(mt),2=Numbers(1000s)
0.01        # SE of log(catch) by fleet for equilibrium and continuous options
2           # Number of genders
24          # Number of ages in population dynamics
### Catch section ###
0  # Initial equilibrium catch (landings + discard) by fishing fleet
117 # Number of lines of catch
# Catch Year Season
1.20226E-05     1896    1.0
9.84327E-06     1897    1.0
7.66395E-06     1898    1.0
7.48234E-06     1899    1.0
7.26441E-06     1900    1.0
7.04648E-06     1901    1.0
6.82854E-06     1902    1.0
6.64693E-06     1903    1.0
6.429E-06 1904  1.0
6.21107E-06     1905    1.0
6.02946E-06     1906    1.0
5.81153E-06     1907    1.0
5.59359E-06     1908    1.0
5.41198E-06     1909    1.0
5.19405E-06     1910    1.0
4.97612E-06     1911    1.0
4.75819E-06     1912    1.0
4.57658E-06     1913    1.0
4.35865E-06     1914    1.0
4.14071E-06     1915    1.0
222.3095338     1916    1.0
302.8494836     1917    1.0
243.8417739     1918    1.0
191.8282666     1919    1.0
132.6028339     1920    1.0
169.004121      1921    1.0
244.3819692     1922    1.0
245.8634922     1923    1.0
306.5593447     1924    1.0
304.0328546     1925    1.0
300.1237275     1926    1.0
363.6154202     1927    1.0
356.7438399     1928    1.0
406.1886006     1929    1.0
379.0328902     1930    1.0
565.5680523     1931    1.0
378.7124472     1932    1.0
360.559652      1933    1.0
455.5334189     1934    1.0
430.1111819     1935    1.0
```

352.2289606	1936	1.0
314.2258872	1937	1.0
380.8249887	1938	1.0
476.0327907	1939	1.0
443.0165853	1940	1.0
299.4103347	1941	1.0
275.0303918	1942	1.0
715.1835957	1943	1.0
381.5808978	1944	1.0
349.1692147	1945	1.0
432.3854738	1946	1.0
619.6672894	1947	1.0
852.1710575	1948	1.0
967.4833747	1949	1.0
922.873363	1950	1.0
973.3426284	1951	1.0
1131.249766	1952	1.0
1429.236831	1953	1.0
1507.991395	1954	1.0
1979.550307	1955	1.0
2359.997146	1956	1.0
2137.397943	1957	1.0
2186.189357	1958	1.0
2032.989914	1959	1.0
1927.010355	1960	1.0
2001.876203	1961	1.0
2283.597107	1962	1.0
2490.741963	1963	1.0
1866.009864	1964	1.0
1801.201188	1965	1.0
2247.325095	1966	1.0
2240.099281	1967	1.0
2090.948768	1968	1.0
2422.36446	1969	1.0
1953.035886	1970	1.0
1582.710657	1971	1.0
1974.162849	1972	1.0
1928.451149	1973	1.0
1922.1665 1974	1.0	
1889.441009	1975	1.0
2125.617299	1976	1.0
1764.262976	1977	1.0
2090.591507	1978	1.0
2672.991997	1979	1.0
2074.65492	1980	1.0
2033.254495	1981	1.0
2287.0123 1982	1.0	
1898.047856	1983	1.0
1653.895329	1984	1.0
1838.105687	1985	1.0
1541.98092	1986	1.0
1526.248494	1987	1.0
1601.677446	1988	1.0
1441.016376	1989	1.0
1110.727732	1990	1.0
1447.342473	1991	1.0
1078.800383	1992	1.0
959.4598536	1993	1.0
1019.190828	1994	1.0
1111.80479	1995	1.0
1014.669843	1996	1.0
962.7805367	1997	1.0
746.6730947	1998	1.0
687.0644075	1999	1.0
626.7292151	2000	1.0
661.5025393	2001	1.0
687.7850328	2002	1.0
675.132215	2003	1.0
611.5029021	2004	1.0
661.5796157	2005	1.0

622.2913507	2006	1.0
623.0496337	2007	1.0
594.6041304	2008	1.0
609.323799	2009	1.0
514.7659745	2010	1.0
426.9124154	2011	1.0
422.4483261	2012	1.0

19 # Number of index observations
Units: 0=numbers,1=biomass,2=F; Errortype: -1=normal,0=lognormal,>0=T
Fleet Units Errortype
1 1 0 # fleet 1: FISHERY
2 1 0 # fleet 2: SURVEY
3 1 0 # fleet 2: SURVEY
4 1 0 # fleet 2: SURVEY
#_year seas index obs se(log)

1980	1	2	8036	0.197304579	#Tri early
1983	1	2	17104	0.157484028	
1986	1	2	19087	0.276605599	
1989	1	2	20178	0.112400015	
1992	1	2	20256	0.113477226	
1995	1	3	18457.53	0.080186251	#Tri late
1998	1	3	28192.95	0.085829686	
2001	1	3	33262.61	0.070906238	
2004	1	3	59170.60	0.083261572	
2003	1	4	20811.0959	0.487843303	#NWFSC
2004	1	4	17199.64322	0.551739012	
2005	1	4	25790.92561	0.506118486	
2006	1	4	14262.68498	0.521127893	
2007	1	4	12291.88076	0.481111835	
2008	1	4	19095.92227	0.450884687	
2009	1	4	19267.05323	0.509892141	
2010	1	4	9613.628482	0.486724234	
2011	1	4	12606.99044	0.463680605	
2012	1	4	17028.72667	0.530939981	

0 #_N_fleets_with_discard
0 #_N_discard_obs
0 #_N_meanbodywt_obs
30 #_DF_meanwt
Population size structure
1 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
30 #_N_LengthBins

2	4	6	8	10	12	14	16	18	20	22	24
	26	28	30	32	34	36	38	40	42	44	46
	48	50	52	54	56	58	60				

0 #_N_Length_obs
#Yr Seas Flt/Svy Gender Part Nsamp datavector(female-male)
22 #_N_age_bins

1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15	16	17	18	19	20	21	22	

0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
0 #_combine males into females at or below this bin number
0 #_N_MeanSize-at-Age_obs
0 #_N_environ_variables
0 #_N_environ_obs
0 # N sizefreq methods to read
0 # no tag data
0 # no morphcomp data
999 # End data file

Control file

#C growth parameters are estimated
1 #_N_Growth_Patterns

```
1 #_N_Morphs_Within_GrowthPattern
0 #_Nblock_Patterns
0.5 #_fracfemale
0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1	#_Growth_Age_for_L1
999	#_Growth_Age_for_L2	(999	to	use	as	Linf)
0	#_SD_add_to_LAA	(set	to	0.1	for	SS2	V1.x	compatibility)
0	#_CV_Growth_Pattern
1	#_maturity_option:	1=length	logistic
0	#_First_Mature_Age
1	#_fecundity	option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0	#_hermaphroditism	option:	0=none;	1=age-specific	fxn
1	#_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2	#_env/block/dev_adjust_method
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-var	use_dev	dev_minyr	dev_maxyr
	dev_stddev	Block	Block_Fxn
0.001 2 0.2 -1.609 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Fem_GP_1
1 26.89759161 13.4487958 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Fem_GP_1
1 83.64 41.82 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Fem_GP_1
0.05 0.776 0.39 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Fem_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_young_Fem_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_old_Fem_GP_1
0.001 2 0.2 -1.609 3 0.4 2 0 0 0 0 0 0 0 # NatM_p_1_Mal_GP_1
1 26.89759161 13.4487958 36 -1 10 -2 0 0 0 0 0 0 0 # L_at_Amin_Mal_GP_1
1 83.64 41.82 70 -1 10 -4 0 0 0 0 0 0 0 # L_at_Amax_Mal_GP_1
0.05 0.776 0.39 0.15 -1 0.8 -4 0 0 0 0 0 0 0 # VonBert_K_Mal_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_young_Mal_GP_1
0.05	0.2	0.1	0.1	-1	0.8	-3	0	0	0	0	0
	0	0	#	CV_old_Mal_GP_1
-3	3	3.02E-06	2.44E-06	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_1_Fem
-3	4	3.21	3.34694	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_2_Fem
1 1000 35.17 55 -1 0.8 -3 0 0 0 0 0 0 0 # Mat50%_Fem
-30	3	-0.392	-0.25	-1	0.8	-3	0	0	0	0	0
	0	0	#	Mat_slope_Fem
-3	3	1	1	-1	0.8	-3	0	0	0	0	0
	0	0	#	Eggs/kg_inter_Fem
-3	3	0	0	-1	0.8	-3	0	0	0	0	0
	0	0	#	Eggs/kg_slope_wt_Fem
-3	3	2.67E-06	2.44E-06	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_1_Mal
-3	4	3.25	3.34694	-1	0.8	-3	0	0	0	0	0
	0	0	#	Wtlen_2_Mal
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_GP_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Area_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	RecrDist_Seas_1
0	0	0	0	-1	0	-4	0	0	0	0	0
	0	0	#	CohortGrowDev
#_seasonal_effects_on_biology_parms
	0	0	0	0	0	0	0	0	0	0
	#_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
3	#_SR_function
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE
1 31 11.1 11 -1 10 3  # SR_R0
0.25 0.99 0.85 0.8  0 0.093 3 # SR_steep
0	2	0.01	0.8	-1	0.8	-4	#	SR_sigmaR
-5	5	0.1	0	-1	1	-3	#	SR_envlink
-5	5	0	0	-1	1	-4	#	SR_R1_offset
0	0	0	0	-1	0	-99	#	SR_autocorr
0	#_SR_env_link
0	#_SR_env_target_0=none;1=devs;_2=R0;_3=steepness
0	#do_recdev:	0=none;	1=devvector;	2=simple	deviations
```

```
2010 # first year of main recr_devs
2010 # last year of main recr_devs
-2 #_recdev phase
1 # (0/1) to read 13 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
1 #_forecast_recruitment
1 #_lambda for fore_recr_like occurring before endyr+1
1990 #_last_early_yr_nobias_adj_in_MPD
1999 #_first_yr_fullbias_adj_in_MPD
2000 #_last_yr_fullbias_adj_in_MPD
2010 #_first_recent_yr_nobias_adj_in_MPD
1.0 #_max_bias_adj_in_MPD
-5 #min rec_dev
5 #max rec_dev
0 #_read_recdevs
#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2001 # F ballpark year (neg value to disable)
1 # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
0.9 # max F or harvest rate, depends on F_Method
# no additional F input needed for Fmethod 1
# if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read
# if Fmethod=3; read N iterations for tuning for Fmethod 3
#4  # N iterations for tuning F in hybrid method (recommend 3 to 7)
#
#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
 0 1 0 0.01 0 99 -1 # InitF_1FISHERY1
#
#_Q_setup
 # Q_type options:  <0=mirror, 0=median_float, 1=mean_float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk,
5=mean_unbiased_float_assign_to_parm
 #_Den-dep  env-var  extra_se  Q_type
 0 0 0 0 # 1 FISHERY1
 0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 2 SURVEY1
 0 0 1 0 # 2 SURVEY1

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
0 5 0.01 0.01 0 99 1 # InitF_1FISHERY1
#_size_selex_types
#_Pattern Discard Male Special
 1 0 0 0 # 1 FISHERY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1
 1 0 0 0 # 2 SURVEY1

#_age_selex_types
#_Pattern ___ Male Special
 10 0 0 0 # 1 FISHERY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
 10 0 0 0 # 2 SURVEY1
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
 0 40 35.17 5 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 7.511324 24 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 35.17 5 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 7.511324 24 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 35.17 5 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 7.511324 24 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
 0 40 35.17 5 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_1_FISHERY1
 0 40 7.511324 24 -1 99 -1 0 0 0 0 0 0 0 # AgeSel_1P_2_FISHERY1
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
0 #_Variance_adjustments_to_input_values
```

1 #_maxlambdaphase
1 #_sd_offset
#
0 # number of changes to make to default Lambdas (default value is 1.0)
999

Starter file

REX_data.ss
REX_control.ss
0 # 0=use init values in control file; 1=use ss3.par
0 # run display detail (0,1,2)
0 # detailed age-structured reports in REPORT.SSO (0,1)
1 # write detailed checkup.sso file (0,1)
4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
1 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce
6 # Turn off estimation for parameters entering after this phase
1 # MCeval burn interval
1 # MCeval thin interval
0.5 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
0 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
1 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
3 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates)
0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file

Forecast file

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.25 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0 0 0
2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.2 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0
2010 2010 2010 2010 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.25 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
0.05 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2013 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2013 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4

```
2 # basis for fcast catch tuning and for fcast catch caps and allocation  (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
# Conditional input if relative F choice = 2
# Fleet relative F:  rows are seasons, columns are fleets
#_Fleet:  FISHERY
#  1
# max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1
# max totalcatch by area (-1 to have no max); must enter value for each fleet
 -1
# fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0
#_Conditional on >1 allocation group
# allocation fraction for each of: 0 allocation groups
# no allocation groups
2 # Number of forecast catch levels to input (else calc catch from forecast F)
3 # basis for input Fcast catch:  2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in
SSV3.20)
# Input fixed catch values
#Year Seas Fleet Catch(or_F)
 2013 1 1 454.7
 2014 1 1 454.7
999 # verify end of input
```

Appendix B. Partitioning OFLs for brown and copper rockfish

During the STAR Panel, the STAT presented regional models for brown rockfish and copper rockfish (north and south of Point Conception). The Panel recommended that the OFL for brown rockfish be based on the coast-wide model, partitioned into areas north and south of Point Conception based on the regional models. The Panel considered the regional models for copper rockfish to be adequate for OFL determination. However, the assessments for brown rockfish (coast-wide) and copper rockfish (north of Point Conception, CA) span the boundary between the PFMC's northern and southern rockfish complexes (40° 10′ N. latitude, roughly near Cape Mendocino). This appendix describes possible methods to partition the OFL estimate into northern and southern components.

When regional assessments are not available, partitioning of OFLs would ideally involve taking the product of density and habitat area to arrive at an estimate of abundance (or relative abundance) in each management area. The STAT considered using estimates of habitat area derived from recreational catch observations (see section 2.1.6.2), combined with a proxy for density (CPUE) derived from recreational catch data. In the end, this approach was not possible for copper rockfish because the STAT did not have CPUE and habitat information off Washington, which is needed to create a complete estimate of relative abundance north of Cape Mendocino. The density of brown rockfish in Washington is effectively zero, but catch rates north of Cape Mendocino are so low that an analysis based on detailed habitat area estimates and catch rates is unlikely to differ significantly from a simpler, catch-based approach.

Appendix B.1. Brown rockfish

To partition the OFL for brown rockfish, we used regional assessments to estimate median vulnerable biomass levels in 2015 assuming recent average catch in 2013-14. Vulnerable biomass estimates in 2015 were 381.6 mt south of Point Conception and 1082.3 mt north of Point Conception. Approximately 26.1% (381.6 / (381.6+1082.3)) of coast-wide brown rockfish biomass in 2013 is south of Point Conception. Dick and MacCall (2010, their Table 65) developed a catch-based allocation of OFL, finding that 2.6% of coast-wide brown rockfish biomass is north of Cape Mendocino. The remaining percentage (biomass in central California) is therefore 71.3% of coast-wide biomass. Applying these percentages to the median OFL in 2015 from the coast-wide brown rockfish assessment (171.7 mt) provides regional estimates of OFL (Table B1).

Table B1. Brown rockfish OFLs for 2015, by region

	% of coast-wide OFL	OFL (mt)
Southern CA	26.1%	44.8
Central CA	71.3%	122.4
South of 40° 10′ N. latitude (South + Central)	97.4%	167.2
North of 40° 10′ N. latitude	2.6%	4.5

Appendix B.2. Copper rockfish

We present three alternative methods for partitioning OFLs for copper rockfish. First, we apply a similar method to that used for brown rockfish (above), but based on regional model OFLs (per the STAR Panel's recommendation). We estimated median vulnerable biomass levels in 2015 assuming recent average catch in 2013-14. Vulnerable biomass estimates in 2015 were 1735.7 mt south of Point Conception and 1677.6 mt north of Point Conception. Approximately 50.9% (1735.7 / (1735.7+1677.6)) of coast-wide copper rockfish biomass in 2013 is south of Point Conception. The large fraction of biomass estimated for southern California is influenced by the recent increases in biomass in that area, relative to the central/northern stock. Dick and MacCall (2010, their Table 65) developed a catch-based allocation of OFL, finding that 15.5% of coast-wide copper rockfish biomass is north of Cape Mendocino. The remaining percentage (biomass in central California) is therefore 33.6% of coast-wide biomass. Using the percentages for central California (33.6%) and the area north of Cape Mendocino (15.5%), we estimate that 31.6% (15.5 / (15.5+33.6)) of the central/northern copper rockfish OFL estimate for 2015 should be allocated north of Cape Mendocino (Table B2).

Table B2. Copper rockfish OFLs ,by region, using catch-based allocation method

	Source	OFL (mt)
South of Conception	model median estimate	154.0
North of Conception	model median estimate	148.9
Coastwide	(sum of regional models)	302.9
North of 40° 10′ N. latitude	Northern OFL * 0.316	47.1
South of 40° 10′ N. latitude	302.9 – 47.1	255.8

Partioning copper rockfish OFL north of Point Conception based on regional models
Unlike brown rockfish, indices for the area north of Cape Mendocino are available for copper rockfish. We also have an estimate of OFL for the area south of Point Conception from the regional base model. As alternative sources of information about relative biomass north and south of 40° 10′ N. latitude, we ran models for the area north of Point Conception based on two scenarios:

1. Include all indices from the base model (north of Point Conception)
    a. Using catches north of Cape Mendocino
    b. Using catches between Point Conception and Cape Mendocino
2. Run separate models for central and northern regions
    a. Indices and catch from area north of Cape Mendocino
    b. Indices and catch from area between Point Conception and Cape Mendocino

The first scenario assumes that information about trends in abundance is the same as the base model, but allows exploitation rates to differ by region. The second scenario is essentially independent assessments of the central and northern areas, allowing both trend information and exploitation patterns to differ between central California and the area north of Cape Mendocino.

Models based on regional catch histories that include all indices north of Point Conception (methods 2 and 2a in Table B3) allocate more yield to the central region relative to results from the catch-based allocation (method 1 in Table B3). Total yield is very similar to the base model (149.6 mt versus 148.9 mt).

Independent assessments (using regional catches and indices) suggest that the exploitation history for copper rockfish north of Cape Mendocino is similar to China rockfish in the same region (Figure B1). This approach (methods 3 and 3a, Table B3) suggests allocating a smaller fraction of the OFL to the region north of Cape Mendocino.

Table B3. Comparison of alternative OFL allocation methods for copper rockfish. The OFL contribution south of Point Conception is not included, as this is accounted for in the southern base model.

Method Number	Method Description	Central Biomass	Central OFL	North Biomass	North OFL	Total Biomass	Total OFL
1	Base Model, Catch Allocation	1147.5	101.8	530.1	47.1	1677.6	148.9
2	Regional Catch, All Indices	1538	120.1	189	29.5	1727	149.6
3	Regional Catch, Regional Indices	1494.7	120.3	124.9	9.4	1619.6	129.7
2a	Same as (2), rescaled to base OFL	--	119.5	--	29.4	--	148.9
3a	Same as (3), rescaled to base OFL	--	138.1	--	10.8	--	148.9

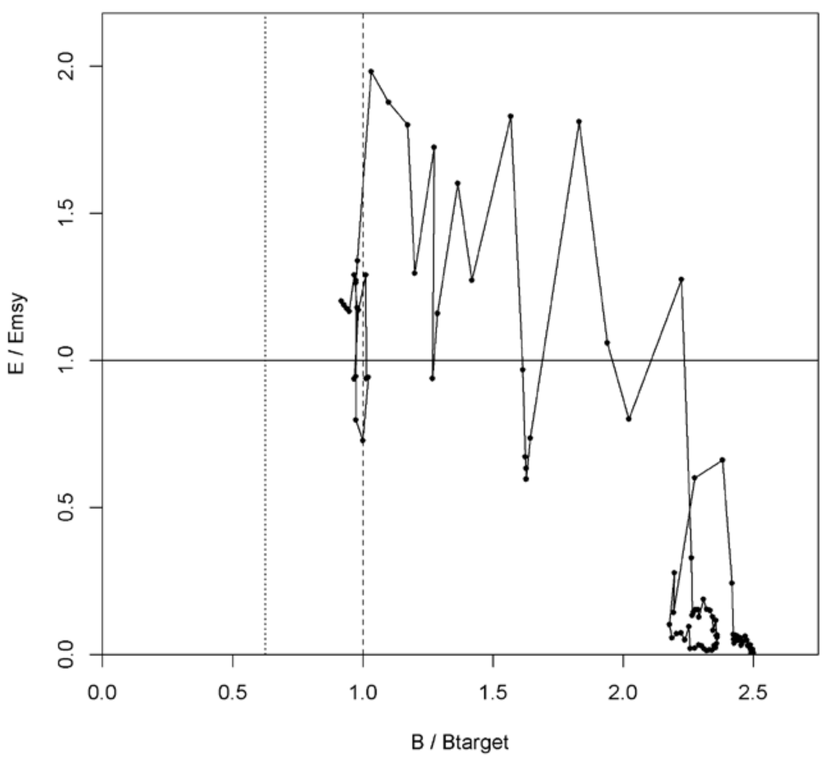


Figure B1. Trends in relative exploitation rate and relative biomass estimated from a regional assessment of copper rockfish, north of Cape Mendocino. The pattern is similar to the northern base model for China rockfish.

Agenda Item F.5.a
Attachment 2
June 2013

Pacific Coast Groundfish Stock Assessment Review (STAR) Panel Report

For Data-Moderate Assessments

April 22-26, 2013
NMFS, Southwest Fisheries Science Center
110 Shaffer Road
Santa Cruz, CA 95060

Methodology Review Panel Members:
Martin Dorn (Chair), Scientific and Statistical Committee (SSC), NMFS, AFSC
Vivian Haist, Center for Independent Experts
Selina Heppell, SSC, Oregon State University
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1. OVERVIEW

A review of data-moderate assessments was conducted by a STAR Review Panel (Panel) at the Southwest Fisheries Science Center, Santa Cruz Laboratory, during 22-26 April 2013. The review panel consisted of three SSC members and two CIE reviewers, and was advised by representatives from the GAP, the GMT and Council staff. The Panel followed the Terms of Reference for the Groundfish and CPS Stock Assessment and Review Process (November 2012). Dr. John Field welcomed the participants on behalf of the Southwest Fisheries Science Center. Dr. Martin Dorn, the Panel chair, reviewed the terms of reference, and clarified the role of STAR panel members, advisors to STAR panel, and the STAT. The Panel was provided extensive background material, including a number of primary documents, through an FTP site, two weeks prior to the review meeting. The STAT gave a number of presentations to the Panel during the meeting, and responded to Panel requests for additional information.

This was the first STAR panel of data-moderate assessments organized by the Pacific Fishery Management Council (PFMC). An overview by Dr. James Hastie described the historical development of the data-moderate assessment methods as a management tool. The need for robust assessment methods that are intermediate between catch-only methods and full age-structured models (e.g., Stock Synthesis) has been recognized for some time. The first workshop that considered data-moderate methods (along with data-poor methods) was held in April 2011. None of the proposed data-moderate methods were endorsed, because they were not sufficiently developed at that time to be used to provide management advice. In June 2012, a methodology review panel was held to review further progress on developing data-moderate assessments suitable for stocks with the exploitation history and biological characteristics of those managed by the PFMC. The 2012 Panel concluded that two data-moderate assessment methods, XDB-SRA (Extended Depletion-Based Stock Reduction Analysis) and exSSS (Extended Simple Stock Synthesis), were sufficiently well developed to form the basis for data-moderate assessments in the next assessment cycle. A comparison of data-moderate assessments results with outputs from full assessments suggested that data-moderate methods can provide improved results over data-poor approaches, such as DB-SRA and SSS.

The STAT provided a draft document with data-moderate assessments for nine stocks. The stocks included a group of nearshore rockfish, including brown rockfish, china rockfish, copper rockfish, and vermillion rockfish, and a shelf-slope group, including English sole, rex sole, sharpchin rockfish, yellowtail rockfish, and stripetail rockfish. Two of these stocks, English sole and yellowtail rockfish, had been previously assessed with full assessments, but the assessments were considered no longer current under NMFS guidelines. Given limited capacity to conduct and review full assessments, it was considered unlikely that these stocks would be prioritized for full assessment in the immediate future. The selection of stocks was guided by several principles, including likelihood of a successful assessment based on an initial evaluation of data availability, and the intent to look at different stocks with different data sets available for assessment in this first data-moderate review panel to explore the utility of the approach.

The first major task of the Panel was to review the data inputs for the assessments. For data-moderate assessments, data inputs consist only of historical catches and abundance indices. Methods to derive historical catches were similar to those used previously for data-poor assessments. While historical catch reconstructions have been used extensively, the Panel notes that historical catch estimates are highly uncertain, and there has been regrettably little effort to evaluate the magnitude of that uncertainty. Catch reconstructions for both commercial and recreational fisheries have also not been completed for all states. Consequently it was difficult for this Panel to evaluate the effects of uncertainty in catch reconstruction on assessment results. This concern applies to all assessments that use these data, but is particularly acute for data-poor and data-moderate approaches in which historical catch is a major determinant of assessment results.

Two types of abundance trend indices were used for data-moderate assessments: fishery independent indices from trawl surveys, and fishery dependent indices based on catch per unit effort (CPUE) in the recreational fishery. In March 2013, the Scientific and Statistical Committee reviewed methods for developing abundance indices for data-moderate assessments, endorsed some methods and made recommendations for improvement. Generalized Linear Mixed Models (GLMM) were used with the trawl survey data to obtain an abundance index. Initial GLMM runs included an extreme catch event (ECE) component to the model. The STAT noted there were no suitable model selection criteria for use to evaluate the benefits of including the ECE component in a GLMM model, beyond visual interpretation of model residuals. The Panel was concerned about this lack of model selection criteria, and the introduction of a new feature without a greater understanding of how to identify when it should be implemented, and consequently recommended that the GLMM models exclude the ECE component.

The Panel also reevaluated the now-standard approach of splitting the triennial time series into early and late periods. The issue is particularly important for data-moderate assessments because indices are the only source of information on stock trends in the assessment. Adding a break greatly reduces the inferences that can be made about long-term trends in abundance. After evaluating model fits with and without the triennial break, the Panel recommended base models that included the split in the triennial survey for English sole, rex sole, and sharpchin rockfish, a base model with a single triennial time series for yellowtail rockfish.

The STAT applied the same approach used previously to construct the RecFIN trip-based CPUE indices by filtering trips using the Stephens-MacCall (2004) method, followed by the use of a delta-GLM analysis. The Panel endorsed this approach. The Panel reviewed and approved an index derived from an expanded (both spatially and temporally) CPFV data set obtained by combining historical CDFW observer CPFV data with more recent data from ongoing CDFW and ODFW observer programs, and data from a CalPoly sampling program. The Panel recommends continuation of efforts to obtain drift-specific data from the earlier California program to allow easier merging of data sets, and exploring improved methods of filtering data using habitat maps.

The Panel developed and applied a standard set of criteria for deciding whether the assessment should be considered acceptable. Generally these criteria pertain to model convergence, goodness of fit, sensitivity to assumptions, plausibility of parameter estimates, and whether the prior is updated as expected given the model inputs (see table below). For the nearshore group, the Panel evaluated both coast-wide assessments and split-area assessments. The Panel considered split-area models to be the most appropriate for nearshore species when acceptable split-area models could be developed because of the greater likelihood that these stocks would exhibit local-scale population dynamics.

The STAT provided results for most stocks for both XDB-SRA and exSSS with several algorithms (MCMC, SIR, AIS) for sampling from the joint posterior distribution. In general, results for the two methods were similar, but not identical. This is not surprising given that the methods differ in terms of population dynamics as well as how priors for stock productivity are specified, and given the uncertainty associated with the outputs from both assessment methods. The Panel made some progress in comparing the two approaches, but ultimately was unable to develop criteria to identify a preferred method for a particular stock. For pragmatic reasons, the Panel adopted a suggestion by the STAT to focus only on XDB-SRA model runs for the nearshore group, and on exSSS model runs for the shelf-slope group.

For the nearshore group, the Panel recommended a coastwide base model for brown rockfish, and split-area base models for china and copper rockfish. For the shelf group, the Panel recommended base models for English sole, rex sole, yellowtail rockfish, and sharpchin rockfish. For stripetail rockfish, the Panel concluded that the stock was above the $B_{40\%}$ target level, but did not endorse a base model for setting the OFL.

Due to a lack of time the Panel was unable to review the draft assessments of vermillion rockfish and yellowtail rockfish south of Cape Mendocino, and cannot make recommendations regarding their use for Council decision-making.

The Chair thanked the SWFSC for hosting the meeting, acknowledged the assistance of SWFSC in providing a meeting room and helping with meeting logistics, and thanked the participants for spirited discussions and a constructive atmosphere during the review, the results of which should help inform the Council and its advisory bodies determine the best available science for the assessment of groundfish.

2. Data Inputs

2.1 Catch data

The catch time-series for the nine species were constructed in essentially the same manner as was the case when DB-SRA was applied during the 2011 assessment cycle to calculate OFLs for Category 3 species. PacFIN was used to determine the commercial landings north of Cape Mendocino for 1981-2012 while CalCOM was used to determine commercial landings to the south of this for 1969-2012. The catches north and south of Point Conception were based on splitting catches by port between Santa Barbara and Morro Bay. The recent (1980-89; 1993-2012) recreational catches were taken from RecFIN (type A+B1). It was noted that recreational catches for Oregon and Washington in RecFIN are based on State sampling programs. However, it was not clear to the Panel whether some of the earlier catches for Oregon (pre-mid-1990s) were still based on using the results from telephone surveys to determine effort. The historical foreign catches were based on the reconstruction by Jean Rogers, while bycatch in the at-sea whiting fishery was extracted from NORPAC (1992-2012). The pre-1969 commercial and pre-1980 recreational catches off California were based on the reconstruction by Ralston *et al*. (2010), while the pre-1981 commercial catches off Oregon were based on the unpublished reconstruction by V. Gertseva. A variety of data sources (e.g., Tagart [1985], the PMFC data series, and the Pacific Fisherman Yearbooks) were used to reconstruct the Washington landings. The discards in the commercial fishery were based on WGCOP and (where available) data from the Pikitch discard study. E.J. Dick noted that removals (including discards) for English sole were taken from the last assessment update.

The Panel noted that the approach used to construct the historical removals was the best available. However, the historical catches, in common with those for most other Council-managed groundfish, are subject to considerable uncertainty. The uncertainty regarding species compositions was noted as a particularly pervasive problem. The Panel noted that the impact of this uncertainty could be addressed in the future with sensitivity tests and/or by adding errors to catches when applying exDB-SRA and exSSS (see Givens and Thompson, 1985). The Panel highlighted the importance of a data workshop to vet the catch series before assessment reviews.

A. Request: Explain how the pre-1981 recreational catches for Oregon were specified.
Rationale: The document does not include this information.
Response: This request was not completed before the end of the Panel meeting. It will be specified in the final assessment document.

B. Request: Create a set of tables (one table for each species) of the historical catches, with columns for each data source. Plot the data by source.
Rationale: The catches are only provided in plots by area, which makes evaluating the uncertainty associated with the catch data difficult. The Panel wished to understand which data sources were most influential on total removals.
Response: This request was not completed before the end of the Panel meeting. The tables will be provided in the final assessment document.

C. Request: Plot the time-series of discard rates by species.
Rationale: The Panel wished to determine how historical discard rates were created.
Response: This request was not completed before the end of the Panel meeting. The plot will be provided in the final assessment document.

2.2 Fishery-independent abundance indices

1.2.1 AFSC Triennial Shelf Survey / NWFSC Slope-Shelf Survey

The focus for the Panel evaluation of the Triennial and NWFSC survey indices was the application of the GLMM model for constructing the indices. The software on which the GLMM analyses were based was evaluated by the SSC in March 2013. The SSC endorsed the new software, and recommended that it be used for stock assessment purposes. It also recommended that documents presented to this data-moderate panel: 1) compare alternative error models (e.g. gamma vs lognormal) when developing indices of abundance using Q-Q plots, posterior predictive checks, and average deviance, and 2) test whether effort impacts the probability of a catch being non-zero. The analysts did not test whether effort impacts the probability of a catch being non-zero.

Model selection for the GLMM involved using mean deviance to select between gamma and lognormal error models, then using visual examination of Q-Q plots to select between models with and without Extreme Catch Events (ECEs) components.

D. Request: For the GLMM-based indices, show Q-Q plots comparing models which include components for ECEs and those that do not. Plot histograms of deviance for each of the four GLMM analyses for each species.
Rationale: The Panel wished to examine the basis for selecting models with ECEs, which was based on the Q-Q plots.
Response: The plots were provided. As expected, the differences in the Q-Q plots for models with and without ECE components was larger for rockfish (e.g. sharpchin) than for flatfish. However, the basis for selecting models with ECE components over those without such components using the Q-Q plots was not obvious. It was noted that the Q-Q plots for some of the "rejected" models would have been "acceptable" had they been provided for, for example, a CPUE standardization.

E. Request: Plot the distribution of the positive catches.
Rationale: The Panel wished to see whether ECEs are evident in the data, especially for species (such as English sole) which do not aggregate.
Response: The plots were provided, but they were not in log-space and so were difficult to interpret. There was some indication that schooling species like yellowtail rockfish showed greater evidence of extreme catch events than non-schooling species like English sole

F. Request: Plot the four GLMM indices (ECE vs non-ECE; lognormal and gamma), along with the design-based index, with associated confidence intervals by species.
Rationale: The Panel wished to more fully understand how different the outcomes from the GLMM are given various assumptions regarding inclusion (or not) of model components for ECEs, as well as the choice of error model.
Response: The plots were provided. In general, the log-normal (no ECE component) result differed the most from the remaining indices.

G. Request: Create time-series of GLMM-based indices for the Triennial survey which (a) include the data for 1977, and (b) analyzes all of the data to form a single time-series.
Rationale: The SWFSC analysts include the Triennial data in assessments as single time-series in their preliminary results, but used the design-based estimates rather than the GLMM estimates which made comparisons very difficult.
Response: The time-series were created. It was noted that the GLMM indices for the entire time-series mimicked those when the data were analyzed separately for 1986-1992 and 1995 onwards for some species (English sole and rex sole), but differed quite markedly for others (e.g. yellowtail north).

In discussion, the Panel agreed that the method proposed for model selection is not ideal because there is no objective basis to select between models with and without ECE components using Q-Q plots, and that the use of average deviance ignores differences in numbers of effective parameters among models. Although the STAT followed the recommendations of the SSC, this problem of model selection has yet to be fully resolved. It therefore recommended that the model selection criteria be a topic for future research. DIC (Deviance Information Criterion) was identified as a possible approach for model selection. The analysts noted that Eric Ward and Jim

Thorson (developers of the GLMM software) do not support the use of DIC for model selection. However, no documentation of the reasons for this was available to the Panel.

Although the Panel is generally supportive of the ECE approach as a potentially useful improvement in GLMM models for survey data, the Panel is concerned about the lack of model selection criteria, and introduction of a new feature to the GLMM models without a greater understanding of how to identify when it should be implemented. For these reasons, the Panel recommended limiting consideration to GLMM models which exclude ECE components.

2.2.2 *Southern California Hook and Line Surveys*

The Panel noted the concerns by the SSC that effort (in terms of *Fishing Time*) in the model is determined by how quickly the hooks are being occupied rather than being treated as an independent variable, meaning that the catch influences *Fishing Time* instead of the other way around. The SSC therefore concluded that including *Fishing Time* in the model was likely inappropriate. The SSC recommended exploring versions of the statistical model that do not use *Fishing Time* as a covariate to examine the sensitivity of the abundance index to the assumption that hook saturation has no important effect. They also identified other analytical approaches that can be used to evaluate the importance of a gear saturation effect, such as dropping the data from a particular hook location as a cross-validation exercise and treating the Y-variable as the number of the 5-hooks per line that caught fish. The abundance index from the Hook and Line Survey included in the assessment for vermillion rockfish ignored the *Fishing Time* covariate as recommended by the SSC.

2.3 Fishery-dependent abundance indices

2.3.1 RecFIN trip-based CPUE

The analysts applied the same approach (Stephens-MacCall [2004] filtering of trips, followed by the use of a Delta-GLM analysis approach) to construct the RecFIN trip-based CPUE indices. The Panel endorsed this approach.

2.3.2 Observer-based Recreational CPUEs from CPFVs

Data are available from four primary data sources (historical observer CPFV data from CDFW, data from recent CDFW and ODFW observer programs, and data from a CalPoly sampling program). The data from the first of these programs is by “fishing site” whereas the data from the latter three sources are available by drift. The analysts aimed to analyze these data to construct indices for southern California, central California and northern California/Oregon. The basic approach involved adding “buffers” about each point with a positive catch from the recent data to define regions, and combining regions which overlap to create “sites”. The data which will be potentially used in subsequent analysis are then the positive catches, along with the zeros which are located in the areas which define the sites. This data set is then restricted in several ways: a) a site needed to be visited at least five times, b) start or ending lat/longs should be available (CDFW and Calpoly), c) there should be no erroneous location or time data (CDFW and Calpoly), d) drifts should not be in San Francisco or San Diego Bays, e) at least 30% of or more of the observed catch should be groundfish (CDFW only), f) the sites should be within 60 fathoms (southern California) or 40 fathoms (Orgeon), and g) the sites should not be not in Conservation Areas. The data were further restricted to exclude records outside the 2.5% and 97.5% quantiles of fishing times and 2.5% and 97.5% of anglers.

The Panel noted that the approach was highly innovative, and attempted to make best use of the available data. However, it is a very complicated and computationally intensive approach, which makes evaluating it difficult. The Panel identified several requests to further explore the sensitivity of outcomes from the approach to some of its specifications.

H. Request: Compare the standardized indices from the proposed method with indices constructed by applying the Stephens-MacCall approach to the data aggregated by trip.
Rationale: The Stephens-MacCall approach has been the standard way to analyze the recreational CPUE data.
Response: There was insufficient time to conduct this analysis during the meeting.

I. Request: Repeat the analysis of the CPFV data for brown rockfish in the central California region based on the final model, changing the buffer to 0.03.
Rationale: The Panel wished to understand how sensitive the outcomes from the proposed method are to changing its assumptions. The size of the buffer determines how many zeros will be included in the analysis, making it an appropriate factor to vary. Brown rockfish in the central California region was selected because this is a species the index for which is based on the historical as well as the recent observer data.
Response: The results were insensitive to the changing the buffer.

J. Request: Provide the graphs for the RecFIN indices for brown rockfish.
Rationale: These graphs were omitted from the document provided to the Panel.
Response: The graphs were provided when the results for brown rockfish were shown to the Panel.

3. Modeling Issues (Technical merits and deficiencies)
3.1 Criteria for evaluating assessment adequacy

Review of model performance focused on model convergence, goodness of fit, sensitivity to assumptions, and plausibility of parameter estimates and whether the prior is updated as expected given the model inputs. The Panel discussed and agreed upon the following set of performance criteria for evaluating the adequacy of data-moderate assessments.

Performance criteria for evaluating data moderate assessments
1. Do the diagnostics for the posterior sampling algorithm indicate that the model has converged?
2. Are the indices used in the assessment sufficiently precise to provide a signal for the assessment?
3. Is an adequate fit achieved to indices of abundance used in the assessment?
4. Does the model capture the evident trends in the abundance indices, or, if not, can the residual pattern be explained by model's inability to account for increases in recruitment? This would only occur when the index is trending more strongly upwards than the model predictions.
5. Do sensitivity analysis indicate the results are robust to uncertain model assumptions?
6. In comparison to catch-only assessments (SSS and DB-SRA), does the addition of index data update the prior distributions in a sensible way, rather than giving strongly divergent results?
7. Is the updating of the distribution of key parameters from prior to posterior reasonable given the likely information content of the indices? For example, a posterior distribution of B_{MSY}/B_0 that is very different than the prior distribution could be a concern because the data are not likely to be very informative about this quantity.
8. Are the estimates of catchability for survey indices within reasonable limits ($0.1<q<3$) for assessments that use survey indices?
9. In cases where a previous assessment has been accepted for the stock, are results reasonably consistent with the previous assessment?

Evaluation of performance criteria was necessarily limited to the collective opinion of the STAT and Panel members, but usually it was straightforward to rank fits for alternative model runs from good to bad. It was more difficult, however, to decide on a threshold to distinguish between adequate and inadequate model fits. The Panel found the checklist approach useful, but acknowledges that these criteria are in need of refinement, and notes that quantitative metrics would assist future Panels in reviewing data-moderate assessments. The use of more objective thresholds for evaluating model performance would also help to assure consistency across assessments. However, even full assessments occasionally display consistent patterns of lack of fit and other assorted problems, and it is important not to apply more stringent criteria to data-moderate assessments than are applied to full assessments.

3.2 Comparison of modeling approaches

One goal of this meeting was to compare outputs from XDB-SRA and exSSS for the same species and provide guidance on their applicability to different stocks. The Panel was able to do this in a general way, but ultimately it was not possible to conduct a formal model comparison for all species due to time constraints and differences in input data in the original model runs (e.g. whether the analysis used the 1977 data point for the triennial survey, split or do not split the triennial index).

In general, XDB-SRA and exSSS gave similar results when input data were the same and, for some stocks, when priors on key parameters were constrained to force the models to behave in similar ways. Both models were considered acceptable for use. The analysts were generally able to sample parameter vectors from the posterior distribution. The Sample-Importance-Resample (SIR) algorithm performed adequately for some stocks, but Adaptive Importance Sampling was able to deal with situations when SIR was inefficient as the posterior differed markedly from the prior. For exSSS, the MLE estimates were not considered useful for providing management advice since the model has a Bayesian formulation, but were useful to rapid exploration of the sensitivity of runs to assumptions.

Due to time constraints, it was not possible to re-run all models with standardized input data for a formal model comparison. In particular, exSSS can take several hours for each model run. To ensure that completed model runs and analyses were available for each species, the STAT proposed and the Panel agreed to apply XDB-SRA for the nearshore species (copper, brown, and china rockfishes, combined and split by region) and apply exSSS to the offshore species with fishery independent data (English and rex sole, yellowfin and sharpchin rockfish).

For the rockfish assessments, exSSS repeatedly led to posteriors for F_{MSY}/M which had most of their mass at far higher values than past assessment models have attributed to rockfishes. For age-structured assessments with a Beverton-Holt stock recruit relationship, a high F_{MSY}/M ratio occurs when the estimated steepness is close to 1.0, but also depends on fishery selectivity and the maturation curve. Maturity and selectivity are assumed to be the same in exSSS which might explain this behavior[1], along with the fact steepness was estimated to be high for stocks with rapidly increasing abundance. Nevertheless, the Panel remains puzzled about the high values for F_{MSY}/M which are given support in the posterior and recommends this be explored further.

XDB-SRA, which has greater flexibility in how productivity changes with stock size, was less likely to assign considerable mass to high F_{MSY}/M ratios than exSSS (note that XDB-SRA imposed a prior on F_{MSY}/M where F_{MSY}/M is a derived quantity of exSSS). XDB-SRA assumes that the priors for F_{MSY}/M and B_{MSY}/B_0 are independent, but the priors are based, at least to some extent, on meta-analysis of stock assessments where these quantities are likely to be strongly correlated. It would not be too difficult to design a simulation experiment to evaluate correlation in F_{MSY}/M and B_{MSY}/B_0 in an age-structured population with more flexible stock-recruit relationships.

When the base models for exSSS and XDB-SRA were compared for the same species, it was clear that some of the differences in model results were due to differences in how the priors for stock productivity were specified. Modifying priors to make the productivity-linked parameters of each model more comparable led to similar model behavior and outputs. Further consideration is needed to specify priors for stock productivity that are appropriate for the life history and biology of the species being assessed. Additional analyses are also needed to compare the performance of exSSS and XDB-SRA; it may be that species life history or catch history can be used to choose a model *a priori* for future assessments, and that the development of a single, "best" approach to modeling will not be possible.

[1] Review of the code for stock synthesis suggests that these were actually not the same.

Chantel Wetzel presented preliminary results of a Management Strategy Evaluation (MSE) to compare the performance of harvest control rules based on data-poor and data-moderate assessment methods for rockfish-like and flatfish-like life histories[2]. Rapid generation of replicate simulations for exSSS is not currently feasible computationally, precluding a full evaluation of this method. The MSE approach is valuable for determining the performance of different models and management strategies under conditions of varying population dynamics and data quality, and will provide future guidance for recommending which assessment methods(s) should be applied to different stocks.

K. Request: For the brown rockfish coastwide assessment, re-weight each point in the posterior by the ratio of the prior probability for F_{MSY}/M for exSSS to that for XDB-SRA and constrain the F_{MSY}/M – B_{MSY}/B_0 point to the relationship between F_{MSY}/M and B_{MSY}/B_0 underlying XDB-SRA.
Rationale: Eliminate the model structure as an issue in the comparison
Response: The marginal posterior for F_{MSY}/M from this version of XDB-SRA was closer to that from exSSS. However, full results from this comparison were not available.

L. Request: Set maturity at age 1 for brown rockfish for XDB-SRA and compare to base run where age at maturity is age 4.
Rationale: To better understand the differences between XDB-SRA and exSSS. One would expect that a shorter time would reduce the proportion of rejected samples from the prior.
Response: There was little change in biomass trends when the time lag was changed. As expected, the stock depletion can go slightly lower when age at maturity is set at age one. This is because the number of pre-model rejections due to the stock going below zero is lower when the time-lag is lower (such rejections are not possible when there is no time lag.)

M. Request: Use knife-edge maturity and selectivity at age 4 for brown rockfish exSSS and compare F_{MSY}/M for both exSSS and XDBSRA.
Rationale: To better understand the differences between XDB-SRA and exSSS.
Response: The pre-data and post-model distribution for F_{MSY}/M were nearly identical. This doesn't seem to be accounting for the difference.

N. Request: Provide tables for all west coast rockfish and all west coast flatfish with the following information from the most recent stock assessment/update: a)year of the assessment/update, b) value of steepness estimated/used in the base model, c) F_{MSY}, d) %SPR at F_{MSY}, e) natural mortality (use female if different than male, use average for mature fish if age-specific), f) F_{MSY}/M (c/e).

Example	Year	Steepness	F_{MSY}	%SPR@MSY	M	F_{MSY}/M
Dover Sole	2011	0.8	0.131	0.291	0.117	1.1

Rationale: The panel wanted to learn if the high F_{MSY}/M ratios from exSSS were consistent with outcomes from other west coast assessments.
Response. The table was provided. Most estimates of F_{MSY}/M range in 0.8 to 1.0. Assumptions for steepness are variable (but are not higher than 0.8). No very high estimates of F_{MSY}/M were found even when the Beverton-Holt stock recruit relationship was assumed. There were quite a few missing values for F_{MSY}.

[2] Due to his involvement in this work, Dr. André Punt recused himself as a Panel member for this discussion.

3.3 Characterization of uncertainty

XDB-SRA and exSSS are fully Bayesian approaches. Given the number of data-moderate assessments conducted, the Panel recommends that a simple and standardized approach be used to characterize uncertainty for constructing decision tables. The Panel recommends that the posterior joint distribution for the final base model be used to evaluate uncertainty for all data-moderate assessments. To construct a decision table, the joint posterior distribution should be split using the 25% and 75% quantiles of ending year stock depletion to provide low, base, and high biomass states of nature. Stock projections should be provided using recent average catch, the ACL in the last specifications cycle, and the 40-10 rule. The GMT may provide additional scenarios for analysis. Analysts should check if the estimated standard deviation in ending biomass (sigma) is greater than the default for category 2 assessments (0.72), and if so the larger value should be used in the calculation of the P* buffer between the OFL and the ABC.

4. Assessments based on fishery-dependent indices

4.1 Brown Rockfish

The catch of brown rockfish is primarily from central area (Point Conception to Cape Mendocino) (80%), with the northern area contributing about 1% of the catch, and the southern area contributing about 19% of the catch. Four abundance indices were included in the assessment models, all of which are derived from recreational fishery data. The indices used are the central and southern California onboard CPFV indices, and the central and southern California RecFIN indices.

Results were presented for both models using several algorithms for sampling from the posterior distribution. For exSSS, results were shown for the MLE estimates, and for posteriors constructed using the AIS and MCMC algorithms, while for XDB-SRA results from the AIS algorithm were presented. For pragmatic reasons, the Panel focused on XDB-SRA for brown rockfish, as there was insufficient time to adequately review both models. The Panel compared a coastwide model with separate models for north and south of Point Conception. The southern area model showed a better fit to the indices, but there was strong updating of the prior for the productivity parameters relative to the central area model, which was considered implausible by the Panel. There is a concern that model results were being strongly driven by recent increases in indices that may be temporary, rather than reflecting true stock productivity. The coastwide model showed reasonable fits to upward trending indices, and more plausible posterior distributions for the productivity parameters than the split-area models. Overall the model was considered acceptable. The Panel recommended that the coastwide XDB-SRA model run be used as the base model, but that the OFL be apportioned spatially using the split-area assessments, since they were considered to be informative about relative abundance north and south of Point Conception.

O. Request: Develop separate XDB-SRA assessments for brown rockfish for the southern and central areas by splitting the RecFIN CPUE time series appropriately.
Rationale: The Panel was interested in learning whether split-area models for north and south of Point Conception would provide an improved characterization of population trends.
Response: Results for the requested models were presented to the Panel. The southern area model was considered marginally inadequate due to strong (and unrealistic updating) of productivity priors.

4.2 China rockfish

China rockfish is a nearshore species with catches primarily from north of Point Conception. Four abundance indices were used, all of which were derived from recreational fishery data: central California and Oregon onboard CPFV indices and coastwide RecFIN indices (separated into areas for the split-area assessments). The STAT developed XDB-SRA and exSSS models for China rockfish. As with other nearshore stocks, the Panel focused on the XDB-SRA model for China rockfish, as there was insufficient time to adequately review both models. For the XDB-SRA model, separate assessments for north and south of Cape Mendocino were presented in addition to a coastwide model.

The coastwide model for China rockfish indicated a highly uncertain biomass estimate due to evidence of different fishing effort and recreational catch trends north and south, leading to marginally acceptable fits to the index data. Sensitivity runs for the northern area assessment indicated that estimates of stock status and the OFL are reasonably robust. Sensitivity runs for the southern area assessment indicated that estimates of depletion and current fishing mortality were robust, but the overall scale of the population is relatively poorly determined. The Panel determined that the northern and southern area models satisfied the criteria for acceptability. While the coastwide model was also considered acceptable by the Panel, the split-area models fit the indices slightly better, had plausible posterior parameter distributions, and there were substantially different trends and exploitation rates by area. Therefore the Panel recommended these models as the base models for China rockfish.

4.3 Copper Rockfish

The catch of copper rockfish is mainly from south of Cape Mendocino, with only 4% of reported landings from north of Cape Mendocino. Four abundance indices were used, all of which are derived from recreational fishery data: central and southern California onboard CPFV indices, the Oregon onboard CPFV index and the coastwide RecFIN index (separated into areas for the split-area assessments). The STAT developed XDB-SRA and exSSS models for copper rockfish. As with other nearshore stocks, the Panel focused on the XDB-SRA model for copper rockfish, as there was insufficient time to adequately review both models. For the XDB-SRA model, separate assessments for north and south of Point Conception were presented in addition to a coastwide model.

The coastwide model showed marginally acceptable convergence statistics, but they were not so poor as to reject the model. The convergence statistics for the split-area models were satisfactory. Other criteria indicated adequate performance of the split-area models, although the overall scale of the population is very sensitive to which indices were included in the models. The split-area models showed evidence of differing exploitation trends spatially, which is an important feature to capture in the assessment. Because the split-area models were considered acceptable, the Panel recommended these models as the base model for copper rockfish.

P. Request: For copper rockfish, include the Oregon index in the northern XDB-SRA model and compare the differences with and without it.

Rationale: Because Oregon is included in the assessment area, the Panel wanted to evaluate the impact of including the Oregon index, even though the fraction of the total catch from Oregon is low.
Response: There were very minor changes in model results. The Panel concluded that it was appropriate to include this index in the assessment.

5. Assessments based on fishery-independent indices

5.1 English sole

English sole is assessed as a coastwide resource. This shelf species, which is caught almost exclusively in trawl fisheries, has a long history of commercial exploitation, with peak catches (catch plus discard) occasionally exceeding 4,000 t over the period 1920 to 1980. Catches have steadily declined since 1980. English sole are well represented in the trawl surveys, occurring in approximately 65% and 40% of Triennial and NWFSC tows, respectively. A full stock assessment of English sole was previously conducted in 2007.

The Panel reviewed results from the exSSS (AIS) and XDB-SRA assessments, and concluded that both models were adequate for management. The abundance indices were considered adequate for providing a signal for the assessments, and diagnostics indicated convergence of the posterior sampling algorithms for both models. Spawning stock biomass trends were similar for the XDB-SRA and exSSS (AIS) model runs, when both models were fit to the GLMM-standardized trawl survey abundance indices. Neither model was able to fit the declining trend in the NWFSC survey indices, but the 2007 full stock assessment was also not able to fit that trend.

Both models met the criteria developed by the Panel for accepting assessments, and there was no objective basis for selecting one model over the other. For pragmatic (workload) reasons, additional model runs were limited to the exSSS (AIS) model, as there was insufficient time to adequately review alternative runs from both models.

The selected English sole base model is the exSSS (AIS) model fit to the Triennial survey GLMM abundance indices (excluding 1977) split into separate early and late series, and the NWFSC abundance indices. Model results were insensitive to fitting a single or split (early/late) Triennial survey abundance series. For the base model, trawl survey q estimates were considered plausible (all slightly greater than 1), and the posterior distribution for 2000 stock depletion was updated from the post-model-pre-data distribution (SSS). Estimates of stock depletion were insensitive to alternative assumptions, with the exception of fitting the model only to the late Triennial survey abundance indices. Median estimates of spawning stock biomass were similar between the exSSS model and the 2007 full assessment, other than the most recent years where the additional data used in the current assessment had updated stock estimates.

5.2 Rex sole

Rex sole is assessed as a coastwide resource. Rex sole is a commonly occurring species in both trawl surveys and commercial fisheries, although it has not been targeted commercially in recent years. Catches peaked in the mid-1950s through mid-1980s, with annual catches up to 2,500 t. For the reasons noted above, the exSSS was the selected model for the rex sole stock assessment.

The exSSS (AIS) base model run for rex sole fits to the Triennial survey GLMM abundance indices (excluding 1977) split into separate early and late series, and the NWFSC abundance indices. This formulation was selected over using a single Triennial survey abundance series because that fit resulted in implausible catchability estimates (*q*s >5). With the split Triennial survey indices, catchability estimates for the NWFSC survey was still quite high (approximately 3). The models are incapable of fitting the relatively flat trend in the NWFSC survey indices, given the reductions in catch that have occurred.

For the base model run, the fits to the two Triennial survey abundance indices were very good, but the fits to the NWFSC survey indices were poor. The Triennial survey as a single time series is relatively informative, but much of the value of the time series is lost when split into two series. The posterior distributions were not updated much from their prior distributions. Stock depletion estimates were relatively insensitive to model assumptions and alternative data series fit in the model, but scale parameters (abundance estimates) were highly sensitive to the alternative assumptions.

The Panel concluded that the base model provides an adequate basis for management, but notes that inability to fit the NWFSC survey index implies some model mis-specification. There is considerably more confidence in stock status estimates than in the biomass scale.

Q. Request: For rex sole, run exSSS using a single triennial CPUE index (excluding 1977).
Rationale: This will be the base model run (assuming no surprises, relative to the equivalent MLE run).
Response: The STAT presented the results from the model run. There were implausible catchability estimates (*q*s >5) for this model. This led the Panel to reject this run as a potential base model.

5.3 Yellowtail Rockfish

The yellowtail rockfish assessment was conducted for a northern stock (north of Cape Mendocino). There was not adequate time to review the assessment for the southern yellowtail rockfish stock. Yellowtail rockfish are common in both commercial and recreational fisheries, although in the northern area they are taken predominantly in commercial fisheries and peak catches (catch plus discard) have exceeded 9,000 mt/year. A full assessment of northern yellowtail rockfish was conducted in 2004 (Wallace and Lai 2005).

The Panel reviewed results from XDB-SRA and exSSS, and determined that both were acceptable for providing management advice. For pragmatic (workload) reasons, the Panel focused on the exSSS run. Initial model runs fit to recreational and survey abundance indices, but the recreational fishery targets juveniles so it was decided to exclude the recreational indices from the assessment.

The exSSS (AIS) base model was fit to a single Triennial survey abundance series (1977 excluded) and the NWFSC survey abundance series. The base model fit the abundance index data reasonably well, with no patterns in residuals and minimal additional variance for the NWFSC survey indices, and moderate additional variance for the Triennial survey indices. The was some update of the 2000 depletion prior distribution relative to the post-model-pre-data

(SSS) distribution, but other model parameters were not updated. Trawl survey catchability parameters were low, considered plausible for this species due to its mid-water distributions (median *q*s of approximately 0.2 for the Triennial survey and 0.4 for the NWFSC survey). Biomass estimates were highly uncertain. Stock biomass trends were similar between the exSSS base model run and the 2004 full stock assessment.

The Panel concluded that the base model was adequate for management of yellowtail rockfish north of Cape Mendocino.

S. Request: For yellowtail rockfish (north), conduct a XDB-SRA run that excludes the fishery-dependent indices (triennial series w/o 1977).
Rationale: This run investigated sensitivity to inclusion of this CPUE index because the recreational fishery targets smaller fish. Other fishery-dependent indices were not updated for this assessment and are of limited value in monitoring recent abundance trends.
Response: The STAR and the STAT agreed to focus on exSSS runs for yellowtail rockfish for pragmatic reasons, and did not consider XDB-SRA runs further.

T. Request: For yellowtail rockfish (north), conduct an exSSS (AIS) run that excludes all fishery-dependent CPUE indices (triennial survey as single series w/o 1977).
Rationale: Investigate sensitivity to inclusion of this CPUE index because the recreational fishery targets smaller fish. Other fishery-dependent indices were not updated for this assessment and are of limited value in monitoring recent abundance trends.
Response: The biomass trends were broadly similar.

5.4 Sharpchin Rockfish

Sharpchin rockfish was assessed as a coastwide stock. This shelf species is generally not a commercial target, although they have been taken in large numbers in trawl fisheries targeting Pacific ocean perch. Commercial catches (catch plus discard) north of Cape Mendocino peaked at about 900 t/year, with little catch taken to south of this. Catches of sharpchin rockfish catches have been negligible since 2000.

The Panel reviewed results from the XDB-SRA and exSSS, and determined that both were acceptable for providing management advice. Additional model runs were limited to exSSS (AIS) for pragmatic (workload) reasons.

The exSSS base model run for sharpchin rockfish was fit to the Triennial survey GLMM abundance indices (excluding 1977) split into separate early and late series, and the NWFSC abundance indices. This formulation was selected over using a single Triennial survey abundance series because analyses based on a single Triennial index resulted in implausible catchability estimates (Triennial survey *q* slightly over 1, and NWFSC survey *q* approximately 10). Catchability for the NWFSC was still fairly extreme (~4) with the split Triennial survey indices. The models are incapable of fitting the large increase in abundance estimated for the NWFSC survey relative to those for the Triennial survey, without extreme catchability estimates.

The base model fit the abundance index data reasonably well, with no patterns in residuals and no additional variance. The model does not follow the flat to downward trend in the NWFSC survey, instead predicting an increasing biomass trend. The posterior distributions of steepness and depletion in 2000 are only updated slightly relative to their prior distributions and the post-model-pre-data (SSS) distributions, indicating that catch trends rather than index trends are primarily driving results. Sensitivity to abundance indices was moderate, with final depletion estimates ranging from about 0.5 to 0.9 for runs that differed in the data series fit in the model.

The Panel concluded that the base model results were adequate for management purposes. Scale parameters were highly uncertain, resulting in high uncertainty in OFL values.

R. Request: Run the exSSS AIS using a single triennial CPUE index (excluding 1977).
Rationale: Results from this run will be compared with an (almost) equivalent XDB-SRA run and a base run will be selected based on the plausibility of the *q* estimates.
Response: This model resulted in implausible catchability estimates, and was not considered further.

5.5 Stripetail Rockfish

Stripetail rockfish is assessed as a coastwide stock. This shelf species is found in trawl fisheries, although they are neither a target of commercial or recreational fisheries. Reported annual catches (catch plus discard) have generally been less than 50 t. With reduced trawl fishing, catches of stripetail rockfish have been negligible since 2000. Stripetail rockfish have not been previously assessed.

The XDB-SRA model was used in a sensitivity analysis to evaluate probable levels of stock status for stripetail rockfish. A similar analysis with exSSS would have yielded similar conclusions, but there was insufficient time to complete the full set of sensitivity analyses requested by the Panel. Neither model was able to obtain credible results without an informative prior to establish the scale of the population. XDB-SRA was fit to the Triennial trawl survey and to the NWFSC survey indices. Convergence to the posterior distribution appeared good, and there was little updating of parameter values from their priors (DB-SRA) except for the depletion parameter (delta in the year 2000).

The Panel noted that stripetail rockfish is rarely caught and appears to be in an essentially unfished state, as indicated by the trawl survey abundance estimates. There is little information in the trawl survey data to estimate catchability, so abundance estimates are extremely uncertain. However, over a broad range of plausible values for trawl survey catchability (*q* range from 0.22 to 4.5), stock depletion estimates were relatively consistent, ranging from 0.75 to 0.95.

The Panel recommends that status of stripetail rockfish can be estimated based on the posterior profile of *q*, but that the extreme uncertainty in abundance estimates precludes using assessment results for setting the OFL.

U. Request: Construct a likelihood profile on log(*q*) from -1.5 to 1.5 in increments of 0.5 for the stripetail rockfish XDB-SRA model.
Rationale: To evaluate the likelihood that the stock is above the target.
Response: Most of the profile was completed including the endpoints by the close of the meeting. Estimates of stock depletion are well above $B_{40\%}$ for all runs.

6. Summary of Base Models Recommended by the Panel

Stock	**Base Model**
Brown rockfish	XDB-SRA coastwide model. Area models should be used for OFL apportionment north and south of Point Conception.
China rockfish	XDB-SRA area models for north and south of Cape Mendocino
Copper rockfish	XDB-SRA area models for north and south of Point Conception. Separate RECFIN indices for each area. Oregon onboard observer time series included in the northern area model.
English sole	exSSS coastwide model, Triennial survey excluding 1977, split into two time periods; NWFSC survey.
Rex sole	exSSS coastwide model, Triennial survey excluding 1977, split into two time periods; NWFSC survey
Sharpchin rockfish	exSSS coastwide model, Triennial survey excluding 1977, split into two time periods; NWFSC survey
Yellowtail rockfish north of Cape Mendocino	exSSS model, exclude all fishery dependent indices, triennial survey excluding 1977, no split; NWFSC survey
Stripetail Rockfish	XDB-SRA model with triennial and NWFSC surveys treated separately. The panel concluded that there is very high probability that the stock is above the $B_{40\%}$ target level. However the Panel did not identify a preferred base model, and recommends that assessment results not be used to set an OFL.
Vermillion rockfish	The panel was unable to review the vermillion rockfish assessment due to time constraints, and can make no recommendation.
Yellowtail rockfish south of Cape Mendocino	The panel was unable to review the assessment of yellowtail rockfish south of Cape Mendocino due to time constraints, and can make no recommendation.

7. Areas of disagreement regarding STAR panel recommendations

There were no areas of disagreement between the STAR panel and the STAT, nor among STAR panel members (including concerns raised by GMT and GAP representatives).

8. Unresolved problems and major uncertainties

The unresolved problems and major uncertainties for the data-moderate assessment methods are discussed Sections 2 and 3. Here the Panel reiterates what it considers the most important issues.

- The data-moderate assessments assume known catches, but there is considerable uncertainty in historical catch reconstructions, particularly for the recreational fishery. This uncertainty has not been measured, and tools for incorporating this uncertainty in assessments are not well developed. This is an issue for all assessments.
- The comparative performance of the two assessment approaches for data-moderate assessments, XDB-SRA and exSSS, is not yet known. In most cases, however, the two models gave similar results for most stocks, and results were highly comparable when productivity parameters were constrained.
- There are fundamental differences between XDB-SRA and exSSS in how stock productivity is modeled. For exSSS, F_{MSY} increases as the ratio of B_{MSY}/B_0 decreases in a

deterministic way, while there is no prior relationship between F_{MSY} and the ratio of B_{MSY}/B_0 for XDB-SRA. It is unclear which of these assumptions is most appropriate. This is a broader issue than for just data-moderate assessments, since it questions the appropriateness of two-parameter curves such as Beverton-Holt to model the stock recruit relationship. Research to improve understanding of the relationship between the inputs of the XDB-SRA and exSSS productivity parameters is encouraged.

- Objective criteria are needed to evaluate minimum standards for model outputs to be considered "acceptable" and "preferred"
- Different priors (uniform of q / uniform on log-q) for the additional variance term were used in the two assessment models. It is unclear which performs best, and, since this term affects the weights given to each index in the model fitting, the form of the prior will influence model results, particularly when the indices are in conflict.

9. Management, data, or fishery issues raised by the GMT or GAP representatives during the STAR panel

- The GMT representative expressed concern about local-scale population dynamics and exploitation patterns for nearshore species that are not captured in large-scale indices and assessment models, and recommended a more spatially-structured evaluation of CPUE data.
- The GMT representative noted that for certain nearshore species there is potential utility in using post-2003 RecFIN dockside data as well as onboard sampling data since depth restrictions have not constrained access to the adult population.
- The GMT representative also recommended expanding the analysis of CPUE data to additional sectors of the recreational fishery, such as private and rental boats. CPUE indices from these sectors may be useful in future assessments of nearshore stocks.

10. Panel Recommendations

10.1 Data input recommendations

1. The Panel strongly emphasizes the value of conducting a data workshop during which catches, indices, biology, and other data inputs are reviewed.
2. Consider developing GLMM models in which latitude and depth are treated as continuous covariates rather than as factors.
3. The historical CPFV drift-specific data should be keypunched, which should allow the algorithm for developing CPFV-based data indices to be improved.
4. Habitat maps should be developed so that structural rather than true zeros are designated using data which are independent from the data used to determine the indices.
5. Revisit the approach used to select among error models and whether to include ECE components when conducting the GLMM analyses.
6. Consider including a vessel factor (as a random effect) when developing indices for the Triennial survey.
7. Splitting the triennial survey into early and last periods became established practice without looking at the issue comprehensively or considering the loss of information from breaking a time series. A comprehensive evaluation of the issues and trade-offs is still needed.

8. Consistent residual patterns in NWFSC surveys for a number of assessments suggests there may be some unknown factor affecting survey catchability, or that some factor is affecting the productivity of multiple stocks in the same way.

10.2 Future reviews of data-moderate assessments

1. Nine stocks proved to be too many assessments to review at this STAR Panel. Reviewing a smaller number of assessments (4-8) may be more feasible goal for STAR Panel review, depending on the level of pre-STAR panel review of data inputs. If area-specific models are considered in addition to coast-wide models, additional time or fewer stocks should be scheduled. However, the first time that any assessment method or stock assessment is reviewed is always the most challenging, and future STAR Panels may find that the review goes much smoother.
2. The Panel recommends that data-moderate assessments continue to be reviewed at full STAR panels for at least for the next assessment cycle. As methods become standardized and the review process becomes more routine, it should be anticipated that review process can be streamlined somewhat.
3. Objective criteria should be developed to specify minimum standards for model outputs to be considered "acceptable" and "preferred" and included in the Terms of Reference for stock assessments. Such criteria might include minimum goodness-of-fit criteria and acceptable limits on posterior distributions.
4. While the Panel made some progress in comparing XDB-SRA and exSSS, our strategy of attempting to isolate the sources of difference between the two models ultimately proved unsuccessful, and resulted in complex requests to the STAT that were difficult to accomplish in the available time. The Panel suggests that some of the model comparison work is more appropriate outside the STAR panel review process, particularly as it involves fundamental differences in how stock productivity is modeled.
5. A standardized set of sensitivity runs, diagnostic plots, and performance statistics, such as runs tests on the residuals, should be developed to rapidly evaluate the performance of data-moderate assessments. Some pre-STAR panel planning involving the STAT and SSC to develop an analysis "package" could be helpful.
6. As with any assessment and review process, there is a trade-off between the number of data-moderate assessments and quality of the assessment and review. This trade-off should be taken into account when planning for future STAR panel reviews of data-moderate assessments.

10.3 Other Prioritized recommendations for future research and data collection

1. The MSE should be further explored to evaluate to performance of exSSS and XDB-SRA. Other potential topics include error in the catch time series, uninformative indices of abundance, and time-varying productivity. The MSE could also be used to test whether more constrained models, such as fixing steepness or B_{MSY}/B_0, results in improved model performance.

11. References

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Available Age and Length Composition Data for the Nine Data-Moderate Stocks Undergoing Assessment in 2013

Brown Rockfish

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1974		2	1987			2000		
1975		14	1988			2001	23	
1976		3	1989			2002	47	
1977	114	508	1990			2003		
1978		458	1991			2004	4	
1979		60	1992			2005		
1980	25	398	1993			2006		
1981	1	132	1994			2007	19	
1982		223	1995			2008	1	
1983	7	137	1996			2009	16	
1984	2	350	1997			TOTAL	293	2439
1985	34	154	1998					
1986			1999					

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52
1978								1		3	2	8	9	4	5	5	5		
1980													2	2	2	3	5	5	1
1981													1		2	1	5	1	
1982										2	3	2	1	4	3	2			
1983										1	1	1		3					
1984							1	1	3	4	3	1		2					
1985								1	1	2			1	1	2	2	1		
1986												1		1					
1988							1												
1990							1												
1991				1	1	3	8	3	7	14	3	5	3	1		1	1		
1992			16	115	214	280	288	247	253	163	115	86	36	14	12	7	5	1	
1993			6	26	55	77	70	67	69	54	33	6	10	13	9	8	5	5	2
1994		3	31	110	81	76	57	63	51	48	54	30	10	5	3		1		
1995	1		5	17	44	77	74	35	39	35	38	20	15	3	3				
1996	1	1	4	42	85	143	141	132	135	85	38	23	10	5	4				
1997		19	53	59	125	179	159	132	107	104	72	40	29	23	9	4	1		
1998			1	2	8	32	24	21	13	13	9	3	3	3	1				
1999			1	8	37	67	119	178	146	146	143	82	40	33	17	16	2	1	
2000				2	11	59	80	90	93	97	79	47	27	8	5	2	1		
2001				2	7	48	65	108	150	169	136	99	63	31	7	4	1	1	
2002						15	28	42	51	52	50	49	37	23	7	3	1		
2003						5	13	9	12	17	13	5	5	2					
2004						6	4	5	11	18	15	9	1	3	2	1			
2005						1	3	4	10	7	12	9	7	4	3				
2006						2	2			1	1	1							
2007					2	1	4	12	9	7	7	2	4	1					
2008				1			2	3	5	6	2	4	1			2		1	
2009						6	6	20	16	29	30	13	12	14	6	1	1		1
2010					2	15	53	74	77	73	70	48	30	18	4	1			
2011					1	1	11	46	48	43	41	15	14	14	5	2	3		
2012						5	7	26	28	37	43	31	18	6	2				

Recreational

Year	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52
1978			1	4	8	20	20	28	20	29	42	26	28	11	3	3	4
1979		1	1	5	13	15	20	23	27	30	22	9	6	5	3		1
1980		1	3	3	3	11	15	25	25	44	21	28	17	6	6	2	
1981			2	1	4	3	9	13	4	11	12	6	6	5	2		
1982				3	1	18	21	14	21	17	17	9	8	5	4	1	1
1983	1			3	6	17	20	20	22	20	5	11	5	4	1	1	
1984			1	2	3	10	26	39	27	25	29	22	19	8	4		2

Oregon Data

None.

NWFSC Hook-&-Line Survey Data

Lengths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
28-29						1				1
30-31	1			1	1	1				4
32-33									1	1
34-35									1	1
36-37								1		1
38-39		1					1	1		3
40-41				1				1	1	3
42-43										0
44-45		2								2
Totals	1	3	0	2	1	2	1	3	3	16

Otoliths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
28-29						1				1
30-31	1			1		1				3
32-33									1	1
34-35									1	1
36-37								1		1
38-39		1					1	1		3
40-41				1				1	1	3
42-43										0
44-45		2								2
Totals	1	3	0	2	0	2	1	3	3	15

China Rockfish

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1977		28	1995		
1978		26	1996		
1979		1	1997		
1980	5	28	1998		
1981	3	9	1999		
1982		15	2000		
1983	9	2	2001		
1984	2	7	2002		
1985	1	3	2003		
1986		2	2004		
1987			2005		
1988			2006		
1989			2007		
1990			2008		
1991			2009	1	
1992			2010	1	
1993			TOTAL	22	121
1994					

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	66
1985															2			
1991							1		1									
1992			1	9	13	41	40	86	69	26	23	4	1					1
1993				2	12	25	28	30	25	21	16	11	14	1				
1994	1		4	7	30	50	73	73	47	28	14	9	3	1			1	
1995				3	10	24	32	17	24	13	6	5	4	3	1			
1996			1	6	18	28	31	31	17	13	12	7	5	4				
1997				2	5	19	48	48	28	14	11	2	4					
1998		1		3	10	9	8	6	7	2	1							
1999						3	18	49	77	71	62	30	11	3				
2000							1	31	45	33	26	10	4	1		1		
2001							3	39	43	35	24	13	6		1			
2002							1	23	26	26	15	3	1		2			
2003								1	10	10	5							
2004						1		10	12	28	34	9	1					
2005						1	4	17	38	32	7	4						
2006						1	2	9	16	16	17	8	4					
2007							3	34	60	67	54	23	5	1				
2008							2	8	37	61	56	18	4			1		
2009							5	24	54	72	32	21	1					
2010							1	10	32	39	28	15	4					
2011								13	4	1								
2012								8	4		1							

Recreational

Year	24	26	28	30	32	34	36	38	40	42
1978		3	2	3	8	5	3			1
1979	2	1		6	6	4	1		2	1
1980		2	2	6	11	10	8	4		1
1981			1	5	2	2	1			
1982	1	1		1	4	1	4	3	2	
1983				3	5	3	3	1	1	
1984		1	3		3	3		1		1

Oregon Data

Commercial otoliths by year and 2-cm length bins (some aged)

Year	Aged?	No length	< 30	30	32	34	36	38	40+
1995	no		9	30	20	23	14	5	1
1996	no		11	23	34	25	15	8	2
1998	no		4	19	44	39	20	9	3
1999	no		10	36	40	16	15	9	4
2000	no		20	236	287	323	219	110	37
2001	no		5	360	566	549	338	133	40
2001	yes		1	12	11	17	12	6	4
2002	no		5	216	394	392	302	124	40
2002	yes	2		13	38	30	24	11	3
2003	no		1	139	234	206	144	65	24
2003	yes		2	20	48	48	39	17	7
2004	no		3	109	196	181	114	28	15
2004	yes			9	13	17	9	6	1
2005	no			28	47	55	44	20	9
2005	yes			2	2	3	1	4	2
2006	no		3	39	75	118	94	55	25
2006	yes			1	8	10	6	4	
2007	no		4	48	149	193	198	108	24
2008	no			28	64	118	83	56	27
2009	no		2	37	99	131	89	51	21
2010	no		3	48	104	175	130	49	20
2011	no		4	64	199	283	279	123	45

Copper Rockfish

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1975		88	1992		
1976		273	1993		
1977		380	1994		
1978		345	1995		
1979		42	1996		
1980	14	192	1997		
1981		76	1998		
1982	7	133	1999		
1983	12	75	2000		
1984	28	66	2001		
1985	23	13	2002		
1986	2	5	2003	1	
1987	1		2004	6	
1988			2005		
1989			2006		
1990			2007	5	
1991			TOTAL	99	1688

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	62
1978										2												
1979														6	9	5	5	1				
1980						1	1	1	3		3	3	6	5	2	3	4	2				
1981											1		1		1	1						
1982											1				1	1		2	1			
1983										3	1	2		1	5		2	1				
1984								1	1	1	2	4	6	4	2	9	8	4	1			
1985						1	1	1	1	3	2	3	5	1	5	3	2					
1986							1				7	4	4	6	3	7	2	1	1			
1987					1		1		2	3	3	1	4	3		4						
1988							1	1	1		2	4	2	5	4	3	3		1			
1989								2	2	1	1	3	4	3	5	3						
1990													2									
1991					1		1	8	12	10	16	19	14	13	12	15	4	1				
1992			1	4	6	17	39	53	64	65	90	70	71	34	38	32	43	26	7	2	1	1
1993	1	6	19	17	34	29	45	61	61	69	79	91	80	55	62	52	25	16	6			
1994		1	6	17	16	21	25	20	16	17	27	35	38	26	32	29	19	4	5			
1995	1		4	12	14	19	39	42	41	42	44	41	24	35	38	24	13	9	7	1		
1996			4	7	17	21	26	41	52	48	53	48	54	41	21	22	13	5	6			
1997		1		3	7	14	40	42	66	62	72	67	49	44	23	23	7	4	1			
1998				2	12	24	32	65	73	78	94	75	68	20	22	10	3	1				
1999			1	4	12	20	36	35	46	52	66	41	70	47	55	35	25	10	3	6	3	
2000					4	9	6	8	5	8	8	7	14	3	6	5	7		1			
2001				1	6	2	9	20	17	24	31	26	16	21	24	27	15	4	2			
2002				1	1	2	4	6	11	5	11	16	8	3	6		1		1			
2003				1			4	8	17	12	13	8	2	14	5	4	2					
2004								1	3		3		5		6	11	3	4				
2005												6	3	2	4	2	1	1				
2006							2	1	1	5	3	3	1	1	1		1					
2007				1	2		2	1	3	5	6	7	6	17	14	6	4					
2008					1	3	3	5	1		5	8	9	6	14	5	4	3	4	1		
2009					2	2	5	5	7	7	3	9	6	2	1	3						
2010					2	8	10	8	8	12	9	8	9	4	3		1	1				
2011				2	10	16	10	10	5	4	4	1		1	3				1			
2012				3	8	15	17	10	6	3	2	3	2	2	1			1				

Recreational

Year	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	98
1978	1	1	2	4	12	10	19	24	35	48	62	45	37	29	8	5		1	1
1979			3	1	7	3	19	27	13	21	35	35	33	21	9	4	2		1
1980			1		7	14	9	11	21	16	23	37	34	11	10	3	1	1	
1981	1	1	1	2		7	4	4	4	4	8	18	10	18	8	2			
1982			1	1	2	7	10	10	12	21	14	27	21	15	5	2			
1983	1					4	4	9	9	11	16	9	21	8	3	2	1		
1984	1				4	2	2	8	6	4	15	17	10	18	11	3		1	

Oregon Data

Commercial otoliths by year and 2-cm length bins (none aged)

Year	< 36	36	38	40	42	44	46	48	50	52+
1999	2			2			2	2	2	
2000	11	11	10	10	5	5	6	8	11	8
2001	27	9	6	10	5	7	11	6	10	1
2002	5	4	3	1	4	3	2	1	2	3
2003	4	4	2	4	4	4	9	3	4	2
2004	4	3	4	6	3	9	5	4	11	4
2005	1		2	2	2	1	2	1		
2006		1	1	7	6	13	7	3	2	1
2007	4	2	2	2	3	7	6	3	1	2
2008		1		5	2	6	5			
2009	2	1	1	2	1	2	3	3		
2010	2	4	4	4	8	8	6	2	2	2
2011	8	6	8	6	10	10	15	8	7	2

NWFSC Hook-&-Line Survey Data

Lengths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
20-21						1	1			2
22-23					1			2		3
24-25								2	1	3
26-27			2		1	2	1	2	1	9
28-29	1		1	2	4	2		2	3	15
30-31		2	2	4	2	1	2		6	19
32-33		5	4	2	5	6	1	3	6	32
34-35	3	5	7	7	6	5	1	4	7	45
36-37	4	7	11	11	9	19	6	11	7	85
38-39	4	10	8	12	5	23	4	9	4	79
40-41	5	7	10	14	18	17	3	7	9	90
42-43	7	10	8	10	10	8	2	8	10	73
44-45	6	17	4	9	4	9	2	3	5	59
46-47	2	2		3	2	10	1	2	2	24
48-49	1	4	2	2	1	1			2	13
50-51		1						1		2
52-53				1						1
Totals	33	70	59	77	68	104	24	56	63	554

Otoliths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
20-21						1	1			2
22-23					1			1		2
24-25								1		1
26-27			2		1	2		2	1	8
28-29	1		1	2	4	2		2	3	15
30-31		2	2	4	2	1	2		6	19
32-33		5	4	2	5	4	1	3	6	30
34-35	3	5	7	7	6	5	1	4	7	45
36-37	4	6	11	11	9	18	6	11	7	83
38-39	4	10	8	11	5	23	4	8	4	77
40-41	5	7	10	14	18	17	3	7	9	90
42-43	7	10	8	10	10	8	2	8	10	73
44-45	6	17	4	9	4	9	2	3	5	59
46-47	2	2		3	2	10	1	2	2	24
48-49	1	4	2	2	1	1			2	13
50-51		1						1		2
52-53				1						1
Totals	33	69	59	76	68	101	23	53	62	544

English Sole

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1966	3911		1978	2102		2001		
1967	5848		1979	900		2002		
1968	7267		1980	4065		2003	74	
1969			1981	2510		2004	56	
1970	4522		1982	2446		2005	280	
1971			1983	1047		2006	60	
1972	2428		1984	1100		2007		
1973	2598		1985	1975		2008	187	
1974	500		1986	775		2009	35	
1975	644		1987	899		2010	10	
1976	625		1988	125		2011	8	
1977	3586		1989	25		TOTAL	50608	0

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
1978									2									
1979						1		1										
1980										1								
1982									1									
1991						1	6	17	11	9	7	7	3	1				
2001	12	24	12	15	2	4	14	39	46	32	22	8	3	1				
2002							3	18	26	24	25	12	7		1			
2003			1	11	11	10	40	132	198	147	55	13	7	5				
2004				2	3	7	35	142	279	273	161	64	18	8				
2005						2	28	147	334	324	232	90	29	4	2	2	1	2
2006				2	5	10	44	130	354	495	465	282	103	28	3	1		
2007				7		4	37	169	409	569	379	193	72	18	4			
2008				2	1	9	45	238	492	466	376	196	76	24	2			
2009					2	10	60	202	350	351	268	164	78	17	3	2		
2010		1	2	2	7	23	82	157	258	187	120	61	32	7	3	2		
2011			1		3	4	51	60	70	44	30	22	9	7	1			
2012					5	24	105	159	211	192	104	49	25	3				

Recreational

None.

Oregon Data

Commercial otoliths by year and 2-cm length bins (some aged)

Year	Aged?	No length	< 30	30	32	34	36	38	40	42+
1966	no			14	40	48	51	28	14	9
1966	yes		13	71	288	419	293	180	82	52
1967	no		6	19	16	19	11	15	7	8
1967	yes		25	98	250	461	513	389	178	85
1968	no			1	4	20	14	10	2	1
1968	yes		18	88	330	523	515	406	214	137
1969	no			1		1	4			
1969	yes		49	199	423	512	497	333	207	124
1970	no			4	4	9	16	5	9	6
1970	yes		55	293	498	559	479	309	191	127
1971	no	1						1		
1971	yes	1201	11	27	50	119	89	51	28	24
1972	no		1	4	9	5	1	1		1
1972	yes	1	27	139	337	412	294	167	88	92
1973	no	1		1			2			
1973	yes		18	122	357	329	260	121	59	30
1974	no		4	5	33	39	14	7	3	2
1974	yes		36	57	162	204	208	112	53	48
1975	no			5	52	54	45	37	6	2
1975	yes		54	97	246	275	199	117	74	35
1977	no		7	38	100	118	95	38	19	11
1977	yes		114	202	376	397	335	230	116	72
1978	no		5	21	37	42	15	7	3	3
1978	yes		90	290	476	446	370	245	113	54
1979	no	9	5	34	113	113	83	45	12	11
1979	yes		23	145	251	275	191	120	51	29
1980	yes		107	465	623	590	385	216	124	103
1981	no		45	69	42	31	29	15	14	35
1981	yes		208	698	888	831	574	318	147	62
1982	no		93	79	24	9		1		70
1982	yes		263	682	901	798	459	247	92	62
1983	no		20	47	29	11	3			
1983	yes		96	273	378	304	208	90	47	23
1984	no		22	20	6	1				
1984	yes		58	137	189	126	76	44	24	7
1985	no		40	16	5	1				
1985	yes		139	247	276	194	129	40	14	12
1986	no		78	209	196	118	69	25	10	1

Year	Aged?	No length	< 30	30	32	34	36	38	40	42+
1986	yes		54	126	111	66	33	12	1	1
1987	no		77	72	79	59	36	26	9	6
1987	yes		241	287	298	232	90	31	12	3
1988	no		19	82	87	52	27	13	6	
1988	yes		63	156	206	126	70	28	11	8
1989	no		18	14	39	37	20	4	4	
1989	yes		63	292	370	233	137	50	16	4
1990	no		1			1				
1990	yes		71	230	326	252	130	28	10	
1991	no			1	1		1			
1991	yes		39	173	335	245	101	34	12	7
1992	yes		70	220	274	160	53	19	7	
1993	no		31	133	231	182	75	26	11	7
1993	yes		9	43	51	29	12	4	1	
1994	yes		72	228	253	158	82	34	3	8
1995	no		1		2					
1995	yes		90	165	138	103	47	21	12	8
1996	no		3	43	65	32	8	2	1	
1996	yes		120	210	193	130	44	5	5	2
1997	no		52	103	125	102	44	14	5	3
1997	yes		259	557	515	251	95	29	11	5
1998	no		215	418	383	186	67	16	6	4
1998	yes		55	142	138	68	38	12	4	4
1999	no		295	451	472	293	168	67	20	9
2000	no		188	402	457	247	115	39	11	10
2001	no		214	481	718	469	213	78	25	14
2001	yes		16	50	63	42	21	7	1	
2002	no		316	490	651	498	222	96	38	21
2002	yes		11	47	65	46	25	5	2	
2003	no		97	272	415	360	155	59	20	3
2003	yes		6	44	79	45	26	2	1	5
2004	no		67	218	395	333	191	62	21	6
2004	yes		2	27	69	48	40	13	4	
2005	no		105	365	526	407	215	89	31	13
2005	yes		15	44	54	47	29	12	1	1
2006	no		270	434	610	522	273	112	29	11
2007	no		54	118	237	281	203	129	47	10
2008	no		19	92	153	242	210	87	30	7
2009	no		62	136	242	255	202	98	42	8
2010	no	1	74	165	284	334	312	137	52	21

Year	Aged?	No length	< 30	30	32	34	36	38	40	42+
2011	no		98	147	204	190	167	77	41	66

Rex Sole

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1975	50		1994		
1976			1995		
1977			1996		
1978			1997		
1979	25		1998		
1980			1999		
1981			2000		
1982			2001		
1983	25		2002	26	
1984			2003	162	
1985			2004	52	
1986			2005	63	
1987			2006	94	
1988			2007	76	
1989			2008	151	
1990			2009	59	
1991			2010	1	
1992			2011	77	
1993			TOTAL	861	0

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46
1978									1	1							
1982												1					
2001							2	4	6	13	24	17	3				
2002				1	3	4	25	36	43	64	47	17	9	1			
2003		2		20	28	19	64	125	277	325	218	100	18	4			
2004						1	19	84	111	155	91	35	11	2			
2005			1	5	13	19	73	199	309	319	212	83	14	5			
2006			2	5	23	69	220	513	919	1095	689	347	107	30	5	1	
2007	1			2	9	41	159	368	743	688	435	179	48	14	1		
2008			1	1	5	53	212	498	799	781	485	193	52	17	7	2	
2009				3	4	11	35	165	348	474	282	134	58	38	10	1	1
2010				1	2	45	90	181	292	380	317	146	49	25	11	3	
2011				2	13	30	89	322	635	714	379	116	35	21	5		
2012		1		5	13	24	83	156	434	589	461	185	68	17	8	2	

Recreational – None.

<u>Oregon Data</u>

Commercial otoliths by year and 2-cm length bins (none aged)

Year	No Length	<26	26	28	30	32	34	36	38	40+
2006		2	23	39	63	55	18	11	6	1
2007		17	77	226	346	433	323	145	41	12
2008		13	58	206	322	354	280	142	50	14
2009		15	58	229	459	524	344	132	39	10
2010	1	14	52	221	614	698	419	194	50	19
2011		29	67	193	470	637	420	159	46	16

Sharpchin Rockfish

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1977	14		1993		
1978		1	1994		
1979	3	1	1995		
1980			1996		
1981			1997		
1982	13		1998		
1983	135		1999		
1984	90		2000		
1985	224		2001	1	
1986	26		2002	2	
1987			2003		
1988			2004		
1989			2005	27	
1990			2006		
1991	1		2007	2	
1992			TOTAL	538	2

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	56	82
1979							1		1		1								
1982					1	3		2	7										
1983					2	23	10	24	64	16	3	2							
1984					4	16	11	19	29	10	1								
1985				1	9	34	14	31	54	58	5	2	1	4					
1986					4	25	25	22	36	17	4	1							
1987				3	13	44	46	41	83	49	6		1	2	2	1			
1988				1	13	19	35	45	146	88	9								
1989				2	2	6	10	21	22	33	3	2							
1990				1	18	49	46	66	59	28	7	2	4						
1991			1		2	13	26	46	56	41	4			2			1		
1992				1	4	11	33	50	29	12	1	1		2	2				1
1993			1	2	6	16	19	42	30	9									
1994			1	9	79	156	103	93	74	34	8	3	2						
1995				6	23	71	116	63	57	31	9	2	3						
1996	1		2	15	22	53	141	104	67	25	5	11	5	4	3				
1997		1		2	9	38	130	120	64	12		1							
1998				1	17	23	77	61	25	6	1	1	2	1					
1999		1		2	38	52	34	21	10	3	1								
2000					2	8	6	14	5										
2001				3	13	16	3	3	1	1	1								
2002					9	14	13	5	2				1					1	
2005							7	17	2	1									
2007						1	2	1											

Recreational

Year	26	30
1978		1
1979	3	

<u>Oregon Data</u>

Commercial otoliths by year and 2-cm length bins (none aged)

Year	<24	24	26	28	30	32	34	36+
1995				2	8	6	6	4
1996	16	31	55	41	51	40	25	24
1997	21	94	144	105	69	48	32	13
1999	11	8	28	28	20	17	12	3
2001		2	4	20	3			
2003			4	5	3	1	2	
2004	1	4	14	11	11	44	45	16
2005				5	5	17	15	4
2007					4	7	10	1
2008				6	14	7	3	
2009			1		3	8	16	2
2010				1	13	18	12	2
2011	2	1	5	5	3	7	8	1

Stripetail Rockfish

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1976		40	1995		
1977	130	40	1996		
1978	137	24	1997		
1979	48	6	1998		
1980	41	4	1999		
1981	12	2	2000		
1982	142	6	2001	29	
1983	247	3	2002	3	
1984	294		2003		
1985	339		2004	10	
1986	9		2005	9	
1987	1		2006	7	
1988			2007		
1989			2008		
1990			2009	13	
1991			2010		
1992			2011	1	
1993			TOTAL	1472	125
1994					

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1978			3	4	2		2	9	13	46	39	11			2	
1979		1	4	7	12	5	2	7	34	41	24	2				
1980			1	2	3	2	1	7	19	14	2	1	1			
1981							1	1	5	2	2					
1982	1			1	2	3	5	13	30	52	43	1				
1983					1		1	9	47	116	71	9		1		
1984			2	4	6	5	4	8	45	127	85	7		1		
1985				4	5	6	22	39	74	120	93	9	1			
1986				1	3	4	15	24	58	89	52	1				
1987				5	1	9	13	29	37	66	45	1	1			1
1988						4	5	6	23	19	10	4				
1989					1	3	17	18	26	30	11	1				
1990		1	1	2	1	7	4	21	31	19	8	3				
1991			3	2	1	2	8	22	27	10	7			1		
1992			2		1			7	15	8	3					
1993		1		1	3	7	19	34	32	13	2					
1994			3	3	5	26	61	88	60	27	8	3	1			
1995				1	5	9	26	40	43	23	5					
1996		1		1	1	2	16	30	31	22	7					
1997		1	5	2	1	3	31	35	28	11	1					
1998		1	1	2	11	31	30	68	59	29	8	1				
1999			1	5	3	23	46	55	26	12	1					
2000					1	2	6	5		2						
2001		1		2		8	41	24	11	1						
2002				1		3	8	5	5	1						
2003								1								
2004		3	3	2	1	1										
2005				1		7	5	3	4	1						
2006								3	2	2						
2007						1		3	4	4	1					
2008							2		1							
2009					1	2	7	7								
2010									2							
2011							1									
2012		1	2	2	3	1	7	8	1		1					

Recreational

Year	20	22	24	26	28	30	36
1978	1	3	3	2	6	1	1
1979				4	4	4	
1980			1				
1981					1		
1982			1				

Oregon Data

Commercial otoliths by year and 2-cm length bins (none aged)

Year	20	22	24	26	28	30	32
2001				4	11	2	
2005				5	13	4	
2006		1	1	8	9	2	
2007				1			
2008	3		2	11	12	3	
2009				24	9	1	
2011		38	19	24	12	15	3

Vermilion Rockfish Complex

NOTE: The data for vermilion rockfish represent a complex of at least two species in southern California, vermilion rockfish (*Sebastes miniatus*) and sunset rockfish (*S, crocotulus*).

California Data

Otoliths (none aged)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1975	428		1994		
1976	553		1995		
1977	230	53	1996		
1978	17	39	1997		
1979	20	34	1998		
1980	15	58	1999		
1981	13	14	2000		
1982	53	56	2001	21	
1983	119	20	2002	1	
1984	129	25	2003	9	
1985	66	18	2004	2	
1986	19	4	2005	1	
1987			2006	8	
1988			2007	12	
1989			2008	2	
1990			2009	4	
1991			2010	4	
1992			TOTAL	1726	321
1993					

a/ Data not in RecFIN.

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	80
1978											1		1	2	5	7	5	6	2	1	1					1					
1979										1	1	5	27	32	39	49	58	94	82	48	29	31	11	5	1	2	2	1			
1980											3	18	44	82	112	105	111	106	86	59	39	33	8	6							
1981									4	7	29	72	109	127	122	97	118	92	49	43	32	5	2	1							
1982									2	1	3	9	33	71	65	56	47	50	28	30	17	7	3	1			1				
1983							1	3	2	2	4	4	11	11	23	27	27	22	30	15	13	9	5	8	7	13	10	4	5		
1984			1			7	4	12	10	6	3	10	26	22	30	26	22	27	27	27	8	7	7	4	1	2					
1985					2	3	2	3	2	4	5	14	13	39	44	66	63	52	52	45	37	19	7	7	2						
1986						4		5	7	11	10	18	30	56	68	80	65	66	54	43	24	14	7	2	3	4	1	2	1	1	1
1987							5	4	2	5	6	6	17	31	24	31	37	20	24	17	10	7	1	1							
1988					1			2	7	12	15	15	20	19	15	18	16	14	6	4	2	3	2	1							
1989					3	5	9	25	23	29	32	23	40	23	50	45	47	35	12	13	6	2	1	1							
1990					1	1	3	7	5	14	23	50	33	14	11	4	8	3	2	7	2	1	1	2							
1991					2	1	3	5	4	15	12	15	27	14	9	4	4	2	1	2	2		2	2	1	1					
1992			1	3	16	44	39	23	30	42	76	80	83	45	38	35	25	26	18	15	13	5	3		1						
1993			7	6	11	31	49	51	81	117	211	260	213	166	95	70	57	41	16	7	12	4	3								
1994	1	2	6	6	14	24	19	33	25	47	78	96	98	97	65	56	38	22	22	14	13	6	5	2							
1995			3	4	7	10	23	38	50	72	120	172	176	139	89	50	57	34	14	3	12	3	3	2							
1996			6	7	9	12	25	33	42	64	76	117	155	173	143	97	85	43	31	9	7	3	3	2							
1997		1	1	12	13	27	33	46	62	80	121	130	128	151	150	103	65	45	26	12	9	4	5	2							
1998				8	9	19	40	60	76	87	144	146	154	122	108	109	76	50	22	12	2	4	4								
1999		1	1	2	7	14	34	59	71	85	81	78	67	62	71	46	39	25	16	3	1										
2000	1				1		1	14	14	30	33	27	27	11	15	5	7	8	4												
2001			1			1	2	9	9	18	17	27	20	16	13	16	7	7		3		1									
2002					10	30	22	20	16	17	22	19	9	8	5	4		2	2	1			1								
2003								2	1	1	7	10	1	5	4	6	4	4	3	1				1							

Year	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	80
2004							1		1	1	3	11	9	11	10	13	5	5	5	2											
2005					1	1			1	1	5	3	5	10	14	9	8	7	1	4		1		1							
2006								2	6	18	24	28	14	18	18	9	11	5	1	2					1						
2007						2	5	2	7	14	22	33	33	41	43	22	19	7	3	2	1										
2008				2	1	6	4	7	7	11	19	18	22	28	13	17	13	6	4	1	1			1							
2009				1	6	14	13	8	4	14	15	16	27	36	41	26	20	8	5	2	1										
2010				3	4	11	5	15	22	13	11	7	8	18	12	8	5	2	1		2										
2011	1	3	10	16	14	35	43	28	24	13	4	10	6	11	4	8	4	3	1												
2012	1		2	6	12	8	20	23	26	20	15	12	3	3	4	4	4	4	1	2											

Recreational

Year	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	96
1978				1		2		1		2	4	1	8	2	3	4			2	1	
1979			1					7	4	2	8	8	4	10	12	12	11	3	1		1
1980			1			1	3	5	6	2	4	8	3	3	2	3					
1981							4	1	2	2	2	3	5	3	1	1					
1982	1	2		4				2	4		4	4	3	7	4	1			2		
1983		1	1	2	1		2	1	2		5	1	3	1	1						
1984		1	3	1	1	2	1	3	1	1	3	1	2	1	3						

Oregon Data

Commercial otoliths by year and 2-cm length bins (some aged)

Year	Aged?	No Length	<38	38	40	42	44	46	48	50	52	54	56+
1999	no		6	2	4			1	2	1		2	1
2000	no		10	9	16	9	4	3	5	5	3	2	2
2001	no		3	11	19	18	20	3	6	4		2	7
2001	yes		1	1	2	5	3	1	1				
2002	no		1	5	2	2	6	6	1	1		1	1
2002	yes		3	3		2		2		1	1		
2003	no				4	3	1	2	2				1
2003	yes		1	3	3	9	8	8	9	3	2	2	2
2004	no		1	6	2	2	3	2	1	2			
2004	yes		5	6	7	10	12	12	7	2	3		
2005	no		1	1	1	3	1	1	1		1		
2005	yes		1	1	5	6	6	5	8	6	3	3	3
2006	no				1	7	4	2		2	1		
2006	yes		1		1	3	5	5	9	10	1	1	3
2007	no			1	2	4	13	9	9	9	9	2	2
2008	no		2		1	2	2	9	3	8	5	1	5
2009	no		2	2	4	8	11	21	23	23	10	7	7
2010	no	1	1	1	3	3	6	8	10	25	12	10	8
2011	no		12	15	12	7	13	9	29	30	33	20	22

NWFSC Hook-&-Line Survey Data

Lengths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
16-17								1		1
18-19	1						3	1	4	9
20-21	1					4	2	15	5	27
22-23	2			2	1	3	6	24	11	49
24-25	2	1	5	7	3	5	13	19	13	68
26-27	4	8	6	10	10	6	14	28	28	114
28-29	13	17	11	13	15	10	28	62	44	213
30-31	19	23	16	20	13	31	19	49	46	236
32-33	38	29	36	30	32	29	16	53	57	320
34-35	36	48	38	56	37	54	28	63	59	419
36-37	54	69	70	58	65	49	32	61	49	507
38-39	88	61	59	103	106	55	63	65	65	665
40-41	103	104	77	116	127	116	90	88	79	900
42-43	65	102	90	128	120	147	141	170	106	1069
44-45	91	78	64	98	106	155	176	194	172	1134
46-47	99	65	31	96	94	165	219	153	121	1043
48-49	70	62	23	68	68	111	149	121	130	802
50-51	30	73	24	33	26	56	87	77	88	494
52-53	26	53	19	23	27	37	32	31	66	314
54-55	5	40	14	25	10	25	17	23	30	189
56-57	4	29	2	17	4	9	17	11	8	101
58-59	3	4	2	9	1	3	9	8	10	49
60-61		4		1			3	2	1	11
62-63	1	1			1		1	2		6
64-65					1					1
Totals	755	871	587	913	867	1070	1165	1321	1192	8741

All Otoliths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
16-17								1		1
18-19	1						3	1	4	9
20-21						4	2	13	5	24
22-23	2			2	1	3	6	23	11	48
24-25	2	1	5	7	3	5	13	17	13	66
26-27	3	8	6	10	10	6	14	26	28	111
28-29	11	17	11	13	15	10	26	62	42	207
30-31	14	23	16	20	13	31	19	48	46	230
32-33	33	29	36	30	32	29	16	53	57	315
34-35	31	48	37	56	37	54	28	63	59	413
36-37	44	69	70	56	64	49	32	61	49	494
38-39	79	61	59	103	106	55	63	65	65	656
40-41	84	99	77	116	127	116	90	88	79	876
42-43	54	99	89	128	120	147	140	170	106	1053
44-45	73	71	62	98	106	155	176	192	172	1105
46-47	84	60	31	96	94	164	218	153	119	1019
48-49	62	58	23	68	68	111	149	121	130	790
50-51	29	63	24	33	26	56	87	77	88	483
52-53	24	48	19	23	27	37	32	31	66	307
54-55	4	39	14	25	10	25	17	23	30	187
56-57	4	21	2	17	4	9	17	11	8	93
58-59	3	3	2	9	1	3	9	8	10	48
60-61		4		1			3	2	1	11
62-63	1	1			1		1	2		6
64-65					1					1
Totals	642	822	583	911	866	1069	1161	1311	1188	8553

Aged Otoliths

Age (years)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
1	1									1
2	5	1			2	6	7	2		23
3	1	8	14	13	6	11	28	10		91
4	6	5	10	8	14	19	4	29		95
5	9	8	5	13	7	22	6	25		95
6	7	11	3	10	3	6	12	6		58
7		8	4	6	3	8	9	4		42
8		5	6	5	6	7	9	3		41
9	3	3	6	6	4	21	9	4		56
10	1	6	2	5	4	21	28	4		71
11	5	12	2	5	3	15	17	3		62
12	3	8	2	2	1	10	21	4		51
13	5	7		9	2	6	13	4		46
14	5	5	7	5	6	12	8	1		49
15	6	10	3	10	5	11	8	6		59
16	7	22	3	5	7	10	12			66
17	3	11	4	8	3	4	11	2		46
18	2		3	10	6	7	4	2		34
19	2	3		4		5	3	1		18
20		2	2	3	1	6	3	1		18
21		6		3	1	4	4			18
22			3	4	2	1	3			13
23	2	1	2	1	3	2	4			15
24						2	1			3
25	1			2		4	3			10
26		1			2		3			6
27		2			1	1	4			8
28				1						1
29					1		1			2
30				2		3				5
31				1	1		1			3
32							1			1
33	1	1					1			3
35		1			1					2
39							1			1
42	1		1							2
44		1								1
45		1								1
46							1			1

Age (years)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
49	1									1
51		1								1
52							1			1
54		2								2
58							1			1
61							1			1
63	1									1
Totals	78	152	82	141	95	224	243	111	0	1126

Maturity

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
18-19							3		1	4
20-21							1		2	3
22-23							3	2	4	9
24-25							5	2	3	10
26-27						1	7	6	4	18
28-29							12	19	8	39
30-31						2	7	16	18	43
32-33						2	2	13	13	30
34-35						9	10	11	13	43
36-37						5	14	11	11	41
38-39						3	17	10	19	49
40-41						9	21	7	7	44
42-43						4	32	8	13	57
44-45						8	26	8	5	47
46-47						15	22		10	47
48-49						12	24		5	41
50-51						6	15		4	25
52-53						3	3		4	10
54-55						7	7		1	15
56-57						3	8			11
58-59						1	4			5
60-61							1			1
Totals	0	0	0	0	0	90	244	113	145	592

Yellowtail Rockfish

California Data

Otoliths (some aged – see table on next page)

Year	Comm.	Rec. a/	Year	Comm.	Rec. a/
1973	89		1993	233	
1974			1994	441	
1975			1995	2	
1976			1996		
1977	80	1943	1997		
1978	135	877	1998		
1979	25	164	1999		
1980	105	436	2000	33	
1981	199	240	2001	180	
1982	265	560	2002	91	
1983	1033	370	2003	59	
1984	1517		2004	64	
1985	883	358	2005	79	
1986	624	7	2006	93	
1987	781		2007	81	
1988	302		2008	74	
1989	698		2009	6	
1990	346		2010	4	
1991	515		2011	29	
1992	537		TOTAL	9603	4955

a/ Data not in RecFIN.

Yellowtail rockfish, number of aged otoliths from commercial fishery, by year and age.

Year	Age (years)																					
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1980			3	3	4	9	8	11	14	21	6	16	10	8	7	5	1			1			
1981			2	3	8	11	8	8	23	15	16	22	18	12	10	11	1	2	2	1			1
1982		1	1	21	10	21	26	7	14	28	23	18	15	16	18	8	12	13	10	5	1	3	2
1983			10	14	50	40	41	31	21	29	25	15	24	12	20	18	14	17	11	17	14	10	7
1984	1	4	19	37	63	141	123	98	38	31	34	17	22	36	19	14	22	10	19	14	11	19	15
1985		1	22	23	44	39	50	49	34	25	26	26	30	32	48	22	33	23	18	18	23	14	13
1986		1	12	32	17	22	42	47	42	43	28	26	17	30	39	29	16	27	31	21	21	14	17
1987		1	7	21	27	22	6	12	11	7	4	4	2	4	3	2	2	3	6	2	3		3
1988	1	3	3	10	22	27	14	14	10	14	6	7	5	7	3	4	4	2	2	4	1	2	3
1989	2	31	71	38	48	89	68	55	39	32	30	26	26	9	9	15	10	10	8	13	10	11	6
1990			29	47	31	24	53	47	29	26	20	20	15	11	7	6	2	2	3		5	3	4
1991		4	26	64	125	34	19	56	39	18	16	22	13	15	8	9	3	1	9	5	7	6	5
1992	2	3	12	20	61	127	13	30	55	30	16	17	15	3	15	14	7	8	5	10	2	6	7
1993		1	4	9	9	18	24	3	10	10	7	5	8	6	5	4		1	1	2	2	1	1
1994			3	25	30	21	59	66	2	13	38	22	8	11	16	2	1	7	2	1	1	6	1
1995			4	11	13	15	13	20	29	8	10	11	8	5	4	1	1	1			2	3	3
1996	1	3	52	79	63	56	51	52	44	49	23	22	15	10	11	7	4	5	2	6	2	2	1
1997			2	9	14	22	25	30	21	28	18	13	12	10	9	3	4	7	2	5	4	1	1
1998				1	8	12	13	16	19	15	25	13	12	4	7	3	1	2	3	2	2	1	2
1999			3	26	12	34	28	21	17	17	7	22	20	5	7	3	9	4	2		3		1
2000			1		9	6	7		4	4		2		1				1					
2001		1	3	5	14	27	12	4	40	18	13	7	3	1	7	9	2	3	2		1	1	
2002	12	24	8	2	5	4	9	3		1		1		1		1							

Yellowtail rockfish, number of aged otoliths from commercial fishery, by year and age, continued.

Year	Age (years)																					
	26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**45**	**46**	**48**	**49**	**TOTAL**
1980																							127
1981																							174
1982	2						1																276
1983	4	7	5	3	2	2	3	3	1	2		1		1									474
1984	4	1	2	3	4	1	3	1	2	1	2	1	4	1	2		2	1	1	2	1		846
1985	5	3	2	2	3	2	4	2			1		1			1	1	1	1				642
1986	21	11	4	4	4	7	7	5	7	5	6	2	2	2	1	1	1						664
1987	1	2	1	2	1		2					1											162
1988	2	1	2					2	1								1						177
1989	7	8	2	5	1	3		1	1		1	1						1					687
1990	4	2		2	2	2	1			1	1				1								400
1991	3	2	4	6	3	1		2	1						1							1	528
1992	9	4	5	4	6	4	7		4	2	2	1			1		1					1	529
1993		1	2		1		2	2	1			1											141
1994	1	1	3	1	7		3	3	1														355
1995	1	1		1		1	1																167
1996	1	6	1	2	1	2					1			1								1	576
1997	2		1	1				1															245
1998			2	3		1	1			1													169
1999		1			1	3		1				1	1		1	1							251
2000																							35
2001	2			1	1						1				1								179
2002																							71

Raw length frequency distributions by fishery, year, and 2-cm length bin

Commercial

Year	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	64
1978					1		1		6	22	26	42	49	38	23	31	16	13	9	7		
1979						1	4	3	6	8	18	31	28	24	17	17	4	4	1	1		
1980								3	4	2	7	25	25	24	16	17	11	6	3			
1981						2		7	6	18	34	55	61	45	55	22	9	5	2			
1982					1	2	1	4	12	21	31	57	65	54	37	26	13	6				
1983						6	11	15	16	43	75	113	113	87	49	27	13	2	5	1		
1984					2	10	21	31	40	76	128	190	181	118	78	48	19	6	2			
1985					1	3	16	35	37	79	110	195	244	177	131	64	42	9	2			1
1986		1			3	12	10	22	41	51	99	136	157	114	70	51	17	3	1			
1987				1	2	3	5	16	35	57	52	45	45	36	20	8	3	1				
1988				1	2	4	6	20	57	44	36	53	39	20	21	14	3	1				
1989				1	4	34	32	51	111	132	126	133	100	89	48	24	13	3				
1990					3	18	35	47	80	76	87	74	71	50	26	18	6	1				
1991		1		1	8	25	67	99	131	158	150	110	79	76	38	18	7	1			1	
1992		8	42	71	99	128	245	319	375	475	470	411	284	192	141	57	14	6	1	1		
1993		9	37	82	136	191	193	220	272	277	199	201	103	81	40	11	9	1		1		
1994	3	23	17	31	60	171	288	339	418	435	460	365	275	156	65	37	14					
1995			4	12	22	67	103	135	167	187	166	150	95	45	38	20	5	1	2			
1996			4	25	58	95	129	144	199	201	207	159	129	70	50	9	8	2				
1997	1	1	8	9	29	41	85	112	137	172	164	127	126	72	38	14	6	1				
1998					6	43	76	129	170	225	203	184	158	80	35	25	7	2		1		
1999		3	4	15	15	29	64	85	83	94	108	75	46	24	11	2						
2000					1	9	18	18	44	68	64	38	27	13	3							
2001						8	7	7	27	53	87	62	48	30	17	6	1					
2002			12	1	14	11	9	6	16	14	7	14	2	3								
2003						2	3	1	4	6	13	16	9	11	6	2	1	1				
2004						2	5	6	3	4	15	13	24	9	10	4						
2005					1	2	2	5	8	16	13	19	15	14	5	5	2		1			

Year	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	64
2006		1		3	5	5	11	14	14	13	27	30	19	15	21	3	2					
2007							5	17	25	23	22	19	39	25	12	5	4					
2008				5	3	5	2	5	11	10	12	18	13	15	10	8	1		1			
2009				2	1	2	1	2	1	14	21	34	17	18	5	7	1	1				
2010								1		1	3		1	1								
2011					2	6	13	15	20	7	7	1	1	2								
2012		1		1	19	31	29	24	14	15	16	6	2	2	1	1						

Recreational

Year	10	16	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	98
1978			3	8	17	42	52	54	42	47	87	156	292	354	311	179	74	29	2	5	1	1	1	13
1979	1			7	27	37	79	93	103	91	86	153	251	304	248	216	100	46	13					4
1980				3	22	40	63	115	85	106	80	100	130	177	152	87	57	14	7	4				
1981			3	5	13	15	24	45	52	85	63	55	108	117	117	62	63	17	4	2				
1982				3	7	34	71	104	90	91	103	117	148	173	185	126	83	30	10	6				
1983		1	2	3	6	29	42	72	61	72	83	118	206	209	137	83	48	19	6		1			
1984				10	24	27	26	33	30	27	33	52	60	109	103	67	36	14	5	2				

Oregon Data

Commercial otoliths by year and 2-cm length bins (some aged)

Year	Aged?	No length	< 36	36	38	40	42	44	46	48	50	52	54+
1972	no				1	5	8	21	15	4	7	6	
1972	yes		3	7	26	85	185	226	182	118	83	55	20
1973	no						1	7	10	22	10	4	3
1973	yes			1	4	18	44	65	71	60	34	20	1
1974	no			1			1	1			1		1
1974	yes		6	4	5	21	55	75	55	17	7	13	
1976	no		4	21	52	44	58	60	49	54	36	14	9
1976	yes		2	6	18	27	11	14	9	7	3	2	
1977	no					1	5	3	3	2	1	2	2
1977	yes		2	4	9	48	118	193	242	174	122	82	36
1978	no		4	2	13	9	12	18	17	16	12	7	1
1978	yes		8	5	10	27	46	59	84	64	42	15	13
1979	no		6	13	21	24	40	80	60	36	16	9	8
1979	yes		10	20	46	53	98	163	162	112	65	29	29
1980	no								1	1	3		
1980	yes		14	21	23	29	60	125	168	174	93	55	31
1981	no			1	1	1	4	4	1	1	4	2	
1981	yes		42	52	79	113	120	179	158	118	74	33	13
1982	no		78	73	47	42	47	55	67	52	31	18	11
1982	yes		91	105	143	191	210	223	260	171	94	66	26
1983	no				1	2			1			1	
1983	yes		10	12	31	45	46	43	42	35	12	11	7
1984	no		3	6	21	23	22	14	11	5		1	1
1984	yes	1	100	103	136	226	216	177	122	55	30	22	4
1985	no		4	2	21	68	93	106	80	51	25	12	3
1985	yes		6	48	117	314	402	499	393	231	88	45	44
1986	no		2	2	5	30	72	66	95	60	21	11	3
1986	yes	1	18	14	54	155	248	264	263	180	106	50	28
1987	yes		92	85	118	224	352	413	383	213	96	45	20
1988	yes		88	55	119	179	323	298	245	196	103	45	19
1989	no						1	1					
1989	yes		93	85	101	183	313	386	324	300	207	87	24
1990	no		1		3		1	1	1	1	1		1
1990	yes		90	107	152	181	305	340	243	189	123	45	17
1991	no				1		2	2	1				1
1991	yes		22	83	111	144	191	242	184	130	113	54	15
1992	no			2	4	5	13	17	4	2	15	4	
1992	yes		54	99	225	383	480	447	298	220	145	57	16

Year	Aged?	No length	< 36	36	38	40	42	44	46	48	50	52	54+
1993	no				4	11	7	9	5	3	2		
1993	yes		63	93	189	360	401	355	232	152	84	39	13
1994	no					2		1		1			
1994	yes		63	123	302	436	534	452	331	230	95	57	14
1995	no		1	3		5	5	7	5	8	2		3
1995	yes		98	159	285	401	426	380	249	146	85	23	11
1996	no		14	11	13	16	9	4	1				
1996	yes		217	197	251	383	420	357	221	105	60	28	12
1997	no		84	48	50	51	27	25	29	19	16	7	3
1997	yes	2	332	317	401	532	631	552	415	283	194	73	32
1998	no	15	26	24	50	38	48	41	33	12	11		1
1998	yes		198	282	422	511	534	445	271	153	71	23	7
1999	no		35	26	28	32	35	25	10	3	1		
1999	yes		158	314	600	658	662	474	304	145	63	27	8
2000	no		18	21	25	26	24	14	10	7		2	
2000	yes	2	147	207	373	621	614	429	250	141	63	10	6
2001	no		4	16	17	13	16	13	3		1		
2001	yes		38	136	319	491	590	519	393	205	95	41	16
2002	no		1	2	2		4	1	7	10	6		
2002	yes		68	101	214	290	278	219	156	107	41	21	10
2003	no		6	6	20	28	19	13	10	9	4	2	
2003	yes		7	5	22	55	105	119	99	99	50	20	3
2004	no		1	1		5	9	9	14	10	8	6	
2004	yes		104	94	108	134	158	187	169	147	106	43	28
2005	no		1	2	2	17	14	14	11	13	9	4	1
2005	yes		18	40	65	113	147	151	134	92	75	37	20
2006	no		5	9	2	4	2	4		1	2		
2006	yes		59	83	100	134	215	157	175	139	101	47	12
2007	no		17	27	52	71	76	118	96	104	91	52	17
2007	yes		32	16	21	28	50	87	66	60	62	37	16
2008	no		5	3				1				1	
2008	yes		19	17	29	41	53	112	100	86	56	37	14
2009	no		6	3	7	24	23	48	52	21	19	12	2
2009	yes		9	7	17	52	68	111	127	92	77	51	27
2010	no		4	4	10	12	45	114	119	83	81	56	30
2010	yes		14	9	27	68	153	209	187	163	130	81	39
2011	no		8	9	14	21	67	112	142	129	155	105	49
2011	yes		50	8	21	56	102	178	165	165	142	92	26

NWFSC Hook-&-Line Survey Data

Lengths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
18-19									1	1
20-21	3								1	4
22-23	5							1		6
24-25	2	7	1	1	1		1	12	1	26
26-27	2	7	8	1	2			33		53
28-29	1	4	9	2	4		1	13	7	41
30-31	8	2	8	5	9	3		2	19	56
32-33	17	11	2		9	3	3	1	33	79
34-35	21	9	6	4	10	6	10	1	1	68
36-37	9	23	5	8	12	8	5	2	1	73
38-39	5	20	11	9	14	8	11	9	1	88
40-41	5	4	17	11	18	14	12	18	5	104
42-43	10	6	7	27	30	10	5	10	14	119
44-45	16	7	6	29	11	10	6	12	13	110
46-47	18	8	3	12	11	6	6	7	4	75
48-49	3	9	3	6	5	7	1	3	2	39
50-51	1	4	2	4	3	5		1	3	23
52-53		1						1		2
Totals	126	122	88	119	139	80	61	126	106	967

All Otoliths

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
18-19									1	1
20-21	2								1	3
22-23	4									4
24-25	3	7	1	1	1				1	14
26-27	3	7	8	1	2					21
28-29		4	9	2	4				7	26
30-31	6	2	8	5	9	3			19	52
32-33	17	11	2		9	3			32	74
34-35	21	9	6	4	10	6			1	57
36-37	7	23	5	8	12	8			1	64
38-39	7	20	11	9	14	8			1	70
40-41	5	4	17	11	18	14			5	74
42-43	9	6	7	27	30	10			14	103
44-45	15	7	6	29	11	10			13	91
46-47	17	8	3	12	11	6			4	61
48-49	7	9	3	6	5	7		1	2	40

Fork Length (cm)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
50-51	1	4	2	4	3	5			3	22
52-53		1								1
Totals	124	122	88	119	139	80	0	1	105	778

Aged Otoliths

Age (years)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
2	4									4
3	7									7
4	4									4
5	37									37
6	16									16
7	2									2
8	1									1
9	1									1
10	1									1
11	12									12
12	6									6
13	5									5
14	10									10
15	6									6
16	5									5
17	1									1
18	2									2
20	2									2
21	1									1
28	1									1
Totals	124	0	0	0	0	0	0	0	0	124

Status of the darkblotched rockfish resource off the continental U.S. Pacific Coast in 2013

by

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DRAFT
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Executive Summary

Stock

Darkblotched rockfish (*Sebastes crameri*) in the Northeast Pacific Ocean occur from the southeastern Bering Sea and Aleutian Islands to near Santa Catalina Island in southern California. This species is most abundant from off British Columbia to Central California. Commercially important concentrations are found from the Canadian border through Northern California. This assessment focuses on the portion of the population that occurs in coastal waters of the western United States, off Washington, Oregon and California, the area bounded by the U.S.-Canada border on the north and U.S.-Mexico border on the south. The population within this area is treated as a single coastwide stock, due to the lack of biological and genetic data supporting the presence of multiple stocks.

Catches

Darkblotched rockfish has always been caught primarily with commercial trawl gear, as part of a complex of slope rockfish, which includes Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), yellowmouth rockfish (*Sebastes reedi*), and sharpchin rockfish (*Sebastes zacentrus*). Catches taken with non-trawl gear over the years comprised less than 2% of the total coastwide domestic catch. This species has not been taken recreationally.

Catch of darkblotched rockfish first became significant in the mid-1940s when balloon trawl nets (efficient in taking rockfish) were introduced, and due to increased demand during World War II. The largest removals of the species occurred in the 1960s, when foreign trawl fleets from the former Soviet Union, Japan, Poland, Bulgaria and East Germany came to the Northeast Pacific Ocean to target large aggregations of Pacific ocean perch, a species that co-occurs with darkblotched rockfish. In 1966 the removals of darkblotched rockfish reached 4,220 metric tons. By the late-1960s, the foreign fleet had more or less abandoned the fishery. Domestic landings of darkblotched rockfish rose again between the late-1970s and the late-1980s, peaking in 1987 with landings of 2,415 metric tons. In 2000, the species was declared overfished, and landings substantially decreased due to management regulations. During the last decade the average landings of darkblotched rockfish made by the domestic trawl fishery was around 120 metric tons. Since the mid-1970s, a small amount of darkblotched rockfish has been also taken as bycatch in the at-sea Pacific hake fishery, with a maximum annual removal of 49 metric tons that occurred in 1995.

In this assessment, removals are divided between two fleets, which include the domestic trawl fishery and bycatch in foreign Pacific ocean perch and at-sea Pacific hake fisheries. Reconstructed removals of darkblotched rockfish bycatch in the Pacific ocean perch and at-sea hake fisheries represent total catch that includes both retained and discarded catch. Discards in the domestic trawl fishery were explicitly modeled in the assessment; total catches were estimated simultaneously with other model parameters and derived quantities of management interest.

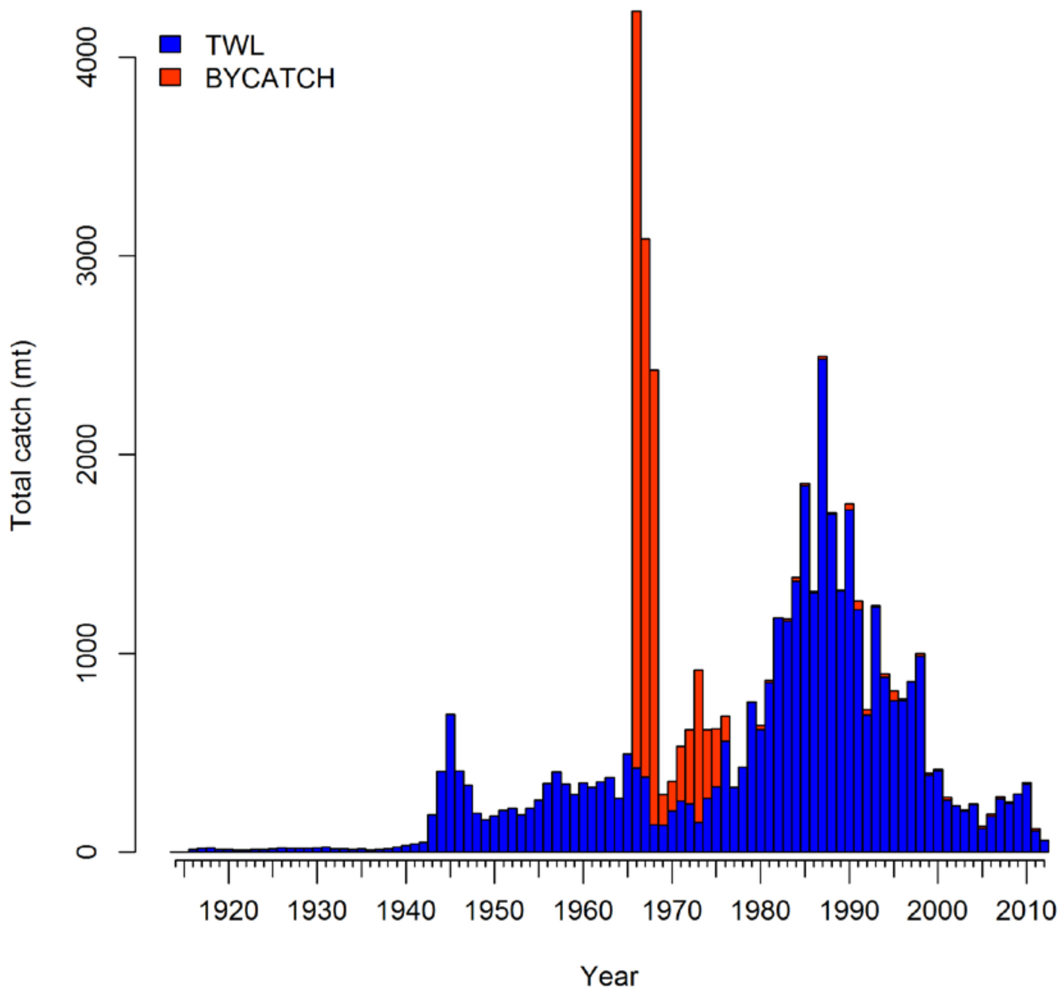

Figure ES-1: Darkblotched rockfish landings history between 1915 and 2012 by fleet (TWL = domestic trawl fleet, BYCATCH = darkblotched rockfish bycatch in Pacific ocean perch and at-sea Pacific hake fisheries).

Table ES-1: Recent darkblotched rockfish landings (mt) by component that comprised two fleets used in the assessment (domestic trawl removals by all three states were combined into TWL fleet and bycatch in foreign POP and at-sea hake fisheries were combined into BYCATCH fleet).

Year	Domestic trawl California	Domestic trawl Oregon	Domestic trawl Washington	Bycatch in foreign POP fishery	Bycatch in at-sea hake fishery	Total
2003	11	62	2	0	4	80
2004	39	136	7	0	7	189
2005	18	68	1	0	11	98
2006	23	71	2	0	11	107
2007	41	87	3	0	12	144
2008	34	74	3	0	6	117
2009	47	89	2	0	0	138
2010	17	152	7	0	8	184
2011	3	87	14	0	12	117
2012	7	70	15	0	2	94

Data and assessment

The last full assessment of darkblotched rockfish was conducted in 2007. The 2007 full assessment was subsequently updated in 2009 and 2011. This assessment uses the Stock Synthesis modeling framework developed by Dr. Richard Methot at the NWFSC. The most recent version (SSv3.24o, distributed on April 10, 2013) was used, since it included improvements in the output statistics for producing assessment results and several corrections to older versions.

The data used in the assessment include landings, length and age compositions from the retained commercial catch and, in recent years, discard ratios, length and age compositions as well as mean individual body weight of the discards. Also, data from four National Marine Fisheries Service (NMFS) bottom trawl surveys are used to estimate indices of relative stock abundance and generate length and age frequency distributions for each survey. The Northwest Fisheries Science Center (NWFSC) shelf-slope survey covers the period between 2003 and 2012 and provides information on the current trend of the stock. Three other surveys (which are discontinued) include the NWFSC slope survey (1999- 2002), the AFSC slope survey (1997-2001), and the AFSC shelf triennial survey (1980-2004).

The modeling period in the assessment begins in 1916, assuming that in 1915 the stock was in an unfished equilibrium condition. Females and males are treated separately to account for sexual dimorphism in growth exhibited by the species. Growth is assumed to follow the von Bertalanffy growth model, and the assessment explicitly estimates most parameters describing growth for both sexes. Externally estimated life history parameters, including those defining the weight-length relationship, female fecundity and maturity schedule, have been revised since the last assessment using the newest data available.

Recruitment dynamics are assumed to follow the Beverton-Holt stock-recruit function. Natural mortality is fixed at the value of 0.05 yr^{-1} for females and estimated for males.

Stock spawning output

The darkblotched rockfish assessment uses a non-proportional egg-to-weight relationship, and the spawning output is reported in the number of eggs. The unexploited level of spawning stock output is estimated to be 3,358 million eggs (95% confidence interval: 2,603-4,114 million eggs). At the beginning of 2013, the spawning stock output is estimated to be 1,214 million eggs (95% confidence interval: 414-2,013 million eggs), which represents 36% of the unfished spawning output level.

The spawning output of darkblotched rockfish started to decline in the 1940s, during World War II, but exhibited a sharp decline in in the 1960s during the time of the intense foreign fishery targeting Pacific ocean perch. Between 1965 and 1975, spawning output dropped from 89% to less than 57% of its unfished level. Spawning output continued to decline throughout the 1980s and 1990s and in 1999 reached its lowest estimated level of 13% of its unfished state. Since 2000, the spawning output has been slowly increasing, which corresponds to decreased removals due to management regulations.

Table ES-2: Recent trends in estimated darkblotched rockfish spawning biomass, recruitment and relative depletion.

Year	Spawning stock output (million eggs)	~95% confidence interval	Estimated recruitment (1000s)	~95% confidence interval	Estimated depletion	~95% confidence interval
2004	583	234-932	3,265	1,180-5,350	17%	9-26%
2005	648	253-1,044	3,004	1,042-4,966	19%	9-29%
2006	738	286-1,189	2,061	650-3,471	22%	11-33%
2007	818	312-1,324	1,434	383-2,486	24%	12-37%
2008	879	325-1,433	6,674	2,159-11,190	26%	12-40%
2009	937	338-1,536	1,216	206-2,226	28%	13-43%
2010	996	349-1,642	1,800	220-3,380	29%	13-46%
2011	1,054	357-1,751	2,858	0-6,154	31%	14-49%
2012	1,131	384-1,879	870	0-2,117	33%	15-53%
2013	1,214	414-2,013	2,254	0-5,691	36%	16-56%

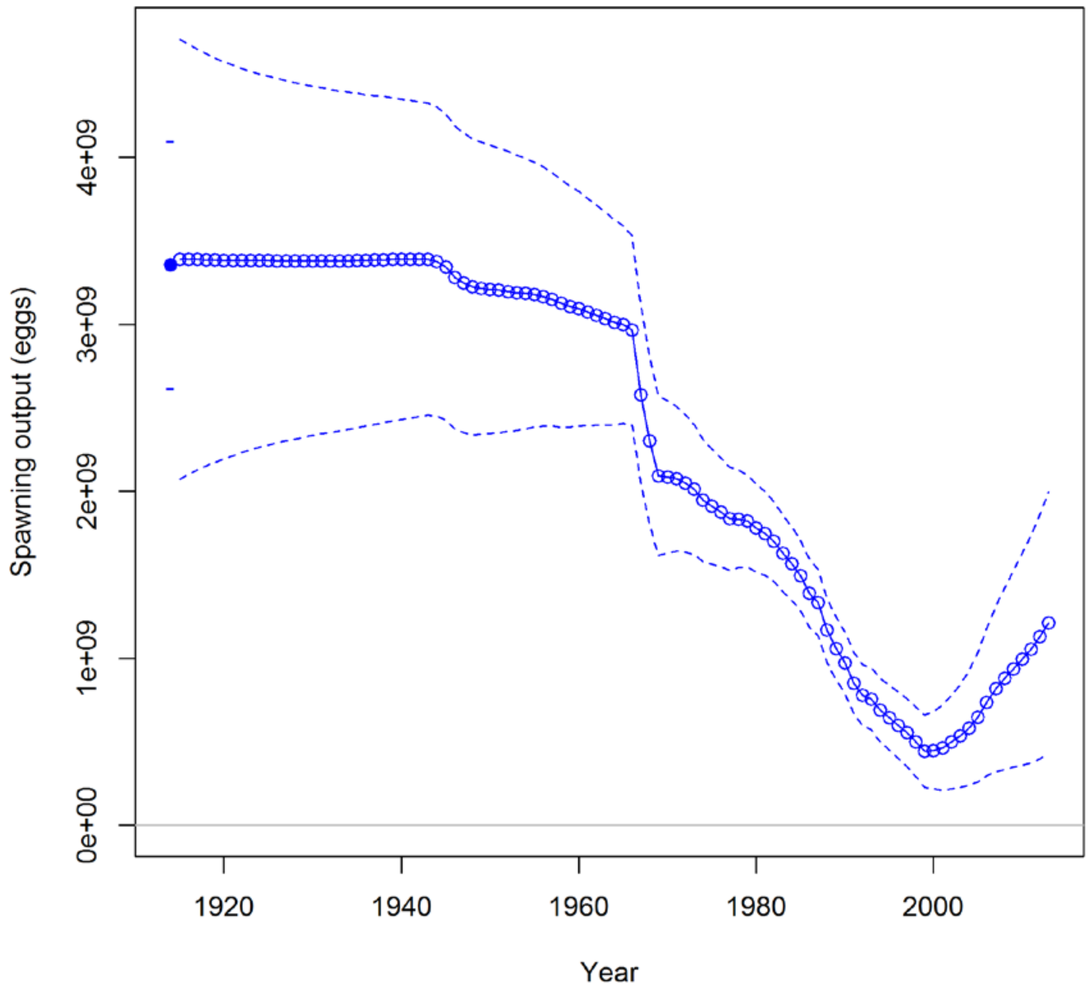

Figure ES-2: Estimated spawning biomass time-series (1915-2013) for the base-case model (circles) with ~ 95% interval (dashed lines).

Recruitment

Recruitment dynamics are assumed to follow a Beverton-Holt stock-recruit function. The level of virgin recruitment is estimated in order to assess the magnitude of the initial stock size. 'Main' recruitment deviations were estimated for modeled years that had information about recruitment, between 1960 and 2011 (as determined from the bias-correction ramp). We additionally estimated 'early' deviations between 1870 and 1959 so that age-structure in the initial modeled year (1915) would deviate from the stable age-structure. The Beverton-Holt steepness parameter (*h*) is fixed in the assessment at the value of 0.779, which is the mean of steepness prior probability distribution, derived from this year's meta-analysis of Tier 1 rockfish assessments.

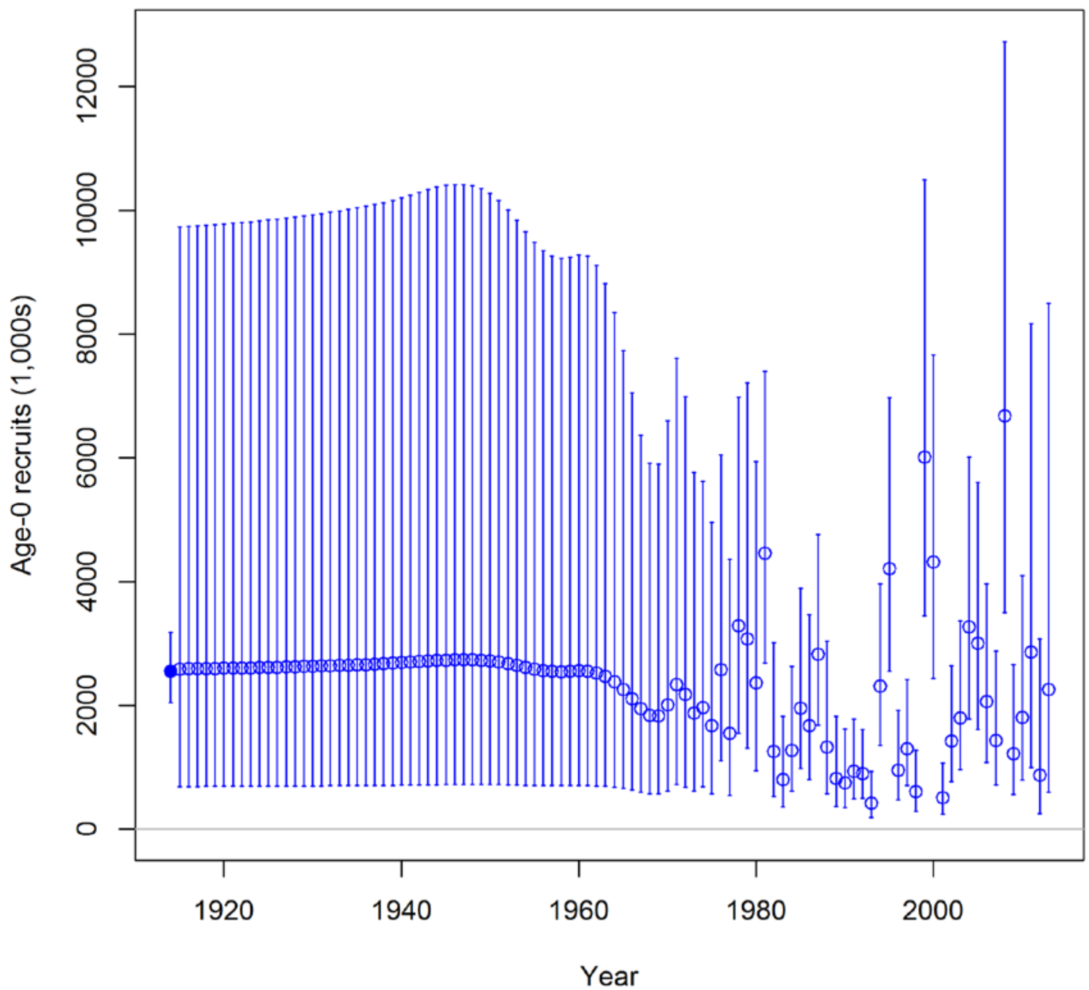

Figure ES-3: Time series of estimated darkblotched rockfish recruitments for the base-case model (solid line) with ~95% intervals (vertical lines).

Reference points

Unfished spawning stock output for darkblotched rockfish was estimated to be 3,358 million eggs (95% confidence interval: 2,603-4,114 million eggs). The stock is declared overfished if the current spawning output is estimated to be below 25% of unfished level. The management target for darkblotched rockfish is defined as 40% of the unfished spawning output ($SB_{40\%}$), which is estimated by the model to be 1,343 million eggs (95% confidence interval: 1,041-1,646), which corresponds to an exploitation rate of 0.0402. This harvest rate provides an equilibrium yield of 675 mt at $SB_{40\%}$ (95% confidence interval: 526-824 mt). The model estimate of maximum sustainable yield (MSY) is 742 mt (95% confidence interval: 578-906 mt). The estimated spawning stock output at MSY is 819 million eggs (95% confidence interval: 635-1,003 million of eggs). The exploitation rate corresponding to the estimated SPR_{MSY} of $F_{30\%}$ is 0.0665.

Table ES-3. Summary of reference points for the base case model.

Quantity	Estimate	~95% Confidence Interval
Unfished Spawning output (million eggs)	3,358	2,603-4,114
Unfished age 1+ biomass (mt)	36,171	28,181-44,161
Unfished recruitment (R0)	2,549	1,970-3,127
Depletion (2013)	36%	16-56%
Reference points based on $SB_{XX\%}$		
Proxy spawning output ($B_{40\%}$)(million eggs)	1,343	1,041-1,646
SPR resulting in $B40_{\%}$ ($SPR_{40\%}$)	44%	NA
Exploitation rate resulting in $B_{40\%}$	4.02%	3.96-4.08%
Yield with $SPR50_{\%}$ at $B_{40\%}$ (mt)	675	526-824
Reference points based on SPR proxy for MSY		
Spawning output (million eggs)	1,550	1,201-1,899
SPR_{proxy}	50%	NA
Exploitation rate corresponding to SPR_{proxy}	3.3%	3.25-3.35%
Yield with SPR_{proxy} at SB_{SPR} (mt)	625	487-763
Reference points based on estimated MSY values		
Spawning output at *MSY* (SB_{MSY}) (million eggs)	819	635-1,003
SPR_{MSY}	30%	29.38-30.13%
Exploitation rate corresponding to SPR_{MSY}	6.65%	6.47-6.83%
MSY (mt)	742	578-906

Exploitation status

The assessment shows that the stock of darkblotched rockfish off the continental U.S. Pacific Coast is currently at 36% of its unexploited level. This is above the overfished threshold of $SB_{25\%}$, but below the management target of $SB_{40\%}$ of unfished spawning biomass. Historically, the spawning output of darkblotched rockfish dropped below the $SB_{40\%}$ target for the first time in 1987, as a result of intense fishing by foreign and domestic fleets. It continued to decline and reached the level of 13% of its unfished output in 1999. Since 2000, when the stock was declared overfished, the spawning output was slowly increasing primarily due to management regulations instituted for the species.

This assessment estimates that the 2012 SPR is 86%, while the SPR-based management fishing mortality target is 50%. For the last 10 years, the relative SPR ratio (calculated as $1\text{-}SPR/1\text{-}SPR_{Target=0.50}$) was below one, which means that overfishing of darkblotched rockfish has not been occurring. Historically, the darkblotched rockfish has been fished beyond the SPR-based target between 1966 and 1968, during the peak years of the Pacific ocean perch fishery and for a prolonged period between from 1981 and 2002. In the early-1970s the estimated darkblotched rockfish SPR ratio remained near the SPR target but exceeded it in 1973 and 1979.

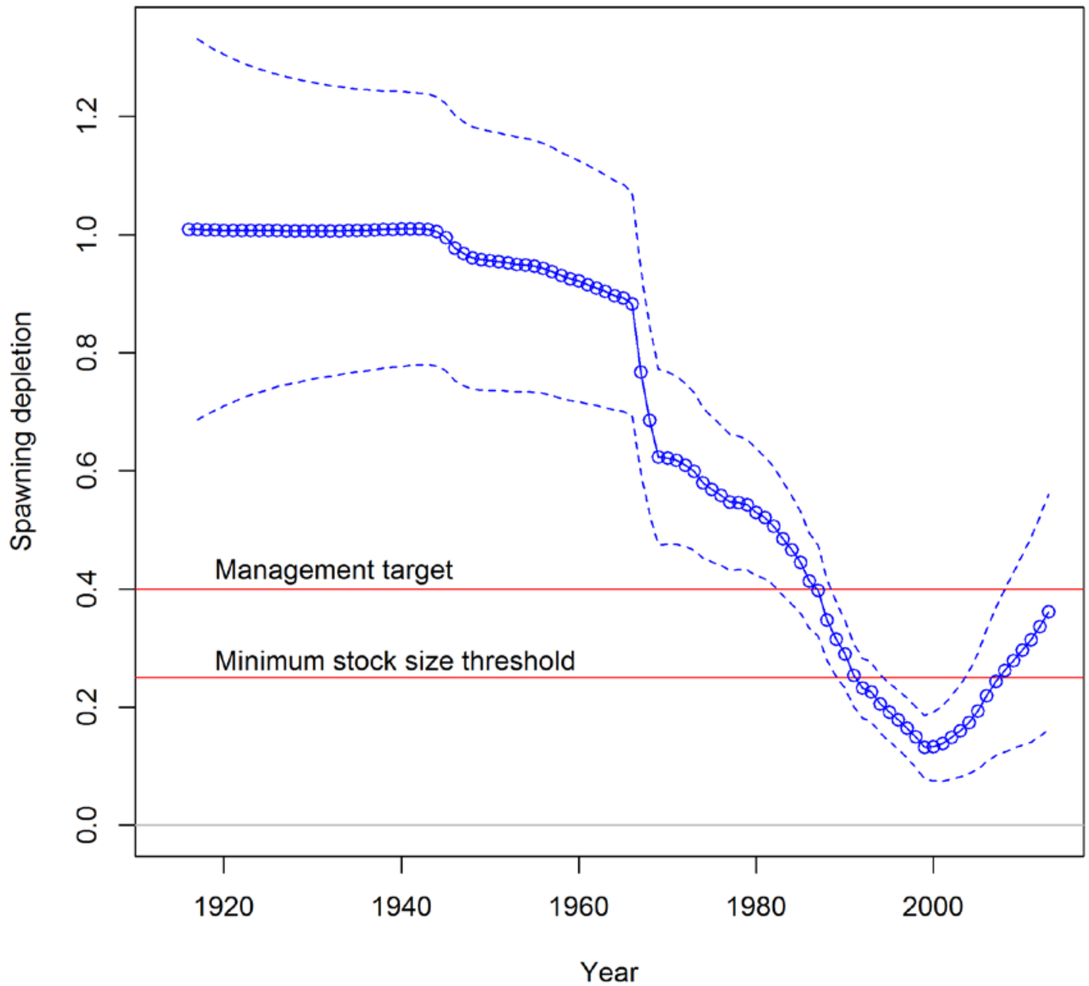

Figure ES-4. Estimated relative depletion with approximate 95% asymptotic confidence intervals (dashed lines) for the base case assessment model.

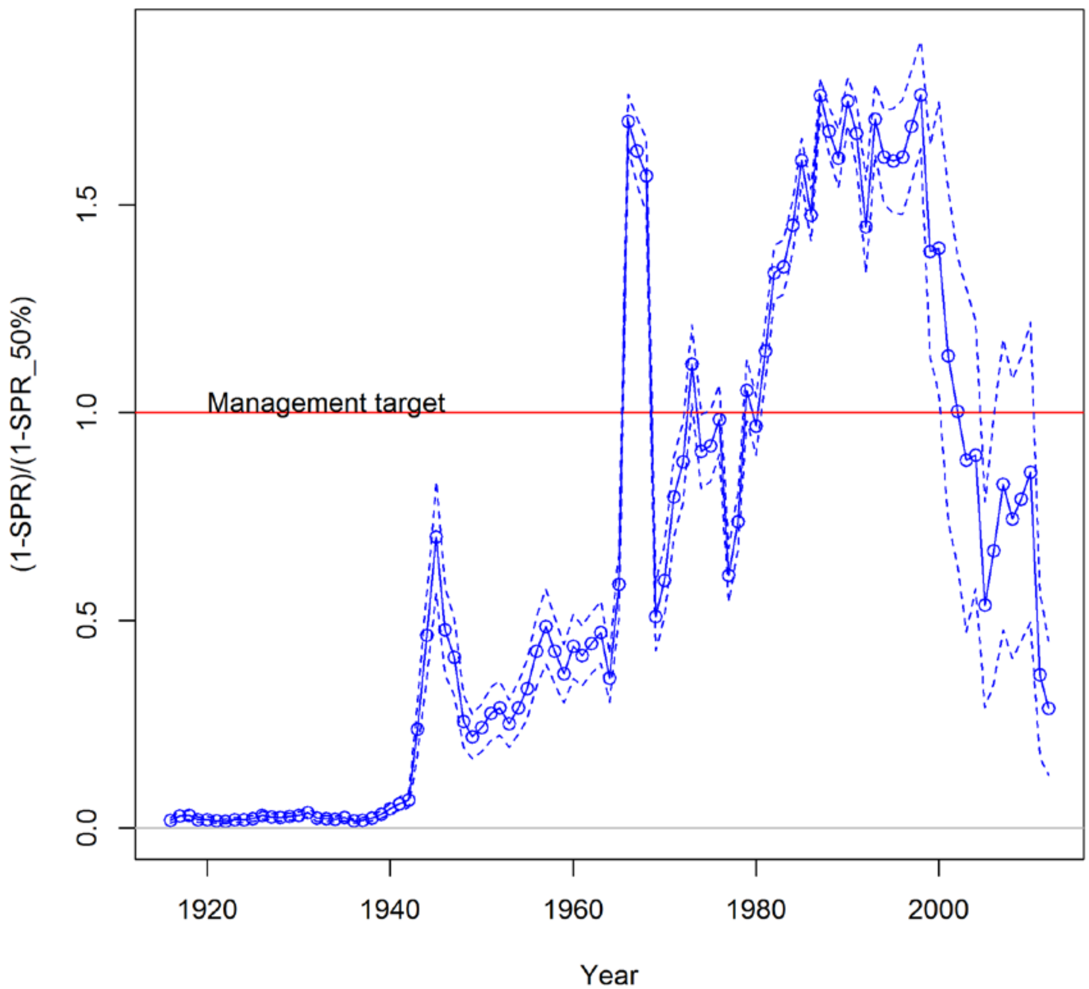

Figure ES-5. Time series of estimated relative spawning potential ratio (1-SPR/1-$SPR_{Target=0.50}$) for the base-case model (round points) with ~95% intervals (dashed lines). Values of relative SPR above 1.0 (100% in the table above) reflect harvests in excess of the current overfishing proxy.

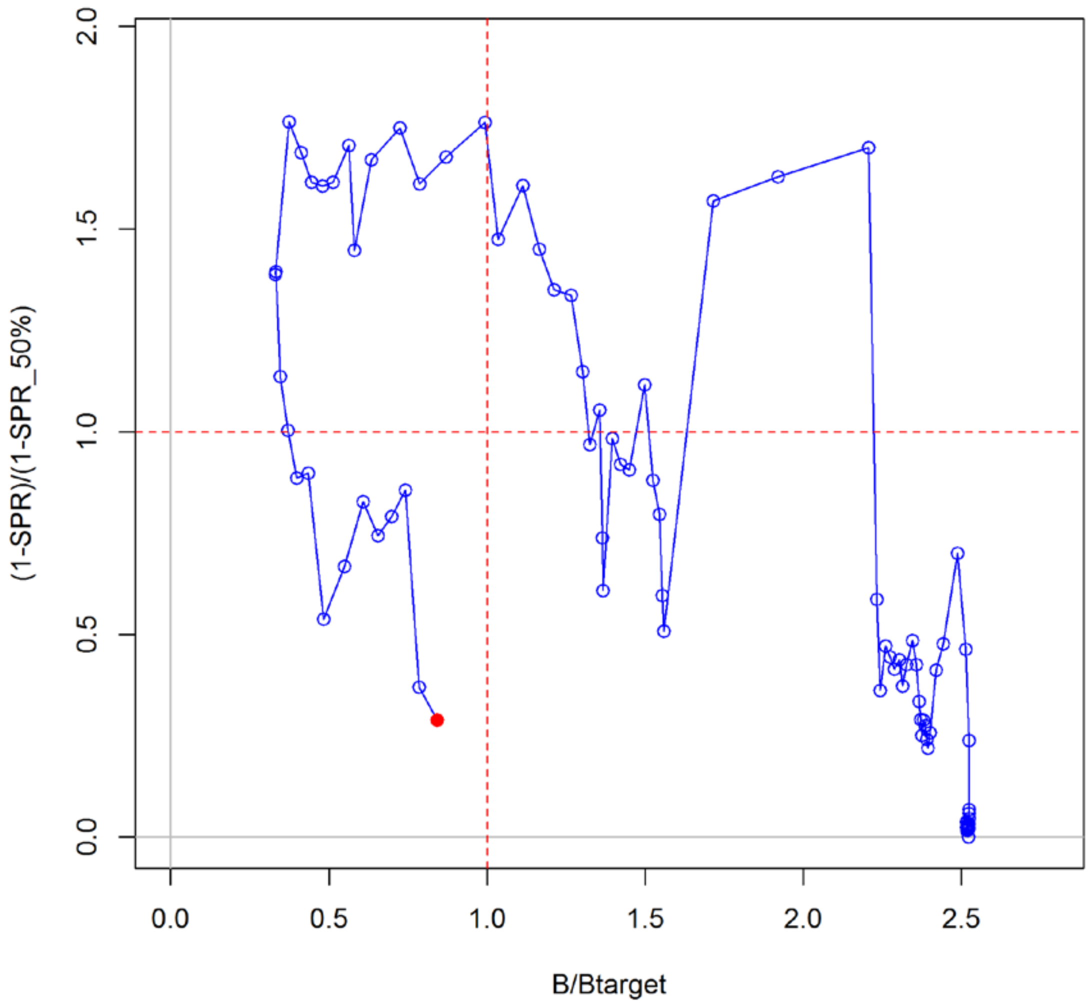

Figure ES-6. Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model. The relative (1-SPR) is (1-SPR) divided by 0.5 (the SPR target). Relative depletion is the annual spawning biomass divided by the spawning biomass corresponding to 40% of the unfished spawning biomass. The red point indicates the year 2012.

Table ES-4. Recent trend in spawning potential ratio (SPR) and harvest rate.

Year	SPR (%)	Harvest rate (proportion)	~95% confidence interval
2003	56%	0.025	0.006-0.044
2004	55%	0.026	0.011-0.042
2005	73%	0.013	0.005-0.021
2006	67%	0.017	0.006-0.029
2007	59%	0.024	0.008-0.040
2008	63%	0.020	0.007-0.034
2009	60%	0.022	0.008-0.037
2010	57%	0.025	0.008-0.042
2011	82%	0.008	0.003-0.013
2012	86%	0.006	0.002-0.010

Ecosystem considerations

Darkblotched rockfish is most abundant from off British Columbia to Central California. This is a slope species that occurs at depths between 25 and 600 m, which majority of fish inhabiting at depths between 100 and 400 meters. Darkblotched rockfish co-occurs with an assemblage of slope rockfish, including Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), yellowmouth rockfish (*Sebastes reedi*), and sharpchin rockfish (*Sebastes zacentrus*). Pacific ocean perch and darkblotched rockfish are the most abundant members of that assemblage off the coasts of Oregon and Washington, but splitnose rockfish and darkblotched rockfish dominate off the northern coast of California. Adults typically are observed resting on mud near cobble or boulders. They feed primarily on large planktonic organisms such as krill, gammarid amphipods, copepods and salps, and less frequently on fishes and octopi. Young darkblotched are eaten by king salmon and albacore.

In this assessment, ecosystem considerations were not explicitly included in the analysis. This is primarily due to lack of relevant data and results of analyses (conducted elsewhere) that could contribute ecosystem-related quantitative information for the assessment.

Management performance

Darkblotched rockfish have historically been managed with bimonthly cumulative landings limit (a.k.a. “trip limits”) as most of the catch came from the limited entry bottom trawl fishery. However, for the last two years, that allocation has been managed as a catch share fishery, using Individual Fishing Quotas (IFQ), where each permit holder has an annual quota. Darkblotched rockfish has had species-specific management guidelines since 2001. For the last 10 years, the total dead catch (as estimated in this assessment) exceeded the Annual Catch Limit (ACL) in 2003, 2004, 2009 and 2010. The total dead catch also exceeded the Overfishing Limit (OFL) in 2003 and 2004, but only by 4% and 2% respectively. Overall, total dead catch of darkblotched rockfish for the last decade has been only 57% of the sum of the OFLs and 81% of the ACLs.

Table ES-5. Recent trend in total catch and commercial landings (mt) relative to the management guidelines. Estimated total catch consists of commercial landings, plus the model-estimated discarded biomass.

Year	OFL (mt)	ACL (mt)	Commercial Landings (mt)	Estimated Total Catch (mt)
2003	205	172	80	212
2004	240	240	189	243
2005	269	269	98	129
2006	294	200	107	190
2007	456	290	144	279
2008	487	330	117	252
2009	437	285	138	293
2010	440	291	184	350
2011	508	298	117	120
2012	497	296	94	96

Unresolved problems and major uncertainties

Uncertainty in the model was explored though asymptotic variance and sensitivity analyses. Asymptotic confidence intervals were estimated within the model and reported throughout the assessment for key model parameters and management quantities. To explore uncertainty associated with alternative model configurations and evaluate the responsiveness of model outputs to changes in key model assumptions, a variety of sensitivity runs were performed, including increase and decrease of fishery removals, runs with different assumptions regarding life-history parameters, shape of selectivity curves, stock-recruitment parameters, and many others. The uncertainty regarding natural mortality, stock-recruit steepness and unfished recruitment level was also explored through likelihood profile analysis. Also, a retrospective analysis was conducted where the model was re-run after removing data from recent years.

A major source of uncertainty is related to main life history parameters, such as natural mortality and stock-recruit curve steepness. In the model, both quantities are fixed at the values estimated outside the model using other life history characteristics of the species (for natural mortality) or meta-analysis of species with similar life history characteristics (in the case of steepness). These quantities, which the model is unable to estimate reliably, but which are essential for understanding the dynamics of the stock, are suggested to be used in defining states of nature in the Decision Table, to further incorporate uncertainty in these parameters into the management process.

Darkblotched rockfish age estimates, particularly from the early time period, have been a source of uncertainty since 2005. Since the 2005 assessment, and prior to this assessment, no age data generated prior to 2004 have been used due to concerns that criteria for estimating ages of darkblotched rockfish might have changed and that a bias may have existed in early age estimates compared to those made during and after 2004. In this assessment, instead of removing these data a prior, we conducted an ageing error analysis to compare recent estimates of darkblotched ages with those conducted prior to 2004. This analysis generated little evidence for ageing bias prior to 2004. We found, however, that a relatively wide aging error exists for the age data, and that imprecision in early age estimates is larger than in recent ones. Our analysis confirmed that it is extremely challenging to estimate ages reliably for long-lived rockfish species, such as darkblotched rockfish, and uncertainty associated with age estimates continue to be an issue.

Historically, darkblotched rockfish landings have not been sampled at the discrete species level; therefore, time series of catch remained a source of uncertainty. Although significant progress has been made in reconstructing historical California and Oregon landings, the lack of early species composition data does not allow to account for a gradual shift of fishing effort towards deeper areas, which can cause the potential to overestimate the historical contribution of slope species (including darkblotched rockfish) to overall landings of the mixed-species market category (i.e. “unspecified rockfish”). Also, it is known that the domestic trawl fishery has discarded a portion of the catch at sea. Previous to 2002, when the West Coast Groundfish Observer Program was established, only one study exists (limited in time and space) that informs pre-2002 discarding practices of darkblotched rockfish.

Decision table

The base model estimate for 2013 spawning depletion is 36%. The primary axis of uncertainty about this estimate used in the decision table was based on female natural mortality. Alternative states of nature were characterized using both the likelihood profile and the prior distribution for female natural mortality. The choice to use both sources of information for this fixed parameter was motivated by the observation that the data showed strong evidence against extremely low values of natural mortality, but was relatively flat for large values. In the absence of a fully integrated posterior distribution, the prior distribution based on maximum age was used as a proxy for the upper end of the range. The low and high states of nature for the decision table were therefore based on female natural mortality values of 0.036 and 0.082, both approximately half as likely as the value used in the base model (0.05). The lower value of natural mortality corresponded to a depletion estimate of 18%, while the higher value corresponded to 82%, illustrating the marked sensitivity of the assessment results to a poorly informed parameter.

Twelve-year forecasts for each state of nature were calculated based on removals at current rebuilding SPR of 64.9% for the base model. Twelve-year forecasts were also calculated based on removals at an SPR of 71.9% for the base model, as requested by the Groundfish Management Team (GMT). This lower catch stream that corresponds to SPR 71.9% was used in the Decision Table of the 2011 darkblotched assessment. Finally, twelve-year forecasts for each state of nature were produced with future catches fixed at the 2014 ACL set for darkblotched rockfish.

Under the middle state of nature (which corresponds to the base model), the spawning output and depletion are projected to increase under all three considered catch streams, and reach the $SB_{40\%}$ target in 2015. Under the low state of nature, spawning output and depletion are also projected to increase under all three catch streams considered, but will stay below the $SB_{40\%}$ target within the next 12 years. Under the middle state of nature, the spawning output remains above the 40% target level throughout the 12-year projection period.

Research and data needs

The following research could improve the ability of future stock assessments to determine the current status and productivity of the darkblotched rockfish population:

1) The base model does not use commercial age composition data for years that lacked coast wide samples. The additional age data could provide information necessary for the model to estimate such parameters as natural mortality. Future research could ascertain whether additional otoliths exist for these years, and whether they could be aged using current ageing methods. Also, alternative fleet structures (with state specific fisheries) could be explored to take use of as much available age data as possible.

2) The base model uses newly available information of female maturity collected within the NWFSC shelf-slope survey. This new information includes data on mass atresia (a form of skipped spawning), not previously available for the assessment. At present, Stock Synthesis allows incorporation of this information only when maturity is expressed as a function of age. Effort should be devoted to expand maturity options in Stock Synthesis to allow expression of maturity information (with mass atresia) as a function of female length. Also, continued collection of maturity samples would allow future researchers to explore differences in maturity at age, either spatially or over time.

3) Additional research would be important to explore whether other life history parameters, such as growth and fecundity vary spatially or change over time as well. This information will help in defining spatial structure of future models.

4) Given that the population range extends north to the border with Canada, it is important that future research would evaluate the impact of not accounting for any Canadian portion of population abundance. Such an analysis would require evaluation of movement of darkblotched along the coast, which information is currently lacking.

5) Future research could also improve existing meta-analyses for natural mortality and steepness, which both contribute to the implied yield curve. Directions for improvements include (1) explaining variability between methods in natural mortality estimates, included in the Hamel natural mortality method and (2) developing a larger database of species for estimating steepness, perhaps by including species from other regions, e.g., Canada and Alaska.

6) Imprecision in the indices of abundance derived from survey sampling, due a low probability the species occurrence, is one of the sources of uncertainty in this assessment. Future research could explore the utility of model-based index standardization techniques; in particular, those using spatial modeling approaches. Spatial models could potentially account for the component of sampling variance arising from the random allocation of sampling tows either in or outside of suitable habitat. Such models could potentially decrease residual variance and imprecision of the resultant indices of abundance.

7) Finally, we note that Markov chain Monte Carlo sampling using the Metropolis algorithm was unable to obtain a sufficient number of independent samples within a feasible time period. However, it had trouble primarily with a single parameter (variance inflation for a survey index). We therefore recommend to improve MCMC options in ADMB, perhaps by making necessary changes to the Hamiltonian MCMC option (i.e., by allowing samples to be thinned during running, and hence making longer MCMC chains feasible for the ADMB implementation of Hamiltonian sampling).

Table ES-6. Summary table of 12-year projections beginning in 2015 for alternate states of nature based on female natural mortality. Columns range over low, mid, and high state of nature, and rows range over different assumptions of catch levels.

			State of nature					
			Low *Female M=0.036*		Base case Female M=0.05		High *Female M=0.082*	
Management decision	Year	Catch (mt)	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion
Catch calculated using SPR of 71.9% applied to the base model	2013	223	607	18%	1,214	36%	3,606	82%
	2014	240	648	19%	1,294	39%	3,770	85%
	2015	252	688	20%	1,374	41%	3,922	89%
	2016	260	722	21%	1,441	43%	4,032	91%
	2017	266	751	22%	1,496	45%	4,101	93%
	2018	271	776	23%	1,541	46%	4,135	94%
	2019	276	798	23%	1,578	47%	4,147	94%
	2020	280	821	24%	1,613	48%	4,150	94%
	2021	285	844	25%	1,646	49%	4,149	94%
	2022	289	867	25%	1,678	50%	4,146	94%
	2023	293	891	26%	1,709	51%	4,140	94%
	2024	297	915	27%	1,739	52%	4,133	94%
Catch calculated using current rebuilding SPR of 64.9% applied to the base model	2013	302	607	18%	1,214	36%	3,606	82%
	2014	323	641	19%	1,288	38%	3,764	85%
	2015	339	674	20%	1,360	41%	3,909	88%
	2016	347	701	20%	1,420	42%	4,011	91%
	2017	353	722	21%	1,467	44%	4,073	92%
	2018	358	738	21%	1,504	45%	4,101	93%
	2019	363	752	22%	1,533	46%	4,106	93%
	2020	368	766	22%	1,560	46%	4,102	93%
	2021	372	780	23%	1,586	47%	4,096	93%
	2022	377	796	23%	1,611	48%	4,087	93%
	2023	381	811	24%	1,635	49%	4,076	92%
	2024	385	826	24%	1,657	49%	4,064	92%
2014 ACL catch assumed for years between 2015 and 2024	2013	317	607	18%	1,214	36%	3,606	82%
	2014	330	640	19%	1,287	38%	3,762	85%
	2015	330	672	20%	1,358	40%	3,907	88%
	2016	330	699	20%	1,418	42%	4,010	91%
	2017	330	722	21%	1,467	44%	4,073	92%
	2018	330	740	22%	1,506	45%	4,103	93%
	2019	330	756	22%	1,538	46%	4,111	93%
	2020	330	773	23%	1,567	47%	4,110	93%
	2021	330	791	23%	1,597	48%	4,106	93%
	2022	330	811	24%	1,626	48%	4,101	93%
	2023	330	830	24%	1,654	49%	4,094	93%
	2024	330	850	25%	1,681	50%	4,085	92%

Table ES-7. Summary of recent trends in estimated darkblotched rockfish exploitation and stock level from the assessment model.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Commercial landings (mt)	80	189	98	107	144	117	138	184	117	94	NA
Estimated Total catch (mt)	212	243	129	190	279	252	293	350	120	96	NA
OFL (mt)	205	240	269	294	456	487	437	440	508	497	541
ACL (mt)	172	240	269	200	290	330	285	291	298	296	317
SPR	56%	55%	73%	67%	59%	63%	60%	57%	82%	86%	NA
Exploitation rate (catch/ age 1+ biomass)	0.025	0.026	0.013	0.017	0.024	0.020	0.022	0.025	0.008	0.006	NA
Age 1+ biomass (mt)	8,477	9,301	10,061	10,924	11,739	12,453	13,211	13,977	14,732	15,691	16,610
Spawning output (million eggs)	536	583	648	738	818	879	937	996	1,054	1,131	1,214
~95% Confidence Interval	220-851	234-932	253-1044	286-1189	312-1324	325-1433	338-1536	349-1642	357-1751	384-1879	414-2013
Recruitment	1,797	3,265	3,004	2,061	1,434	6,674	1,216	1,800	2,858	870	2,254
~95% Confidence Interval	617-2,977	1,180-5,350	1,042-4,966	650-3,471	383-2,486	2,159-11,190	206-2,226	220-3,380	0-6,154	0-2,117	0-5,691
Depletion (%)	16%	17%	19%	22%	24%	26%	28%	29%	31%	33%	36%
~95% Confidence Interval	8-24%	9-26%	9-29%	11-33%	12-37%	12-40%	13-43%	13-46%	14-49%	15-53%	16-56%

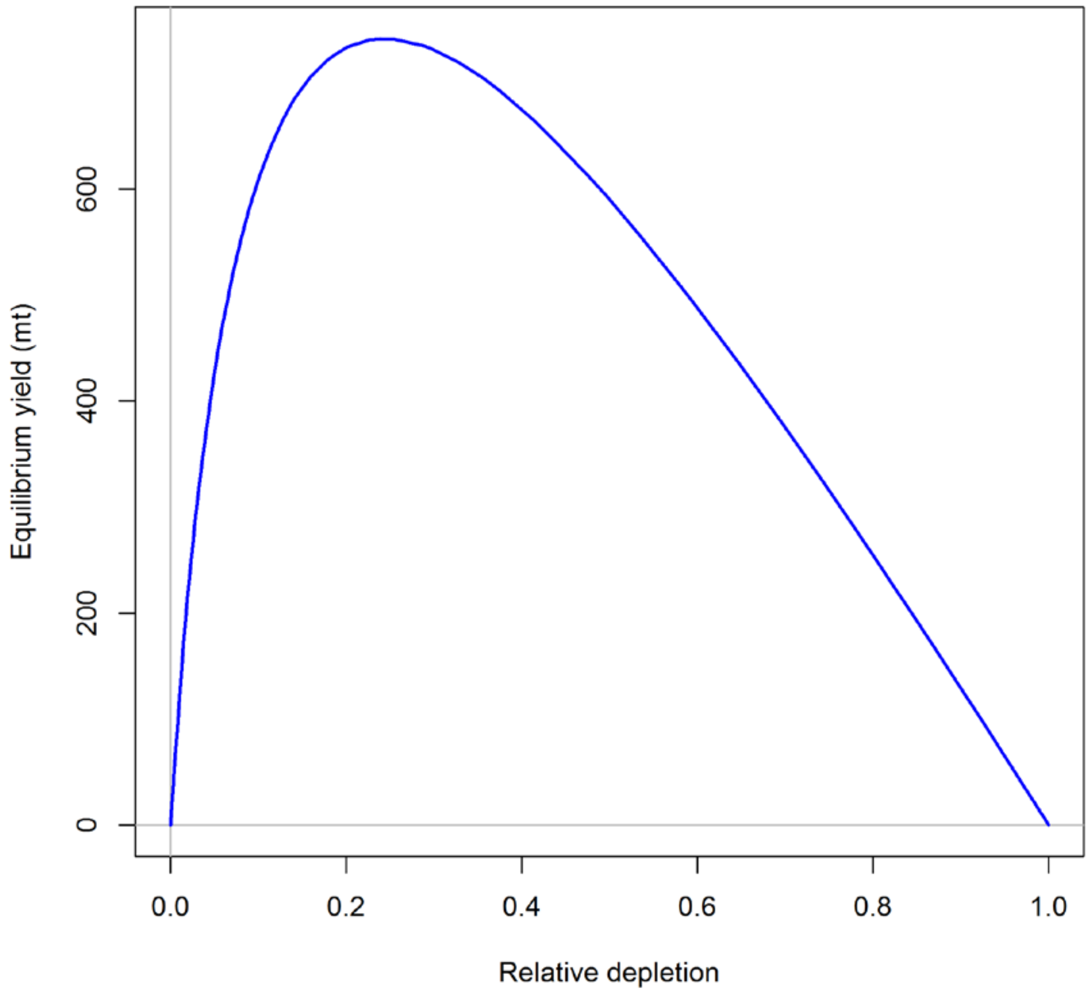

Figure ES-7. Equilibrium yield curve (derived from reference point values reported in Table ES-5) for the base case model. Values are based on 2012 fishery selectivity and distribution with steepness fixed at 0.779. The depletion is relative to unfished spawning biomass.

1 Introduction

1.1 Basic Information

Darkblotched rockfish (*Sebastes crameri*) are found in the Northeast Pacific Ocean from the southeastern Bering Sea and Aleutian Islands to near Santa Catalina Island in southern California. This species is most abundant from off British Columbia to Central California. Darkblotched rockfish occur at depths between 25 m and 900 m (Love et al., 2002), with the majority of fish inhabiting depths between 100 m and 600 m. Commercially important concentrations are found from the Canadian border through Northern California, on or near the bottom, at depths between 183 m and 366 m.

There are no clear stock delineations for darkblotched rockfish in the waters of the United States. There are no distinct breaks in the fishery landings and catch distributions (Figure 1). Survey catches exhibit a continuous distribution of fish over most of the species range (Figure 2), with areas of higher abundance present in the Columbia, Eureka and Monterey International North Pacific Fisheries Commission (INPFC) areas.

Microsatellite analyses of spatial genetic structure in darkblotched rockfish (Gomez-Uchida and Banks, 2005) suggested a possibility of genetic changes in the stock along the coast, but the level of genetic differentiation was found to be small and no distinct breaks in the stock were identified. Analysis of darkblotched rockfish length at age data collected within the NMFS Northwest Fisheries Science Center shelf-slope survey indicated a gradual cline in growth parameters, with growth coefficient decreasing with higher latitude, but again no district growth morphs and clear boundaries between them were identified.

For the purpose of this assessment, the species is treated as a single stock from the U.S.-Canadian border in the north to the U.S.-Mexican border in the south, due to the lack of biological and genetic data supporting the presence of multiple stocks. A map depicting the spatial scope of the assessment is shown in Figure 3.

1.2 Life History

Darkblotched rockfish are among the longer living rockfish; the data used in this assessment includes individuals that have been aged to be 98 years old. In the literature, the maximum darkblotched rockfish age is reported to be 105 years (Love et al., 2002). As with many other *Sebastes* species, darkblotched rockfish exhibit sexually dimorphic growth; females reach larger sizes than males, while males attain maximum length earlier than females (Love et al., 2002; Nichol, 1990; Rogers et al., 2000).

There are indications that darkblotched rockfish life history parameters, particularly those related growth, might be varying with latitude. Analysis conducted within this assessment detected continues gradient along the coast in growth parameters, which is common for *Sebastes* species on the West Coast of the United States, but did not identify specific areas with different growth. It was also suggested that maturity schedule of darkblotched rockfish may vary with latitude. Maturity parameters of fish collected in waters off California (Echeverria, 1987; Phillips, 1964) were found to be smaller than those of fish collected off Oregon (Nichol, 1990). However, Nichol (1990) argued that these differences are rather attributed to different criteria used to determine maturity in two studies. Also, Westrheim (1975) determined that the size at 50% maturity for darkblotched rockfish decreased, rather than increased, with increasing latitude from Oregon to Alaska. Size-at-age parameters reported in literature also vary widely. For instance, substantially smaller size-at-age was estimated for darkblotched rockfish off British Columbia, Canada, than for fish off Oregon (Hamel, 2008).

Darkblotched rockfish mate from August to December, eggs are fertilized from October through March, and larvae are released from November through April (Love et al., 2002). Fecundity increases with fish size, and all larvae released in one batch. Older larvae and pelagic juvenile darkblotched rockfish are found closer to the surface than many other rockfish species. Pelagic juvenile settle at 4 to 6 cm in length in about 55 to 200 m (Love et al., 2002). As many other *Sebastes*, this species exhibits ontogenetic movement, with fish migrating to deeper waters as they mature and increase in size and age (Lenarz, 1993; Nichol, 1990).

1.3 Ecosystem Considerations

In this assessment, ecosystem considerations were not explicitly included in the analysis. This is primarily due to lack of relevant data and results of analyses (conducted elsewhere) that could contribute ecosystem-related quantitative information for the assessment. Here, we briefly overview habitat preferences of the species and its ecosystem role and trophic relationships.

Darkblotched rockfish is a slope species. This species co-occurs with an assemblage of slope rockfish, including Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), yellowmouth rockfish (*Sebastes reedi*), and sharpchin rockfish (*Sebastes zacentrus*) (Rogers and Pikitch, 1992; Rogers, 1994). Pacific ocean perch and darkblotched rockfish are the most abundant members of that assemblage off the coasts of Oregon and Washington, but splitnose rockfish and darkblotched rockfish dominate off the northern coast of California.

Adults typically are observed resting on mud near cobble or boulders (Love et al., 2002). Demersal juveniles are often found perched on the highest bit of structure in the benthic habitat. Juveniles occasionally are seen around the bottoms of deepwater oil platforms. Darkblotched rockfish feed primarily in midwater on large planktonic organisms such as krill, gammarid amphipods, copepods and salps. Occasionally, darkblotched rockfish take fishes and octopi. Young darkblotched are eaten by king salmon and albacore (Love et al., 2002).

1.4 Fishery Information and Summary of Management History

Darkblotched rockfish has always been caught primarily with commercial trawl gear, as part of a complex of slope rockfish, which includes Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), yellowmouth rockfish (*Sebastes reedi*), and sharpchin rockfish (*Sebastes zacentrus*) (Rogers and Pikitch, 1992; Rogers, 1994). Over the years, catches with non-trawl gear comprised less than 2% of the total coastwide domestic catch (Figure 4). This species has not been taken recreationally as evident from RecFIN (www.recfin.com), a regional source of recreational data managed by the Pacific States Marine Fisheries Commission (PSMFC).

The rockfish fishery off the U.S. Pacific coast first developed off California in the late 19th century. At that time, most rockfish were taken by hook and line, with a minor amount taken by gillnets (Love et al., 2002). Until the 1940s, catches of rockfish were very small because almost all fishing efforts were directed toward the various salmon species and Pacific halibut.

The rockfish fishery was established in the early 1940s, when the United States became involved in World War II and wartime shortage of red meat created an increased demand for other sources of protein (Alverson et al., 1964; Harry and Morgan, 1961). Also, in 1943, the new balloon trawls were introduced. These balloon trawls were lighter than the old paranzellas and otter trawl nets. They were built to fish over low-lying rocky reefs and proved to be successful in taking rockfish (Love et al., 2002). With this new technology and increased demands during the World War II, the catch of rockfish increased in the mid-1940s. The increased demand caused the fishery to shift toward previously unexploited areas, including those preferred by darkblotched rockfish. The California fishery moved north, to the Eureka INPFC area; and both the California and Oregon fisheries had moved deeper into the slope area, those greater than 100 fm (183 m) (Harry and Morgan, 1961; Scofield, 1948) . This is when darkblotched rockfish catch first became significant (Figure 5).

Domestic demand for rockfish declined after World War II and rockfish catches dropped (Cleaver, 1951), but in the early 1950s, the Pacific ocean perch fishery developed in Oregon and Washington (Love et al., 2002), and landings of darkblotched rockfish, which co-occur with Pacific ocean perch, also increased. Prior to 1965, Pacific ocean perch and species incidentally caught in the Pacific ocean perch fishery off of the U. S. West Coast were harvested almost entirely by U. S. and Canadian vessels. Most of these vessels were of multi-purpose design and used in other fisheries, such as salmon and herring, when not engaged in the groundfish fishery. Generally under 200 gross tons and less than 33 m in length, these vessels had very little at-sea processing capabilities. These characteristics, for the most part, restricted the distance these vessels could fish from home ports, and limited the size of their landings.

In the mid-1960s, foreign trawl fleets from the former Soviet Union, Japan, Poland, Bulgaria and East Germany came to the Northeast Pacific Ocean to target large aggregations of Pacific ocean perch over high-relief rocky outcrops (Love et al., 2002). Using very large vessels (often called factory trawlers), foreign fleets, particularly the Soviet, had the capacity to operate independently, by processing and freezing their own catch. Support vessels, such as refrigerated transports, oil tankers, and supply ships permitted these large stern trawlers to operate at sea for extended periods of time. Foreign fleets were known not to discard fish (Rogers, 2003).

Foreign catch was particularly significant between 1966 and 1968 (Figure 5). Within a short period of time, catches of Pacific ocean perch and rockfish co-occurring with Pacific ocean perch (including darkblotched rockfish) skyrocketed. However, regulations increasingly reduced catch of slope rockfish by foreign fleets. Catches declined rapidly, and the fishery proceeded with more moderate landings (Figure 5). By the late-1960s, the Soviet fleet had more or less abandoned the fishery, although the Japanese fleet continued fishing for some time. In 1976, on-bottom trawling by foreign fleets was prohibited, and the depleted Pacific ocean perch fishery became largely domestic (Love et al., 2002).

A very small amount of darkblotched rockfish has also been taken as bycatch in the at-sea Pacific hake fishery (Figure 5). The at-sea Pacific hake fishery dates back to 1960s when foreign vessels participated. In the 1980s, the fishery evolved into a joint venture with U.S. catcher vessels delivering to foreign processing vessels. By 1991, foreign vessels were no longer allowed to fish in U.S. waters, the pacific hake fishery became completely domesticated, allowing only U.S. vessels to catch and process fish.

After the Pacific ocean perch fishery ended, domestic landings of rockfish rose again from the late-1970s. The fishery targeting slope rockfish at that time operated primarily between 244 m-515 m (134 fm and 282 fm) and used bottom trawl gear utilizing rollers (roller gear) with 3.5 inch cod end mesh, which is smaller than the mesh size used in the mid-1970s (Rogers, 2005). In 1992 and 1995, minimum codend mesh size changed again, increasing from 3 to 4.5 inches through regulatory changes (Appendix 1).

Prior to 1977, darkblotched rockfish in the waters off the United States were managed by the individual states (within the three miles). With implementation of the Magnuson-Stevens Fishery Conservation and Management Act (MFCMA) in 1976, primary responsibility for management of the groundfish stocks off Washington, Oregon and California shifted from the states to the Pacific Fishery Management Council (PFMC).

Limits on domestic rockfish catch were first instituted in 1983, with darkblotched rockfish managed as part of a group of around 50 species, designated as the *Sebastes* complex (Hamel, 2008). Commercial vessels were not required to separate most rockfish catches into individual species, and port biologists in each state routinely have sampled mixed-species market categories, such as the *Sebastes* complex, to determine the actual species composition of these mixed-species categories. In 1994, the *Sebastes* complex was divided into northern and southern areas, for annual harvest specifications and setting bimonthly cumulative landings limits (a.k.a. “trip limits”). In 1996, an assessment of the major species in the *Sebastes* complex was conducted (Rogers et al., 1996). This assessment led to a species-specific Overfishing Limit (OFL) (then called Acceptable Biological Catch (ABC)) for darkblotched rockfish in 1997.

The stock assessment conducted by Rogers et al. (2000) found the darkblotched rockfish stock to be depleted and an overfished determination was made. In 2001, darkblotched rockfish was given an individual ABC (then Optimum Yield (OY)). However, landed catch of darkblotched rockfish continued to be managed by trip limits established for the northern and southern minor slope rockfish complexes. Since 2000, when stock was declared overfished, landings of darkblotched rockfish decreased substantially, primarily due to management regulations instituted for the species.

In 2002, Rockfish Conservation Areas (RCAs), which are large marine areas closed to commercial fishing, were implemented by the PFMC as a measure to reduce bycatch of overfished rockfish species. Specific boundaries for the RCAs have varied among bimonthly periods, years and areas and there are a number of latitudinal differences in the extent of the current RCAs. The description of exact boundaries of the RCAs and how they change over time are available upon request. Trawl gear that is used shoreward of the RCAs is required to have small footropes (<8" diameter), which increases the risk of gear loss in rocky areas. Reductions in trip limits for shelf rockfish species have also reduced incentives to fish in rocky areas shoreward of the RCA. Since 2005, vessels using trawl gear shoreward of the RCA north of $40^{o}10'$ N latitude have also been required to use nets that are designed to be more selective for flatfish. A summary of the major management shifts on the West Coast of the United States related to groundfish species through 2005 (prepared by Daniel Erickson of PFMC' Groundfish Management team (GMT)) is provided in Appendix 1.

For the last two years (2011 and 2012), the shorebased trawl allocation (including non-hake groundfish trawl, and shorebased hake trips) has been managed as a catch share fishery, using Individual Fishing Quotas (IFQ), where each permit holder has an annual quota. Under this system, discard of darkblotched rockfish, and many other species has decreased dramatically, due to individual accountability; both landed and discarded fish count towards each fisher's annual quota.

1.5 Management Performance

Table 1 and Figure 6 present a summary of management performance for darkblotched rockfish over the last 10 years, which include a comparison of darkblotched rockfish Overfishing Limits (OFLs), Annual Catch Limits (ACLs), landings, and catch (i.e., landings plus discard). Between 2003 and 2012, the total dead catch (as estimated in this assessment) exceeded the ACLs in 2003, 2004, 2009 and 2010. The total dead catch also exceeded the OFLs in 2003 and 2004, but only by 4% and 2% respectively. Overall, total dead catch of darkblotched rockfish for the last decade has been only 57% of the sum of the OFLs and 81% of the ACLs.

1.6 Fisheries off Canada, Alaska, and/or Mexico

Darkblotched rockfish have a widespread distribution through the Canadian West Coast Exclusive Economic Zone; however, the highest concentrations occur along the shelf northwest of Vancouver Island and in Moresby Gully southeast of the Queen Charlotte Islands. Similarly to the Unites States, the Canadian commercial trawl fleet captures this species in slope rockfish assemblage and as a bycatch to the important Pacific ocean perch fishery, but in much lower numbers than those in the Unites States. A formal stock assessment of darkblotched rockfish has not been conducted in Canada. However, a review of darkblotched rockfish biology, distribution, and abundance trends along the Pacific coast of Canada was completed by Haigh and Starr (2008). In this review Haigh and Starr (2008) use values for natural mortality and individual growth drawn from the contemporary U.S. assessments. This review was not intended to advise fisheries managers on harvest policy and, therefore did not yield a conclusion on a status and long-term trends of the stock. In the future this review could serve as a basis for a stock assessment.

In the Gulf of Alaska and the Bering Sea-Aleutian Islands, darkblotched rockfish are rare but still occur in fishery catches. It is managed within other rockfish complex, with management measures set based on area-swept biomass estimates and natural mortality assumptions. The range of darkblotched rockfish does not extend beyond southern California; therefore, there is no information about whether a fishery in Mexico exists.

2 Assessment

2.1 Data

The darkblotched rockfish data used in the assessment are summarized Figure 7. These data include both fishery-dependent and fishery-independent sources.

2.1.1 Fishery-dependent data

The fishery removals in the assessment are divided among two fleets, which include domestic trawl fishery and bycatch in the foreign Pacific ocean perch (POP) and at-sea Pacific hake fisheries. The domestic trawl fishery has historically reported landed catch only, even though a portion of the darkblotched catch was discarded at sea. The foreign POP fishery, on the other hand, was known not to discard fish based on fish size or species, while the at-sea hake fishery reports total catch, which includes both retained and discarded fish. To account for differences in discarding practices and catch reporting, and most importantly avoid inflating darkblotched removals in POP and at-sea hake fisheries, the domestic trawl fleet and bycatch in foreign POP and at-sea hake fisheries were separated. The discarded portion of the domestic trawl fleet was estimated within the model based on data collected by the West Coast Groundfish Observer Program (WCGOP) and historical discard data provided in the Pikitch study (Pikitch et al., 1988) (both described in details below).

Landings of darkblotched rockfish were reconstructed back to 1916, and the assessment assumes a zero catch and equilibrium unfished biomass in 1915. The reconstructed time series of darkblotched rockfish landings by the domestic trawl fishery and removals by bycatch fleet are presented in Figure 5 and Table 2. Figure 1 shows the spatial distribution of darkblotched rockfish catch, as observed by the WCGOP between 2002 and 2008.

2.1.1.1 Domestic commercial landings

Estimates of recent commercial landings of darkblotched rockfish (between 1981 and 2012) were obtained from the Pacific Fisheries Information Network (PacFIN), a regional fisheries database that manages fishery-dependent information in cooperation with west coast state agencies and NOAA Fisheries (www.pacfin.com). Landings data were extracted by gear type on March 14, 2013 and then combined into the fishing fleets used in the assessment.

Time series of historical (pre-1981) landings were reconstructed by gear group (trawl and non-trawl) for each state separately and then combined to produce annual coastwide estimates for domestic trawl fleet. The methods used to reconstruct historical landings for each state are described below.

2.1.1.1.1 Washington

The records of rockfish landings in Washington go back to 1935 (Hongskul, 1975; Tagart and Kimura, 1982). Historically, rockfish landings in Washington were reported on fish tickets in two mixed species complexes "Pacific Ocean Perch" and "Other Rockfish" (Tagart and Kimura, 1982). In 1966, the Washington Department of Fish and Wildlife (WDFW) initiated a sampling program to estimate landings of each rockfish species within these mixed species complexes. Tagart and Kimura (1982) described methodology employed in calculating rockfish landings by species based on data collected by the WDFW sampling program, and Tagart (1985) provided time series of darkblotched rockfish landings by year between 1963 and 1980. The rockfish landings for the earlier time period (1935-1962) were compiled by Hongskul (1975), but no species-specific catches were estimated. To derive estimates of darkblotched rockfish from rockfish landings between 1935 and 1962, we first estimated the proportion of darkblotched rockfish in 1963-1967 rockfish landings, the earliest five years of the Tagart data (Tagart, 1985), and then applied this proportion to the 1935-1962 Hongskul (1975) landings by year. The time series of Washington landings of darkblocthed rockfish as used in this assessemnt are presented in Table 2.

2.1.1.1.2 Oregon

Oregon records of darkblotched rockfish landings go back to late 1930s. Similar to Washington, darkblotched rockfish were historically landed in Oregon in mixed species market categories, primarily within "Pacific Ocean Perch" and "Unspecified Rockfish". A small portion of rockfish in Oregon between 1942 and the early 1980s were also landed in "Animal Food" category (also called "Mink Food" or "Miscellaneous" by some sources). This portion of catch went to feed mink for the fur trade. Mink food consisted mainly of red meat until World War II, when horsemeat became increasingly difficult and expensive to obtain. During this period, there was an abundance of fillet carcasses, which were used as a protein source for mink. When the demand exceeded the supply, whole fish were specifically targeted to supplement the carcasses(Niska, 1969).

A time series of Oregon historical landings of darkblotched rockfish through 1986 was provided by the Oregon Department of Fish and Wildlife (ODFW), which in collaboration with the National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center (NWFSC), conducted a reconstruction of historical groundfish landings in Oregon (Karnowski et al., 2012). Karnowski et al. (2012) provide a detailed description of methods used in calculating rockfish landings by species. A variety of data sources were used to reconstruct historical landings of rockfish market categories, including Oregon Department of Fish and Wildlife's Pounds and Value reports derived from the Oregon fish ticket line data (1969-1986), Fisheries Statistics of the United States (1927-1977), Fisheries statistics of Oregon (Cleaver, 1951; Smith, 1956), Reports of the

Technical Sub-Committee of the International Trawl Fishery Committee (now the Canada-U.S. Groundfish Committee) (1942-1975) and many others.

To inform species compositions of rockfish within different market categories, the ODFW has routinely sampled species compositions of multi-species rockfish categories from commercial bottom trawl landings since 1963. Rockfish landings by species estimated based on data collected by ODFW sampling program have been summarized in several ODFW reports, including (Barss and Niska, 1978; Douglas, 1998; Niska, 1976). The latter publication by Douglas (1998) was an expansion and improvement on earlier publications by (Niska, 1976) and (Barss and Niska, 1978). These sources were also used by Karnowski et al. (2012) in reconstructing historical landings of darkblotched rockfish in Oregon. The reconstructed landings of darkblotched rockfish in Oregon are presented in Table 2.

2.1.1.1.3 California

A time series of California landings of darkblotched rockfish during the most recent "historical" period (between 1969 and 1980) were available from the California Cooperative Groundfish Survey (CalCOM) database.

Earlier landing records (between 1916 and 1968) were reconstructed by the NMFS's Southwest Fisheries Science Center (SWFSC) (Ralston et al., 2010). These reconstructed landings, in addition to apportioning catches to trawl and non-trawl gear included a portion assigned to unknown gear type. To assign unknown gear type landings to trawl and non-trawl catches, we calculated the proportion of trawl and non-trawl landings within landings assigned to trawl and non-trawl gear by year between 1916 and 1968, and applied these proportions to unknown gear type landings by years. The reconstructed landings of darkblotched rockfish in California are presented in Table 2.

2.1.1.2 Discard

There are three main sources of rockfish discard information on the West Coast of the United States. Since 2002, the WCGOP has collected bycatch and discard information on board fishing vessels in the trawl and fixed gear fleets along the entire coast, and produced discard ratio and total fishing mortality estimates for all species observed. The WCGOP was implemented in 2001 and began with gathering data for the limited entry trawl and fixed gear fleets. Observer coverage has expanded to include the California halibut trawl, the nearshore fixed gear and pink shrimp trawl fisheries. Since 2011, darkblotched rockfish was harvested with a catch share fishery, using Individual Fishing Quotas (IFQ), where each permit holder has an annual quota. The WCGOP provides 100% at-sea observer monitoring of catch for this new, catch share based IFQ fishery.

Prior to 2002, there were two studies of bycatch and discard in the trawl fishery, including the Enhanced Data Collection Project (EDCP) and the Pikitch study (Pikitch et al., 1988). The EDCP administered by the ODFW collected data on bycatch and discard of groundfish species off the Oregon coast from late 1995 to early 1999 (Sampson, pers.com.). The project had limited spatial coverage (Oregon waters only) and due to time constraints, the observers only recorded discarded catch for darkblotched rockfish.

Retained catch of darkblotched rockfish was recorded in the logbooks and fish tickets, but only as part of a mixed-species group of rockfish, which prevented calculation of the species-specific discard ratios for darkblotched rockfish. For this reason, the EDCP data were not included in the assessment.

The Pikitch study was conducted between 1985 and 1987. The northern and southern boundaries of the study were 48°42’ and 42°60’ North latitude respectively, which is primarily within the Columbia INPFC area (Pikitch et al., 1988; Rogers and Pikitch, 1992). Participation in the study was voluntary and included vessels using bottom, midwater and shrimp trawl gears. Observers of normal fishing operations on commercial fishing vessels collected the data, estimated the total weight of the catch by tow and recorded the weight of each species retained or discarded in the sample.

The WCGOP provided estimates of the discard ratios of darkblotched rockfish for the period between 2002 and 2011. The WCGOP data are collected by gear type, fishery (e.g., open access, limited entry) and species/management units. The discard ratios were computed as the total estimated discarded weight (in pounds) on observed trips divided by the estimated total catch (discarded and retained). To aggregate these ratios into the fleet modeled in this assessment, each state, fishery and gear combination was catch-weighted by the total estimated catch (discarded and retained weight). Thus, the discard rates used for each fleet represent the weighted estimates from each contributing segment within that fleet. Uncertainty in these values was quantified via bootstrapping the individual observations and then aggregating to the total estimate, providing a distribution of the discard rate. From this distribution a standard error associated with year specific discard ratio estimate was provided.

The estimates of discard ratios of darkblotched rockfish for 2000 and 2001 were retained from the previous assessments (Hamel, 2008; Rogers, 2005). They were originally computed using information from fish ticket, species composition samples, logbook, and observer data. Discard ratios for 1985 and 1987 were estimated from observations of retained and discarded catch collected in the Pikitch study following methods used in previous assessments (Hamel, 2008; Rogers, 2005). In previous assessment, however, the entire Pikicth study dataset was combined to estimate a single discard ratio, while in this assessment year specific discard ratios were calculated for 1985, 1986 and 1987.

2.1.1.3 Bycatch in the foreign POP fishery

As described in the Introduction, between mid-1960s and mid-1970s, foreign trawl fleets from the former Soviet Union, Japan, Poland, Bulgaria and East Germany targeted aggregations of Pacific ocean perch in the Northeast Pacific Ocean, in the waters off the U.S. West Coast (Love et al., 2002). Rogers (2003) estimated removals of POP and other species caught within this foreign POP fishery, including removals of darkblotched rockfish. In the assessment, we used estimates of darkblotched bycatch in the foreign POP fishery between 1966 and 1976 as estimated by Rogers (2003).

2.1.1.4 Bycatch in the at-sea Pacific hake fishery

As also described in the the Introduction, small amounts of darkblotched rockfish are also incidentally caught in in the Pacific hake fishery. The At-Sea Hake Observer Program (A-SHOP) monitors the at-sea hake processing vessels and collects total catch and bycatch data. Since the 1970s observers were deployed onto foreign fishing vessels that were catching Pacific hake. After 1991, observers continued to be deployed aboard U.S. flagged catcher processor and mothership vessels.

The annual amounts of darkblotched rockfish bycatch in the at-sea hake fishery, collected by A-SHOP, have been obtained from the North Pacific Database Program (NORPAC). Since 1991, virtually 100% of hauls in the at-sea hake fishery have been sampled for catch and species composition, and the total catch (retained and discarded) has been estimated for both targeted and bycatch species for each haul. To derive the total amount of darkblotched rockfish bycatch by year, we simply summed the estimated catch in every haul within a year. Prior to 1991 (time of foreign fishery and joint venture), not every haul was sampled. For these years, NORPAC provided an expansion factor (one for each year), which is a ratio of total hauls to sampled hauls. These year-specific expansion factors were used to estimate the total amount of darkblotched rockfish caught by multiplying the amount of total catch in sampled hauls by the expansion factor. The removals of darkblotched in the at-sea hake fishery between 1976 and 2012 are presented in Table 2 and Figure 4.

2.1.1.5 Fishery biological data

Biological information on domestic commercial landings was obtained from PacFIN (date of data extraction: March 14, 2013) and on commercial discard from the WCGOP and the Pikitch study. The fishery biological data included sex, length and age of individual fish (amount of data available varied by source, year and state). These biological data were used to generate length and age frequency distributions by sex (when possible), which were then used in the assessment to describe selectivity and retention of the domestic trawl fleet. The summary of sampling efforts, which include number of sampled trips, hauls (when available) and fish by source, year and state is provided in Table 3 and Table 4. The WCGOP also provided average weight for discarded fish. No biological information was available on darkblotched removals in foreign POP fishery. Biological data were available from at-sea hake fishery, however, given that at-sea hake fishery operates in the midwater (not the major habitat for darkblotched) and darkblotched bycatch represents tiny amount of overall darkblotched removals (Figure 4), these data were not used in the assessment, since the model interpreted the data as representative of the entire stock, and iterative tuning of the composition data resulted in them receiving implausibly high weight (e.g., at-sea-hake bycatch having equal weight to the NWFSC shelf-slope survey compositional data).

2.1.1.5.1 Length composition data

Length composition data from commercial fisheries were compiled into 30 length bins, ranging from 4 to 62 cm. Most of the length data from PacFIN were reported for females and males separately; therefore length frequency distributions of darkblotched rockfish in commercial landings were generated by year and sex. The number of fish sampled by port samplers from different trips has not been proportional to the amount of landed catch in these trips. Sampling effort also has varied among states. To account for non-proportional sampling of darkblotched rockfish among trips and states, and to generate length frequency distributions that would be more representative of coastwide species landings, the observed length composition data were expanded using the following algorithm:

1. Length composition data were acquired at the trip level by year, state and sex;
2. For each trip, raw length observations were scaled up to represent darkblotched rockfish landings for the entire trip:
    a. An expansion factor was calculated by dividing the total weight of trip landings by the total weight of darkblotched rockfish sampled for length within the same trip;
    b. The observed raw length composition data within each trip were multiplied by the expansion factor and then summed up by state.
3. The expanded and summed lengths in each state were then expanded again to account for differences in species landings among states:
    a. The expansion factor was computed by dividing the total weight of state landings by the total weight of organisms sampled for length within this state;
    b. The length frequency distributions for each state (from step 2 of this algorithm) were multiplied by the expansion factor (from step 3.a) and then summed up to determine the coastwide sex-specific length frequency distributions by year.

We only used randomly collected samples. The coastwide length frequency distributions of darkblotched rockfish (generated as described above) landed in the domestic trawl fishery by year and sex are shown in Figure 8 and Figure 9.

Length frequencies distributions were developed for the period between 1977 and 2012. Length distributions for 1977 and 1978, however, were not use in the assessment as those distributions were substantially different from distributions in the other years. More probably, 1977 and 1978 length data mainly represented catches in midwater trawl fishery targeting widow rockfish, the dominant rockfish fishery in the late-1970s on the U.S. West Coast. Landings of that period, however, were not distinguished between bottom and midwater trawl; therefore, we were unable to confirm our assumption regarding the reason for observed difference.

Length-frequency distributions of darkblotched rockfish that were discarded at sea were obtained from the WCGOP for the period between 2002 and 2011, and from the Pikitch study for the year of 1986. The discard length composition data were analyzed using a weighting method consistent with that applied to the port samples of landed catch described above. Length frequency distributions of discarded fish, however, were developed for both sexes combined, since the vast majority of data did now have sex information associated with length measurements. The length frequency distributions of darkblotched rockfish discarded at sea by year are shown in Figure 10.

The initial input sample sizes for length frequency distributions of darkblotched landings by year were calculated as a function of the number of trips and number of fish sampled using the method developed by Stewart and Miller (pers. com.):

$$N_{input} = N_{trips} + 0.138 N_{fish} \qquad \text{when} \quad \frac{N_{fish}}{N_{trips}} < 44$$

$$N_{input} = 7.06 N_{trips} \qquad \text{when} \quad \frac{N_{fish}}{N_{trips}} \geq 44$$

The method was developed based on analysis of the input and model-derived effective sample sizes from west coast groundfish stock assessments. A step-wise linear regression was used to estimate the increase in effective sample size per sample based on fish-per-sample and the maximum effective sample size for large numbers of individual fish.

2.1.1.5.2 Age composition data

Age composition data from commercial fisheries were compiled into 36 age bins, ranging from age 0 to age 35 fish. The amount of age data sampled from commercial landings varied among state (Table 4). In the assessment, we used data from only those years when age estimates were available from all three states (2002-2008) to account for gradient in length-at-age parameters along the coast observed. Age data on discarded fish were available from the WCGOP for 2004 and 2005.

The age data were used to derive marginal age compositions using the same weighting methods as used for the length frequency distributions. The marginal composition approach was preferred over the conditional age-at-length compositions (used for fishery-independent data) because the commercial fishery often operates over a more protracted season than the surveys (making age-at-length less stationary during a single year) and in order to speed the computation time of model runs. The marginal age compositions for commercial landings and discards used in the assessment are presented in Figure 11, Figure 12 and Figure 13.

In two previous full assessment of darkblotched rockfish (Rogers 2005, Hamel 2007), only age data aged in 2004 and later were used, as a way to deal with uncertainty in ageing (Rogers 2005). The concern was that criteria for estimating ages of darkblotched rockfish might have changed (Hamel 2007) and that a bias may have existed in "early" age data compared to those generated in 2004 and later (Rogers 2005). We re-evaluated all the age data available for darkblotched rockfish and, based on the communication with age readers involved in ageing of darkblotched rockfish over the years (McDonald, Kamikawa, Menkel, pers. com), established that no changes were made in ageing criteria for this species. We also explored a presence of potential bias in "early" age data by comparing double reads made by the same age reader in the "early" and "late" periods and found little support for "early" age data being biased relative to "late" age estimates or having different imprecision.

Since 2005, darkblotched rockfish age structures (otoliths) were read by a single reader (Reader 1) from the Ageing Laboratory in the Hatfield Marine Science Center in Newport (Oregon) using the break and burn method, with few other readers producing double-reads of the same age structures. Prior to 2005, several age readers were involved in ageing darkblotched rockfish, who use the same method (break and burn) and same criteria to estimate ages from darkblotched rockfish otoliths as the current age reader for this species. To account for the change in age readers in 2005, we estimated a separate pattern for ageing error in an "early" (prior to and including data aged in 2004) and "late" (after and including data aged in 2005) periods of age data (see "Ageing bias and impression" section for details).

2.1.1.5.3 Average weight of discarded fish

Also, average body weight estimates from the discarded catch were available from the WCGOP for years between 2002 and 2011. These estimates were available for some hauls where length data were not collected, as they were calculated via the sample weight divided by the count of fish in that haul. The smallest average fish weight was reported for the domestic trawl fishery discards in 2011, the first year of the IFQ fishery, which is consistent with other changes related to IFQ fishery. Such changes include negligible discard and changes in length frequency distributions, with smaller (relative to previous years) fish were discarded.

2.1.2 Fishery-independent data

2.1.2.1 Surveys used in the assessment

The assessment utilizes fishery-independent data from four bottom trawl surveys conducted on the continental shelf and slope of the Northeast Pacific Ocean by NWFSC and Alaska Fisheries Science Centers (AFSC), including: 1) the AFSC shelf survey (often called "triennial", since it was conducted every third year), 2) the AFSC slope survey, 3) the NWFSC slope survey, and 4) the NWFSC shelf-slope survey (often referred to as "combo" survey). Details on latitudinal and depth coverage of these surveys by year are presented in Table 5.

The AFSC triennial survey was conducted every third year between 1977 and 2004 (in 2004 this survey was conducted by the NWFSC using the same protocols). Survey methods are most recently described in Weinberg et al. (2002). The basic design was a series of equally spaced transects from which searches for tows in a specific depth range were initiated. Over the years, the survey area varied in depth and latitudinal range (Table 5). Prior to 1995, the depth range was limited to 366 m (200 fm) and the surveyed area included four INPFC areas (Monterey, Eureka, Columbia and U.S. Vancouver). After 1995, the depth coverage was expanded to 500 m (275 fm) and the latitudinal range included not only the four INPFC areas covered in the earlier years, but also part of the Conception area with a southern border of 34°50' N. latitude. For all years, except 1977, the shallower surveyed depth was 55 m (30 fm); in 1977 no tows were conducted shallower than 91 m (50 fm). The data from the 1977 survey were not used in the assessment, because of the differences in depths surveyed and the large number of "water hauls", when the trawl footrope failed to maintain contact with the bottom (Zimmermann et al., 2001). The tows conducted in Canadian and Mexican waters were also excluded. In the assessment, the triennial survey was divided into two periods: 1980- 1992, and 1995-2004; separate catchability coefficients (*Q*) were estimated for each time period. This was done to account for differences in spatial coverage before and after 1995 (Table 5) and to reflect a change in the timing of the survey. The survey was conducted from mid-summer to early fall in the earlier time period, and was conducted at least a full month earlier in the later time period (Figure 14).

The AFSC slope survey was initiated in 1984. The survey methods are described in Lauth (2000). Prior to 1997, the survey was conducted in different latitudinal ranges each year (Table 5). In this assessment, only data from 1997, 1999, 2000 and 2001 were used – these years were consistent in latitudinal range (from 34°30' N. latitude to the U.S.-Canada border) and depth coverage (183-1280 m; 100-700 fm).

The NWFSC slope survey was conducted annually from 1999 to 2002 (Keller et al., 2007). The surveyed area ranged between 34°50' and 48°07' N. latitude, encompassing the U.S. Vancouver, Columbia, Eureka, Monterey INPFC areas, and a portion of the Conception area, and consistently covered depths from 100 to 700 fm (183-1280 m) (Table 5).

The NWFSC shelf-slope (combo) survey has been conducted annually since 2003, and the data between 2003 and 2012 were used in the assessment. The survey consistently covered depths between 55 and 1280 m (30 and 700 fm) and the latitudinal range between 32°34' and 48°22' N. latitude, the extent of all five INPFC areas on the U.S. west coast (Table 5). The survey is based on a random-grid design, and four industry chartered vessels per year are assigned an approximately equal number of randomly selected grid cells. The survey is conducted from late May to early October, and is divided into two passes, with two vessels operating during each pass. The survey methods are most recently described in detail in Bradburn et al. (2011).

2.1.2.2 Survey abundance indices

Indices of abundance for each of the four bottom trawl surveys were derived using a delta-generalized linear mixed model, or delta-GLMM (Maunder and Punt, 2004), implemented using the software from Thorson and Ward (In press). The analysis associated with this method and the new and improved software for constructing survey abundance indices were recently reviewed by the PFMC's Scientific and Statistical Committee (SSC). The SSC endorsed the analysis and recommended using this software in stock assessments.

For each survey abundance index, spatial strata were first identified based on depth and latitude, via examination of trends in size across latitude and depth and evaluation of the presence (or absence) of darkblotched in certain depth- or latitudinal areas. Survey data are based on a randomly-stratified survey design with pre-specified strata. We attempted to retain strata already recognized by the survey, while balancing the need to inform strata designation by species-specific characteristics of the stock. Also, the number of positive tows in each strata x year combination were computed to ensure that each stratum x year combination has a sufficient number of positive tows, for the estimation model to perform adequately.

Darkblotched exhibit ontogenetic movement, when fish move into deeper water as they mature, a common phenomenon observed in the genus *Sebastes* (Love et al., 2002). Survey data we evaluated also exhibited a rapid increase in fish size over the shallowest depths to roughly 300 m. Therefore, 300 m was used as the depth break for AFSC slope, NWFSC slope surveys, and the NWFSC combo surveys as well as the late period (1995-2004) of the AFSC triennial shelf survey. In the early period (prior to 1995) the AFSC triennial survey went as deep as 400 meters and to satisfy requirement for a positive tow number, a single depth stratum was used for early AFSC survey. No darkblotched was found beyond 550 m, and in order to avoid extrapolating biomass into those deeper areas, for the analysis surveys that went passed 550 m, were cut at 549 m.

INPFC area boundaries were used as latitudinal breaks; however, due to few occurrences of darkblotched in the water off California, Conception and Monterey INPFC areas were combined into a single stratum. Also, Columbia and U.S. Vancouver INPFC areas were combined in the later period of the AFSC triennial shelf survey and AFSC slope survey, again due to very few positive tows in those areas. Finally, in case of NWFSC combo survey, the boundary at 34°5' N. lat. maintained the break in sampling density to the north and south. There was only 3 occurrences of darkblotched rockfish south of 34°5' N. lat. over the entire time series of the survey, therefore, we limited the survey to 34°5' N. lat. on the south and eliminated data from 32° -34°5' N. lat. from the analysis. Resultant strata for all the surveys are shown in Table 6. These strata were used in constructing survey abidance indices used in the assessment.

The delta-GLMM approach used to construct survey abundance indices, for every tow explicitly models both the probability that it encounters the target species (using a logistic regression), and the expected catch for an encounter (using a generalized linear model). The product of these two components yields an estimate of overall abundance. Year is always included in both model components (because it is the design variable), and strata are generally included as a fixed effect. The delta-mixed-model implementation is necessary to treat vessels as a random effect for the NWFSC slope and combined shelf-slope surveys, because these vessels are selected in an open-bid for the sampling contract from the population of all possible commercial vessels (Helser et al., 2004). Lognormal and gamma errors structures were considered for the model component representing positive catches, while a Bernoulli error structure was assumed for the presence/absence model component.

We also explored an option to model extreme catch events (ECEs, defined as hauls with extraordinarily large catches) as a mixture distribution (Thorson et al., 2011), which has been shown to improve precision for estimated indices of abundance in simulated data in some cases (Thorson et al., 2012). Model convergence was evaluated using the effective sample size of all estimates parameters (>500 was sought) and visual inspection of trace plots and autocorrelation plots (where a maximum lag-1 autocorrelation of <0.2 was sought). Model goodness-of-fit was evaluated using Bayesian posterior predictive checks and Q-Q plots. For all indices, Q-Q plots indicated that an ECE error structure was necessary. Also, a comparison of average deviance between lognormal-ECE and gamma-ECE indicated support for using the gamma-ECE error structure for all indices.

2.1.2.3 Length composition data

Length composition data collected by the surveys were used to derive length frequency distributions by survey, year and sex. Amount of length composition data available for the assessment varied by survey and year. A summary of sampling efforts in all surveys are summarized in Table 7, Table 8, Table 9 and Table 10. Length composition data were compiled into 30 length bins, ranging from 4 to 62 cm. The observed length compositions were expanded to account for differences in catches among tows and spatial strata. To generate coastwide length frequency distributions the following algorithm was used:

1. For a specific year and survey, length data by sex were acquired at the tow level;
2. For each tow, the raw length observations were expanded to represent the entire tow:
    a. An expansion factor was calculated by dividing the total weight of darkblotched within the tow by the total weight of darkblotched in this tow measured for length;
    b. The observed length frequencies were multiplied by the expansion factor and then summed up within a spatial stratum.
3. The expanded and summed length frequencies in each spatial stratum were then expanded again to account for differences in catches among spatial strata:
    a. The expansion factor was computed by dividing the total weight of darkblotched within a stratum by the total weight of darkblotched within this stratum measured for length;
    b. The length frequency distributions within each stratum (calculated via step 2 above) were multiplied by the second expansion factor (from step 3.a) and then summed up to produce annual sex-specific length frequency distributions for the entire survey area.

Spatial strata used to generate annual length frequency distributions were consistent with the strata used to compute survey abundance indices (Table 6). The coast-wide length frequency distributions of female and male darkblotched rockfish by survey, year and sex are shown in Figure 15 through Figure 22.

The initial input sample sizes for the survey length frequency distribution data were calculated as a function of both the number of fish and number of tows sampled using the method developed by Stewart and Miller (NWFSC, pers.com.):

$$N_{input} = N_{tows} + 0.0707 N_{fish} \quad \text{when} \quad \frac{N_{fish}}{N_{tows}} < 55$$

$$N_{input} = 4.89 N_{tows} \quad \text{when} \quad \frac{N_{fish}}{N_{tows}} \geq 55$$

2.1.2.4 Age composition data

Age composition data were collected for all the surveys, but the amount of data varied by survey and year. A summary of age data available for the assessment is presented in Table 7, Table 8, Table 9 and Table 10.

As in case of fishery-independent age data in several previous assessments (Hamel, 2008; Rogers, 2005), only age data generated in 2004 and later were used. The concern was that criteria for estimating ages of darkblotched rockfish might have changed (Hamel, 2008) and that a bias may have esisted in “early” age data (Rogers, 2005). We re-evaluated all the age data available for darkblotched rockfish and, based on the communication with age readers involved in ageing of darkblotched rockfish over the years (McDonald, Kamikawa, Menkel, pers. com), established that no changes were made in ageing criteria for this species. We also explored a presence of potential bias in “early” age data by comparing double reads made by the same age reader in the “early” and “late” periods of age data and found little support for “early” age data being biased relative to “late” age estimates or for those data having different imprecision.

Since 2005, darkblotched rockfish age structures (otoliths) were read by a single reader (Reader 1) from the Ageing Laboratory at the Hatfield Marine Science Center in Newport (Oregon) using the break and burn method, with few other readers producing double-reads of the same age structures. Prior to 2005, several age readers were involved in ageing darkblotched rockfish; all readers used the same method (break and burn) and same criteria to estimate ages from darkblotched rockfish otoliths as the current age reader for this species. To account for the change in age readers in 2005, we estimated a separate pattern for ageing error in an “early” (prior to and including data aged in 2004) and “late” (after and including data aged in 2005) periods of age data (see “Ageing bias and impression” section for details).

Age composition data from the surveys were compiled as conditional distributions of ages at length by survey, year and sex. Prior to that, the observed age compositions were expanded to account for differences in catches among tows and spatial strata, using the same approach as described for length composition data above. The conditional ages at length approach uses an age-length matrix, in which columns correspond to ages and rows to length bins. The distribution of ages in each column then is treated as a separate observation, conditioned on the corresponding length bin (row). The conditional ages at length approach has been used in most recent stock assessments on the West Coast of the United States, since it has several advantages over the use of marginal age frequency distributions. Age structures are usually collected from the individuals that have been measured for length. If the standard age compositions are used along with length frequency distributions in the assessment, the information on sex ratio and year class strength may be double-counted since the same fish are contributing to likelihood components that are assumed to be independent. The use of conditional age distributions within each length bin allows avoiding such double-counting. Also, the use of conditional ages at length distributions allows the reliable estimation of growth parameters within the assessment model.

The number of ages within each length bin was used as the initial input sample sizes for conditional ages and length distributions. Conditional ages at length compositions generated and used in the assessment are shown in Figure 23 through Figure 29.

2.1.3 Biological parameters

Several biological parameters used in the assessment were estimated outside the model or obtained from literature. Their values were treated in the model as fixed, and therefore uncertainty reported for the stock assessment results does not include any uncertainty in these quantities (however some were investigated via sensitivity analyses described later in this report). These parameters include weight-length relationship parameters, female maturity and fecundity parameters, natural mortality and ageing error and impression. The methods used to derive these parameters in the assessment are described below.

2.1.3.1 Weight-length relationship

The weight-length relationship used for this assessment is based on observations from 3167 females and 3558 males collected in the NWSFC shelf-slope survey between 2003 and 2010. Male and female weight-length curves were fit separately using the following relationship:

$$W = \alpha(L)^{\beta}$$

Where W is individual weight (kg), L is total natural length (cm) and α and β are coefficients used as constants.

The parameters derived from this analysis were the following: α = $1.110 \cdot 10^{-5}$ for females and $1.205 \cdot 10^{-5}$ for males, and β = 3.1351 for females and 3.122 for males. Estimated parameters fit the data well, and indicated little difference in the weight-length relationship between female and male darkblotched rockfish (Figure 30).

2.1.3.2 Maturity schedule

Maturity data on female darkblotched rockfish were produced via histological analysis of fish collected in the NWFSC shelf-slope survey in 2011 and 2012. Methods used for identifying maturity of darkblotched rockfish are described in McDermott (1994). A female was classified as 'mature' if histological analysis suggested it was producing eggs, and that atresia was less than 25%. The presence of old (and otherwise mature) female individuals with significant atresia suggests that darkblotched rockfish will skip spawning intermittently. We therefore estimated an asymptotic maturity rate less than one, where this maturity schedule represents the combined effect of maturation and atresia.

Maturity at age was estimated from 303 records of females that had maturity and age recorded. Maturity at age was modeled using three parameters:

$$\hat{m}(a) = m_{\infty} \frac{1}{1 + e^{-(\beta \cdot (a - \alpha))}}$$

Where m_∞ is the asymptotic maturity for an old female; α is the age at which maturity is 50% of m_∞, and β is the slope of maturity as a function of age.

Model selection using AIC supported the use of this model over one in which m_∞ was fixed at 1. Records were then assumed to be Bernoulli distributed given the prediction of maturity $\hat{m}(a)$. This resulted in estimates of α = 4.82, β = 1.03, and m_∞ = 0.915.

Maturity-at- relationship for female darkblotched rockfish used in the assessment, shown with fit to the data from the NWFSC shelf-slope survey samples is shown in Figure 31.

2.1.3.3 Fecundity

Fecundity (number of eggs) was assumed to be related to female body weight linearly as follows:

$$\frac{\Phi}{W} = a + bW$$

Where Φ is the number of eggs, *W* is female weight in kg, and *a* and *b* are constant coefficients.

This linear relationship follows the work of Dick (2009) who calculated this relationship for several species of rockfish and found the egg and female weight was not proportional. For darkblotched, Dick (2009) estimated parameters *a* and *b* to be 101100 and 44800 respectively, and we used these values in the assessment.

In several previous assessments, fecundity parameters were used as estimated by Nickol (1990) using data collected in waters off Oregon. Dick's (2009) analysis included data from several darkblotched fecundity studies, including those conducted using data from Oregon (Nickol and Pikitch, 1994), Washington (Snytko and Borets, 1973) and California (Phillips, 1964) waters. We explored the model sensitivity to fecundity parameters via a sensitivity analysis (Figure 128, Figure 129 and Figure 34).

2.1.3.4 Natural mortality

A fixed value for natural mortality, equal for males and females, has been assumed in all stock assessments of darkblotched rockfish. The value of 0.05 used by early assessments is consistent with results from the Hoenig (1983) method. Other life history-based methods provide wildly different estimates that are generally considered to be inconsistent with rockfish life history (Hamel, pers. com.). In Rogers (2005) and Hamel (2008) the value of 0.07 was used, based upon the estimates from the Hoenig (1983) maximum age method and Gunderson (2003) gonadosomatic index meta-analyses, and also based on model results, achieving a balance between natural mortality and steepness values (the steepness was 0.95 and 0.6 in Roger (2005) and Hamel (2008), respectively).

Exploration of the base model indicates that natural mortality in this assessment is estimated to have an implausibly large value. This was also true for many alternative model parameterizations (including those with Hamel natural mortality prior). A minority of runs estimated a natural mortality between 0.045 and 0.060, while most runs estimated this parameter to be greater than 0.10, which is inconsistent with the maximum observed age for this species. We, therefore, have chosen to fix this parameter *a priori* at the value of 0.05 yr^{-1} for females and estimate it for males. Dimorphic growth in fish is often accompanied by different rates of natural mortality. Even though model is unable to reliably estimate natural mortality for both sexes, compositional data can inform the difference between the sexes quite well, and estimating at least one sex would capture more of the uncertainty in the model results.

We explored the impact of using 0.07 yr^{-1} for natural mortality of both sexes (as assumed in previous several assessments) via a sensitivity analysis (Figure 128, Figure 129 and Figure 130). We also use alternative values of natural mortality in defining states of nature in the Decision Table, to further incorporate uncertainty in this parameter into the management process.

2.1.3.5 Ageing bias and imprecision
In the assessment, two ageing error matrices were used to account for the change in age readers in 2005. Separate patterns for ageing error were estimated in an "early" (prior to and including data aged in 2004) and "late" (after and including data aged in 2005) periods of age data.

To develop ageing error matrices, we analyzed all available data from double-reads using a state-space model developed by Punt et al. (2008) and software developed by Stewart et al. (2011). We did not use formal model selection tools, however, because this often resulted in patterns that were implausible (i.e. residual patterns for the unbiased reader).

For the "early" peroid, age reads made by Reader 3 (re-reads of early ages done by the current reader after 2005) were assumed to be unbiased. We therefore started with a model with different linear (1-parameter) bias and imprecision for each Readers 1-2 (assumed throughout to have the same bias and imprecision) and Reader 3. We then explored adding a quadratic term to the bias and imprecision for either Reader 1-2 or Reader 3, and found that each such change caused little difference in the estimated ageing error or bias schedules. We also found that the estimated ageing imprecision and bias was very similar for Readers 1-2 and Reader 3, so we used a model in which imprecision and bias were identical for all readers.

For the "late" period, age reads made by Reader 1 (the current darkblotched rockfish age reader) were assumed to be unbiased. Comparison of age estimates of Reader 1 with those made by all other readers indicated small but important differences in precision and bias among readers. However, the only the bias and imprecision schedule for Reader 1 is used in the assessment model (given that Reader 1 provided all age reads used in the model after and including 2005).

Comparison of results from the "early" and "late" periods indicates greater imprecision during the early than that of in the later period (Figure 32, Figure 33 and Figure 34).

2.2 History of Modeling Approaches Used for this Stock

2.2.1 Previous assessments

The first stock assessments of darkblotched rockfish was done in 1993 and stock assessments have been conducted frequently since then (Lenarz, 1993; Rogers et al., 1996; Rogers et al. 2000; Rogers, 2003; Rogers, 2005; Hamel, 2008; Wallace and Hamel, 2009; Stephens et al. 2011).

Lenarz (1993) reviewed the available life-history and fishery information on the species. Based on the Hoenig (1983) method and a maximum age of 60 to 105 years, Lenarz (1993) estimated the natural mortality rate to be between 0.025 and 0.05 yr^{-1}. Based on these values, the target fishing mortality rate ($F_{35\%}$) was estimated to be between 0.04 and 0.06, and the overfishing level ($F_{20\%}$) between 0.07 and 0.11. Analysis of length composition data, available at that time, indicated that average size of fish had decreased between 1983 and 1993, which was consistent with estimated fishing impacts. OFL (then called ABC) was not estimated.

Rogers et al. (1996) analyzed 13 commercially important rockfish species (including darkblotched) using an F = M approach, which was modified to derive OFLs under the assumption of an$F_{35\%}$ target fishing mortality rate. Rogers et al. (1996) averaged the AFSC triennial survey abundance indices for several species over the period between 1980 and 1995 and developed a proxy adjustment factor based on the OFLs from available stock assessments of U.S. West Coast rockfish species and characteristics of each species analyzed. For darkblotched rockfish, this proxy adjustment factor was 0.8. The OFL was determined under the assumption of natural mortality rate of 0.05 yr^{-1}. At the same time, darkblotched rockfish was also assessed using a simple stock synthesis model, mostly to confirm the F = M approach, used by Rogers et al. (1996). That was a two sex model, which included two survey indices of abundance (one was derived from AFSC triennial survey and the other was based on POP bycatch effort), as well as length and age composition data from the AFSC triennial survey and the commercial fishery. The model was structured to have northern and southern fishing fleets; the modeling time period spanned between 1980 and 1995, and assumed equilibrium condition in 1979, with an equilibrium catch of 300 mt. The model produced estimates of age-1 recruitment for the period between 1980 and 1993, estimated dome-shaped selectivity for the AFSC triennial survey and the southern fishery and asymptotic selectivity for the northern fishery. Catchability for the AFSC triennial survey was fixed at 1.0. The $F_{35\%}$ fishing mortality rate was estimated to be 0.04 for the northern fishery and 0.02 for the southern fishery.

Rogers et al. (2000) expanded the 1996 model to develop the first full assessment of the darkblotched rockfish stock. The model covered the period from 1963 to 1999, with an equilibrium catch of 200 mt assumed prior to the first year of the model. Five abundance indices were used. In addition to the AFSC triennial and POP bycatch indices (used in the 1996 assessment), 2000 assessment included AFSC slope survey and POP survey (Wilkins and Golden, 1983) abundance indices, as well as CPUE index developed based on commercial trawl fishery logbook data. Length composition data included samples from all years of the AFSC triennial, AFSC slope and POP surveys. The model included a single fishing fleet and discard assumptions were explored only via sensitivity analysis, because incorporating discard in the assessment complicated the model without substantially changing the model output. Fishery selectivity was assumed to be asymptotic, while survey selectivity was allowed to be dome-shaped. Age-1 recruits were estimated between 1963 and 1998, with the 1999 recruitment fixed at an assumed value.

The 2000 assessment included two models - a Stock Assessment Team (STAT) model and a Stock Assessment Review Panel (STAR) model. Both models produced similar results, but their assumptions were quite different. The STAT model included subjective weights on the log-likelihood components and informative prior distributions on some of the fitted parameters as well as assumed a Beverton-Holt stock-recruitment relationship. The STAR model had all weights on the likelihood components to be either 1 or 0, assumed no prior knowledge about the estimated parameters, and placed no bounds on the estimated recruitments. The STAT model considered CPUE and POP bycatch indices less reliable than the other indices of abundance, and the AFSC triennial survey index more reliable than AFSC slope or POP survey indices. The STAT model (similarly to the STAR model) estimated dome-shaped selectivity for all three surveys used in the assessment. The steepness prior probability distribution had a mean of 0.8 and a CV of 0.1; the estimated parameter value based on this prior was 0.83. Uncertainty in the 2000 assessment was expressed both through choice between the models and through assumptions regarding the amount of darkblotched foreign bycatch relative to the estimated catch of POP. The target fishing mortality ($F_{50\%}$) was estimated to be around 0.032, regardless of the choice of model or the foreign bycatch assumption. Given the range of foreign bycatch, spawning depletion in 1999 was estimated to be between 17% and 28% in the STAT model and between 13% and 26% in the STAR model. Base on this assessment, stock was declared overfished.

In the 2001 update assessment, selectivity parameters and survey catchability parameters were fixed at the values estimated in the 2000 assessment. Only the age-1 recruits were re-estimated, with 2000 and 2001 recruitment fixed at an assumed level. The fishing mortality rate at $F_{50\%}$ was estimated to be 0.032, the spawning depletion at the beginning of 2002 was 14%, and the 2002 OFL (then called ABC) was 187 mt.

The 2003 assessment was a comprehensive update of the 2000 assessment. The model structure and values of fixed parameters used in the assessment were not changed. However, the data used in the assessment were extended through 2002 and all the fitted parameters were estimated. Newly available age composition data were not included in the model, since they were not consistent with the growth curve and the aging error parameters fixed in the 2000 model. Management related discard was added to the 2001 and 2002 landings, using rates assumed by the PFMC (0.1 discard ratio in 2001 and 0.2 in 2002). Estimates of darkblotched catch in the foreign POP fishery between1966 and 1976 were included as estimated by Rogers (2003). The fishing mortality rate at $F_{50\%}$ was estimated to be 0.032, the 2004 spawning depletion 11%, and the 2004 OFL (then called ABC) was 240 mt.

In 2005, full assessment (Rogers, 2005) was conducted using the Stock Synthesis 2 (SS2 v1.) modeling framework. The time series of landings were extended back to 1928, assuming unfished equilibrium condition of the stock in 1927. Discard ratio estimates were calculated from the data available for 1986 and the period between 2000 and 2004, and the full time series of discards were estimated within the model. Retention curve parameters were also estimated within the model. Only age data from otoliths read in 2004 were included in the assessment due to a concern of a bias in earlier age data. The AFSC slope survey index was re-estimated using a GLM approach, and the NWFSC slope survey index (1999-2004) and length composition data (2000-2004) were added to the assessment. Most of the growth parameters were estimated within the assessment model, while natural mortality was fixed at the value of 0.07 yr^{-1}. The assessment used a Beverton-Holt model to describe the stock-recruitment relationship with the steepness parameter fixed at the value of 0.95. Spawning depletion at the start of 2005 was estimated to be 17% of the unfished level. Natural mortality was used as the main axis of uncertainty for the decision table, with three states of nature encompassing the range of *M* values (0.05, 0.07 and 0.09yr^{-1}) that corresponded to low, medium (base case) and high states of nature respectively.

The most recent full assessment (prior to the current assessment) was conducted in 2007 (Hamel, 2008). In the 2007 assessment, recent landings and discard ratio estimates were updated, while newly available landings, discard and NWFSC slope survey data were added. The shelf portion of the NWFSC shelf-slope (combo) survey (2003-2006) was also included in the assessment. The new GLMM approach was used to estimate abundance indices for all the surveys. Conditional ages-at-length compositions were used in the assessment for the first time for this stock to input age data from the fishery landings, fishery discards, the AFSC slope and NWFSC shelf and slope surveys. The use of age data was still limited to ages estimated during and after 2004. Data from the two year POP survey were no longer used in this assessment. Also, the average weight of discarded fish and mean size-at-age data were no longer used in the assessment since the conditional ages-at-length compositions encompass the same data sources and provide similar information. Natural mortality was fixed at the value of 0.07 yr^{-1} and spawner-recruit steepness was first estimated (with the prior) within the model and then fixed at the estimated value (0.6). The point estimate for the depletion of the spawning output at the start of 2007 was estimated to be 22.4% relative to spawning output in an unfished equilibrium condition. The decision table was developed based on uncertainty in the assumed value of natural mortality, with natural mortality values of 0.05, 0.07 and 0.09 yr^{-1} representing low, medium (base case) and high states of nature.

The 2007 assessment (Hamel, 2008) was updated twice; the first by Wallace and Hamel (2009) and then by Stephens et al. (2011). The 2009 update assessment retained the same model structure as the 2007 assessment, but updated the historical time series of catch with newly reconstructed California historical landings. It also included two more years of data that became available since the 2007 assessment. The point estimate of depletion was 27.5% at the start of 2009. The 2011 update assessment retained the same model structure as the 2007 full assessment, but, like the 2009 assessment, updated the time series of catch to incorporate the newly reconstructed Oregon historical landing of darkblotched rockfish. The data that became available since the 2009 were also included.

The spawner-recruit steepness was updated from 0.6 (as in the 2007 and 2009 assessments) to 0.76, based upon information from a new meta-analytic prior (Martin Dorn, pers.com.) and the model fit. In addition, selectivity for the NWFSC slope survey was found to be dome-shaped in that assessment, rather than the asymptotic as previously estimated. At the start of 2011, the spawning depletion was estimated to be 30%. The decision table was based on spawner-recruit steepness as the major axis of uncertainty (rather than natural mortality as in the 2007 full assessment and 2009 update assessment) with steepness of 0.76 to represent medium state of nature (base case). Alternative steepness values to represent low and high states of nature (0.54 and 0.95, respectively) were calculated as the 12.5% and 87.5% quantiles from the prior distribution on steepness.

In aggregate, these assessments have largely drawn the same conclusions regarding historical trends in stock dynamics: the darkblotched rockfish abundance declined rapidly in the 1960s and 1970s due to high fishing intensity, and continued to decline in the 1980s and 1990s reaching the lowest point around 2000 (Figure 139). For the last decade, the stock was slowly increasing primarily due to management efforts toward rebuilding of the stock.

2.2.2 Responses to 2007 STAR panel recommendation

The STAR panel report from the last full assessment (conducted in 2007) identified a number of recommendations for the next assessment as well as general long term recommendations for future assessments. Below, we list the 2007 STAR panel recommendations and explain how these recommendations were taken into account in this assessment. Not all the long term recommendations could be addressed in this assessment, but we summarized the progress done toward each of them.

For the next assessment the following recommendations were made:

1) *GLMM survey index swept area biomass data for the NWFSC shelf and slope surveys were much higher than simple swept area biomass calculations. Although some differences might be expected, the magnitude and consistency of the differences was surprising. GLMM procedures and models used to standardize the survey data should be checked and differences should be explained.*

Since 2007, considerable progress has been made in applying the GLMM for constructing survey abundance indices, and this method has become the default approach to deal with survey abundance data. The software for constructing indices of abundance using a delta-GLMM method (i.e. the probability that a catch during a haul is positive and the size of the catch in the haul are modeled separately) has been most recently updated. New software (a) improves the speed with which analyses can be conducted, (b) allows additional fit diagnostics to be produced, (c) allows catches to be modeled as a mixture of distributions so that exceptional catch-rates can be modeled, (d) allows the coefficient of variation of the distribution for the positive catches to be estimated rather than pre-specified, and (e) treats effort as an offset. This new software was recently reviewed by the PFMC' SSC. The SSC endorsed the new software for the analysis of trawl survey data and recommends using it in stock assessments. Following the recommendation of the 2007 STAR Panel, we did calculate survey abundance indices using design-based approach and included them in the model data file for comparison.

2) *Assessment data and background information should be presented clearly and completely before dealing with assessment models and modeling results. Data tables should be distributed at the start of the review.*

In this assessment, we substantially extended sections describing background information and data used. We also provide additional Tables and Figures to clearly summarize data used in the assessment and set the stage for explaining the model results.

3) *Future assessments should include complete sets of model diagnostics for GLMM standardized abundance indices, and other types of model runs.*

The new delta-GLMM software by Thorson and Ward (in press) produces a standard set of diagnostics, which include a posterior predictive check for all positive catch rate data, which (in case of this assessment) indicated no evidence of poor model fit. We included Bayesian Q-Q plots obtained from these posterior predictive checks for all surveys used in the assessment (Figure 35 through Figure 38). These plots show that the model can account for the variability seen in the positive catch rate data. Also, these Q-Q plots indicated that a mixture distribution was necessary to use to account for extreme catches (Thorson et al. 2011, 2012), while a comparison of average deviance (as recommended by A. MacCall, pers. com.) indicated that the gamma-mixture distribution provided better fit than a lognormal-mixture model.

4) *Maps showing the spatial overlap of the darkblotched rockfish stock area, surveys, fishing grounds and prime habitat should be provided and considered in interpreting survey data.*

In addition to the map of spatial distribution of darkblotched rockfish catch as observed by the WCGOP in Figure 1 (a similar map was included in the 2007 assessment), we supplied a detailed (5 page) map of spatial distribution of darkblotched rockfish catches in the NWFSC shelf-slope (combo) survey (Figure 2). We also included a table (Table 5) that summarizes latitudinal and depth ranges from four NMFS trawl surveys. Finally, to help interpret survey data, we included maps with NWFSC combo and AFSC triennial surveys catches per haul data (Figure 39, Figure 40).

General or long term recommendation on 2007 STAR Panel included:

1) *Continued work to characterize effective sample size for length composition and, particularly, conditional age composition data is needed. For example, the procedure used to assign effective sample size initially for darkblotched rockfish was questioned in this assessment.*

Considerable work has been done to address this long-term recommendation (Stewart and Miller, pers. com., Stewart and Hamel, pers.com.). The current consensus is that a combination of the number of trips (or tows) and the number of fish should be used to estimate input sample sizes used in the assessment.

2) *A full Bayesian assessment.*

We have explored the ability for Metropolis sampling to provide sufficient independent samples from the Bayesian posterior to allow for a Bayesian analysis of the model. Achieving 1,000,000 samples requires approximately 24 hours, and after discarding the first half and thinning to every 1,000th sample, this still results in significant lag-1 autocorrelation for the extra standard deviation parameter for the AFSC triennial survey. Previous research has also identified this parameter as being difficult to sample. Based on observed autocorrelation, we estimate that Bayesian sampling would require a 10-fold increase in samples. We, therefore, did not pursue using a Bayesian assessment in 2013. It is worth pointing, however, that the estimated parameters and time series of depletion are very similar between maximum likelihood and Bayesian runs, which supports continued attempts to improve Markov chain Monte Carlo sampling methods in future assessments.

3) *It would be useful to routinely check model estimates of survey catchability to determine if they imply implausible biomass estimates. This can be done by comparing the prior and posterior for q in a fully Bayesian assessment. Other approaches involve calculating bounds for plausible q values, comparison of model and minimum swept-area biomass estimates from trawl surveys.*

We have estimated a parameter for ln(Q) for every survey, and have determined that these values are plausible. The ln(Q) for the early triennial survey time series is estimated to be 0.59 (SE = 0.177), and the late triennial time series has an additive offset (in log-space) of 0.13 (SE = 0.312). The ln(Q) for the Alaska slope is estimated to be -0.04 (SE = 0.402), for the NWFSC slope 0.17 (SE = 0.370), and for the NWFSC shelf-slope (combo) survey 0.68 (SE = 0.336). The ln(Q) for the NWFSC combo survey being greater than zero is more probably explained by a single extreme catch in 2003 (Figure 39). This very large positive residual contributes to a high average observed in the NWFSC combo survey and causes the design-based estimate for that year to be aberrantly high and the delta-GLMM estimate for 2003 to be higher than can be fit by the model. Similarly, the ln(Q) greater than zero for the AFSC triennial survey is more probably explained by extreme catches in 1983, 1986, and 1995 (Figure 40).

We additionally explored including an 'extra standard deviation' parameter for all survey indices. This extra standard deviation parameter accounts for process errors, which are not otherwise estimated during index standardization (e.g., the survey only encountering a portion of total abundance) (Maunder and Punt, 2004, Wilberg et al., 2010). This extra standard deviation was estimated to be zero for the Alaska slope and NWFSC slope surveys, but was non-zero for the AFSC triennial and NWFSC combo surveys. These latter two surveys were the ones with ln(Q) greater than zero, and the 'extra standard deviation' parameters indicate that these indices have one or more years that are outliers (i.e., the model has trouble fitting these years given other data types and assumptions about stock productivity).

4) *Assessment and review work would have been enhanced if the STAT had consisted of more than one person and if more time had been available to carry out the assessment.*

As in the 2009 and 2011 update assessments, the current STAT includes more than one stock assessment scientists, which makes the entire process of stock assessment less stressful and more efficient.

2.3 Model Description

2.3.1 Changes made from the last assessment

The last full assessment of darkblotched rockfish was conducted in 2007. It was updated since then twice, in 2009 and 2011. This assessment relies on much of the same data used in the 2007 assessment; however, nearly all aspects of the analysis have been revised to some degree. Below, we describe the most important changes made since the last full assessment and explain rationale for each change:

1) Upgraded to the newest SS version. *Rationale*: This is standard practice to capitalize on newly developed features, corrections to older versions of the code and increases in computational efficiency. Model results were nearly identical before and after this change.

2) Updated Washington historical landings and used the recently reconstructed Oregon and California landings conducted by SWFSC and ODFW in collaboration with NWFSC. *Rationale*: To utilize the best available information for the assessment. Portion (but not the entire time series) of the new estimates for California historical landings was included in in 2009 update assessment and Oregon reconstructed landings were included in 2011 update assessment. The updated estimates of landings used in this assessment were very close to those used in the most recent update assessment (Figure 41).

3) Extended assessment time series back to 1915 (from 1928). *Rationale:* The recently reconstructed historical landings show that non-zero darkblotched rockfish catch in California goes back to 1916 (see Table 2). We used 1916 as the first years of catch, and assumed that the stock was in unfished equilibrium condition in 1915. Model results were nearly identical before and after this change.

4) Changed the structure of fishing fleets and divided fishery removals between two fisheries (instead of combining all removals into one fleet as in the last assessment). *Rationale*: Domestic trawl fishery has historically reported landed catch only, even though a portion of the darkblotched catch was discarded at sea.

Foreign POP fishery, on the other hand, was known not to discard, while at-sea hake fishery reports total catch, which includes both retained and discarded fish. To avoid inflating darkblotched catch in POP and at-sea hake fisheries, the domestic trawl fleet (TWL) and bycatch in foreign POP and at-sea hake fisheries (BYCATCH) were treated separately.

5) Treated the NWFSC shelf-slope survey as a single survey time series (instead of dividing it into slope and shelf portions as was done in the last assessment). *Rationale*: In the 2007 assessment, NWFSC shelf-slope survey was divided into slope and shelf portions and the slope portion was used as continuation of NWFSC slope survey, to have a longer survey time series in the assessment. The change in this assessment was made to utilize the much longer time series of NWFSC shelf-slope survey now available (2003-2012) that runs consistently across all depths and geographic areas.

6) Divided AFSC triennial survey into two time-series, 1980-1992 and 1995-2004 (instead of treating it as a single time series). *Rationale*: The change was made to account for differences in spatial coverage during two periods (Table 5) and to reflect a change in the timing of the survey after 1992 (Figure 14).

7) Used the newest GLMM software to construct survey abundance indices. *Rationale*: This new software includes a number of improvements compared with the previously used.

8) Included discard ratio estimates from Pikitch study for 1985, 1986 and 1987 (instead of using three year the data combined to generate one discard ratio estimate, as it was previous done). *Rationale*: The examination of Pikitch data showed that sampling of retained and discarded catch was conducted throughout the entire three years of the study. Model results were nearly identical before and after this change.

9) Brought back to the assessment "early" age data (those read prior to 2004). *Rationale*: the 2005 and 2007 assessments did not use early ages due to concerns that criteria for estimating ages of darkblotched rockfish may have changed and that a bias may have existed in those early estimates. We re-evaluated all the age data available and established that no changes were made in ageing criteria. We also explored a presence of potential bias in early age data by comparing double reads made by the same age reader in the early and late periods and found little support for early age data being biased relative to late age.

10) Extend the range of modeled ages, setting the 'plus group' in the age data to 35 (from 30). *Rationale*: For avoid having a large percentage of the mass of the data in the 'plus-group' with addition of previously unused early age data (see above).

11) Restructured data length bins, which now range between 4 and 62 cm, in 2 cm increments (instead of bins between 6 and 51 cm with variable increments

between bins). *Rationale*: To include the entire range data and aid interpretation by having uniform step size.

12) Updated fishery and survey biological data. *Rationale*: This was done to account for changes in length and age bin structures and utilize updates made to the analysis and data weighting methods, to account for sampling differences among trips and states.

13) Updated the weight-length relationship. *Rationale*: The relationship had not been revisited in several assessments. The revised estimates are based on NWSFC shelf-slope survey data, not previously available. In this, assessment, we also estimated and used weight-length relationships for females and males separately, instead of using one set of parameters for both sexes, as was done in previous assessment. Model results were nearly identical before and after this change (see Sensitivity analysis section).

14) Updated the maturity parameters. *Rationale*: The last assessment used the maturity schedule as estimated by Nickol (1990). The new maturity data collected within the NWFSC shelf-slope survey became recently available. These data were used to develop maturity at age matrix used in the assessment. Model results were nearly identical before and after this change (see Sensitivity analysis section).

15) Update fecundity parameters. *Rationale*: In several previous assessments, fecundity parameters were used as estimated by Nickol (1990) using data collected in waters off Oregon. Dick's (2009) analysis included data from several darkblotched fecundity studies, including those conducted using data from Oregon (Nickol and Pikitch, 1994), Washington (Snytko and Borets, 1973) and California (Phillips, 1964) waters. Model results were nearly identical before and after this change (see Sensitivity analysis section).

16) Used an updated prior to inform stock-recruit steepness. *Rationale*: In initial runs, an attempt was made to estimate the stock recruitment steepness (h) using the prior probability distribution derived from this year's meta-analysis of Tier 1 rockfish assessments. The estimated value was hitting the upper bound of 1 for the parameter. Therefore, following the recommendation of the PFMC' SSC, h was fixed in the assessment at the value of 0.778, which is the mean of steepness prior probability distribution. In 2007, the steepness was fixed at the value of 0.6, and in 2011 update assessment, steepness value was updated to 0.76. Model results were nearly identical when 0.76 (instead of 0.779) steepness value was used in this assessment (see Sensitivity analysis section).

17) Extended the estimation of recruitment deviations. *Rationale*: 'Main' recruitment deviations were estimated for modeled years that had information about recruitment (as determined from the bias-correction ramp), i.e., 1960-2011. We additionally estimated 'early' deviations between 1870 and 1959 so that age-

structure in the initial modeled year (1915) would deviate from the stable age-structure to a degree that is consistent with estimated variability in recruitment. This resulted in an estimate of B_0 that is also consistent with estimated variability in recruitment given the assumption that initial catch was negligible.

18) Updated the value for natural mortality from fixed 0.07 yr^{-1} for both sexes, as used in previous assessment, to estimating natural mortality for male while holding the value for females fixed at 0.05 yr^{-1}. *Rationale*: Natural mortality has been a major axis of uncertainty in several darkblotched rockfish assessments. The fixed value of 0.07 was used for natural mortality for both sexes in the 2005 and 2007 assessments. This value was selected as a reasonable when the stock-recruit steepness of 0.6 was used the model. In and prior to the 2003 assessment, the fixed value of 0.05 was used for both sexes. The lower estimate was supported by the Hoenig method (1983). For this assessment, we went back to using female natural mortality value of 0.05 yr^{-1}, as we found it to be more plausible than other (much higher) values derived from different (than Hoenig) methods. Dimorphic growth in fish is often accompanied by different rates of natural mortality. Even though model is unable to reliably estimate natural mortality for both sexes, compositional data can inform the difference between the sexes quite well, and estimating at least one sex would capture more of the uncertainty in the model results.

19) Estimated the extra standard deviations for AFSC triennial and NWFSC shelf-slope survey indices. *Rationale*: Estimating the additional variance components speeds the process of iterative reweighting among data sources and propagates the uncertainty about the true survey index variance into the model results. The attempt was made to estimate extra standard deviations for the surveys, but for AFSC and NWFSC slope surveys, these extra standard deviations were estimated to be 0.

20) Employed age selectivity type 11 (to include age-0 fish) instead of 10 (that assumes that age 0 fish are not selected). *Rationale*: The survey data used in the assessment include age-0 fish.

21) Re-evaluated length-based selectivity assumptions. In the last assessment, the length-based selectivity curves of fishery and NWFSC slope survey were assumed to be asymptotic. This assessment assumes only fishery to be asymptotic, but does not force any of the surveys to be asymptotic. *Rationale*: Examination of length composition data showed that domestic trawl fleet is catching the largest fish observed, therefore, assumption of trawl fleet selectivity being Plus, when allowed to be dome-shaped, the trawl fishery selectivity was essentially asymptotic (with a drop observed in the very last bin). The selectivity curves for slope surveys, on the other hand, were estimated to be dome-shaped. We attributed survey dome-shaped selectivity to differences in gear used in survey vs. fishery (roller gear vs. rockhoppers) and to potentially more complex dynamics of darkblotched rockfish in the water column that currently known.

22) Re-evaluated length-based selectivity blocks. *Rationale*: In this assessment, blocks were created after the careful analysis of management actions that are most likely affect length-based selectivity of the fishery. The new block (2011-2012) was created for fishery retention inflection and slope parameters to reflect changes in selectivity with the start of the IFQ fishery. The number of blocks applied to asymptotic retention parameter was used to reflect changes in discard rates caused by changes in trip limits. A new block was added to descending width parameter for the AFSC shelf survey, to account for changes in depth coverage of the survey during 1995-2004 period.

The list above documents only the most important changes made to this assessment, compared to previous one. We also updated a number of settings in the model files to new recommended defaults. Despite the large number of changes made to data sources and model configuration, the results of this assessment are very consistent with those from previous analyses. Comparison of spawning depletion between this assessment and 2011 update assessment is shown in Figure 42.

2.3.2 Modeling software

This assessment uses the Stock Synthesis modeling framework developed by Dr. Richard Methot (NMFS, NWFSC). The most recent version (SSv3.24o, distributed on April 10, 2013) was used, since it included improvements in the output statistics for producing assessment results and several corrections to older versions.

2.3.3 General model specifications

This assessment focuses on a portion of a population of darkblotched rockfish that occurs in coastal waters of the western United States, off Washington, Oregon and California, the area bounded by the U.S.-Canada border on the north and U.S.-Mexico border on the south. The population within this area is treated as a single coastwide stock, given the lack of data suggesting the presence of multiple stocks. The modeling period begins in 1916, assuming that in 1915 the stock was in an unfished equilibrium condition.

Fishery removals are divided among two fleets: 1) the domestic trawl fishery, 2) bycatch in the foreign POP and at-sea Pacific hake fisheries. As described earlier, these two fleets are treated separately to account for difference in handling and reporting the discards. The domestic trawl fishery is associated with a particular amount of catch discarded at sea. The foreign POP fishery is known not to discard fish (based on their size or species), while the at-sea hake fishery, which is managed under maximized retention regulations. There, the time series of discards, therefore, are estimated for the domestic trawl fleet only, and no discard is assumed for the bycatch fleet.

Historical catches for the domestic trawl fishery were reconstructed by state, and then combined into the coastwide fleet. Selectivity and retention parameters are estimated for the domestic trawl fleet, while selectivity of the bycatch fleet is mirrored to that of the domestic trawl fishery. Each survey is treated as a separate fleet with independently estimated selectivity and catchability parameters reflecting differences in depth and latitudinal coverage, design and methods among them. No seasons are used to structure removals or biological predictions; data collection is assumed to be relatively continuous throughout the year. Fishery removals occur instantaneously at the mid-point of each year and recruitment on the 1st of January. Error distribution assumptions associated with different data sources used in the assessment are listed in Table 11.

This is a sex-specific model. The sex-ratio at birth is assumed to be 1:1. Growth of darkblotched rockfish is assumed to follow the von Bertalanffy growth model, and separate growth parameters are estimated for females and males. Females and males also have separate weight-at-length parameters.

Recruitment dynamics are assumed to be governed by a Beverton-Holt stock-recruit function. 'Main' recruitment deviations were estimated for modeled years that had information about recruitment, between 1960 and 2011 (as determined from the bias-correction ramp). We additionally estimated 'early' deviations between 1870 and 1959 so that age-structure in the initial modeled year (1915) would deviate from the stable age-structure that is consistent with estimated variability in recruitment. This resulted in an estimate of B_0 that is also consistent with estimated variability in recruitment given the assumption that initial catch was negligible.

The length composition data are summarized into thirty 2-cm bins, ranging between 4 and 62 cm. Population length bins are defined at a finer, 1-cm scale. The age data are summarized into thirty six bins, ranging being age 0 and age 35. Age data beyond age 35 comprise less than 5% of all the age data available for the assessment. For the internal population dynamics, ages 0-45 are individually tracked, with the accumulator age of 45 determining when the 'plus-group' calculations are applied. This accumulator age is selected since little growth is predicted to occur at and beyond this age, since the model does not allow growth to continue in the plus-group.

Iterative re-weighting was used in the assessment to achieve consistency between the input sample sizes and the effective sample sizes for length and age composition samples based on model fit. This reduces the potential for particular data sources to have a disproportionate effect on total model fit.

2.3.4 Estimated and fixed parameters

In the assessment, there are parameters of three types, including life history parameters, stock-recruitment parameters and selectivity parameters. These parameters were either fixed or estimated within the model. Reasonable bounds were specified for all estimated parameters. A full list of all parameters used in the assessment is provided in Table 12.

2.3.4.1 Life history parameters

Life history parameters that were fixed in the model included weight-at-length parameters for females and males, female maturity-at-length and fecundity-at-length and natural mortality. These parameters were either derived from data or obtained from the literature, as described in Section 2.1.3.

The von Bertalanffy growth function (von Bertalanffy, 1938) was used to model the relationship between length and age in darkblotched rockfish. This is the most widely applied somatic growth model in fisheries (Haddon 2001), and has been commonly used to model growth in rockfish species, including darkblotched (Hamel, 2008; Love et al., 2002; Rogers, 2005).

Female darkblotched rockfish were reported to reach larger sizes than males; therefore, time-invariant growth was modeled for each sex separately. The Stock Synthesis modeling framework uses the following version of the von Bertalanffy function:

$$L_A = L_\infty + (L_1 - L_\infty)e^{-k(A-A_1)}$$

Where asymptotic length, L_∞, is calculated as:

$$L_\infty = L_1 + \frac{L_2 - L_1}{1 - e^{-k(A_2-A)}}$$

In these equations, L_A is length (cm) at age A, k is the growth coefficient, $L_\propto$ is asymptotic length, and L_1 and L_2 are the sizes associated with a minimum A_1 and maximum A_2 reference ages.

Ages A_1 and A_2 were set to be 2 and 30 years, respectively. Female parameters L_1, L_2, growth coefficient k and CV associated with L_1 estimates were estimated in the model. The male L_2 and growth coefficient k were estimated in the model while L_1 and CV associated with L_1 were set to be identical to those of for females. CVs associated with L_∞ were fixed in the model at the values estimated outside the model for both sexes. To estimate CV at L_∞ we used length and age data from the NWFSC shelf-slope survey. These data were used to fit a 5-parameter growth model (L_1, L_∞, k, CV_1 and CV_∞), which matches the one used in Stock Synthesis, i.e., errors are normally distributed around the von Bertalanffy growth curve, and the standard deviation of errors varies as a function of length, being linearly interpolated between CV at L_1 and CV at L_∞.

2.3.4.2 Stock recruitment parameters

Recruitment dynamics are assumed in the assessment to be governed by a Beverton-Holt stock-recruit function. This relationship is parameterized to include two estimated quantities: the log of unexploited equilibrium recruitment (R_0) and steepness (h).

In this assessment the log of R_0 was estimated, while h was fixed at its prior mean of 0.779. This prior was estimated using a likelihood profile approximation to a maximum marginal likelihood mixed-effect model for steepness from ten Tier-1 rockfish species off the U.S. West Coast (Pacific ocean perch, bocaccio, canary, chilipepper, black, darkblotched, gopher, splitnose, widow and yellowtail rockfish). Both northern and southern assessments of black rockfish were used, although the log-likelihood for each was given a 0.5 weighting, to ensure that the together these two assessments had an equal weighting to the other species. This likelihood profile model is intended to synthesize observation-level data from assessed species, while avoiding the use of model output and thus improving upon previous meta-analyses (Dorn, 2002; Forrest et al., 2010). This methodology has been simulation tested, and has been recommended by the PFMC' SSC for use in stock assessments.

We estimate lognormal deviations from the standard Beverton-Holt stock-recruit relationship for the period between 1870 and 2011. Deviations are penalized in the objective function, and the standard deviation of the penalty (σ_R) is specified as:

$$\hat{\sigma}_R = \sqrt{\frac{\sum_{y=1870}^{2011} \hat{r}_y^{\,2}}{2011-1870} + \left(\frac{\sum_{y=1870}^{2011} \hat{s}\left(\hat{r}_y\right)}{2011-1870+1} \right)^2}$$

Where $\hat{r}_y$ is the estimated recruitment deviation in year y, $\hat{s}(\hat{r}_y)$ is the estimated standard error of $\hat{r}_y$, the first summand on the right-hand side represents the sample variance of the recruitment deviations; the second summand on the right-hand side represents the average standard error-squared of recruitment deviations, as recommended in the "**Estimating** $\boldsymbol{\sigma_R}$" subsection of Methot and Taylor (2011) and correcting for their typo.

'Main' recruitment deviations were estimated for modeled years that had information about recruitment (as determined from the bias-correction ramp), i.e., 1960-2011. We additionally estimated 'early' deviations between 1870 and 1959 so that age-structure in the initial modeled year (1915) would deviate from the stable age-structure to a degree that is consistent with estimated variability in recruitment. This resulted in an estimate of B_0 that is also consistent with estimated variability in recruitment given the assumption that initial catch was negligible.

Recruitment deviations are also bias-corrected following Methot and Taylor (2011), by providing a proportion of the total bias correction for year y that varies depending upon how informative the data are about r_y. Specifically, we used R4SS (Taylor et al., 2012) to estimate a five-parameter bias-correction ramp (Figure 43).

2.3.4.3 Selectivity parameters

Gear selectivity parameters used in this assessment were specified as a function of size. Separate size-based selectivity curves were fit to each fishery fleet and survey, for which length composition data were available. Age-based selectivity was assumed to be 1.0 for all ages beginning at age-0.

A double-normal selectivity curve was used for all fleets, except for bycatch fishery, which was "mirrored" to domestic trawl fleet. The double-normal selectivity curve has six parameters, including: 1) peak, which is the length at which selectivity is fully selected, 2) width of the plateau on the top, 3) width of the ascending part of the curve, 4) width of the descending part of the curve, 5) selectivity at the first size bin, and 6) selectivity at the last size bin.

The selectivity curve for the domestic trawl fleet was assumed to be asymptotic because examination of length composition data revealed that this fleet is catching the largest fish observed. The selectivity curve was forced to be asymptotic by fixing the selectivity at the last size bin (parameter 6) at a large value. We also fixed the width of the plateau on the top (parameter 2) and the width of the descending part of the curve (parameter 4) at intermediate values since these parameters are redundant when selectivity is fixed to be asymptotic. When allowed to be dome-shaped (not fixed asymptotic), the fishery selectivity was essentially asymptotic with a drop observed in the very last bin, and trends in spawning output, recruitment, spawning depletion, relative SPR ratio as well as estimated current depletion levels were nearly identical for both runs (Figure 131 through Figure 134, Table 16).

A separate retention curve was estimated for the domestic trawl fleet. This retention curve is defined as a logistic function of size. It is controlled by four parameters including 1) inflection, 2) slope, 3) asymptotic retention, and 4) male offset to inflection. Male offset to retention was fixed at 0 (i.e. no male offset was applied). Asymptotic retention was set as a time-varying quantity to match the observed amount of discard between 2000 and 2010. The base value of asymptotic retention used for the period prior to 2000 and after 2010 was assumed to be 1, since only a small portion of the catch was discarded prior to 2000 and since implementation of the IFQ fishery. Inflection and the slope of the retention curve were also allowed to change in 2011 (the beginning of the IFQ fishery) since analysis of length composition data of retain catch indicated a change relative to the pre-IFQ years, with smaller fish being retained. The time-varying parameters were set via use of time blocks.

The selectivity curves for all the surveys were estimated to be dome-shaped. The most important factors justifying dome-shaped selectivity for the slope surveys are related to differences in the specific types of trawl gear used in the survey versus the fishery. The NWFSC shelf-slope survey uses roller gear that is efficient in catching groundfish on the soft bottom and rock piles, but not in structurally complex habitats, where a number of rockfish, including darkblotched rockfish, reside as adults.

The fishery, on the other hand, has often been using large rollers, often called rockhopper gear for the last 30 years. Rockhopper gear (as well as other technological innovations to access areas with structurally complex habitats, such as rock pinnacles, boulder fields and deep sea coral forests) replaced bottom trawls that were historically dragged on relatively smooth bottoms in shallow water. Such trawls could not be used in the high relief habitats without risking expensive damage to the net from snagging on and rubbing against the rough bottom. With rockhoppers, fishing vessels are able to trawl in structurally complex habitats with a reduced probability of gear damage or loss, though with much greater destruction of important fish habitat and bottom dwelling species so that fishery management councils in the U.S. have enacted some limitation on the size of roller or rockhopper gear to protect rocky habitat and their inhabitants.

Another reason for bottom trawl surveys not taking largest individuals of darkblotched rockfish can be related to complex behavior of darkblotched rockfish in the water column. Adult darkblotched rockfish are known to spend most of their time on the sea floor. However, Love et al. (2002) reports that darkblotched rockfish feed primarily in the midwater. The fact that darkblotched rockfish are among few rockfish species being bycaught in at-sea hake fishery (which operates in the midwater) confirms that this species can spend significant amount of time off the bottom, and therefore being not selected by bottom trawl survey gear.

2.4 Model Selection and Evaluation

2.4.1 Key assumptions and structural choices

The structure of the base model was selected to balance model realism and parsimony. Exploratory model runs, when natural mortality and shape of fishery selectivity curve were both estimated, demonstrated that the model was extremely unstable (i.e. was subject to local minima and produced wildly different results based on small differences in model assumptions). We agreed that we have more *a priori* information about natural mortality than about the shape of selectivity curve and, therefore, chose to fix natural mortality at a value ($0.05yr^{-1}$) that is consistent with the Hoenig method and a number of earlier assessments. Given this specification, the domestic trawl fishery selectivity curve is estimated to be asymptotic even when given the opportunity to be a dome-shaped (i.e. a double-normal form). We have, therefore, chosen to specify that fishery selectivity is asymptotic, which is consistent with previous assessments.

We additionally sought to account for the effect of Rockfish Conservation Areas (RCAs) on fishery selectivity. RCAs were initiated in September of 2002, and could conceivably influence both the ascending and descending shape of a dome-shaped selectivity curve. When conducting a sensitivity run, in which the descending component was blocked to be asymptotic prior to RCAs and dome-shaped after RCAs, the model continued to estimate an asymptotic shape after RCAs. Additionally, sensitivity runs that specified a different block for the ascending limb resulted in implausible shapes for the ascending slope of selectivity prior to 2003. This occurs primarily because there is limited data to estimate blocks in the retention curve prior to 2003, and the retention curve estimated that after 2003 most fish smaller than 25cm are being discarded. There is therefore essentially no information in the retained fishery length composition data to estimate changes in selectivity for the ascending limb affecting fish smaller than 25cm prior to 2003. For this reason, we stipulate that fishery selectivity is constant prior to and after of implementation of RCAs.

Finally, earlier model structures explored splitting the fishery catches into several different fleets, corresponding to trawl and non-trawl gears, at-sea-hake bycatch and the foreign POP fishery removals. Such a split allowed us to separately estimate selectivity curves for at-sea-hake fishery and by non-trawl gear fleet. However, these fleets had similar selectivity to the trawl fishery, and contributed only 1-2% to the total catch of darkblotched rockfish (Figure 4). Nevertheless, the model interpreted their composition data as representative of the entire stock, and iterative tuning of the composition data resulted in them receiving implausibly high weight (e.g., at-sea-hake bycatch having equal weight to the NWFSC shelf-slope survey compositional data). We, therefore, chose not to use at-sea compositional data in the assessment, and selected the fleet structure defined in the base model.

2.4.2 Changes made during the STAR Panel meeting

During the STAR Panel meeting, analysis and evaluation of the base model were performed to further explore data sources and model assumptions to better understand model performance. The STAR Panel provided useful recommendations that were incorporated into the base model. Specific changes made to the pre-STAR model during the STAR Panel meeting included:

1) Change setting for the ages A_1 and A_2 in growth parameter specification section from 0 and 999 (the latter corresponds to L_∞) to 2 and 30 years, to improve estimability of CV parameters.
2) Assume a single CV for young ages for both sexes since estimating the CV for young males seems redundant.
3) Estimate the value for male natural mortality while holding the value for females fixed at 0.05 yr^{-1}. Dimorphic growth in fish is often accompanied by different rates of natural mortality. Even though model is unable to reliably estimate natural mortality for both sexes, compositional data can inform the difference between the sexes quite well, and estimating at least one sex would capture more of the uncertainty in the model results.

2.4.3 Evidence of search for global best estimates

For all model runs, we checked for evidence that the reported estimates were not the global optimum using three techniques. First, we used R4SS (Taylor et al. 2012) to do 25 re-estimates of the model after 'jittering' starting values using a standard deviation of 0.1 times their parameter range, and ensured that the reported estimates had the greatest log-likelihood of all runs. In the case of the base model, jittering resulted in recovery of the initial estimates 25 times out of the 25 tests. Second, we conducted a likelihood profile across different values of ln(R_0) from 7.0 to 9.0 by 0.2 increments, to ensure that the reported estimates were at the maximum log-likelihood of this profile. Third, we ran 1,000,000 samples of Markov chain Monte Carlo, extracted the sample with the maximum log-likelihood, and re-ran the optimizer from this location to ensure that this run resulted in the same final value as the reported estimates. For the base model, all three techniques yielded no evidence that the reported estimates differed from the global optimum.

2.4.4 Convergence criteria

A number of tests were done to verify convergence of the base model. Following conventional AD Model Builder methods (Fournier et al. 2012), we checked that the Hessian matrix for the base model was positive definite. We also confirmed that the final gradient was below 0.01.

2.5 Base-Model Results

The list of the all the parameters used in the assessment model and their values (either fixed or estimated) is provided in Table 12. The life history parameters estimated within the model are reasonable and consistent with what we know about the species. Both sexes follow the same trajectory in their growth. Males grow slightly faster than females, but with females reaching larger sizes (Figure 44). The estimated growth parameters for females and males are very close to the values used in previous assessments. Figure 45 through Figure 48 show weight-at-length relationships by sex, female maturity-at-length, fecundity-at-weight and spawning output-at-length generated based on fixed parameters that were derived outside the model. Female fecundity and spawning output in the assessment are expressed in number of eggs.

The base model was able to capture general trends for indices in all surveys (Figure 49 through Figure 52). Fit to the NWFSC slope and AFSC slope surveys was generally flat, as might be expected for such short time-series. We additionally explored including an extra standard deviation parameter for these two slope surveys, but it was estimated to be zero for both of them. With the offset estimate for the AFSC triennial survey beginning in 1995, predicted survey values fit the AFSC shelf survey abundance index well (Figure 49).

The NWFSC shelf-slope survey exhibits a slightly increasing trend in recent years, and the fit to the survey is mostly flat with a slight increase in recent years. The model was unable to fit the first (2003) point of the NWFSC survey time series. This is mostly because that survey abundance index reflects patchiness in the spatial distribution of darkblotched rockfish. The map of NWFSC survey catches by haul of the survey by year (Figure 39) shows that the NWFSC shelf-slope survey encountered one large haul of darkblotched rockfish in 2003, which causes the delta-GLMM estimate for 2003 to be higher than can be fit by the model, and also causes the design-based estimate for that year to be aberrantly high. For the AFSC triennial and NWFSC shelf-slope surveys, the model estimated non-zero extra SD parameters (0.01 and 0.06 for the AFSC shelf and NWFSC shelf-slope survey, respectively).

The model fit to length and age frequency distributions, by year and aggregated across year, and Pearson residuals for the fits by fleet, year and sex are shown in Figure 53 through Figure 80. The quality of fit varies among years and fleets, which reflects the differences in quantity and quality of data. The Pearson residuals, which reflect the noise in the data both within and among years, did not exhibit any strong trends.

Plots of observed and expected length composition for the trawl landings aggregated across all years (Figure 57, Figure 58) shows that the model is able to replicate the single-modal length composition, as well as the tighter peak in length composition seen for males because the distribution of male length at maximum age has less overlap with the selectivity of the trawl fleet than does females. Similarly, the model is able to largely match the observed length composition for surveys, which incorporates differences in selectivity at length for these fleets. The survey length composition generally exhibits smaller average length than the fishery, and hence is more likely to pick out individual cohorts. This is born out in length composition plots by year for the NWFSC shelf-slope survey, where multiple modes are frequently seen and are generally matched by the model (e.g., male and female length compositions in 2010). Finally, the model is able to predict the changes in length composition of discards, including a noticeable decline in average length of discards following implementation of IFQ fishery in 2011 (Figure 62).

Plots of observed and expected age compositions for the trawl fishery aggregated across all years (Figure 79, Figure 80) indicate general agreement between model and data, with the model able to replicate the large abundance of the data plus group. We also show the age compositions of trawl landings for years (1980-2001, and 2009-2012) that were not used in the model because age sampling was not conducted coastwide (Figure 81, Figure 82). These age compositions do not contribute to the likelihood and do not affect model fit in any way. These compositions are, therefore, often called “ghost” compositions. The fit to the “ghost” trawl age compositions shows that the model is able to reproduce a decline in the proportion of total abundance available to the fishery within the data plus group, despite these data not being included in the model log-likelihood. This ability to replicate data that are not included in the model provides additional support for the suitability of this model.

The fits to conditional ages at length and Pearson residuals for the fits by survey are shown in Figure 86 through Figure 99. These plots show that predicted average age at length is generally within predicted error bars around the observed average age at length, which provides support for the assumption that length at age is adequately approximated by the base model, as is necessary to model size at age internally to Stock Synthesis. For visual interpretation of fit to survey age composition data, we included the “ghost” marginal survey age compositions, with the likelihood contribution turned off so that they do not affect model fit (Figure 100 through Figure 103).

Estimated selectivity curves for fisheries and surveys are shown in Figure 104 through Figure 111. Selectivity curves for the trawl surveys are generally credible and broadly similar (Figure 104). Shelf surveys (the AFSC shelf and the NWFSC shelf-slope) have peak selectivity at length for smaller fishes than slope surveys, as is plausible for a species that has ontogenetic movement offshore. The AFSC shelf survey also would be expected to take fewer larger fish due to limited coverage of the depth range of the species. Trawl fishery selectivity curve, which is fixed to be asymptotic, shows that trawl fleet takes much larger fish than any of the surveys (Figure 104). The retention function, as expected shows changes in asymptote with changes in discard ratios as well as changes in slope and inflection of the curve at the start of the IFQ fishery. Estimated values for selectivity and retention parameters are provided in Table 12.

Discard ratios for domestic trawl fishery, as estimated from WCGOP and Pikitch study data, were fit by the model very well (Figure 112). Based on these data, year-specific discard fraction and discard amounts were estimated within the model (Figure 113, Figure 114). These estimates follow the assumption that discard amounts were minimal until 2000, when the species was declared overfished, and more restrictive management measures were implemented. Discard ratios increased following the implementation of management measures in the 2000s but decreased after the implementation of IFQ fishery. The retention curve is similarly estimated to shift to smaller fishes following IFQ implementation, as fishers are encouraged to retain broader sizes of fish. The mean body weights of individuals in the discard were also fit very well (Figure 115).

The deviations from the estimated stock-recruitment function had a very large uncertainty prior to the mid-1960s, when the data first become informative about incoming cohort strengths (Figure 116). Therefore, the relative bias adjustment was ramped to the maximum value during this period. Recruitment of darkblotched rockfish was estimated to be quite variable over the historical record, and the estimated stock-recruit function predicts a wide range of cohort sizes over the observed range of spawning biomass (Figure 117).

The estimated time series of total and summary biomass, spawning output, spawning depletion (relative to B_0), recruitment and fishing mortality are presented in Figure 118 through Figure 123 and Table 13. Trends in total and summary biomass, spawning output and spawning depletion track one another very closely. The spawning output of darkblotched rockfish started to decline in the 1940s, during the World War II, but exhibited a sharp decline in the 1960s during the time of the intense foreign fishery targeting Pacific ocean perch. Between 1965 and 1975, the spawning output dropped from 89% to under 57% of its unfished level. The spawning output continued to decrease throughout the 1980s and 1990s and in 1999 reached its lowest estimated level of 13% of its unfished state. Since 2000, the spawning output has been slowly increasing that corresponds to decreased removals due to management regulations. Currently, the spawning output is estimated to be 36% of its unfished level (Figure 121).

2.6 Uncertainty and Sensitivity Analyses

Parameter uncertainty in the assessment is explicitly captured in the asymptotic confidence intervals estimated within the model and reported throughout this assessment for key parameters and management quantities (Figure 120, Figure 121 and Figure 122). These intervals reflect the uncertainty in the model fits to the data sources in the assessment, but do not include the uncertainty associated with alternative model configurations and fixed parameters. To explore uncertainty associated with alternative model configurations and evaluate the responsiveness of model outputs to changes in model assumptions, a variety of sensitivity runs were performed.

2.6.1 Sensitivity Analyses

A large number of configurations of the base model addressing alternative assumptions regarding key model parameters and structural choices were explored via the sensitivity analysis. Only the most relevant ones are reported here. Results of these selected sensitivity runs are summarized in Table 14, Table 15, Table 16 and Figure 124 through Figure 134.

2.6.1.1 Alternative assumptions about fishery removals

Historically, darkblotched rockfish landings have not been sampled at the discrete species level; therefore, time series of catch remained a source of uncertainty. Although significant progress has been made in reconstructing historical California and Oregon landings, the lack of early species composition data does not allow to account for a gradual shift of fishing effort towards deeper areas, which can cause the potential to overestimate the historical contribution of slope species (including darkblotched rockfish) to overall landings of the mixed-species market category (i.e. "unspecified rockfish"). To explore the model sensitivity to uncertainty in darkblotched rockfish removals, we ran the model assuming: 1) landings in full time series of domestic trawl fishery doubled, 2) landings in full time series of domestic trawl fishery halved, 3) landings in historical (pre-1980) time series of domestic trawl fishery doubled, 4) landings in historical (pre-1980) time series of domestic trawl fishery halved, 5) catches in both fleets (TWL and BYCATCH) doubled, and 6) catches in both fleets (TWL and BYCATCH) halved. Although these runs differed in the absolute estimate of B_0 and R_0 (Figure 124Figure 125), the trends in spawning depletion, and relative SPR ratio as well as estimated depletion levels varied only slightly (Figure 126, Figure 127, Table 14).

2.6.1.2 Alternative assumptions about life history parameters

A major uncertainty in this assessment is associated with life history parameters, particularly natural mortality and stock-recruit curve steepness. These quantities, which the model is unable to estimate reliably, were fixed at the values estimated outside the model. The model response to different values of natural mortality and steepness was explored via detailed likelihood profile analyses described above.

In this assessment, we also updated such life history parameters as female maturity and fecundity as well as parameters of weight-length relationships for both sexes. We used the newly available maturity data (collected within the NWFSC shelf-slope survey) to develop maturity at age matrix for the assessment, and new female fecundity estimates generated by Dick (2009) to describe female fecundity at weight relationship. In previous several assessments, female maturity and fecundity parameters were used as estimated by Nickol (1990). For new weight-length parameters, we used previously unavailable data from NWFSC shelf-slope survey and estimated separate sets of parameters for females and males, instead using one set of parameters for both sexes, as was done in several previous assessments. To explore the model sensitivity to updated maturity, fecundity and weight-length parameters, we ran the model assuming: 1) maturity parameters from Nickol (1990) as used in the previous assessment, 2) female fecundity parameters from Nickol (1990) as used in the previous assessment, and 3) weight-length relationship parameters as used in the previous assessment. We also ran the model with stock-recruit steepness fixed at the value of 0.76, as used in the 2011 assessment, and not at the value of 0.779 as used in this assessment. Model results, including trends in spawning output, recruitment, spawning depletion and relative SPR ratio, were nearly identical before and after these changes (Figure 128 through Figure 130, Table 15). Estimated current depletion levels varied only slightly. Finally, ran the model with combination of assumed values of stock-recruit steepness (0.6) and natural mortality (0.07) as used in 2007 assessment. None of these changes had significant effect on model outputs.

2.6.1.3 Alternative assumptions about selectivity parameters

In the base model, fishery selectivity curve was fixed asymptotic. We ran the model, allowing fishery selectivity to be dome-shaped. In this run, the fishery selectivity was essentially asymptotic with a drop in the very last bin, and trends in spawning output, recruitment, spawning depletion, relative SPR ratio as well as estimated current depletion levels were nearly identical for both runs (Figure 131 through Figure 134, Table 16).

In the assessment, the shape of selectivity curves for all the surveys were estimated and, therefore, allowed to be dome-shaped. In the previous assessment, NWFSC slope survey (which included a slope portion of NWFSC shelf-slope survey) was fixed asymptotic. In this assessment, we use NWFSC shelf-slope survey as a single time period, and to explore how sensitive model is to the assumption of this survey selectivity being dome-shaped vs. asymptotic, we ran the model with this survey selectivity fixed asymptotic. The results are shown in Figure 131 through Figure 134 and Table 16. Even though trends in spawning output, recruitment, spawning depletion, relative SPR ratio as well as estimated current depletion levels were only slightly different, overall model fit degraded as indicated by the increased in negative log-likelihood degraded (Table 16).

2.6.2 Retrospective analysis

A retrospective analysis was conducted, where the model is fitted to a series of shortened input data sets, with the most recent years of input data sequentially being dropped. A 5-year retrospective analysis was conducted by running the model using data only through 2007 (“5 year”), 2008, 2009, 2010 and 2011 (Figure 135 through Figure 138, Table 17). Little evidence of retrospective patterns was apparent.

The second type of retrospective analysis addresses assessment error, or at least the historical context of the current result given previous analyses. Figure 139 shows the spawning depletion time series for all assessment (full and update assessment) conducted since 2005. In aggregate, these assessments have largely drawn the same conclusions regarding historical trends: that the darkblotched resource declined rapidly due to high fishing intensity in the 1960s and 1970s, with continued decline in the 1980s and 1990s reaching the lowest point around 2000. For the last decade, the stock was slowly increasing due to management efforts toward rebuilding of the stock.

2.6.3 Likelihood profile analyses

The base model included several key parameters, such as natural mortality and stock-recruit steepness, which were fixed at the values determined based on life-history traits of the species of meta-analysis of species with similar life-history characteristics. To explore how informative the data in the model are in regard to these parameters, we performed likelihood profile analyses where we varied the values of these parameters and recorded the change the overall fit of the model.

A likelihood profile analysis conducted over a range of values for natural mortality shows that the negative log-likelihood for the base model declines with increasing natural mortality for all values between 0.02 and 0.10 (Figure 140). Natural mortality >0.10 is inconsistent with the age of old individuals that have been observed, as well as previous assessments, and we, therefore, conclude that the model is unable to reliably estimate natural mortality. Also, the fact that the length and age composition data available for the assessment were collected only after extremely high darkblotched removals by the foreign POP fishery (and, therefore, these data cannot be expected to represent unfished equilibrium) provides an additional argument for the model not being able to estimate natural mortality reliably.

Similarly, a likelihood profile for steepness shows that the negative log-likelihood for the base model declines with increasing steepness up to the value of 0.95 (Figure 141). This value of steepness is considered to be implausible for a slow growing rockfish, although it is logical for the model to prefer a high steepness value given the strong recruitments seen at low biomass in 1995, 1999, 2000 and 2005. Given this implausible value, have chosen to fix steepness at the mean of the prior distribution obtained from 10 Tier-1 rockfish assessments off the U.S. West Coast (h = 0.779). This approach is consistent with recommendation of the PFMC' SSC regarding the use of the steepness prior.

We also conducted a likelihood profile analysis for $\ln(R_0)$, which shows that the negative log-likelihood for the base model is optimized at a value of approximately 7.7 (as is estimated in the assessment), and that the primary source of information about $\ln(R_0)$ is in recruitment penalties (Figure 142). Exploratory analysis shows that different values of $\ln(R_0)$ scale recruitment deviations up or downward from the mean value of 0, with low values of $\ln(R_0)$ having high recruitment deviations and vice-versa (Figure 143, Figure 144). Additionally, resulting recruitment scales with of $\ln(R_0)$, with high values of $\ln(R_0)$ having higher recruitment and low values of $\ln(R_0)$ having lower recruitment. This indicates that available data cause the model to seek a particular value for recruitment, and changes in $\ln(R_0)$ cause the model to compensate by changing recruitment deviations to continue achieving that desired level of recruitment, which causes recruitment deviations to contribute the greatest change in log-likelihood to $\ln(R_0)$.

3 Reference Points

Unfished spawning stock output for darkblotched rockfish was estimated to be 3,358 million eggs (95% confidence interval: 2,603-4,114 million eggs). The stock is declared overfished if the current spawning output is estimated to be below 25% of unfished level. The management target for darkblotched rockfish is defined as 40% of the unfished spawning output ($SB_{40\%}$), which is estimated by the model to be 1,343 million eggs (95% confidence interval: 1,041-1,646), which corresponds to an exploitation rate of 0.0402. This harvest rate provides an equilibrium yield of 675 mt at $SB_{40\%}$ (95% confidence interval: 526-824 mt). The model estimate of maximum sustainable yield (MSY) is 742 mt (95% confidence interval: 578-906 mt). The estimated spawning stock output at MSY is 819 million eggs (95% confidence interval: 635-1,003 million of eggs). The exploitation rate corresponding to the estimated SPR_{MSY} of $F_{30\%}$ is 0.0665.

The assessment shows that the stock of darkblotched rockfish off the continental U.S. Pacific Coast is currently at 36% of its unexploited level. This is above the overfished threshold of $SB_{25\%}$, but below the management target of $SB_{40\%}$ of unfished spawning output. Historically, the spawning output of darkblotched rockfish dropped below the $SB_{40\%}$ target for the first time in 1987, as a result of intense fishing by foreign and domestic fleets. It continued to decline and reached the level of 13% of its unfished spawning output in 1999. Since 2000, when the stock was declared overfished, the spawning output was slowly increasing primarily due to management regulations implemented for the species (Figure 121).

This assessment estimates that the 2012 SPR is 86%, while the SPR-based management fishing mortality target is 50%. For the last 10 years, the relative SPR ratio (calculated as 1-SPR/1-$SPR_{Target=0.50}$) was below one, which means that overfishing of darkblotched rockfish has not been occurring (Figure 145). Historically, the darkblotched rockfish has been fished beyond the SPR-based target between 1966 and 1968, during the peak years of the Pacific ocean perch fishery and for a prolonged period between from 1981 and 2002. In the early-1970s the estimated darkblotched rockfish SPR ratio remained near the SPR target but exceeded it in 1973 and 1979. Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model is shown in Figure 146, which also indicates that overfishing of darkblotched rockfish is not occurring.

A summary of reference points for the base model is provided in Table 18. A summary of recent trends in estimated darkblotched rockfish exploitation and stock level from the assessment model is given in Table 19.

4 Harvest Projections and Decision Table

The base model estimate for 2013 spawning depletion is 36%. The primary axis of uncertainty about this estimate used in the decision table was based on female natural mortality. Alternative states of nature were characterized using both the likelihood profile and the prior distribution for female natural mortality. The choice to use both sources of information for this fixed parameter was motivated by the observation that the data showed strong evidence against extremely low values of natural mortality, but was relatively flat for large values. In the absence of a fully integrated posterior distribution, the prior distribution based on maximum age was used as a proxy for the upper end of the range. The low and high states of nature for the decision table were therefore based on female natural mortality values of 0.036 and 0.082, both approximately half as likely as the value used in the base model (0.05). The lower value of natural mortality corresponded to a depletion estimate of 18%, while the higher value corresponded to 82%, illustrating the marked sensitivity of the assessment results to a poorly informed parameter.

Twelve-year forecasts for each state of nature were calculated based on removals at current rebuilding SPR of 64.9% for the base model. Twelve-year forecasts were also calculated based on removals at an SPR of 71.9% for the base model, as requested by the Groundfish Management Team (GMT). This lower catch stream that corresponds to SPR 71.9% was used in the Decision Table of the 2011 darkblotched assessment. Finally, twelve-year forecasts for each state of nature were produced with future catches fixed at the 2014 ACL set for darkblotched rockfish.

Under the middle state of nature (which corresponds to the base model), the spawning output and depletion are projected to increase under all three considered catch streams, and reach the SB40% target in 2015. Under the low state of nature, spawning output and depletion are also projected to increase under all three catch streams considered, but will stay below the SB40% target within the next 12 years. Under the middle state of nature, the spawning output remains above the 40% target level throughout the 12-year projection period.

5 Regional Management Considerations

This species is currently managed coastwide, with coastwide ACLs determined for management purposes. This assessment is not spatially structured. There are indications, however, that life history parameters, particularly growth, might be varying with latitude. Analysis conducted within this assessment did not allow to identify specific areas with different growth parameters, but rather detected continues gradient along the coast, which is common for *Sebastes* species on the West Coast of the United States. It was also suggested that maturity parameters may vary with latitude, as maturity schedule of fish collected in waters off California (Echeverria, 1987; Phillips, 1964) were found to be smaller than those of fish collected off Oregon (Nichol, 1990). However, Nichol (1990) argued that these differences can be rather attributed to different criteria used in different studies to determine maturity. Besides, Westrheim (1975) reported that the size at 50% maturity for darkblotched rockfish decreased, rather than increased, with increasing latitude increased from Oregon to Alaska. To evaluate appropriateness of coastwise management of darkblotched rockfish, further research should be conducted to evaluate latitudinal variability in life history characteristics of this species. Also, given that the population range extends north to the border with Canada, it is important that future research evaluates the feasibility of a joint assessment with Canada.

6 Research Needs

The following research could improve the ability of future stock assessments to determine the current status and productivity of the darkblotched rockfish population:

1) The base model does not use commercial age composition data for years that lacked coast wide samples. The additional age data could provide information necessary for the model to estimate such parameters as natural mortality. Future research could ascertain whether additional otoliths exist for these years, and whether they could be aged using current ageing methods. Also, alternative fleet structures (with state specific fisheries) could be explored to take use of as much available age data as possible.

2) The base model uses newly available information of female maturity collected within the NWFSC shelf-slope survey. This new information includes data on mass atresia (a form of skipped spawning), not previously available for the assessment. At present, Stock Synthesis allows incorporation of this information only when maturity is expressed as a function of age. Effort should be devoted to expand maturity options in Stock Synthesis to allow expression of maturity information (with mass atresia) as a function of female length. Also, continued collection of maturity samples would allow future researchers to explore differences in maturity at age, either spatially or over time.

3) Additional research would be important to explore whether other life history parameters, such as growth and fecundity vary spatially or change over time as well. This information will help in defining spatial structure of future models.

4) Given that the population range extends north to the border with Canada, it is important that future research would evaluate the impact of not accounting for any Canadian portion of population abundance. Such an analysis would require evaluation of movement of darkblotched along the coast, which information is currently lacking.

5) Future research could also improve existing meta-analyses for natural mortality and steepness, which both contribute to the implied yield curve. Directions for improvements include (1) explaining variability between methods in natural mortality estimates, included in the Hamel natural mortality method and (2) developing a larger database of species for estimating steepness, perhaps by including species from other regions, e.g., Canada and Alaska.

6) Imprecision in the indices of abundance derived from survey sampling, due a low probability the species occurrence, is one of the sources of uncertainty in this assessment. Future research could explore the utility of model-based index standardization techniques; in particular, those using spatial modeling approaches. Spatial models could potentially account for the component of sampling variance arising from the random allocation of sampling tows either in or outside of suitable habitat. Such models could potentially decrease residual variance and imprecision of the resultant indices of abundance.

7) Finally, we note that Markov chain Monte Carlo sampling using the Metropolis algorithm was unable to obtain a sufficient number of independent samples within a feasible time period. However, it had trouble primarily with a single parameter (variance inflation for a survey index). We therefore recommend to improve MCMC options in ADMB, perhaps by making necessary changes to the Hamiltonian MCMC option (i.e., by allowing samples to be thinned during running, and hence making longer MCMC chains feasible for the ADMB implementation of Hamiltonian sampling).

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8 Tables

Table 1: Recent darkblotched rockfish Overfishing Limits (OFLs) and Annual Catch Limits (ACLs) relative to recent total landings and total dead catch estimated in this assessment.

Year	OFL (mt)	ACL (mt)	Commercial Landings (mt)	Estimated Total Catch (mt)*
2003	205	172	80	213
2004	240	240	189	244
2005	269	269	98	130
2006	294	200	107	192
2007	456	290	144	281
2008	487	330	117	253
2009	437	285	138	294
2010	440	291	184	350
2011	508	298	117	120
2012	497	296	94	96

*Includes discards estimated within the stock assessment and therefore may differ from total mortality reports used by management.

Table 2: Total landings (mt) of darkblotched rockfish for the domestic trawl fleet (provided here by state) and bycatch fleet (separated here as bycatch in foreign POP and in at-sea Pacific hake fisheries).

Year	Domestic trawl California	Domestic trawl Oregon	Domestic trawl Washington	Bycatch in foreign POP fishery	Bycatch in at-sea hake fishery	Total
1915	0	0	0	0	0	0
1916	13	0	0	0	0	13
1917	21	0	0	0	0	21
1918	21	0	0	0	0	21
1919	14	0	0	0	0	14
1920	14	0	0	0	0	14
1921	12	0	0	0	0	12
1922	11	0	0	0	0	11
1923	14	0	0	0	0	14
1924	14	0	0	0	0	14
1925	16	0	0	0	0	16
1926	21	0	0	0	0	21
1927	18	0	0	0	0	18
1928	18	0	0	0	0	18
1929	19	0	0	0	0	19
1930	21	0	0	0	0	21
1931	26	0	0	0	0	26
1932	16	0	0	0	0	16
1933	16	0	0	0	0	16
1934	15	0	0	0	0	15
1935	17	0	0	0	0	17
1936	11	0	0	0	0	12
1937	13	1	0	0	0	14
1938	16	0	0	0	0	17
1939	23	1	0	0	0	24
1940	20	13	0	0	0	33
1941	22	19	0	0	0	42
1942	12	36	1	0	0	48
1943	57	125	2	0	0	184
1944	177	218	3	0	0	398
1945	334	337	8	0	0	679
1946	189	209	4	0	0	401
1947	199	130	2	0	0	332
1948	99	89	3	0	0	191
1949	70	86	4	0	0	160

Year	Domestic trawl California	Domestic trawl Oregon	Domestic trawl Washington	Bycatch in foreign POP fishery	Bycatch in at-sea hake fishery	Total
1950	73	101	4	0	0	178
1951	106	96	3	0	0	206
1952	78	136	3	0	0	217
1953	87	96	1	0	0	185
1954	79	136	2	0	0	217
1955	131	123	2	0	0	256
1956	149	189	2	0	0	339
1957	190	205	1	0	0	396
1958	180	153	2	0	0	335
1959	139	142	2	0	0	283
1960	151	189	2	0	0	342
1961	120	197	2	0	0	319
1962	107	235	3	0	0	345
1963	136	225	7	0	0	368
1964	85	175	5	0	0	265
1965	97	380	6	0	0	483
1966	84	320	8	3807	0	4220
1967	102	262	6	2706	0	3076
1968	110	17	7	2288	0	2422
1969	43	80	11	153	0	287
1970	49	145	8	149	0	351
1971	65	174	11	278	0	528
1972	84	148	6	374	0	611
1973	67	67	13	768	0	914
1974	95	144	24	346	0	609
1975	106	102	111	293	0	612
1976	121	322	99	118	11	670
1977	123	130	62	0	2	318
1978	60	156	199	0	1	416
1979	148	497	88	0	4	736
1980	166	334	99	0	21	620
1981	522	266	37	0	12	836
1982	170	941	24	0	2	1136
1983	510	582	22	0	12	1126
1984	596	625	82	0	20	1323
1985	802	848	111	0	13	1774
1986	417	622	215	0	6	1260
1987	1647	686	68	0	14	2415
1988	750	789	108	0	10	1656

Year	Domestic trawl California	Domestic trawl Oregon	Domestic trawl Washington	Bycatch in foreign POP fishery	Bycatch in at-sea hake fishery	Total
1989	441	737	91	0	5	1274
1990	870	764	16	0	28	1679
1991	333	774	54	0	45	1206
1992	187	451	20	0	29	687
1993	285	892	9	0	8	1194
1994	292	550	9	0	15	866
1995	366	342	28	0	49	786
1996	408	309	19	0	6	743
1997	452	342	22	0	4	820
1998	497	395	20	0	14	927
1999	113	227	10	0	11	361
2000	114	129	8	0	8	259
2001	87	66	10	0	12	175
2002	50	52	7	0	3	112
2003	11	62	2	0	4	80
2004	39	136	7	0	7	189
2005	18	68	1	0	11	98
2006	23	71	2	0	11	107
2007	41	87	3	0	12	144
2008	34	74	3	0	6	117
2009	47	89	2	0	0	138
2010	17	152	7	0	8	184
2011	3	87	14	0	12	117
2012	7	70	15	0	2	94

Table 3: Summary of fishery sampling effort (number of trips, hauls and fish sampled) used to create length frequency distributions of the domestic trawl fishery.

Year	Lengths from retained catch						Lengths from discarded catch		
	California		Oregon		Washington				
	# Trips	# Fish	# Trips	# Fish	# Trips	# Fish	# Trips	#Hauls	# Fish
1977	0	0	5	304	0	0	0	0	0
1978	26	263	2	200	0	0	0	0	0
1979	11	86	0	0	0	0	0	0	0
1980	31	206	0	0	0	0	0	0	0
1981	29	195	0	0	0	0	0	0	0
1982	55	444	2	300	0	0	0	0	0
1983	115	792	0	0	0	0	0	0	0
1984	161	1925	1	70	0	0	0	0	0
1985	206	2985	0	0	0	0	0	0	0
1986	145	2436	0	0	0	0	5	0	145
1987	119	2644	0	0	0	0	0	0	0
1988	93	1339	0	0	0	0	0	0	0
1989	91	1098	0	0	0	0	0	0	0
1990	89	862	1	100	0	0	0	0	0
1991	72	756	2	200	0	0	0	0	0
1992	45	421	0	0	0	0	0	0	0
1993	42	509	0	0	0	0	0	0	0
1994	39	436	2	200	0	0	0	0	0
1995	40	745	7	188	0	0	0	0	0
1996	72	1003	23	833	0	0	0	0	0
1997	52	909	22	802	0	0	0	0	0
1998	70	1232	13	541	24	317	0	0	0
1999	37	712	9	430	24	332	0	0	0
2000	50	869	7	224	20	652	0	0	0
2001	39	692	30	1005	20	660	0	0	0
2002	39	861	21	611	47	1124	34	70	674
2003	27	436	59	1398	28	580	40	91	851
2004	29	526	58	1305	19	605	67	117	742
2005	33	567	54	1275	9	117	109	257	1526
2006	62	1129	62	1457	10	397	116	292	1152
2007	74	1520	79	2155	22	529	108	169	573
2008	81	1795	102	2689	12	350	121	202	674
2009	52	1214	136	2828	11	350	203	317	1154
2010	44	746	136	2855	5	206	89	138	538
2011	53	559	148	2570	17	869	82	125	349
2012	0	0	124	2301	17	729	0	0	0

Table 4: Summary of fishery sampling effort (number of trips, hauls and fish sampled) used to create age frequency distributions of the domestic trawl fishery.

Year	Ages from retained catch						Ages from discarded catch		
	California		Oregon		Washington				
	# Trips	# Fish	# Trips	# Fish	# Trips	# Fish	# Trips	#Hauls	# Fish
1980	28	185	0	0	0	0	0	0	0
1981	29	195	0	0	0	0	0	0	0
1982	52	413	0	0	0	0	0	0	0
1983	79	527	0	0	0	0	0	0	0
1985	198	2874	0	0	0	0	0	0	0
1986	17	169	0	0	0	0	0	0	0
1987	48	1071	0	0	0	0	0	0	0
1988	29	372	0	0	0	0	0	0	0
1990	75	798	0	0	0	0	0	0	0
1991	35	352	0	0	0	0	0	0	0
1993	37	468	0	0	0	0	0	0	0
1994	35	417	0	0	0	0	0	0	0
1995	17	354	0	0	0	0	0	0	0
1996	58	776	0	0	0	0	0	0	0
1997	48	810	1	33	0	0	0	0	0
1998	53	855	0	0	0	0	0	0	0
1999	23	500	1	24	0	0	0	0	0
2000	30	562	6	183	0	0	0	0	0
2001	27	620	25	843	0	0	0	0	0
2002	29	635	20	610	12	388	0	0	0
2003	22	319	51	1162	11	369	0	0	0
2004	15	243	27	753	11	414	42	62	229
2005	31	493	42	912	6	103	81	171	506
2006	46	856	54	1219	8	293	0	0	0
2007	30	559	66	1774	18	423	0	0	0
2008	21	309	87	2350	9	243	0	0	0
2009	0	0	35	905	11	272	0	0	0
2010	0	0	116	2331	4	120	0	0	0
2011	0	0	0	0	15	535	0	0	0
2012	0	0	16	421	10	455	0	0	0

Table 5: Latitudinal and depth ranges by year of four NMFS groundfish trawl surveys used in the assessment.

Survey	Year	Latitudes	Depths (fm)
AFSC shelf	1977	34^o 00'- Border	50-250
	1980	36^o 48'- 49^o 15'	30-200
	1983	36^o 48'- 49^o 15'	30-200
	1986	36^o 48'- Border	30-200
	1989	34^o 30'- 49^o 40'	30-200
	1992	34^o 30'- 49^o 40'	30-200
	1995	34^o 30'- 49^o 40'	30-275
	1998	34^o 30'- 49^o 40'	30-275
	2001	34^o 30'- 49^o 40'	30-275
	2004	34^o 30'- Border	30-275
AFSC slope	1988	44^o 05'- 45^o 30'	100-700
	1990	44^o 30'- 40^o 30'	100-700
	1991	38^o 20'- 40^o 30'	100-700
	1992	45^o 30'- Border	100-700
	1993	43^o 00'- 45^o 30'	100-700
	1995	40^o 30'- 43^o 00'	100-700
	1996	43^o 00'- Border	100-700
	1997	34^o 00'- Border	100-700
	1999	34^o 00'- Border	100-700
	2000	34^o 00'- Border	100-700
	2001	34^o 00'- Border	100-700
NWFSC slope	1999	34^o 50'- 48^o 10'	100-700
	2000	34^o 50'- 48^o 10'	100-700
	2001	34^o 50'- 48^o 10'	100-700
	2002	34^o 50'- 48^o 10'	100-700
NWFSC shelf-slope	2003	32^o 34'- 48^o 27'	30-700
	2004	32^o 34'- 48^o 27'	30-700
	2005	32^o 34'- 48^o 27'	30-700
	2006	32^o 34'- 48^o 27'	30-700
	2007	32^o 34'- 48^o 27'	30-700
	2008	32^o 34'- 48^o 27'	30-700
	2009	32^o 34'- 48^o 27'	30-700
	2010	32^o 34'- 48^o 27'	30-700
	2011	32^o 34'- 48^o 27'	30-700
	2012	32^o 34'- 48^o 27'	30-700

Table 6: Spatial strata used in constructing survey abundance indices for surveys used in the assessment.

Survey	Latitude (N. lat.)	Depth (m)
AFSC shelf (1980-1992)	36^{0}5” – 40^{0}5”	55-400
	40^{0}5” – 43^0	55-400
	43^0 – 47^{0}5”	55-400
	47^{0}5” – 49^0	55-400
AFSC shelf (1995-2004)	34^{0}5” – 40^{0}5”	55-300 300-500
	40^{0}5” – 43^0	55-300 300-500
	43^0 – 49^0	55-300 300-500
AFSC slope	34^{0}5” – 43^0	183-300 300-549
	43^0 – 49^0	183-300 300-549
NWFSC slope	34^{0}5”– 40^{0}5”	183-300 300-549
	40^{0}5” – 43^0	183-300 300-549
	43^0 – 47^{0}5”	183-300 300-549
	47^{0}5” – 49^0	183-300 300-549
NWFSC shelf-slope	34^{0}5” – 40^{0}5”	55-300 300-549
	40^{0}5” – 43^0	55-300 300-549
	43^0 – 47^{0}5”	55-300 300-549
	47^{0}5” – 49^0	55-300 300-549

Table 7: Summary of sampling effort used to produce AFSC shelf survey biomass index and generate length and age frequency distributions.

Year	Number of hauls	Number of positive hauls	Number of hauls with lengths	Number of lengths	Number of hauls with ages	Numbers of ages
1980	349	126	12	656	2	96
1983	521	232	44	4483	1	117
1986	484	188	39	1839	8	219
1989	505	198	91	3056	0	0
1992	482	159	43	1614	0	0
1995	512	172	163	2897	45	626
1998	528	169	169	3396	62	467
2001	506	186	186	2935	115	1030
2004	383	152	152	3578	148	1134

Table 8: Summary of sampling effort used to produce AFSC slope survey biomass index and generate length and age frequency distributions.

Year	Number of hauls	Number of positive hauls	Number of hauls with lengths	Number of lengths	Number of hauls with ages	Numbers of ages
1997	182	27	25	314	0	0
1999	199	32	32	259	0	0
2000	208	27	27	236	24	128
2001	207	22	22	363	18	191

Table 9: Summary of sampling effort used to produce NWFSC slope survey biomass index and generate length and age frequency distributions.

Year	Number of hauls	Number of positive hauls	Number of hauls with lengths	Number of lengths	Number of hauls with ages	Numbers of ages
1999	324	53	0	0	0	0
2000	329	54	25	296	25	291
2001	334	54	45	494	45	359
2002	426	56	54	1027	54	827

Table 10: Summary of sampling effort used to produce NWFSC shelf-slope survey biomass index and generate length and age frequency distributions.

Year	Number of hauls	Number of positive hauls	Number of hauls with lengths	Number of lengths	Number of hauls with ages	Numbers of ages
2003	376	101	100	2375	100	748
2004	347	92	90	1062	90	595
2005	466	112	110	1983	110	804
2006	455	130	130	1925	130	940
2007	499	132	132	2086	132	987
2008	493	111	111	1647	111	762
2009	500	126	126	2298	126	1159
2010	515	117	117	2239	117	912
2011	502	110	108	1828	108	796
2012	506	102	102	2205	102	791

Table 11: Error distribution assumptions regarding data sources used in the assessment.

Data sources used	Error distribution assumption
Landings	Assumed to be known without error (uncertainty explored via sensitivity analysis)
Abundance	Lognormal
Length composition	Multinomial
Age composition	Multinomial
Mean body weight	Normal
Discard	Normal

Table 12: List of parameter values used in the base model.

Parameter	Estimated value	Bounds (low, high)	Fixed value
Natural mortality (*M*, female)	-	NA	0.05
Natural mortality (*M*, male)	0.067	(0.01,0.15)	-
Individual growth			
Females:			
Length at A_1	15.34	(1,20)	-
Length at A_2	42.57	(20,60)	-
von Bertalanffy *K*	0.20	(0.05,0.3)	-
CV of length at A_1	0.11	(0.05,0.3)	-
CV of length at A_2	-	NA	0.046
Males:			
Length at A_1 (set equal to females)	-	NA	0.0
Length at A_2	37.63	(50,60)	-
von Bertalanffy *K*	0.264	(0.2,0.45)	-
CV of length at A_1 (set equal to females)	-	NA	0.0
CV of length at A_2	-	NA	0.046
Weight at length			
Females:			
Coefficient	-	NA	1.11E-05
Exponent	-	NA	3.13512
Males:			
Coefficient	-	NA	1.21E-05
Exponent	-	NA	3.10958
Fecundity at length			
Inflection	-	NA	101100
Slope	-	NA	44800
Stock and recruitment			
Ln(R_0)	7.84	(5,12)	-
Steepness (*h*)	-	NA	0.779
Recruitment SD (σ_r)	-	NA	Iterated to 0.75
Survey catchability and variability			
Ln(*Q*) – AFSC shelf (1980-1992)	0.555982	(-10,2)	
Ln(*Q*) – AFSC shelf offset (1995-2004) to early	0.023689	(-4,4)	
Ln(*Q*) – AFSC slope	-0.15737	(-10,2)	
Ln(*Q*) – NWFSC slope	0.019763	(-10,2)	
Ln(*Q*) – NWFSC shelf-slope	0.544378	(-10,2)	
Extra additive SD for AFSC shelf	0.010632	(0,1)	
Extra additive SD for NWFSC shelf-slope	0.049063	(0,1)	
Selectivity and retention			
TWL fishery (double-normal)			
Peak	36.2	(20, 45)	-
Top: width of plateau	-	NA	2
Ascending slope	4.9	(-1,9)	-
Descending slope	-	NA	0.6
Selectivity at first bin	-	NA	-999
Selectivity at last bin	-	NA	9

Parameter	Estimated value	Bounds (low, high)	Fixed value
TWL retention (logistic function)			
Inflection base	27.84	(15,70)	-
Inflection block (2011-2012)	25.58	(15,70)	-
Slope base	1.58	(0.1,10)	-
Slope block (2011-2012)	1.50	(0.1,10)	-
Asymptotic retention base	-	NA	1
Asymptotic retention block (2000-2001)	0.66	(0,1)	-
Asymptotic retention block (2002)	0.51	(0,1)	-
Asymptotic retention block (2003)	0.40	(0,1)	-
Asymptotic retention block (2004)	0.85	(0,1)	-
Asymptotic retention block (2005)	0.79	(0,1)	-
Asymptotic retention block (2006)	0.57	(0,1)	-
Asymptotic retention block (2007)	0.52	(0,1)	-
Asymptotic retention block (2008)	0.48	(0,1)	-
Asymptotic retention block (2009)	0.50	(0,1)	-
Asymptotic retention block (2010)	0.54	(0,1)	-
Male offset to inflection	-	NA	0
AFSC shelf survey (double-normal)			
Peak	21.89	(10, 45)	-
Top: width of plateau	-	NA	-6
Ascending slope	3.40	(-1,9)	-
Descending slope base	4.94	(-1,9)	-
Descending slope block (1995-2004)	4.83	(-1,9)	-
Selectivity at first bin	-	NA	-999
Selectivity at last bin	-	NA	-999
AFSC slope survey (double-normal)			
Peak	22.07	(10, 45)	-
Top: width of plateau	-1.74	(-6,4)	-
Ascending slope	1.69	(-1,9)	-
Descending slope	3.39	(-1,9)	-
Selectivity at first bin	-	NA	-999
Selectivity at last bin	-	NA	-999
NWFSC slope survey (double-normal)			
Peak	24.32	(10, 45)	-
Top: width of plateau	-	NA	-6
Ascending slope	3.032	(-1,9)	-
Descending slope	4.99	(-1,9)	-
Selectivity at first bin	-	NA	-999
Selectivity at last bin	-	NA	-999
NWFSC shelf-slope survey (double-normal)			
Peak	21.39	(8, 45)	-
Top: width of plateau	-	NA	-6
Ascending slope	3.41	(-1,9)	-
Descending slope	5.26	(-1,9)	-
Selectivity at first bin	-	NA	-999
Selectivity at last bin	-	NA	-999

Table 13: Time series of total biomass, summary biomass, spawning output, depletion relative to B_0, recruitment, and exploitation rate estimated in the base model.

Year	Total biomass (mt)	Summary biomass (mt)	Spawning output (million fish)	Depletion (%)	Age-0 Recruits (1000s)	Exploitation rate (catch/ age 1+ biomass)
1915	36,498	36,495	3,389	100%	2,588	
1916	36,502	36,498	3,389	100%	2,590	0.00036
1917	36,493	36,490	3,388	100%	2,592	0.00058
1918	36,478	36,475	3,386	100%	2,594	0.00060
1919	36,464	36,461	3,385	100%	2,596	0.00038
1920	36,460	36,456	3,384	100%	2,598	0.00040
1921	36,456	36,453	3,383	100%	2,601	0.00034
1922	36,456	36,452	3,382	100%	2,603	0.00032
1923	36,458	36,455	3,382	100%	2,606	0.00038
1924	36,460	36,456	3,382	100%	2,609	0.00039
1925	36,462	36,459	3,381	100%	2,612	0.00044
1926	36,465	36,461	3,381	100%	2,615	0.00060
1927	36,463	36,460	3,381	100%	2,619	0.00051
1928	36,466	36,463	3,380	100%	2,623	0.00051
1929	36,471	36,468	3,380	100%	2,626	0.00054
1930	36,477	36,474	3,380	100%	2,630	0.00059
1931	36,483	36,479	3,380	100%	2,635	0.00073
1932	36,486	36,482	3,380	100%	2,639	0.00046
1933	36,500	36,497	3,380	100%	2,644	0.00045
1934	36,517	36,513	3,381	100%	2,649	0.00043
1935	36,536	36,533	3,382	100%	2,654	0.00049
1936	36,555	36,552	3,384	100%	2,660	0.00033
1937	36,582	36,579	3,385	100%	2,666	0.00038
1938	36,609	36,606	3,387	100%	2,672	0.00047
1939	36,635	36,632	3,389	100%	2,680	0.00066
1940	36,656	36,653	3,390	100%	2,688	0.00091
1941	36,671	36,667	3,391	100%	2,698	0.00117
1942	36,679	36,676	3,391	100%	2,707	0.00134
1943	36,685	36,681	3,390	100%	2,716	0.00511
1944	36,557	36,554	3,377	100%	2,725	0.01111
1945	36,222	36,218	3,343	99%	2,731	0.01914
1946	35,616	35,613	3,282	97%	2,733	0.01150
1947	35,310	35,307	3,250	96%	2,734	0.00960
1948	35,090	35,087	3,225	95%	2,733	0.00557
1949	35,026	35,023	3,216	95%	2,727	0.00468
1950	35,003	35,000	3,210	95%	2,716	0.00519

Year	Total biomass (mt)	Summary biomass (mt)	Spawning output (million fish)	Depletion (%)	Age-0 Recruits (1000s)	Exploitation rate (catch/ age 1+ biomass)
1951	34,971	34,967	3,205	95%	2,697	0.00602
1952	34,915	34,912	3,197	94%	2,672	0.00635
1953	34,853	34,849	3,189	94%	2,644	0.00541
1954	34,824	34,821	3,185	94%	2,612	0.00637
1955	34,761	34,757	3,178	94%	2,582	0.00753
1956	34,654	34,650	3,168	93%	2,559	0.01000
1957	34,457	34,454	3,150	93%	2,545	0.01175
1958	34,197	34,194	3,126	92%	2,541	0.01001
1959	33,995	33,992	3,107	92%	2,546	0.00851
1960	33,841	33,838	3,094	91%	2,554	0.01033
1961	33,624	33,621	3,074	91%	2,553	0.00969
1962	33,430	33,426	3,056	90%	2,521	0.01055
1963	33,210	33,207	3,035	90%	2,465	0.01133
1964	32,969	32,966	3,012	89%	2,376	0.00822
1965	32,832	32,829	2,999	88%	2,254	0.01503
1966	32,468	32,465	2,965	87%	2,105	0.13028
1967	28,409	28,406	2,579	76%	1,943	0.10860
1968	25,535	25,533	2,304	68%	1,835	0.09499
1969	23,350	23,347	2,094	62%	1,830	0.01242
1970	23,298	23,296	2,087	62%	2,009	0.01529
1971	23,173	23,170	2,076	61%	2,335	0.02306
1972	22,870	22,867	2,048	60%	2,176	0.02698
1973	22,498	22,496	2,013	59%	1,877	0.04080
1974	21,851	21,848	1,948	57%	1,960	0.02819
1975	21,523	21,521	1,911	56%	1,674	0.02882
1976	21,199	21,196	1,875	55%	2,578	0.03230
1977	20,817	20,815	1,837	54%	1,543	0.01569
1978	20,804	20,800	1,834	54%	3,285	0.02054
1979	20,712	20,708	1,822	54%	3,072	0.03650
1980	20,343	20,340	1,780	53%	2,362	0.03131
1981	20,174	20,168	1,749	52%	4,454	0.04272
1982	19,870	19,868	1,700	50%	1,254	0.05919
1983	19,345	19,344	1,629	48%	801	0.06047
1984	18,865	18,863	1,566	46%	1,267	0.07306
1985	18,129	18,127	1,495	44%	1,951	0.10204
1986	16,841	16,839	1,390	41%	1,669	0.07756
1987	16,022	16,018	1,334	39%	2,827	0.15522
1988	14,000	13,998	1,168	34%	1,320	0.12178
1989	12,764	12,763	1,057	31%	816	0.10321

Year	Total biomass (mt)	Summary biomass (mt)	Spawning output (million fish)	Depletion (%)	Age-0 Recruits (1000s)	Exploitation rate (catch/ age 1+ biomass)
1990	11,928	11,927	972	29%	748	0.14655
1991	10,645	10,644	852	25%	932	0.11845
1992	9,798	9,797	779	23%	898	0.07308
1993	9,439	9,438	757	22%	418	0.13104
1994	8,513	8,510	690	20%	2,311	0.10499
1995	7,898	7,893	644	19%	4,213	0.10253
1996	7,410	7,409	599	18%	951	0.10349
1997	7,084	7,083	554	16%	1,298	0.12086
1998	6,780	6,779	501	15%	606	0.14685
1999	6,385	6,377	443	13%	6,012	0.06189
2000	6,630	6,625	447	13%	4,320	0.06326
2001	6,988	6,987	465	14%	508	0.03952
2002	7,668	7,666	499	15%	1,424	0.03080
2003	8,479	8,477	536	16%	1,797	0.02503
2004	9,305	9,301	583	17%	3,265	0.02618
2005	10,065	10,061	648	19%	3,004	0.01285
2006	10,927	10,924	738	22%	2,061	0.01738
2007	11,741	11,739	818	24%	1,434	0.02380
2008	12,462	12,453	879	26%	6,674	0.02027
2009	13,212	13,211	937	28%	1,216	0.02221
2010	13,979	13,977	996	29%	1,800	0.02502
2011	14,736	14,732	1,054	31%	2,858	0.00814
2012	15,692	15,691	1,131	33%	870	0.00615
2013	16,613	16,610	1,214	36%	2,254	NA

Table 14: Comparison among sensitivity analyses to alternative assumptions about darkblotched rockfish landings.

Model	Base	TWL landings doubled	TWL landings halved	TWL historical landings doubled	TWL historical landings halved	All landings doubled	All landings halved
Negative log-likelihood							
Total	1378.84	1378.57	1379.85	1379.71	1378.54	1378.84	1378.84
Indices	-12.65	-12.75	-12.47	-12.38	-12.80	-12.65	-12.65
Length frequencies	436.75	437.08	436.40	436.45	437.01	436.75	436.75
Age frequencies	991.03	990.79	991.31	991.22	990.86	991.03	991.03
Discard	-33.450	-33.447	-33.457	-33.464	-33.444	-33.450	-33.450
Mean body weight	-9.499	-9.499	-9.499	-9.499	-9.499	-9.499	-9.499
Selected parameters							
Ln(R_0)	7.843	8.416	7.360	8.039	7.733	8.536	7.150
Steepness (*h*)	0.779	0.779	0.779	0.779	0.779	0.779	0.779
Female *M*	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Male *M*	0.067	0.067	0.067	0.067	0.067	0.067	0.067
Female L at A_1	15.34	15.34	15.34	15.34	15.34	15.34	15.34
Female L at A_2	42.57	42.55	42.59	42.59	42.56	42.57	42.57
Male L at A_1	15.34	15.34	15.34	15.34	15.34	15.34	15.34
Male L at A_2	37.63	37.63	37.63	37.63	37.63	37.63	37.63
Female von Bert *K*	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Male von Bert *K*	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Management quantities							
Equilibrium spawning output (million eggs)	3,358	5,945	2,075	4,088	3,003	6,716	1,679
2013 Spawning depletion	36%	35%	39%	39%	35%	36%	36%

Table 15: Comparison among sensitivity analyses to alternative assumptions about selected life history parameters.

Model	Base	2011 maturity	2011 fecundity	2011 W-L relationships	2011 steepness	2007 steepness and natural mortality
Negative log-likelihood						
Total	1378.84	1379.01	1378.84	1378.84	1378.84	1378.84
Indices	-12.65	-12.70	-12.65	-12.65	-12.65	-12.65
Length frequencies	436.75	436.90	436.75	436.75	436.75	436.75
Age frequencies	991.03	991.03	991.03	991.03	991.03	991.03
Discard	-33.450	-33.442	-33.450	-33.450	-33.450	-33.450
Mean body weight	-9.499	-9.499	-9.499	-9.499	-9.499	-9.499
Selected parameters						
$Ln(R_0)$	7.843	7.842	7.843	7.843	7.843	7.843
Steepness (h)	0.779	0.779	0.779	0.779	0.779	0.779
Female M	0.050	0.050	0.050	0.050	0.050	0.050
Male M	0.067	0.067	0.067	0.067	0.067	0.067
Female L at A_1	15.34	15.34	15.34	15.34	15.34	15.34
Female L at A_2	42.57	42.57	42.57	42.57	42.57	42.57
Male L at A_1	15.34	15.34	15.34	15.34	15.34	15.34
Male L at A_2	37.63	37.63	37.63	37.63	37.63	37.63
Female von Bert K	0.20	0.20	0.20	0.20	0.20	0.20
Male von Bert K	0.26	0.26	0.26	0.26	0.26	0.26
Management quantities						
Equilibrium spawning output (million eggs)	3,358	3,474	3,358	3,358	3,358	3,358
2013 Spawning depletion	36%	32%	36%	36%	36%	36%

Table 16: Comparison among sensitivity analyses to alternative assumptions about selectivity parameters

Model	Base	TWL dome-shaped	NWFSC combo asymptotic
Negative log-likelihood			
Total	1378.84	1379.13	1411.36
Indices	-12.648	-12.663	-9.924
Length frequencies	436.748	437.179	447.233
Age frequencies	991.028	990.921	1004.74
Discard	-33.45	-33.451	-33.447
Mean body weight	-9.499	-9.498	-9.429
Selected parameters			
$Ln(R_0)$	7.84	7.84	7.79
Steepness (*h*)	0.779	0.779	0.779
Female *M*	0.05	0.05	0.05
Male *M*	0.067	0.067	0.066
Female L at A_1	15.342	15.338	15.42
Female L at A_2	42.57	42.57	42.71
Male L at A_1	15.34	15.34	15.42
Male L at A_2	37.63	37.63	37.61
Female von Bert *K*	0.2	0.2	0.193
Male von Bert *K*	0.26	0.26	0.25
Management quantities			
Equilibrium spawning output (million eggs)	3,358	3,354	3,203
2013 Spawning depletion	36%	36%	28%

Table 17: Results from the retrospective analysis. Likelihoods in italics are not comparable across rows

Model	Base	-1 year	-2 years	-3 years	-4 years	-5 years
Negative log-likelihood						
Total	*1378.84*	*1311.95*	*1263.19*	*1209.32*	*1133.38*	*1024.96*
Indices	*-12.65*	*-12.16*	*-11.70*	*-11.57*	*-10.54*	*-11.00*
Length frequencies	*436.75*	*418.29*	*401.44*	*383.61*	*356.42*	*324.68*
Age frequencies	*991.03*	*943.84*	*905.53*	*864.95*	*811.30*	*733.83*
Discard	*-33.45*	*-33.456*	*-29.014*	*-26.279*	*-24.088*	*-21.273*
Mean body weight	*-9.499*	*-9.532*	*-8.073*	*-7.251*	*-6.234*	*-5.215*
Selected parameters						
Ln(R_0)	7.84	7.84	7.84	7.84	7.87	7.86
Steepness (h)	0.779	0.779	0.779	0.779	0.779	0.779
Female M	0.05	0.05	0.05	0.05	0.05	0.05
Male M	0.067	0.067	0.068	0.067	0.067	0.068
Female L at A_1	15.34	15.39	15.37	15.36	15.27	15.36
Female L at A_2	42.57	42.58	42.54	42.5	42.42	42.36
Male L at A_1	15.34	15.39	15.37	15.36	15.27	15.36
Male L at A_2	37.63	37.64	37.62	37.58	37.55	37.56
Female von Bert K	0.200	0.202	0.203	0.207	0.212	0.217
Male von Bert K	0.260	0.262	0.263	0.266	0.272	0.276
Management quantities						
Equilibrium spawning output (million eggs)	3,358	3,360	3,348	3,359	3,438	3,411
2013 Spawning depletion	36%	NA	NA	NA	NA	NA

Table 18: Summary of reference points for the base model.

Quantity	Estimate	~95% Confidence Interval
Unfished Spawning output (million eggs)	3,358	2,603-4,114
Unfished age 1+ biomass (mt)	36,171	28,181-44,161
Unfished recruitment (R0)	2,549	1,970-3,127
Depletion (2013)	36%	16-56%
Reference points based on $SB_{XX\%}$		
Proxy spawning output ($B_{40\%}$)(million eggs)	1,343	1,041-1,646
SPR resulting in $B40_{\%}$ ($SPR_{40\%}$)	44%	NA
Exploitation rate resulting in $B_{40\%}$	4.02%	3.96-4.08%
Yield with $SPR50_{\%}$ at $B_{40\%}$ (mt)	675	526-824
Reference points based on SPR proxy for MSY		
Spawning output (million eggs)	1,550	1,201-1,899
SPR_{proxy}	50%	NA
Exploitation rate corresponding to SPR_{proxy}	3.3%	3.25-3.35%
Yield with SPR_{proxy} at SB_{SPR} (mt)	625	487-763
Reference points based on estimated MSY values		
Spawning output at *MSY* (SB_{MSY}) (million eggs)	819	635-1,003
SPR_{MSY}	30%	29.38-30.13%
Exploitation rate corresponding to SPR_{MSY}	6.65%	6.47-6.83%
MSY (mt)	742	578-906

Table 19: Summary of recent trends in estimated darkblotched rockfish exploitation and stock level from the base model.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Commercial landings (mt)	80	189	98	107	144	117	138	184	117	94	NA
Estimated Total catch (mt)	212	243	129	190	279	252	293	350	120	96	NA
OFL (mt)	205	240	269	294	456	487	437	440	508	497	541
ACL (mt)	172	240	269	200	290	330	285	291	298	296	317
SPR	56%	55%	73%	67%	59%	63%	60%	57%	82%	86%	NA
Exploitation rate (catch/ age 1+ biomass)	0.025	0.026	0.013	0.017	0.024	0.020	0.022	0.025	0.008	0.006	NA
Age 1+ biomass (mt)	8,477	9,301	10,061	10,924	11,739	12,453	13,211	13,977	14,732	15,691	16,610
Spawning output (million eggs)	536	583	648	738	818	879	937	996	1,054	1,131	1,214
~95% Confidence Interval	220-851	234-932	253-1044	286-1189	312-1324	325-1433	338-1536	349-1642	357-1751	384-1879	414-2013
Recruitment	1,797	3,265	3,004	2,061	1,434	6,674	1,216	1,800	2,858	870	2,254
~95% Confidence Interval	617-2,977	1,180-5,350	1,042-4,966	650-3,471	383-2,486	2,159-11,190	206-2,226	220-3,380	0-6,154	0-2,117	0-5,691
Depletion (%)	16%	17%	19%	22%	24%	26%	28%	29%	31%	33%	36%
~95% Confidence Interval	8-24%	9-26%	9-29%	11-33%	12-37%	12-40%	13-43%	13-46%	14-49%	15-53%	16-56%

Table 20: Summary table of 12-year projections beginning in 2015 for alternate states of nature based on female natural mortality. Columns range over low, mid, and high state of nature, and rows range over different assumptions of catch levels.

			State of nature					
			Low *Female M=0.036*		Base case Female M=0.05		High *Female M=0.082*	
Management decision	Year	Catch (mt)	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion
Catch calculated using SPR of 71.9% applied to the base model	2013	223	607	18%	1,214	36%	3,606	82%
	2014	240	648	19%	1,294	39%	3,770	85%
	2015	252	688	20%	1,374	41%	3,922	89%
	2016	260	722	21%	1,441	43%	4,032	91%
	2017	266	751	22%	1,496	45%	4,101	93%
	2018	271	776	23%	1,541	46%	4,135	94%
	2019	276	798	23%	1,578	47%	4,147	94%
	2020	280	821	24%	1,613	48%	4,150	94%
	2021	285	844	25%	1,646	49%	4,149	94%
	2022	289	867	25%	1,678	50%	4,146	94%
	2023	293	891	26%	1,709	51%	4,140	94%
	2024	297	915	27%	1,739	52%	4,133	94%
Catch calculated using current rebuilding SPR of 64.9% applied to the base model	2013	302	607	18%	1,214	36%	3,606	82%
	2014	323	641	19%	1,288	38%	3,764	85%
	2015	339	674	20%	1,360	41%	3,909	88%
	2016	347	701	20%	1,420	42%	4,011	91%
	2017	353	722	21%	1,467	44%	4,073	92%
	2018	358	738	21%	1,504	45%	4,101	93%
	2019	363	752	22%	1,533	46%	4,106	93%
	2020	368	766	22%	1,560	46%	4,102	93%
	2021	372	780	23%	1,586	47%	4,096	93%
	2022	377	796	23%	1,611	48%	4,087	93%
	2023	381	811	24%	1,635	49%	4,076	92%
	2024	385	826	24%	1,657	49%	4,064	92%
2014 ACL catch assumed for years between 2015 and 2024	2013	317	607	18%	1,214	36%	3,606	82%
	2014	330	640	19%	1,287	38%	3,762	85%
	2015	330	672	20%	1,358	40%	3,907	88%
	2016	330	699	20%	1,418	42%	4,010	91%
	2017	330	722	21%	1,467	44%	4,073	92%
	2018	330	740	22%	1,506	45%	4,103	93%
	2019	330	756	22%	1,538	46%	4,111	93%
	2020	330	773	23%	1,567	47%	4,110	93%
	2021	330	791	23%	1,597	48%	4,106	93%
	2022	330	811	24%	1,626	48%	4,101	93%
	2023	330	830	24%	1,654	49%	4,094	93%
	2024	330	850	25%	1,681	50%	4,085	92%

9 Figures

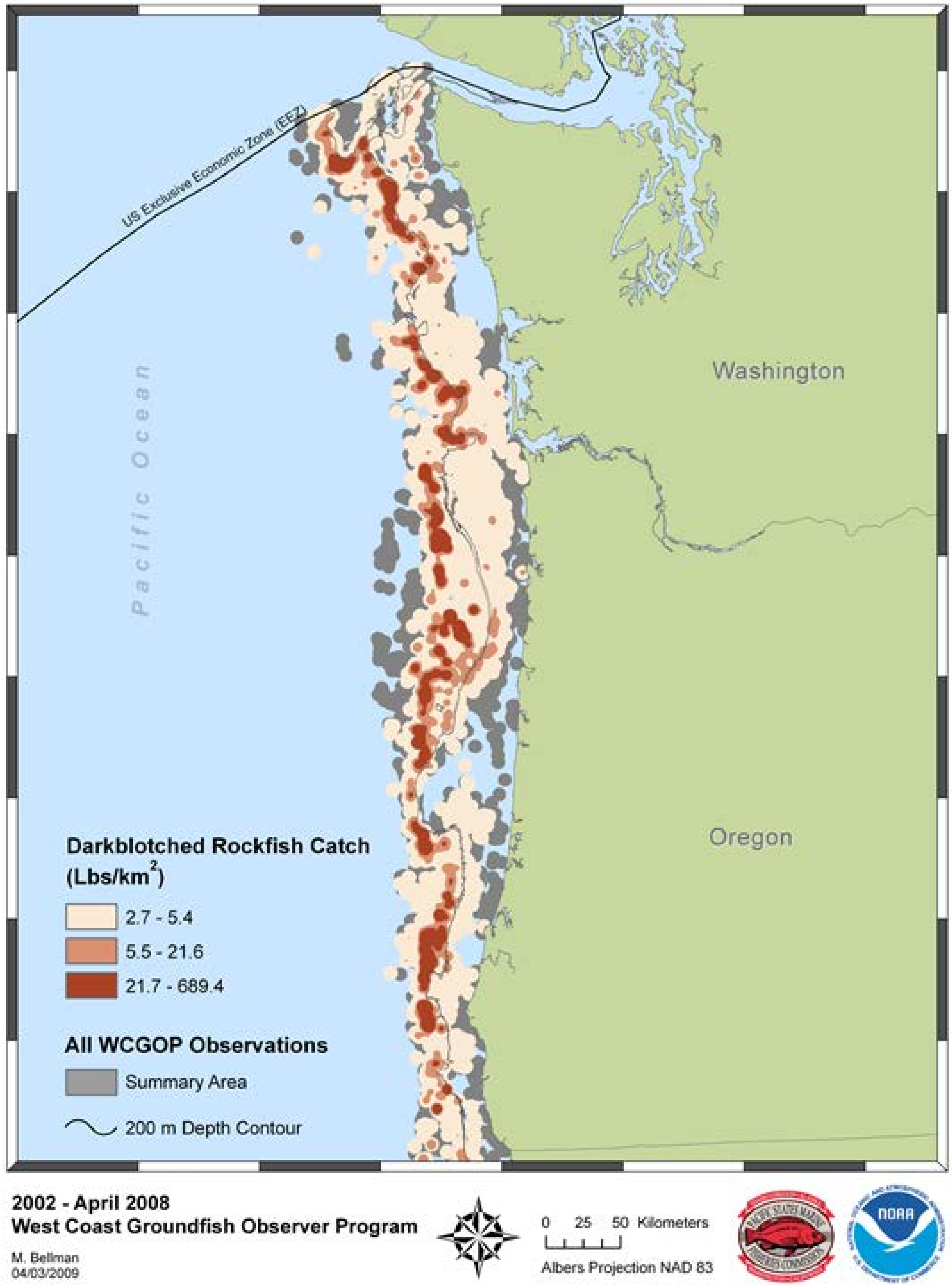

Figure 1: Spatial distribution of darkblotched rockfish catch (lbs/km^2) observed by the West Coast Groundfish Observer Program and the summary area of all observed fishing events.

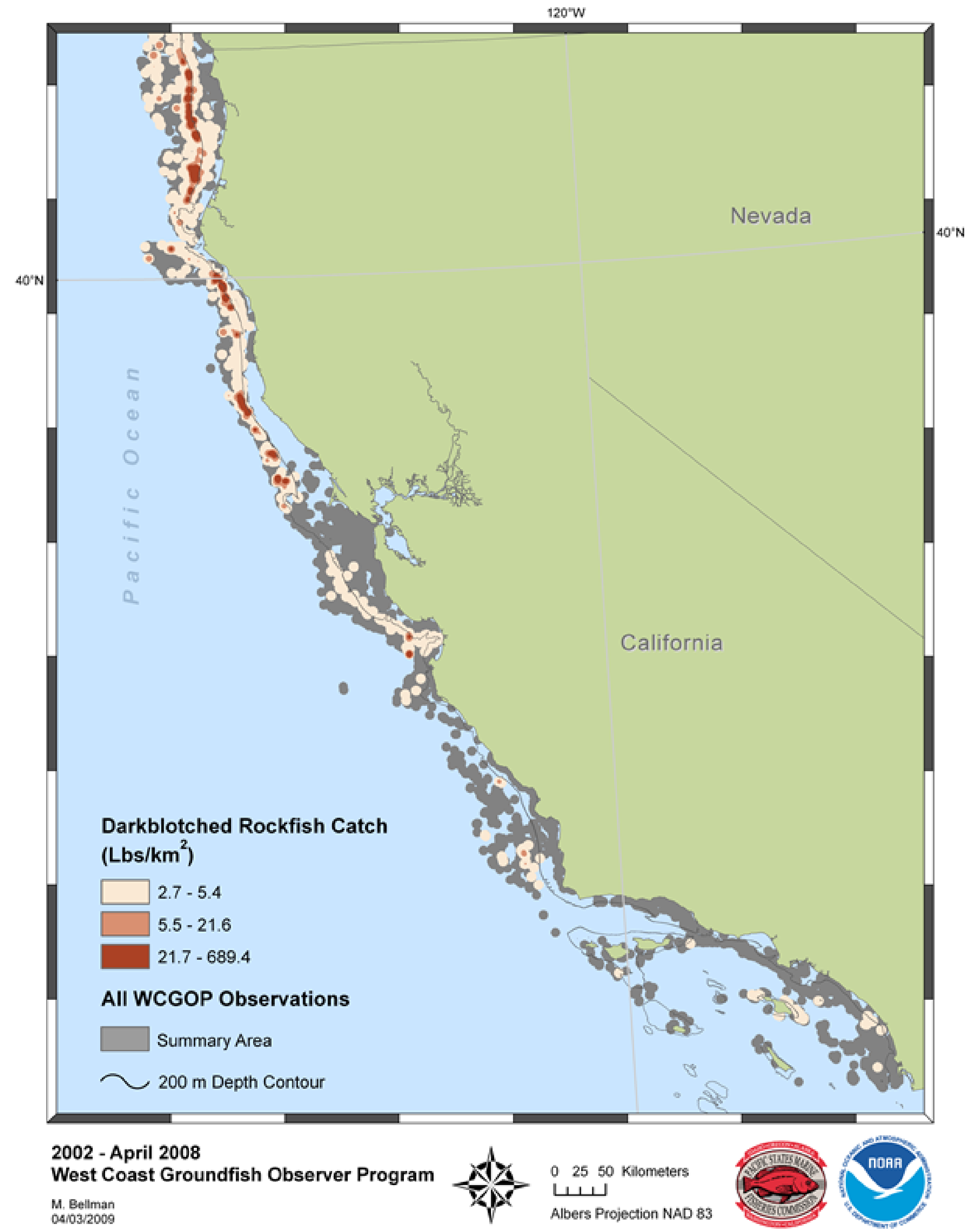

Figure 1 (continued): Spatial distribution of darkblotched rockfish catch (lbs/km^2) observed by the West Coast Groundfish Observer Program and the summary area of all observed fishing events.

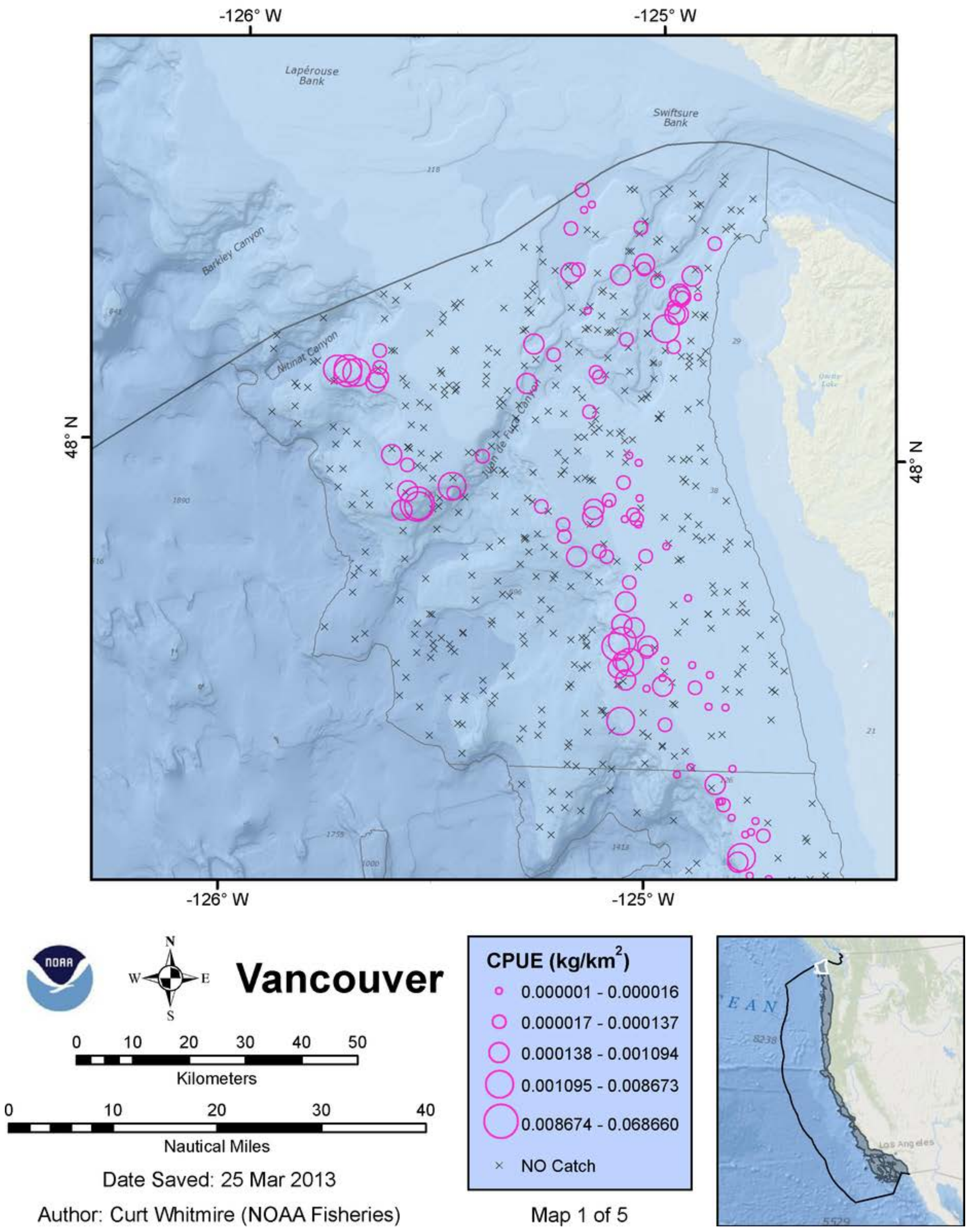

Figure 2: Spatial distribution of darkblotched rockfish (*Sebastes crameri*) catch in the NWFSC groundfish survey (2003-2012) by INPFC area.

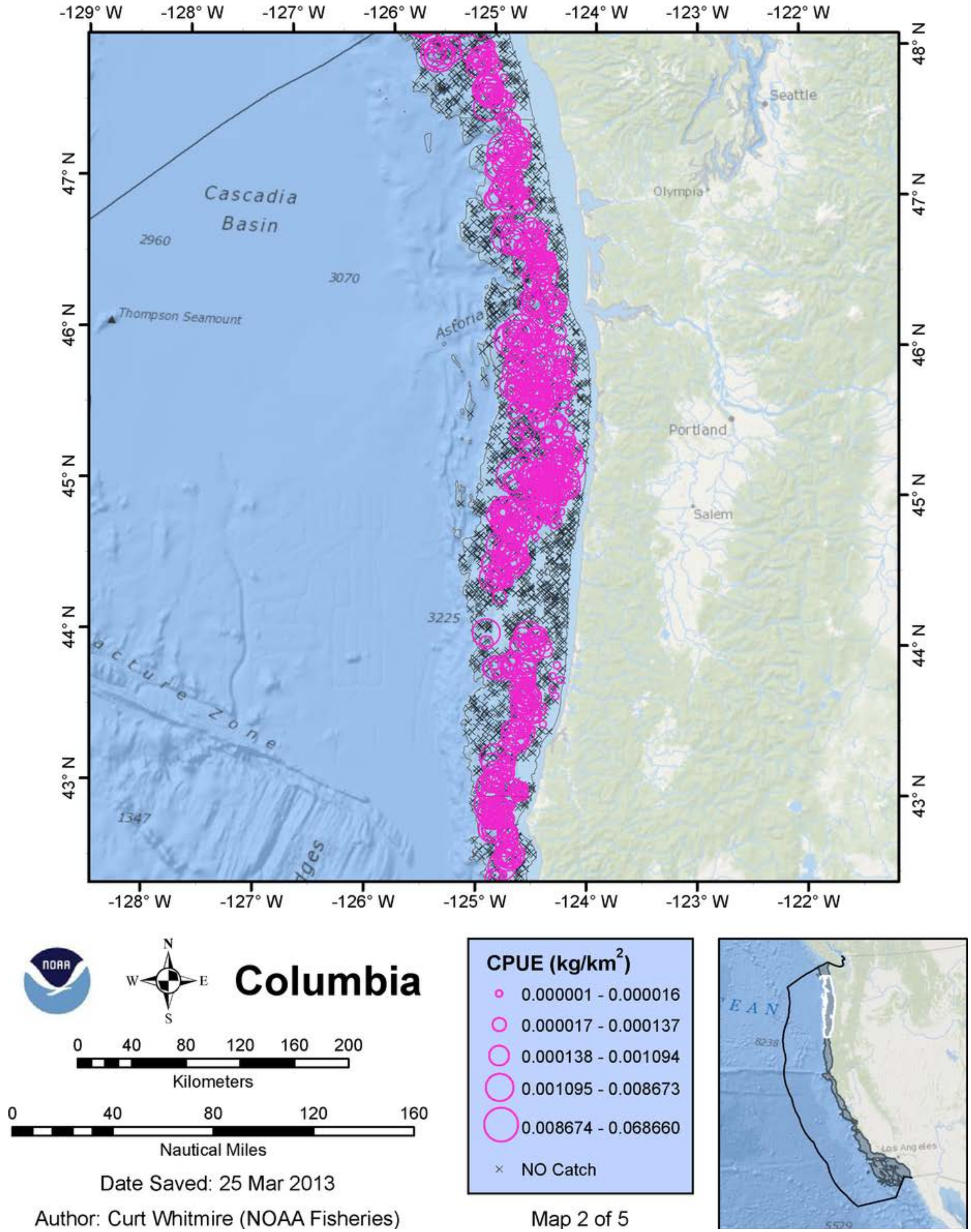

Figure 2 (continued): Spatial distribution of darkblotched rockfish (*Sebastes crameri*) catch in the NWFSC groundfish survey (2003-2012) by INPFC area.

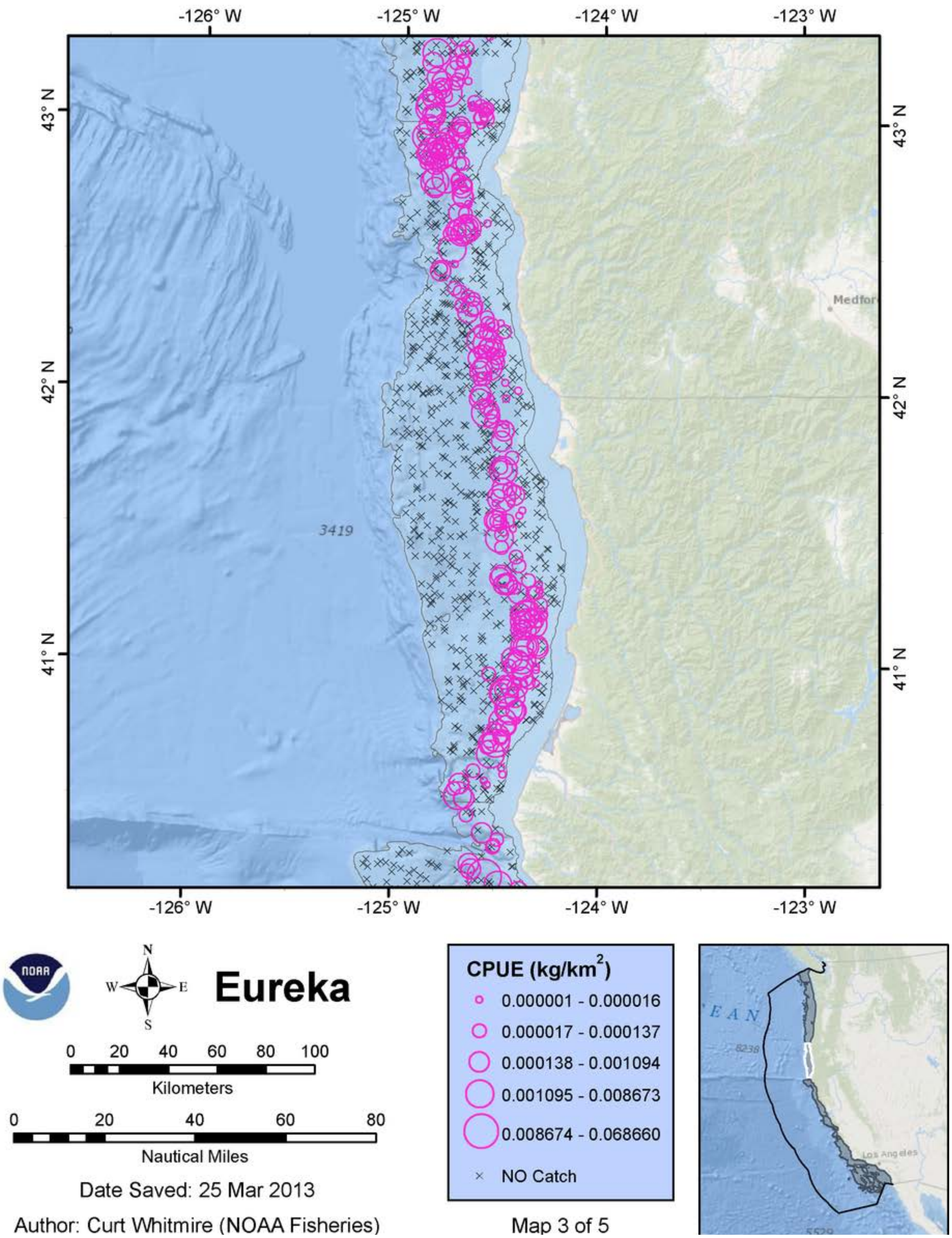

Figure 2 (continued): Spatial distribution of darkblotched rockfish (*Sebastes crameri*) catch in the NWFSC groundfish survey (2003-2012) by INPFC area.

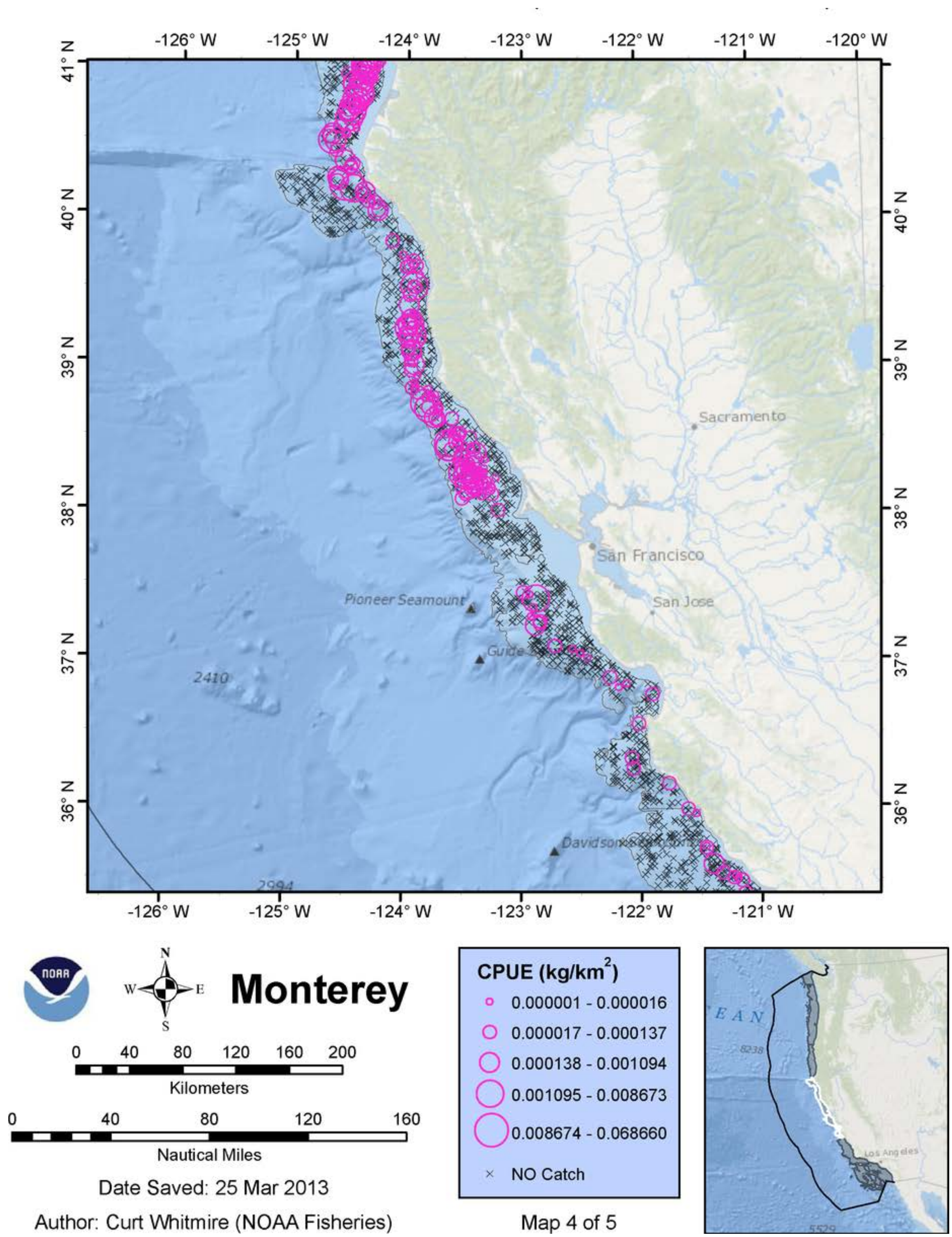

Figure 2 (continued): Spatial distribution of darkblotched rockfish (*Sebastes crameri*) catch in the NWFSC groundfish survey (2003-2012) by INPFC area.

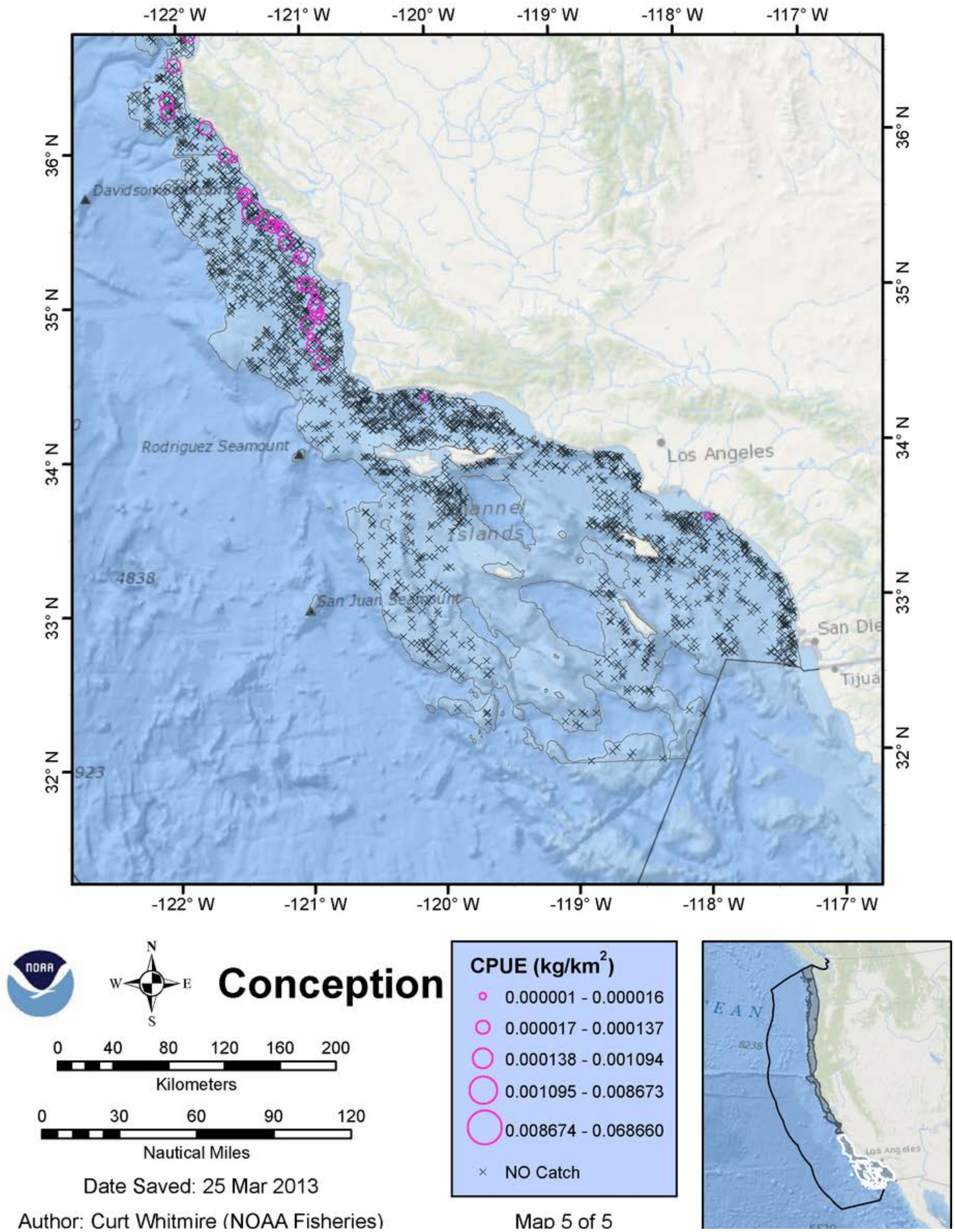

Figure 2 (continued): Spatial distribution of darkblotched rockfish (*Sebastes crameri*) catch in the NWFSC groundfish survey (2003-2012) by INPFC area.

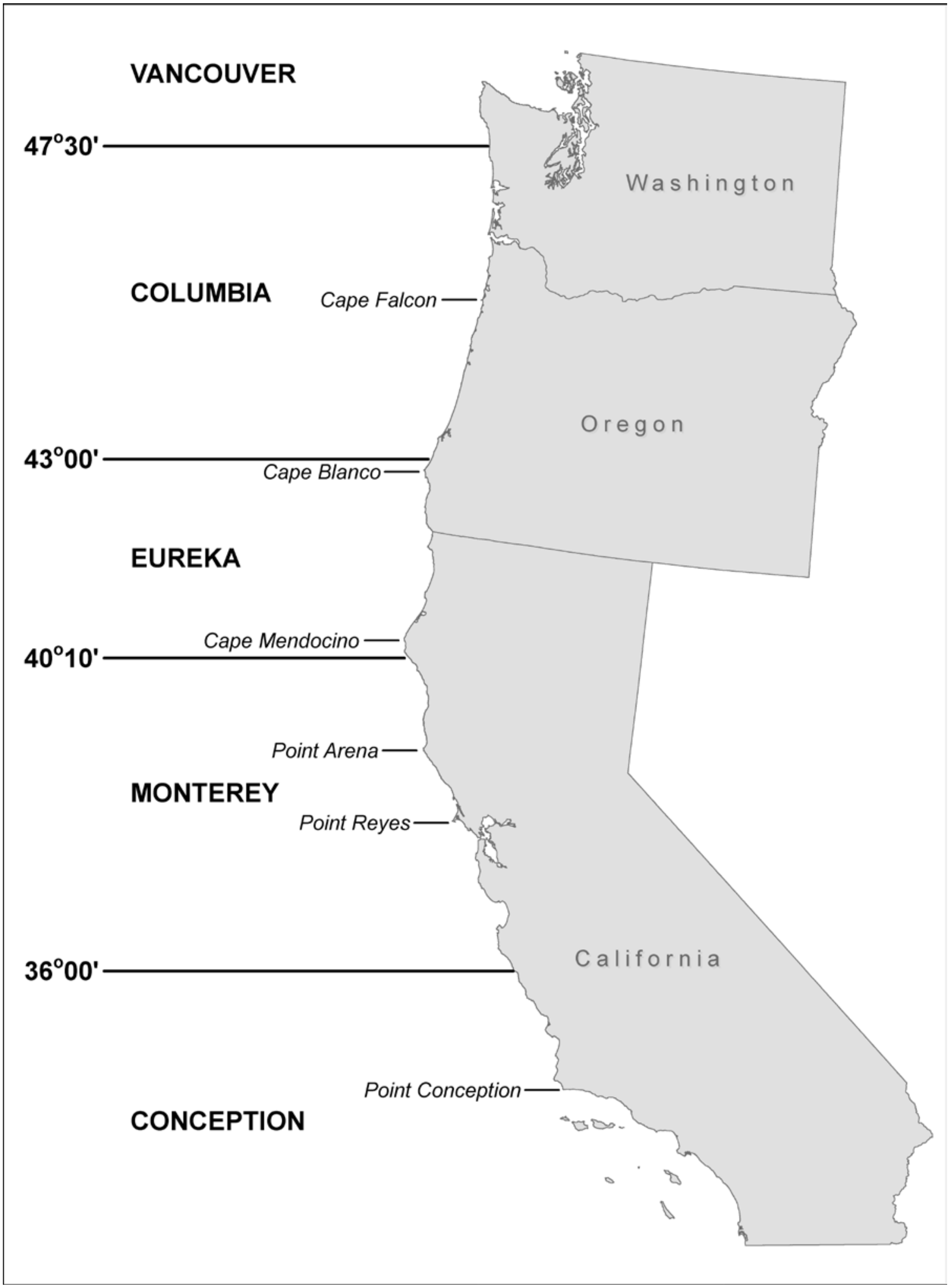

Figure 3: A map of the assessment area that includes coastal waters off three U.S. west coast states and five International North Pacific Fisheries Commission (INPFC) areas.

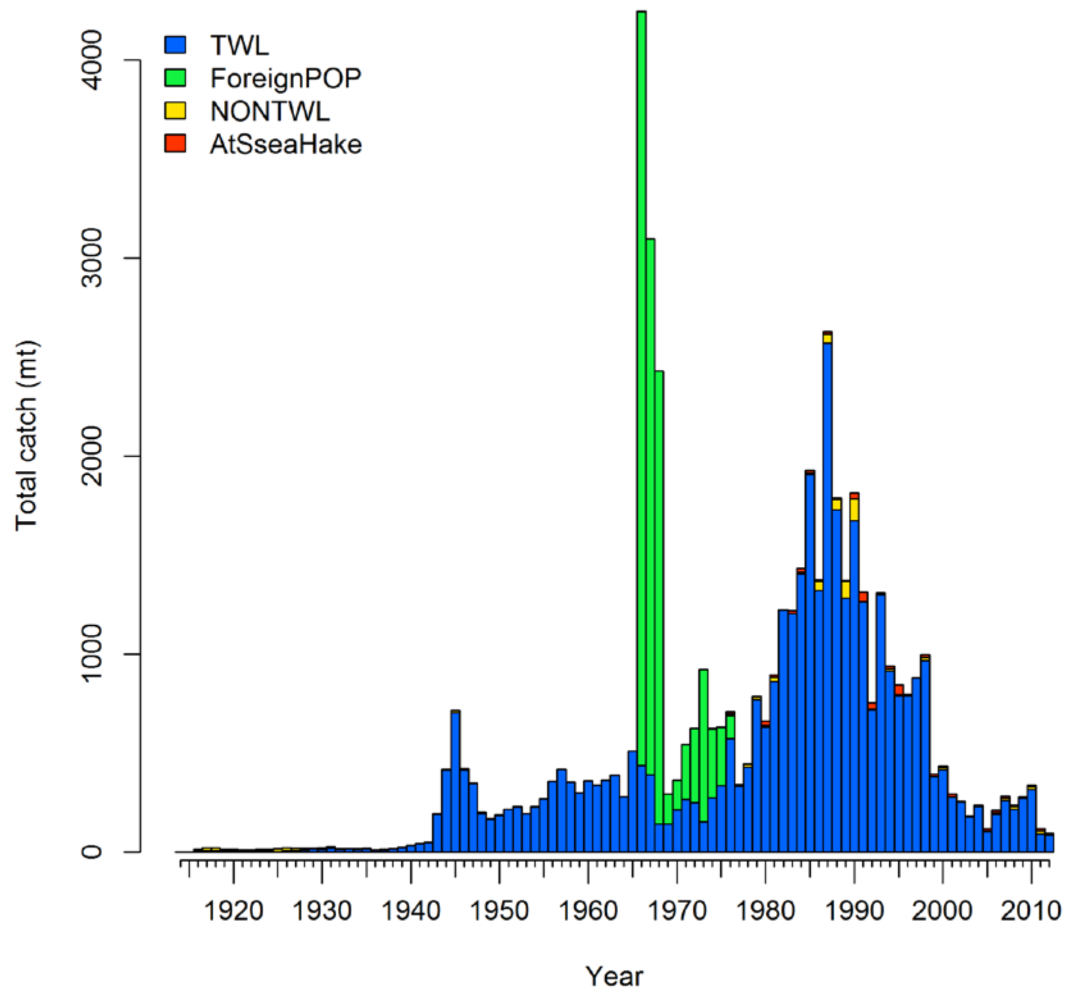

Figure 4: Darkblotched rockfish landings history, 1915-2012, with separate contribution of domestic trawl and non-trawl landings, bycatch in foreign POP and at-sea Pacific hake fisheries.

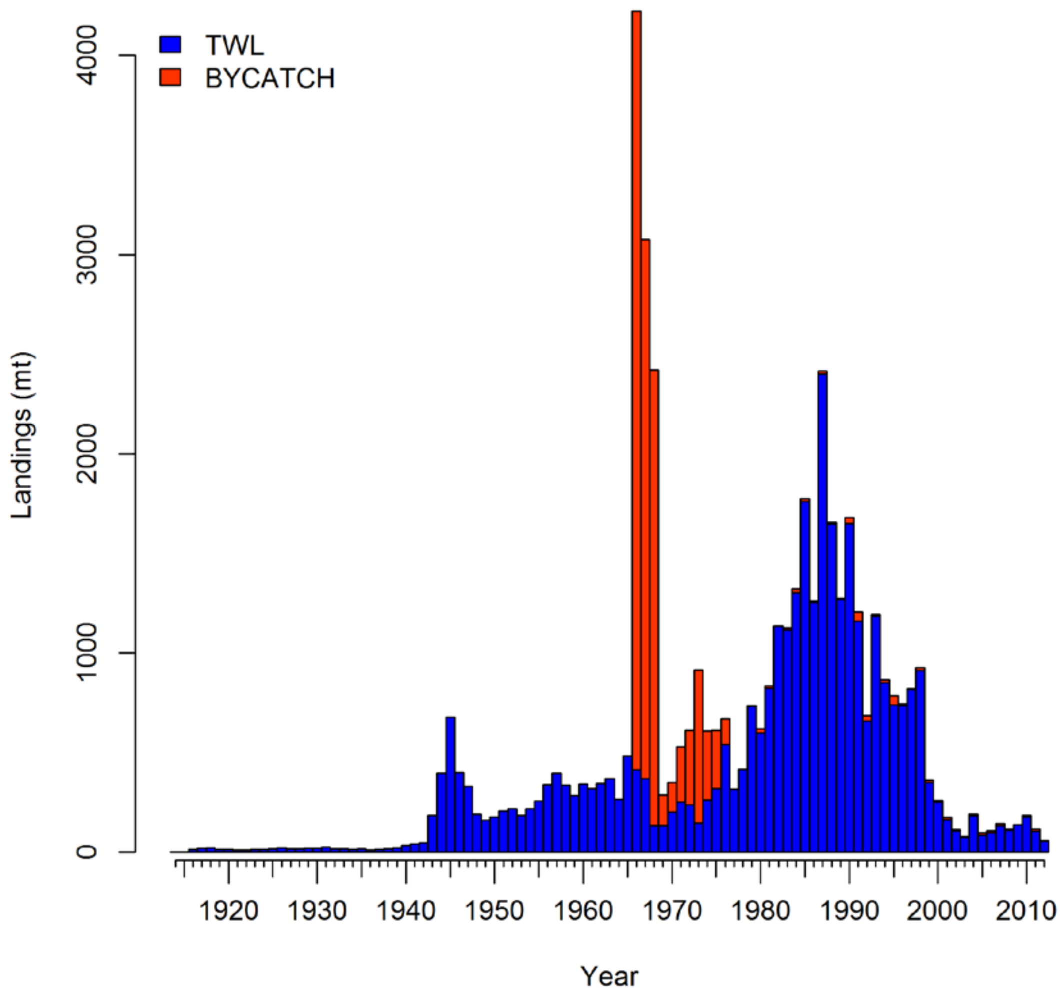

Figure 5: Darkblotched rockfish landings history, 1915-2012. Landings in the assessment are divided between two fleets that include domestic trawl fishery (TWL) and bycatch in foreign POP fishery and at-sea hake fishery (BYCATCH).

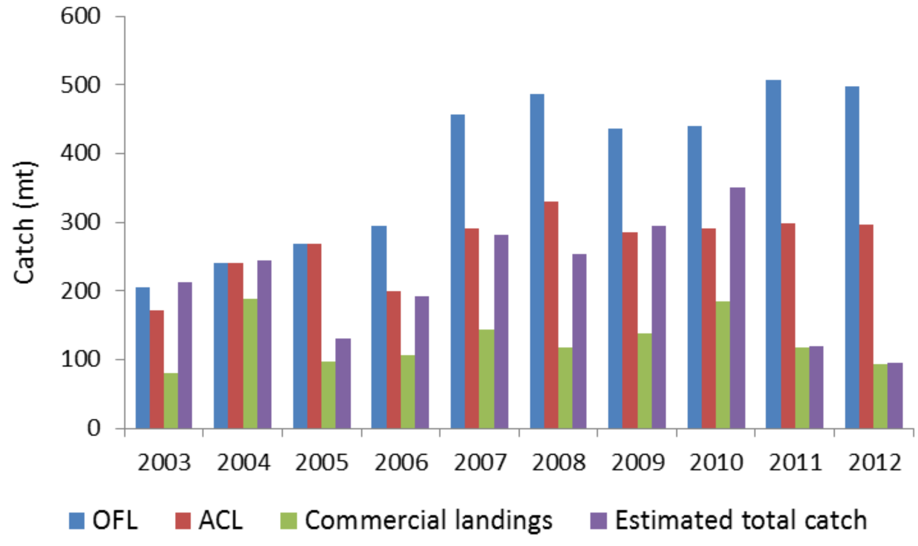

Figure 6: Recent darkblotched rockfish Overfishing Limits (OFLs) and Annual Catch Limits (ACLs) relative to recent total landings and total dead catch estimated in this assessment.

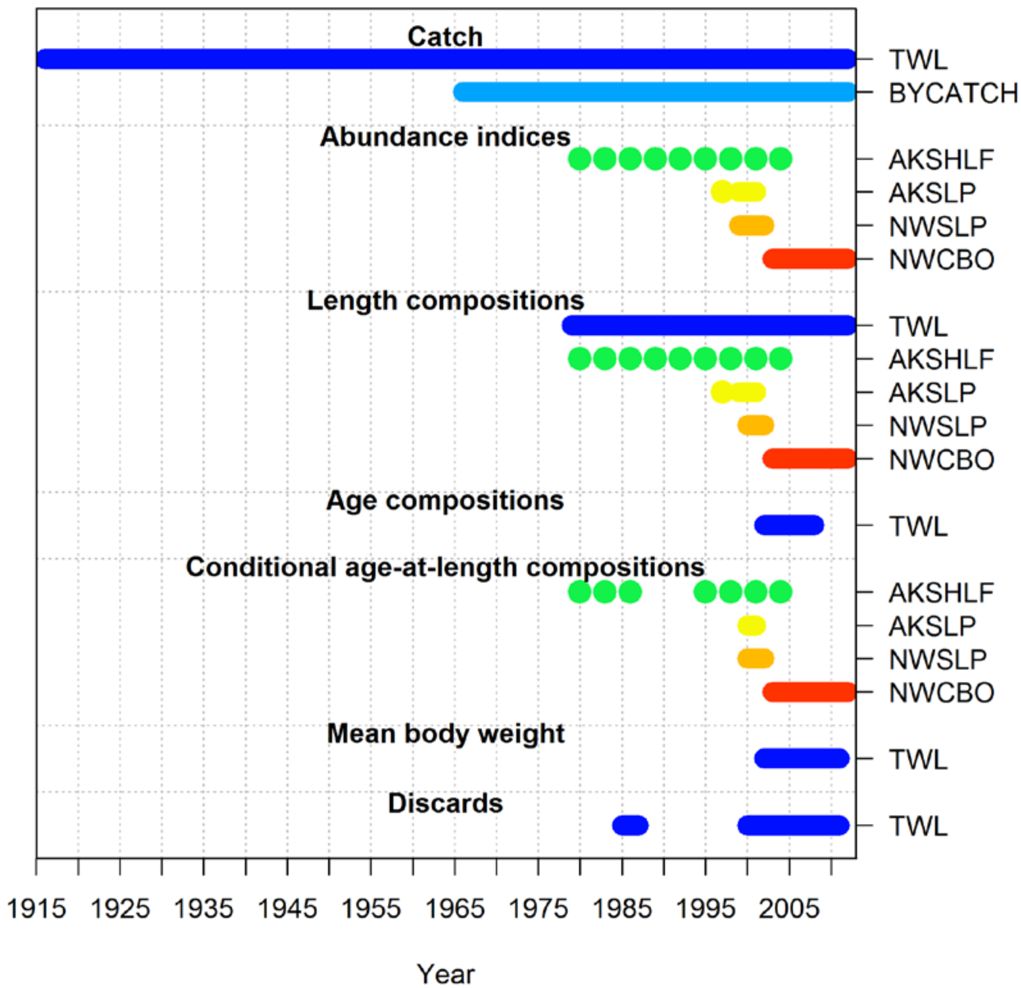

Figure 7: Summary of sources and data used in the assessment.

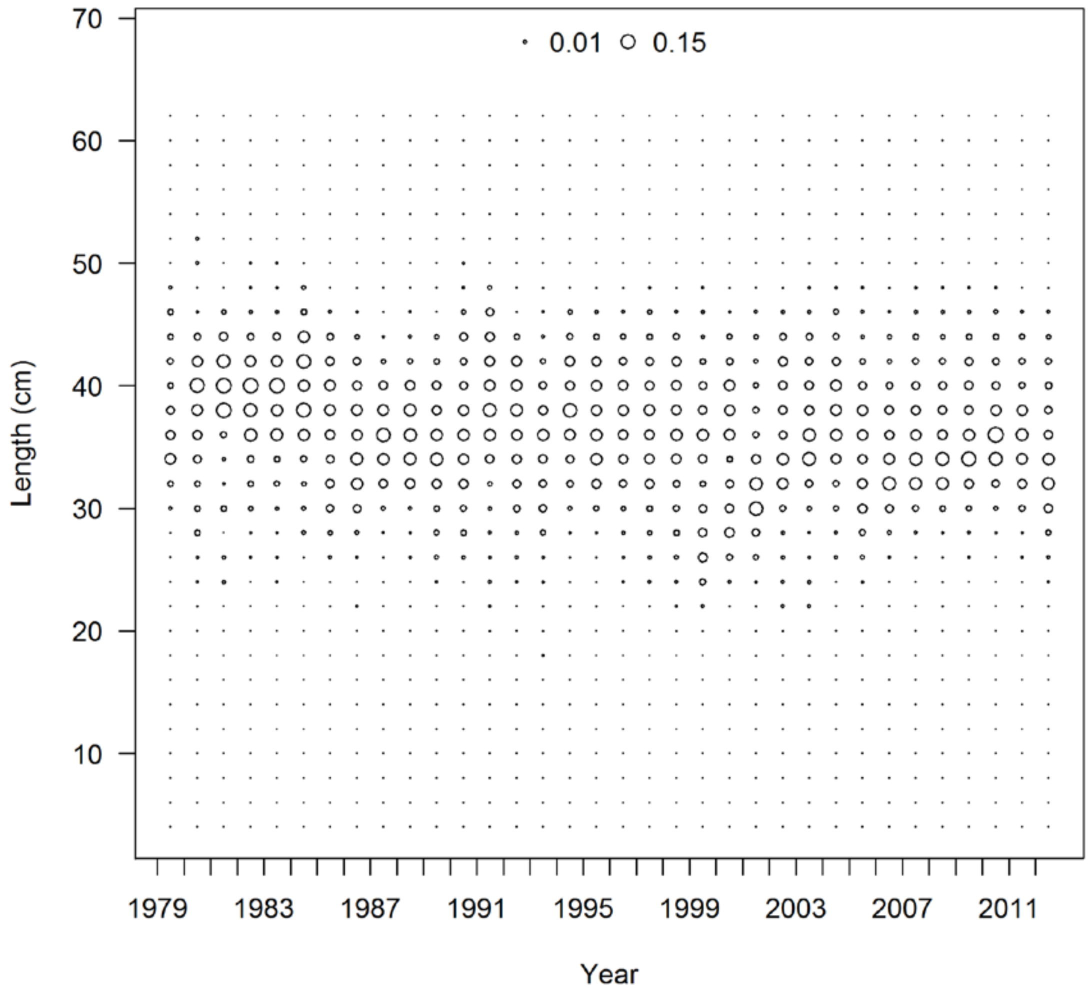

Figure 8: Length-frequency distributions for female darkblotched rockfish from the domestic trawl landings by year.

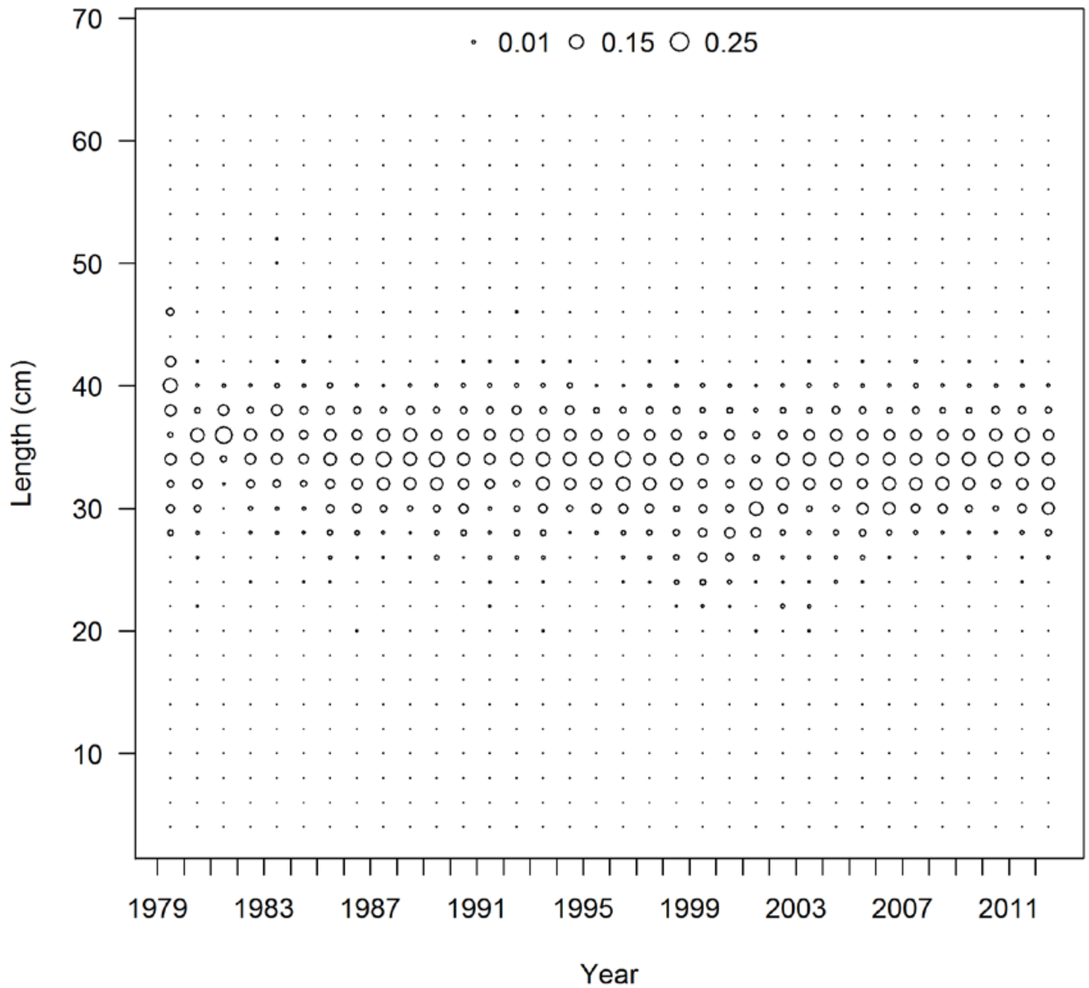

Figure 9: Length-frequency distributions for male darkblotched rockfish from the domestic trawl landings by year.

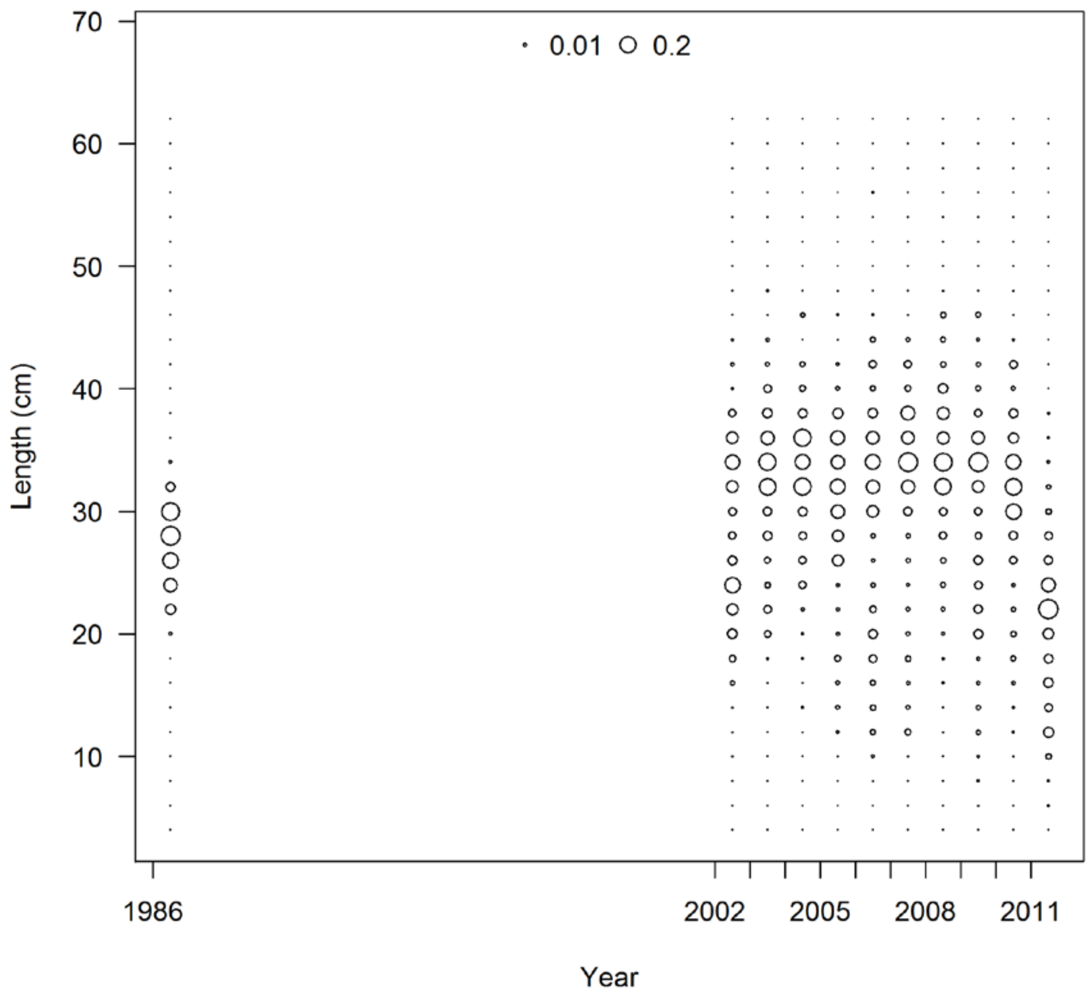

Figure 10: Length-frequency distributions for darkblotched rockfish (sexes combined) from the domestic trawl discards by year.

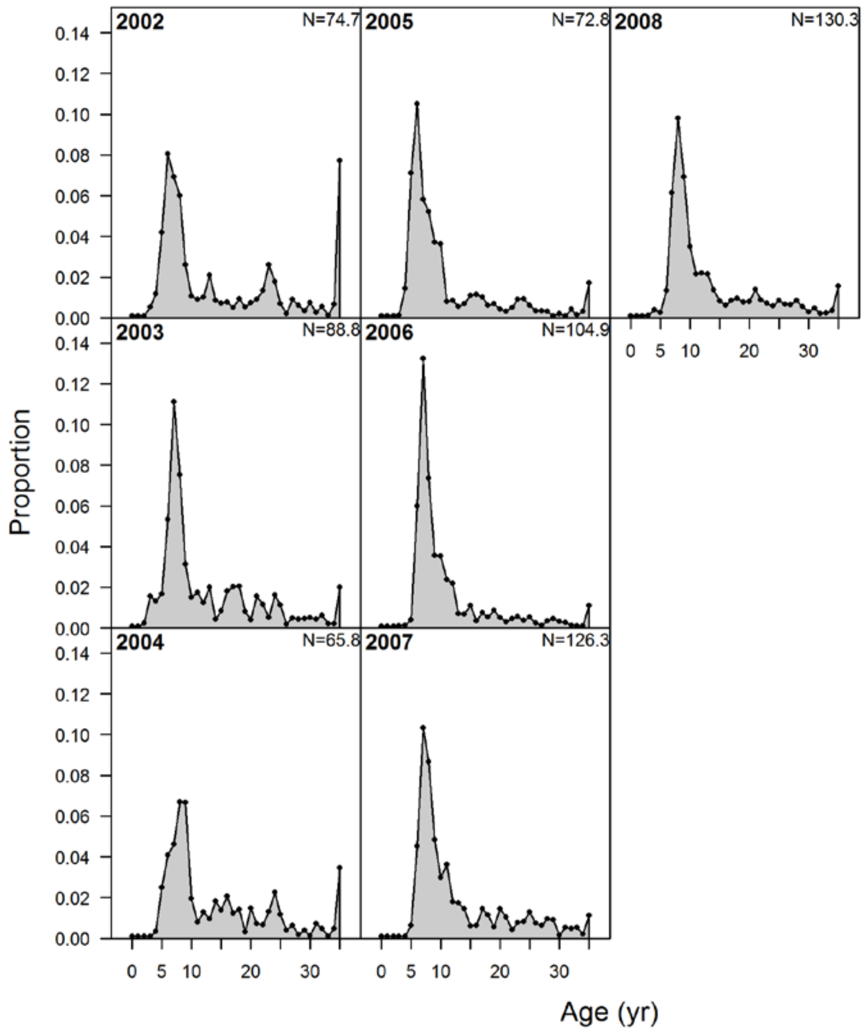

Figure 11: Age-frequency distributions for female darkblotched rockfish from the domestic trawl landings by year.

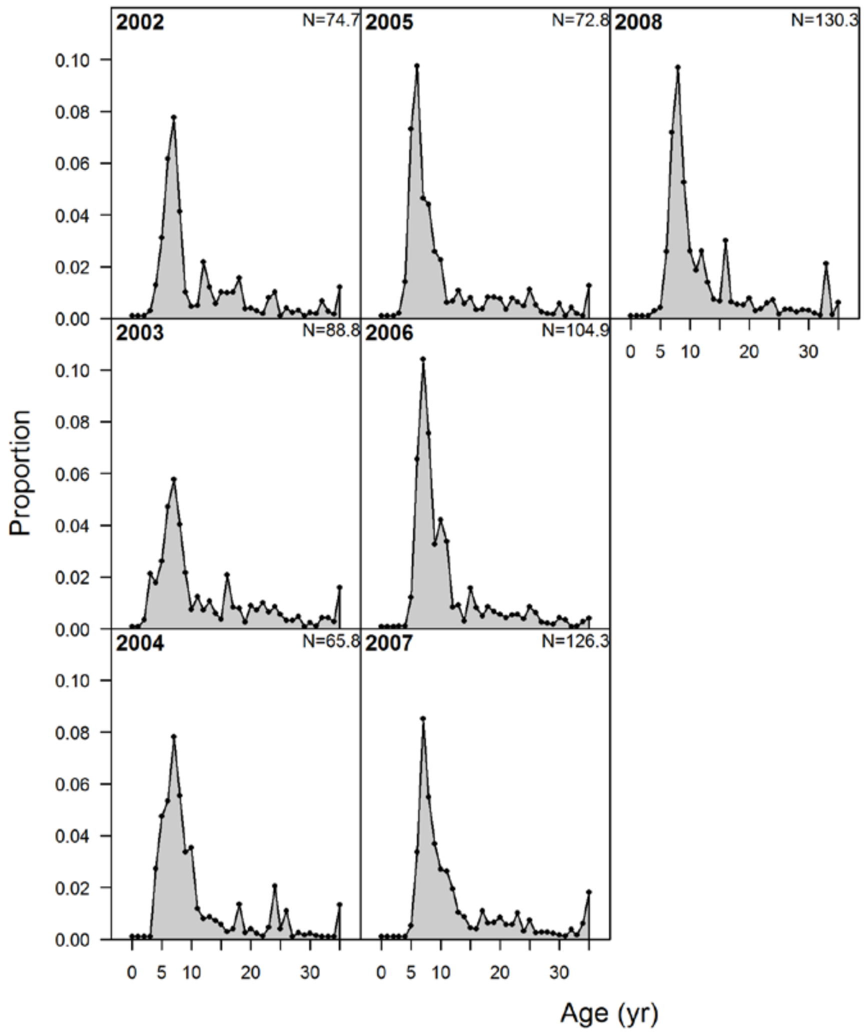

Figure 12: Age-frequency distributions for male darkblotched rockfish from the domestic trawl landings by year.

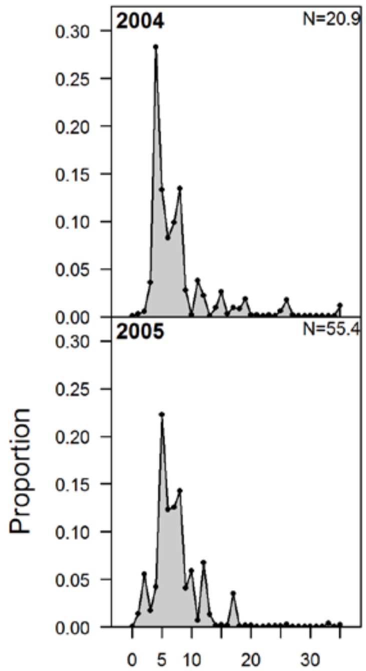

Figure 13: Age-frequency distributions for darkblotched rockfish (sexes combined) from the domestic trawl discards by year.

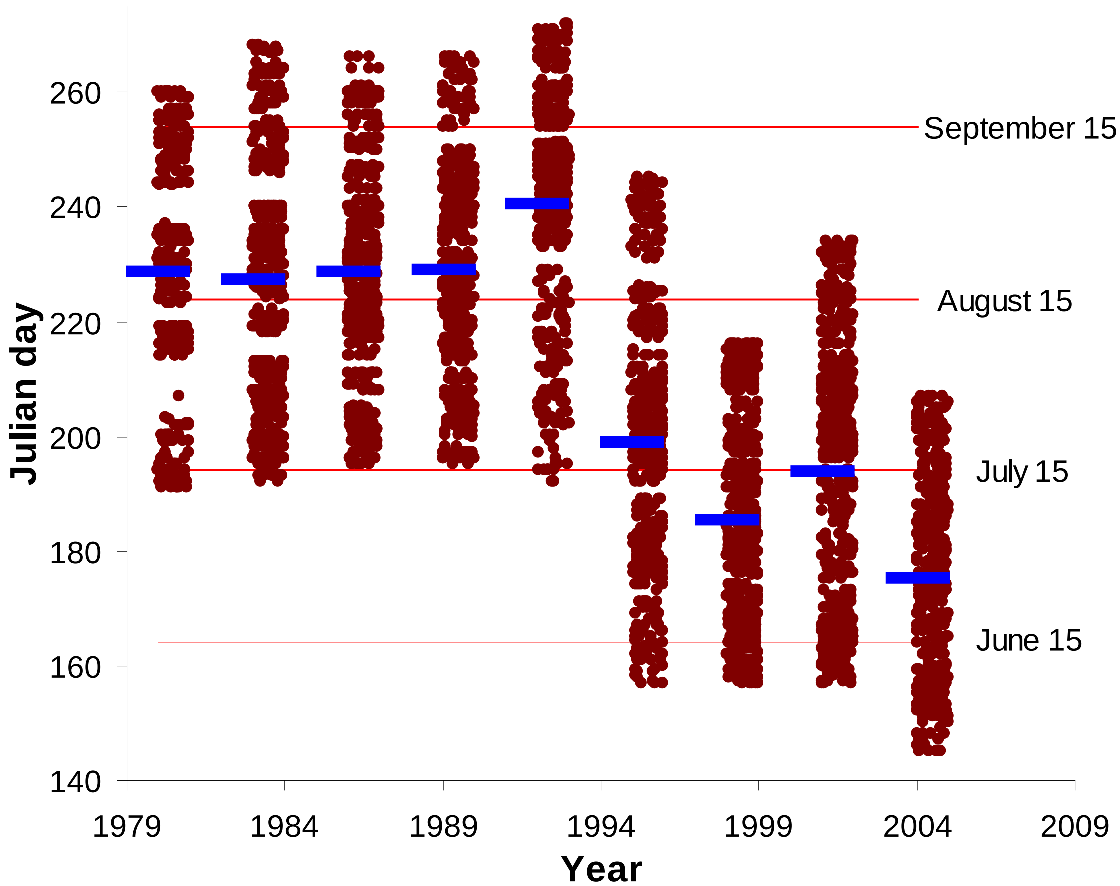

Figure 14: Distribution of dates of operation for the AFSC shelf (triennial) bottom trawl survey (1980-2004). Solid bars show the mean date for each survey year, points represent individual hauls dates, but are jittered to allow better delineation of the distribution of individual points.

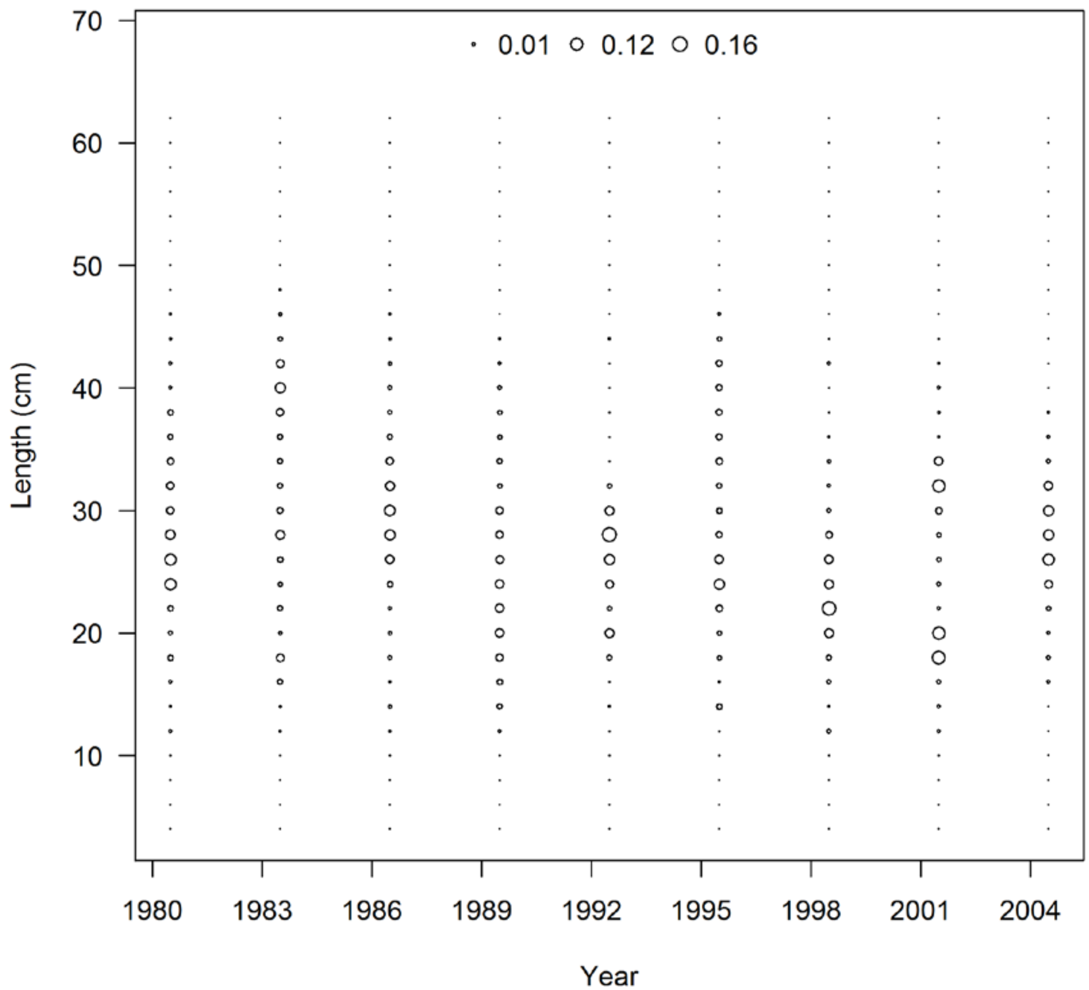

Figure 15: Length-frequency distributions for female darkblotched rockfish from the AFSC shelf survey.

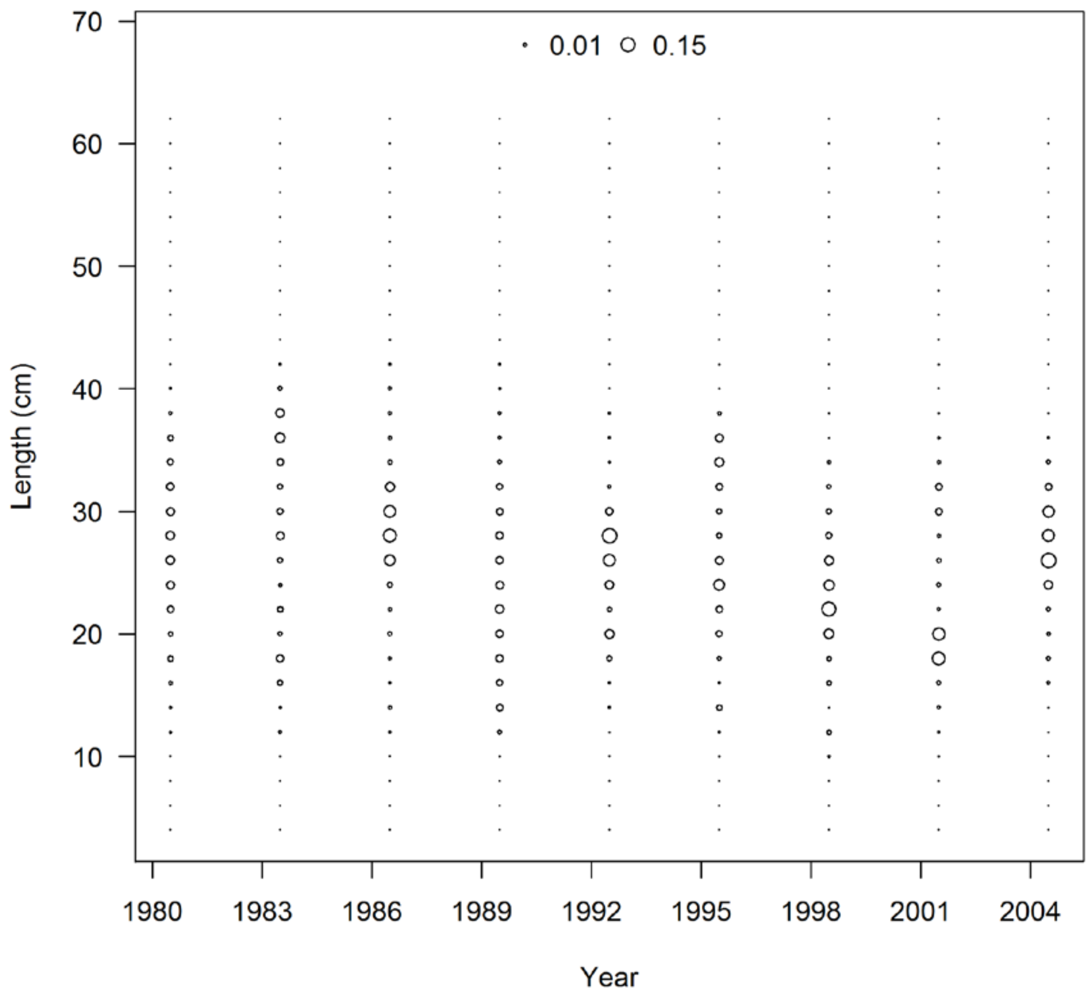

Figure 16: Length-frequency distributions for male darkblotched rockfish from the AFSC shelf survey.

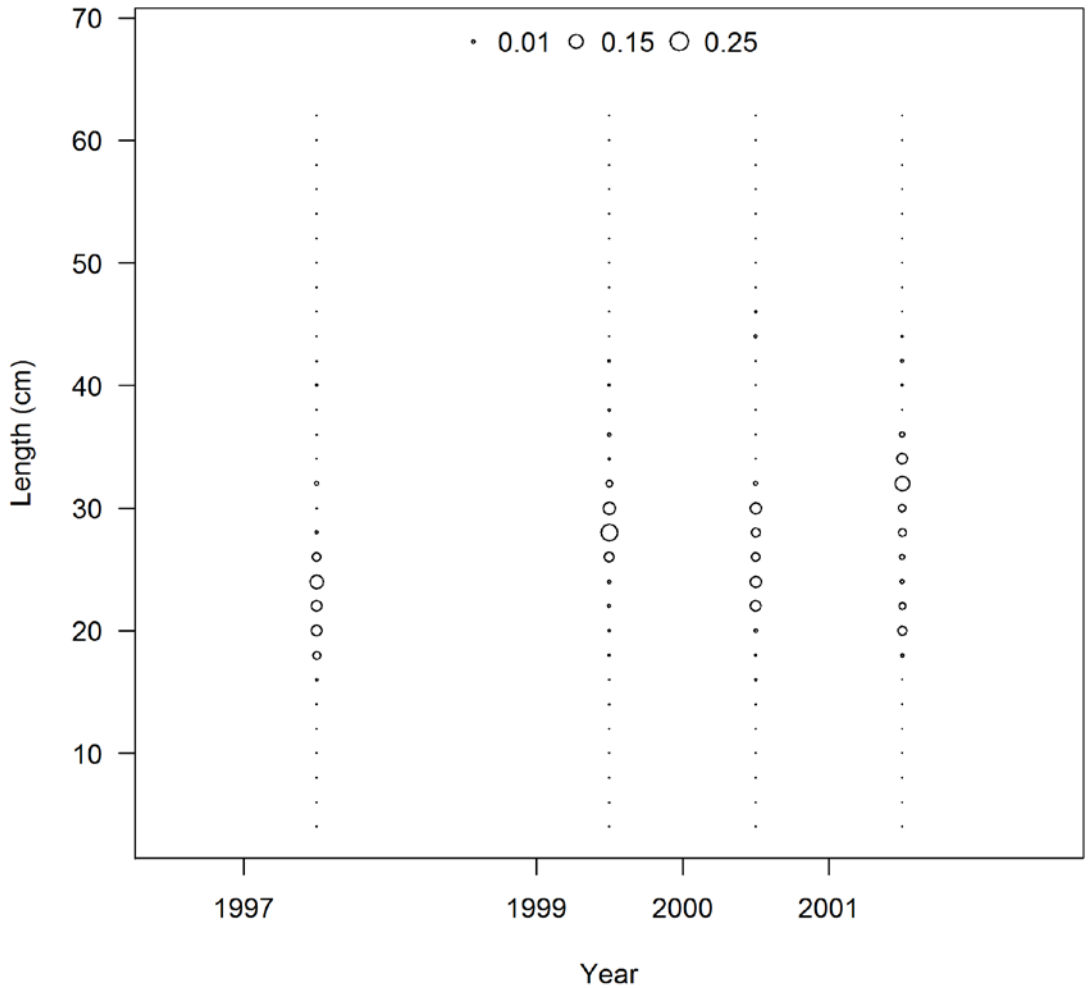

Figure 17: Length-frequency distributions for female darkblotched rockfish from the AFSC slope survey.

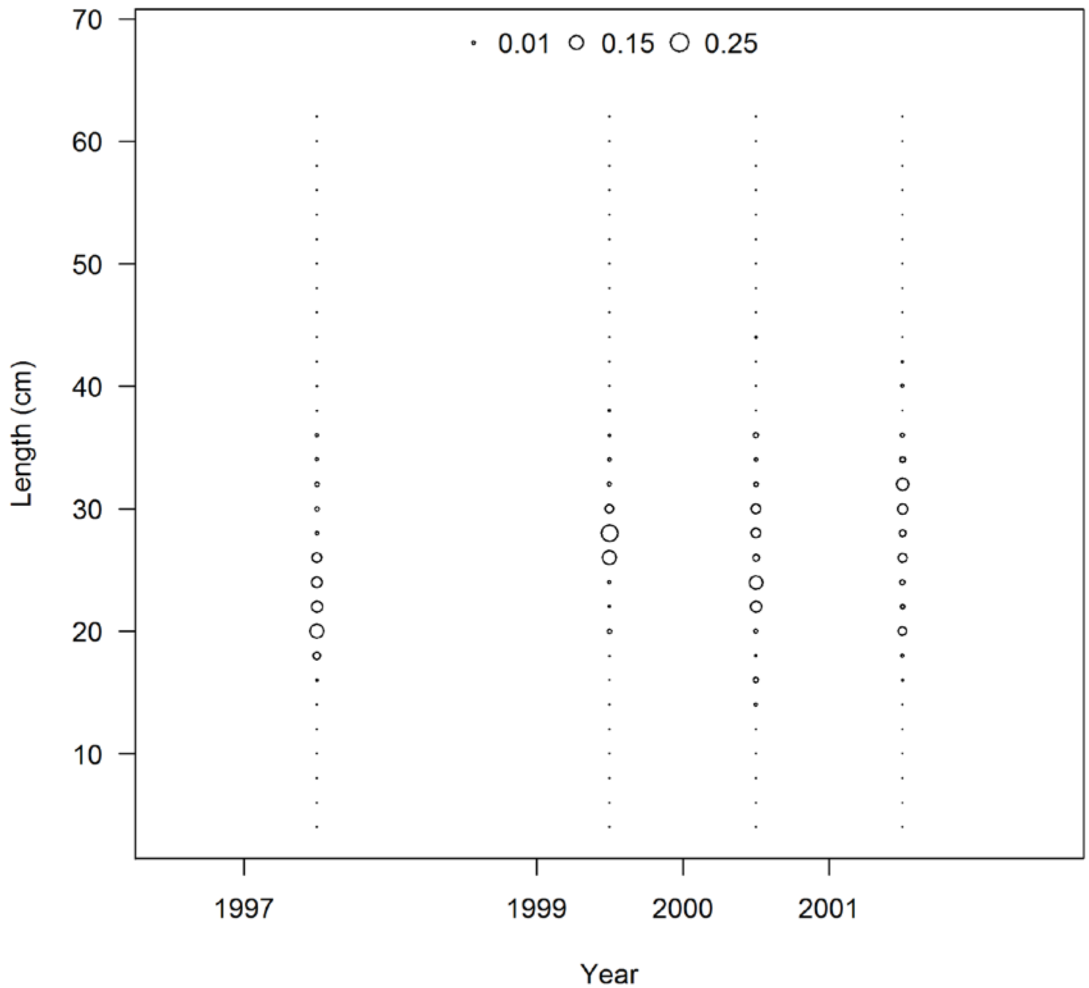

Figure 18: Length-frequency distributions for male darkblotched rockfish from the AFSC slope survey.

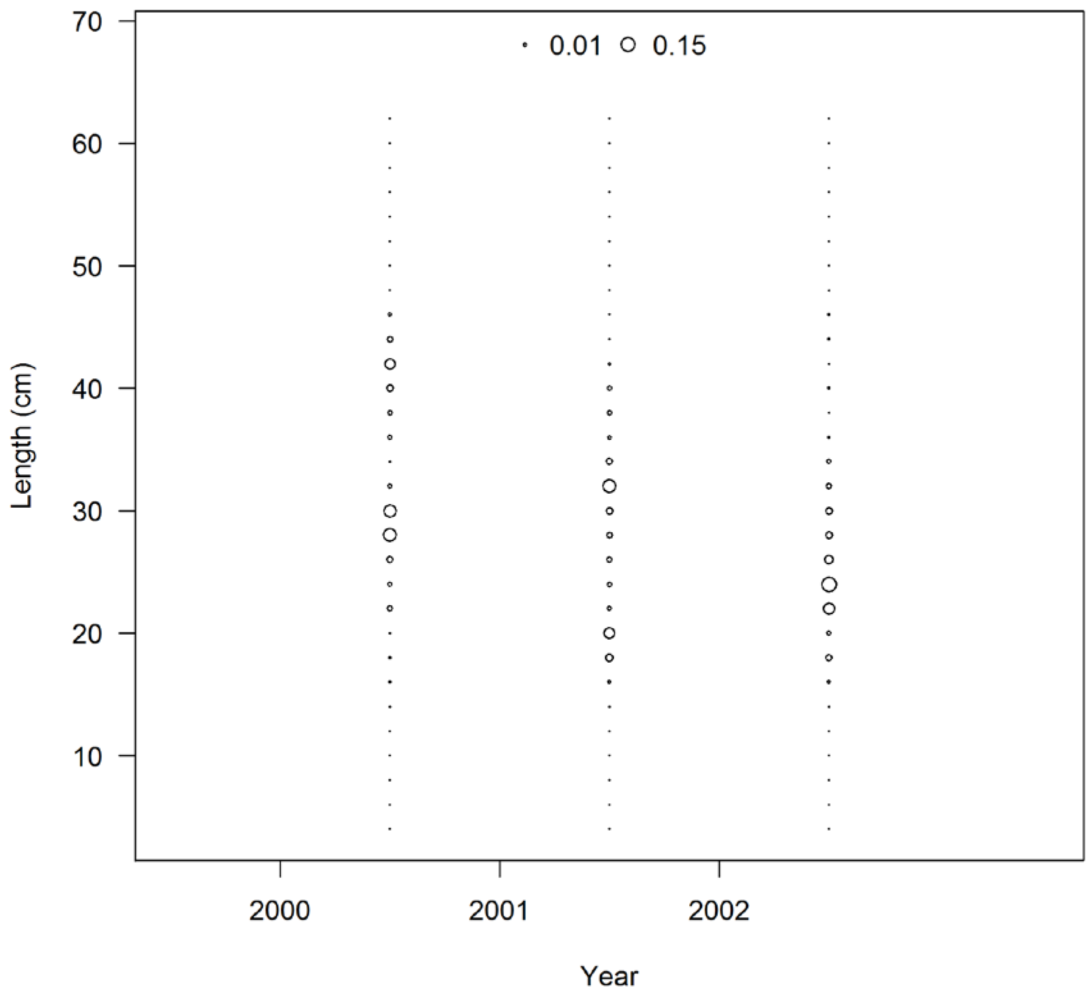

Figure 19: Length-frequency distributions for female darkblotched rockfish from the NWFSC slope survey.

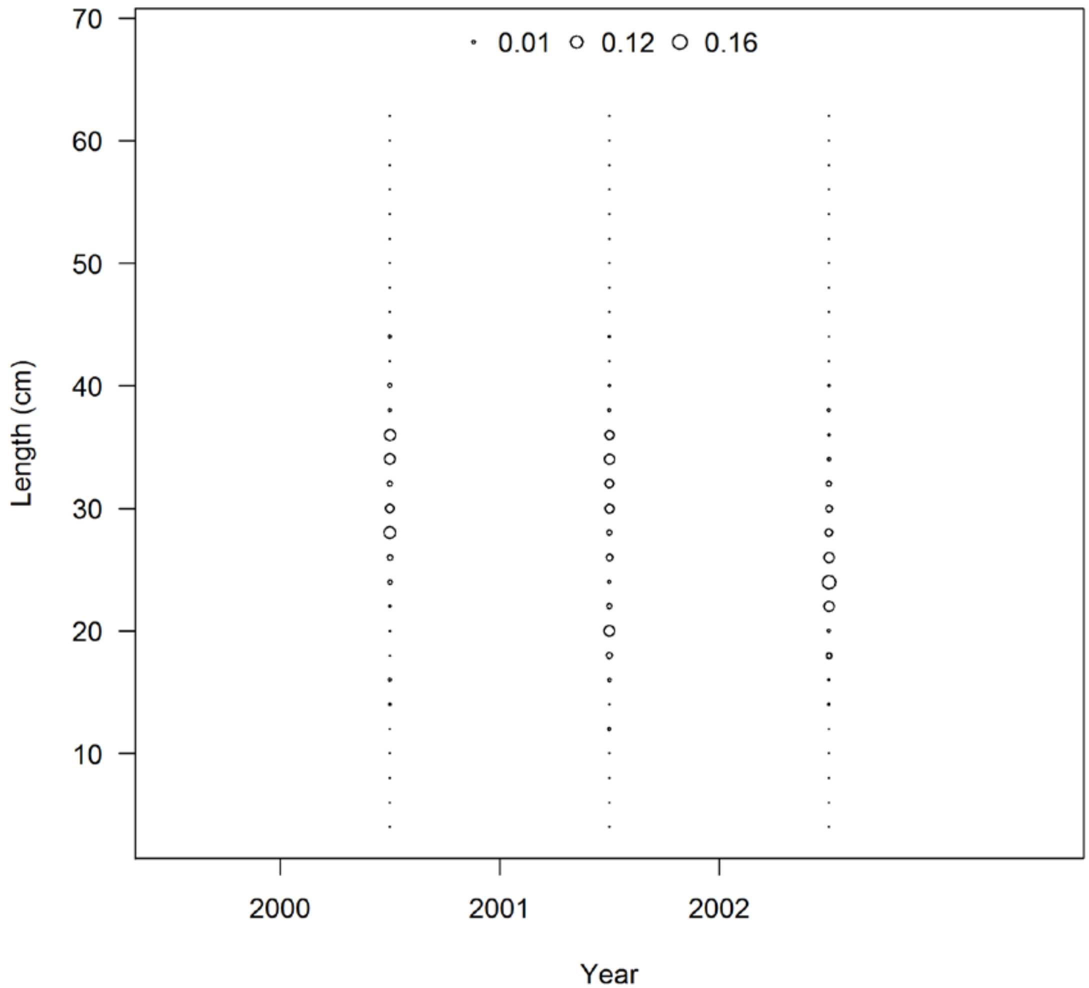

Figure 20: Length-frequency distributions for male darkblotched rockfish from the NWFSC slope survey.

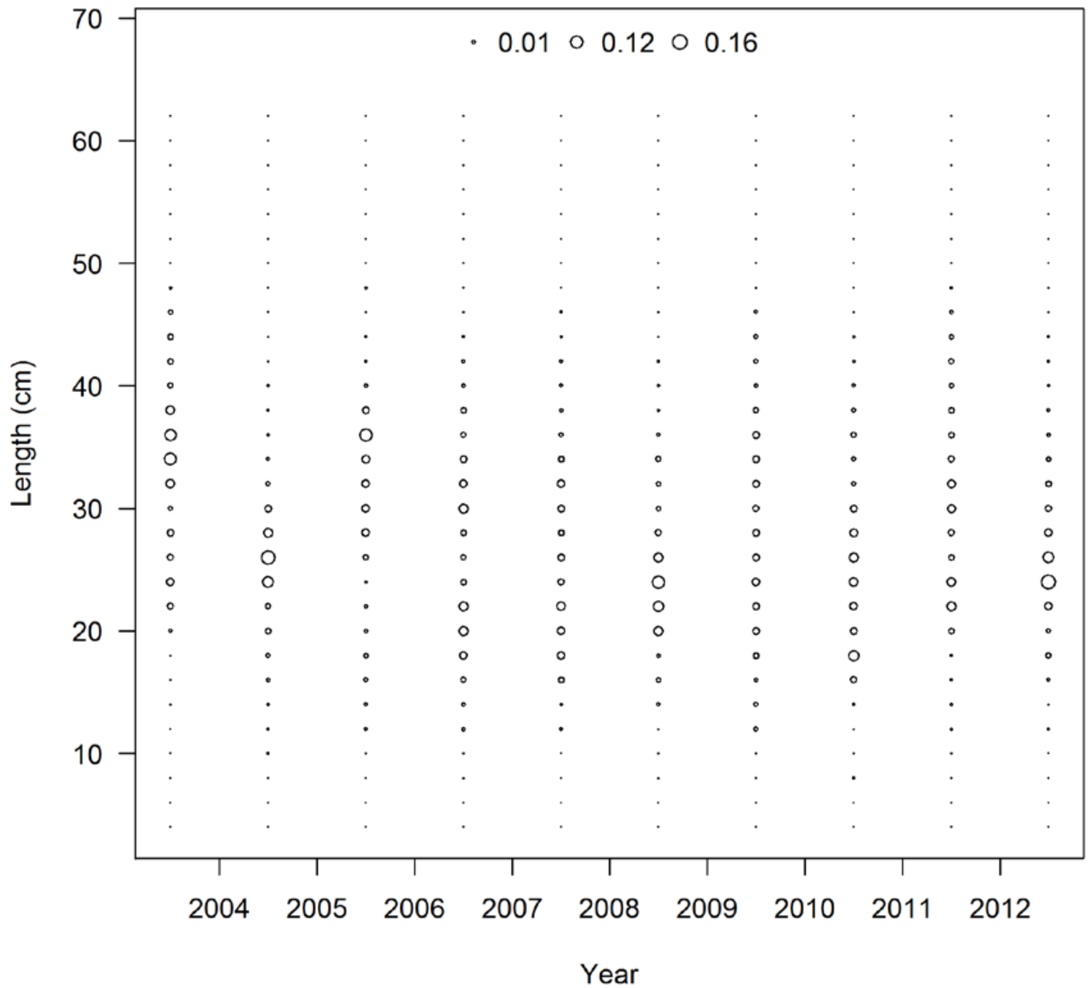

Figure 21: Length-frequency distributions for female darkblotched rockfish from the NWFSC shelf-slope survey.

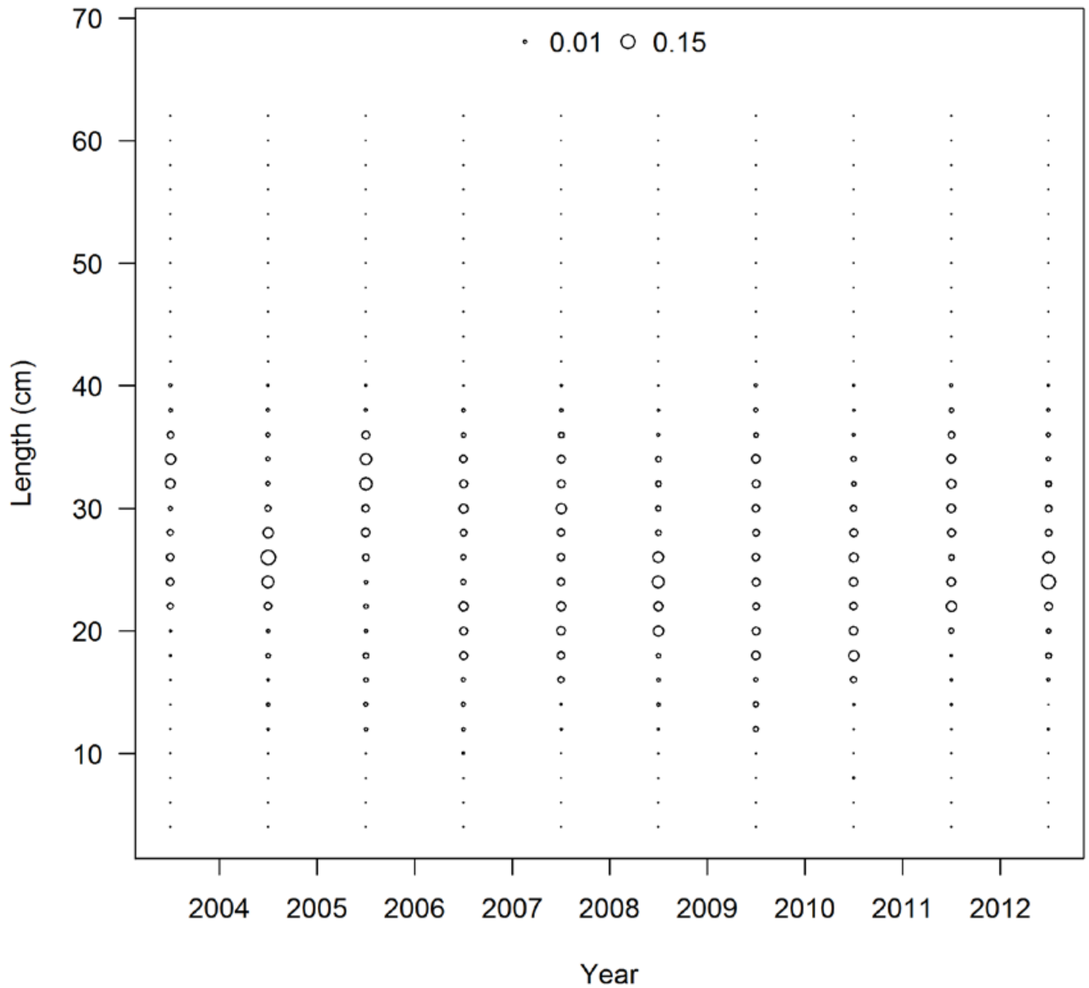

Figure 22: Length-frequency distributions for male darkblotched rockfish from the NWFSC shelf-slope survey.

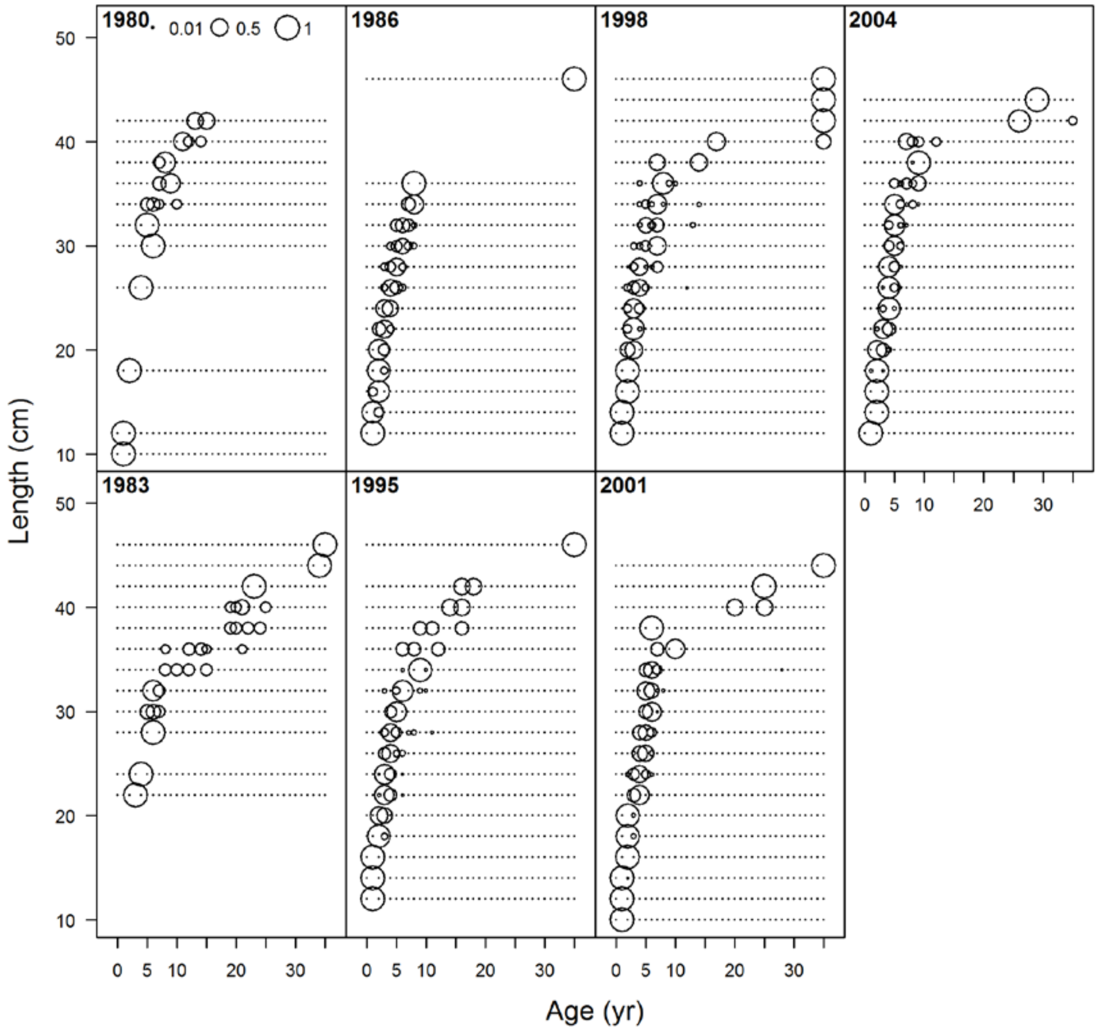

Figure 23: Conditional age-frequency distributions for female darkblotched rockfish from the AFSC shelf survey.

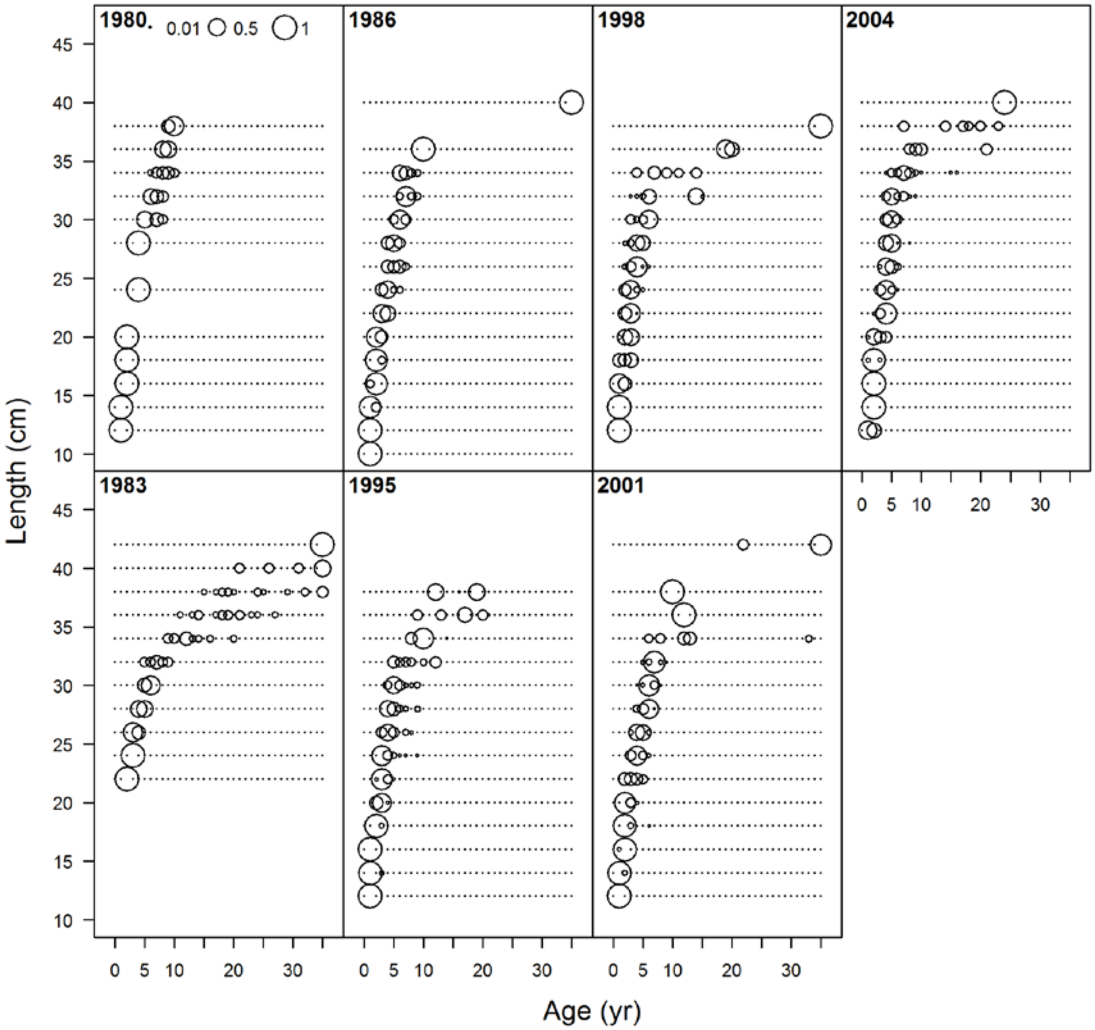

Figure 24: Conditional age-frequency distributions for male darkblotched rockfish from the AFSC shelf survey.

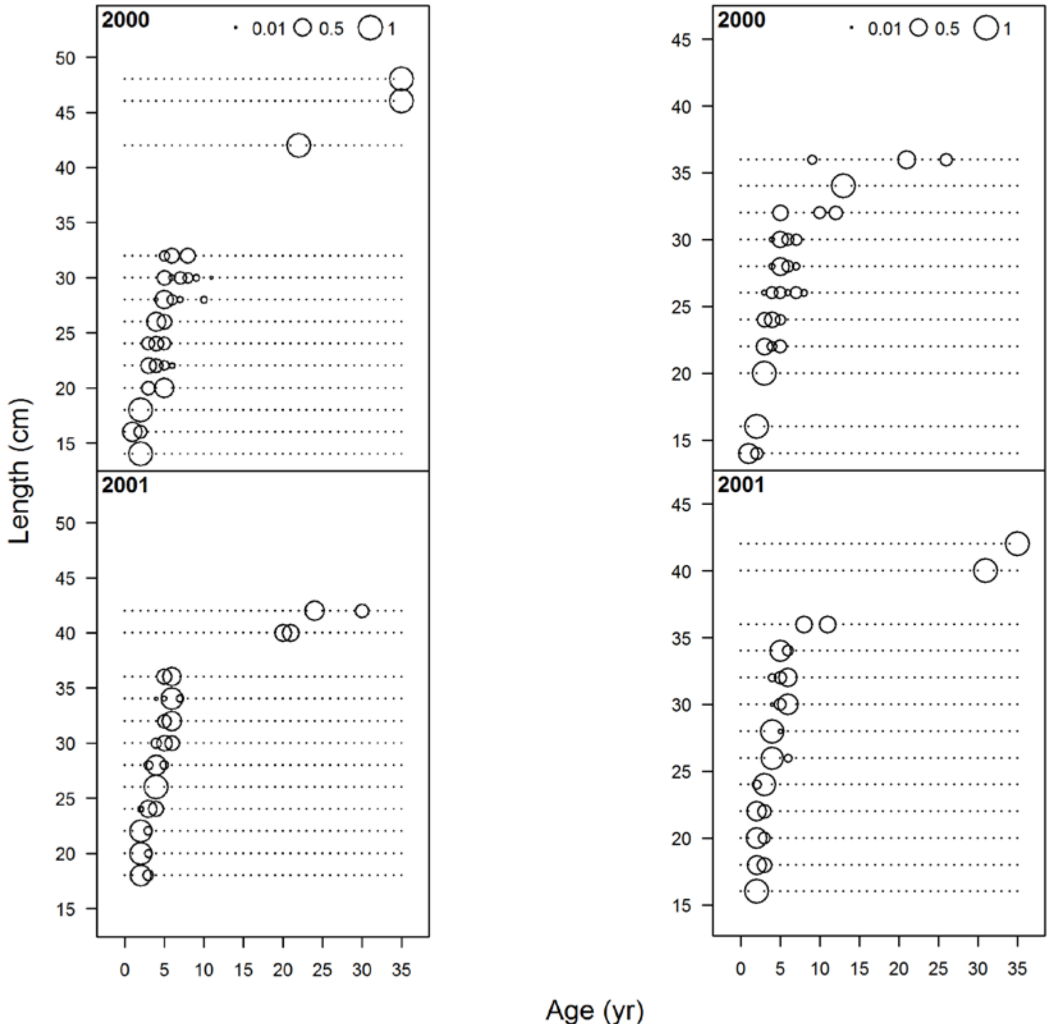

Figure 25: Conditional age-frequency distributions for female (left panel) and male (right panel) darkblotched rockfish from the AFSC slope survey.

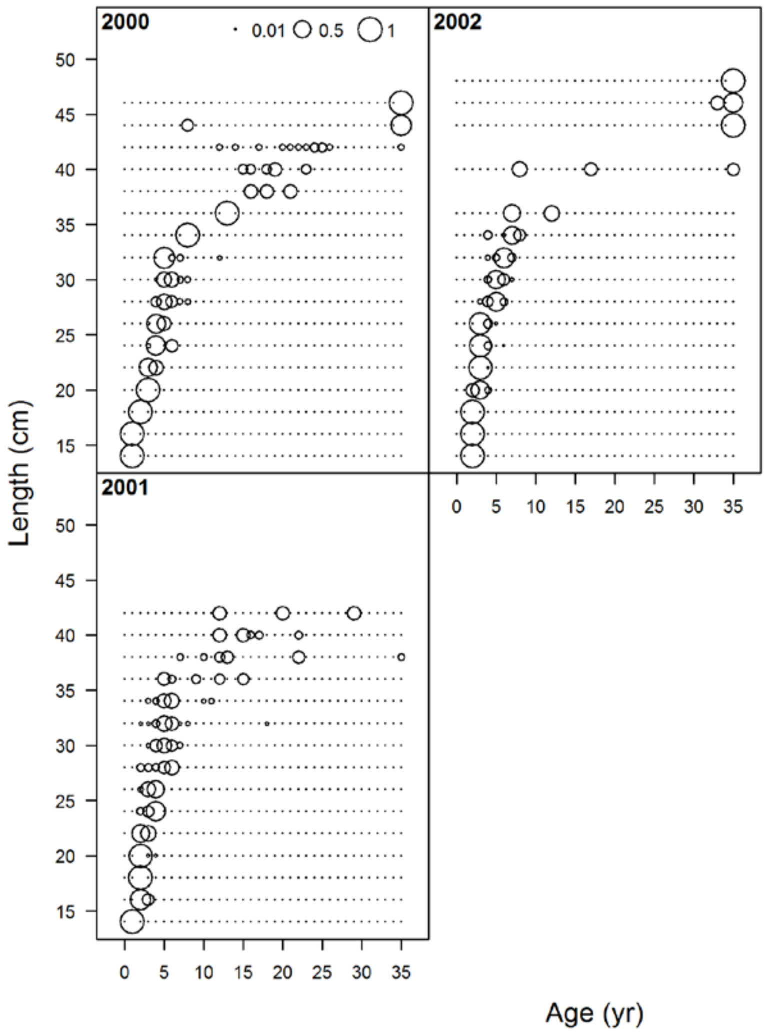

Figure 26: Conditional age-frequency distributions for female darkblotched rockfish from the NWFSC slope survey.

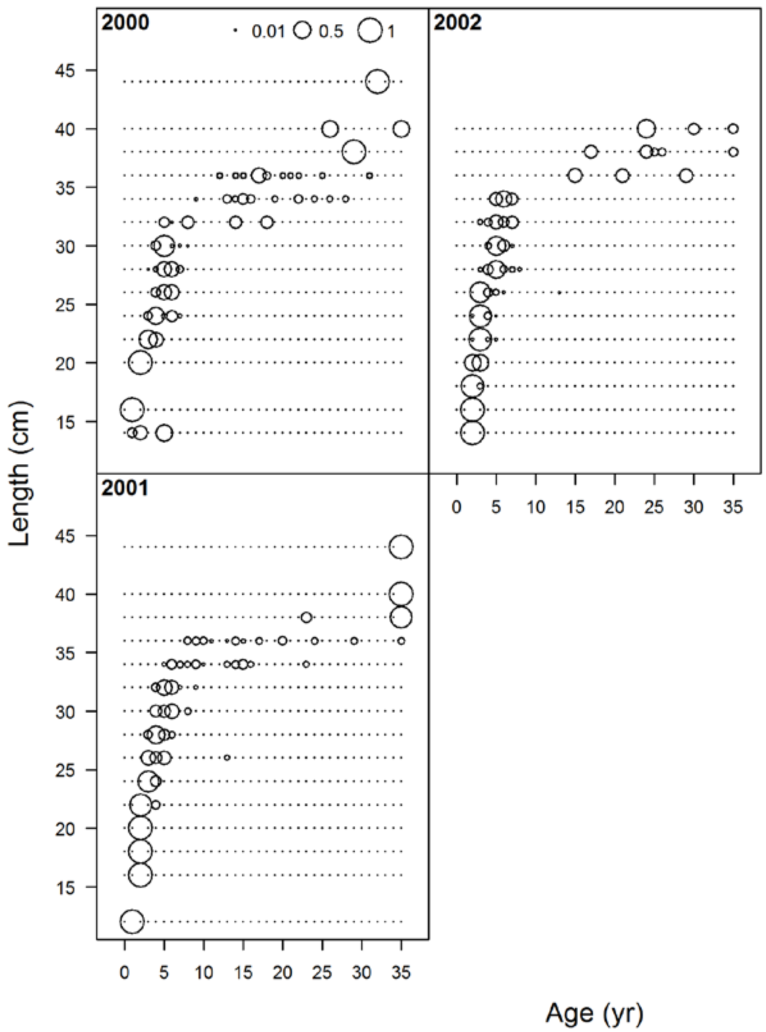

Figure 27: Conditional age-frequency distributions for male darkblotched rockfish from the NWFSC slope survey.

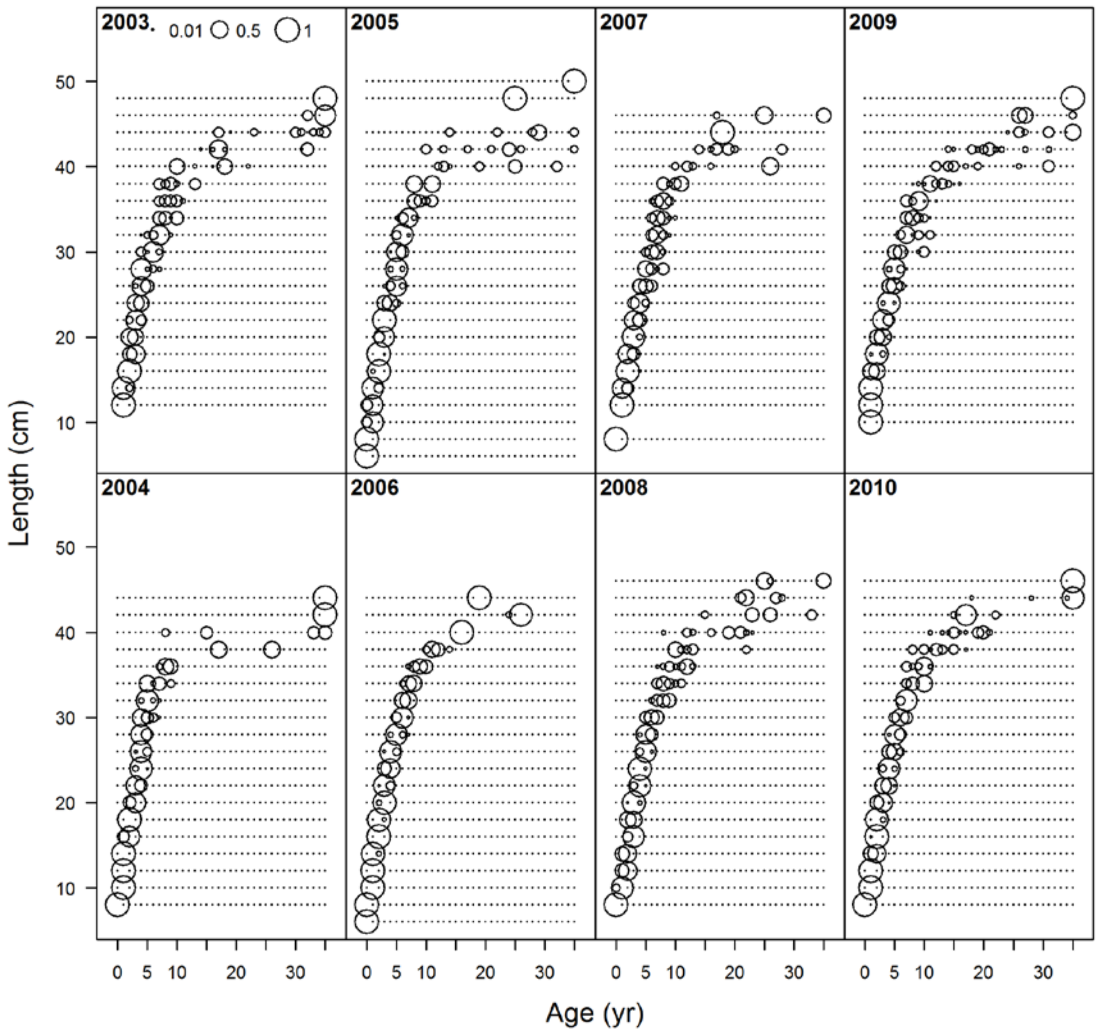

Figure 28: Conditional age-frequency distributions for female darkblotched rockfish from the NWFSC shelf-slope survey.

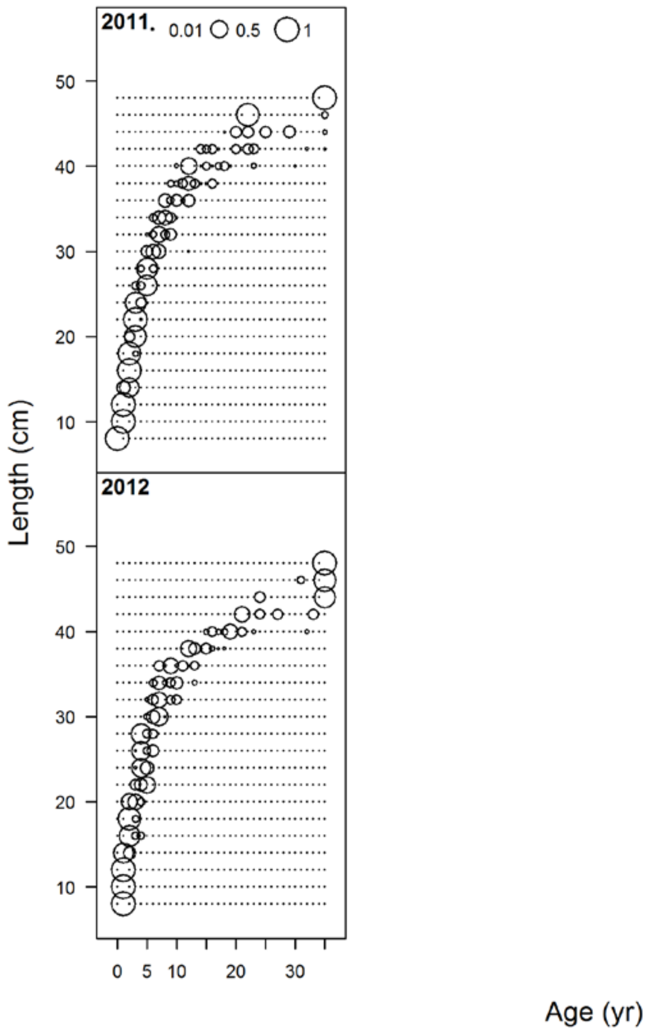

Figure 28 (continued): Conditional age-frequency distributions for female darkblotched rockfish from the NWFSC shelf-slope survey.

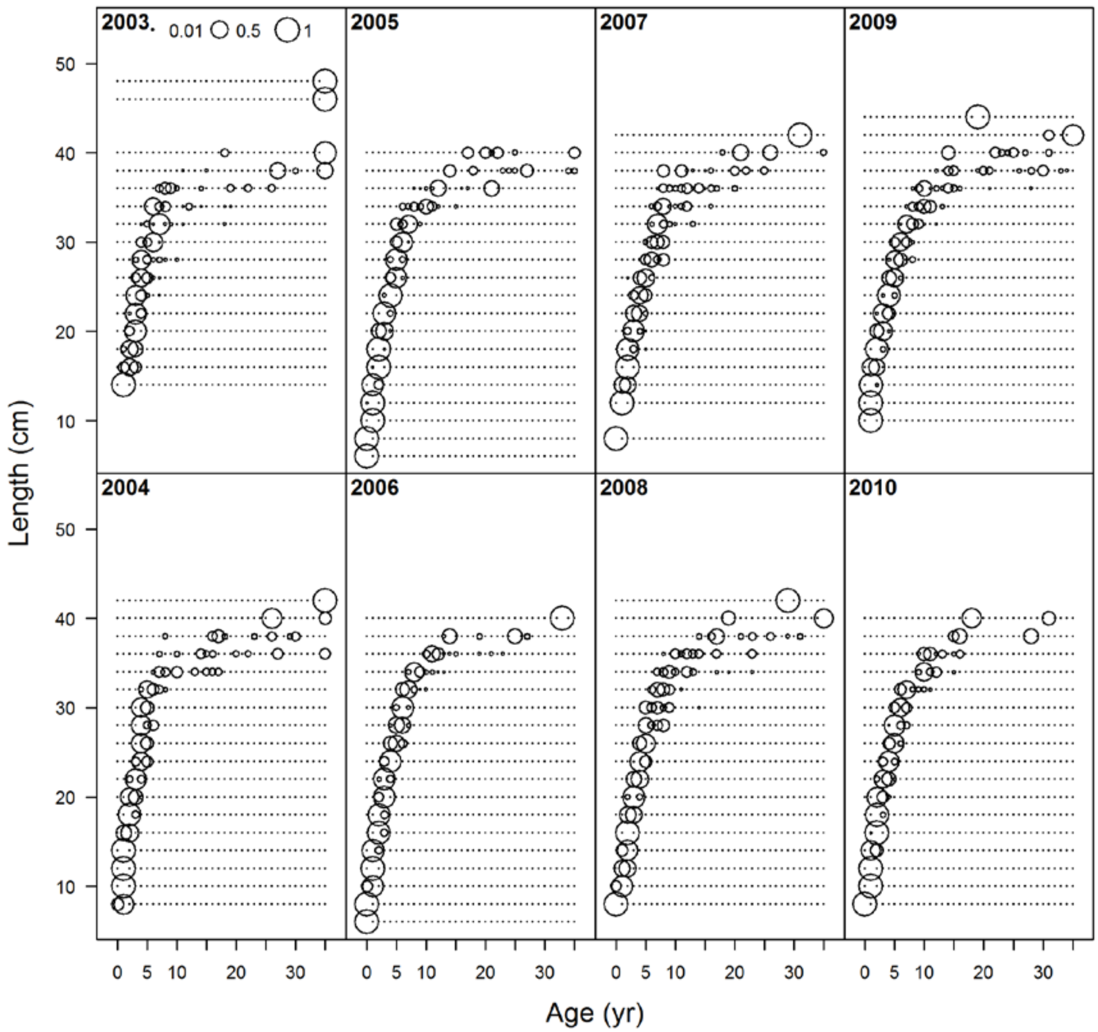

Figure 29: Conditional age-frequency distributions for male darkblotched rockfish from the NWFSC shelf-slope survey.

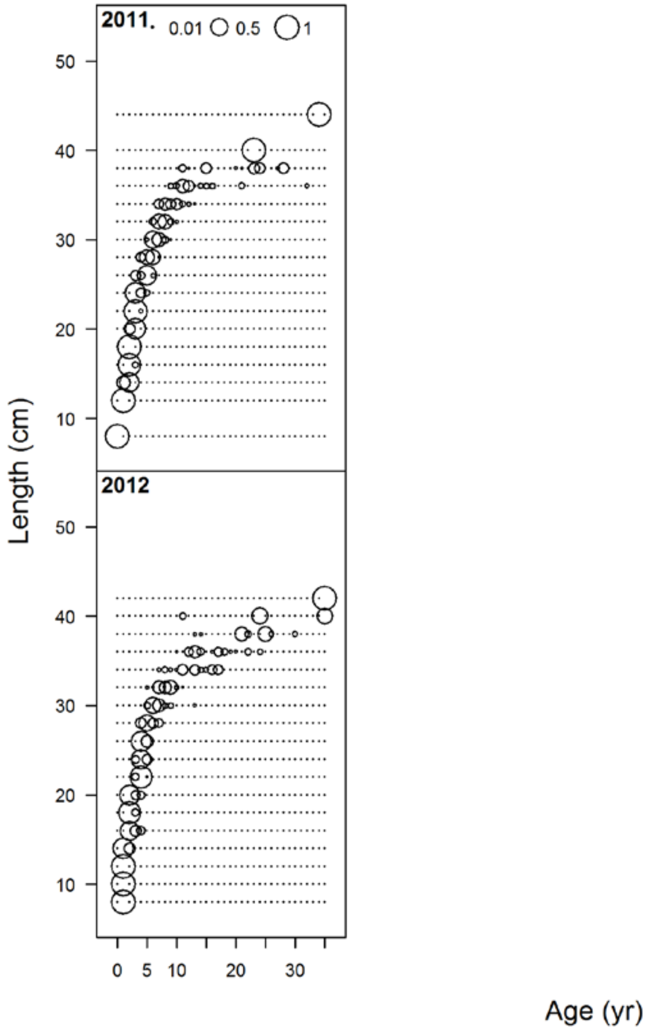

Figure 29 (continued): Conditional age-frequency distributions for male darkblotched rockfish from the NWFSC shelf-slope survey.

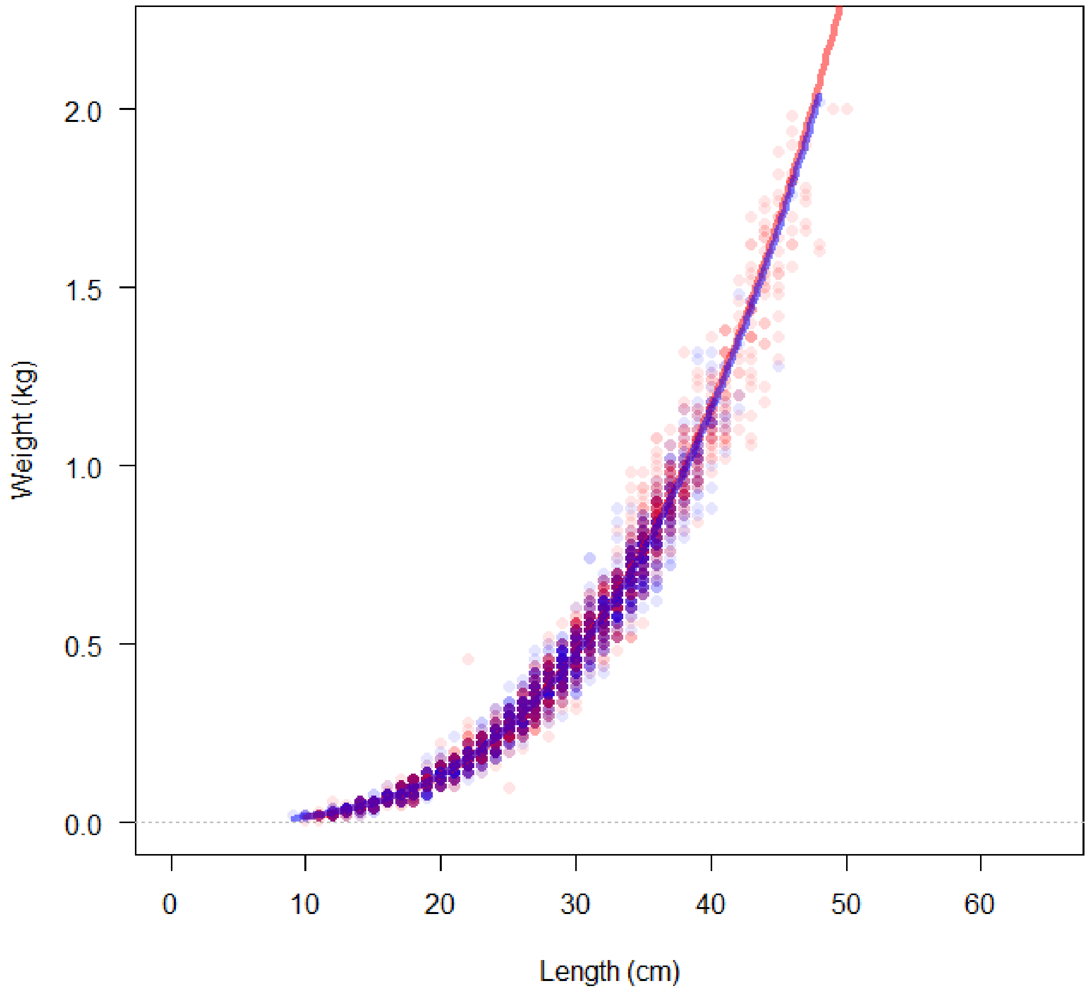

Figure 30: Weight-length relationship for female (red) and male (blue) darkblotched rockfish used in the assessment, shown with fit to the data from the NWFSC shelf-slope survey samples (shaded points).

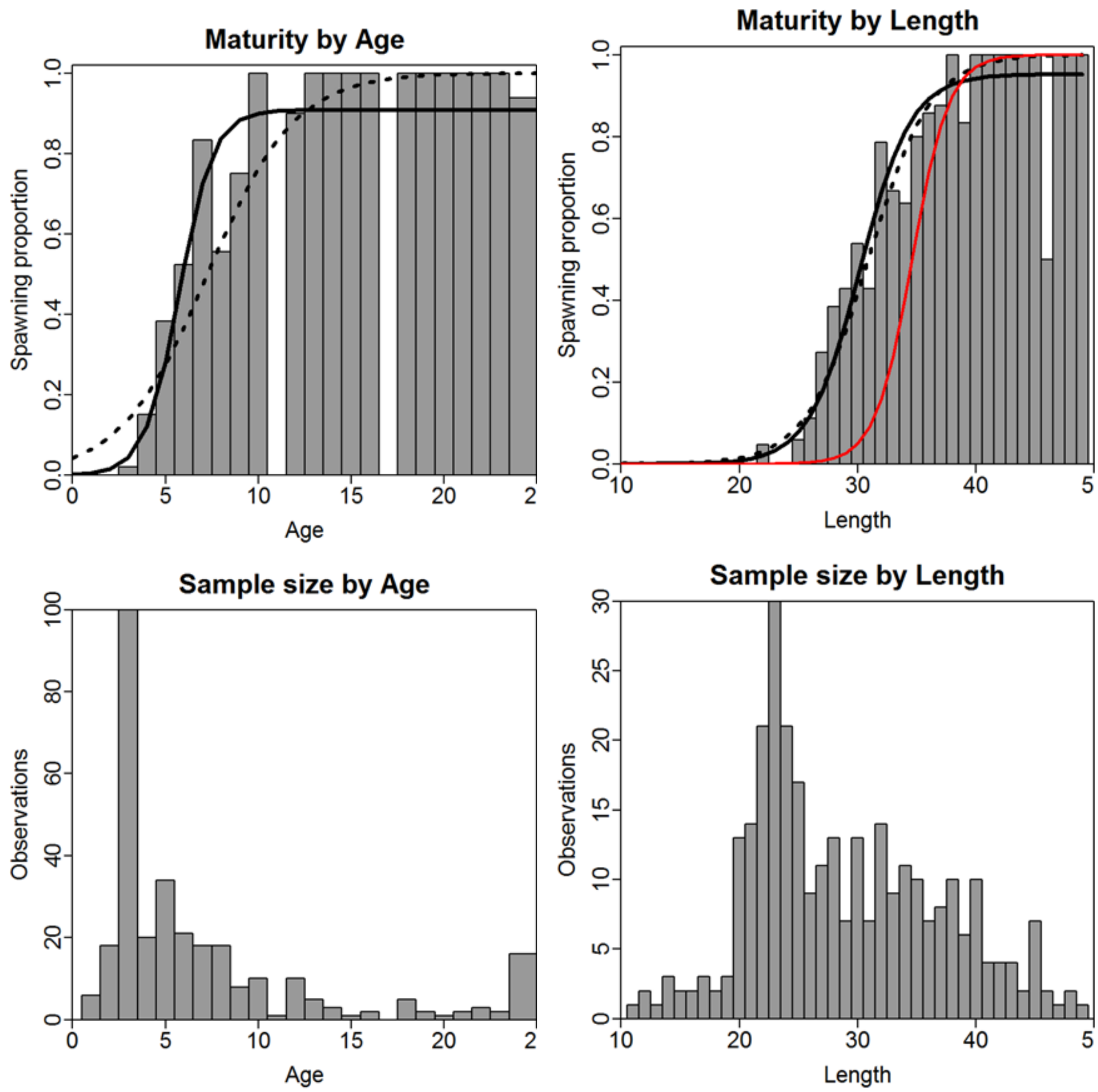

Figure 31: Maturity-at-age (left column) relationship for female darkblotched rockfish used in the assessment, shown with fit to the data from the NWFSC shelf-slope survey samples using a three-parameter (black line) and two-parameter (dashed line) model (top row) and the data availability by age (bottom row), and maturity-at-length (right column) relationship estimated using these same data (displayed identically to maturity at age except the addition red line shows the maturity-at-length schedule from the 2011 assessment).

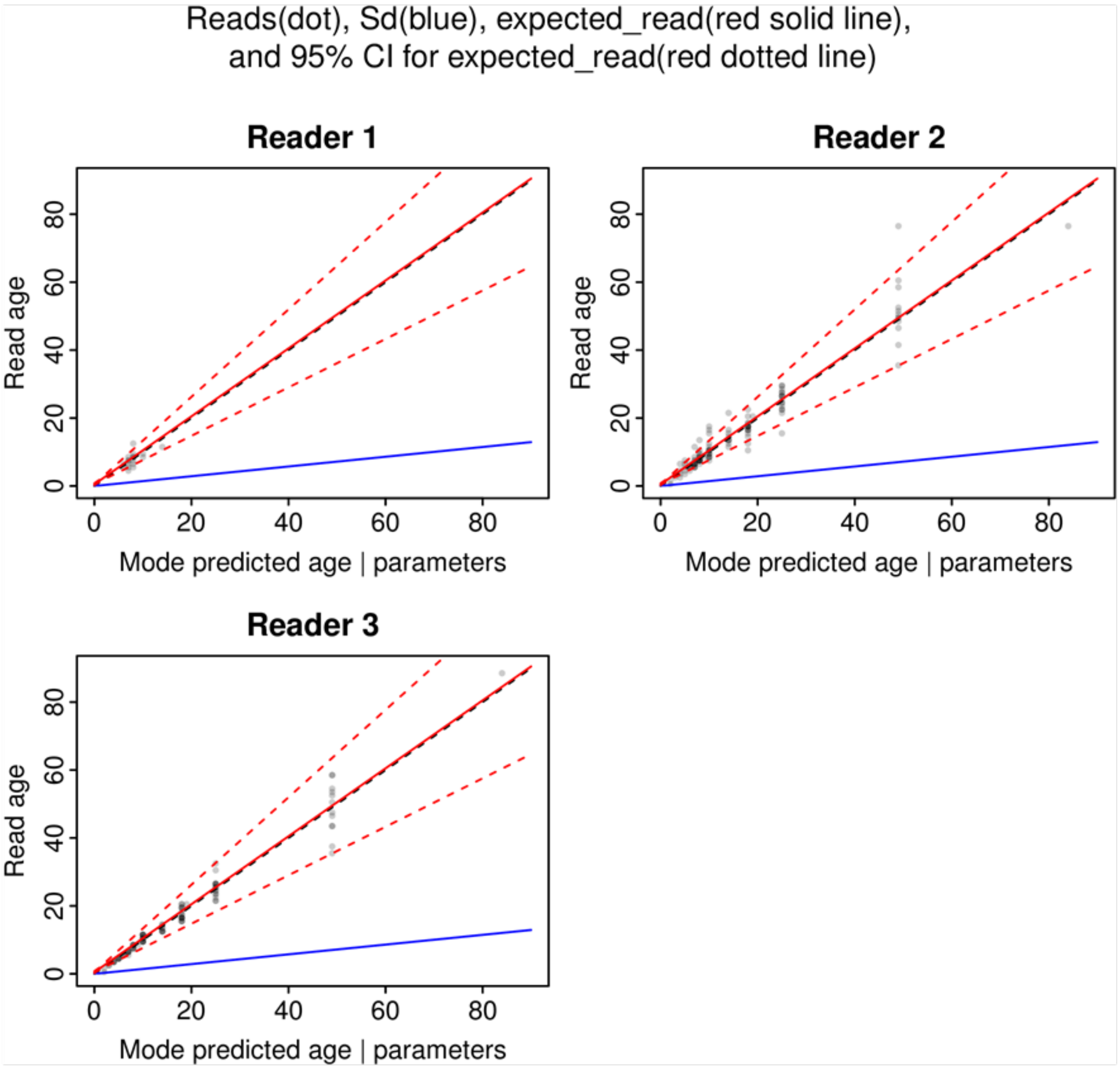

Figure 32: Ageing error figure for “early” reads (Reader 3 is recent re-reads of otoliths that were read prior to 2005, and hence is specified as unbiased).

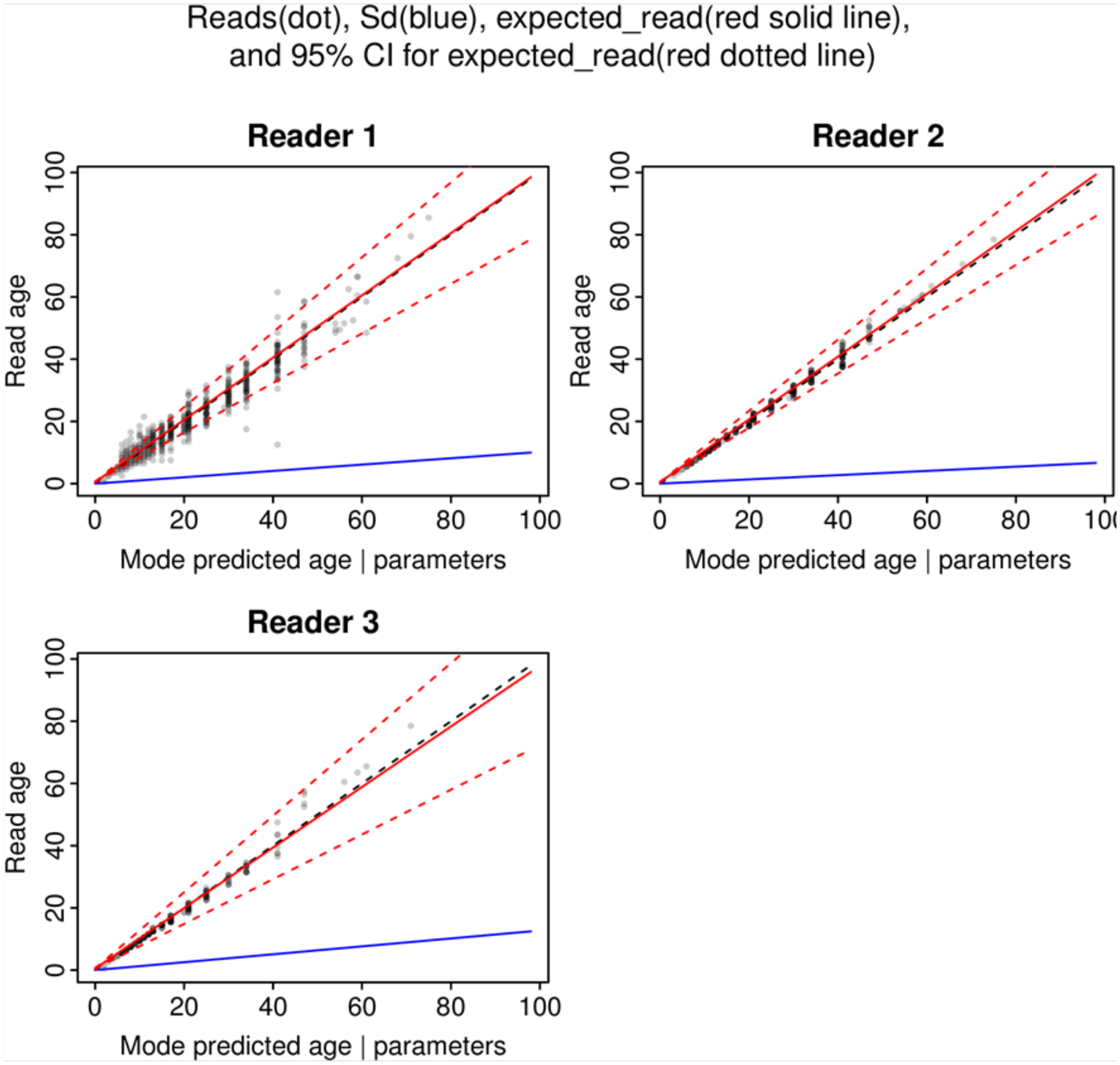

Figure 33: Ageing error figure for "late" reads (where Reader 1 is the reader of retained compositional data after 2005, and is believed *a priori* to be unbiased, while bias and imprecision are estimated separately for Readers 2-3).

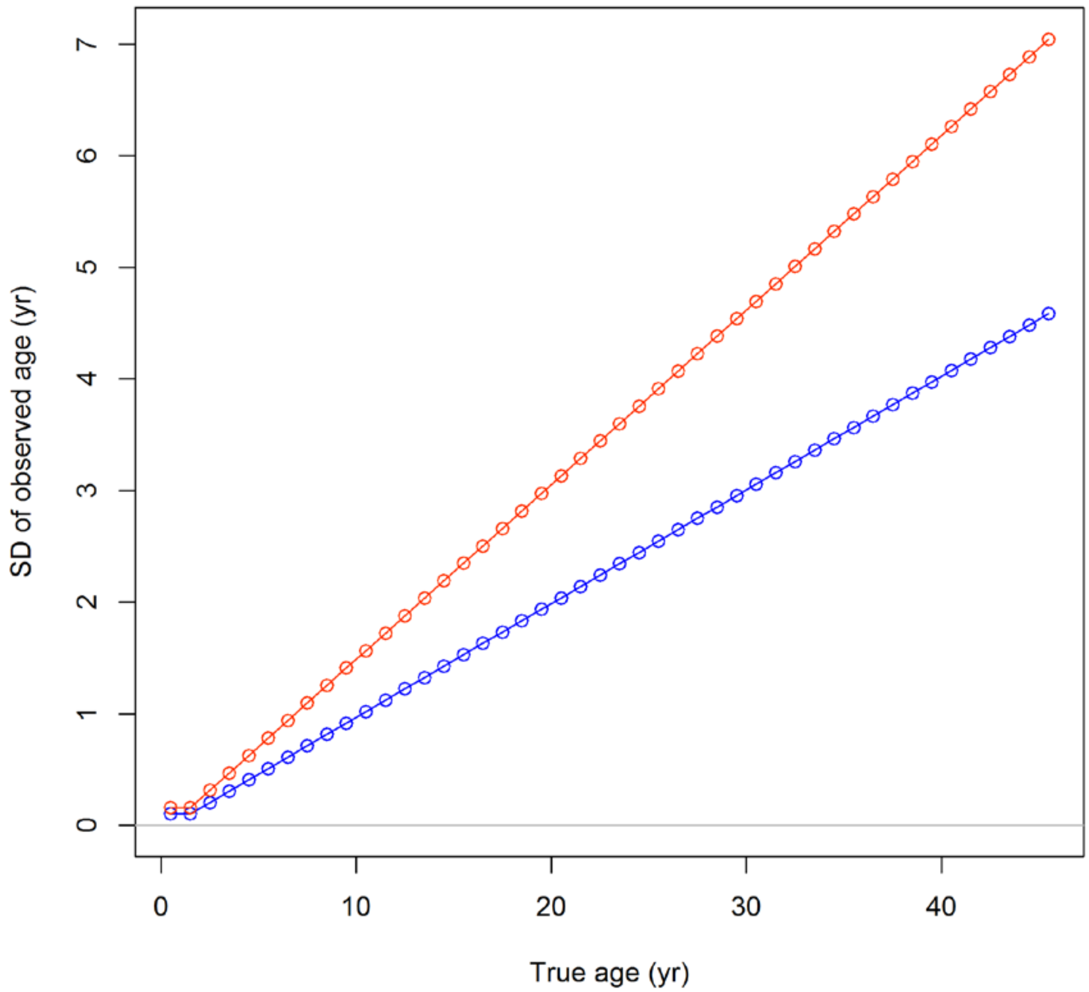

Figure 34: SD of observed age versus true age for “early” (red) and “late” (blue) age data used in the assessment.

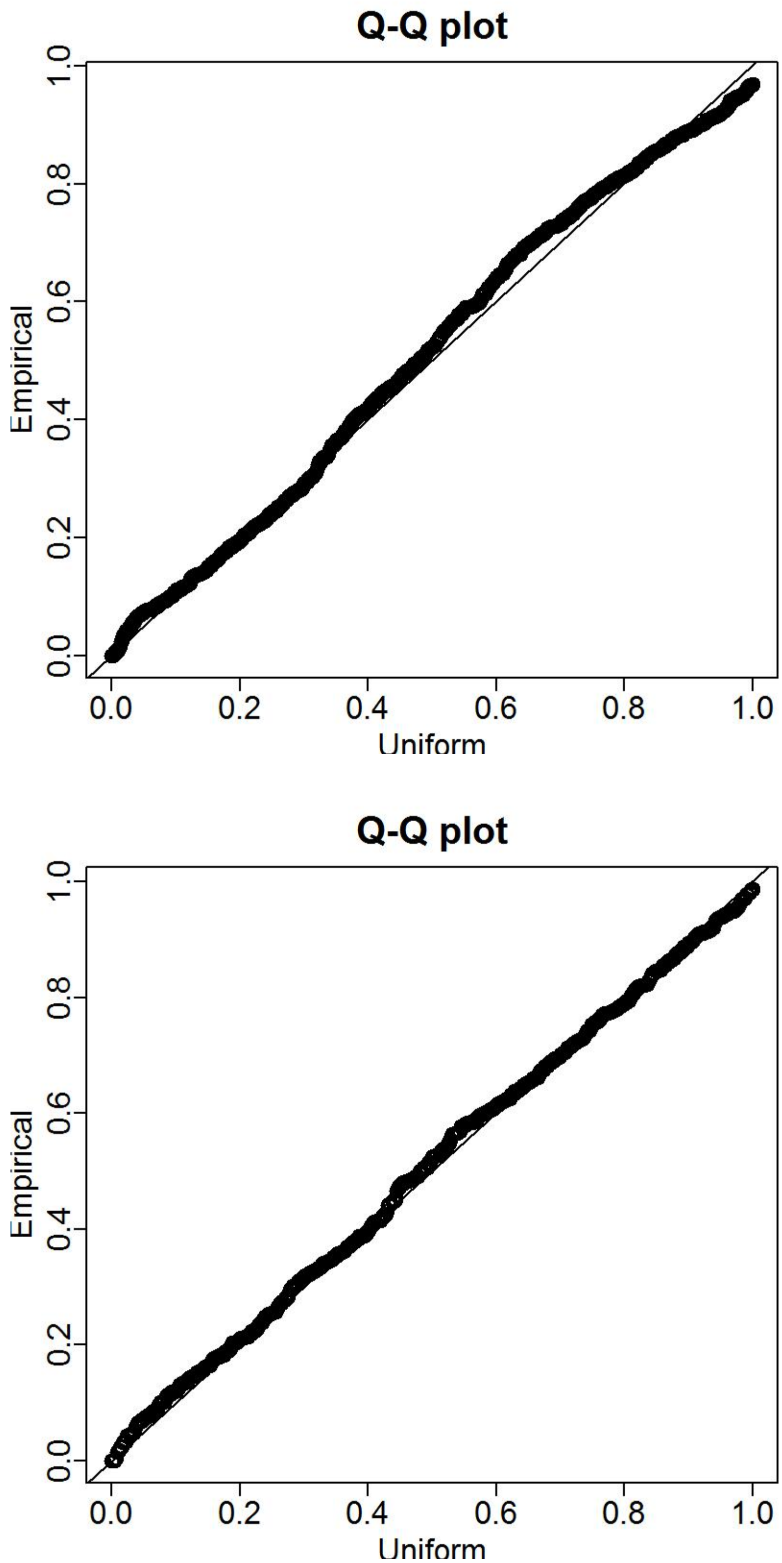

Figure 35: Bayesian Q-Q plot for AFSC shelf survey for 1980-1992 (upper panel) and 1995-2004 (lower panel).

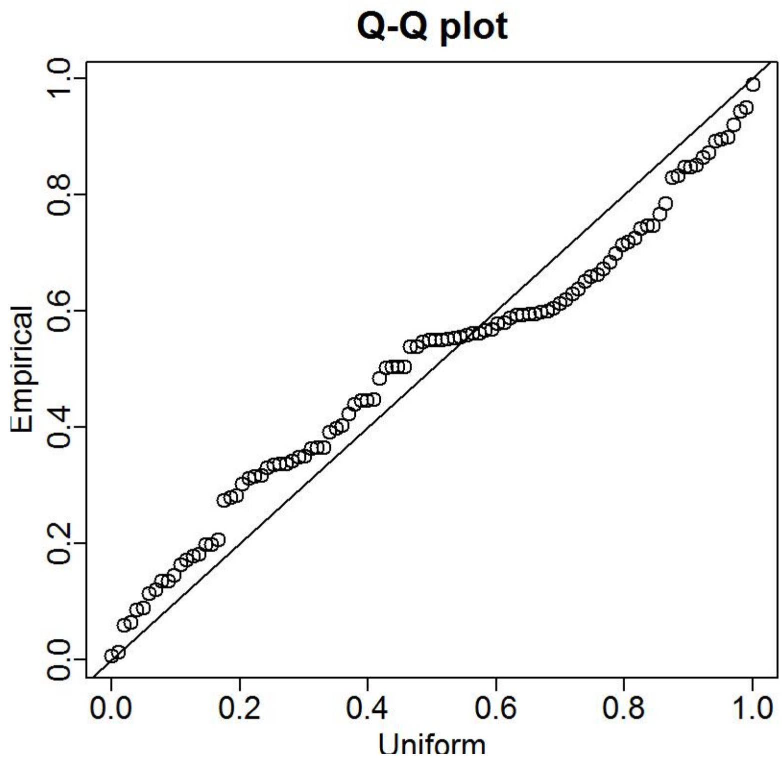

Figure 36: Bayesian Q-Q plot for AFSC slope survey.

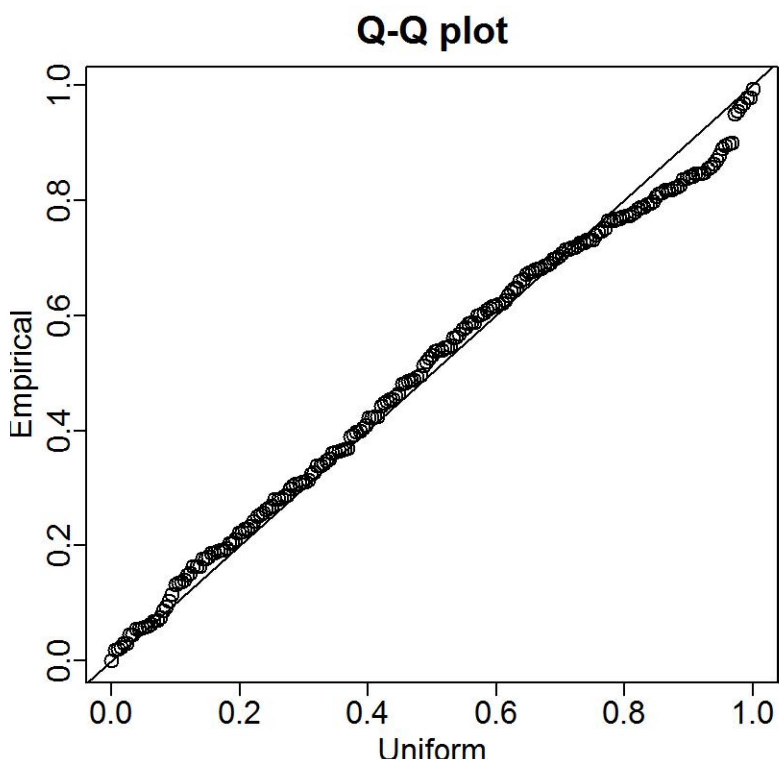

Figure 37: Bayesian Q-Q plot for NWFSC slope survey.

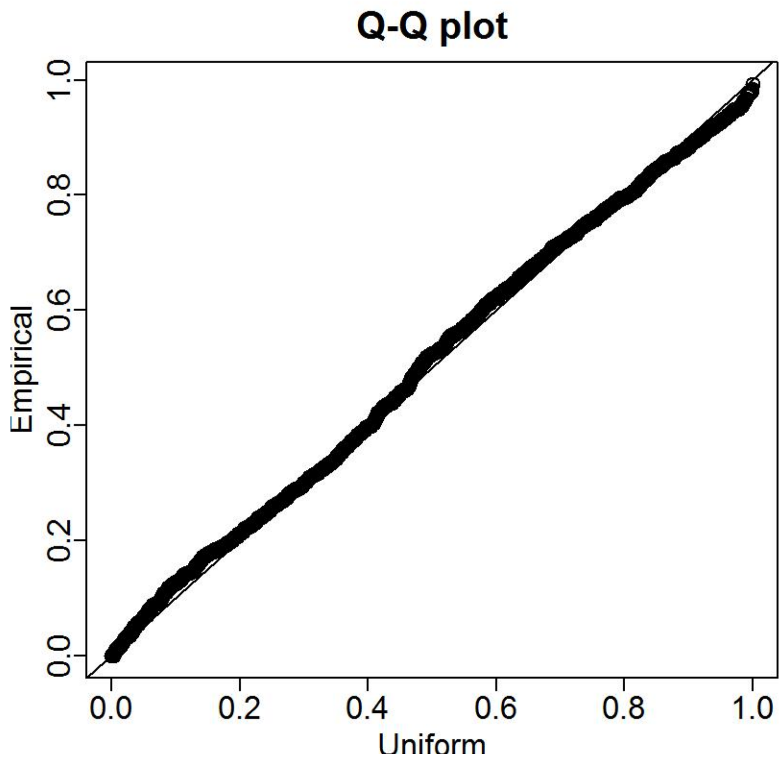

Figure 38: Bayesian Q-Q plot for NWFSC shelf-slope survey.

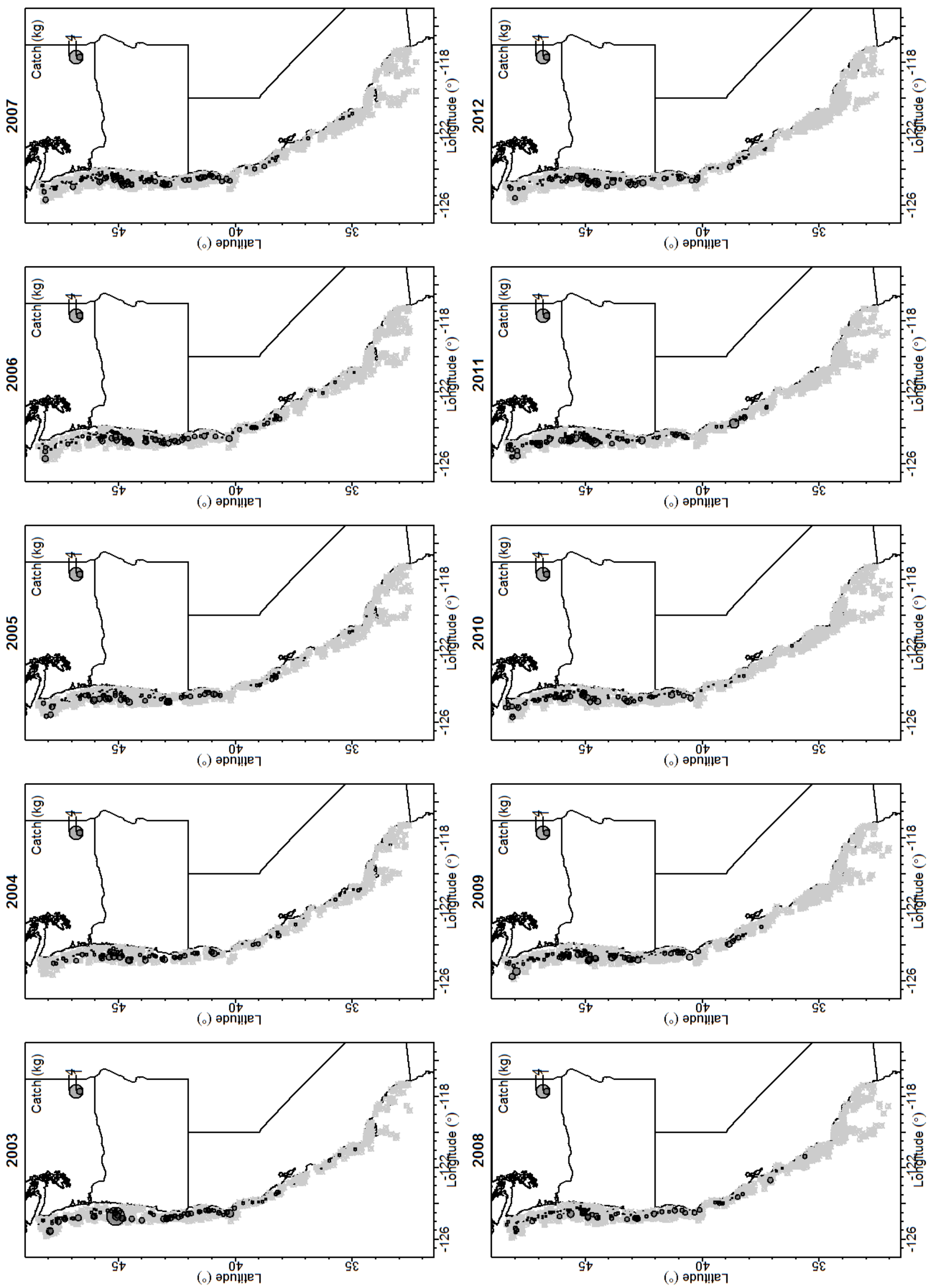

Figure 39: Distribution of darkblotched rockfish catch by haul observed within the NWFSC shelf-slope survey, by year and latitude.

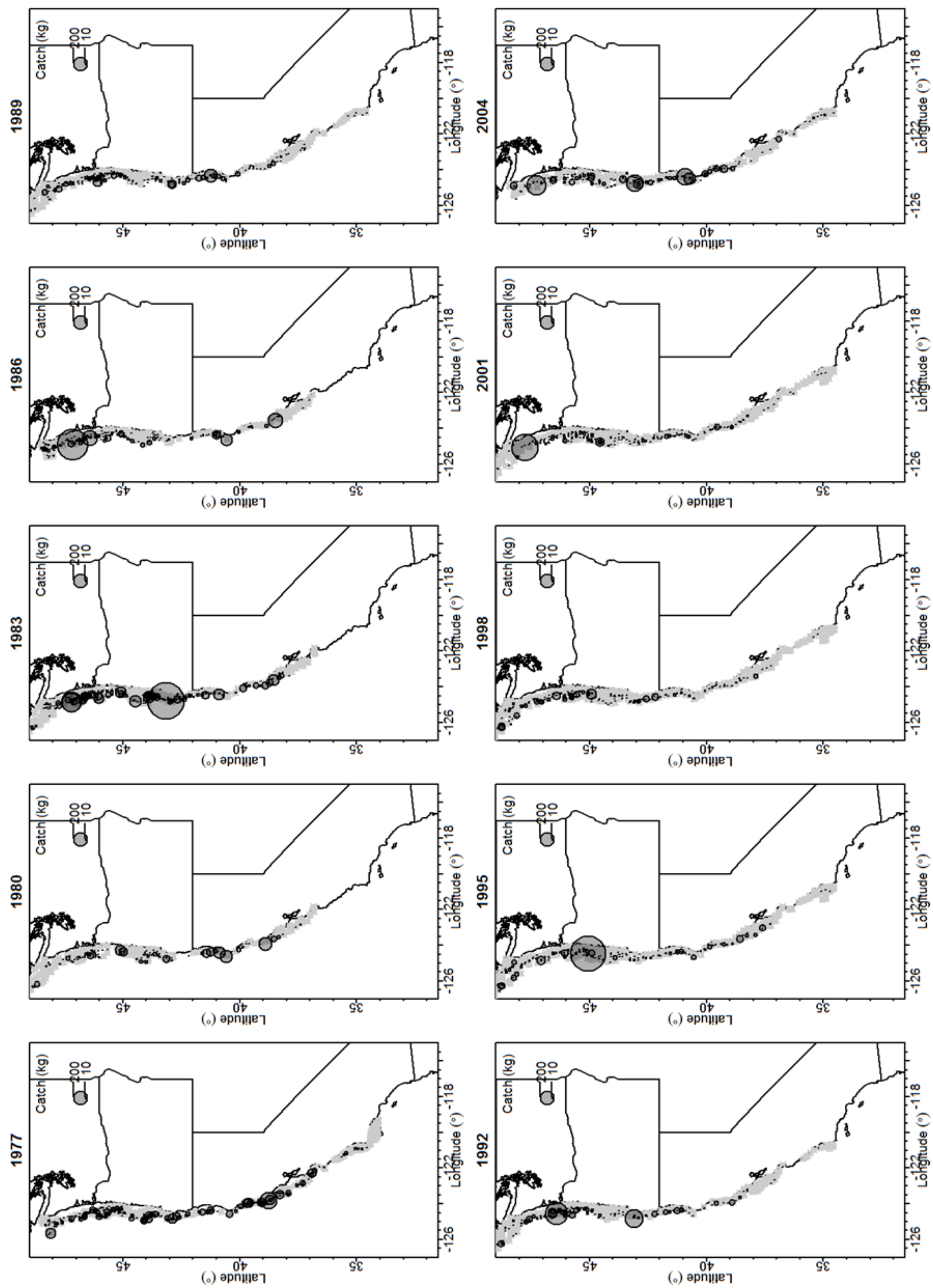

Figure 40: Distribution of darkblotched rockfish catch by haul observed within the AFSC triennial shelf survey, by year and latitude.

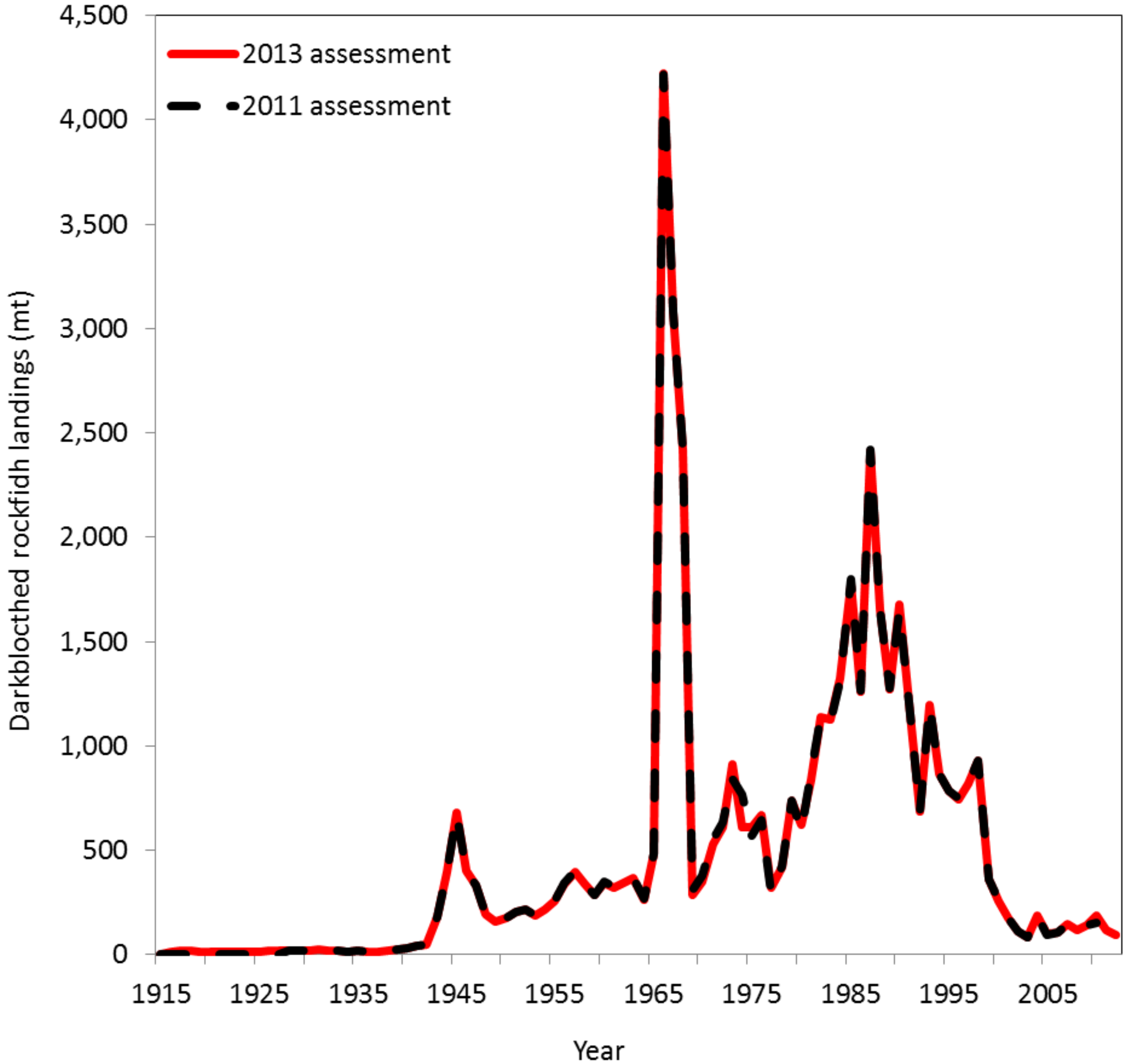

Figure 41: Time series of darkblotched rockfish landings used in this and 2011 assessments.

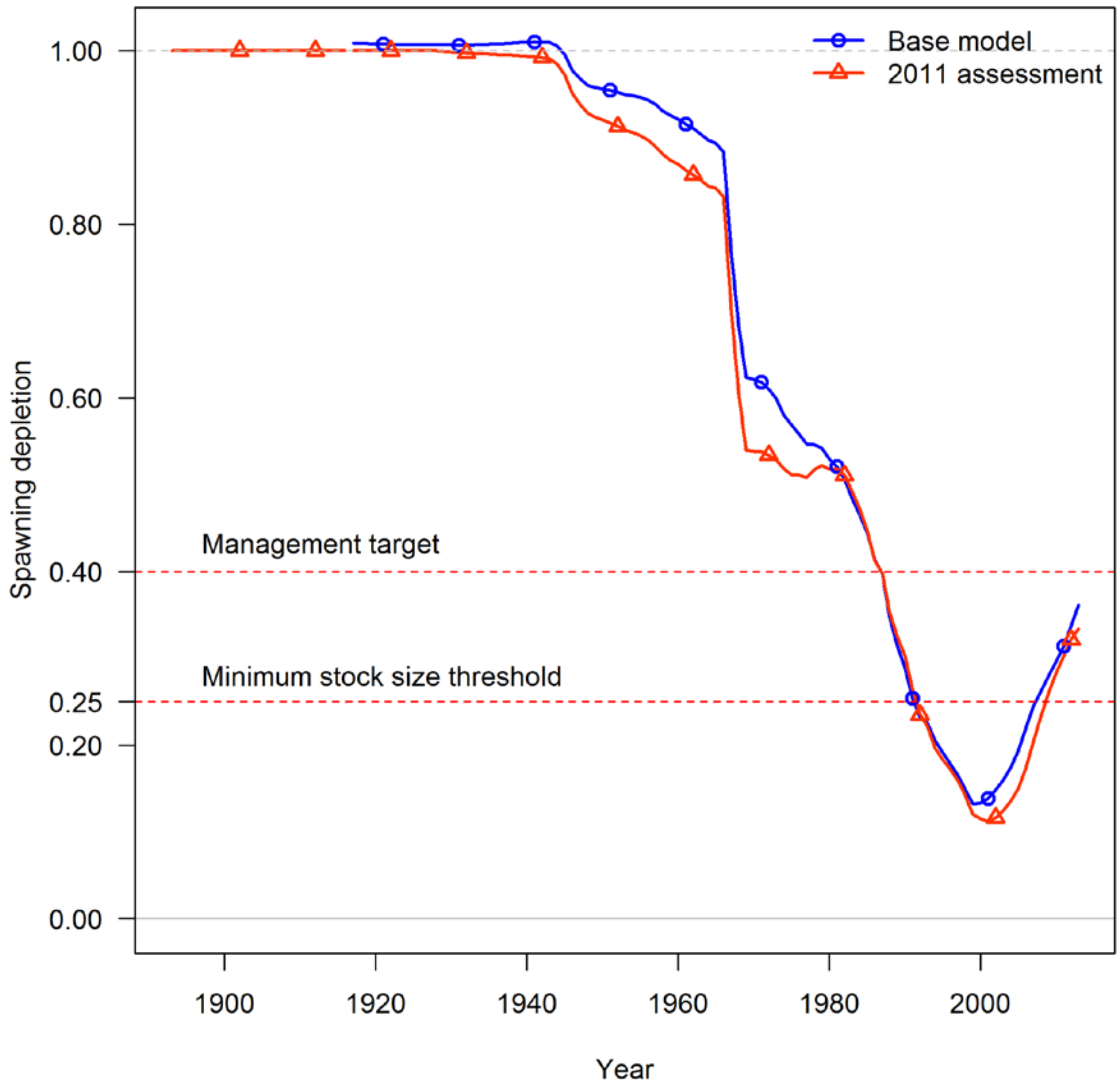

Figure 42: Time series of spawning depletion from this and 2011 assessments.

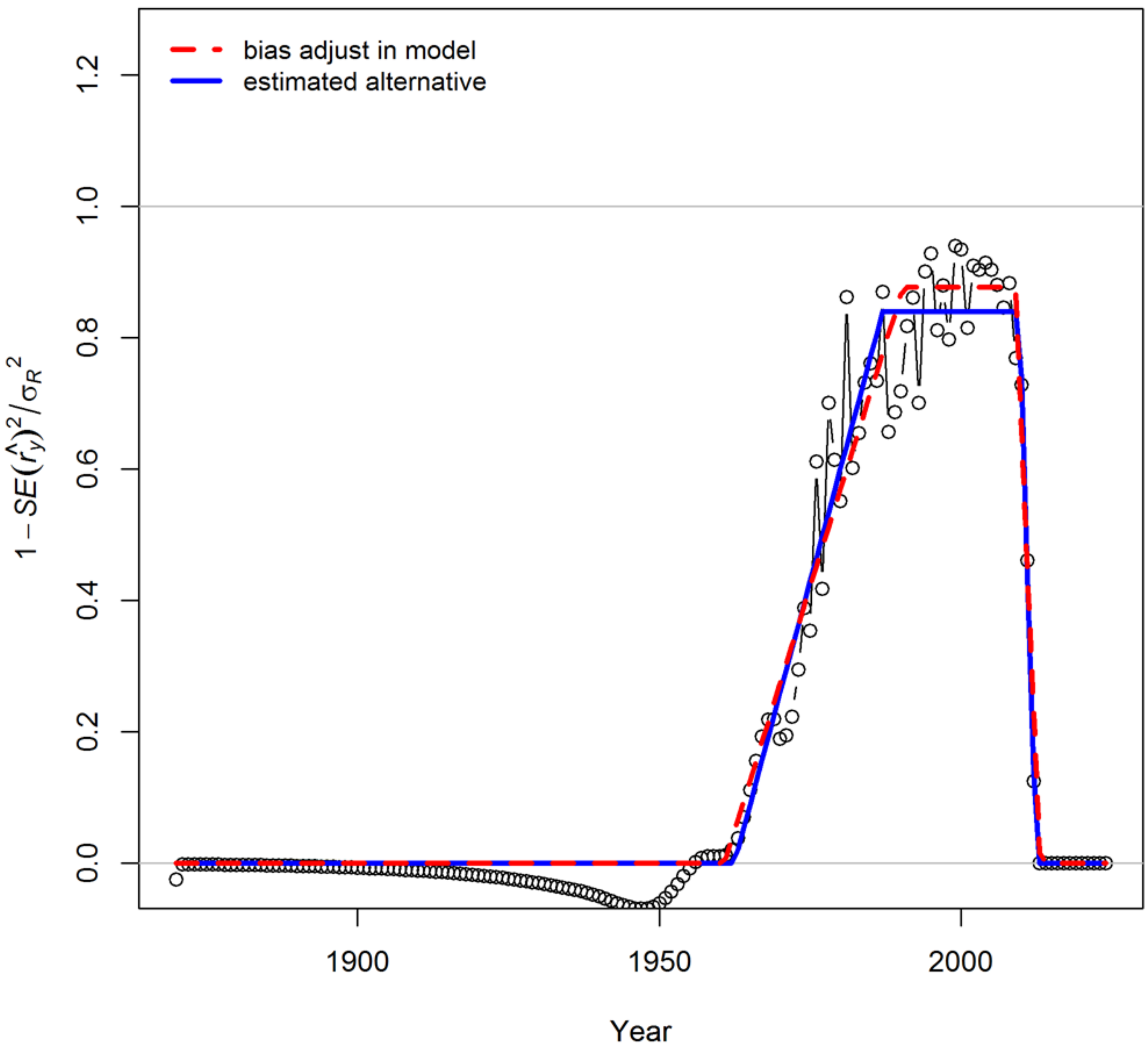

Figure 43: Bias correction ramp estimated by R4SS using particle swarm optimization to avoid local minima.

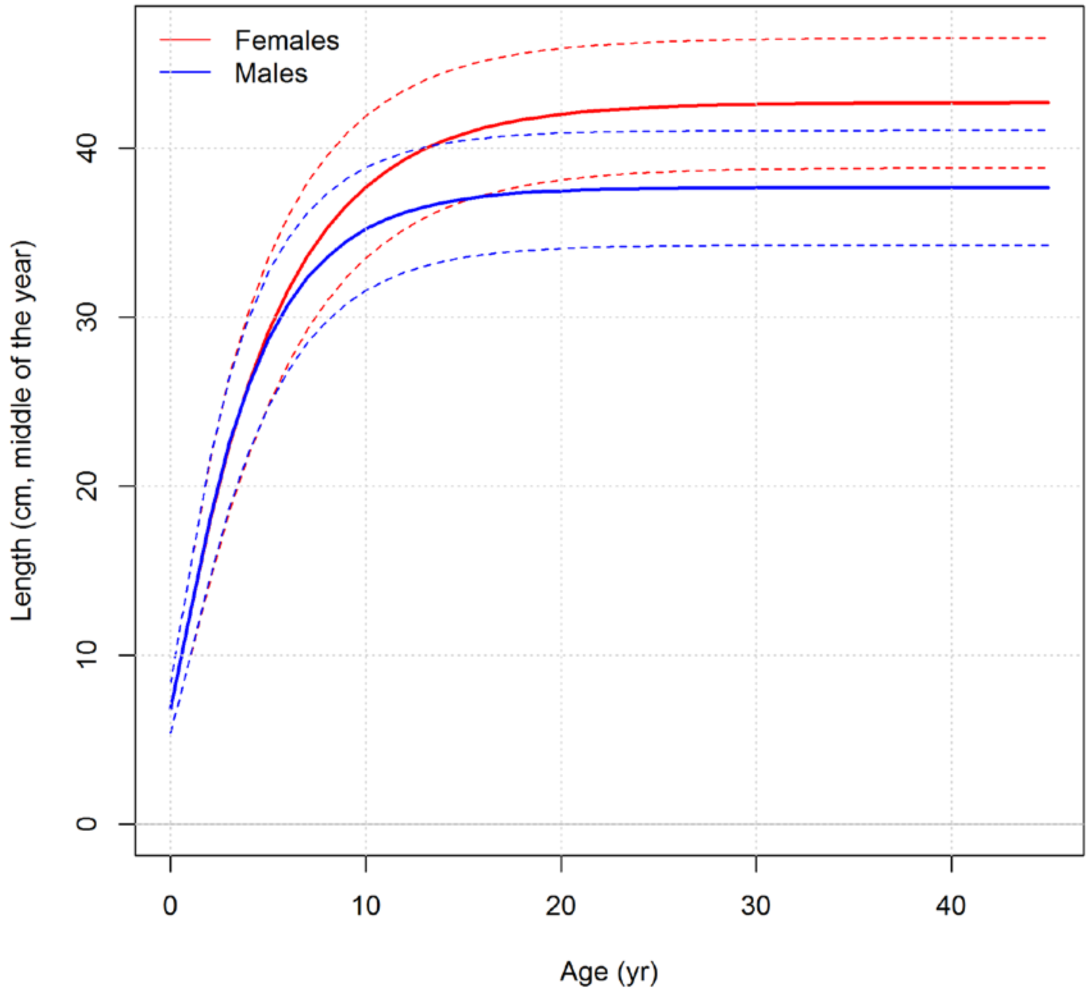

Figure 44: Growth curves for females and males of darkblotched rockfish used in the assessment model.

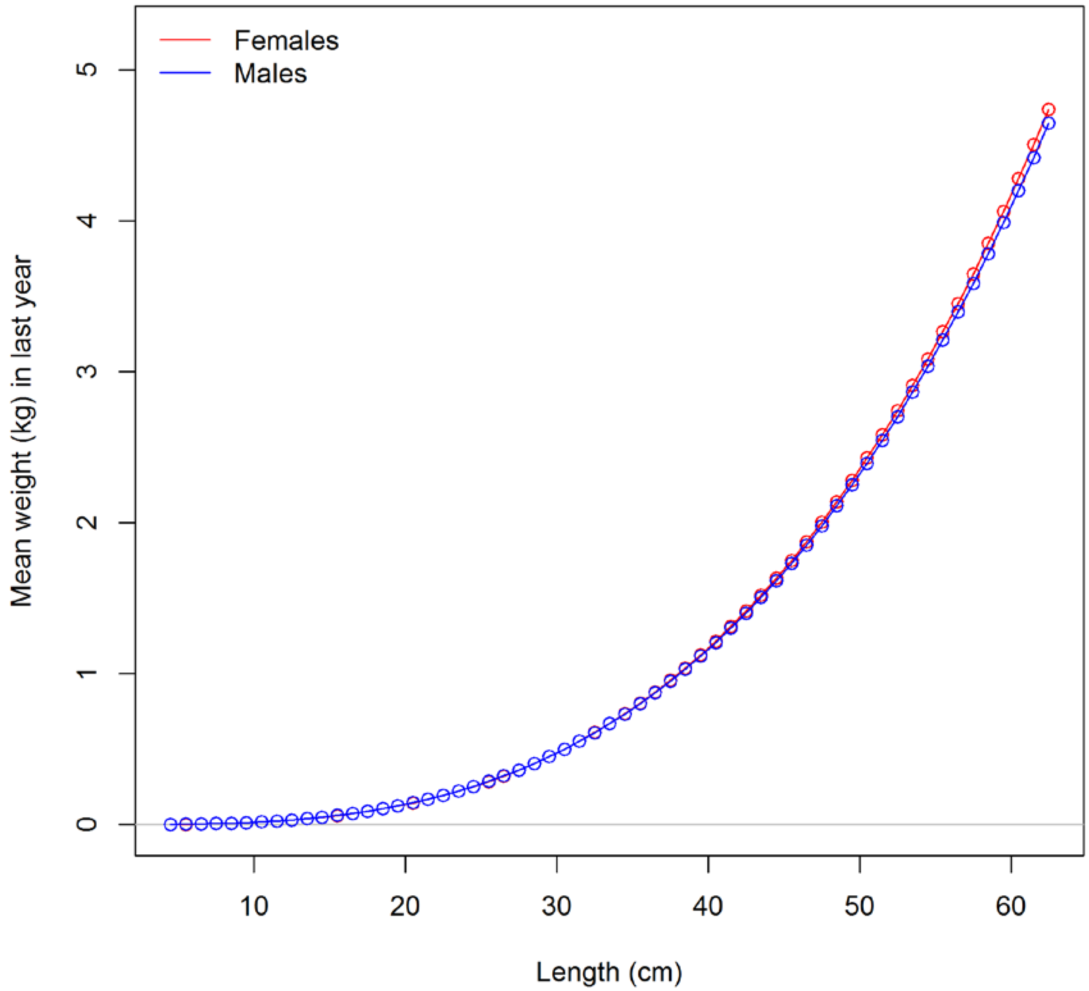

Figure 45: Weight-at-length relationship for females and males of darkblotched rockfish used in the assessment model.

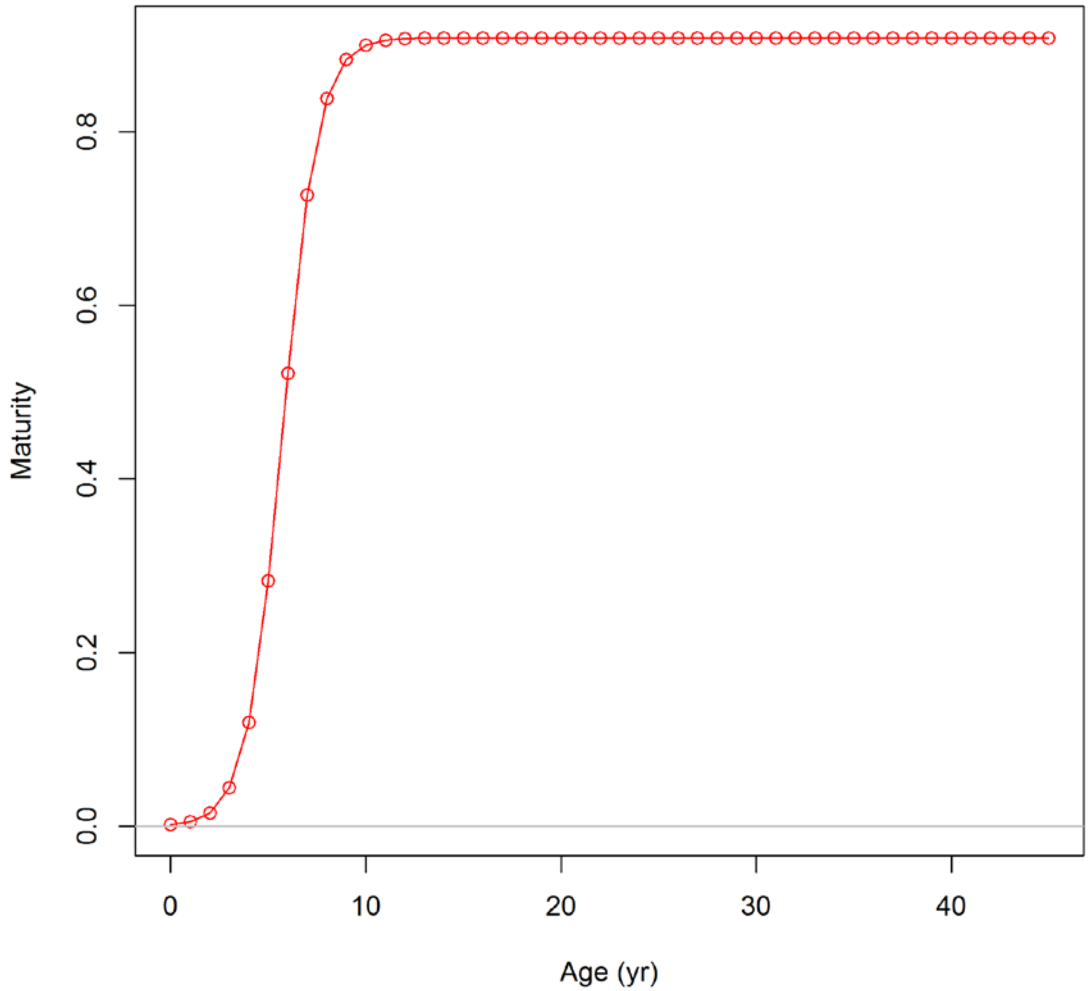

Figure 46: Female maturity at age relationship used in the assessment model. The parameters were estimated from the data collected within the NWFSC shelf-slope survey between 2011 and 2012.

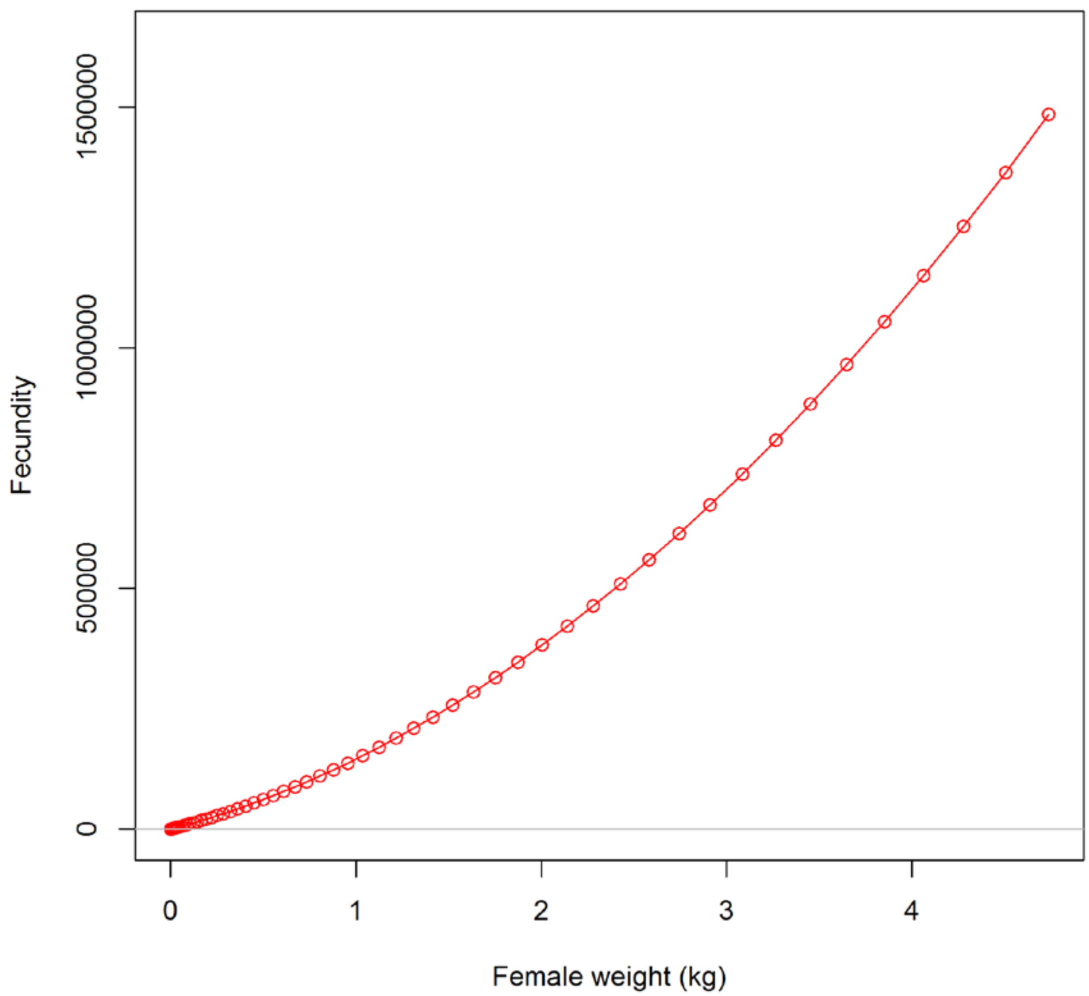

Figure 47: Female darkblotched rockfish fecundity at weight relationship used in the assessment, based on the parameters estimated by Dick (2009).

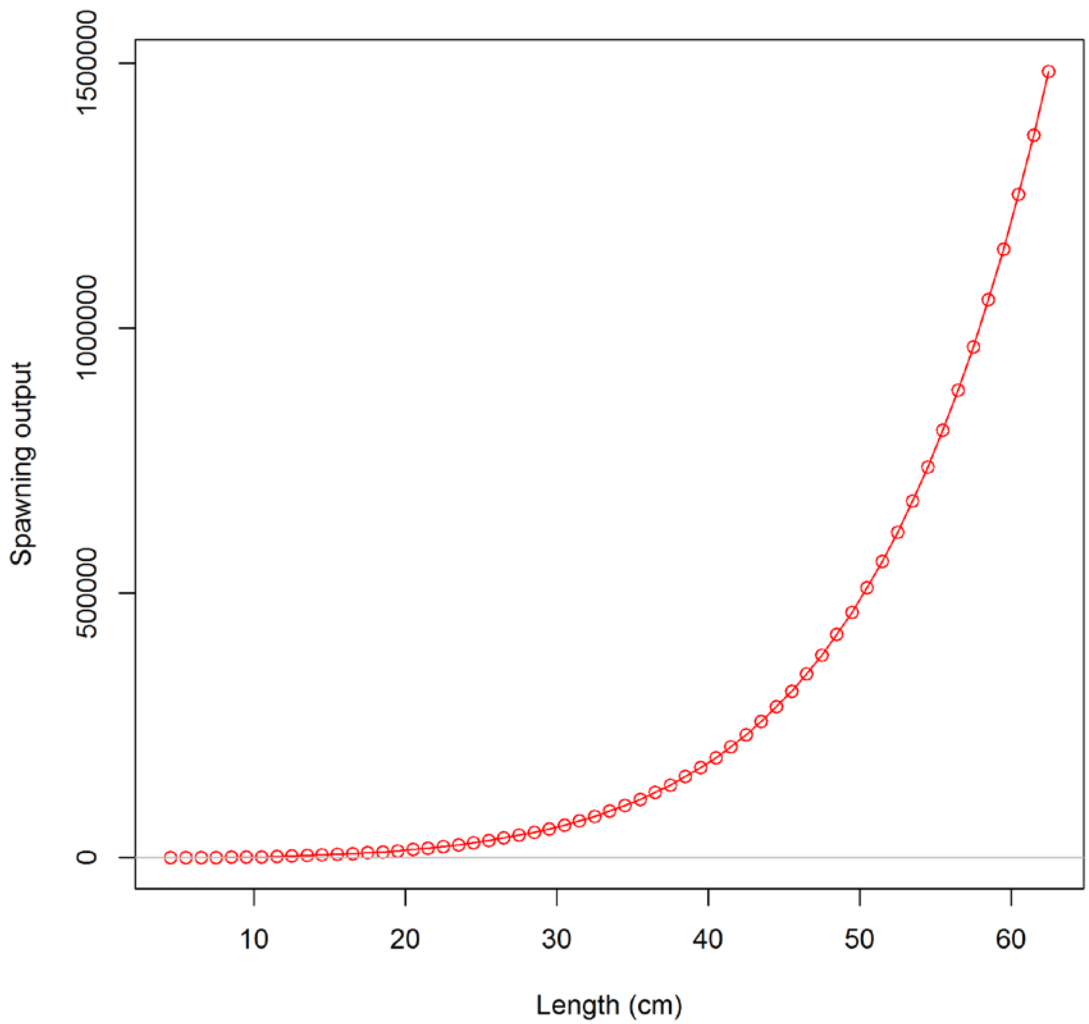

Figure 48: Female darkblotched rockfish spawning output-at-length relationship used in the assessment model.

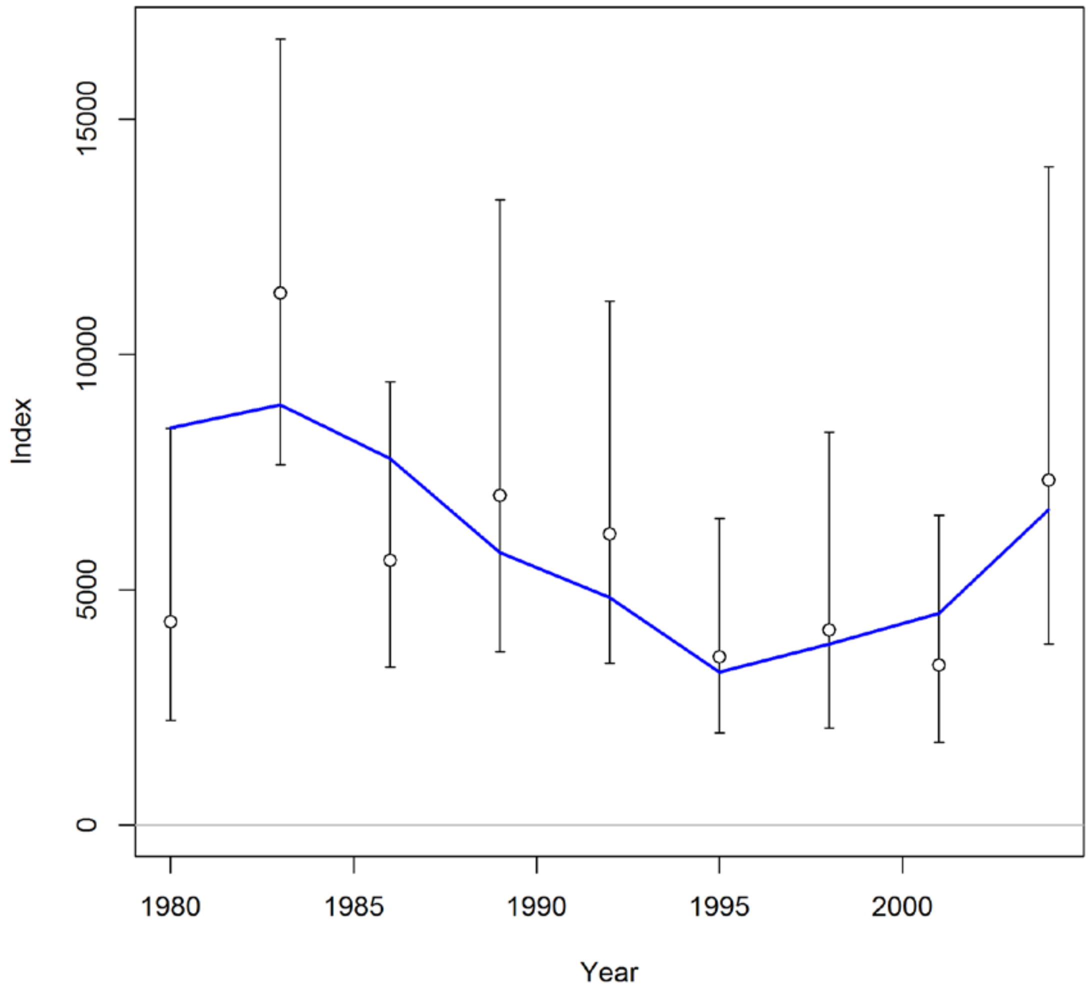

Figure 49: Observed and expected values of darkblotched rockfish biomass index (mt) for the AFSC shelf survey.

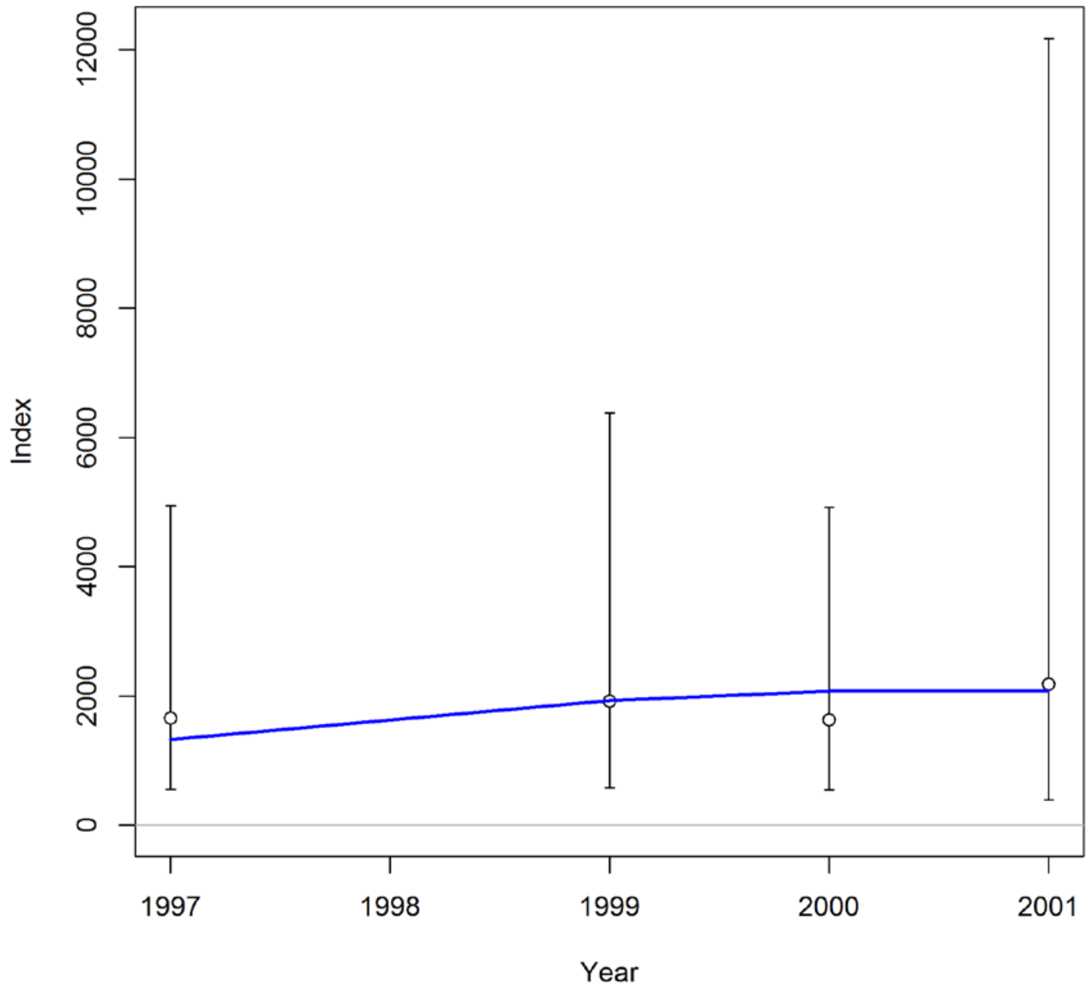

Figure 50: Observed and expected values of darkblotched rockfish biomass index (mt) for the AFSC slope survey.

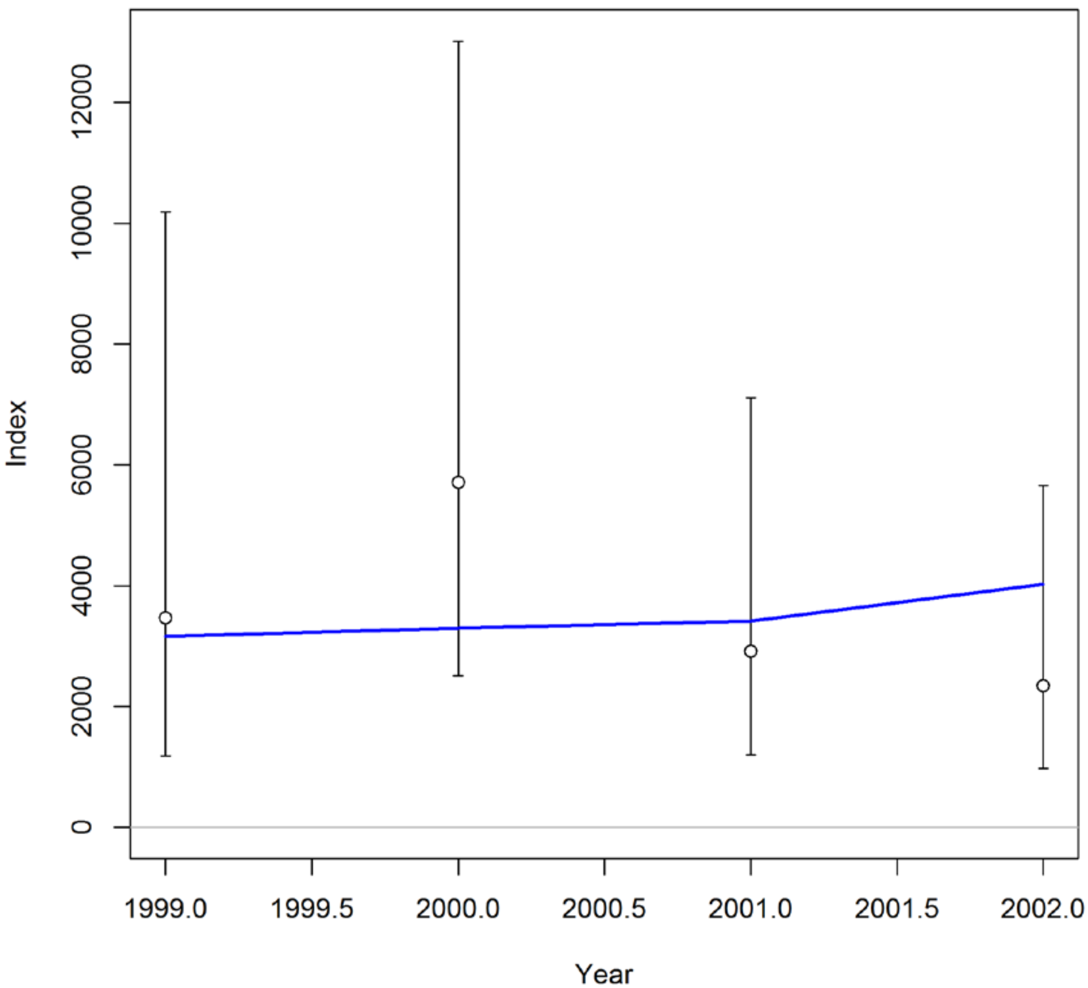

Figure 51: Observed and expected values of darkblotched rockfish biomass index (mt) for the NWFSC slope survey.

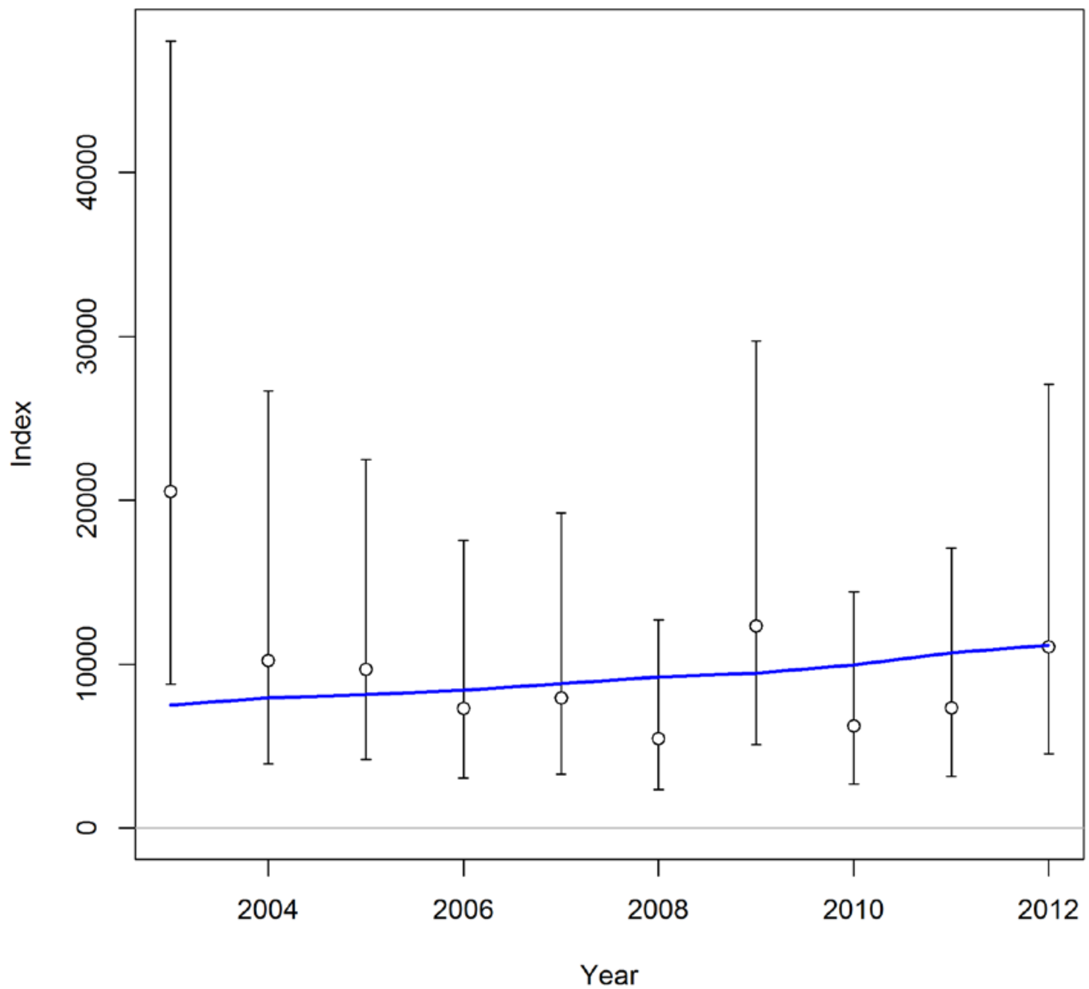

Figure 52: Observed and expected values of darkblotched rockfish biomass index (mt) for the NWFSC shelf-slope survey.

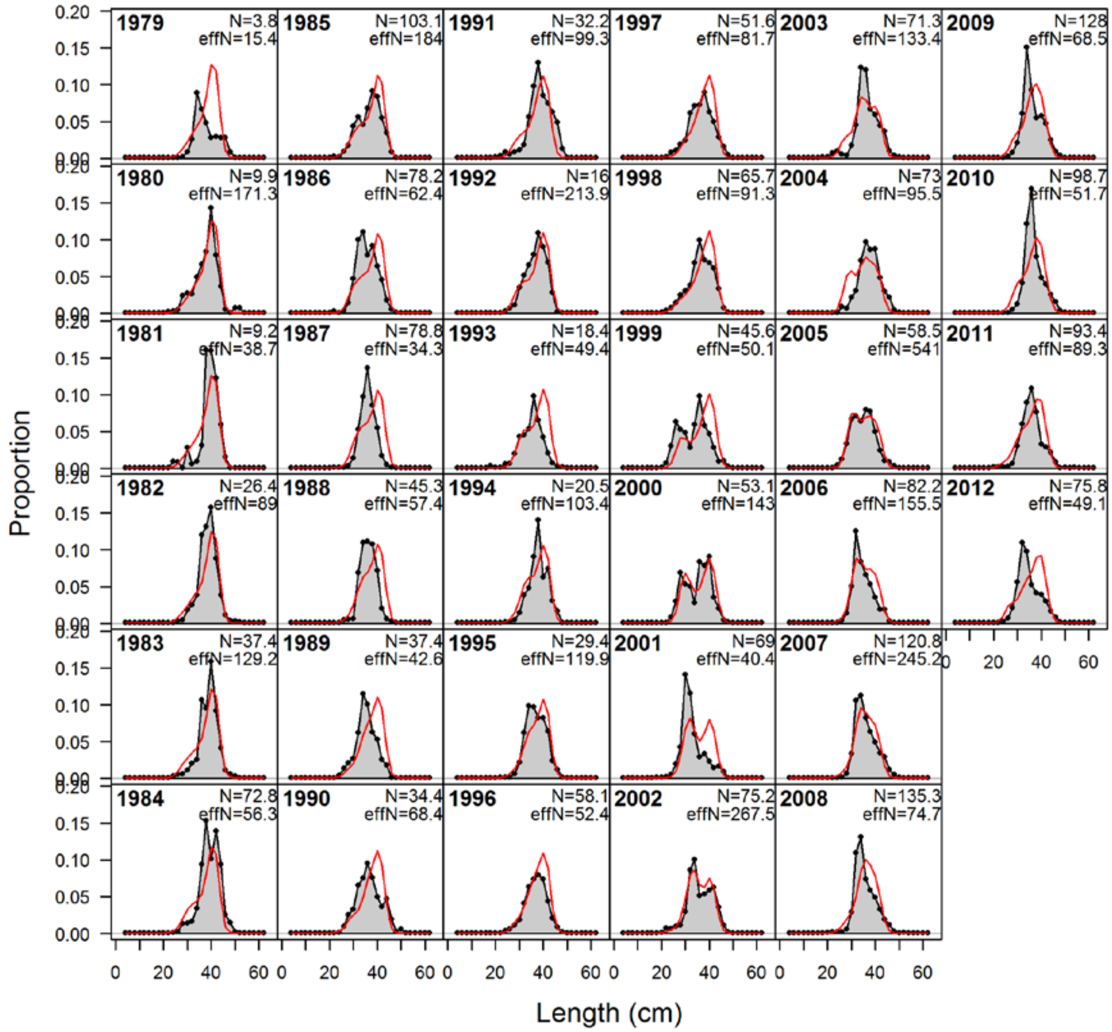

Figure 53: Fit to length-frequency distributions of female darkblotched rockfish for the domestic trawl fishery landings, by year.

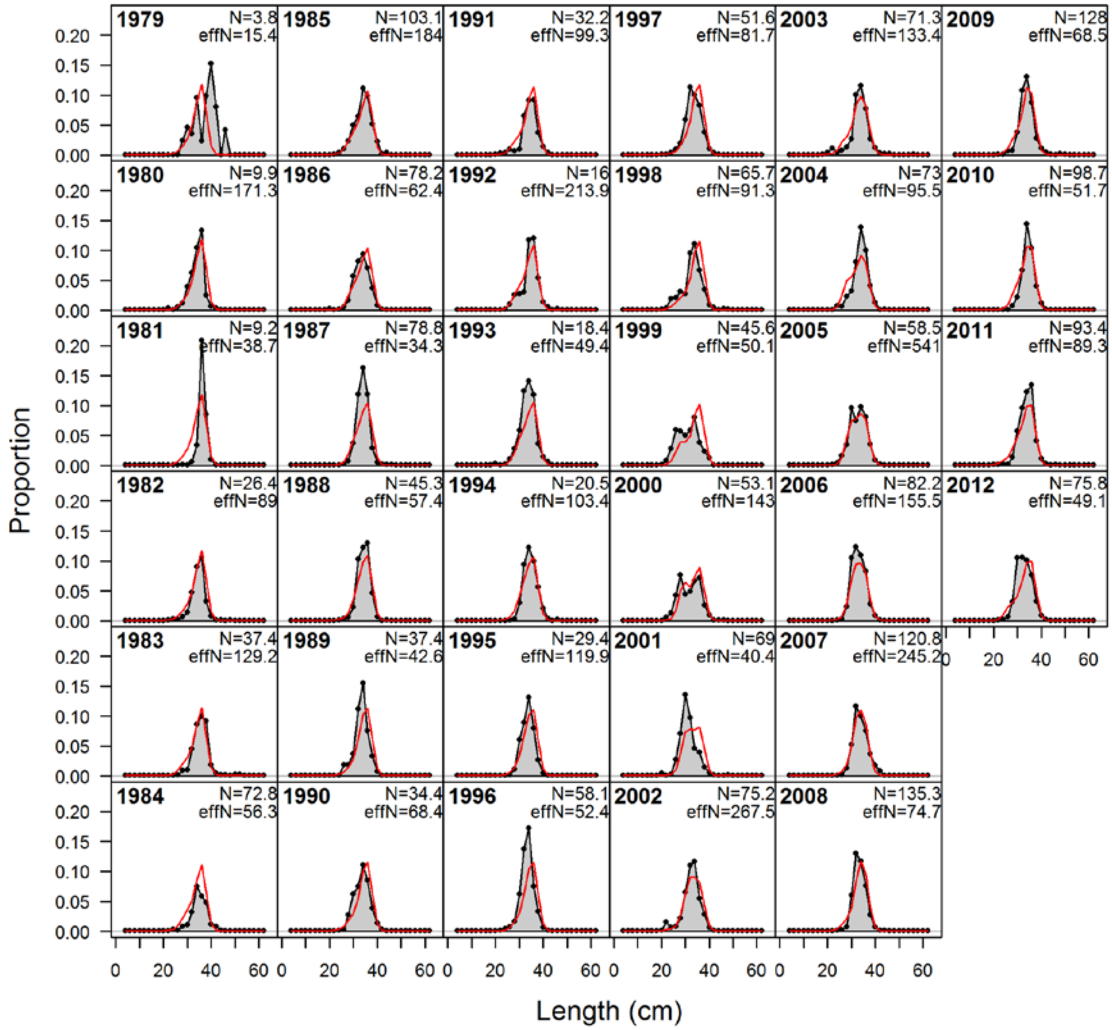

Figure 54: Fit to length-frequency distributions of male darkblotched rockfish for the domestic trawl fishery landings, by year.

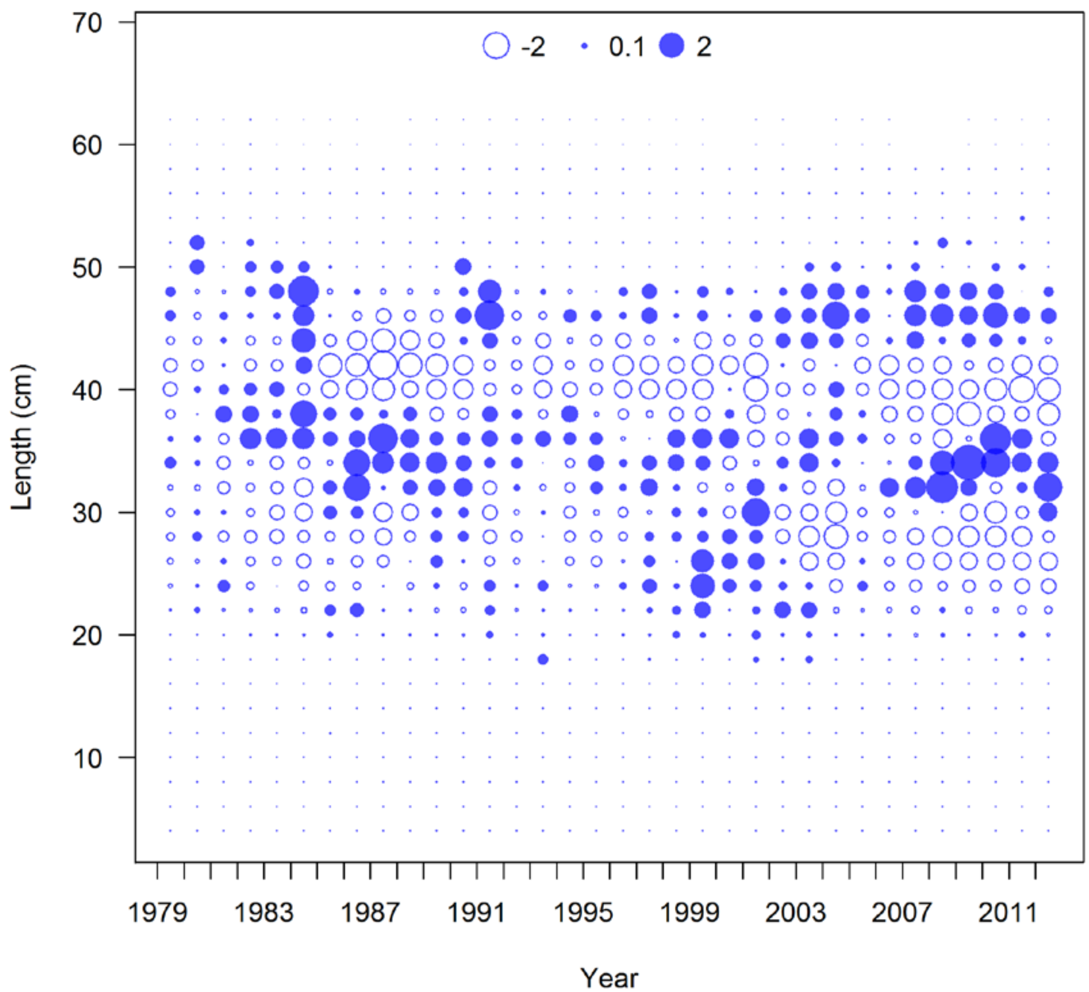

Figure 55: Pearson residuals for the fit to length-frequency distributions of female darkblotched rockfish for the domestic trawl fishery landings, by year.

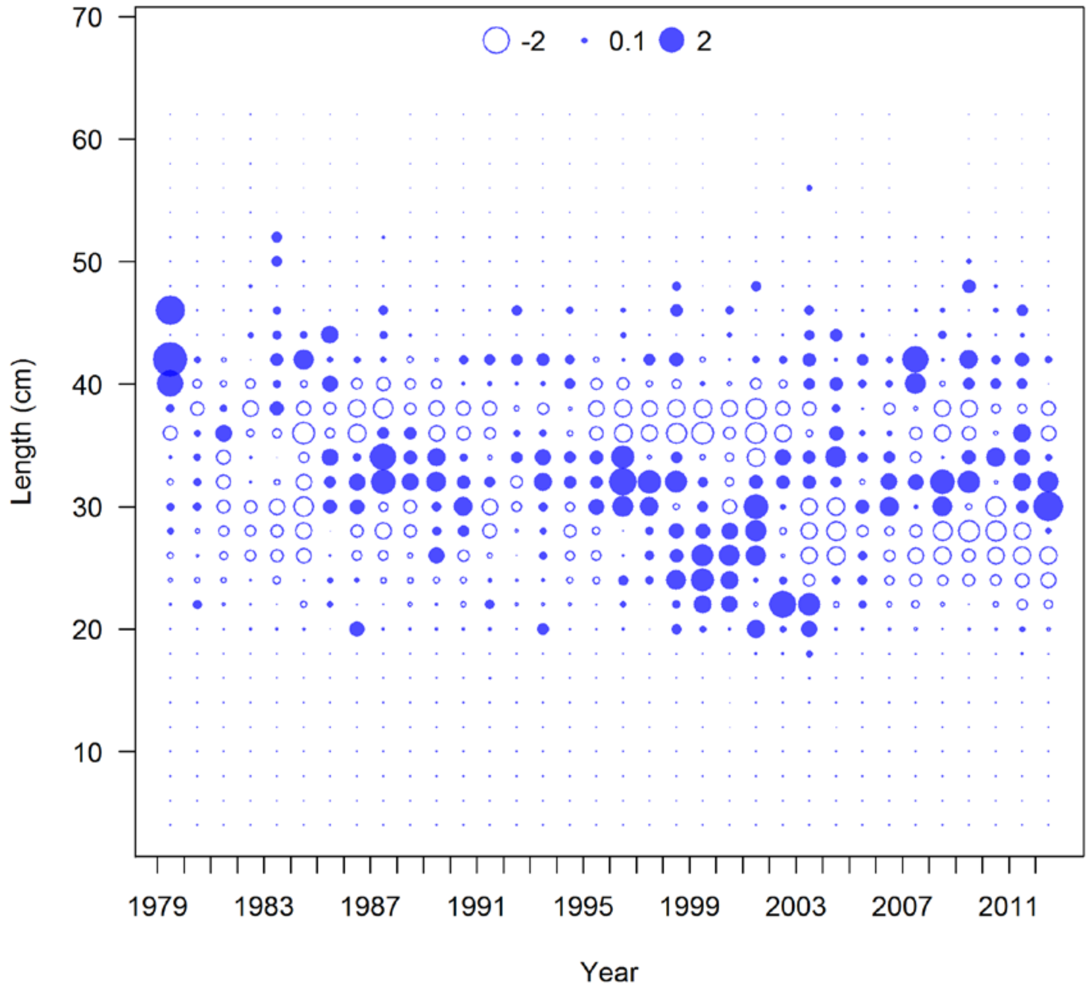

Figure 56: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish for the domestic trawl fishery landings, by year.

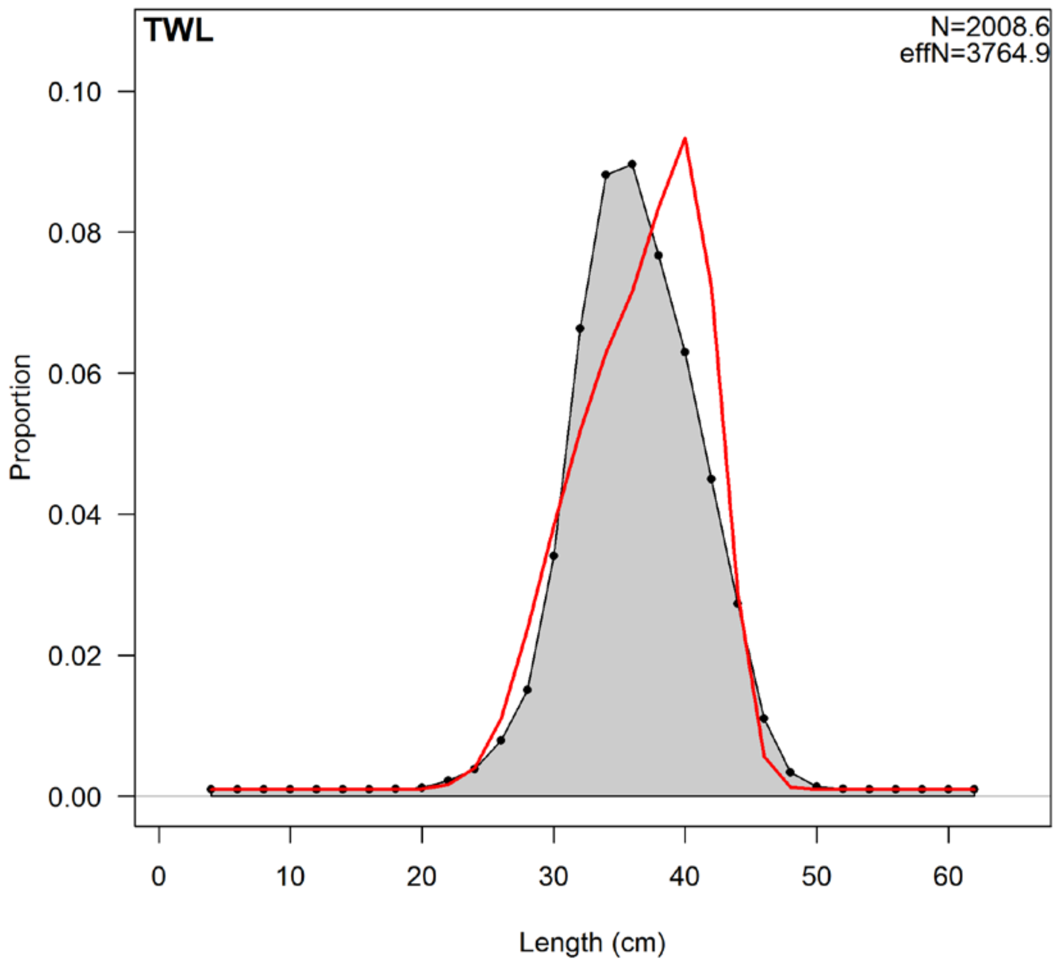

Figure 57: Fit to length-frequency distributions of female darkblotched rockfish from domestic trawl fishery landings, aggregated across all years.

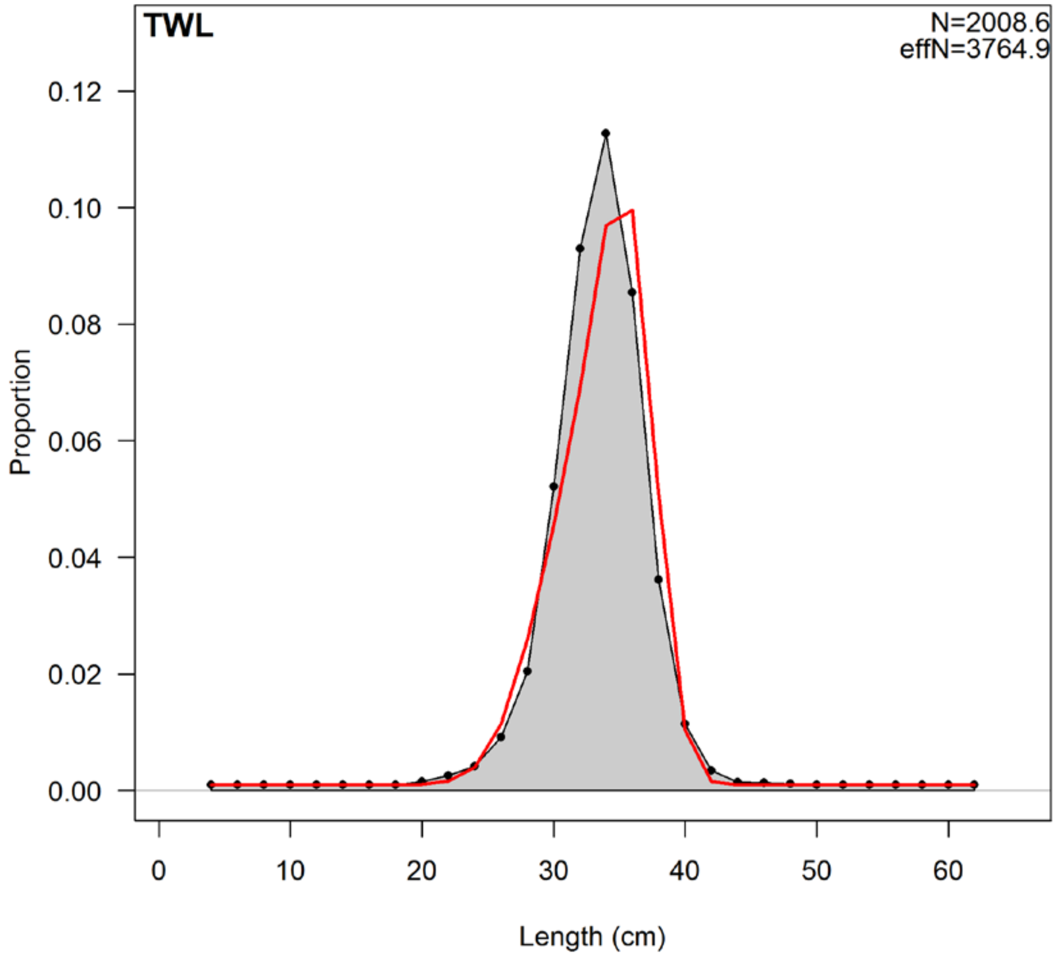

Figure 58: Fit to length-frequency distributions of male darkblotched rockfish from domestic trawl fishery landings, aggregated across all years.

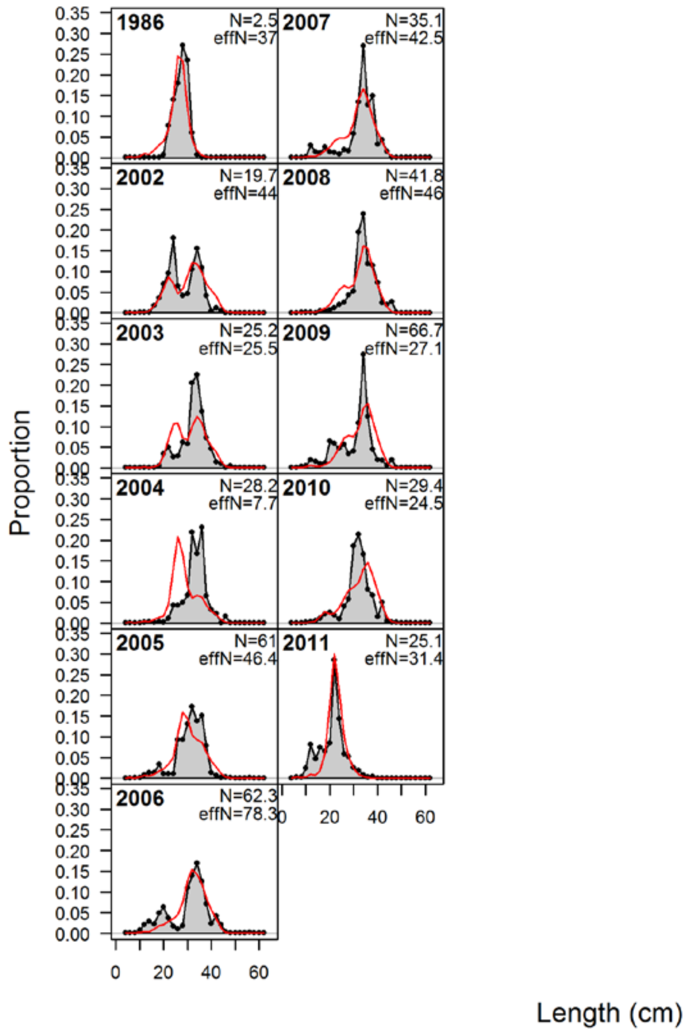

Figure 59: Fit to length-frequency distributions of darkblotched rockfish (sexes combined) for the domestic trawl fleet discard, by year.

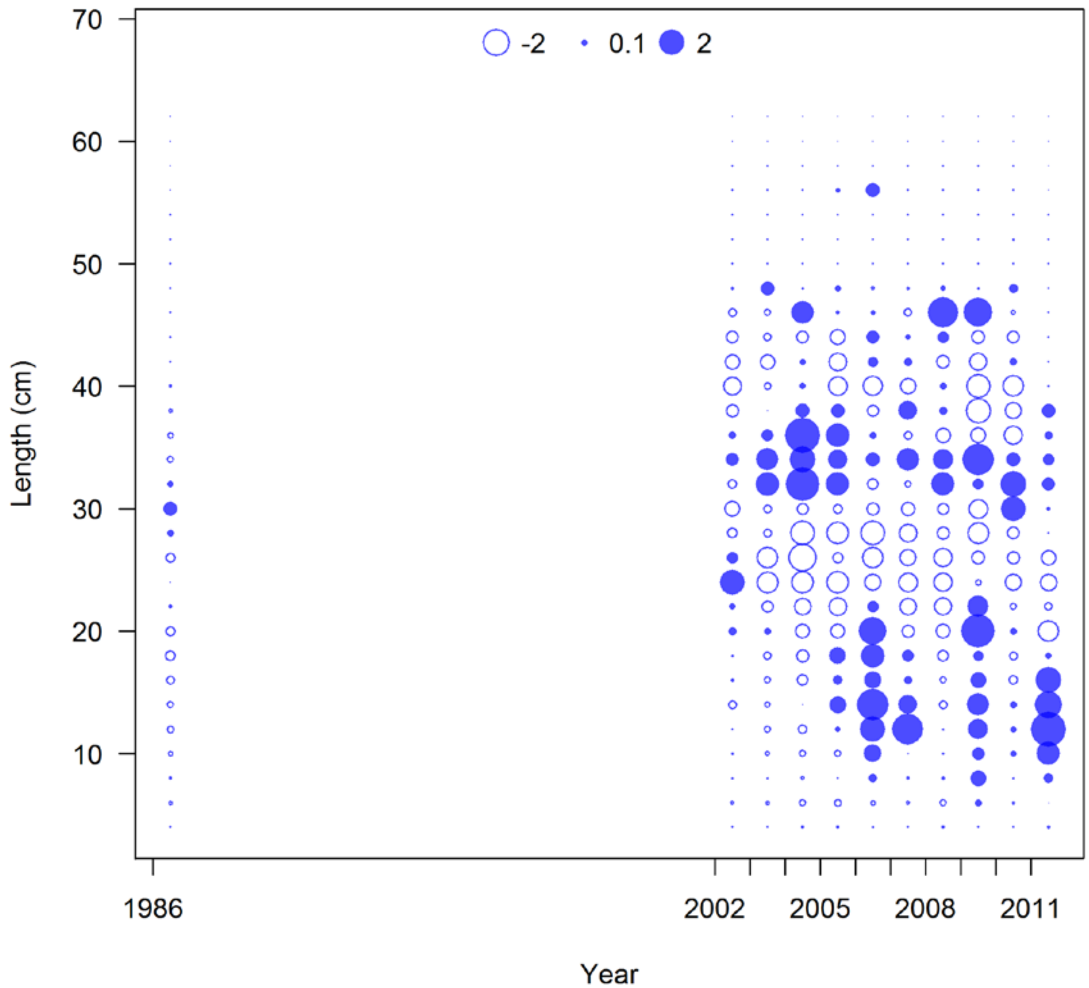

Figure 60: Pearson residuals for the fit to length-frequency distributions of darkblotched rockfish (sexes combined) for the domestic trawl fleet discard, by year.

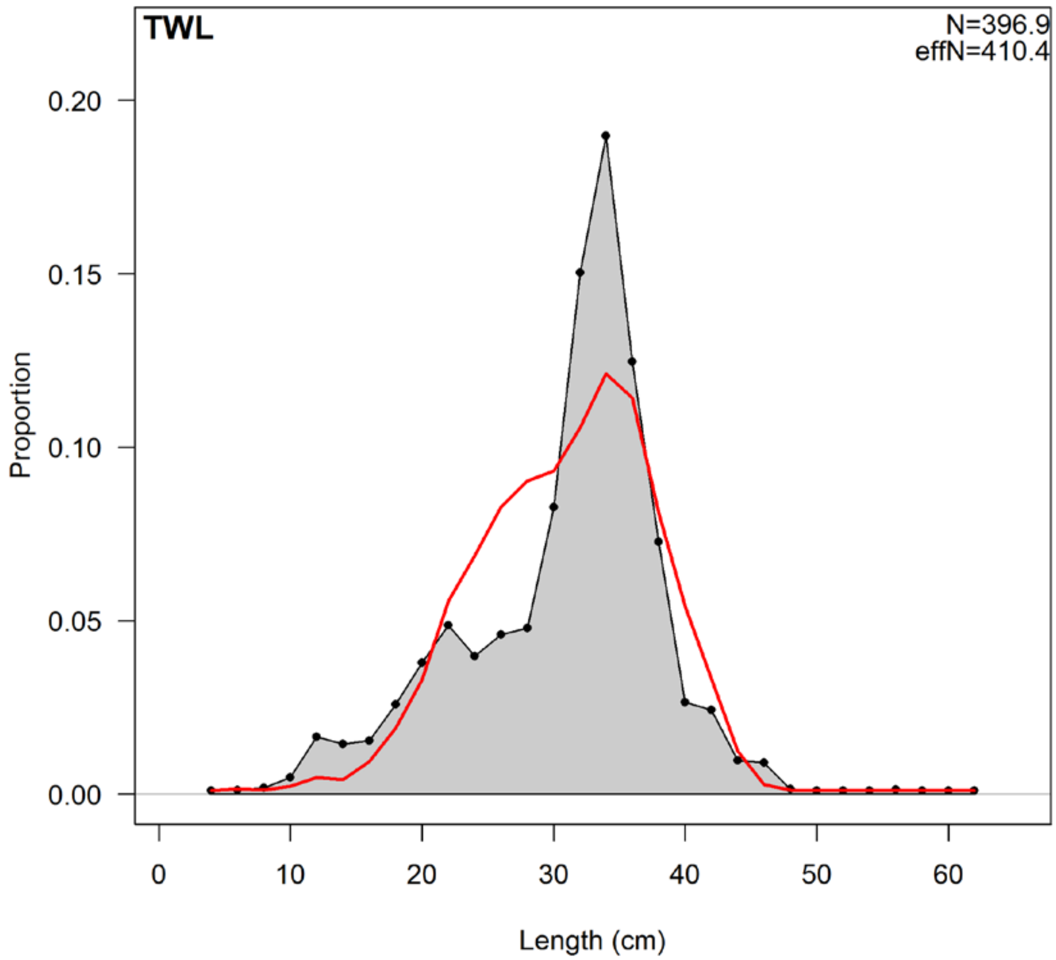

Figure 61: Fit to length-frequency distributions of darkblotched rockfish (sexes combined) from domestic trawl fishery discard, aggregated across all years.

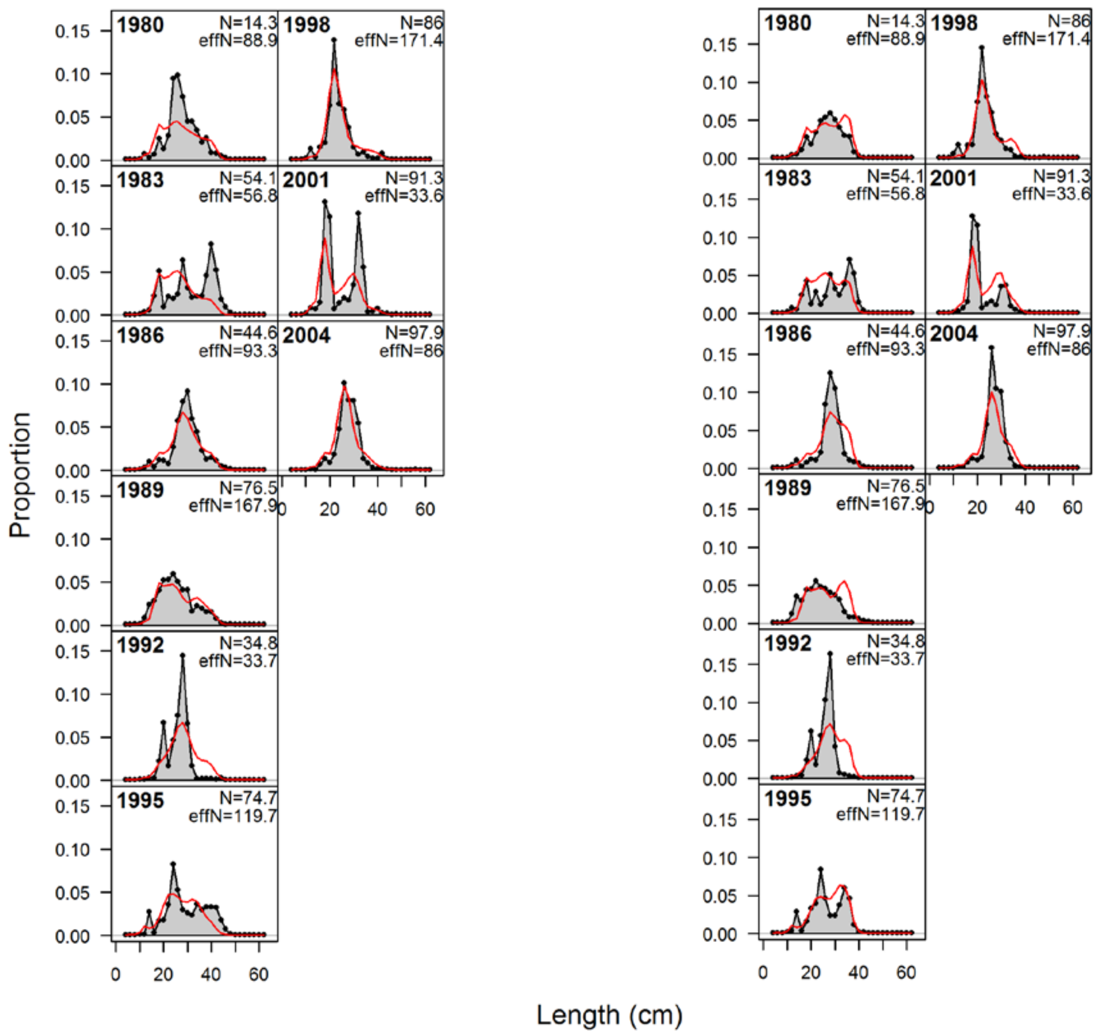

Figure 62: Fit to length-frequency distributions of female (left panel) and male (right panel) darkblotched rockfish from the AFSC shelf survey, by year.

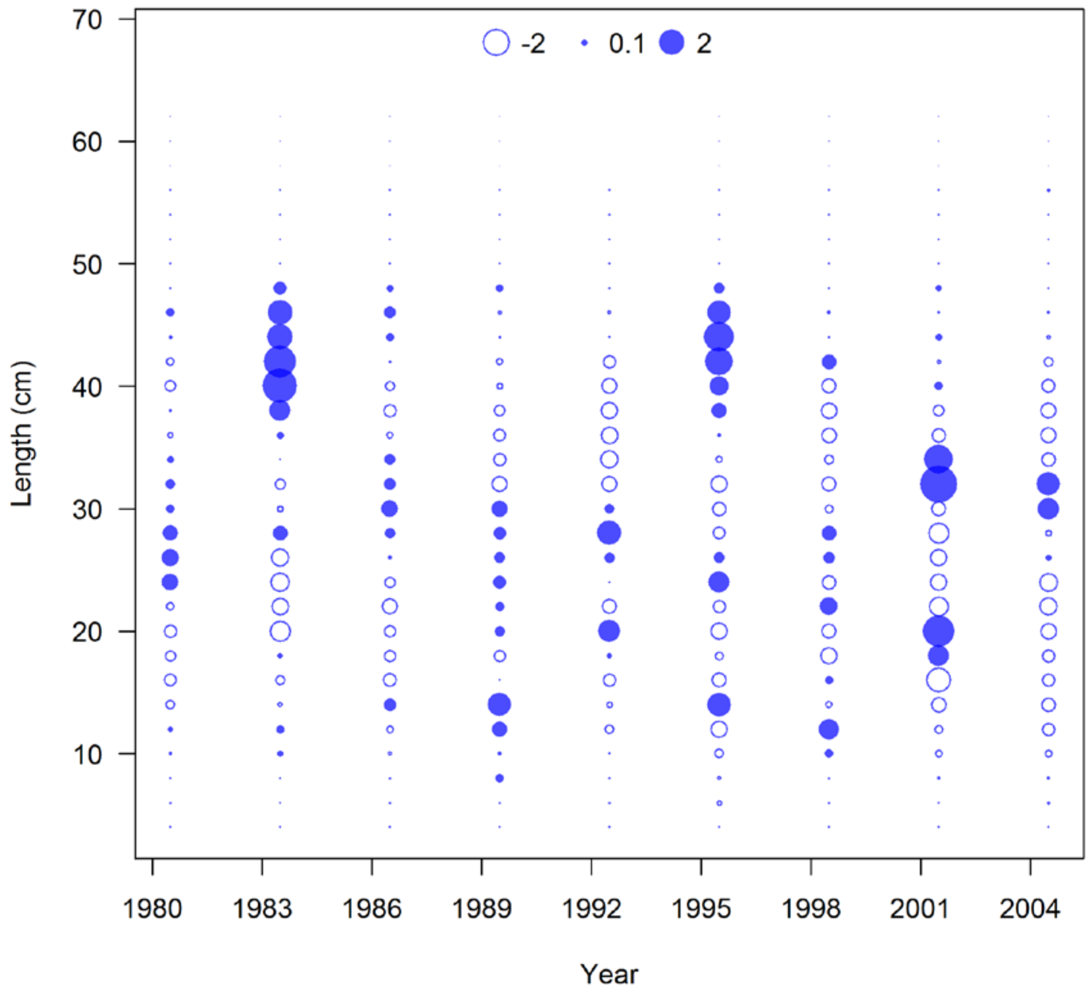

Figure 63: Pearson residuals for the fit to length-frequency distributions of female darkblotched rockfish from the AFSC shelf survey, by year.

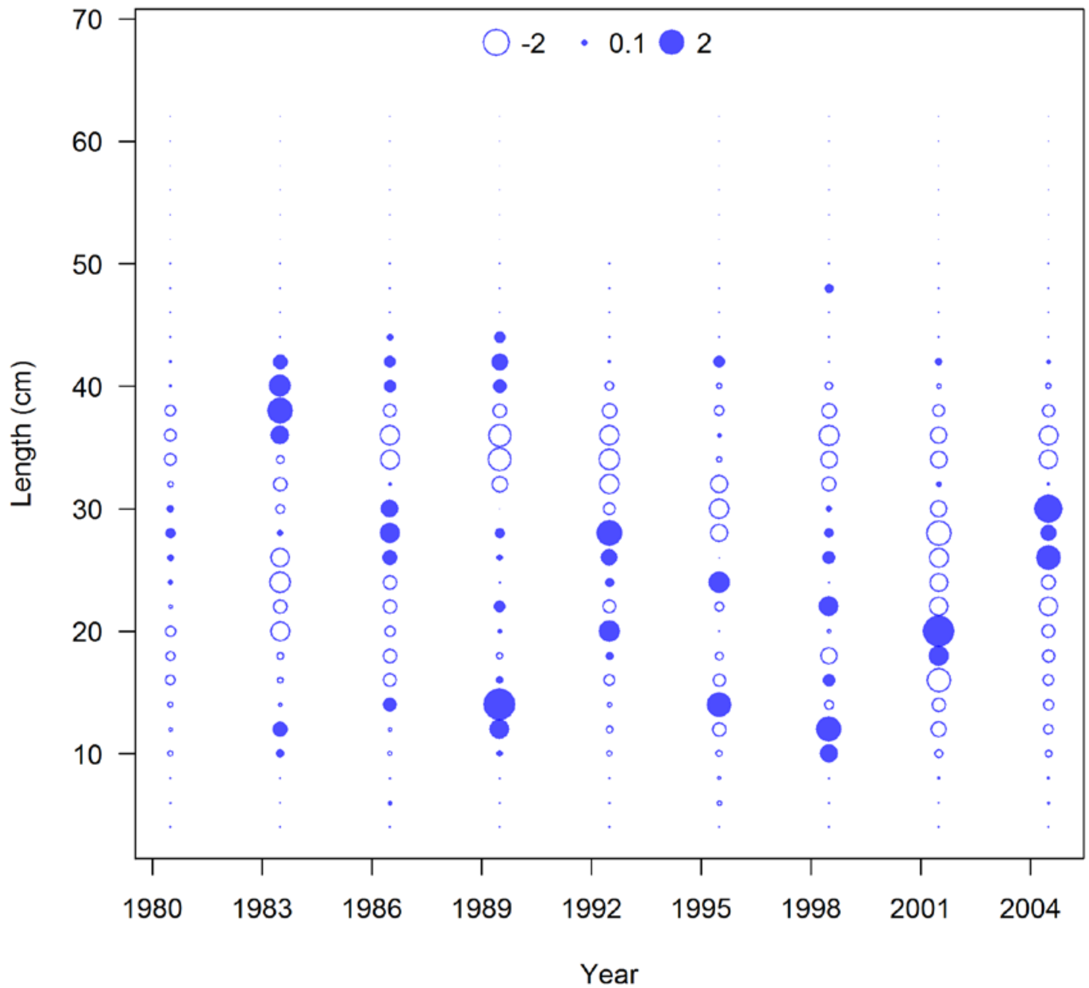

Figure 64: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish from the AFSC shelf survey, by year.

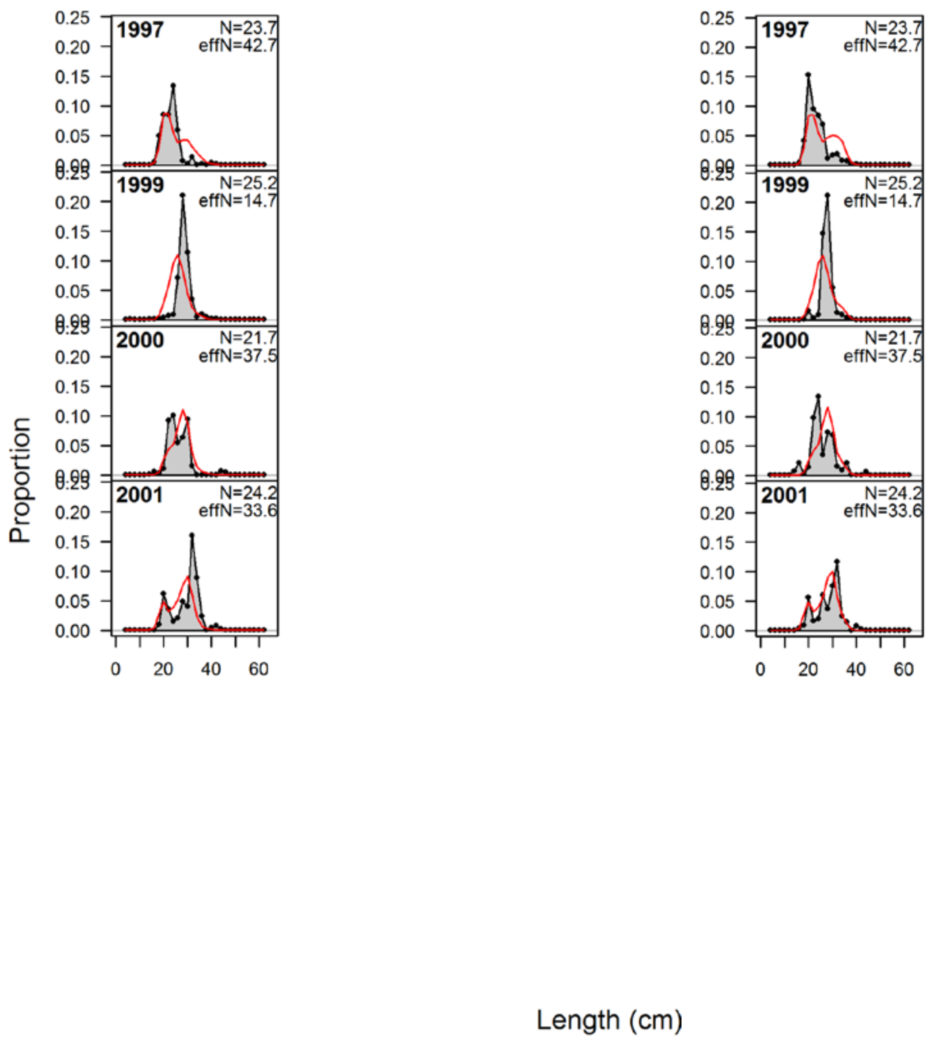

Figure 65: Fit to length-frequency distributions of female (left panel) and male (right panel) darkblotched rockfish from the AFSC slope survey, by year.

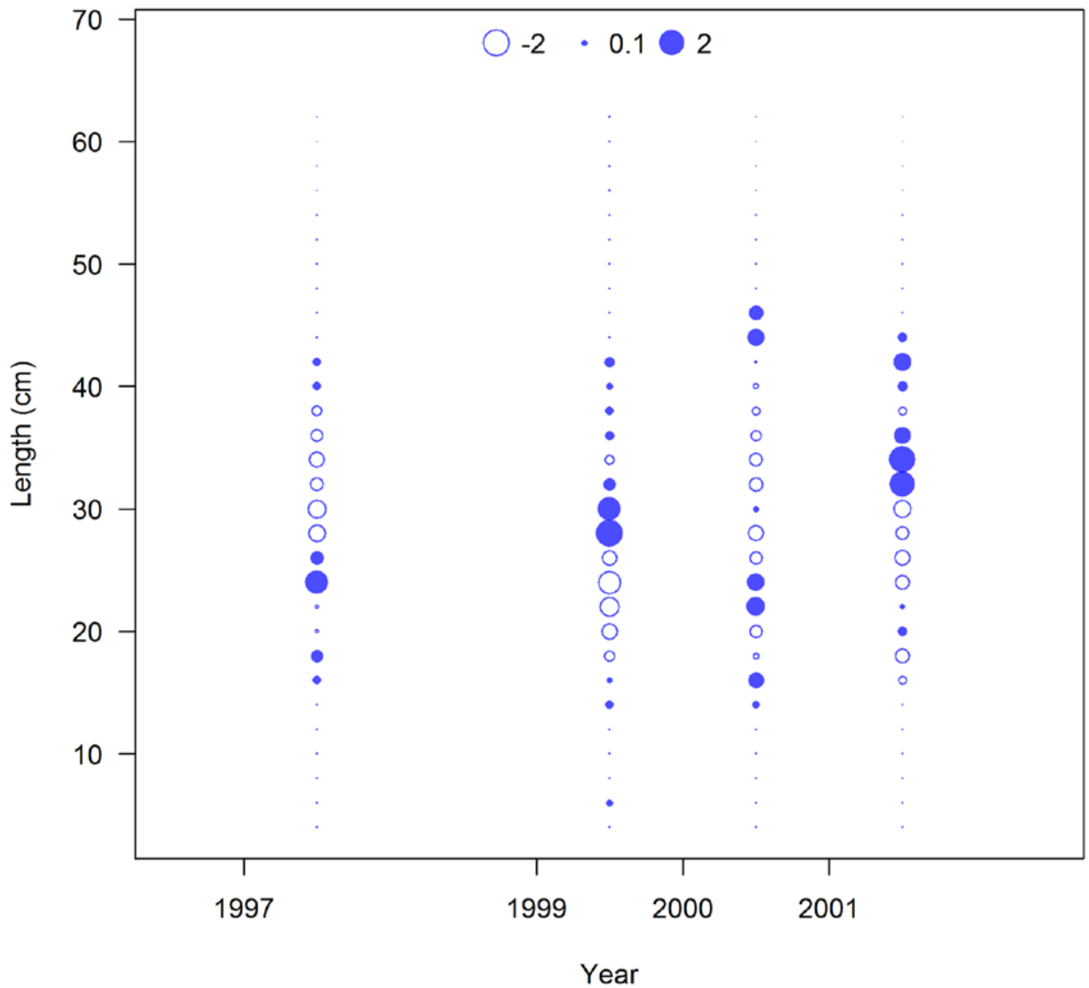

Figure 66: Pearson residuals for the fit to length-frequency distributions of female darkblotched rockfish from the AFSC slope survey, by year.

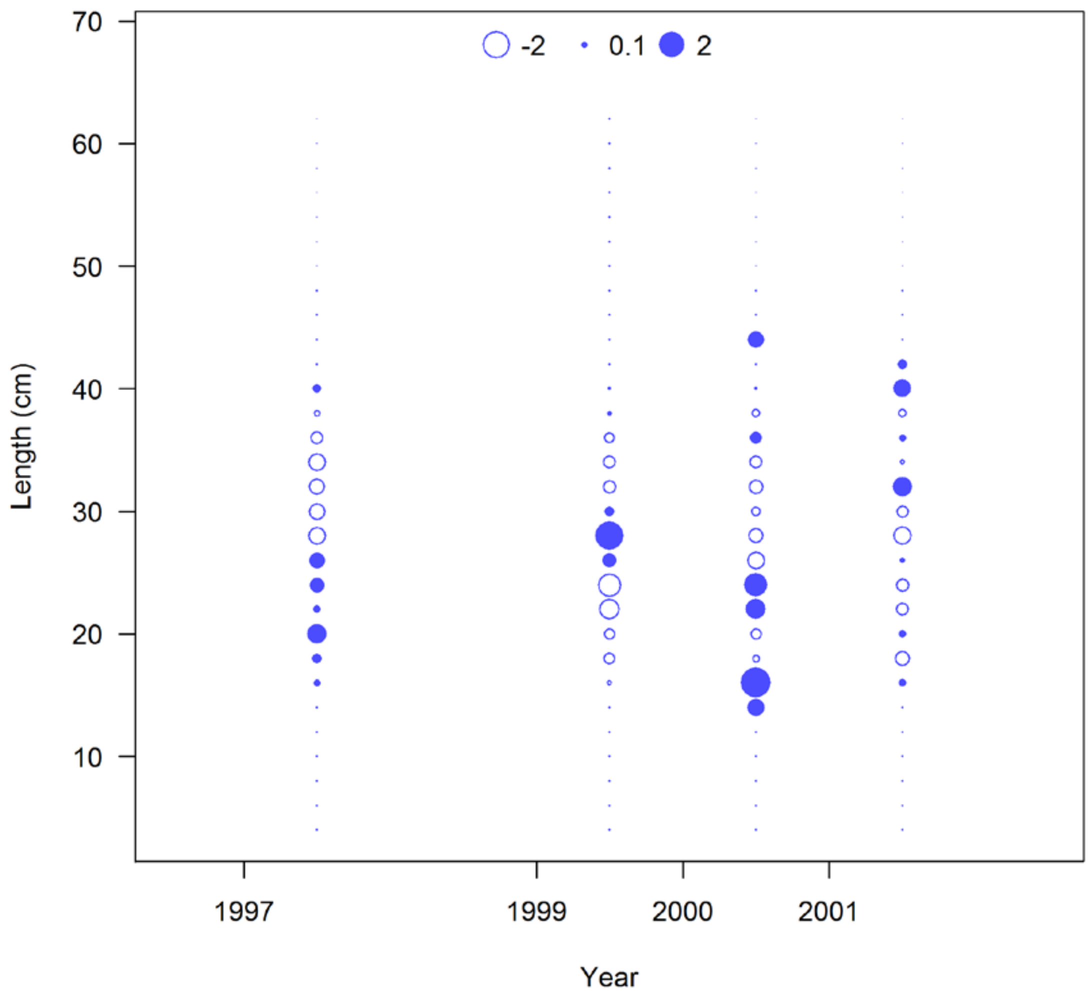

Figure 67: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish from the AFSC slope survey, by year.

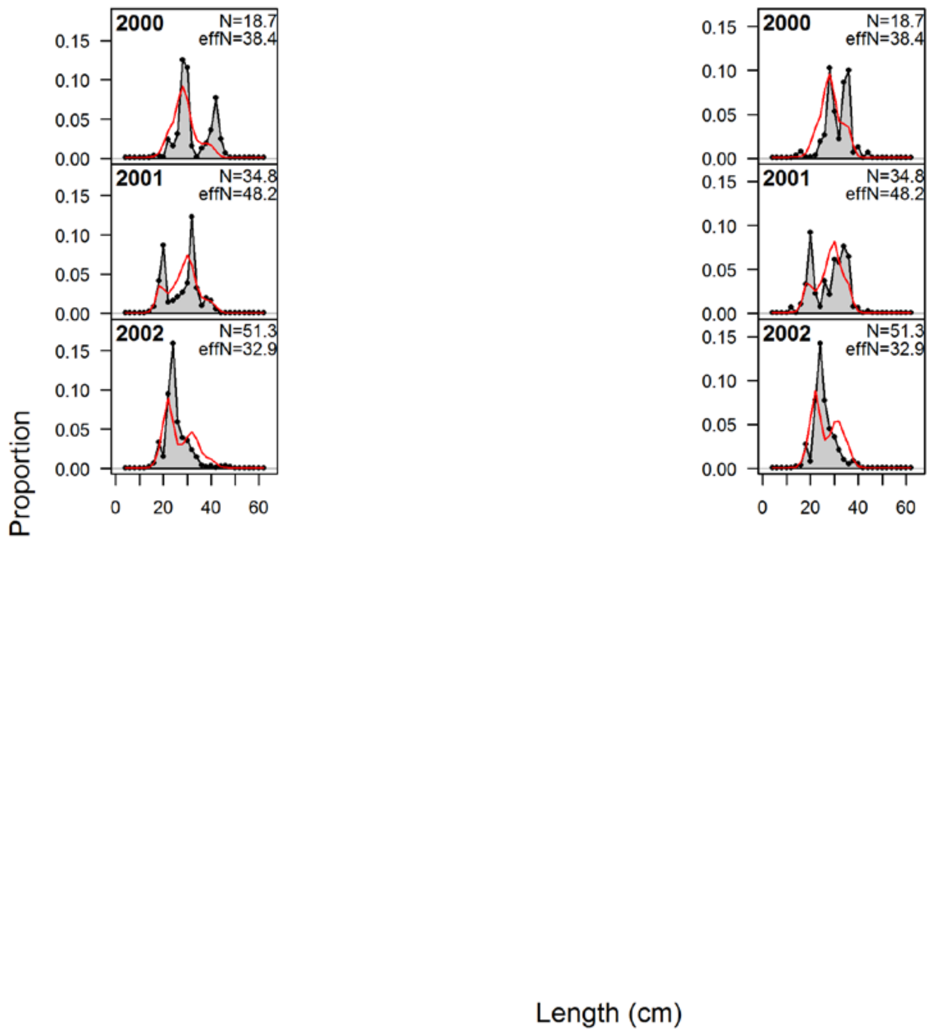

Figure 68: Fit to length-frequency distributions of female (left panel) and male (right panel) darkblotched rockfish from the NWFSC slope survey, by year.

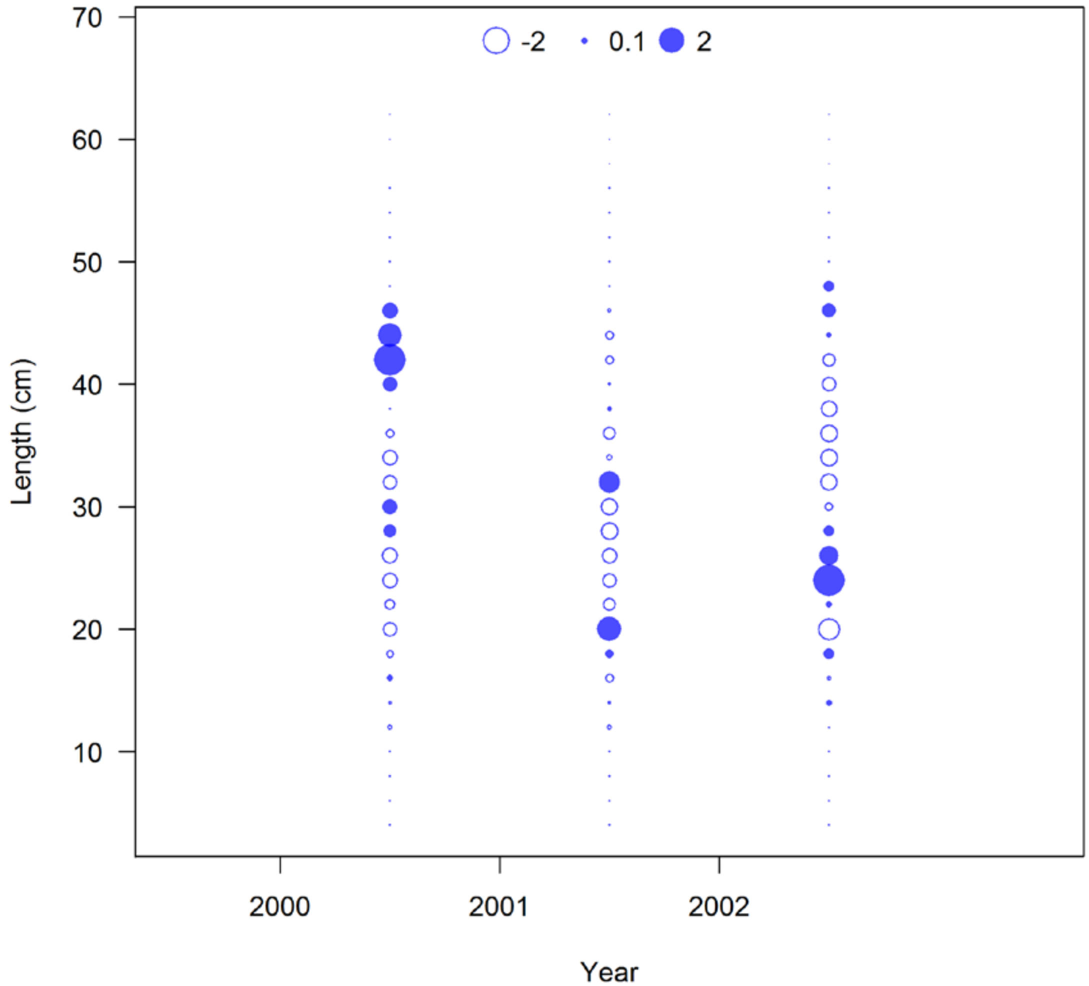

Figure 69: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish from the NWFSC slope survey, by year.

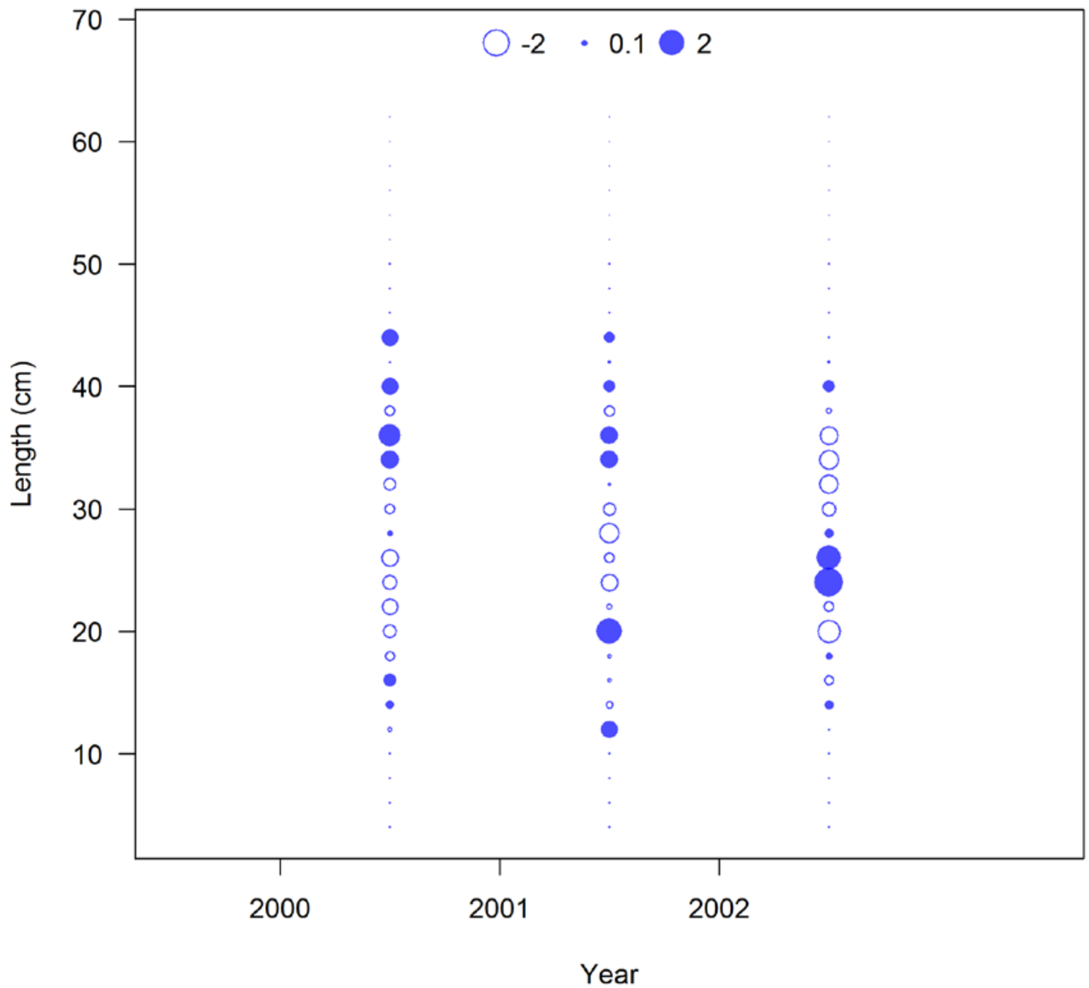

Figure 70: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish from the NWFSC slope survey, by year.

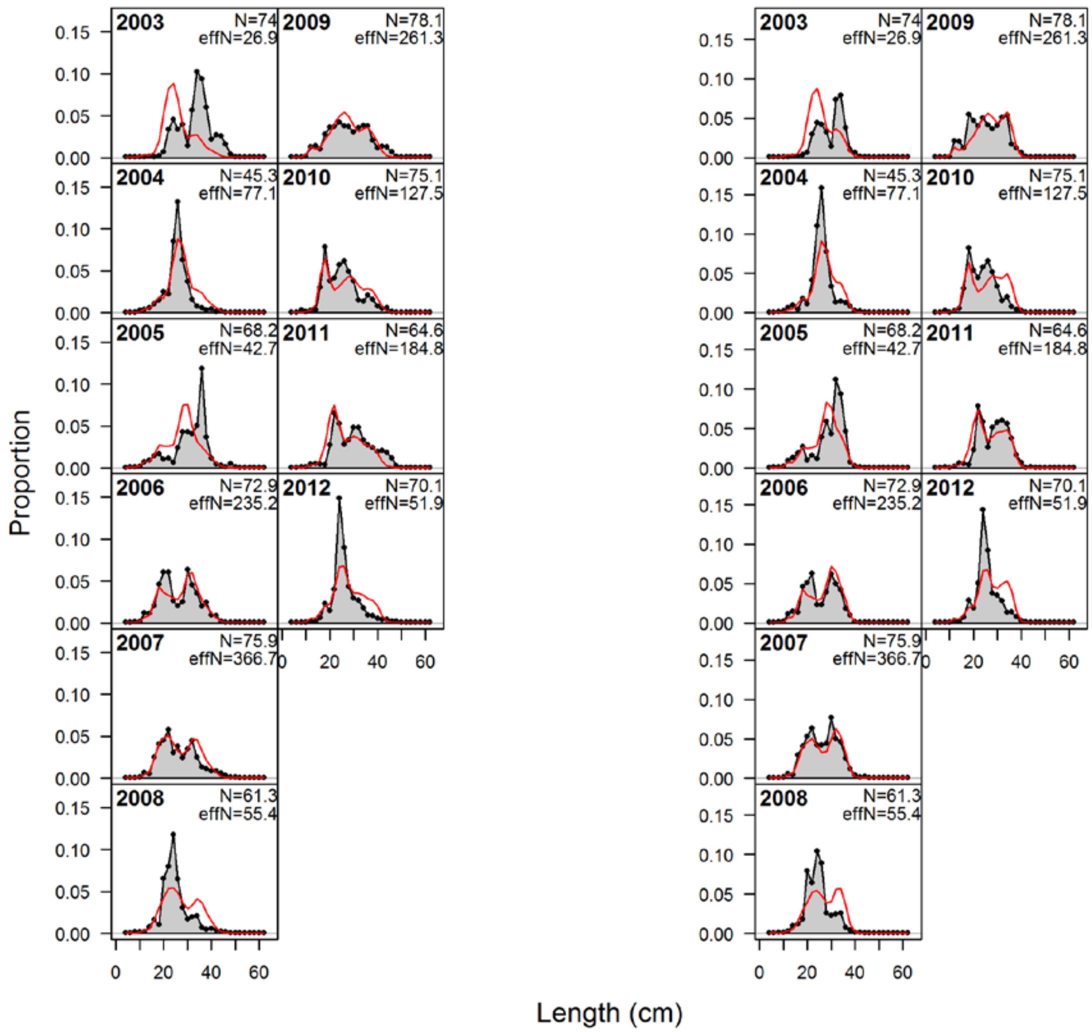

Figure 71: Fit to length-frequency distributions of female (left panel) and male (right panel) darkblotched rockfish from the NWFSC shelf-slope survey by year.

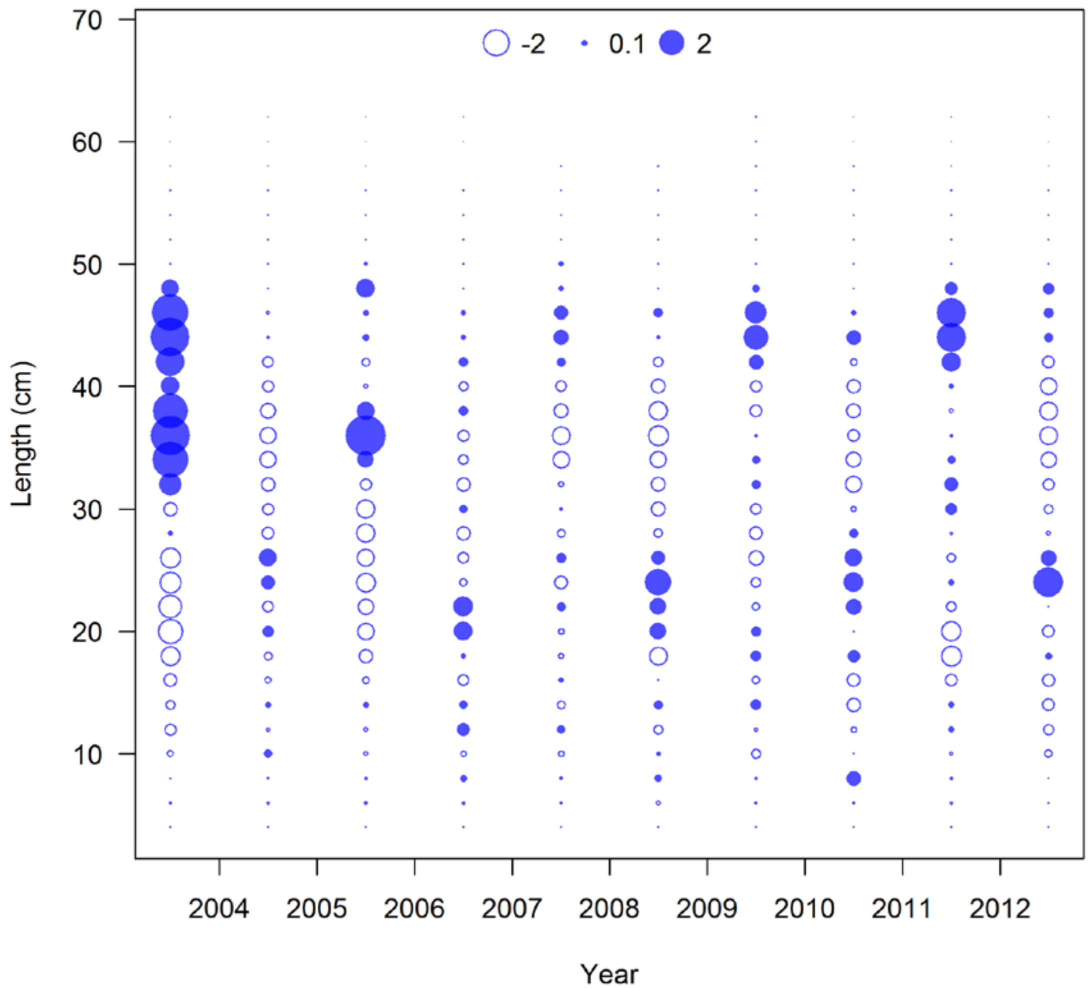

Figure 72: Pearson residuals for the fit to length-frequency distributions of female darkblotched rockfish from the NWFSC shelf-slope survey by year.

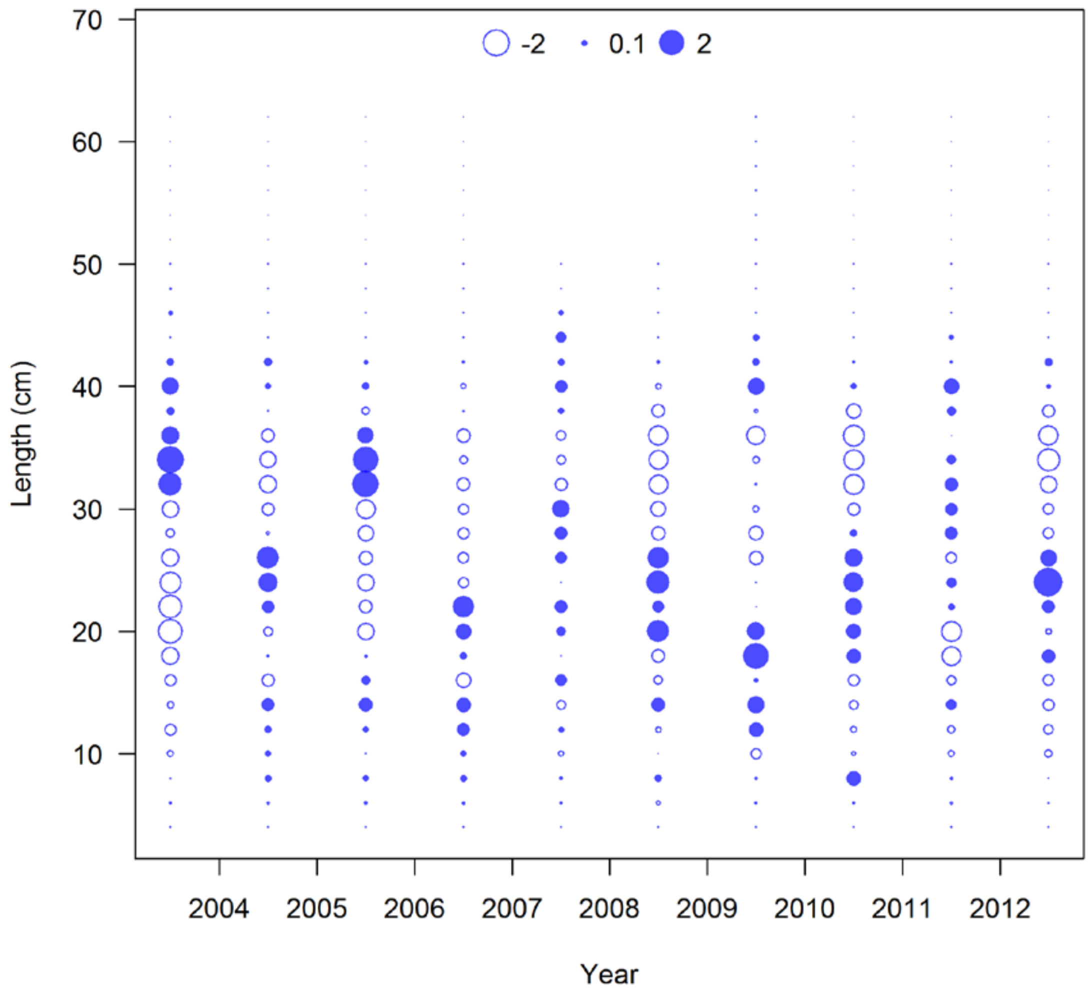

Figure 73: Pearson residuals for the fit to length-frequency distributions of male darkblotched rockfish from the NWFSC shelf-slope survey by year.

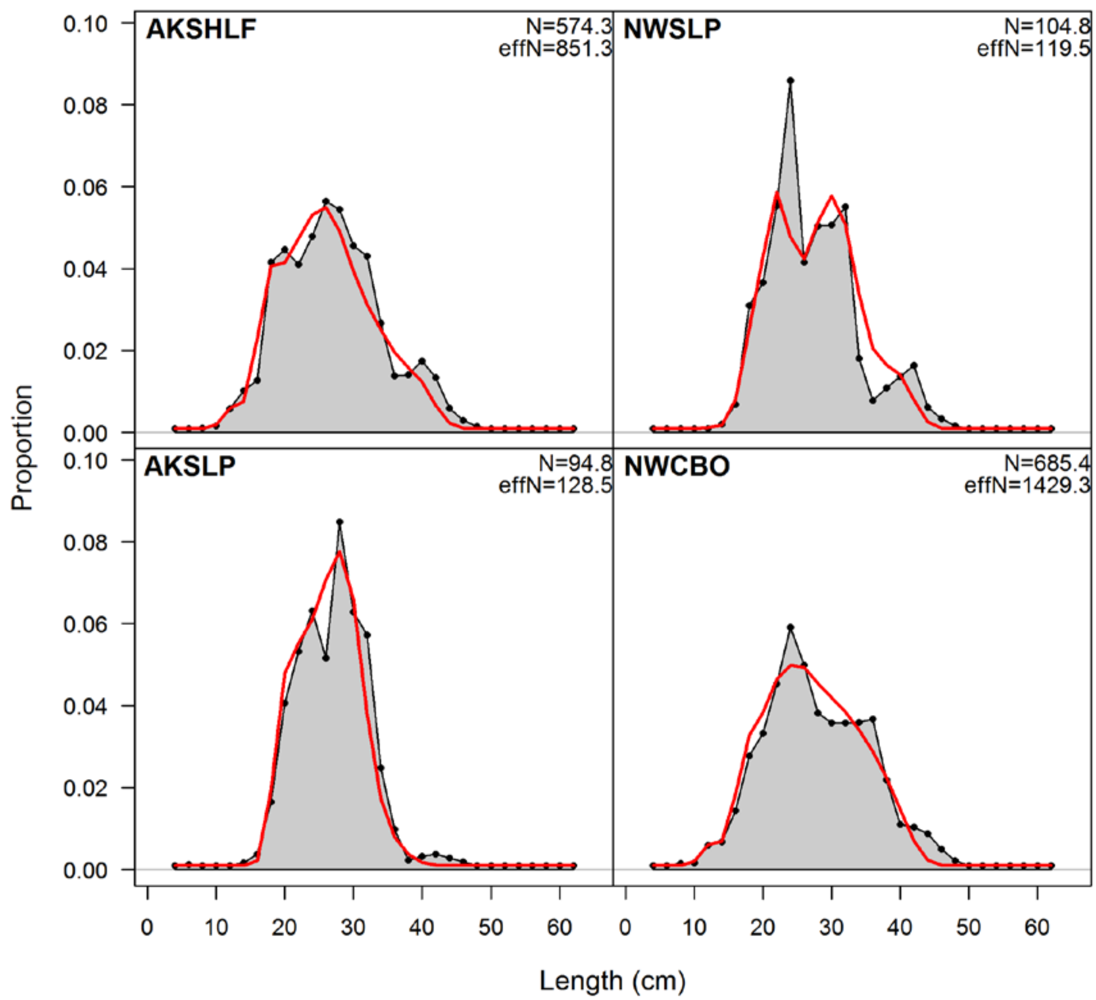

Figure 74: Fit to length-frequency distributions of female darkblotched rockfish from the fishery-independent surveys, aggregated across all years.

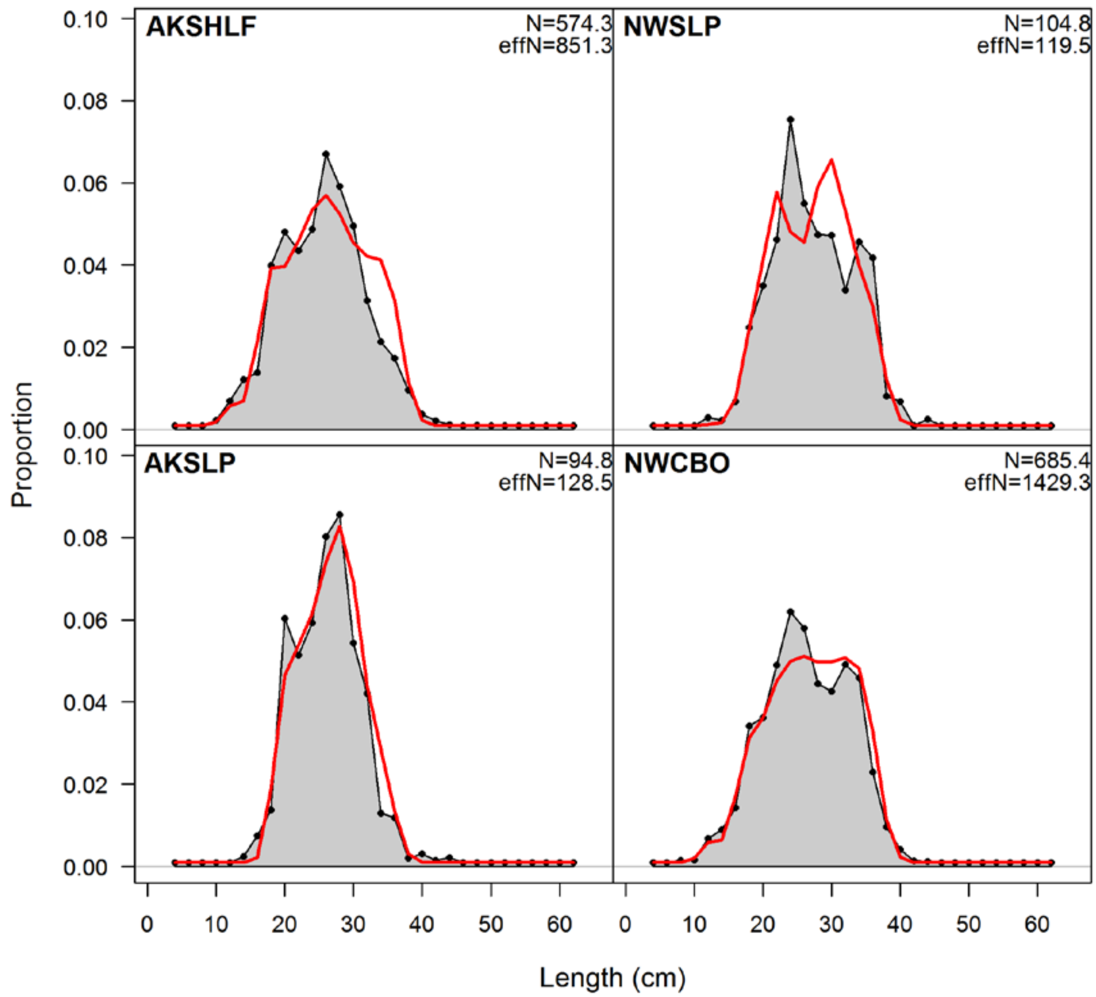

Figure 75: Fit to length-frequency distributions of male darkblotched rockfish from the fishery-independent surveys, aggregated across all years.

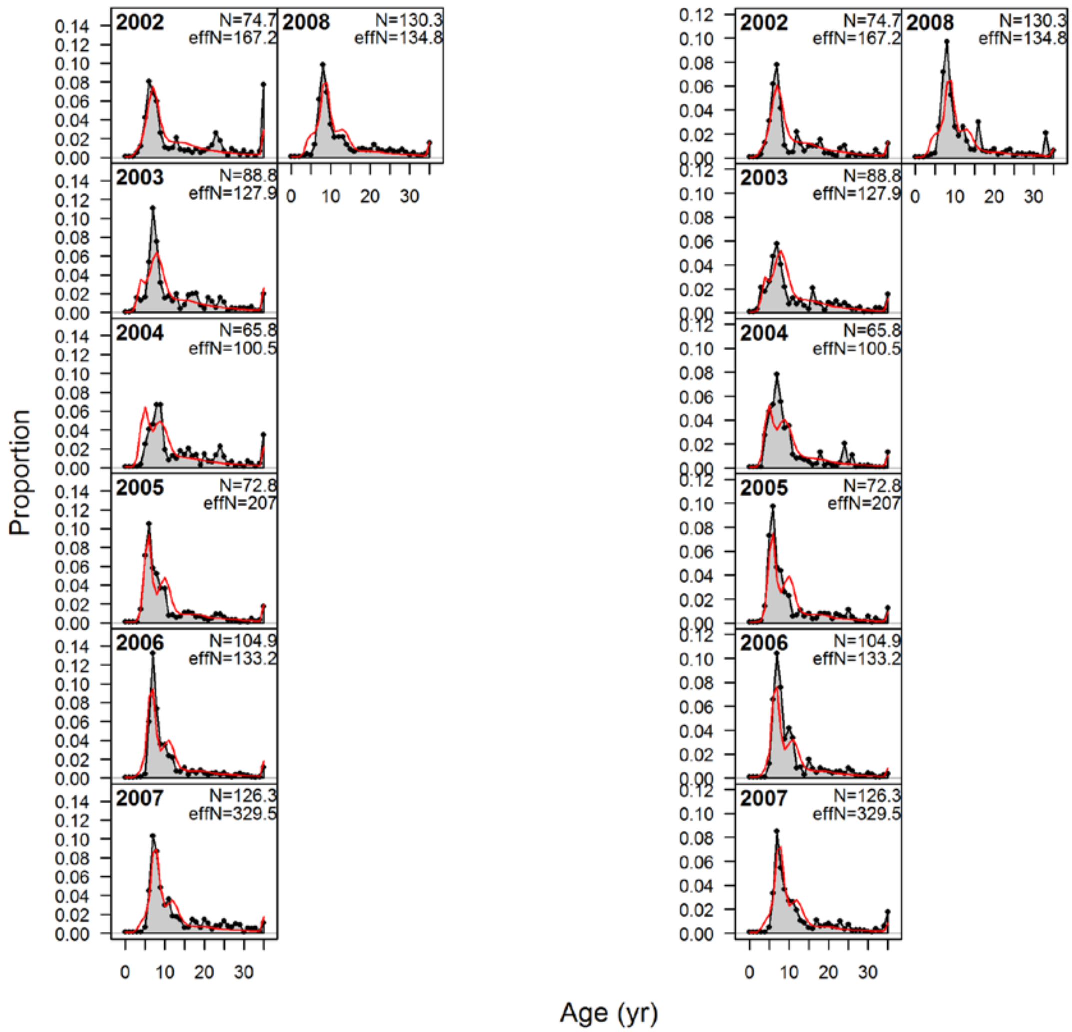

Figure 76: Fit to age-frequency distributions of female (left panel) and male (right panel) darkblotched rockfish from the domestic trawl fishery landings by year.

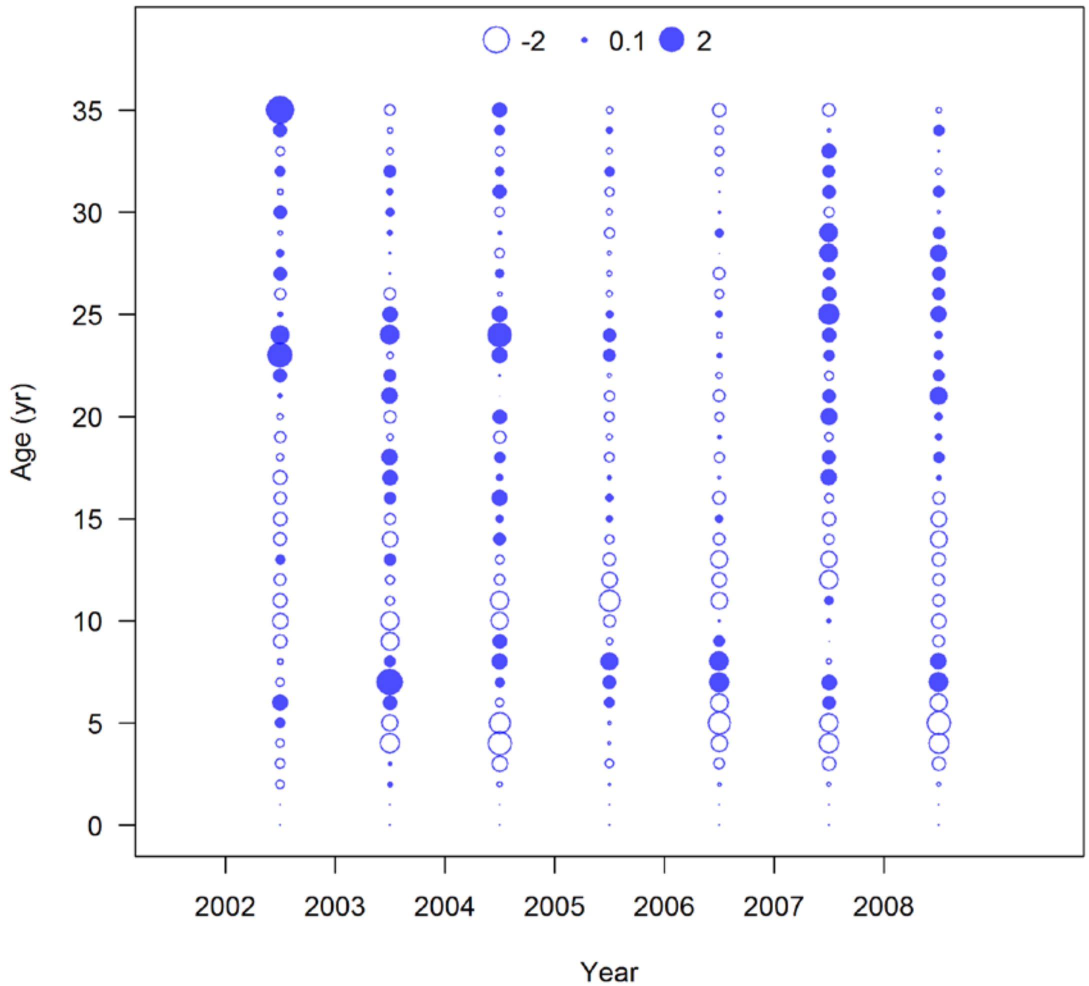

Figure 77: Pearson residuals for the fit to age-frequency distributions of female darkblotched rockfish from the domestic trawl fishery landings.

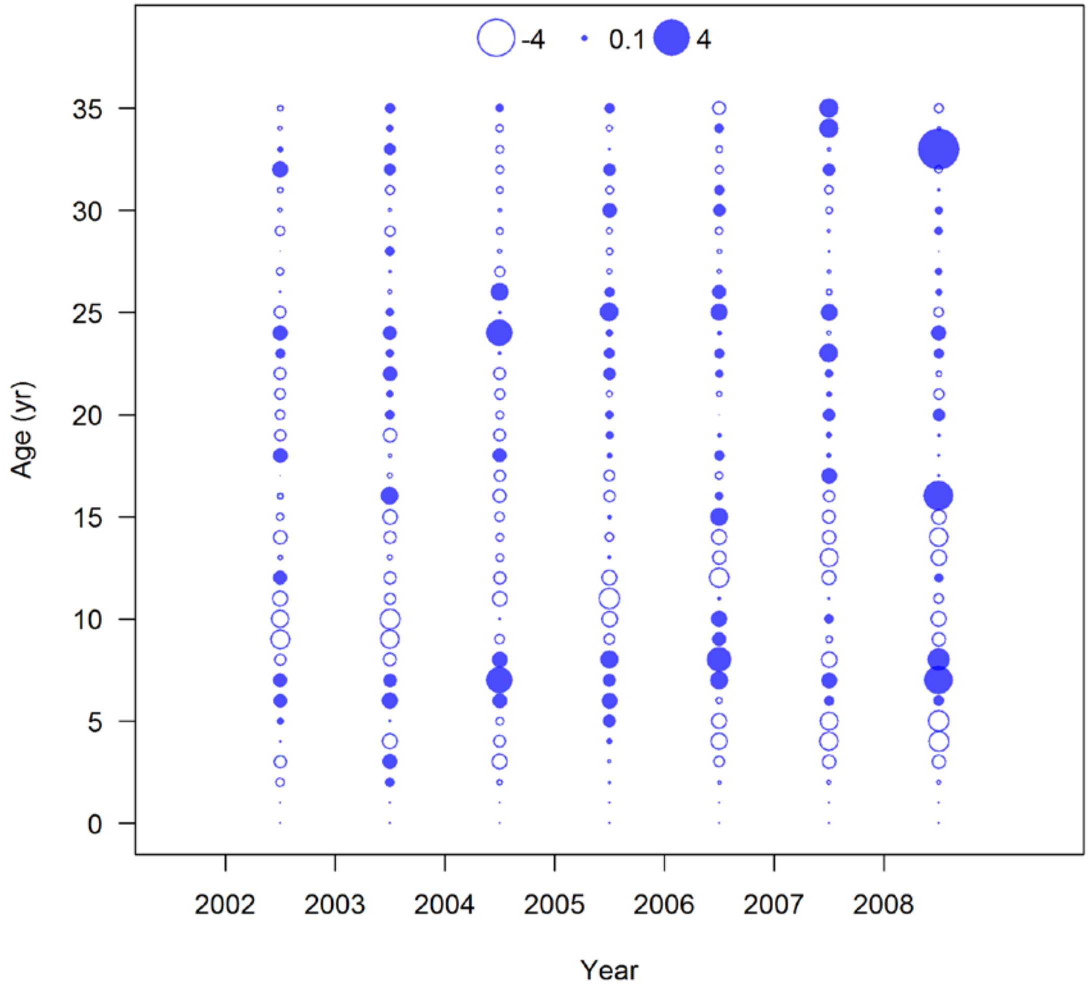

Figure 78: Pearson residuals for the fit to age-frequency distributions of male darkblotched rockfish from the domestic trawl fishery landings.

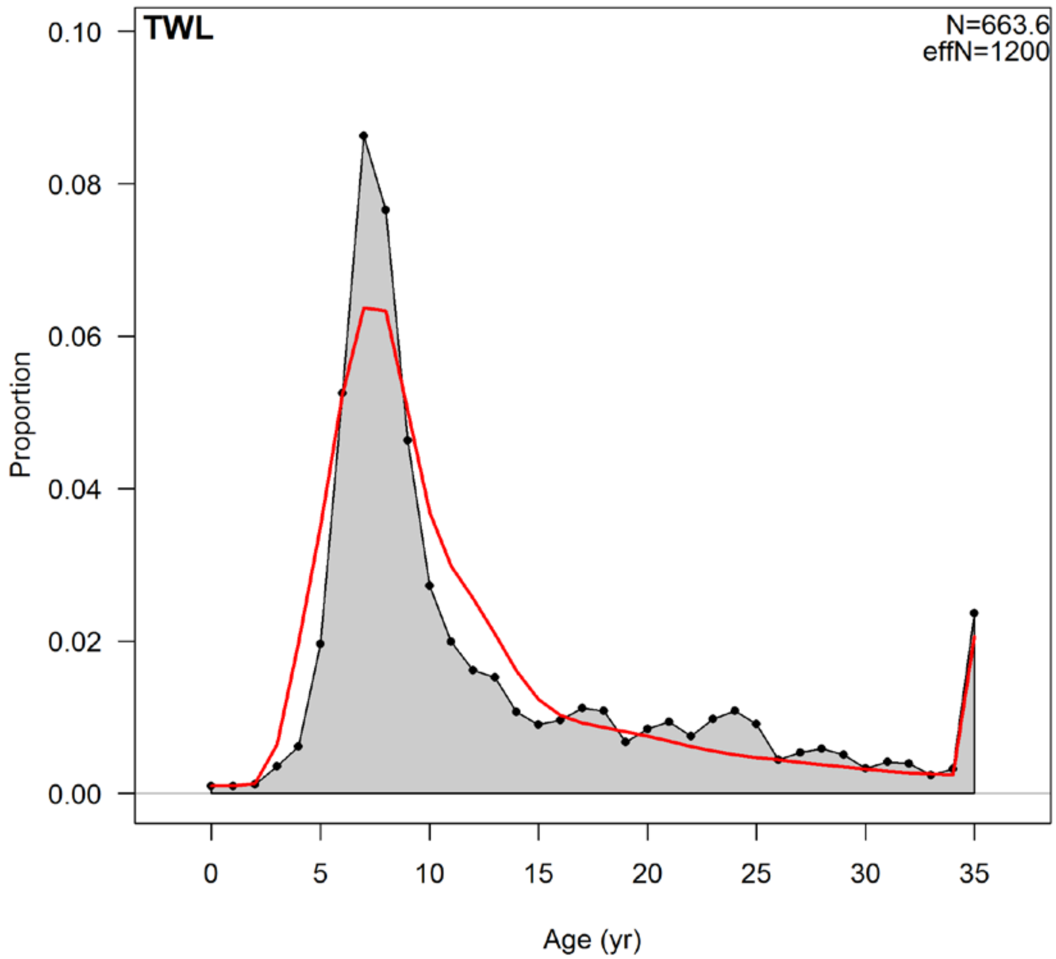

Figure 79: Fit to age-frequency distributions of female darkblotched rockfish from the domestic trawl fishery landings, aggregated across all years.

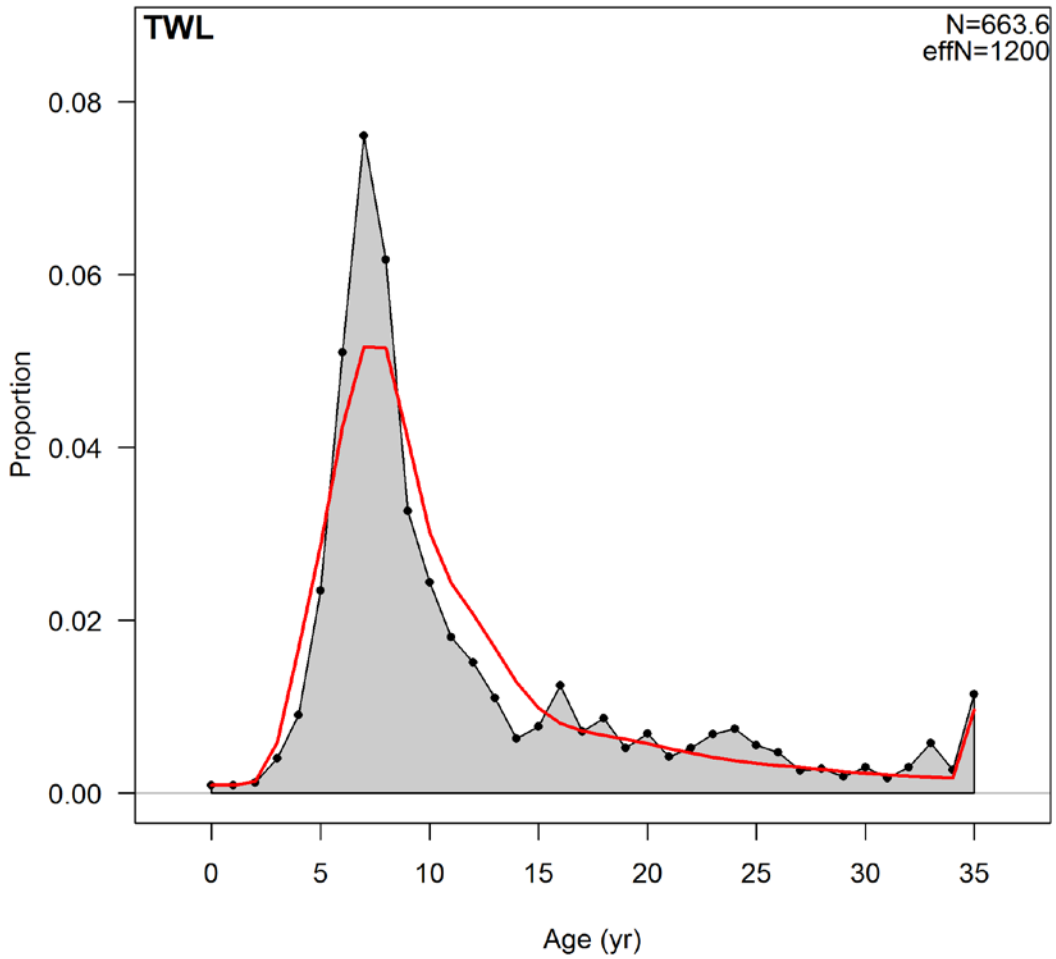

Figure 80: Fit to age-frequency distributions of male darkblotched rockfish from the domestic trawl fishery landings, aggregated across all years.

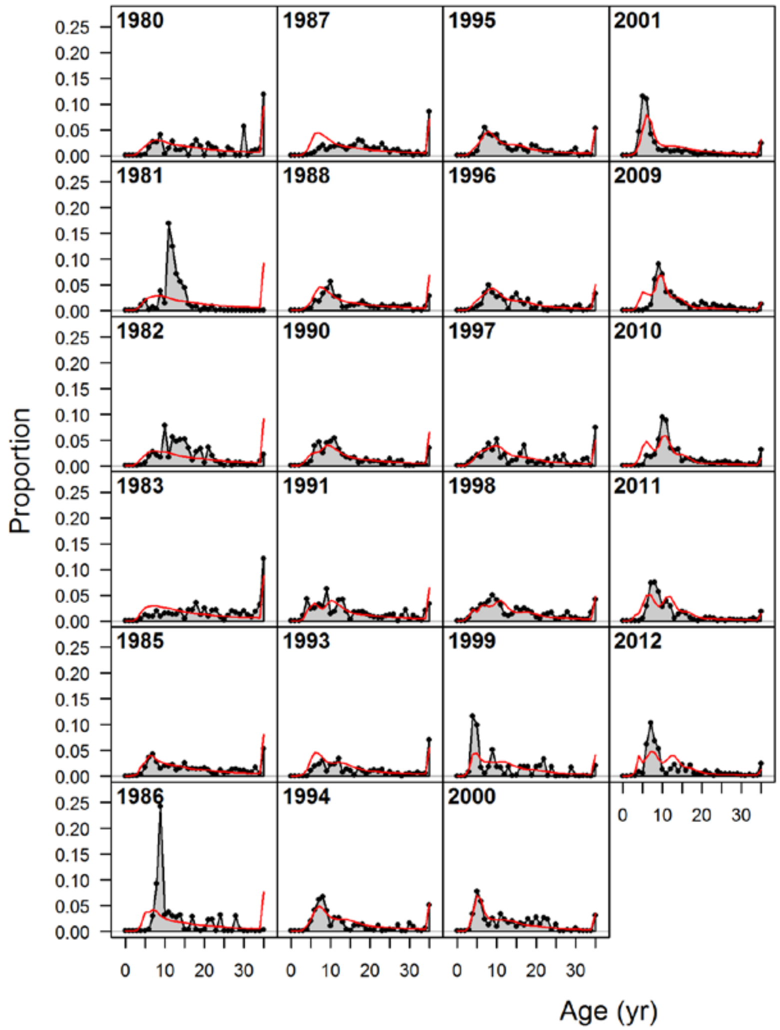

Figure 81: Implied fit to “ghost” marginal age compositions for female darkblotched rockfish from the domestic trawl landings. Age data from these years were not explicitly used in the assessment. Fits are provided for evaluation only, but not included in the model likelihood.

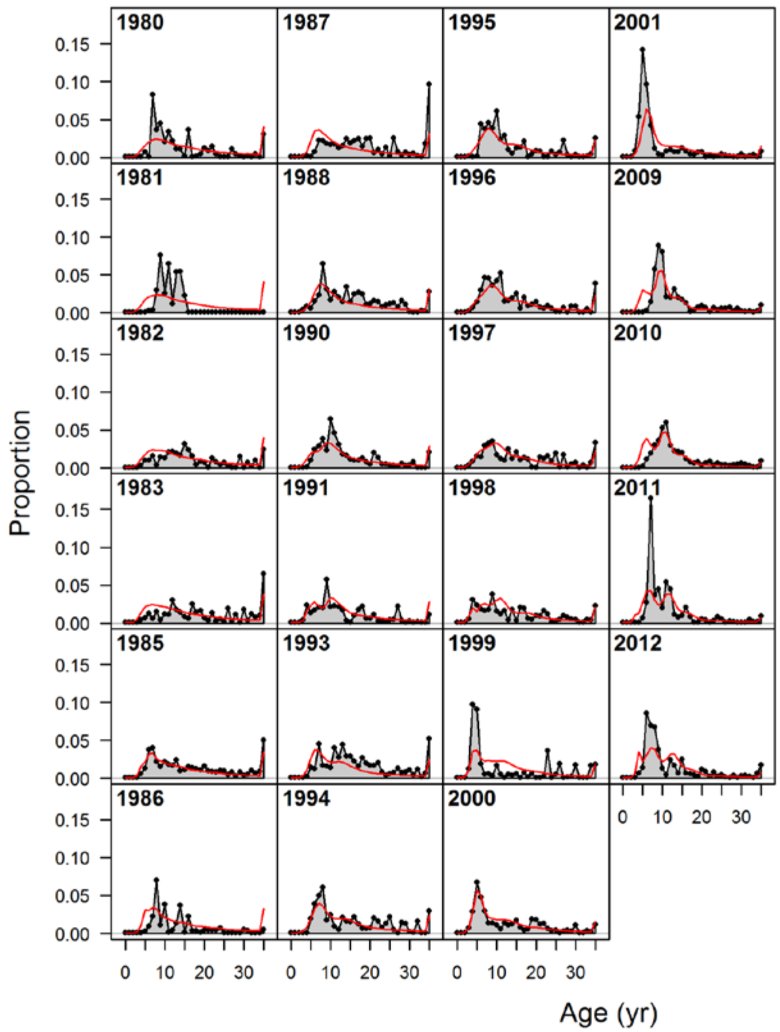

Figure 82: Implied fit to “ghost” marginal age compositions for male darkblotched rockfish from the domestic trawl landings. Age data from these years were not explicitly used in the assessment. Fits are provided for evaluation only, but not included in the model likelihood.

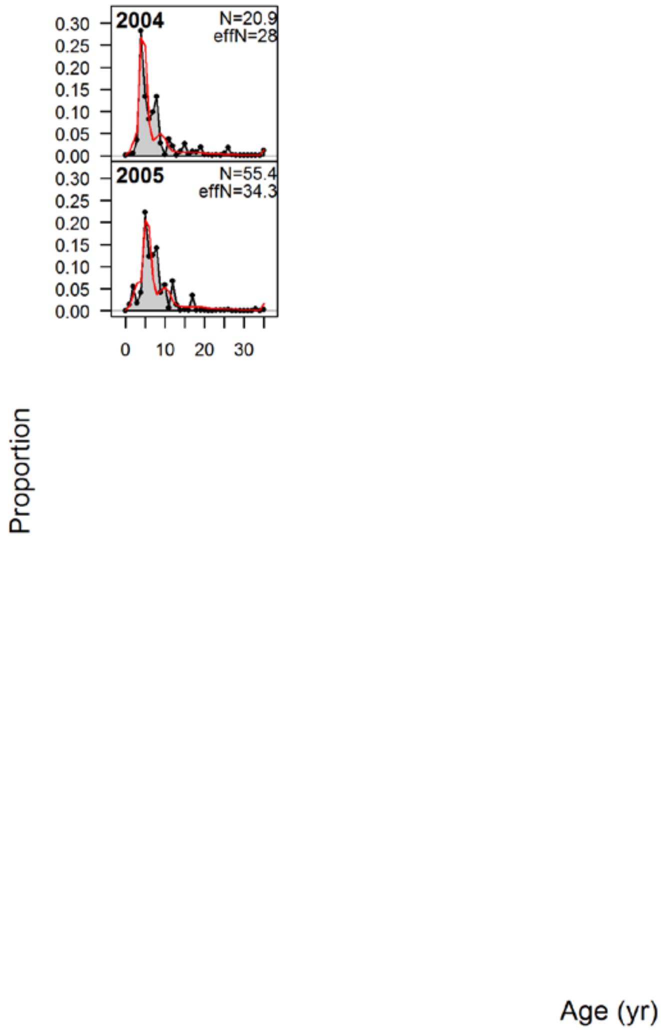

Figure 83: Fit to age-frequency distributions of darkblotched rockfish (sexes combined) from the domestic trawl fishery discard by year.

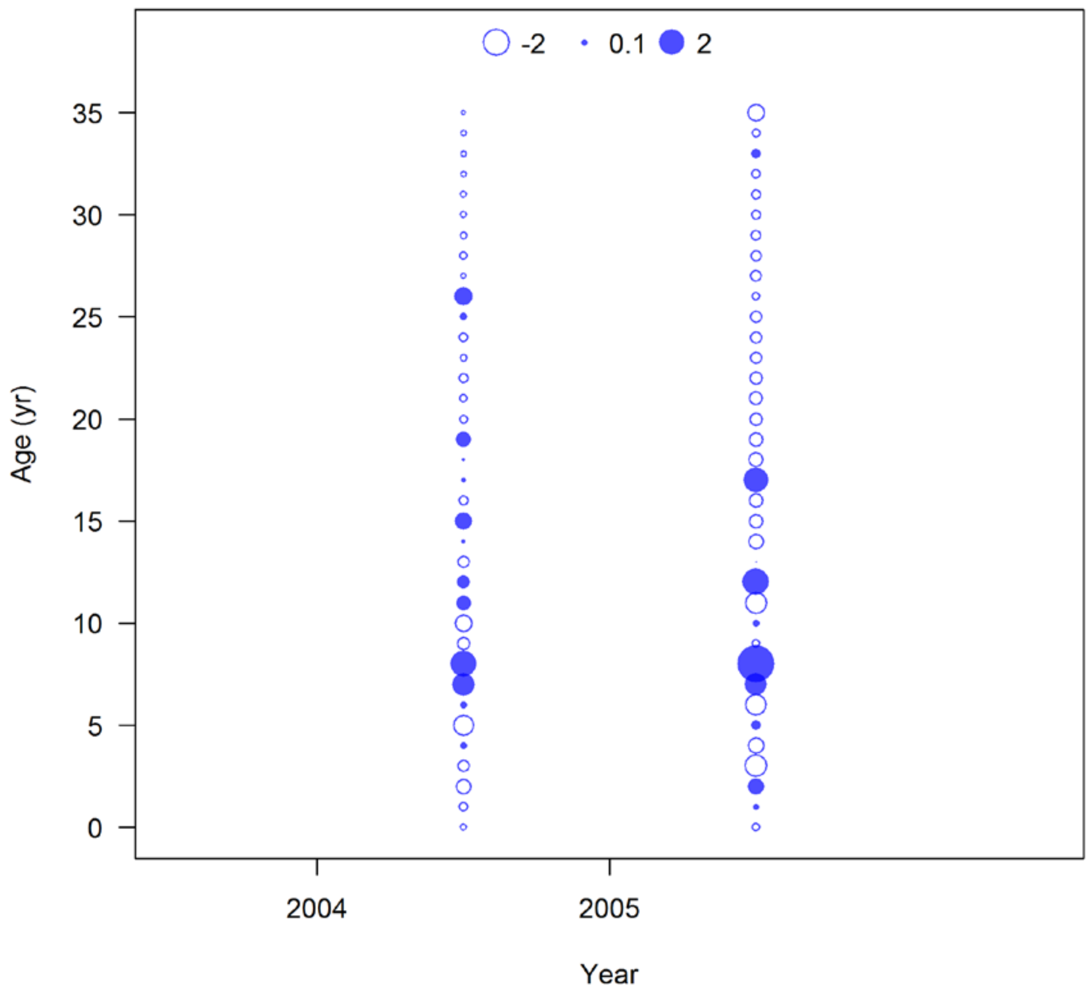

Figure 84: Pearson residuals for the fit to age-frequency distributions of darkblotched rockfish (sexes combined) from the domestic trawl fishery discard**.**

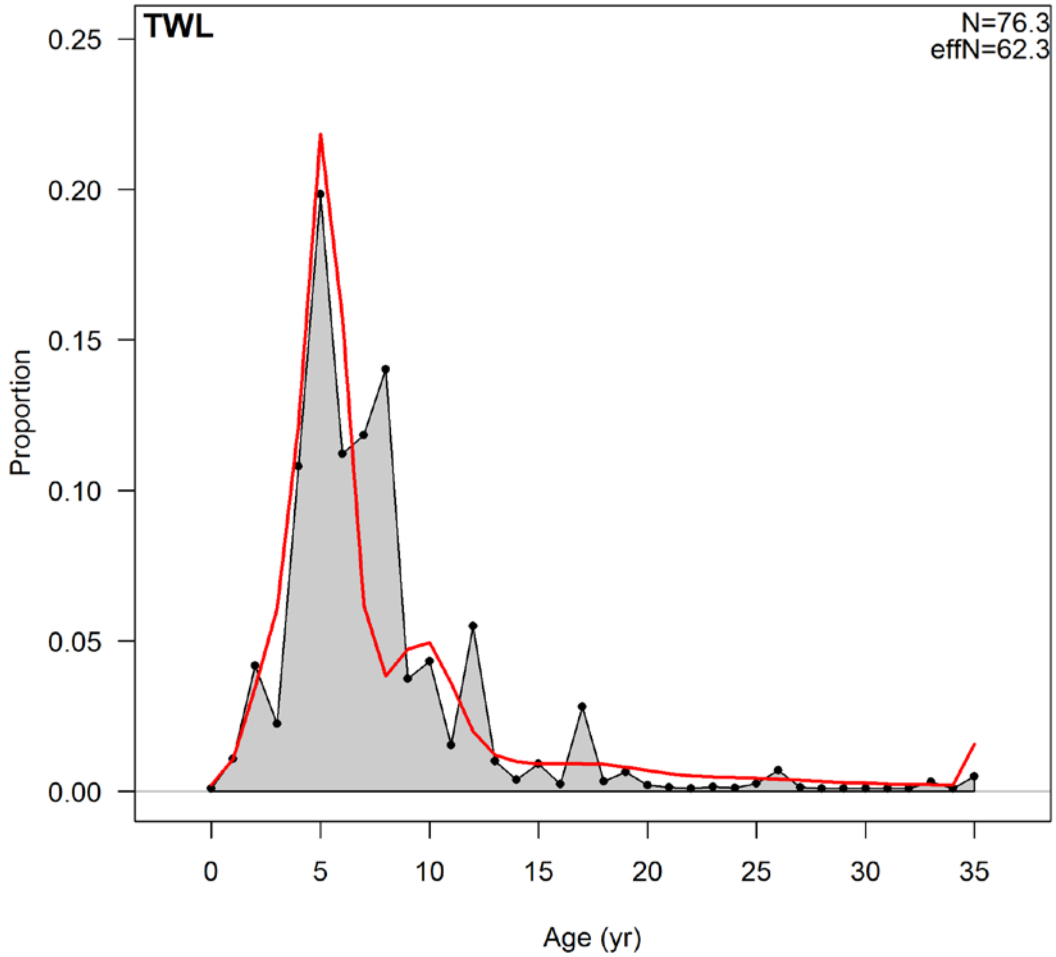

Figure 85: Fit to age-frequency distributions of darkblotched rockfish (sexes combined) from the domestic trawl fleet discard, aggregated across all years.

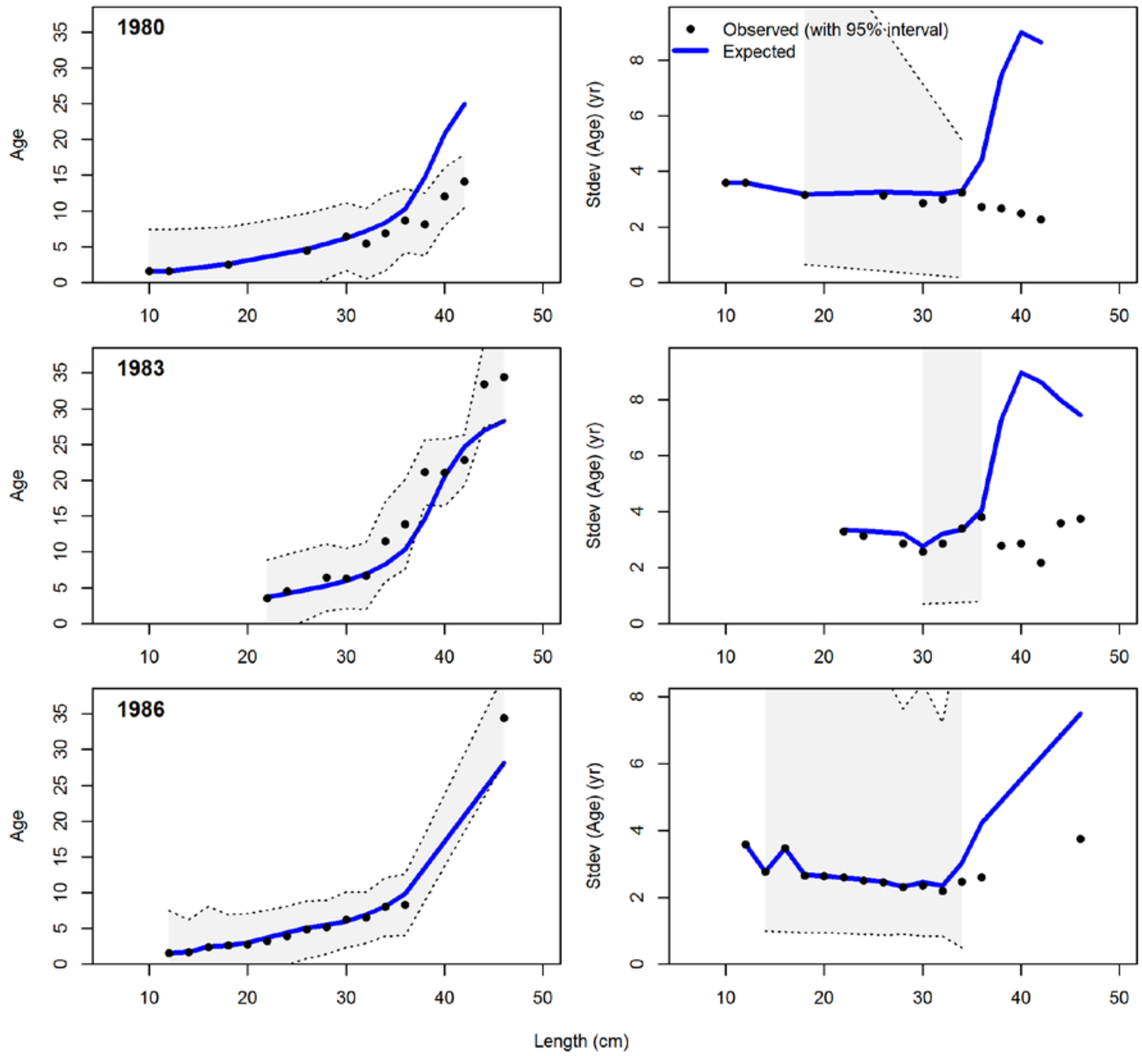

Figure 86: Fit to conditional ages-at-length compositions of female darkblotched rockfish from the AFSC shelf survey.

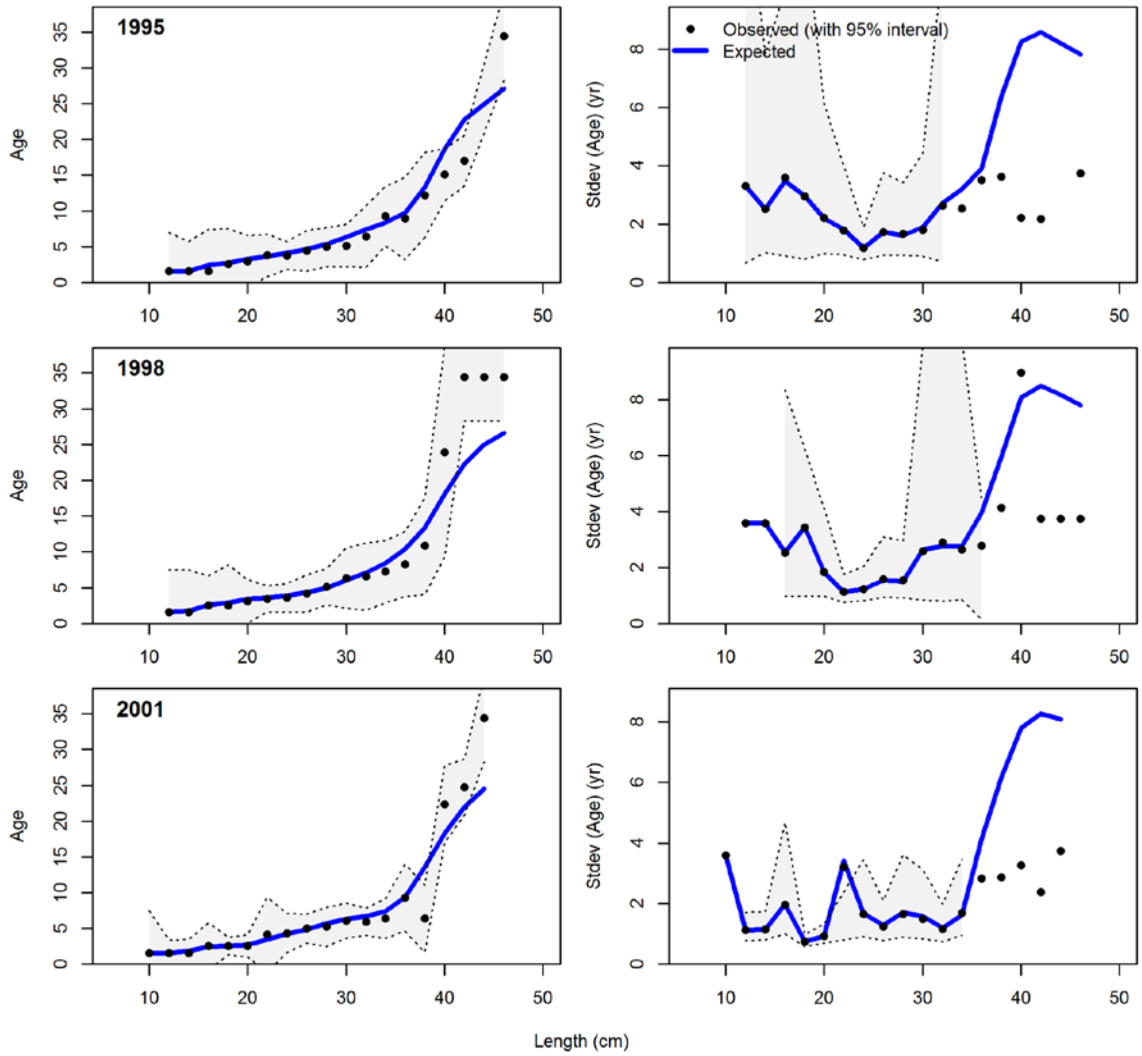

Figure 86 (continued): Fit to conditional ages-at-length compositions of female darkblotched rockfish from the AFSC shelf survey.

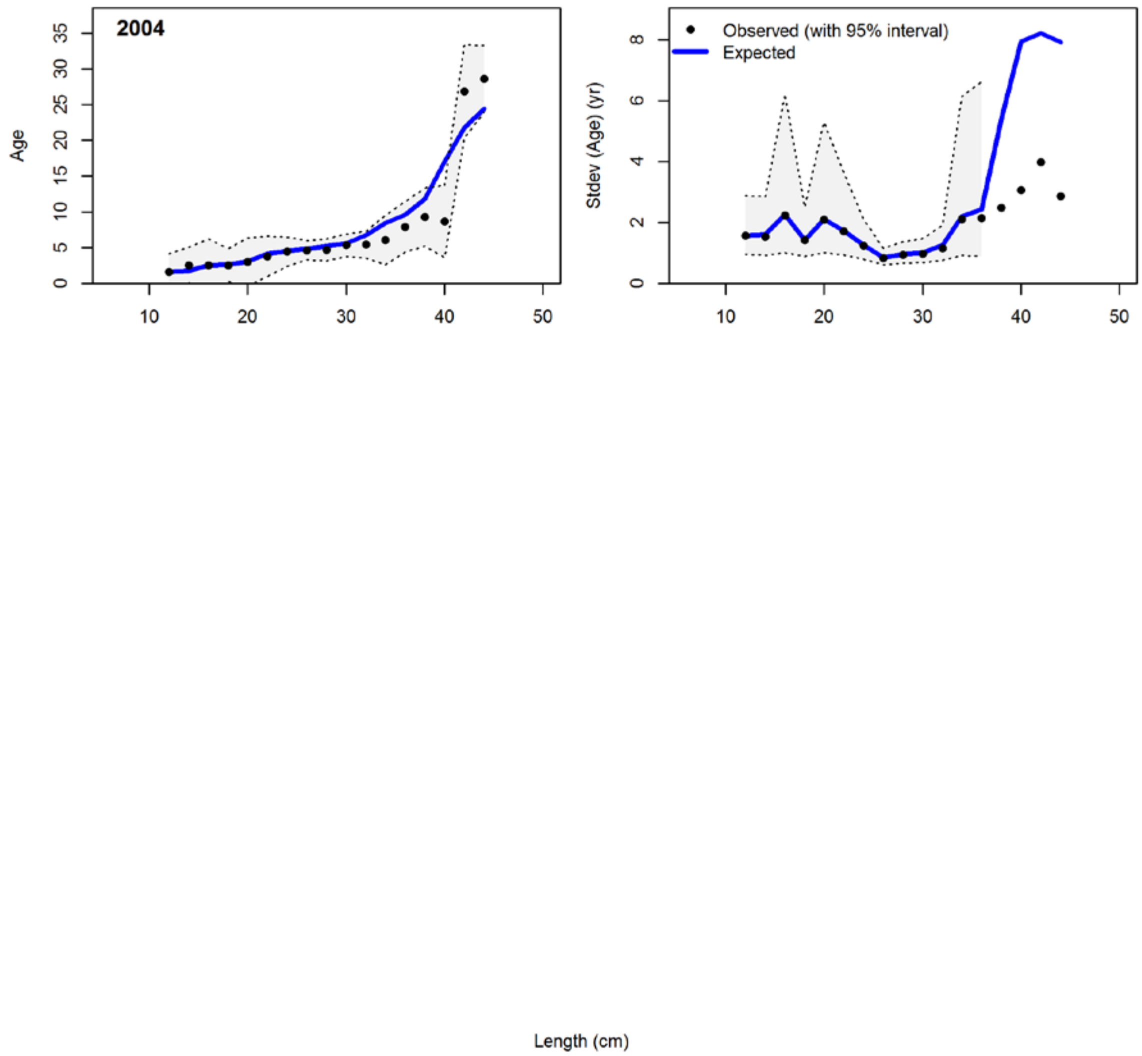

Figure 86 (continued): Fit to conditional ages-at-length compositions of female darkblotched rockfish from the AFSC shelf survey.

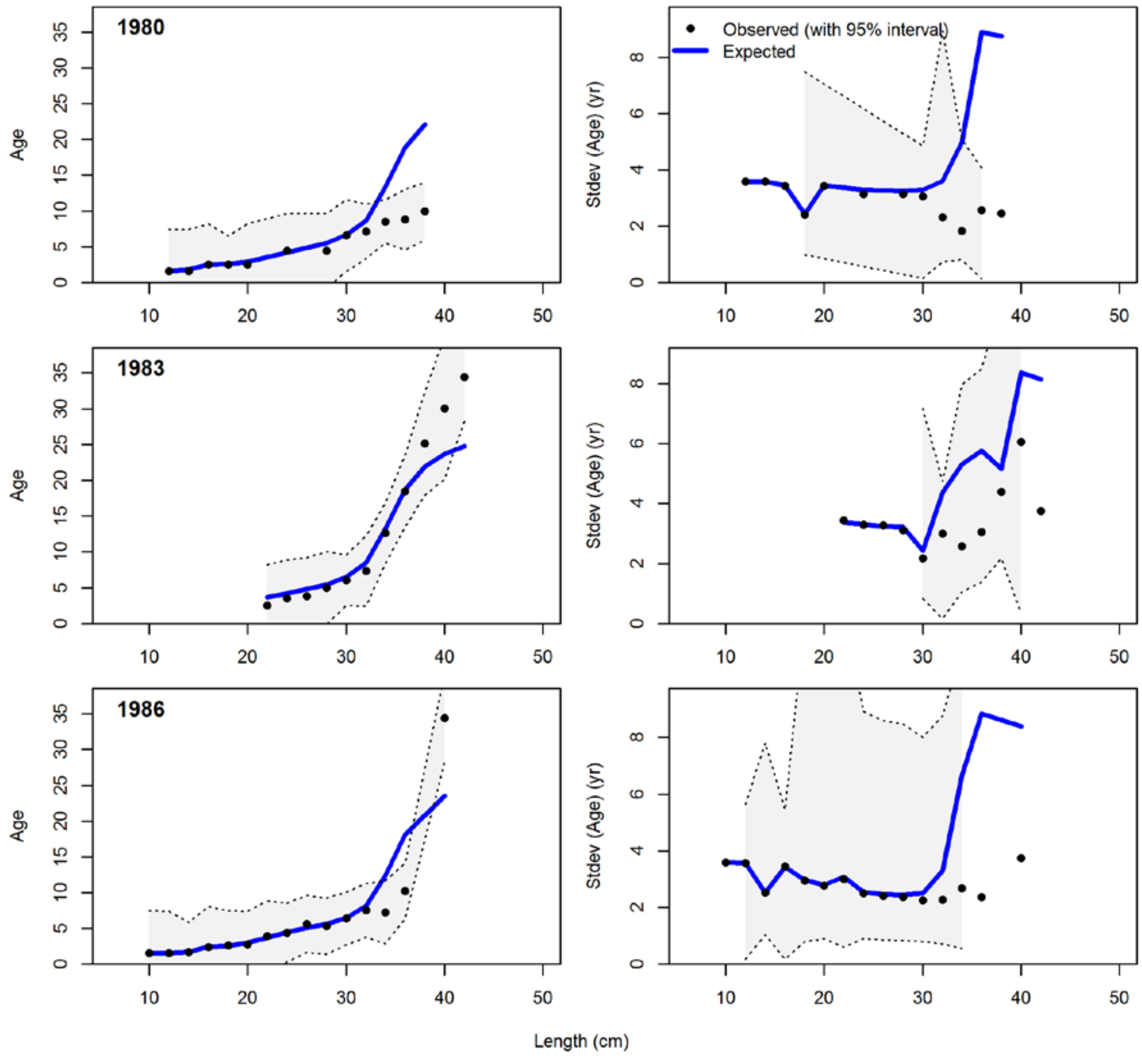

Figure 87: Fit to conditional ages-at-length compositions of male darkblotched rockfish from the AFSC shelf survey.

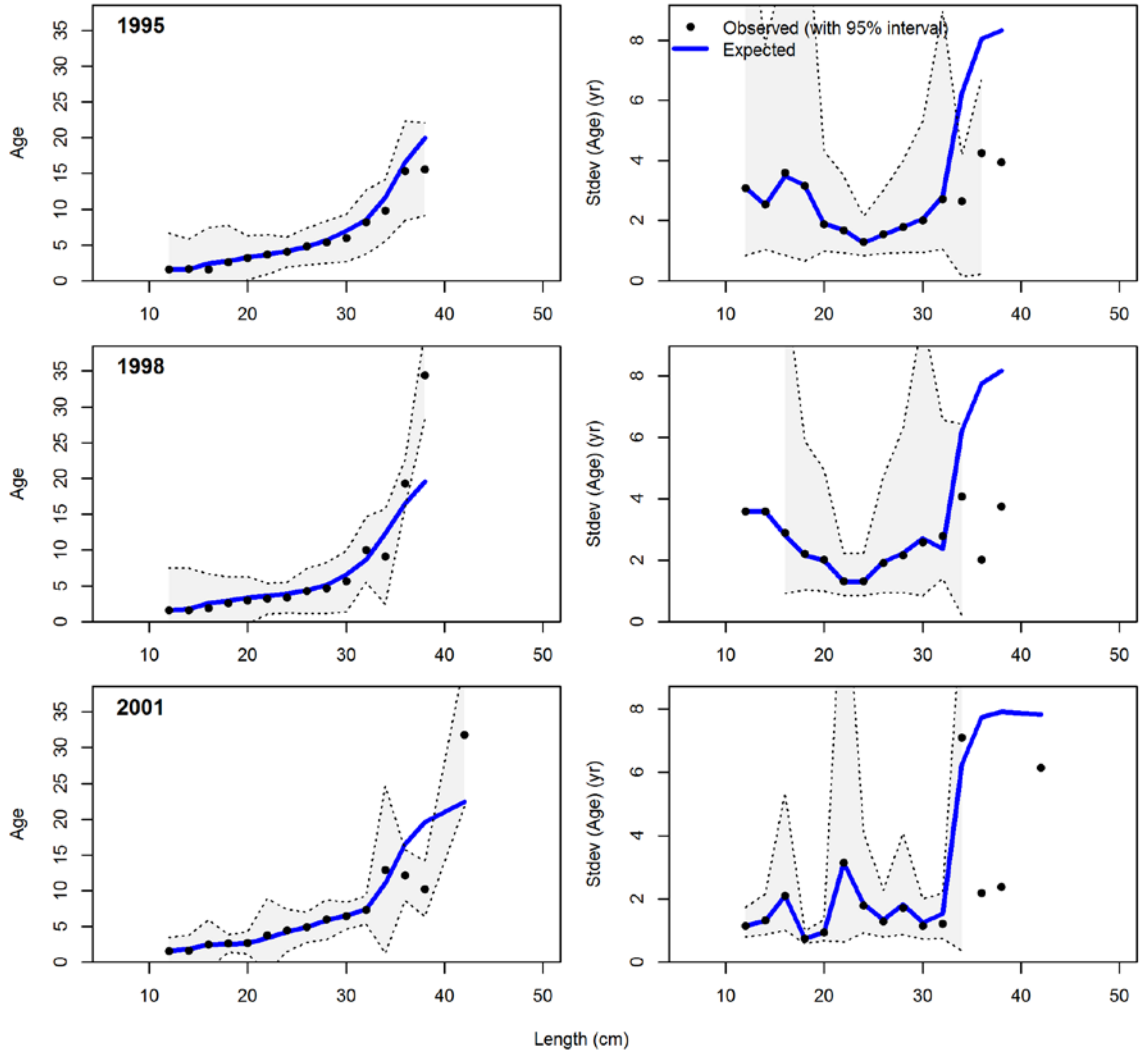

Figure 87 (continued): Fit to conditional ages-at-length compositions of male darkblotched rockfish from the AFSC shelf survey.

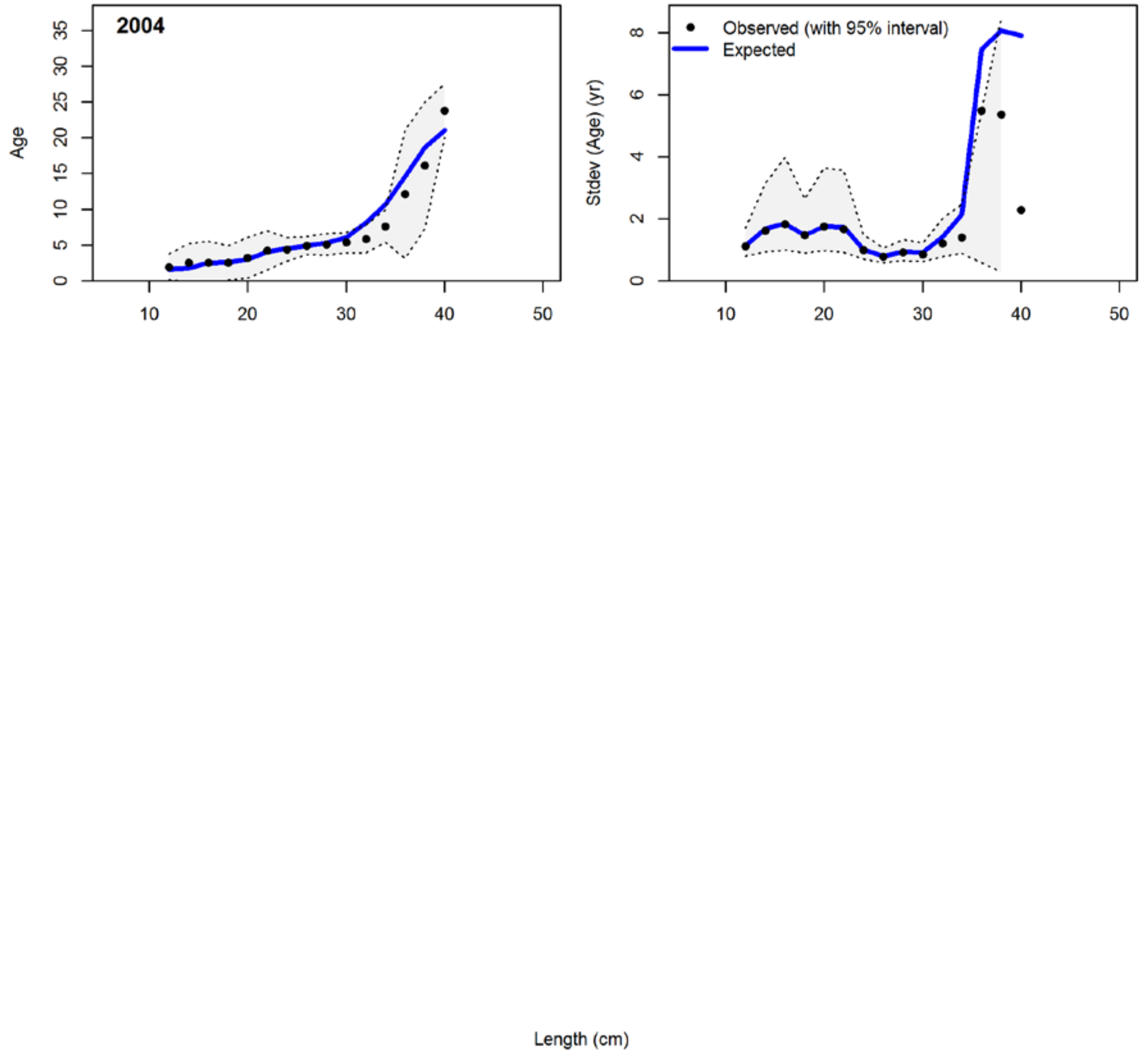

Figure 87 (continued): Fit to conditional ages-at-length compositions of male darkblotched rockfish from the AFSC shelf survey.

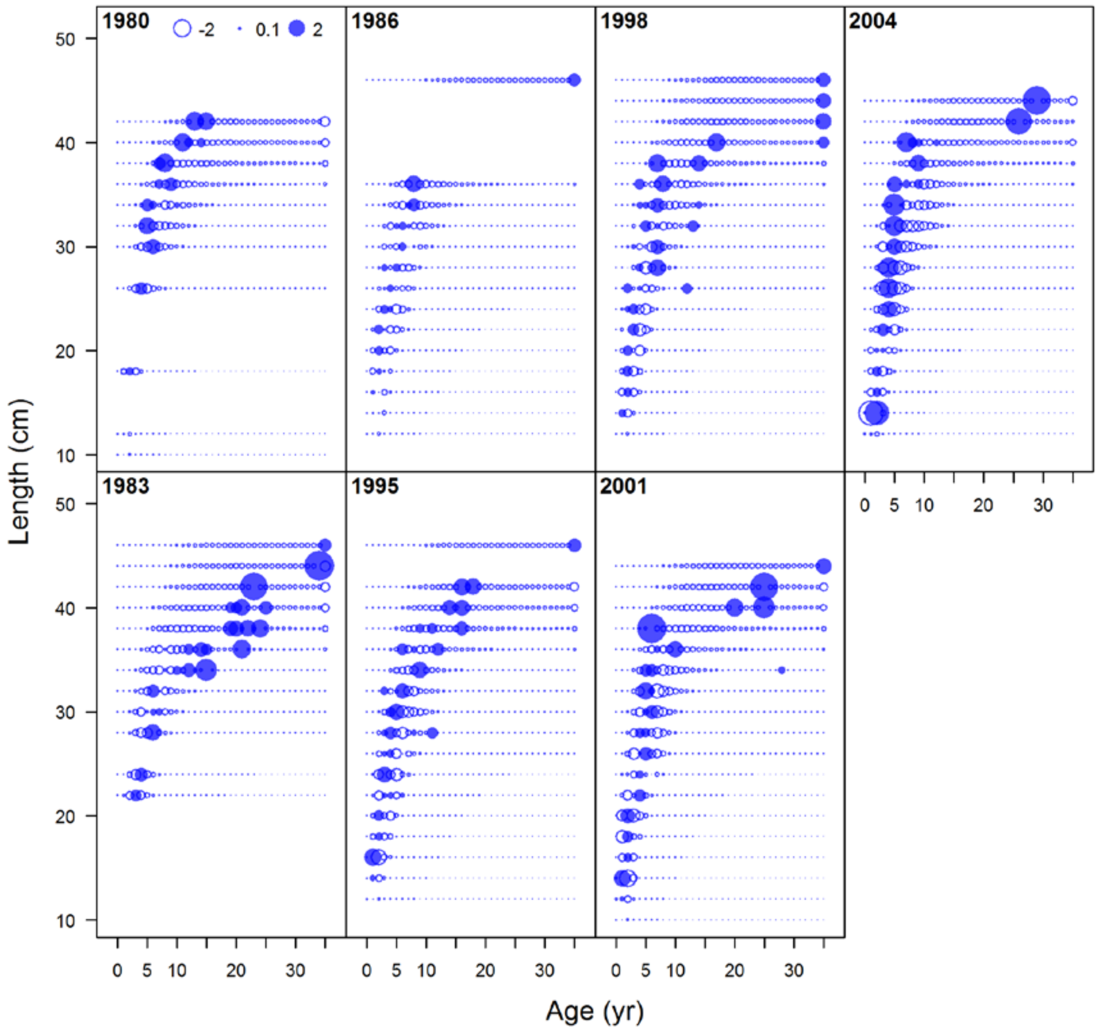

Figure 88: Pearson residuals for the fit to conditional ages-at-length compositions of female darkblotched rockfish from the AFSC shelf survey.

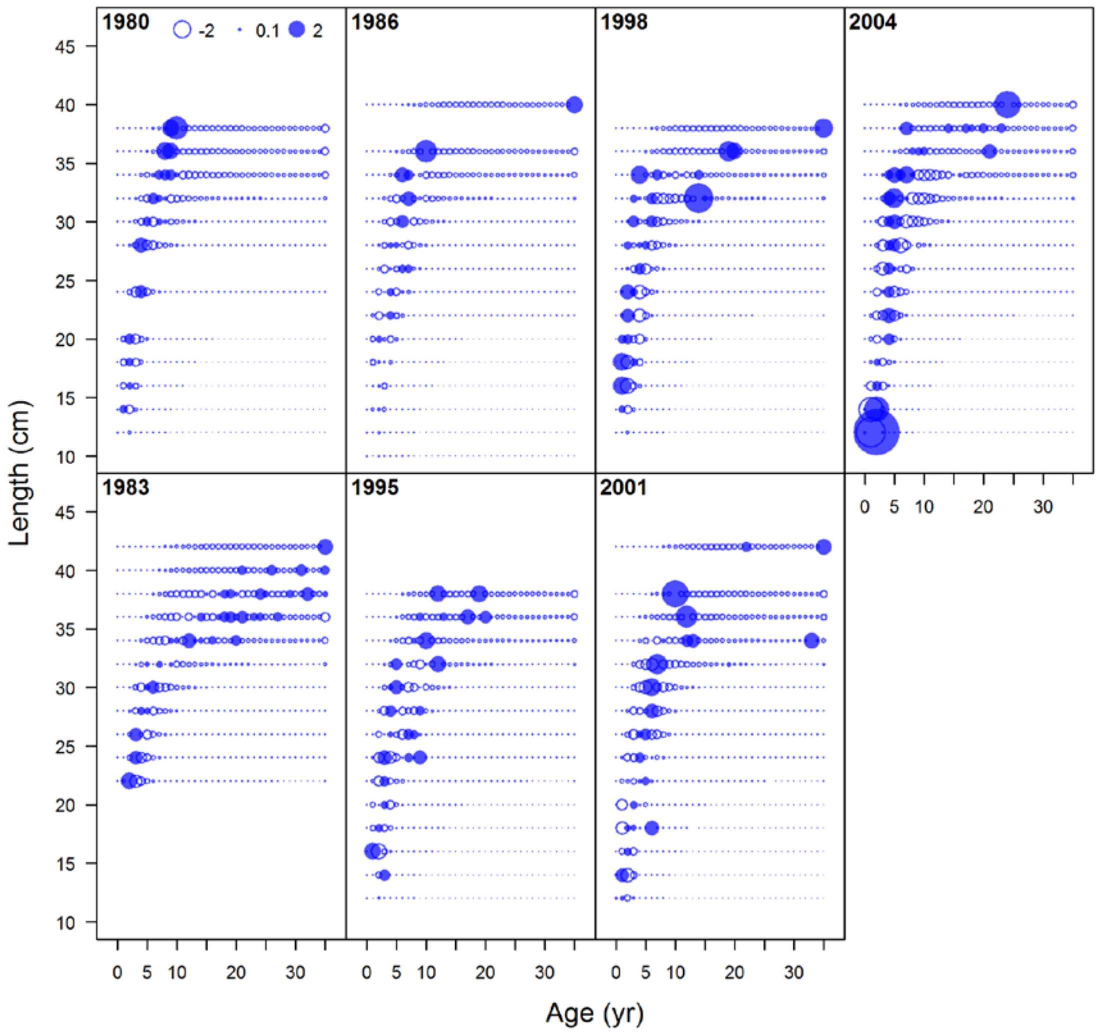

Figure 89: Pearson residuals for the fit to conditional ages-at-length compositions of male darkblotched rockfish from the AFSC shelf survey.

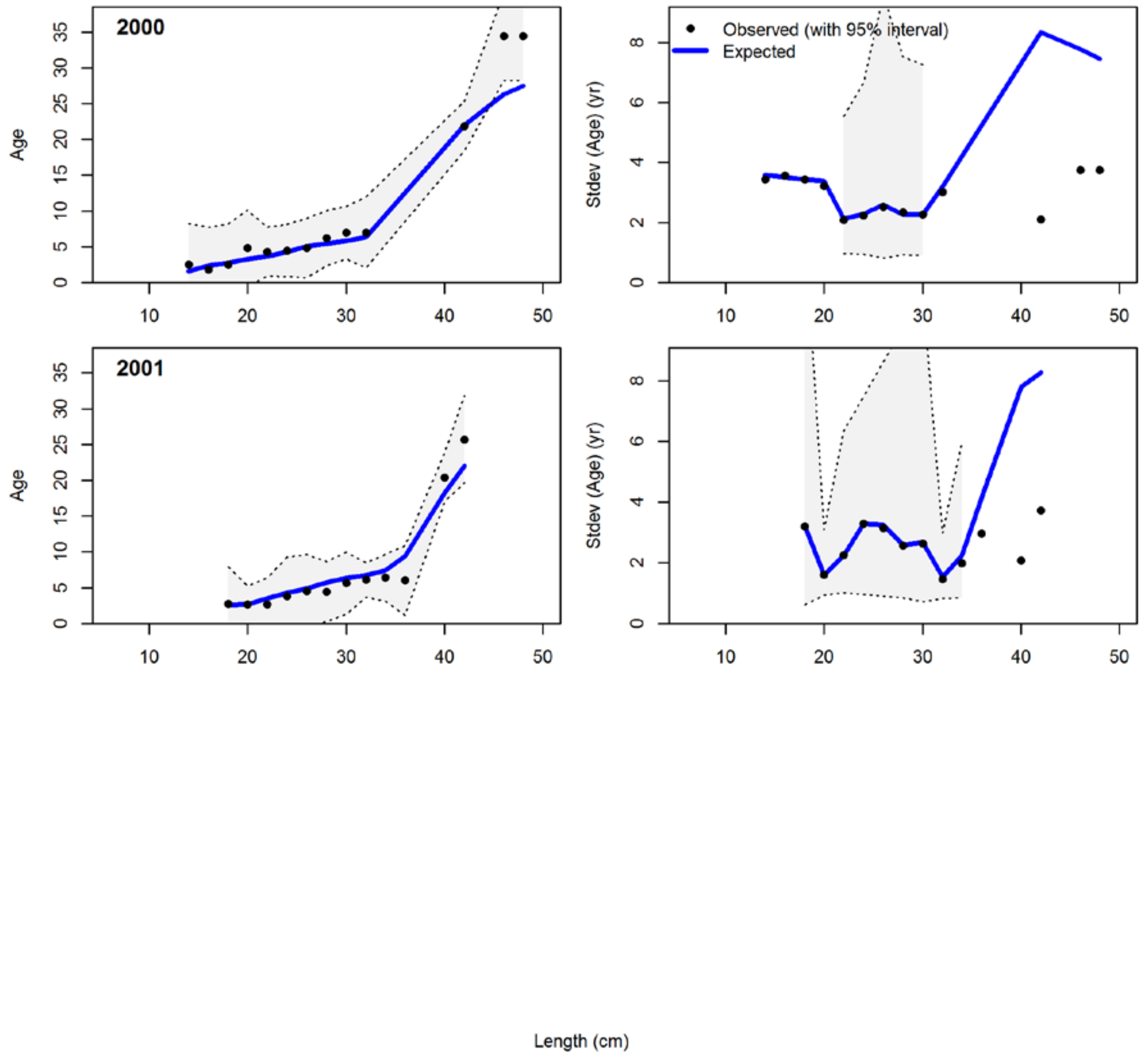

Figure 90: Fit to conditional ages-at-length compositions of female darkblotched rockfish from the AFSC slope survey.

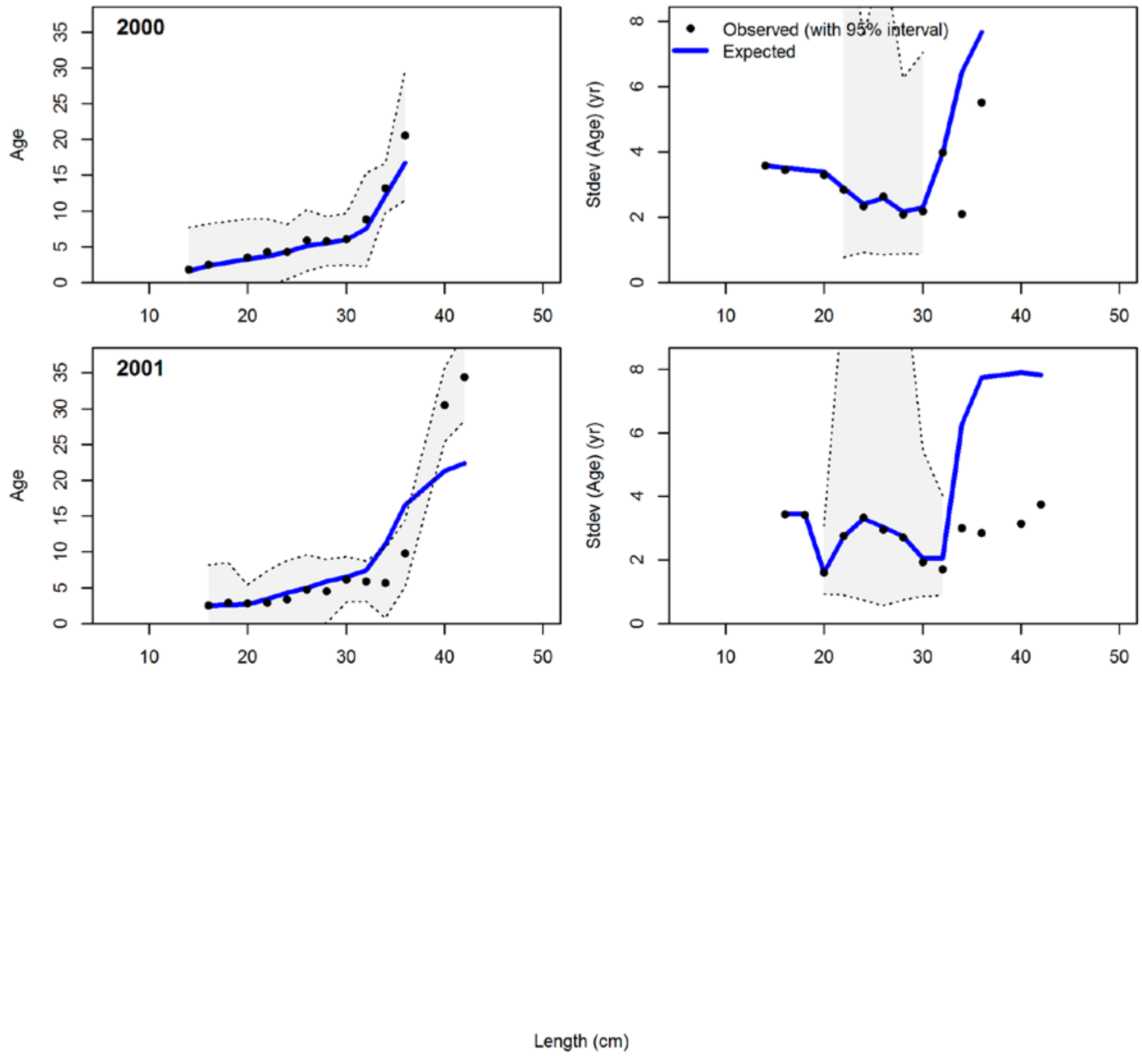

Figure 91: Fit to conditional ages-at-length compositions of male darkblotched rockfish from the AFSC slope survey.

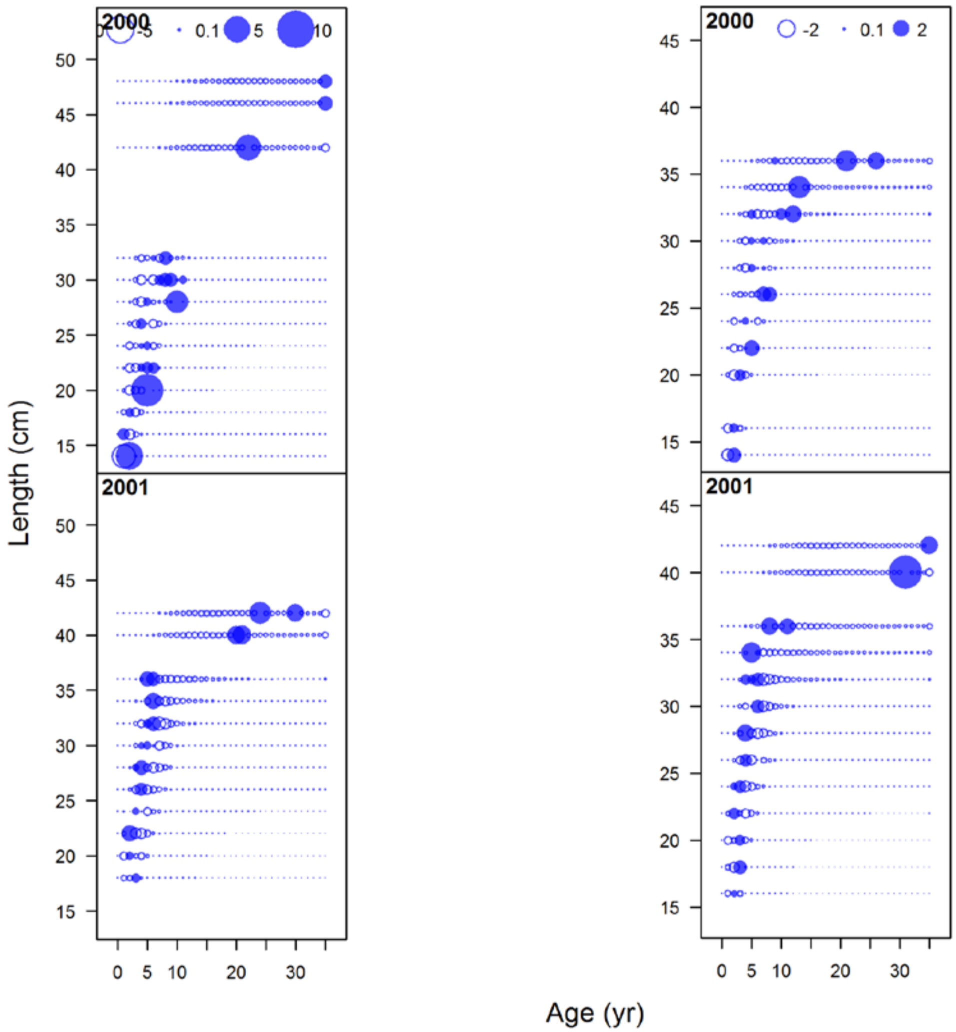

Figure 92: Pearson residuals for the fit to conditional ages-at-length compositions of female (left) and male (right) darkblotched rockfish from the AFSC slope survey.

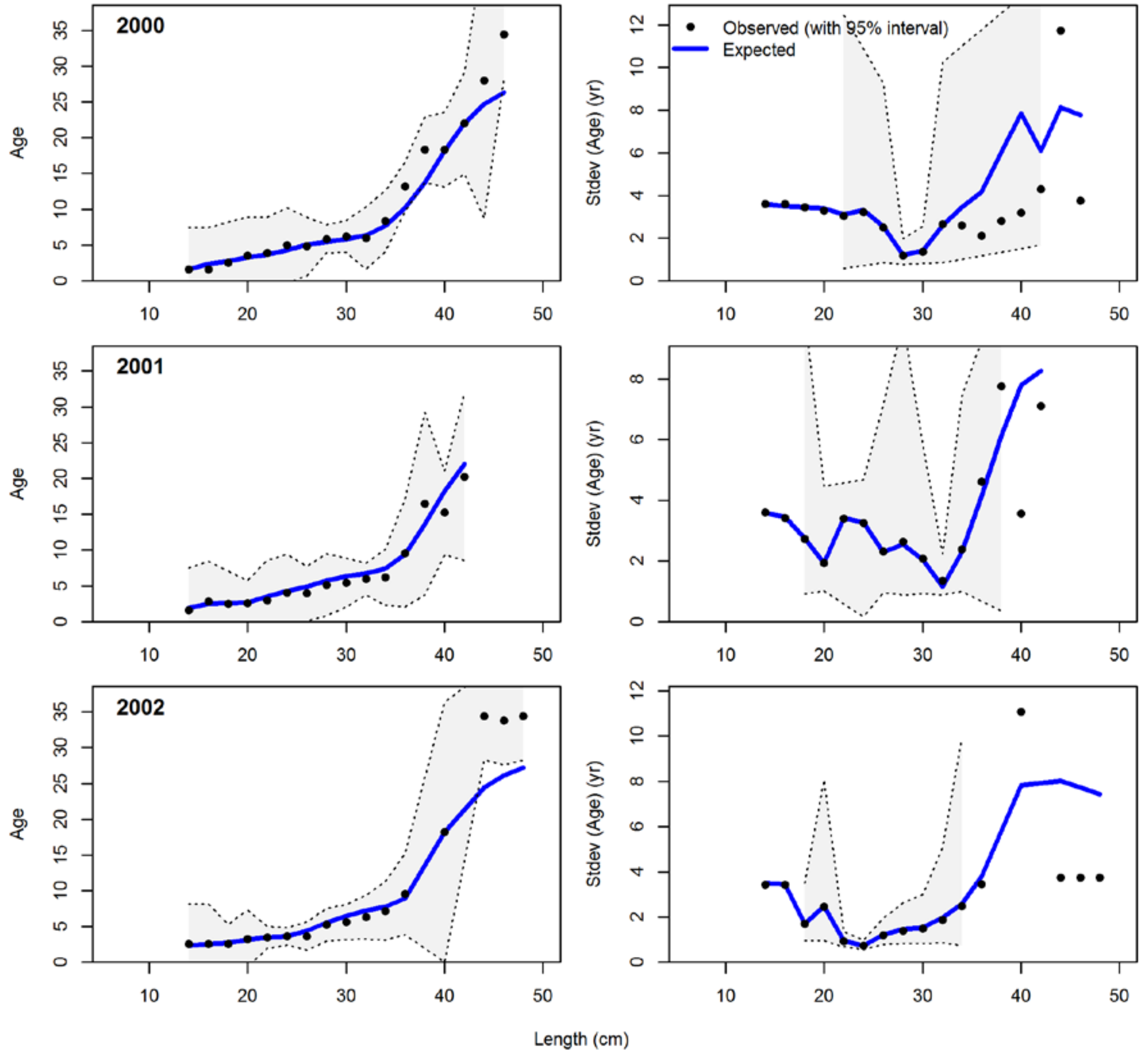

Figure 93: Fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC slope survey.

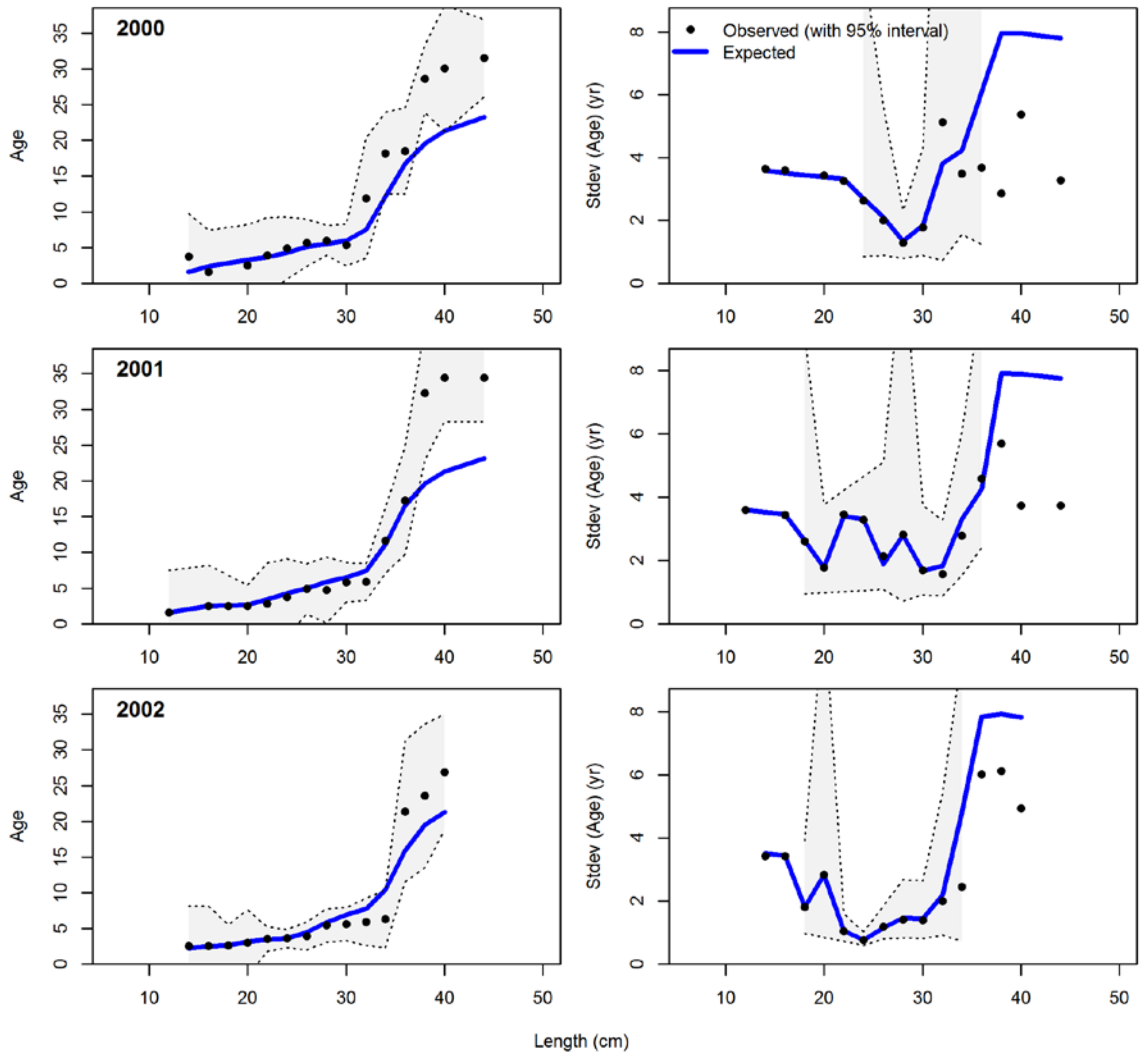

Figure 94: Fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC slope survey.

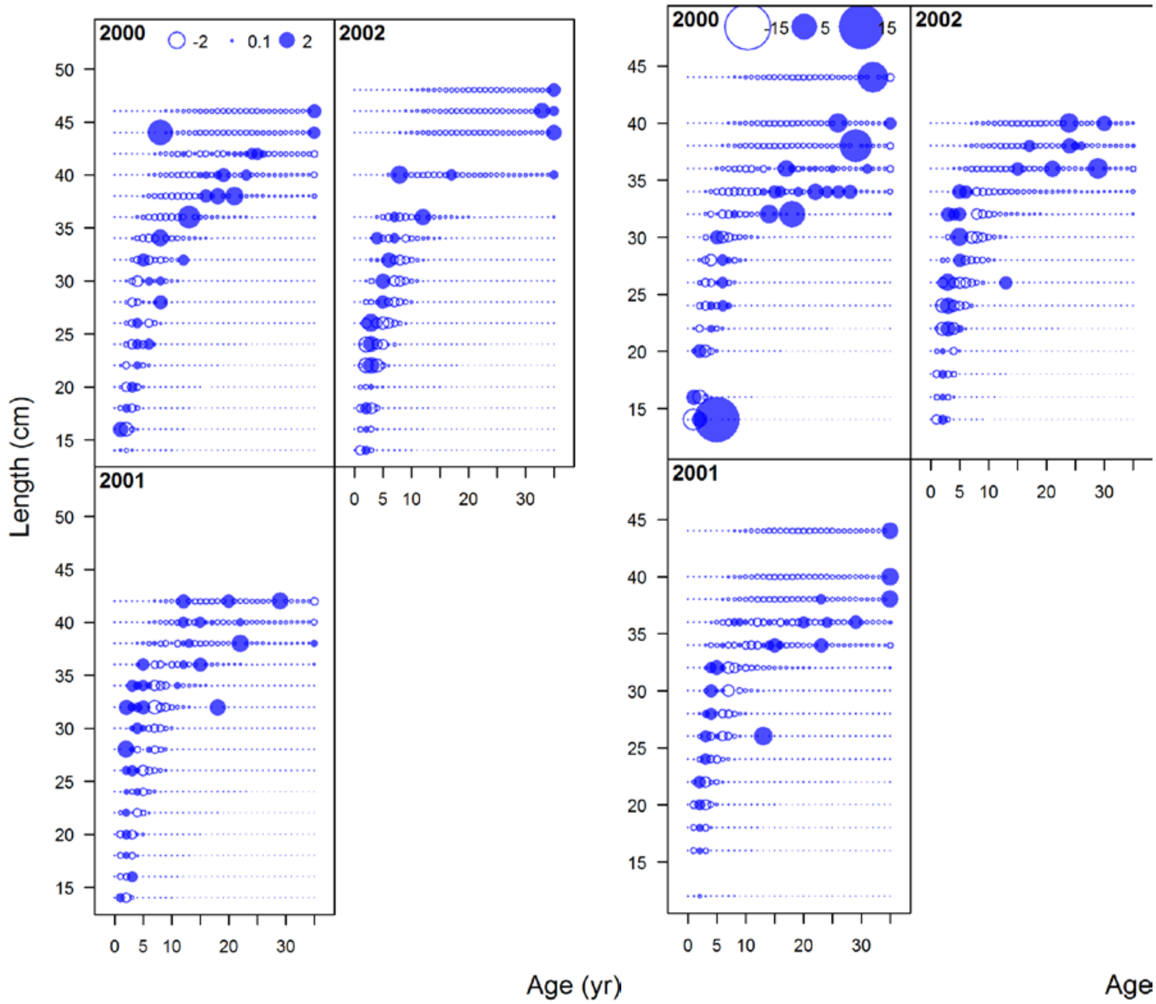

Figure 95: Pearson residuals for the fit to conditional ages-at-length compositions of female (left) and male (right) darkblotched rockfish from the NWFSC slope survey.

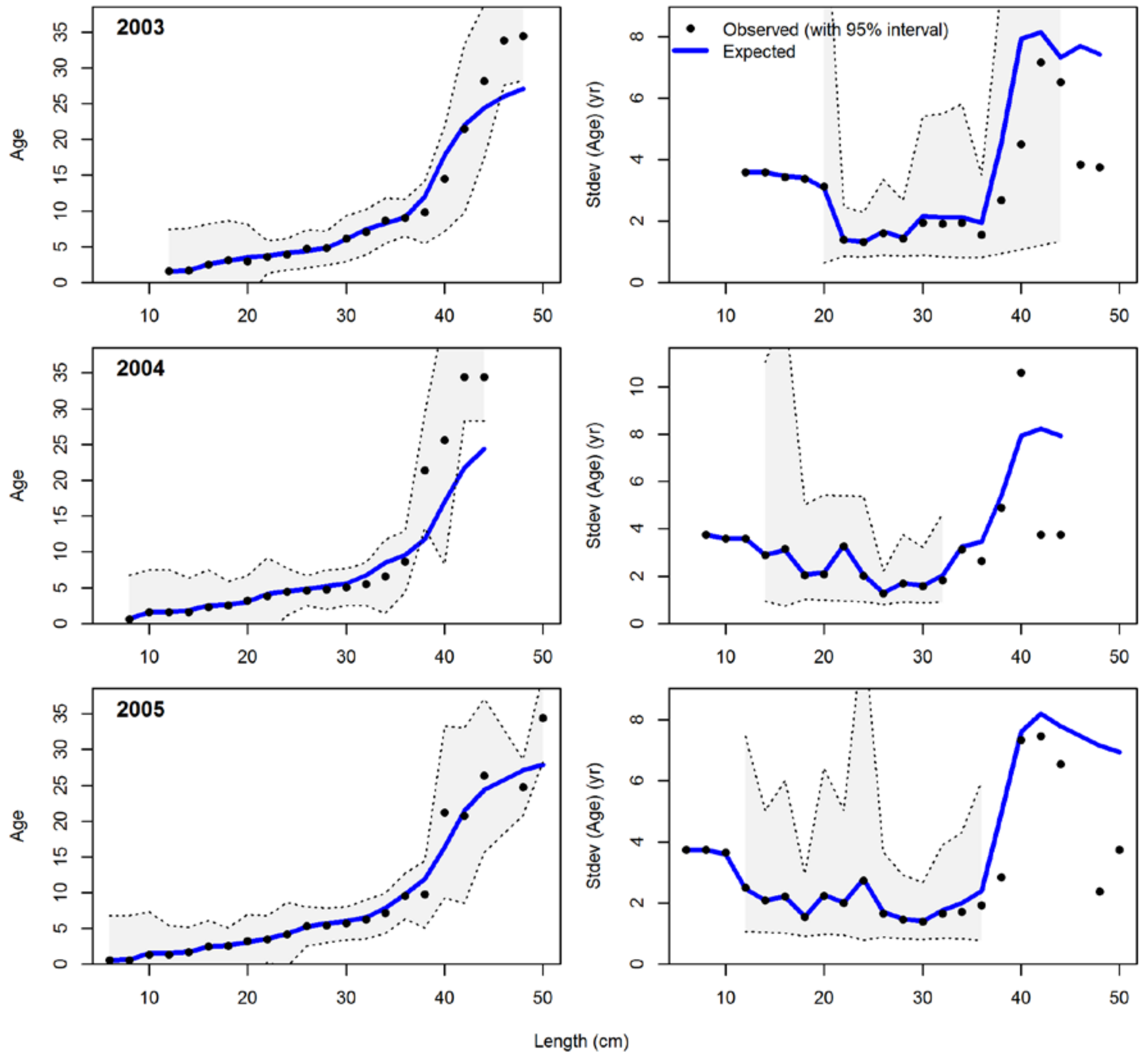

Figure 96: Fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

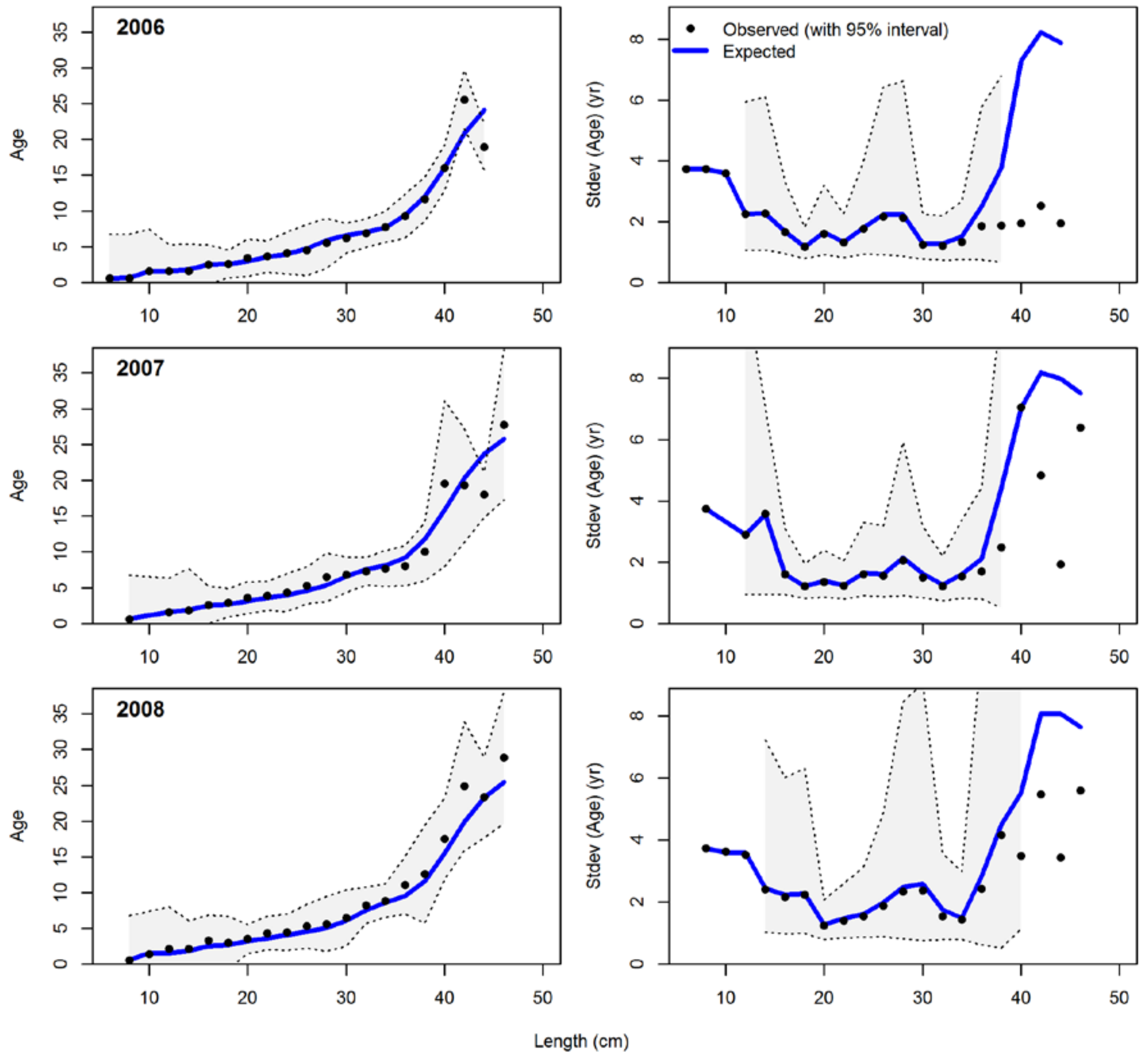

Figure 96 (continued): Fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

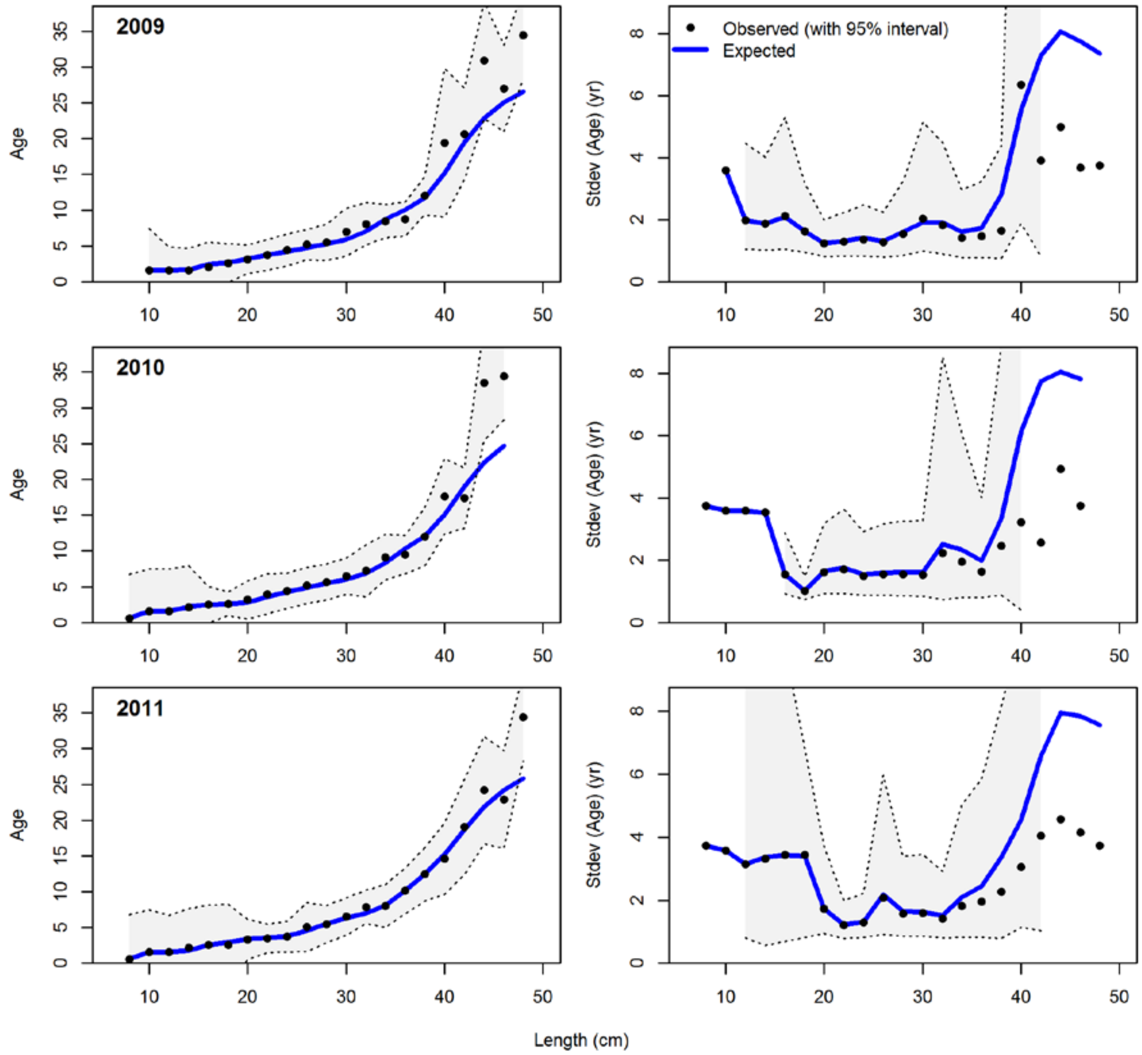

Figure 96 (continued): Fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

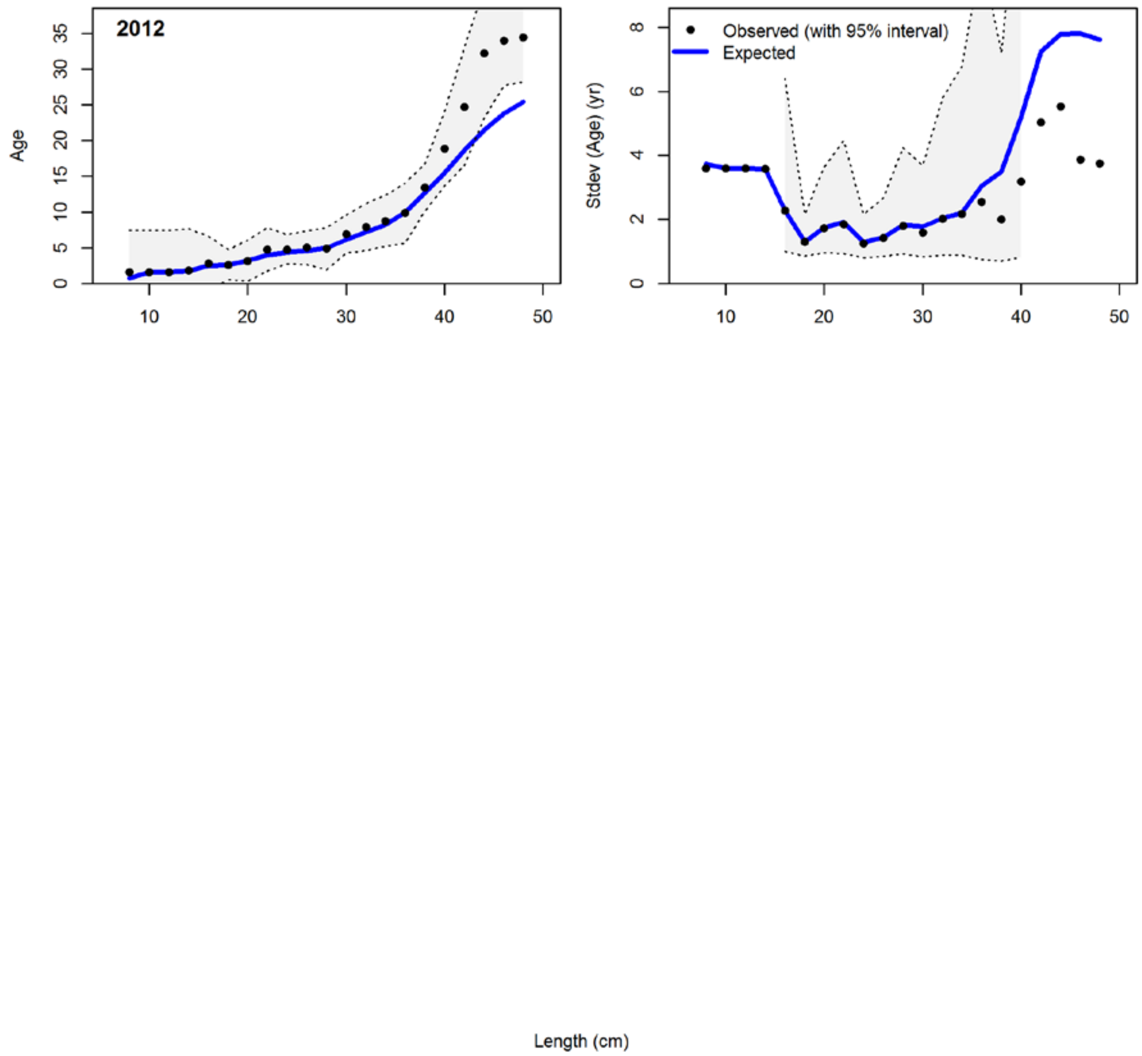

Figure 96 (continued): Fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

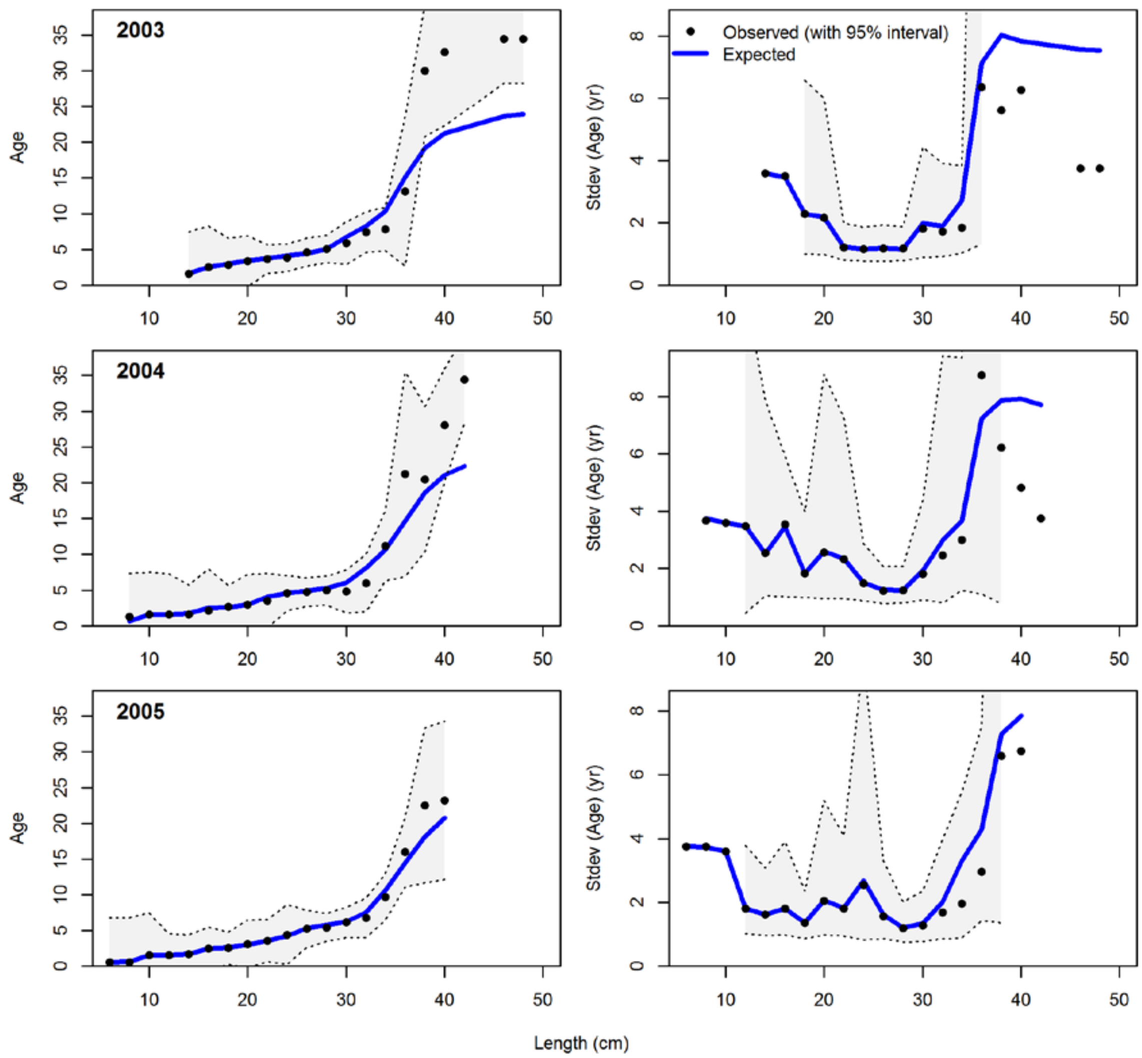

Figure 97: Fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

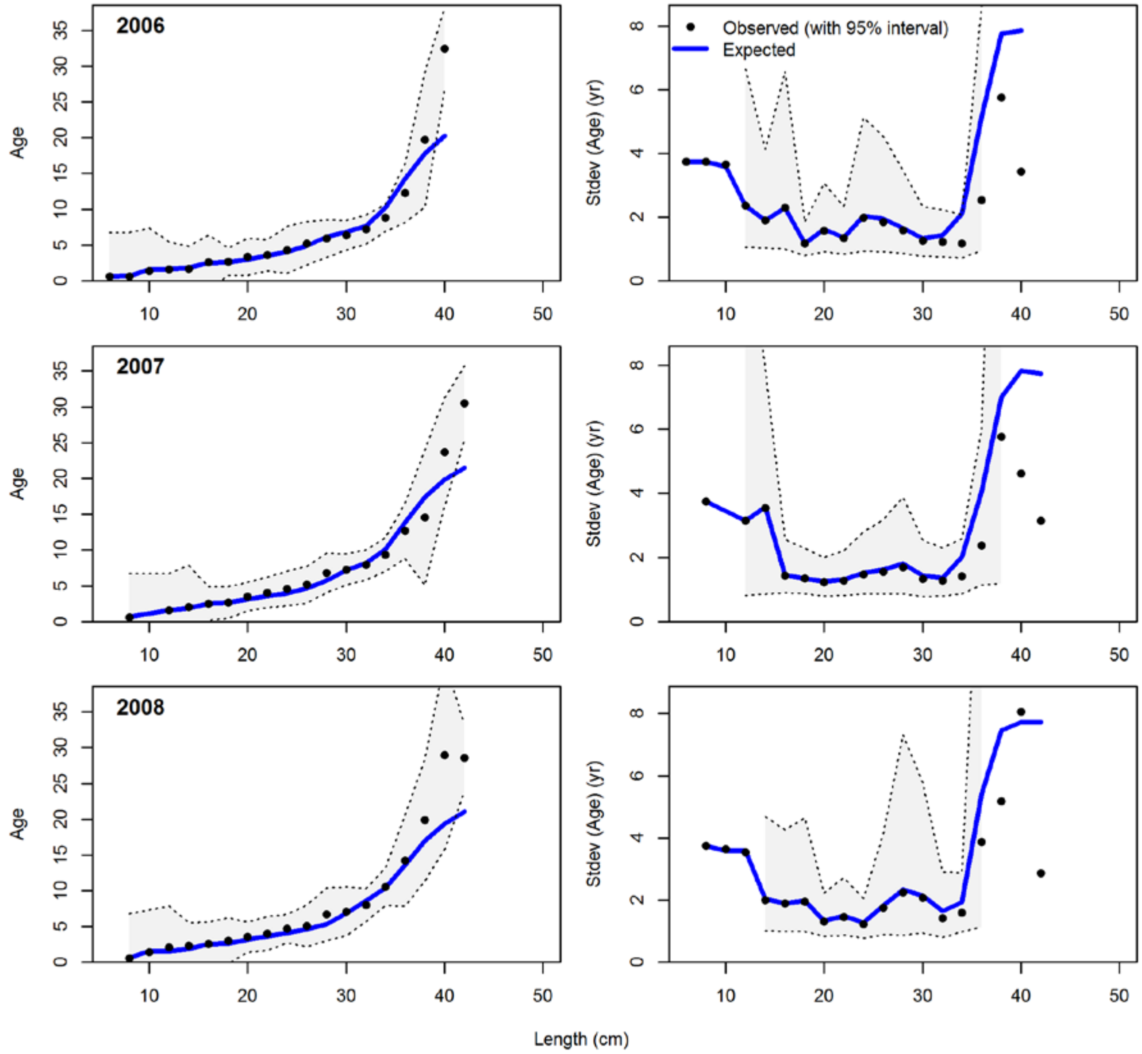

Figure 97 (continued): Fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

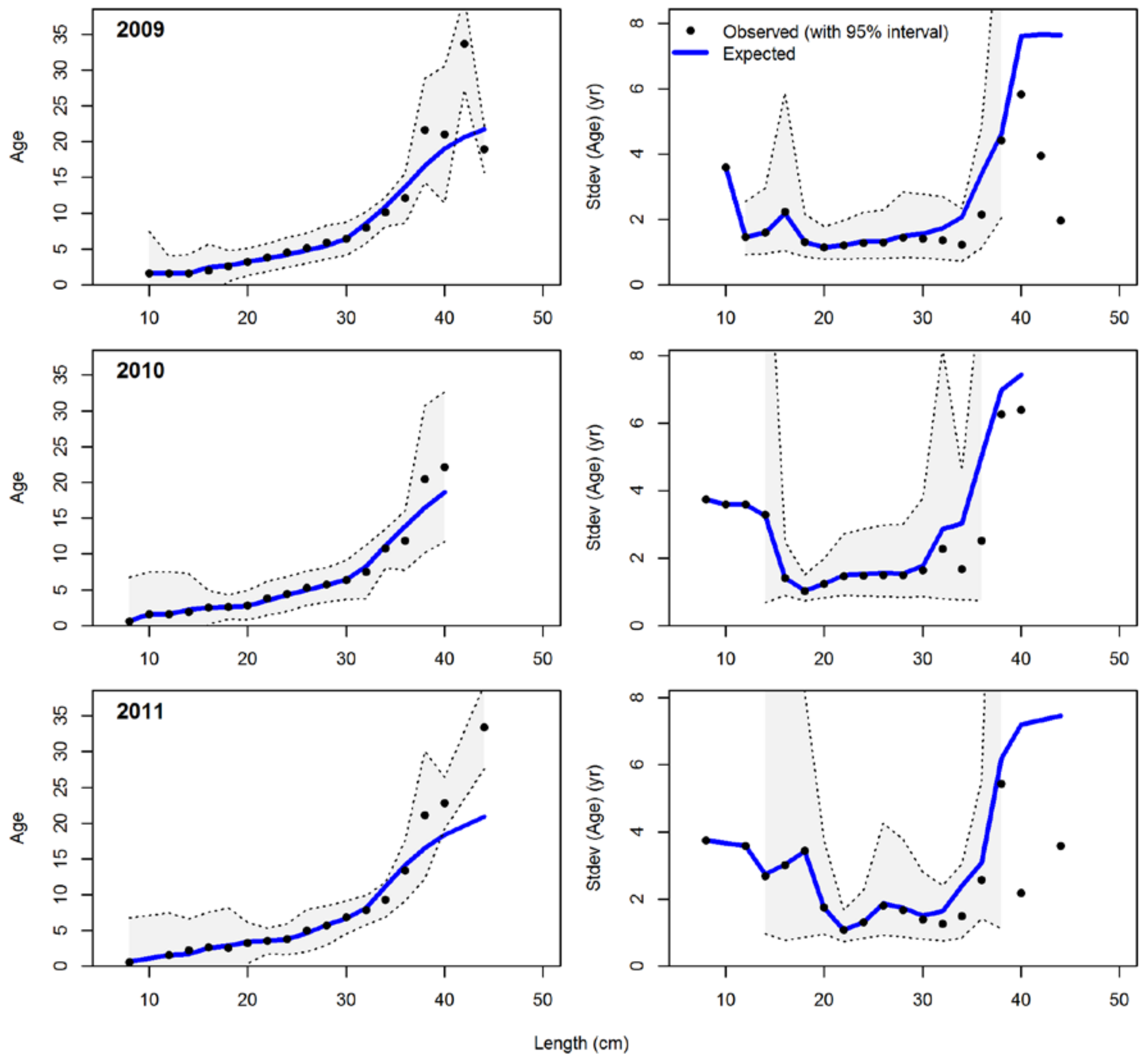

Figure 97 (continued): Fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

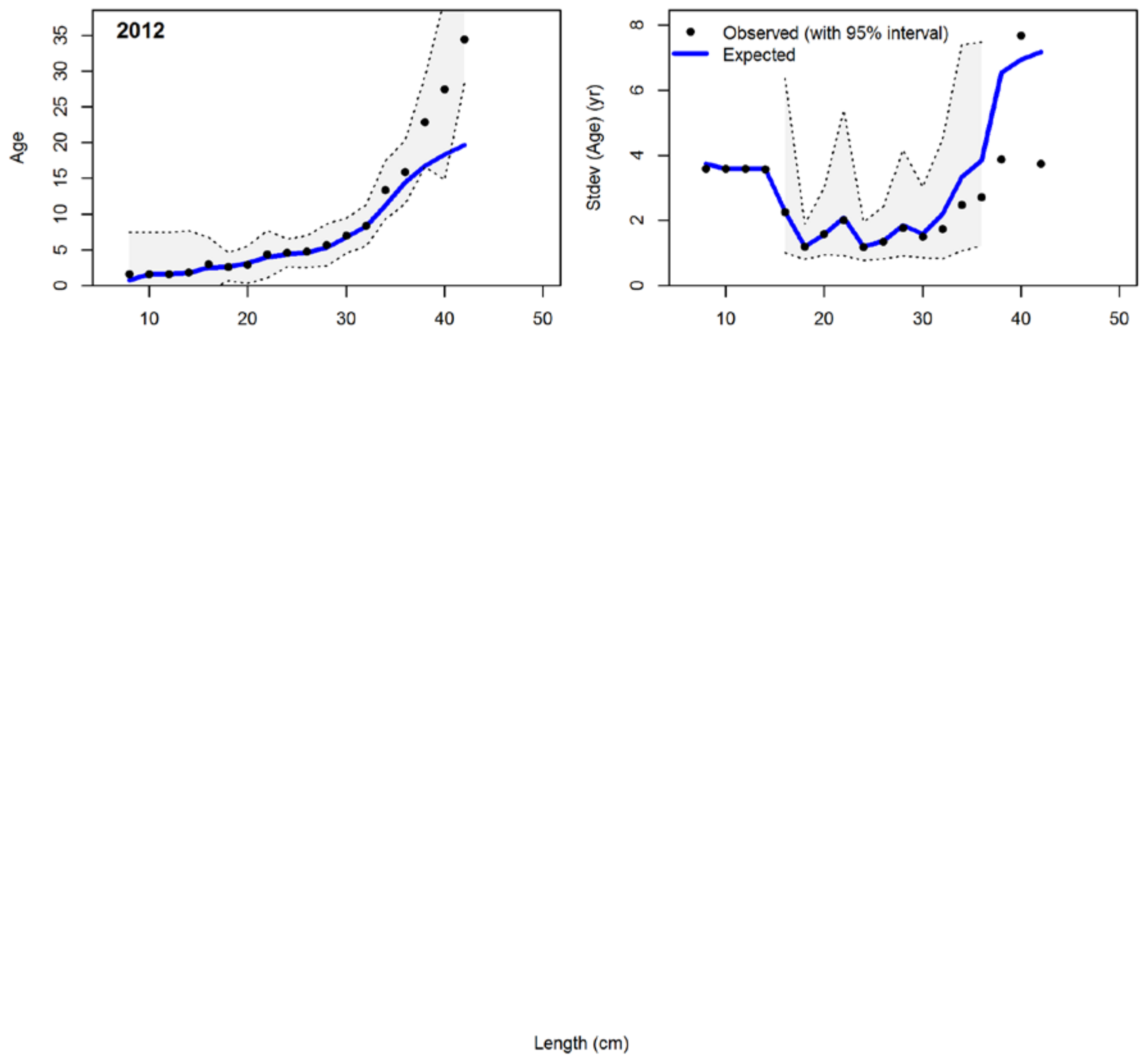

Figure 97 (continued): Fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

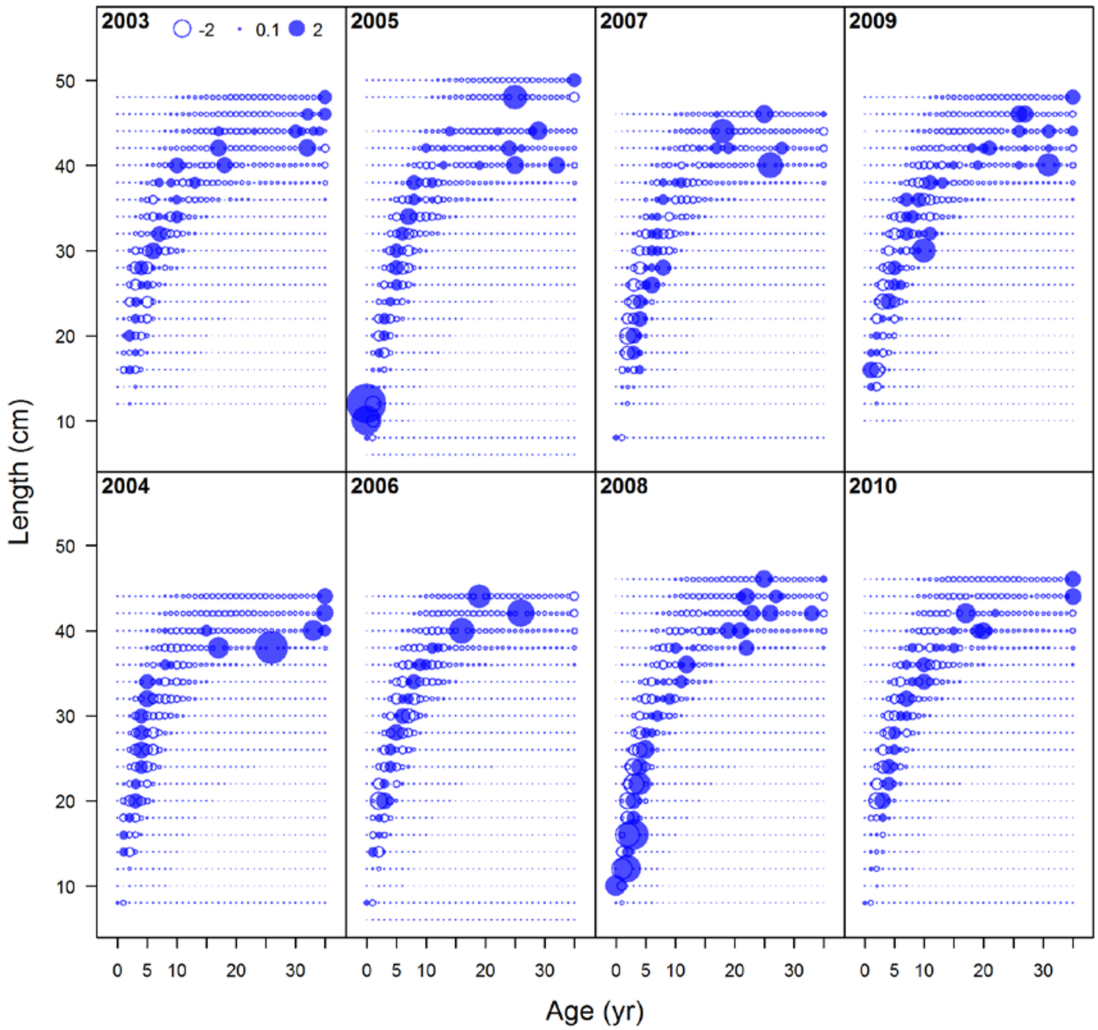

Figure 98: Pearson residuals for the fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

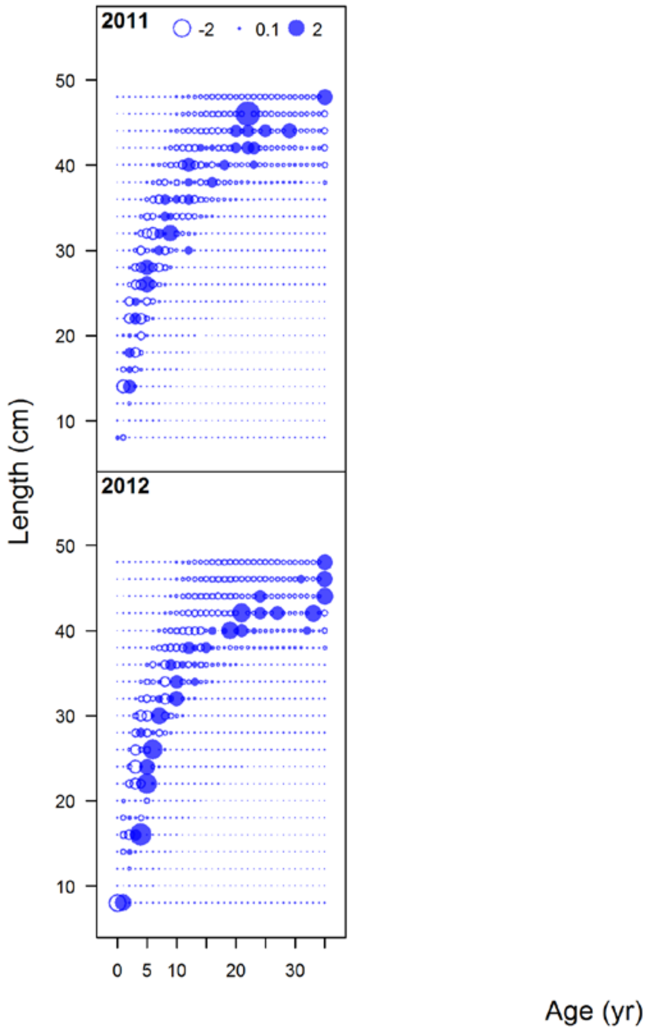

Figure 98 (continued): Pearson residuals for the fit to conditional ages-at-length compositions of female darkblotched rockfish from the NWFSC shelf-slope survey.

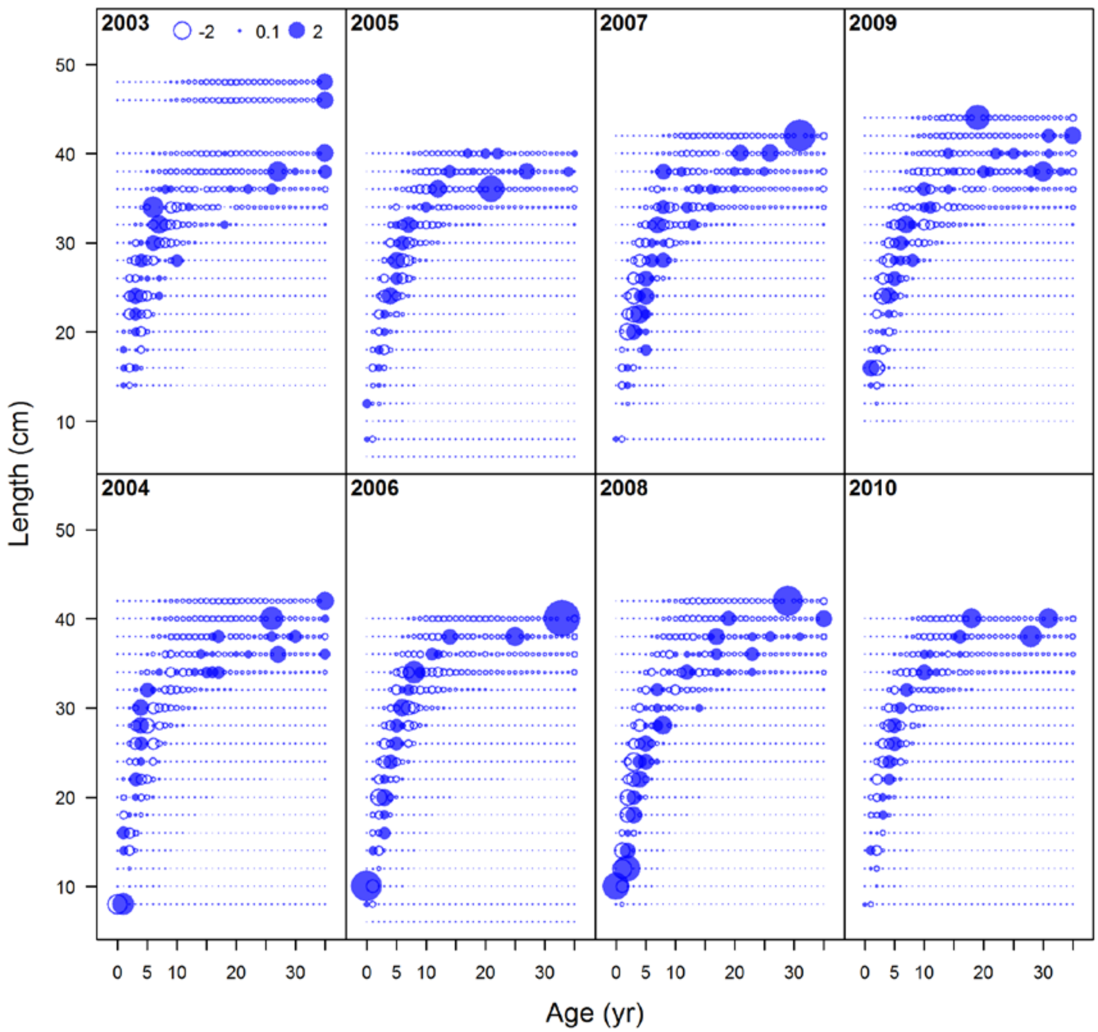

Figure 99: Pearson residuals for the fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

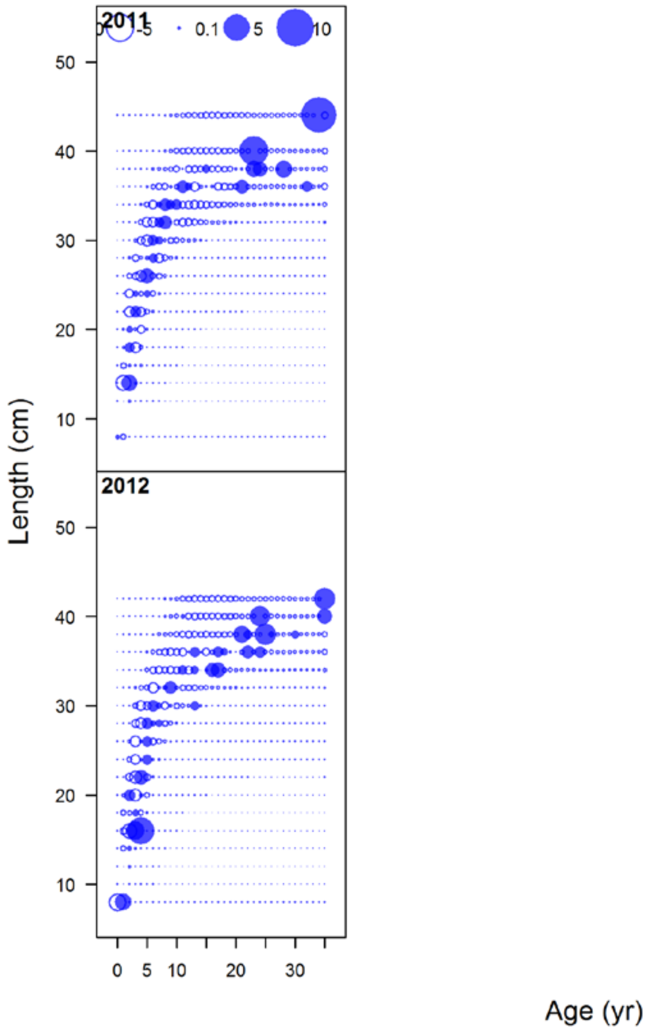

Figure 99 (continued): Pearson residuals for the fit to conditional ages-at-length compositions of male darkblotched rockfish from the NWFSC shelf-slope survey.

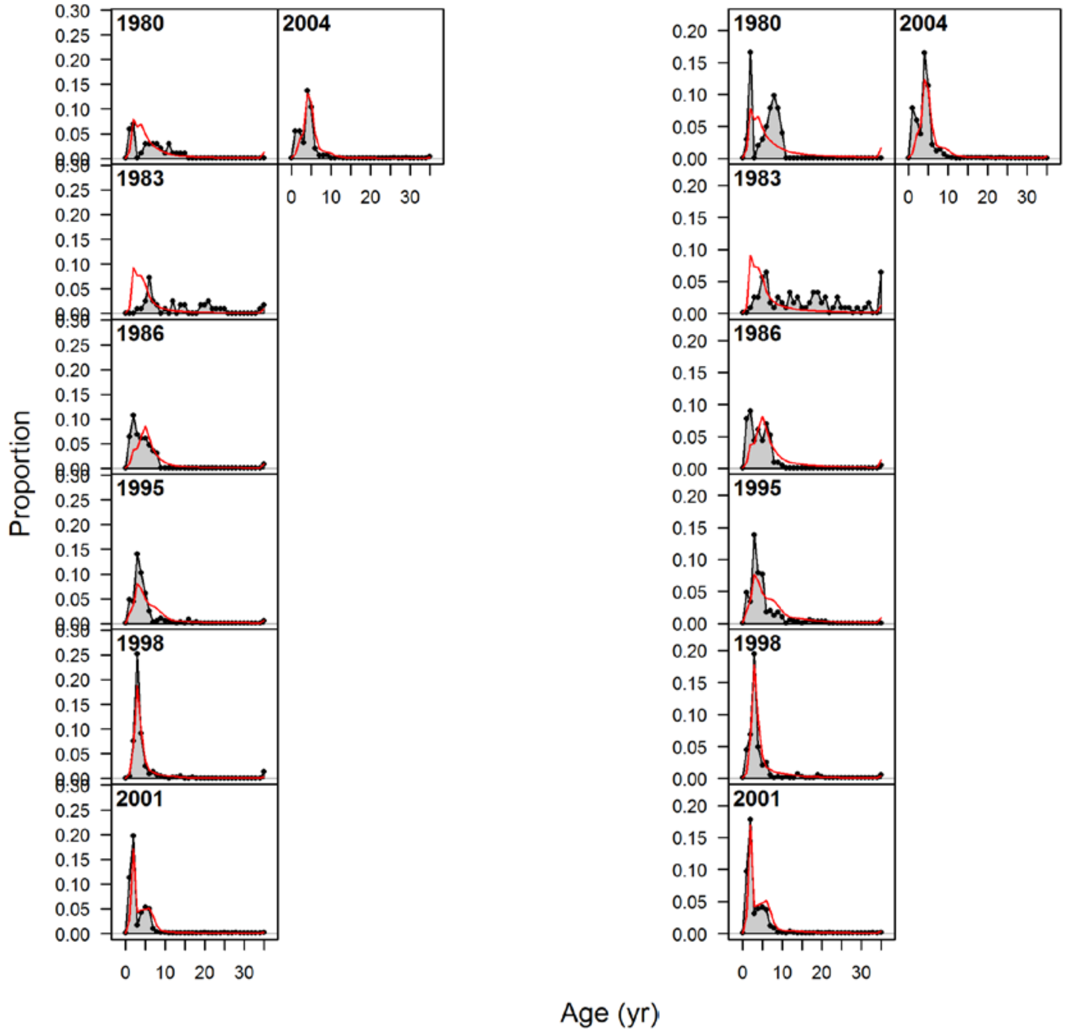

Figure 100: Implied fit to conditional ages-at-length compositions of female (left panel) and male (right panel) darkblotched rockfish from the AFSC shelf survey marginal age frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

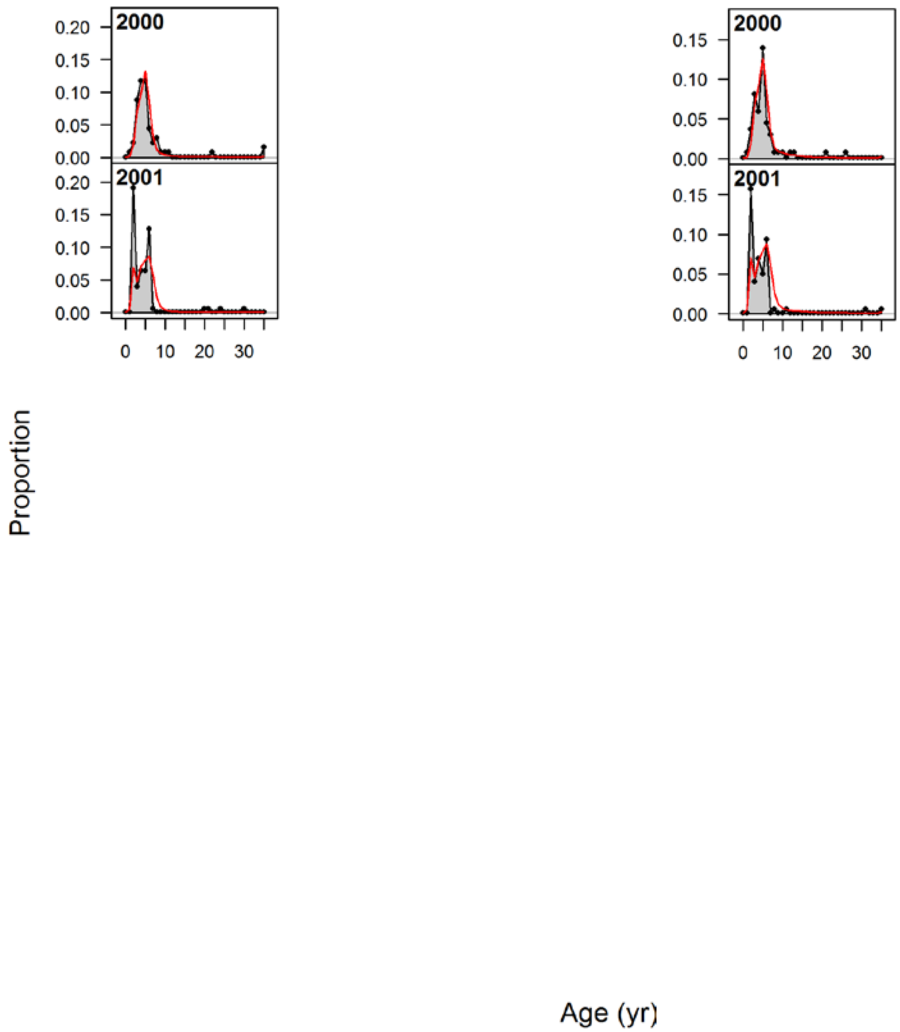

Figure 101: Implied fit to conditional ages-at-length compositions of female (left panel) and male (right panel) darkblotched rockfish from the AFSC slope survey marginal age frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

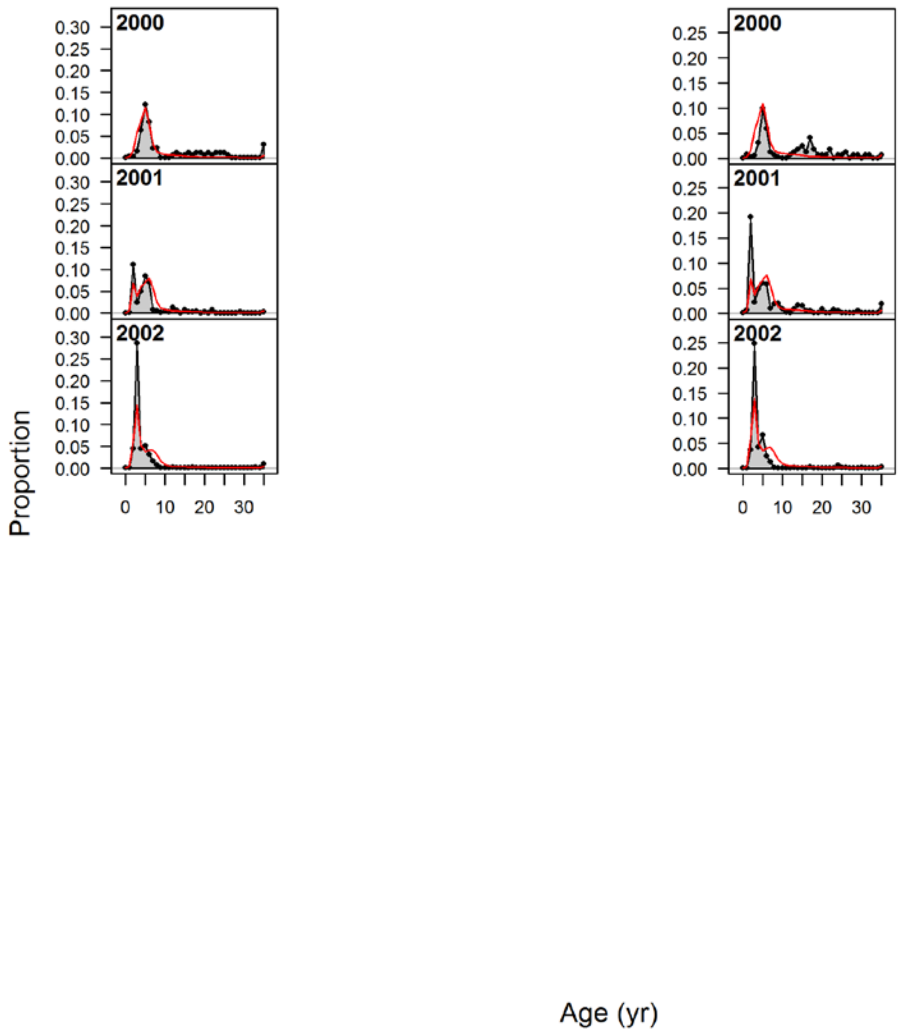

Figure 102: Implied fit to conditional ages-at-length compositions of female (left panel) and male (right panel) darkblotched rockfish from the NWFSC slope survey marginal age frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

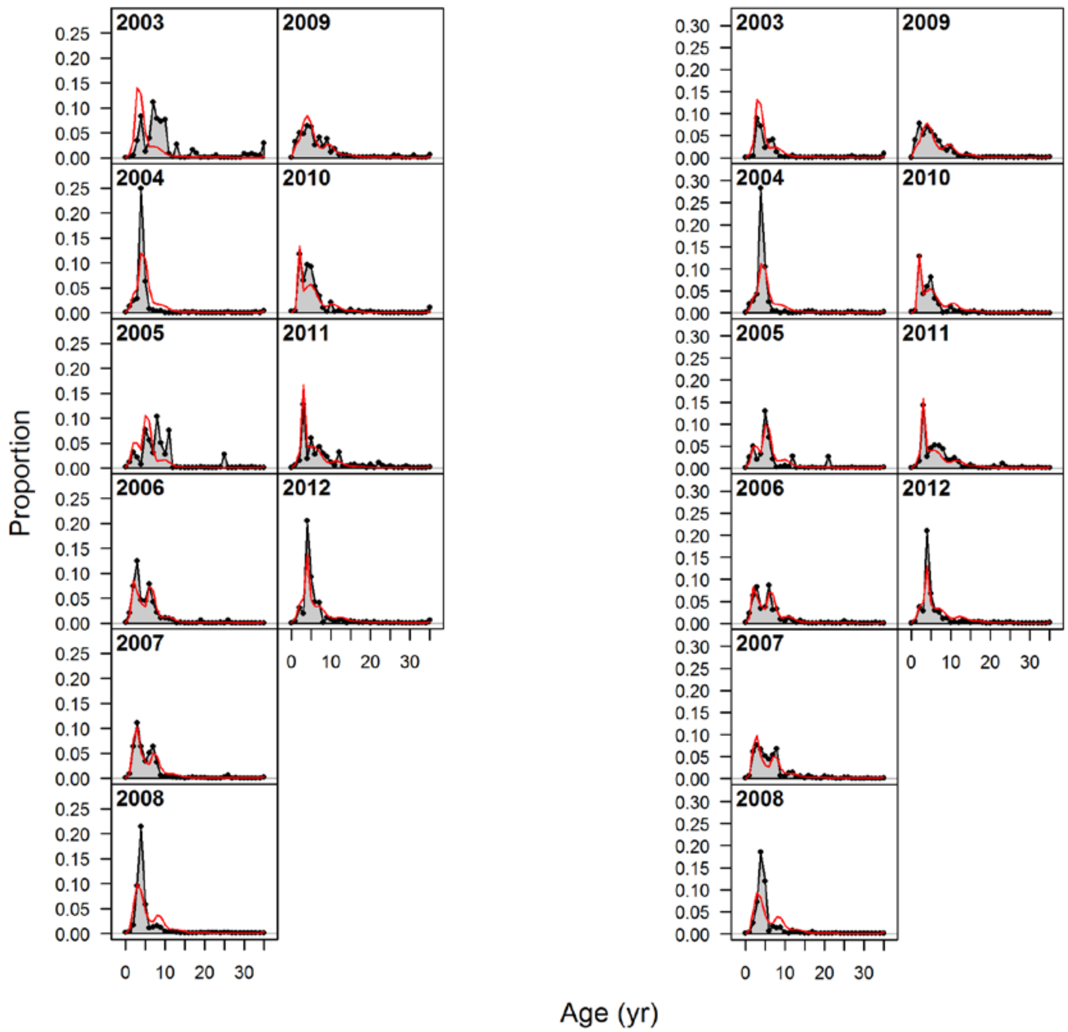

Figure 103: Implied fit to conditional ages-at-length compositions of female (left panel) and male (right panel) darkblotched rockfish from the NWFSC shelf-slope survey marginal age frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

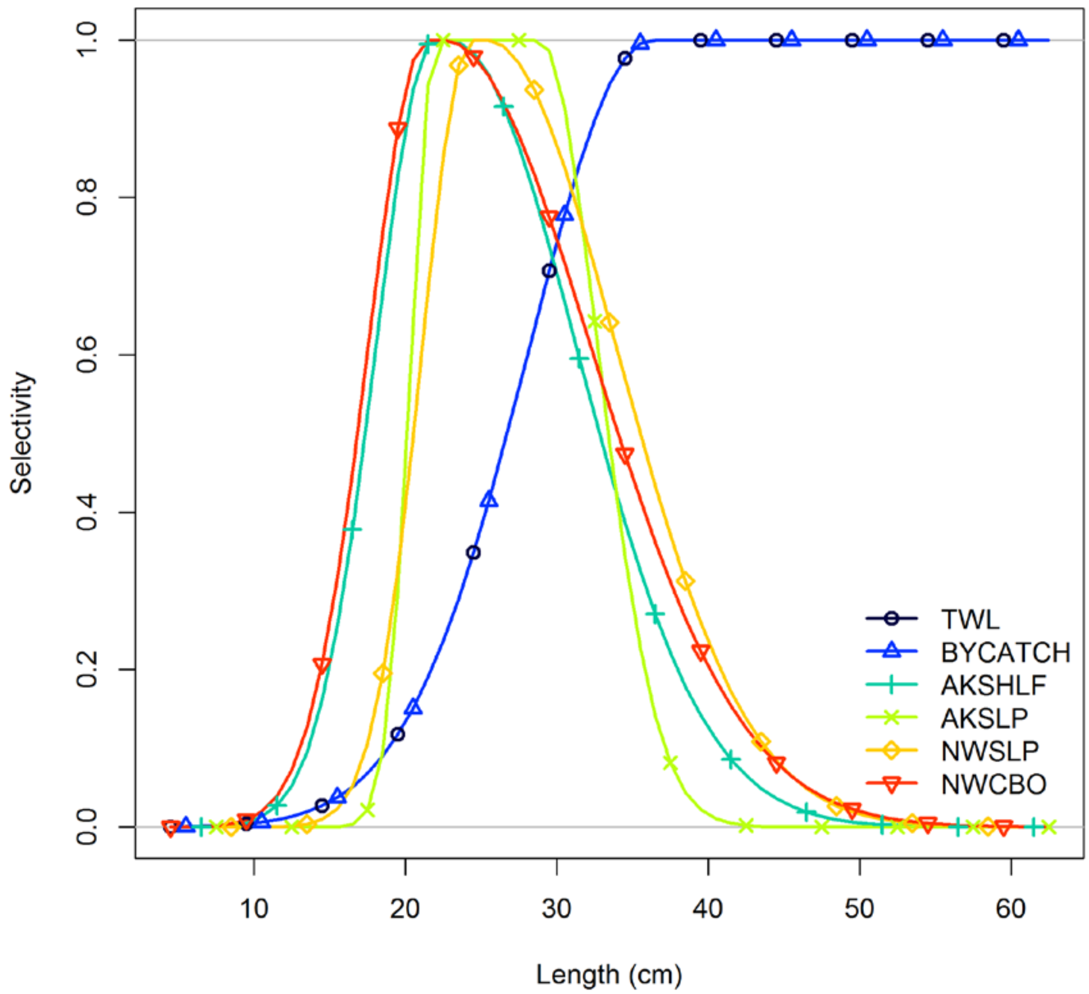

Figure 104: Length-based selectivity curves estimated for the all fleets used in the assessment.

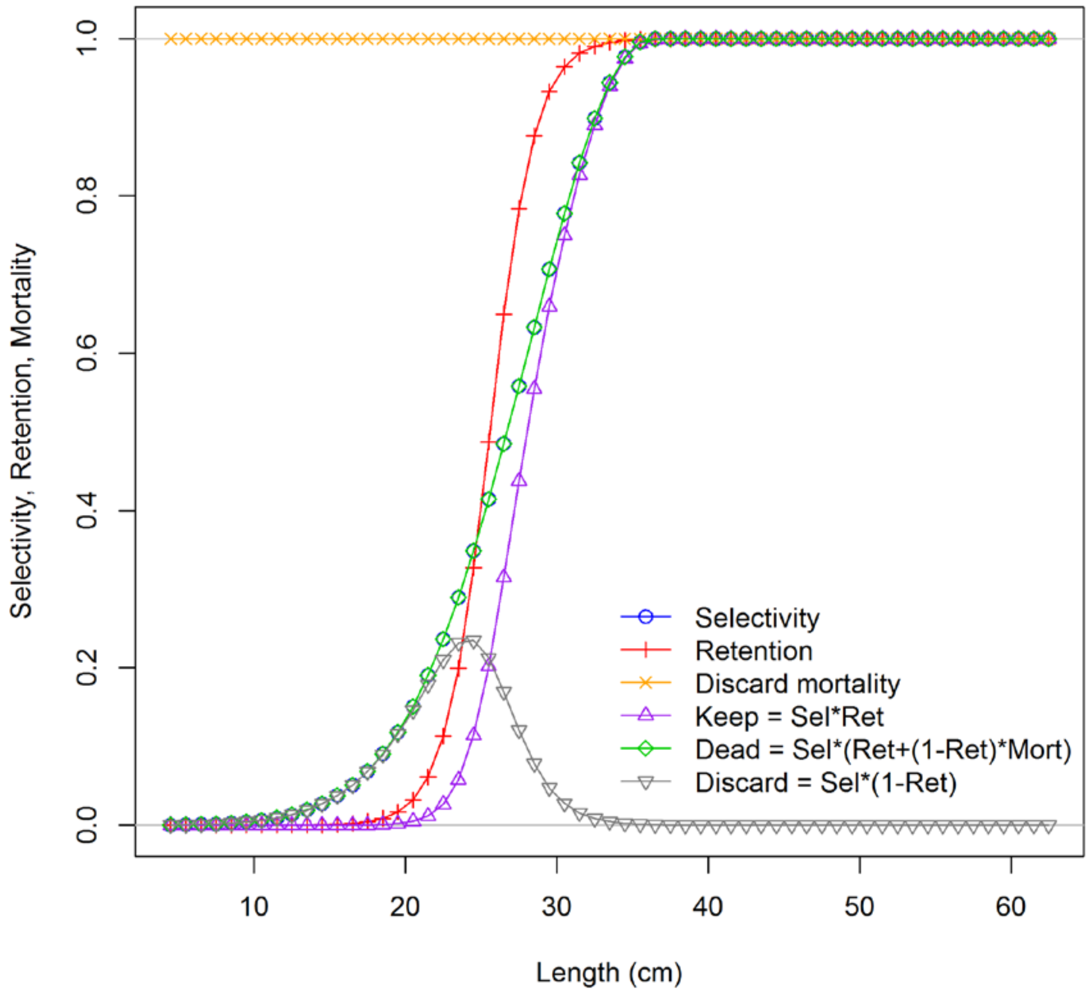

Figure 105: Estimated 2012 length-based selectivity, retention and discard mortality curves for the domestic trawl fishery.

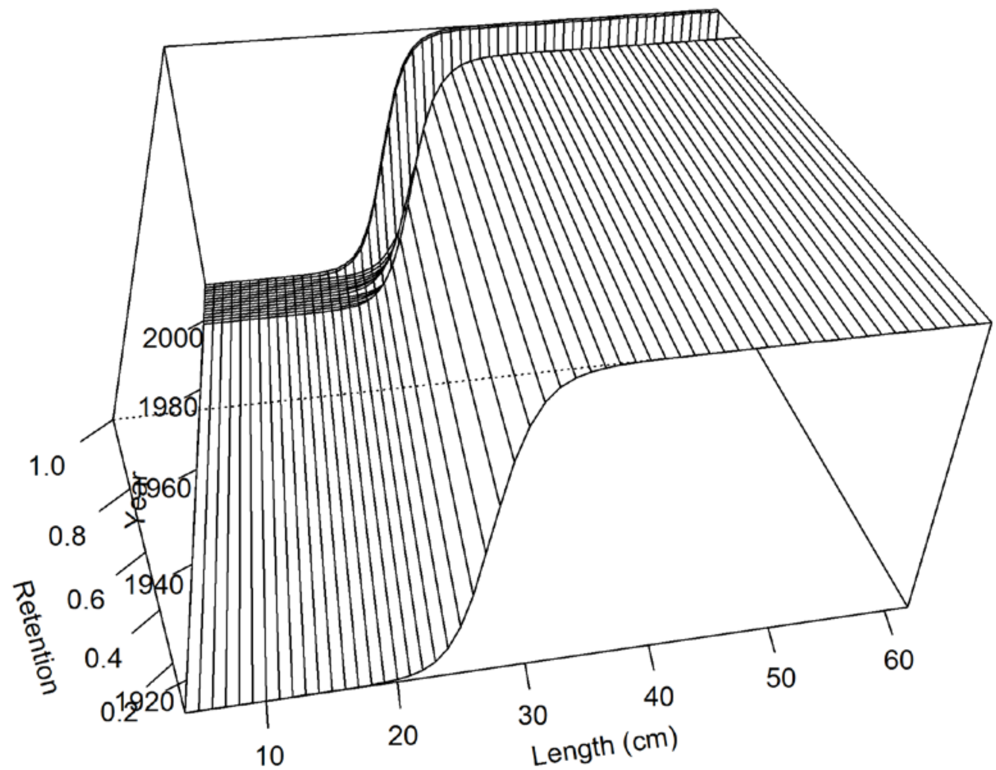

Figure 106: Estimated time-varying length-based retention of domestic trawl fishery.

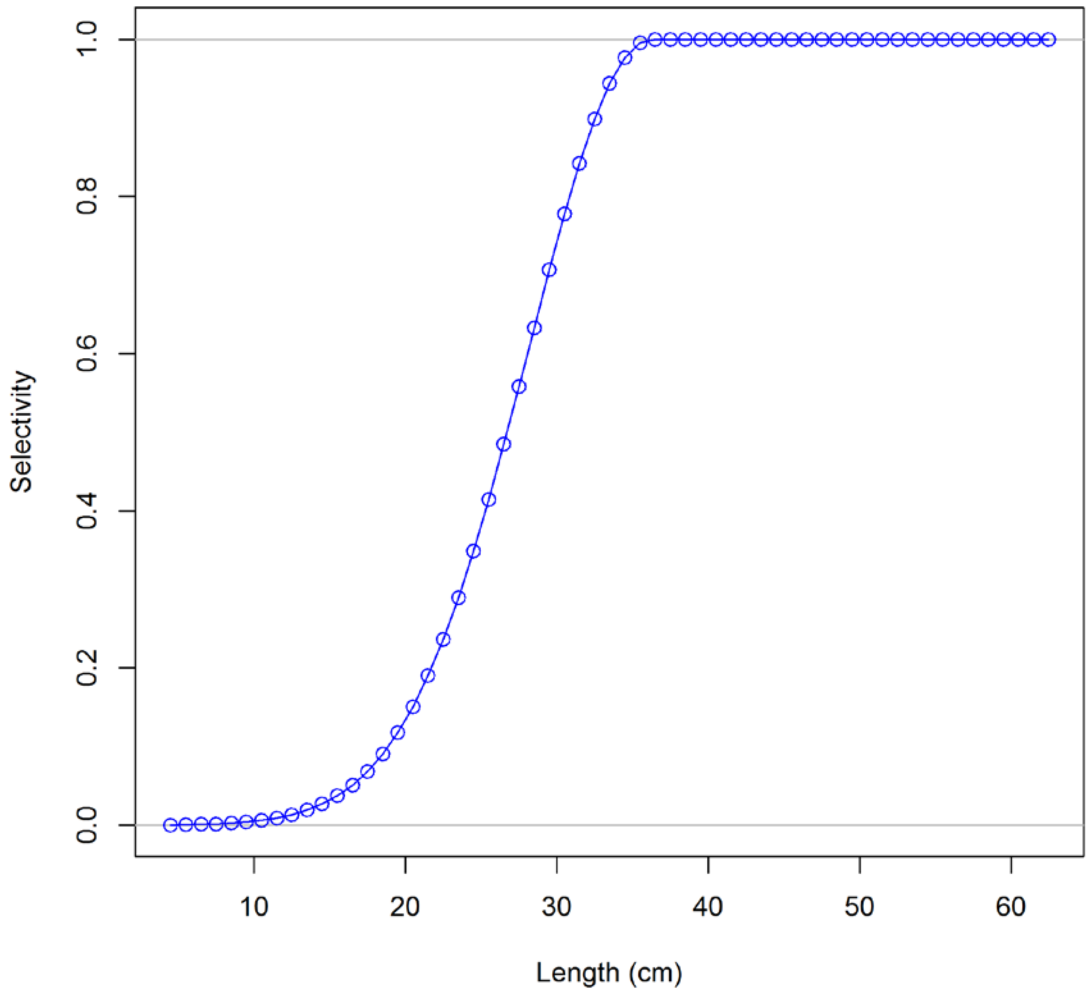

Figure 107: Length-based selectivity curve for bycatch fleet, mirrored to selectivity curve of domestic trawl fishery in the assessment.

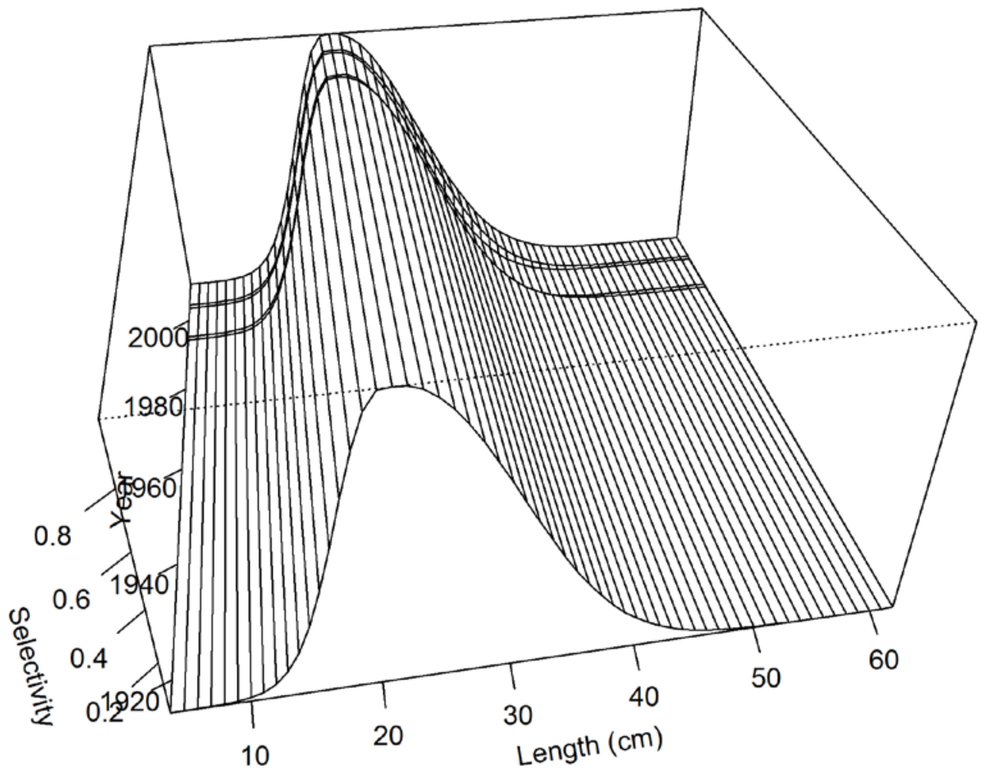

Figure 108: Estimated time-varying length-based selectivity curve for the AFSC shelf survey.

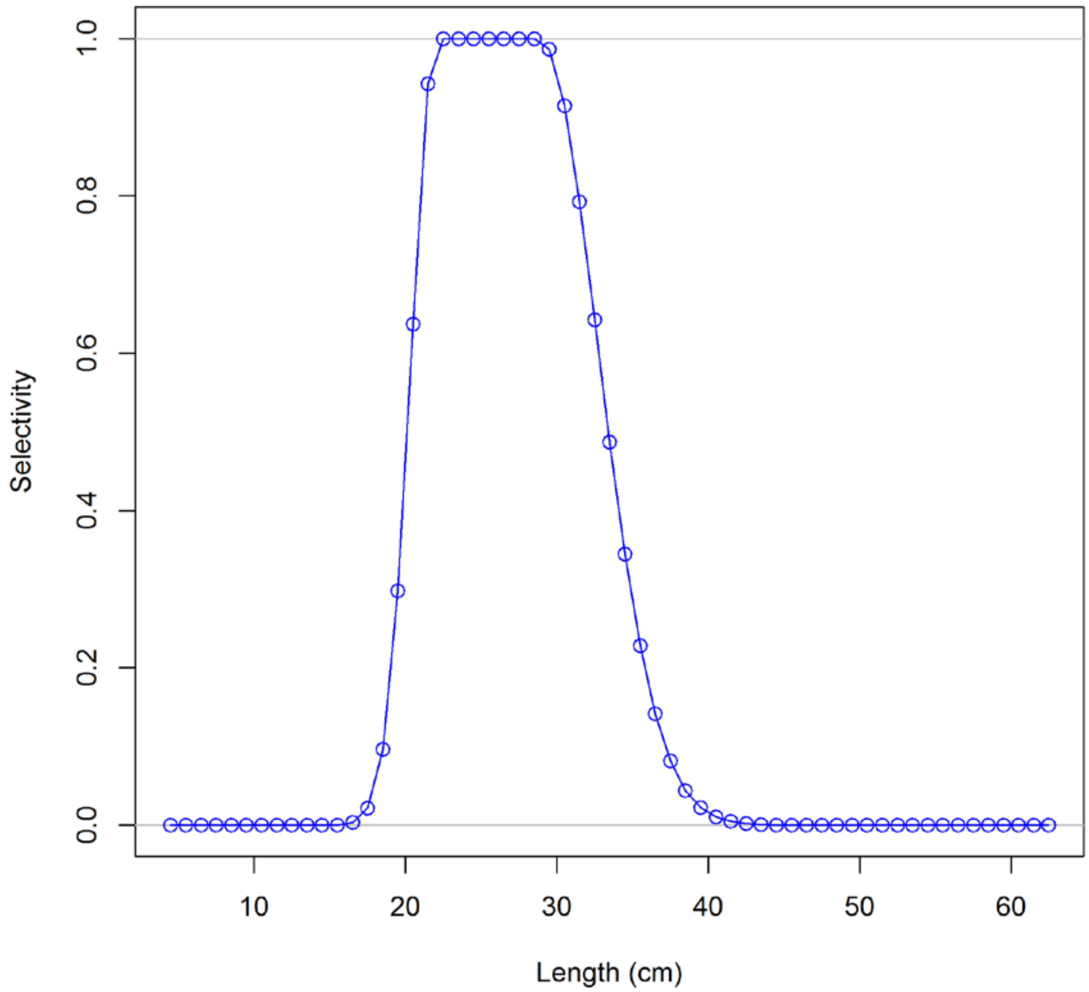

Figure 109: Estimated length-based selectivity curve for the AFSC slope survey.

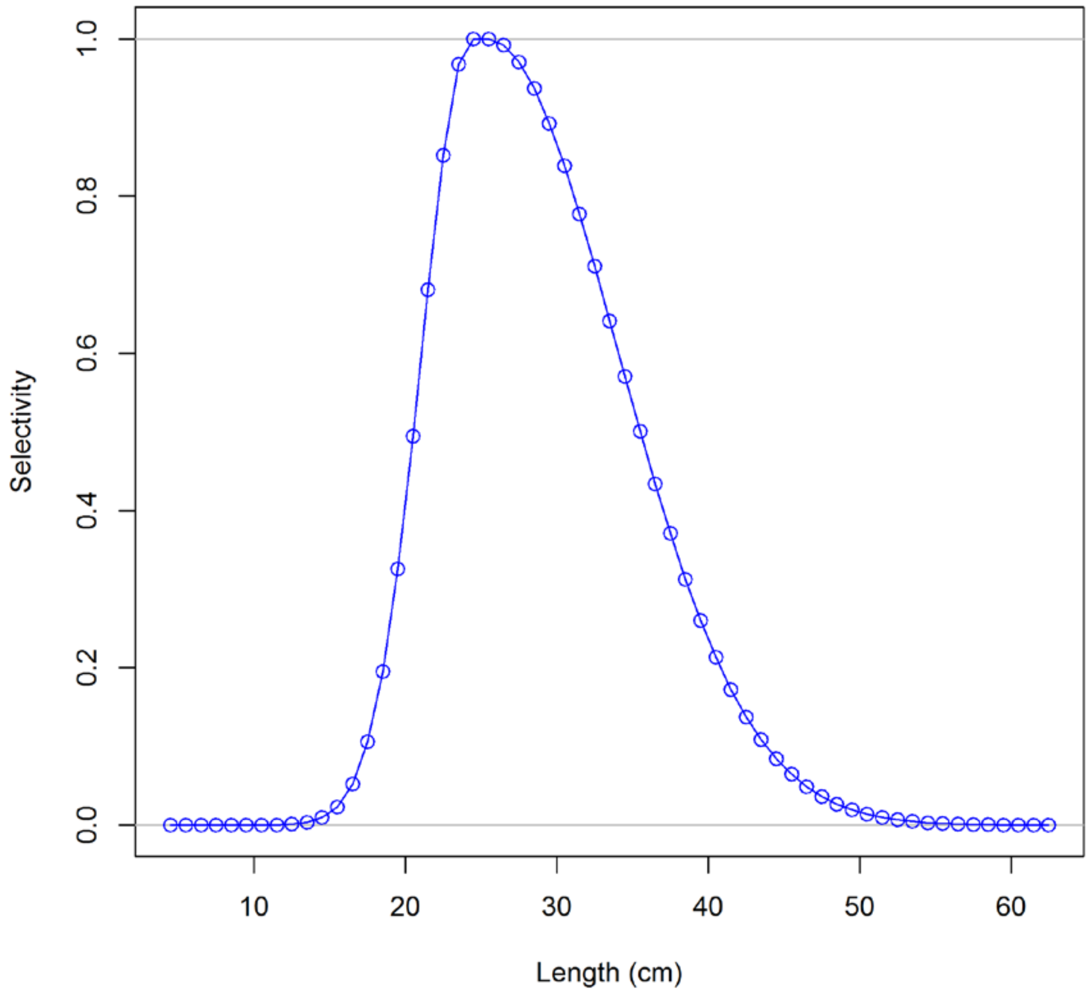

Figure 110: Estimated length-based selectivity curve for the NWFSC slope survey.

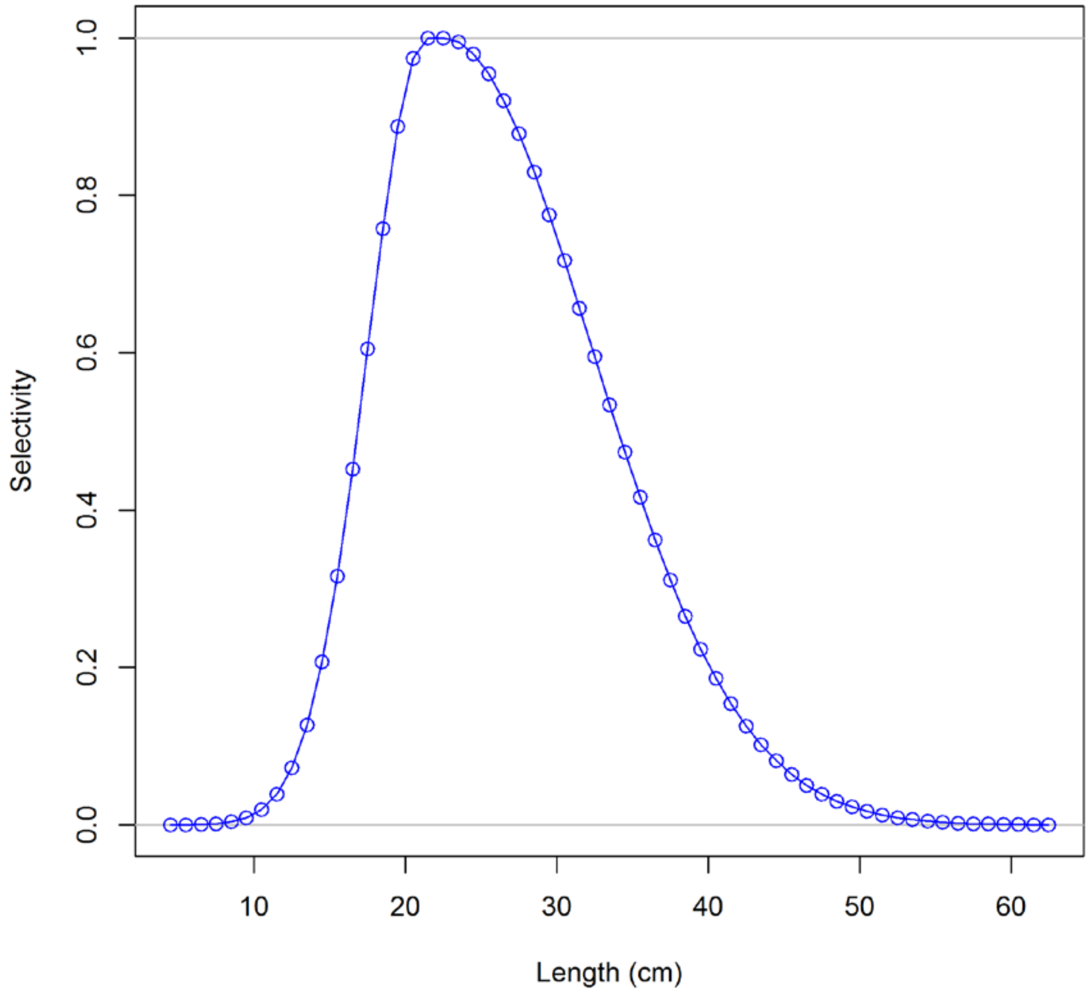

Figure 111: Estimated length-based selectivity curve for the NWFSC shelf-slope survey.

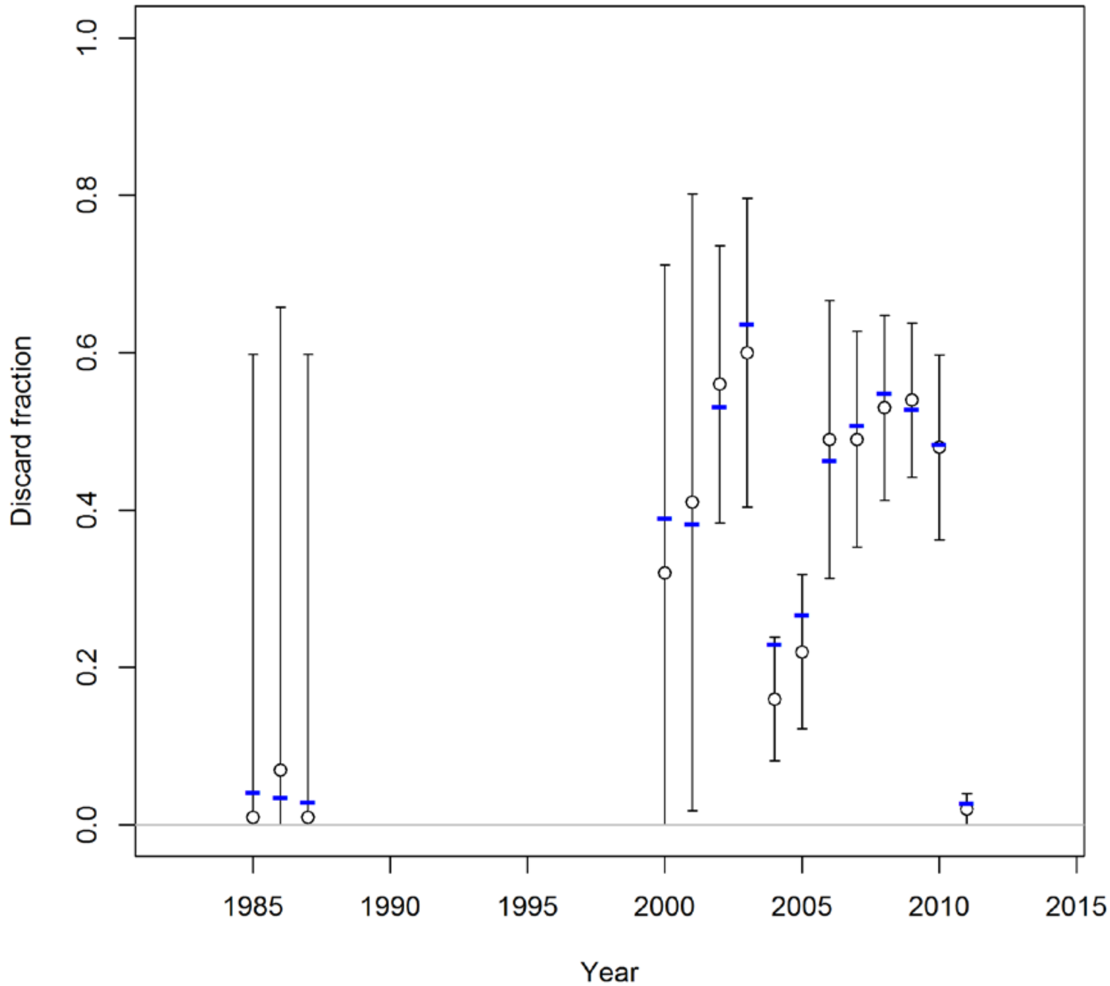

Figure 112: Fit to the discard ratio data of the domestic trawl fishery.

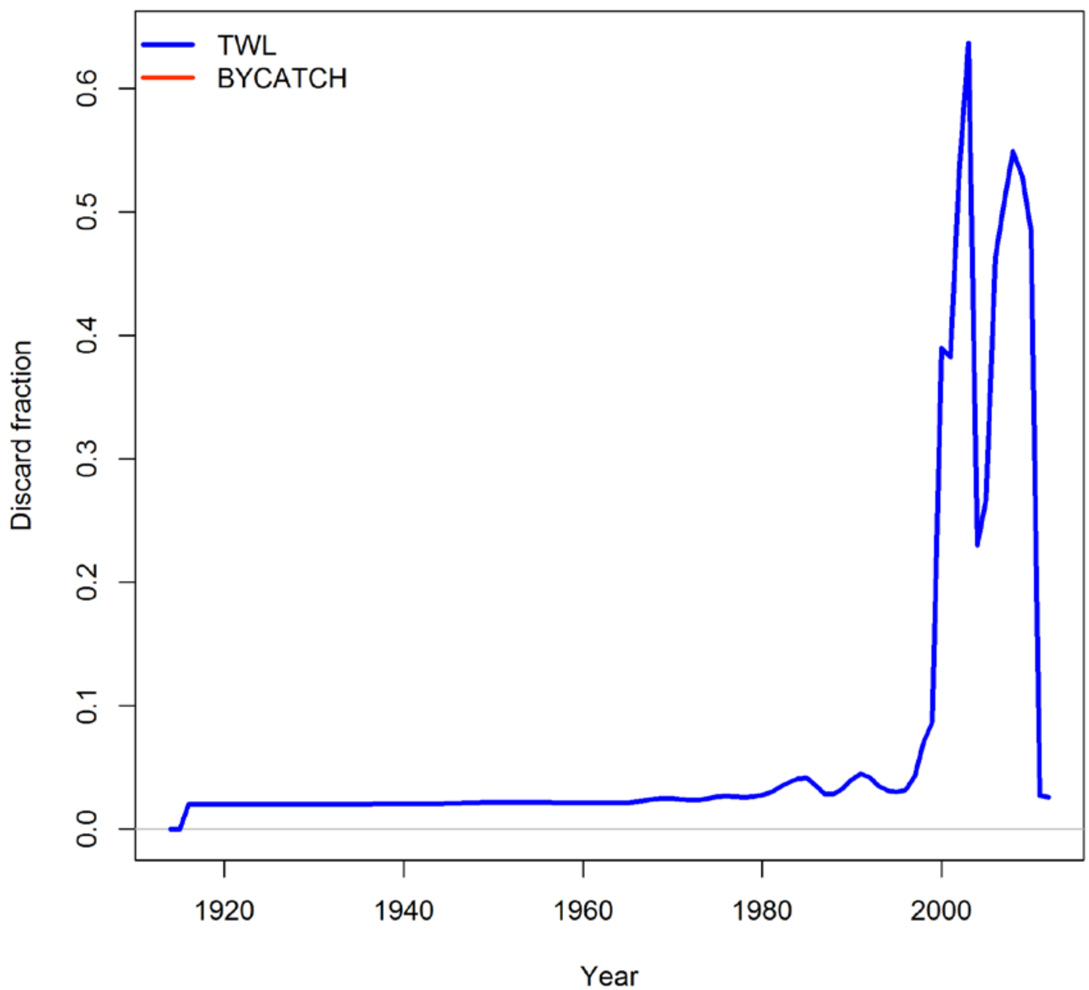

Figure 113: Discard fraction for the domestic trawl fishery estimated in the assessment.

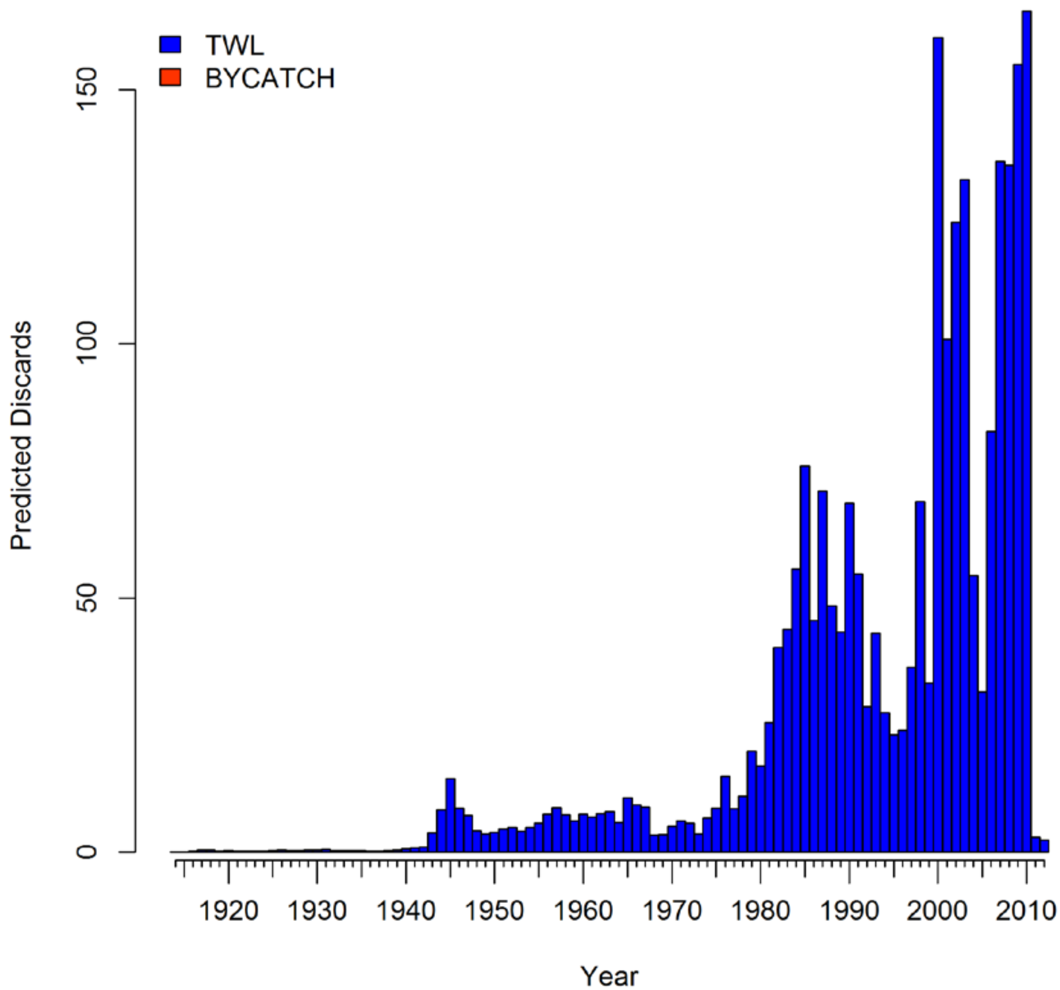

Figure 114: Predicted discard for the domestic trawl fishery.

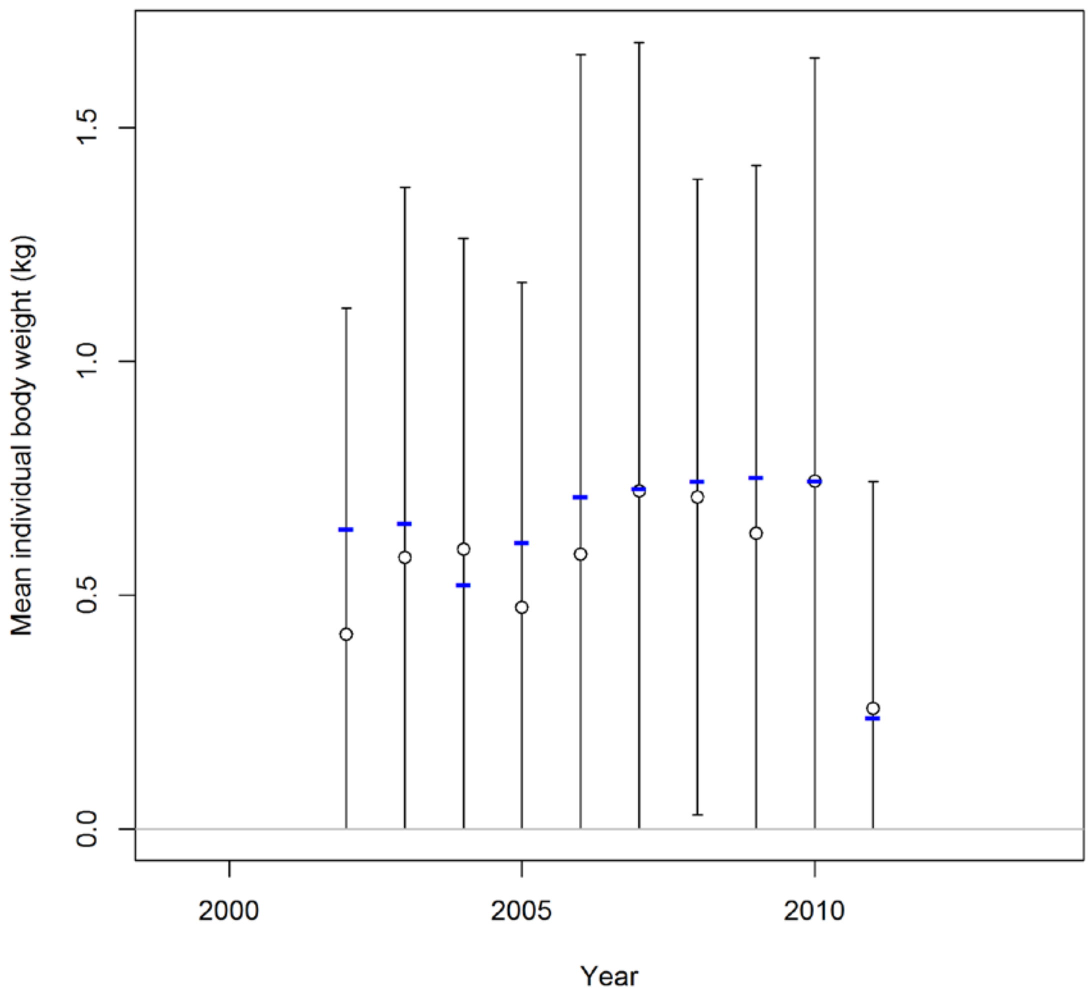

Figure 115: Fit to the mean body weight data for the domestic trawl fishery discard**.**

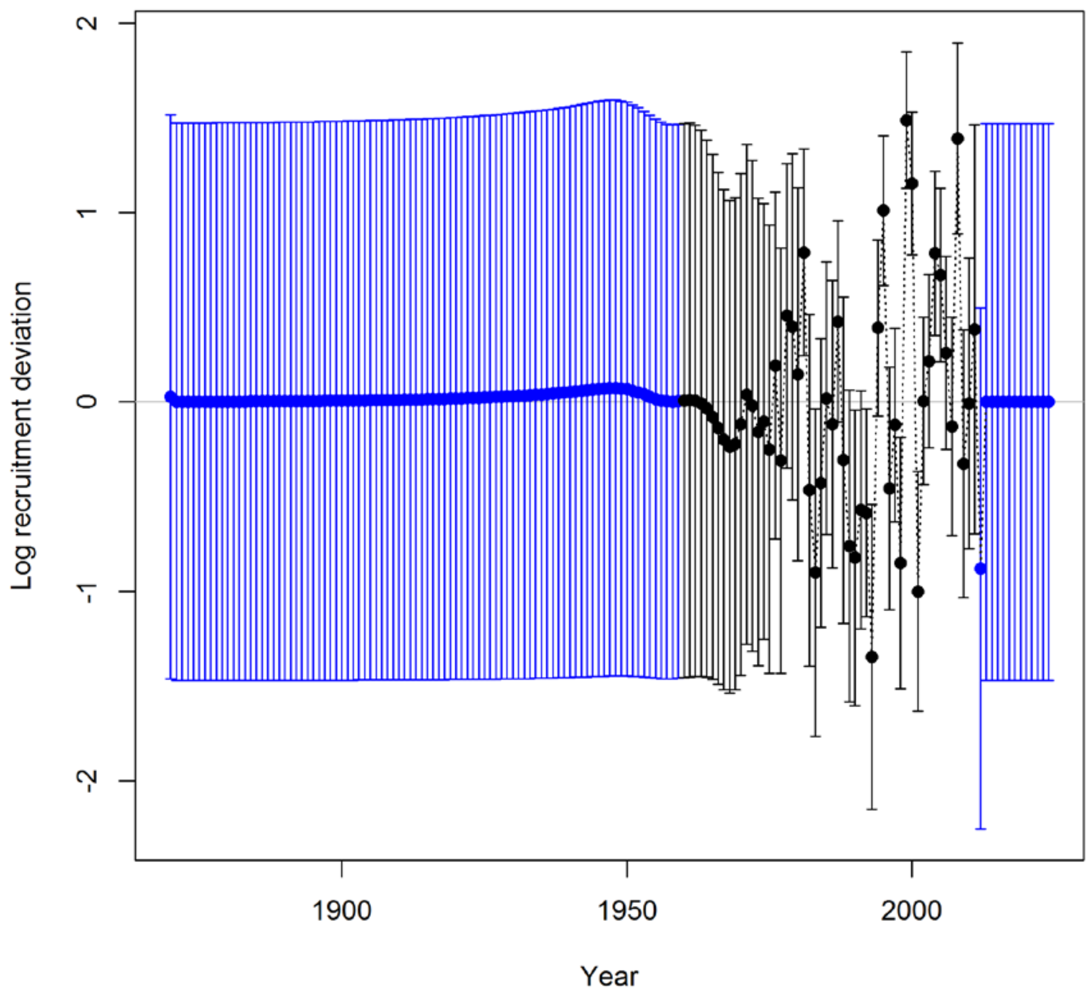

Figure 116: Recruitment deviation time-series estimated in the assessment model.

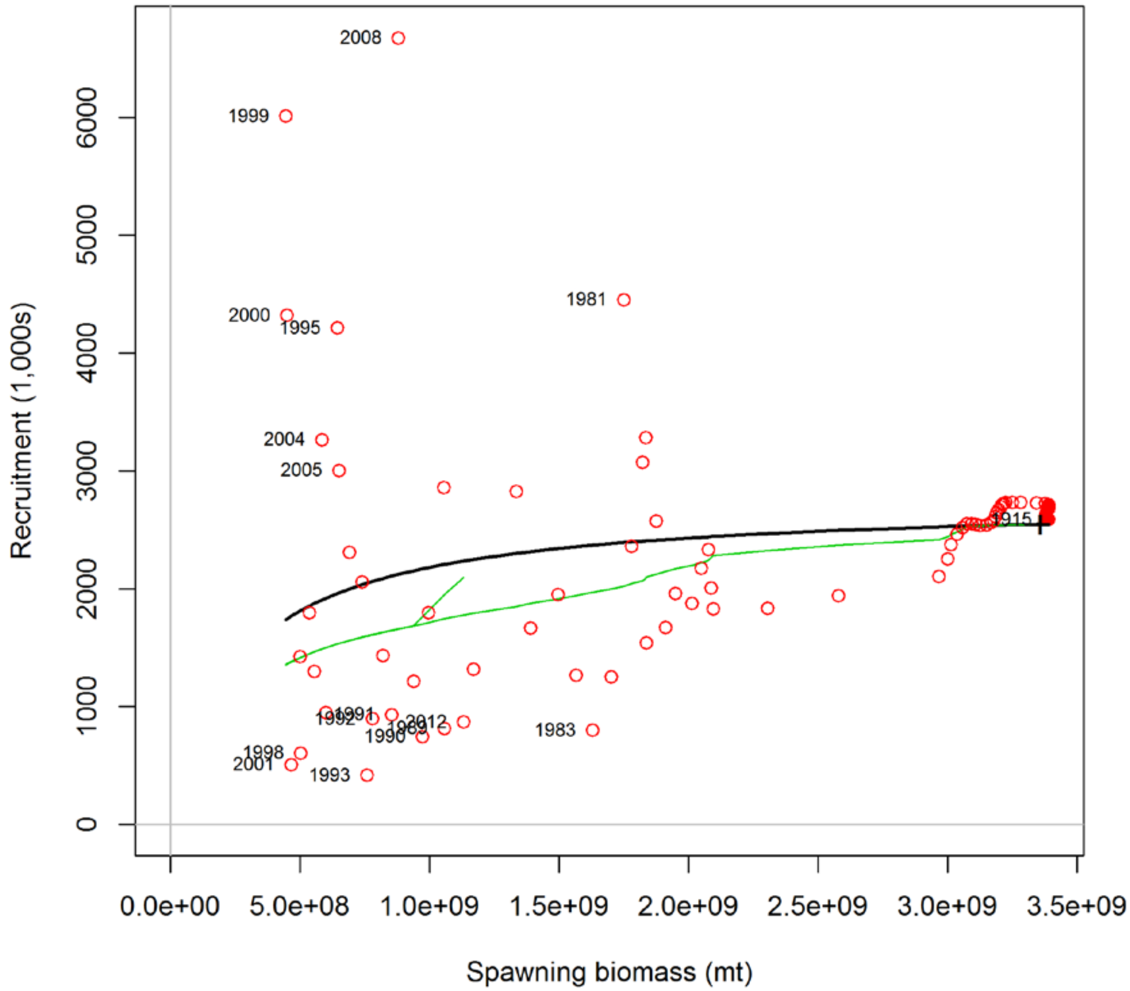

Figure 117: Estimated stock-recruit function for the assessment model.

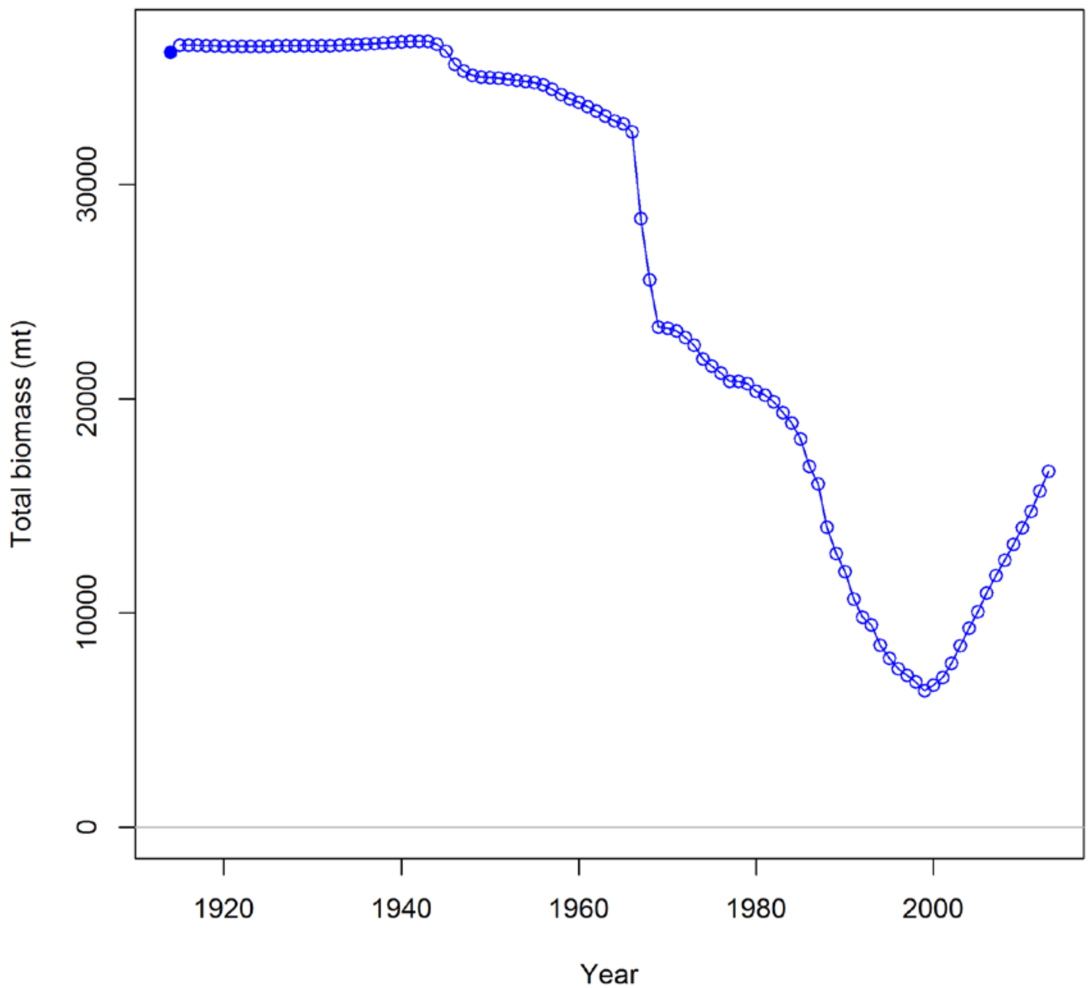

Figure 118: Time series of total biomass (mt) estimated in the assessment model.

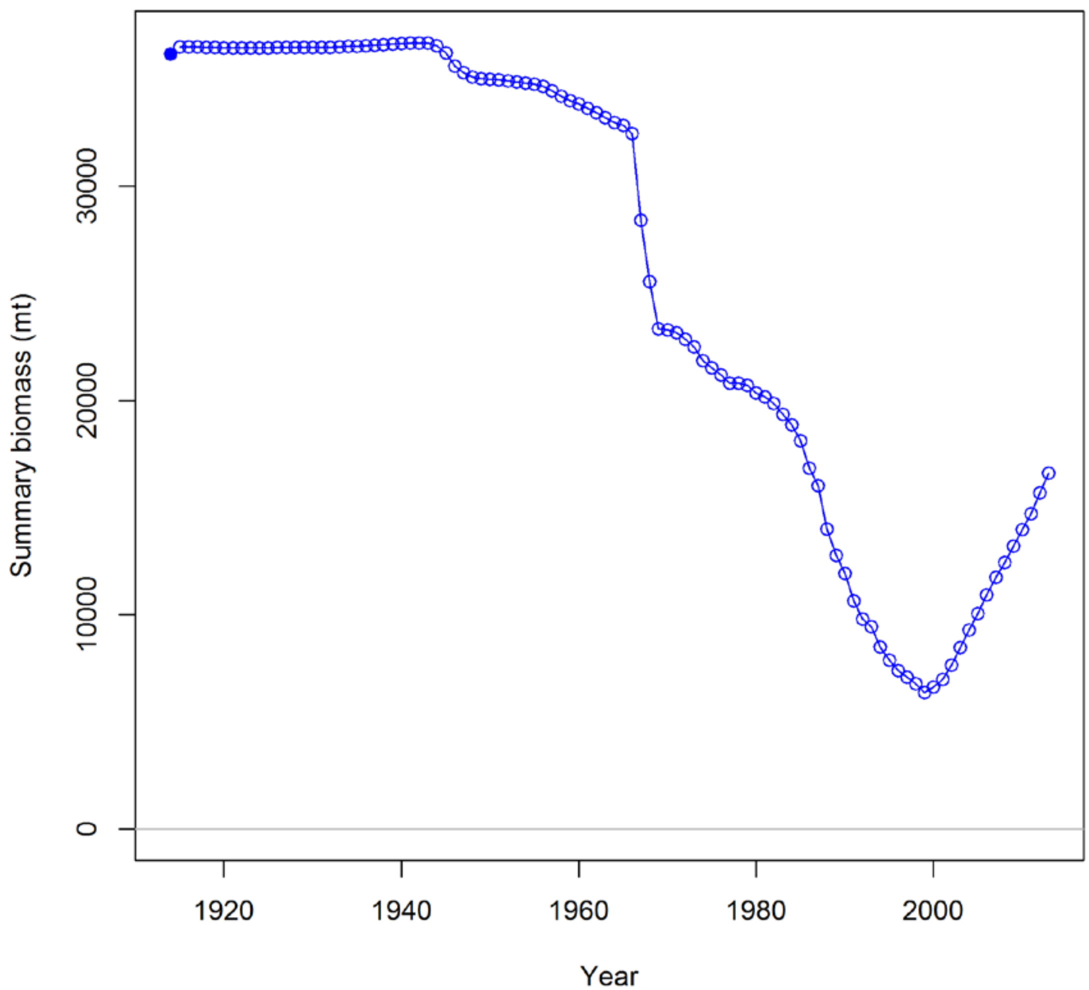

Figure 119: Time series of summary biomass (mt) estimated in the assessment model.

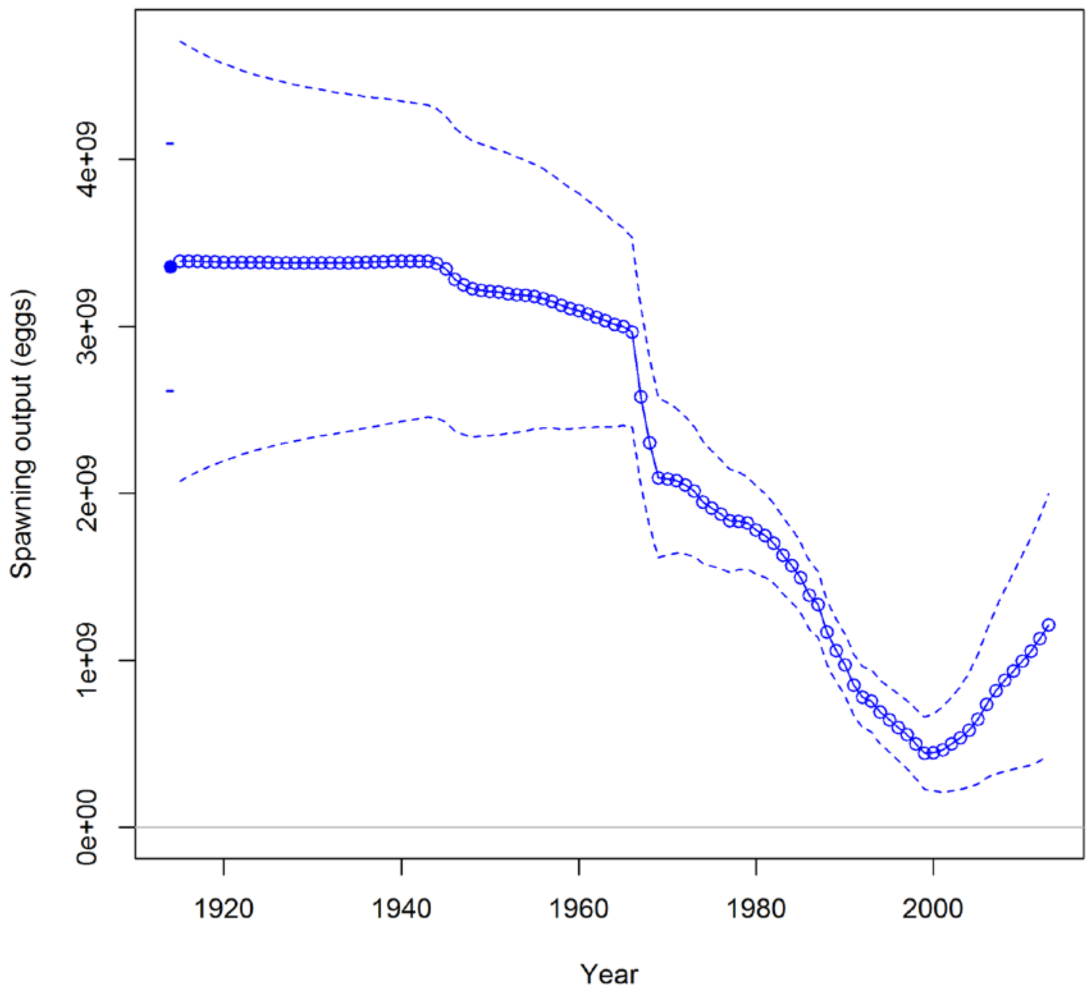

Figure 120: Time series of spawning output estimated in the assessment model (solid line) with ~ 95% interval (dashed lines).

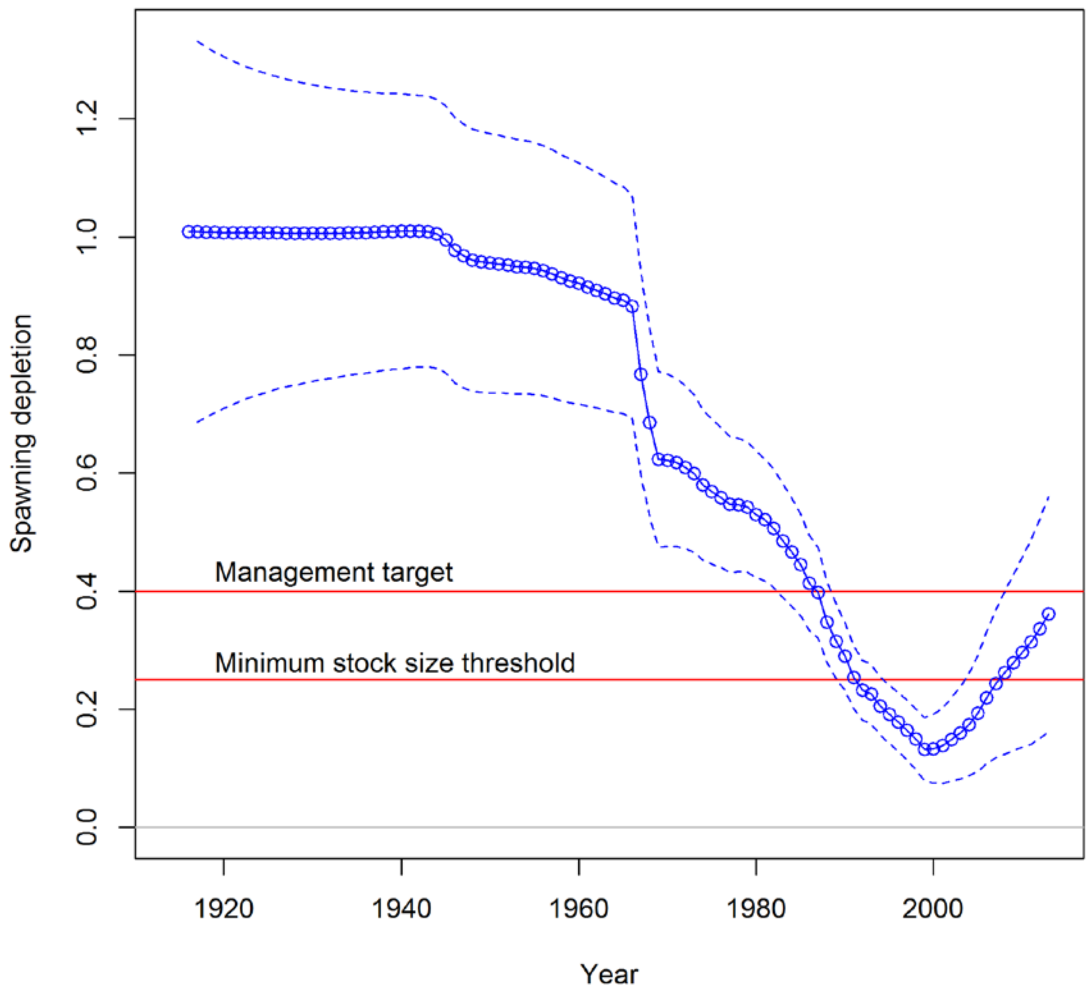

Figure 121: Time series of spawning depletion estimated in the assessment model (solid line) with ~ 95% interval (dashed lines).

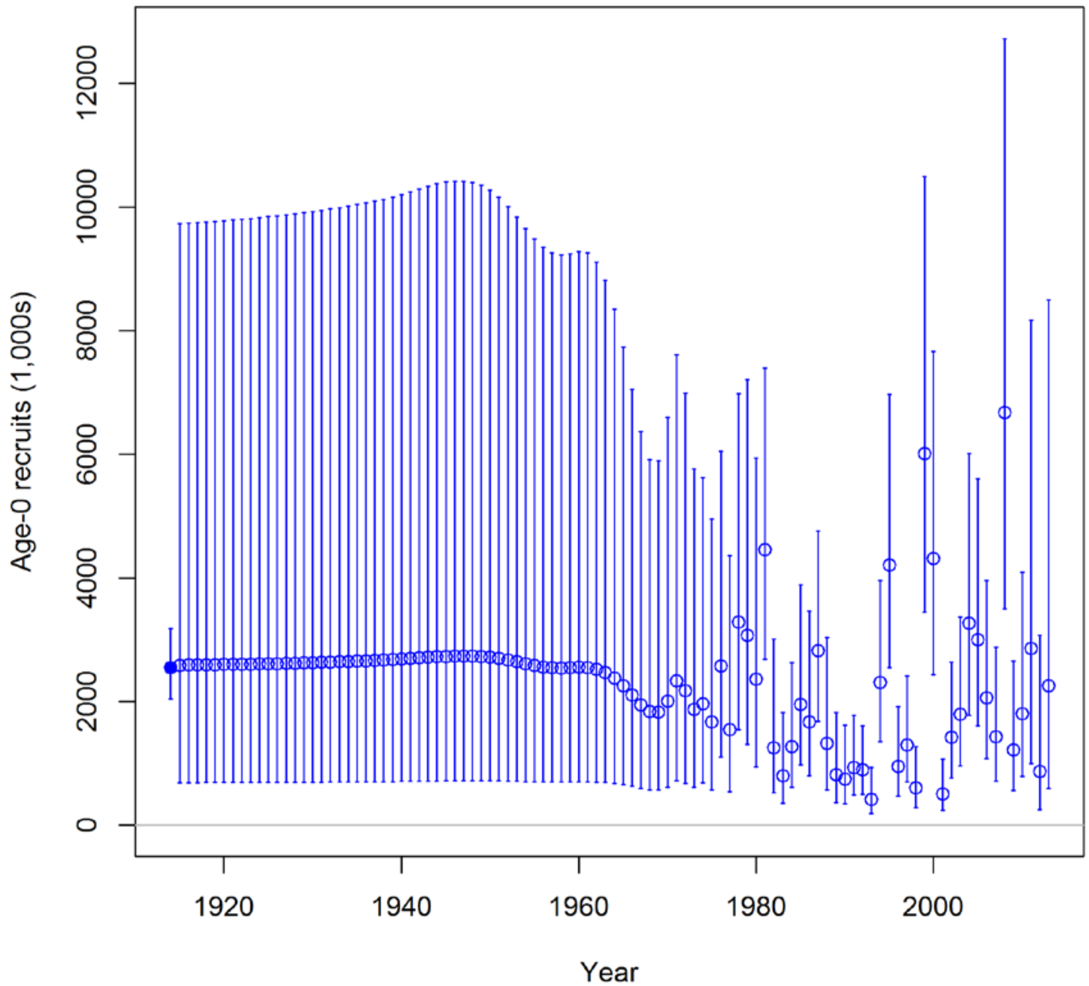

Figure 122: Time series of recruitment estimated in the assessment model with ~ 95% interval.

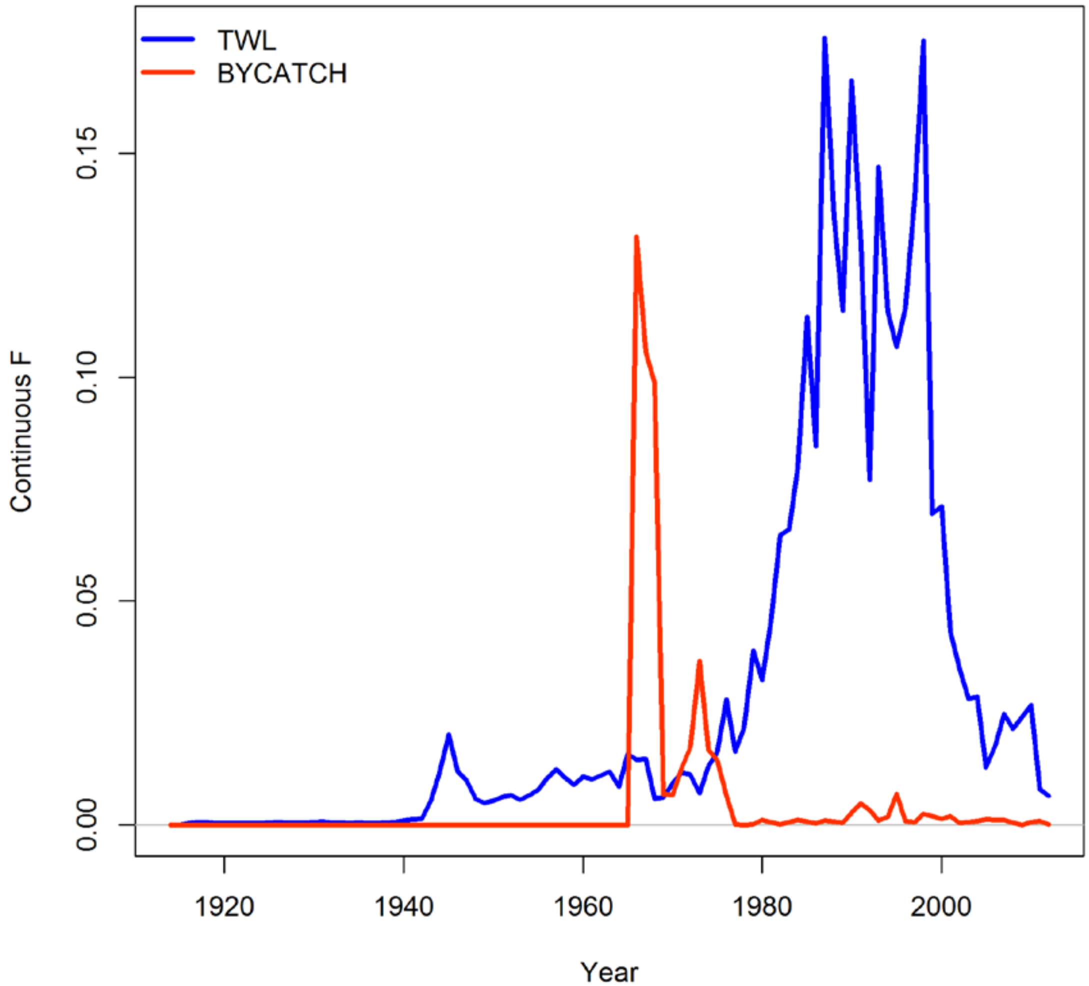

Figure 123: Time series of fishing mortality of darkblotched rockfih estimated by the assessment model.

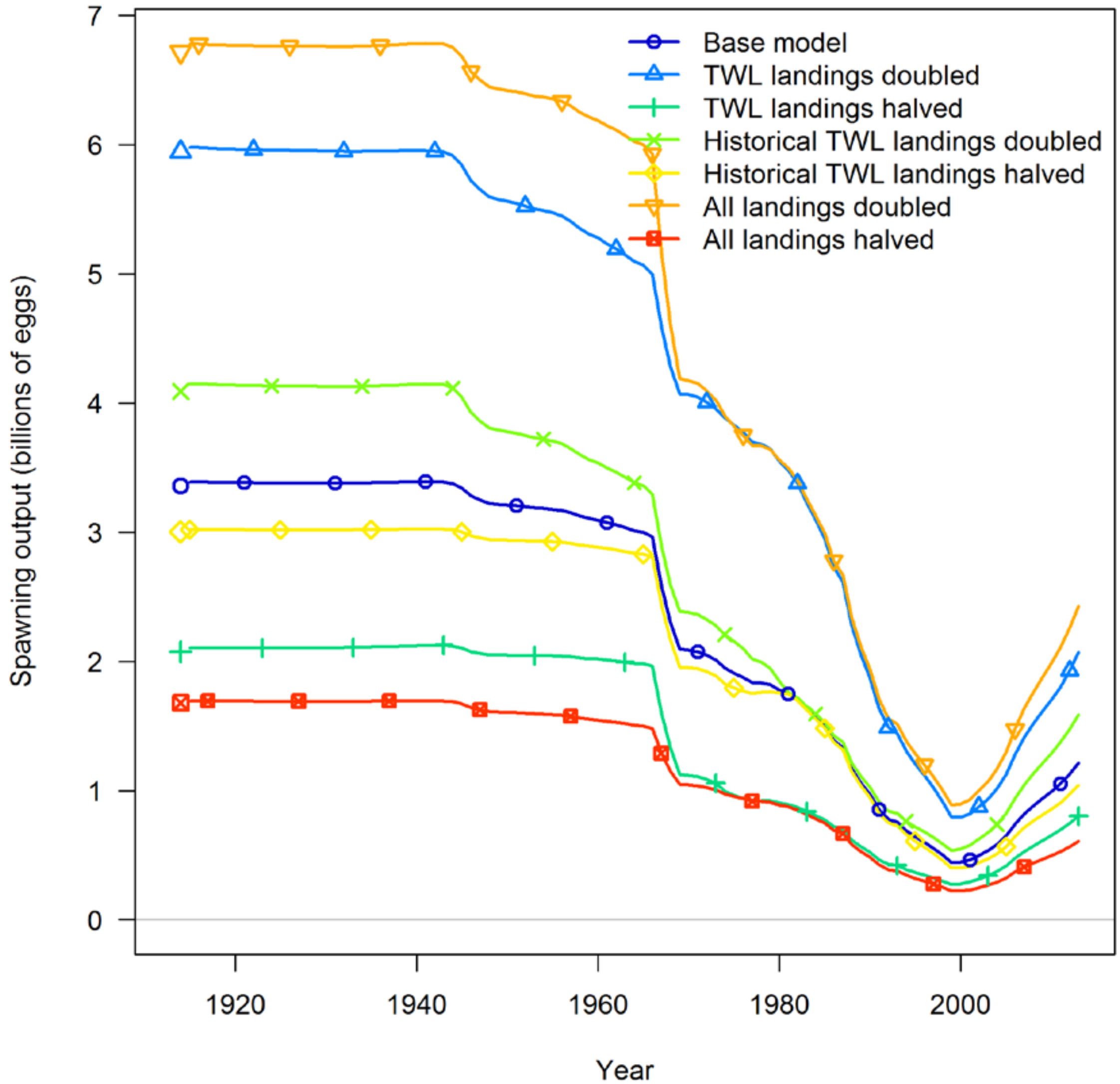

Figure 124: Sensitivity of darkblotched rockfish spawning output to alternative assumptions about fishery removals.

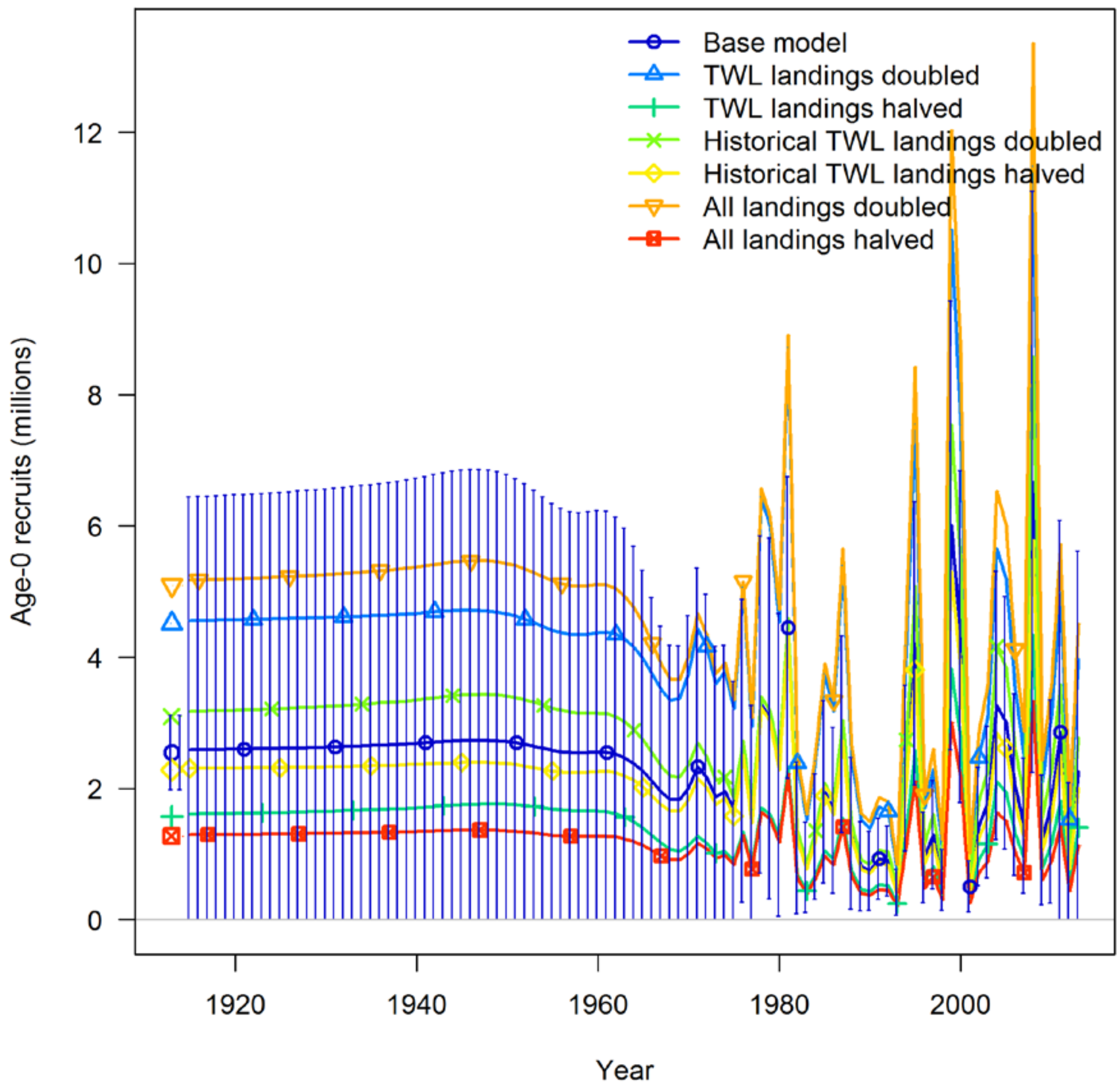

Figure 125: Sensitivity of darkblotched rockfish recruitment to alternative assumptions about fishery removals. Recruitment time series of this assessment are provided with ~ 95% interval.

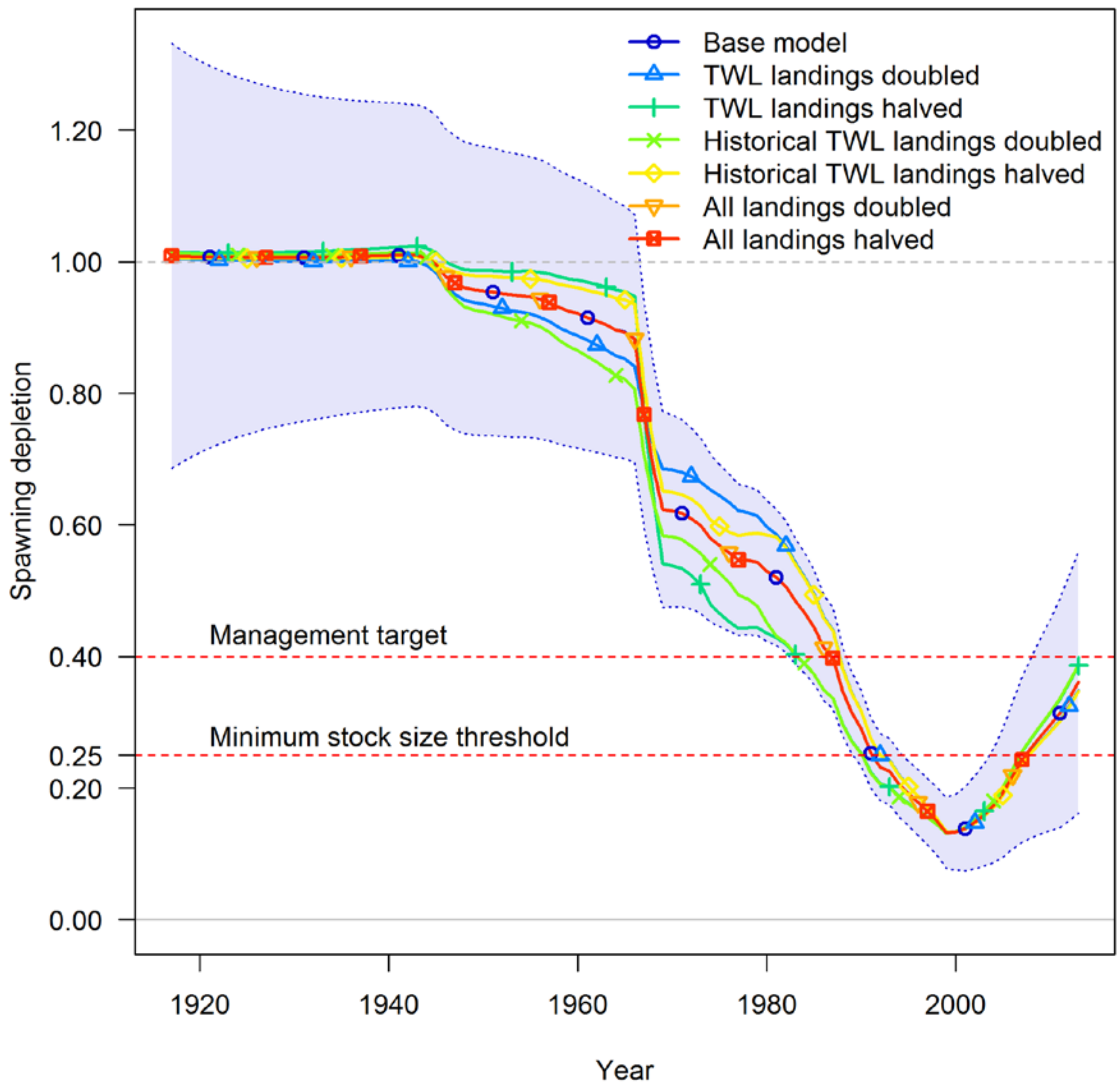

Figure 126: Sensitivity of darkblotched rockfish spawning depletion to alternative assumptions about fishery removals. Depletion time series of this assessment are provided with ~ 95% interval.

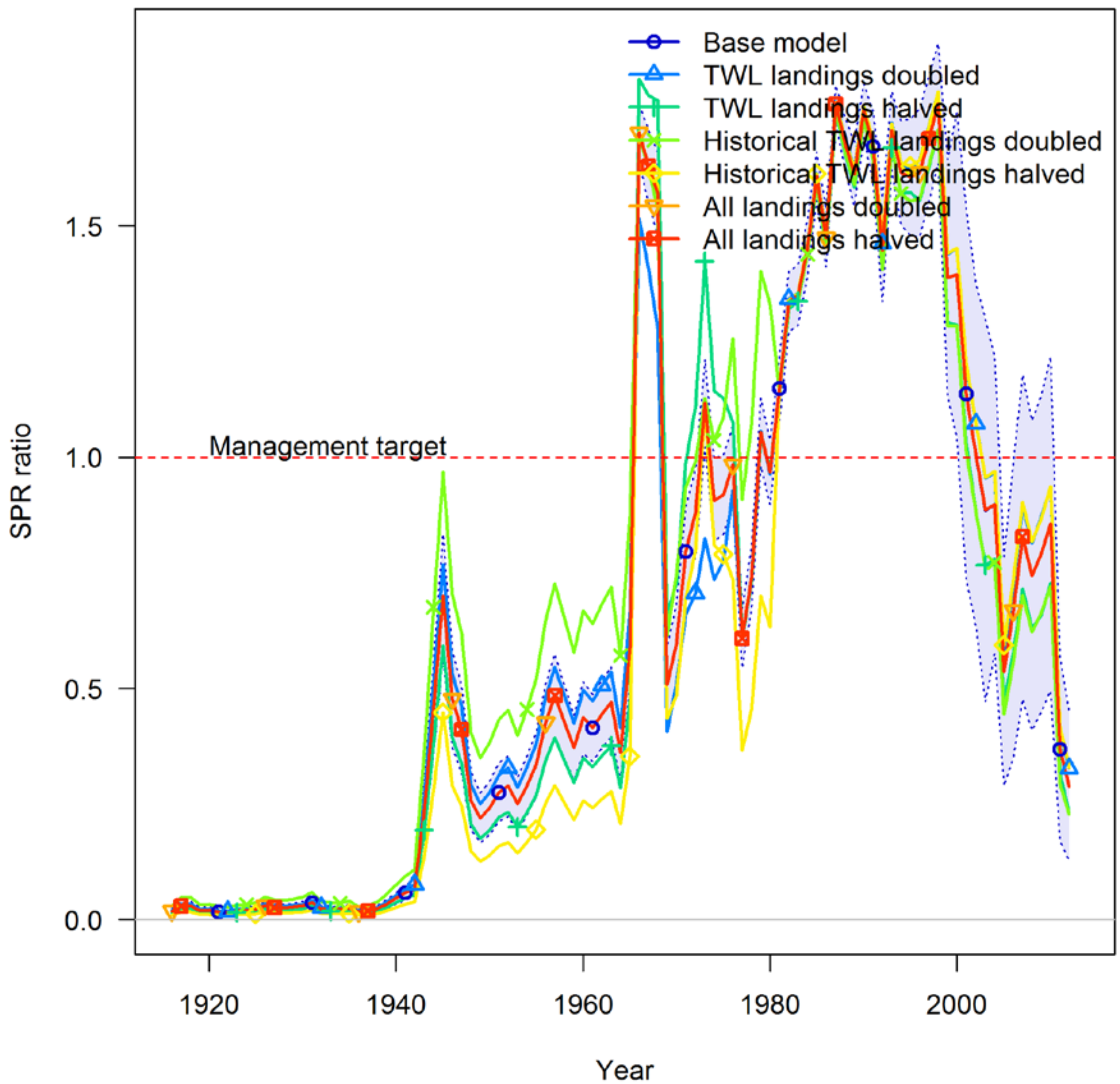

Figure 127: Sensitivity of darkblotched rockfish relative SPR ratio (1-SPR/1-$SPR_{Target=0.50}$) to alternative assumptions about fishery removals. Relative SPR ratio time series of this assessment are provided with ~ 95% interval.

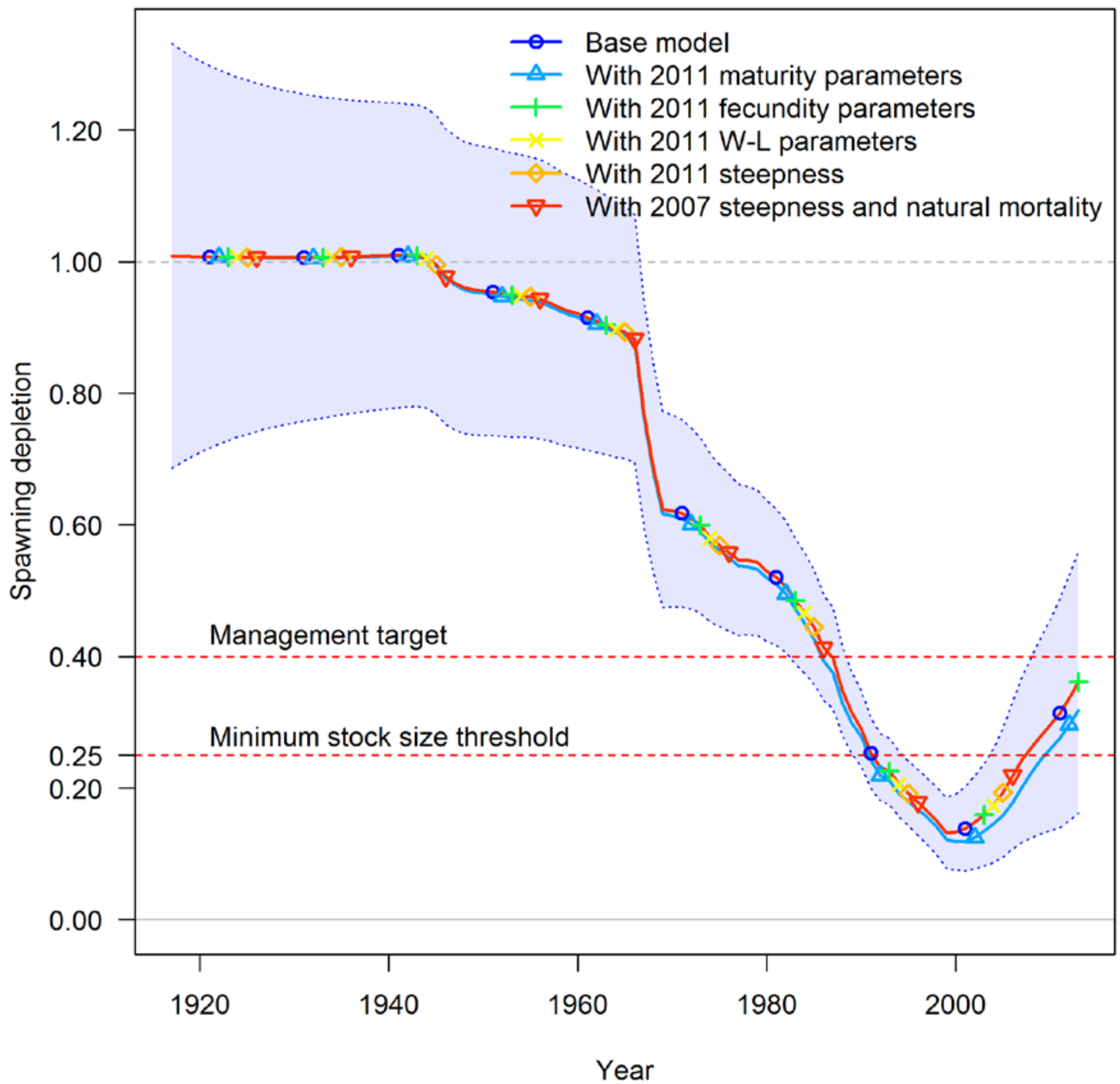

Figure 128: Sensitivity of darkblotched rockfish spawning depletion to updated maturity and fecundity parameters, weight-length relationships and stock-recruit steepness value (in combination with value for natural mortality). Depletion time series of this assessment are provided with ~ 95% interval.

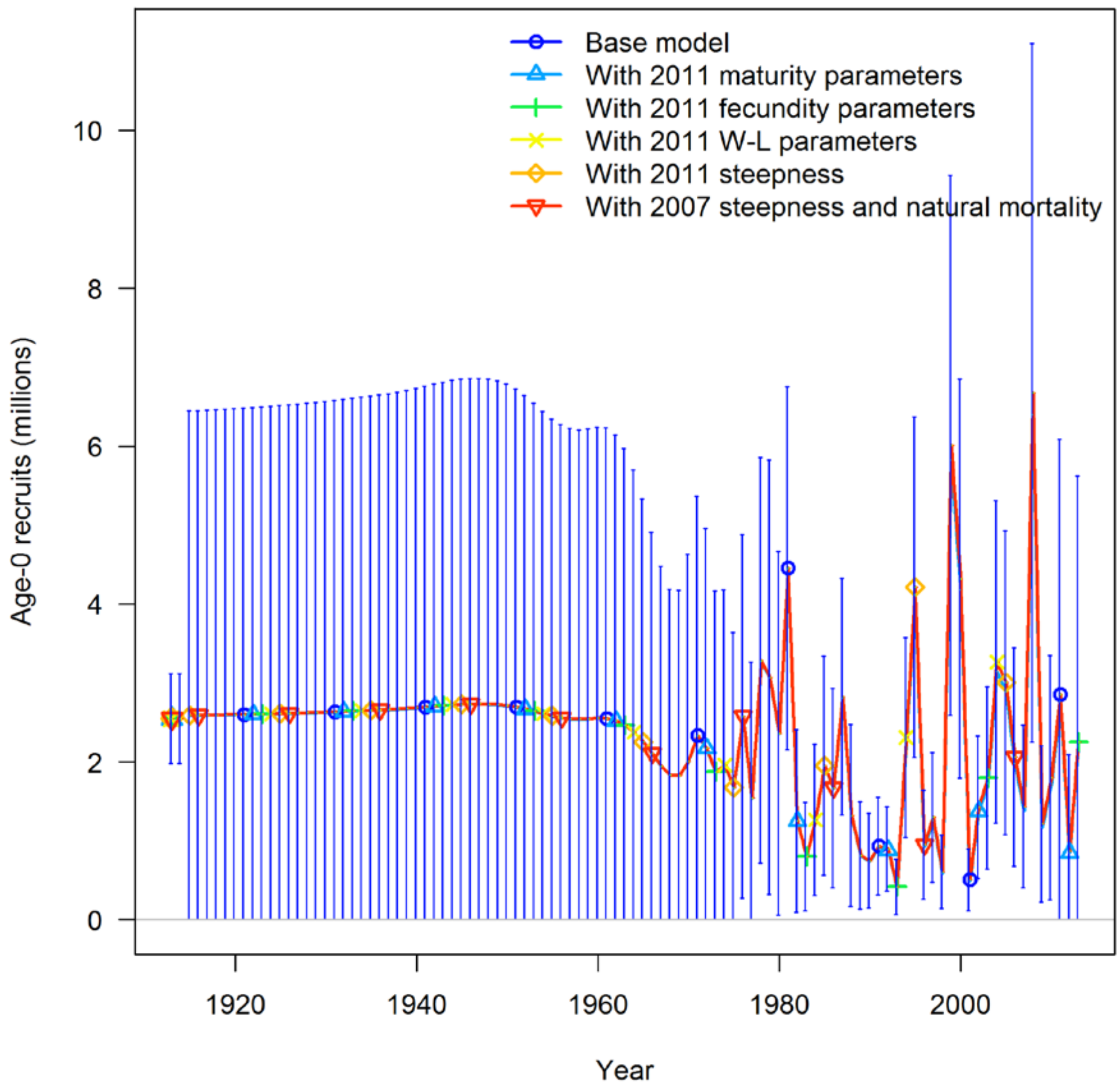

Figure 129: Sensitivity of darkblotched rockfish recruitment to updated maturity and fecundity parameters, weight-length relationships and stock-recruit steepness value (in combination with value for natural mortality). Recruitment time series of this assessment are provided with ~ 95% interval.

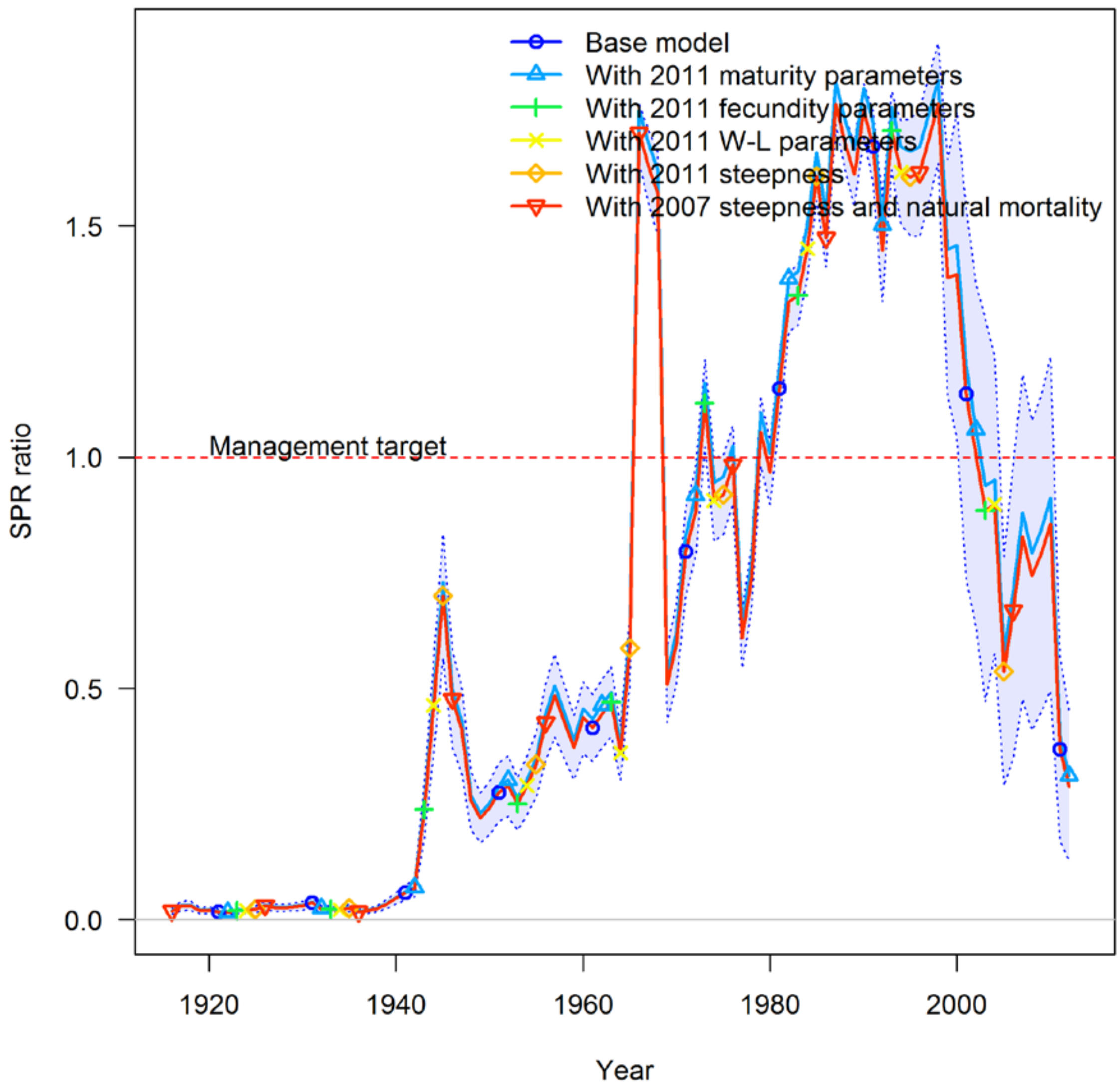

Figure 130: Sensitivity of darkblotched rockfish relative SPR ratio (1-SPR/1-$SPR_{Target=0.50}$) to updated maturity and fecundity parameters, weight-length relationships and stock-recruit steepness value (in combination with value for natural mortality). Relative SPR ratio time series of this assessment are provided with ~ 95% interval.

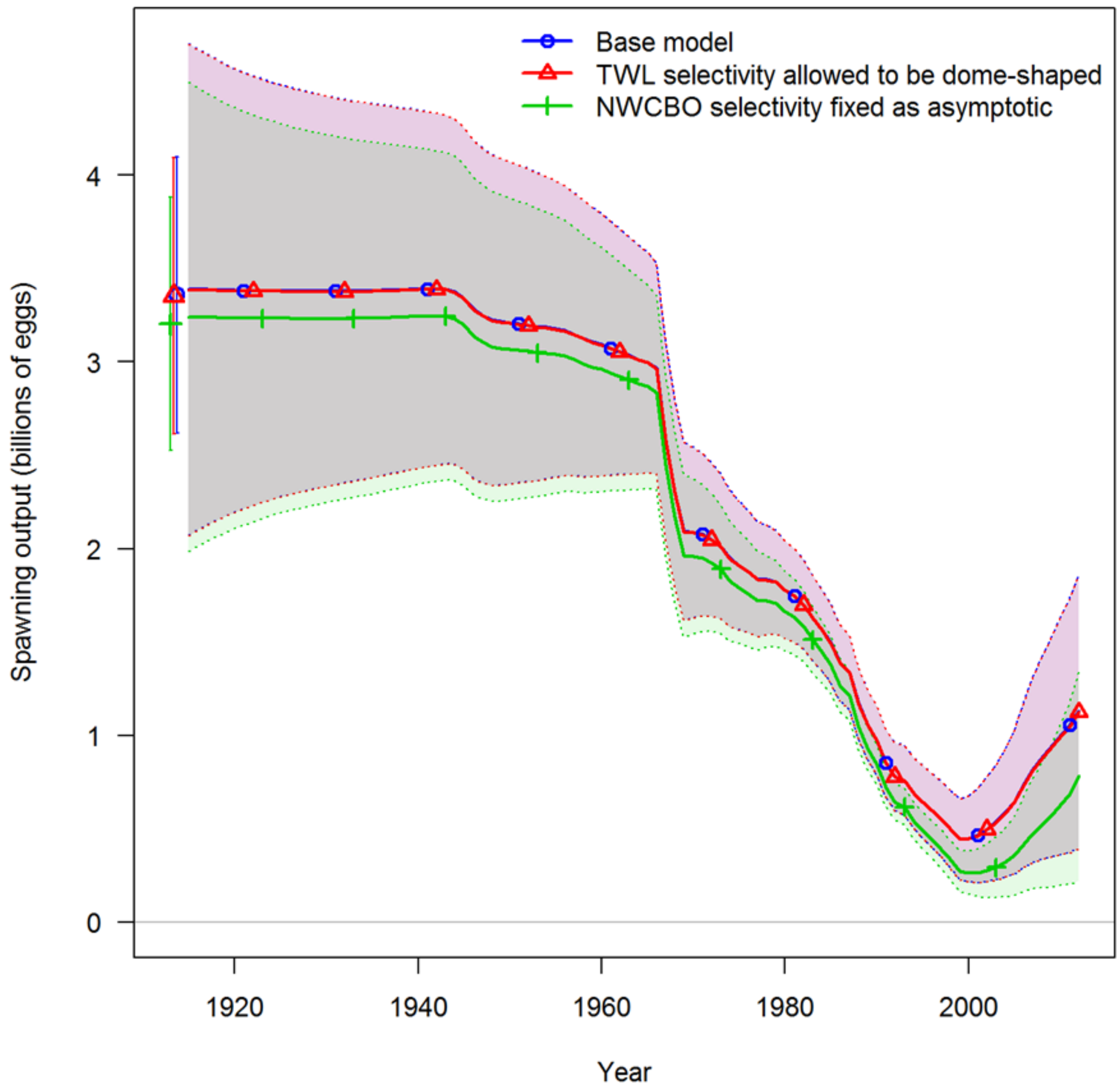

Figure 131: Sensitivity of darkblotched rockfish spawning output to alternative assumptions about selectivity. Spawning output time series of this assessment are provided with ~ 95% interval.

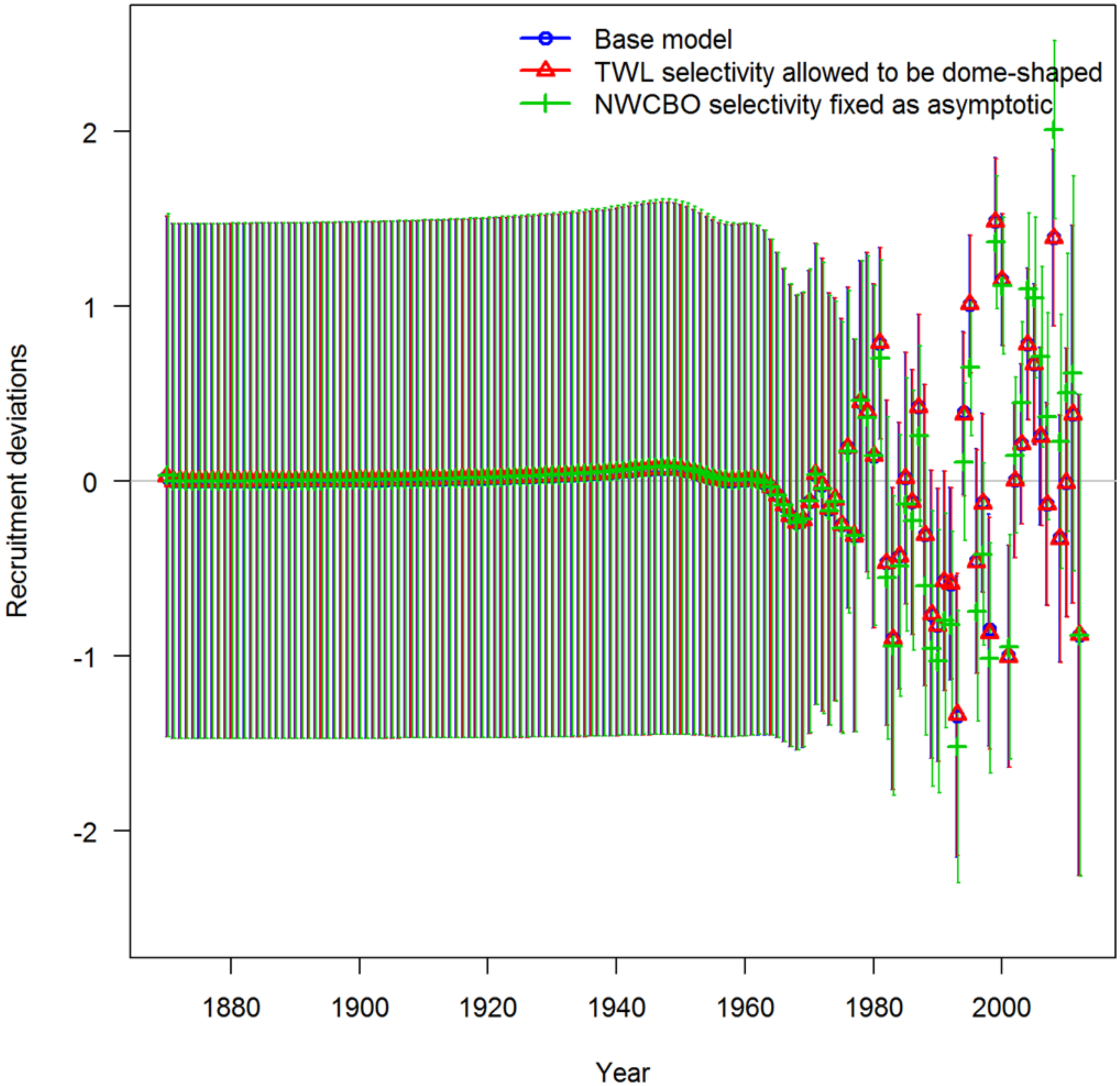

Figure 132: Sensitivity of darkblotched rockfish recruitment to alternative assumptions about selectivity. Recruitment time series of this assessment are provided with ~ 95% interval.

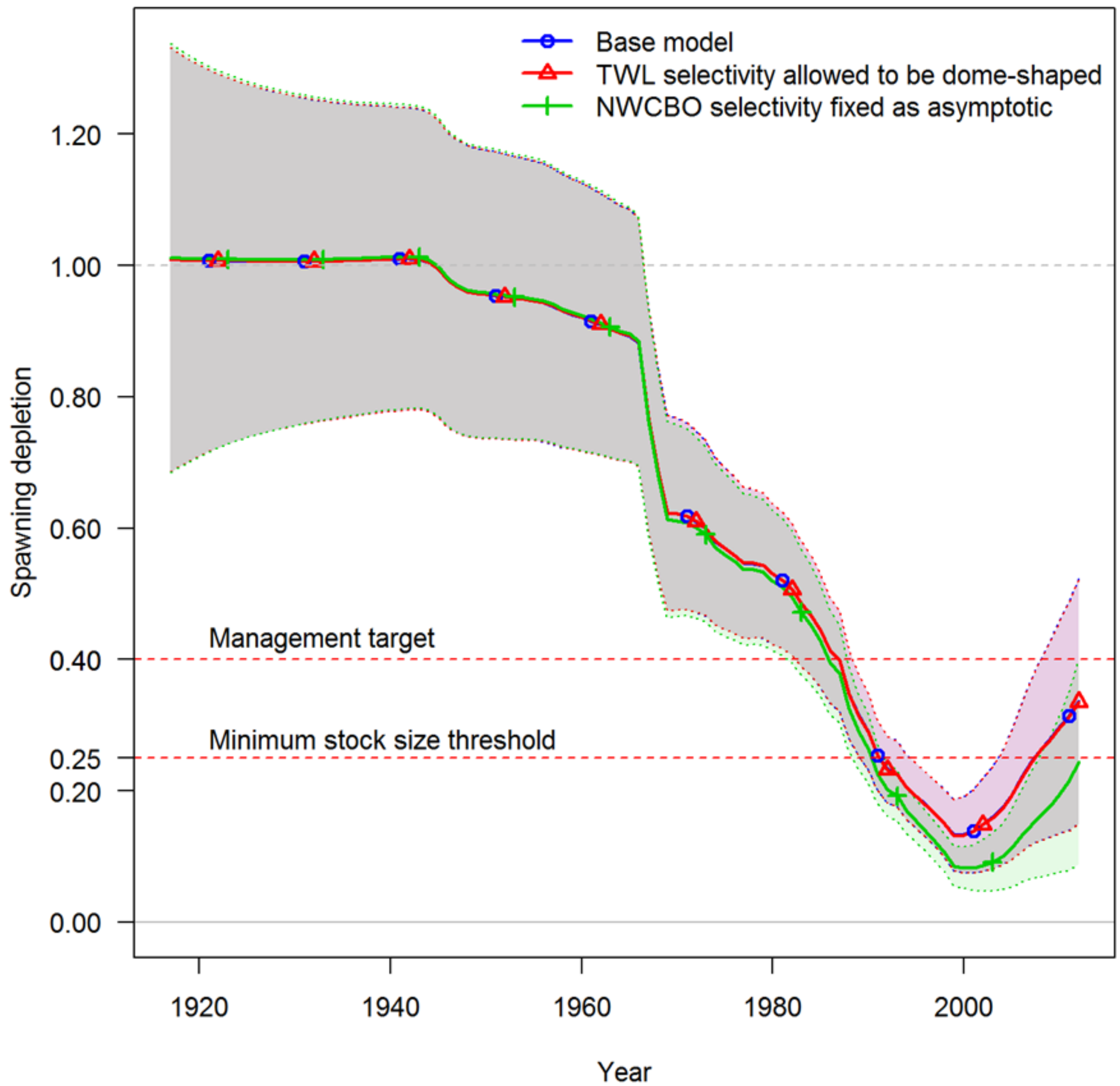

Figure 133: Sensitivity of darkblotched rockfish depletion to alternative assumptions about selectivity. Depletion time series of this assessment are provided with ~ 95% interval.

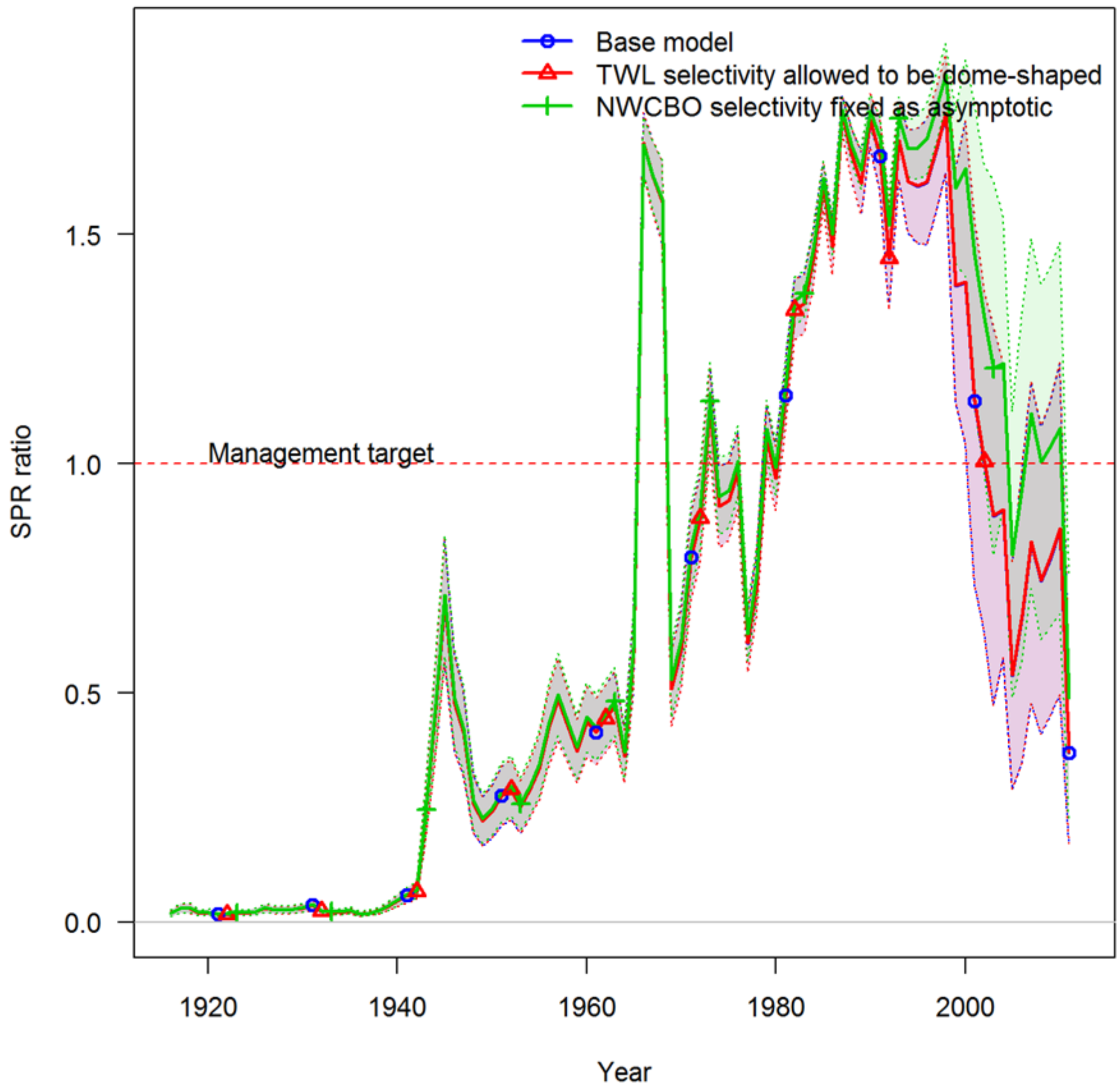

Figure 134: Sensitivity of darkblotched rockfish relative SPR ratio (1-SPR/1-$SPR_{Target=0.50}$) to alternative assumptions about selectivity. Time series of this assessment are provided with ~ 95% interval.

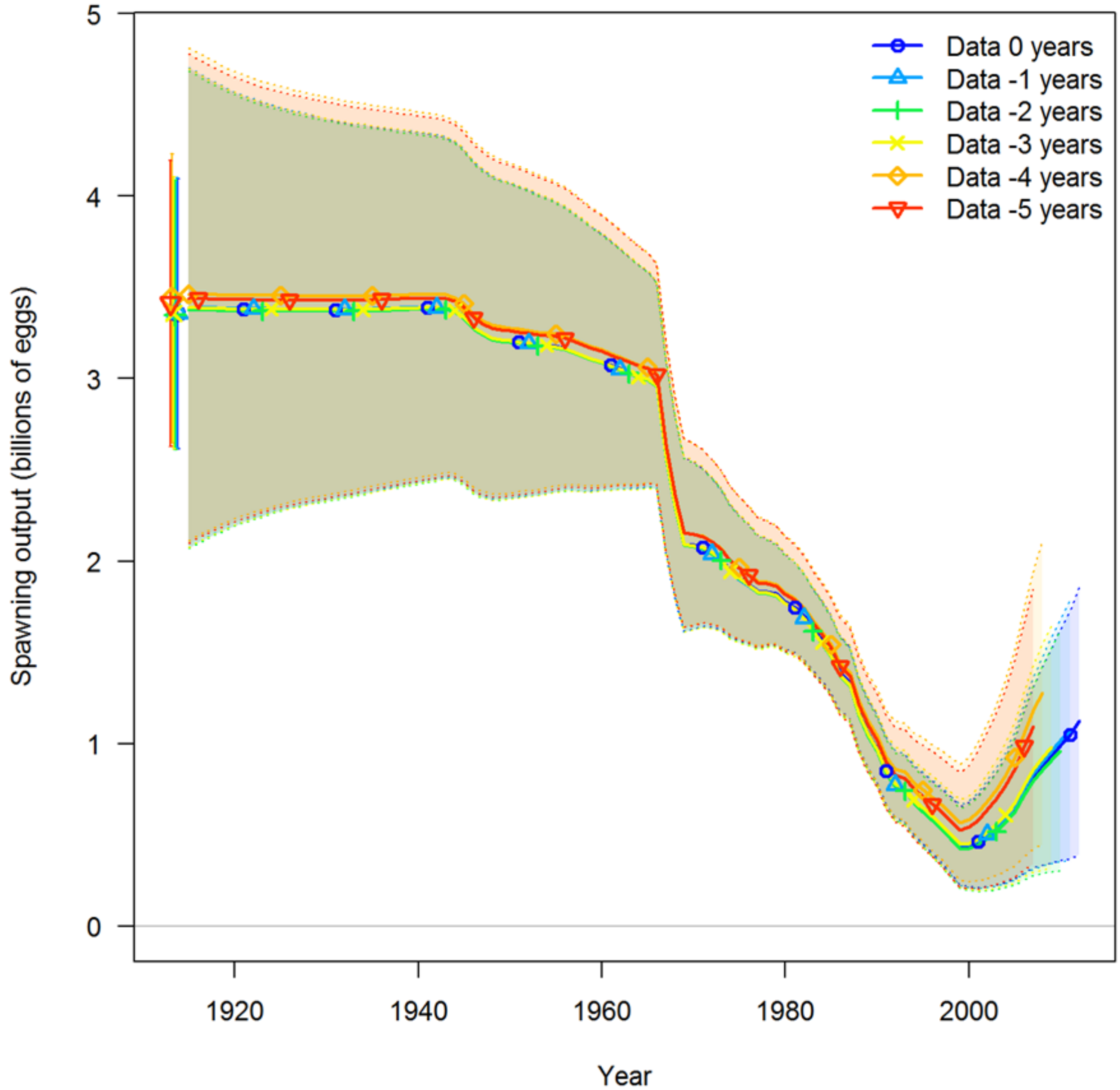

Figure 135: Results of retrospective analysis. Spawning output ime series of the base model are provided with ~ 95% interval.

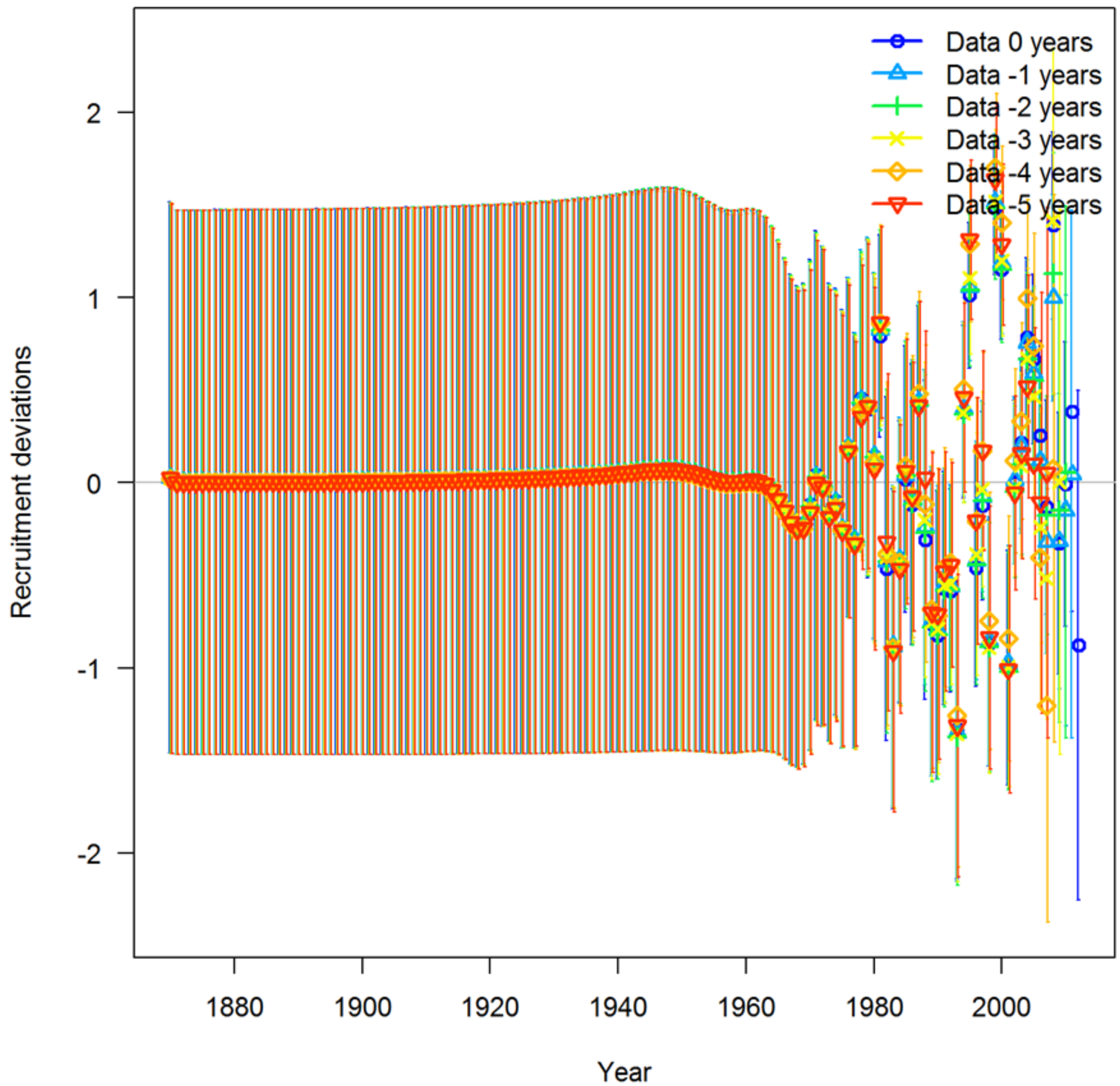

Figure 136: Results of retrospective analysis. Recruitment of the base model are provided with ~ 95% interval.

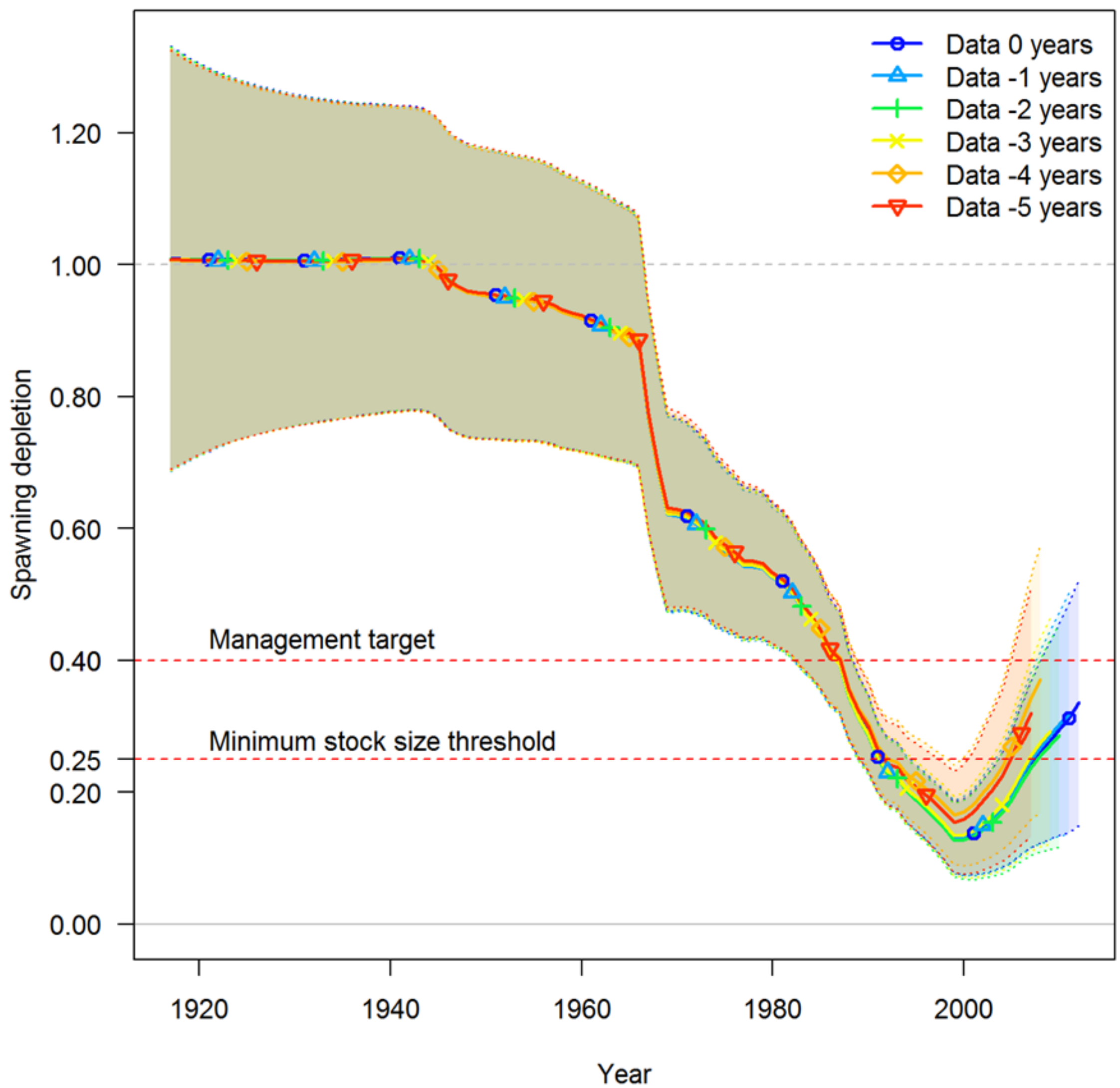

Figure 137: Results of retrospective analysis. Depletion of the base model are provided with ~ 95% interval.

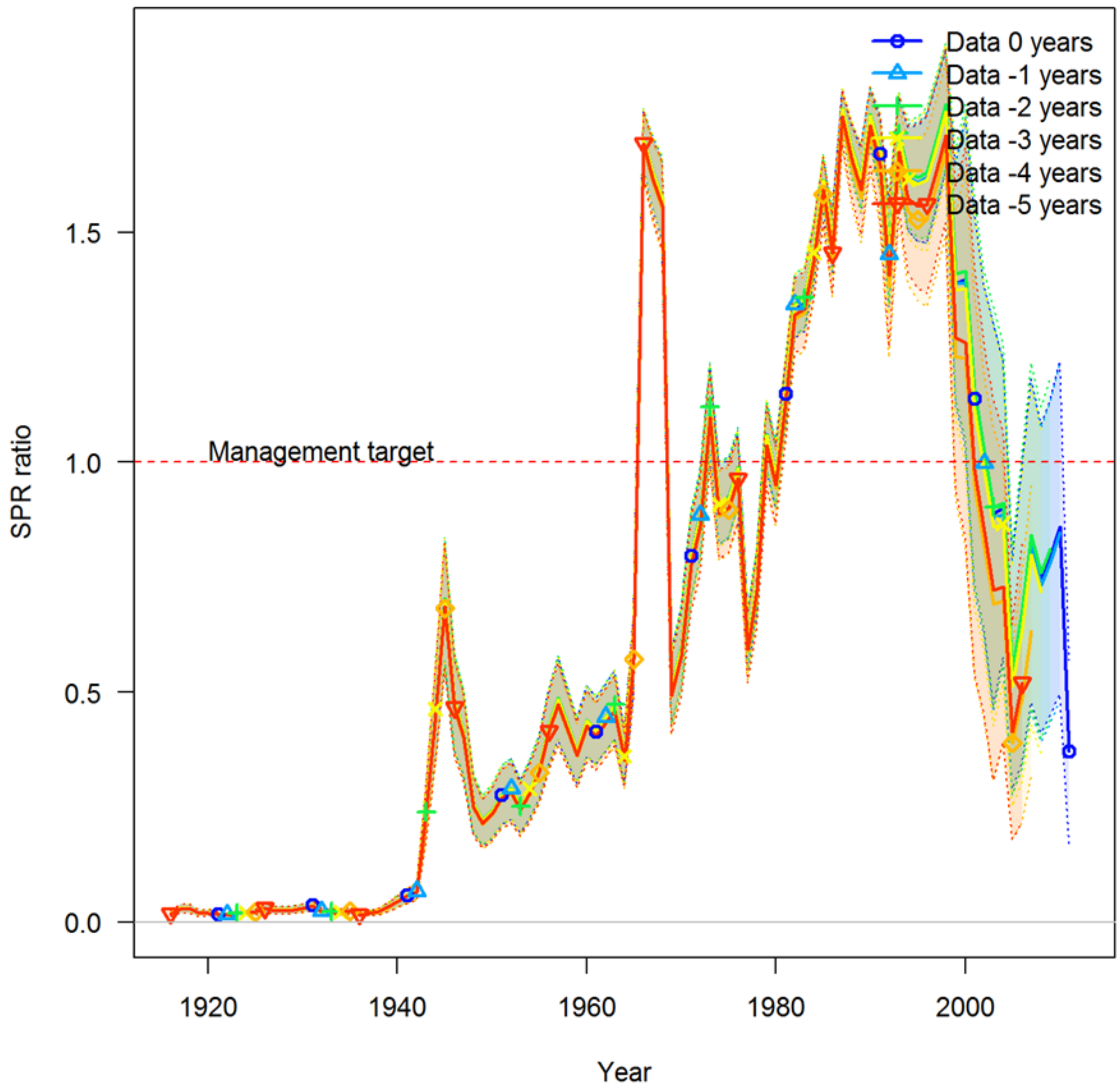

Figure 138: Results of retrospective analysis. Relative SPR ratio (1-SPR/1-$SPR_{Target=0.50}$) of the base model are provided with ~ 95% interval.

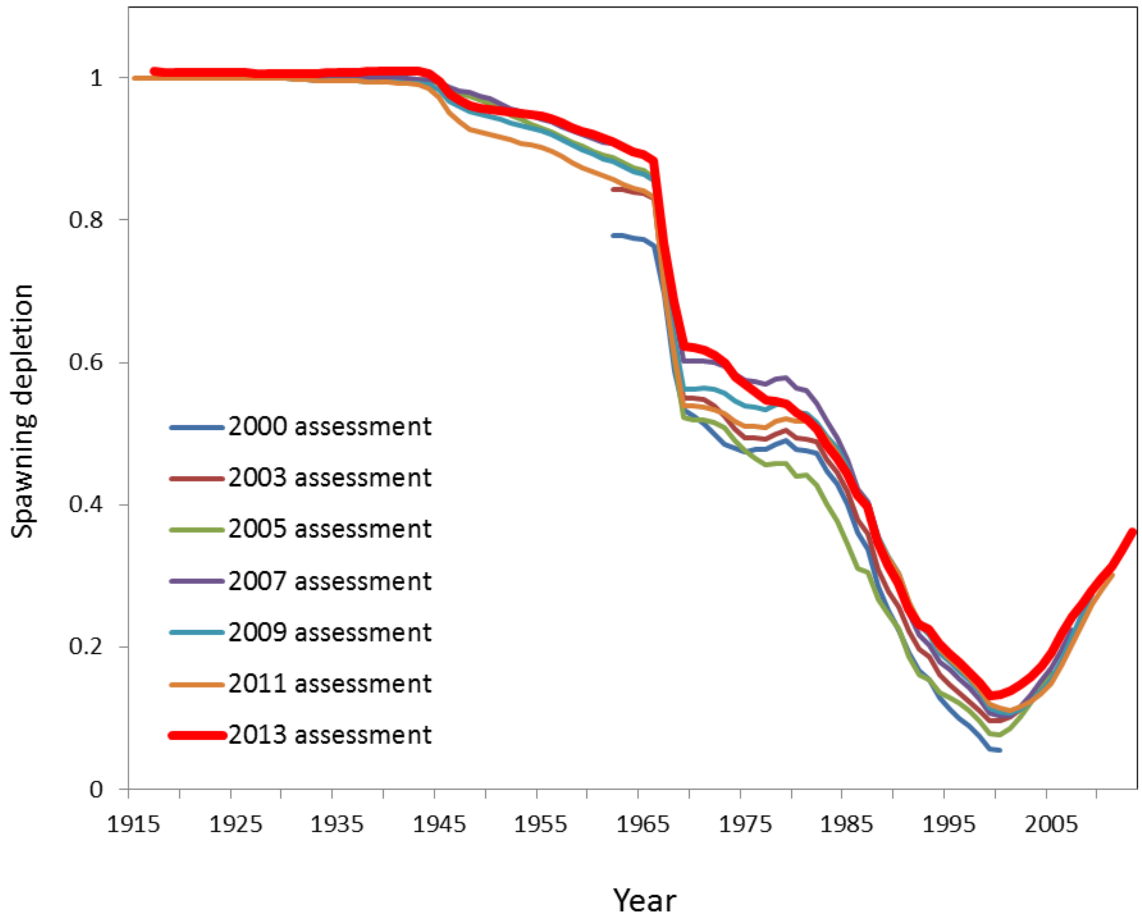

Figure 139: Comparison of spawning depletion time series among darkblotched rockfish assessments.

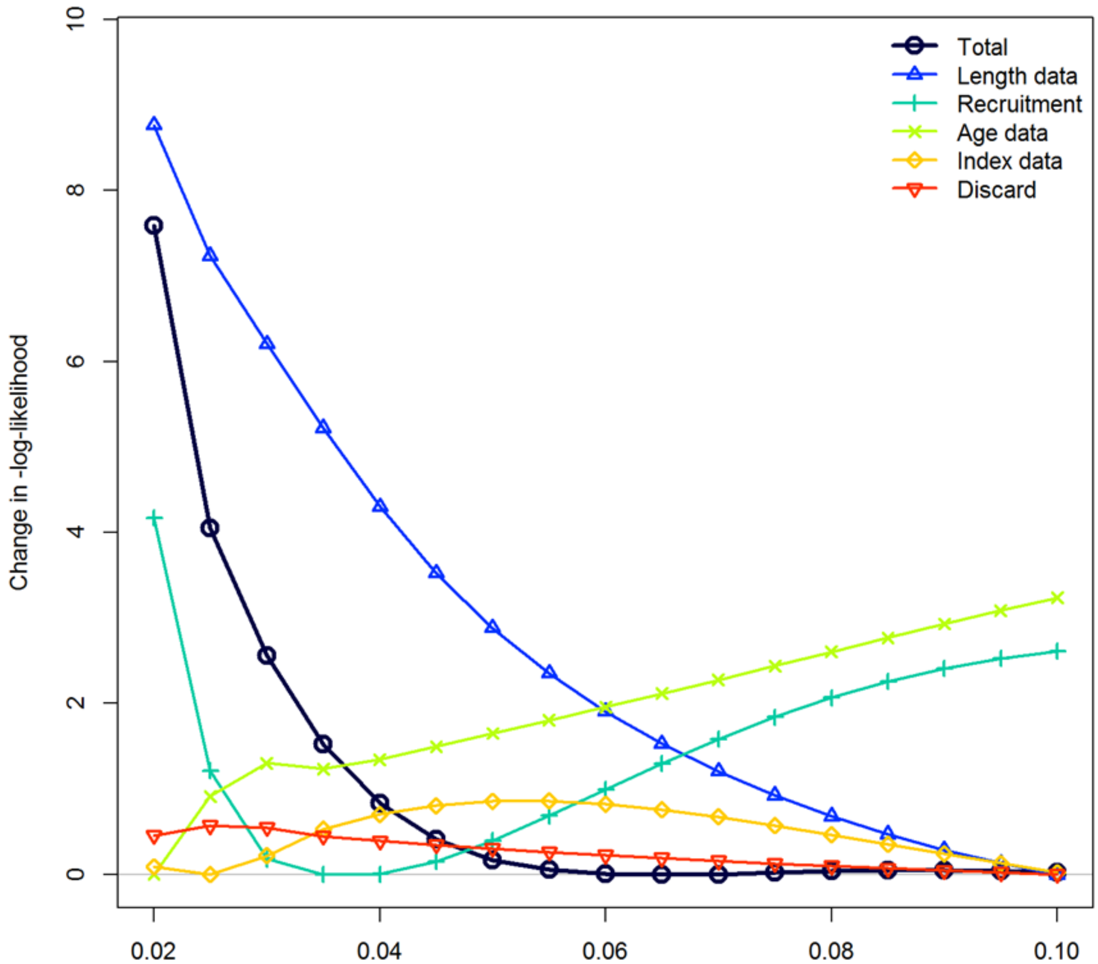

Figure 140: Negative log-likelihood profile for each data component and in total given different values of natural mortality ranging from 0.02 to 0.1 by increments of 0.005.

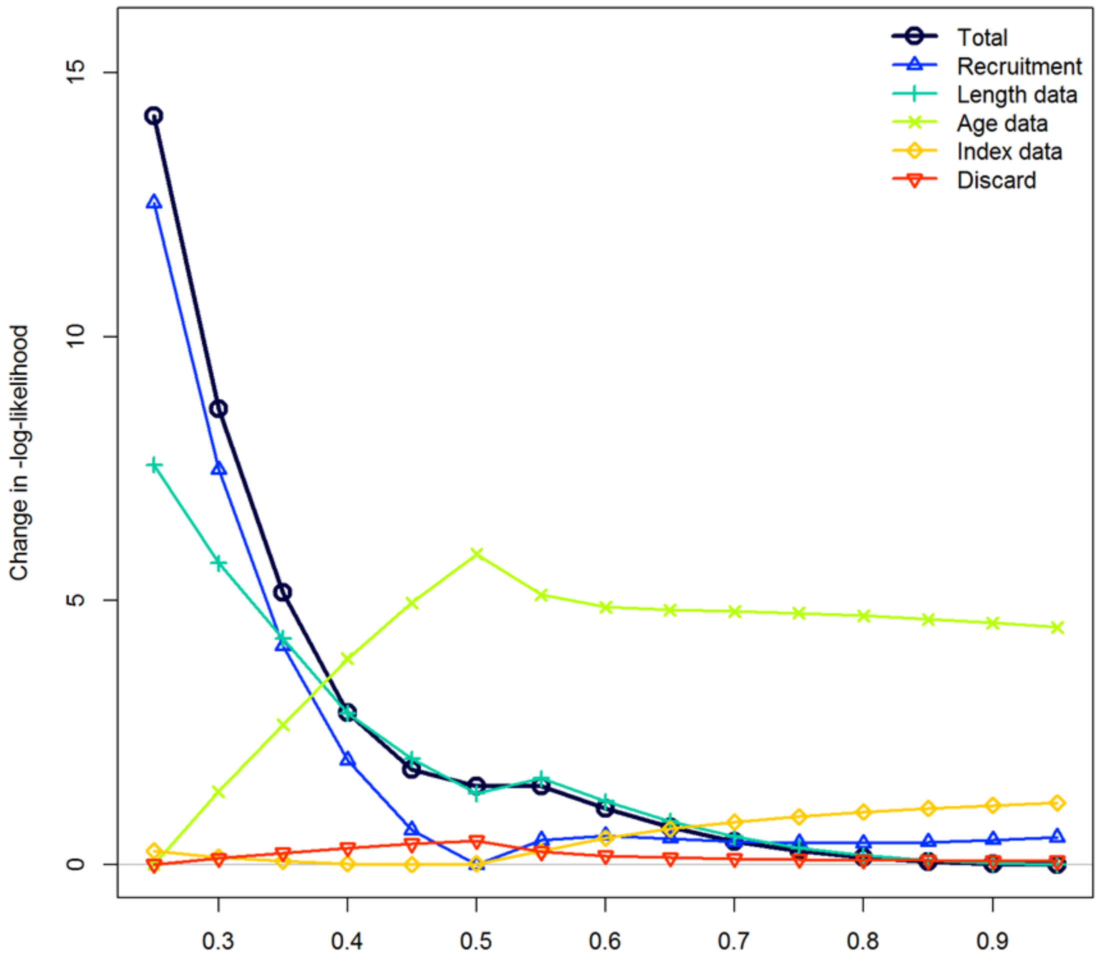

Figure 141: Negative log-likelihood profile for each data component and in total given different values of stock-recruit steepness ranging from 0.25 to 0.95 by increments of 0.05.

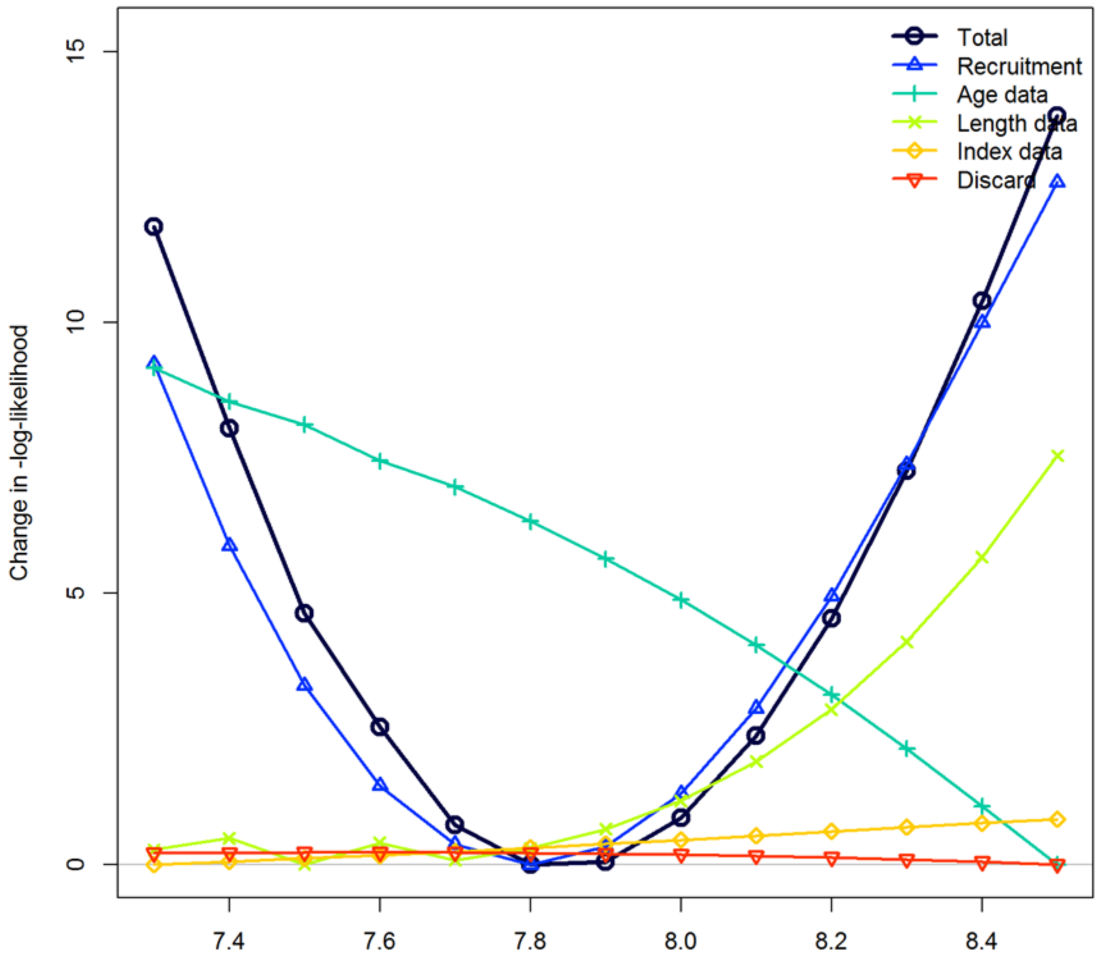

Figure 142: Negative log-likelihood profile for each data component and in total given different values of ln(R_0) ranging from 7.3 to 8.4 by increments of 0.1.

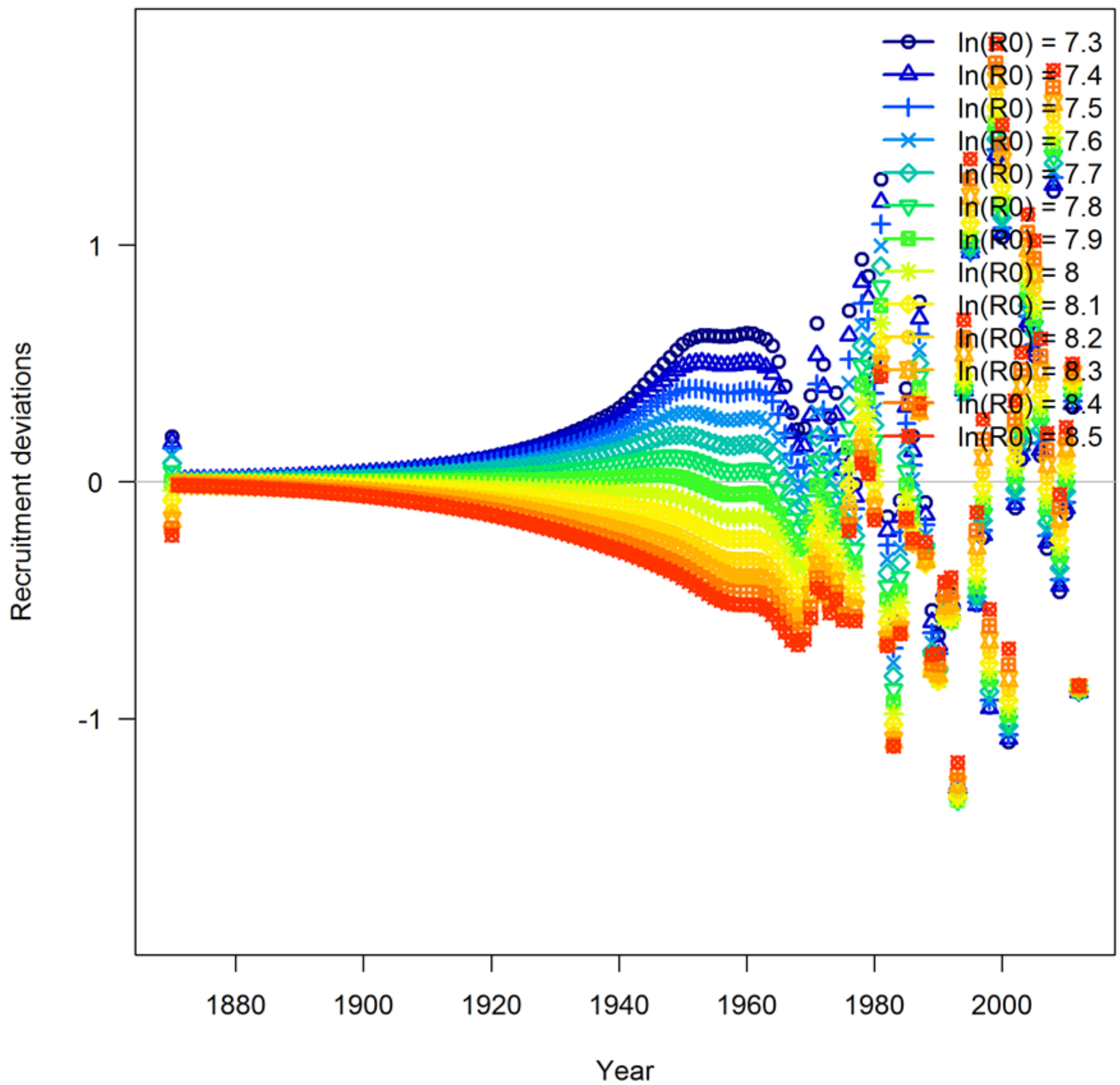

Figure 143: Values of recruitment deviations given different values of ln(R_0) ranging from 7.3 to 8.4 by increments of 0.1.

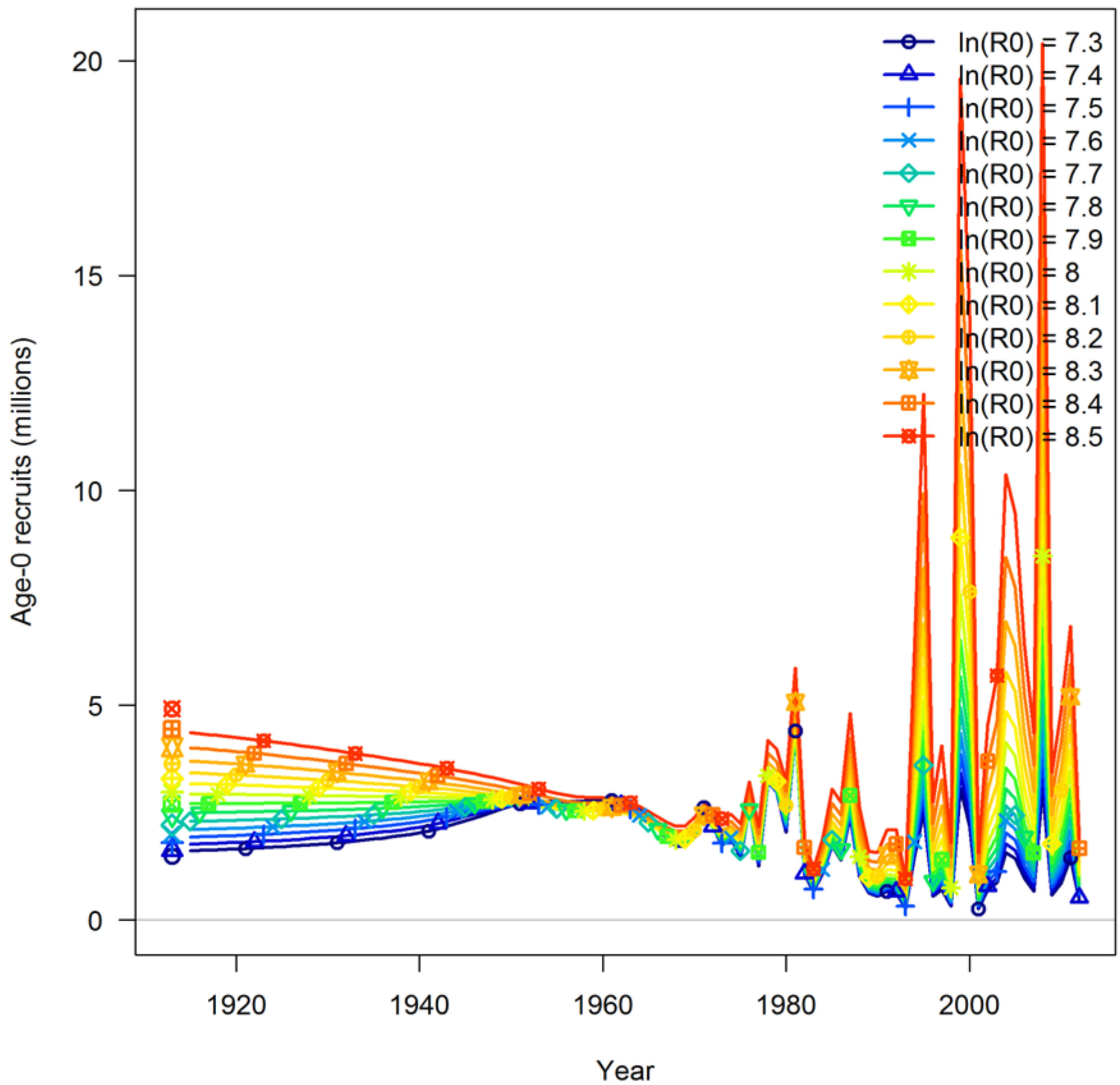

Figure 144: Values of estimated recruitment given different values of ln(R_0) ranging from 7.3 to 8.4 by increments of 0.1.

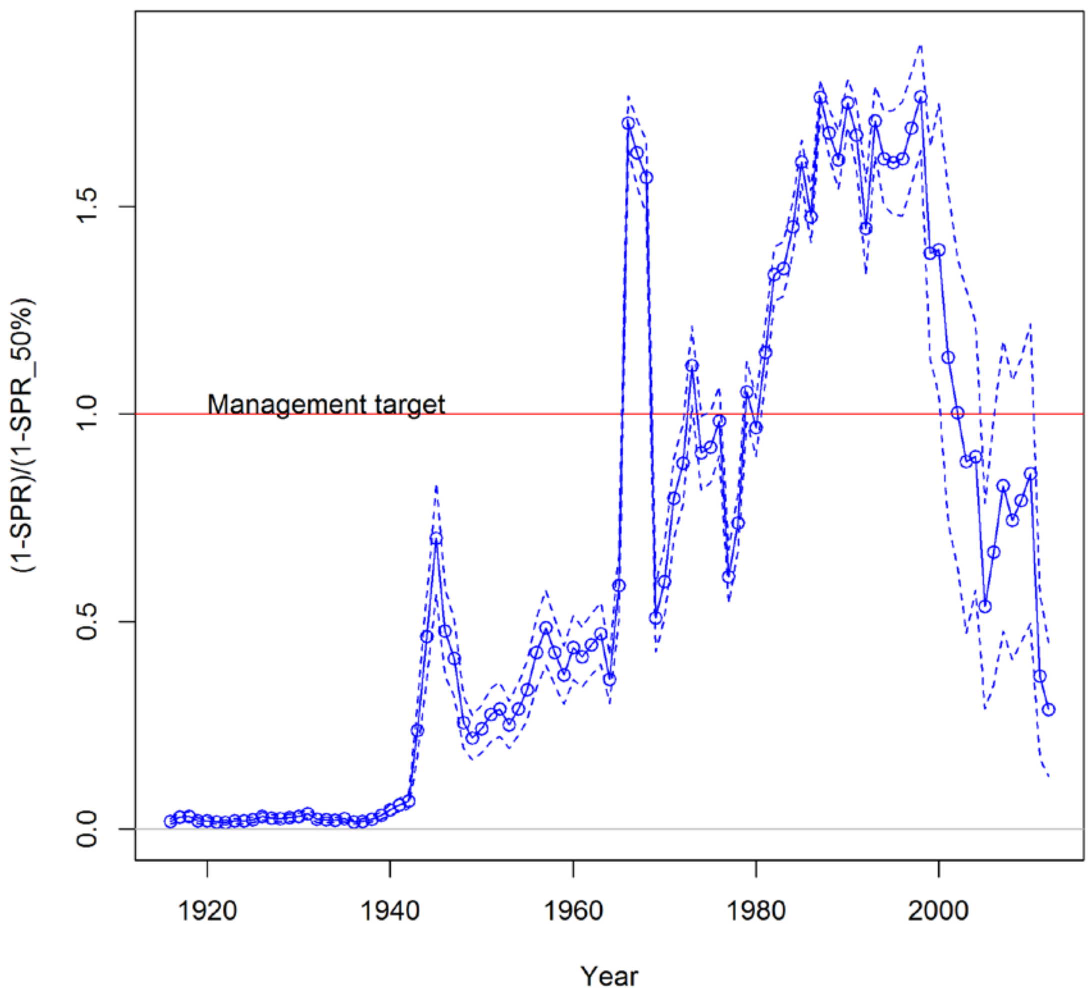

Figure 145: Time series of estimated relative spawning potential ratio (1-SPR/1-SPR$_{Target=0.50}$) for the base model (round points) with ~95% intervals (dashed lines). Values of relative SPR above 1.0 reflect harvests in excess of the current overfishing.

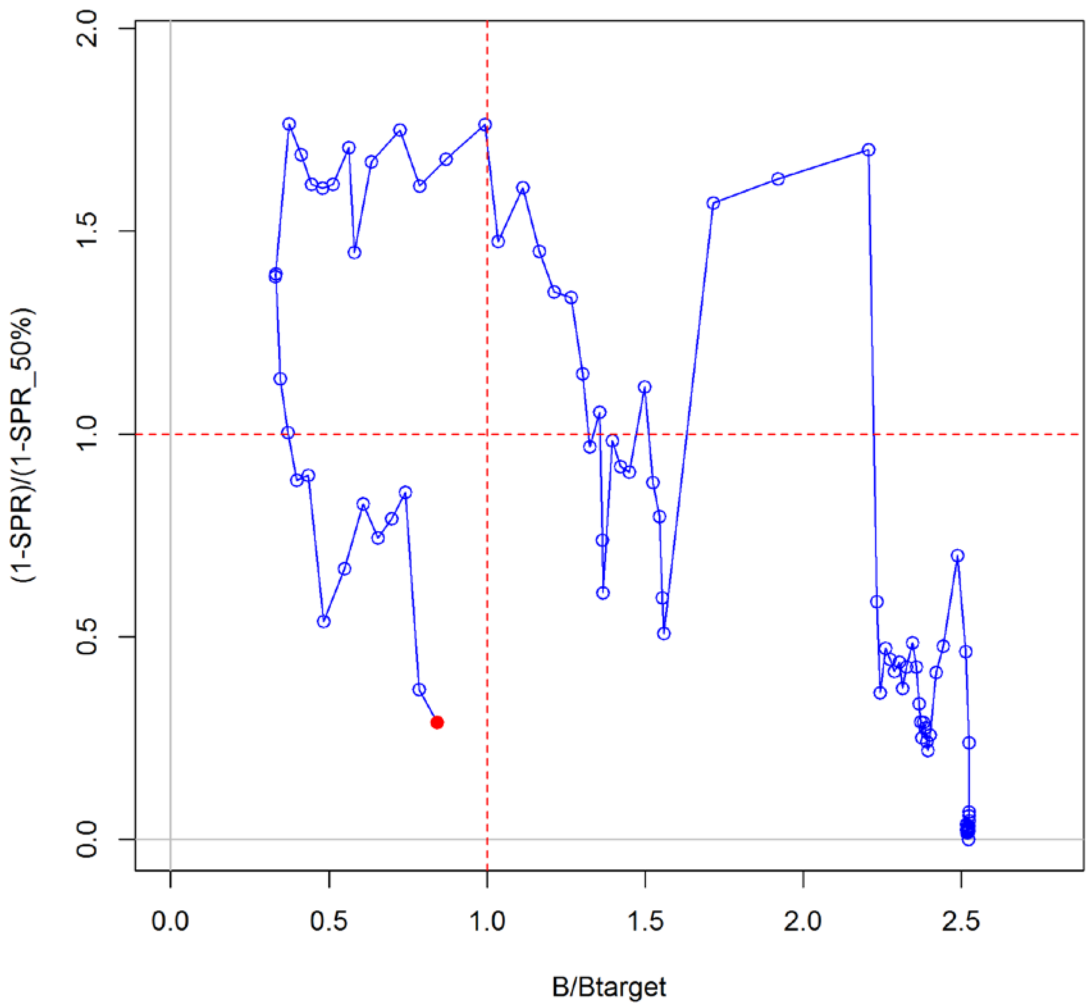

Figure 146: Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base model. The relative (1-SPR) is (1-SPR) divided by 0.5 (the SPR target). Relative depletion is the annual spawning biomass divided by the spawning biomass corresponding to 40% of the unfished spawning biomass. The red point indicates the year 2012.

Appendix A. Management shifts related to West Coast groundfish species

Effective October 18, 1982

- First trip limits established (widow rockfish and sablefish).

Effective January 1, 1992

- First **cumulative trip limits** for various species and species groups (widow RF; Sebastes complex; Pacific ocean perch; deepwater complex; non-trawl sablefish).

Effective May 9, 1992

- Increased the **minimum legal codend mesh size** for roller trawl gear north of Point Arena, California (40° 30' N latitude) from 3.0 inches to 4.5 inches; prohibited double-walled codends; removed provisions regarding rollers and tickler chains for roller gear with codend mesh smaller than 4.5 inches.

Effective January 1, 1994

- Divided the commercial groundfish fishery into two components: the **limited entry** fishery and the open access fishery.
    - A federal limited entry permit is required to participate in the limited entry segment of the fishery. Permits are issued based on the fishing history of qualifying fishing vessels.

Effective September 8, 1995

- The **trawl minimum mesh size** now applies throughout the net; removed the legal distinction between bottom and roller trawls and the requirement for continuous riblines; clarified the distinction between bottom and pelagic (midwater) trawls; modified chafing gear requirements;

Effective January 1, 1999:

- Dividing line between north and south management areas moved to 40° 10'.

Effective January 1, 2000

- **chafing gear** may be used only on the last 50 meshes of a small footrope trawl, running the length of the net from the terminal (closed) end of the codend.

New rockfish categories in 2000.

- Rockfish (except thornyheads) are divided into new categories north and south of 40° 10' N. lat., depending on the depth where they most often are caught: nearshore, shelf, or slope. New trip limits have been established for "minor rockfish" species according to these categories.
    - Nearshore: numerous minor rockfish species including black and blue rockfishes.
    - Shelf: shortbelly, widow, yellowtail, bocaccio, chilipepper, cowcod rockfishes, and others.
    - Slope: Pacific ocean perch, splitnose rockfish, and others

New Limited Entry Trawl Gear Restrictions in 2000.

- Limited entry trip limits may vary depending on the type of trawl gear that is onboard a vessel during a fishing trip: large footrope, small footrope, or midwater trawl gear.
    - **Large footrope trawl gear** is bottom trawl gear, with a footrope diameter larger than 8 in. (20 cm) (including rollers, bobbins or other material encircling or tied along the length of the footrope).
    - **Small footrope trawl gear** is bottom trawl gear, with a footrope diameter 8 in. (20 cm) or smaller (including rollers, bobbins or other material encircling or tied along the length of the footrope), except chafing gear may be used only on the last 50 meshes of a small footrope trawl, running the length of the net from the terminal (closed) end of the codend.
    - **Midwater trawl gear** is pelagic trawl gear, The footrope of midwater trawl gear may not be enlarged by encircling it with chains or by any other means.

Effective during 2001:

- First conservation area was established (Cowcod Conservation Area)
- The West Coast Observer Program was initiated
- It is unlawful to take and retain, possess or land petrale sole from a fishing trip if large footrope gear is onboard and the trip is conducted at least in part between May 1 and October 31

Effective during 2002:

- Darkblotched Conservation Area was established.

Effective during 2003:

- Vessel buyback program was initiated (December 4, 2003)
- Yelloweye Rockfish Conservation Area was established
- Rockfish Conservation areas for several rockfish species were established.

Effective during 2004:

- Vessel Monitoring System (VMS) was initiated.

Effective during 2005:

- Selective flatfish trawl required shoreward of the RCA North of 40^{o} 10'.

Appendix B. Assessment model files

Appendix B.1. SS data file

```
#Global specifications
1915 # Start year
2012 # End year
1   # N seasons per year
12  # Months per season
1   # Spawning Season
2   # N fishing fleets
4   # N surveys
1   # Number of areas
TWL%BYCATCH%AKSHLF%AKSLP%NWSLP%NWCBO #Names divided by "%"
0.5   0.5   0.5   0.5   0.5  0.5 #Timing of each fishery/survey
1   1   1   1   1   1  # Area of each fleet
1   1   # Units for catch by fishing fleet:
1=Biomass(mt),2=Numbers(1000s)
0.01 0.01 # SE of log(catch) by fleet for equilibrium and continuous
options
2  # Number of Genders
45 # Accumulator age

#Landings section
# Initial equilibrium catch (landings + discard) by fishing fleet
0  0 # Initial equilibrium catch (landings + discard) by fishing fleet
98       # Number of lines catch data
# Landed catch (only) time series by fleet
# Catch(by fleet) Year Season
0         0            1915   1
13.009    0            1916   1
20.633    0            1917   1
21.345    0            1918   1
13.733    0            1919   1
14.439    0            1920   1
12.312    0            1921   1
11.311    0            1922   1
13.643    0            1923   1
13.863    0            1924   1
15.798    0            1925   1
21.328    0            1926   1
18.319    0            1927   1
18.159    0            1928   1
19.318    0            1929   1
21.079    0            1930   1
26.002    0            1931   1
16.433    0            1932   1
16.044    0            1933   1
15.249    0            1934   1
17.499    0            1935   1
11.881    0            1936   1
13.537    0            1937   1
16.741    0            1938   1
23.738    0            1939   1
32.725    0            1940   1
41.860    0            1941   1
48.165    0            1942   1
183.614   0            1943   1
```

397.657	0	1944	1
678.760	0	1945	1
401.009	0	1946	1
331.568	0	1947	1
191.102	0	1948	1
160.203	0	1949	1
177.770	0	1950	1
205.861	0	1951	1
216.837	0	1952	1
184.548	0	1953	1
216.901	0	1954	1
256.018	0	1955	1
339.045	0	1956	1
396.068	0	1957	1
335.049	0	1958	1
283.182	0	1959	1
342.106	0	1960	1
318.933	0	1961	1
345.280	0	1962	1
368.227	0	1963	1
264.989	0	1964	1
482.897	0	1965	1
413.119	3807	1966	1
370.119	2706	1967	1
133.875	2288	1968	1
133.554	153	1969	1
202.068	149	1970	1
250.117	278	1971	1
237.284	374	1972	1
146.314	768	1973	1
263.084	346	1974	1
318.595	293	1975	1
541.032	128.759	1976	1
315.707	2.396	1977	1
415.123	1.075	1978	1
732.379	3.716	1979	1
598.373	21.430	1980	1
824.186	11.848	1981	1
1134.167	1.653	1982	1
1114.261	11.559	1983	1
1302.935	19.582	1984	1
1760.872	12.769	1985	1
1254.632	5.720	1986	1
2401.271	13.985	1987	1
1646.800	9.519	1988	1
1268.669	5.289	1989	1
1650.955	28.252	1990	1
1161.030	44.969	1991	1
657.876	29.453	1992	1
1185.669	8.026	1993	1
851.283	14.734	1994	1
737.049	49.066	1995	1
736.793	5.993	1996	1
815.790	3.879	1997	1
912.558	14.058	1998	1
350.348	11.114	1999	1
250.741	8.145	2000	1

```
162.871   12.357       2001   1
109.061   3.217        2002   1
75.486    4.371        2003   1
181.873   7.274        2004   1
86.647    11.059       2005   1
95.978    11.148       2006   1
131.538   12.052       2007   1
111.054   6.317        2008   1
138.071   0.353        2009   1
176.168   8.176        2010   1
104.814   12.197       2011   1
91.828    2.225        2012   1

#Survey Indices section
27   # number of Survey data points    (#_N_cpue)
#_Units:  0=numbers; 1=biomass; 2=F
#_Errtype:  -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0 # fleet (fishery or survey) # TWL
2 1 0 # fleet (fishery or survey) # BYCATCH
3 1 0 # fleet (fishery or survey) # AKSHLF
4 1 0 # fleet (fishery or survey) # AKSLP
5 1 0 # fleet (fishery or survey) # NWSLP
6 1 0 # fleet (fishery or survey) # NWCBO
#
#Year   Seas     Flt/Svy    Value         se(log)
#AKSHLF triennial early (N=5)
#Random-SY, Random-VY, GammaECE,
"C:\Users\thorsonja\Dropbox\Darkblotched\delta-GLMM\AFSC triennial
early\2012-11-01 -- PRELIMINARY=2 (1e6 1e6)\Model=2"
1980      1        3       4329.510695 0.328855581
1983      1        3      11307.197   0.188300112
1986      1        3       5626.360727 0.2519586
1989      1        3        7000.510252 0.316365157
1992      1        3       6185.453803 0.289054054
#AKSHLF triennial late (N=4)
#Random-SY, Random-VY, GammaECE,
"C:\Users\thorsonja\Dropbox\Darkblotched\delta-GLMM\AFSC triennial
late\2012-10-31 -- PRELIMINARY=2 (RandomSY 1e6 1e6)\Model=2"
1995      1        3       3574.325258 0.295860335
1998      1        3        4152.80707  0.345400667
2001      1        3       3408.702865 0.325285022
2004      1        3       7329.157077 0.31872779
#AKSLP survey (N=4)
#Random-SY, no-VY, GammaECE,
"C:\Users\thorsonja\Dropbox\Darkblotched\delta-GLMM\AFSC slope\2012-10-
31 -- FINAL=1 (syRandom 1e7 1e7)\Model=1"
1997      1        4         1655.059106 0.558034217
1999      1        4         1917.966195 0.612989277
2000      1        4         1633.165459 0.56262013
2001      1        4         2180.37366  0.87740395
#NWSLP survey (N=4)
#Random-SY, Random-VY, GammaECE,
"C:\Users\thorsonja\Dropbox\Darkblotched\delta-GLMM\NWFSC Slope\2012-
10-27 FINAL=1 (randomSY 1e6 1e6)\Model=1"
# DESIGN-BASED ESTIMATOR FOR COMPARISON (NOT FOR USE IN FINAL VERSION)
#1999     1        5        1980.11701  0.307066331
```

```
#2000     1        5       12126.93371  0.572797746
#2001     1        5        2005.12022  0.396825554
#2002     1        5        2574.42879  0.26878881
# DELTA-GLMM ESTIMATOR
1999      1        5        3467.103363  0.550010623
2000      1        5        5715.048007  0.419764141
2001      1        5        2917.12162  0.454480825
2002      1        5        2341.556201  0.450368493
#NWCBO survey (N=8)
#Random-SY, Random-VY, GammaECE,
"C:\Users\thorsonja\Dropbox\Darkblotched\delta-GLMM\NWFSC Shelf-
Slope\2012-20-25 -- FINAL=1 (randomSY 1e5 1e5)\Model=1"
# DESIGN-BASED ESTIMATOR FOR COMPARISON (NOT FOR USE IN FINAL VERSION)
#2003     1        6       29491.70636  0.447743895
#2004     1        6        7145.27004  0.350662071
#2005     1        6      18703.44015  0.594542112
#2006     1        6        6926.73444  0.313141466
#2007     1        6        6637.2545  0.246326496
#2008     1        6        7959.38225  0.455466139
#2009     1        6        8541.61435  0.24777762
#2010   1     6        5760.22799  0.239968945
#2011     1        6        9205.62902  0.365206277
#2012   1     6       10828.18408  0.326540118
# DELTA-GLMM ESTIMATOR
2003      1        6        20552.13635  0.384022882
2004      1        6        10230.08715  0.43975924
2005      1        6         9694.664868 0.380098505
2006      1        6        7307.025971 0.398102335
2007      1        6        7939.416324 0.402346728
2008      1        6        5457.79612  0.382583144
2009      1        6       12320.90375  0.400567506
2010   1     6         6238.576159 0.378720104
2011      1        6        7332.597194 0.383124894
2012   1     6        11078.9046  0.407218248

1 #_N_fleets_with_discard
#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)
#_discard_errtype:  >0 for DF of T-dist(read CV below); 0 for normal
with CV; -1 for normal with se; -2 for lognormal

#_Fleet units errtype
 1     2     -1 # TWL

15   # Discards N observations
# Year  seas    fleet   obs      err
#TWL from Pikitch study
1985   1     1     0.01   0.3
1986   1     1     0.07   0.3
1987   1     1     0.01   0.3
#TWL not updated from 2011 assessment
2000   1     1     0.32   0.2
2001   1     1     0.41   0.2
#TWL from WCGOP, updated for 2013 assessment
2002   1     1     0.56  0.09
2003   1     1     0.60  0.10
2004   1     1     0.16  0.04
2005   1     1     0.22  0.05
```

```
2006   1     1     0.49  0.09
2007   1     1     0.49  0.07
2008   1     1     0.53  0.06
2009   1     1     0.54  0.05
2010   1     1     0.48    0.06
2011  1     1    0.02  0.01
# Mean Body Weight
10 # Number of mean body weight observations
30  # Degrees of freedom for mean body weight for T-distribution
# Partition: 0=whole catch, 1=discarded catch, 2=retained catch
# Must be in kilograms
# TWL discards (N=8), from WCGOP (BOTTOM TWL data only used)
# Year  seas    fleet   partition  Wghtd.AVG_W (kg)  CV
2002  1    1    1      0.416450827     0.819466364
2003  1    1    1      0.581344497     0.665118295
2004  1    1    1      0.598224386     0.544009321
2005  1    1    1      0.474385534     0.716121165
2006  1    1    1      0.588179866     0.888292027
2007  1    1    1      0.723247633     0.648731964
2008  1    1    1      0.709967399     0.468556145
2009  1    1    1      0.632089049     0.609463429
2010  1    1    1      0.74342529      0.596264103
2011  1    1    1      0.258565477     0.917604301

# Population Length Structure
2 # Population Length Bin Option (1=use databins; 2=generate from
binwidth,min,max below; 3=read vector)
1
4
62

-1 # Minimum proportion for compressing tails of observed compositional
data
0.001 # Constant added to expected frequencies

0 # Combine males and females at and below this bin number

30 # Number of Observed Length Bins
# Data length bins
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52
54 56 58 60 62

71   # Length Composition Observations
#TWL updated with final BDS data (N=36)
#Year  Seas  Fleet Gender Partition Nsamp   F-4 F-6 F-8 F-10 F-12 F-14
F-16 F-18 F-20 F-22 F-24 F-26 F-28 F-30 F-32 F-34 F-36 F-38 F-40 F-42
F-44 F-46 F-48 F-50 F-52 F-54 F-56 F-58 F-60 F-62 M-4 M-6 M-8 M-10 M-12
M-14 M-16 M-18 M-20 M-22 M-24 M-26 M-28 M-30 M-32 M-34 M-36 M-38 M-40
M-42 M-44 M-46 M-48 M-50 M-52 M-54 M-56 M-58 M-60 M-62
#1977  1     1   3     2    35    0 0 0 0 0 0 0 0 0 1914.311761
8447.189383 23282.71024 40963.27848 38691.86716 24160.47346 6366.774088
249.0473021 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2631.266311
3929.259234 15502.25843 55012.6241 33762.55328 16064.29309 1674.110431
0 27.64792253 0 0 0 0 221.3993796 0 0 0 0 0 0 0
#1978  1     1   3     2    92    0 0 0 0 0 0 0 0 0 0 2654.541186
11288.73276 24730.62613 37302.99765 46770.13087 20279.60283 3196.226015
2680.221187 4813.686321 3993.711816 2326.003466 800.3764266 0 0 0 0 0 0
```

0 0 0 0 0 0 0 0 0 0 0 0 159.5999888 16258.39831 38571.91764 62212.25422 25371.65385 12533.24112 6234.264334 10100.90814 3771.698166 944.3406064 9.002974819 0 0 0 0 0 0 0 0 0
1979 1 1 3 2 23 0 0 0 0 0 0 0 0 0 0 0 0 187.0178901 986.9114107 3337.553785 11771.8282 8763.342485 6310.989136 3631.702319 3803.127859 3658.610074 3644.368124 986.9114107 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3108.096232 6037.31718 4639.289159 12631.05806 2975.776975 13027.97433 20300.11892 10603.51199 0 5487.915112 0 0 0 0 0 0 0 0
1980 1 1 3 2 59 0 0 0 0 0 0 0 14.1245199 0 341.5827773 465.1675222 806.7502995 4608.982179 5332.078349 4972.459065 9550.955786 12853.63294 16273.10718 27904.15002 15354.37974 7103.884406 846.9172915 0 1293.988275 1293.988275 0 0 0 0 0 0 0 0 0 0 0 0 0 0 601.0434002 0 1022.492419 2187.417316 7613.442179 12114.84818 20347.6575 26001.46245 4802.886545 1145.186135 579.9361702 0 0 0 0 0 0 0 0 0 0
1981 1 1 3 2 55 0 0 0 0 0 0 0 0 0 0 4111.398272 3808.044462 0 12411.23447 2153.625383 4088.080409 13733.90088 73028.35079 72587.42033 55758.71499 26673.4204 6885.995675 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 568.5416305 0 2574.767331 14909.6067 94828.06148 38417.77327 4322.912438 0 0 0 0 0 0 0 0 0 0 0
1982 1 1 3 2 158 0 0 0 0 0 0 0 0 0 0 141.107601 391.7627012 3332.307139 4666.822319 22212.68479 30211.57036 47038.94247 149357.272 163726.4129 196877.531 110032.1401 47445.21335 13850.36024 4317.368022 2903.41653 1265.619761 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 842.5759597 3007.607563 1454.220001 8192.365199 17140.79626 58768.54555 111735.468 131941.1415 40437.51449 9174.058524 1221.213789 900.1212691 186.0885041 372.1770083 131.1479027 0 0 0 0 0 0
1983 1 1 3 2 224 0 0 0 0 0 0 0 0 0 0 1033.104686 2289.135478 2456.429082 5048.709867 9459.491108 12226.57873 51884.06434 46236.28544 77169.8221 44374.84056 19693.23106 5304.930922 2459.051214 1114.837508 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 237.3667002 305.9650694 531.3125784 4292.571954 4851.707936 21568.5045 42013.42948 48689.14646 44623.64969 8596.168177 2152.257731 643.2970558 456.7044719 0 880.9075103 880.9075103 0 0 0 0 0
1984 1 1 3 2 436 0 0 0 0 0 0 77.08972888 0 0 77.08972888 386.3550732 1463.641462 14794.58623 15364.99252 18234.08535 39546.27728 110538.6401 181734.556 119614.7121 164612.9052 110557.2208 29483.42379 16656.76367 1744.884437 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2870.183575 1134.512604 8679.13254 12034.54931 37178.23321 88207.14088 68267.27387 56525.12778 13213.71109 8952.269282 796.7670072 0 0 126.1000609 0 0 0 0 0 0
1985 1 1 3 2 617 0 0 0 0 47.41340848 0 0 0 354.5062826 1381.136334 807.9672303 6935.942996 13597.68098 35749.02301 46028.1168 37747.88528 56202.57688 75100.5107 69275.22871 44766.7245 28430.99728 6313.49024 197.6202453 109.2632825 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 27.68293826 667.5551279 2545.870203 8289.462271 18615.74018 41162.08328 53342.43644 92086.81612 81408.69361 42700.35395 18107.47684 1110.112068 2652.306468 0 0 0 0 0 0 0 0 0
1986 1 1 3 2 468 0 0 0 0 0 0 0 0 0 0 1054.006598 113.4973481 1378.423818 5839.841107 20730.2738 44257.45192 48695.82395 34942.61006 40492.03189 28067.185 19959.1041 7560.863851 2133.920072 442.0831101 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1054.006598 57.19133848 724.7431714 2069.725476 6899.653749 24897.13043 36112.87477 41409.91512 31103.47778 15886.09692 3467.2717 678.2286844 0 0 0 0 0 0 0 0 0 0
1987 1 1 3 2 472 0 0 0 0 0 0 0 0 0 0 734.9731404 1612.840097 1082.157628 5189.353081 25713.69599 102233.1739 189530.4193 263806.8812 165933.0851 106322.2853 32045.18492 8490.945713 1498.241428

174.8722778 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 495.4223748 658.8466328
4059.334839 11895.83215 72031.21875 231069.3842 317437.6124 230601.1852
55664.29084 9410.713671 2714.855375 1417.284024 1997.411359 0 0
314.6631419 0 0 0 0 0
1988 1 1 3 2 271 0 0 0 0 0 0 0 0 0 502.9816598
260.9105303 3281.304203 3846.222829 4892.110885 57917.23352 92338.8421
93925.82112 90449.23858 60517.84789 16927.53751 4910.551963 2006.957307
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 460.2120487 2769.255674 4051.801358
18107.49741 86844.921 102967.104 109740.5496 38483.62498 5429.328757 0
197.1537175 0 0 0 0 0 0 0 0 0
1989 1 1 3 2 224 0 0 0 0 0 0 0 0 0 0 1326.606814
5580.735643 8937.493899 11895.20034 27401.94871 51206.29838 44913.42328
27963.29112 23338.81728 11210.36493 7691.386286 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 138.767002 349.5964047 7779.313414 8075.720142 16074.50957
49854.4239 69428.90944 33503.33562 14751.22098 2888.012499 196.8726007
0 41.94236831 0 0 0 0 0 0 0 0
1990 1 1 3 2 206 0 0 0 0 0 0 0 0 0 0 1440.525222
14923.00972 43166.62343 56955.89493 113766.4597 131950.7731 167021.6282
133245.8111 87059.24771 63392.3459 80904.82145 33193.44631 3772.998574
8509.176359 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1849.659359 2527.295459
46572.62702 108785.6275 131884.7093 194981.0641 149314.6888 66360.8989
22888.21773 4581.832975 0 0 0 0 0 0 0 0 0 0
1991 1 1 3 2 193 0 0 0 0 0 0 0 0 1067.413529
2770.412244 8288.539527 5298.926186 8222.809868 12182.75168 19174.65563
61161.51675 107748.7335 143208.6061 93692.84726 81717.48472 68679.60326
52994.13398 13559.84746 0 0 0 0 0 0 0 0 0 0 0 0 119.0922073 0
435.2323958 2474.989138 3877.416381 9865.189323 6912.146019 9965.745482
71802.53334 99732.99674 100812.1833 39802.39918 14853.931 3625.471926 0
0 0 0 0 0 0 0 0 0 0
1992 1 1 3 2 96 0 0 0 0 0 0 0 0 0 0 489.8299149
1115.595158 2111.026489 6632.094043 9795.554493 12585.27662 15389.88697
21022.25332 17352.64035 13382.33317 5438.350447 258.6139356 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 298.8107534 1827.09747 4821.705943 5221.846245
5677.855452 22739.26078 23191.61988 10376.76492 2536.361576 899.6415959
0 451.2416971 0 0 0 0 0 0 0 0
1993 1 1 3 2 110 0 0 0 0 0 0 0 813.2131571 146.5311538
187.6008825 1617.735947 1807.973243 6363.446748 13750.34832 14452.04782
17090.27668 31775.38059 21036.78754 13419.33611 6542.906958 2107.582361
813.2131571 406.6065786 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 994.5648149 0
605.6023024 3398.252145 8975.07354 18869.25385 40371.17826 45703.21439
38356.32238 11745.49391 4398.497467 1841.218088 0 0 0 0 0 0 0 0 0 0
1994 1 1 3 2 123 0 0 0 0 0 0 0 0 0 644.3413834
908.0391572 950.854858 4145.39283 13973.84447 37101.68234 47084.36832
89290.00135 139048.2679 62095.66423 72909.75688 30178.61874 15689.66677
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 581.3311822 2796.863504
29251.90567 93087.07656 120955.5654 98392.77365 55259.63286 19534.31584
3196.384401 0 1228.965312 0 0 0 0 0 0 0 0
1995 1 1 3 2 176 0 0 0 0 0 0 0 0 0 0 425.6337958
798.9397108 542.8741319 3840.82204 16067.83142 47380.47662 75479.90434
74180.31796 62887.56502 62991.8875 49302.04604 18011.67552 8745.975812
394.4143931 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 202.6386939 167.8482303
920.6121949 8025.098218 46037.32866 68312.19807 101040.4083 61165.42252
20094.10249 3002.570341 37.1756116 0 0 0 0 0 0 0 0 0 0
1996 1 1 3 2 348 0 0 0 0 0 0 0 0 0 0 99.48424167
2126.295637 4606.286368 8670.635218 14947.14731 34107.22816 53478.55067
61921.90059 67124.88687 62168.3685 36800.77059 16894.27303 6598.288855
1411.548522 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 681.4663721 2880.493013

5369.403004 12980.26612 52743.74524 116398.1592 146467.2405 63475.86444
27260.68969 4546.106808 825.5007597 392.821623 317.3017179 0 0 0 0 0 0
0 0
1997 1   1   3   2   309   0 0 0 0 0 0 0 0 76.34660269
1323.751208 6659.683934 9180.72493 17413.19227 22166.5614 56854.15826
66042.76802 67502.21272 83873.65696 58772.94092 46132.27701 26122.90088
14217.58522 3718.419668 75.33093196 0 0 0 0 0 0 0 0 0 0 0 0 0 0
211.233915 677.017096 3541.650955 8085.02352 18276.86919 55032.31323
106108.7192 93669.45963 77272.0214 34729.95925 9178.599935 2949.589421
148.083673 0 0 0 0 0 0 0 0 0
1998 1   1   3   2   393   0 0 0 0 0 0 0 0 1006.854338
3446.310847 7172.116268 14058.08367 25889.06823 31930.63269 39921.45618
72571.63679 105109.148 76779.99368 72250.96239 64805.25409 35458.13502
7202.112539 615.7380675 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1758.168767
3198.868062 19496.65389 21860.35015 33082.92432 28919.58708 101302.5328
117880.2234 71346.74115 36273.29006 8956.038265 4049.469472 0
1841.27956 978.1845885 0 0 0 0 0 0 0
1999 1   1   3   2   273   0 0 0 0 0 0 0 0 326.8956951
3457.308775 15810.0696 33010.87726 27605.23248 25014.74847 14426.12523
30979.21634 51472.42936 30240.13679 24249.57327 14656.81304 4652.8568
4868.878198 1270.024048 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 401.1893314
4005.935446 14459.90165 30988.27692 30279.87687 26071.48241 30692.16598
42055.78859 19904.39346 12111.27104 6395.086548 51.78627754 65.18946242
0 12.72562903 0 0 0 0 0 0 0
2000 1   1   3   2   318   0 0 0 0 0 0 0 0 0 207.1368958
2356.652865 9131.22199 21102.42148 16264.44248 15360.3077 8317.094
25609.16761 23997.87347 27623.52779 10738.7524 6011.794469 1361.385546
334.1319006 0 0 0 0 0 0 0 0 0 0 0 13.04945384 13.04945384 13.04945384 0
0 1590.474914 3768.672228 12869.35085 23318.25422 13420.27382
15068.93126 20344.64295 21957.31307 7714.050191 2659.09312 226.7364325
128.6808374 292.3861102 8.771518597 0 0 0 0 0 0 0
2001 1   1   3   2   413   0 0 0 0 0 0 0 96.78375128 225.6232673
253.339908 923.869111 3824.898271 8477.02799 28395.60699 23207.32166
12116.44346 5709.015617 6607.015303 4601.108365 2764.156677 3151.676602
1615.889577 45.41639699 5.842798872 0 0 0 0 0 0 0 0 0 0 0 0 0 0
885.0328309 23.98399886 511.1263261 5364.185489 14128.87314 27370.91259
19593.82459 9077.73994 7812.144408 2850.848596 928.0661834 260.8471964
0 0 238.5760097 0 0 0 0 0 0 0
2002 1   1   3   2   450   0 0 0 0 0 0 0 0 73.79886508
896.4053614 788.1775471 1177.379192 1382.122824 3884.383245 11446.30438
13335.91224 6733.008787 7103.376541 7768.060123 8319.189146 4666.037518
1353.211274 145.4907813 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 120.2040784
1939.830725 748.6142852 1036.612082 2884.41909 8565.693317 14644.99811
15550.77002 7295.65244 3751.601539 792.6635532 176.8259535 16.26851113
0 6.861648974 0 0 0 0 0 0 0
2003 1   1   3   2   427   0 0 0 0 0 0 0 60.8809982 61.54023704
538.3218484 816.352246 429.8930624 301.7429148 1481.556454 3908.931619
10791.83941 10525.87017 5796.04001 5151.352771 3800.984494 3171.544904
792.2132209 310.3271586 78.65809411 2.718436208 0 0 0 0 0 0 0 0 0 0 0
7.36960102 49.962233 297.7221299 941.7316453 266.3857414 596.4219568
1123.731867 2330.209768 8773.296384 10116.8518 6778.463533 2352.626022
1026.919975 251.1702569 105.7015784 93.03418081 0 0 0 0 35.46164451 0 0
0
2004 1   1   3   2   437   0 0 0 0 0 0 0 0 0 7.954751937
13.87842829 1663.699742 1206.344577 4152.41865 6026.073768 14302.1887
19385.65586 17162.60565 17357.26262 9644.214729 5789.382678 4136.054725
791.3788892 208.8354526 0 0 0 0 0 0 0 0 0 0 4.337008839 0 0 0 0 0

1318.905777 1193.99086 4439.259592 6266.876423 16080.27682 27666.94795
19887.58401 8128.051849 2398.842412 127.6755077 331.9060942 8.464184213
0 0 0 0 0 0 0 0
2005 1 1 3 2 350 0 0 0 0 0 0 0 0 0 0 13.21908273
416.5167131 1346.652792 3665.253545 7414.54966 7888.382456 7075.923932
8811.387235 8585.498347 5509.936735 2637.430475 1076.318763 911.5426636
284.4442555 11.63556773 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 132.7686674
389.7033808 1728.092363 3858.44418 10744.98248 8313.762784 10931.87114
9021.225863 3897.366496 967.8865274 248.6863326 32.04683915 8.775703694
0 0 0 0 0 0 0 0
2006 1 1 3 2 492 0 0 0 0 0 0 0 0 0 2.494196853
12.47098427 361.6947158 1451.228018 5561.018948 14079.10516 9336.918568
7383.011436 5878.315332 3925.967491 2024.154541 2047.338484 290.3869791
70.62271652 32.66113004 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3.513784697
19.043287 311.1394059 2504.11596 11734.99506 13862.51125 12280.64878
9259.81674 3068.27375 858.9669756 110.5961075 4.842130171 0 0 0 0 0 0 0
0 0
2007 1 1 3 2 723 0 0 0 0 0 0 0 0 0 0 16.05148061
70.27121067 894.0837481 4806.418141 15494.31008 16486.029 11981.77323
9259.603697 7137.703996 4895.637549 4122.075413 1621.469065 722.0544235
94.44817994 26.09090511 0 0 0 0 0 0 0 0 0 0 0 0 0 3.52520125 0 0
153.8000942 1836.181705 7655.046405 16966.08856 14601.59555 10914.28554
5316.845807 2526.506941 1117.491244 11.28300938 18.17996012 0 0 0 0 0 0
0 0
2008 1 1 3 2 810 0 0 0 0 0 0 0 0 36.9784794 136.1851992
207.3583375 207.2508805 688.760986 3600.136209 13971.47525 16751.29588
9348.73678 7451.127101 6268.391504 4124.188203 2415.319632 1448.226238
272.5297156 0 106.1779041 0 0 0 0 0 0 0 0 0 0 0 0 6.794087742
9.802128433 53.46881575 160.9210524 207.5275815 823.355196 7704.606388
16618.41548 14965.95766 9697.370715 3453.29184 792.6809733 66.78444444
74.80697518 29.7212469 0 0 0 0 0 0 0 0
2009 1 1 3 2 766 0 0 0 0 0 0 0 0 5.285738662 0
14.39955622 335.3996349 1256.189338 3870.43453 11127.14459 27971.35499
17151.85375 10095.24064 10593.57381 8588.524438 4505.734514 1608.660458
581.4775591 8.325038393 40.73542596 0 0 0 0 0 0 0 0 0 0 0 0 0 0
92.73809727 87.45235861 1104.811763 1282.469354 6981.059927 19924.45458
24183.87968 16227.90168 5088.798803 1980.856138 747.829429 37.92589494
0 282.9248087 40.73542596 0 0 0 0 0 0
2010 1 1 3 2 591 0 0 0 0 0 0 0 0 0 0 0 2.90381847
820.2240816 2175.181047 7329.785565 22069.60375 30912.44672 13885.37571
8767.966419 7114.704234 4511.23964 2724.702665 497.2734098 117.7758282
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 7.058090575 64.89270118 1209.839381
3969.150588 12091.90616 26278.15413 18805.10834 7353.926978 2021.157018
250.8073167 22.01763422 46.47041188 34.84886201 0 0 0 0 0 0 0
2011 1 1 3 2 559 0 0 0 0 0 0 0 0 111.0910125
162.5748393 113.0106963 200.3135872 633.3551631 3311.830454 6672.989118
9889.241158 12019.94543 8430.24616 3517.654587 3153.794612 2304.544926
905.9758309 19.98334853 45.17479112 0 23.79320599 0 0 0 0 0 0 0 0 0 0 0
0 101.2346845 87.97525158 209.0946574 226.902537 1399.18693 6399.661925
10662.7152 13628.04755 15002.83575 4493.392029 1227.289248 302.0012718
25.5024563 142.7704102 0 0 0 0 0 0 0 0
2012 1 1 3 2 454 0 0 0 0 0 0 5.58112209 0 5.58112209
60.53011413 212.2701326 677.1097589 2228.91526 6095.837713 11918.63285
10660.80002 5674.340708 4441.322978 4163.097523 3209.129257 1770.002445
840.0042196 148.5039024 0 0 0 0 0 0 0 0 0 0 0 0 0 5.58112209 0 0
19.29131182 155.6073452 715.2037393 3404.059886 11365.85008 11540.81192

```
11019.27794 8334.636251 3523.390988 881.1727372 128.6275731 6.73213462
0 0 0 0 0 0 0 0 0
#TWL discard from Pikitch study (N=1)
#year season fleet gender partition Nsamp   4  6      8      10     12
14     16     18     20     22     24     26     28     30     32
34     36     38     40     42     44     46     48      50     52 54
56     58 60 62 4  6      8      10     12     14     16     18     20
22     24     26     28     30     32     34     36     38     40
42     44     46     48     50     52 54 56 58 60 62
1986  1    1   0     1    15   0  0      0      0      0      0      0
0      18     228     415     533     804     698     179     18     0
0      0      0      0      0      0       0      0  0  0      0  0  0
0  0      0      0      0      0      0      0      18     228     415
533     804     698     179     18     0      0      0      0      0
0      0      0      0  0  0  0  0  0
#TWL discard from WCGOP (N=10)
#year season fleet gender partition Nsamp     4 6 8 10 12 14 16 18 20
22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 4 6 8 10
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58
60 62
2002  1    1   0     1    118   0 0 0 0.00041424 0.000828481 0.00041424
0.017062756 0.035664119 0.070091189 0.09759817 0.185357737 0.066220353
0.041935635 0.047463792 0.106649823 0.158820597 0.111288431 0.041535877
0.003648064 0.011358431 0.003648064 0 0 0 0 0 0 0 0 0 0 0 0 0.00041424
0.000828481 0.00041424 0.017062756 0.035664119 0.070091189 0.09759817
0.185357737 0.066220353 0.041935635 0.047463792 0.106649823 0.158820597
0.111288431 0.041535877 0.003648064 0.011358431 0.003648064 0 0 0 0 0 0
0 0 0
2003  1    1   0     1    151   0 0 0 0 0.000159582 0.000159582
0.000478745 0.004422749 0.034585672 0.05051657 0.026343116 0.029120547
0.063290815 0.0590463 0.210750216 0.230833919 0.139644332 0.073853911
0.0472177 0.014213054 0.010368959 0.001004692 0.003989539 0 0 0 0 0 0 0
0 0 0 0 0.000159582 0.000159582 0.000478745 0.004422749 0.034585672
0.05051657 0.026343116 0.029120547 0.063290815 0.0590463 0.210750216
0.230833919 0.139644332 0.073853911 0.0472177 0.014213054 0.010368959
0.001004692 0.003989539 0 0 0 0 0 0 0
2004  1    1   0     1    169   0 0 0 0 0.000877672 0.003170212
0.001316508 0.003344787 0.001852744 0.011556348 0.043422163 0.043740165
0.049823976 0.067722578 0.225189881 0.171296712 0.237653043 0.066468373
0.03325045 0.022716034 0 0.016378935 0.000219418 0 0 0 0 0 0 0 0 0 0 0
0.000877672 0.003170212 0.001316508 0.003344787 0.001852744 0.011556348
0.043422163 0.043740165 0.049823976 0.067722578 0.225189881 0.171296712
0.237653043 0.066468373 0.03325045 0.022716034 0 0.016378935
0.000219418 0 0 0 0 0 0 0
2005  1    1   0     1    365   0 0 0.000273245 0.001092982 0.007257076
0.012492418 0.012549572 0.033116664 0.011074908 0.01059667 0.010323573
0.095016673 0.094673091 0.134825264 0.17655022 0.141193521 0.154894739
0.080288223 0.013555889 0.006400773 0.000966118 0.002038644 0.000546491
0 0 0 0.000273245 0 0 0 0 0 0.000273245 0.001092982 0.007257076
0.012492418 0.012549572 0.033116664 0.011074908 0.01059667 0.010323573
0.095016673 0.094673091 0.134825264 0.17655022 0.141193521 0.154894739
0.080288223 0.013555889 0.006400773 0.000966118 0.002038644 0.000546491
0 0 0 0.000273245 0 0 0
2006  1    1   0     1    373   0 0 0.001048408 0.007030499 0.021093234
0.028849201 0.022316169 0.049574602 0.06507985 0.037205337 0.016481587
0.01005238 0.018095129 0.112514412 0.142802592 0.174298092 0.129121847
0.072634089 0.023085612 0.043339327 0.02038228 0.002590184 0 0 0 0
```

0.002405171 0 0 0 0 0 0.001048408 0.007030499 0.021093234 0.028849201
0.022316169 0.049574602 0.06507985 0.037205337 0.016481587 0.01005238
0.018095129 0.112514412 0.142802592 0.174298092 0.129121847 0.072634089
0.023085612 0.043339327 0.02038228 0.002590184 0 0 0 0 0.002405171 0 0
0
2007 1 1 0 1 210 0 0 0 0.000744505 0.030093011
0.013532037 0.011202017 0.026395843 0.013133576 0.012389116 0.008170599
0.018551225 0.016682365 0.058990981 0.137386852 0.276738351 0.131171573
0.153327177 0.032053364 0.043840026 0.015125862 0.00047152 0 0 0 0 0 0
0 0 0 0 0 0.000744505 0.030093011 0.013532037 0.011202017 0.026395843
0.013133576 0.012389116 0.008170599 0.018551225 0.016682365 0.058990981
0.137386852 0.276738351 0.131171573 0.153327177 0.032053364 0.043840026
0.015125862 0.00047152 0 0 0 0 0 0 0 0
2008 1 1 0 1 250 0 0 0.000388243 0.000388243 0.001261789
0 0.003370778 0.004694501 0.006965721 0.012093297 0.020258718
0.025594359 0.043046509 0.052377274 0.200593051 0.245209737 0.120947179
0.116460404 0.073949204 0.024203799 0.020496041 0.027099379 0.000601776
0 0 0 0 0 0 0 0 0 0.000388243 0.000388243 0.001261789 0 0.003370778
0.004694501 0.006965721 0.012093297 0.020258718 0.025594359 0.043046509
0.052377274 0.200593051 0.245209737 0.120947179 0.116460404 0.073949204
0.024203799 0.020496041 0.027099379 0.000601776 0 0 0 0 0 0 0
2009 1 1 0 1 399 0 0.00075435 0.003063823 0.004993623
0.019323389 0.01565856 0.009737843 0.01126201 0.065455708 0.059766056
0.048658789 0.057091309 0.034382952 0.041093452 0.110455815 0.280892895
0.127942659 0.04483543 0.019870622 0.018562175 0.006039979 0.019926453
0.000232108 0 0 0 0 0 0 0 0 0.00075435 0.003063823 0.004993623
0.019323389 0.01565856 0.009737843 0.01126201 0.065455708 0.059766056
0.048658789 0.057091309 0.034382952 0.041093452 0.110455815 0.280892895
0.127942659 0.04483543 0.019870622 0.018562175 0.006039979 0.019926453
0.000232108 0 0 0 0 0 0 0
2010 1 1 0 1 176 0 0.00010837 0 0.001062027 0.002227275
0.005150579 0.010316502 0.021524613 0.025572076 0.019244472 0.009994735
0.040721305 0.059260631 0.190968716 0.219714411 0.170839415 0.08290886
0.068215058 0.015157367 0.049796139 0.003922998 0.001517182 0.0016689 0
0.00010837 0 0 0 0 0 0 0.00010837 0 0.001062027 0.002227275 0.005150579
0.010316502 0.021524613 0.025572076 0.019244472 0.009994735 0.040721305
0.059260631 0.190968716 0.219714411 0.170839415 0.08290886 0.068215058
0.015157367 0.049796139 0.003922998 0.001517182 0.0016689 0 0.00010837
0 0 0 0 0
2011 1 1 0 1 150 0 0.002185965 0.002595833 0.024728729
0.083032514 0.04702671 0.075279169 0.066503593 0.086260228 0.293040714
0.146802349 0.060185319 0.053015343 0.025548466 0.019218275 0.007741959
0.002732456 0.004102377 0 0 0 0 0 0 0 0 0 0 0 0 0.002185965
0.002595833 0.024728729 0.083032514 0.04702671 0.075279169 0.066503593
0.086260228 0.293040714 0.146802349 0.060185319 0.053015343 0.025548466
0.019218275 0.007741959 0.002732456 0.004102377 0 0 0 0 0 0 0 0 0 0 0 0
#AKSHLF (N=9)
#year season fleet gender partition Nsamp F4 F6 F8 F10
F12 F14 F16 F18 F20 F22 F24 F26 F28
F30 F32 F34 F36 F38 F40 F42 F44 F46
F48 F50 F52 F54 F56 F58 F60 F62 M4 M6 M8 M10
M12 M14 M16 M18 M20 M22 M24 M26 M28
M30 M32 M34 M36 M38 M40 M42 M44 M46
M48 M50 M52 M54 M56 M58 M60 M62
1980 1 3 3 0 54 0 0 0 0.085607806
0.711003314 0.200154463 0.652158114 2.557541498 1.260406023 2.906166924
9.908796555 10.28368534 7.689484089 4.690205958 4.657968323 3.559396444

2.131293919 2.61906414 0.839453953 0.767149676 0.385689688 0.239313408
0 0 0 0 0 0 0 0 0 0 0 0
0.432028738 0.472686992 1.123652283 2.858100866 1.893887677 3.537584122
5.111525401 5.637092768 6.212701515 5.331207926 4.243478161 3.087463828
2.891183848 0.767149676 0.255716559 0 0 0 0 0
0 0 0 0 0 0
1983 1 3 3 0 205 0 0 0 0.086023124 0.3585804
0.51813282 2.264531039 5.338247026 0.927737264 2.18513411 1.924821789
2.466371005 6.629168062 3.280167597 2.053156578 2.241027248 2.267714515
4.744853944 8.593220892 5.466384428 1.883872555 0.956207327 0.227324737
0 0 0 0 0 0 0 0 0 0 0.156365982 0.708496832
0.477867002 2.433433717 4.444196623 1.24022505 2.900394269 1.116787267
2.283165536 5.344864813 3.392759828 2.459123033 3.990177612 7.402880004
5.508537704 1.421172582 0.306875686 0 0 0 0 0 0 0
0 0 0
1986 1 3 3 0 169 0 0 0 0.053815215
0.242891337 0.971017847 0.311189555 1.213975355 1.124803031 0.732900647
2.722865806 5.978745739 8.297019285 9.604379846 6.245260118 4.646361021
2.310650342 1.220978627 1.450753973 1.121910196 0.435395154 0.254992794
0.072565859 0 0 0 0 0 0 0 0 0.040268329 0
0.036179609 0.336353558 1.02419469 0.241435399 0.748094887 1.236745417
1.039758187 2.128656175 8.821745928 13.17018685 11.06471071 6.321238845
1.962735543 1.035821841 0.817565154 0.671573697 0.217697577 0.072565859
0 0 0 0 0 0 0 0 0
1989 1 3 3 0 290 0 0 0.084666398 0.084666398
0.837369999 2.444690636 2.919222382 4.160137442 5.492347168 5.504379982
6.187020475 5.240222359 4.246492909 4.258320736 1.65210194 2.299252401
1.991027032 1.584011336 1.544172328 0.725273927 0.219000854 0
0.066797771 0 0 0 0 0 0 0 0 0 0 0.115560065
1.251205106 3.700303599 3.048366894 4.62217863 4.705095039 5.803122303
4.968807042 4.776544259 4.2600844 3.845534396 3.246055374 1.53949547
0.763877113 0.756251917 0.564839545 0.34099881 0.150505565 0 0
0 0 0 0 0 0 0
1992 1 3 3 0 132 0 0 0 0.054486168
0.054486168 0.218205444 0.182146301 2.268320846 7.01389238 1.6554459
4.855550731 7.887346149 15.22556089 6.883371569 1.644770483 0.112573343
0.122852083 0.127107246 0.127107246 0.061426041 0.197043615 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0.108972336
0.23359587 0.311420817 2.425038515 6.477672676 1.817369823 5.909217268
10.83569646 17.27887851 4.331847336 0.685692719 0.450157279 0.249959329
0.192788451 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 3 0 283 0 0 0 0.055323155 0.0579755
2.792784601 0.236992885 1.755948779 1.78378972 3.660065015 8.668013886
5.514997139 3.097656194 2.664315337 2.389944969 3.733799442 3.10280146
3.414274403 3.418135549 3.313054844 1.804610227 0.728667829 0.127285669
0 0 0 0 0 0 0 0 0 0 0.116914925 0.315134709
2.930393003 0.315778198 1.58013033 3.389929469 4.131112006 8.843210707
4.799606732 2.395783102 2.447876919 3.887925042 6.256735921 4.825103632
1.14876664 0.127285669 0.167876394 0 0 0 0 0 0 0
0 0 0
1998 1 3 3 0 326 0 0 0 0.166015745
1.319666735 0.294360889 1.517200187 2.053249422 6.610049534 14.62690127
6.828416444 6.059522665 3.897657058 1.469067917 0.646272334 0.914011098
0.353257498 0.156332023 0.114508974 0.781017589 0.063506183 0.026200241
0 0 0 0 0 0 0 0 0 0 0 0.538549148
1.792917766 0.182440366 1.704065447 1.773135705 7.728668443 15.26098968
8.487142675 6.28323573 3.330782271 2.378119371 1.245993906 1.074043899

```
0.157574172 0.076595262 0 0 0 0 0.088532353 0
0 0 0 0 0 0
2001 1 3 3 0 346 0 0 0 0.09907038 0.769176408
0.684721928 1.489401487 13.78491152 11.95740645 0.633662764 1.421645471
1.99667697 1.755009519 3.607731529 12.37694765 5.750071042 0.331091695
0.378693774 0.724012424 0.214069416 0.107861605 0.015398948 0.045781676
0 0 0 0 0 0 0 0 0 0 0.067182638 0.198675374
0.724878222 1.562376727 13.45399567 12.11491129 0.706608743 1.228201382
1.586385352 1.061585726 3.677888738 3.851749235 0.883647734 0.459457028
0.182818659 0.033610622 0.062684209 0 0 0 0 0 0 0
0 0 0
2004 1 3 3 0 371 0 0 0 0 0.026982377 0
0.632555449 1.338322352 0.853609908 1.861618112 4.957416326 10.60213384
8.532965525 8.456054094 5.665285118 1.310081415 0.763634564 0.222228973
0.096744577 0.070686156 0.025602645 0 0 0 0 0
0.013448734 0 0 0 0 0 0 0 0.142021439 0.141172911
0.712824867 1.261012608 1.078808505 1.469344458 6.037390534 16.72390925
11.08084273 10.5775407 3.641786464 1.286554655 0.24891405 0.126909368
0.01655363 0.025043673 0 0 0 0 0 0 0 0 0 0
#AKSLP (N=4)
#year season fleet gender partition Nsamp F4 F6 F8 F10
F12 F14 F16 F18 F20 F22 F24 F26 F28
F30 F32 F34 F36 F38 F40 F42 F44 F46
F48 F50 F52 F54 F56 F58 F60 F62 M4 M6 M8 M10
M12 M14 M16 M18 M20 M22 M24 M26 M28
M30 M32 M34 M36 M38 M40 M42 M44 M46
M48 M50 M52 M54 M56 M58 M60 M62
1997 1 4 3 0 47 0 0 0 0 0 0
0.483162203 5.119658032 8.865704307 8.871780439 14.07394753 6.189300967
0.637362583 0.168815878 1.351805773 0 0.179069811 0
0.36200366 0.17880465 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0.377983001 4.307832576
16.17938986 10.02465972 8.801847767 7.278500158 1.134848524 1.70471581
1.928873074 0.723727788 0.705238785 0.180397765 0.170569338 0 0
0 0 0 0 0 0 0 0 0
1999 1 4 3 0 50 0 0.099160609 0 0 0
0.139853068 0.139853068 0.197350748 0.396223048 0.681712152 0.892409864
7.477594831 22.21741689 11.99273985 3.648955742 0.539458418 1.000717512
0.527481208 0.210531573 0.225324974 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0.098190139 1.618514132 0.365488712 0.873598364 15.49188846 22.3447159
5.792986841 1.362207991 0.928480591 0.466937394 0.270207919 0 0
0 0 0 0 0 0 0 0 0 0
2000 1 4 3 0 43 0 0 0 0 0
0.117518001 0.591502381 0.327465736 1.063852711 9.675612167 10.638987
5.644377709 6.683279066 9.920151445 1.552642188 0 0 0 0
0 0.672361804 0.463870373 0 0 0 0 0 0 0 0 0
0 0 0 0 0.659822575 2.158128245 0.236368494
1.419502066 10.21468483 14.13108349 3.690707155 7.738720595 7.201697718
1.619338982 0.899508649 2.123863372 0 0 0 0.554953249 0
0 0 0 0 0 0 0 0
2001 1 4 3 0 48 0 0 0 0 0 0 0
0.925327417 6.447317712 3.656054471 1.565475095 2.121317613 5.088532782
4.149888463 16.8723884 9.318815706 2.452712986 0 0.360956128
0.760390194 0.195289092 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0.411283982 0.81097655 5.879927088
1.612469747 2.044653958 6.329925363 3.818834612 7.998944915 12.29789765
```

```
2.504858221 1.458560509 0      0.721912255 0.195289092 0      0      0
0      0  0  0  0  0  0
#NWSLP (N=3)
#year Season Fleet gender partition Nsamp   F4 F6     F8     F10
F12     F14     F16     F18     F20     F22     F24     F26     F28
F30     F32     F34     F36     F38     F40     F42     F44     F46
F48      F50     F52 F54 F56     F58 F60 F62 M4 M6     M8     M10
M12     M14     M16     M18     M20     M22     M24     M26     M28
M30     M32     M34     M36     M38     M40     M42     M44     M46
M48     M50     M52 M54 M56 M58 M60 M62
2000  1    5   3    0    43     0  0      0      0      0
0.055422438 0.298781534 0.338302827 0.067843015 2.44029948 1.580276293
3.17521869 13.16970592 12.17986314 1.564683908 0.066446577 1.249039861
1.932550514 3.747126601 8.118776642 2.54487793 0.624523439 0       0
0  0  0      0  0  0  0  0      0      0      0      0.295707968
0.732077213 0.053808465 0.108325674 0.279301579 1.948170968 2.723250042
10.8111998 5.545857682 2.283084452 9.062965026 10.50441857 0.624523439
1.249046879 0      0.624523439 0      0      0      0  0  0  0  0  0
2001  1    5   3    0    80     0  0      0      0      0
0.128910665 0.823697599 4.305546968 9.115705484 1.378814823 1.599758602
2.147109527 2.726391318 3.967119371 12.91594837 3.328774137 0.994580904
1.971576336 1.660380252 0.500233731 0      0      0      0      0  0
0      0  0  0  0  0      0      0      0.64710087 0      1.041549698
3.446233221 9.64297286 2.296623144 0.698101214 3.849215084 2.158907376
6.401656151 6.089272862 7.984818617 6.724847951 0.696221473 0.568918481
0      0.189012913 0      0      0      0  0  0  0  0  0
2002  1    5   3    0    118    0  0      0      0      0
0.119564461 0.609046108 3.471583472 1.507528554 9.94582967 16.73643556
6.191392653 4.057452087 3.646068812 2.384830379 1.439924091 0.337223562
0.098783216 0.25588888 0.049384722 0.206504158 0.308096767 0.154048384
0      0  0  0      0  0  0  0  0      0      0      0      0.186893493
0.303510846 2.809241526 0.793984043 8.137599663 14.95340746 8.108280066
4.643830249 3.662484481 2.165367208 0.977352023 0.443305692 0.858338423
0.436819299 0      0      0      0      0      0  0  0  0  0  0
#NWCBO (N=10)
#year Season Fleet gender partition Nsamp   F4 F6     F8     F10
F12     F14     F16     F18     F20     F22     F24     F26     F28
F30     F32     F34     F36     F38     F40     F42     F44     F46
F48      F50     F52 F54 F56     F58 F60 F62 M4 M6     M8     M10
M12     M14     M16     M18     M20     M22     M24     M26     M28
M30     M32     M34     M36     M38     M40     M42     M44     M46
M48     M50     M52 M54 M56 M58 M60 M62
2003  1    6   3    0    268    0  0      0      0      0.009661759
0.064115111 0.048337562 0.127862008 0.607772204 3.452489019 4.726184253
3.464001433 4.108514403 1.411052155 5.893019051 10.74680449 9.860567278
6.221079688 2.243290534 2.771110627 2.644775169 1.633686852 0.376394363
0      0  0  0      0  0  0  0  0      0      0      0      0.126051627
0.133649859 0.31517893 0.600035893 3.069303809 4.589951149 4.368660813
3.364083349 1.444939269 7.695890247 8.301280572 3.91675591 0.945197344
0.61115708 0.072142924 0      0.025957108 0.009046153 0      0  0  0  0
0  0
2004  1    6   3    0    164    0  0      0.02055708 0.22882472
0.364659185 0.580345692 1.024302284 1.531700874 2.529457048 2.279617294
8.958001836 13.92555905 6.58279921 3.843400442 1.568357607 0.759263521
0.531817754 0.256281651 0.394324475 0.085428913 0.116549482 0      0
0      0  0  0      0  0  0  0  0      0.074102166 0.165525198
0.571359602 0.951004084 0.385216264 1.880306201 1.101294653 4.267079816
```

11.56215639 16.68674629 8.126356023 3.48749837 1.312493204 1.441463436
1.245061912 0.839537899 0.19906275 0.122487628 0 0 0 0
0 0 0 0 0 0
2005 1 6 3 0 247 0 0.034332186 0.026858867 0.125028112
0.695285723 0.850273002 1.417745891 1.671703499 1.016596838 1.174726032
0.596044897 2.446154388 4.46929116 4.509581194 4.203528829 5.240752721
12.45120191 3.815772796 1.131533367 0.369514891 0.225656096 0.063119204
0.438508714 0.022170269 0 0 0 0 0 0 0 0.034332186
0.05939815 0.154827756 0.891977938 1.336489583 1.925678446 2.785058147
0.93052362 1.585234941 1.132729792 4.048871 6.169774741 4.452381691
11.78537945 9.893471388 4.809145123 0.748715621 0.228752928 0.031876915
0 0 0 0 0 0 0 0 0 0
2006 1 6 3 0 264 0 0.023445712 0.064551679 0.07757188
1.189940013 1.128602477 2.09308497 4.772336117 6.340411285 6.331090271
2.69392517 2.115630722 2.600755931 6.677650854 4.738412299 3.66480673
2.044060524 2.503162863 0.935958435 0.851046621 0.190493488 0.047464126
0 0 0 0 0 0 0 0 0 0.023445712 0.064557523
0.203560441 1.160603653 1.493542115 1.374525322 4.830447822 5.324654446
6.588233397 2.370938865 2.374106256 4.097126492 6.492153897 5.209541376
4.410160642 1.835404206 0.984340053 0.078255616 0 0 0 0
0 0 0 0 0 0 0
2007 1 6 3 0 275 0 0 0.023683149 0.033904175
0.618285289 0.462967357 2.594178714 4.208857822 4.726808051 6.033860883
3.086900487 3.967552466 2.472035711 3.633991638 4.62066217 2.576601558
1.291547663 1.120128431 0.841585201 0.83830938 0.541014097 0.256359087
0.032636675 0.032636675 0 0 0 0 0 0 0 0 0.023688936
0.041358695 0.513250641 0.36009151 2.991114536 4.238363367 5.507304388
6.613617648 4.332395654 4.368620685 4.557084607 8.023523177 5.223158693
4.825962426 2.594855872 1.171331954 0.375926577 0.065892631 0.125314647
0.032636675 0 0 0 0 0 0 0 0
2008 1 6 3 0 222 0 0 0.086163009 0.097809384
0.09536221 0.712123675 1.658776567 1.016352744 6.823957497 8.349066411
12.36473499 6.773811766 3.190544431 1.688034061 1.971820892 2.091394996
0.660837739 0.375662497 0.5376685 0.296344593 0.179299105 0.143669652
0 0 0 0 0 0 0 0 0 0 0.086163009 0.060341642
0.19269457 0.94668004 1.154026627 1.847767412 8.286785646 6.674532527
10.95567874 9.341742458 2.601613265 2.356605025 2.517664735 2.650696357
0.739314063 0.375887435 0.066566228 0.031805502 0 0 0 0
0 0 0 0 0 0
2009 1 6 3 0 283 0 0 0 0.106325939
1.275794266 1.422107182 0.986268933 2.873716348 3.769751332 3.838106293
4.406887966 3.884690266 3.832962796 3.160537183 3.691262378 3.946079231
3.865520277 2.076460806 1.107611363 1.358454719 1.283003262 0.623200142
0.063575963 0 0 0 0 0 0 0 0 0 0 0.056083468
2.175109749 2.054325319 1.210134804 5.724086709 4.885039691 4.125962128
5.225810995 4.313954019 3.749798344 4.204514082 5.306540949 5.656492248
1.746570496 1.226451795 0.637469633 0.075428957 0.053909969 0 0
0 0 0 0 0 0 0
2010 1 6 3 0 272 0 0 0.248112791 0.05252704
0.176611055 0.255095037 3.115667149 8.235133989 3.960662556 4.298732529
5.935334568 6.464792107 5.124615141 3.967368605 1.534784981 1.391869892
2.150460002 1.554665602 0.778117199 0.508273271 0.514084444 0.051604544
0 0 0 0 0 0 0 0 0 0 0.248101743 0.019366895
0.151504798 0.520077907 3.15156164 8.663039618 5.588940034 4.618059812
6.029998138 6.893487658 5.390724892 3.449991899 1.582323914 2.049300292
0.727158954 0.372997776 0.224851526 0 0 0 0 0
0 0 0 0 0 0

```
2011  1    6   3    0    234    0  0      0.020313128 0.047110092
0.404284202 0.425786275 0.370262119 0.315392605 2.806783353 6.868667731
5.49934146 2.862639642 3.45470957 5.004066958 5.057357632 3.441876679
2.845387923 2.495385984 1.948038633 2.099819098 1.834804976 1.172832856
0.20949478  0      0  0  0      0  0  0  0  0      0.020313128 0
0.157729997 0.577513791 0.515698342 0.344731116 2.338252865 8.243072285
6.124586288 2.702680977 5.330299649 5.99526579 6.32053096 5.865800885
3.910392726 1.688834451 0.645817888 0      0.034123167 0      0      0
0  0  0  0  0  0
2012  1    6   3    0    254    0  0      0.00830749 0.00830749
0.188935526 0.113834048 0.604845807 2.374385373 1.491594764 4.171217376
15.67937323 9.440892348 4.557474707 3.076960799 2.777494051 1.787950931
0.937195846 0.866812241 0.538414248 0.341335113 0.34829689 0.151655821
0.144845317  0      0  0  0      0  0  0  0  0      0.00830749
0.00830749 0.215210013 0.105485588 0.653660192 2.964138398 1.960466872
5.250850754 15.12388703 9.705216143 3.944857173 3.676820851 2.872406182
1.336670785 1.464056505 0.774818446 0.236032315 0.088678362 0      0
0      0      0  0  0  0  0  0

#Age composition set-up
36 # Number of Age Bins
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
27 28 29 30 31 32 33 34 35

2 # Number of Ageing Error Sets
# Ageing error for "late" period (2005 forward)
0.5    1.5    2.5    3.5    4.5    5.5    6.5    7.5    8.5    9.5
10.5    11.5   12.5   13.5   14.5   15.5   16.5   17.5   18.5   19.5
20.5   21.5   22.5   23.5   24.5   25.5   26.5   27.5   28.5   29.5
30.5   31.5   32.5   33.5   34.5   35.5   36.5   37.5   38.5   39.5
40.5   41.5   42.5   43.5   44.5   45.5
0.101891  0.101891  0.203782  0.305673  0.407564  0.509455  0.611346
0.713238  0.815129  0.91702  1.01891  1.1208  1.22269 1.32458 1.42648
1.52837 1.63026 1.73215 1.83404 1.93593 2.03782 2.13971 2.2416  2.34349
2.44539 2.54728 2.64917 2.75106 2.85295 2.95484 3.05673 3.15862 3.26051
3.36241 3.4643  3.56619 3.66808 3.76997 3.87186 3.97375 4.07564 4.17753
4.27943 4.38132 4.48321 4.5851
# Ageing error for "early" dataset
0.5    1.5    2.5    3.5    4.5    5.5    6.5    7.5    8.5    9.5
10.5    11.5   12.5   13.5   14.5   15.5   16.5   17.5   18.5   19.5
20.5   21.5   22.5   23.5   24.5   25.5   26.5   27.5   28.5   29.5
30.5   31.5   32.5   33.5   34.5   35.5   36.5   37.5   38.5   39.5
40.5   41.5   42.5   43.5   44.5   45.5
0.156547  0.156547  0.313095  0.469642  0.626189  0.782737  0.939284
1.09583  1.25238  1.40893  1.56547  1.72202 1.87857 2.03512 2.19166
2.34821 2.50476 2.6613  2.81785 2.9744  3.13095 3.28749 3.44404 3.60059
3.75714 3.91368 4.07023 4.22678 4.38333 4.53987 4.69642 4.85297 5.00951
5.16606 5.32261 5.47916 5.6357  5.79225 5.9488  6.10535 6.26189 6.41844
6.57499 6.73154 6.88808 7.04463

773    # Number of age comp observations
3    # Age-Length Bin Option (1=poplenbins; 2=datalenbins; 3=lengths)
0    # Combine Males & Females Below this Bin
#TWL updated for 2013 assessment (N=762)
#TWL marginal ages (N=30), 2002-2008 are used in the model, the rest
are ghost compositions
```

```
#Year Seas Fleet Gender Partition AgeError LbinLo LbinHi Nsamp Age_0
Age_1 Age_2 Age_3 Age_4 Age_5 Age_6 Age_7 Age_8 Age_9 Age_10 Age_11
Age_12 Age_13 Age_14 Age_15 Age_16 Age_17 Age_18 Age_19 Age_20 Age_21
Age_22 Age_23 Age_24 Age_25 Age_26 Age_27 Age_28 Age_29 Age_30 Age_31
Age_32 Age_33 Age_34 Age_35 Age_0 Age_1 Age_2 Age_3 Age_4 Age_5 Age_6
Age_7 Age_8 Age_9 Age_10 Age_11 Age_12 Age_13 Age_14 Age_15 Age_16
Age_17 Age_18 Age_19 Age_20 Age_21 Age_22 Age_23 Age_24 Age_25 Age_26
Age_27 Age_28 Age_29 Age_30 Age_31 Age_32 Age_33 Age_34 Age_35
1980 1  -1 3 2 2 -1 -1 53   0 0 0 0 0 376.7662985 2843.551403
5160.263577 4903.886209 7733.666772 568.3924995 2667.128815 5374.743042
2012.772082 2030.397967 2796.774388 0 3769.835618 5711.024613
3494.212323 0 4381.56719 3134.737997 2634.364797 0 259.6560989
2804.285868 2071.017044 0 0 10883.29991 0 1427.270943 2025.317571
2393.658294 22971.9882 0 0 0 0 0 1257.63867 0 15929.72404 6952.989348
8579.441933 3898.922305 6562.591537 4062.953191 2071.496895 2071.496895
191.626201 6944.83384 0 175.896067 778.9682966 2256.636993 1614.689998
2664.988008 778.9682966 0 0 0 2025.317571 778.9682966 200.6240796 0
376.7662985 0 778.9682966 0 5768.694955
1981 1  -1 3 2 2 -1 -1 55   0 0 0 0 4425.280631 8592.731461 868.6052688
2940.063655 1182.487627 17443.62336 6650.643821 77748.468 57258.98998
32881.53155 25799.78651 20177.3663 5834.873454 3024.518522 3534.70714 0
2181.515293 568.5416305 3557.910226 0 568.5416305 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 868.6052688 1522.428144 13521.24659 34718.29918 11401.54918
29576.21243 4874.147767 24289.31756 24815.28483 9939.814952 0
47.37846921 0 0 0 47.37846921 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1982 1  -1 3 2 2 -1 -1 106   0 0 0 0 325.1388715 1004.248345
3504.736206 5157.875771 3949.348127 3134.431887 15115.03152 3094.420069
10800.81047 9104.121769 9710.599113 9920.963524 6718.26057 2066.516647
5195.366622 6425.959862 1067.528398 6776.032115 3731.72866 1625.74793
921.4293185 0 1730.672532 0 1017.75708 1126.850647 652.0191128 0
652.6049341 291.1595564 1707.669105 4109.977311 0 0 0 0 318.6610397
1852.166269 1728.524557 2852.830301 499.1197521 2662.022277 2283.442156
3902.02018 4039.469674 3580.487408 2989.149676 6001.876627 4477.263946
2867.481908 670.2705989 1488.774855 1228.015545 21.38247764 2386.944366
1319.021749 623.6403727 1216.52511 339.315294 0 0 2826.345893 23.18876
1170.493941 291.1595564 1715.837956 0 4529.297721
1983 1  -1 3 2 2 -1 -1 150   0 0 0 11.37607129 1907.191721 5882.956858
3977.133359 4209.093813 9334.205478 4241.766628 7415.88334 7354.287524
6356.950808 6117.160641 10017.34024 1755.826945 10613.57223 10279.38492
17106.62777 5600.044449 12148.69383 4192.473653 9953.716958 10425.54117
3618.135649 313.410764 5397.075009 9412.556607 7947.45233 6167.629118
9322.80477 5605.217047 3636.096087 8886.028669 14915.22154 59018.1181 0
0 0 21.85627696 1739.483735 3016.901974 5725.775691 2627.063345
6832.905145 1636.661146 5345.104961 5118.117319 14527.58484 8212.145223
6522.61113 3821.032786 2641.631556 11802.38894 6537.839899 7486.362712
2955.274367 1239.981556 6174.954981 819.1697385 2455.588701 409.5268004
9028.904759 786.5438587 5005.223883 25.15533763 8293.927705 1084.701099
5387.373233 3435.102102 4335.004062 31558.89293
1985 1  -1 3 2 1 -1 -1 593  0 0 49.37611911 427.1371877 2438.411575
14077.56707 30319.85792 35570.66109 23032.41436 12142.75368 16916.38569
15302.06577 18595.02581 9694.442346 12525.16928 20908.70655 10901.78046
12237.73282 11460.84469 11153.57528 12648.38145 9721.937094 4516.905781
2474.285495 9693.302345 5051.373156 5811.478538 10037.83438 11002.91887
8170.028585 8398.077858 5662.257564 6155.666102 13868.82515 3953.495565
44101.23791 0 0 0 190.5305852 4133.620049 10286.17663 30931.91819
33023.11978 17679.44754 12453.49525 17578.57282 14447.9531 13353.66466
19760.69902 7516.234253 8293.824575 12404.60521 11076.46857 9497.009889
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8545.921311 12746.82286 7110.331258 6448.722999 6207.764928 8138.603895
7528.920886 3157.097473 6132.491921 1707.604696 6101.316875 2492.066588
3644.838494 7873.92911 4863.054539 6639.483508 41315.43952
1986 1 -1 3 2 1 -1 -1 40   0 0 0 0 0 0 1633.137513 14963.47608
47049.4953 123463.0434 16080.7846 18722.50844 14607.1174 13773.66702
15913.8662 1533.330051 1533.330051 14189.75495 1533.330051 0
1533.330051 11038.89685 11442.71776 0 16029.34104 139.3882488 0 0
14607.1174 1533.330051 0 139.3882488 914.2600624 0 0 1193.03656 0 0 0 0
0 914.2600624 4471.736036 11082.58191 35417.48556 4966.74707 19058.8766
139.3882488 1862.01028 6723.077788 18380.03063 278.7764977 11194.18488
1583.233782 1533.330051 278.7764977 1802.621571 1672.7183 1722.622031
1942.00982 3206.048352 49.90373066 0 0 0 0 2134.914677 1533.330051 0 0
0 2039.688996
1987 1 -1 3 2 2 -1 -1 196 0 0 0 0 1255.744079 5681.134516 11107.69993
26070.65304 39416.65305 19977.67301 31246.05742 32256.18511 38998.84052
33048.4228 23239.00067 32560.04327 39253.59841 57105.98071 53533.24436
30181.25662 22999.15698 29209.73761 24777.77926 42693.35108 24291.23495
11685.14013 20007.97676 21763.06155 9133.025164 9879.288317 12959.10444
91.5514708 12904.27708 1197.947211 8067.777367 166194.2962 0 0 0 0
3571.54247 1180.942961 13411.67518 42651.68164 41215.91559 34357.61049
31979.46738 33828.80808 23762.27362 28619.8081 47196.75463 36416.69135
41404.13797 47812.78827 27214.57904 46981.46524 49203.4033 10804.34556
19178.52788 8229.788418 24555.15104 3185.444008 48301.89277 13375.64696
4942.77642 12175.01085 6570.689634 9523.468483 3601.133536 0
34416.96094 187225.3912
1988 1 -1 3 2 2 -1 -1 75   0 0 0 725.3580368 2218.864023 3570.043705
15238.44948 13861.33335 25730.73834 33028.91419 43501.48846 21419.99519
21478.48909 5750.412143 5606.844945 7754.395933 8176.993993 9285.50169
13886.68638 8331.240626 6143.290885 5213.572324 4151.416265 8249.676276
5620.627844 5089.549814 8110.298836 5038.397198 5089.549814 6830.133039
7674.909034 531.0780298 2374.136054 0 6343.196741 22200.72152 0 0 0
2960.440817 6168.478168 4191.094483 11581.25219 17563.1481 49646.69725
23571.73619 12291.507 21090.68422 15541.94394 10711.72754 26042.87744
10688.13663 18576.50375 20161.03415 18904.25998 7869.638691 8533.481871
12021.05496 10995.50177 5440.275903 7267.268539 8790.998648 9736.831397
5767.77071 11753.28338 8025.050148 757.7816087 0 0 1782.529608
936.6455552 21184.20664
1990 1 -1 3 2 2 -1 -1 175   0 0 0 1964.018216 1842.920981 7566.926282
33619.56081 39998.3121 21464.87186 38335.72649 41335.35578 46669.29929
27606.005 18391.43951 13892.44203 12357.92314 14453.13168 4834.176571
6296.770075 11530.22386 6300.394524 7533.920221 7328.274181 1542.578292
5063.587804 11582.77416 3849.870608 7099.081662 8430.43415 490.1854779
490.1854779 0 3053.641308 1998.247573 2100.866912 29757.7445 0 0 0 0
388.8720784 8141.656337 20383.41419 24297.16741 32643.84252 19667.57512
55101.48264 39359.62705 26318.20024 15010.05359 13966.4019 9346.333766
8017.5613 8100.42968 10815.12055 6266.951782 3818.286613 16639.96359
11119.28161 3724.389185 3844.772583 2181.282067 1632.607468 864.6922235
4051.92664 2011.020576 2472.563359 6093.101772 0 0 0 17607.3733
1991 1 -1 3 2 1 -1 -1 80   0 0 0 3573.904571 15189.09443 8423.100837
8820.782495 11272.58243 9679.077756 21976.37071 4970.305386 6385.545678
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3759.417549 679.4677707 730.9019758 376.2439971 1225.786639 1446.942085
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2377.179641 4206.764934 3356.366143 692.1659843 4559.364761 3379.202727
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2259.734353 741.9850796 1688.20806 23076.86236 0 0 0 0 598.8486339
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1998 1 -1 3 2 1 -1 -1 170   0 0 0 3300.022437 11964.20942 11781.37449
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0 2386.403072 1909.853497 12529.26343
1999 1 -1 3 2 2 -1 -1 96   0 0 0 3676.271938 50732.54969 43385.85135
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831.7777423 3724.961012 187.0840679 99.75577766 661.8033278 0
1563.732859 0 187.0840679 87.32829021 106.1262068 9131.704206 0 0
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3795.374778 3892.196751 3049.133747 1479.706022 3843.769574 3083.247927
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0 312.1724593 156.7103141 248.7968885 91.64244896 0 0 0 2556.421078
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11731.06248 6438.34458 5768.518788 4070.377121 4002.232747 809.0455446
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2006 1   1 3 2 1 -1 -1 392 0 0 0 29.77233037 41.36739723 382.7993195
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2007 1   1 3 2 1 -1 -1 472 0 0 0 0 9.504166146 845.9857981 6782.184534
15720.83472 13178.63686 7293.235977 4430.767429 5415.745058 2594.731353
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788.5104365 2633.553418
2008 1 1 3 2 1 -1 -1 487 0 0 0 57.39442787 384.9719484 224.6263289
1639.79547 7902.562836 12673.99631 8907.151335 4457.320734 2678.075787
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0 0 0 21.59090411 254.1586327 413.0080073 3237.19097 9241.844194
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903.4003857 248.8219945 383.9850621 640.5634628 815.661292 97.73969753
348.3720434 338.1310535 217.5372284 314.7878908 282.6564449 142.2029225
37.99069188 2627.024351 73.37183197 672.6252378
2009 1 -1 3 2 1 -1 -1 208 0 0 0 0 19.27934417 14.45950813 421.9057626
1229.010153 6384.29241 9583.684507 7455.922783 3764.888711 3748.303496
2771.191521 2070.220779 1547.621543 1433.664454 509.7473658 1095.136221
578.7427136 1723.048495 1327.494381 449.7039115 1265.706562 872.5114198
872.7859942 346.2908893 905.4378927 575.8418941 103.103013 356.3494262
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324.2247445 559.5845673 531.103076 681.2909602 173.1708179 578.5215862
161.1303564 77.20930929 140.7291798 0 141.3973999 1008.012516
2010 1 -1 3 2 1 -1 -1 356 0 0 0 0 0 299.3291942 3475.066304
3047.701908 3838.13269 8957.487378 16710.06916 15673.78637 6135.760835
5142.575021 5677.271253 1475.710841 2551.085564 2394.826809 1705.737303
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216.6341581 619.3714329 666.9915517 171.0290558 5470.123986 0 0 0
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6255.34215 9285.999835 10621.50575 5123.410473 3868.629455 3719.653207
3437.982187 1987.749183 1284.403405 1007.352001 1212.078026 434.3419446
1004.770404 1366.56597 453.7915315 951.2924 579.1581825 666.0219391
319.9235573 666.2274136 697.4234884 966.1845845 736.7732498 376.3672274
108.511248 126.2148425 1530.346868
2011 1 -1 3 2 1 -1 -1 86 0 0 0 0 0 92.92483906 467.4173939 1211.8888
1224.411082 924.8745852 460.7342874 638.4516741 473.5845356 87.43533278
207.2514306 294.5595283 250.6589657 97.89243262 27.43652768 4.256968051
26.19952849 111.4016041 95.9424549 77.20708371 4.256968051 54.60082685
0 46.87806342 27.43652768 12.64227209 38.8830715 0 30.55108854
89.14319124 19.44153575 294.7673106 0 0 0 0 0 95.90118399 438.985251
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175.8838739 116.9225977 149.7256163 335.0463369 129.9281556 0
10.71211449 73.13206881 57.76554796 0 44.33576782 120.3613667
81.46405176 4.256968051 27.43652768 19.44153575 0 0 0 62.63489638
12.64227209 19.44153575 140.0107273
2012 1 -1 3 2 1 -1 -1 135 0 0 6.179673638 67.30416185 886.6412031
550.6700692 6611.328116 11143.48545 7304.334842 5737.136084 1346.581415
374.6860793 1458.843144 2318.752458 970.6366802 2318.092849 1137.824109
2196.833497 475.0835805 343.4233549 355.6707695 928.3243086 425.3876416
87.36959433 958.0146702 359.376092 363.5538861 432.2214323 289.151354

366.9192216 165.7530397 23.68512103 310.8220629 56.45418228 175.5099698
2590.480965 0 0 6.179673638 0 653.8303494 1422.273366 9126.10652
7473.766436 7193.941677 3983.78204 1302.655444 399.4455939 2478.444882
1738.479683 633.4787481 2557.356855 599.287357 525.3464671 372.9421716
170.0591451 1169.796349 844.3761187 166.0767416 771.9203761 132.4434086
368.8182608 80.17770866 13.92819095 301.1826601 37.93701389 256.2794554
330.8812469 181.2542564 13.92819095 610.6637763 1834.371295
#TWL WCGOP discard marginal ages (N=2)
#Year Seas Fleet Gender Partition AgeError LbinLo LbinHi Nsamp 0 1 2 3
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
30 31 32 33 34 35 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
2004 1   1   0   1   1   -1   -1   78   0 0.002521126 0.005042252
0.036309947 0.292008225 0.137401718 0.08493528 0.101543199 0.13816349
0.027801917 0.001260563 0.038447174 0.022311967 0 0.008823942
0.026408797 0.002521126 0.009139082 0.007563378 0.018656334 0.001260563
0.001260563 0 0.001260563 0 0.005357393 0.01739577 0.001260563 0 0 0 0
0 0 0 0.011345068 0 0.002521126 0.005042252 0.036309947 0.292008225
0.137401718 0.08493528 0.101543199 0.13816349 0.027801917 0.001260563
0.038447174 0.022311967 0 0.008823942 0.026408797 0.002521126
0.009139082 0.007563378 0.018656334 0.001260563 0.001260563 0
0.001260563 0 0.005357393 0.01739577 0.001260563 0 0 0 0 0 0 0
0.011345068
2005 1   1   0   1   1   -1   -1   207   0 0.013171064 0.056466155
0.017012383 0.042506283 0.229761351 0.126660875 0.129269256 0.146692004
0.041659433 0.059906629 0.006018945 0.068701636 0.012993603 0.000868422
0.001736844 0.001143422 0.035373714 0.000578948 0.000872186 0.001157896
0 0 0.000289474 0.000289474 0.000289474 0.001948949 0 0 0 0 0 0
0.003184213 0 0.00144737 0 0.013171064 0.056466155 0.017012383
0.042506283 0.229761351 0.126660875 0.129269256 0.146692004 0.041659433
0.059906629 0.006018945 0.068701636 0.012993603 0.000868422 0.001736844
0.001143422 0.035373714 0.000578948 0.000872186 0.001157896 0 0
0.000289474 0.000289474 0.000289474 0.001948949 0 0 0 0 0 0 0.003184213
0 0.00144737
#
#AKSHLF updated for 2013 assessment (N=210)
#AKSHLF CAAL (N=203)
#AKSHLF females
#year Season Fleet gender partition ageErr LbinLo LbinHi Nsamp F0 F1
F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21
F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F0.1 F1.1 F2.1
F3.1 F4.1 F5.1 F6.1 F7.1 F8.1 F9.1 F10.1 F11.1 F12.1 F13.1 F14.1 F15.1
F16.1 F17.1 F18.1 F19.1 F20.1 F21.1 F22.1 F23.1 F24.1 F25.1 F26.1 F27.1
F28.1 F29.1 F30.1 F31.1 F32.1 F33.1 F34.1 F35.1
1980 1   3   1   0   2   10   10   1   0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1   3   1   0   2   12   12   5   0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1   3   1   0   2   18   18   7   0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1   3   1   0   2   26   26   1   0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1980 1 3 1 0 2 30 30 1 0 0 0 0 0 0 100 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1 3 1 0 2 32 32 1 0 0 0 0 0 100 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1 3 1 0 2 34 34 6 0 0 0 0 0 33.33333333
33.33333333 16.66666667 0 0 16.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 33.33333333 33.33333333 16.66666667 0 0
16.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1 3 1 0 2 36 36 3 0 0 0 0 0 0 0 33.33333333
0 66.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 33.33333333 0 66.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1980 1 3 1 0 2 38 38 4 0 0 0 0 0 0 0 25 75 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 25 75 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1 3 1 0 2 40 40 5 0 0 0 0 0 0 0 0 0 0 0 0 60
20 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
60 20 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1 3 1 0 2 42 42 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0
50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 22 22 1 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 24 24 1 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 28 28 3 0 0 0 0 0 0 100 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 30 30 8 0 0 0 0 0 37.5 37.5 25 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 37.5 37.5
25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 32 32 4 0 0 0 0 0 0 75 25 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 75 25 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 34 34 4 0 0 0 0 0 0 0 0 0 25 0 25 0
25 0 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 25 0
25 0 25 0 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 36 36 7 0 0 0 0 0 0 0 0 0
14.28571429 0 0 0 28.57142857 0 28.57142857 14.28571429 0 0 0 0 0
14.28571429 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 14.28571429 0 0
0 28.57142857 0 28.57142857 14.28571429 0 0 0 0 0 14.28571429 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 38 38 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 25 25 0 25 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 25 25 0 25 0 25 0 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 40 40 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 20 20 40 0 0 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 20 20 40 0 0 0 20 0 0 0 0 0 0 0 0 0 0
1983 1 3 1 0 2 42 42 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0

1983 1   3   1   0   2   44   44   1   0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0
1983 1   3   1   0   2   46   46   2   0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
1986 1   3   1   0   2   12   12   5   0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   14   14   10   0 84.06365806 15.93634194
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
84.06365806 15.93634194 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   16   16   5   0 14.5118006 85.4881994 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
14.5118006 85.4881994 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1986 1   3   1   0   2   18   18   10   0 0 90 10 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 90 10 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   20   20   10   0 0 73.83901213
26.16098787 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 73.83901213 26.16098787 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   22   22   10   0 0 33.22333564
55.70221915 11.07444521 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 33.22333564 55.70221915 11.07444521 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   24   24   10   0 0 0 52.28087763
47.71912237 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 52.28087763 47.71912237 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   26   26   10   0 0 0 10 50 30 10 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 10 50 30 10 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   28   28   11   0 0 0 10.10164254
20.20328508 57.29372241 12.40134997 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 10.10164254 20.20328508 57.29372241
12.40134997 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   30   30   10   0 0 0 0 11.41080004
22.82160008 44.75478081 14.00854605 7.004273024 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 11.41080004 22.82160008
44.75478081 14.00854605 7.004273024 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   32   32   11   0 0 0 0 0 26.73273605
39.04324243 27.75339755 6.470623974 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 26.73273605 39.04324243 27.75339755
6.470623974 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1986 1   3   1   0   2   34   34   7   0 0 0 0 0 0 0 35.64293591
64.35706409 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 35.64293591 64.35706409 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1986 1   3   1   0   2   36   36   1   0 0 0 0 0 0 0 0 100 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1986 1 3 1 0 2 46 46 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
1995 1 3 1 0 2 12 12 7 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 14 14 12 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 16 16 1 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 18 18 8 0 0 91.18336928
8.816630721 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 91.18336928 8.816630721 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 20 20 14 0 0 56.05428381
43.94571619 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 56.05428381 43.94571619 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 22 22 20 0 0 2.222868555 66.4609605
30.24434573 0 1.071825208 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 2.222868555 66.4609605 30.24434573 0 1.071825208 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 24 24 46 0 0 0.880104514
72.29086633 25.9942892 0 0.834739955 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.880104514 72.29086633 25.9942892 0
0.834739955 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 26 26 21 0 0 0 26.68637296
57.3266764 8.522555714 7.464394922 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 26.68637296 57.3266764 8.522555714
7.464394922 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 28 28 24 0 0 0 13.66068366
55.39443082 20.53366901 0 4.152436046 4.639211664 0 0 1.619568796 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 13.66068366 55.39443082
20.53366901 0 4.152436046 4.639211664 0 0 1.619568796 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 30 30 17 0 0 0 0 27.6145254
72.3854746 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 27.6145254 72.3854746 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 32 32 8 0 0 0 3.78466342 0
9.479694407 80.00831005 0 0 5.141134986 1.586197135 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3.78466342 0 9.479694407
80.00831005 0 0 5.141134986 1.586197135 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 34 34 3 0 0 0 0 0 0 2.310753936 0
0 95.64705372 2.042192339 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 2.310753936 0 0 95.64705372 2.042192339 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 36 36 4 0 0 0 0 0 0 33.09777278 0
33.09777278 0.706681653 0 0 33.09777278 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 33.09777278 0 33.09777278 0.706681653 0 0
33.09777278 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 38 38 3 0 0 0 0 0 0 0 0 0 0
33.33333333 0 33.33333333 0 0 0 0 33.33333333 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 33.33333333 0 33.33333333 0 0 0 0
33.33333333 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 40 40 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 42 42 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 50 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1995 1 3 1 0 2 46 46 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
1998 1 3 1 0 2 12 12 1 0 100 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 14 14 1 0 100 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 16 16 11 0 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 18 18 5 0 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 20 20 20 0 0 42.27492232
57.72507768 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 42.27492232 57.72507768 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 22 22 52 0 0 13.90356004 82.3554753
3.740964652 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 13.90356004 82.3554753 3.740964652 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 24 24 43 0 0 12.49726661
67.60972591 19.89300748 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 12.49726661 67.60972591 19.89300748 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 26 26 27 0 0 9.774531442
28.77981923 50.14370294 10.16718618 0 0 0 0 0 0 1.134760199 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 9.774531442 28.77981923
50.14370294 10.16718618 0 0 0 0 0 0 1.134760199 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 28 28 28 0 0 1.104127724
13.35685252 54.57078261 2.793380878 4.349564422 23.82529185 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1.104127724 13.35685252
54.57078261 2.793380878 4.349564422 23.82529185 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 30 30 9 0 0 0 8.79918667
8.79918667 21.41463729 0 60.98698937 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 8.79918667 8.79918667 21.41463729 0
60.98698937 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 32 32 8 0 0 0 0 5.156799119
43.75683525 11.93936501 34.31695519 0 0 0 0 0 4.830045435 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5.156799119 43.75683525
11.93936501 34.31695519 0 0 0 0 0 4.830045435 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1998 1 3 1 0 2 34 34 9 0 0 0 0 5.16877239
13.60553131 4.629029874 68.79326744 3.431401102 0 0 0 0 0 4.371997881 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5.16877239 13.60553131

4.629029874 68.79326744 3.431401102 0 0 0 0 0 4.371997881 0 0 0 0 0 0 0
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#AKSHLF males
#year Season Fleet gender partition ageErr LbinLo LbinHi Nsamp M0 M1
M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21
M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M0.1 M1.1 M2.1
M3.1 M4.1 M5.1 M6.1 M7.1 M8.1 M9.1 M10.1 M11.1 M12.1 M13.1 M14.1 M15.1
M16.1 M17.1 M18.1 M19.1 M20.1 M21.1 M22.1 M23.1 M24.1 M25.1 M26.1 M27.1
M28.1 M29.1 M30.1 M31.1 M32.1 M33.1 M34.1 M35.1
1980 1 3 2 0 2 12 12 2 0 100 0 0 0 0 0 0 0 0 0 0 0
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1980 1   3   2   0   2   14   14   1   0 100 0 0 0 0 0 0 0 0 0 0
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1980 1   3   2   0   2   24   24   1   0 0 0 0 100 0 0 0 0 0 0 0
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1980 1   3   2   0   2   28   28   1   0 0 0 0 100 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1980 1   3   2   0   2   30   30   6   0 0 0 0 0 50 0 33.33333333
16.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 50 0 33.33333333 16.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1980 1   3   2   0   2   32   32   9   0 0 0 0 0 0 44.44444444
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33.33333333 66.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0
# AKSHLF ghost marginal ages (N=7)
#Year Seas  Fleet Gender Partition AgeError LbinLo LbinHi Nsamp 0 1 2 3
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
30 31 32 33 34 35 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
1980 1    -3   3    0     2    -1   -1   96   0 6 7 0 1 3 3 3 3 2 1 3 1
1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3 17 0 2 3 5 8 10 8 4 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1983 1    -3   3    0     2    -1   -1   117   0 0 0 1 1 3 9 3 2 0 1 0
3 0 2 2 0 0 0 2 2 3 1 1 1 1 0 0 0 0 0 0 0 0 1 2 0 0 1 3 3 7 8 2 1 3 2 1
4 2 3 1 1 2 4 4 2 3 0 1 3 1 1 1 0 1 0 1 2 0 0 8
1986 1    -3   3    0     2    -1   -1   219   0 15 25 16 14 14 11 8 7
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 18 21 10 14 10
16 12 2 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
1995 1    -3   3    0     2    -1   -1   393   0 20 18 59 43 25 10 1 2
4 2 2 1 0 1 0 3 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 20 14 58 33 32
7 8 5 7 4 0 2 1 1 0 1 2 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1998 1    -3   3    0     2    -1   -1   428   0 2 34 114 41 11 4 6 3 2
1 0 1 1 2 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 6 0 20 31 88 22 9 11
2 0 1 0 1 0 0 3 1 0 0 0 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2
```

```
2001 1    -3   3    0     2    -1   -1   1019  0 121 212 17 45 57 53 10
3 1 2 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 2 0 0 1 0 0 0 0 0 0 2 0 104 192 32 41
44 39 12 8 1 1 0 3 1 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 1
2004 1    -3   3    0     2    -1   -1   1134  0 62 62 35 156 118 23 6
6 7 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 3 0 89 67 43 187
129 24 12 15 6 2 1 0 0 1 1 1 1 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0
#
#AKSLP updated for 2013 assessment (N=51)
#AHSLP CAAL (N=49)
#AKSLP females
#year Season Fleet gender partition ageErr LbinLo LbinHi Nsamp F0 F1 F2
F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21
F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F0.1 F1.1 F2.1
F3.1 F4.1 F5.1 F6.1 F7.1 F8.1 F9.1 F10.1 F11.1 F12.1 F13.1 F14.1 F15.1
F16.1 F17.1 F18.1 F19.1 F20.1 F21.1 F22.1 F23.1 F24.1 F25.1 F26.1 F27.1
F28.1 F29.1 F30.1 F31.1 F32.1 F33.1 F34.1 F35.1
2000 1    4   1    0     2    14   14   1   0 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    16   16   2   0 69.17759437 30.82240563 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
69.17759437 30.82240563 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    18   18   1   0 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    20   20   3   0 0 0 33.33333333 0
66.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 33.33333333 0 66.66666667 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    22   22   13  0 0 0 44.69480571
32.65873989 16.95370719 5.692747203 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 44.69480571 32.65873989 16.95370719
5.692747203 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    24   24   11  0 0 0 31.11291151
38.55779617 30.32929232 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 31.11291151 38.55779617 30.32929232 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    26   26   8   0 0 0 0 63.18298085
36.81701915 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 63.18298085 36.81701915 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    28   28   10  0 0 0 0 3.180049447
60.97433427 18.55883306 8.019935167 0 0 9.266848052 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 3.180049447 60.97433427
18.55883306 8.019935167 0 0 9.266848052 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    30   30   10  0 0 0 0 0 37.54134503
7.544265464 26.63390255 18.04292173 8.717222804 0 1.520342418 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 37.54134503 7.544265464
26.63390255 18.04292173 8.717222804 0 1.520342418 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   1    0     2    32   32   5   0 0 0 0 0 18.65054414
41.14864293 0 40.20081293 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 18.65054414 41.14864293 0 40.20081293 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

2000 1 4 1 0 2 42 42 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 4 1 0 2 46 46 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
2000 1 4 1 0 2 48 48 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
2001 1 4 1 0 2 18 18 6 0 0 80.12751331 19.87248669
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
80.12751331 19.87248669 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2001 1 4 1 0 2 20 20 24 0 0 89.05582432 10.94417568
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
89.05582432 10.94417568 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2001 1 4 1 0 2 22 22 12 0 0 86.32451839 13.67548161
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
86.32451839 13.67548161 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2001 1 4 1 0 2 24 24 5 0 0 5.707612438 52.85380622
41.43858134 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 5.707612438 52.85380622 41.43858134 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 26 26 3 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 28 28 8 0 0 0 14.22801764
73.09980806 12.6721743 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 14.22801764 73.09980806 12.6721743 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 30 30 7 0 0 0 0 17.80416572
44.50441173 37.69142255 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 17.80416572 44.50441173 37.69142255 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 32 32 21 0 0 0 0 0 31.82677186
68.17322814 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 31.82677186 68.17322814 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 34 34 11 0 0 0 0 2.473996013
4.661640977 82.54088257 10.32348044 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 2.473996013 4.661640977 82.54088257
10.32348044 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 36 36 3 0 0 0 0 0 40.78356144
59.21643856 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 40.78356144 59.21643856 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 40 40 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 50 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 50 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 1 0 2 42 42 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 66.7570103 0 0 0 0 0 33.2429897 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 66.7570103 0 0 0 0 0 33.2429897 0
0 0 0 0
#AKSLP males

```
#year Season Fleet gender partition ageErr LbinLo LbinHi Nsamp M0 M1 M2
M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21
M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M0.1 M1.1 M2.1
M3.1 M4.1 M5.1 M6.1 M7.1 M8.1 M9.1 M10.1 M11.1 M12.1 M13.1 M14.1 M15.1
M16.1 M17.1 M18.1 M19.1 M20.1 M21.1 M22.1 M23.1 M24.1 M25.1 M26.1 M27.1
M28.1 M29.1 M30.1 M31.1 M32.1 M33.1 M34.1 M35.1
2000 1    4   2    0     2    14   14   2   0 73.02329463 26.97670537 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
73.02329463 26.97670537 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    16   16   4   0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    20   20   1   0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    22   22   7   0 0 0 51.54489519
17.39157285 31.06353196 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 51.54489519 17.39157285 31.06353196 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    24   24   10  0 0 0 36.7604527
44.30764538 18.93190192 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 36.7604527 44.30764538 18.93190192 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    26   26   8   0 0 0 5.427530023
26.04818707 26.15997676 7.569610583 26.04818707 8.746508498 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 5.427530023 26.04818707
26.15997676 7.569610583 26.04818707 8.746508498 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    28   28   11  0 0 0 0 7.498000048
56.90301359 26.1441846 9.454801769 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 7.498000048 56.90301359 26.1441846
9.454801769 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    30   30   10  0 0 0 0 5.502131626
48.0891056 24.24066711 22.16809567 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 5.502131626 48.0891056 24.24066711
22.16809567 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    32   32   4   0 0 0 0 0 43.30581346 0 0 0
0 25.35369866 0 31.34048788 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 43.30581346 0 0 0 0 25.35369866 0 31.34048788 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    34   34   1   0 0 0 0 0 0 0 0 0 0 0 0 0
100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1    4   2    0     2    36   36   3   0 0 0 0 0 0 0 0 0
14.21501161 0 0 0 0 0 0 0 0 0 0 0 58.13063623 0 0 0 0 27.65435215 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 14.21501161 0 0 0 0 0 0 0 0 0 0 0
58.13063623 0 0 0 0 27.65435215 0 0 0 0 0 0 0 0 0
2001 1    4   2    0     2    16   16   2   0 0 100 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1    4   2    0     2    18   18   3   0 0 62.31818439 37.68181561
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
62.31818439 37.68181561 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2001 1    4   2    0     2    20   20   24  0 0 74.81060723 25.18939277
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

74.81060723 25.18939277 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 22 22 8 0 0 67.39957843 32.60042157 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
67.39957843 32.60042157 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 24 24 3 0 0 14.30455071 85.69544929 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
14.30455071 85.69544929 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 26 26 6 0 0 0 0 87.799809 0
12.200191 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 87.799809 0 12.200191 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 28 28 7 0 0 0 0 95.41634496
4.583655042 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 95.41634496 4.583655042 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 30 30 12 0 0 0 0 2.197363768
24.4661159 73.33652034 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2.197363768 24.4661159 73.33652034 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 32 32 16 0 0 0 0 11.19482091
28.4431382 60.36204089 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 11.19482091 28.4431382 60.36204089 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 34 34 2 0 0 0 0 0 79.49727051
20.50272949 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 79.49727051 20.50272949 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 36 36 2 0 0 0 0 0 0 0 0 50 0 0 50 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 50 0 0 50
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2001 1 4 2 0 2 40 40 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0
2001 1 4 2 0 2 42 42 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100
AKSLP ghost marginal ages (N=2)
#Year Seas Fleet Gender Partition AgeError LbinLo LbinHi Nsamp 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
2000 1 -4 3 0 2 -1 -1 128 0 1 3 12 16 16 6 3 4 1 1
1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 1 5 11 8 19 6 4 1 1
1 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0
2001 1 -4 3 0 2 -1 -1 191 0 0 39 8 13 13 26 1 0 0
0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 32 8 14 10 19 0
1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1
#
#NWSLP updated for 2013 assessment (N=94)
#NWSLP CAAL (N=91)
#NWSLP females
#year Season Fleet gender partition ageErr LbinLo LbinHi nSamps F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21 F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F0.1 F1.1 F2.1

F3.1 F4.1 F5.1 F6.1 F7.1 F8.1 F9.1 F10.1 F11.1 F12.1 F13.1 F14.1 F15.1 F16.1 F17.1 F18.1 F19.1 F20.1 F21.1 F22.1 F23.1 F24.1 F25.1 F26.1 F27.1 F28.1 F29.1 F30.1 F31.1 F32.1 F33.1 F34.1 F35.1
2000 1 5 1 0 2 14 14 0.5 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 16 16 2.5 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 18 18 3 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 20 20 1 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 22 22 8 0 0 0 60.69761758 39.30238242 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 60.69761758 39.30238242 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 24 24 4.5 0 0 0 4.055968277 67.8684186 0 28.07561312 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 4.055968277 67.8684186 0 28.07561312 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 26 26 11 0 0 0 1.755413427 63.03443642 35.21015015 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1.755413427 63.03443642 35.21015015 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2000 1 5 1 0 2 28 28 48 0 0 0 0 18.27659028 43.18709708 24.7130521 7.122094949 6.701165598 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18.27659028 43.18709708 24.7130521 7.122094949 6.701165598 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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#NWSLP males
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M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21
M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M0.1 M1.1 M2.1
M3.1 M4.1 M5.1 M6.1 M7.1 M8.1 M9.1 M10.1 M11.1 M12.1 M13.1 M14.1 M15.1
M16.1 M17.1 M18.1 M19.1 M20.1 M21.1 M22.1 M23.1 M24.1 M25.1 M26.1 M27.1
M28.1 M29.1 M30.1 M31.1 M32.1 M33.1 M34.1 M35.1
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0 81.71717172
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0 0 0 0 0 0 0 0 0 0
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0 0 0 0 30.8505453 12.27685371 11.19844026 0 0 0 0 0 0 0 0 14.82361543
2002 1    5   2    0     2    40   40   3    0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 23.72961196 0 0 0 0 16.64016958
# NWSLP ghost marginal ages (N=3)
#Year Seas Fleet Gender Partition AgeError LbinLo LbinHi Nsamp F0 F1 F2
F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21
F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 M0 M1 M2 M3 M4
M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23
M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35
2000 1    -5   3    0     2    -1   -1   270  0 0.354203749 0.284494183
1.668875353 6.697577743 13.11093498 8.758101 2.219822316 2.465665372 0
0 0 0.692366017 1.249039073 0.624523045 0.624523045 1.24904609
0.624523045 1.24904609 1.249039073 0.624523045 1.24904609 0.624523045
1.24904609 1.249039073 1.24904609 0.624523045 0 0 0 0 0 0 0 0
3.169406385 0 0.787492136 0.216651211 0.554743306 3.196205341
10.62364939 6.245469036 1.31733115 0.69096958 0.211697018 0 0
0.624523045 1.249039073 1.873569135 2.498085162 1.249039073 4.259202536
1.873562117 0.624523045 0.624523045 0.624523045 1.873562117 0
0.624523045 0.624523045 1.24904609 0 0.624523045 0.624523045 0
0.624523045 0.624523045 0 0 0.624523045
2001 1    -5   3    0     2    -1   -1   357  0 0.128910793 11.79726675
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0.129825931 0.329721754 0.198510749 1.332342016 0.580271702 0
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0.576512216 0 0 0 0 0.580271702 0 0 0 0 0 1.929828206
2002 1    -5   3    0     2    -1   -1   819   0 0 4.737140295
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0 0 0 0.134024406 0 0 0 0 0.166304843 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0.166304843 0 0.976565835 0 0 3.906841745 26.5118234 4.464904941
7.013572106 2.582600184 1.286934521 0.124053828 0 0 0 0 0.112774955 0
0.077836616 0 0.278928312 0 0 0 0.073292015 0 0 0.557856623 0.110998429
0.101248195 0 0 0.073292015 0.110998429 0 0 0 0 0.211861022
#
#NWCBO final (N=386)
#NWCBO CAAL (N=376)
#NWCBO females
#year Season Fleet gender partition ageErr LbinLo LbinHi nSamps F0 F1
F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21
F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F0.1 F1.1 F2.1
F3.1 F4.1 F5.1 F6.1 F7.1 F8.1 F9.1 F10.1 F11.1 F12.1 F13.1 F14.1 F15.1
F16.1 F17.1 F18.1 F19.1 F20.1 F21.1 F22.1 F23.1 F24.1 F25.1 F26.1 F27.1
F28.1 F29.1 F30.1 F31.1 F32.1 F33.1 F34.1 F35.1
2003 1    6   1    0     2    12   12   1      0 100 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 89.82767374 10.17232626 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
2003 1    6   1    0     2    16   16   3.5    0 0 100 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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62.04754875 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 37.95245125 62.04754875 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 54.63202559 45.36797441 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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44.97237169 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 55.02762831 44.97237169 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 5.609095774 62.541633 31.84927123 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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#NWCBO males
#year Season Fleet gender partition ageErr LbinLo LbinHi nSamps M0 M1
M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21
M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M0.1 M1.1 M2.1
M3.1 M4.1 M5.1 M6.1 M7.1 M8.1 M9.1 M10.1 M11.1 M12.1 M13.1 M14.1 M15.1
M16.1 M17.1 M18.1 M19.1 M20.1 M21.1 M22.1 M23.1 M24.1 M25.1 M26.1 M27.1
M28.1 M29.1 M30.1 M31.1 M32.1 M33.1 M34.1 M35.1
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1.303353845 0 14.31084361 28.51197627 10.5236706 0 2.437237981
14.95194783 8.523744147 2.437237981 2.048039913 0 8.523744147 0
6.428203682 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1.303353845 0
14.31084361 28.51197627 10.5236706 0 2.437237981 14.95194783
8.523744147 2.437237981 2.048039913 0 8.523744147 0 6.428203682 0 0 0 0
0 0 0 0 0 0 0
2012 1 6 2 0 1 38 38 8 0 0 0 0 0 0 0 0 0 0 0 0
0 0 2.540269433 2.540269433 0 0 0 0 0 0 34.53927661 8.976531608 0 0
41.76637738 4.818637772 0 0 0 4.818637772 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 2.540269433 2.540269433 0 0 0 0 0 0 34.53927661 8.976531608 0 0
41.76637738 4.818637772 0 0 0 4.818637772 0 0 0 0 0
2012 1 6 2 0 1 40 40 4 0 0 0 0 0 0 0 0 0 0 0 0
8.480307925 0 0 0 0 0 0 0 0 0 0 0 0 47.20599354 0 0 0 0 0 0 0 0 0 0
44.31369854 0 0 0 0 0 0 0 0 0 0 0 0 8.480307925 0 0 0 0 0 0 0 0 0 0 0 0
47.20599354 0 0 0 0 0 0 0 0 0 0 44.31369854
2012 1 6 2 0 1 42 42 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100

2012 1   6   2   0   1   8   8   0.5   0 100 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
#NWCBO ghost marginal ages (N=10)
#Year Seas Fleet Gender Partition AgeError LbinLo LbinHi Nsamp F0 F1
F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21
F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 M0 M1 M2 M3 M4
M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23
M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35
2003 1   -6   3   0   2   -1   -1   748   0 0.067354237
0.431164156 3.591990083 8.806127788 1.312760371 4.104490986 11.83099869
8.347924897 7.724762523 8.121425875 0.8231769 0.05167833 2.807979938
0.024733567 0.008852457 0.076755179 1.674382106 0.907839072 0.026047244
0.057717409 0 0.065114274 0.466056186 0 0.009046153 0 0 0 0 0.798443333
0.438027879 0.826588624 0.413294312 0.413294312 3.007630086 0
0.151749838 0.451007392 9.43573581 7.610681656 2.416536774 4.045227849
4.444000756 1.309480972 0.24275218 0.165371806 0.112003915 0.466056186
0.024482338 0.082199747 0.01903777 0 0.008451642 0.173152226
0.105523747 0 0 0.057717409 0 0 0 0.057717409 0.413294312 0 0
0.057717409 0 0 0 0 0.914443895
2004 1   -6   3   0   2   -1   -1   594   0.02055708 1.374871728
2.47390205 2.958458874 26.70929445 6.643177998 0.773521179 0.510380384
0.344783949 0.35423817 0 0 0 0 0.123836051 0 0.148072033 0 0 0 0 0 0
0 0 0.148072033 0 0 0 0 0 0 0.123836051 0 0.419980118 0.020551991
2.027528474 2.946796294 4.437230357 30.26892578 11.12324239 2.675335987
0.49828529 0.290119418 0 0.348172814 0 0 0.123836051 0.123836051
0.179197691 0.337166635 0.395744135 0.054074278 0 0.052415464 0
0.05536164 0.049662648 0 0 0.271908084 0.148072033 0 0.054074278
0.123836051 0 0 0 0 0.267644017
2005 1   -6   3   0   1   -1   -1   804   0.189891813 1.169445316
3.282405716 2.219979801 0.715746865 8.121243202 5.891015756 3.190062468
10.94676693 5.341787057 2.820065257 7.976985488 0.065411534 0.136669948
0.05242078 0 0 0.026255473 0 0.087124058 0 0.026255473 0.026255473 0
0.087124058 2.843262042 0.026255473 0 0.026255473 0.084159003 0 0
0.113285897 0 0 0.074681231 0.061808386 2.509105579 5.262028819
2.093078928 3.408602605 13.79738439 7.31601064 2.173659057 0.205327437
0.262856434 0.523573173 0.31747933 2.8752881 0 0.135549816 0.052510945
0.04858875 0.178791064 0.052510945 0 0.087124058 2.669017394
0.087124058 0.022187626 0.022170286 0.044340572 0 0.113285897 0 0 0 0 0
0 0.026255473 0.11352865
2006 1   -6   3   0   1   -1   -1   940   0.049532917 2.128097991
7.897718616 13.24744316 4.963214679 4.685687751 8.348832824 4.416324755
2.254203563 1.041850932 1.084371167 0.937326893 0.677068696 0
0.141416596 0 0.037757454 0 0 0.590520501 0 0 0 0 0.046055795 0
0.590520501 0 0 0 0 0 0 0 0 0 0.094437464 2.331179446 6.675665108
8.861839802 3.647968458 3.929515991 9.135673384 3.18130947 3.403722554
0.968393078 0.5569765 1.370658105 0.75206934 0.146921552 0.636576296
0.113289893 0 0 0 0.13755962 0 0.076321366 0 0.046055795 0 0.590520501
0 0.092111591 0 0 0 0 0 0.113289893 0 0
2007 1   -6   3   0   1   -1   -1   987   0.02368316 0.874725809
6.758839224 11.79853109 6.781457452 3.573761004 5.357672429 6.834981856
3.379532472 0.476146104 0.307956315 0.242665571 0.17930791 0.100335106
0.057720467 0 0.107569698 0.134279811 0.075372871 0.100335106
0.042585701 0 0 0 0 0.19582593 0.513100399 0 0.075372871 0 0 0 0 0 0
0.143082862 0.023688947 0.602184268 6.488560663 8.107187712 6.984263316
5.37097829 4.557613395 5.653086856 7.189800962 0.627904689 0.467869731
1.289690417 1.48443984 0.304078573 0.513100399 0.061713962 0.58232676

```
0.19582593 0.019394494 0 0.484729224 0.19582593 0.19582593 0 0
0.19582593 0.162477356 0 0 0 0 0.075372871 0 0 0 0.031392341
2008 1    -6   3    0     1    -1   -1   762   0.09817008 0.355231961
1.685055894 10.16302912 22.85685908 6.100688924 1.060739484 1.323870823
1.543806241 1.257913467 0.364136418 0.416516029 0.426692551 0.156188663
0 0.023959813 0.077933384 0 0 0.178007684 0 0.197992293 0.16281271
0.093205923 0 0.093205923 0.093205923 0.0403648 0.015272539 0 0 0 0
0.044146092 0 0.077933384 0.098166202 0.324745058 2.595559825
7.677603764 19.81425366 12.6736049 0.612359773 1.718300232 1.409378425
1.47839184 0.349771389 0.08400672 0.665829172 0.311877032 0.142711753 0
0.077933384 0.441507456 0 0.082300291 0 0.039860628 0 0.198306431 0 0
0.077933384 0 0 0.098286427 0 0.042439663 0 0 0 0.077933384
2009 1    -6   3    0     1    -1   -1   1159  0 3.368428016
5.267932859 5.024825327 6.787309934 6.529055432 2.689500823 4.291434739
2.299846573 3.981583335 1.180221728 1.852160435 0.530481479 0.587581869
0.419016693 0.23885054 0.043667916 0.042938917 0.10921479 0.128816752
0.10921479 0.22359107 0.043667916 0.043667916 0.024313453 0 0.490121057
0.341598842 0 0 0 0.490850055 0 0 0 0.577861888 0 4.319676685
8.206256203 5.589268241 7.414239728 6.387692704 5.277315341 3.970063358
2.228989709 1.691497244 2.601152493 1.183506722 0.217786081 0.24951102
0.830900901 0.449981134 0.112679783 0 0 0.088924329 0.183235147
0.165338682 0.135359739 0.056339892 0.042938917 0.10921479 0.050026404
0.042511418 0.152153707 0 0.279930961 0.07801185 0 0.050026404
0.025177452 0.092537822
2010 1    -6   3    0     1    -1   -1   912   0.248112681 0.365667361
12.57271628 6.865688214 10.26895722 9.824861149 5.632736777 3.637969592
0.970145111 0.171197529 2.136450375 0.181124025 0.531694495 0.333567824
0.075423692 0.594324773 0.033071748 0.385111582 0.033071748 0.234485155
0.295855978 0.075644649 0.04191003 0 0 0 0 0.036750683 0 0 0 0 0
0.037711846 1.094571555 0.248101634 0.453182928 13.62827786 4.666905853
6.39972292 8.665018879 3.469064493 2.055248655 0.080135601 0.227353766
1.437811774 0.511283587 0.37127967 0.113130014 0 0.191663677 0.34784165
0 0.151294822 0 0 0 0 0 0 0 0 0.228215498 0 0 0.075644649 0 0 0 0
2011 1    -6   3    0     1    -1   -1   796   0.020313115 0.581672295
1.507353444 13.5417138 1.866096526 6.351598064 2.897482887 4.543071408
3.105114688 2.386781342 1.177067976 0.519678787 3.329964501 0.345178543
0.400486051 0.631651221 0.721664312 0.286472679 0.458994561 0.031307227
0.690357085 0.046258064 1.101312574 0.515697994 0 0.345178543 0 0 0
0.371946607 0.033492571 0 0.037651465 0 0 0.169561558 0.020313115
0.325804067 1.651528422 15.22634971 2.656151533 4.786641056 5.489739567
5.335749792 4.530484016 2.098580604 1.962049518 2.419089784 1.486703382
0.106162498 0.283854116 0.690357085 0.361910388 0 0 0 0.03123021
0.451687615 0 1.101312574 0.369039232 0.016731845 0 0.040857279
0.345178543 0 0 0 0.163251015 0 0.034123144 0
2012 1    -6   3    0     1    -1   -1   791   0 0.311348137
3.265156121 1.977999204 21.86302932 9.903355448 4.494942184 4.344241265
0.144463998 1.15250055 0.822167463 0.254985779 0.599226666 0.583970002
0.013403551 0.290472256 0.172563236 0.052725467 0.077610123 0.255282025
0 0.240933008 0 0.020475634 0.076437745 0 0 0.066106957 0 0 0
0.035486477 0.021061823 0.066106957 0 0.623632285 0 0.337619476
3.798477529 2.991840915 22.45886807 7.246533978 3.109513568 2.634259508
1.049183217 1.181201735 0.129421639 0.320434062 0.147171181 0.670618776
0.214589184 0.066106957 0.261638706 0.39033864 0.087657271 0.025064294
0.021061823 0.254361772 0.153764228 0 0.174331257 0.307585184
0.035486477 0 0 0 0.035486477 0 0 0 0 0.167700392
#
#
```

```
0       # Mean Size at Age Observations
0       # Total number of environmental variables
0       # Total number of environmental observations
0       # No Weight frequency data
0       # No tagging data
0       # No morph composition data

999 # End data file
```

Appendix B.2. SS control file

```
# Morph setup
1 # Number of growth patterns
1 # N sub morphs within growth patterns

3 # Blocks
1 10 1 #1: blocks in each design
2011 2012  #1: Retention inflection and slope, to reflect IFQ
2000 2001 2002 2002 2003 2003 2004 2004 2005 2005 2006 2006 2007 2007
2008 2008 2009 2009 2010 2010 #2: TWL retention asymptote to fit
changes in discard ratios
1995 2004 #3: AKSHLF selectivity for later period

# Mortality and growth specifications
0.5 # Fraction female at birth
0  # M setup: 0=single
Par,1=N_breakpoints,2=Lorenzen,3=agespecific;_4=agespec_withseasinterpo
late
 # no additional input for selected M Option; read 1P per morph
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2;
3=notimplemented; 4=notimplemented
2  # Age for growth Lmin
30 # Age for growth Lmax or 999 = Linf
0  # SD constant added to LAA (0.1 mimics v1.xx for compatibility only)
0  # CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
3  # Maturity option: 1=length logistic, 2=age logistic, 3=read age-
maturity matrix by growth_pattern
0.001739756 0.005167382 0.015234516 0.043959551 0.119591027 0.282761575
0.521345184 0.727124058 0.838074814 0.883280433 0.899554999 0.905148746
0.90704054 0.907676833 0.90789045 0.907962122 0.907986163 0.907994227
0.907996932 0.907997839 0.907998143 0.907998245 0.90799828 0.907998291
0.907998295 0.907998296 0.907998297 0.907998297 0.907998297 0.907998297
0.907998297 0.907998297 0.907998297 0.907998297 0.907998297 0.907998297
0.907998297 0.907998297 0.907998297 0.907998297 0.907998297 0.907998297
0.907998297 0.907998297 0.907998297 0.9079982972
# First age allowed to mature, from Nickols 1990
1 # fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b;
(4)eggs=a+b*L; (5)eggs=a+b*W
0 # hermaphroditism option: 0=none; 1=age-specific fxn
1  # parameter_offset_approach (1=none, 2= M,G,CV_G As offset from
female-GP1, 3=like SS2 V1.x)
2 # env/block/dev_adjust_method  (1=standard; 2=logistic transform
keeps in Base parm bounds; 3=standard w/ no bound check)

# Maturity & Growth Parameters
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev devmnyr devmxyr
devstd Block Block_Fxn
# female growth
 0.01 0.15 0.05 0.08 -1 99 -3 0 0 0 0 0 0 0 # NatM
 1 20 14.5 14.6 -1 99 2 0 0 0 0 0 0 0 # L_at_Amin
 20 60 42.44 42.5 -1 99 2 0 0 0 0 0 0 0 # L_at_Amax
 0.05 0.3 0.2 0.2 -1 99 2 0 0 0 0 0 0 0 # VonBert_K
 0.05 0.3 0.1 0.2 -1 99 3 0 0 0 0 0 0 0 # CV_young
 0.03 0.3 0.046 0.1 -1 99 -3 0 0 0 0 0 0 0 # CV_old
# male growth as direct estimates (parameter offset approach = 1)
```

```
 0.01 0.15 0.05 0.08 -1 99 3 0 0 0 0 0 0 0 0 # NatM
 -3 3 0 0 -1 99 -3 0 0 0 0 0 0 0 0 # L_at_Amin (set equal to females)
 20 60 42.44 42.5 -1 99 2 0 0 0 0 0 0 0 0 # L_at_Amax
 0.05 0.3 0.2 0.2 -1 99 2 0 0 0 0 0 0 0 0 # VonBert_K
 -3 3 0 0 -1 99 -3 0 0 0 0 0 0 0 0 # CV_young
 0.03 0.3 0.046 0.1 -1 99 -3 0 0 0 0 0 0 0 0 # CV_old
# female weight and maturity
 0 1 1.11E-05 1.11E-05 -1 99 -3 0 0 0 0 0 0 0 0 # Wtlen coeff # estimated
from NWFSC shelf-slope survey data 2003-2010
 2 4 3.13512 3.13512 -1 99 -3 0 0 0 0 0 0 0 0 # Wtlen Exp # estimated
from NWFSC shelf-slope survey data 2003-2010
 0 60 34.59 55 -1 99 -3 0 0 0 0 0 0 0 0 # Mat50%_Fem # from 2005
assessment, from Nickol 1990
 -3 3 -0.6429 -0.6429 -1 99 -3 0 0 0 0 0 0 0 0 # Mat_slope # from 2005
assessment, from Nickol 1990
 -3 150000 101100 101100 -1 99 -3 0 0 0 0 0 0 0 0 # eggs/kg intercept,
from E.J.Dick 2009
 0 50000 44800 44800 -1 99 -3 0 0 0 0 0 0 0 0 # eggs/kg slope, from
E.J.Dick 2009
# male weight as direct assignment
 0 1 1.21E-05 1.21E-05 -1 99 -3 0 0 0 0 0 0 0 0 # Wtlen coeff # estimated
from NWFSC shelf-slope survey data 2003-2010
 2 4 3.10958 3.10958 -1 99 -3 0 0 0 0 0 0 0 0 # Wtlen Exp # estimated
from NWFSC shelf-slope survey data 2003-2010
# stuff that we don't need for this model
 0 2 1 1 -1 99 -5 0 0 0 0 0 0 0 0 # Recruitment apportionment by growth
pattern
 0 2 1 1 -1 99 -5 0 0 0 0 0 0 0 0 # Rec app by Area
 0 2 1 1 -1 99 -5 0 0 0 0 0 0 0 0 # Rec app by Season
 0 2 1 1 -1 99 -5 0 0 0 0 0 0 0 0 # Cohort growth deviation
#_seasonal_effects_on_biology_parms
 0 0 0 0 0 0 0 0 0 0 #_femwtlen1, femwtlen2, mat1, mat2, fec1, fec2,
Malewtlen1, malewtlen2, L1, K

3 #Recruitment Function 1 BH w/flat top, 2 Ricker, 3 BH, 4 none
# Recruitment Parms
# Low High Init Prior PrType SD  phase
 5  12 8.2 8  -1  99  1  # R0
 0.2 1  0.779 0.779 2  0.152 -2  # h
 0  2  0.75 0.75 -1  99  -1  # sigma R
 -5  5  0  0  -1  99  -3  # Env link coeff
 -5  5  0  0  -1  99  -3  # Init Equilb offset to virgin
 -1  1  0  0  -1  99  -1  # placeholder for Autocorrelation

0 # index of environmental variable to be used
0 # env target parameter: 0=none, 1=rec devs, 2=R0, 3=steepness

# Recruitment residuals
2  # rec dev type: 0=none, 1=devvector (zero-sum), 2=simple deviations
(no sum constraint)
1960 # Start year recruitment residuals
2011 # End year recruitment residuals
3 # Phase

1  # Read 11 advanced recruitment options: 0=no, 1=yes
1870 # first year for early rec devs
3  # phase for early rec devs
```

```
5  # Phase for forecast recruit deviations
1  # Lambda for forecast recr devs before endyr+1
 1960.754 #_last_early_yr_nobias_adj_in_MPD
 1990.399 #_first_yr_fullbias_adj_in_MPD
 2008.982 #_last_yr_fullbias_adj_in_MPD
 2013.077 #_first_recent_yr_nobias_adj_in_MPD
  0.877 #_max_bias_adj_in_MPD (1.0 to mimic pre-2009 models)
0  # placeholder
-5 # Lower bound rec devs
5 # Upper bound rec devs
0 # read intitial values for rec devs

# Fishing mortality setup
0.2  # F ballpark for tuning early phases
-1999 # F ballpark year
3  #  F_Method:  1=Pope; 2=instan.  F; 3=hybrid  (hybrid is
recommended)
4 #  max F  or harvest rate,  depends on F_Method
#  no additional F  input  needed for Fmethod 1
#  if Fmethod=2; read  overall start  F  value; overall phase; N
detailed  inputs to read
#  if Fmethod=3; read  N  iterations for tuning for Fmethod 3
4  #  N  iterations for tuning F  in hybrid method (recommend 3  to 7)

# Initial Fishing Mortality Parameters
#LO  HI  INIT  PRIOR PR_type SD  PHASE
0  1  0  0.01  -1  99 -1 # InitF_1TWL
0  1  0  0.01  -1  99 -1 # InitF_2BYCATCH

# Catchability Specification (Q_setup)
# A=do power: 0=skip, survey is prop. to abundance, 1= add par for non-
linearity
# B=env. link: 0=skip, 1= add par for env. effect on Q
# C=extra SD: 0=skip, 1= add par. for additive constant to input SE (in
ln space)
# D=type: <0=mirror lower abs(#) fleet, 0=no par Q is median unbiased,
1=no par Q is mean unbiased, 2=estimate par for ln(Q)
# 3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of
devs about Q for indexyr-1
# A  B  C  D
0  0    0     0 # 1 TWL
0  0    0     0 # 2 BYCATCH
0  0    1     4 # 3 AKSHLF
0  0    0     2 # 4 AKSLP
0  0    0     2 # 5 NWSLP
0  0    1     2 # 6 NWCBO
#
1 #_If q has random component, Then 0=read one parm For each fleet With
random  q; 1=read a parm For each Year of index
#_Q_parms(if_any)
# Lo  Hi  Init    Prior   Prior_type Prior_sd   Phase
0 1   0.4 0.1 -1     99     3   # Q_extraSD_5_AKSHLF
0 1   0.4 0.1 -1     99     3   # Q_extraSD_8_NWCBO

# bnd bnd  value mean type SD phase Early period
-10 2 -0.0003 0 -1 99  1 # AKSHLF (log) base parameter (1980)
-4 4  0 0 -1 99 -5 # AKSHLF 1983 deviation
```

```
-4 4  0 0 -1 99 -5 # AKSHLF 1986 deviation
-4 4  0 0 -1 99 -5 # AKSHLF 1989 deviation
-4 4  0 0 -1 99 -5 # AKSHLF 1992 deviation
# Late period
-4 4  0 0 -1 99  1 # AKSHLF 1995 deviation
-4 4  0 0 -1 99 -5 # AKSHLF 1998 deviation
-4 4  0 0 -1 99 -5 # AKSHLF 2001 deviation
-4 4  0 0 -1 99 -5 # AKSHLF 2004 deviation

# Other catchability parameters
-10 2 -0.0003 0 -1 99  1 # AKSLP (log) base parameter
-10 2 -0.0003 0 -1 99  1 # NWSLP (log) base parameter
-10 2 -0.0003 0 -1 99  1 # NWCBO (log) base parameter

# Selectivity Specification
#_size_selex_types
#_Pattn Discard Male    Special
24  1   0   0   # 1 TWL
15  0   0   1   # 2 BYCATCH
24  0   0   0   # 3 AKSHLF
24  0   0   0   # 4 AKSLP
24  0   0   0   # 5 NWSLP
24  0   0   0   # 6 NWCBO
#_age_selex_types
#_Pattn Discard Male    Special
11  0   0   0   # 1 TWL
11  0   0   0   # 2 BYCATCH
11  0   0   0   # 3 AKSHLF
11  0   0   0   # 4 AKSLP
11  0   0   0   # 5 NWSLP
11  0   0   0   # 6 NWCBO

# Length-based selectivity, retention and discard mortality section
#TWL
#Low High Init Prior PrType SD Phase env usedev minyr maxyear sd block
blswitch
 20 45 36 32 -1 99 2 0 0 0 0 0 0 0 0 # PEAK
-6 4 2 0 -1 99 -3 0 0 0 0 0 0 0 0 # TOP:_width_of_plateau
-1 9 4 4 -1 99 2 0 0 0 0 0 0 0 0 # Asc_width
-1 9 0.6 5.5 -1 99 -3 0 0 0 0 0 0 0 0 # Desc_width
-999 9 -999 -2 -1 99 -2 0 0 0 0 0 0 0 0 # INIT:_selectivity_at_fist_bin
-5 9 9 5 -1 99 -3 0 0 0 0 0 0 0 0 # FINAL:_selectivity_at_last_bin
#TWL retention
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_min dev_max
dev_std Block Block_Fxn
15 70 27 35 -1 99 2 0 0 0 0 0 1 2 #Inflection
0.1 10 2 1 -1 99 2 0 0 0 0 0 1 2 #Slope # 1 means that parm’ = baseparm
+ blockparm
0.001 1 1 1 -1 99 -3 0 0 0 0 0 2 2 #Asymptotic retention # 2 means that
parm’ = blockparm
0 0 0 0 -1 99 -3 0 0 0 0 0 0 0 #Male offset To inflection
#AKSHLF
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_min dev_max
dev_std Block Block_Fxn
10 45 21 23 -1 99 2 0 0 0 0 0 0 0 0 # PEAK
-6 4 -6 -1 -1 99 -2 0 0 0 0 0 0 0 0 # TOP:_width_of_plateau
-1 9 4 4 -1 99 3 0 0 0 0 0 0 0 0 # Asc_width
```

```
-1 9 4 6 -1 99 4 0 0 0 0 0 3 2 # Desc_width
-999 9 -999 -4 -1 99 -2 0 0 0 0 0 0 0 # INIT:_selectivity_at_fist_bin
-999 9 -999 -1 -1 99 -3 0 0 0 0 0 0 0 # FINAL:_selectivity_at_last_bin
#AKSLP
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_min dev_max
dev_std Block Block_Fxn
 10 45 23 28 -1 99 2 0 0 0 0 0 0 0 # PEAK
-6 4 -1 -1 -1 99 2 0 0 0 0 0 0 0 # TOP:_width_of_plateau
-1 9 2 4 -1 99 3 0 0 0 0 0 0 0 # Asc_width
-1 9 2 4 -1 99 3 0 0 0 0 0 0 0 # Desc_width
-999 9 -999 -4 -1 99 -4 0 0 0 0 0 0 0 # INIT:_selectivity_at_fist_bin
-999 9 -999 -2 -1 99 -3 0 0 0 0 0 0 0 # FINAL:_selectivity_at_last_bin
#NWSLP
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_min dev_max
dev_std Block Block_Fxn
10 45 25 28 -1 99 2 0 0 0 0 0 0 0 # PEAK
-6 4 -6 1 -1 99 -5 0 0 0 0 0 0 0 # TOP:_width_of_plateau
-1 9 3 4 -1 99 4 0 0 0 0 0 0 0 # Asc_width
-1 9 .1 4 -1 99 4 0 0 0 0 0 0 0 # Desc_width
-999 9 -999 -4 -1 99 -5 0 0 0 0 0 0 0 # INIT:_selectivity_at_fist_bin
-999 9 -999 1 -1 99 -4 0 0 0 0 0 0 0 # FINAL:_selectivity_at_last_bin
#NWCBO
#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_min dev_max
dev_std Block Block_Fxn
 8 45 18 20 -1 99 2 0 0 0 0 0 0 0 # PEAK
-6 4 -6 -1 -1 99 -3 0 0 0 0 0 0 0 # TOP:_width_of_plateau
-1 9 -0.5 2 -1 99 3 0 0 0 0 0 0 0 # Asc_width
-1 9 3 4 -1 99 4 0 0 0 0 0 0 0 # Desc_width
-999 9 -999 -3 -1 99 -4 0 0 0 0 0 0 0 # INIT:_selectivity_at_fist_bin
-999 9 -999 -4 -1 99 -3 0 0 0 0 0 0 0 # FINAL:_selectivity_at_last_bin

# age sel: select all ages following user manual instructions:
# "If it is desired that age 0 fish be selected, then use pattern #11
and set the minimum age to 0.1"
# all ages selected for fleets 1 & 2
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected
0 1 0.1 0.1 -1 99 -3 0 0 0 0 0.5 0 0 # Min age selected
0 100 100 100 -1 99 -3 0 0 0 0 0.5 0 0 # Max age selected

1 # Selex block setup: 0=Read one line apply all, 1=read one line each
parameter

# Lo Hi Init Prior P_type SD Phase
#TWL retention inflection and slope, to reflect changes with IFQ
15  70  27  35  -1  99   2  #Inflection
0.1  10  2   1   -1  99   2  #Slope
#TWL Retention asymptote, to fit discard ratio
0    1   0.6   0.6    -1   99   3
```

```
0    1   0.44  0.44   -1   99   3
0    1   0.4   0.4    -1   99   3
0    1   0.84  0.84   -1   99   3
0    1   0.78  0.78   -1   99   3
0    1   0.51  0.51   -1   99   3
0    1   0.51  0.51   -1   99   3
0    1   0.47  0.47   -1   99   3
0    1   0.46  0.46   -1   99   3
0    1   0.52  0.52   -1   99   3
#AKSHLF selectivity parameters 1995-2004
-1  9   5   5  -1   99  4  # Desc_width

1 #_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep
in base parm bounds)
0 # Tagging flag: 0=none,1=read parameters for tagging

### Likelihood related quantities ###
# variance/sample size adjustment by fleet
1 # Do variance adjustments
0  0 0 0 0  0  # const added to survey CV
0   0 0  0  0  0  # const added to discard sd
0   0 0  0  0  0  # const added to body weight sd
0.1670494 1 0.2639248 0.5042809 0.4347276 0.276025 # mult scalar for
length comps
0.2675704 1 0.1684169 0.1924211 0.1440778 0.1182449 # mult scalar for
age comps
1   1 1  1  1  1  # mult scalar for length at age obs

2 # Max N lambda phases: read this N values for each item below
1 # SD offset (CPUE, discard, mean body weight, recruitment devs):
0=omit log(s) term, 1=include

2 # N changes to default Lambdas = 1.0
# Component codes:
#  1=survey
#  2=discard
#  3=mean body weight
#  4=length frequency
#  5=age frequency
#  6=Weight frequency
#  7=size at age
#  8=catch
#  9=initial equilibrium catch
#  10=rec devs
#  11=parameter priors
#  12=parameter deviations
#  13=Crash penalty
#  14=Morph composition
#  15=Tag composition
#  16=Tag return
# Component fleet/survey  phase  value  wtfreq_method
4 1   1    0.5  1   #TWL length comps
5 1   1    0.5  1   #TWL age comps
0 # extra SD pointer
```

Appendix B.3. SS starter file

```
darkblotched_data.SS # Data file
darkblotched_control.SS # Control file
1 # Read initial values from .par file: 0=no,1=yes
1 # DOS display detail: 0,1,2
2 # Report file detail: 0,1,2
0 # Detailed checkup.sso file (0,1)
0 # Write parameter iteration trace file during minimization
2 # Write cumulative report: 0=skip,1=short,2=full
0 # Include prior likelihood for non-estimated parameters
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # N bootstrap datafiles to create
25 # Last phase for estimation
0 # MCMC burn-in
1 # MCMC thinning interval
0 # Jitter initial parameter values by this fraction
-1 # Min year for spbio sd_report (neg val = styr-2, virgin state)
-2 # Max year for spbio sd_report (-1=endyr+1, -2=entire forecast)
0 # N individual SD years
0.0001 # Ending convergence criteria
0 # Retrospective year relative to end year (i.e. -4)
1 # Min age for summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel
X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
1 # (1-SPR)_reporting: 0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-
SPR_Btarget); 4=notrel
1 # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num);
3=sum(frates)
#0 45  #_min and max age over which average F will be calculated
0 # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt

999 # end of file marker
```

Appendix B.4. SS forecast file

```
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to
F(endyr)
0.5 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF,
end_relF (enter actual year, or values of 0 or -integer to be rel.
endyr)
 0 0 0 0 0 0
# 2010 2010 2010 2010 2010 2010 # after processing
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast
below
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses
first-last relF yrs); 5=input annual F scalar
12 # N forecast years
0.20 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual
year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0
# 1180659524 1667592815 7631713 0 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.40 # Control rule Biomass level for constant F (as frac of Bzero,
e.g. 0.40); (Must be > the no F level below)
0.10 # Control rule Biomass level for no F (as frac of Bzero, e.g.
0.10)
1 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC
catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
#-65534 #_Forecast loop control #5 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with
fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set
value>0.0 to cause active impl_error)
0 # Do West Coast gfish rebuilder output (0/1)
2001 # Rebuilder: first year catch could have been set to zero
(Ydecl)(-1 to set to 1999)
2011 # Rebuilder: year for current age structure (Yinit) (-1 to set to
endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x
fleet(col) below
# Note that fleet allocation is used directly as average F if
Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and
allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
# Conditional input if relative F choice = 2
# Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY
# 0
# max totalcatch by fleet (-1 to have no max) must enter value for each
fleet
```

```
-1 -1
# max totalcatch by area (-1 to have no max); must enter value for each
fleet
-1
# fleet assignment to allocation group (enter group ID# for each fleet,
0 for not included in an alloc group)
0 0
#_Conditional on >1 allocation group
# allocation fraction for each of: 0 allocation groups
# no allocation groups
0 # Number of forecast catch levels to input (else calc catch from
forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch;
99=input Hrate(F) (units are from fleetunits; note new codes in
SSV3.20)
#
999 # verify end of input
```

Agenda Item F.5.a
Attachment 5
June 2013

Darkblotched Rockfish
Stock Assessment Review (STAR) Panel Report

Silver Cloud University Inn
Seattle, Washington

May 13-17, 2013

STAR Panel Members

Noel Cadigan Center for Independent Experts (CIE)
Yan Jiao Center for Independent Experts (CIE)
Ian Stewart International Pacific Halibut Commission (IPHC)
Tien-Shui Tsou (Chair) Washington Department of Fish & Wildlife, PFMC Scientific & Statistical Committee (SSC)

Pacific Fishery Management Council (PFMC) Advisors

John DeVore PFMC Staff
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Stock Assessment Team (STAT)

Vlada Gertseva NMFS, Northwest Fisheries Science Center
Jim Thorson NMFS, Northwest Fisheries Science Center

Overview

A draft assessment of the coastwide darkblotched rockfish (*Sebastes crameri*) off the U.S. west coast using data through 2012 was reviewed by the STAR panel during May 13-17, 2013. This assessment used the Stock Synthesis platform version 3.24o. Fisheries are grouped into two fleets: the domestic trawlers and "bycatch" fleet (foreign POP fishery, and at-sea hake fishery). The draft assessment incorporated a variety of data sources into the candidate base model, including landings, length- and age-compositions from the retained commercial catch, discard ratios, length- and age-compositions as well as mean individual body weight of the discards. Also, data from four National Marine Fisheries Service (NMFS) bottom trawl surveys are used to estimate indices of relative stock abundance and generate length and age frequency distributions for each survey. The Northwest Fisheries Science Center (NWFSC) shelf-slope survey covers the period between 2003 and 2012 and provides information on the current trend of the stock. Three other surveys (which are discontinued) include the NWFSC slope survey (1999- 2002), the AFSC slope survey (1997-2001), and the AFSC shelf triennial survey (1980-2004).

The last full assessment of darkblotched rockfish was conducted in 2007. The 2007 full assessment was subsequently updated in 2009 and 2011. Significant changes made in this assessment comparing to the 2007 assessment include:

1. Updated Washington historical landings and used the recently reconstructed Oregon and California landings conducted by SWFSC and ODFW in collaboration with NWFSC.
2. Changed the structure of fishing fleets and divided fishery removals between two fisheries instead of combining all removals into one fleet as in the last assessment.
3. Used the newest GLMM software to construct survey abundance indices
4. Changes in both fecundity and maturity parameters/functions, such as considering atresia in maturity function.
5. Estimated male natural mortality (M) while fixing female M=0.05.
6. Used a fixed value for steepness (*h*=0.779) which is the mean of the prior from Thorson et al 2013.

Multiple model runs were conducted and reviewed to examine model assumptions and structure, and to identify uncertainties in the assessment. Panel discussion focused on the model selection criteria for the survey abundance and the implication of the new fecundity and maturity parameters. The recommended base case model after discussion with the STAT is includes updated maturity and fecundity functions, sex specific M with female M fixed at 0.05 and male M estimated, steepness of *h*=0.779.

Darkblotched rockfish stock status – the terminal year depletion rate (SSB_{2013}/SSB_0) from the final base model is 36%. Natural mortality is used to bracket the uncertainty in the states of nature in the decision table.

The STAR panel concluded that the darkblotched rockfish assessment was based on the best available data, and that this new assessment constitutes the best available information on darkblotched rockfish off the U.S. west coast. The STAR panel thanks the STAT team for their willingness to respond to panel requests and their dedication in finding possible solutions to difficult assessment problems.

Discussion and Additional Analyses Requested by the STAR Panel

1. ***Request*****:**

   a. Plot the estimated GLMM vessel effect coefficients over time from the two sides (presence-absence, positive catch rate) of the NWCOMBO model. Specifically, plot the posterior modes from each year from each vessel with a reference line at zero.

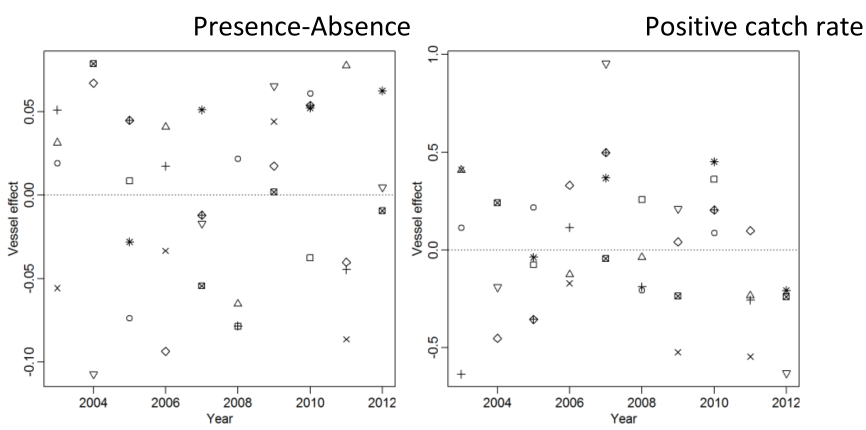
   b. Plot the mean of the log catches vs. the SD of the log catches, for each year and strata combination on one plot.

   c. Plot a comparison of the design-based index series, the GLMM-based result, and the GLMM with the ECE-based result for the NWCOMBO survey.

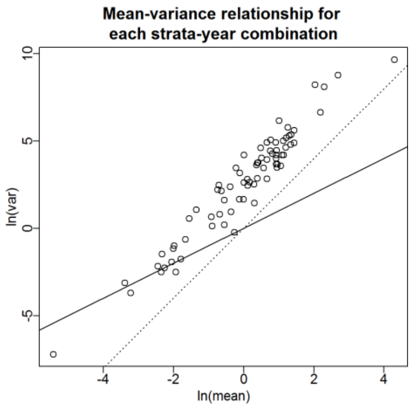
<u>*Rationale*</u>: Request "a" could reveal potential confounding between random vessel effects and actual trends in the surveyed stock over time. Request "b" will illustrate the need for adding the ECE implementation to the standard GLMM. Request "c" will indicate the sensitivity of the resulting index to the method employed.

<u>Results</u>:

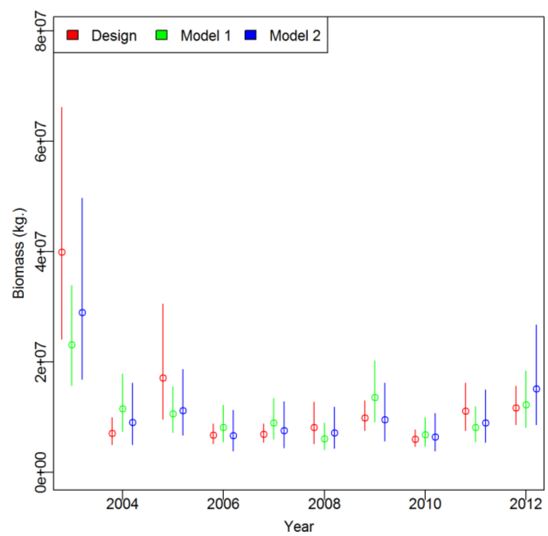
a. Vessel effects were small in the presence:absence of darkblotched (creating a relatively noisy survey), but larger for positive catch rates; however, there were some trends in the time series of vessel effects for positive catches (e.g. 2010-2012) which indicated the possibility of confounding with year effects. One reason for this "vessel effect" could be the random draw of survey sites or stations that may or may not have darkblotched. Therefore, there may not be a vessel effect on darkblotched catching efficiency; this may be more of a random station effect.



b. No apparent need for ECE.



c. Year 2003 was the extreme catch event year and all models showed this catch event that year, although the model with ECEs less so. The design-based model had consistently smaller confidence intervals for the lowest index values. However, the plot did not indicate significant model sensitivity to an ECE treatment.



Model 1 – GLMM with ECE

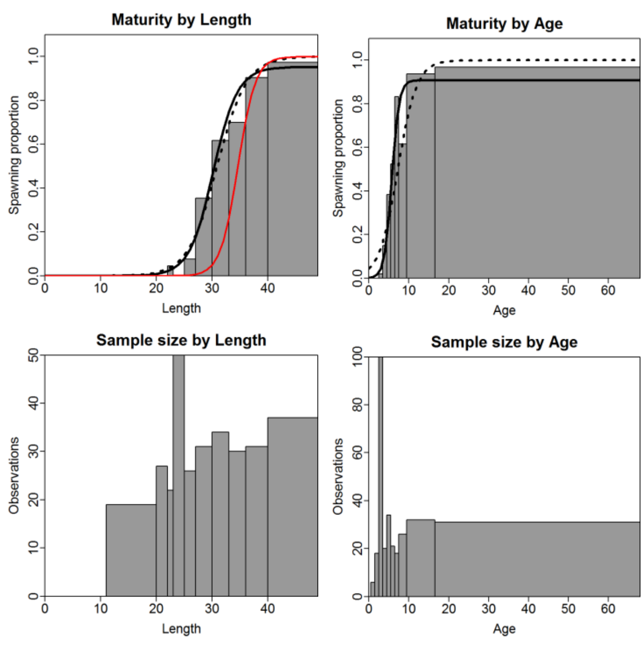
Model 2 – GLMM

There were further discussions about model selection criteria. The darkblotched STAT chose between the ECE-based gamma and lognormal error distributions based on goodness-of-fit and matching the variance in the error distribution using Q-Q plots. A design-based model was summarily rejected since it does not include a random vessel effect. Model strata were chosen a priori. The panel recommended further exploration of ECE treatment in GLMM estimates with different criteria for model selection. This evaluation and the summary of the results used for assessment needs to be species specific.

2. **Plot the newly collected maturity data binned both by age and by size. On the age-plot, add the model fit. Overlay the 2011 maturity-at-size model on the size-plot.**

Rationale: These are new unpublished data and, despite model constraints, it is important to establish that the logistic model is fitting the data adequately and to evaluate how the new relationship compares with that from the previous assessment.

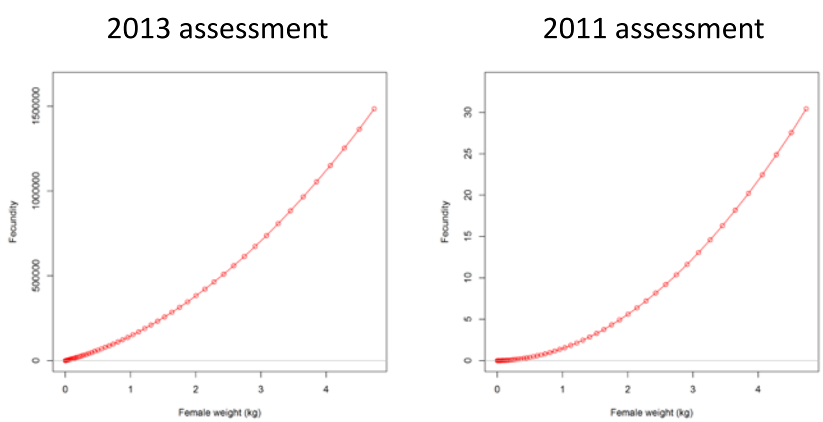
Results: Maturity as a function of length looks smooth and is the preferred approach compared to modeling maturity as a function of age. However, asymptotic proportion mature appears to be less than one. Atresia has been observed in mature darkblotched females. It is not possible to account for atresia in the current version of SS3 when maturity is a function of length. Therefore, maturity by age was modeled in this assessment. There was a substantial change in the maturity ogive compared to the 2011 assessment update, with the maturity shift at the peak of the stock's yield curve. The previous maturity ogive was based on an earlier study (circa 1990) in which maturity was determined histologically but was limited to one part of the OR coast. The newer maturity information shows a significantly higher maturity at younger ages and the presence of some atresia at older ages. The new maturity parameters were used in the proposed base model because it provides samples from a broader range of the species' distribution.

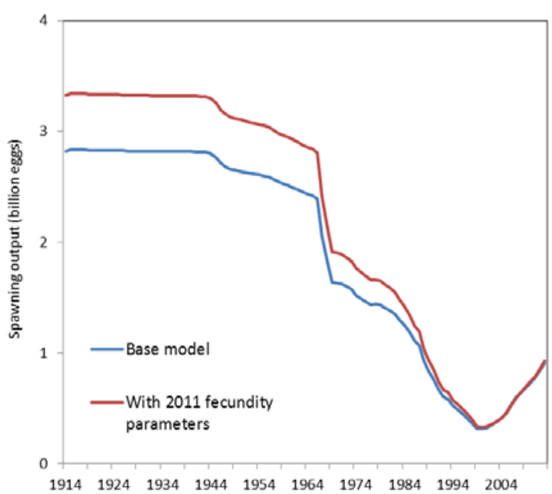


3. **Plot the 2011 fecundity relationship with the newer curve used this year; also show sensitivity of model output to this change if this was not reflected in the tabled sensitivity results.**

Rationale: The sensitivity in Table 14 appears to use fecundity proportional to spawning biomass and not the 2011 fecundity relationship, which differs from the curve used in this assessment.

Results: There was more curvature in the 2011 fecundity-weight relationship; the 2013 assessment used the relationship provided by E.J. Dick in his dissertation. The STAT also plotted the spawning output time series varying only the fecundity-weight relationship from the 2011 assessment and that of the 2013 assessment. The big change was in the equilibrium, unfished spawning output; it was lower using the new fecundity-weight relationship which resulted in a lower depletion ratio. Clarification provided by the STAT indicated that the newer fecundity relationship included the data from which the older values had been derived in addition to several other sources. Exploring the darkblotched fecundity relationship is a research recommendation.





Model	Base	With 2011 fecundity parameters
Negative log-likelihood		
Total	1400.71	1400.91
Indices	-12.34	-12.40
Length frequencies	445.05	445.24
Age frequencies	1004.82	1004.80
Selected parameters		
$Ln(R_0)$	7.67	7.67
Steepness (*h*)	0.779	0.779
Female *M*	0.05	0.05
Male *M*	0.05	0.05
Female L at A_{min}	2.27	2.27
Female L at A_{max}	42.72	42.72
Male L at A_{min}	2.27	2.27
Male L at A_{min}	37.97	37.97
Female von Bert *K*	0.198	0.198
Male von Bert *K*	0.239	0.239
Management quantities		
Equilibrium spawning output (million eggs)	2,821	3,327
2013 Spawning depletion	32%	28%

4. **Run an alternate model with sex-specific M; specifically, estimate the value for males holding the value for females at 0.05. Compare this with the base case.**

Rationale: Dimorphic growth is often accompanied by different rates of natural mortality. Although the data are insufficient to estimate M for both males and females, if female M is fixed then the compositional data should be informative about the difference in M between the sexes. Estimating at least one sex would capture more of the uncertainty in the model results. The anticipation is that the male natural mortality is likely to be greater than that for females.

Results: Male M was estimated to be 0.67, which is higher than female M (0.05) as expected. The total negative log likelihood was lower and the model converged well. The STAT recommended this model change. SSB depletion for this model is 35%.

5. **Report tuning results by fleet and data source; specifically, input vs. harmonic mean effective sample sizes, input σs vs. RMSE for surveys, mean body weights, and discard ratios.**

Rationale: There is a need to see the results of the methods that were documented and applied.

Results: The AFSC slope survey tuning exhibited the biggest change of fit. However, since that survey only had 4 data points and was a flat fit, it had little effect on model results. Discard ratios had a big tuning difference since the years were time blocked (for the retention curve asymptote) to approximate the WCGOP annual total mortality estimates of darkblotched discards.

6. **Add to the table listing parameter estimates, the error distributions assumed for each data source.**

Rationale: The data summary figure (Figure 7 in the draft assessment) is helpful, but a tabular summary would help specify the specific approach used in this stock assessment.

Results:

Data sources used	Error distribution assumption
Catch	Assumed to be known without error (uncertainty explored via sensitivity analysis)
Abundance	Lognormal
Length composition	Multinomial
Age composition	Multinomial
Mean body weight	Normal
Discard	Normal

7. **Run an alternate sensitivity assuming a single CV young parameter for both sexes. Then, in a second run, try estimating the CV for old fish freely, but only one parameter for both sexes. If time permits, (and the second run was successful) estimate the CV for old fish for each sex separately, and consider adjusting Amax.**

Rationale: The CV for length at age is often an important parameter in defining equilibrium unfished biomass levels. Estimating the CV for young (Age-0) males seems redundant. SS can be configured to use the same value for females, even when parameters are directly estimated for each sex. This may improve the estimability of the CVs for old fish, especially if Amax is reduced from -999 to something within the range of the data.

Results: The STAT concluded that there was not enough conditional age data to reliably estimate the CV for older females and males either separately, or as a single parameter. Estimating CVs for all life stages caused an implausible growth gradient. Also, the estimated values for CV old were very close to those estimated outside the model and fixed in the base case.

The new proposed base model would fix the CV old for both sexes at the value estimated outside the model, and estimate CV young for males and females as a single parameter (female CV young is estimated and male CV young is set to be equal to estimated value of female CV young). Including more of the historical age data (particularly from California) via a reconfiguration of the fleet structure and/or ageing of additional historical samples may solve this problem and allow free estimation of CVs for young and old fish in future assessments. A new base case would also include a slight change in setting of A1 and A2 (ages associated with L1 and L2 in the von Bertalanffy growth model used in the model).

Model	Base	CVyoung the same for both sexes	Female CVold estimated	CVold estimated for both sexes	With 2011 A_1 andA_2 settings
Negative log-likelihood					
Total	1400.71	1401.56	1400.14	1399.74	1391.31
Indices	-12.34	-12.35	-12.37	-12.39	-12.50
Length frequencies	445.05	444.92	450.53	449.48	452.53
Age frequencies	1004.82	1005.80	998.93	999.64	987.75
Selected parameters					
$\ln(R_0)$	7.67	7.67	7.66	7.66	7.66
Steepness (*h*)	0.779	0.779	0.779	0.779	0.779
Female *M*	0.05	0.05	0.05	0.05	0.05
Male *M*	0.05	0.05	0.05	0.05	0.05
Female L at A_{min}	2.27	2.24	2.26	2.25	2.27
Female L at A_{max}	42.72	42.71	42.82	42.76	42.72
Male L at A_{min}	0.00	0.00	0.00	0.00	0.00
Male L at A_{min}	37.97	37.98	38.02	38.03	37.97
Female CV young	0.127	0.132	0.137	0.137	0.112
Male CV young	0.139	0.000	0.000	0.000	0.000
Female CV old	0.046	0.046	0.042	0.044	0.045
Male CV old	0.046	0.046	0.000	0.041	0.041
Female von Bert *K*	0.198	0.198	0.197	0.198	0.198
Male von Bert *K*	0.239	0.239	0.238	0.238	0.239
Management quantities					
Equilibrium spawning output (million eggs)	2,821	2,819	2,803	2,803	2,821
2013 Spawning depletion	32%	32%	31%	31%	32%

8. Plot the Pearson residuals for conditional age-at-length for NWCOMBO survey ages.

Rationale: If fixed CVs for old fish are causing lack of fit, it should be evident in the residuals.

Results: There were some large residuals, especially for male age-at-length samples in some years which indicates noisy data. The error assumption may not be particularly robust which can be addressed with the previous research recommendation to supplement the ageing samples by ageing older and larger fish.

9. If time permits, plot the at-sea hake bycatch age-distributions.

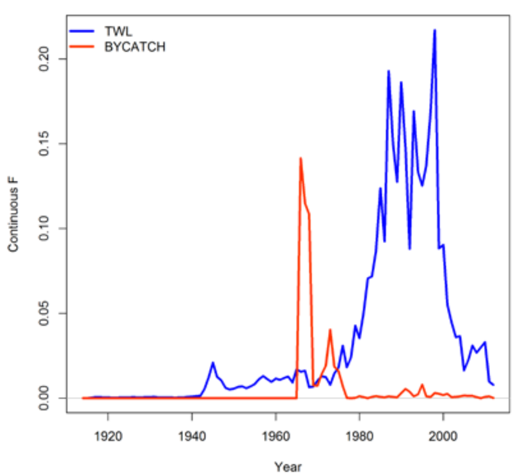
Rationale: These data might provide information on the degree of dome-shape for the trawl fishery.

Results: Sample sizes are small, yet the annual patterns did not appear to be significantly different that for bottom trawl. The patterns and comparisons did not provide compelling evidence of dome-shaped fishery selectivity. It is recognized that the age data are limited in this model reinforcing the recommendation to enhance the ageing of historical samples.

10. Plot the fishing mortality rates (fully selected F, or sum of Fs) by fleet.

Rationale: To assist in understanding the length and age composition time series.

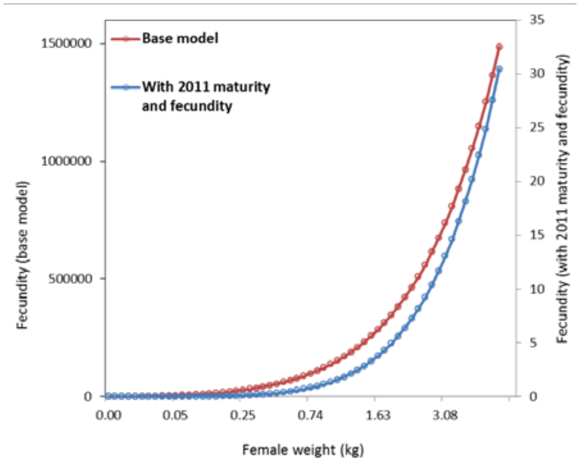
Results:

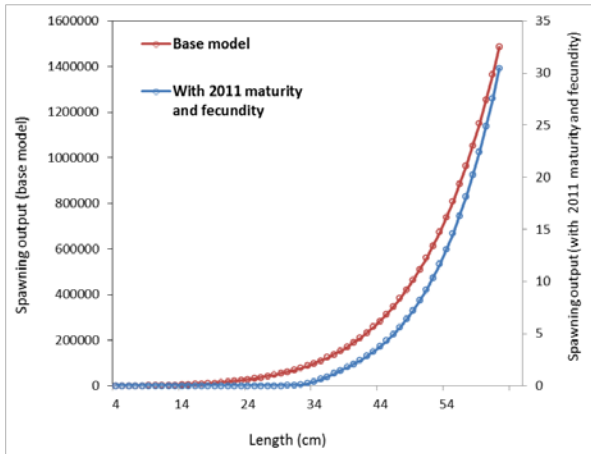


11. Plot the fecundity at weight relationship used in this assessment and the relationship used in 2011 in the same units (slide 6 of STAT day 1 response- combine the two plots into 1 panel). Make a second plot which adds the spawning output at length based on the 2011 base case model fecundity and maturity parameters to the data plotted in figure 46 (in the draft document), again using equivalent units.

Rationale: It would be helpful to be able to make a direct comparison of the changes that have been made between the two models.

Results: The STAT confirmed the Nichols 1990 study was part of E.J.'s maturation analysis of darkblotched. It wasn't clear that the maturity comparison was done appropriately. ***This will be double checked for the post-STAR draft of the assessment.*** The apparent change in maturity shows a significantly earlier age at maturation than modeled in the past assessment.





12. Present a comprehensive set of results and diagnostics (fit to data and residuals) for the revised base case model reflecting changes made as a result of the Day 1 analyses.

Rationale: In order to review the revisions, the STAR panel needs to see a reasonably complete set of results.

Results: The negative log likelihoods (NLLs) for the new base case indicated improved fits to all data with a total NLL improvement of about 20 units. The changes in the modeling of growth parameters did not change the von Bertalanffy growth functions for males and females but did improve the fits, which is a good outcome. The STAT team reported that convergence diagnostics also looked better for the revised approach.

13. Re-create the sensitivity analyses corresponding to levels proposed by the STAT for the axes of uncertainty for the decision table using the revised base case model.

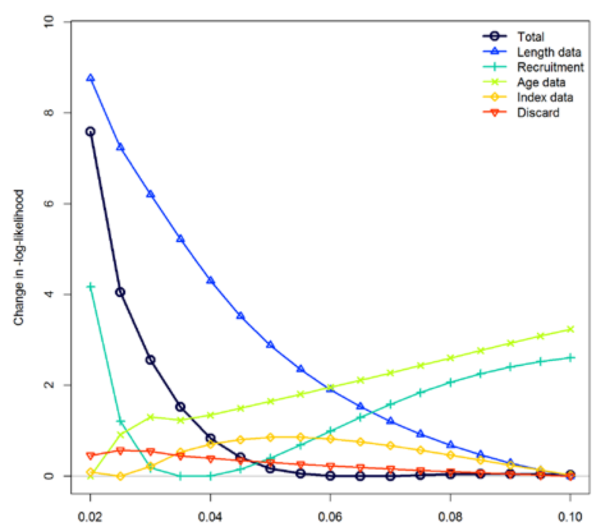
Rationale: This will be helpful in selecting the final format for the decision table.

Results: The STAT varied female M, which is the major axis of uncertainty, to determine spawning output that corresponded to the 12.5% and 87.5% quantiles of 2013 spawning output confidence intervals found in the 'new' base run. These values of female M are 0.045 and 0.06 (base case of 0.05). The STAT proposed these values as the high and low states of nature for the decision table. The STAR Panel rejected these bounds because they did not properly account for uncertainty due to M. This is because the spawning output confidence intervals found in the 'new' base run, which were proposed to generate a range of female M's for the decision table, were based on a fixed female M=0.05. Alternate methods for determining the appropriate quantiles were provided by the STAT and discussed.

14. Re-create the natural mortality and steepness likelihood profiles using the revised base case model.

Rationale: This will provide background for potential decision table levels for these parameters.

Results: The profile on M showed a reasonable pattern. However, the length data seem to be driving the model towards high M. The M profile is appreciably flatter with male M being estimated (i.e., model improvement). The logical inconsistency is high M does not comport with a long-lived species like darkblotched. Fixing female M may have created some other mis-specification in the model that has not been discovered. The additional (early) age data could provide information for the model to estimate natural mortality. It was recommended that future research could ascertain whether additional otoliths exist and whether they could be aged using current ageing methods.



15. Find the lower and upper states of nature for natural mortality that are approximately half as likely as the base case based on the methods presented. Use the likelihood profile for the lower M bound and the prior distribution for the upper M bound). This is a proxy for actually running a model with estimated natural mortality using the

informative prior. Run and summarize the sensitivity analyses (high and low) for each of these.

Rationale: These runs will serve as the basis for the decision table.

Results: The female natural mortalities used to bracket low and high states of nature were 0.036 and 0.082, respectively. The rationale for selecting these values is provided in the section "Description of base model and alternative models used to bracket uncertainty". It was clear that the range of the states of nature shown as depletion is wide given the proposed low and high states. The next assessment should focus on an informed M and h priors for darkblotched. A more representative age sample over time may also assist in directly estimating M.

16. Present the decision table results for at least one catch stream, for all three states of nature.

Rationale: This will allow a final look at the range of results coming from the states of nature, leaving additional catch alternatives for the STAT to identify in consultation with the GMT, council, etc.

Results:

			State of nature					
			Low *Female M=0.036*		Base case Female M=0.05		High *Female M=0.082*	
Management decision	Year	Catch (mt)	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion	Spawning output (million eggs)	Depletion
Catch calculated using SPR of 71.9% applied to the base model	2013	223	607	18%	1,214	36%	3,606	82%
	2014	240	648	19%	1,294	39%	3,770	85%
	2015	252	688	20%	1,374	41%	3,922	89%
	2016	260	722	21%	1,441	43%	4,032	91%
	2017	266	751	22%	1,496	45%	4,101	93%
	2018	271	776	23%	1,541	46%	4,135	94%
	2019	276	798	23%	1,578	47%	4,147	94%
	2020	280	821	24%	1,613	48%	4,150	94%
	2021	285	844	25%	1,646	49%	4,149	94%
	2022	289	867	25%	1,678	50%	4,146	94%
	2023	293	891	26%	1,709	51%	4,140	94%
	2024	297	915	27%	1,739	52%	4,133	94%
Catch calculated using current rebuilding SPR of 64.9% applied to the base model	2013	302	607	18%	1,214	36%	3,606	82%
	2014	323	641	19%	1,288	38%	3,764	85%
	2015	339	674	20%	1,360	41%	3,909	88%
	2016	347	701	20%	1,420	42%	4,011	91%
	2017	353	722	21%	1,467	44%	4,073	92%
	2018	358	738	21%	1,504	45%	4,101	93%
	2019	363	752	22%	1,533	46%	4,106	93%
	2020	368	766	22%	1,560	46%	4,102	93%
	2021	372	780	23%	1,586	47%	4,096	93%
	2022	377	796	23%	1,611	48%	4,087	93%
	2023	381	811	24%	1,635	49%	4,076	92%
	2024	385	826	24%	1,657	49%	4,064	92%
2014 ACL catch assumed for years between 2015 and 2024	2013	317	607	18%	1,214	36%	3,606	82%
	2014	330	640	19%	1,287	38%	3,762	85%
	2015	330	672	20%	1,358	40%	3,907	88%
	2016	330	699	20%	1,418	42%	4,010	91%
	2017	330	722	21%	1,467	44%	4,073	92%
	2018	330	740	22%	1,506	45%	4,103	93%
	2019	330	756	22%	1,538	46%	4,111	93%
	2020	330	773	23%	1,567	47%	4,110	93%
	2021	330	791	23%	1,597	48%	4,106	93%
	2022	330	811	24%	1,626	48%	4,101	93%
	2023	330	830	24%	1,654	49%	4,094	93%
	2024	330	850	25%	1,681	50%	4,085	92%

Description of the Base Model and Alternative Models Used to Bracket Uncertainty

The darkblotched rockfish stock base model covered the portion of the population occurring off the U.S. west coast. The model included historical catches from both foreign and domestic fleets, and incorporated time-varying retention to allow for changes in the recent fishery. The fishery data used in the assessment include landings, length and age compositions from the retained commercial catch and in recent years discard ratios are incorporated, including their length and age compositions as well as mean individual body weight of the discards. Data from four National Marine Fisheries Service (NMFS) bottom trawl surveys provided fishery-independent indices of relative abundance, and length- and age-frequency distributions. The assessment model is sex-specific to account for dimorphic growth, using the von Bertalanffy growth equation and estimating most of the associated parameters, although fixing the CV of length-at-maximum-age. Externally estimated life history parameters, including the weight-length relationship, female fecundity and maturity schedule, have been substantially revised since the last assessment. Recruitment dynamics are assumed to follow the Beverton-Holt stock-recruit function, with steepness fixed at a value of 0.78. Because fecundity is estimated to differ from female body-weight, spawning output is reported in millions of eggs. Natural mortality for female darkblotched rockfish is fixed at the value of 0.05/yr, while the corresponding value for males is freely estimated.

Summary:
Start year of the model =1915; one area; two genders; two fishery fleets (domestic trawl and foreign bycatch), discard estimated within the model for the domestic trawl fleet, no discard is assumed for foreign bycatch fleet.

Biology:
Natural mortality (M) is fixed at 0.05 for females and estimated for males;
Von Bertalanffy growth model, length at A_1 = 2 and CV young are assumed the same for both genders (estimated for females, set equal to females for males), CV old age (A_2 = 30) fixed for both genders, all other growth parameters estimated within the model for females and males separately; and
Beverton-Holt stock-recruitment model, *h* is fixed at 0.779 (based on this year's prior), recruitment deviations estimated.

Selectivity:
Asymptotic length-based selectivity for fisheries; and
Dome-shaped length-based for surveys.

Abundance indices:
AFSC triennial trawl survey (1980-2004), divided into two time series;
AFSC slope bottom trawl survey (1997, 1999-2001);
NWFSC slope bottom trawl survey (1999-2002); and
NWFSC shelf-slope bottom trawl survey (2003-2012).

Length frequencies:
Domestic trawl;
AFSC triennial trawl survey;
AFSC slope bottom trawl survey;
NWFSC slope bottom trawl survey; and
NWFSC shelf-slope bottom trawl survey.

Age frequencies:
Domestic trawl;
AFSC triennial trawl survey;
AFSC slope bottom trawl survey;
NWFSC slope bottom trawl survey; and
NWFSC shelf-slope bottom trawl survey.

The current assessment estimates a similar relative stock trend to recent updates, and the 2007 assessment, indicating that the stock declined rapidly during the 1960s through the 1990s, and has been increasing in recent years. The base case model estimate for 2013 spawning depletion is 36%. Uncertainty about this estimate is characterized via both the likelihood profile and the prior distribution for female natural mortality. The choice to use both sources of information for this fixed parameter was motivated by the observation that the assessment data showed strong information against extremely low values of natural mortality, but was relatively uninformative (i.e. flat profile) for large values. In the absence of a fully integrated posterior distribution, the prior distribution based on maximum age was used as a proxy for the upper end of the range. The primary axis of uncertainty for the decision table was therefore based on female natural mortality values of 0.036 and 0.082, both approximately half as likely as the base case value of M=0.05. The lower value of natural mortality corresponded to a 2013 depletion estimate of 18% and the higher value of natural mortality corresponded to a depletion estimate of 82% illustrating the marked sensitivity of the assessment results to a very poorly informed parameter. Both the fixed value for steepness, and the magnitude of historical catch were identified as large sources of additional uncertainty not captured in the decision table.

Comments on the Technical Merits of the Assessment

This stock assessment was carried out in a highly competent and professional manner. The draft document was well written and distributed to the Panel two weeks in advance of the meeting. The panel appreciated the Executive Summary, and particular the section *Unresolved problems and major uncertainties*. The suite of sensitivity analyses provided in advance to the Panel greatly simplified the review process. A detailed description of changes since the last full assessment of this stock (i.e. 2007) was provided, and included the impacts on model results. Again this greatly simplified the review process.

Panel discussion and requests focused on better understanding of model selection criteria for survey indices, implication of new maturity and fecundity parameters, and the sensitivity of model outputs to natural mortality values. The STAT responded to several Panel requests for additional analyses and always provided results the next day. Any potential discrepancies were quickly resolved. This resulted in an improved stock assessment for darkblotched rockfish and the Panel concluded that the stock assessment was based on the best available data, the new assessment estimates constitute the best available information on stock status, and are suitable to serve as the basis for fishery management decisions.

Areas of Disagreement

There were no major areas of disagreement between the STAT and the STAR Panel.

Unsolved Problems and Major Uncertainties

Problems unresolved at the end of the meeting form the basis for some of the research recommendations, below. Many of the research recommendations address detailed aspects of the fishery and survey data; the biology and vital rates; and nuances of the modeling. However, clearly the assessment is sensitive to the treatment of natural mortality (M) as evidenced by the decision table analyses. Because M was fixed at 0.05 for females, and results are sensitive to this assumption, probability intervals for spawning output and depletion do not reflect the real uncertainty about these 'states of nature'.

Uncertainty about the catch history was explored in the draft document, but not quantified or incorporated into the final assessment model or decision table. This may be a substantial source of uncertainty, and could require investigation of catch reconstructions with regard to uncertainty in order to better understand the plausible range for historical estimates.

Concerns Raised by the GMT and GAP Advisors During the Meeting

There were no major concerns raised by either the GMT or GAP advisors.

Prioritized Research Recommendations

1) The base model does not use commercial age composition data for years that lacked coast wide samples. The additional age data could provide information necessary for the model to estimate such parameters as the CVs defining the distribution of lengths at older ages and natural mortality. Future research could ascertain whether additional otoliths exist for these years, and whether they could be aged using current ageing methods. Also, alternative fleet structures (with state specific fisheries) could be explored to take use of as much currently available age data as possible.

2) There is a large quantity of age data from California that is currently being excluded from the model (<2002, and from other states >2008). Work should be continued to try to incorporate these data into the model, potentially by restructuring the fleets, reading additional historical ages, or other means. This would help to reconcile and make consistent the treatment of length data and age data over time and space. Additional ages may help to allow estimation of the CV parameters for male and female growth and perhaps explore alternate approaches to the growth parameters themselves.

3) Use a prior for female M in the next assessment – the current likelihood profile indicates that it may be estimable given a reasonably informative prior.

4) The base model uses newly available information of female maturity collected within the NWFSC shelf-slope survey. This new information includes data on mass atresia (a form of skipped spawning), not previously available for the assessment. At present, Stock Synthesis allows incorporation of this information only when maturity is expressed as a function of age. Effort should be devoted to expand maturity options in Stock Synthesis to allow expression of maturity information (with mass atresia) as a function of female length.

5) Continued collection of maturity samples would allow future researchers to explore differences in maturity at age, either spatially or over time.

6) Additional research would be important to explore whether other life history parameters, such as growth and fecundity vary spatially or change over time as well. This information will help in defining spatial structure of future models.

7) Given that the population range extends north to the border with Canada, it is important that future research would evaluate the impact of not accounting for any Canadian portion of population abundance. Such an analysis would require evaluation of movement of darkblotched (including larvae) along the coast, which information is currently lacking.

8) Future research could also improve existing meta-analyses for natural mortality and steepness, which both contribute to the implied yield curve. Directions for improvements include (1) explaining variability between methods in natural mortality estimates, included in the Hamel natural mortality method and (2) developing a larger database of species for estimating steepness, perhaps by including species from other regions, e.g., Canada and Alaska.

9) As a diagnostic, a natural mortality value, as indicated by the likelihood profile, that is very different value than that used in the model indicates some model misspecification. Additional effort should be made to determine what features (such as the CV of length at age for old fish, selectivity, steepness, or other model structure) might be creating this pattern.

10) Continue to pursue making this assessment fully Bayesian. This will allow for probabilistic interpretation of the results, as well as far more efficient reporting and treatment of uncertainty in terms of the decision table, use of priors, etc.

11) General recommendations for all species:
    a. Recommend that STAT teams to present a sensitivity analysis (Tables and Figures) in the draft document for any axis of uncertainty that is likely to be considered for the decision table. This would facilitate efficient discussions during the meeting.

b. It would be helpful to routinely include a time-series of species-specific Canadian (B.C.) landings for comparison with U.S. landings and trends.

c. The specific treatment and results of model tuning procedures should be reported in the document including all input/output sample sizes, effective sample sizes, sigmas, RMSEs (including recruitment deviations), that are applicable.

d. For survey GLMM analyses, the STAT teams need to report a standard summary of the raw data, and fitting of the model including both results and diagnostics. Additional research should attempt to identify (and perhaps simulation test) a method for model selection including the error distribution, the treatment of random vs. fixed effects and the inclusion of ECE mixture distributions that can be reliably applied across all species.

e. General recommendation to identify where and when E.J. Dicks fecundity relationships are better than existing data for a given species.

Agenda Item F.5.a
Attachment 6 (Entire Document Electronic Only)
June 2013

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DRAFT Status of the U.S. petrale sole resource in 2012

by

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DRAFT SAFE
April 2013

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Executive Summary

Stock

This assessment reports the status of the petrale sole (*Eopsetta jordani*) resource off the coast of California, Oregon, and Washington using data through 2012. While petrale sole are modeled as a single stock, the spatial aspects of the coast-wide population are addressed through geographic separation of data sources/fleets where possible. There is currently no genetic evidence suggesting distinct biological stocks of petrale sole off the U.S. coast. The limited tagging data available to describe adult movement suggests that petrale sole may have some homing ability for deep water spawning sites but also have the ability to move long distances between spawning sites and seasonally.

Catches

While records do not exist, the earliest catches of petrale sole are reported in 1876 in California and 1884 in Oregon. Fishery removals were divided among 4 fleets: 1) winter North trawl, 2) summer North trawl, 3) winter South trawl, and 4) summer South trawl. Landings for the North fleet are defined as fish landed in Washington and Oregon ports. Landings for the South fleet are defined as fish landed in California ports. Recent annual catches during 1981–2012 range between 749-2,903 mt (Table a, Figure a). Petrale sole are almost exclusively caught by trawl fleets; non-trawl gears contribute less than 3% of the catches. Based on the 2005 assessment, annual catch limits (ACLs) were reduced to 2499 mt for 2007-2008. Following the 2009 assessment ACLs were further reduced to a low of 976 mt for 2011 and have subsequently increased to a high value of 2,652 for 2014. From the inception of the fishery through the war years, the vast majority of catches occurred between March and October (the summer fishery), when the stock is dispersed over the continental shelf. The post-World War II period witnessed a steady decline in the amount and proportion of annual catches occurring during the summer months (March-October). Conversely, petrale catch during the winter season (November–February), when the fishery targets spawning aggregations, has exhibited a steadily increasing trend since the 1940s. Since the mid-1980s until recently, catches during the winter months have been roughly equivalent to or exceeded catches throughout the remainder of the year (Figure a).

Table a: Recent Catches based on the November 1 – October 31 fishing year.

Fishing Year	North Catch (mt)	South Catch (mt)	Total Catch (mt)
2003	1,258	436	1,694
2004	1,759	444	2,204
2005	2,032	871	2,903
2006	1,549	579	2,128
2007	1,466	879	2,346
2008	1,196	933	2,130
2009	1,488	720	2,209
2010	550	199	749
2011	645	117	762
2012	884	232	1,116

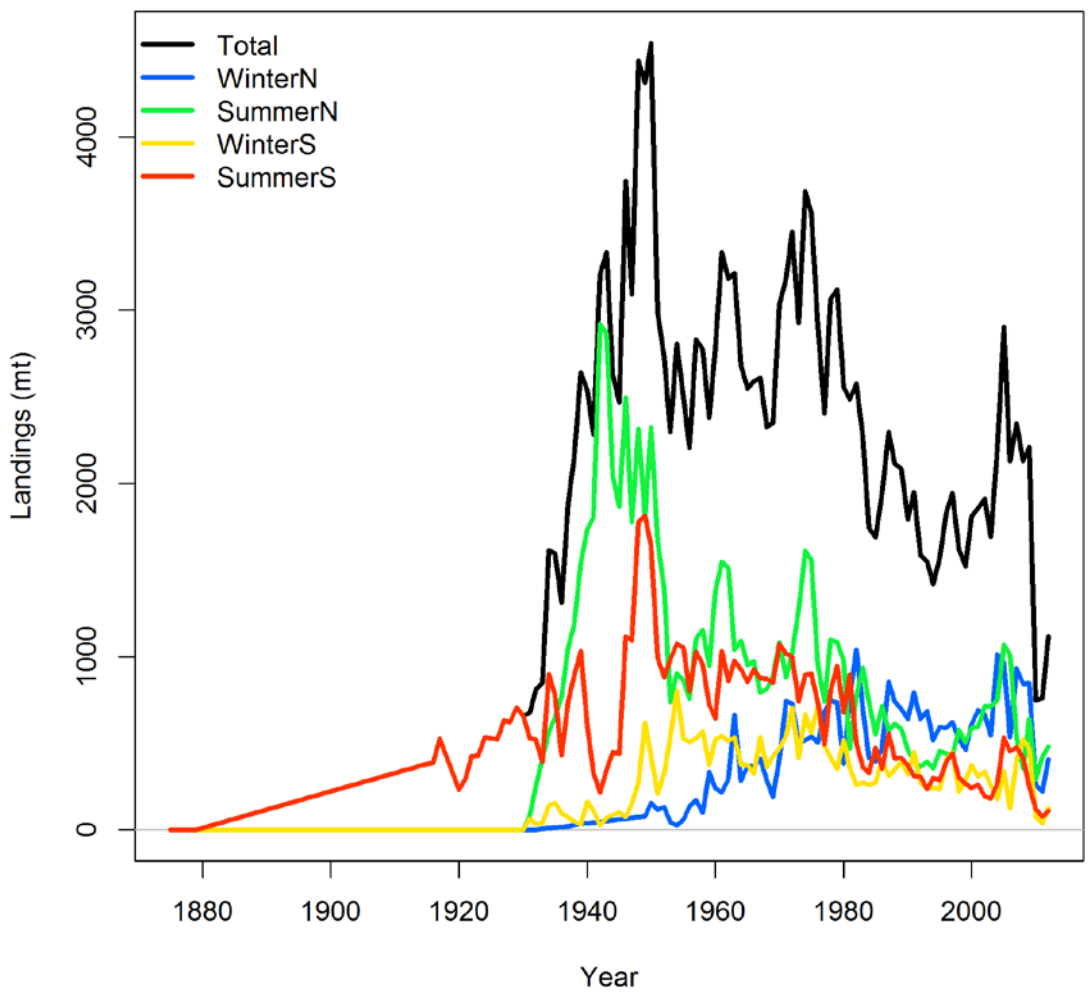

Figure a: Catch History

Data and assessment

The previous stock assessment for petrale sole was developed during 2011 using Stock Synthesis 3, an integrated length-age structured model. The current assessment has been upgraded to a newer version of SS (3.24o, R. Methot) and is structured as an annual model with the start of the fishing year on November 1 and ending on October 31. The fisheries are structured seasonally based on winter (November to February) and summer (March to October) fishing seasons due to the development and growth of the wintertime fishery, beginning in the 1950s. In recent decades the wintertime catches often exceed the summertime catches. The four fisheries are divided into North Winter, North Summer, where the north includes both Washington and Oregon, and South Winter, and South Summer, which encompasses California fisheries. The model includes catch, length- and age-frequency data from the trawl fleets described above as well as standardized winter fishery CPUE indices. While the impact of rapidly changing regulations in the trawl fishery after 2000 can make the fishery-based CPUE indices unreliable, the standardized fishery CPUE indices attempt to account for the impact of some of the management changes. Biological data are derived from both port and on-board observer sampling programs. The National Marine

Fisheries Service (NMFS) early (1980, 1983, 1986, 1989, 1992) and late (1995, 1998, 2001, and 2004) triennial bottom trawl survey and the Northwest Fisheries Science Center (NWFSC) trawl survey (2003–2012) relative biomass indices and biological sampling provide fishery independent information on relative trend and demographics of the petrale sole stock.

The base case assessment model includes parameter uncertainty from a variety of sources, but likely underestimates the uncertainty in recent trends and current stock status. For this reason, in addition to asymptotic confidence intervals (based upon the model's analytical estimate of the variance near the converged solution), results from models that reflect alternate states of nature regarding the rate of female natural mortality are presented as a decision table.

Stock biomass

Petrale sole were lightly exploited during the early 1900s, but by the 1950s the fishery was well developed and showing clear signs of depletion and declines in catches and biomass (Figures a, b). The rate of decline in spawning biomass accelerated through the 1930s–1970s reaching minimums generally around or below 10% of the unexploited levels during the 1980s through the early 2000s (Figure b). The petrale sole spawning stock biomass is estimated to have increased slightly from the late 1990s, peaking in 2005, in response to above average recruitment (Table b, Figure b). However, this increasing trend reversed between 2005 and 2010 and the stock declined, most likely due to strong year classes having passed through the fishery (Table b). Since 2010 the total biomass of the stock has increased as large recruitments during the late 2000s appear to be moving into the population. The estimated relative depletion level in 2013 is 22.3% of unfished biomass (~95% asymptotic interval: 15.1% - 29.5%, ~ 75% interval based on the range of states of nature: 18.2% - 27.6%), corresponding to 7,233 mt (~95% asymptotic interval: 5,668 – 8,796 mt, states of nature interval: 6,800 – 7,846 mt) of female spawning biomass in the base model (Table b). The base model indicates that the spawning biomass was generally below 25% of the unfished level between the 1960s and 2013.

Table b: Recent trend in beginning of the year biomass and depletion

Fishing Year	Spawning Biomass (mt)	~95% confidence interval	Range of states of nature	Estimated depletion	~95% confidence interval	Range of states of nature
2004	4,229	3783 - 4673	3933 - 4645	13%	9.5% - 16.6%	0.105 - 0.163
2005	4,618	4146 - 5089	4305 - 5059	14.20%	10.4% - 18.1%	0.115 - 0.178
2006	4,354	3876 - 4829	4042 - 4793	13.40%	9.7% - 17.1%	0.108 - 0.169
2007	4,230	3749 - 4710	3931 - 4695	13%	9.5% - 16.6%	0.105 - 0.164
2008	3,868	3369 - 4365	3580 - 4274	11.90%	8.5% - 15.3%	0.096 - 0.15
2009	3,612	3063 - 4160	3325 - 4017	11.10%	7.8% - 14.4%	0.089 - 0.141
2010	3,378	2729 - 4025	3072 - 3804	10.40%	7% - 13.8%	0.082 - 0.134
2011	4,146	3324 - 4967	3809 - 4616	12.80%	8.7% - 16.9%	0.102 - 0.162
2012	5,465	4351 - 6577	5081 - 6002	16.90%	11.5% - 22.2%	0.136 - 0.211
2013	7,233	5668 - 8796	6800 - 7846	22.30%	15.1% - 29.5%	0.182 - 0.276

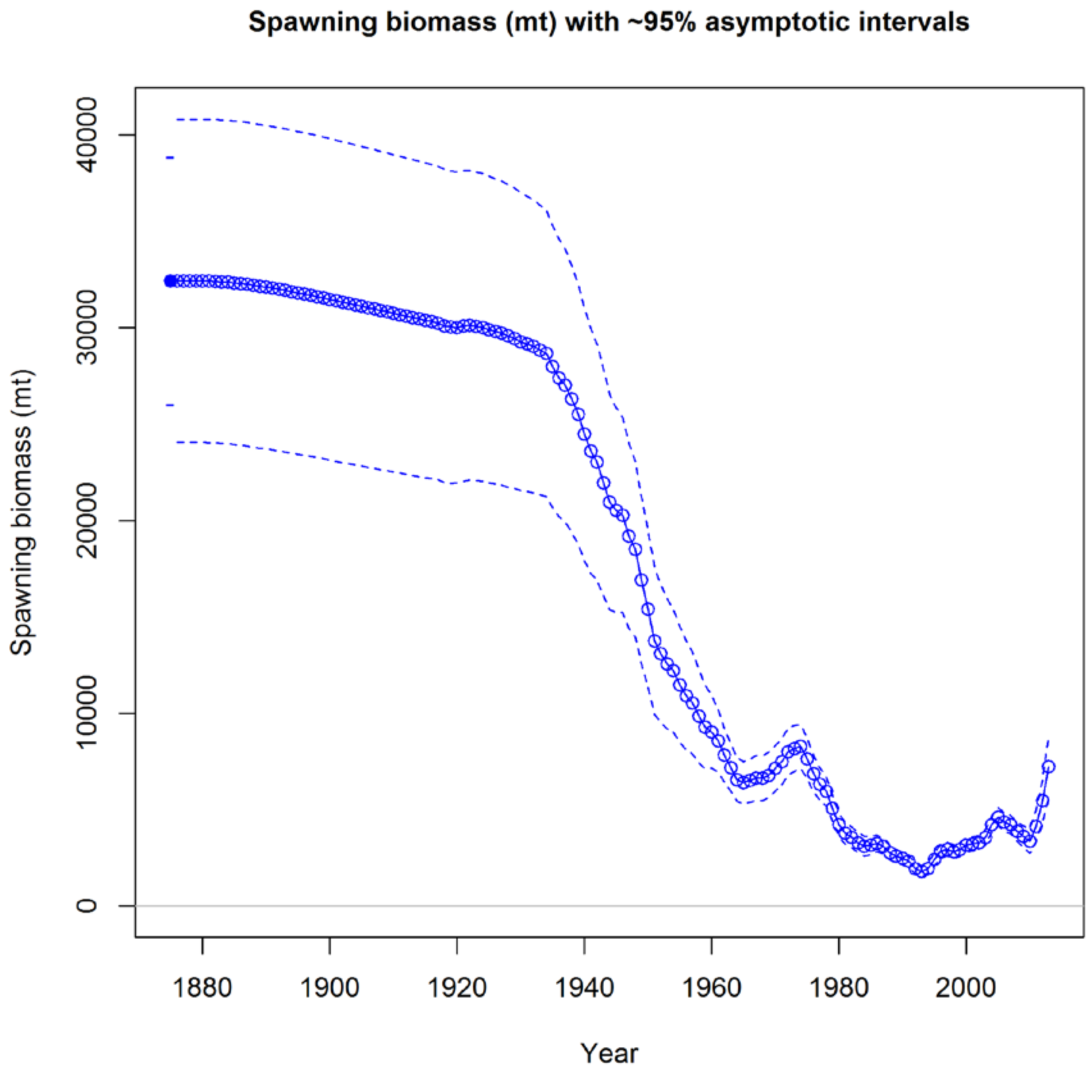

Figure b: Biomass time series.

Recruitment

Annual recruitment was treated as stochastic, and estimated as annual deviations from log-mean recruitment where mean recruitment is the fitted Beverton-Holt stock recruitment curve. The time-series of estimated recruitments shows a relationship with the decline in spawning biomass, punctuated by larger recruitments (Figure c). The three strongest recruitments during the last 10 years are estimated to be from 2007, 2008, and 2009, while the four weakest recruitments are estimated to be from 2004, 2005, and 2011 (Table c, Figure c).

Table c: Recent recruitment

Fishing Year	Estimated recruitment (1,000's)	~95% confidence interval	Range of states of nature
2004	9,841	6749 - 14352	7404 - 13925
2005	9,779	6574 - 14548	7322 - 13905
2006	15,448	10413 - 22919	11571 - 21937
2007	22,443	15060 - 33446	16899 - 31673
2008	33,214	22197 - 49699	25240 - 46356
2009	16,584	10269 - 26786	12655 - 23068
2010	11,349	6145 - 20965	8792 - 15597
2011	11,219	5287 - 23812	8582 - 15551
2012	13,824	6102 - 31324	10266 - 19571
2013	14,555	6370 - 33258	10548 - 20987

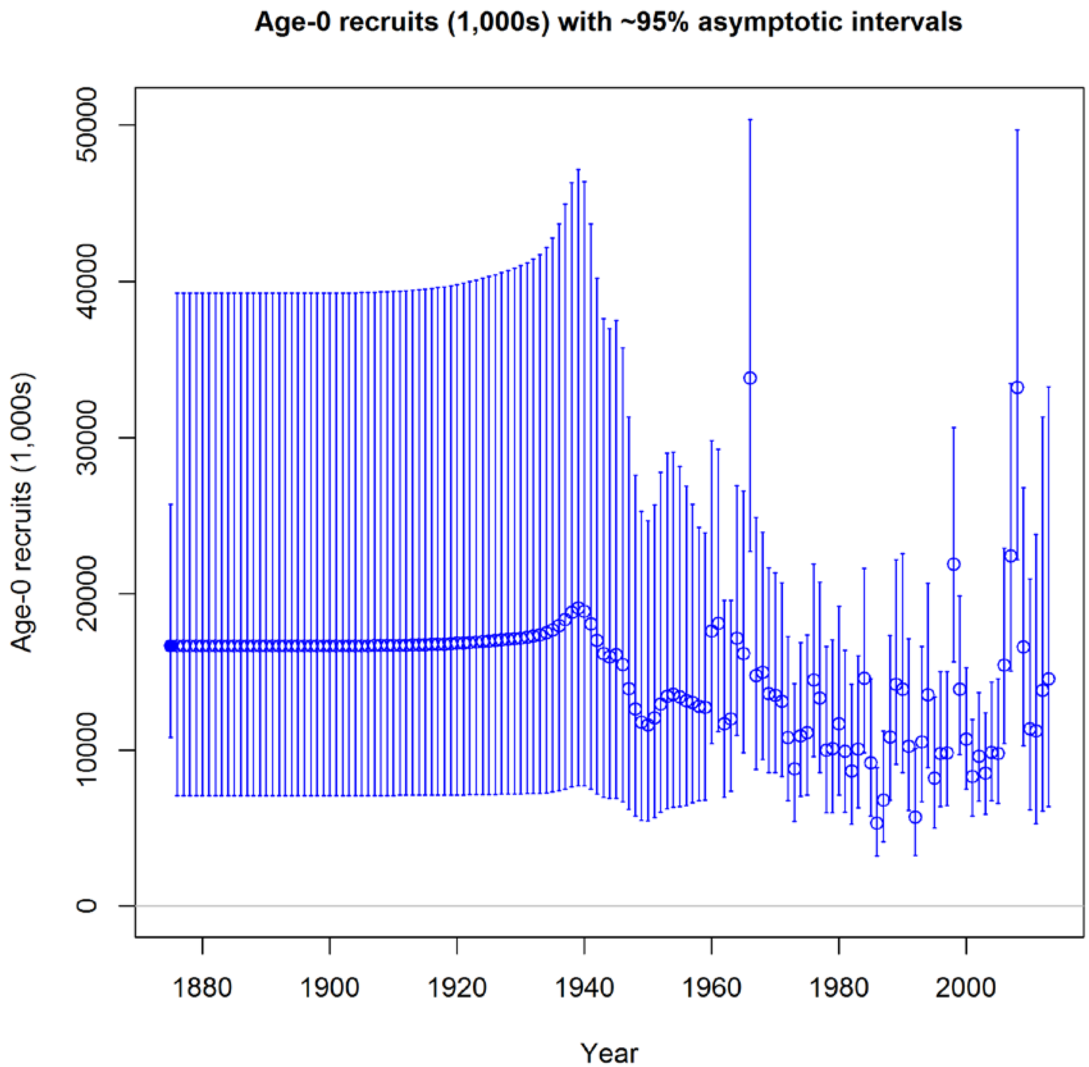

Figure c: Recruitment time series.

Exploitation status

The abundance of petrale sole was estimated to have dropped below the $SB_{25\%}$ management target during the 1960s and generally stayed there through 2013 (Figure d). The stock declined below the $SB_{12.5\%}$ overfished threshold from the early1980s until the early 2000s. In 1984 the stock dropped below 10% of the unfished spawning biomass and did not rise above the 10% level until 2001 (Figure d). Since 2000 the stock has increased, reaching a peak of 14.2% of unfished biomass in 2005, followed by a decreasing trend through 2010 (Table d, Figure d). Fishing mortality rates in excess of the current F-target for flatfish of $SPR_{30\%}$ are estimated to have begun during the 1950s and continued until 2010 (Table d, Figures e, f). Current F (catch/biomass of age-3 and older fish) is estimated to have been 0.08 during 2012, and are projected to meet the targets from 2013 forward (Table d, Figures e,f).

Table d. Recent trend in spawning potential ratio (entered as 1-SPR) and summary exploitation rate (catch divided by biomass of age-3 and older fish).

Fishing Year	Estimated 1-SPR (%)	~95% confidence interval	Harvest rate (proportion)	~95% confidence interval
2004	0.81	0.74 - 0.87	0.23	0.21 – 0.26
2005	0.84	0.79 - 0.9	0.31	0.27 – 0.34
2006	0.81	0.74 - 0.87	0.25	0.22 – 0.28
2007	0.82	0.76 - 0.89	0.28	0.24 – 0.31
2008	0.82	0.76 - 0.88	0.27	0.23 – 0.31
2009	0.84	0.77 - 0.9	0.28	0.23 – 0.33
2010	0.66	0.56 - 0.76	0.1	0.08 – 0.12
2011	0.58	0.47 - 0.68	0.07	0.05 – 0.08
2012	0.60	0.5 - 0.7	0.08	0.06 – 0.10
2013	0.73	0.64 - 0.81	0.15	0.12 – 0.19

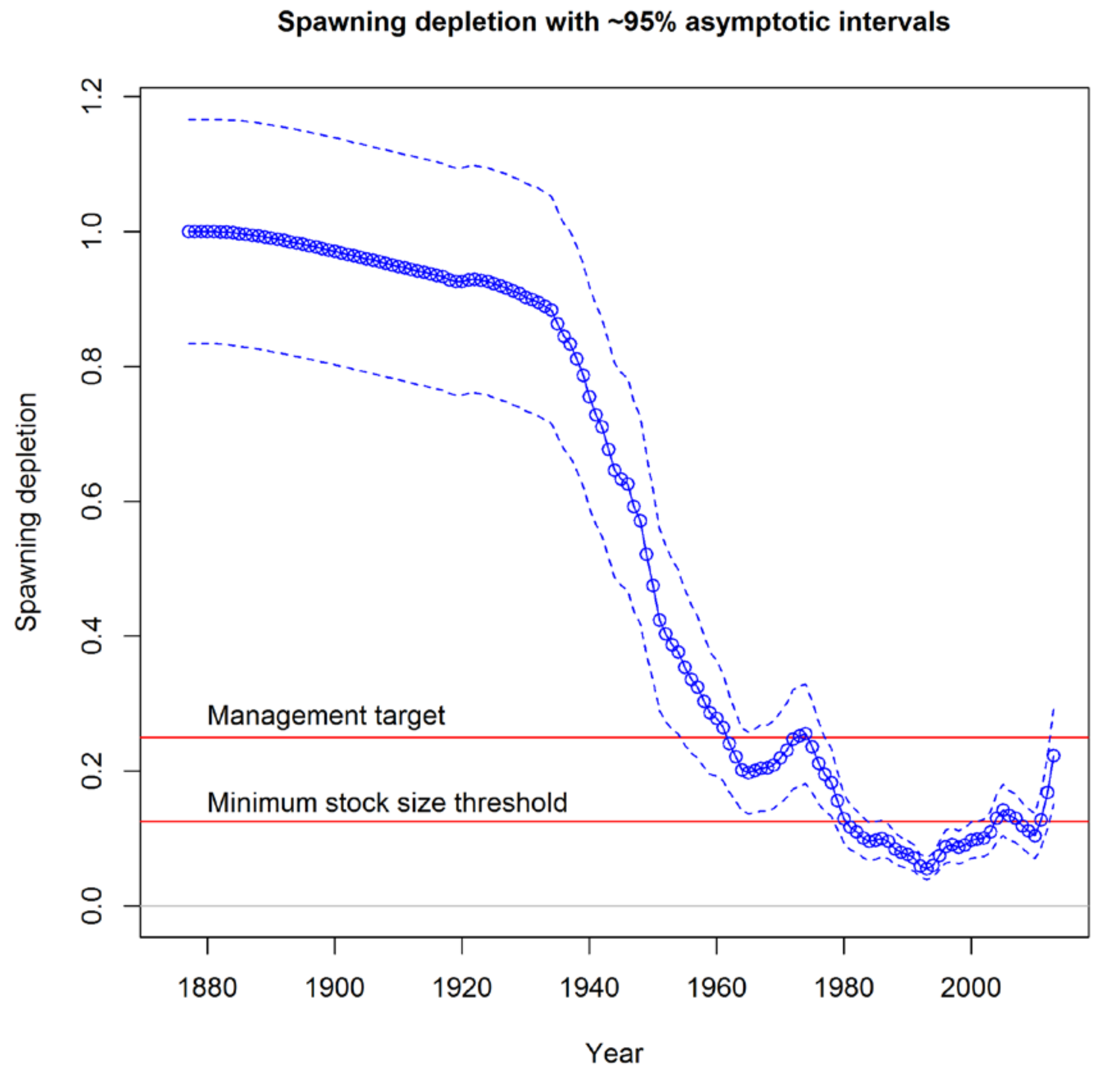

Figure d. Estimated relative depletion with approximate 95% asymptotic confidence intervals (dashed lines).

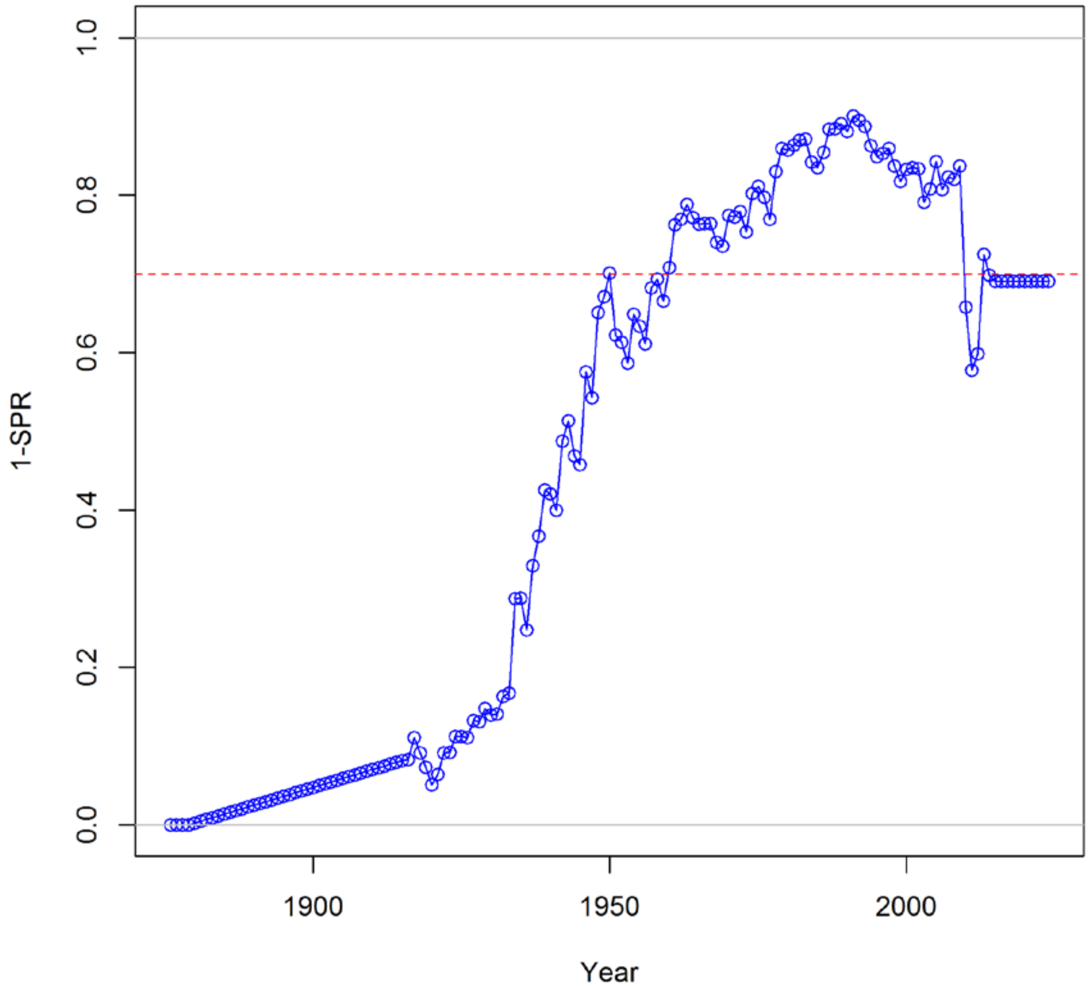

Figure e. Estimated spawning potential ratio (SPR). One minus SPR is plotted so that higher exploitation rates occur on the upper portion of the y-axis. The management target is plotted as a red horizontal line and values above this reflect harvests in excess of the overfishing proxy based on the $SPR_{30\%}$ harvest rate.

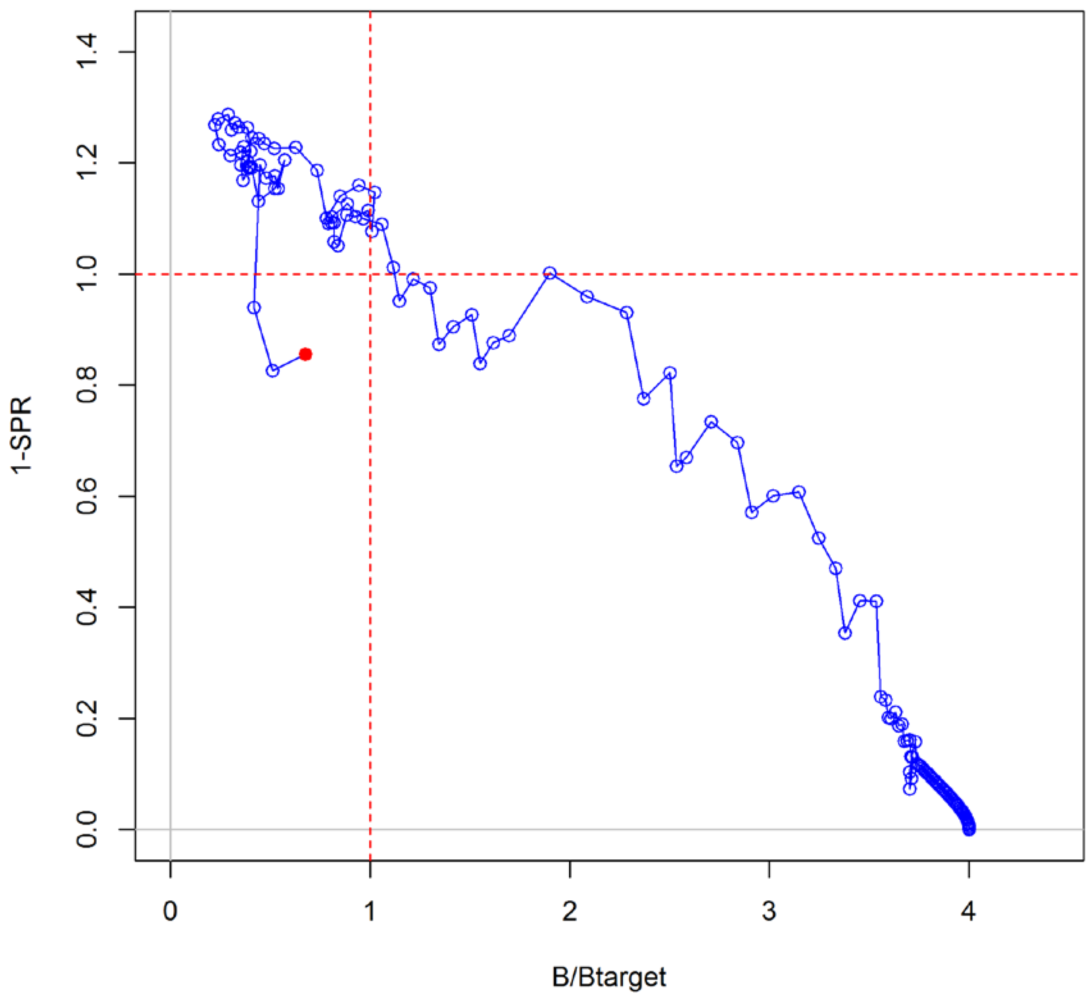

Figure f. Phase plot of estimated relative (1-SPR) vs. relative spawning biomass for the base case model. The relative (1-SPR) is (1-SPR) divided by 30% (the SPR target). Relative depletion is the annual spawning biomass divided by the spawning biomass corresponding to 25% of the unfished spawning biomass. The red point indicates 2012.

Ecosystem considerations

Ecosystem factors have not been explicitly modeled in this assessment, but there are several aspects of the California current ecosystem that may impact petrale sole population dynamics and warrant further research. Castillo (1992) and Castillo et al. (1995) suggest that density-independent survival of early life stages is low and show that offshore Ekman transportation of eggs and larvae may be an important source of variation in year-class strength in the Columbia INPFC area. The effects of the Pacific Decadal Oscillation (PDO) on California current temperature and productivity (Mantua et al. 1997) may also contribute to non-stationary recruitment dynamics for petrale sole. The prevalence of a strong late 1990s year-class for many west coast groundfish species suggests that environmentally driven recruitment variation may be correlated among species with relatively diverse life history strategies. Although current research efforts along these lines are limited, a more explicit exploration of ecosystem processes may be possible in future petrale sole stock assessments if resources are available for such investigations.

Reference points

Pacific coast flatfish, including petrale sole, are considered overfished when the stock falls below 12.5% of unfished spawning biomass and rebuilt when it reaches 25% of unfished spawning biomass.

Unfished spawning stock biomass was estimated to be 32,426 mt in the base case model (Figure b). The target stock size ($SB_{25\%}$) is therefore 8,107 mt which gives a catch of 2,750s mt (Table e, Figure b). Model estimates of spawning biomass at MSY are slightly lower than those specified under the current harvest control rule. Maximum sustained yield (MSY) applying recent fishery selectivity and allocations was estimated at 2,761 mt, occurring at a spawning stock biomass of 7,146 mt (SPR = 0.25) (Table e).

Table e. Summary of reference points for the base case model.

Quantity	Estimate	~95% Confidence Interval
Unfished Spawning biomass (mt)	32,426	6,416
Unfished age 3+ biomass (mt)	50,132	8,241
Unfished recruitment (R0)	16,672	7,336
Depletion (2013)	0.223	0.07
Reference points based on $SB_{25\%}$		
Proxy spawning biomass ($B_{25\%}$)	8,107	1,604
SPR resulting in $B25_{\%}$ ($SPR_{30\%}$)	0.28	0.03
Exploitation rate resulting in $B_{25\%}$	0.17	0.02
Yield with *SPR* at $B_{25\%}$ (mt)	2,750	218
Reference points based on SPR proxy for MSY		
Spawning biomass	8,739	2,189
SPR_{proxy}	0.3	
Exploitation rate corresponding to SPR_{proxy}	0.16	0.03
Yield with SPR_{proxy} at SB_{SPR} (mt)	2,732	249
Reference points based on estimated MSY values		
Spawning biomass at *MSY* (SB_{MSY})	7,146	1,810
SPR_{MSY}	0.25	0.07
Exploitation rate corresponding to SPR_{MSY}	0.19	0.03
MSY (mt)	2,761	200

Management performance

The 2009 stock assessment estimated petrale sole to be at 11.6% of unfished spawning stock biomass in 2010. Based on the 2009 stock assessment, the 2010 coast-wide ACL was reduced to 1,200 mt to reflect the overfished status of the stock and the 2011 coast-wide overfishing limit (OFL) and ACL were set at 1,021 mt and 976 mt, respectively (Table f). Recent coast-wide annual landings have not exceeded the ACL. The 2005, 2009, and 2011 stock assessments estimated that petrale sole have been below 25 percent of unfished biomass from the 1960s until recently, with estimated harvest rates in excess of a fishing mortality rate of $F_{30\%}$. The length of time that the petrale sole stock had been below the 25 percent of unfished level while sustaining relatively stable annual landings lead the 2009 STAR panel and SSC to investigate new reference points for all flatfish managed by the PFMC. The end result is that new reference points were specified for flatfish. The new reference points are as follows: the target reference point is 25 percent of the unfished biomass, the overfished reference point is 12.5 percent of the unfished level, the limit reference point is 5% of the unfished level, and the F target is $F_{30\%}$. The 2011 assessment continued to estimate that petrale sole have been below the $SB_{25\%}$ management target since the 1960s and below the new overfished threshold between the early 1980s and the early 2000s with fishing mortality rates in excess of the current F-target for flatfish of $SPR_{30\%}$ since the mid-1930s. This 2013 assessment is consistent with the previous two assessments for petrale sole.

Table f. Recent trend in total catch and commercial landings (mt) based on the calendar year relative to the management guidelines. Estimated total catch reflect the commercial landings plus the model estimated discarded biomass for the calendar year.

Calendar Year	OFL (mt)	ACL (mt)	Commercial Landings (mt)	Estimated Total Catch (mt)
2004	2,762	2,762	1,953	2,248
2005	2,762	2,762	2,734	2,956
2006	2,762	2,762	2,609	2,171
2007	3,025	2,499	2,253	2,374
2008	2,919	2,499	2,220	2,153
2009	2,811	2,433	1,767	2,265
2010	2,751	1,200	797	870
2011	1,021	976	928	787
2012	1,279	1,160	1,092	1,144
2013	2,711	2,592		
2014	2774	2652		

Unresolved problems and major uncertainties

Parameter uncertainty is explicitly captured in the asymptotic confidence intervals reported throughout this assessment for key parameters and management quantities. These intervals reflect the uncertainty in the model fit to the data sources included in the assessment, but do not include uncertainty associated with alternative model configurations, weighting of data sources (a combination of input sample sizes and relative weighting of likelihood components), or fixed parameters.

There are a number of major uncertainties regarding model parameters that have been explored via sensitivity analysis. The most notable explorations involved the sensitivity of model estimates to 1) fleet/model structure, 2) use of early pre-1990s surface age error, 3) inclusion of the OR landings reconstruction and summary of landings by port, 3) use and treatment of revised winter commercial CPUE indices, and 4) exploration of selectivity and retention options including time varying (time blocks, random walk), non-time varying, and dome shaped.

Some problems remain with the Oregon commercial age data from 1981–1997 for years that have not been re-aged using break and burn reads. Ages from this period were aged using a combination of methods and in a non-random manner (i.e. one individual aged all males and another individual aged all females). While age reader information exists it is not currently in the Pacific Fishery Information Network (PacFIN) database, making it impossible to closely examine the impact of varying ageing methods and non-random reader design. This results in higher uncertainty regarding the ages from this period of the Oregon fishery. While some of these historical samples that have been aged using a combination of aging methods have been re-aged using the break and burn method, all of these years have not been re-aged. Age reader information and the aging method for each age read also need to be routinely included in PacFIN.

To date a comprehensive reconstruction of Washington landings has not been completed for west coast groundfish. This is an issue as early Washington landings for petrale sole may have been larger than the current data indicate (T.Tsou , pers. comm.). This assessment would benefit from the completion of a comprehensive groundfish catch reconstruction for the state of Washington.

Decision table

The forecast of stock abundance and yield was developed using the base model. The total catches in 2013 and 2014 are set to the PFMC adopted ACLs. The exploitation rate for 2015 and beyond is based upon an SPR of 30%(Table g). The 25:5 control rule reduces forecasted yields below those corresponding to $F_{30\%}$ if the stocks are estimated to be lower than the management target of $SB_{25\%}$. The average 2011-2012 exploitation rate was used to distribute catches among the fisheries. Uncertainty in the forecasts is based upon the three states of nature agreed upon at the STAR panel. The states of nature were based on the likelihood profile of female M, chosen using a change of 1.2 NLL units (75% interval) from the minimum value to correspond to the midpoints of the lower 25% probability and upper 25% probability regions, from the base model and are low (0.12, rounded to the second decimal place) and high (0.19, rounded to the second decimal place) values for female natural mortality. Each forecast scenario includes random variability in future recruitment deviations. Current base model medium-term forecasts project that the stock, under the current control rule, will increase through 2016 as large recruitments move into the population, reaching a stock depletion of 30% during 2016-2017 (Tables f and g). In and absence of strong recruitments into the future the stock is then expected to decline and stabilized around a stock depletion of 28% (Tables g and h). Catches during the projection period under the current control rule between 2700 mt - 2900 mt, under a control rule that stabilizes the spawning biomass at ~30% of the unfished level catches range between 2300 mt - 2500 mt, and under a control rule that stabilizes the spawning biomass at ~40% of the unfished level catches range between 1400 mt - 2200 mt (Tables g and h).

Table g. Projection of potential OFL, ACL, landings, and catch, summary biomass (age-3 and older), spawning biomass, and depletion projected with status quo catches in 2013 and 2014, and catches at the ACL from 2015 forward. The 2013 and 2014 ACL's are values specified by the PFMC and not predicted by this assessment. The ACL from 2015 forward is the calculated total catch determined by F_{SPR}.

Year	Predicted OFL (mt)	ACL Catch (mt)	Age 3+ biomass (mt)	Spawning Biomass (mt)	Depletion (%)
2013	2,711	2,592	16,954	7,233	0.22
2014	2,774	2,652	17,656	8,540	0.26
2015	2,946	2,828	18,043	9,462	0.29
2016	3,044	2,922	18,037	9,740	0.3
2017	3,015	2,895	17,803	9,592	0.3
2018	2,936	2,820	17,546	9,331	0.29
2019	2,864	2,751	17,368	9,122	0.28
2020	2,821	2,708	17,284	9,007	0.28
2021	2,804	2,692	17,269	8,966	0.28
2022	2,804	2,692	17,289	8,969	0.28
2023	2,811	2,698	17,318	8,990	0.28
2024	2,818	2,706	17,343	9,012	0.28

Table h. Summary table of 12-year projections beginning in 2015 for alternate states of nature based on an axis uncertainty. Columns range over low, mid, and high state of nature, and rows range over different assumptions of catch levels.

			State of nature					
			Low Female M = 0.12		Base case Female M = 0.15		High Female M = 0.19	
Relative probability			0.25		0.5		0.25	
Manage-ment decision	Year	Catch (mt)	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion
ABC 25:5 Rule	2015	2828	9095	0.244	9461	0.292	10017	0.352
	2016	2922	9519	0.255	9739	0.300	10137	0.357
	2017	2895	9531	0.256	9592	0.296	9819	0.346
	2018	2820	9393	0.252	9330	0.288	9427	0.332
	2019	2751	9255	0.248	9122	0.281	9145	0.322
	2020	2708	9159	0.246	9006	0.278	9005	0.317
	2021	2692	9103	0.244	8966	0.276	8971	0.316
	2022	2692	9072	0.243	8969	0.277	8993	0.316
	2023	2698	9052	0.243	8989	0.277	9033	0.318
	2024	2706	9033	0.242	9011	0.278	9066	0.319
Catch that stabilizes the stock at ~$SB_{30\%}$	2015	2367	9095	0.244	9461	0.292	10017	0.352
	2016	2533	9784	0.262	9999	0.308	10389	0.366
	2017	2576	10049	0.270	10092	0.311	10297	0.362
	2018	2566	10130	0.272	10028	0.309	10081	0.355
	2019	2544	10164	0.273	9966	0.307	9918	0.349
	2020	2533	10199	0.274	9951	0.307	9850	0.347
	2021	2536	10243	0.275	9979	0.308	9859	0.347
	2022	2549	10290	0.276	10034	0.309	9911	0.349
	2023	2565	10334	0.277	10097	0.311	9975	0.351
	2024	2581	10370	0.278	10157	0.313	10034	0.353
Catch that stabilizes the stock at ~$SB_{40\%}$	2015	1460	9095	0.244	9461	0.292	10017	0.352
	2016	1678	10304	0.276	10509	0.324	10886	0.383
	2017	1815	11120	0.298	11128	0.343	11288	0.397
	2018	1900	11717	0.314	11537	0.356	11498	0.405
	2019	1960	12199	0.327	11863	0.366	11666	0.411
	2020	2009	12607	0.338	12154	0.375	11838	0.417
	2021	2055	12958	0.348	12419	0.383	12018	0.423
	2022	2098	13260	0.356	12661	0.390	12198	0.429
	2023	2138	13518	0.363	12878	0.397	12368	0.435
	2024	2172	13736	0.368	13069	0.403	12519	0.441

Research and data needs

Progress on a number of research topics and data issues would substantially improve the ability of this assessment to reliably and precisely model petrale sole population dynamics in the future:

1. In the past many assessments have derived historical catches independently. The states of California and Oregon have completed comprehensive historical catch reconstructions. At the time of this assessment, a comprehensive historical catch reconstruction is not available for Washington. Completion of a Washington catch reconstruction would provide the best possible estimated catch series that accounts for all the catch and better resolves historical catch uncertainty for flatfish as a group.
2. Due to limited data, new studies on both the maturity and fecundity relationships for petrale sole would be beneficial.
3. Increased collection of commercial fishery age data as well as re-aging any available historical samples from California would help reduce uncertainty. While some recent age data were made available from California, sample sizes could be increased and this data collection needs to continue into the future. Without good age data, the ability to estimate year-class strength and the extent of variation in recruitment is compromised.
4. Where possible, historical otolith samples aged using a combination of surface and break-and-burn methods should be re-aged using the break-and-burn method. Early surface read otoliths should also be re-aged using the break and burn method. Historical otoliths aged with a standard method will allow the further evaluation of the potential impacts of consistent under aging using surface methods, changes in selectivity during early periods of time without any composition information, and potential changes in growth.
5. The effect of the implementation of the IFQ (catch shares) program that began during 2011 on fleet behavior, including impacts on discards, fishery selectivity, and fishing locations would benefit from further study.
6. Studies on stock structure and movement of petrale sole, particularly with regard to the winter-summer spawning migration of petrale sole and the likely trans-boundary movement of petrale sole between U.S. and Canadian waters seasonally.
7. The extent of spatial variability on productivity processes such as growth, recruitment, and maturity is currently unknown and would benefit from further research.

Rebuilding projections

This assessment indicates that petrale sole continue to be below the overfished threshold of 25% of unfished biomass at the start of 2013. However, the stock is estimated to be at 22.3% of unfished spawning biomass at the beginning of 2013 and is projected to rebuild to 26.3% of unfished spawning biomass at the beginning of 2014. Under the current rebuilding plan the petrale stock is managed under the flatfish control rule.

Table i. Summary table of the results.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Comm. landings (mt)	1,194	1,939	1,590	1,415	1,287	1,362	491	540	710	
Total Est. catch (mt)	2,248	2,956	2,171	2,374	2,153	2,265	870	787	1,144	
OFL (mt)	2,762	2,762	2,762	3,025	2,919	2,811	2,751	1,021	1,279	2,711
ACL (mt)	2,762	2,762	2,762	3,025	2,919	2,811	2,751	1,021	1,279	2,711
1-SPR	0.81	0.84	0.81	0.82	0.82	0.84	0.66	0.58	0.6	0.73
Exploitation rate	0.23	0.31	0.25	0.28	0.27	0.28	0.1	0.07	0.08	0.15
Age 3+ biomass (mt)	9,650	9,662	8,788	8,525	8,038	8,092	8,707	11,717	14,628	16,953
Spawning Biomass	4,229	4,618	4,354	4,230	3,868	3,612	3,378	4,146	5,465	7,233
~95% CI	3783 - 4673	4146 - 5089	3876 - 4829	3749 - 4710	3369 - 4365	3063 - 4160	2729 - 4025	3324 - 4967	4351 - 6577	5668 - 8796
Recruits (mt)	9,841	9,779	15,448	22,443	33,214	16,584	11,349	11,219	13,824	14,555
~95% CI	6749 - 14352	6574 - 14548	10413 - 22919	15060 - 33446	22197 - 49699	10269 - 26786	6145 - 20965	5287 - 23812	6102 - 31324	6370 - 33258
Depletion (%)	13%	14.20%	13.40%	13%	11.90%	11.10%	10.40%	12.80%	16.90%	22.30%
~95% CI	9.5% - 16.6%	10.4% - 18.1%	9.7% - 17.1%	9.5% - 16.6%	8.5% - 15.3%	7.8% - 14.4%	7% - 13.8%	8.7% - 16.9%	11.5% - 22.2%	15.1% - 29.5%

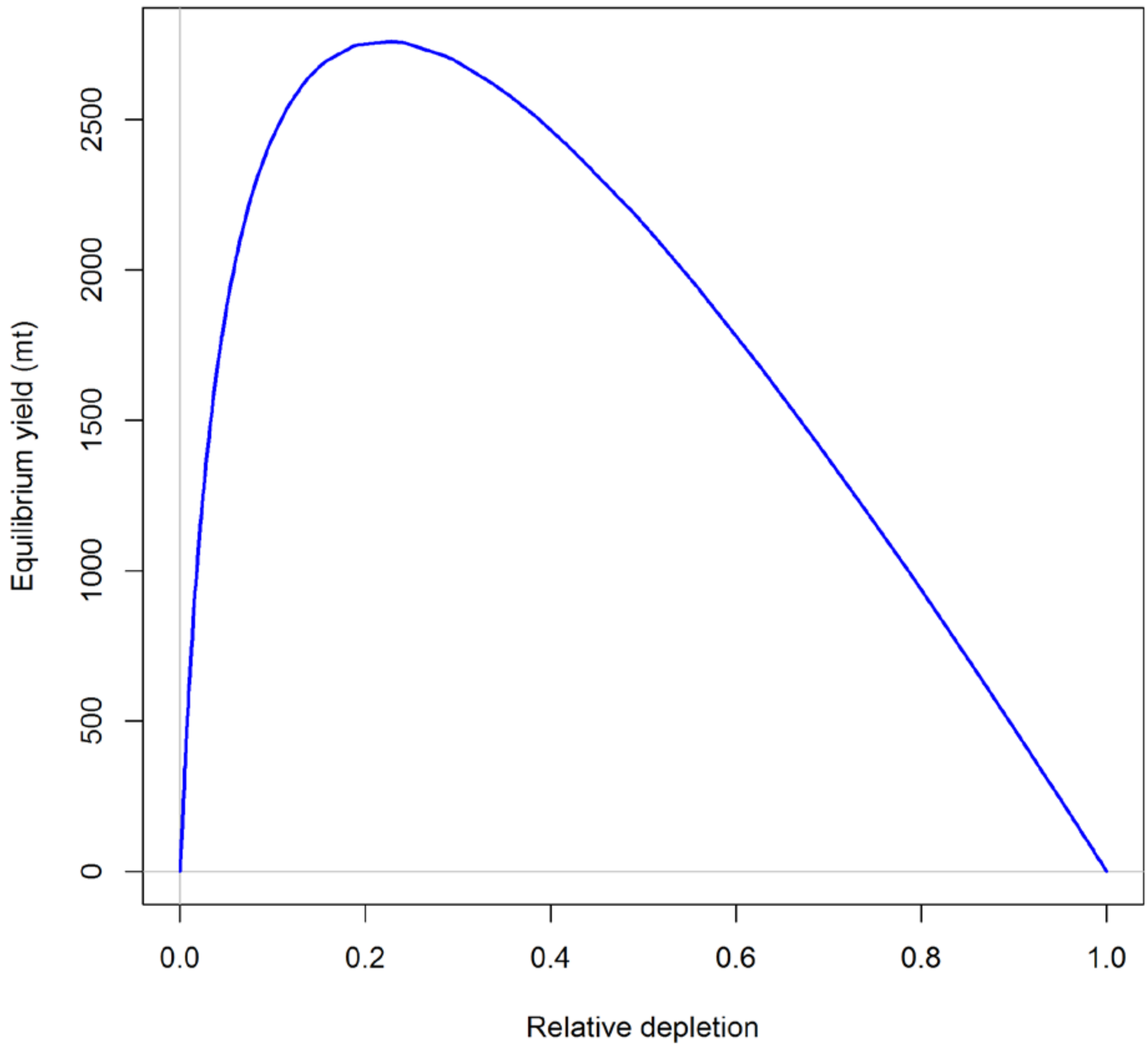

Figure g. Equilibrium yield curve. Values are based on 2012 fishery selectivity and distribution.

1 Introduction

1.1 Basic Information

Petrale sole (*Eopsetta jordani*) is a right-eyed flounder in the family Pleuronectidae ranging from the western Gulf of Alaska to the Coronado Islands, northern Baja California, (Hart 1973; Kramer et al. 1995; Love et al. 2005) with a preference for soft substrates at depths ranging from 0-550 m (Love et al. 2005). Common names include brill, California sole, Jordan's flounder, cape sole, round nose sole, English sole, soglia, petorau, nameta, and tsubame garei (Smith 1937; Hart 1973; Gates and Frey 1974; Love 1996; Eschmeyer and Herald 1983). In northern and central California petrale sole are dominant on the middle and outer continental shelf (Allen et al. 2006). PacFIN fishery logbook data show that adults are caught in depths from 18 to 1,280 m off the U.S. west coast with a majority of the catches of petrale sole being taken between 70–220 m during March through October, and between 290–440 m during November through February.

There is little information regarding the stock structure of petrale sole off the U.S. Pacific coast. No genetic research has been undertaken for petrale sole and there is no other published research indicating separate stocks of petrale sole within U.S. waters. Tagging studies show adult petrale sole can move up to 350 - 390 miles, having the ability to be highly migratory with the possibility for homing ability (Alverson 1957; MBC Appl. Environ. Sci. 1987). Juveniles show little coast-wide or bathymetric movement while studies suggest that adults generally move inshore and northward onto the continental shelf during the spring and summer to feeding grounds and offshore and southward during the fall and winter to deep water spawning grounds (Hart 1973; MBC Appl. Environ. Sci. 1987; Horton 1989; Love 1996). Adult petrale sole can tolerate a wide range of bottom temperatures (Perry et al., 1994).

Tagging studies indicate some mixing of adults between different spawning groups. DiDonato and Pasquale (1970) reported that five fish tagged on the Willapa Deep grounds during the spawning season were recaptured during subsequent spawning seasons at other deepwater spawning grounds, as far south as Eureka (northern California) and the Umpqua River (southern Oregon). However, Pederson (1975) reported that most of the fish (97%) recaptured from spawning grounds in winter were originally caught and tagged on those same grounds.

Mixing of fish from multiple deep water spawning grounds likely occurs during the spring and summer when petrale sole are feeding on the continental shelf. Fish that were captured, tagged, and released off the northwest coast of Washington during May and September were subsequently recaptured during winter from spawning grounds off Vancouver Island (British Columbia, 1 fish), Heceta Bank (central Oregon, 2 fish), Eureka (northern California, 2 fish), and Halfmoon Bay (central California, 2 fish) (Pederson, 1975). Fish tagged south of Fort Bragg (central California) during July 1964 were later recaptured off Oregon (11 fish), Washington (6 fish), and Swiftsure Bank (southwestern tip of Vancouver Island, 1 fish) (D. Thomas, California Department of Fish and Game, Menlo Park, CA, cited by Sampson and Lee, 1999).

The highest densities of spawning adults off of British Columbia, as well as of eggs, larvae and juveniles, are found in the waters around Vancouver Island. Adults may utilize nearshore areas as summer feeding grounds and non-migrating adults may stay there during winter (Starr and Fargo, 2004).

Past assessments completed by Demory (1984), Turnock et al. (1993), and Sampson and Lee (1999) considered petrale sole in the Columbia and U.S.-Vancouver INPFC areas a single stock. Sampson and Lee (1999) assumed that petrale sole in the Eureka and Monterey INPFC areas represented two additional distinct socks. The 2005 petrale sole assessment assumed two stocks, northern (U.S.-Vancouver and Columbia INPFC areas) and southern (Eureka, Monterey and Conception INPFC areas), to maintain continuity with previous assessments. Three stocks (west coast Vancouver Island, Queen Charlotte Sound, and Heceta Strait) are considered for petrale sole in the waters off British Columbia, Canada (Starr and Fargo, 2004). The 2009, 2011, and 2013 assessments integrate the previously separate north-south assessments to provide a coast-wide status evaluation. The decision to conduct a single-area assessment is based on strong evidence of a mixed stock from tagging studies, a lack of genetic studies on stock structure, and a lack of evidence for differences in growth between the 2005 northern and southern assessment areas and from examination of the fishery size-at-age data, as well as confounding differences in data collection between Washington, Oregon, and California. This 2013 assessment provides a coast-wide status evaluation for petrale sole using data through 2012.

Fishing fleets are separated both geographically and seasonally to account for spatial and seasonal patterns in catch given the coast-wide assessment area. The petrale sole fisheries possess a distinct seasonality, with catches peaking during the winter months, so the fisheries are divided into winter (November-February) and summer (March-October) fisheries (Figure 1). Note that the “fishing year” for this assessment (November 1 to October 31) differs from the standard calendar year. The U.S.-Canadian border is the northern boundary for the assessed stock, although the basis for this choice is due to political and current management needs rather than the population dynamics. Given the lack of clear information regarding the status of distinct biological populations, this assessment treats the U.S. petrale sole resource from the Mexican border to the Canadian border as a single coast-wide stock.

1.2 Map

A map showing the scope of the assessment and depicting boundaries for fisheries or data collection strata is provided in Figure 2.

1.3 Life History

Petrale sole spawn during the winter at several discrete deepwater sites (270-460 m) off the U.S. west coast, from November to April, with peak spawning taking place from December to February (Harry 1959; Best 1960; Gregory and Jow 1976; Castillo et al. 1993; Carison and Miller 1982; Reilly et al. 1994; Castillo 1995; Love 1996; Moser 1996a; Casillas et al. 1998). Females spawn once each year and fecundity varies with fish size, with one large female laying as many as 1.5 million eggs (Porter, 1964). Petrale sole eggs are planktonic, ranging in size from 1.2 to 1.3 mm, and are found in deep water habitats at water temperatures of 4–10 degrees C and salinities of 25–30 ppt (Best 1960; Ketchen and Forrester, 1966; Alderdice and Forrester 1971; Gregory and Jow 1976). The duration of the egg stage can range from approximately 6 to 14 days (Alderdice and Forrester 1971; Hart 1973; Love 1996, Casillas et al. 1998). The most favorable conditions for egg incubation and larval growth are 6–7 degrees C and 27.5–29.5 ppt (Ketchen and Forrester, 1966; Alderdice and Forrester, 1971; Castillo et al., 1995). Predators of petrale sole eggs include planktonic invertebrates and pelagic fishes (Casillas et al. 1998).

Petrale sole larvae are planktonic, ranging in size from approximately 3 to 20 mm, and are found up to 150 km offshore foraging upon copepod eggs and nauplii (Hart 1973; Moser 1996a; MBS Appl. Env. Sci 198; Casillas et al. 1998). The larval duration, including the egg stage, spans approximately 6 months with larvae settling at about 2.2 cm in length on the inner continental shelf (Pearcy 1977). Juveniles are benthic and found on sandy or sand-mud bottoms (Eschmeyer and Herald 1983; MBS Appl. Environ. Sci. 1987) and range in size from approximately 2.2 cm to the size at maturity, 50% of the population is mature at approximately 38 cm and 41 cm for males and females, respectively (Casillas et al. 1998). No specific areas have been identified as nursery grounds for juvenile petrale sole. In the waters off British Columbia, Canada larvae are usually found in the upper 50 m far offshore, juveniles at 19–82 m and large juveniles at 25–125 m (Starr and Fargo 2004).

Adult petrale sole achieve a maximum size of around 50 cm and 63 cm for males and females, respectively (Best 1963; Pedersen 1975). The maximum length reported for petrale sole is 70 cm (Hart

1973; Eschmeyer and Herald 1983; Love et al. 2005) while the maximum observed break and burn age is 31 years (Haltuch et al. 2013).

1.4 Ecosystem Considerations

Petrale sole juveniles are carnivorous, foraging on annelid worms, clams, brittle star, mysids, sculpin, amphipods, and other juvenile flatfish (Ford 1965; Casillas et al. 1998; Pearsall and Fargo 2007). Predators on juvenile petrale sole include adult petrale sole as well as other larger fish (Ford 1965; Casillas et al. 1998) while adults are preyed upon by marine mammals, sharks, and larger fishes (Trumble 1995; Love 1996; Casillas et al. 1998).

One of the ambushing flatfishes, adult petrale sole have diverse diets that become more piscivorous at larger sizes (Allen et al. 2006). Adult petrale sole are found on sandy and sand-mud bottoms (Eschmeyer and Herald 1983) foraging for a variety of invertebrates including, crab, octopi, squid, euphausiids, and shrimp, as well as anchovies. hake, herring, sand lance, and other smaller rockfish and flatfish (Ford 1965; Hart 1973; Kravitz et al. 1977; Birtwell et al. 1984; Reilly et al. 1994; Love 1996; Pearsall and Fargo 2007). In Canadian waters evidence suggests that petrale sole tend to prefer herring (Pearsall and Fargo 2007). On the continental shelf petrale sole generally co-occur with English sole, rex sole, Pacific sanddab, and rock sole (Kravitz et al. 1977).

Ecosystem factors have not been explicitly modeled in this assessment, but there are several aspects of the California current ecosystem that may impact petrale sole population dynamics and warrant further research. Castillo (1992) and Castillo et al. (1995) suggest that density-independent survival of early life stages is low and show that offshore Ekman transportation of eggs and larvae may be an important source of variation in year-class strength in the Columbia INPFC area. The effects of the Pacific Decadal Oscillation (PDO) on California current temperature and productivity (Mantua et al. 1997) may also contribute to non-stationary recruitment dynamics for petrale sole. The prevalence of a strong late 1990s year-class for many west coast groundfish species suggests that environmentally driven recruitment variation may be correlated among species with relatively diverse life history strategies. Although current research efforts along these lines are limited, a more explicit exploration of ecosystem processes may be possible in future petrale sole stock assessments.

1.5 Fishery Information

Petrale sole have been caught in the flatfish fishery off the U.S. Pacific coast since the late 19th century. The fishery first developed off of California where, prior to 1876, fishing in San Francisco Bay was by hand or set lines and beach seining (Scofield 1948). By 1880 two San Francisco based trawler companies were running a total of six boats, extending the fishing grounds beyond the Golden Gate Bridge northward to Point Reyes (Scofield 1948). Steam trawlers entered the fishery during 1888 and 1889, and four steam tugs based out of San Francisco were sufficient to flood market with flatfish (Scofield 1948). By 1915 San Francisco and Santa Cruz trawlers were operating at depths of about 45–100 m with catches averaging 10,000 lbs per tow or 3,000 lbs per hour (Scofield 1948). Flatfish comprised approximately 90% of the catch with 20–25% being discarded as unmarketable (Scofield 1948). During 1915 laws were enacted that prohibited dragging in California waters and making it illegal to possess a trawl net from Santa Barbara County southward (Scofield 1948). By 1934 twenty 56–72 foot diesel engine trawlers operated out of San Francisco fishing between about 55 and 185 m (Scofield 1948). From 1944-1947 the number of California trawlers fluctuated between 16 and 46 boats (Scofield 1948). Although the flatfish fishery in California was well developed by the 1950s and 1960s, catch statistics were not reported until 1970 (Heimann and Carlisle 1970). In this early California report petrale sole landings during 1916 to 1930 were not separated from the total flatfish landings. During 1931–68, the landings of petrale sole averaged about 700 mt annually.

The earliest trawl fishing off Oregon began during 1884-1885, and the fishery was solidly established by 1937, with the fishery increasing rapidly during WWII (Harry and Morgan, 1961). Initially trawlers stayed close to the fishing grounds adjacent to Newport and Astoria, operating at about 35–90 m between Stonewall Bank and Depoe Bay. Fishing operations gradually extended into deep water. For example, Newport-based trawlers were commonly fishing at about 185 m in 1949, at about 185–365 m by 1952, and at about 550 m by 1953.

Alverson and Chatwin (1957) describe the history of the petrale sole fishery off of Washington and British Columbia with fishing grounds ranging from Cape Flattery to Destruction Island. Petrale catches off of Washington were small until the late 1930s with the fishery extending to about 365 m following the development of deepwater rockfish fisheries during the 1950s.

By the 1950s the petrale sole fishery was showing signs of depletion with reports suggesting that petrale sole abundance had declined by at least 50% from 1942 to 1947 (Harry 1956). Sampson and Lee (1999) reported that three fishery regulations were implemented during 1957–67: 1) a winter closure off Oregon, Washington and British Columbia, 2) a 3,000 lb per trip limit, and 3) no more than two trips per month during 1957. With the 1977 enactment of the Magnuson Fishery Conservation and Management Act (MFCMA) the large foreign-dominated fishery that had developed since the late 1960s was replaced by the domestic fishery that continues today. Petrale sole are harvested almost exclusively by bottom trawls in the U.S. west coast groundfish fishery. Recent petrale sole catches exhibit marked seasonal variation, with substantial portions of the annual harvest taken from the spawning grounds during December and January. Evidence suggests that the winter fishery on the deepwater spawning grounds developed sporadically during the 1950s and 1960s as fishers discovered new locations (e.g., Alverson and Chatwin, 1957; Ketchen and Forrester, 1966). Both historical and current petrale sole fisheries have primarily relied upon trawl fleets. Fishery removals were divided among 4 fleets: 1) winter North trawl, 2) summer North trawl, 3) winter South trawl, and 4) summer South trawl. Landings for the North fleet are defined as fish landed in Washington and Oregon ports. Landings for the South fleet are defined as fish landed in California ports.

Historical landings reconstructions show peak catches from the summer fishery occurred during the 1940s and 1950s and subsequently declined, during which time the fleet moved to fishing in deeper waters during the winter. After the period of peak landings during the 1940s and 1950s, total landings were somewhat stable until about the late 1970s, and then generally declined until the mid-2000s. (Table 1,Figure 1). During 2009 the fishery was declared overfished and during 2010 management restrictions limited the catch to 701 mt (Table 1, Figure 1).

1.6 Summary of Management History and Performance

Beginning in 1983 the Pacific Fishery Management Council (PFMC) established coast-wide annual catch limits (ACLs) for the annual harvests of petrale sole in the waters off the US west coast (see, for example, PFMC, 2002). Previous assessments of petrale sole in the U.S.-Vancouver and Columbia INPFC areas have been conducted by Demory (1984), Turnock et al. (1993), Sampson and Lee (1999), and Lai at al. (2005) (Figure 2). Based on the 1999 assessment a coast-wide ACL of 2,762 mt was specified and remained unchanged between 2001 and 2006 (Table 2).

The 2005 assessment of petrale sole stock assessment split the stock into two areas, the northern area that included U.S.-Vancouver and Columbia INPFC areas and the southern area that included the Eureka, Monterey and Conception INPFC areas (Lai et al. 2005) (Figure 2). While petrale sole stock structure is not well understood, CPUE and geographical differences between states were used to support the use of two separate assessment areas. In 2005 petrale sole were estimated to be at 34 and 29 percent of unfished spawning stock biomass in the northern and southern areas, respectively. In spite of different models and data, the biomass trends were qualitatively similar in both areas, providing support for a coast-wide stock.

Based on the 2005 stock assessment results, ACLs were set at 3025 mt and 2919 mt for 2007 and 2008, respectively, with an ACT of 2499 mt for both years (Table 2). The 2009 coast-wide stock assessment estimated that the petrale sole stock had declined from its 2005 high to 11.6% of the unfished spawning stock biomass, resulting in an overfished declaration for petrale sole and catch restrictions. Recent coast-wide annual landings have not exceeded the ACL (PFMC 2006) (Table 2).

The 2005 stock assessment estimated that petrale sole had been below the Pacific Council's minimum stock size threshold of 25 percent of unfished biomass from the mid-1970s until just prior to the completion of the assessment, with estimated harvest rates in excess of the target fishing mortality rate implemented for petrale sole at that time ($F_{40\%}$). However, the 2005 stock assessment determined that the stock was in the precautionary zone and was not overfished (i.e., the spawning stock biomass (SB) was not below 25% of the unfished spawning stock biomass (SB_0)). In comparison to the 1999 assessment of petrale sole, the 2005 assessment represented a significant change in the perception of petrale sole stock status. The stock assessment conducted in 1999 (Washington-Oregon only) estimated the spawning stock biomass in 1998 at 39 percent of unfished stock biomass. Although the estimates of 1998 spawning-stock biomass were little changed between the 1999 and 2005 (Northern area) assessments, the estimated depletion in the 2005 assessment was much lower. The change in status between the 1999 and 2005 analyses was due to the introduction of a reconstructed catch history in 2005, which spanned the entire period of removals. The 1999 stock assessment used a catch history that started in 1977, after the bulk of the removals from the fishery had already taken place. Thus the 1999 stock assessment produced a more optimistic view of the petrale stock's level of depletion. The stock's estimated decline in status between the 2005 and 2009 assessments was driven primarily by a significant decline in the trawl-survey index over that period. The 2011 assessment concluded that the stock status continued to be below the target of 25% of unfished biomass.

The fishery for petrale sole (and groundfish in general) has been altered substantially by changes in fishery regulations implemented since 1998. Specifically, in 1996, the PFMC implemented 2-month cumulative vessel landing limits to reduce discards. Beginning in 2000, restrictions were placed on the use of large footropes (more than 8"). Large footrope gear has been prohibited from the waters inside of 275 m (150 fm) following the advent of rockfish conservation areas delineated by depth-based management lines. Although the January and February months of the winter petrale sole fishery have not been subject to vessel landing limits until recently, the 2-month limits restricted petrale sole landings from March through October, and beginning in 2006during November and February. The areas in which the winter petrale sole fishery has been allowed to operate have also been restricted by actions designed to reduce bycatch of slope rockfish. Effectively, many of the more marginal petrale sole winter fishing grounds were closed while the main fishing areas have remained open. Additionally, industry members indicated that after the 2003 vessel buyback program fishing effort for petrale sole during the winter declined. The skippers also indicated that small petrale limits during 2010 lead to large changes targeting strategies for petrale sole.

Area closures have been used by the PFMC for groundfish management since 2001. Current major area closures are: i) the Cowcod Conservation Areas (CCAs): adopted during 2000 and implemented in 2001; ii) the Yelloweye Rockfish Conservation Areas (YRCAs): the first was adopted during 2002 and implemented in 2003; and iii) the Rockfish Conservation Areas (RCAs) for several rockfish species: adopted during 2002, implemented as an emergency regulation during fall of 2002 and through regulatory amendment in 2003. Since then, RCAs have been specified continuously for regions north and south of $40^{o}10'$ N latitude for trawl and fixed-gear groups (Figure 2). The boundaries of the RCAs are delineated by depth-based management lines, and may be changed throughout the year in an effort to achieve fishery management objectives. The area between 180 m and 275 m has been continuously closed to most all bottom groundfish trawling since the implementation of the RCAs.

Vessels with exempted fishing permits (EFPs) issued under 50 CFR part 600 are allowed to operate in some conservation areas. Oregon EFP vessels were allowed to fish in the RCA using more selective 'pineapple'trawl gear (this gear has a longer headrope than footrope, allowing some rockfish a chance to escape capture) from February–October during 2003 and 2004. In pilot experiments, this gear was found to reduce the CPUE of some overfished rockfish and increase CPUE of flatfish relative to standard commercial flatfish gear (King et al. 2004). Beginning in 2005, this modified "selective flatfish" trawl gear has been required shoreward of the RCA, north of 40^{o}10'N latitude. The skippers present at the 2011 pre-assessment workshop in Newport, OR indicated that, prior to the use of the pineapple trawl fishing took place around the clock. However, when using the pineapple trawl gear they only fish during the day because the skippers are unable to catch fish at night. The ACLs for several species under rebuilding plans have resulted in limited harvests of other groundfish in recent years.

Port sampling conducted by each state routinely samples market categories to determine the species composition of these mixed-species categories. Since 1967, various port sampling programs have been utilized by state and federal marine fishery agencies to determine the species compositions of the commercial groundfish landings off the U.S. Pacific coast (Sampson and Crone 1997). Current port sampling programs use stratified multi-stage sampling designs to evaluate the species compositions of the total landings in each market category, as well as for obtaining biological data on individual species (Crone 1995, Sampson and Crone 1997).

An IFQ program, referred to as catch shares, was implemented for the trawl fleet beginning in 2011, resulting in changes in fleet behavior and the distribution of fishing effort.

1.7 Fisheries off Canada, Alaska, and/or Mexico

The Canadian fishery developed rapidly during the late 1940s to mid-1950s following the discovery of petrale sole spawning aggregations off the west coast of Vancouver Island (Anon. 2001). Annual landings of petrale sole in British Columbia peaked at 4,800 mt in 1948 but declined significantly after the mid-1960s (Anon. 2001). By the 1970s, analysis conducted by Pederson (1975) suggested that petrale abundance was low and abundance remained low into the 1990s. In the early 1990s vessel trip quotas were established to try to halt the decline in petrale sole abundance (Anon. 2001). Winter quarter landings of petrale sole were limited to 44,000 lb per trip during 1985–91; to 10,000 lb per trip during 1991–95; and to 2,000 lb per trip in 1996. Biological data collected during 1980-1996 showed a prolonged decline in the proportion of young fish entering the population (Anon. 2001). Therefore, no directed fishing for petrale sole has been permitted in Canada since 1996 due to a continuing decline in long term abundance (Fargo, 1997, Anon. 2001). Current landings of petrale sole in Canada are very low due to the effect of the non-directed fishery. As of 2005 petrale sole off of British Columbia were treated as three "stocks" and were still considered to be at low levels. The recent assessments for the Canadian stocks have been based on catch histories and limited biological data.

The most recent assessment of petrale sole in British Columbia uses a single area combined sex delay-difference stock assessment model with knife edge recruitment (at 6 or 7 years old) and tuned to fishery CPUE, mean fish weight of the commercial landings, and a number of fishery independent surveys beginning in the early 1980s (P. Starr, pers. comm.). Stock predictions are based on average recruitment (P. Starr, pers. comm.) This assessment suggests that the stock is currently above the target reference point and that there is some evidence for above average recruitment (about 10% above average) since about 1996 (P. Starr, pers. comm.). Petrale sole in Canadian waters appear to have similar life history characteristics (Starr and Fargo 2004). The Canadian assessment has not been updated between the U.S. petrale sole 2011 and 2013 assessments.

In Alaska petrale sole are not targeted in the Bering Sea/Aleutian Island fisheries and are managed as a minor species in the "Other Flatfish" stock complex.

2 Assessment

2.1 Data

The following sources of data were used in building this assessment:

1) Fishery independent data including bottom trawl survey-based indices of abundance and biological data (age and length) from 2003-2012 (NWFSC survey) and 1980-2004 (Triennial survey).
2) Estimates of fecundity, maturity, length-weight relationships and ageing error from various sources.
3) Commercial landings from 1876-2012.
4) Estimates of discard length frequencies, mean weight, and fraction discarded in the fishery obtained from the West Coast Groundfish Observer Program (WCGOP) and the study by Pikitch et al (1988).
5) Fishery CPUE (North and South fleets, 1987-2009).

Data availability by source and year is presented in Table 3. A description of each of the specific data sources is presented below.

2.1.1 Fishery Independent Data: NWFSC trawl survey

Three sources of information are produced by this survey: an index of relative abundance, length-frequency distributions, and age-frequency distributions. Only years in which the NWFSC survey included the continental shelf (55-183 m) are considered (2003-2012) since the highest percent of positive survey tows with petrale sole are found on the continental shelf.

The NWFSC survey is based on a random-grid design; covering the coastal waters from a depth of 55 m to 1,280 m (Keller et al. 2007). This design uses four industry chartered vessels per year, assigned to a roughly equal number of randomly selected grid cells and is divided into two ‘passes’ of the coast that are executed from north to south. Two vessels fish during each pass, which have been conducted from late-May to early-October each year. This design therefore incorporates both vessel-to-vessel differences in catchability as well as variance associated with selecting a relatively small number (~700) of possible cells from a very large population of possible cells spread from the Mexican to the Canadian border. Much effort has been expended on appropriate analysis methods for this type of data, culminating in the west coast trawl survey workshop held in Seattle in November, 2006 (see background materials).

The NWFSC survey commonly encounters petrale sole along the U.S. west coast, except south of Point Conception (Table 4, Figure 3Figure 4). The survey did not fish shallower than 54 m and no petrale sole were caught deeper than 550 m. Figure 5 shows that the percentage of positive tows and the catch rate over depth peak around 100 m and decline as depth increases. The prevalence and density of petrale are generally higher in the northern latitudes (Figure 5).

Petrale sole are known to form winter spawning aggregations in deep water. It could therefore be expected that large-sized petrale sole would also appear more frequently in deep water. Figure 6 displays the mean fish length per tow of petrale sole against tow depth and shows that the mean length of females increases initially with depth and then levels out (even though the survey was conducted during the summer rather than winter). This trend of increasing size at depth is also apparent for males. Given the ontogenetic shift of increasing size at depth, the 2005 assessment (Lai et al. 2005) re-stratified the survey data into three depth strata. This assessment uses a similar approach, developed during the 2009 assessment, implementing a piece-wise linear regression (Neter et al., 1985) of year- and sex-specific mean length and depth data to aid in choosing a depth stratum boundary (Appendix A).

The NWFSC index of abundance is estimated using a delta-generalized linear mixed model (delta-GLMM, Maunder and Punt 2004), implemented using the software from Thorson and Ward (In press). For every tow, the delta-GLMM approach explicitly models both the probability that it encounters the target species (using a logistic regression), and the expected catch for an encounter (using a generalized linear model). The product of these two components yields an estimate of overall abundance (Pennington 1983). Year was always included in both model components (because it is the design variable), strata, and strata:year interactions are included as a fixed effects. The delta-mixed-model implementation was necessary to treat vessels, as vessel:year interactions as random effects for the NWFSC slope and combined shelf-slope surveys, because these vessels are selected in an open-bid for the sampling contract from the population of all possible commercial vessels (Helser et al. 2004). Lognormal and gamma errors structures were considered for the model component representing positive catches, while a Bernoulli error structure was assumed for the presence/absence model component. Additionally an option to model extreme catch events (ECEs, defined as hauls with extraordinarily large catches) as a mixture distribution was explored (Thorson et al. 2011), which has been shown to improve precision for estimated indices of abundance in simulated data in some cases (Thorson et al. 2012). However, as petrale sole are commonly encountered in the trawl survey the ECE model was not necessary. Model convergence was evaluated using the effective sample size of all estimates parameters (>500 was sought) and visual inspection of trace plots and autocorrelation plots (where a maximum lag-1 autocorrelation of <0.2 was sought). Model goodness-of-fit was evaluated using Bayesian posterior predictive checks and Q-Q plots. This method for constructing survey abundance indices was reviewed by the Pacific Fishery Management Council's Scientific and Statistical Committee (SSC). The SSC endorsed the analysis and recommended using this approach in stock assessments. When implementing the GLMM approach, it is recommended that there are at least three positive tows in each stratum/year combination. Based on the ontogenetic shift of increasing size at depth the survey tows were stratified into three depth zones (54.86–100 m, 100–183 m and 183–549 m) for each INPFC area (Figure 2). Since the Eureka Deep and Vancouver Deep strata had fewer than three observations in some years, these areas were combined with the Columbia deep area. The lognormal model with fixed strata:year interactions was chosen as it provided a lower deviance and better fit to the data compares to models with the gamma error distribution and random strata:year interactions (Figure 7). The coast-wide biomass index increases from 2003 to 2004, followed by a general decline through 2008 and 2009, and increases during 2009 through 2012 (Table 5, Figure 8).

Length bins from 12 to 62 cm in increments both 1 and 2 cm were used to summarize the length frequency of the survey catches in each year. Table 4 shows the number of lengths taken by the survey. The first bin includes all observations less than 14 cm and the last bin includes all fish larger than 62 cm. The length frequency distributions for the NWFSC survey from 2003-2012 generally show a strong cohort growing through 2005 and smaller fish entering the population beginning in 2007 (Figure 9). Age-frequency data from the NWFSC survey (Figure 10) were included in the model as conditional age-at-length distributions by sex and year. Individual length- and age-observations can be thought of as entries in an age-length key (matrix), with age across the columns and length down the rows. The approach consists of tabulating the sums within rows as the standard length-frequency distribution and, instead of also tabulating the sums to the age margin, instead the distribution of ages in each row of the age-length key is treated as a separate observation, conditioned on the row (length) from which it came. This approach has several benefits for analysis above the standard use of marginal age compositions. First, age structures are generally collected as a subset of the fish that have been measured. If the ages are to be used to create an external age-length key to transform the lengths to ages, then the uncertainty due to sampling and missing data in the key are not included in the resulting age-compositions used in the stock assessment. If the marginal age compositions are used with the length compositions in the assessment, the information content on sex-ratio and year class strength is largely double-counted as the same fish are contributing to likelihood components that are assumed to be independent. Using conditional age distributions for each length bin allows only the additional information provided by the limited age data (relative to the generally far more numerous length observations) to be captured, without creating a 'double-counting' of the data in the total likelihood. The second major benefit of using conditional age-composition observations is that in addition to being able to estimate the basic growth parameters (LminAge, LmaxAge, K) inside the assessment model, the distribution of lengths at a given age, governed by two parameters for the standard deviation of length at a young age and the standard deviation at an older age, are also quite reliably estimated. This information could only be derived from marginal age-composition observations where very strong and well-separated cohorts existed and where they were quite accurately aged and measured; rare conditions at best. By fully estimating the growth specifications within the stock assessment model, this major source of uncertainty is included in the assessment results, and bias due to size-based selectivity is avoided. Therefore, to retain objective weighting of the length and age data, and to fully include the uncertainty in growth parameters (and avoid potential bias due to external estimation where size-based selectivity is operating) conditional age-at-length compositions were developed using the NWFSC trawl survey age data.

Age distributions included bins from age 1 to age 17, with the last bin including all fish of greater age (Figure 10). These data show the growth trajectory of females reaching a maximum size near 56 cm and males reaching a maximum size of about 41 cm (Figure 11). The marginal NWFSC age-compositions, which allow for easier viewing of strong cohorts, show the strong 1998 cohort ageing from 2003 to 2007, with younger fish appearing in 2008-2012 (Figure 11). The exception to this is the female composition in 2005, where only one female fish was aged from the tow with the largest catch rate. The expansion of numbers to tow can greatly affect the marginal age distribution, but does not have as much effect on the conditional age-at-length data.

2.1.2 Fishery Independent Data: Triennial trawl survey

The triennial shelf trawl survey conducted by NMFS starting in 1977 is the second source of fishery-independent data regarding the abundance of petrale sole (Dark and Wilkins 1994). The sampling methods used in the survey over the 21-year period are most recently described in Weinberg et al. (2002); the basic design was a series of equally spaced transects from which searches for tows in a specific depth range were initiated (Figure 12). In general, all of the surveys were conducted in the mid-summer through early fall, although survey timing between years was variable (Figure 13). While the AFSC conducted all of the previous Triennial surveys, the 2004 survey was conducted by the NWFSC FRAM division following the AFSC survey protocols. Haul depths ranged from 91–457 m during the 1977 survey with no hauls shallower than 91 m. In all subsequent years the survey sampled depths from 55–366 m. Given the different depths surveyed during 1977 the results from the 1977 survey are not included in this assessment. Water hauls (Zimmermann et al., 2003) and tows located in Canadian and Mexican waters were also excluded from the analyses for this assessment. Due to changes in survey timing the Triennial data have been split into independent early (1980-1992) and late (1995-2004) survey time series. The splitting of this time series was investigated during the 2009 STAR panel due to the changes in survey timing and the expected change in petrale sole catchability because of its seasonal onshore-offshore migrations (Cook et al. 2009). Ultimately the 2009 STAR panel supported a split of the survey for the previous reasons as well as improved fits to the split time series and small changes in the estimation of the selectivity curves.

As with the NWFSC trawl survey, petrale sole were encountered throughout the West Coast (Table 6, Figure 14). Larger catch rates were observed around depths of 100 m but no trend in catch rate was apparent over latitude, other than low catch rates in the Conception INPFC area which was only partially sampled (Figure 15). An analysis of the mean length by depth also showed evidence of an ontogenetic movement of petrale to deeper water (Figure 16) and depth stratification similar to the strata used for the NWFSC survey was used for the triennial survey. Similarly to the NWFSC survey, the early and late Triennial trawl survey indices of abundance are based on a general linear model (GLM), however, random vessel effects are not included in the modeling of this survey. The early Triennial was partitioned into five strata using INPFC area and two depth strata (55 m -100 m and 100 m – 400 m): Vancouver-Columbia shallow, Eureka shallow, Vancouver-Columbia-Eureka deep, Monterey-Conception shallow, and Monterey-Conception deep. The late Triennial survey data are partitioned into seven strata, using INPFC areas and two depth strata (55 m -100 m and 100 m – 500 m) as follows: Vancouver-Columbia shallow, Vancouver- Columbia deep, Eureka shallow, Eureka deep, Monterey-Conception shallow, Monterey deep, and Conception deep. Strata were determined based on having an adequate sample size in each year-strata combination. The models fit the data well (Figure 17, Figure 18) and the estimated biomass indices are given in Table 5 and Figure 19.

Size distributions (for both 1 and 2 cm bins) were calculated following the same procedures as the NWFSC survey. The numbers of fish and number of hauls represented in each year of the survey are presented in Table 6. The length frequency distributions generally show little trend, although there is evidence of small fish in 1992 and large fish in 2004 (Figure 20).

There are no petrale sole age data from the Triennial survey.

2.1.3 Fishery Independent Data: Other

A series of trawl surveys was conducted by the ODFW during 1971–74, the data from which are stored in the survey database at the Alaska Fishery Science Center (RACEBASE). However, the data from these surveys are not included in the assessment owing to their very limited temporal and spatial coverage.

2.1.4 Biological Data: Weight-Length

The weight-length relationship is based on the standard power function: $W = a\ (L^b)$ where W is weight in grams and L is length in centimeters. The parameters from the 1999, 2005, and 2009 assessments (Sampson and Lee 1999; Lai et al. 2005) were re-estimated using data from the NWFSC survey (Figure 21). The previous assessments used length and weight data from ODFW (1971–86), WDFW market samples, and the ODFW flatfish surveys (1971–72; Demory et al., 1976). New length and weight data from the NWFSC survey estimate the following length weight relationships for males, W=0.00000305$L^{3.360544}$, and females, W=0.00000208296$L^{3.473703}$.

More recent length-weight parameters estimated for the British Columbia petrale sole suggest that petrale sole in British Columbia generally weigh less at a given size than petrale sole of the U.S. west coast (Starr and Fargo 2004).

2.1.5 Biological Data: Maturity and Fecundity

Petrale sole maturity-at-length information is generally sparse in space and time, has not been collected in a systematic fashion across time, is of varying quality, and does not always agree between studies. It is possible that maturity may have changed over time. However, it is not possible to assess this quantitatively owing to differences in when historical samples on which maturity ogives could be based were taken, and how maturity stage (visual vs. histological) was determined. The 2005 petrale sole assessment used the most recent study for the west coast of the U.S. that was based on observations collected during 2002 from Oregon and Washington (Hannah et al. 2002). The maturity observations were fitted to a logistic model:

$p_l - \frac{e^{B_0 + B_l^1}}{1 + e^{B_0 + B_l^1}}$ where p_l is the proportion of natural fish at length l, and B_0 and B_1 are the regression coefficients. Parameter estimates from the Hannah et al. (2002) are: β_0= -24.593, β_1=0.743. The length at 50% maturity for females is 33.1 cm (Figure 22).

2.1.6 Biological Data: Natural Mortality

The instantaneous rate of natural mortality for a wild fish population is notoriously difficult to estimate. One accepted method is to examine the age distribution of an unexploited or lightly exploited stock. This method cannot readily be applied to petrale sole given the long history of exploitation off the U.S. West Coast. Ketchen and Forrester (1966) estimated that the natural mortality coefficients were 0.18–0.26 yr^{-1} for males and 0.19–0.21 yr^{-1} for females based on a catch curve analysis (1943–45) Washington trawl data from Swiftsure Bank, off the southwest corner of Vancouver Island. However, petrale sole catches were relatively high during mid-1940s through the 1950s. Starr and Fargo (2004) estimated the instantaneous rate of natural mortality (*M*) using Hoenig's method (Hoenig 1983): $\ln(M) = 1.44 - 0.984\ln(t_{\max})$ where *M* is natural mortality and t_{max} is the maximum age of petrale sole. *M* Values of 0.22 and 0.15 were estimated given maximum ages of 20 and 30 years, respectively. An archived set of commercial samples collected between the late 1950s and early 1980s from Northern California recently found that multiple samples were aged between 20-31 years old suggesting a similar range of M values for U.S. west coast petrale sole. U.S. stock assessments prior to 2009 and current British Columbia stock assessments assumed a value of *M* = 0.2 for both sexes. A recent meta-analysis (O. Hamel, pers. comm.) produced the following normal prior distributions for females (mean = 0.151, standard deviation = 0.16) and males (mean = 0.206, standard deviation = 0.218). The Hamel priors are used for M in this stock assessment.

2.1.7 Biological Data: Length at age

Sager and Summler (1982) summarize the growth of petrale sole in length using several growth functions. Female petrale sole can grow to 70 cm total length, with males being smaller. Petrale sole can live to at least 30 yrs, although more recent data show that few are aged to be older than 17 yrs. This information on growth is subject to error for two reasons: 1) growth determination is difficult because two ageing techniques (otolith surface and break-and-burn) were used in the past, and 2) the observed lengths of young fish may be positively biased due to gear selectivity. Pederson (1975) estimated growth parameters for several locations (see Table 6 of Turnock et al. (1993)). Sampson and Lee (1999) estimated the values of the parameters of the von Bertalanffy growth curve using data based on BB readings for petrale sole older than age 3, and ODFW survey observations (1970–74) for younger ages. In the 2005 stock assessment the mean-length-at-age data used to estimate parameters for the growth equation were obtained from the 2004 NMFS triennial survey. The empirical estimate of the CV of length at age in the 2004 survey, used in Lai et al. (2005), is 0.08, the same value that was used by Sampson and Lee (1999). Beginning with the 2009 assessment length at age has been estimated inside the stock assessment model. Starting parameter values for the estimation were determined by fitting the von-Bertalanffy model ($L_i = L_\infty e^{(-k[t-t_0])}$) where L_i is length in cm at age *i*, *t* is age in years, *k* is the rate of increase in growth, t_0 is the intercept, and L_∞ is the maximum length estimated from the NWFSC survey data (Figure 11). Exploration of the NWFSC survey residuals across age and time did not show any evidence of time variation in growth (Cadigan et al. 2013).

2.1.8 Biological Data: Sex ratios

Both the Triennial and NWFSC sex ratios for petrale sole are generally about 50% each males and females. There is no indication of changes in sex ratio over time in the recent survey data. Canadian data from the most recent published stock assessment also suggests sex ratios of petrale sole in British Columbia are generally 50% males, 50% females (Starr and Fargo 2004). The fishery data show a somewhat higher proportion of females to males, as might be expected given dimorphic growth and winter fisheries that target spawning aggregations.

2.1.9 Biological Data: Aging precision and bias

Historically petrale sole have been aged using the otolith surface ageing technique by all three state agencies that provide age data (WA, OR, and CA). At some point during the 1980s the Oregon and Washington protocols for ageing petrale sole were: i) surface readings for all males, ii) surface readings for females up to age 10, and iii) BB readings for any females that appeared to be older than 10 years (Lai et al. 2005). However, age readers often failed to track gender, resulting the break and burn ages for males and females (Bob Hannah, ODFW, pers. comm.). Otoliths that were difficult to read and appeared older were also broken and burned, resulting in break and burn ages for fish younger than age 7 (Bob Hannah, ODFW, pers. comm.). The Cooperative Aging Project (CAP) formed in Newport, Oregon during 1996 and started aging petrale sole for the 1999 stock assessment. During 1999, otolith samples collected by ODFW between 1981 and 1999 were aged by three different age readers in the CAP using a combination of surface and break-and-burn (BB) techniques. The samples were not randomly distributed between age readers, that is, one reader aged all females, one reader aged primarily males (and some females), and one reader read both. Furthermore, while two of the age readers produced surface ages, one age reader was using a 'combination' ageing method where otoliths that appeared to be younger than about 10 years were surface aged and those that appeared older were broken and burned. The multitude of problems with the 1981-1999 age data for Oregon resulted in most of these data being removed from the 2005 stock assessment during the STAR panel review (Lai et al. 2005). Oregon otoliths aged for the 2005 stock assessment were solely surface aged. The Washington Department of Fish and Wildlife (WDFW) continued to use the 'combination' ageing method for all commercial otolith samples through 2008.
An unpublished study in 1981–82 by W. Barss (ODFW, Newport) indicated that ages based on otolith surface readings are biased relative to ages based on break-and-burn readings for male petrale sole, with significant under-aging for males older than about 10 years. However, the same study suggested that ages based on surface and break-and-burn (BB) readings were similar for females. Turnock et al. (1993) reported differences between ages based on surface and break-and-burn readings for males and also argued that there was no apparent bias for females. This unpublished information informed the ageing error used in the 1993 and 1999 assessments (Turnock et al., 1993; Sampson and Lee, 1999). However, given the variety of ageing protocols for petrale sole the results from early ageing bias and precision studies were reanalyzed for the 2009 stock assessment and have been applied to subsequent stock assessments.

More recent comparisons of surface and BB readings were conducted by the CAP laboratory as well as comparisons of the 'combination' and break and burn methods by the WDFW for the 2005 petrale sole stock assessment. Lai et al. (2005) concluded that CAP ages based on surface readings are younger than those based on BB readings, but the differences were not statistically significant. However, the results of the CAP study are not consistent with those from the WDFW data analyzed by Lai et al. (2005). Nevertheless, both data sets suggested that the differences in age estimates between the surface and break and burn techniques are smaller than implied by the ageing error matrix reported by Turnock et al. (1993). The September 2005 STAR Panel discussed the ageing error matrices used in the 2005 stock assessment and the implied ageing error coefficients of variation. It was concluded that the 2005 ageing error matrices are not informative and should be used with caution because the ageing method is not standardized between agencies.

Currently, Oregon commercial samples from 2000 to 2004 are exclusively surface aged. Oregon commercial samples from 2007 forward, WDFW samples from 2009 forward, and the NWFSC survey otoliths were aged using the break and burn method for most fish except those very young fish (generally age 0-3 year olds that are very clear) (P. MacDonald, pers. comm.) for which the age readers believe surface ages are reliable. It is common procedure for the CAP lab to surface read young fish with clear otoliths, no matter the species.

In order to conduct a comprehensive estimation of ageing bias and imprecision the 2009 assessment compiled and analyzed all of the available double-read data from the state of Oregon, the CAP, and the WDFW, as well information from a bomb radiocarbon age validation study for petrale sole off the U.S. west coast (Table 7) (Haltuch et al. 2013). In the 2009 analysis, all sources of ageing information were revisited both through inspection of the various cross- and double-read efforts as well as through simultaneous estimation of bias and imprecision for all studies in a rigorous statistical framework programmed in AD Model Builder (Otter Research Ltd. 2005) by A. Punt, University of Washington (Punt et al. 2008). This program estimates the underlying age distribution of a sample and can do this for multiple samples simultaneously. The most important assumption of the estimation technique is that at least one ageing method must be unbiased, so it is therefore not an age-validation. Functional forms can be explored for each method for both the age bias (none, linear, type 2) and imprecision (constant CV, or type 2 increase in CV with age) as well as the choice of minus and plus ages. Model selection is based on AIC. Sample sizes for these analyses are on the order of hundreds of double and triple reads.

The 2009 aging error analysis compressed data sets with three or more reads down into double-read data for analyses, because this reduced the number of age compositions, improving model performance. However, since 2009 the aging error model has been improved to better deal with otoliths with more than two reads. Therefore, both the 2011 and 2013 analyses used the triple read data available from the bomb radiocarbon study. The WDFW aging lab was able to re-age most of the otoliths used for the bomb radiocarbon study, both break and burn and surface ages, so the estimation of aging error for the Washington commercial samples was much improved during the 2011 assessment compared to the 2009 assessment.

Results from the bomb radiocarbon study indicated that age reader #1 break-and-burn ages are unbiased (Haltuch et al. 2013). Therefore, these ages are used as the unbiased ‘radiocarbon’ ages in the age error analysis. Sex and age reader information is available for some, but not all, of the samples. In order to increase the power of the analysis and reduce the total number of data sets in the analysis samples are pooled over age reader and sex.

The aging error analyses found that the best fit model included a non-linear bias, except for the combination age reads from both labs and the WDFW break and burn age reads, which had linear bias. The best fit models for the CAP break and burn and surface ages and the WDFW surface ages fit the standard deviation of the aging bias as a non-linear function but the best fit models for both the CAP and WDFW combination age reads as well as the WDFW break and burn reads fit a linear function for the standard deviation. Generally, all of the ageing methods applied to petrale sole are negatively biased (under ageing), particularly for older ages (Table 7, Figure 24). The break-and-burn and combination ages show a smaller negative bias at older ages than the surface ages. The WDFW break and burn and combination ages show very little bias while the surface ages show stronger negative bias, particularly after approximately age 13 (Table 7,Figure 24).

Prior age error analyses pooled all surface age reads for the CAP and WDFW labs, regardless of the time period in which those ages were produced. However, this 2013 stock assessment evaluated the possibility that surface age reads done prior to the advent of break and burn ageing were likely to produce younger surface age reads in comparison to surface age reads as break and burn age methods were being developed and researchers were realizing that surface reads produced negatively biased ages (i.e., older surface ages are likely to be more bias than more recent surface reads). Estimation of aging error for surface read otoliths completed prior to the 1990’s found a stronger negative age bias in comparison to surface ages from the later time period (Table 7, Figure 24).

2.1.10 Biological Data: Research removals

Catches of petrale sole for research purposes are very small in comparison to the trawl fishery catches and are therefore included in the total catches.

2.1.11 Biological Data: Ecosystem data

While there are studies that suggest potential qualitative ecosystem relationships for petrale sole that could be included in future stock assessments recent rigorous analysis of these relationships are lacking and time series of potentially relevant environmental data are not readily available for evaluation within the stock assessment.

2.1.12 Fishery Dependent Data: Landings

All landings for the 2013 assessment were summarized by port of landing, where available, as well as for a northern fleet consisting of Washington and Oregon and a southern fleet consisting of California. Landings for Washington and Oregon are summed into a single northern fleet due to the fact that vessels commonly fish and land in each other's waters and ports. In contrast, the 2009 and 2011 stock assessments summarized landings by catch area for each state individually. The CDFG and SWFSC provided comprehensive landings reconstruction for the California commercial fishery (Ralston et al. 2009). In some cases early CDFG data were only recorded by general catch area and subsequently allocated to port complexes. The ODFW and the NWFSC also recently completed a historical landings reconstruction that is limited to providing annual catches based on the port of landing (Gertseva et al. 2010). The California and Oregon landings reconstructions represent the best available data on landings in each state. At the time of this assessment, a comprehensive historical catch reconstruction is not available for Washington. In 2009, WDFW provided improved landings data for a few years previously reconstructed by Lai et al. (2005). The main change to the catches used in the 2013 assessment was the use of the Oregon catch reconstruction, which had slightly larger landings from approximately 1960 to 1980 and the change to summarizing California landings by port, which had slightly larger landings from approximately 1950 through the mid-1960s (Table 1, Figure 1). The landings used in this assessment begin in 1916 with the commercial landings data obtained from the following sources:

1. The PacFIN database (1981–2012 for CA and WA; 1987-2012 for OR);
2. The Pacific Marine Fisheries Commission (PMFC) Data Series for 1956-1980 (PMFC, 1979) for Washington. A comprehensive set of these data were not available for the 2005 stock assessment. The paper document was key punched after the 2007 round of assessments and is generally accepted as the best data currently available for WA catches during this period.
3. State of California landings reconstruction extending from 1931-1980 (Ralston et al. 2009). CDFG Fish Bulletins for 1916–1930 landings (Heimann and Carlisle, 1970) as reconstructed by Lai et al. (2005). The California fishery began in 1876 but no landings data are available from 1876-1915. Therefore a linear interpolation between landings of 1 ton in 1876 and the landings recorded for 1916 are used to filling this period. Lai et al. (2005) and Haltuch et al. (2009) found that this early assumed increase in the petrale sole fishery did not impact the model;
4. Oregon landings reconstruction for 1932 to 1986 (Gertseva et al. 2010);
5. WDFW landings reconstruction for 1935, 1939 and 1949– 1969 (pers. comm. T. Tsou and G. Lippert). These catches from WDFW grey literature are much larger than the catches used for Washington in the 2005 (Lai et al. 2005) stock assessment. Therefore landings for the early years that have not yet been reconstructed by WDFW are filled in by interpolating between the years with landings data;

Landings data from 1981 (1986 for Oregon) – 2012 were extracted from PacFIN (4 April 2013), as updates and corrections to the PacFIN database can cause small changes to this portion of the catch history. Monthly data are mostly unavailable for the early petrale fisheries. In years where monthly landings data were not available, all landings are assumed to be from the summer fishery because it is likely that most of the fleets operating early in the development of the fishery did not fish in deep water during winter.

Landings for the fishing year, beginning on 1 November, are summarized by fleet in Table 1 and Figure 1. The landings of petrale sole by gear types other than groundfish-trawl have been inconsequential, averaging less than 2.5% of the coast-wide landings. The non-trawl landings are included in the trawl landings but do not include discarded petrale sole (Table 8. Pikitch discard ratios.

Fishing	North winter		North summer	
Year	Mean	SD	Mean	SD
1985	0.0222	0.1103	0.0346	0.0419
1986	0.0215	0.1162	0.0343	0.0432
1987	0.027	0.1186	0.0315	0.045

Table 9). The post-World War II period witnessed a steady decline in the amount and proportion of annual landings occurring during the summer months (March-October). Conversely, petrale landings during the winter season (November–February), when the fishery targets spawning aggregations, has exhibited a steadily increasing trend since the 1940's. In the past few decades there has been a distinct seasonality in petrale sole landings that corresponds to the targeting of spawning aggregations during winter. Due to the seasonal harvesting pattern, landings in this assessment, as in previous assessments, are separated into two time periods: winter (November-February) and summer (March–October).

Although they are not used in this assessment, the Canadian landings of petrale sole can be found in Starr and Fargo (2004).

2.1.13 Fishery Dependent Data: Discards

The catch statistics in Table 1 do not include discards. Prior to the 2001 creation of the Northwest Fishery Science Center West Coast Groundfish Observer Program (NWFSC WCGOP), data on fishery discard for petrale sole was sparse and of mostly questionable quality. While several historical studies report discard estimates, in most cases the original data and estimation methods, which likely varied between studies, are not reported.

A limited 1950 study of Astoria, Oregon based trawlers estimated that 32.5% of the "number" of the petrale sole caught were discarded (Harry 1956). However, the details of the data collection as well as the original data are missing, so this value is not used in the assessment. A 1977–81 study reported annual discard factors for the U.S Vancouver and Columbia INPFC areas (total catch weight / retained catch) that ranged from 1.1 to 1.4 with an average value of 1.21 (meaning 17% of the total catch weight was discarded) (Demory 1984). However, Demory (1984) did not provide the data used to derive the discard factor, f = 1 + Discard/Retained, from which the discard rate is derived. Therefore the Demory measures of discard are not used. Scofield (1948) reported that 20–25% of the catches of sole in California were discarded during the 1940s and 1950s, but no specific date, data sources, or analyses were reported, so this value is not used in the assessment. Data collected by Pikitch et al. (1988) off the Oregon coast during 1986-1987 inform discard rates for the Oregon fisheries. Due to different analyses producing different discard rates for the Pkitch et al. (1988) data (Sampson and Lee 1999, D. Erickson , pers. comm. 2011) the NWFSC completed a comprehensive reanalysis of the data in preparation for the 2013 stock assessment cycle NWFSC staff (Table 8, J. Wallace , pers. comm.).

Discard observations for the trawl fleet from the WCGOP provide yearly discard rates (Table 9) and average weight of the discard (Table 10) based on at-sea observer data for 2002-2012 (2012 includes only the first half of the winter fishing season). While discard rates for petrale sole have typically been small, during 2011 the trawl fishery transitioned into an ITQ program referred to as catch shares, with 100%

observer coverage, resulting in many fleets with zero or near zero discard rates for 2011-2012. Length data are available from both the Pikitch et al. (1988) data (sex specific) as well as from the WCGOP data as of 2006 (sexes combined), providing length compositions of the discard (Figure 30 -Figure 35). These length compositions are used to estimate the retention curves for each fleet.

Several studies have reported retention curves for petrale sole. TenEyck and Demory (1975) reported that the age-at-50%-retention is 5.6 years for male petrale sole and 5.1 years for females, equivalent to a ~ 30 cm length-at-50%-retention. Turnock et al. (1993) estimated a logistic length-retention curve using the unpublished data collected during a mesh-size study (Wallace et al., 1996), and reported that the length-at-50%-retention was 21.3 cm. Sampson and Lee (1999) estimated the length-at-50%-retention to be 28.6 cm for males and 29.5 cm for females, based on unpublished data from the discard study by Pikitch et al. (1988).

2.1.14 Fishery Dependent Data: Foreign landings

The impact of landings of petrale sole by foreign fishing fleets prior to the institution of the exclusive economic zone (EEZ) of the U.S. west coast is currently not quantified and remains an area for research.

2.1.15 Fishery Dependent Data: Logbooks

Sampson and Lee (1999) used commercial logbook data from PacFIN to construct a delta-GLM-based standardized CPUE indices of abundance for the Oregon fleets from 1987-1997. These indices were also used in the 2005 northern area stock assessment (Lai et al. 2005) and in the 2009 coast-wide stock assessment. The logbook data for the years prior to 1987 were not included, because information on fishing location is not available for much of these data. Beginning in 1998, the west coast groundfish fishery has been subjected to a series of regulatory changes that would render extension of the Sampson and Lee index unreliable.

Lai et al. (2005) produced delta GLM-based indices of abundance for the 2005 southern area assessment using data filtered in a similar manner to Sampson and Lee (1999). However the southern area CPUE indices used more vessels that had been in the fishery a relatively short amount of time and extended the index to 2004, well beyond the time where regulatory changes began to restrict the groundfish fishery. These problems with the CPUE indices were noted during the 2005 STAR panel review.

Due to multiple changes in management beginning in the early 2000s and resulting changes in fishing behavior, for which limited data are available, and spatial closures, the 2009 stock assessment did not include commercial CPUE indices. One example of a regulatory induced change in fishing behavior is the switch from fishing around the clock to fishing only during the day with the selective flatfish trawl (‘pineapple trawl’) that began to be used in 2003 and was used coast-wide by 2005. Many of these types of changes are not well documented or are not documented at all in the logbook data.

Management and fishing behavior changes beginning during the early 2000s suggest that the changes in CPUE are likely not proportional to changes in stock abundance. In addition to the impact of changing management actions and resulting changes in fishing behavior on commercial CPUE the winter fleets were not analyzed due to concerns regarding the likelihood that changes in winter catch rates would not be proportional to changes in spawning stock biomass due to the spawning aggregations that are the target of the winter fishery (Hilborn and Walters 2001). However, in 2009 plots of raw CPUE (lbs/hour) for all fleets were calculated for comparison with the fishery independent NWFSC survey index. The downturn in the NWFSC survey index (from the summer season) between 2005 and 2008 was also apparent in the raw CPUE from the summer fisheries, although the magnitude of the changes in the CPUE was much larger than those from the survey (Haltuch et al. 2009). During the 2009 assessment review process there were concerns regarding the lack of a recent CPUE analysis for all fleets, regardless of the management impacts on the fishery. Therefore, the 2011 assessment attempted to conduct a CPUE analysis that considers some of the management impacts on the petrale fleet (Haltuch et al. 2011).

While the 2011 analysis attempted to account for the impact of management measures on the fishery it was unable to account for changes in fishing behavior, or changes in spawning aggregation dynamics with stock size during the winter spawning/fishing season. Changes in the CPUE indices from approximately the years 2000-2003 forward could be due to management measures, fishing behavior, and spawning aggregation dynamics (winter only) that were not been captured in the analysis. For example, industry reports that the 2003 vessel buyback removed some of the more productive vessels in the fleet, but there is not information on the skippers that fished those vessels, many of which may have switched to fishing on different vessels. The 2011 CPUE analysis was also unable to capture changes in fishing behavior and targeting strategies for petrale sole and the Dover-thornyhead-sablefish deep water fishery, which likely increased, as rockfish fishing opportunities became increasingly limited between the late 1990s and present. During the summer, the spatial management restrictions have changed on an annual basis and are captured only at a gross level. During the winter, the spatial areas that have remained open to fishing since 2003 have been more stable, however, little is known about petrale sole spawning aggregation dynamics and how these spawning aggregation dynamics change as the stock increased from historical low levels in the 1990s to higher levels in the mid-2000s. Ancillary evidence suggests that the timing of spawning (historically December - February) has shifted to be later in the winter season. This issue may have been captured by limiting the data used in the analysis to January-February. However little is known about how the timing of peak spawning, the duration of the spawning season, size of spawning aggregations, and density of spawning aggregations change with changes in the size of the spawning stock. It was not possible to capture these dynamics in the CPUE analysis competed for the 2011 stock assessment as there is a lack of understanding between how changes in catch rates and changes in the true population are related.

During the 2011 STAR the summer CPUE was excluded from the stock assessment model as a viable index due to the annual changes in spatial management. While the summer CPUE indices were removed from the 2011 assessment the general trends in the commercial summer CPUE were similar to the trend from the NWFSC fishery independent survey during the period of overlap. STAR panel discussions lead to the inclusion of the winter CPUE indices, modeled with a power function, due to the more consistent spatial management during the winter, regardless of the possible issues with spawning aggregation dynamics.

In preparation for the 2013 stock assessment the CPUE analyses were reanalyzed and improved (Appendix B). The major changes include the calculation of a prediction interval around the CPUE indices, the division of fishing grounds into finer spatial grids than the areas used in the 2011 analysis, the aggregation of tow by tow data to the trip level, the calculation and inclusion of new covariates to represent changes in fishing tactics over time, and evaluating the impact of modeling CPUE using a mixed effects model with vessel as the random effect. Both the summer and winter CPUE indices computed for the 2013 assessment explain a greater amount of the variation in the data than those computed for the 2011 stock assessment and generally show the same trends as the NWFSC fishery independent survey (Appendix B). The winter CPUE time series are used in the base assessment model. The north shows relatively clear periods of decline and increase during the early part of the time series, followed by a large increase in both the index and its variance between 2003 and 2004 after which the index is fairly stable (Figure 36). The southern index is more variable and shows fewer strong trends during years prior to 2004, but does show the same large increase in the index and its variance as the northern index from 2003 to 2004 (Figure 37).

2.1.16 Fishery Dependent Data: Biological sampling

Commercial landings and the biological characteristics of these landings were not consistently sampled for scientific purposes until the mid-1950s. Statewide sampling of landed catches began in 1955 in Washington, 1966 in Oregon, and sporadically in 1948 in California. The first rigorous monitoring programs that included routine collection of biological data (e.g., sex, age, size, maturity, etc.) began in 1980. Currently, port biologists employed by each state fishery agency (California Department Fish and Game, Oregon Department of Fish and Wildlife - ODFW, and Washington Department of Fish and Wildlife - WDFW) collect species-composition information and biological data from the landed catches of commercial trawling vessels. The sampling sites are commonly processing facilities located at ports in California, Oregon and Washington. The monitoring programs currently in place vary between the states but are generally based on stratified, multistage sampling designs.

The PacFIN BDS database contains data from ODFW (1966–present) and WDFW (1955– present), but only 2001– present data from CDFG. The CDFG dataset for the years prior to 2000 was extracted and provided from CALCOM by Brenda Erwin (CDFG). Demory and Bailey (1967) provide length compositions for the Columbia INPFC area for 1949–51, 1960, and 1963–65. However no information is provided on the total size of the landings or sampling protocol, making it impossible to expand the raw length data. Therefore, the Demory and Bailey (1967) data are not used in the current assessment.

Commercial length-frequency distributions based on the fishing year were developed for each state for which observations were available, following the same bin structure as was used for research observations. For each fleet, the raw observations (compiled from the PacFIN and CalCOM databases) were expanded to the sample level, to allow for any fish that were not measured, then to the trip level to account for the relative size of the landing from which the sample was obtained. The expanded length observations were then expanded by the landings in each state. Age frequencies were computed in the same manner. Length and age data collected from commercial landings for each fleet are summarized by the number of tows (Table 11 -Table 12). Figure 38 -Figure 53 show plots of the commercial length and age composition data.

2.1.17 Ecosystem data

Due to staffing constraints this assessment was unable to generate new analyses to evaluate potential ecosystem data and methodologies for this stock assessment. Given a lack of recent rigorous ecosystem analyses and peer review publications for petrale sole specifically this assessment does not directly incorporate environmental or ecosystem data.

2.2 History of Modeling Approaches Used for this Stock

2.2.1 Previous assessments

United States

Early stock assessments only assessed petrale sole in the combined U.S.-Vancouver and Columbia INPFC areas, i.e. petrale in these areas were treated as a unit stock, using time series of data that began during the 1970s (Demory 1984, Turnock et al. 1993). The first assessment used stock reduction analysis and the second assessment used the length-based Stock Synthesis model (Methot 1989). The third petrale sole assessment utilized the hybrid length-and-age-based Stock Synthesis 1 model, using data from 1977–1998 (Sampson and Lee 1999). During the 1999 stock assessment an attempt was made to include separate area assessments for the Eureka and Monterey INPFC areas but acceptable models could not be configured due to a lack of data (Sampson and Lee 1999).

The 2005, petrale sole assessment was conducted as two separate stocks, the northern stock encompassing the U.S. Vancouver and Columbia INPFC areas and the southern stock including the Eureka, Monterey and Conception INPFC areas, using Stock Synthesis 2, a length-age structured model (Methot 2000). Both the northern- and southern-area models specified the fishing year as beginning on November 1 and continuing through October 31 of the following year, with a November–February winter fishery and a March–October summer fishery. Landings prior to 1957 were assumed to have been taken during the summer season in years where monthly data were not available to split the catches seasonally. The complete catch history was reconstructed for petrale sole for the 2005 stock assessment, with the northern area model starting in 1910 and the southern area model in 1876. In 2005, the STAR panel noted that the petrale sole stock trends were similar in both northern and southern areas, in spite of the different modeling choices made for each area, and that a single coast-wide assessment should be considered. The 2009 and 2011 assessments treated petrale sole as a single coast-wide stock, with the fleets and landings structured by state (WA, OR, CA) area of catch. During the 2011 STAR panel concerns were raised regarding the difficulty of discriminating landings from Washington and Oregon waters, particularly in light of the OR historical landings reconstruction that includes a summary of data by port of landing but not by catch area, due to the fact that the OR and WA vessels commonly fish in each other's waters and land in each other's ports. The availability of the historical comprehensive landings reconstruction for OR by port of landing lead the STAR panel to recommend combining the Washington and Oregon fleets within the coast-wide stock assessment using port of landing rather than catch area. This 2013 stock assessment continues with the coast-wide stock assessment, but is restructured to summarize petrale sole landings by the port of landing and combines Washington and Oregon into a single fleet.

Canada

Ketchen and Forrester (1966) conducted the first assessment of petrale sole off British Columbia. A recent series of petrale sole assessments in Canadian waters were conducted by Tyler and Fargo (1990), Fargo (1997, 1999), Fargo et al. (2000), Starr and Fargo (2004), and Starr (2009). The 2004 stock assessment of petrale sole was based on three areas: the west coast of Vancouver Island, Queen Charlotte Sound, and Hecate Strait (Starr and Fargo, 2004). In the most recent 2006 assessment in British Columbia petrale sole are assessed using a single area, combined sex, delay-difference stock assessment model with knife edge recruitment (at 6 or 7 years old) (Starr 2009). The model is tuned to fishery CPUE, mean fish weight of the commercial landings, and a number of fishery independent surveys beginning in the early 1980s. Stock predictions are based on average recruitment.

2.2.2 GAP and GMT input

The GMT representative on the 2009 petrale sole STAR panel compiled a history of regulatory actions that impacted the petrale sole fishery, and more generally the groundfish fishery (Appendix C). The GAP representative provided ancillary information on the comparative catches of petrale sole by the fishery, indicating that during the 1980s catch rates were very poor but that recently catch rates have much improved (B. Pettinger , pers. comm.). The GAP representative, as well as other fishery participants who were present at the 2009 STAR panel, provided invaluable information regarding the history of the fishery and the timing of the impact of management regulations on fleet behavior. This information from the 2009 STAR panel GAP representative and fleet members was used to make decisions regarding the time blocking of fishery selectivity in the model. Information provided by the GAP and GMT representatives regarding the fishery for petrale sole helped guide the use of the commercial CPUE indices during the 2011 stock assessment. Discussion with industry members present at the 2013 March PFMC GAP meeting contributed the following comments that are relevant to the petrale sole fishery and stock assessment.

1. The fleet has changed fishing locations in recent years, such as moving deeper, to avoid petrale and other species with limited quotas (other overfished stocks) and non-target species (such as dogfish).
2. The petrale tribal fishery has changed since IFQ management was implemented in 2011 but not due to IFQ management. The tribal fishery generally fishes off of Cape Flattery about 20 miles, mostly in the spring and summer for smaller fish. The landings were very large in 2011; by the

July/August time period the landings were about double the tribal allocation (~100 tons). The 2012 tribal landings were ~70 tons and, due to an inability to avoid petrale, the bottom trawl fishery was cut short. These observations corroborate survey and past assessment evidence of strong incoming late 2010s year classes of petrale that are starting to move into the fishery.

3. In the Eureka-Ft. Bragg area (roughly Cape Blanco to Pt. Reyes/San Francisco) shelf fishing has either been very limited or stopped completely during the summer in favor of moving off shore so landings of shelf species like English and petrale soles are lower. This is due to bycatch avoidance of species like canary and darkblotched. There has also been a lack of observers in this area for the winter petrale fishery.
4. The winter petrale fishery, at least in the Eureka area, in recent years has been delayed and/or limited due to the Dungeness crab fishery opening during the same time period. This has limited the winter landings of petrale as many fishers choose to fish for crab due to higher value and the greater ability to retain crew for the rest of the groundfish season.
5. There is an interaction between the timing of the Canadian petrale fishery and the U.S. petrale fishery that drives when fishers are choosing to target petrale. The Canadian fishery ends in Feb, the same time as the winter U.S. petrale fishery. This results in lower prices when the Canadian fish are coming onto the market and pushes the U.S. fishery towards summer targeting as prices are higher. The timing of the Canadian and U.S. fisheries have likely been this way for a long time but with the introduction of the IFQ program fishers are paying more attention to price and the best time to fish. Prior to the IFQ there was no 'penalty' for fishing petrale in the winter, but now that petrale is limited the fishery will likely trend towards summer when prices are higher for the U.S. fleet.
6. In CA, the vessels leaving the fleet have been small 'beach' boats that fished shoreward of the RCA; they did not have enough bycatch quota to keep trawling. This may impact the size comps in CA. Some of these vessels have switched to fixed gear sablefish; some are selling quotas.
7. Due to strong bycatch penalties for yelloweye and canary in the north there has been avoidance of the beach fishery.

2.3 Response to STAR Panel Recommendations

The STAR panel report from 2011 outlined a number of research and modeling recommendations (Chen et al. 2011). Where possible, the current assessment has addressed these recommendations, the details follow.

1. The STAR panel identified the overarching unresolved problem / major uncertainty for the petrale sole stock assessment as stock structure with respect to the Canadian border and connectivity of the U.S. and Canadian 'stocks'. As there is no political or management framework to facilitate joint stock assessments and management for most groundfish species that are undoubtedly connected the STAR concluded that resolution of this issue is beyond the scope of what can be reasonably expected from the STAT. However, the 2011 STAR panel found it critical for the credibility of the management system to establish a formal framework and to conduct petrale sole assessments (and perhaps other transboundary stocks) jointly with Canada.
   - Response: A formal framework for joint stock assessment and management of U.S-Canadian transboundary groundfish stocks does not exist, with the exception of Pacific hake, so this stock assessment follows the PFMC terms of reference for groundfish stock assessments and is restricted to petrale sole in U.S. waters.

2. Conduct a formal review of all historical catch reconstructions and if possible stratify by month and area. The mixing of U.S. and Canadian catches is of particular concern for the Washington fleet.
   - Response: The PFMC is the body responsible for formal review of the California and Oregon landings reconstructions, resources to complete such a review has not been available. These catch

reconstructions have not substantially changed since those that were available during the 2011 stock assessment. A comprehensive landings reconstruction for Washington is not available.

3. Discard estimates from the WCGOP should be documented, presented and, reviewed (similar to catch reconstructions) outside of the STAR panel process. The reviewed WCGOP data should then be made available to the assessment process.
   - Response: The WCGOP discard estimates have been documented (see background materials) but have not yet been review by the PFMC.

4. Consider combining Washington and Oregon fleets in future assessments within a coast-wide model.
   - Response: Washington and Oregon fleets have been combined, and the landings are summarized by port of landing. Sensitivity to fleet structure is included in this assessment.

5. The petrale sole maturity and fecundity information is dated and should be updated.
   - Response: These data have not been updated as there are higher priority groundfish species for which such data are being collected and analyzed.

6. As noted by the previous STAR Panel, the current assessment platform (SS3) is structurally complex, making it difficult to understand how individual data elements are affecting outcomes. The Panel recommends, where possible, investigating simpler, less structured models, including statistical catch/length models, to compare and contrast results as data and assumptions are changed.
   - Response: As part of the NWFSC research into data poor/moderate stock assessment methods a simple model has been produced for petrale sole (Figure 54) that shows similar results to the full stock assessment model (J. Cope , pers. comm).

7. The length binning structure in the stock assessment should be evaluated, including tail compression fitting options.
   - Response: Much of the discussion during the 2011 STAR panel focused on the choice of values for the small constant added to expected frequencies and the bin size. The constant added to expected frequencies was chosen based on the minimum value observed in the data. The impact of changing the bin size from 2 cm to 1 cm bins was also explored.

8. The residual patterns in the age-conditioned, length compositions from the surveys should be investigated and the potential for including time-varying growth, selectivity changes, or other possible solutions should be examined.
   - Response: Options for better fitting all of the length and age data have been explored via selectivity and fleet/model structure. These are discussed in the sensitivity section of this document. The NMFS Fisheries and the Environment (FATE) program funded a project to investigate and conduct a meta-analysis of time-varying growth for California Current groundfish. However, at the time of this stock assessment results are not ready for inclusion in this stock assessment.

9. Management strategy evaluation is recommended to examine the likely performance of new flatfish control rules.
   - Response: The NWFSC has not had the resources available to conduct an MSE for the PFMC flatfish control rule.

2.4 Model Description

2.4.1 Transition from 2011 to 2013 stock assessment

As with the 2009 and 2011 petrale sole stock assessments, the current model is implemented as a single-area model. The current assessment has been upgraded to a new version of SS (3.24o). A thorough description of the 2013 assessment model is presented separately below; this section linking the two models is intended to clearly identify where substantive changes were made. These changes include:

1. Landings summarized by port of landing rather than area of catch.
2. Combining the Washington and Oregon fleets into a single northern fleet.
3. Use of the Oregon historical landings reconstruction.
4. Specification of the male growth parameters to be directly estimated rather than estimated as an offset to the female growth parameters.
5. Use of an early, pre-1990s, age error matrix for surface ages.
6. Addition of data for 2011 and 2012.

2.4.2 Summary of data for fleets and areas

Fishery removals were divided among 4 fleets: 1) winter North trawl, 2) summer North trawl, 3) winter South trawl, and 4) summer South trawl. Landings for the North fleet are defined as fish landed in Washington and Oregon ports. Landings for the South fleet are defined as fish landed in California ports. Other removals are very small and are included in the trawl fishery removals. The data available for each fleet are described in Table 3.

2.4.3 Modeling software

This assessment used the Stock Synthesis 3 modeling framework written by Dr. Richard Methot at the NWFSC. The most recent version (SS-V3.24o) was used, since it included improvements and corrections to older versions (Methot 2007).

2.4.4 Data weighting

Indices of relative abundance all had variance estimates generated as part of the analysis of raw catch data. These variances are converted to standard deviations in log space for use in the model; additional variances for the indices of abundance were estimated inside the model. The number of trawl tows was used as the initial input sample sizes for length and marginal age compositional data. The number of fish aged was used as the input sample sizes for the survey conditional length-at-age compositions.

This assessment follows the iterative re-weighting approach to developing consistency between the input composition sample sizes (or standard errors) and the effective sample sizes based on model fit. This approach attempts to reduce the potential for particular data sources to have a disproportionate effect on total model fit, while creating estimates of uncertainty that are commensurate with the uncertainty inherent in the input data. Iterative re-weighting was applied to all compositional data. This consisted of comparing the mean input sample size for compositional data with the mean effective sample size based on model fit. A single iteration was completed using a multiplicative scalar to tune the input sample sizes for all length- or age-compositions for a given fleet or survey such that the ratio between the input sample sizes and the model effective sample sizes were approximately one (Stewart et al. In prep.).

A second weighting issue arises when both length and age data are included from the same individual fish and samples. In this case, it is appealing to treat the age data as conditional to the length observations, as for the survey data, to avoid duplication of information. However, due to unacceptably long run times, this approach was not used for the commercial age samples. Instead the lambda values (a direct multiplier on the likelihood component), were reduced to 0.5 for length and age data for fleets where both types of data are available. This is consistent with many other west coast groundfish assessments. Sensitivity to completing the iterative re-weighting of compositional data and then adjusting the lambdas to 0.5 and vice-versa produced nearly identical model results.

The value of σ_R was determined using an iterative procedure to ensure that the value of σ_R assumed by the assessment model and the empirical variance in recruitment were self-consistent. This involved setting σ_R to an initial value, fitting the model and calculating the variance of the recruitment deviations for the years for which recruitments are estimated in the model, then replacing the assumed value of σ_R by the calculated value. Very little iterative reweighting was necessary for σ_R.

2.4.5 Priors

Priors were applied only to parameters for steepness (Figure 55) and natural mortality (Figure 56). The steepness prior is based on the Myers (Myers et al. 1999) meta-analysis of flatfish steepness and the natural mortality prior is based on a meta-analysis completed by Hamel (In prep.).

2.4.6 General model specifications

Stock synthesis has a broad suite of structural options available. Where possible, the ‘default’ or most commonly used approaches are applied to this stock assessment. The assessment is sex-specific, including the estimation of separate growth curves, natural mortality, and selectivity for males and females. Therefore, the assessment only tracks female spawning biomass for use in calculating stock status.

This is a coast-wide assessment that captures seasons and regions using fleets to structure landings. The time-series of landings begins during 1876, at the documented start of the fishery, so the stock is assumed to be in equilibrium at the beginning of the modeled period. The sex-ratio at birth is fixed at 1:1, although by allowing increased natural mortality for males, size-based selectivity, and dimorphic growth, the sex ratio can vary.

The internal population dynamics include ages 0-40, where age 40 is the ‘plus-group’. As there is little growth occurring at age 40, the data use a plus group of age 17; there are relatively few observations in the age compositions that are greater than age 17.

The following likelihood components are included in this model: catch, indices, discards, mean weight of the discards, length compositions, age compositions, recruitments, parameter priors, and parameter soft bounds. See the SS technical documentation for details (Methot and Wetzel 2013).

Model data, control, starter, and forecast files can be found in Appendices D-G.

2.4.7 Estimated and fixed parameters

A full list of all estimated and fixed parameters is provided in Table 13. Time-invariant, sex-specific growth is estimated in this assessment with the length at age 1 assumed to be equal for males and females. The log of the unexploited recruitment level for the Beverton-Holt stock-recruit function is treated as an estimated parameter. Annual recruitment deviations are estimated beginning in 1845 in order to obtain more reasonable estimates of uncertainty in recruitment variability (and therefore derived quantities such as unfished spawning biomass) in the early years of the model. Asymptotic selectivity is used for both the triennial and NWFSC surveys and for all fishing fleets in the base case model. Selectivity and retention for the fishing fleets is modeled as time-varying using time blocks (Table 14). The survey catchability parameters are calculated analytically (set as scaling factors) such that the estimate is median unbiased, which is comparable to the way q is treated in most groundfish assessments. The commercial CPUE catchability and power parameters are estimated.

2.5 Model Selection and Evaluation

2.5.1 Key assumptions and structural choices

All structural choices for stock assessment models are likely to be important under some circumstances. In this assessment these choices are generally made to 1) be as objective as possible, 2) follow generally accepted methods of approaching similar models and data and 3) address the previous STAR panel concerns. The relative effect on assessment results of each of these choices is often unknown; however an effort is made to explore alternate choices through sensitivity analysis. Major choices in the structuring of this stock assessment model include a coast-wide model with seasonal fleet structure for two regions, north and south, splitting the triennial survey into an early and late time period, and estimates of selectivity and retention curves for each fleet.

2.5.2 Alternate models explored

Comparison of key model assumptions, include comparisons based on nested models (e.g., asymptotic vs. domed selectivity, constant vs. time-varying selectivity). Many variations on the base case model were explored during this analysis; only the most relevant and recent are reported in this document. Some of these are reported as sensitivity and retrospective analyses. Prior to the STAR panel, detailed exploration was made to evaluate:

1. Estimation of natural mortality with and without a prior.
2. Estimation of the stock-recruitment steepness as well as values for h fixed at 0.78 and 0.91, based on the 12.5 and 87.5 midpoints of the lower 25% probability and upper 25% probability regions from the base model.
3. Tuning of composition sample sizes and interaction with the choice of composition lambdas.
4. The period over which recruitment deviations are estimated.
5. Time varying, combined female and male versus sex specific selectivity, and asymptotic versus dome-shaped selectivity for fishing fleets and surveys.
6. The tuning of recruitment variability.
7. Commercial age data and aging error estimates.
8. Revised commercial CPUE indices and the inclusion of the summer commercial CPUE.
9. The choice of 1 cm versus 2 cm bins for length data.
10. The use of an early, pre 1990s, surface age error matrix compared to a later surface age error matrix.
11. Landings summarized by port of landing rather than area of catch.
12. Combining the Washington and Oregon fleets into a single fleet or separate fleets.
13. Use of the Oregon historical landings reconstruction.
14. Specification of the male growth parameters to be directly estimated rather than estimated as an offset to the female growth parameters.
15. The impact of the 2012 NWFSC survey data on derived model outputs.
16. Time blocking of retention parameters.
17. Estimation of the NWFSC survey added standard deviation parameter (went to zero).
18. Fleet structure such that the model with 4 fleets, WA and OR combined into a single northern fleet, retained separate age and length compositions for the WA and OR compositions with selectivity mirrored.
19. Model structure similar to the 2011 assessment with 6 fleets, winter and summer fleets for WA, OR, and CA, respectively.

2.5.3 Convergence

Convergence testing through use of over dispersed starting values often requires very extreme values to actually explore new areas of the multivariate likelihood surface. For this reason, a good target for convergence testing is to ‘jitter’ or randomly adjust starting values between reasonable upper and lower bounds by a factor. Jitter is a SS option that allows for the generation of a uniform random number equal to the product of the input value and the range between upper and lower parameter bounds for each parameter. These random numbers are then added to initial parameter values in the input files and the model minimization started at these new conditions. The SS jitter option was used to explore the identification of a global best estimate for the base model and none of these trials found a different global minimum. A total of 100 jittered model runs, using a jitter value of 0.01 resulted in 87% of the model runs returning to the base case and 13% finding local minima. These results, in conjunction with other convergence checks, indicate that it is likely that the base case model result represents the global minimum.

2.6 Base-Model Results

The biological parameters estimated from the base-case model (Table 15, Figure 57) are reasonable and are similar to those estimated in past assessments for petrale sole (Hatuch et al. 2009, Haltuch et al. 2011). Female and male petrale sole have similar growth trajectories until about age 5; beyond age 5, females grow to a maximum size of approximately 60 cm while males grow to approximately 45 cm (Figure 57). Both sexes show a similar distribution of lengths-at-age and relative CVs at age. Natural mortality for females is estimated to be lower, 0.16, compared to males, 0.18 (Table 16). This difference in sex-specific natural mortality suggests that the sex ratios will be dominated by females at older ages.

Estimated selectivity curves for the NWFSC and triennial surveys were generally similar, although in the later years, the triennial survey selected a slightly higher fraction of small petrale sole than in the early years (Figure 58 -Figure 63). The catchability values for the NWFSC and the early and late triennial surveys are different, 3.36 and 0.55 and 0.72, respectively (Table 16). The catchability estimates are similar to those estimated in past assessments. A power function was used to relate the winter commercial CPUE indices to the population size. The estimates of the Beta parameters for the winter north and winter south are -0.22 and -1.01, respectively (Table 16). These values are lower than those estimated in the 2011 stock assessment but given the ~95% confidence intervals suggest that the model cannot clearly discriminate between estimates of *Beta* greater than or less than zero (Table 16). However, the revised commercial CPUE indices explain a greater proportion of the variability in the commercial data due to the inclusion of targeting covariates and show a less marked increase at the end of the time series. Furthermore, this assessment models the decrease in petrale effort that took place between 2003 and 2004 due to the vessel buyback program with a time step in *q* between these years (P. Leipzip, pers. comm.), providing an alternative persective on changes in petrale winter commercial CPUE.

Selectivity curves for the fishing fleets largely showed, as expected, a tendency towards larger fish being caught in the winter fisheries and smaller fish being captured in the summer fisheries (Figure 64 -Figure 71). Time blocks were implemented to account for some of the residual patterns in the composition data that are likely due to the impact of changing management regulations. Time blocks beginning in 1973, 1983, 1993, 2003, and 2011 are used to estimate different selectivity curves for each fleet and sex (Figure 72 -Figure 79). These time blocks were chosen based on changes in fishing practices, the timing of management measures implemented for the groundfish fishery (Appendix C), and the implementation of the trawl ITQ program. Similarly to selectivity, time blocks were also implemented for fishery retention to account for management impacts driving changes in discard practices (Figure 80 -Figure 87). Time blocks were implemented for data collected during the early years of the WCGOP observer program (2003-2008 for summer and 2003-2009 for winter), the period of time in which catch limits were decreased and the fishery was being declared overfished (2009-2010 for summer and 2010 for winter), and the implementation of the trawl IFQ program (2011-2012). During the 2011-2012 IFQ period discards in the winter fishery are essentially zero and the discard rates for the summer fisheries are very small (Table 9).

The base-case model was able to fit the triennial and NWFSC fishery independent indices of abundance, as well as the winter commercial CPUE indices well (Figure 88 -Figure 92). The estimated additional standard deviations for the early triennial and late triennial were 0.16 and 0.19, respectively (Table 16). The estimated additional standard deviations for the winter north and winter south indices in earlier model runs were deemed to be to small incomparison to those from the surveys. Therefore, the maximum standard deviation from the NWFSC survey was added to the bootstrap standard errors from the CPUE analysis. Fits to the fishery independent length and age distributions are good (Figure 93 -Figure 94Figure 105). Slight residual patterns in the last few years of NWFSC survey compositions (Figure 95 -Figure 96, and Figure 104 -Figure 105) suggest that there are proportionally more small/young fish in the population than expected.

The discard rates for petrale sole are generally quite small, resulting in small values for the standard deviations around the weights. The standard deviations on the discard ratios, particularly those that had only partial observer coverage during 2003-2010, WCGOP data are likely underestimates; therefore a small additional standard deviation is added to the estimates provided by the WCGOP. Model fits to the discard rates are generally good, with the exception of some observations for the summer south fleet (Figure 106 -Figure 109). The time series of estimated total discards from the model were an order of mangnitude less than the landed catches. The fits to the average weight of the discarded catch and the summer fleets and WCGOP discard length compositions are good (Figure 110 -Figure 113). Fits to the Pikitch discard length compositions are poor, but the sample sizes are very small (Figure 114-Figure 115) but fits to the WCGOP length compositions are good (Figure 116).

The model fits the time aggregated fishery dependent length compositions well even though it fails to fit some specific years during periods of strong recruitments and early in the data when a higher proportion of large fish are observed in the population (Appendix H). The Pearson residuals reflect the noise in the data both within and between years. The model does not fit the time aggregated fishery age compositions as well as the lengths, in many cases missing the peak of the age distributions (Appendix H). The fishery length- and age-frequency data required some tuning of input sample sizes to make the average effective sample sizes equal to or greater than average input sample sizes (Appendix H). The lack of fit, particularly in the early years of length and age comps could be due to aging methodolies applied at that time as the more recent, improved, age and length data do not show the same lack of fit.

The estimated recruitment deviations show relatively low variability. The recruitment variability was estimated to be 0.34 (input value of 0.4), which is similar to the output values from previous stock assessments. The choice of start year for estimating the main recruitment deviations, 1959, is based on the availability of more reliable length and age composition data. Early recruitment deviations begin in 1845 but are not bias corrected until 1945, shortly before the first age and length compositions became available. The time-series of estimated recruitments shows a weak relationship with the decline in spawning biomass, punctuated by larger recruitments (Table 17-Table 18, Figure 120 -Figure 122). The three weakest recruitments since 1959 are estimated to be from 1986, 1987, and 1992, while the five strongest recruitments since 1959 are estimated to be from 1966, 1998, and 2007-2009 (Table 17-Table 18, Figure 120 -Figure 122). Until 2007 the most recent large recruitment event, is estimated to be in 1998, this was the recruitment that supported the increase in the stock and the fishery through 2005. The estimate of stock-recruitment steepness is 0.86 (Table 16), which is similar to the value estimated in the 2011 assessment.

The biomass time series shows a strong decline from the late-1930s through the mid-1960s, followed by a small recovery through the mid-1970s, and another decline to its lowest point during the early 1990s (Table 17-Table 18, Figure 123). This general pattern of stock decline is coincident with increasing catches and the movement of the fishery from summer fishing in shallow waters to winter fishing on spawning aggregations in deeper waters (Figure 1). From the mid-1990s through 2005 the stock increased slightly, then declined through 2010 (Table 17-Table 18, Figure 123). The stock has increased strongly since 2010 in response to three years of strong recruitment.

2.7 Uncertainty and Sensitivity Analyses

The base-case assessment model includes parameter uncertainty from a variety of sources, but underestimates the considerable uncertainty in recent trend and current stock status. For this reason, in addition to asymptotic confidence intervals (based upon the model's analytical estimate of the variance near the converged solution), two alternate states of nature regarding the female rate of natural mortality are presented in a decision table. Much additional exploration of uncertainty was performed prior to and during the STAR panel. Some of that exploration of other sources of uncertainty is provided below.

2.7.1 Sensitivity analysis

Sensitivity analysis was performed to determine the model behavior under different assumptions than those of the base case model. The model provided highly consistent behavior in the numerous sensitivity model runs that were explored. Results from the base case and sensitivity runs are shown in Table 19 and selected models in Figure 125 -Figure 126. The sensitivity model runs produce similar trajectories of stock decline and recovery, with the estimates of unfished biomass falling within the 95% confidence intervals from the base model run. The base stock status was estimated at 22.3% while the model sensitivities ranged from 22.1% to 24.8%. The largest range in results was obtained from the model runs with low and high values of female M that were used as the axis of uncertaintly for the decision table (Table 19, Figure 125). Sensitivities exploring the treatmentof the winter commercial CPUE were all generally similar to the base model results (Table 19, Figure 126).

Many model runs were completed to explore alternative selectivity options. Model runs exploring non-time varying commercial selectivity failed to fit the composition data well and were not pursed further. Model runs including time varying selectivity for the commercial fleets as random walks, rather than time blocks as in the base model, resulted in long run times (~1.5 hours without a hessian), had problems converging, poor gradients, and were slightly more pessimistic than the model sensitivities presented in this document. Model runs exploring dome-shaped selectivity for the surveys clearly supported asymptotic selectivity. Model runs exploring dome-shaped selectivity for the commercial fleets resulted in very long run times (generally greater than 2.5 hours without a hessian), also had convergence problems, and poor gradients. Furthermore model runs investigating dome-shaped selectivity produced inconsistent results by sex and fleet. None of the model runs investigating alternative options for modeling selectivity were deemed to outperform the base case model.

2.7.2 Retrospective analysis

A retrospective analysis was conducted by running the model using data only through 2008, 2009, 2010, 2011, and 2012 (Table 20, Figure 127). The retrospective model runs were nearly identical to the base model, well within the 95% confidence levels from the current base model. The stock depletion in a given year is similar across retrospective model runs.

2.7.3 Historical assessment analysis

Comparisons between the base model estimates for spawning biomass and stock depletion from assessments conducted during 2005, 2009, and 2011 are similar, with trends at the end of each time series being driven by the available data (Figure 128). The 1999 stock assessment started during the late 1970s, after the bulk of the removal from the stock has already taken place, and while trends in spawning biomass are similar, estimates of stock depletion are much higher due to this shifting baseline.

2.7.4 Likelihood profiles

Likelihood profiles for steepness and female natural mortality were completed to investigate the uncertainty in the estimates of *h* and female *M* (Figure 129 -Figure 130). Plausible values for *h* range from approximately 0.7 to 1.0 while values for female *M* range from approximately 0.12 to 0.22. The length and age composition data most strongly inform the estimates of *h* and *M*, while the indices suggest a lower value for *h*. Likelihood profiles for R_o also show the length and age composition data more strongly informing the estimate of R_o, with the indices suggesting a higher value for R_o (Figure 131). Evaluating R_o likelihood profiles for likelihood components for each fleet/survey provided mixed results (Figure 132) and was hard to interpret. The indices generally suggested larger values, except for the NFWSC survey index which suggests a lower value. Ages from the winter south fleet trend towards higher values, while the ages from the other fleets/surveys provide little information regarding R_o or trend towards lower values. Lengths from the early triennial and NWFSC surveys show opposite trends compare do the rest of the fleets/surveys.

3 Rebuilding parameters

The petrale sole stock has been declared overfished and is being managed under a rebuilding plan that essentially impliments the current flatfish 25:5 control rule. See both this stock assessment as well as the most recent rebuilding plan for petrale sole for further information (Haltuch 2011).

4 Reference Points

The 2009 stock assessment estimated petrale sole to be at 11.6% of unfished spawning stock biomass in 2010. Based on the 2009 stock assessment, the 2010 coast-wide ACL was reduced to 1,200 mt to reflect the overfished status of the stock and the 2011 coast-wide OFL and ACL were set at 1,021 mt and 976 mt, respectively (Table 21). Recent coast-wide annual landings have not exceeded the ACL. The 2005, 2009, and 2011 stock assessments estimated that petrale sole have been below 25 percent of unfished biomass from the 1960s until recently, with estimated harvest rates in excess of a fishing mortality rate of $F_{30\%}$. The length of time that the petrale sole stock had been below the 25 percent of unfished level while sustaining relatively stable annual landings lead the 2009 STAR panel and SSC to investigate new reference points for all flatfish managed by the PFMC. The end result is that new reference points were specified for flatfish. The new reference points are as follows: the target reference point is 25 percent of the unfished biomass, the overfished reference point is 12.5 percent of the unfished level, the limit reference point is 5% of the unfished level, and the F target is $F_{30\%}$. The 2011 assessment continued to estimate that petrale sole have been below the $SB_{25\%}$ management target since the 1960s and below the new overfished threshold between the early 1980s and the early 2000s with fishing mortality rates in excess of the current F-target for flatfish of $SPR_{30\%}$ since the mid-1930s (Figure 133 -Figure 134). This 2013 assessment is consistent with the previous two assessments for petrale sole.

While the base model indicates that the spawning biomass was generally below 25% of the unfished level between the 1960s and 2013, the total biomass of the stock has increased since 2010 as a large recruitment(s) during the late 2000s move into the population (Figure 135). The estimated relative depletion level in 2013 is 22.3% (~95% asymptotic interval: ±15.1% - 29.5%, ~ 75% interval based on the range of states of nature: 18.2% - 27.6%), 7,233 mt (~95% asymptotic interval: 5,668 – 8,796 mt, states of nature interval: 6,800 – 7,846 mt) of female spawning biomass in the base model (Table 21). Unfished spawning stock biomass was estimated to be 32,425 mt in the base case model. The target stock size (SB25%) is 8,106 mt which gives a catch of 2,749 mt. Current F (catch/biomass of age-3 and older fish) is estimated to have been 0.08 during 2012. Model estimates of spawning biomass at MSY are slightly lower than those specified under the current harvest control rule. Maximum sustained yield (MSY) applying recent fishery selectivity and allocations was estimated at 2,760 mt, occurring at a spawning stock biomass of 7,146 mt (SPR = 0.25).

5 Harvest Projections and Decision Tables

The forecast of stock abundance and yield was developed using the base model. The total catches in 2013 and 2014 are set to the PFMC adopted ACLs (Table 21). The exploitation rate for 2015 and beyond is based upon an SPR of 30%. The 25:5 control rule reduces forecasted yields below those corresponding to

$F_{30\%}$ if the stocks are estimated to be lower than the management target of $SB_{25\%}$. The average 2011-2012 exploitation rate was used to distribute catches among the fisheries.

Current medium-term projections of expected petrale sole catch, spawning biomass and depletion from the base model using the 25-5 control rule predict an increasing trend in abundance and catch through 2016 followed by a small decline as spawning biomass and stock depletion stabilize in later years, with ACL values for 2015 set at 2,828 mt under the 25-5 harvest policy (Table 21). The stock is expected to remain above the target stock size of $SB_{25\%}$ during the projection period, assuming average recruitment based on the stock-recruit curve.

Uncertainty in the forecasts is based upon the three states of nature agreed upon at the STAR panel. The states of nature were based on the likelihood profile of female M, chosen using a change of 1.2 NLL units (75% interval) from the minimum value to correspond to the midpoints of the lower 25% probability and upper 25% probability regions, from the base model and are low (0.12, rounded to the second decimal place) and high (0.19, rounded to the second decimal place) values for female natural mortality. Each forecast scenario includes random variability in future recruitment deviations. Current medium-term forecasts based on the alternative states of nature also project that the stock, under the current control rule as applied to the base model, will increase through 2016-2017 as large recruitments move into the population, reaching peak stock depletion between 25.6% and 35.7%. In and absence of strong recruitments into the future the stock is then expected to decline between 2016-1-2017 and 2024.

Two alternative catch projections were evaluated based on GMT requests, the catches that stabilize the stock at approximately 30% of unfished spawning biomass, and the catches that stabilize the stock at approximately 40% of unfished biomass (Table 22). Both of these scenarios are more conservative than implementing the current control rule, with the second option extending the period of stock inceases allowing for catches ranging between 1,460 mt during 2015 and 2,172 during 2024.

6 Regional Management Considerations

Currently petrale sole are managed using a coast-wide harvest; therefore this assessment does not provide a recommended method for allocating harvests regionally. The resource is modeled as a single stock. There is currently no genetic evidence that there are distinct biological stocks of petrale sole off the U.S. coast and the limited tagging data that describes adult movement suggests that movement may be significant across depth and latitude.

7 Research Needs

Progress on a number of research topics would substantially improve the ability of this assessment to reliably and precisely model petrale sole population dynamics in the future and provide better monitoring of progress toward rebuilding:

1. In the past many assessments have derived historical catches independently. The states of California and Oregon have completed comprehensive historical catch reconstructions. At the time of this assessment, a comprehensive historical catch reconstruction is not available for Washington. Completion of a Washington catch reconstruction would provide the best possible estimated catch series that accounts for all the catch and better resolves historical catch uncertainty for flatfish as a group.
2. Due to limited data, new studies on both the maturity and fecundity relationships for petrale sole would be beneficial.
3. Increased collection of commercial fishery age data as well as re-aging any available historical samples from California would help reduce uncertainty. While some recent age data were made available from California, sample sizes could be increased and this data collection needs to

continue into the future. Without good age data, the ability to estimate year-class strength and the extent of variation in recruitment is compromised.

4. Where possible, historical otolith samples aged using a combination of surface and break-and-burn methods should be re-aged using the break-and-burn method. Early surface read otoliths should also be re-aged using the break and burn method. Historical otoliths aged with a standard method will allow the further evaluation of the potential impacts of consistent under aging using surface methods, changes in selectivity during early periods of time without any composition information, and potential changes in growth.
5. The effect of the implementation of the IFQ (catch shares) program that began during 2011 on fleet behavior, including impacts on discards, fishery selectivity, and fishing locations would benefit from further study.
6. Studies on stock structure and movement of petrale sole, particularly with regard to the winter-summer spawning migration of petrale sole and the likely trans-boundary movement of petrale sole between U.S. and Canadian waters seasonally.
7. The extent of spatial variability on productivity processes such as growth, recruitment, and maturity is currently unknown and would benefit from further research.

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10 Tables

Table 1. Total landed catches (mt) of petrale sole by fleet and season used in the assessment model. See text for a description of sources.

Fishing year	North Winter	North Summer	South Winter	South Summer	Total Winter	Total Summer
1876	0.00	0.00	0.00	1.00	0	1
1877	0.00	0.00	0.00	1.00	0	1
1878	0.00	0.00	0.00	1.00	0	1
1879	0.00	0.00	0.00	1.00	0	1
1880	0.00	0.00	0.00	11.55	0	11.55
1881	0.00	0.00	0.00	22.10	0	22.1
1882	0.00	0.00	0.00	32.65	0	32.65
1883	0.00	0.00	0.00	43.20	0	43.2
1884	0.00	0.00	0.00	53.75	0	53.75
1885	0.00	0.00	0.00	64.30	0	64.3
1886	0.00	0.00	0.00	74.85	0	74.85
1887	0.00	0.00	0.00	85.40	0	85.4
1888	0.00	0.00	0.00	95.95	0	95.95
1889	0.00	0.00	0.00	106.50	0	106.5
1890	0.00	0.00	0.00	117.05	0	117.05
1891	0.00	0.00	0.00	127.60	0	127.6
1892	0.00	0.00	0.00	138.15	0	138.15
1893	0.00	0.00	0.00	148.71	0	148.71
1894	0.00	0.00	0.00	159.26	0	159.26
1895	0.00	0.00	0.00	169.81	0	169.81
1896	0.00	0.24	0.00	180.36	0	180.6
1897	0.00	0.20	0.00	190.91	0	191.11
1898	0.00	0.15	0.00	201.46	0	201.61
1899	0.00	0.15	0.00	212.01	0	212.16
1900	0.00	0.15	0.00	222.56	0	222.71
1901	0.00	0.14	0.00	233.11	0	233.25
1902	0.00	0.14	0.00	243.66	0	243.8
1903	0.00	0.13	0.00	254.21	0	254.34
1904	0.00	0.13	0.00	264.76	0	264.89
1905	0.00	0.13	0.00	275.31	0	275.44
1906	0.00	0.12	0.00	285.86	0	285.98
1907	0.00	0.12	0.00	296.41	0	296.53
1908	0.00	0.11	0.00	306.96	0	307.07
1909	0.00	0.11	0.00	317.51	0	317.62
1910	0.00	0.10	0.00	328.06	0	328.16
1911	0.00	0.10	0.00	338.61	0	338.71
1912	0.00	0.10	0.00	349.16	0	349.26
1913	0.00	0.09	0.00	359.71	0	359.8
1914	0.00	0.09	0.00	370.26	0	370.35
1915	0.00	0.08	0.00	380.81	0	380.89
1916	0.00	0.08	0.00	386.42	0	386.5
1917	0.00	0.08	0.00	526.41	0	526.49
1918	0.00	0.07	0.00	423.85	0	423.92
1919	0.00	0.07	0.00	333.44	0	333.51
1920	0.00	0.06	0.00	230.49	0	230.55
1921	0.00	0.06	0.00	293.76	0	293.82
1922	0.00	0.05	0.00	424.78	0	424.83
1923	0.00	0.05	0.00	427.36	0	427.41

Fishing year	North Winter	North Summer	South Winter	South Summer	Total Winter	Total Summer
1924	0.00	0.05	0.00	532.86	0	532.91
1925	0.00	0.04	0.00	528.47	0	528.51
1926	0.00	0.04	0.00	521.67	0	521.71
1927	0.00	0.04	0.00	632.04	0	632.08
1928	0.00	0.00	0.00	620.09	0	620.09
1929	0.00	1.54	0.00	706.04	0	707.58
1930	0.00	1.23	0.00	658.83	0	660.06
1931	0.00	81.45	63.39	530.88	63.39	612.33
1932	1.99	250.88	36.40	519.91	38.39	770.79
1933	5.96	408.43	38.57	392.08	44.53	800.51
1934	9.93	567.86	139.41	896.36	149.34	1464.22
1935	13.90	649.96	155.38	777.21	169.28	1427.17
1936	15.88	769.79	95.49	431.51	111.37	1201.3
1937	19.75	1051.41	74.53	741.05	94.28	1792.46
1938	27.49	1186.87	47.86	890.00	75.35	2076.87
1939	35.22	1544.54	30.84	1028.96	66.06	2573.5
1940	39.09	1736.58	161.81	596.70	200.9	2333.28
1941	41.40	1802.66	110.81	331.17	152.21	2133.83
1942	46.00	2919.25	24.37	215.56	70.37	3134.81
1943	50.61	2867.31	71.66	344.72	122.27	3212.03
1944	55.21	2046.97	85.53	446.91	140.74	2493.88
1945	59.82	1866.05	101.75	439.34	161.57	2305.39
1946	64.43	2492.36	71.91	1115.57	136.34	3607.93
1947	69.03	1777.99	153.68	1092.66	222.71	2870.65
1948	73.64	2314.74	272.66	1778.02	346.3	4092.76
1949	75.94	1808.65	616.96	1812.18	692.9	3620.83
1950	156.21	2322.24	424.24	1638.09	580.45	3960.33
1951	117.97	1665.62	208.45	992.79	326.42	2658.41
1952	131.01	1390.43	326.31	881.70	457.32	2272.13
1953	46.07	737.10	533.36	981.17	579.43	1718.27
1954	26.56	903.36	800.58	1073.40	827.14	1976.76
1955	57.14	862.59	525.58	1051.75	582.72	1914.34
1956	137.25	759.22	508.30	800.73	645.55	1559.95
1957	170.95	1103.29	527.21	1027.18	698.16	2130.47
1958	99.18	1152.19	567.97	957.29	667.15	2109.48
1959	332.10	946.78	379.04	723.17	711.14	1669.95
1960	240.87	1374.20	519.64	643.74	760.51	2017.94
1961	216.66	1546.63	542.06	1028.73	758.72	2575.36
1962	294.86	1511.89	514.91	859.37	809.77	2371.26
1963	663.29	1038.41	534.03	977.64	1197.32	2016.05
1964	282.32	1090.04	377.62	926.80	659.94	2016.84
1965	370.46	950.39	373.69	852.88	744.15	1803.27
1966	366.06	971.69	324.88	924.63	690.94	1896.32
1967	408.63	793.42	532.28	874.08	940.91	1667.5
1968	284.40	810.62	360.61	870.76	645.01	1681.38
1969	190.34	887.30	421.00	848.00	611.34	1735.3
1970	411.71	1081.31	472.00	1071.00	883.71	2152.31
1971	742.62	882.61	540.00	1016.00	1282.62	1898.61
1972	730.42	1016.88	703.00	1000.00	1433.42	2016.88
1973	497.47	1271.83	417.00	742.00	914.47	2013.83
1974	516.99	1610.53	665.00	893.00	1181.99	2503.53
1975	538.95	1559.16	561.00	901.00	1099.95	2460.16
1976	505.73	951.12	713.00	737.00	1218.73	1688.12

Year	North Winter	North Summer	South Winter	South Summer	Total Winter	Total Summer
1977	682.08	742.77	484.00	495.00	1166.08	1237.77
1978	746.25	1097.75	419.00	801.00	1165.25	1898.75
1979	734.31	1085.56	353.00	945.00	1087.31	2030.56
1980	382.50	976.23	518.00	680.00	900.5	1656.23
1981	760.67	467.91	359.66	895.22	1120.33	1363.13
1982	1041.19	770.69	261.53	502.07	1302.72	1272.76
1983	696.32	935.35	272.60	361.12	968.92	1296.47
1984	415.77	739.01	259.83	328.99	675.6	1068
1985	392.13	552.89	273.26	471.13	665.39	1024.02
1986	474.12	714.44	402.91	355.06	877.03	1069.5
1987	854.04	572.67	311.09	556.08	1165.13	1128.75
1988	742.90	610.43	349.11	411.04	1092.01	1021.47
1989	695.99	583.01	392.60	414.73	1088.59	997.74
1990	640.66	459.82	319.43	372.68	960.09	832.5
1991	792.58	397.34	448.01	310.12	1240.59	707.46
1992	639.53	365.97	271.71	307.26	911.24	673.23
1993	685.39	392.08	237.09	233.99	922.48	626.07
1994	518.13	355.43	245.86	299.41	763.99	654.84
1995	591.37	453.92	235.56	287.43	826.93	741.35
1996	591.03	439.75	405.92	393.94	996.95	833.69
1997	621.05	430.04	447.63	442.28	1068.68	872.32
1998	522.14	577.35	220.73	300.46	742.87	877.81
1999	463.34	504.25	286.80	266.64	750.14	770.89
2000	610.16	585.53	373.62	241.46	983.78	826.99
2001	691.41	596.99	308.34	260.30	999.75	857.29
2002	666.97	713.85	335.16	195.12	1002.13	908.97
2003	544.48	713.44	256.21	179.67	800.69	893.11
2004	1009.91	749.51	177.24	267.16	1187.15	1016.67
2005	963.68	1068.76	337.18	533.41	1300.86	1602.17
2006	537.45	1011.62	125.28	453.54	662.73	1465.16
2007	930.38	536.11	404.35	474.86	1334.73	1010.97
2008	842.46	353.82	519.44	414.02	1361.9	767.84
2009	846.71	641.75	469.66	250.38	1316.37	892.13
2010	258.09	292.34	77.60	120.95	335.69	413.29
2011	221.60	423.11	39.59	77.70	261.19	500.81
2012	406.05	477.71	124.46	107.63	530.51	585.34

Table 2. Recent trend in estimated total petrale sole catch and commercial landings (mt) relative to management guidelines.

Year	OFL (mt) for the Calendar Year	ACL (mt) for the Calendar Year	Commercial Landings (mt) for the Calendar Year	Estimated Total Catch (mt) for the Calendar Year	Estimated Total Catch (mt) for the Fishing Year
2002	2,762	2,762	1,796	2,067	1,911
2003	2,762	2,762	1,931	1,750	1,694
2004	2,762	2,762	1,953	2,249	2,204
2005	2,762	2,762	2,734	2,956	2,903
2006	2,762	2,762	2,609	2,171	2,128
2007	3,025	2,499	2,253	2,373	2,346
2008	2,919	2,499	2,220	2,153	2,130
2009	2,811	2,433	1,767	2,263	2,208
2010	2,751	1,200	797	871	749
2011	1,021	976	928	787	762
2012	1,279	1,160	1,092	1,144	1,116
2013	2,711	2,592			
2014	2,774	2,652			

[1] Estimated total catches reflect the commercial landings plus the model estimated annual discard biomass (commercial landings * retained catch/total catch) for the fishing year. The total amounts of discard may differ from those reported in the NWFSC reports on total catch for some years.

Table 3. Summary of data sources available in 2013.

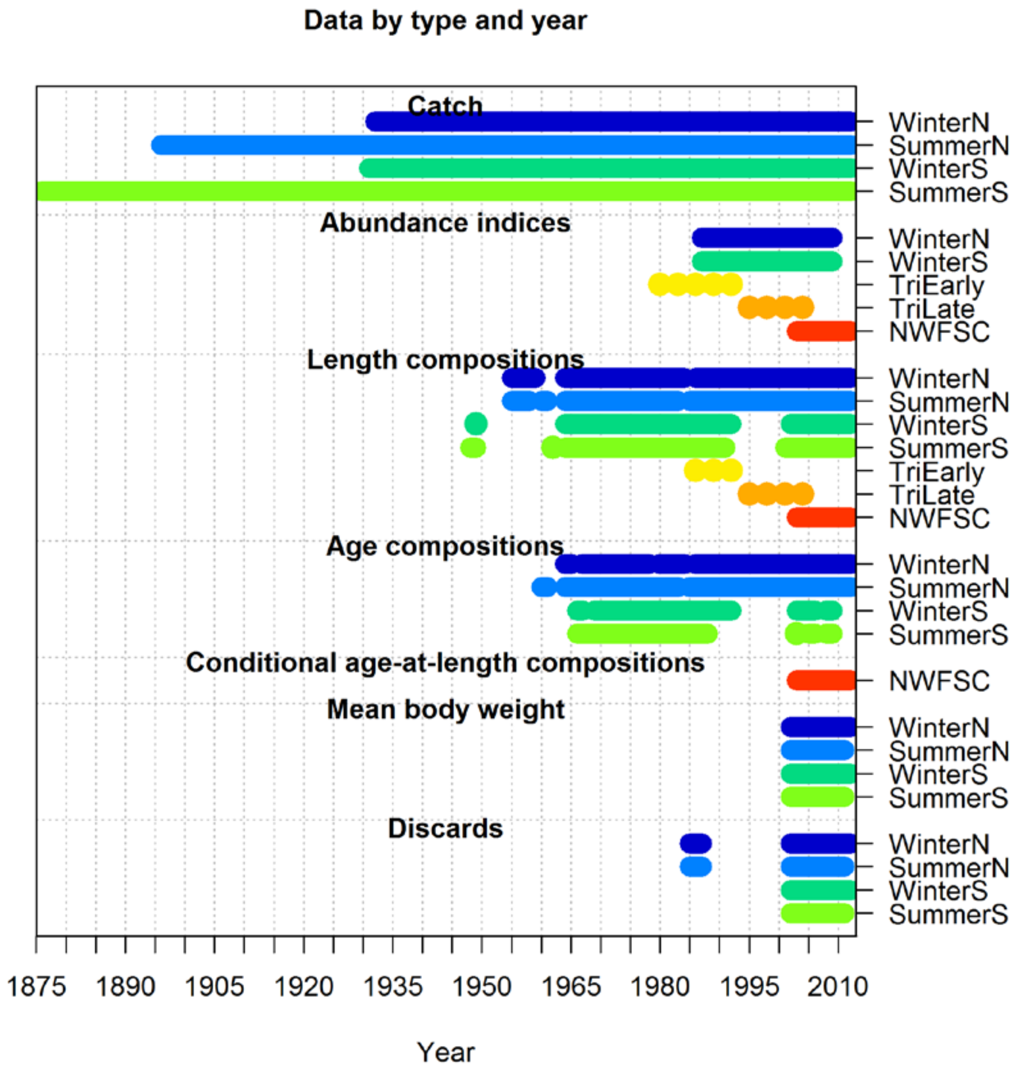


Table 4. Summary of the tow data from the NWFSC survey.

Year	Number of tows	Number of tows with petrale	Percent of tows with petrale
2003	541	198	36.6%
2004	471	216	45.9%
2005	637	279	43.8%
2006	642	248	38.6%
2007	688	258	37.5%
2008	681	258	37.9%
2009	682	279	40.9%
2010	713	325	45.6%
2011	697	323	46.3%
2012	701	299	42.7%

Year	Number of tows with lengths	Percent petrale tows with lengths	Number of lengths
2003	197	99%	2837
2004	213	99%	3371
2005	277	99%	4551
2006	248	100%	3743
2007	258	100%	3435
2008	258	100%	3053
2009	278	100%	3440
2010	325	100%	6052
2011	322	100%	6187
2012	298	100%	5407

Year	Number of tows with ages	Percent petrale tows with ages	Number of ages
2003	173	87%	765
2004	168	78%	725
2005	236	85%	750
2006	237	96%	783
2007	197	76%	695
2008	226	88%	749
2009	259	93%	779
2010	297	91%	801
2011	291	90%	804
2012	272	91%	790

Table 5. Indices of biomass (mt) and standard errors (of the natural log of biomass).

	Triennial		NWFSC	
Year	Estimate (B)	SE(logB)	Estimate (B)	SE(logB)
1980	1864	0.329		
1981				
1982				
1983	2300	0.128		
1984				
1985				
1986	2193	0.146		
1987				
1988				
1989	3234	0.109		
1990				
1991				
1992	2126	0.117		
1993				
1994				
1995	2407	0.148		
1996				
1997				
1998	3548	0.112		
1999				
2000				
2001	3832	0.115		
2002				
2003			18298	0.156
2004	9713	0.141	27552	0.221
2005			21671	0.132
2006			19572	0.149
2007			20789	0.173
2008			15597	0.134
2009			15784	0.141
2010			22574	0.137
2011			30367	0.127
2012			36852	0.152

Table 6. Summary of the tow data from the Triennial survey.

Year	Number of tows	Number of tows with petrale	Percent of tows with petrale
1980	301	139	46
1983	479	250	52
1986	483	268	55
1989	440	275	63
1992	421	251	60
1995	441	209	47
1998	468	291	62
2001	466	256	55
2004	383	244	64

Year	Number of tows with lengths	Percent petrale tows with lengths	Number of lengths
1980	1	1	16
1983	2	1	30
1986	36	13	540
1989	141	51	1419
1992	116	46	1015
1995	145	69	1369
1998	236	81	2624
2001	254	99	3016
2004	239	98	4676

Table 7. The estimates of bias and imprecision (SD of observed age at true age) from the best fit models that are used for the various age reading methods in the assessment.

	CAP								WDFW					
	Break and Burn		Surface		Surface pre 1990		Combo		Break and Burn		Surface		Combo	
True Age	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev
0.5	0.262	0.169	0.159	0.119	0.000	0.000	0.475	0.127	0.503	0.151	0.132	0.103	0.488	0.133
1.5	1.346	0.169	1.271	0.119	0.711	0.000	1.425	0.127	1.510	0.151	1.323	0.103	1.465	0.133
2.5	2.406	0.229	2.353	0.179	2.020	0.082	2.375	0.254	2.516	0.301	2.470	0.206	2.442	0.267
3.5	3.442	0.293	3.406	0.246	3.241	0.168	3.325	0.382	3.522	0.452	3.577	0.309	3.418	0.400
4.5	4.454	0.363	4.429	0.320	4.381	0.259	4.274	0.509	4.529	0.602	4.643	0.413	4.395	0.534
5.5	5.443	0.439	5.424	0.402	5.444	0.354	5.224	0.636	5.535	0.753	5.672	0.516	5.371	0.667
6.5	6.409	0.521	6.393	0.492	6.435	0.456	6.174	0.763	6.541	0.903	6.663	0.619	6.348	0.801
7.5	7.353	0.610	7.335	0.592	7.361	0.562	7.124	0.890	7.548	1.054	7.618	0.722	7.325	0.934
8.5	8.275	0.706	8.251	0.703	8.224	0.675	8.074	1.017	8.554	1.204	8.539	0.825	8.301	1.068
9.5	9.177	0.810	9.142	0.825	9.030	0.793	9.024	1.145	9.560	1.355	9.427	0.928	9.278	1.201
10.5	10.058	0.923	10.008	0.959	9.782	0.919	9.974	1.272	10.567	1.505	10.283	1.031	10.255	1.335
11.5	10.918	1.045	10.851	1.108	10.483	1.051	10.924	1.399	11.573	1.656	11.108	1.135	11.231	1.468
12.5	11.759	1.177	11.671	1.273	11.137	1.190	11.873	1.526	12.579	1.806	11.904	1.238	12.208	1.602
13.5	12.581	1.320	12.469	1.455	11.748	1.337	12.823	1.653	13.586	1.957	12.671	1.341	13.185	1.735
14.5	13.384	1.475	13.244	1.656	12.318	1.492	13.773	1.781	14.592	2.107	13.410	1.444	14.161	1.869
15.5	14.168	1.643	13.999	1.878	12.849	1.656	14.723	1.908	15.599	2.258	14.122	1.547	15.138	2.002
16.5	14.935	1.824	14.733	2.123	13.345	1.828	15.673	2.035	16.605	2.408	14.809	1.650	16.114	2.135
17.5	15.684	2.021	15.447	2.395	13.808	2.010	16.623	2.162	17.611	2.559	15.471	1.753	17.091	2.269
18.5	16.416	2.234	16.141	2.694	14.239	2.202	17.573	2.289	18.618	2.710	16.110	1.857	18.068	2.402
19.5	17.131	2.465	16.816	3.026	14.642	2.405	18.522	2.416	19.624	2.860	16.725	1.960	19.044	2.536
20.5	17.830	2.715	17.473	3.392	15.018	2.618	19.472	2.544	20.630	3.011	17.318	2.063	20.021	2.669
21.5	18.513	2.985	18.112	3.796	15.369	2.844	20.422	2.671	21.637	3.161	17.890	2.166	20.998	2.803
22.5	19.180	3.278	18.733	4.243	15.696	3.081	21.372	2.798	22.643	3.312	18.441	2.269	21.974	2.936
23.5	19.832	3.595	19.338	4.737	16.001	3.332	22.322	2.925	23.649	3.462	18.972	2.372	22.951	3.070
24.5	20.470	3.938	19.926	5.283	16.286	3.597	23.272	3.052	24.656	3.613	19.485	2.475	23.927	3.203
25.5	21.092	4.310	20.497	5.887	16.552	3.876	24.222	3.180	25.662	3.763	19.979	2.579	24.904	3.337
26.5	21.700	4.712	21.054	6.553	16.800	4.170	25.171	3.307	26.668	3.914	20.455	2.682	25.881	3.470
27.5	22.295	5.148	21.595	7.290	17.031	4.481	26.121	3.434	27.675	4.064	20.913	2.785	26.857	3.604
28.5	22.876	5.620	22.121	8.104	17.247	4.808	27.071	3.561	28.681	4.215	21.356	2.888	27.834	3.737

	CAP								WDFW					
	Break and Burn		Surface		Surface pre 1990		Combo		Break and Burn		Surface		Combo	
True Age	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev	Bias	Stdev
29.5	23.443	6.131	22.633	9.004	17.448	5.154	28.021	3.688	29.688	4.365	21.782	2.991	28.811	3.871
30.5	23.998	6.684	23.130	9.998	17.636	5.519	28.971	3.815	30.694	4.516	22.193	3.094	29.787	4.004
31.5	24.539	7.283	23.615	11.097	17.811	5.903	29.921	3.943	31.700	4.666	22.589	3.197	30.764	4.137
32.5	25.069	7.932	24.086	12.312	17.975	6.309	30.871	4.070	32.707	4.817	22.971	3.301	31.740	4.271
33.5	25.586	8.634	24.544	13.653	18.127	6.737	31.821	4.197	33.713	4.967	23.340	3.404	32.717	4.404
34.5	26.092	9.395	24.989	15.136	18.270	7.188	32.770	4.324	34.719	5.118	23.695	3.507	33.694	4.538
35.5	26.586	10.218	25.423	16.775	18.403	7.665	33.720	4.451	35.726	5.268	24.037	3.610	34.670	4.671
36.5	27.068	11.110	25.844	18.586	18.527	8.167	34.670	4.579	36.732	5.419	24.367	3.713	35.647	4.805
37.5	27.540	12.076	26.254	20.587	18.642	8.697	35.620	4.706	37.738	5.570	24.685	3.816	36.624	4.938
38.5	28.001	13.121	26.653	22.799	18.750	9.256	36.570	4.833	38.745	5.720	24.991	3.919	37.600	5.072
39.5	28.451	14.253	27.041	25.243	18.851	9.846	37.520	4.960	39.751	5.871	25.287	4.023	38.577	5.205
40.5	28.891	15.479	27.418	27.944	18.945	10.468	38.470	5.087	40.757	6.021	25.572	4.126	39.553	5.339

Table 8. Pikitch discard ratios.

Fishing	North winter		North summer	
Year	Mean	SD	Mean	SD
1985	0.0222	0.1103	0.0346	0.0419
1986	0.0215	0.1162	0.0343	0.0432
1987	0.027	0.1186	0.0315	0.045

Table 9. WCGOP petrale sole discard ratios (discard/discard+retained) and bootstrap estimated standard deviations for the commercial fisheries used in the model.

Fishing	North winter		North summer		South winter		South summer	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2002	0.0077	0.0034	0.1856	0.0253	0.0372	0.0244	0.0569	0.0158
2003	0.01	0.0064	0.1111	0.0252	0.0062	0.0026	0.0325	0.0126
2004	0.0019	0.0008	0.0843	0.0244	0.0526	0.0521	0.0343	0.0153
2005	0.0013	0.0009	0.0421	0.0112	0.0069	0.0071	0.0122	0.0035
2006	0.0131	0.0073	0.078	0.0171	0.0598	0.0446	0.036	0.0157
2007	0.0037	0.0015	0.1138	0.0232	0.0194	0.0139	0.061	0.0209
2008	0.0275	0.0146	0.0502	0.0167	0.0099	0.0056	0.0259	0.0147
2009	0.0253	0.0151	0.2018	0.0673	0.0221	0.0147	0.0233	0.0082
2010	0.1971	0.0444	0.1037	0.0308	0.2584	0.0717	0.0554	0.0119
2011	0.0017	0	0.037	0	0.0009	0	0.0411	0
2012	0.0006	0	0	0	0.0046	0	0	0

Table 10. WCGOP petrale sole mean weight of the discards.

Fishing	North winter		North summer		South summer		South winter	
Year	Mean	CV	Mean	CV	Mean	CV	Mean	CV
2002	0.411	0.471	0.241	0.453	0.410	0.658	0.190	0.738
2003	0.297	0.453	0.234	0.546	0.178	0.407	0.175	0.409
2004	0.332	0.477	0.274	0.368	0.309	0.394	0.183	0.472
2005	0.316	0.538	0.304	0.412	0.270	0.664	0.252	0.438
2006	0.417	0.624	0.267	0.447	0.284	0.668	0.318	0.643
2007	0.401	0.314	0.259	0.399	0.217	0.470	0.366	0.629
2008	0.522	0.443	0.241	0.475	0.300	0.445	0.219	0.427
2009	0.416	0.453	0.217	0.525	0.554	0.416	0.213	1.049
2010	0.601	0.547	0.258	0.544	0.417	0.969	0.183	0.369
2011	0.276	0.516	0.246	0.530	0.326	0.132	0.246	0.666
2012	0.264	0.512	0.000	0.000	0.202	0.687	0.000	0.000

Table 11. Summary of number of tows generating length-frequency distributions used in the assessment model for the trawl fleets.

Year	North Winter	Year	North Summer	Year	South Winter	Year	South Summer
1955	1	1955	3	1949	10	1948	4
1956	1	1956	8	1964	1	1949	4
1957	10	1957	11	1965	2	1962	3
1958	1	1958	3	1966	8	1964	22
1959	2	1960	2	1967	20	1965	14
1964	4	1961	1	1968	11	1966	33
1965	3	1964	3	1969	14	1967	44
1966	2	1965	2	1970	13	1968	87
1967	4	1966	37	1971	7	1969	49
1968	15	1967	44	1972	23	1970	29
1969	14	1968	66	1973	12	1971	37
1970	11	1969	62	1974	31	1972	39
1971	12	1970	64	1975	11	1973	41
1972	4	1971	24	1976	12	1974	35
1973	4	1972	33	1977	8	1975	19
1974	5	1973	25	1978	17	1976	26
1975	12	1974	56	1979	7	1977	38
1976	3	1975	27	1980	6	1978	33
1977	2	1976	6	1981	36	1979	13
1978	4	1977	21	1982	26	1980	81
1979	2	1978	21	1983	26	1981	65
1980	9	1979	24	1984	13	1982	34
1981	10	1980	44	1985	13	1983	33
1982	5	1981	37	1986	10	1984	19
1983	4	1982	17	1987	20	1985	17
Year	North Winter	Year	North Summer	Year	South Winter	Year	South Summer

1984	3	1983	1	1988	12	1986	32
1986	3	1985	5	1989	18	1987	29
1987	7	1986	9	1990	4	1988	12
1988	4	1987	16	1991	24	1989	18
1989	10	1988	8	1992	9	1990	2
1990	4	1989	13	2002	15	1991	2
1991	11	1990	11	2003	7	2001	9
1992	4	1991	7	2004	12	2002	10
1993	7	1992	11	2005	9	2003	30
1994	9	1993	8	2006	26	2004	15
1995	8	1994	9	2007	42	2005	36
1996	3	1995	2	2008	58	2006	47
1997	5	1996	4	2009	62	2007	103
1998	5	1997	12	2010	31	2008	97
1999	9	1998	22	2011	18	2009	62
2000	14	1999	15	2012	32	2010	52
2001	18	2000	24			2011	23
2002	9	2001	18			2012	40
2003	20	2002	31				
2004	27	2003	35				
2005	25	2004	30				
2006	16	2005	35				
2007	37	2006	51				
2008	61	2007	46				
2009	43	2008	36				
2010	38	2009	66				
Year	North Winter	Year	North Summer	Year	South Winter	Year	South Summer
2011	33	2010	59				

2012	35	2011	47
		2012	44

Table 12. Summary of the number of tows and the aging agency and aging method applied to generate age-frequency distributions used in the assessment model for the trawl fleets.

North Winter				North Summer				South Winter				South Summer			
Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N
1964	W/O	CAP Early Surface	3	1960	W/O	CAP Early Surface	1	1966	C	CAP Early Surface	8	1966	C	CAP Early Surface	27
1965	W/O	CAP Early Surface	3	1961	W/O	CAP Early Surface	1	1967	C	CAP Early Surface	13	1967	C	CAP Early Surface	11
1967	W/O	CAP Early Surface	4	1964	W/O	CAP Early Surface	2	1969	C	CAP Early Surface	8	1968	C	CAP Early Surface	56
1968	W/O	CAP Early Surface	15	1965	W/O	CAP Early Surface	2	1970	C	CAP Early Surface	10	1969	C	CAP Early Surface	31
1969	W/O	CAP Early Surface	14	1966	W/O	CAP Early Surface	35	1971	C	CAP Early Surface	6	1970	C	CAP Early Surface	29
1970	W/O	CAP Early Surface	8	1967	W/O	CAP Early Surface	44	1972	C	CAP Early Surface	23	1971	C	CAP Early Surface	37
1971	W/O	CAP Early Surface	5	1968	W/O	CAP Early Surface	56	1973	C	CAP Early Surface	12	1972	C	CAP Early Surface	38
1972	W/O	CAP Early Surface	4	1969	W/O	CAP Early Surface	57	1974	C	CAP Early Surface	29	1973	C	CAP Early Surface	38
1973	W/O	CAP Early Surface	4	1970	W/O	CAP Early Surface	61	1975	C	CAP Early Surface	9	1974	C	CAP Early Surface	34
1974	W/O	CAP Early Surface	5	1971	W/O	CAP Early Surface	22	1976	C	CAP Early Surface	12	1975	C	CAP Early Surface	18
1975	W/O	CAP Early Surface	11	1972	W/O	CAP Early Surface	32	1977	C	CAP Early Surface	8	1976	C	CAP Early Surface	23
1976	W/O	CAP Early Surface	3	1973	W/O	CAP Early Surface	24	1978	C	CAP Early Surface	9	1977	C	CAP Early Surface	33
1977	W/O	CAP Early Surface	2	1974	W/O	CAP Early Surface	47	1979	C	CAP Early Surface	5	1978	C	CAP Early Surface	32
1978	W/O	CAP Early Surface	4	1975	W/O	CAP Early Surface	24	1980	C	CAP Early Surface	6	1979	C	CAP Early Surface	11
1980	W/O	CAP Early Surface	7	1976	W/O	CAP Early Surface	5	1981	C	CAP Early Surface	18	1980	C	CAP Early Surface	50

North Winter				North Summer				South Winter				South Summer			

Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N
1981	W/O	CAP Early Surface	3	1977	W/O	CAP Early Surface	19	1982	C	CAP Early Surface	1	1981	C	CAP Early Surface	27
1981	O	CAP Combo	5	1978	W/O	CAP Early Surface	16	1983	C	CAP Early Surface	12	1982	C	CAP Early Surface	18
1982	O	CAP Combo	5	1979	W/O	CAP Early Surface	21	1984	C	CAP Early Surface	6	1983	C	CAP Early Surface	8
1983	O	CAP Combo	3	1980	W/O	CAP Early Surface	38	1985	C	CAP Early Surface	2	1984	C	CAP Early Surface	3
1984	O	CAP Combo	2	1981	O	CAP Combo	37	1986	C	CAP BB	4	1985	C	CAP Early Surface	4
1986	O	CAP BB	3	1982	O	CAP Combo	16	1987	C	CAP BB	10	1986	C	CAP BB	16
1987	O	CAP Combo	7	1983	O	CAP Combo	1	1988	C	CAP BB	5	1987	C	CAP BB	12
1988	O	CAP Combo	4	1985	O	CAP BB	5	1989	C	CAP BB	2	1988	C	CAP BB	6
1989	O	CAP BB	10	1986	O	CAP BB	9	1990	C	CAP BB	2	2003	C	CAP BB	5
1990	O	CAP BB	4	1987	O	CAP Combo	16	1991	C	CAP BB	15	2005	C	CAP BB	10
1991	O	CAP Combo	11	1988	O	CAP Combo	8	1992	C	CAP BB	1	2006	C	CAP BB	7
1992	O	CAP Combo	4	1989	O	CAP BB	12	2003	C	CAP BB	1	2008	C	CAP BB	18
1993	O	CAP Combo	7	1990	O	CAP BB	11	2004	C	CAP BB	1	2009	C	CAP BB	3
1994	O	CAP Combo	9	1991	O	CAP Combo	7	2005	C	CAP BB	3				
1995	O	CAP Combo	8	1992	O	CAP Combo	11	2006	C	CAP BB	2				
1996	O	CAP Combo	3	1993	O	CAP Combo	8	2008	C	CAP BB	3				
1997	O	CAP Combo	5	1994	O	CAP Combo	9	2009	C	CAP BB	4				
North Winter				North Summer				South Winter				South Summer			
Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N

1998	W	WDFW Combo	1	1995	O	CAP Combo	2								
1998	O	CAP BB	1	1996	O	CAP Combo	4								
1998	O	CAP Surface	3	1997	O	CAP Combo	11								
1999	W	WDFW Combo	2	1998	W	WDFW Combo	11								
1999	O	CAP BB	4	1998	O	CAP BB	6								
2000	W	WDFW Combo	5	1998	O	WDFW Combo	5								
2000	O	CAP BB	1	1999	W	WDFW Combo	9								
2001	W	WDFW Combo	6	1999	O	CAP BB	4								
2002	W	WDFW Combo	5	2000	W	WDFW Combo	12								
2002	O	CAP Surface	4	2001	W	WDFW Combo	10								
2003	W	WDFW Combo	5	2001	O	CAP Surface	1								
2003	O	CAP Surface	7	2002	W	WDFW Combo	10								
2004	W	WDFW Combo	7	2002	O	CAP Surface	10								
2004	O	CAP Surface	8	2003	W	WDFW Combo	19								
2005	W	WDFW Combo	5	2003	O	CAP Surface	7								
2006	W	WDFW Combo	5	2004	W	WDFW Combo	18								
2007	W	WDFW Combo	5	2004	O	CAP Surface	6								
North Winter				North Summer				South Winter				South Summer			
Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N	Year	Agency	Method	N
2007	O	CAP BB	4	2005	W	WDFW	18								

						Combo	
2008	W	WDFW Combo	3	2006	W	WDFW Combo	14
2008	O	CAP BB	4	2007	W	WDFW Combo	16
2009	W	WDFW BB	3	2007	O	CAP BB	8
2009	W	WDFW Combo	3	2008	W	WDFW Combo	17
2009	O	CAP BB	28	2008	O	CAP BB	9
2010	W	WDFW BB	4	2009	W	WDFW BB	8
2010	O	CAP BB	21	2009	W	WDFW Combo	1
2011	W	WDFW BB	1	2009	O	CAP BB	31
2011	O	CAP BB	11	2010	W	WDFW BB	4
2012	W	WDFW BB	2	2010	O	CAP BB	30
2012	O	CAP BB	12	2011	W	WDFW BB	11
				2011	O	CAP BB	31
				2012	W	WDFW BB	10

Table 13. Description of model parameters in the base-case assessment model.

Parameter	Number estimated	Bounds (low, high)	Prior (Mean, SD) Type
Natural mortality (*M*, female)	1	(0.005,0.5)	(-1.888, 0.33) Lognormal
Natural mortality (*M*, male)	1	(000.5,0.6)	(-1.58, 0.33) Lognormal
Stock and recruitment			
Ln(R_0)	1	(5,20)	-
Steepness (*h*)	1	(0.2,1)	(.8,.09) Normal
σ_r	-	-	-
Ln(Early Recruitment Deviations): 1845-1958	114	(-4,4)	-
Ln(Main Recruitment Deviations): 1959-2009	51	(-4,4)	-
Ln(Forecast Recruitment Deviations): 2010-2024	15	(-4,4)	-
Indices			
Ln(*q*) – NWFSC survey	-	Analytic solution	
Ln(*q*) – Triennial survey (early and late)	-	Analytic solution	
Ln (q) – North winter commercial CPUE	2	(-20,5)	-
Ln (q) – South winter commercial CPUE	2	(-20,5)	-
Beta (power) – North winter commercial CPUE	1	(-5,5)	-
Beta (power) – South winter commercial CPUE	1	(-5,5)	-
Extra SD – Early Triennial	1	(0.001, 2)	-
Extra SD – Late Triennial	1	(0.001, 2)	-
Selectivity (asymptotic, sex specific, with retention curves)			
Fisheries:			
Length at peak selectivity	4	(15, 75)	-
Width of top (as logistic)	-		-
Ascending width (as exp(width))	4	(-4,12)	-
Descending width (as exp(width))	-		-
Initial selectivity (as logistic)	-		-
Final selectivity (as logistic)	-		-
Male 1	4	(-15,15)	-
Male 2	4	(-15,15)	-
Male 3	-		-
Male 4	-		-
Male 5	-		-
Retention 1	4	(10,40)	-
Retention 2	4	(0.1,10)	-
Retention 3	4	(0.001,1)	-
Retention 4	-		-
Selectivity time block parameters (Peak)	20	(-3,2)	-
Retention time block parameters (Inflection, Slope, Asymptote)	36	(-3,4)	-
Surveys:			-
Length at peak selectivity	3	(15,61)	-
Width of top (as logistic)	-		-
Ascending width (as exp(width))	3	(-4,12)	-
Descending width (as exp(width))	-		-
Initial selectivity (as logistic)	-		-
Final selectivity (as logistic)	-		-
Male 1	3	(-15,15)	-
Male 2	3	(-15,15)	-
Male 3	-		-
Male 4	-		-
Male 5	-		-

Parameter	Number estimated	Bounds (low, high)	Prior (Mean, SD) Type
	Individual growth		
Females:			
Length at age min	1	(10,45)	-
Length at age max	1	(35,80)	-
von Bertalanffy *K*	1	(0.04,0.5)	-
CV of length at age min	1	(0.01,1)	-
CV of length at age max	1	(0.01,1)	-
Males:			
Length at age min	1	(-1,2)	-
Length at age max	1	(-1,2)	-
von Bertalanffy K	1	(0.04,0.5)	-
CV of length at age min	1	(0.01,1)	-
CV of length at age max	1	(0.01,1)	-
Total: 118 + 180 recruitment deviations =298 estimated parameters			

Table 14. Time blocks

Block Pattern					
#1 Selectivity	1973-1982	1983-1992	1993-2002	2003-2010	2011-2012
#2 Retention, Winter			2003-2009	2010-2010	2011-2012
#3 Retention, Summer			2003-2008	2009-2010	2011-2012

Table 15. Estimates of the growth parameters from the base case model. Age min is 2 and Age max is 17.

Parameter	Value
Females:	
Length at age min	15.88
Length at Linf	54.31
von Bertalanffy *K*	0.13
CV of length at age min	0.18
CV of length at age max	0.03
Males:	
Length at age min	16.35
Length at Linf	42.57
von Bertalanffy *K*	0.21
CV of length at age min	0.13
CV of length at age max	0.05

Table 16. Petrale sole catchability, power, index extra standard deviation, and productivity parameters.

Parameter	Value	~95% CI	
Catchability, Power, Extra SD:			
NWFSC survey catchability (*q*)	3.36		
Triennial survey catchability (*q*) early, late	0.55, 0.72		
North winter commercial CPUE (*q*)	-6.46, 0.59	-12.03, -0.89	0.23, 0.97
South winter commercial CPUE (*q*)	-0.14, 0.77	-4.74, 4.45	0.32, 1.22
North winter commercial CPUE (*Beta*)	-0.22	-0.92, 0.47	
South winter commercial CPUE (*Beta*)	-1.01	-1.57, -0.44	
Q_extraSD Triennial survey early	0.16	-0.04, 0.35	
Q_extraSD Triennial survey late	0.19	0.04, 0.42	
Productivity:			
R_0	9.72	9.28, 10.16	
Steepness (*h*)	0.86	0.75, 0.97	
Female natural mortality (*M*)	0.15	0.12, 0.19	
Male natural mortality (*M*)	0.17	0.13, 0.21	

Table 17. Time-series of population estimates from the base case model.

Fishing year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	SPR	Relative exploitation rate
1876	50,700	32,426	1.000	16,673	1.0	0	0
1877	50,699	32,425	1.000	16,673	1.0	0	0
1878	50,699	32,425	1.000	16,673	1.0	0	0
1879	50,698	32,424	1.000	16,673	1.0	0	0
1880	50,697	32,424	1.000	16,673	11.6	0	0
1881	50,687	32,416	1.000	16,673	22.2	0	0
1882	50,667	32,402	0.999	16,673	32.8	0.01	0
1883	50,638	32,381	0.999	16,673	43.4	0.01	0
1884	50,601	32,355	0.998	16,673	54.1	0.01	0
1885	50,557	32,323	0.997	16,672	64.7	0.01	0
1886	50,506	32,287	0.996	16,672	75.3	0.02	0
1887	50,450	32,246	0.995	16,672	85.9	0.02	0
1888	50,388	32,200	0.994	16,671	96.5	0.02	0
1889	50,321	32,152	0.993	16,671	107.1	0.02	0
1890	50,250	32,100	0.991	16,670	117.7	0.03	0
1891	50,176	32,045	0.990	16,670	128.3	0.03	0
1892	50,098	31,987	0.988	16,670	138.9	0.03	0
1893	50,017	31,928	0.987	16,669	149.6	0.03	0
1894	49,934	31,866	0.985	16,669	160.2	0.03	0
1895	49,848	31,803	0.983	16,669	170.8	0.04	0
1896	49,761	31,738	0.981	16,669	181.6	0.04	0
1897	49,671	31,671	0.980	16,669	192.2	0.04	0
1898	49,581	31,604	0.978	16,669	202.8	0.04	0
1899	49,489	31,535	0.976	16,670	213.4	0.05	0
1900	49,396	31,466	0.974	16,670	224.0	0.05	0
1901	49,302	31,395	0.972	16,671	234.6	0.05	0
1902	49,207	31,325	0.971	16,672	245.2	0.05	0.01
1903	49,112	31,253	0.969	16,674	255.8	0.05	0.01
1904	49,017	31,181	0.967	16,676	266.4	0.06	0.01
1905	48,921	31,109	0.965	16,678	277.0	0.06	0.01
1906	48,825	31,037	0.963	16,681	287.7	0.06	0.01
1907	48,728	30,964	0.961	16,685	298.3	0.06	0.01
1908	48,632	30,891	0.959	16,689	308.9	0.07	0.01
1909	48,536	30,818	0.957	16,694	319.5	0.07	0.01
1910	48,440	30,746	0.955	16,700	330.1	0.07	0.01
1911	48,345	30,673	0.954	16,706	340.7	0.07	0.01
1912	48,250	30,600	0.952	16,714	351.3	0.08	0.01
1913	48,156	30,528	0.950	16,723	361.9	0.08	0.01
1914	48,062	30,456	0.948	16,734	372.6	0.08	0.01
1915	47,970	30,385	0.946	16,745	383.2	0.08	0.01
1916	47,878	30,314	0.944	16,758	388.8	0.08	0.01
1917	47,793	30,247	0.943	16,773	529.6	0.11	0.01
1918	47,585	30,094	0.939	16,787	426.5	0.09	0.01
1919	47,494	30,021	0.937	16,805	335.5	0.07	0.01
1920	47,504	30,018	0.937	16,827	231.9	0.05	0
1921	47,620	30,090	0.939	16,853	295.6	0.06	0.01
1922	47,676	30,122	0.940	16,880	427.4	0.09	0.01
1923	47,609	30,069	0.939	16,908	430.0	0.09	0.01
1924	47,548	30,019	0.938	16,937	536.1	0.11	0.01

Fishing year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	SPR	Relative exploitation rate
1925	47,397	29,905	0.935	16,969	531.7	0.11	0.01
1926	47,266	29,803	0.932	17,002	524.9	0.11	0.01
1927	47,159	29,716	0.930	17,038	636.0	0.13	0.01
1928	46,964	29,566	0.926	17,076	623.9	0.13	0.01
1929	46,803	29,439	0.923	17,117	712.0	0.15	0.02
1930	46,581	29,269	0.919	17,163	664.2	0.14	0.01
1931	46,432	29,147	0.916	17,217	682.2	0.14	0.01
1932	46,294	29,031	0.913	17,281	815.9	0.16	0.02
1933	46,061	28,844	0.909	17,367	852.4	0.17	0.02
1934	45,834	28,657	0.904	17,496	1,629.6	0.29	0.04
1935	44,912	27,986	0.886	17,685	1,613.3	0.29	0.04
1936	44,094	27,376	0.870	17,970	1,326.0	0.25	0.03
1937	43,649	27,008	0.861	18,365	1,904.1	0.33	0.04
1938	42,745	26,313	0.843	18,797	2,171.3	0.37	0.05
1939	41,717	25,512	0.823	19,082	2,662.9	0.43	0.06
1940	40,378	24,472	0.796	18,884	2,562.7	0.42	0.06
1941	39,323	23,607	0.776	18,082	2,312.0	0.4	0.06
1942	38,675	23,023	0.763	17,008	3,239.4	0.49	0.09
1943	37,295	21,953	0.736	16,179	3,373.5	0.51	0.09
1944	35,916	20,952	0.708	15,975	2,667.4	0.47	0.08
1945	35,261	20,537	0.695	16,095	2,498.7	0.46	0.07
1946	34,751	20,284	0.685	15,451	3,788.5	0.58	0.11
1947	32,990	19,201	0.651	13,929	3,132.5	0.54	0.1
1948	31,833	18,512	0.628	12,610	4,497.3	0.65	0.14
1949	29,336	16,917	0.579	11,785	4,384.7	0.67	0.15
1950	26,907	15,403	0.531	11,614	4,610.8	0.7	0.17
1951	24,242	13,752	0.478	12,076	3,029.8	0.62	0.13
1952	23,054	13,100	0.455	12,923	2,775.0	0.61	0.12
1953	22,064	12,565	0.435	13,427	2,343.8	0.59	0.11
1954	21,449	12,226	0.423	13,562	2,865.8	0.65	0.14
1955	20,348	11,479	0.401	13,383	2,546.8	0.63	0.13
1956	19,615	10,897	0.387	13,146	2,253.1	0.61	0.12
1957	19,241	10,535	0.380	13,028	2,888.5	0.68	0.15
1958	18,342	9,848	0.362	12,805	2,841.9	0.69	0.16
1959	17,564	9,279	0.346	12,744	2,433.0	0.67	0.14
1960	17,240	9,030	0.340	17,612	2,846.7	0.71	0.17
1961	16,602	8,581	0.327	18,091	3,415.8	0.76	0.21
1962	15,565	7,820	0.307	11,675	3,263.2	0.77	0.22
1963	14,849	7,168	0.293	11,987	3,300.1	0.79	0.23
1964	14,208	6,553	0.280	17,159	2,759.6	0.77	0.2
1965	14,111	6,404	0.278	16,163	2,629.1	0.76	0.19
1966	14,196	6,519	0.280	33,816	2,662.5	0.76	0.2
1967	14,401	6,638	0.284	14,761	2,690.0	0.76	0.2
1968	14,888	6,640	0.294	14,975	2,397.8	0.74	0.17
1969	15,900	6,793	0.314	13,595	2,433.4	0.74	0.16
1970	16,954	7,136	0.334	13,493	3,152.7	0.77	0.19
1971	17,264	7,503	0.341	13,108	3,290.5	0.77	0.2
1972	17,244	8,015	0.340	10,799	3,560.5	0.78	0.21
1973	16,708	8,175	0.330	8,785	3,057.5	0.75	0.19

Fishing year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits	Total catch (mt)	SPR	Relative exploitation rate
1974	16,302	8,277	0.322	10,892	3,850.0	0.8	0.24
1975	14,851	7,644	0.293	11,104	3,710.2	0.81	0.26
1976	13,303	6,874	0.262	14,470	3,041.0	0.8	0.24
1977	12,257	6,329	0.242	13,314	2,502.4	0.77	0.21
1978	11,744	5,944	0.232	9,974	3,190.6	0.83	0.28
1979	10,665	5,078	0.210	10,095	3,270.5	0.86	0.32
1980	9,568	4,206	0.189	11,661	2,739.1	0.86	0.3
1981	8,969	3,801	0.177	9,930	2,638.8	0.86	0.31
1982	8,444	3,571	0.167	8,641	2,713.2	0.87	0.34
1983	7,853	3,287	0.155	10,063	2,444.8	0.87	0.32
1984	7,418	3,108	0.146	14,574	1,890.5	0.84	0.27
1985	7,446	3,164	0.147	9,179	1,821.4	0.84	0.26
1986	7,559	3,238	0.149	5,322	2,094.8	0.85	0.29
1987	7,426	3,109	0.146	6,803	2,464.5	0.88	0.35
1988	6,870	2,759	0.136	10,840	2,295.7	0.89	0.34
1989	6,356	2,593	0.125	14,194	2,257.5	0.89	0.37
1990	5,823	2,472	0.115	13,875	1,917.6	0.88	0.35
1991	5,662	2,333	0.112	10,230	2,086.4	0.9	0.4
1992	5,506	1,936	0.109	5,704	1,738.4	0.9	0.34
1993	5,787	1,803	0.114	10,531	1,680.1	0.89	0.31
1994	6,175	1,954	0.122	13,530	1,541.7	0.86	0.26
1995	6,666	2,427	0.131	8,195	1,682.8	0.85	0.27
1996	7,016	2,849	0.138	9,787	1,932.6	0.85	0.29
1997	7,098	2,948	0.140	9,824	2,046.1	0.86	0.3
1998	7,038	2,831	0.139	21,894	1,729.0	0.84	0.26
1999	7,309	2,936	0.144	13,879	1,615.8	0.82	0.23
2000	7,876	3,167	0.155	10,683	1,914.6	0.83	0.27
2001	8,384	3,221	0.165	8,309	1,971.2	0.84	0.25
2002	8,932	3,278	0.176	9,588	2,052.9	0.83	0.24
2003	9,375	3,556	0.185	8,511	1,748.1	0.79	0.19
2004	9,969	4,228	0.197	9,841	2,248.0	0.81	0.23
2005	9,961	4,618	0.196	9,779	2,955.8	0.84	0.31
2006	9,126	4,353	0.180	15,448	2,171.2	0.81	0.25
2007	8,902	4,230	0.176	22,443	2,373.5	0.82	0.28
2008	8,619	3,867	0.170	33,214	2,153.4	0.82	0.27
2009	8,921	3,612	0.176	16,584	2,264.7	0.84	0.28
2010	9,718	3,377	0.192	11,349	870.2	0.66	0.1
2011	12,245	4,146	0.242	11,219	787.2	0.58	0.07
2012	15,015	5,465	0.296	13,824	1,144.2	0.6	0.08

Table 18. Asymptotic standard deviation estimates for spawning biomass and recruitment.

Fishing year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)	Year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)	Year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)
1876	4,270.3	7,647.8	1923	4,083.4	7,822.8	1970	606.0	3,197.2
1877	4,271.0	7,647.9	1924	4,070.0	7,845.7	1971	611.6	3,099.2
1878	4,271.5	7,648.0	1925	4,054.6	7,869.6	1972	617.2	2,625.0
1879	4,271.9	7,648.1	1926	4,037.5	7,895.9	1973	607.8	2,201.4
1880	4,272.3	7,648.2	1927	4,018.2	7,924.2	1974	579.8	2,458.3
1881	4,273.3	7,648.2	1928	3,995.9	7,953.6	1975	532.6	2,565.2
1882	4,275.1	7,648.2	1929	3,970.9	7,986.1	1976	480.5	3,099.1
1883	4,277.2	7,648.1	1930	3,942.3	8,021.4	1977	429.0	3,044.5
1884	4,279.4	7,647.9	1931	3,910.8	8,062.8	1978	381.6	2,645.7
1885	4,281.2	7,647.7	1932	3,875.6	8,111.2	1979	338.1	2,750.2
1886	4,282.5	7,647.4	1933	3,835.8	8,172.9	1980	307.2	3,009.5
1887	4,283.3	7,647.1	1934	3,791.5	8,263.4	1981	289.0	2,579.9
1888	4,283.5	7,646.8	1935	3,736.5	8,391.0	1982	276.3	2,230.8
1889	4,283.3	7,646.5	1936	3,675.3	8,581.9	1983	266.5	2,429.9
1890	4,282.4	7,646.2	1937	3,609.3	8,846.4	1984	255.0	2,965.5
1891	4,281.1	7,645.9	1938	3,532.0	9,132.3	1985	239.6	2,192.5
1892	4,279.4	7,645.6	1939	3,444.9	9,305.7	1986	218.9	1,412.6
1893	4,277.3	7,645.4	1940	3,346.1	9,138.3	1987	197.9	1,769.3
1894	4,274.7	7,645.3	1941	3,238.6	8,569.2	1988	180.6	2,633.8
1895	4,271.9	7,645.2	1942	3,123.1	7,844.0	1989	170.6	3,273.5
1896	4,268.7	7,645.2	1943	2,992.5	7,300.5	1990	163.5	3,497.9
1897	4,265.3	7,645.2	1944	2,852.0	7,164.4	1991	155.9	2,738.0
1898	4,261.6	7,645.6	1945	2,712.4	7,280.5	1992	147.8	1,698.0
1899	4,257.7	7,645.9	1946	2,577.5	6,929.3	1993	147.6	2,486.7
1900	4,253.5	7,646.4	1947	2,443.8	6,012.3	1994	156.8	2,961.9
1901	4,249.2	7,647.1	1948	2,325.9	5,246.0	1995	171.0	2,089.0
1902	4,244.7	7,648.0	1949	2,203.3	4,769.9	1996	181.0	2,159.5
1903	4,239.9	7,649.2	1950	2,076.6	4,638.7	1997	182.2	2,148.8
1904	4,235.0	7,650.6	1951	1,945.9	4,830.6	1998	180.6	3,782.6
1905	4,229.9	7,652.3	1952	1,829.7	5,241.0	1999	183.1	2,557.4
1906	4,224.5	7,654.4	1953	1,721.9	5,489.4	2000	185.1	1,962.4
1907	4,219.0	7,657.0	1954	1,625.2	5,481.9	2001	182.8	1,555.3
1908	4,213.3	7,660.1	1955	1,532.6	5,264.5	2002	184.8	1,750.0
1909	4,207.3	7,663.7	1956	1,444.9	4,963.3	2003	202.6	1,635.9
1910	4,201.1	7,667.9	1957	1,348.9	4,658.8	2004	227.2	1,912.0
1911	4,194.7	7,672.7	1958	1,231.5	4,287.9	2005	240.5	2,002.3
1912	4,187.9	7,678.4	1959	1,100.1	4,197.1	2006	243.1	3,140.9
1913	4,180.8	7,684.9	1960	965.4	4,810.1	2007	245.0	4,615.9
1914	4,173.4	7,692.5	1961	829.8	4,502.7	2008	254.0	6,902.3
1915	4,165.6	7,701.1	1962	709.7	3,134.0	2009	279.7	4,117.8
1916	4,157.3	7,710.6	1963	624.2	3,049.6	2010	330.8	3,642.4
1917	4,148.5	7,721.3	1964	574.2	3,994.9	2011	419.1	4,471.2
1918	4,138.3	7,731.9	1965	561.6	4,170.3	2012	567.9	6,029.7
1919	4,127.9	7,745.6	1966	572.7	6,947.0			
1920	4,117.3	7,762.0	1967	589.2	4,008.3			
1921	4,107.0	7,781.3	1968	597.9	3,632.0			
1922	4,095.8	7,801.7	1969	602.2	3,276.7			

Table 19. Results from sensitivity model runs.

Label	Base	High M	Low M	No Comm. CPUE	Increase Comm. CPUE SD	Comm. CPUE, TVQ	Comm. CPUE, BlockQ
TOTAL_like	1454.3	1455.9	1455.9	1502.2	1463.6	1458.2	1458.8
Survey_like	-70.62	-70.43	-70.72	-22.19	-63.91	-67.25	-66.68
Discard_like	-143.14	-143.18	-143.08	-143.21	-143.06	-143.09	-143.10
Mean_body_wt_like	-75.76	-75.77	-75.76	-75.74	-75.79	-75.77	-75.77
Length_comp_like	813.91	813.41	814.98	814.41	817.80	815.00	814.97
Age_comp_like	950.91	951.76	950.25	950.15	948.89	950.48	950.44
SR_BH_steep	0.86	0.76	0.94	0.85	0.85	0.86	0.86
NatM_p_1_Fem_GP_1	0.15	0.19	0.12	0.15	0.16	0.15	0.15
L_at_Amin_Fem_GP_1	15.88	15.83	15.92	15.88	15.82	15.87	15.87
L_at_Amax_Fem_GP_1	54.31	54.42	54.18	54.26	54.29	54.30	54.30
VonBert_K_Fem_GP_1	0.13	0.13	0.13	0.13	0.13	0.13	0.13
CV_young_Fem_GP_1	0.18	0.18	0.18	0.18	0.18	0.18	0.18
CV_old_Fem_GP_1	0.03	0.03	0.03	0.03	0.03	0.03	0.03
NatM_p_1_Mal_GP_1	0.17	0.21	0.13	0.17	0.17	0.17	0.17
L_at_Amin_Mal_GP_1	16.35	16.29	16.39	16.34	16.32	16.34	16.34
L_at_Amax_Mal_GP_1	42.57	42.64	42.48	42.55	42.54	42.56	42.56
VonBert_K_Mal_GP_1	0.21	0.21	0.21	0.21	0.21	0.21	0.21
CV_young_Mal_GP_1	0.13	0.13	0.13	0.13	0.13	0.13	0.13
CV_old_Mal_GP_1	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SSB_Unfished_thou_mt	32.425	28.418	37.281	32.277	32.161	32.512	32.473
Bratio_2012	0.169	0.162	0.102	0.168	0.187	0.167	0.169
Bratio_2013	0.223	0.211	0.136	0.222	0.248	0.221	0.224
F_2012	0.08	0.07	0.09	0.08	0.07	0.08	0.08
F_2013	0.15	0.17	0.10	0.13	0.14	0.13	0.13
SSB_Btgt_thou_mt	8.106	7.105	9.32	8.069	8.04	8.128	8.118
SPR_Btgt	0.28	0.31	0.26	0.28	0.28	0.28	0.28
Fstd_Btgt	0.17	0.18	0.16	0.17	0.17	0.17	0.17
TotYield_Btgt_thou_mt	2.749	2.762	2.671	2.747	2.78	2.749	2.752
SSB_SPRtgt_thou_mt	8.739	6.832	10.763	8.677	8.612	8.762	8.749
Fstd_SPRtgt	0.16	0.19	0.14	0.16	0.16	0.16	0.16
TotYield_SPRtgt_thou_mt	2.731	2.76	2.61	2.73	2.765	2.731	2.734
SSB_MSY_thou_mt	7.146	7.173	6.994	7.146	7.146	7.168	7.16
SPR_MSY	0.25	0.31	0.20	0.25	0.26	0.25	0.25
Fstd_MSY	0.19	0.18	0.20	0.19	0.19	0.19	0.19
TotYield_MSY_thous_mt	2.76	2.762	2.715	2.757	2.79	2.76	2.763
RetYield_MSY	2724	2723	2682	2721	2753	2724	2727

Table 20. Results from the retrospective model runs. Shaded values are for are forecast values.

Assessment Year	Base	2011	2010	2009	2008	2007
SSB Unfished	32,425	32,013	32,034	31,893	31,473	31,961
2007 Depletion	0.130	0.131	0.132	0.140	0.135	0.152
2008 Depletion	0.119	0.119	0.121	0.130	0.125	0.153
2009 Depletion	0.111	0.111	0.113	0.124	0.121	0.161
2010 Depletion	0.104	0.103	0.105	0.118	0.124	0.169
2011 Depletion	0.128	0.126	0.128	0.146	0.161	0.204
2012 Depletion	0.169	0.166	0.170	0.188	0.202	0.237
2013 Depletion	0.223	0.221	0.219	0.230	0.235	0.263

Table 21. Projection of potential petrale sole OFL, ACL, spawning biomass and depletion for the base case model based on the SPR= 0.3 fishing mortality target and $F_{30\%}$ overfishing limit/target (OFL). Assuming the ACLs of 2,592 and 2,652 mt are attained in 2013 and 2014.

Year	Predicted OFL (mt)	ACL Catch (mt)	Age 3+ biomass (mt)	Spawning Biomass (mt)	Depletion (%)
2013	2,711	2,592	16,954	7,233	0.22
2014	2,774	2,652	17,656	8,540	0.26
2015	2,946	2,828	18,043	9,462	0.29
2016	3,044	2,922	18,037	9,740	0.3
2017	3,015	2,895	17,803	9,592	0.3
2018	2,936	2,820	17,546	9,331	0.29
2019	2,864	2,751	17,368	9,122	0.28
2020	2,821	2,708	17,284	9,007	0.28
2021	2,804	2,692	17,269	8,966	0.28
2022	2,804	2,692	17,289	8,969	0.28
2023	2,811	2,698	17,318	8,990	0.28
2024	2,818	2,706	17,343	9,012	0.28

Table 22. Decision table of 12-year projections for alternate states of nature (columns) and management options (rows) beginning in 2011. Relative probabilities of each state of nature are based on low and high values for the rate of female natural mortality.

			State of nature					
			Low Female M = 0.12		Base case Female M = 0.15		High Female M = 0.19	
Relative probability			0.25		0.5		0.25	
Manage-ment decision	Year	Catch (mt)	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion
ABC 25:5 Rule	2015	2828	9095	0.244	9461	0.292	10017	0.352
	2016	2922	9519	0.255	9739	0.300	10137	0.357
	2017	2895	9531	0.256	9592	0.296	9819	0.346
	2018	2820	9393	0.252	9330	0.288	9427	0.332
	2019	2751	9255	0.248	9122	0.281	9145	0.322
	2020	2708	9159	0.246	9006	0.278	9005	0.317
	2021	2692	9103	0.244	8966	0.276	8971	0.316
	2022	2692	9072	0.243	8969	0.277	8993	0.316
	2023	2698	9052	0.243	8989	0.277	9033	0.318
	2024	2706	9033	0.242	9011	0.278	9066	0.319
Catch that stabilizes the stock at ~$SB_{30\%}$	2015	2367	9095	0.244	9461	0.292	10017	0.352
	2016	2533	9784	0.262	9999	0.308	10389	0.366
	2017	2576	10049	0.270	10092	0.311	10297	0.362
	2018	2566	10130	0.272	10028	0.309	10081	0.355
	2019	2544	10164	0.273	9966	0.307	9918	0.349
	2020	2533	10199	0.274	9951	0.307	9850	0.347
	2021	2536	10243	0.275	9979	0.308	9859	0.347
	2022	2549	10290	0.276	10034	0.309	9911	0.349
	2023	2565	10334	0.277	10097	0.311	9975	0.351
	2024	2581	10370	0.278	10157	0.313	10034	0.353
Catch that stabilizes the stock at ~$SB_{40\%}$	2015	1460	9095	0.244	9461	0.292	10017	0.352
	2016	1678	10304	0.276	10509	0.324	10886	0.383
	2017	1815	11120	0.298	11128	0.343	11288	0.397
	2018	1900	11717	0.314	11537	0.356	11498	0.405
	2019	1960	12199	0.327	11863	0.366	11666	0.411
	2020	2009	12607	0.338	12154	0.375	11838	0.417
	2021	2055	12958	0.348	12419	0.383	12018	0.423
	2022	2098	13260	0.356	12661	0.390	12198	0.429
	2023	2138	13518	0.363	12878	0.397	12368	0.435
	2024	2172	13736	0.368	13069	0.403	12519	0.441

11 Figures

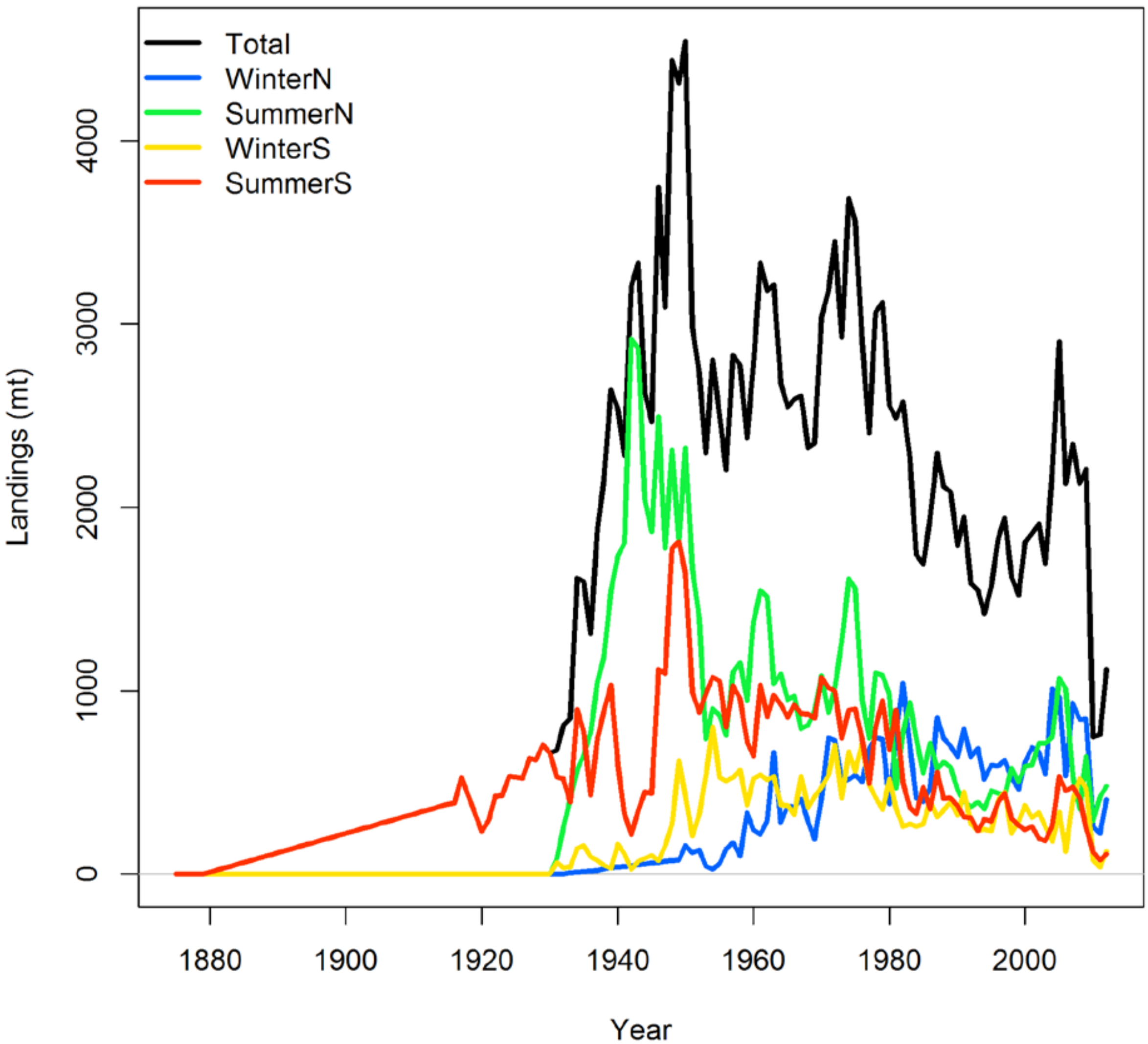


Figure 1. Time series of total landings and landings for each fleet**.**

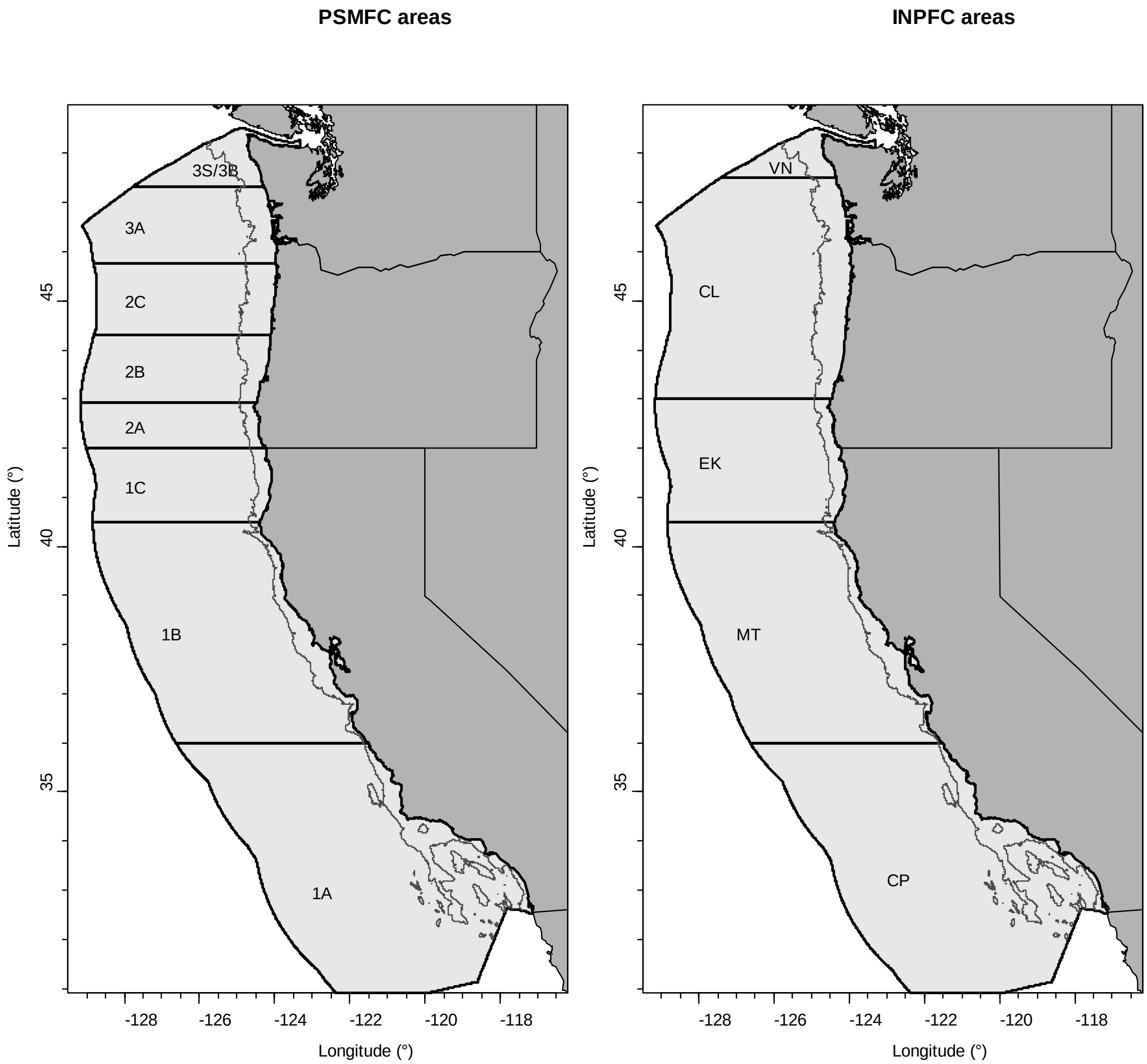


Figure 2. Map showing PSMFC and INPFC boundaries. The solid gray line off the coast is the 300 fathom depth contour.

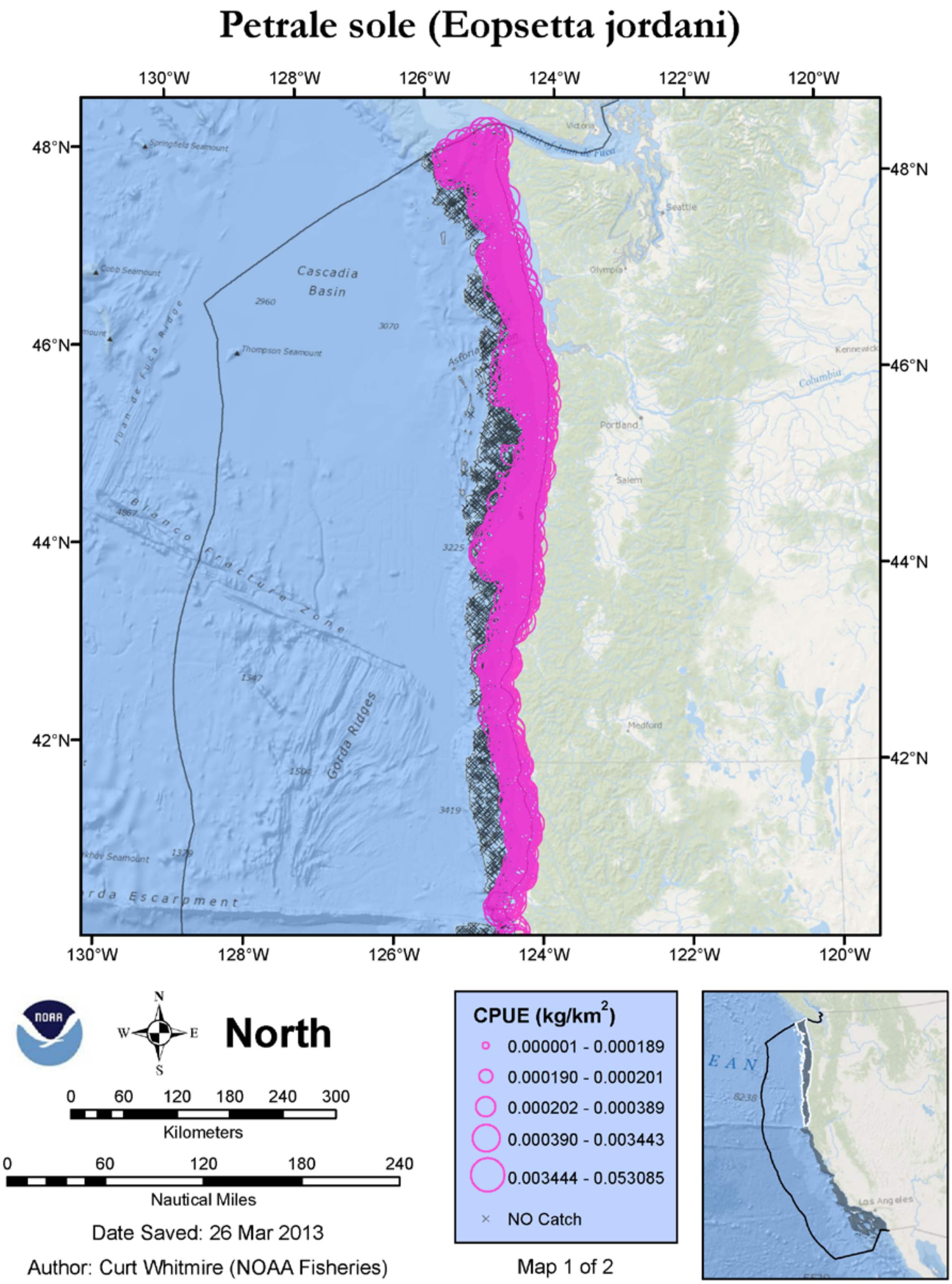


Figure 3. NWFSC survey catch rates, north.

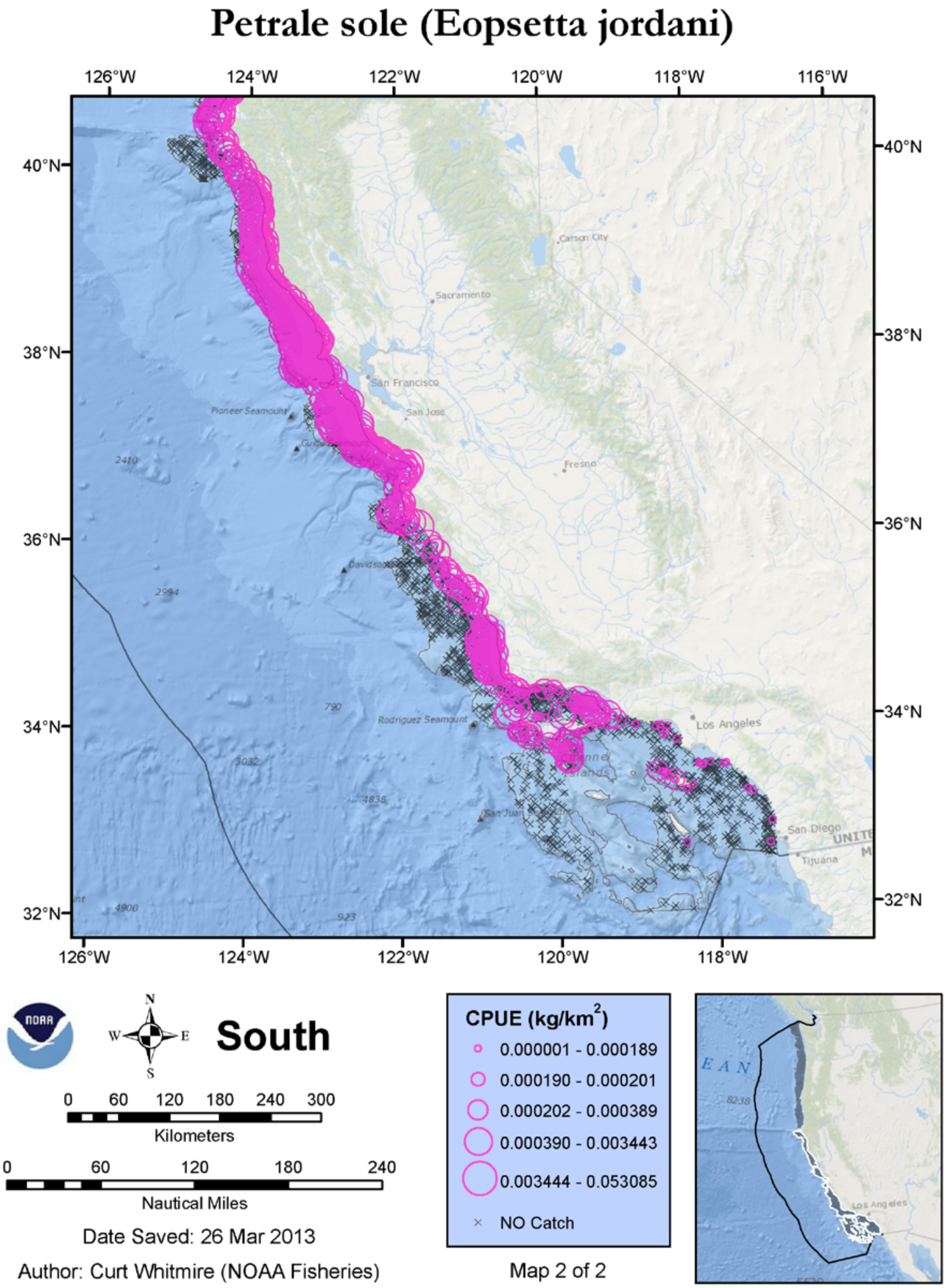


Figure 4. NWFSC survey catch rates, south.

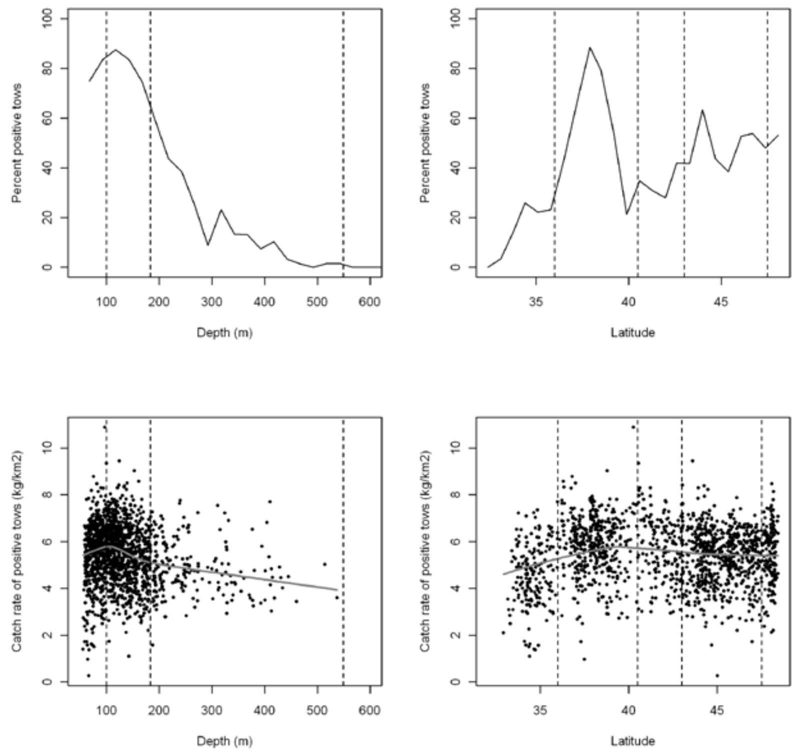


Figure 5. Plots of the percentage of positive tows and the catch rates for all positive tows over depth and latitude for the NWFSC survey.

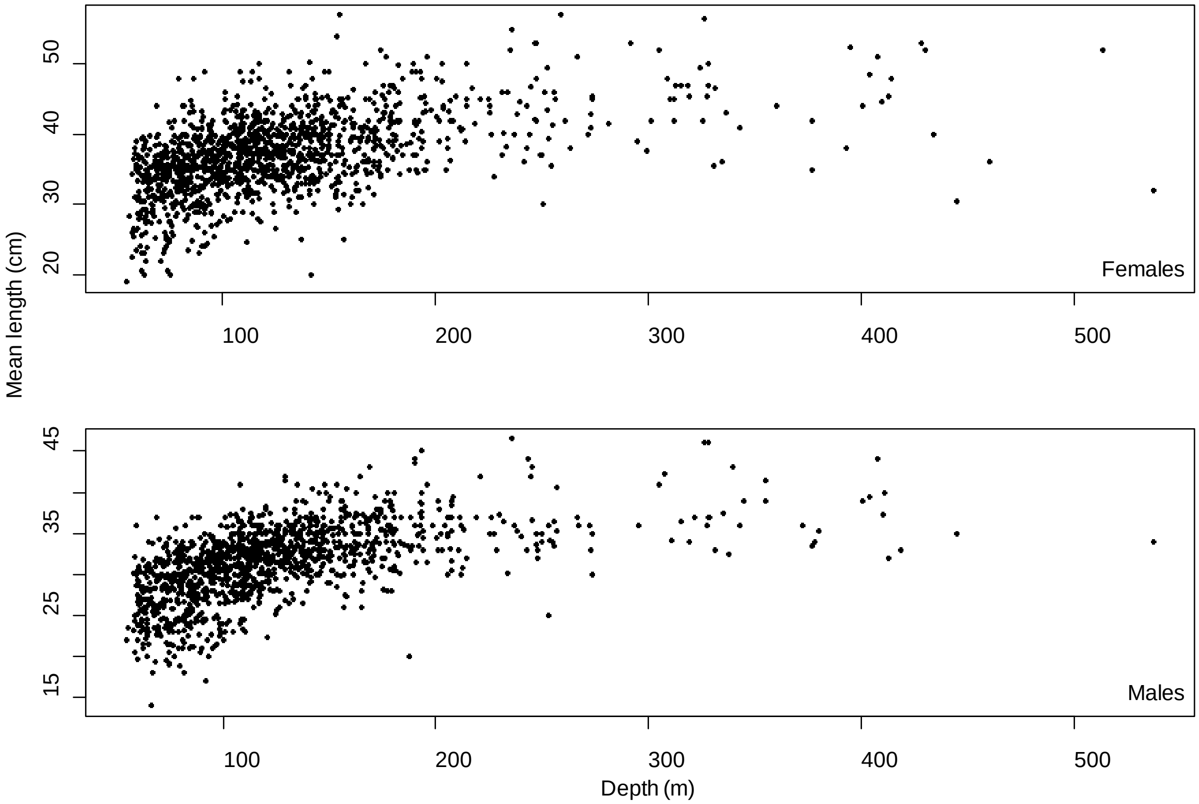


Figure 6. NWFSC survey mean length per tow by depth for females and males.

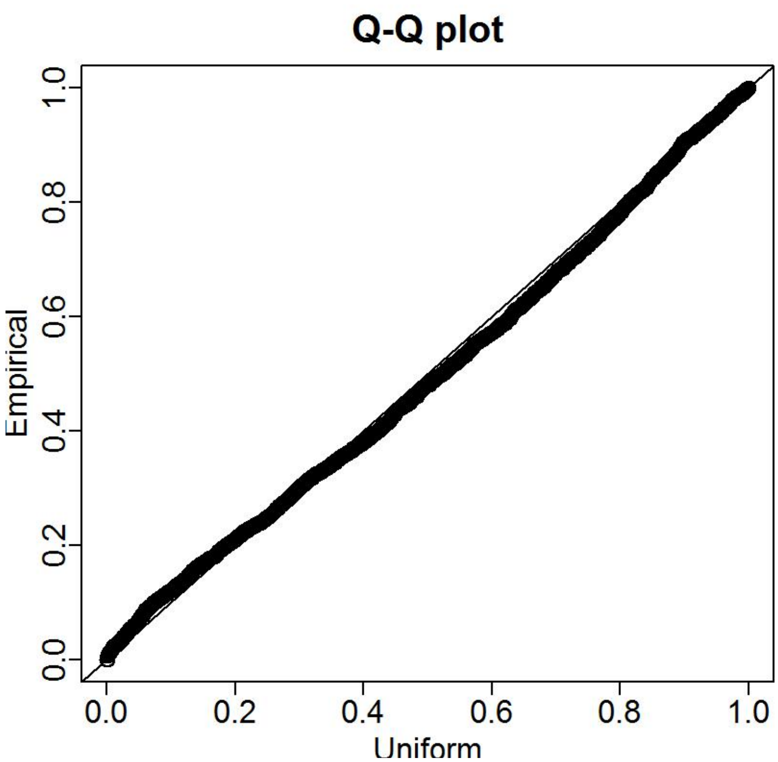


Figure 7. NWFSC GLMM Q-Q plot.

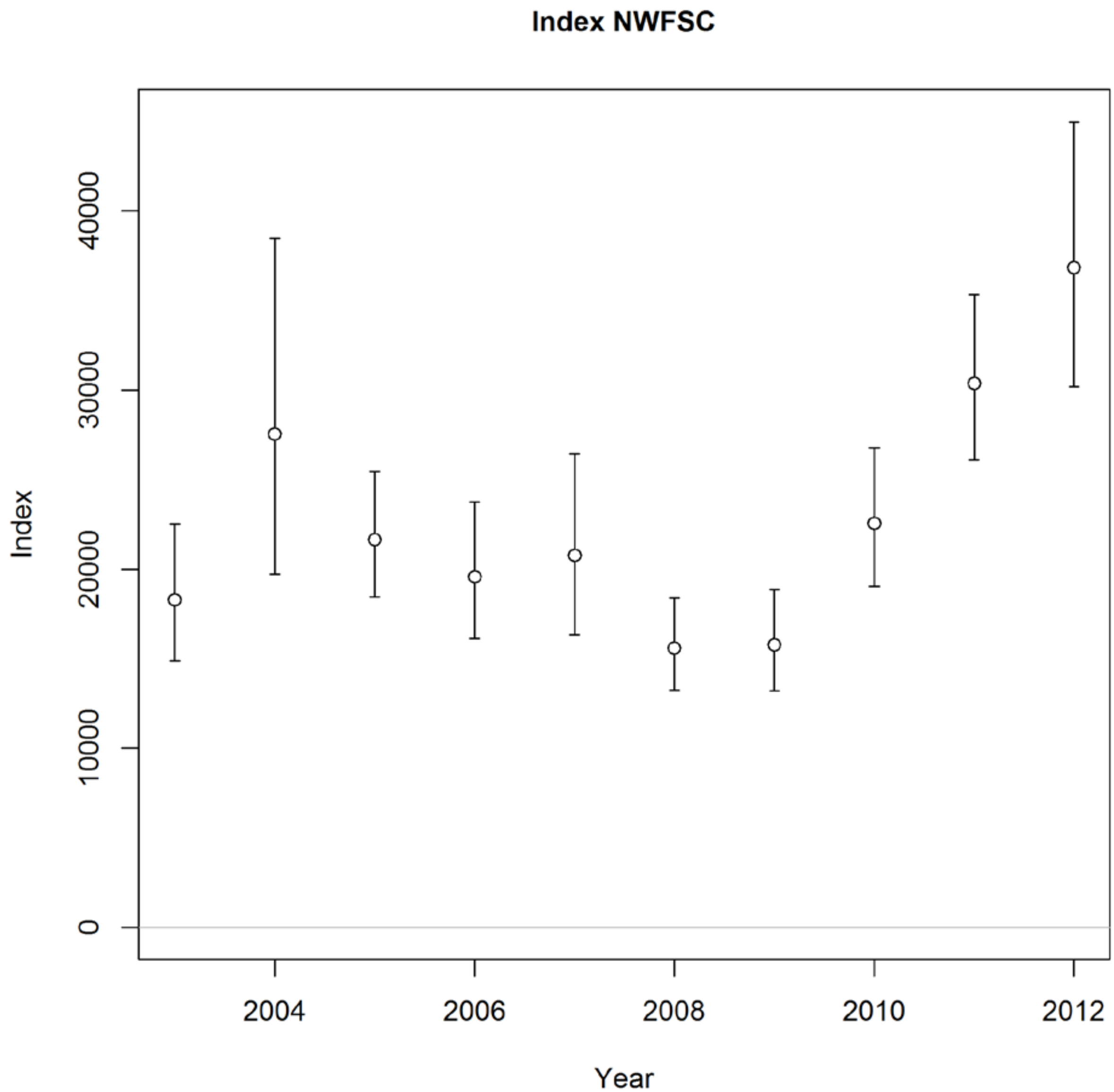


Figure 8. GLMM biomass estimates from the NWFSC survey.

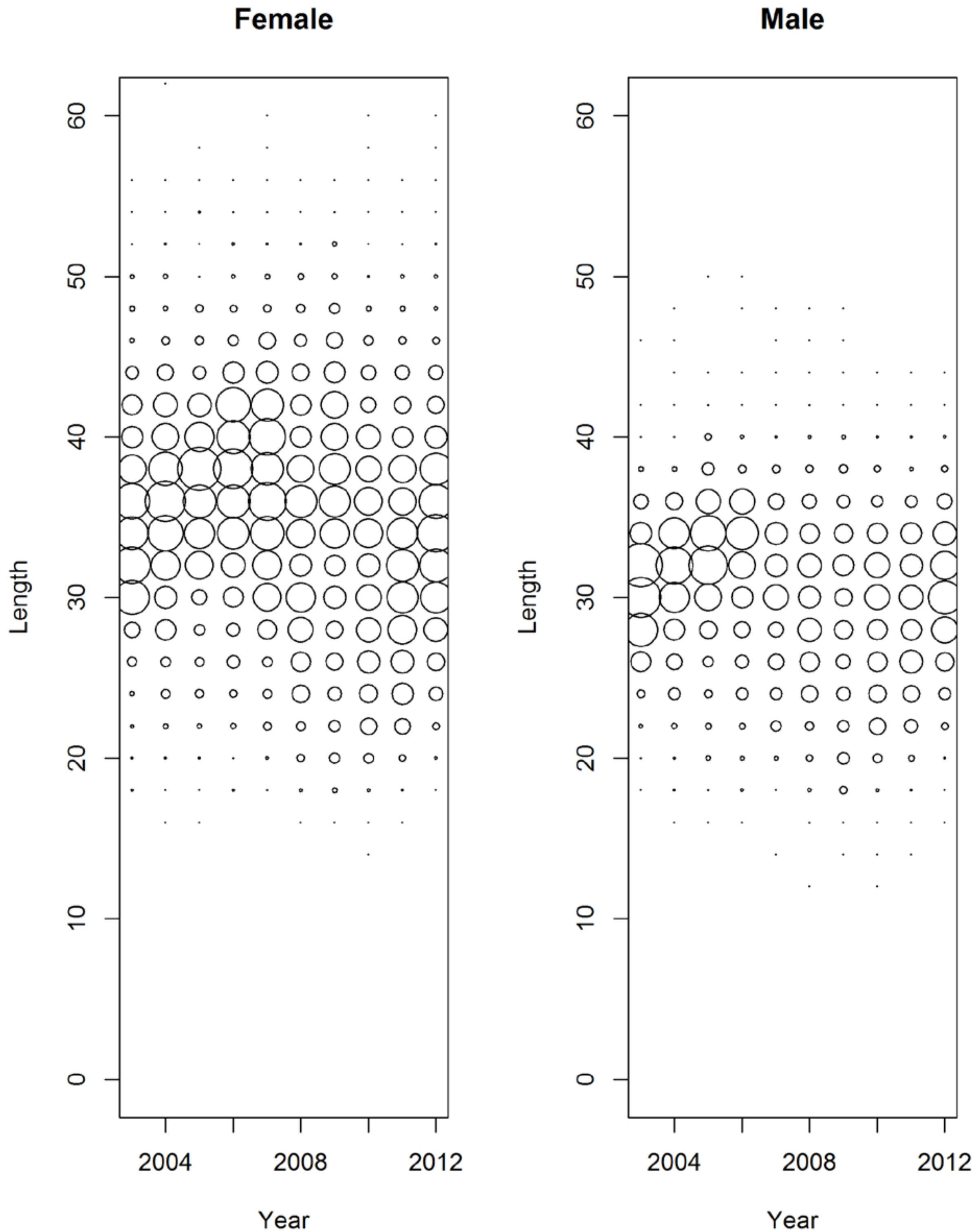


Figure 9. Female (left panel) and male (right panel) length frequencies for the NWFSC survey.

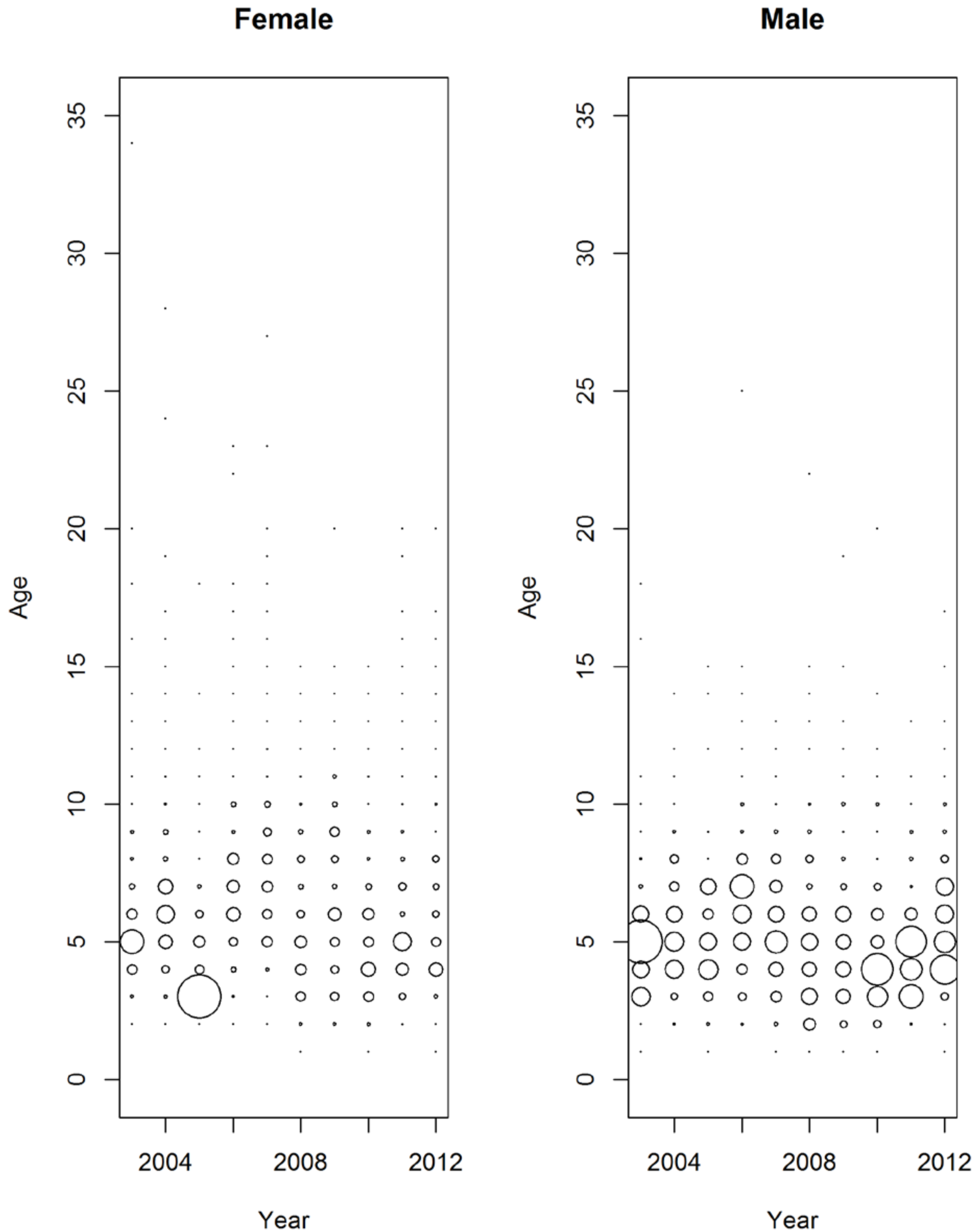


Figure 10. Female (left panel) and male (right panel) age frequencies from the NWFSC survey.

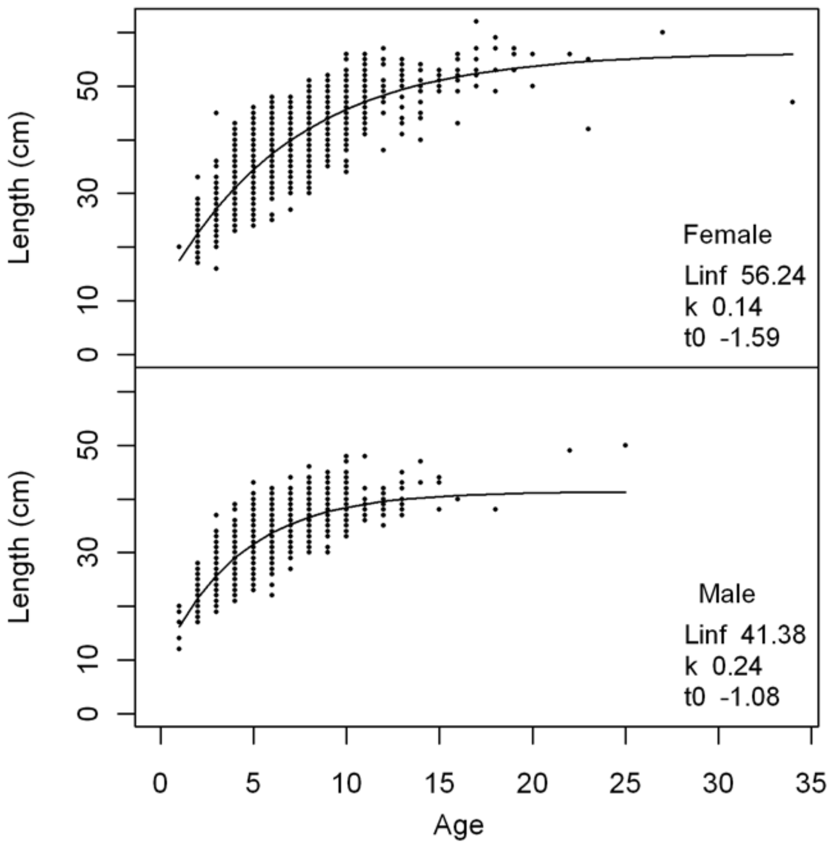


Figure 11. Length at age for males and females from the NWFSC survey with fits to the von Bertalanffy growth curve.

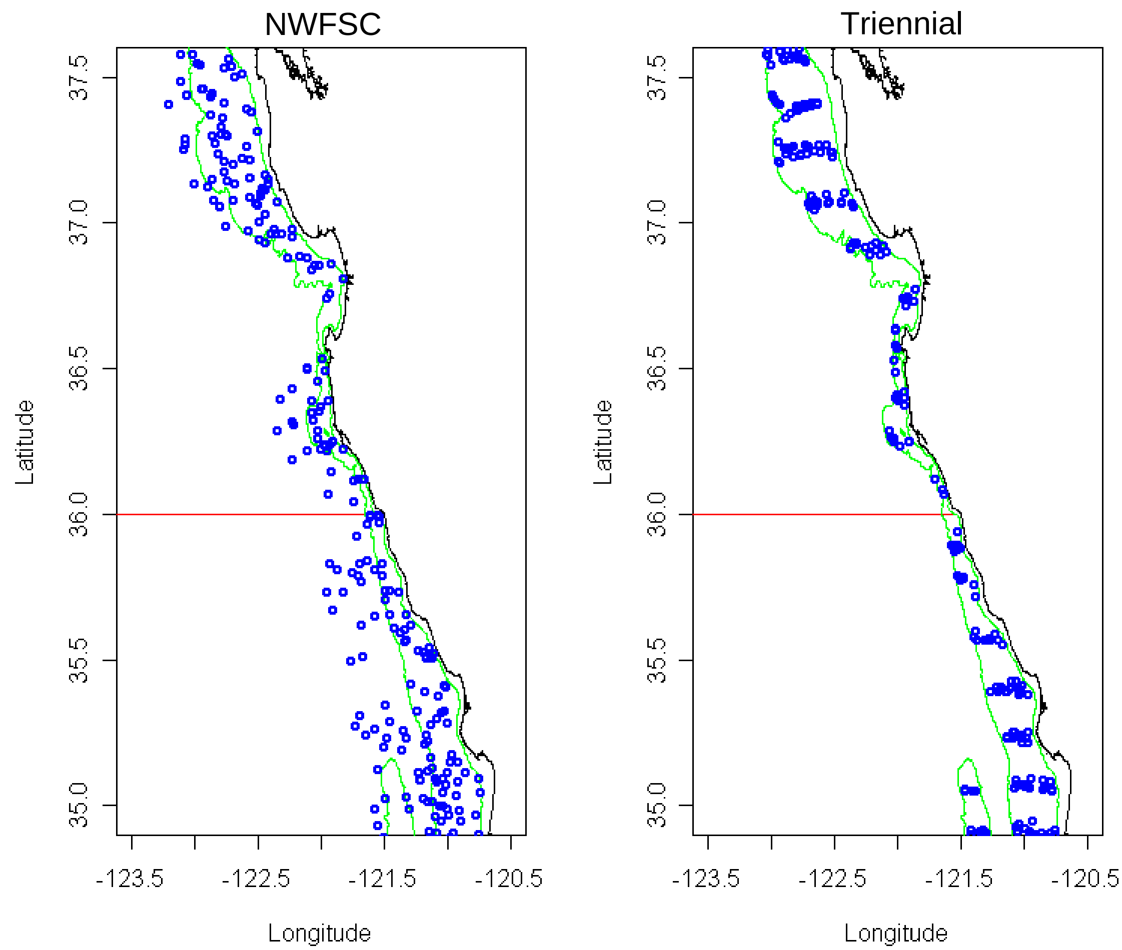


Figure 12. Survey tow locations in 2004, showing the difference in station design for the NWFSC trawl survey relative to the Triennial trawl survey.

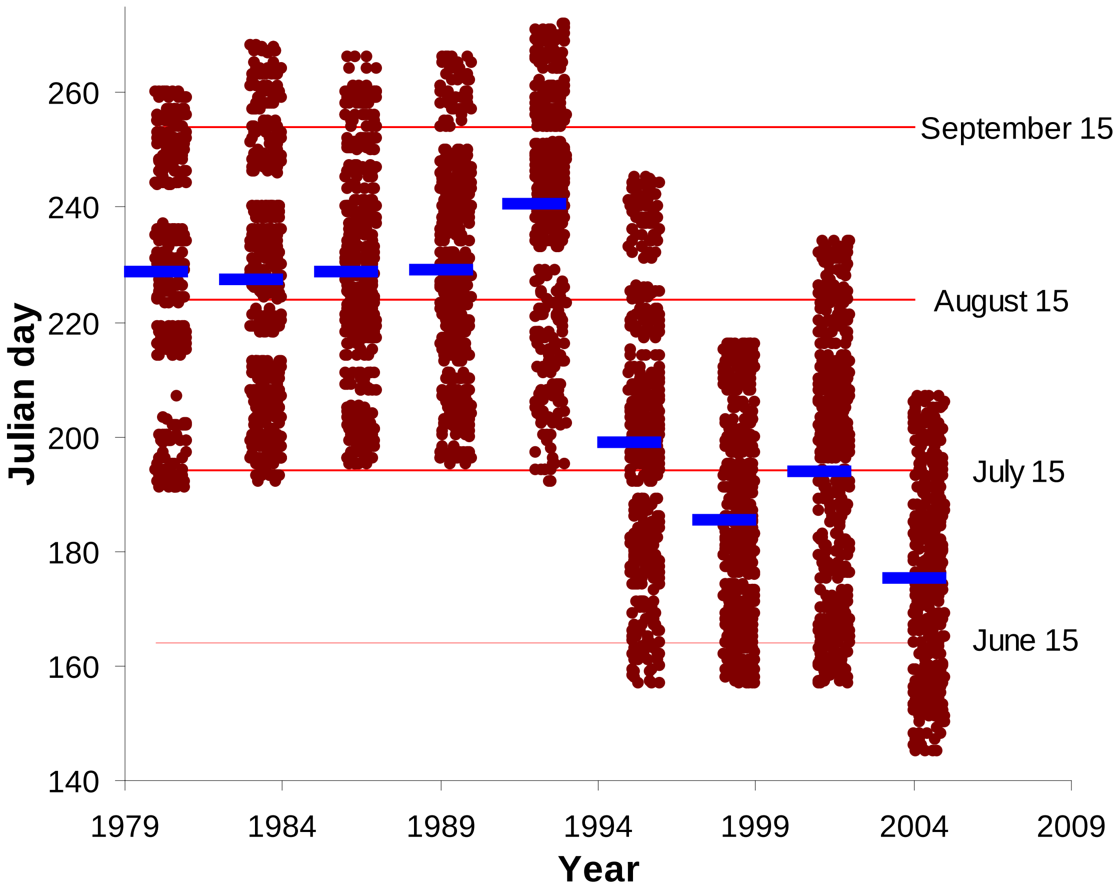


Figure 13. Distribution of dates of operation for the triennial survey (1980-2004). Solid bars show the mean date for each survey year, points represent individual hauls dates, but are jittered to allow better delineation of the distribution of individual points.

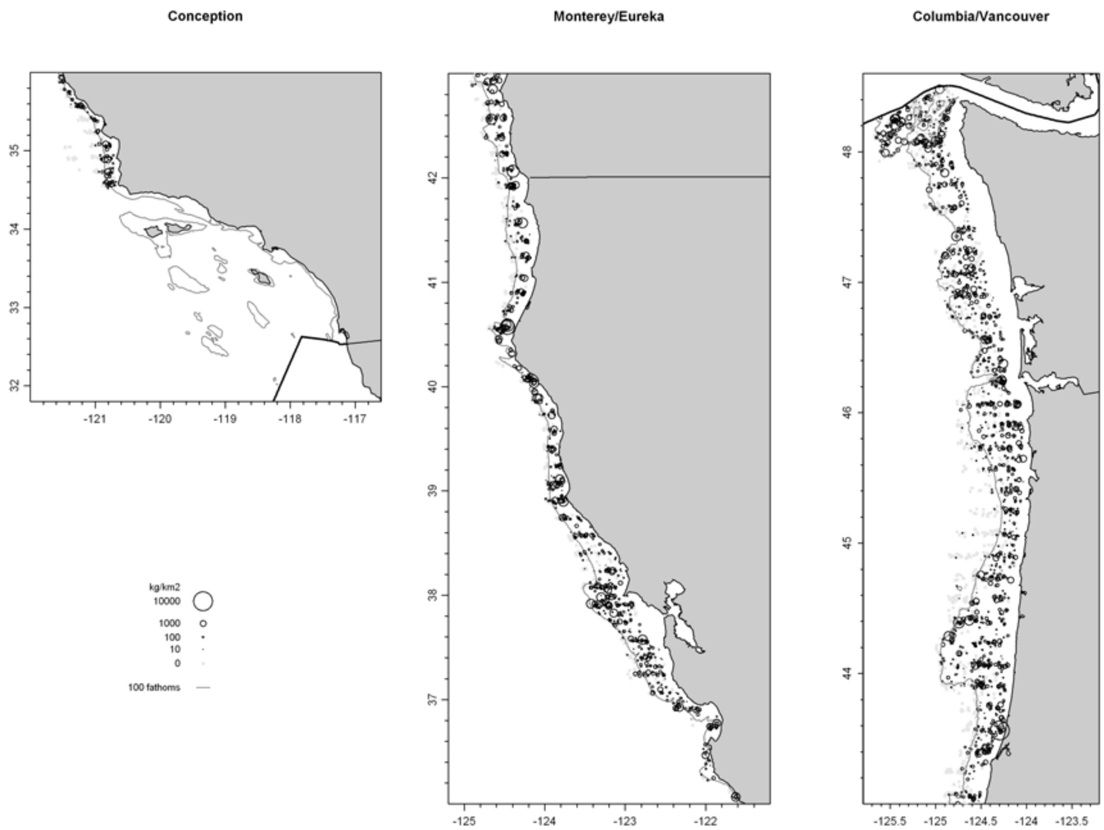


Figure 14. Catch rates over all years for the Triennial survey.

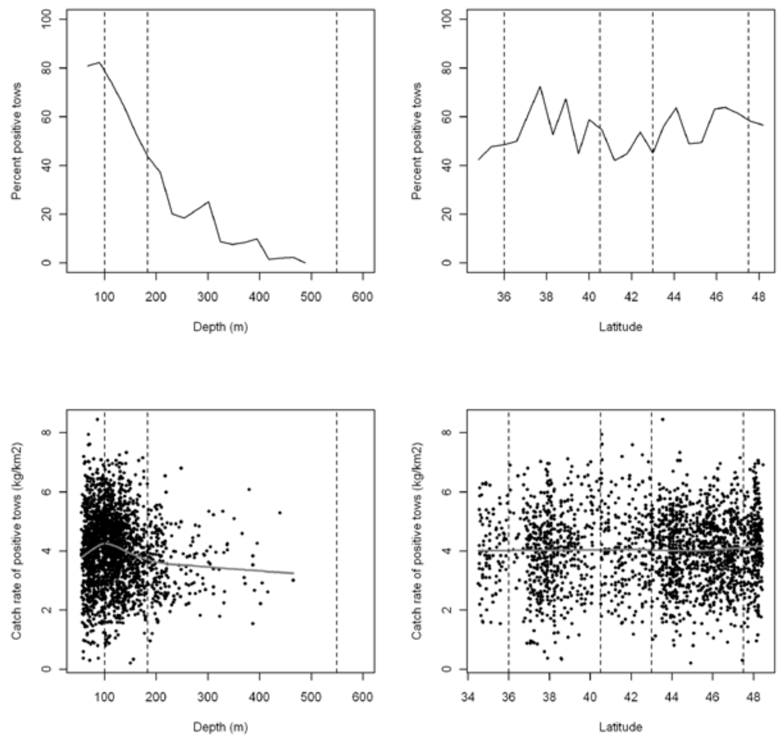


Figure 15. Plots of the percentage of positive tows and the catch rates for all positive tows over depth and latitude for the Triennial Survey.

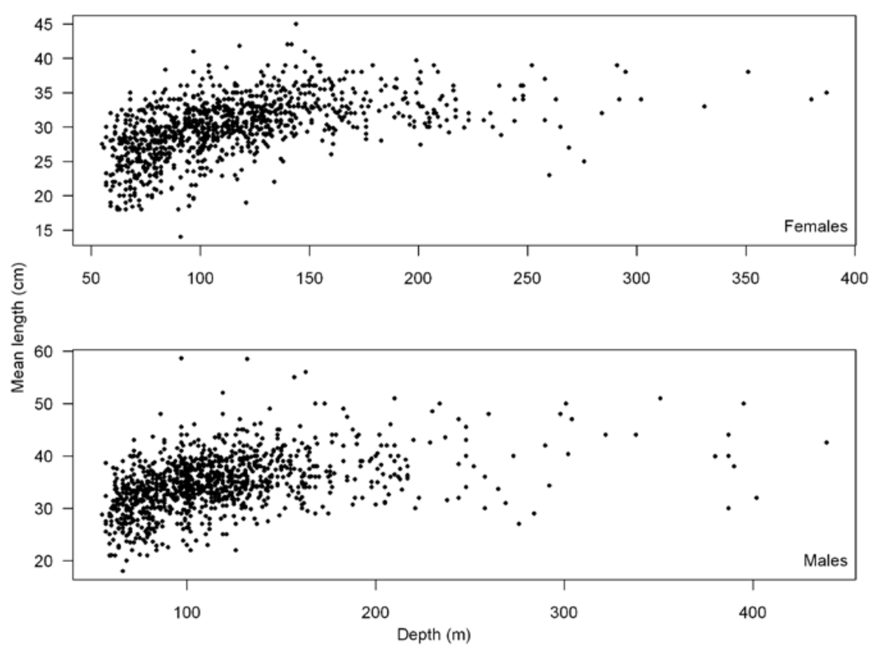


Figure 16. The mean length per tow from the Triennial trawl survey data plotted over depth for females and males.

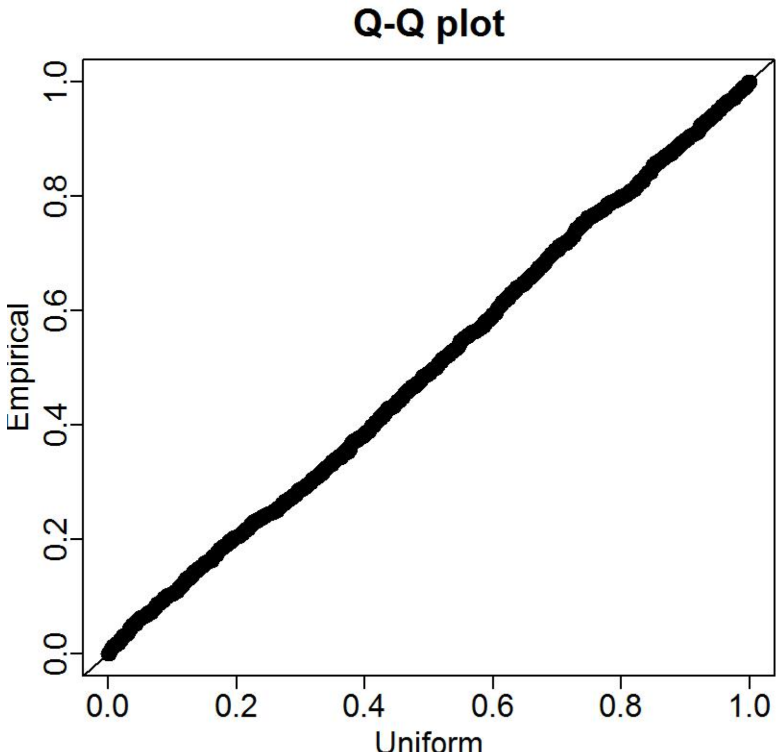


Figure 17. Early triennial survey GLM Q-Q plot.

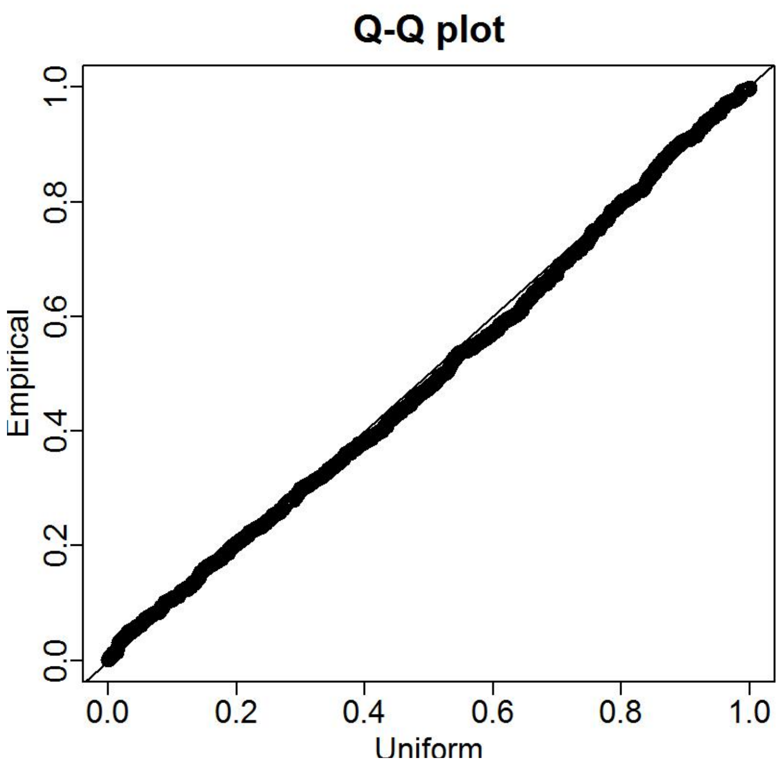
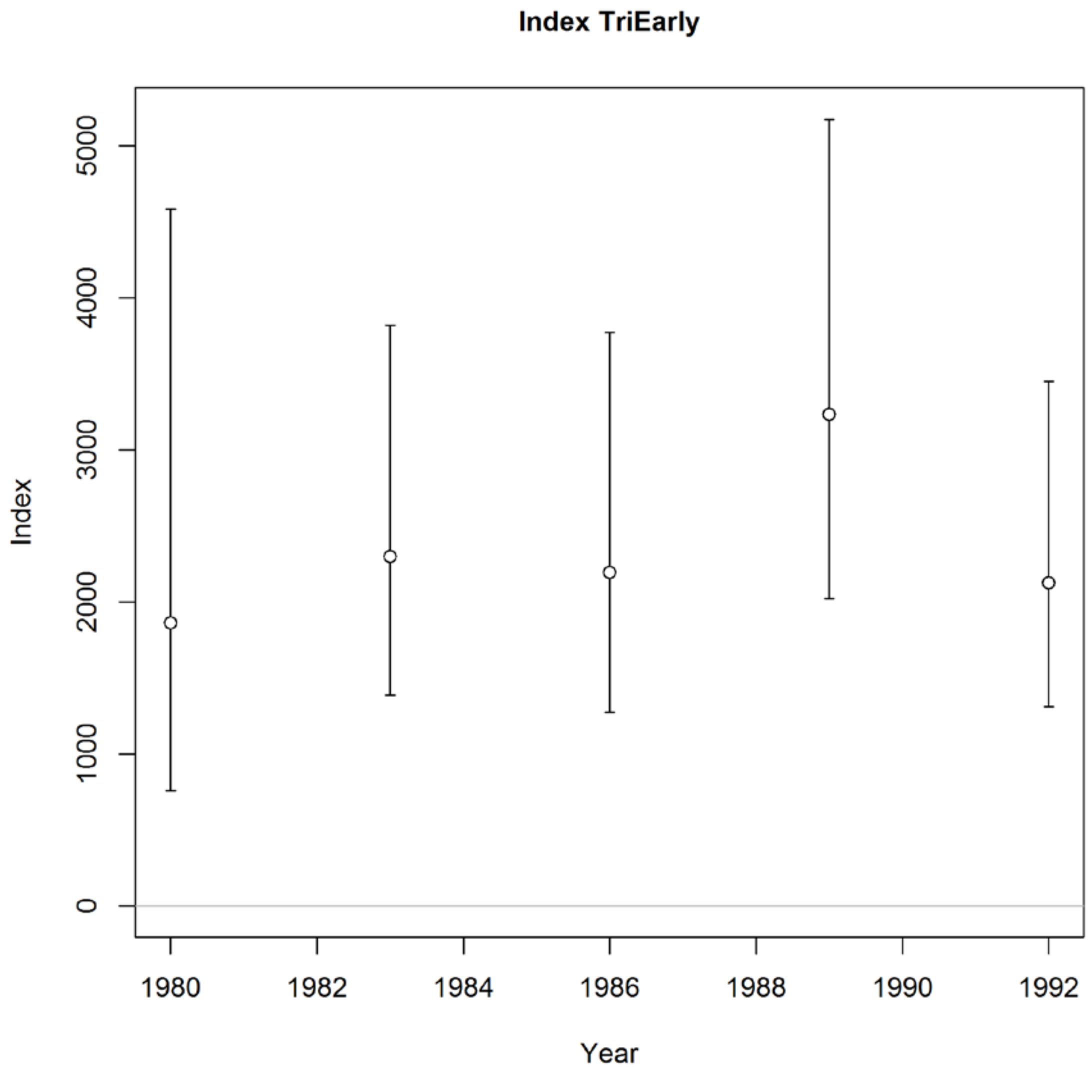


Figure 18. Late triennial survey GLM Q-Q plot.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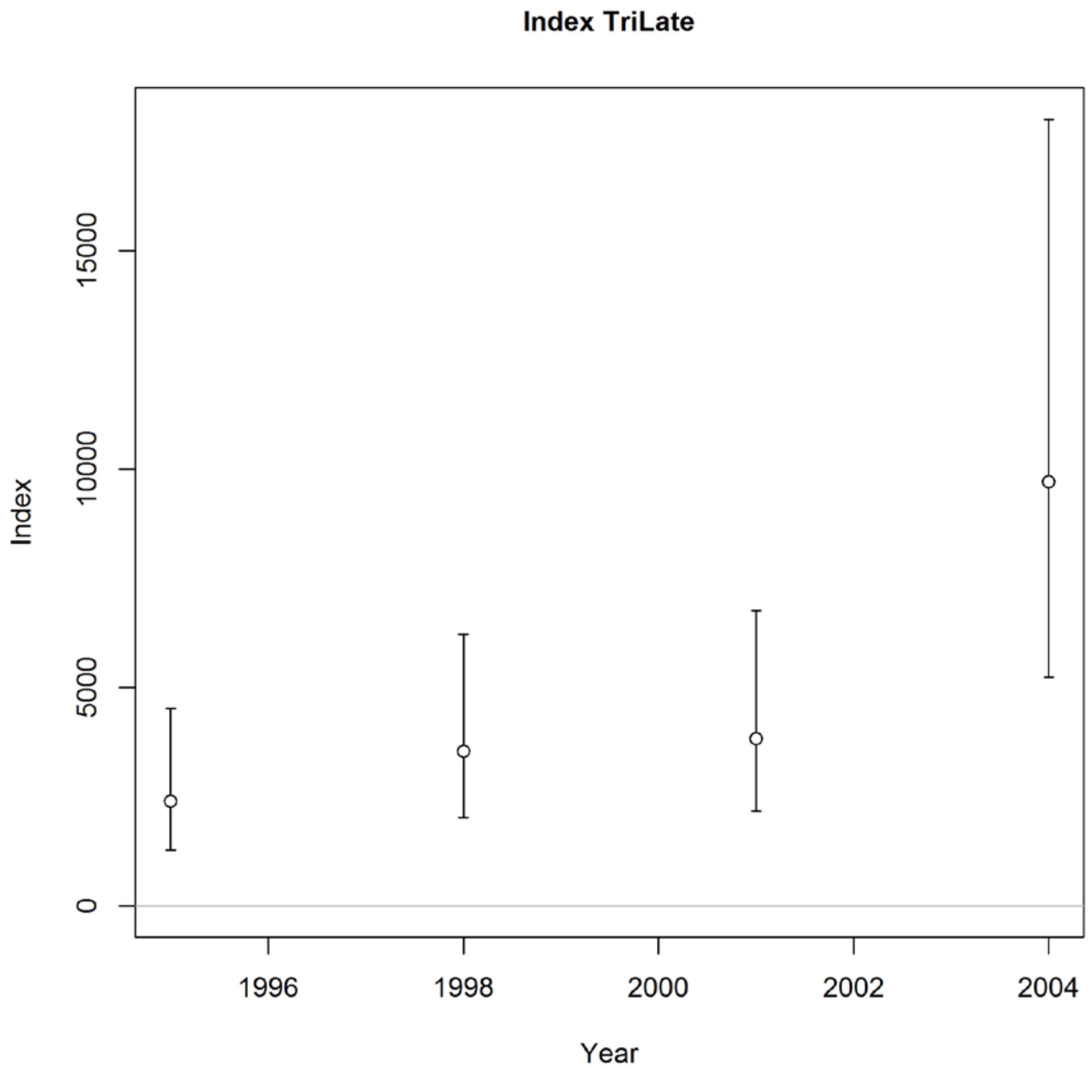


Figure 19. GLMM biomass estimates from the early (top panel) and late (bottom panel) Triennial survey.

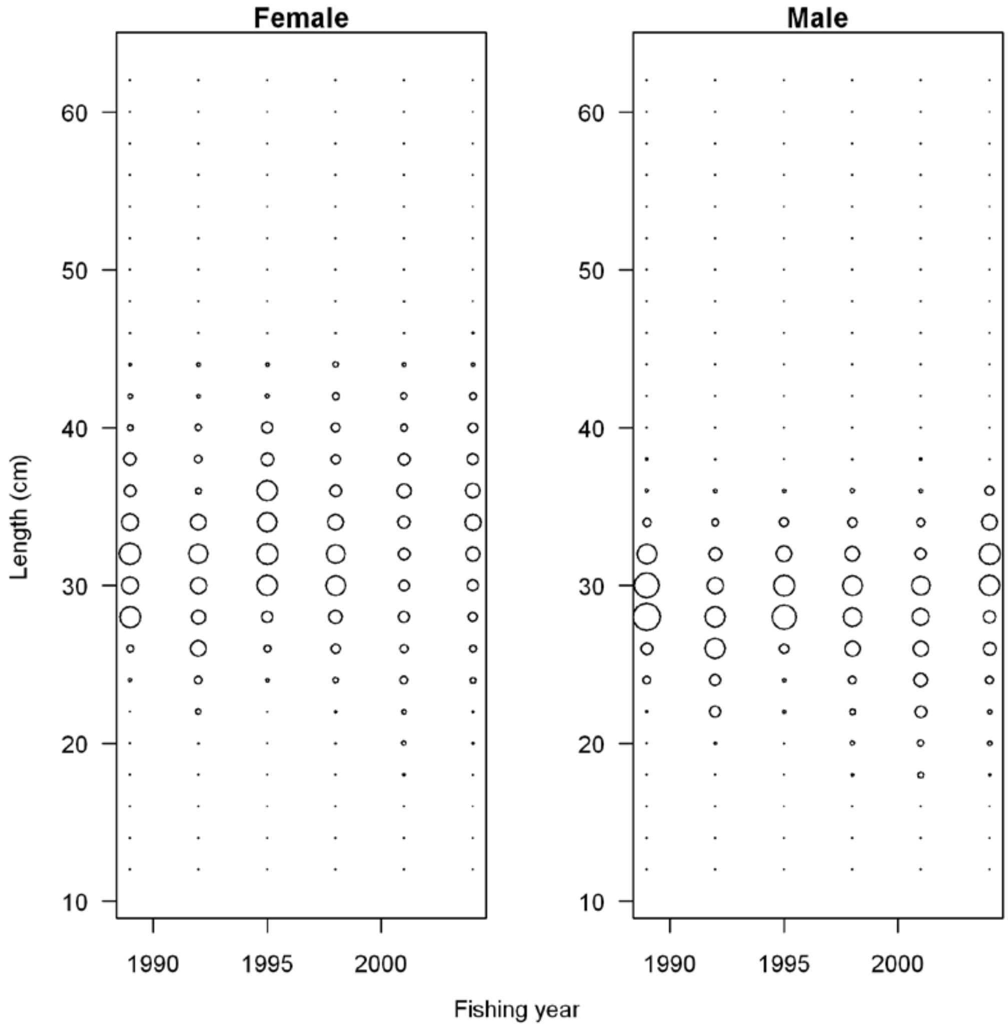


Figure 20. Plots of length frequencies from the triennial survey.

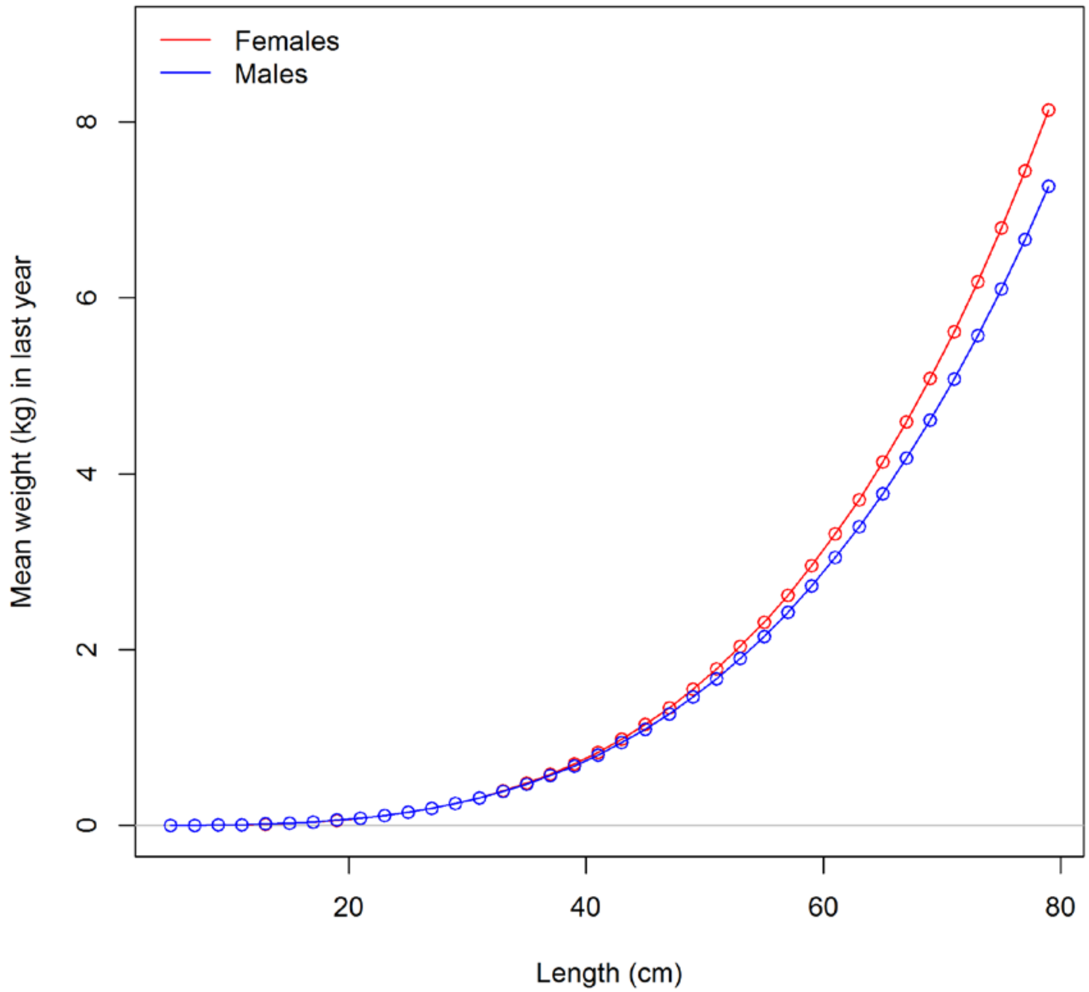


Figure 21. Petrale sole weight-length relationship.

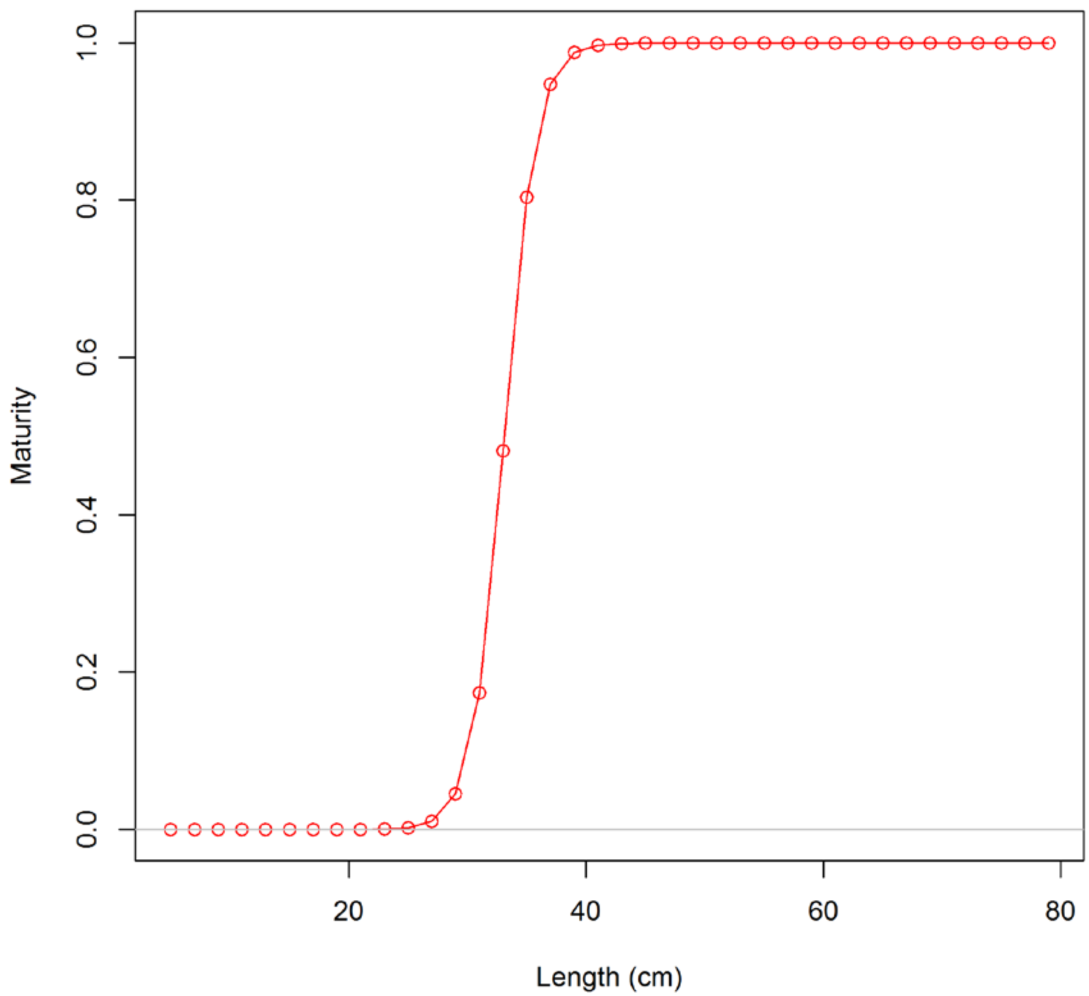


Figure 22. Petrale sole maturity ogive (females only).

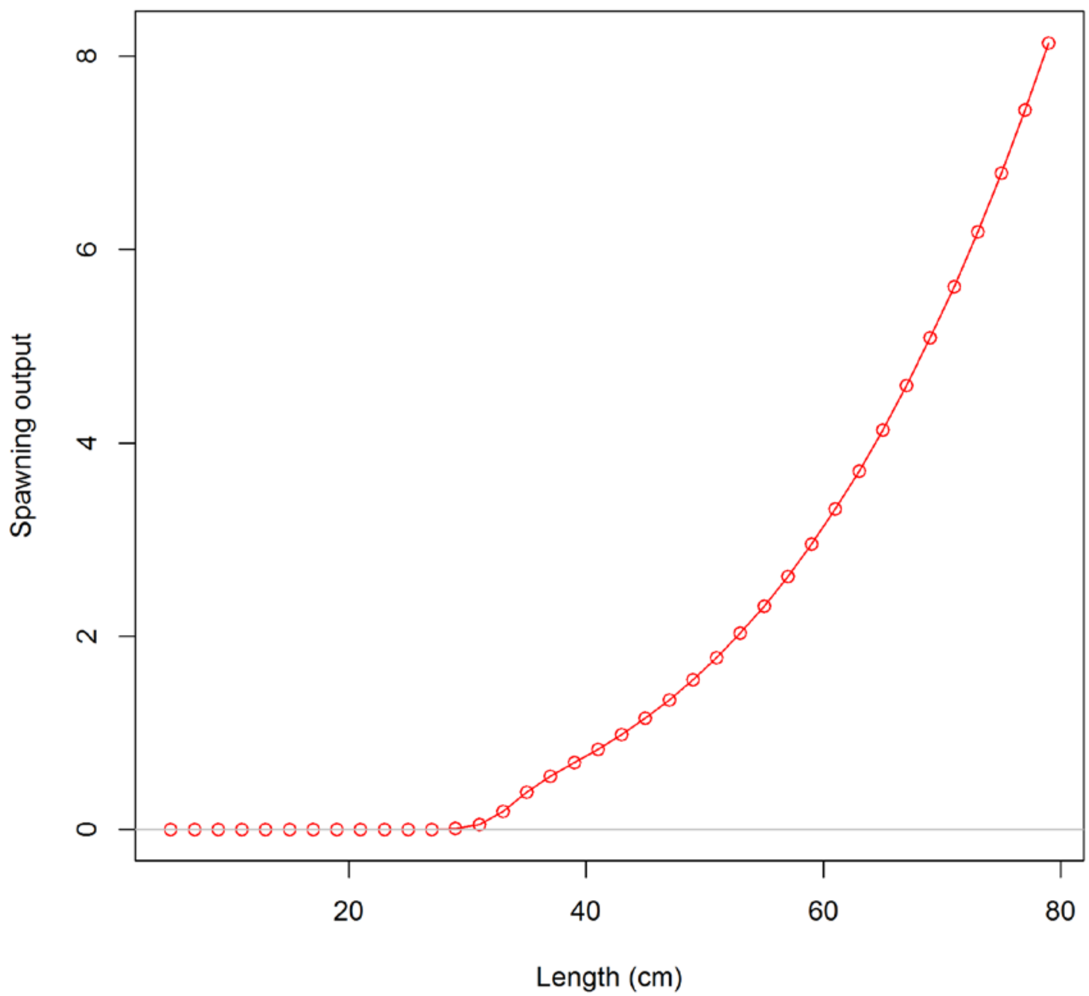


Figure 23. Petrale sole spawning output as a function of length.

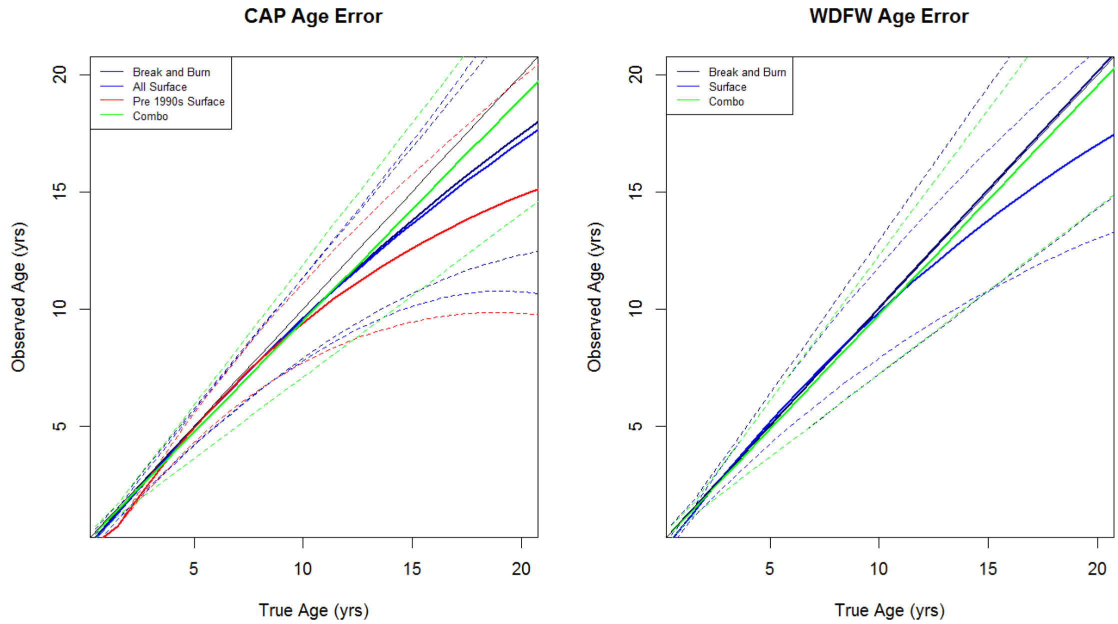


Figure 24. Plots of bias and imprecision for each data set. The 1:1 line is the dark bold line.

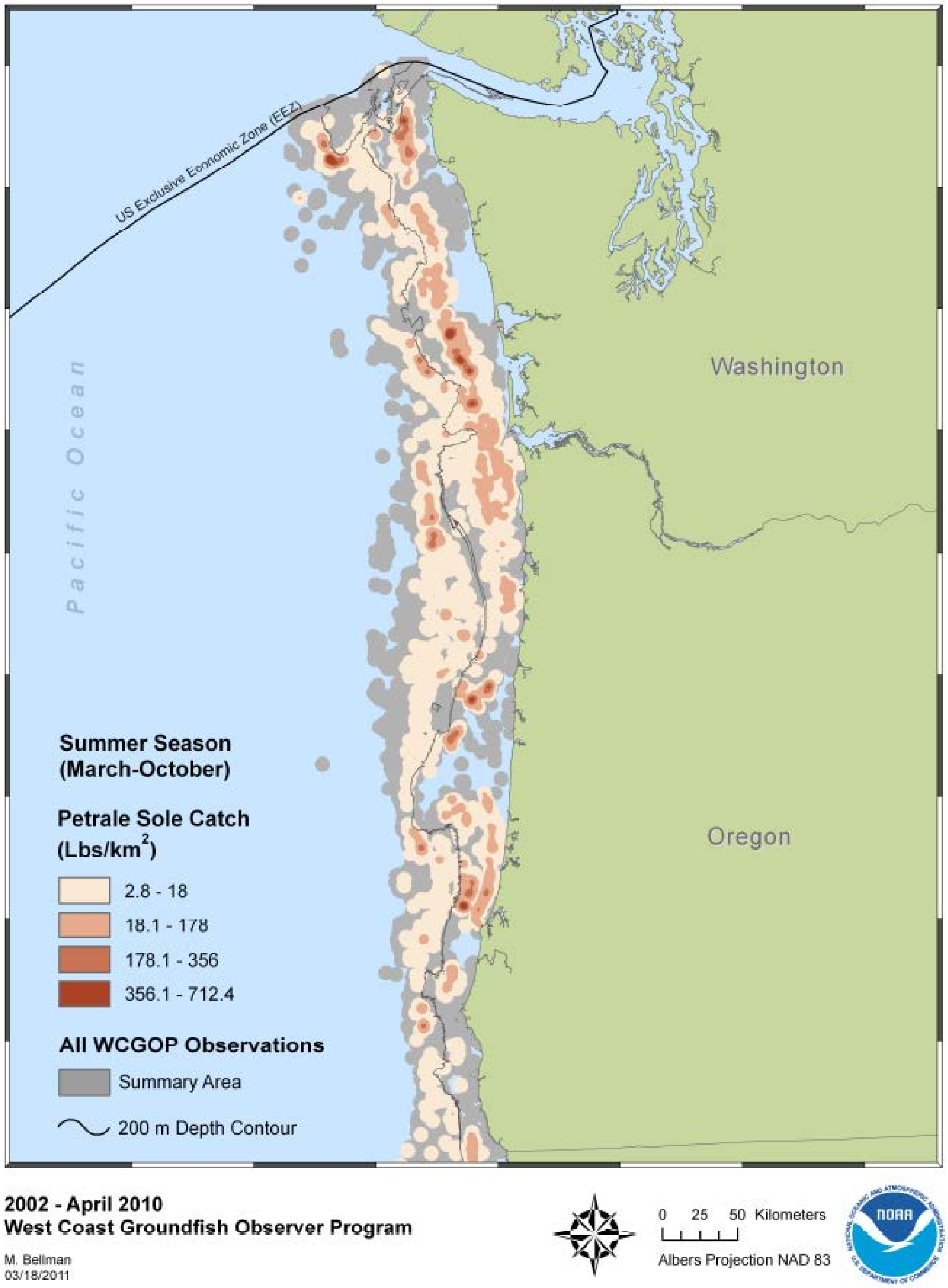


Figure 25. Spatial distribution of northern petrale sole catch (lbs/km2), in the summer (March-October) season, observed by the West Coast Groundfish Observer Program from 2002 – April 2010 and the summary area of all observed fishing events. The range of catch (minimum to maximum value) was mapped; the two highest classifications were defined by dividing the maximum value in half, and the resulting value in half, and the remaining observations were then allocated into equal proportions into the two lowest classifications.

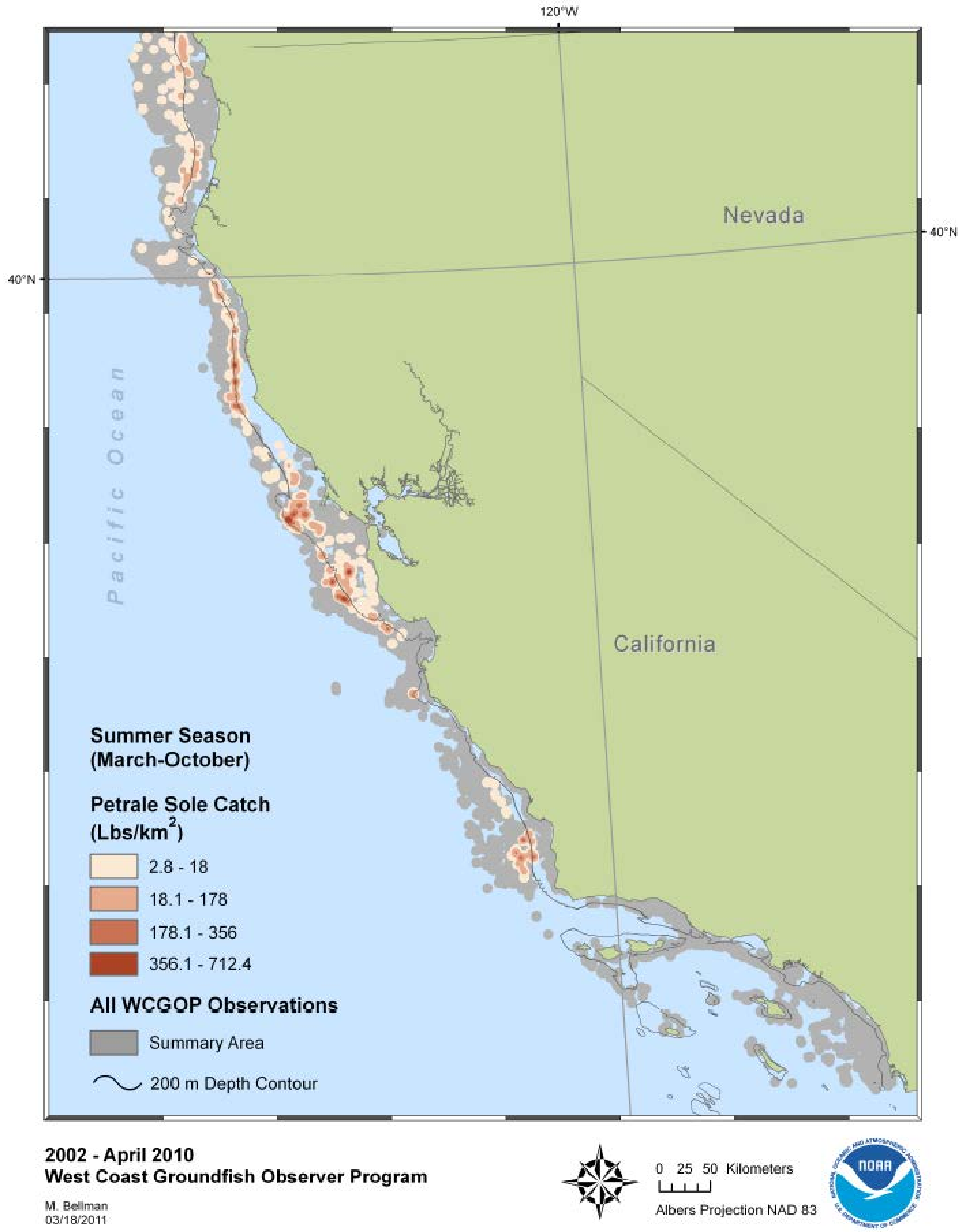


Figure 26. Spatial distribution of southern petrale sole catch (lbs/km2), in the summer (March-October) season, observed by the West Coast Groundfish Observer Program from 2002 – April 2010 and the summary area of all observed fishing events. The range of catch (minimum to maximum value) was mapped; the two highest classifications were defined by dividing the maximum value in half, and the resulting value in half, and the remaining observations were then allocated into equal proportions into the two lowest classifications.

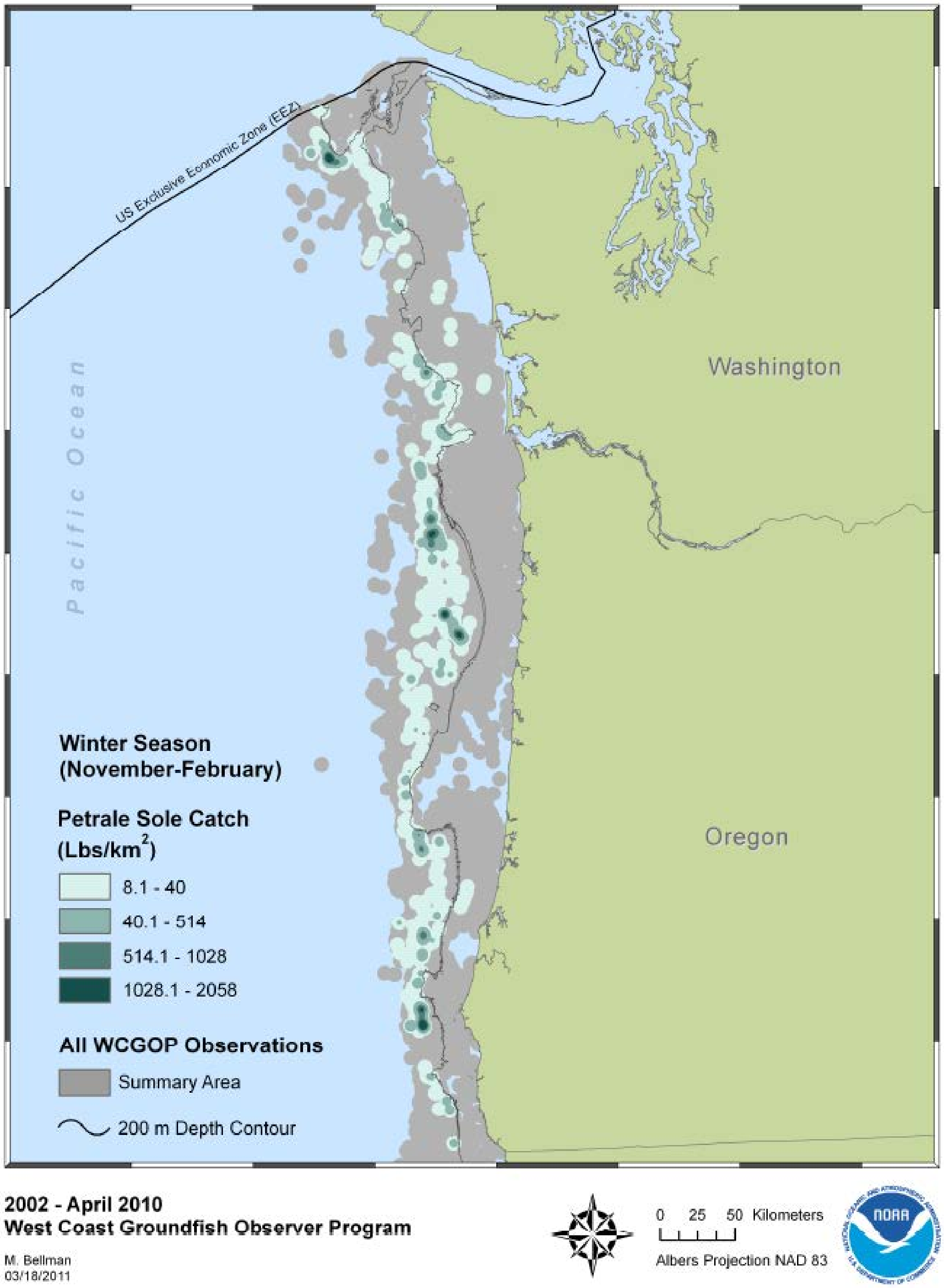


Figure 27. Spatial distribution of northern petrale sole catch (lbs/km2), in the winter season (November-February), observed by the West Coast Groundfish Observer Program from 2002 – April 2010 and the summary area of all observed fishing events. The range of catch (minimum to maximum value) was mapped; the two highest classifications were defined by dividing the maximum value in half, and the resulting value in half, and the remaining observations were then allocated into equal proportions into the two lowest classifications.

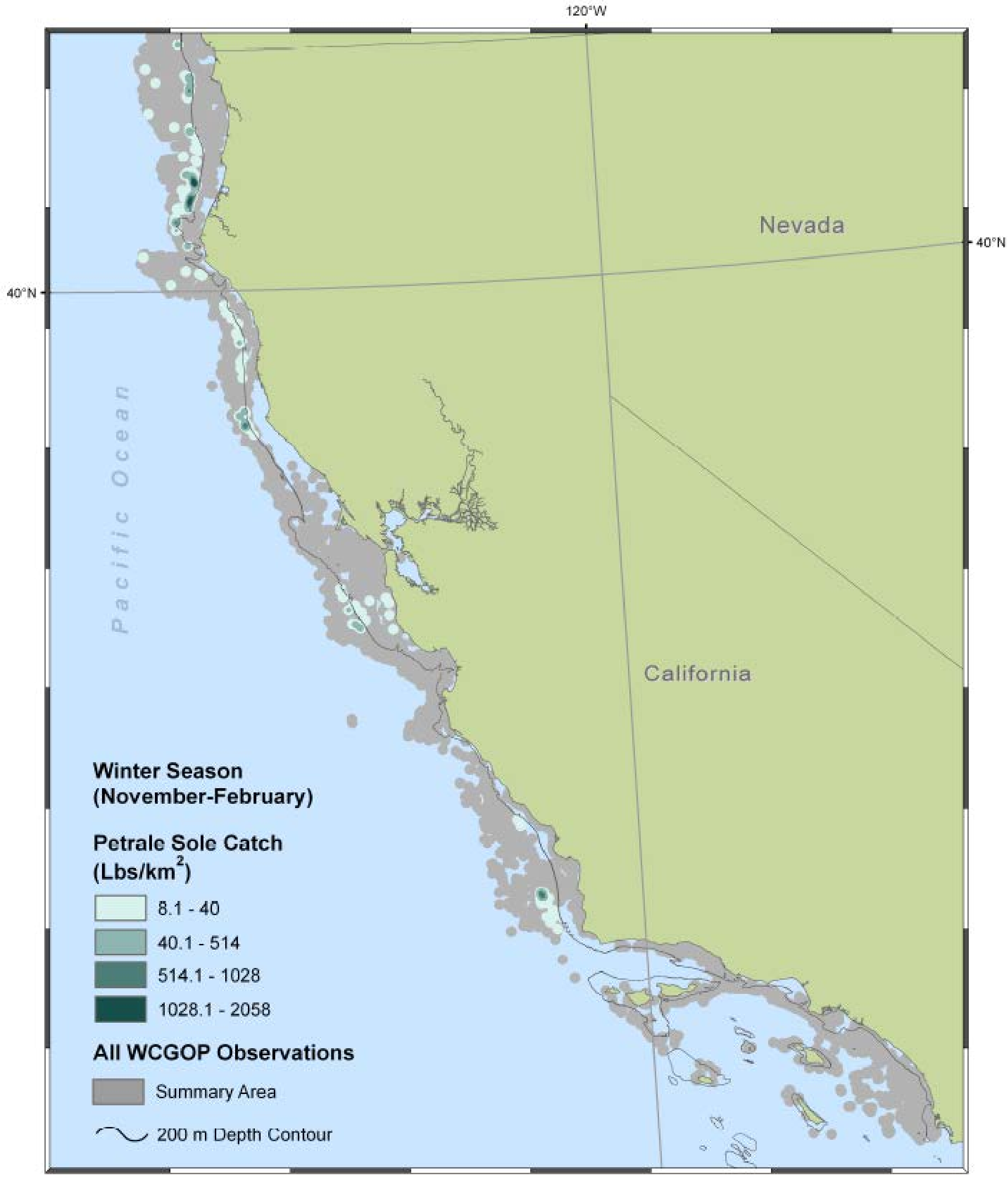


Figure 28. Spatial distribution of southern petrale sole catch (lbs/km2), in the winter season (November-February), observed by the West Coast Groundfish Observer Program from 2002 – April 2010 and the summary area of all observed fishing events. The range of catch (minimum to maximum value) was mapped; the two highest classifications were defined by dividing the maximum value in half, and the resulting value in half, and the remaining observations were then allocated into equal proportions into the two lowest classifications.

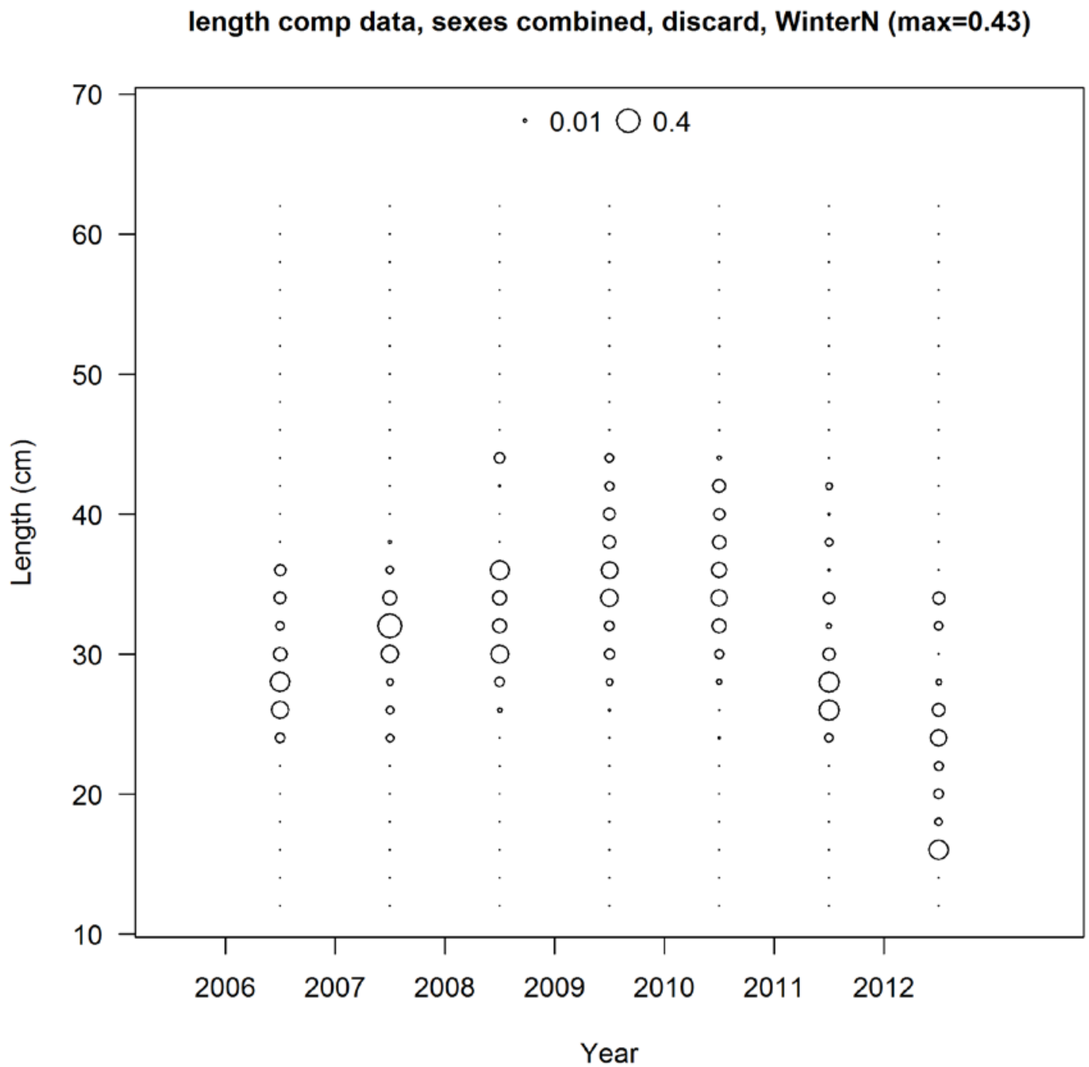


Figure 29. WCGOP winter north discard length compositions, sex combined.

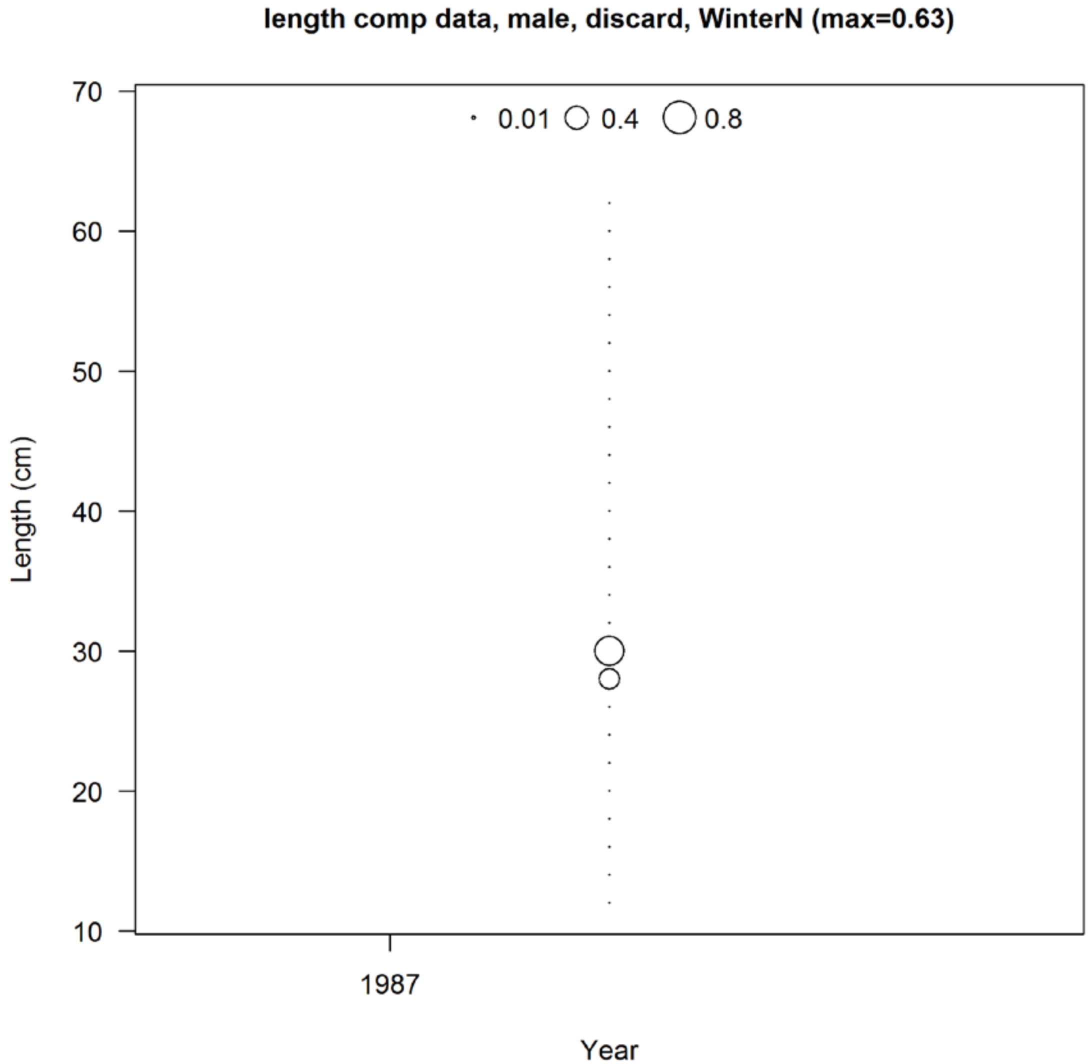


Figure 30. Pikitch winter north discard length compositions, males.

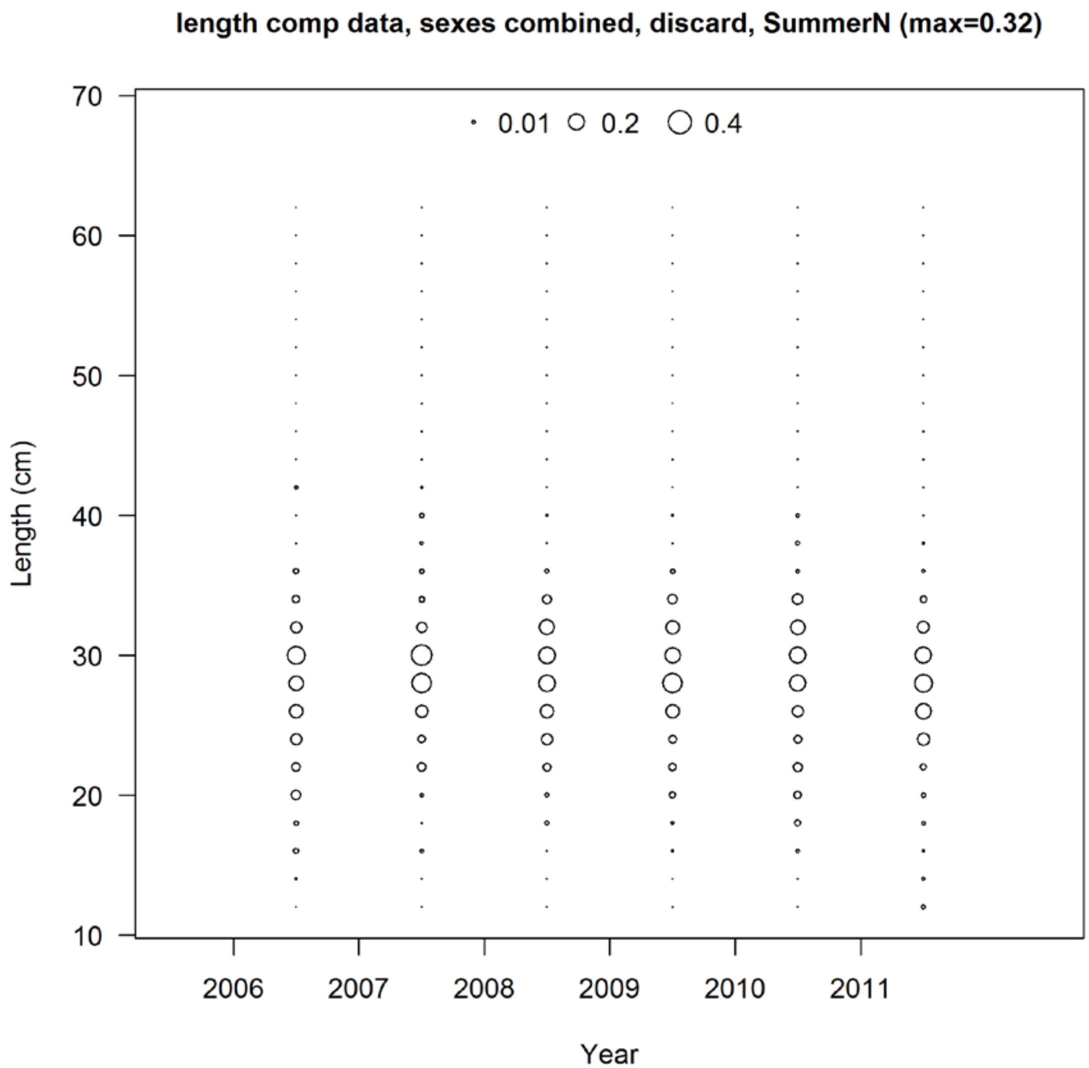


Figure 31. WCGOP summer north discard length compositions, sexes combined.

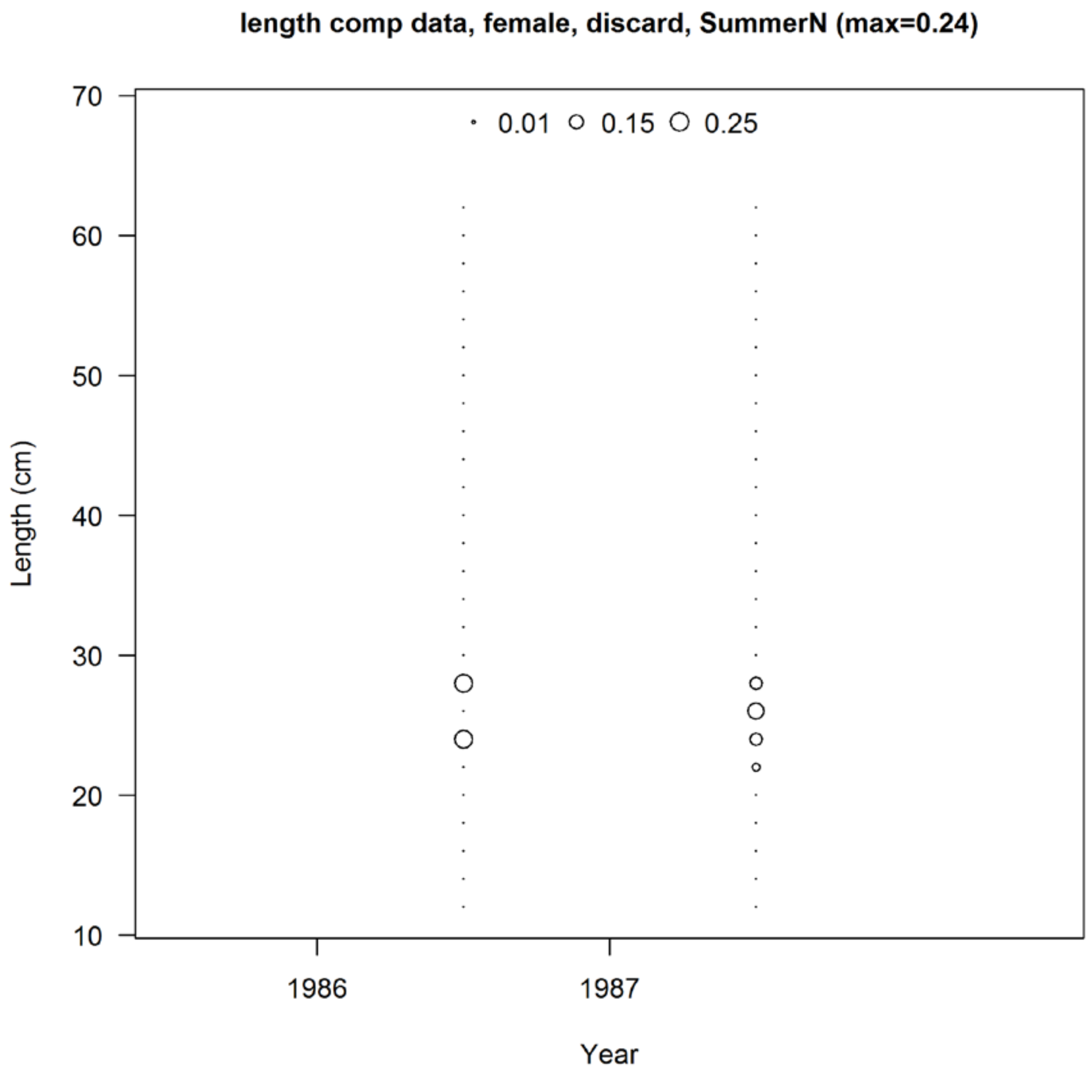


Figure 32. Pikitch summer north discard length compositions, females.

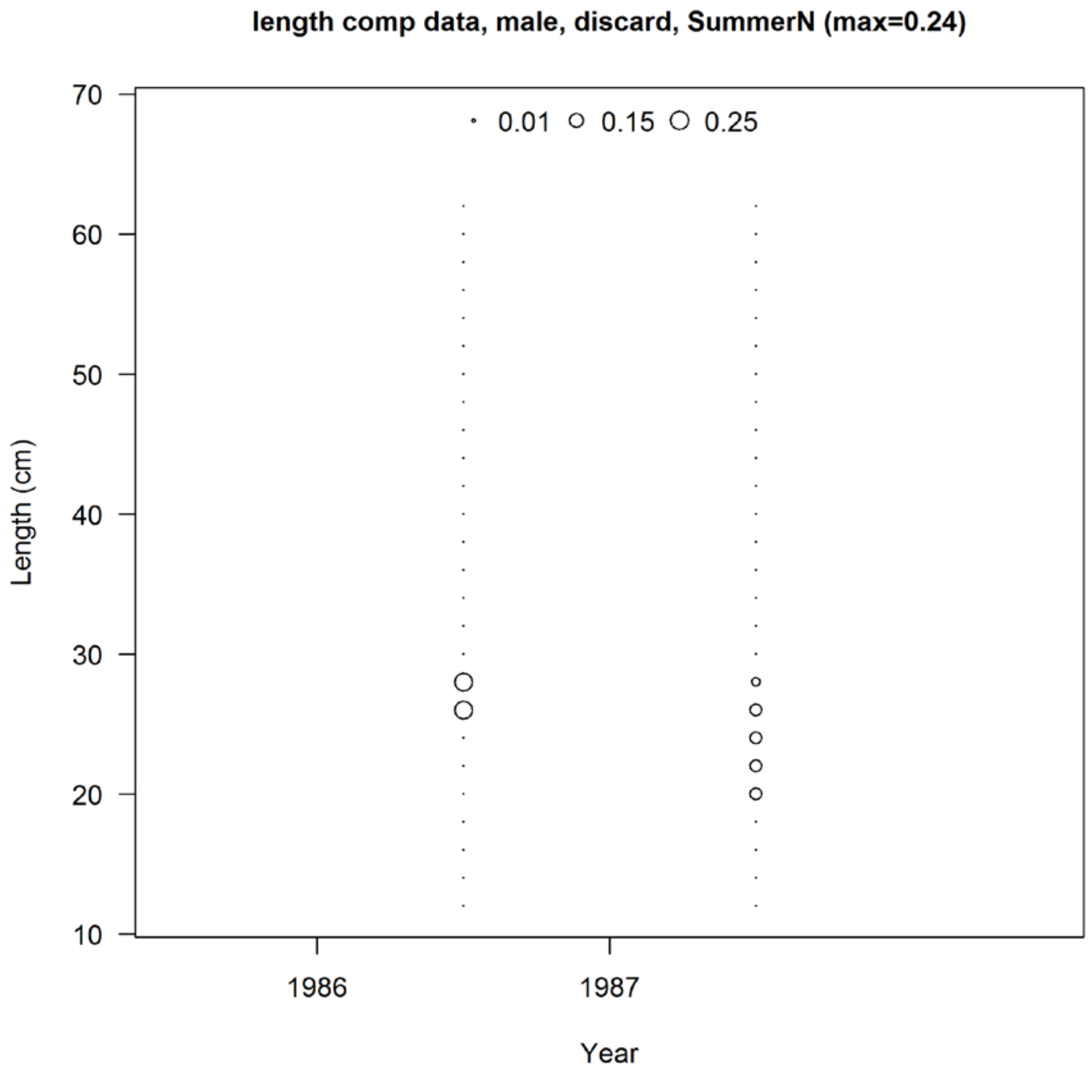


Figure 33. Pikitch summer north discard length compositions, males.

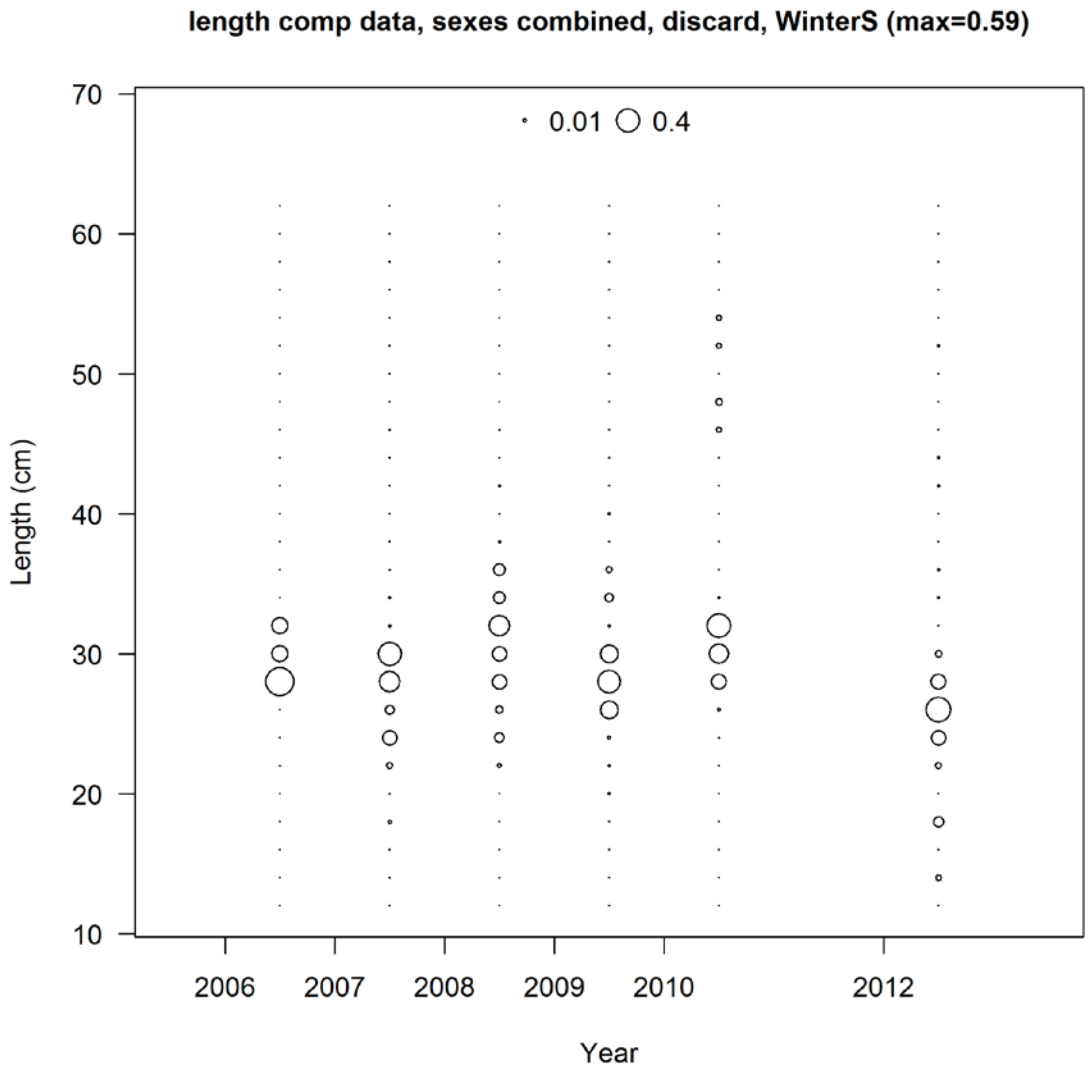


Figure 34. WCGOP winter south discard length compositions, sexes combined.

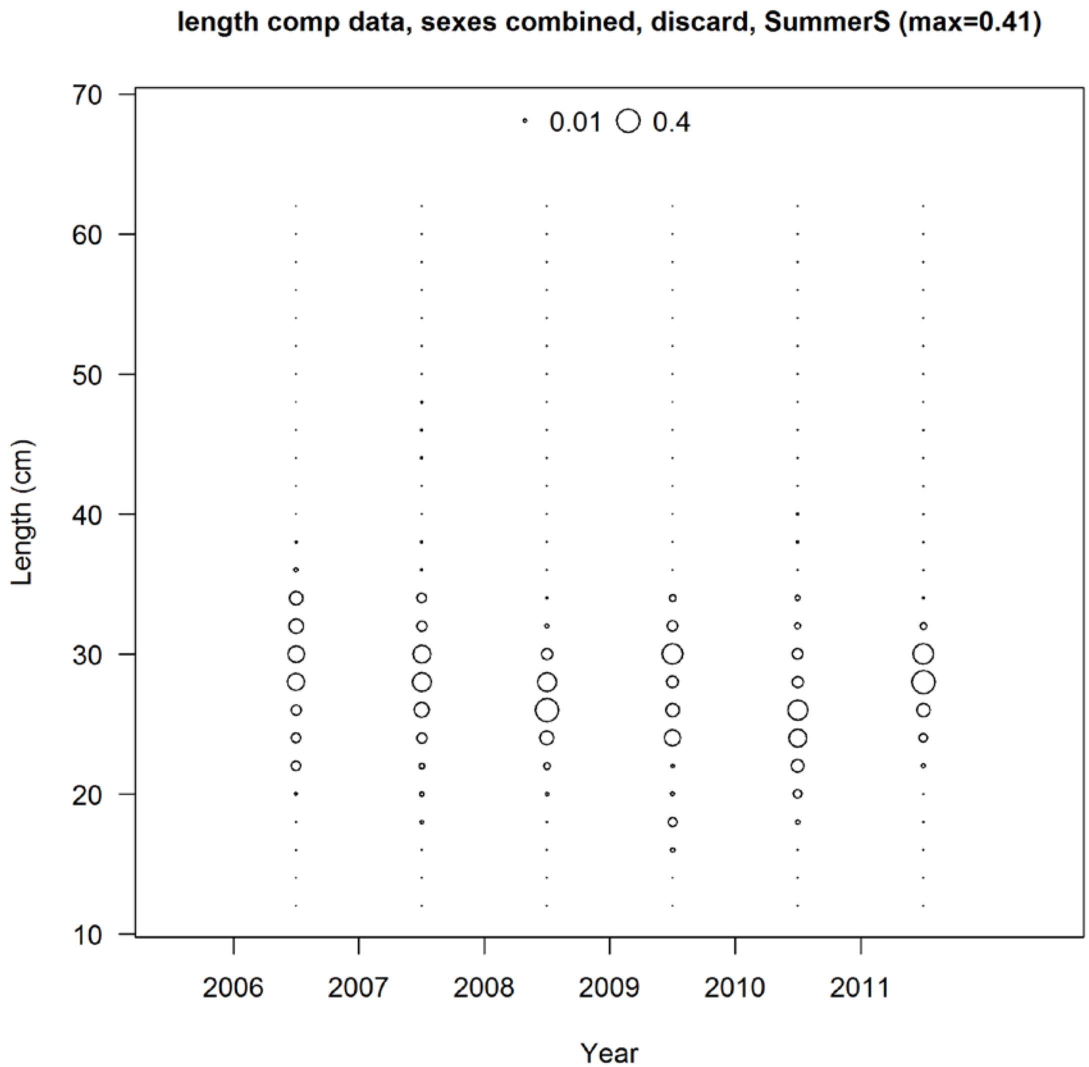


Figure 35. **WCGOP summer south discard length compositions, sexes combined.**

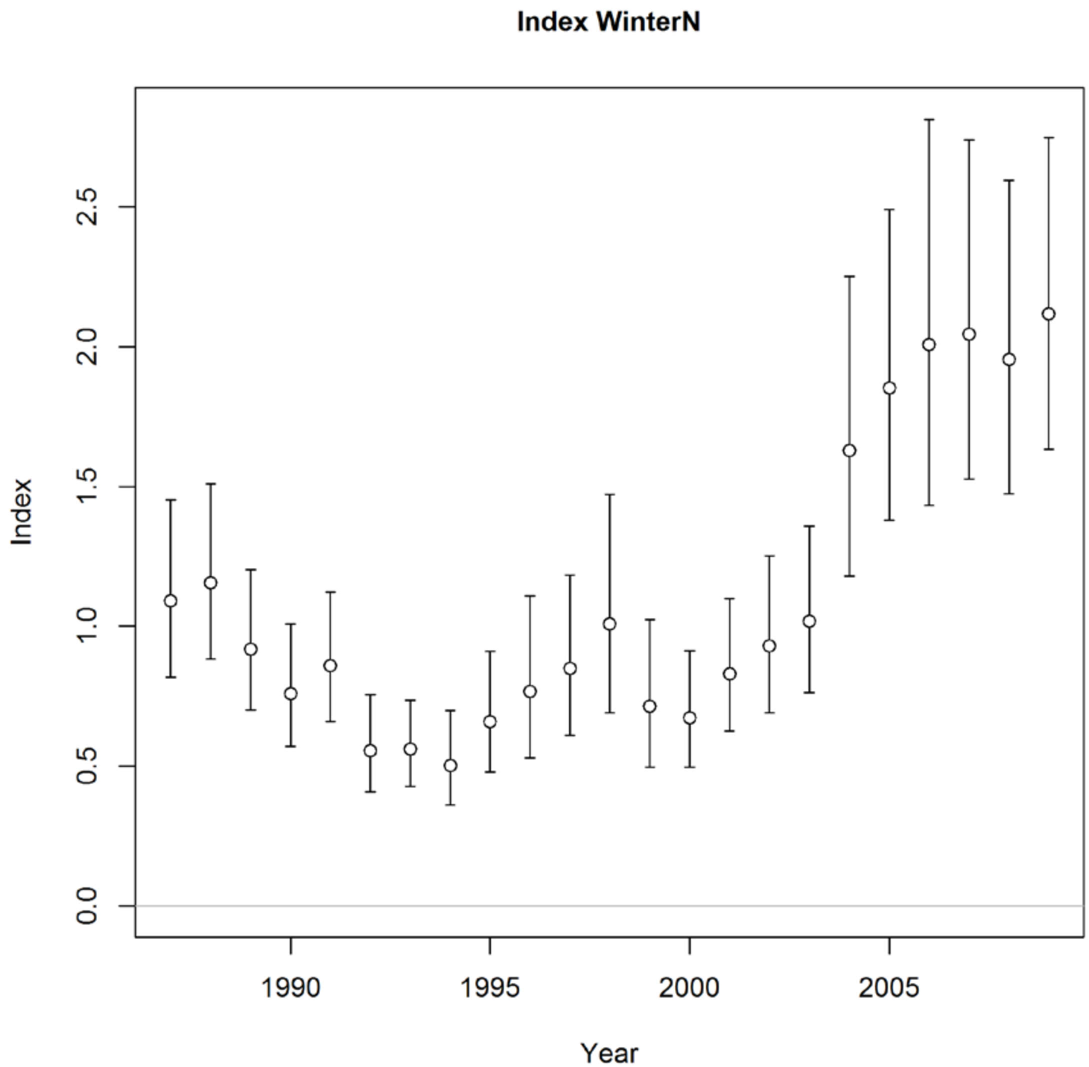


Figure 36. Winter north standardized commercial CPUE index.

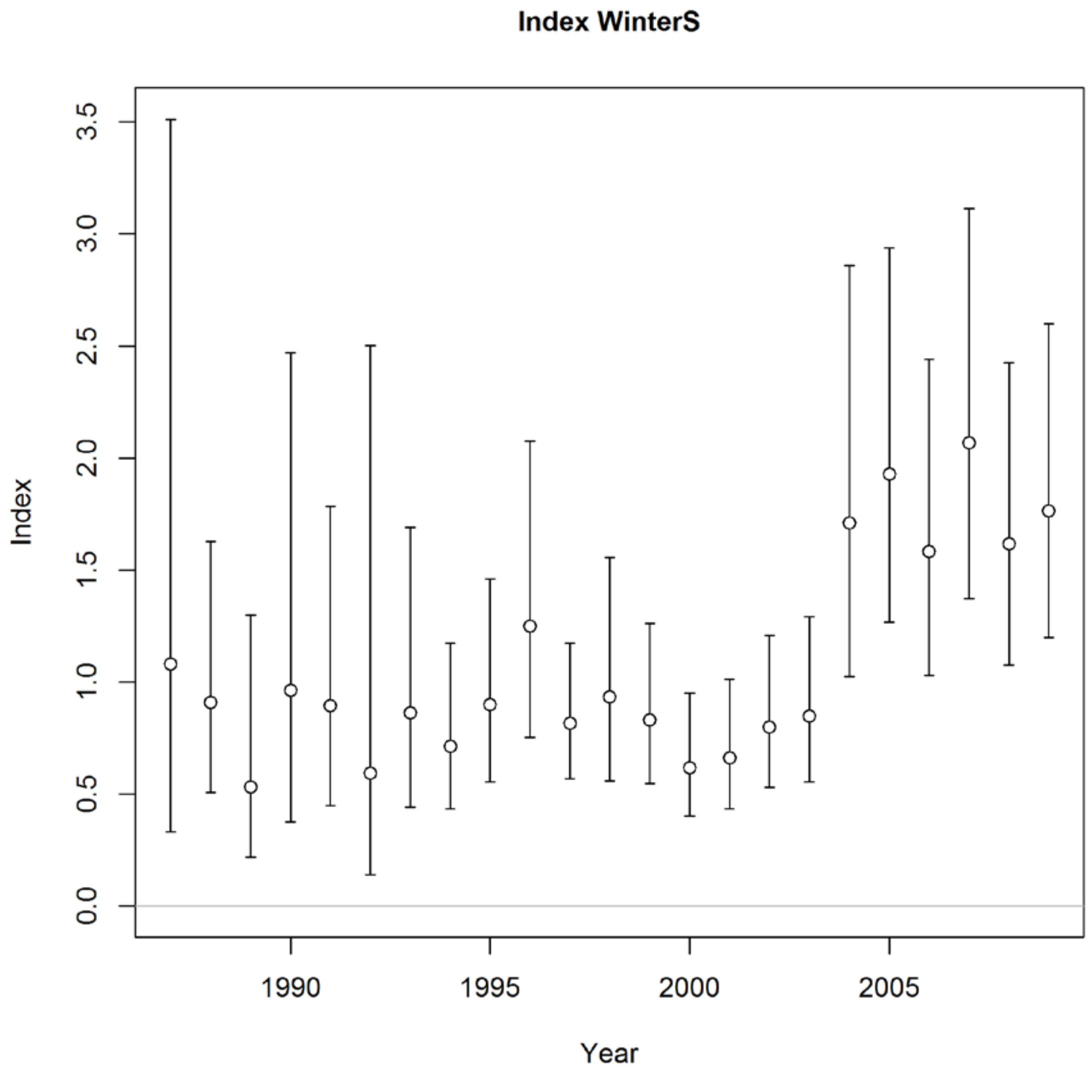


Figure 37. Winter south standardized CPUE index.

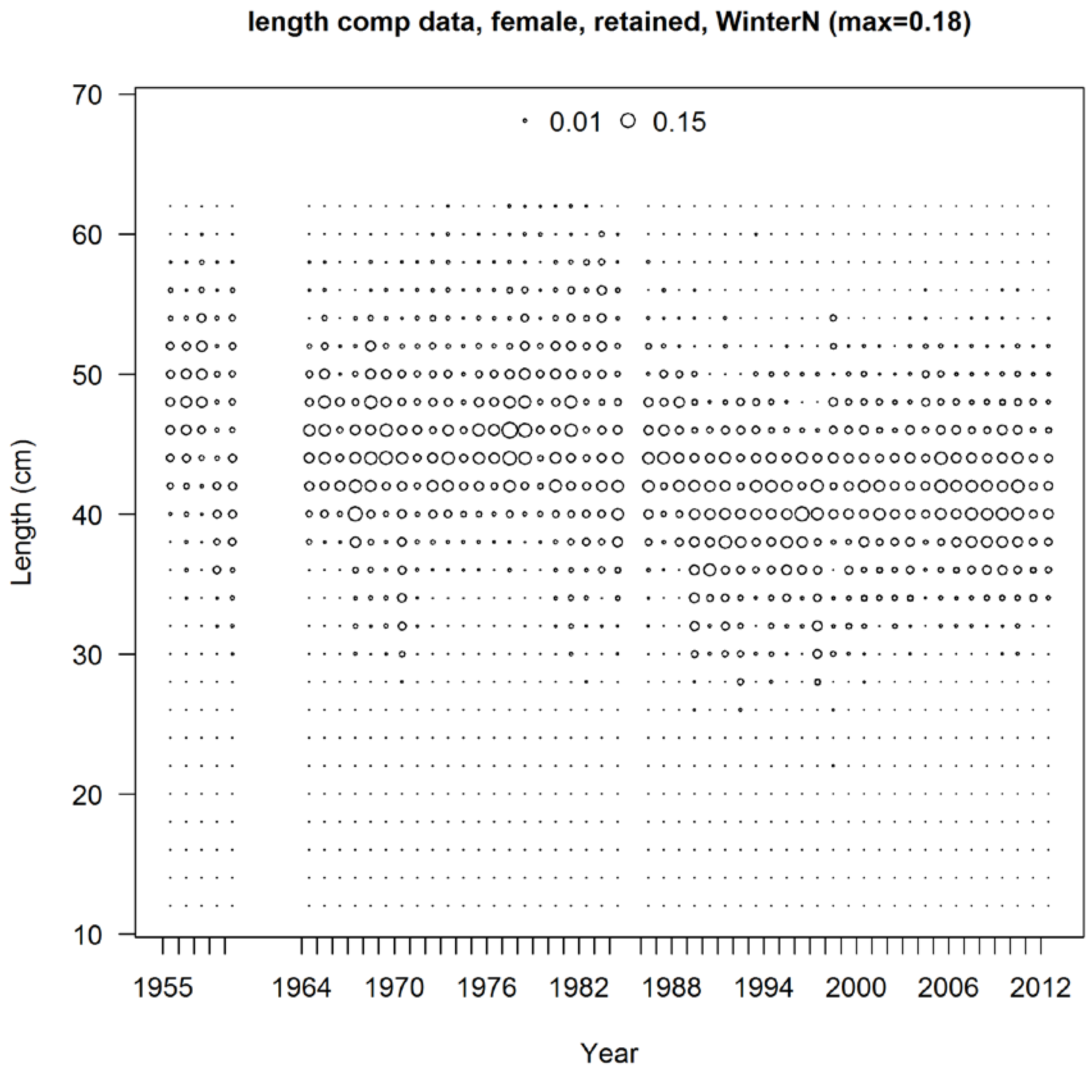


Figure 38. Winter north length-frequency data, females.

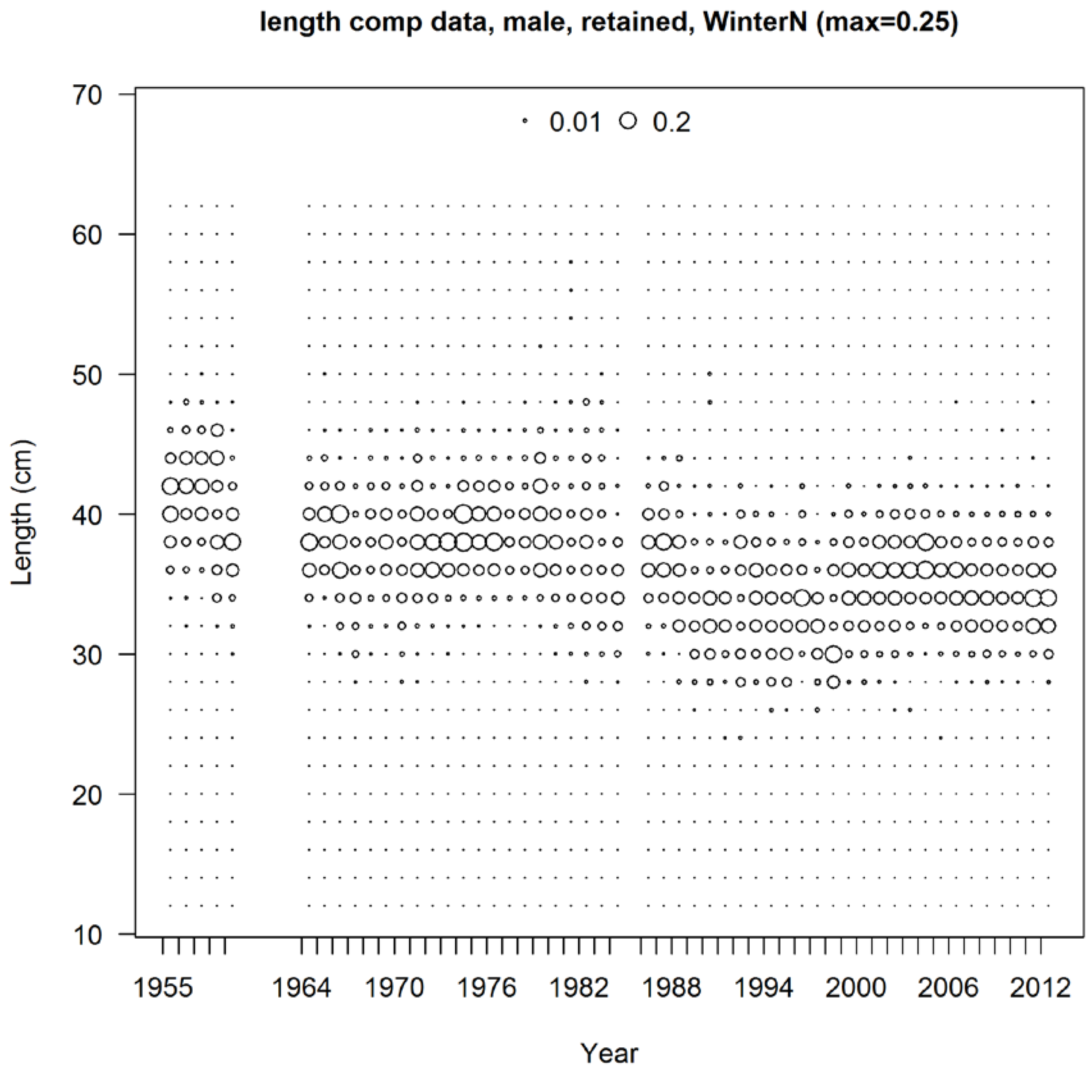


Figure 39. Winter north length-frequency data, males

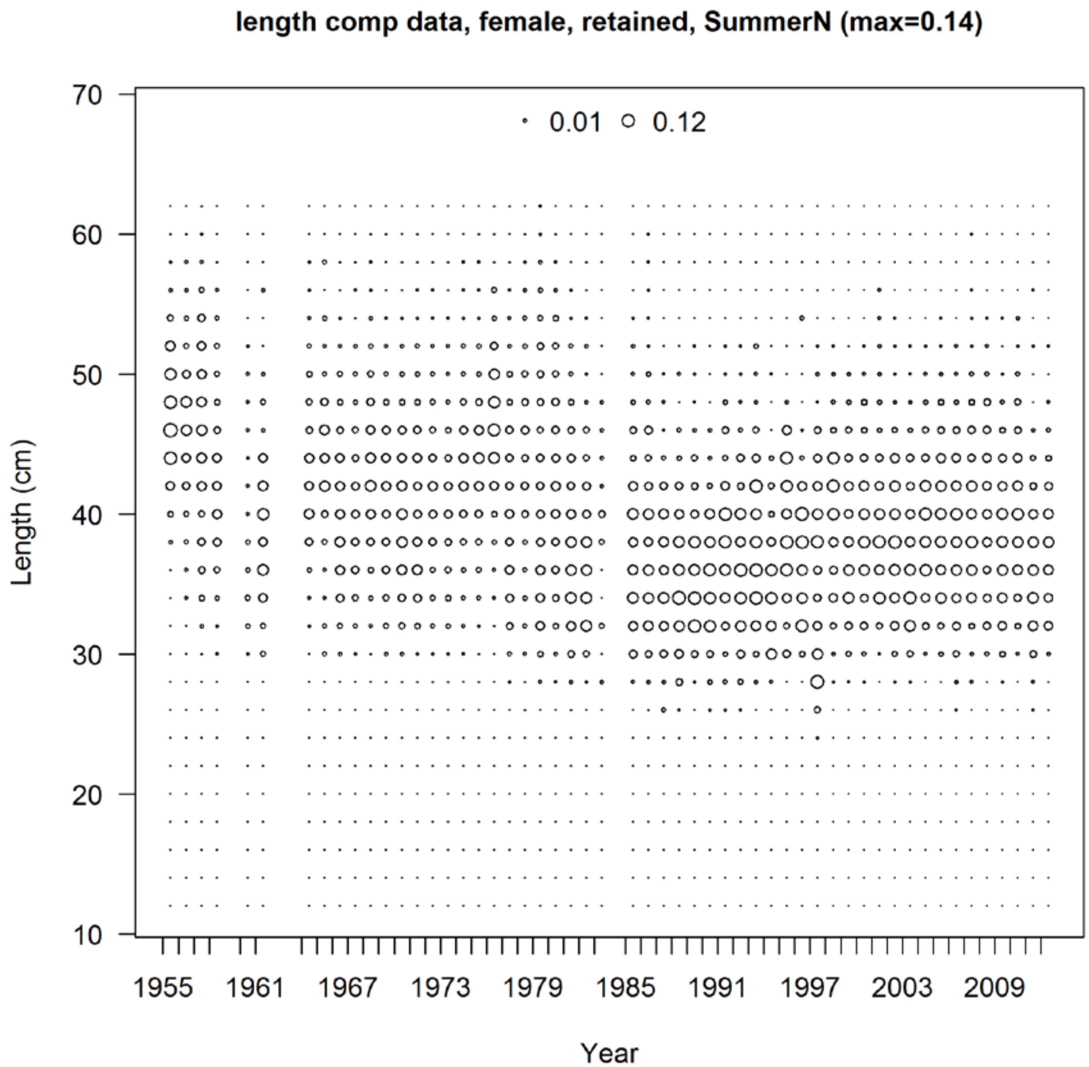


Figure 40. Summer north length-frequency data, females.

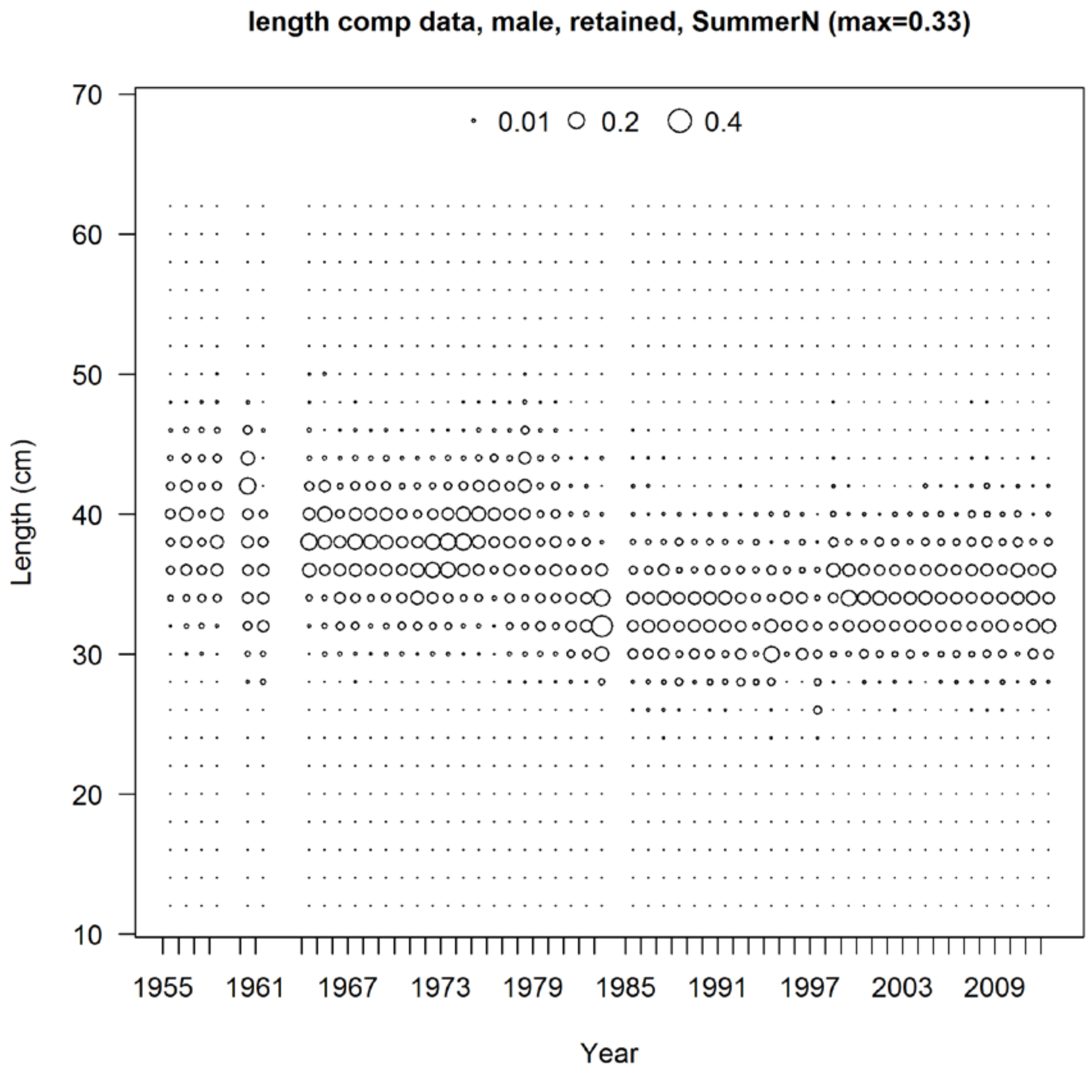


Figure 41. Summer north length-frequency data, males.

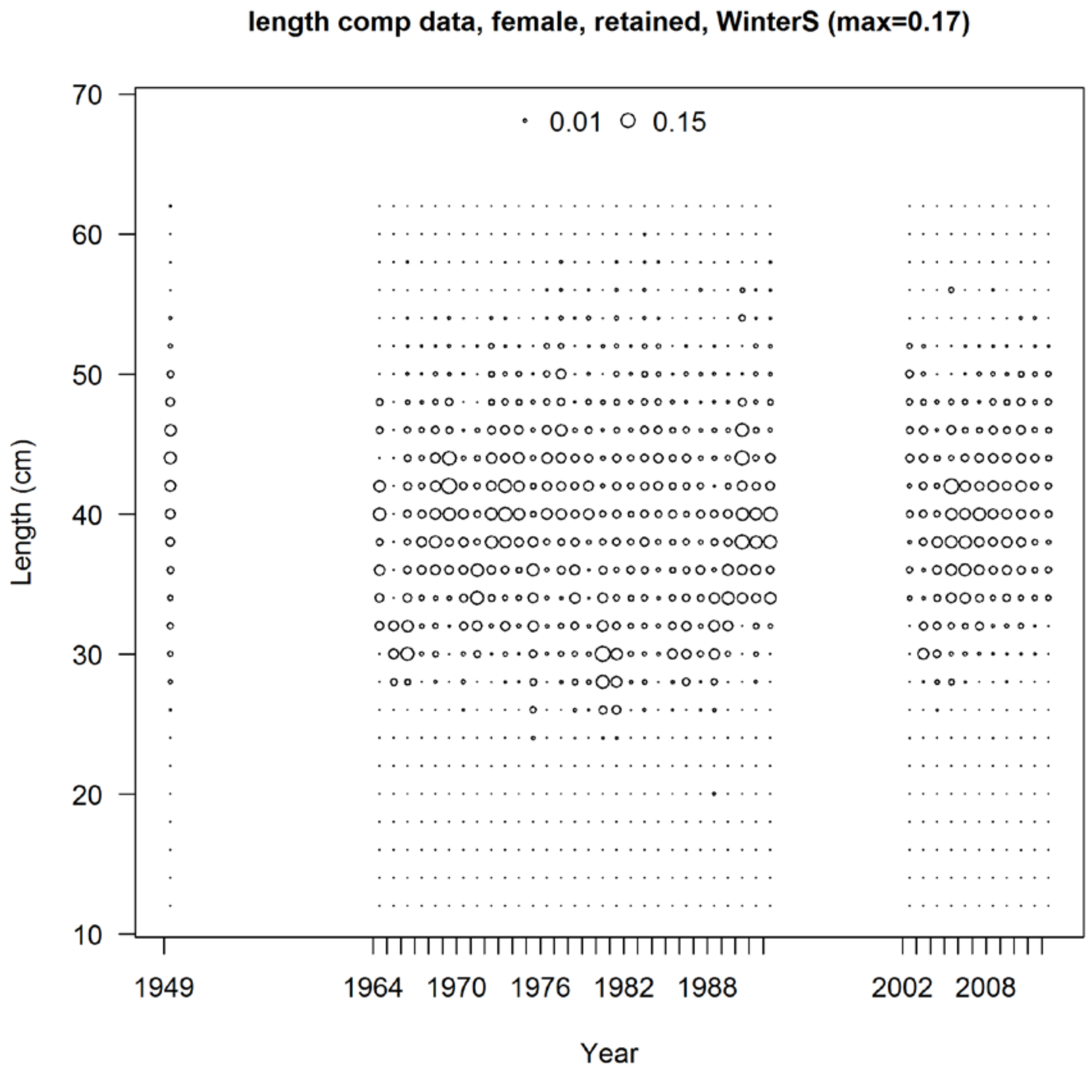


Figure 42. Winter south length-frequency data, females.

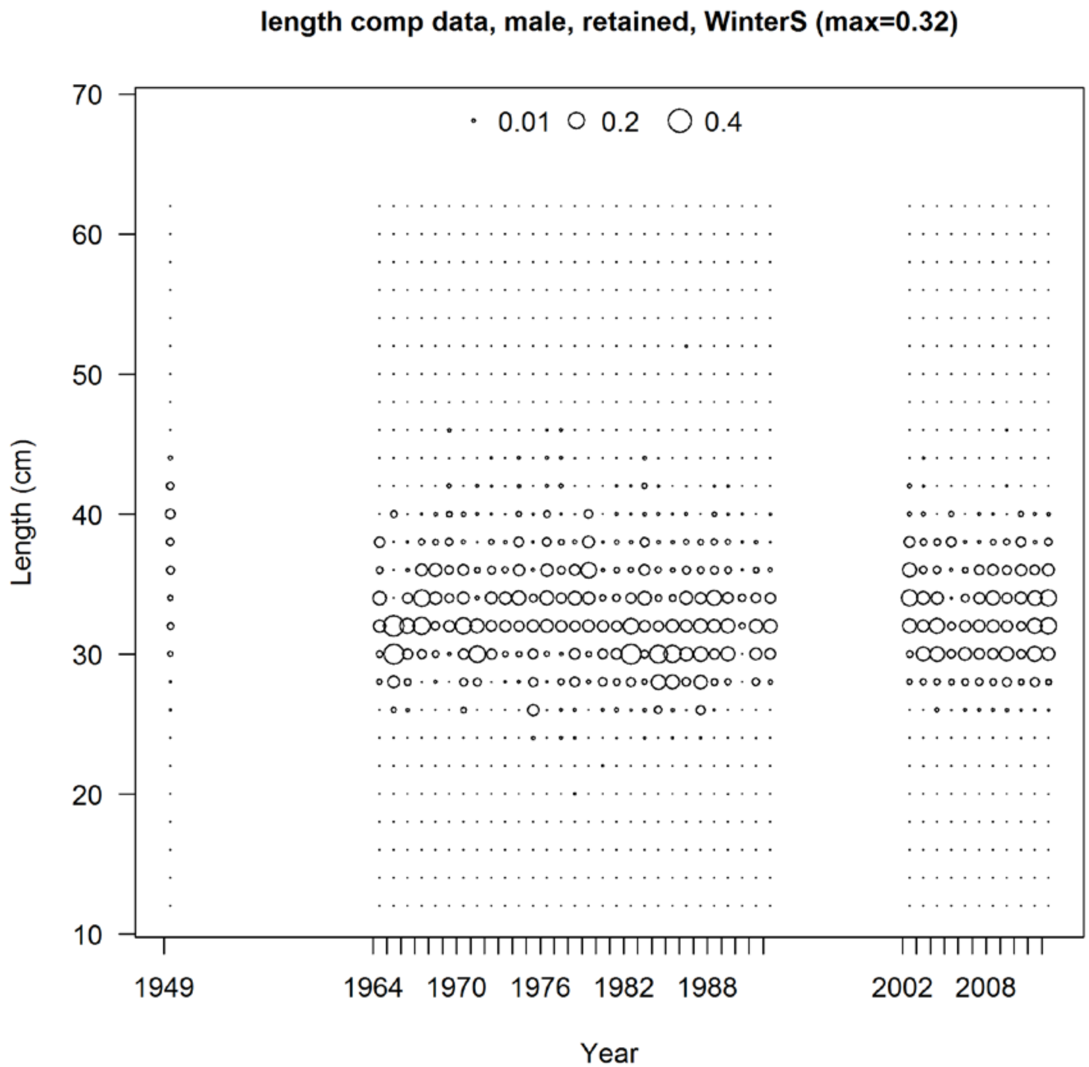


Figure 43. Winter south length-frequency data, males.

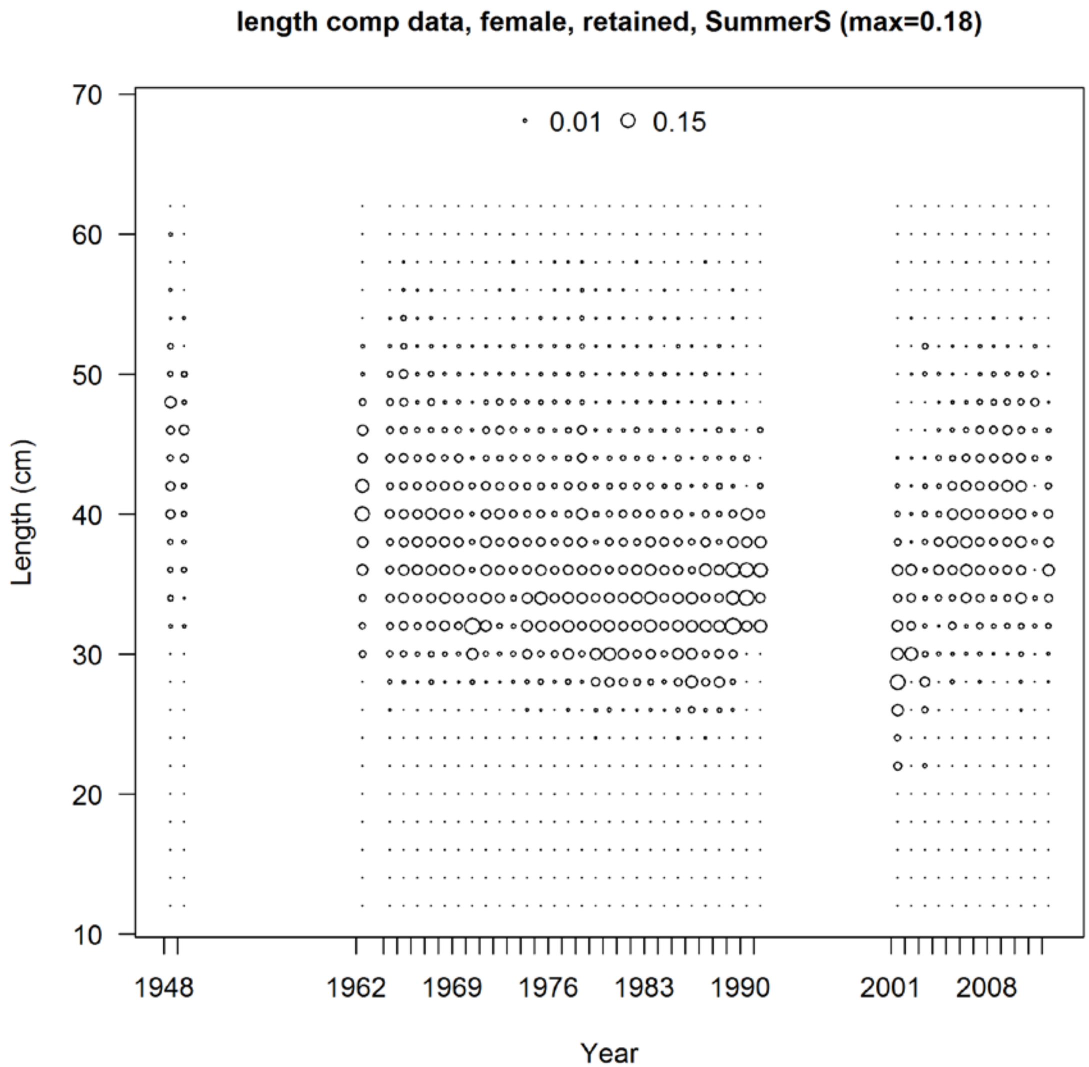


Figure 44. Summer south length-frequency data, females.

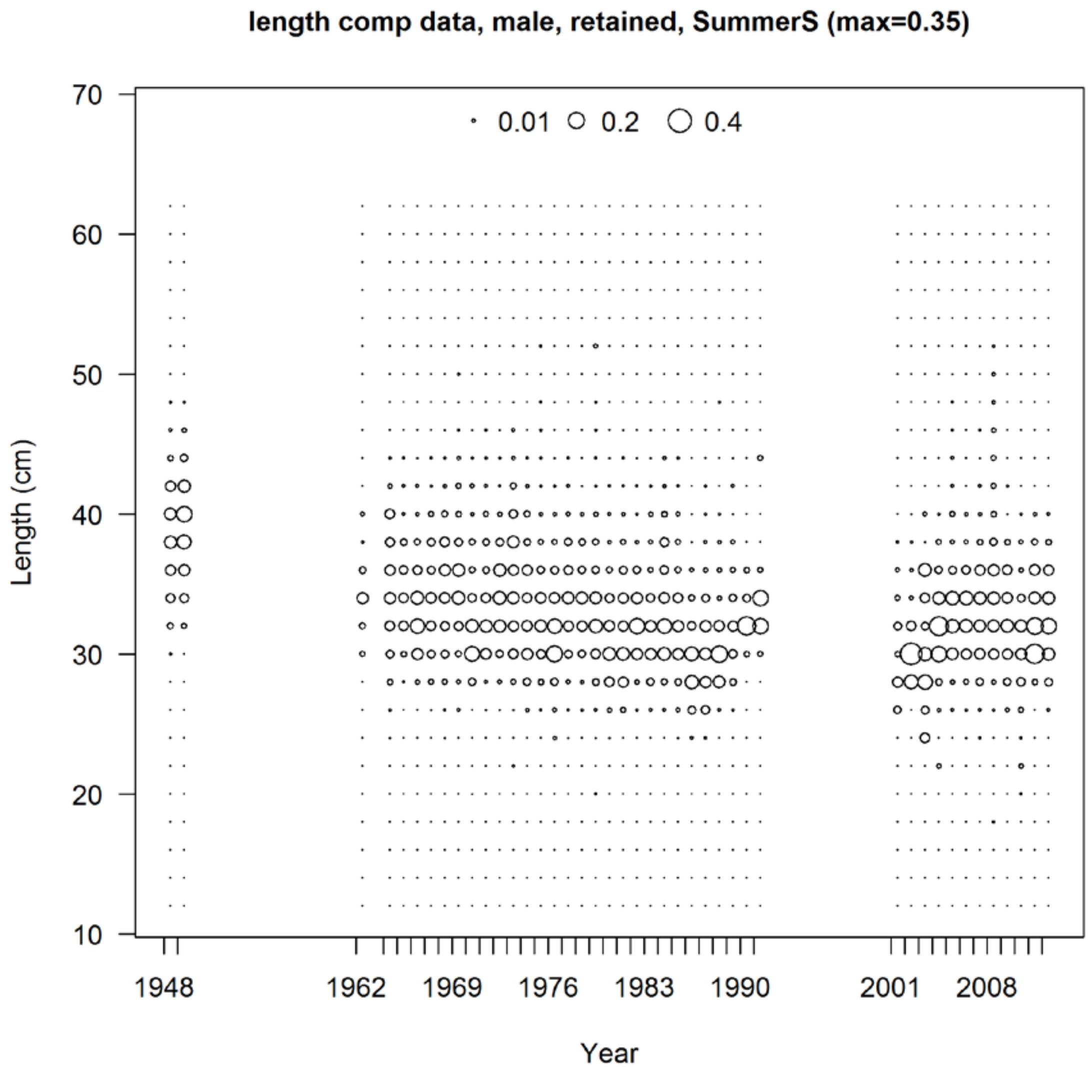


Figure 45. Summer south length-frequency data, males.

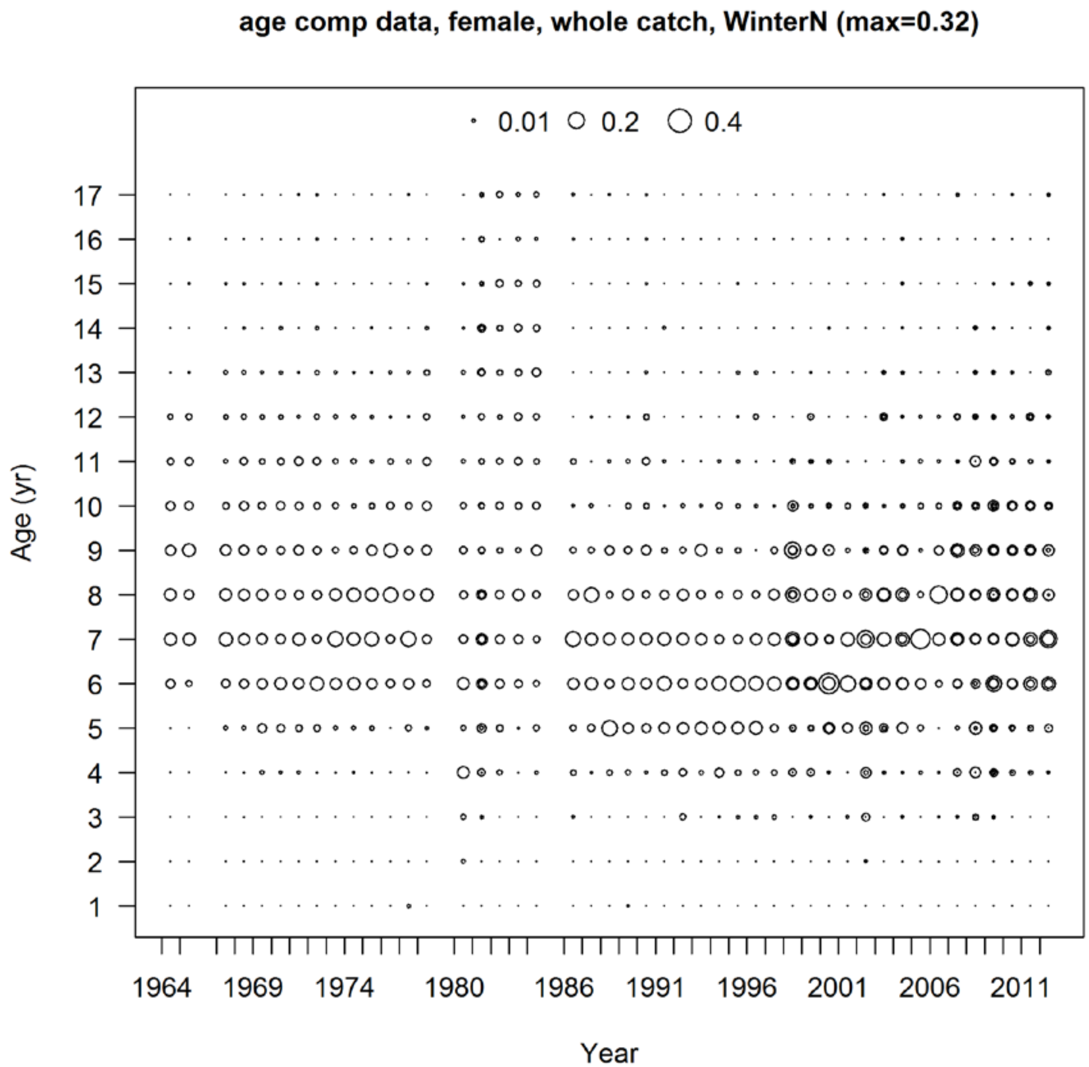


Figure 46. Winter north age-frequency data, females.

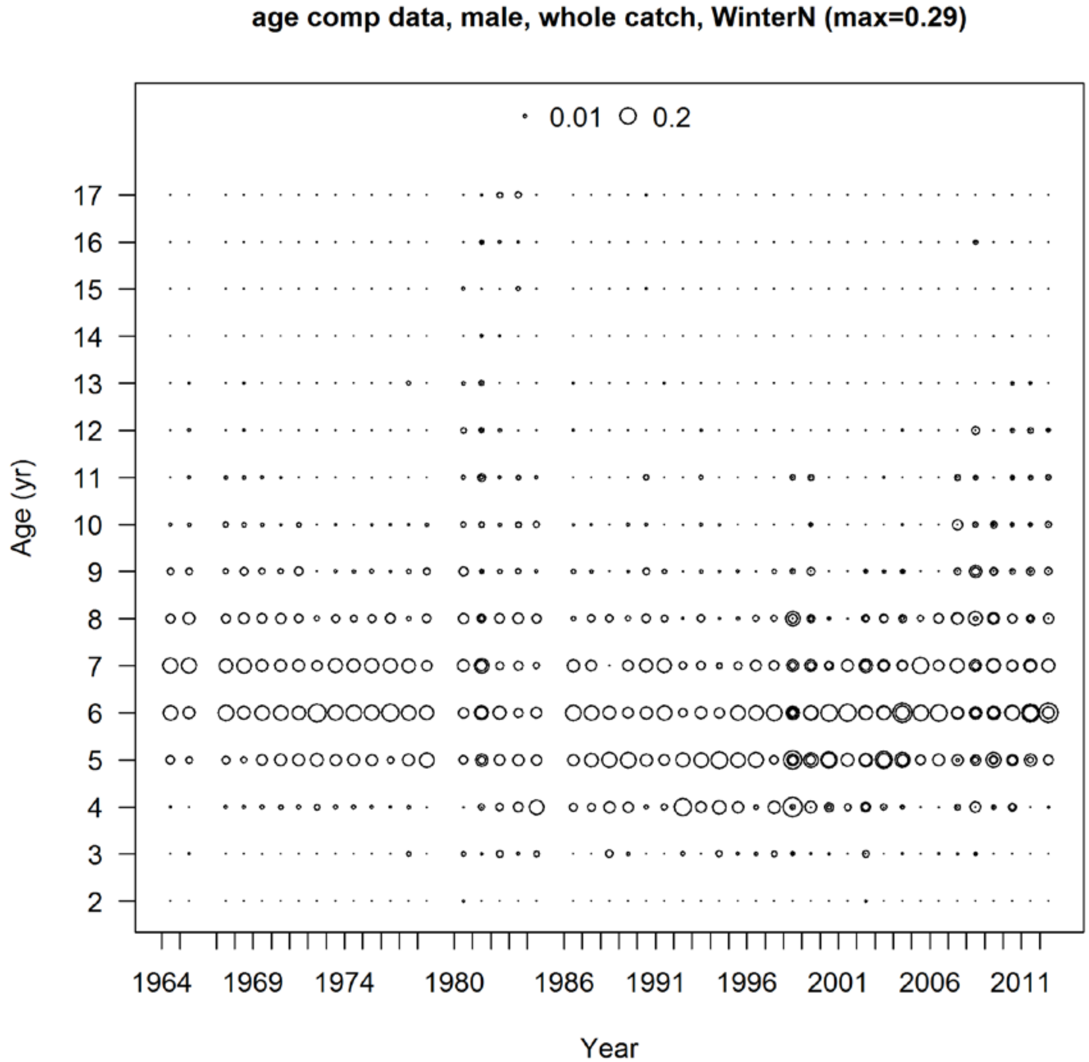


Figure 47. Winter north age-frequency data, males.

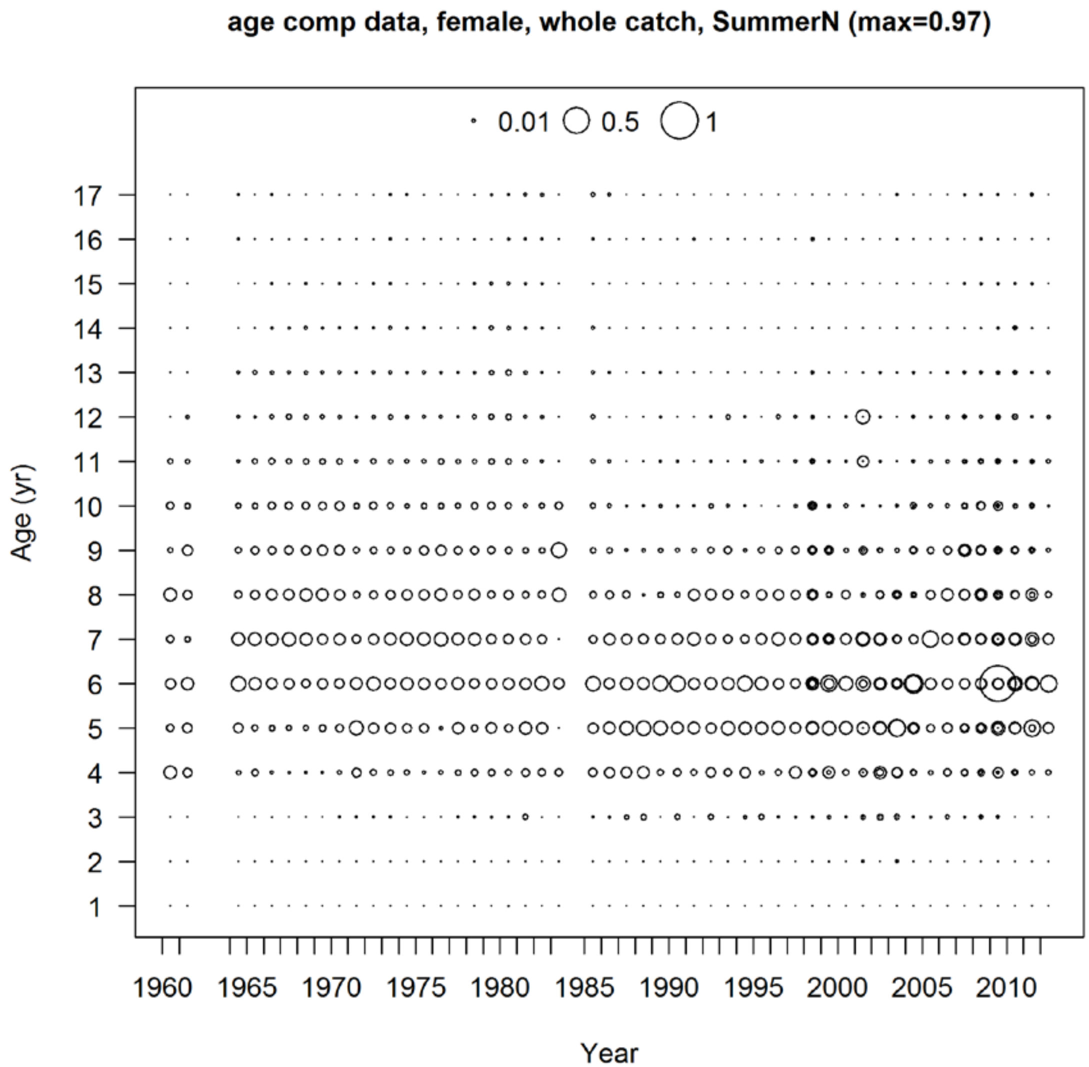


Figure 48. Summer north age-frequency data, females.

Figure 49. Summer north age-frequency data, males.

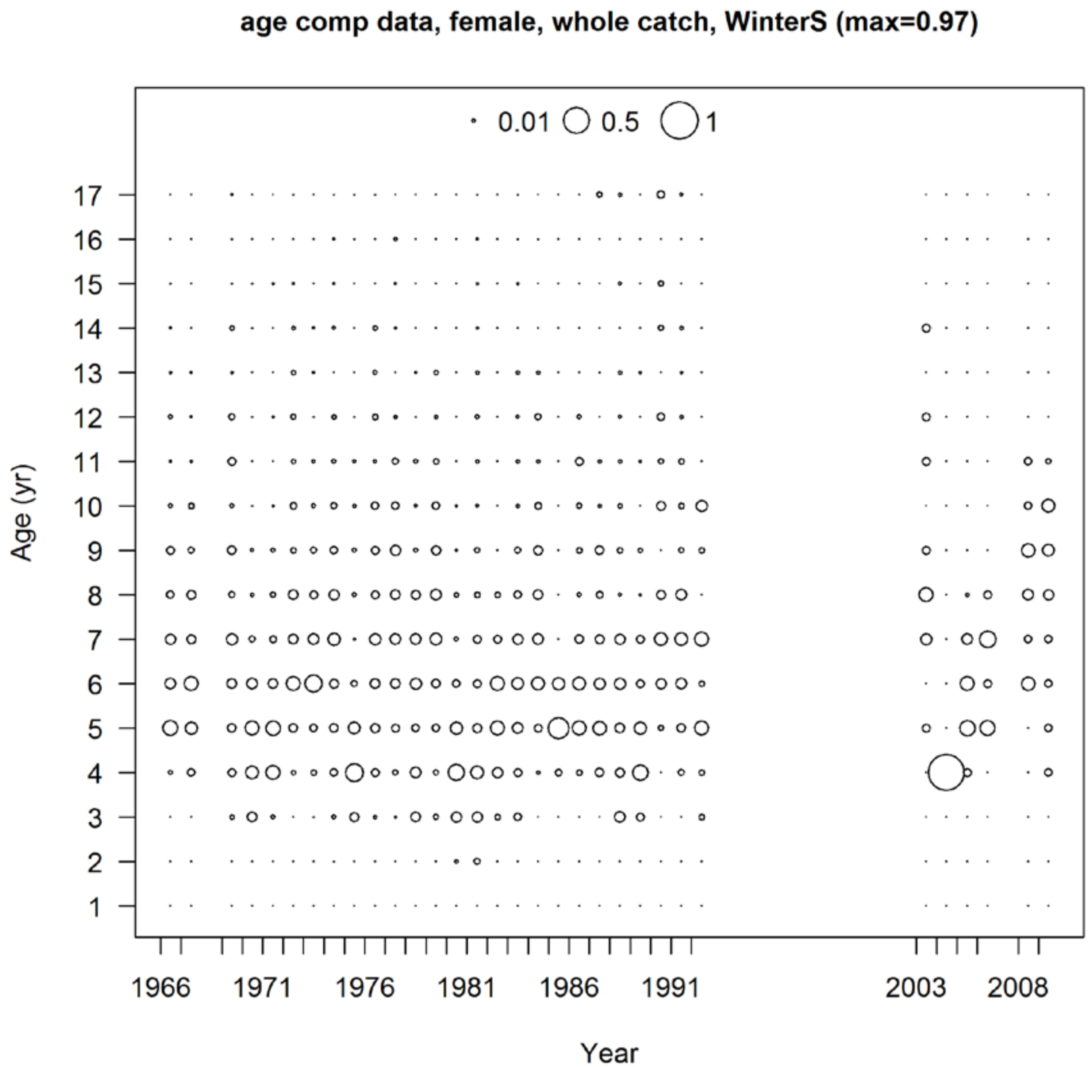


Figure 50. Winter south age-frequency data, females.

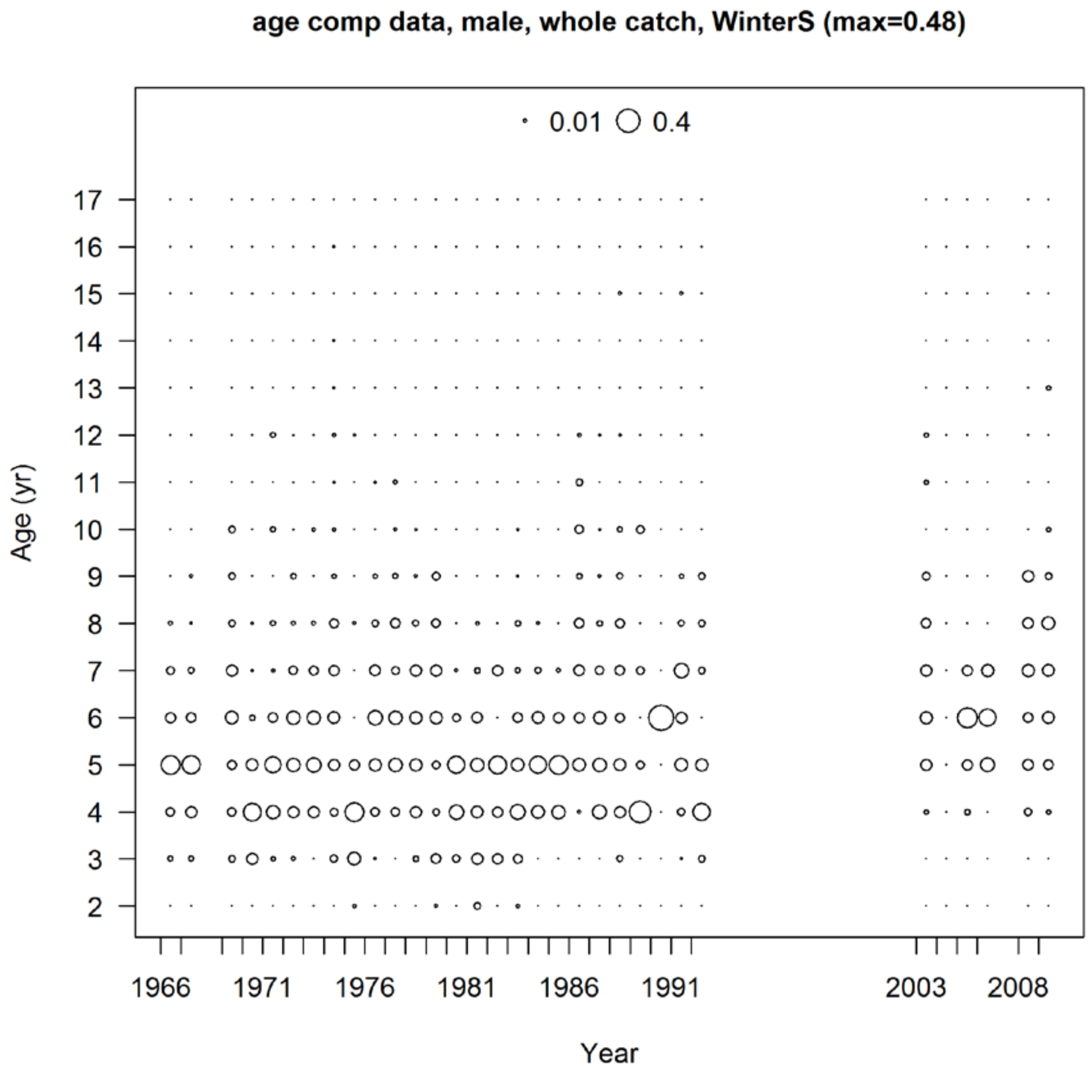


Figure 51. Winter south age-frequency data, males.

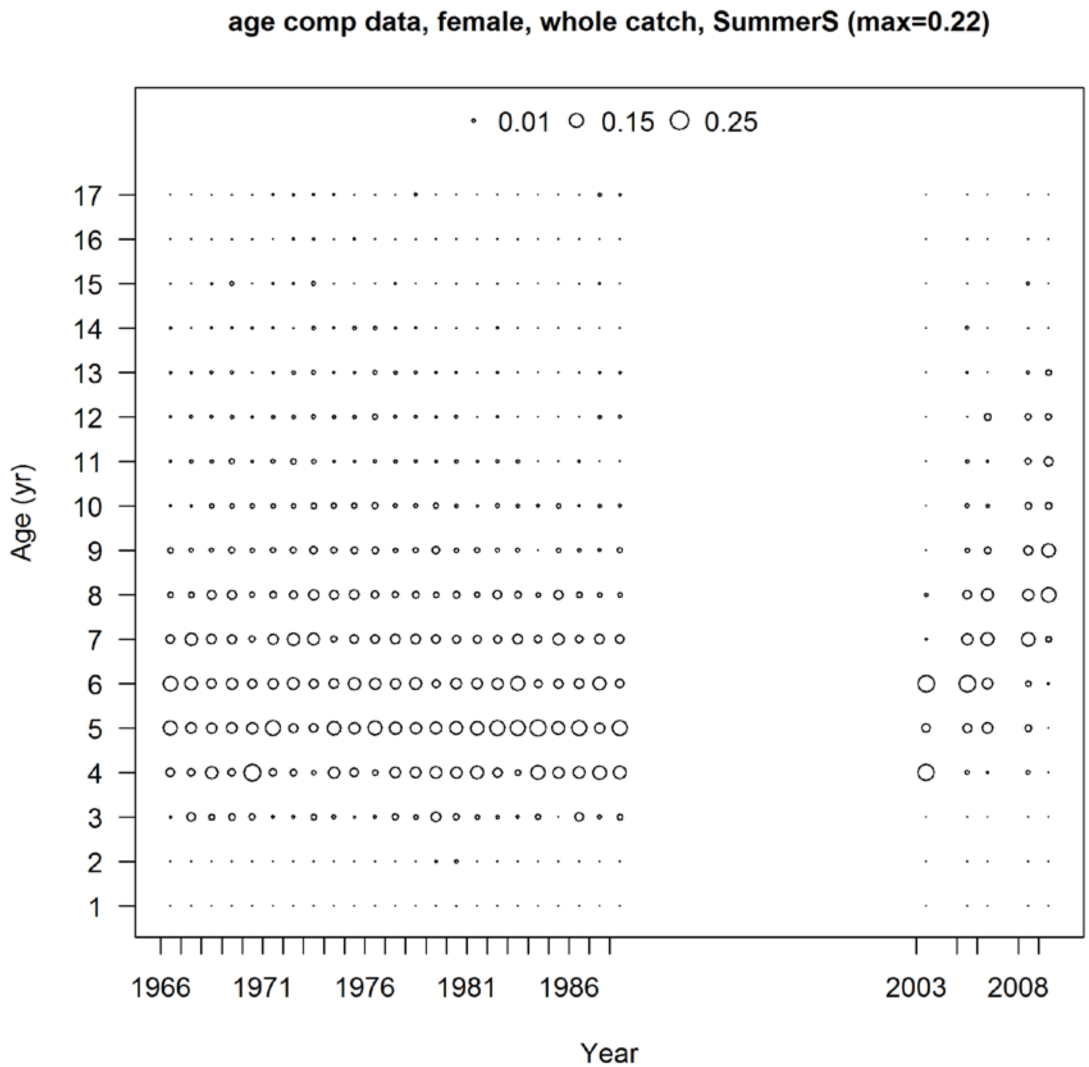


Figure 52. Summer south age-frequency data, females.

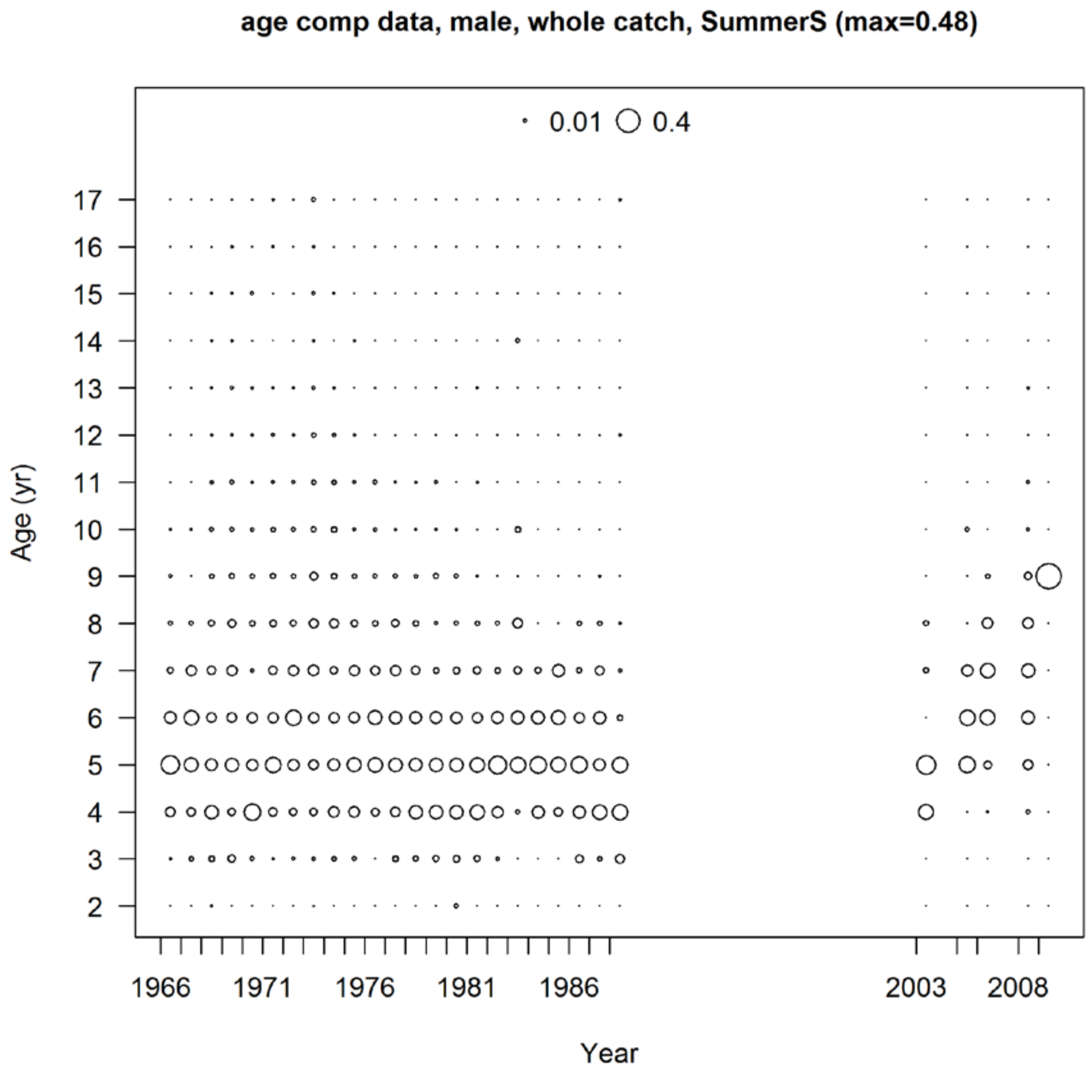


Figure 53. Summer south age-frequency data, males.

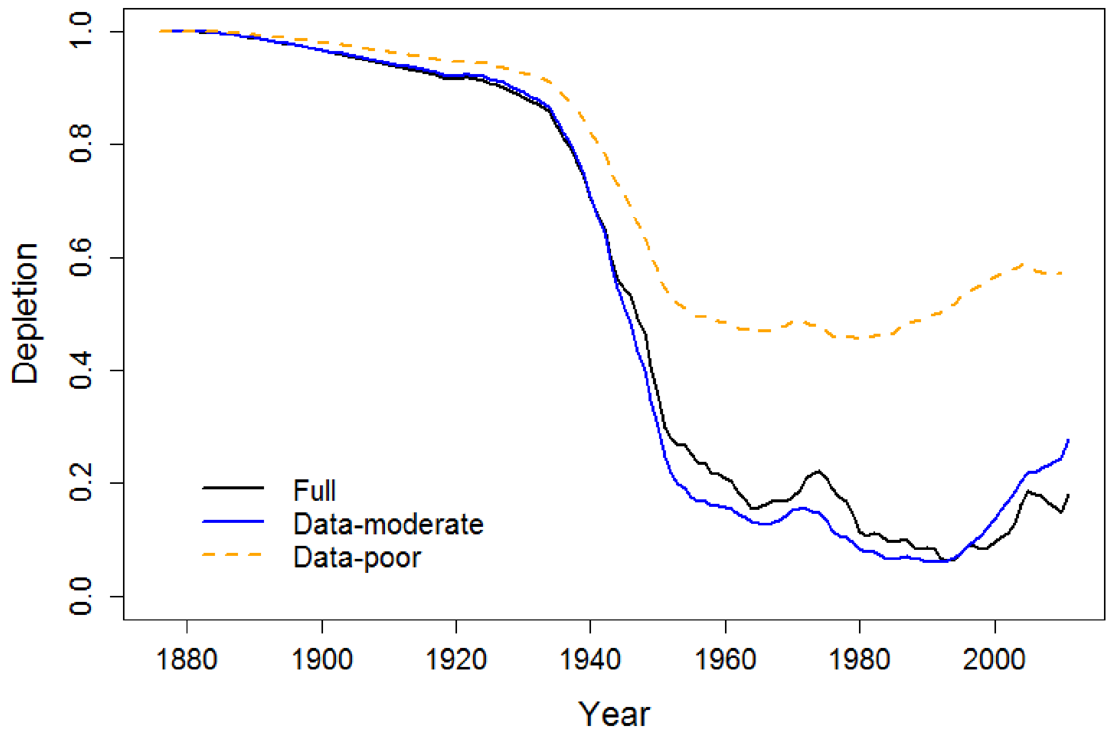


Figure 54. Times series of depletion for three petrale sole models through 2011. The "data-poor" model refers to a catch and life history only implementation of SS (Cope 2013), which assumes a terminal depletion value of around 60%, based on a preliminary relationship of the Productivity-Susceptibility Analysis to depletion. The data-moderate model uses catch, life history, and all available indices of abundance, while estimating natural mortality, steepness, and R0. Recruitment is assumed deterministic Beverton-Holt and informative priors are used on natural mortality and steepness. The "full" model is the 2011 petrale sole assessment.

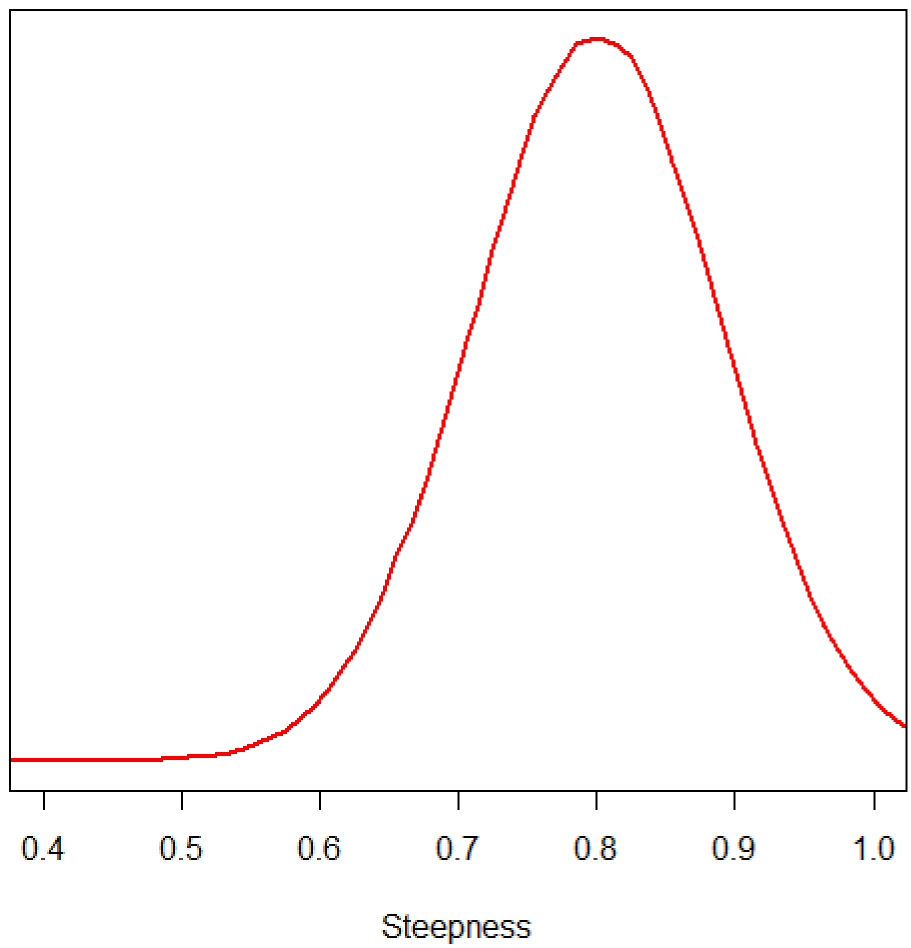


Figure 55. Prior for steepness

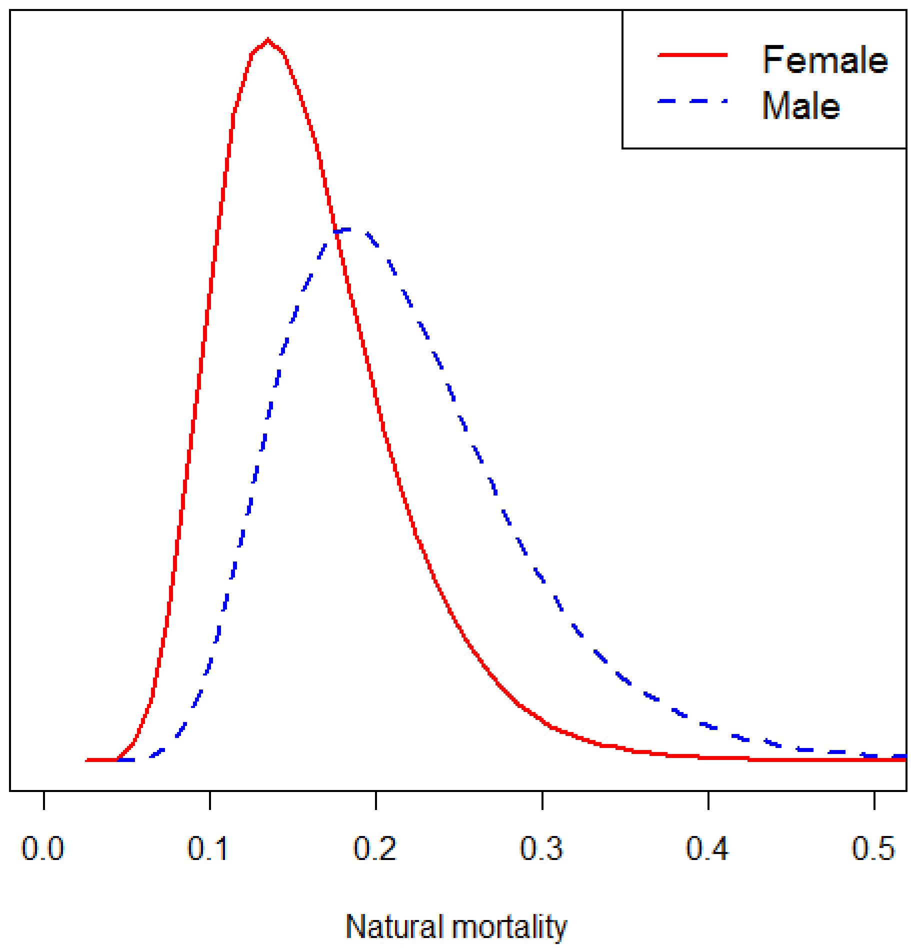


Figure 56. Priors for female (red solid line) and male (blue dashed line) for M.

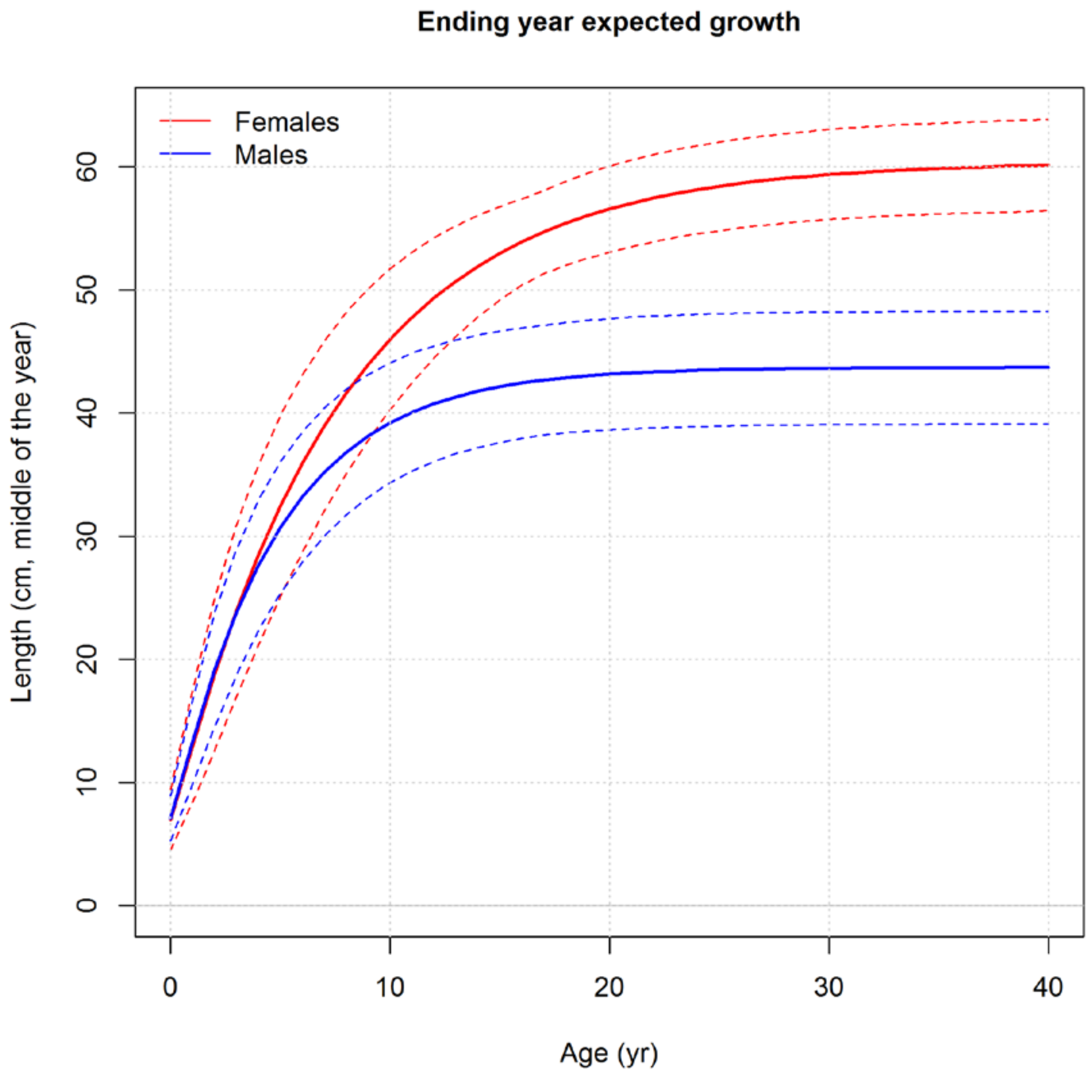


Figure 57. The growth curve for females (upper solid line) and males (lower solid line) with ~95% interval (dashed lines) indicating the estimated variability of length-at-age for the base case model.

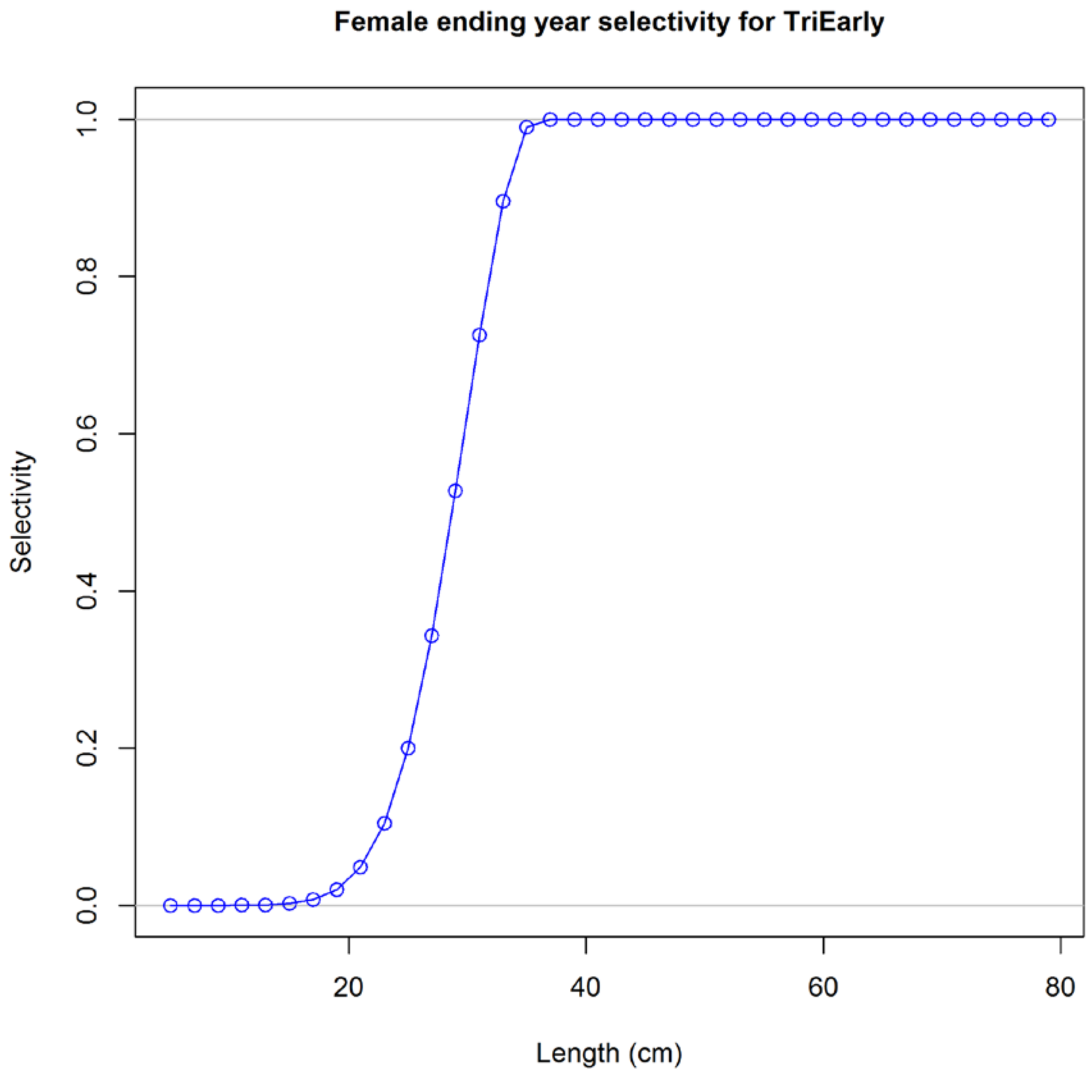


Figure 58. Estimated length-based selectivity curves for the early triennial survey, females.

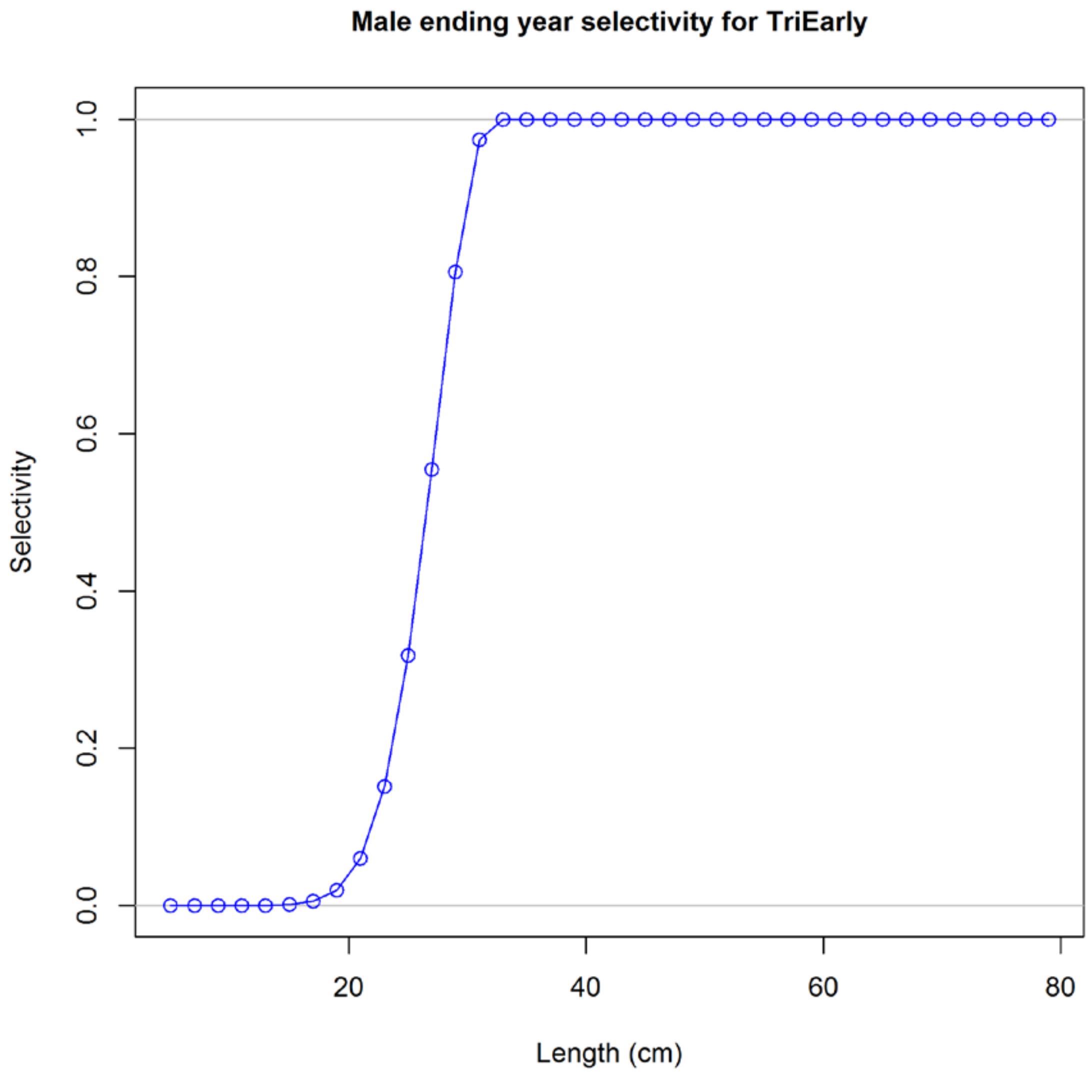


Figure 59. Estimated length-based selectivity curves for the early triennial survey, males.

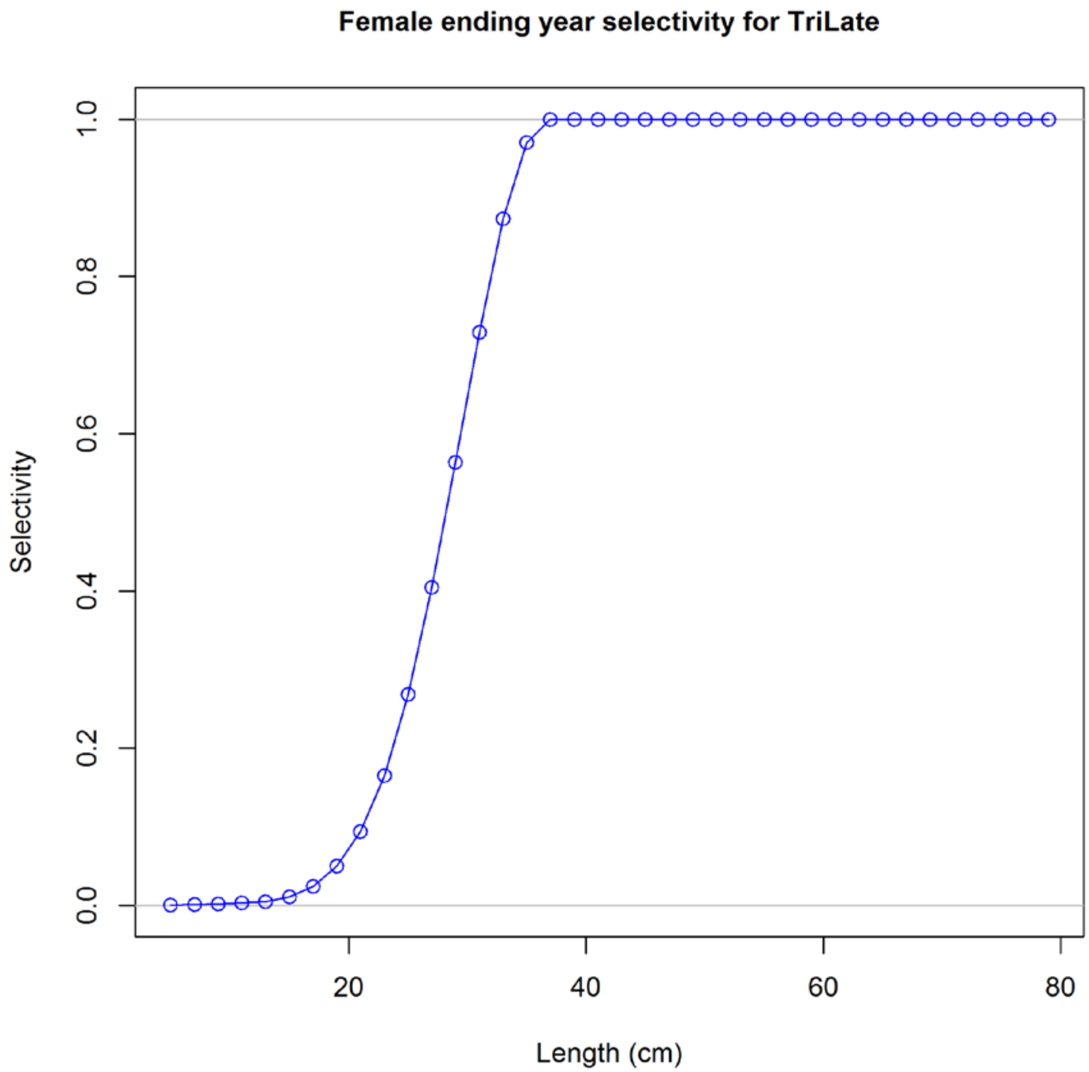


Figure 60. Estimated length-based selectivity curves for the late triennial survey, females.

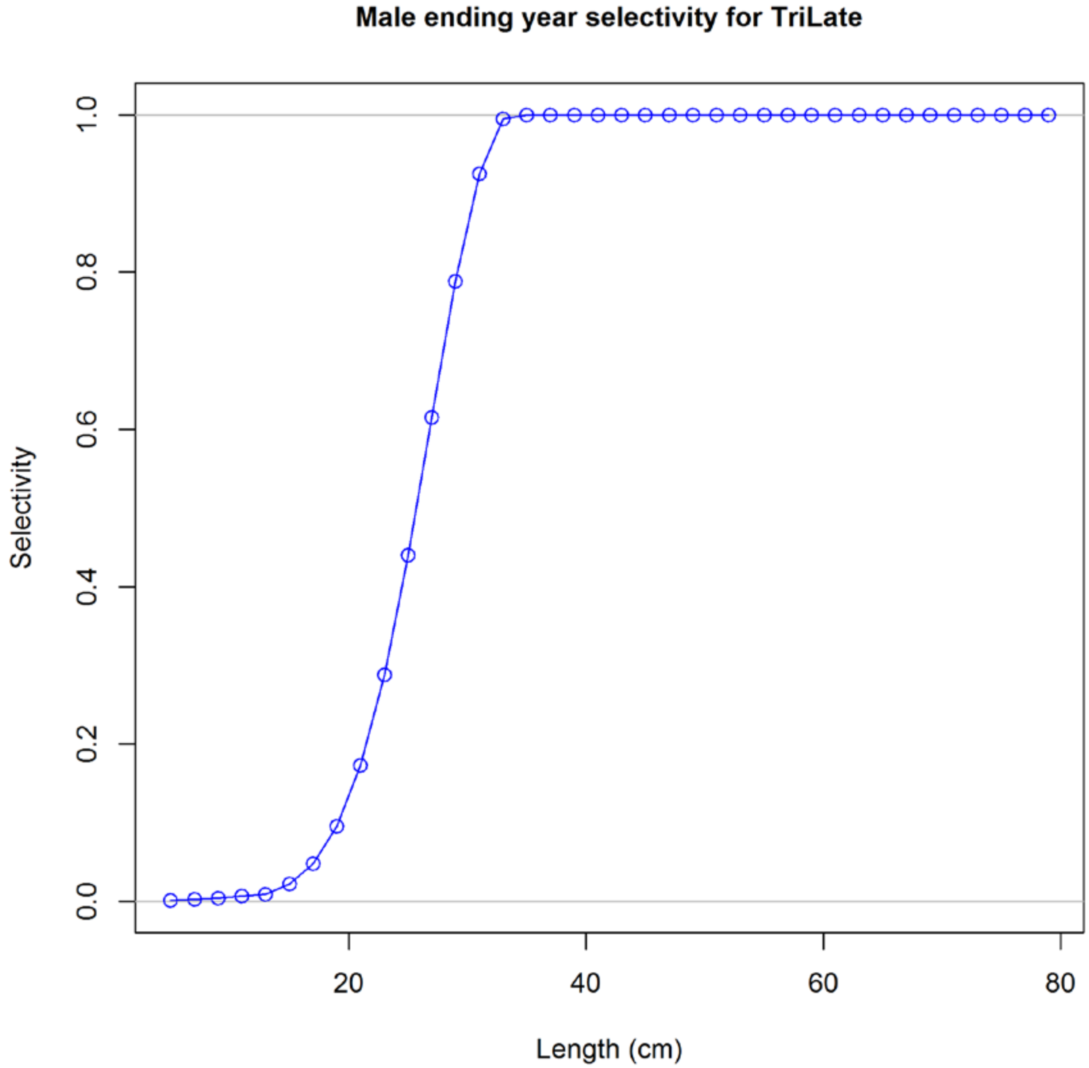


Figure 61. Estimated length-based selectivity curves for the late triennial survey, males.

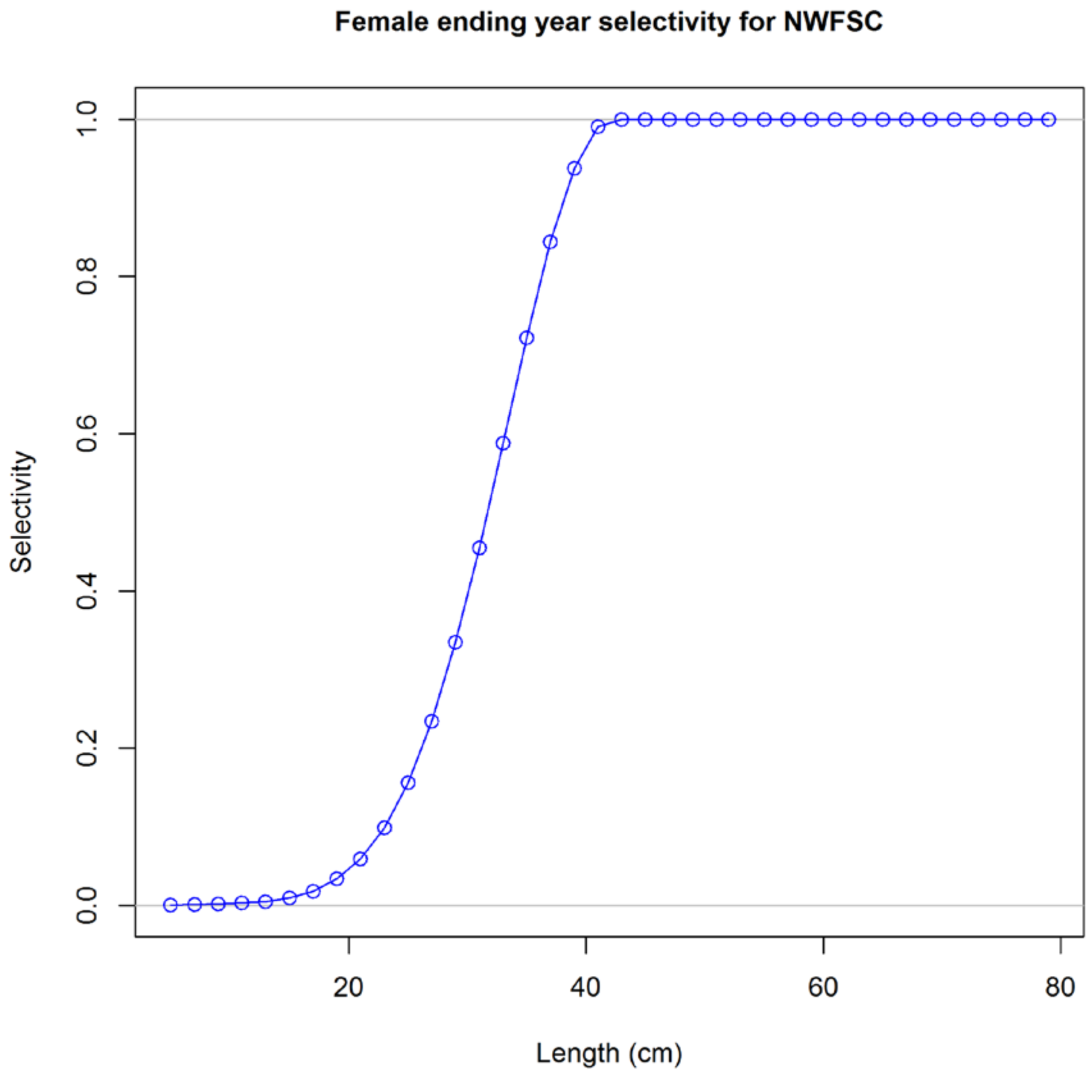


Figure 62. Estimated length-based selectivity curves for the NWFSC survey, females.

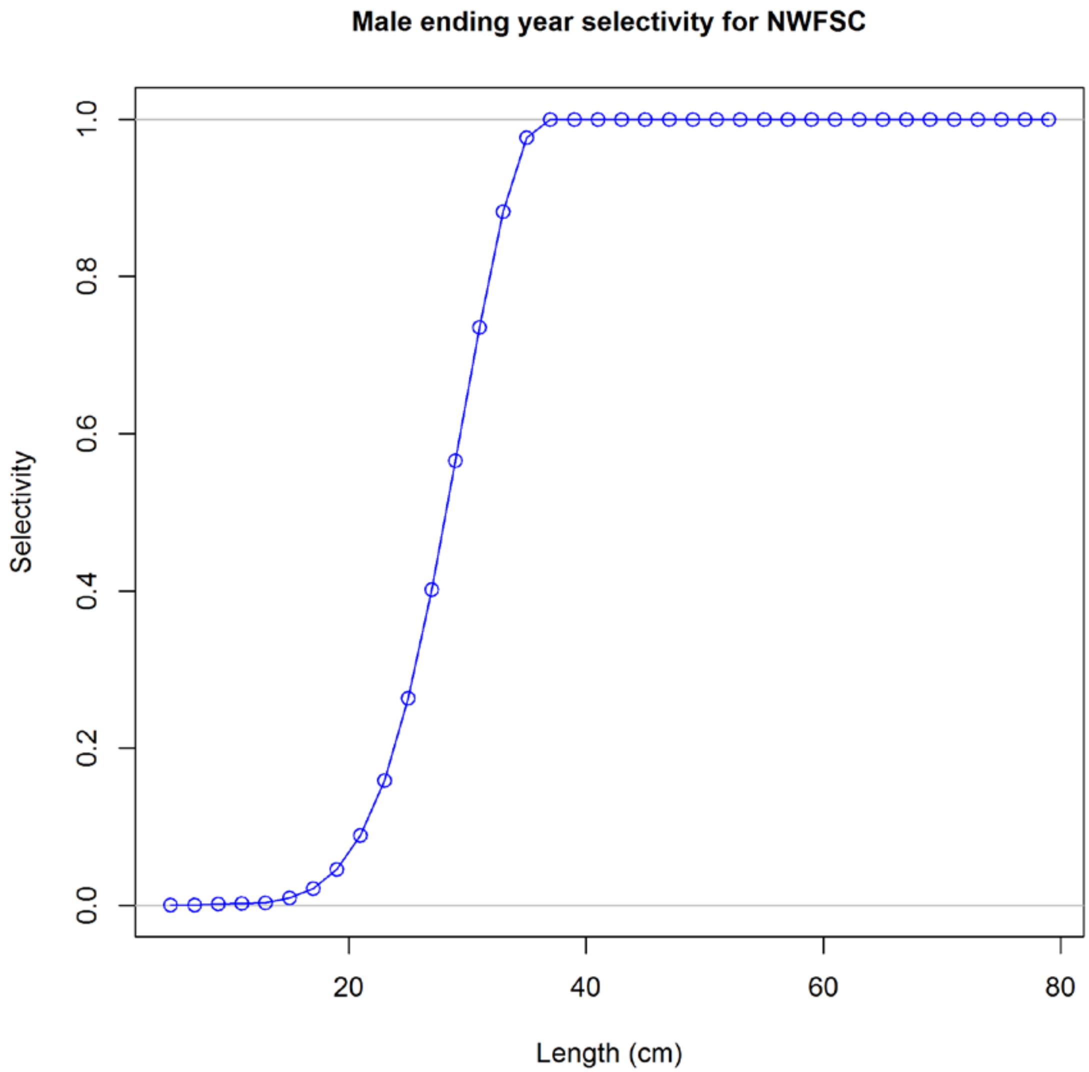


Figure 63. Estimated length-based selectivity curves for the NWFSC survey, males.

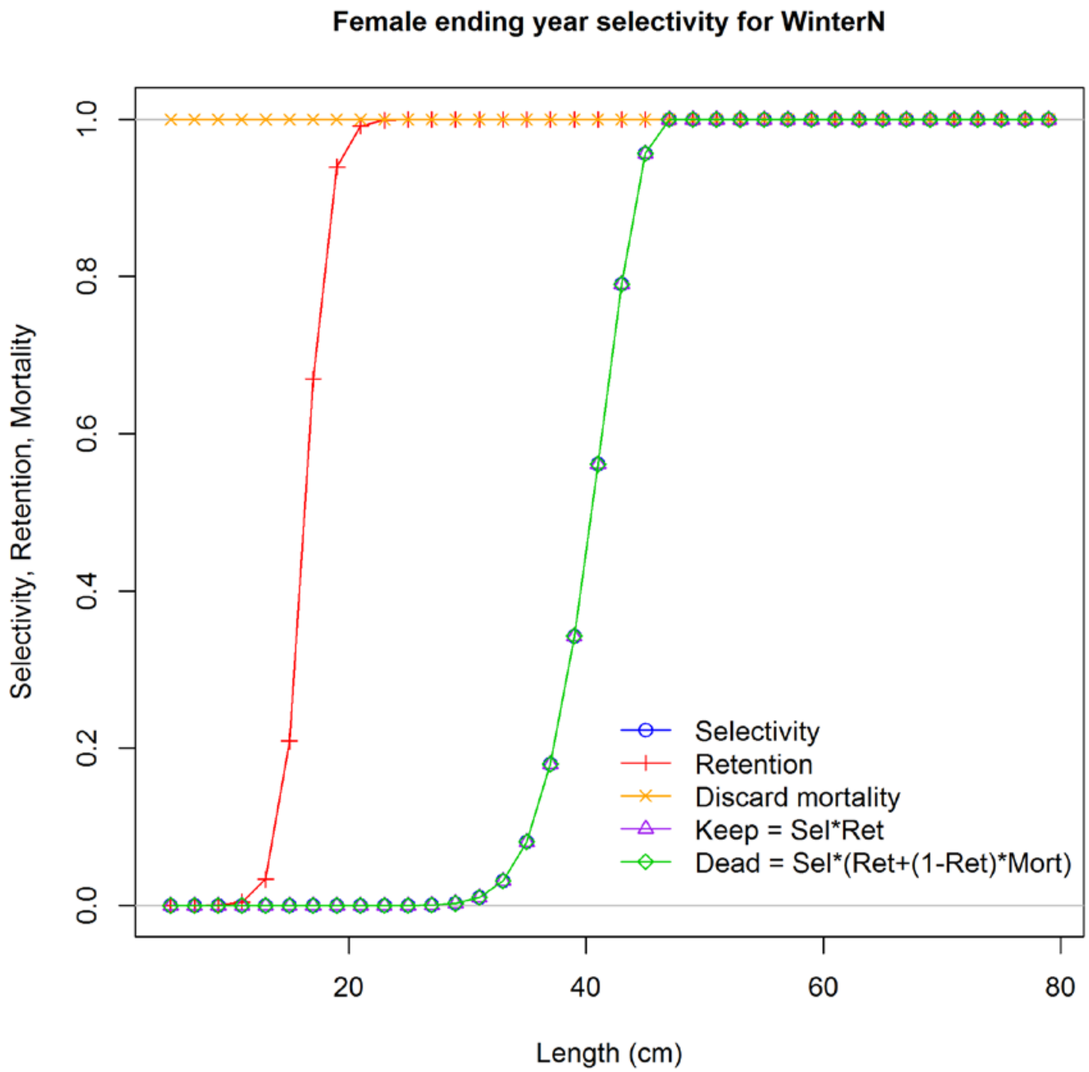


Figure 64. Estimated end year length-based selectivity curves for the winter north fleet, females.

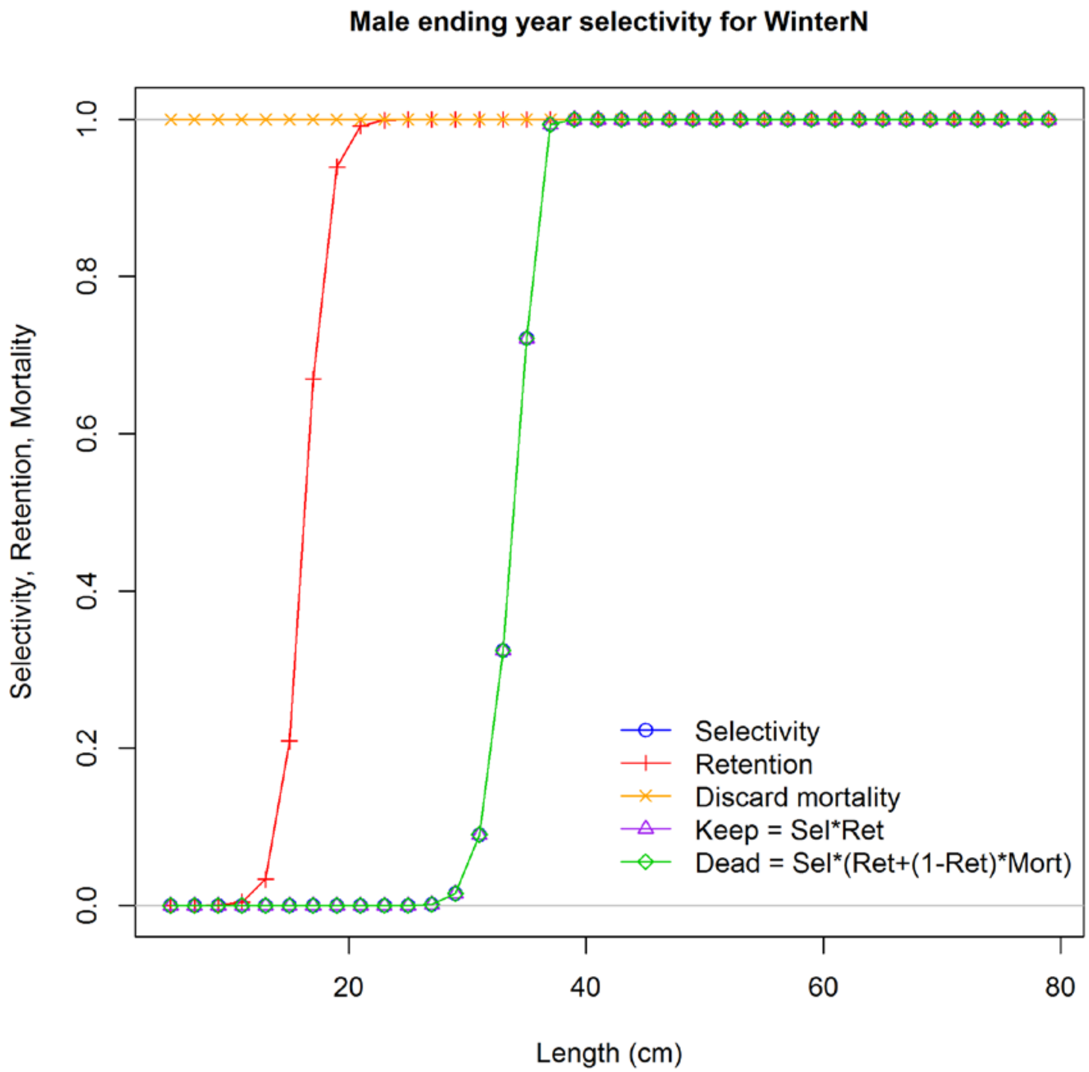


Figure 65. Estimated end year length-based selectivity curves for the winter north fleet, males.

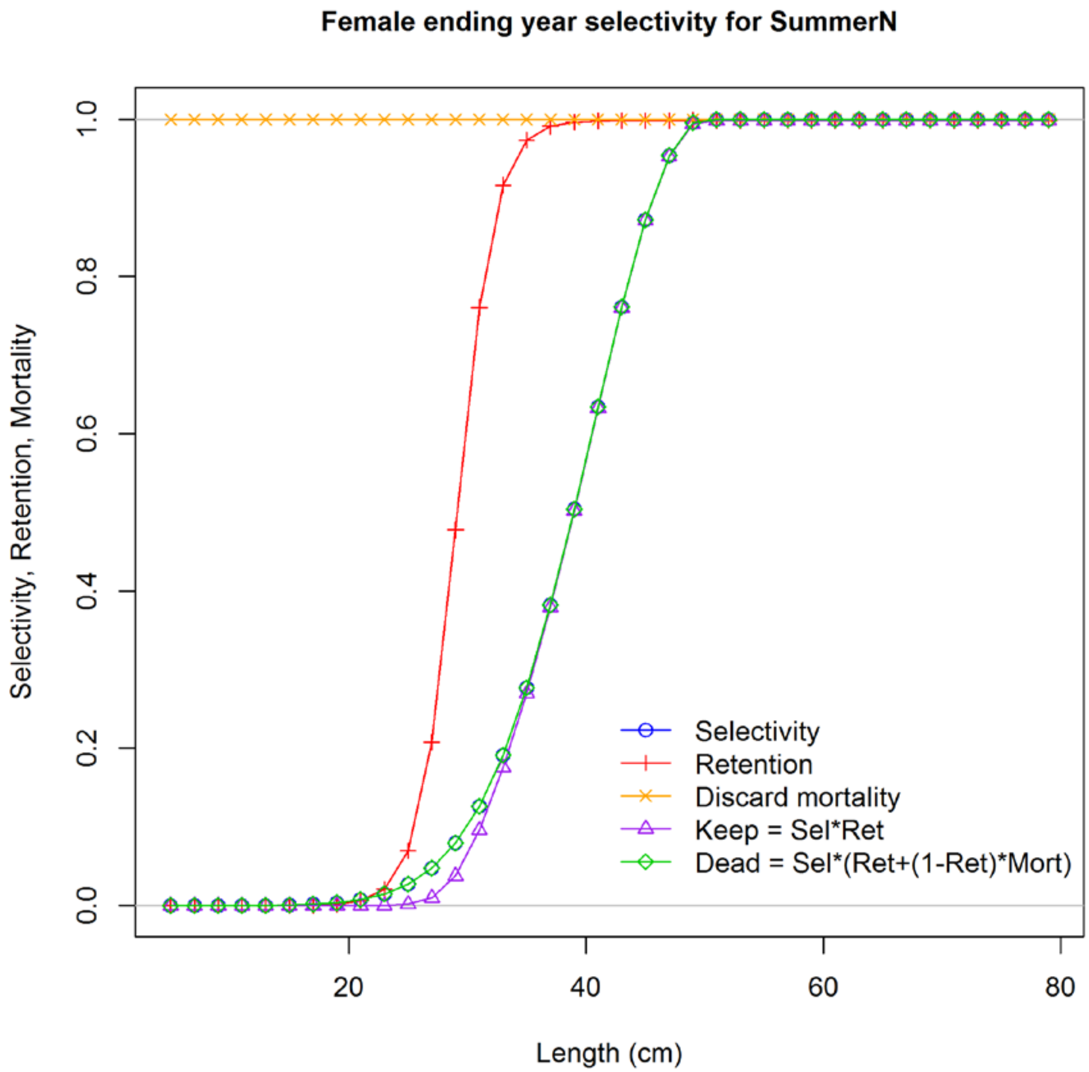


Figure 66. Estimated end year length-based selectivity curves for the summer north fleet, females.

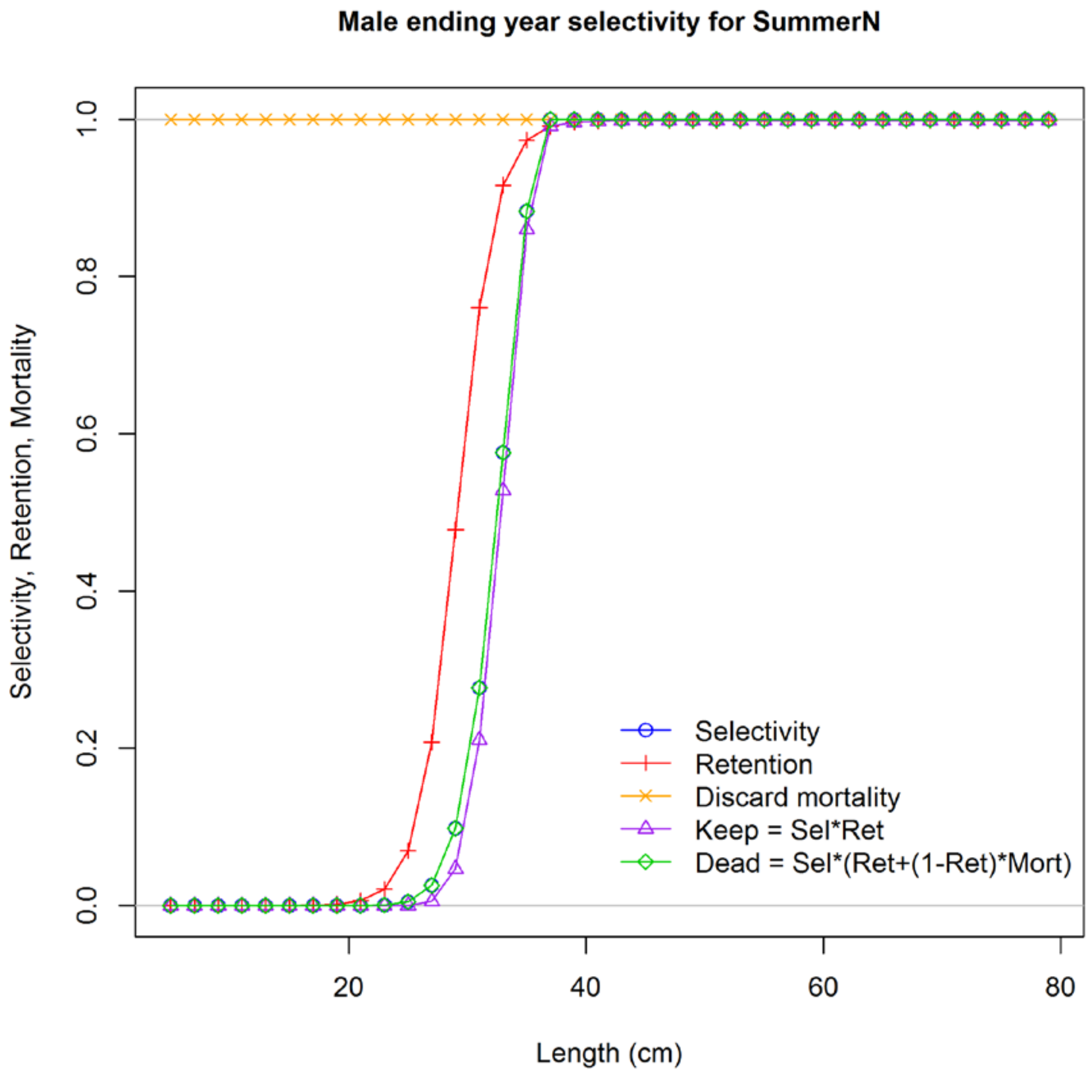


Figure 67. Estimated end year length-based selectivity curves for the summer north fleet, males.

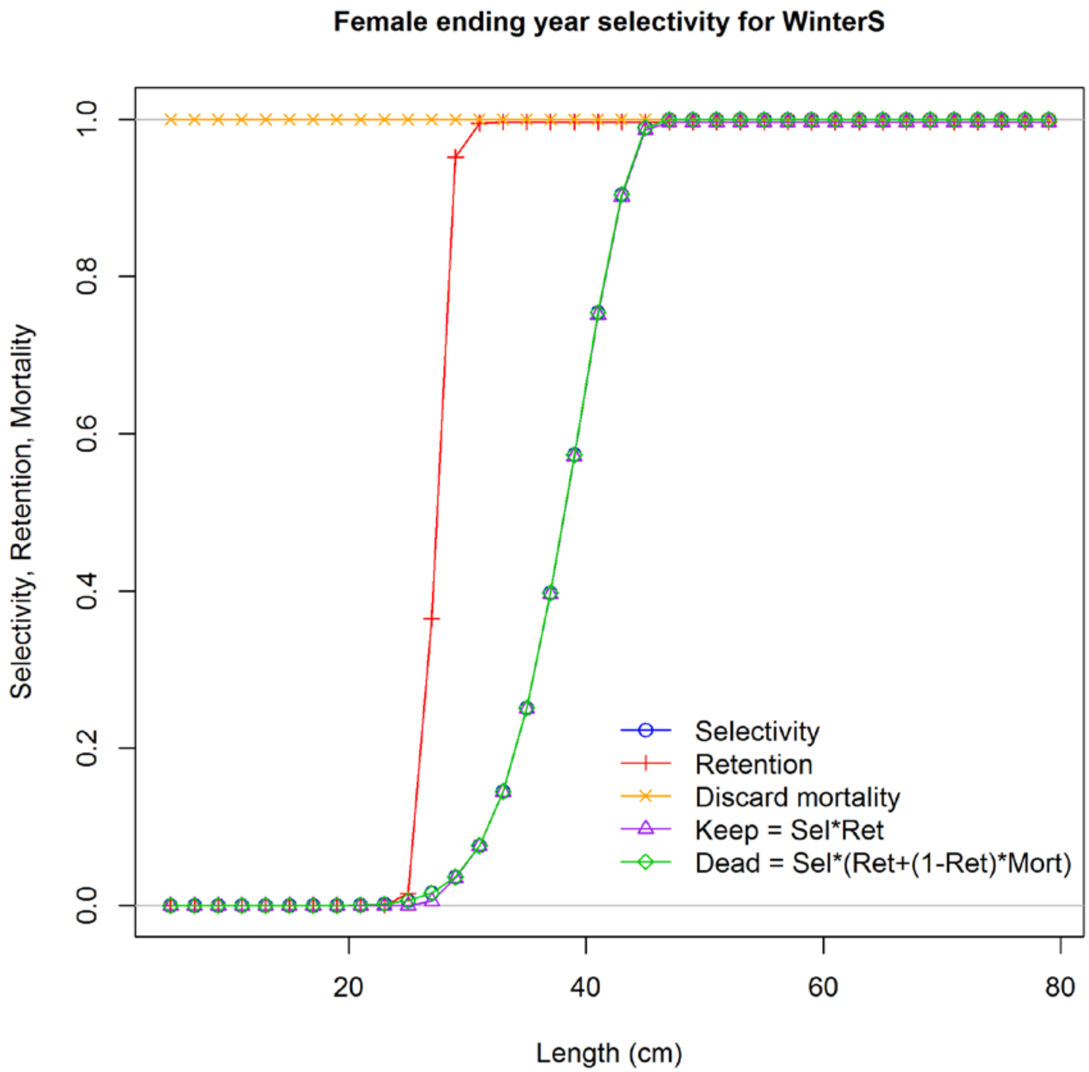


Figure 68. Estimated end year length-based selectivity curves for the winter south fleet, females.

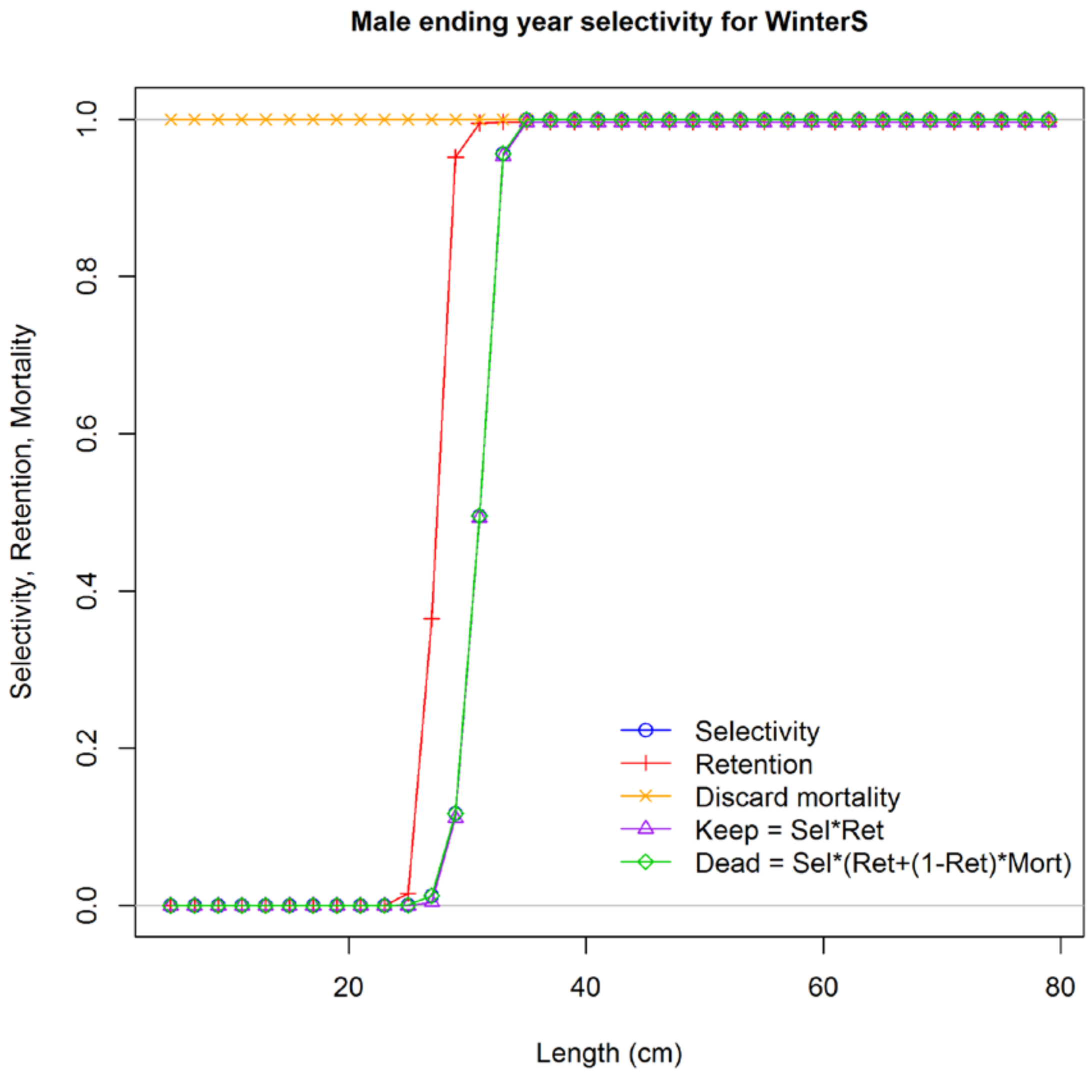


Figure 69. Estimated end year length-based selectivity curves for the winter south fleet, males.

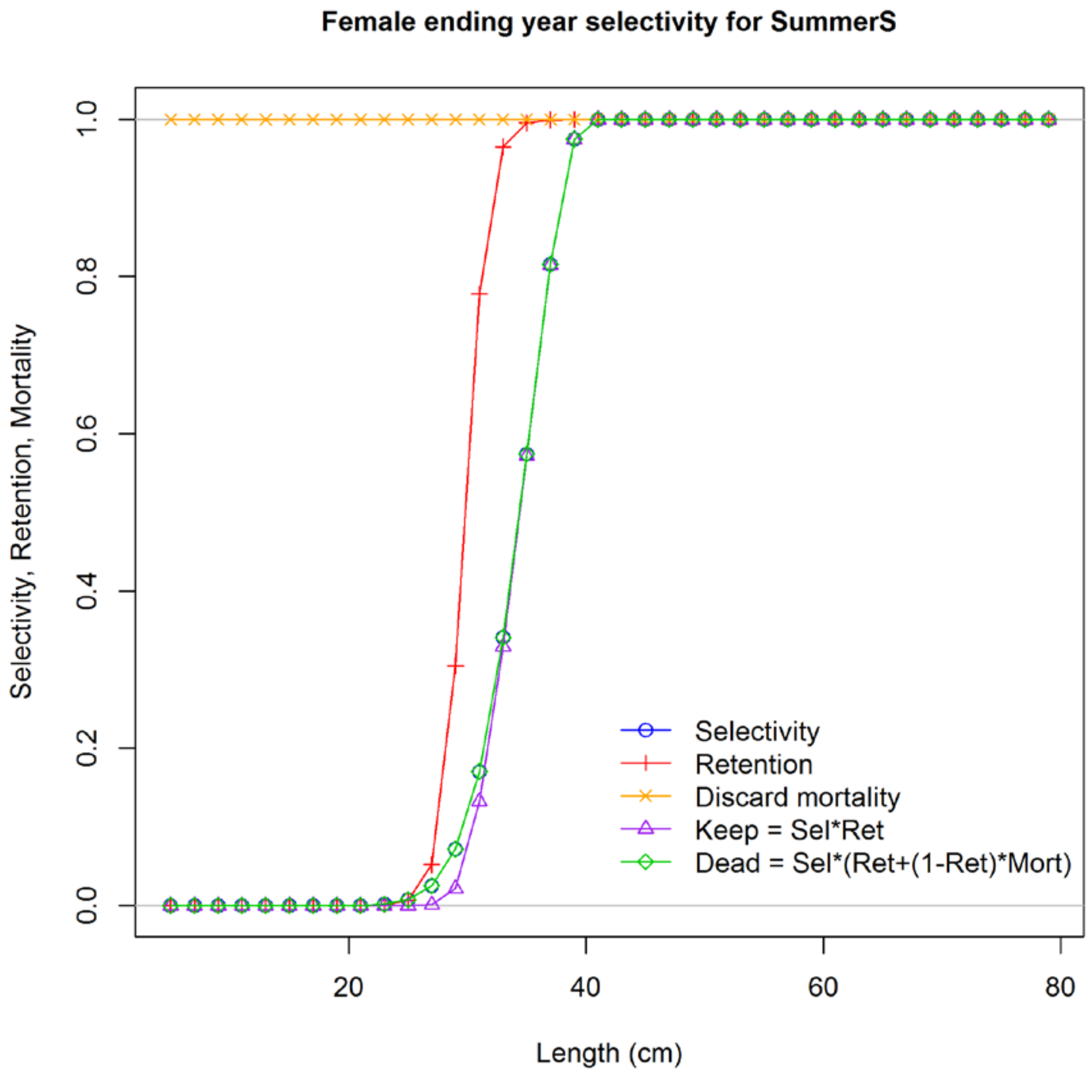


Figure 70. Estimated end year length-based selectivity curves for the summer south fleet, females.

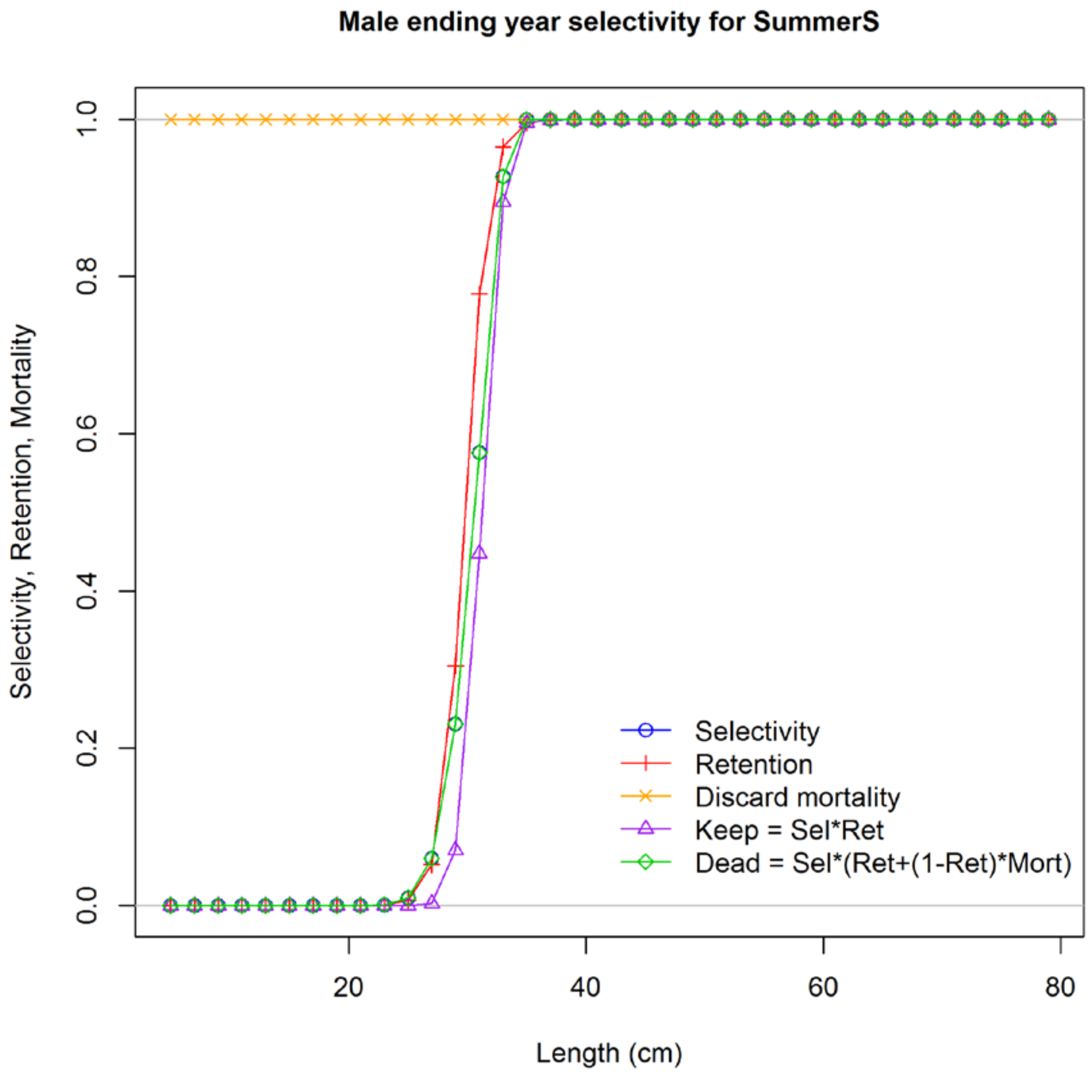


Figure 71. Estimated end year length-based selectivity curves for the summer south fleet, males.

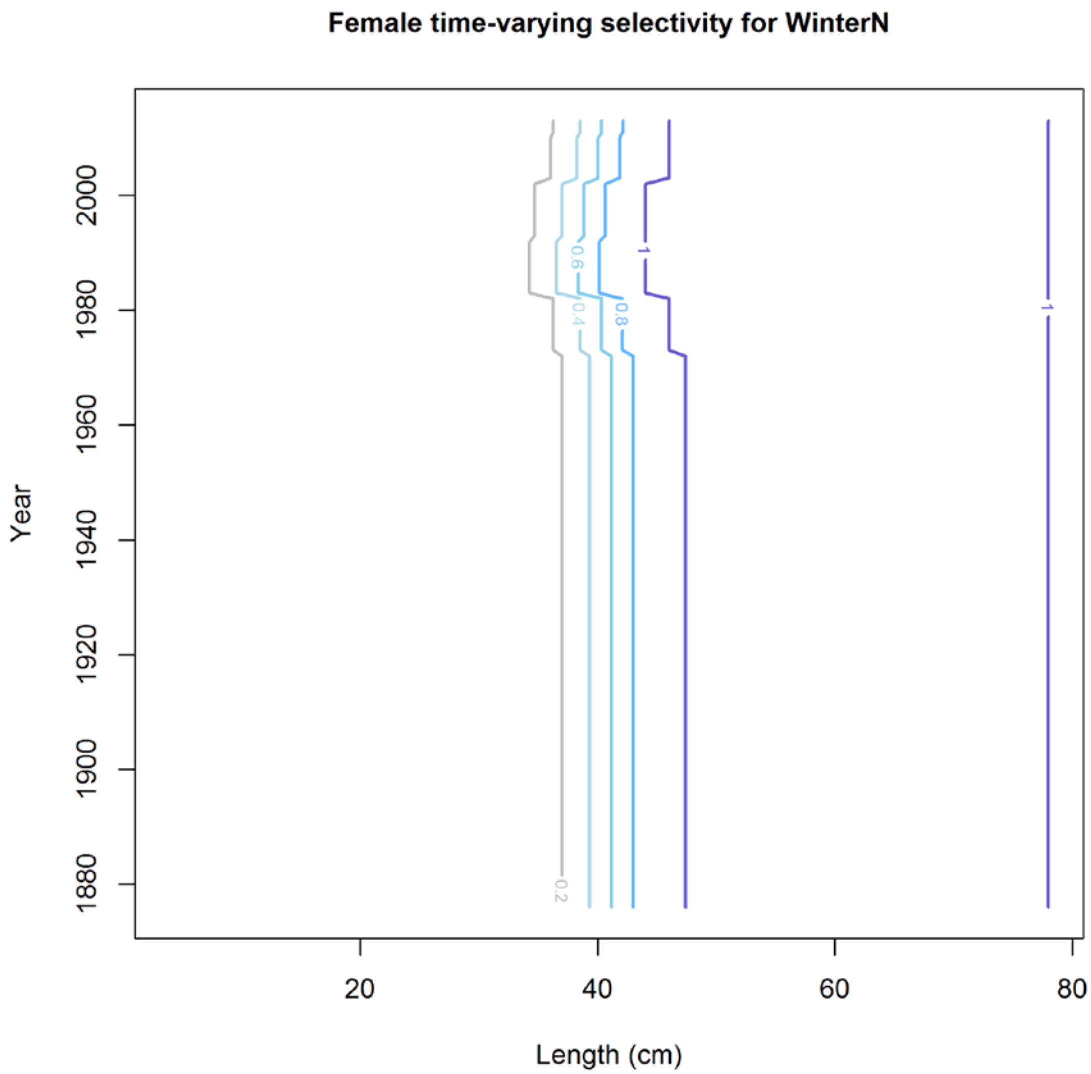


Figure 72. Estimated time varying length-based selectivity curves for the winter north fleet, females.

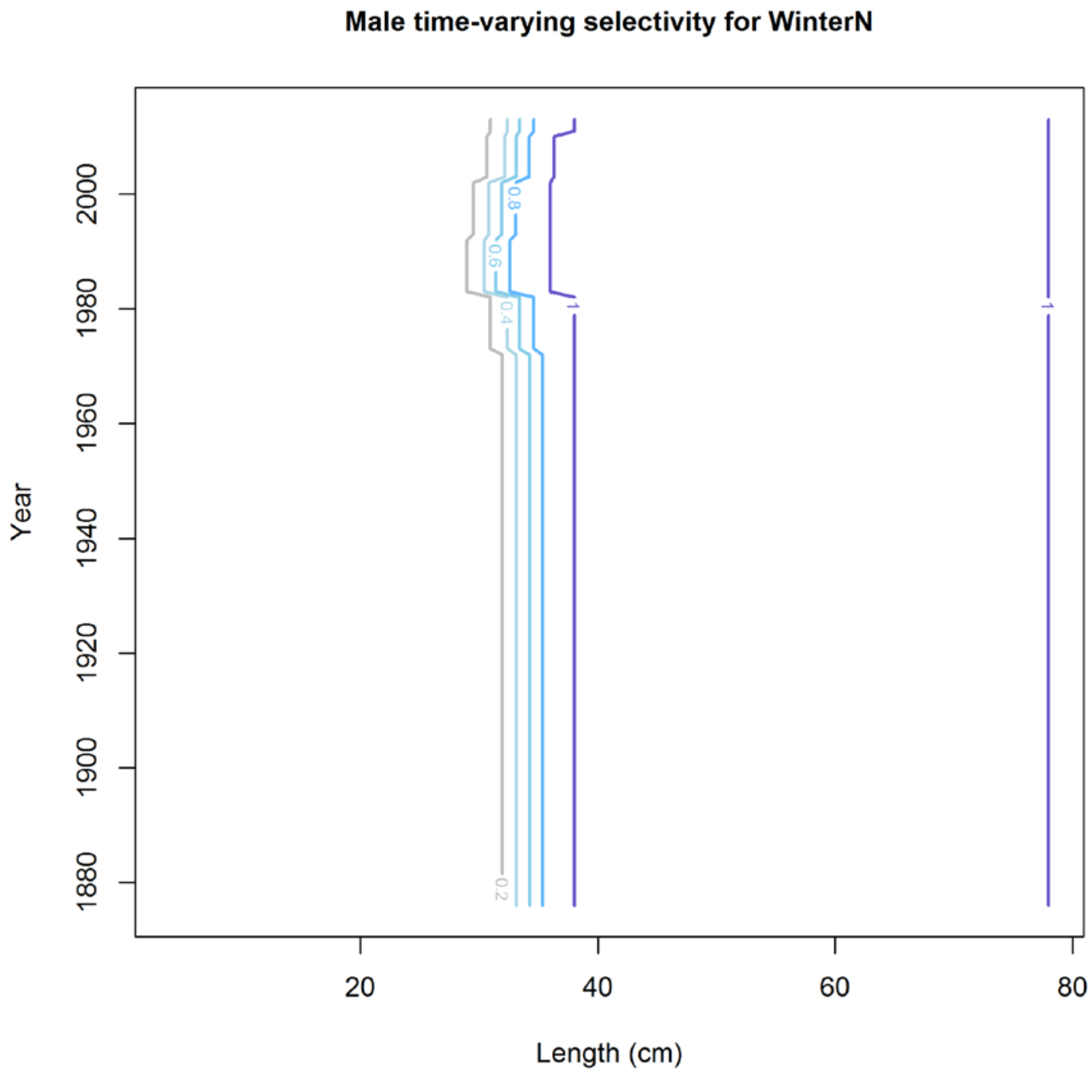


Figure 73.Estimated time varying length-based selectivity curves for the winter north fleet, males.

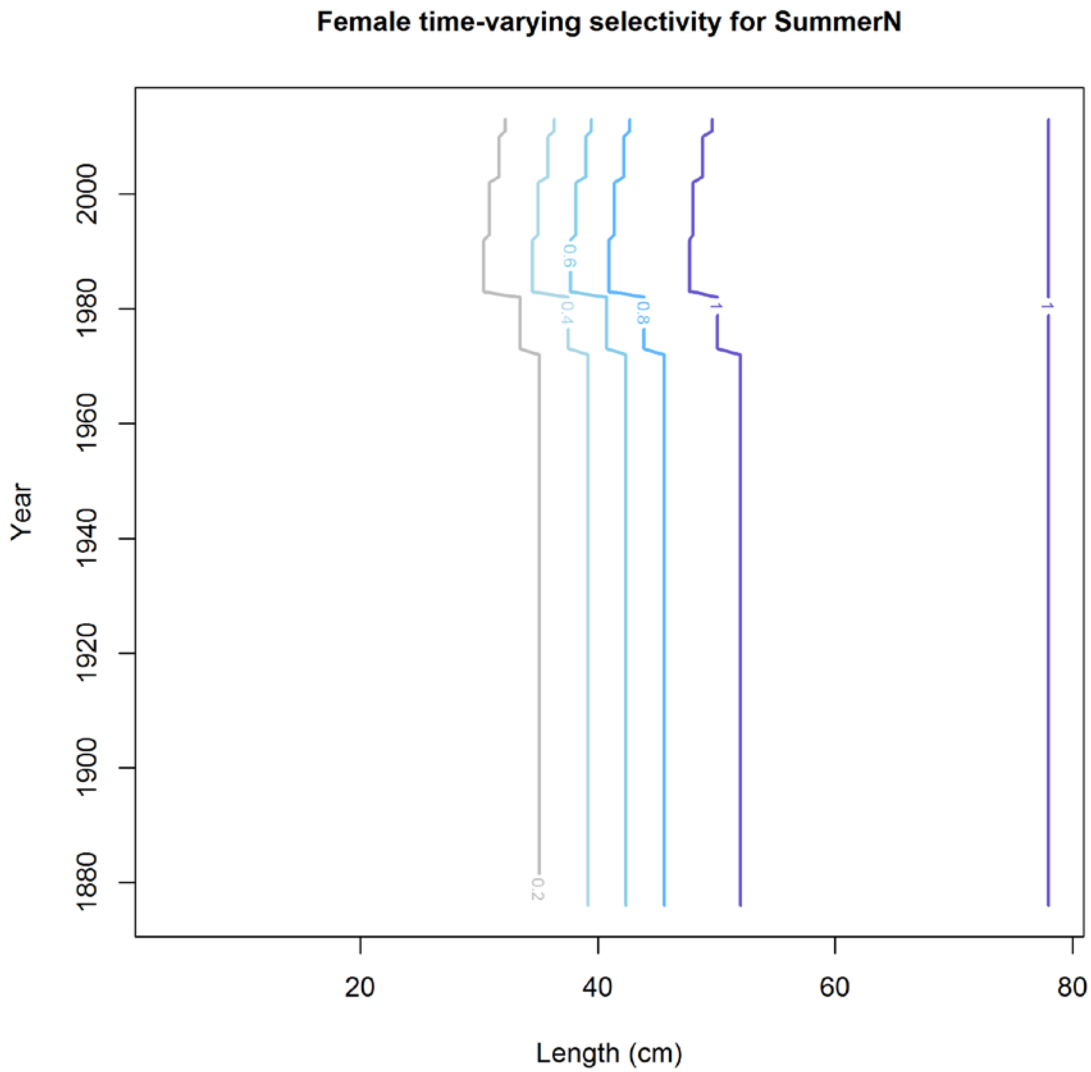


Figure 74. Estimated time varying length-based selectivity curves for the summer north fleet, females.

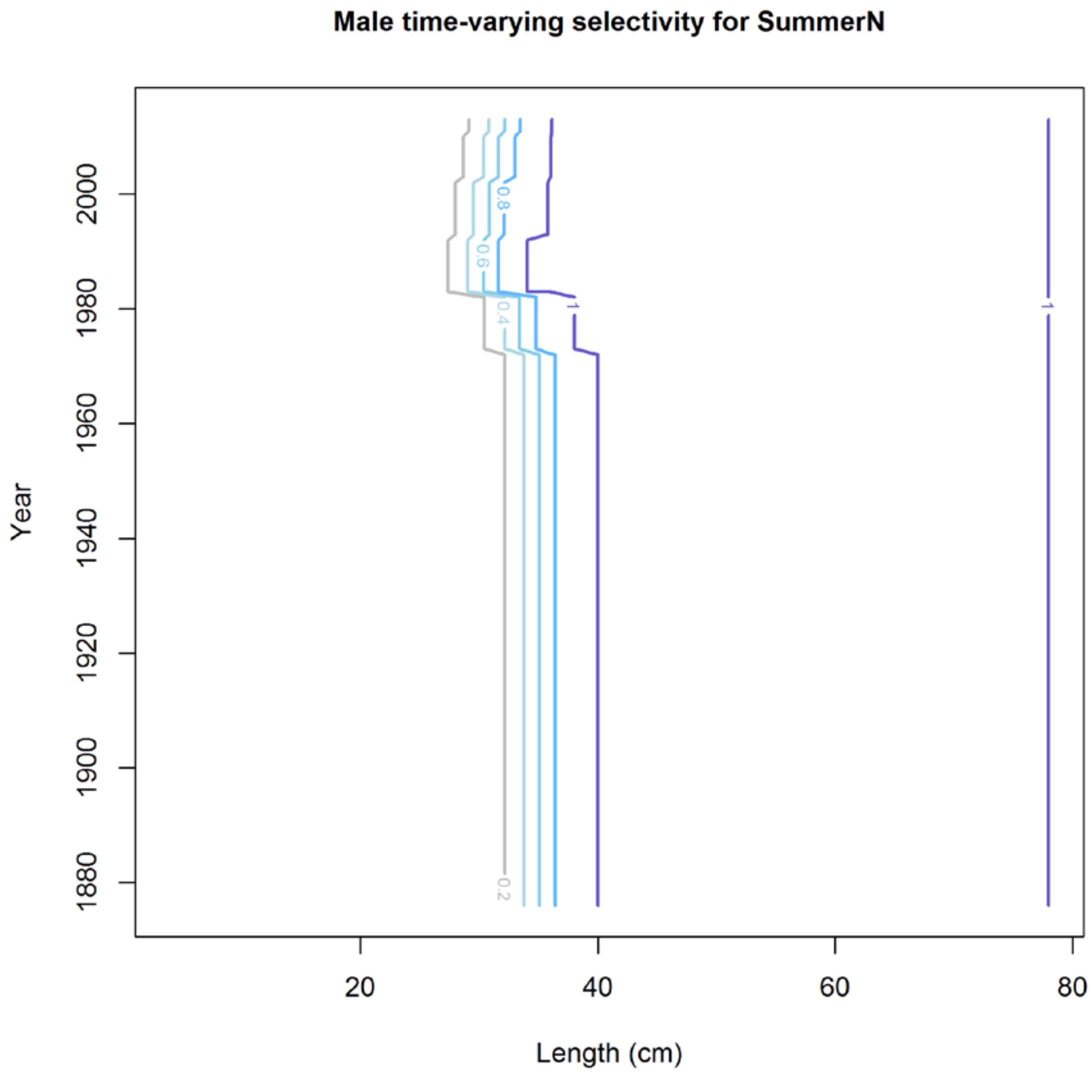


Figure 75. Estimated time varying length-based selectivity curves for the summer north fleet, males.

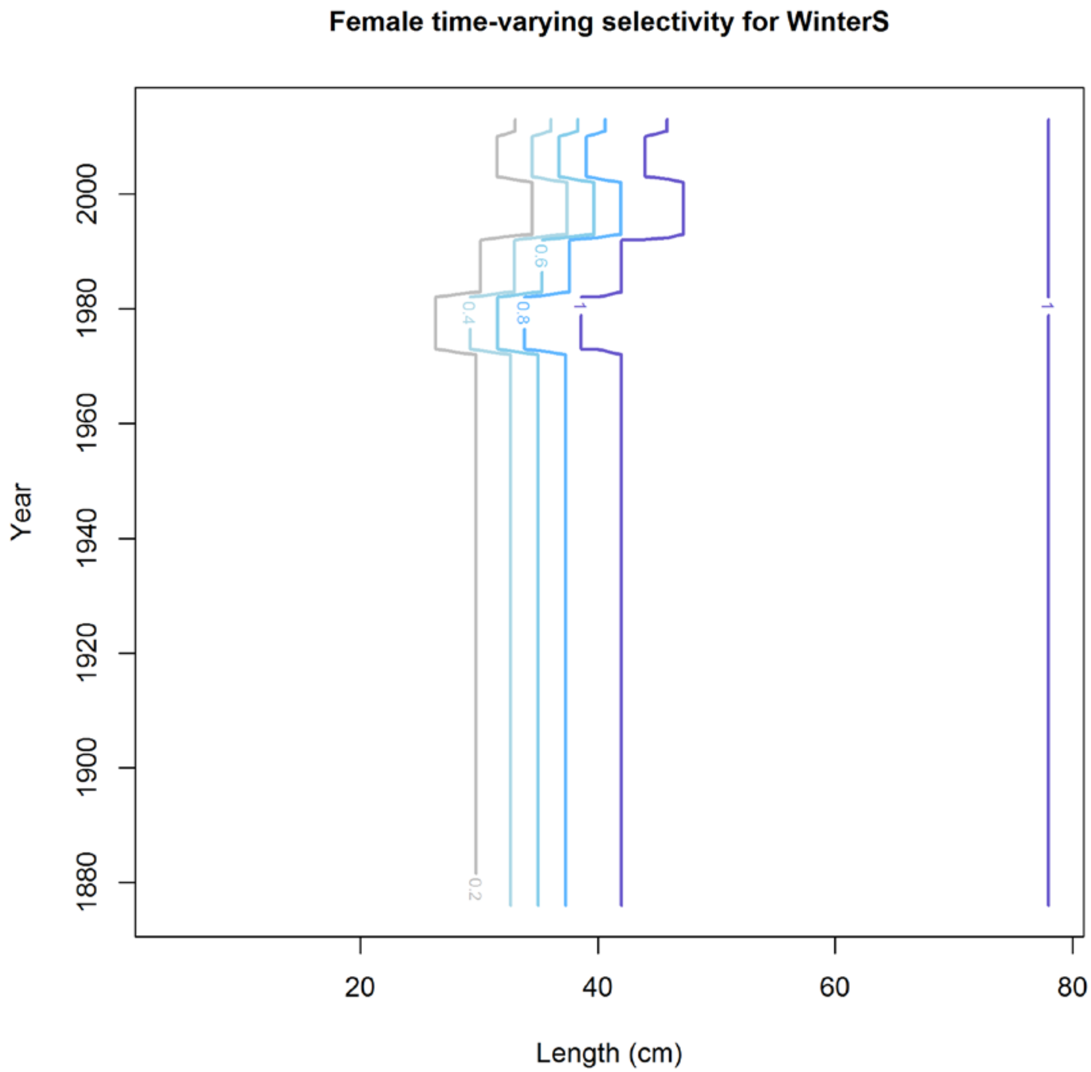


Figure 76. Estimated time varying length-based selectivity curves for the winter south fleet, females.

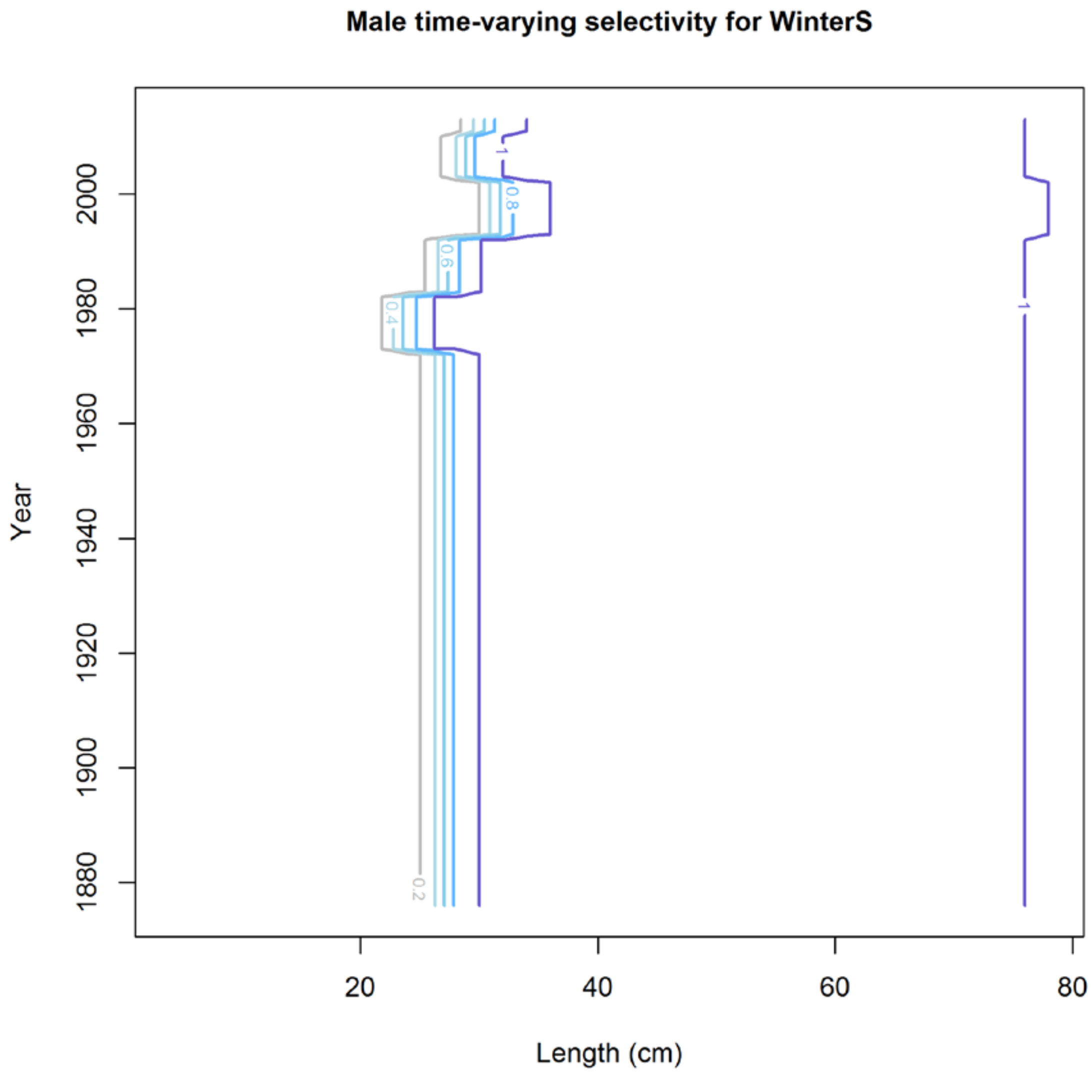


Figure 77.Estimated time varying length-based selectivity curves for the winter south fleet, males.

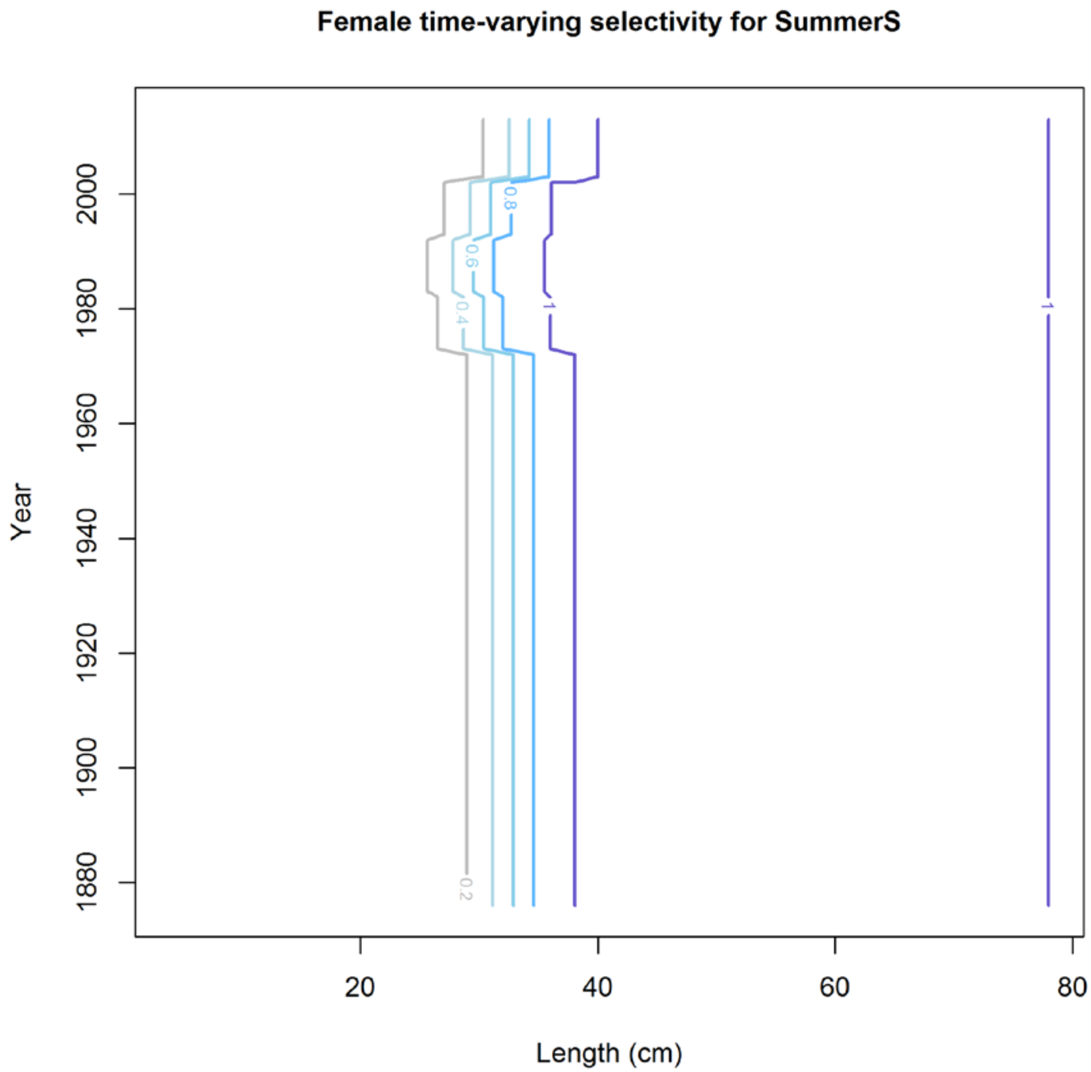


Figure 78. Estimated time varying length-based selectivity curves for the summer south fleet, females.

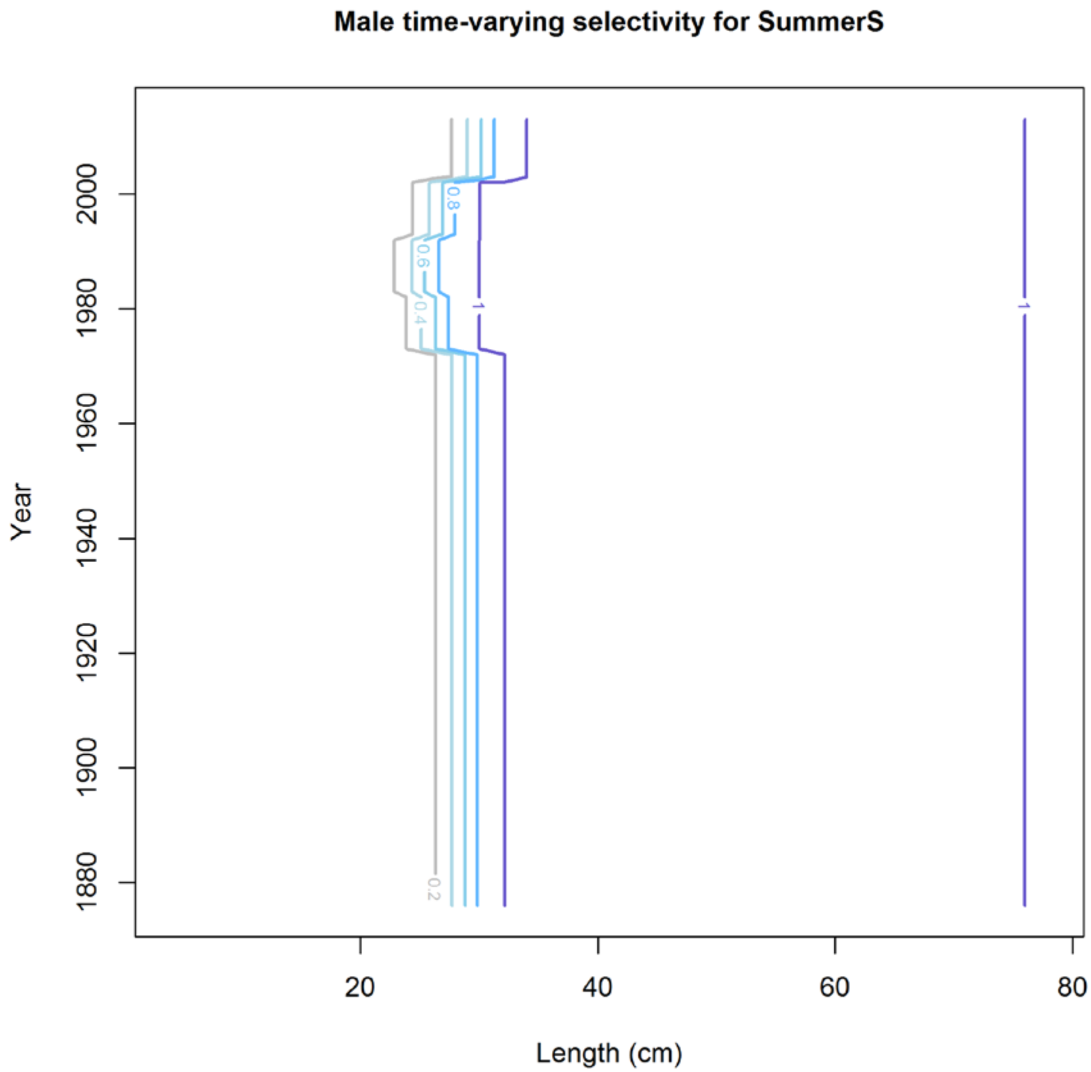


Figure 79. Estimated time varying length-based selectivity curves for the summer south fleet, males.

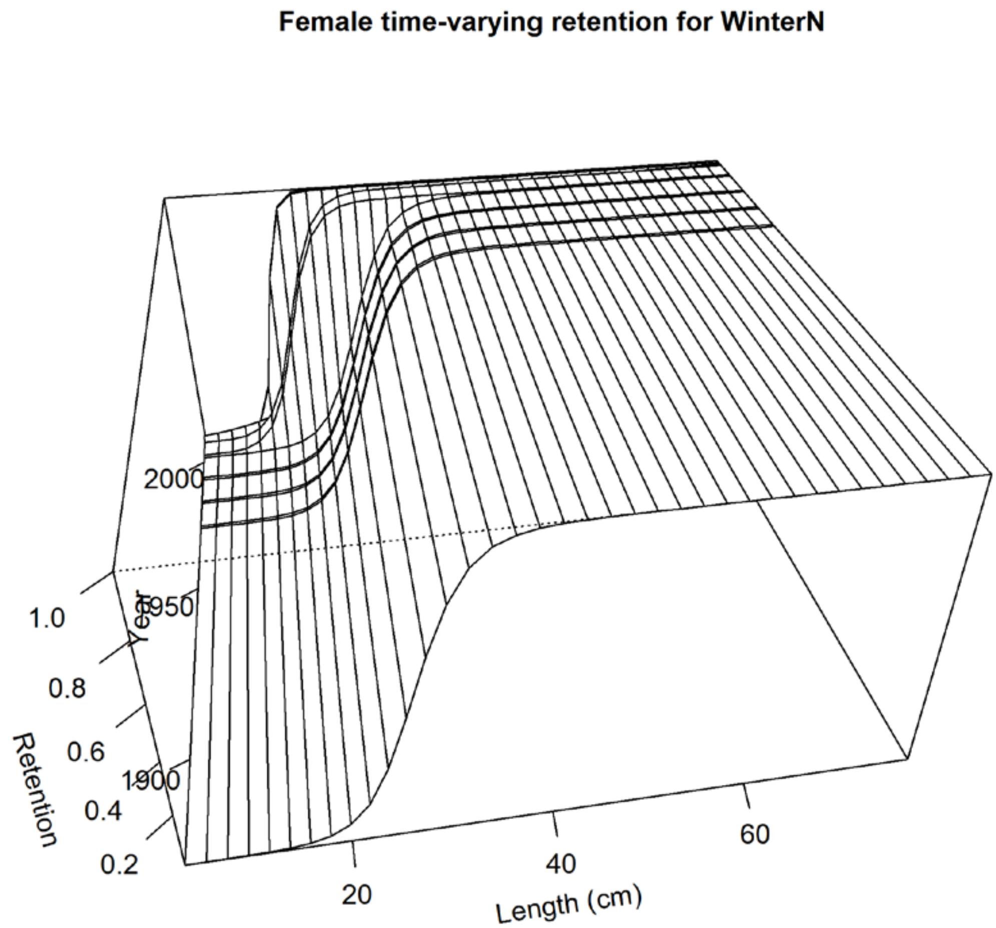


Figure 80. Estimated time varying length-based retention curves for the winter north fleet, females.

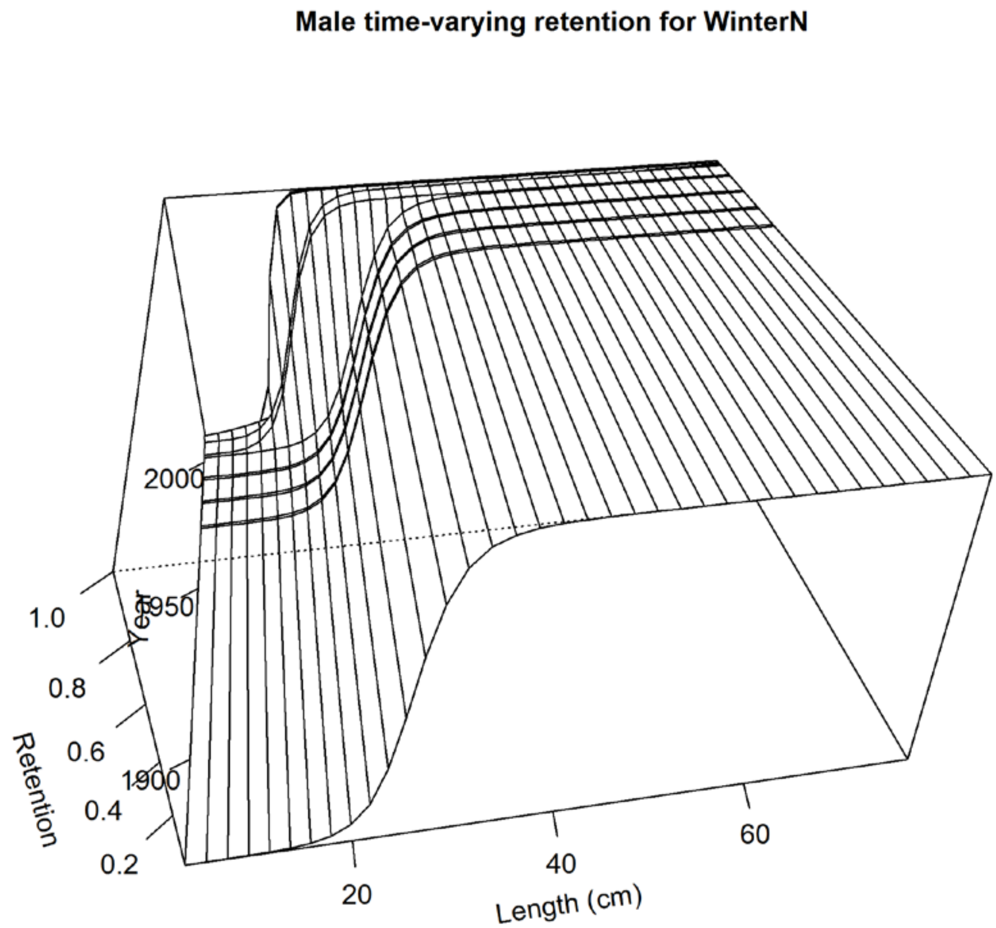


Figure 81.Estimated time varying length-based retention curves for the winter north fleet, males.

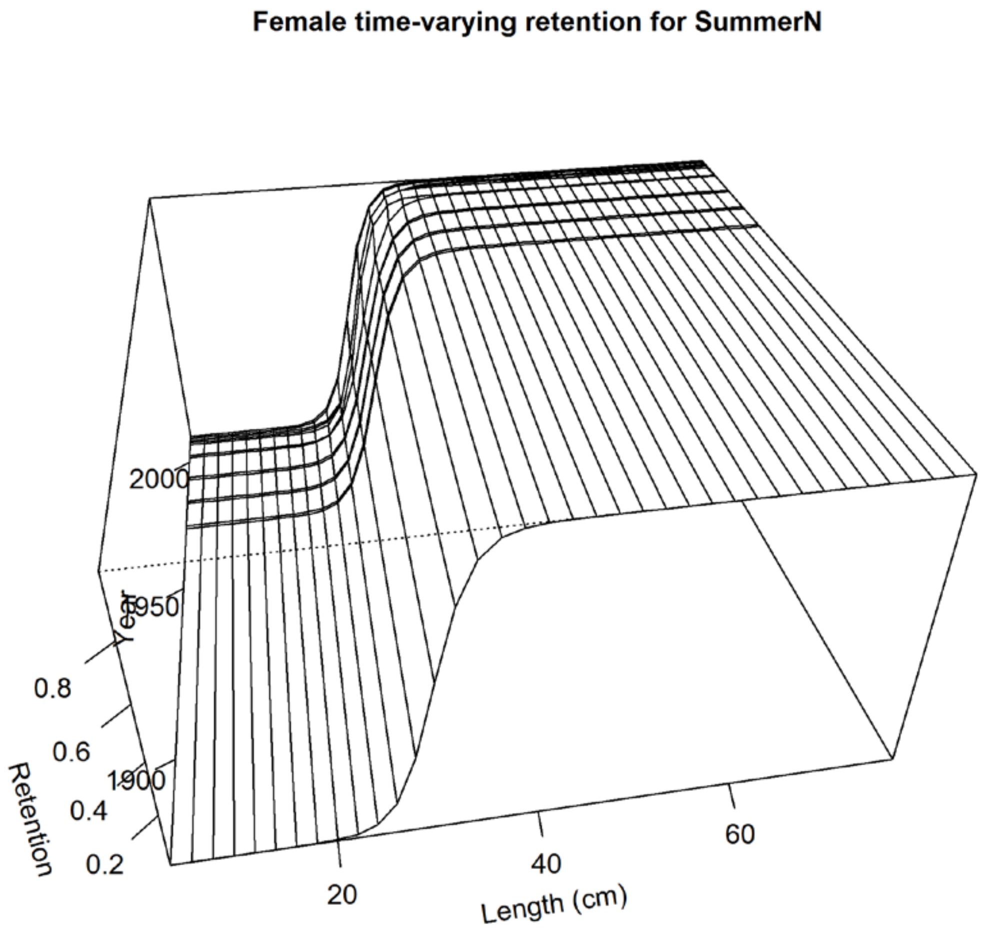


Figure 82. Estimated time varying length-based retention curves for the summer north fleet, females.

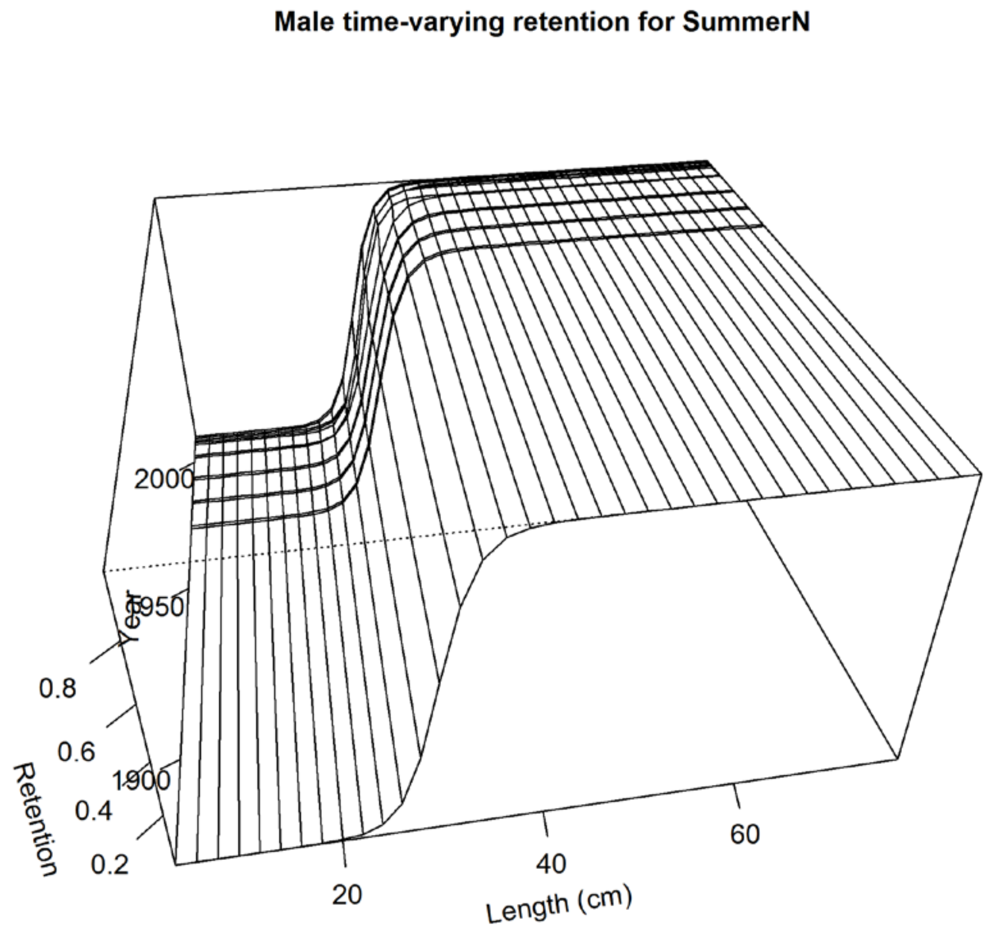


Figure 83. Estimated time varying length-based retention curves for the summer north fleet, males.

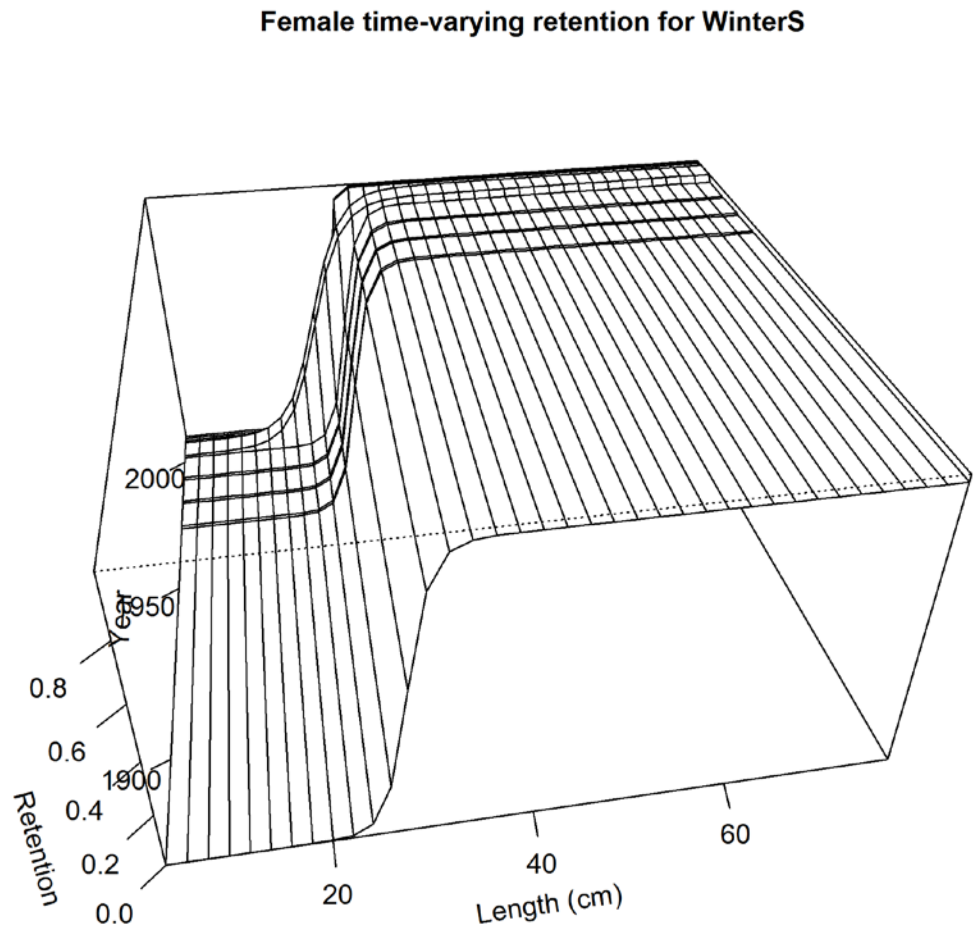


Figure 84. Estimated time varying length-based retention curves for the winter south fleet, females.

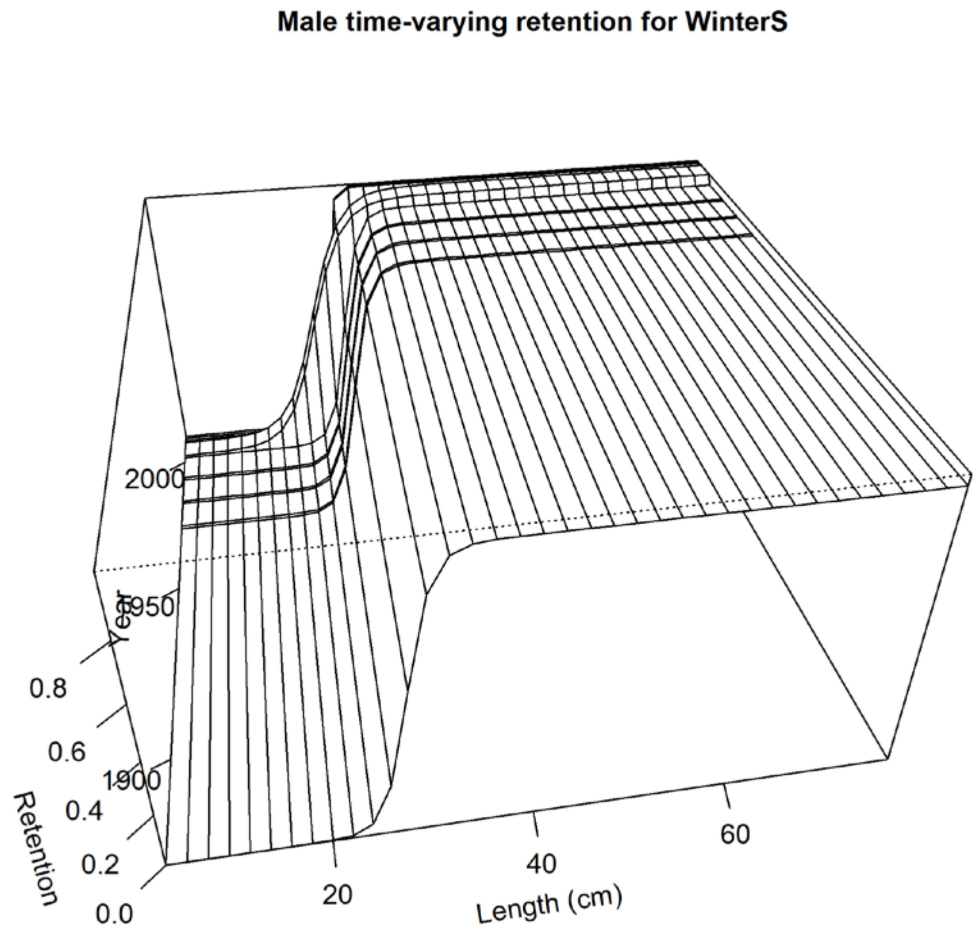


Figure 85.Estimated time varying length-based retention curves for the winter south fleet, males.

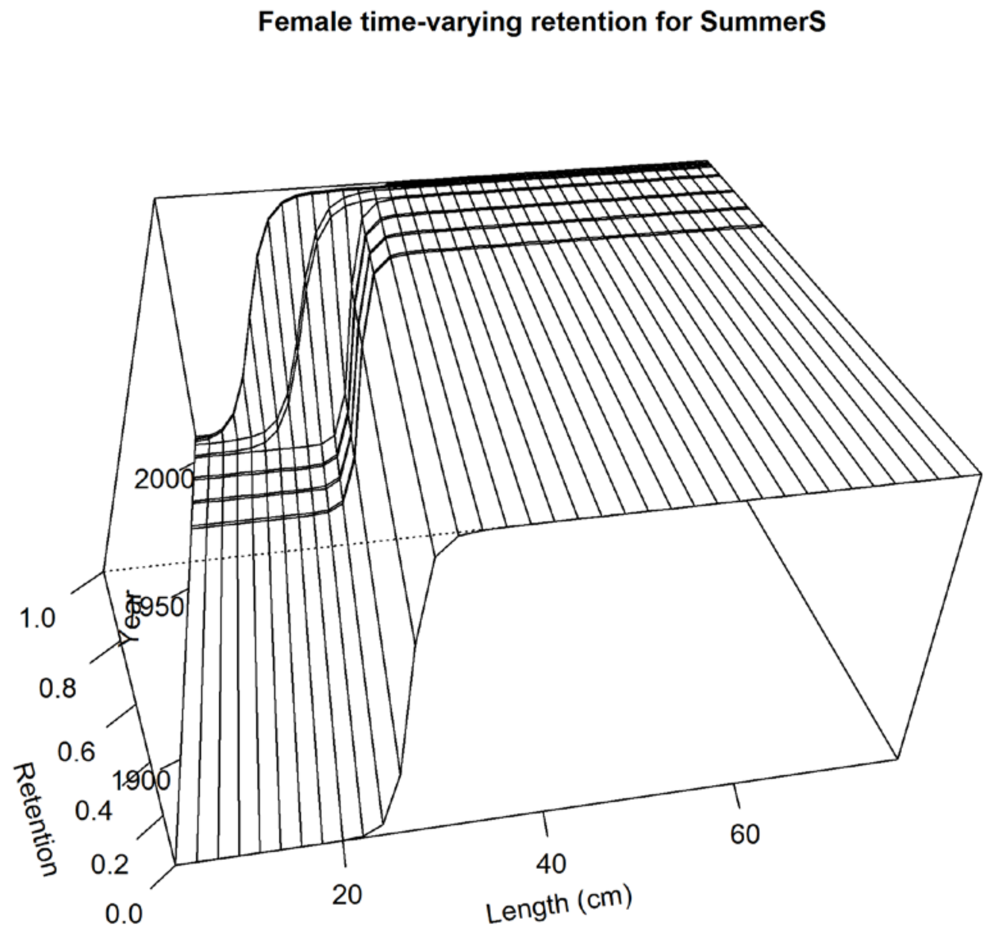


Figure 86. Estimated time varying length-based retention curves for the summer south fleet, females.

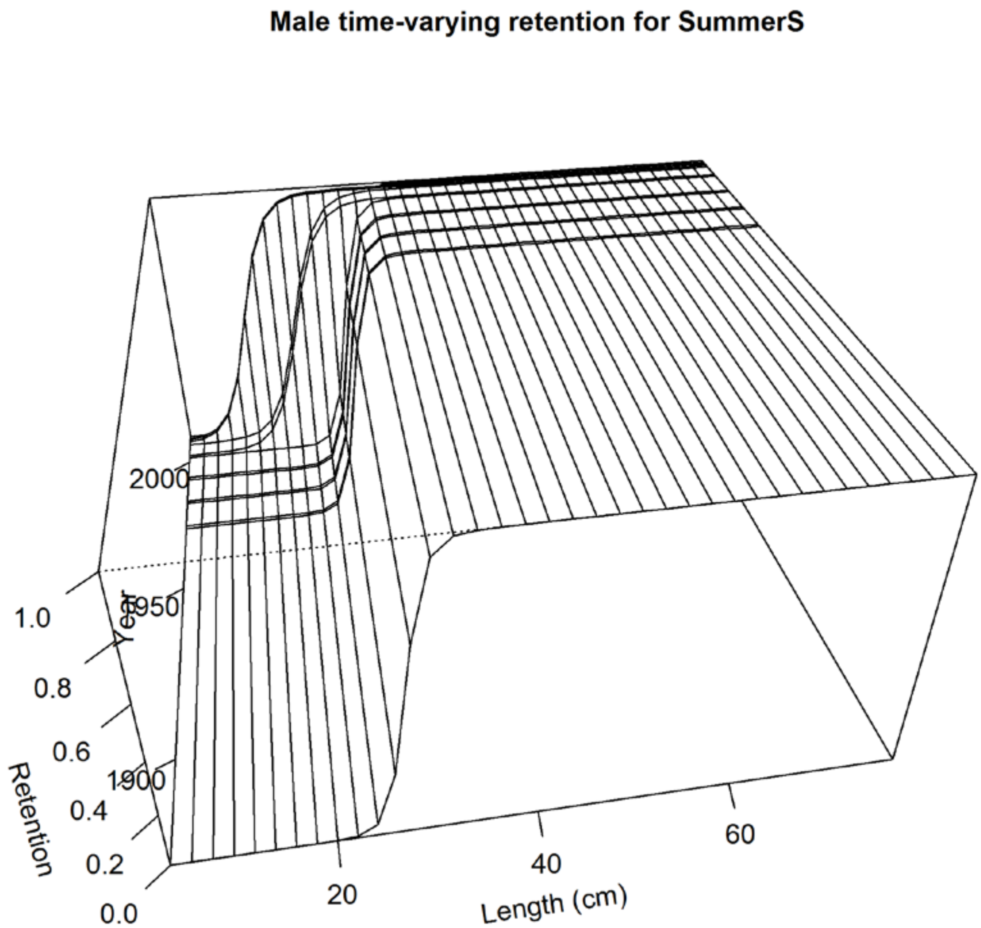


Figure 87. Estimated time varying length-based retention curves for the summer south fleet, males.

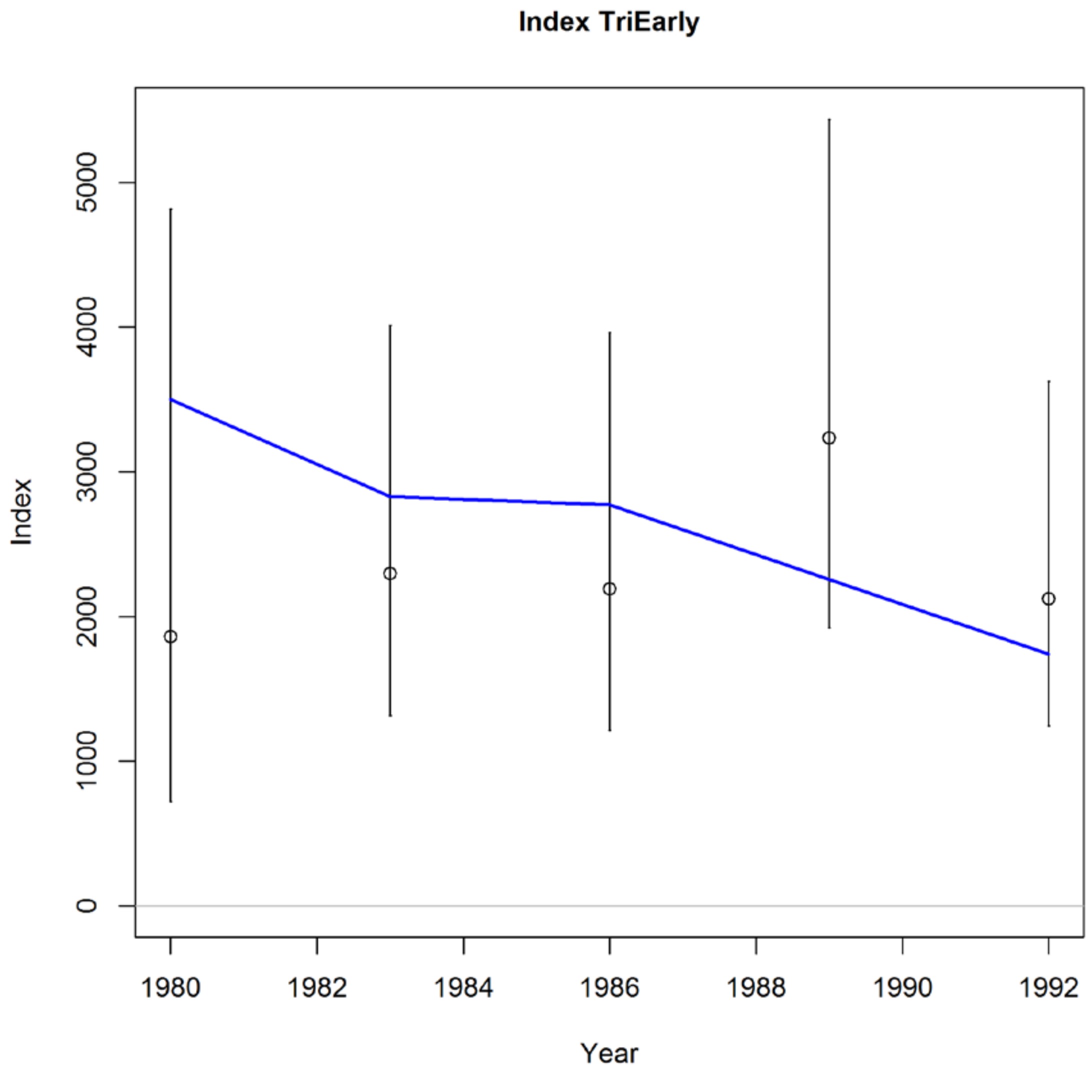


Figure 88. Fit to the early triennial.

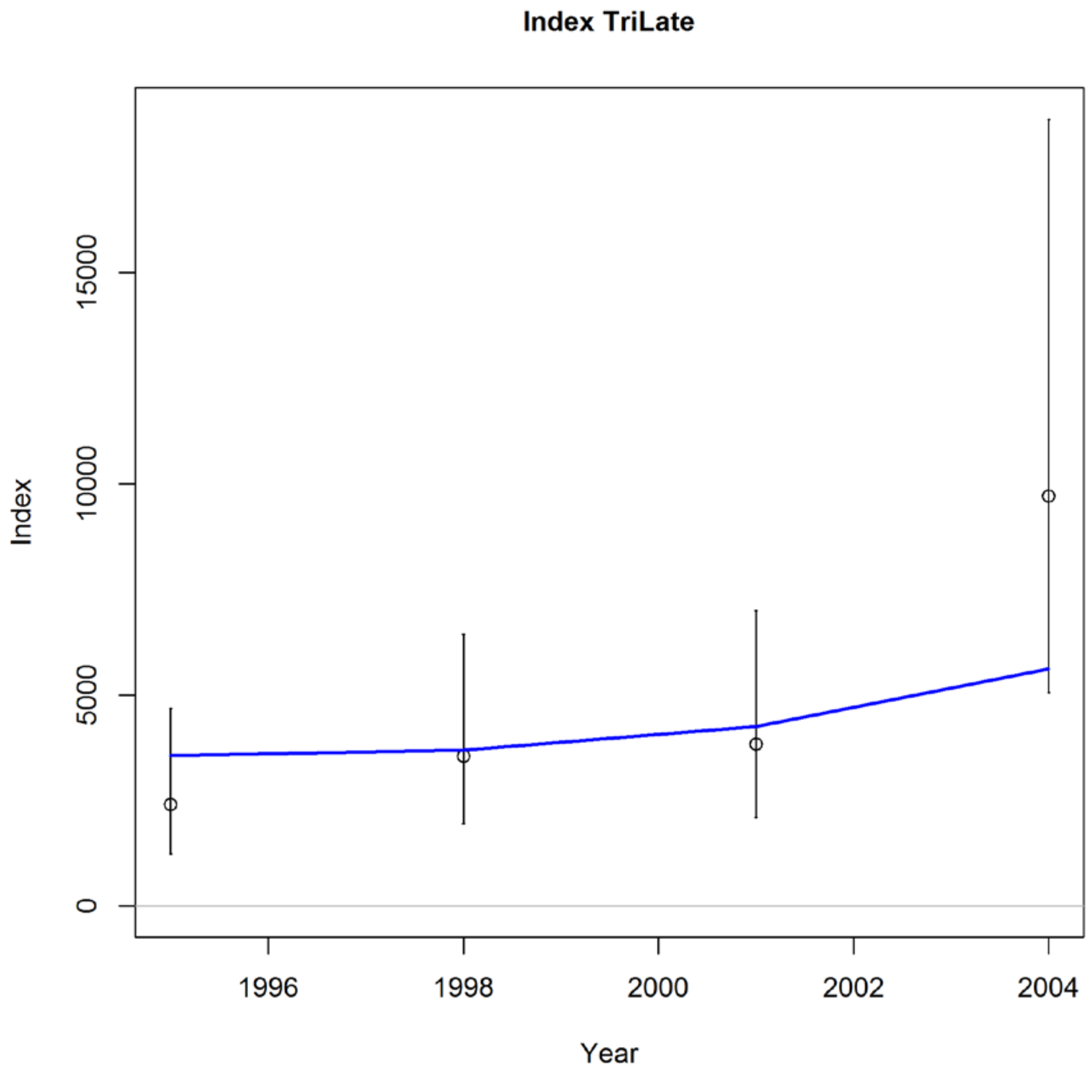


Figure 89. Fit to the late triennial.

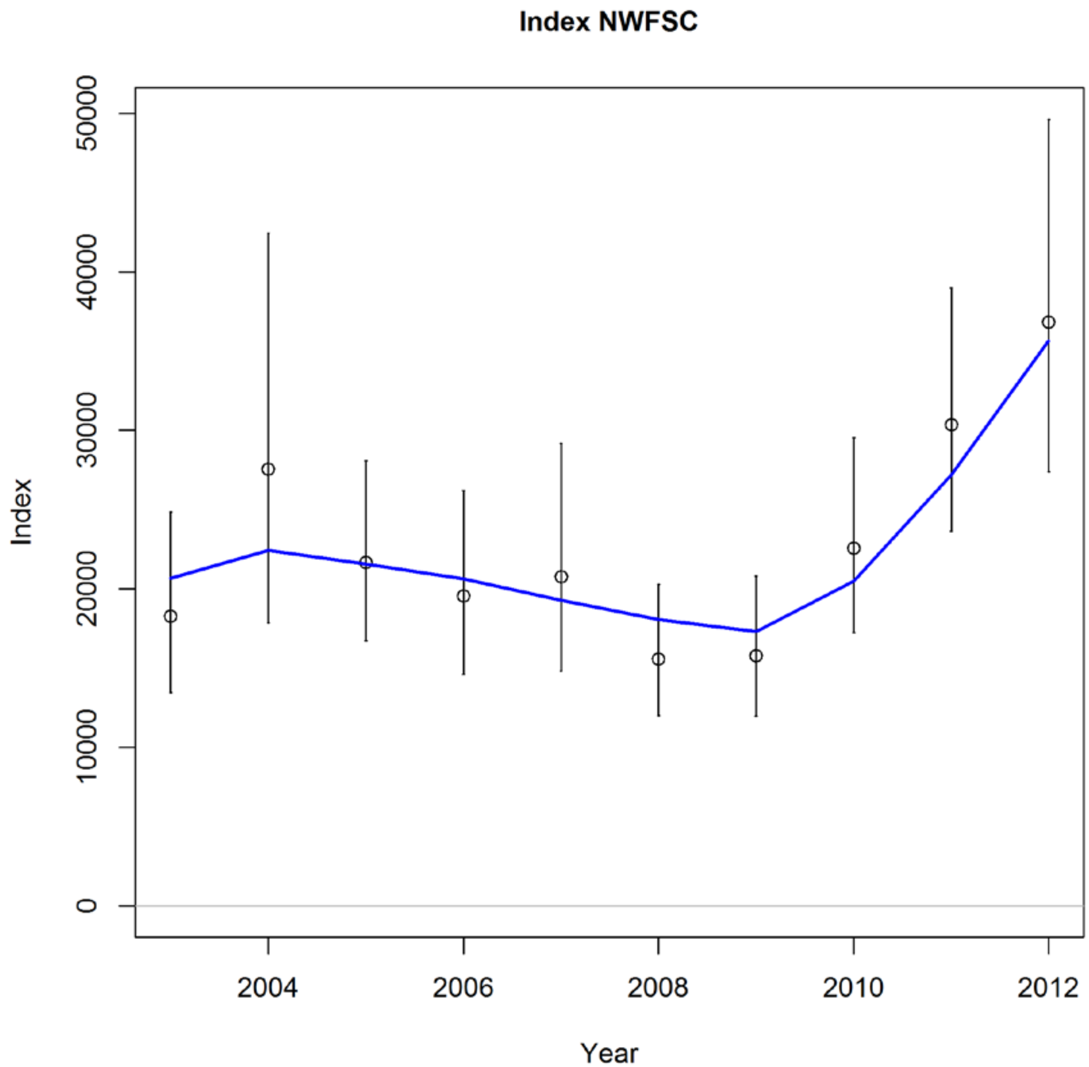


Figure 90. Fit to NWFSC survey.

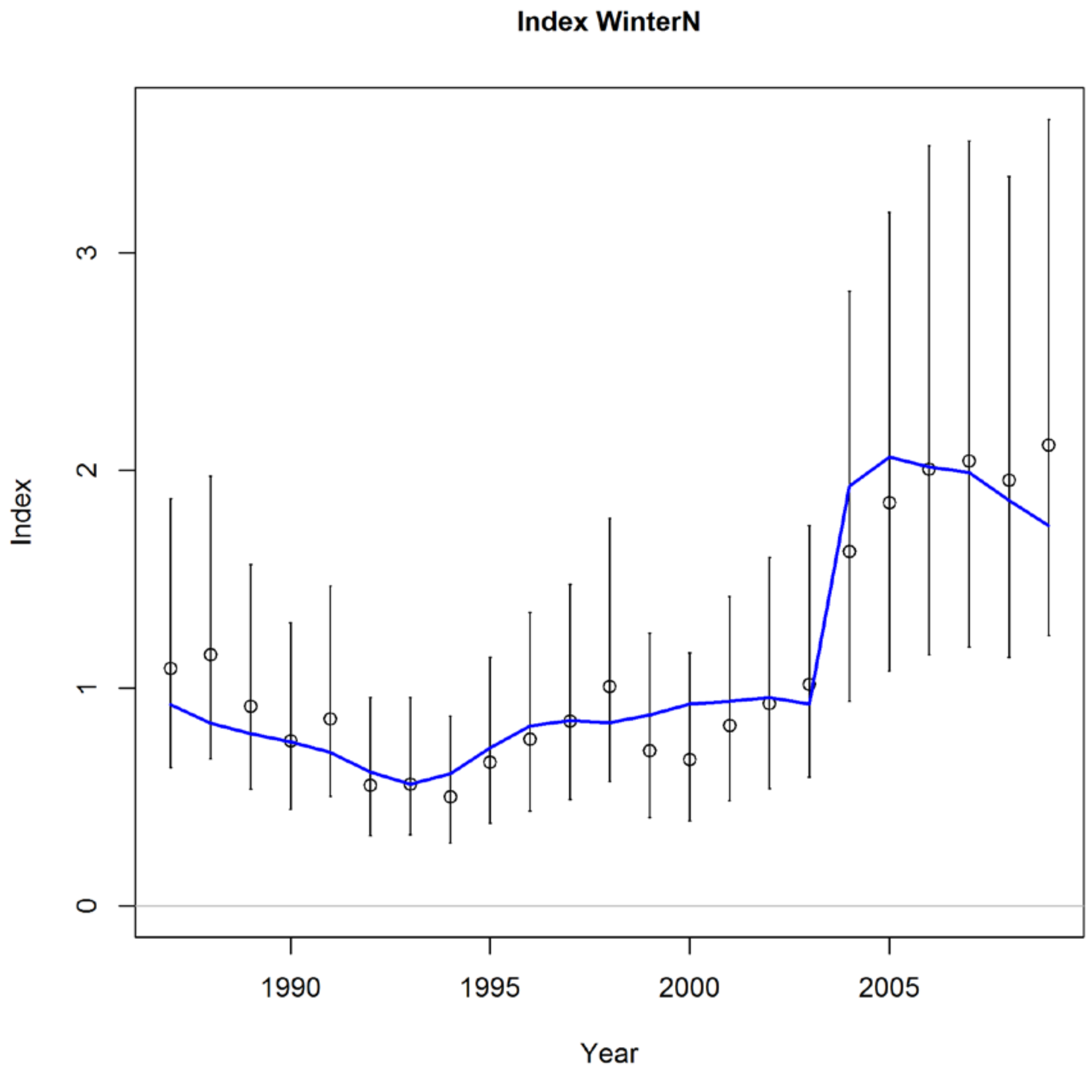


Figure 91. Fit to winter north commercial CPUE.

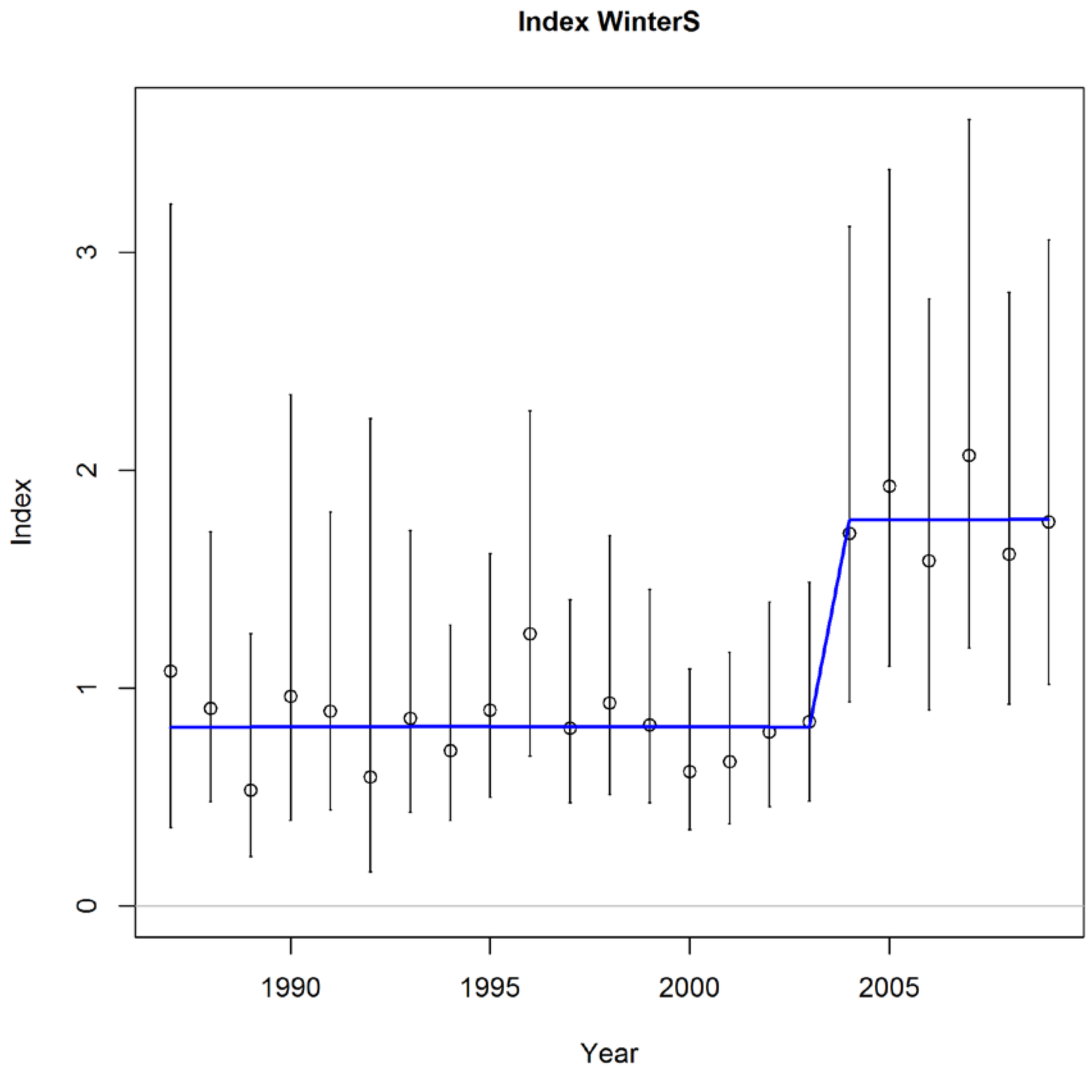


Figure 92. Fit to winter south commercial CPUE.

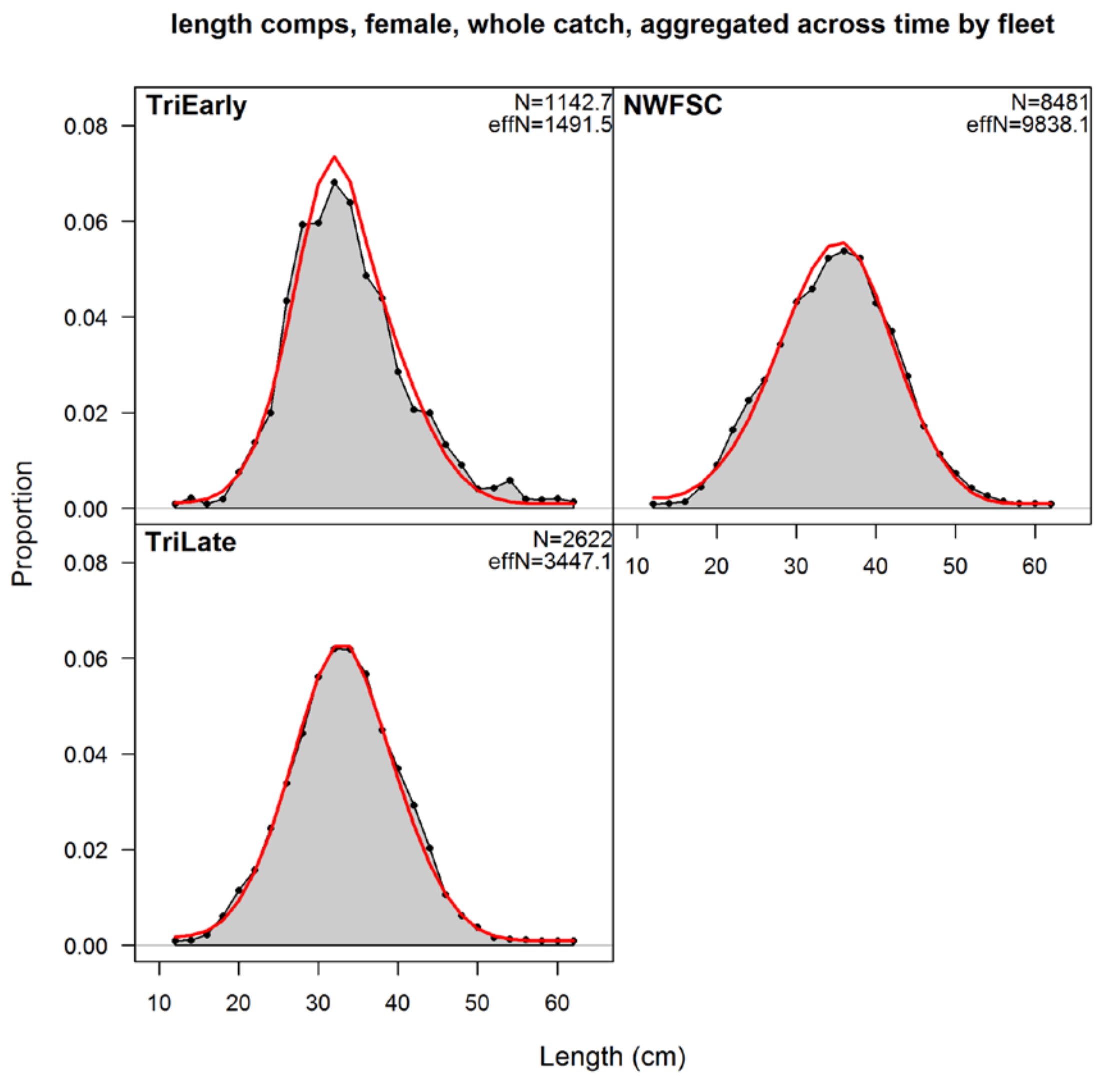


Figure 93. Fit to the composite survey length-frequencies, females.

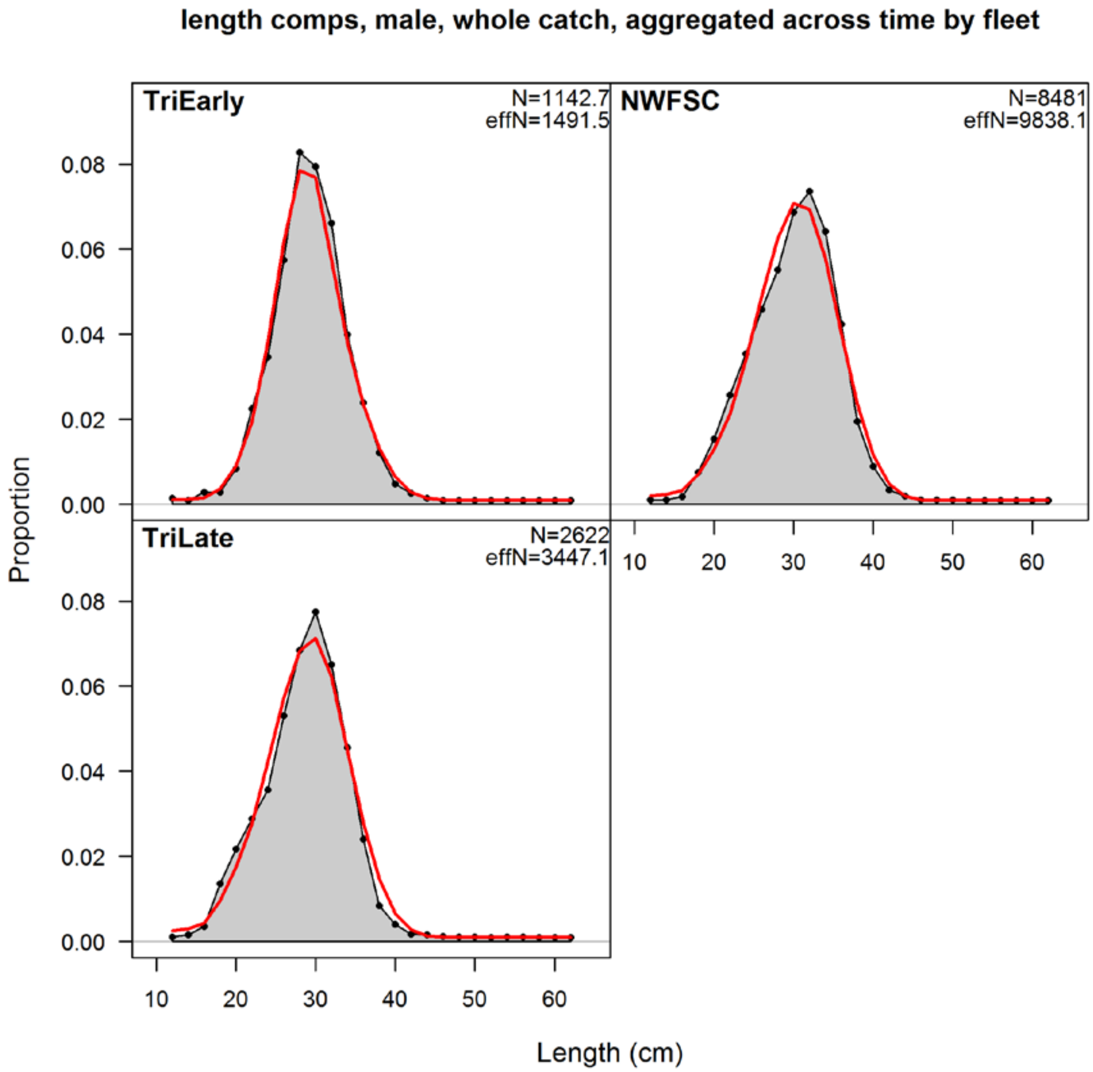


Figure 94. Fit to the composite survey length-frequencies, males.

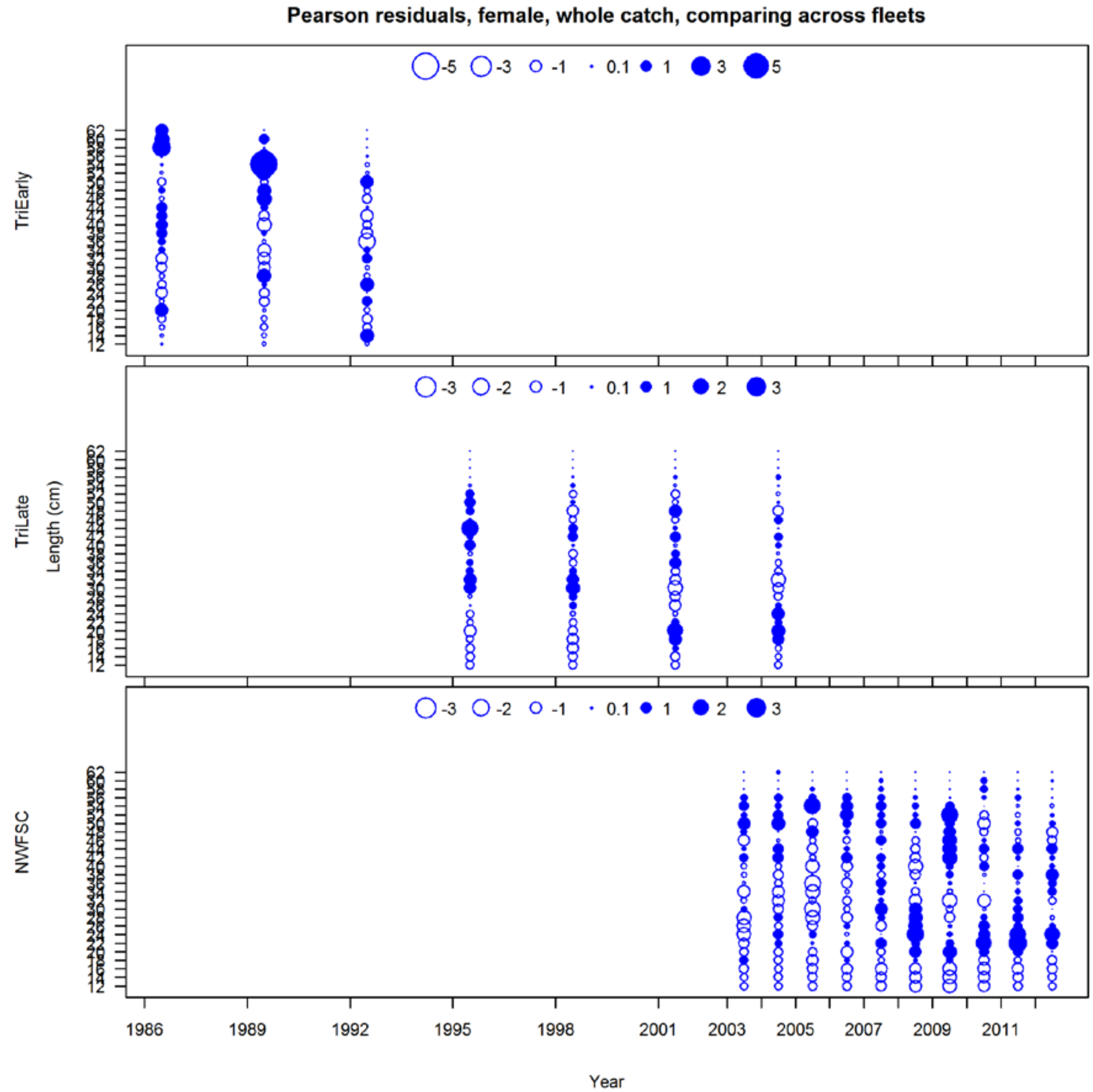


Figure 95. Pearson residuals for the fit to survey length-frequencies, females.

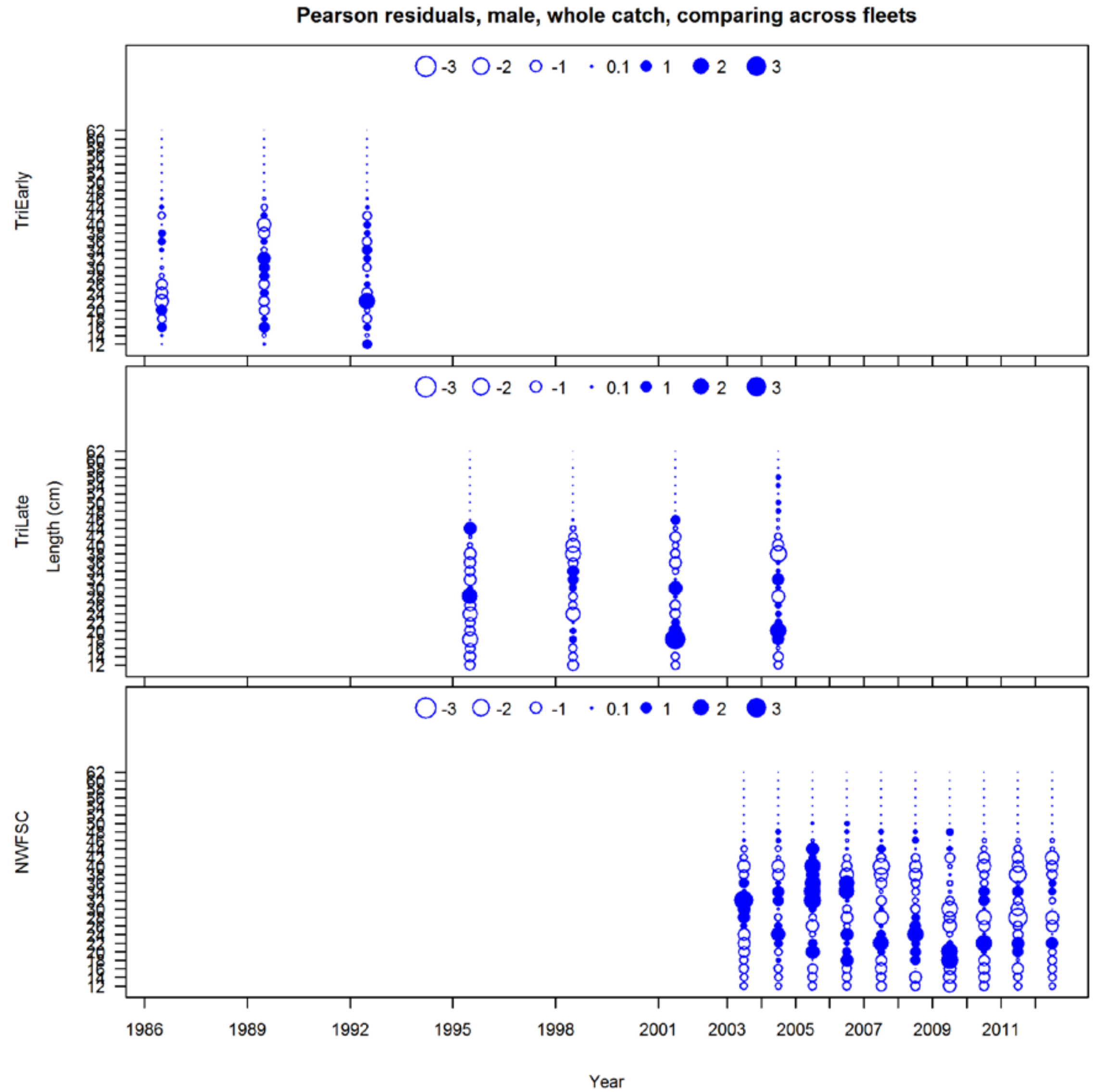


Figure 96. Pearson residuals for the fit to survey length-frequencies, males.

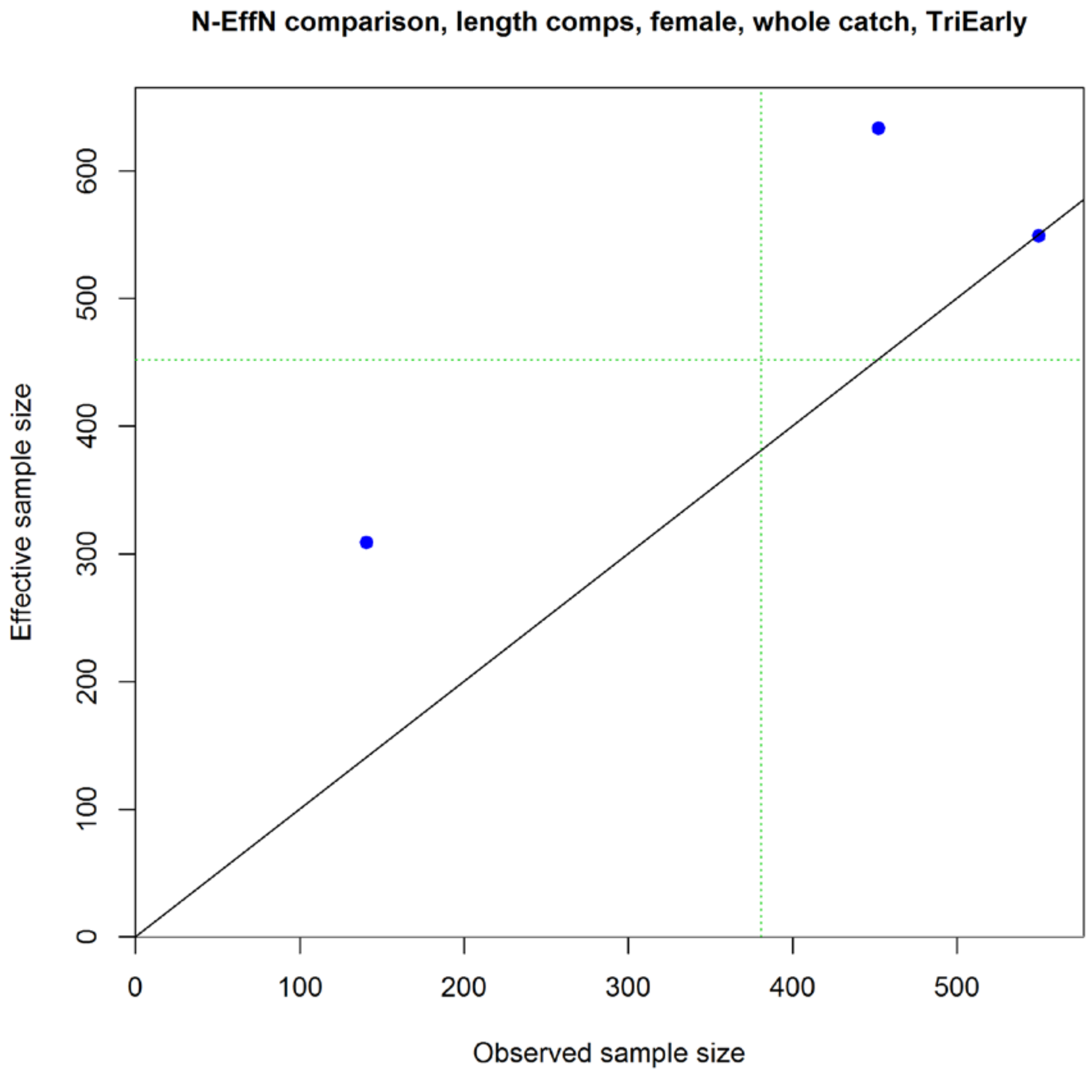


Figure 97. Observed and effective sample sizes for the early triennial survey length-frequency observations, females.

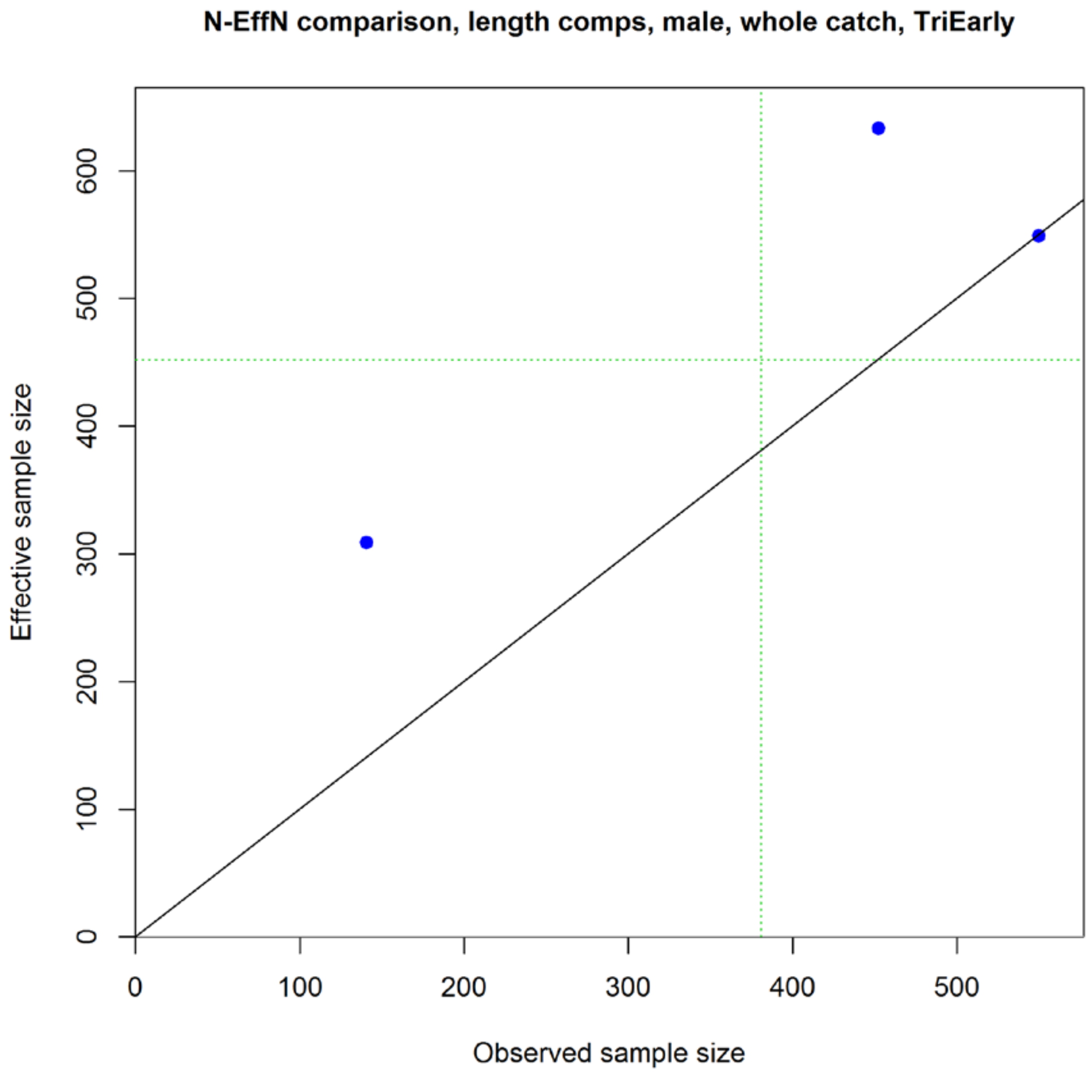


Figure 98. Observed and effective sample sizes for the early triennial survey length-frequency observations, males.

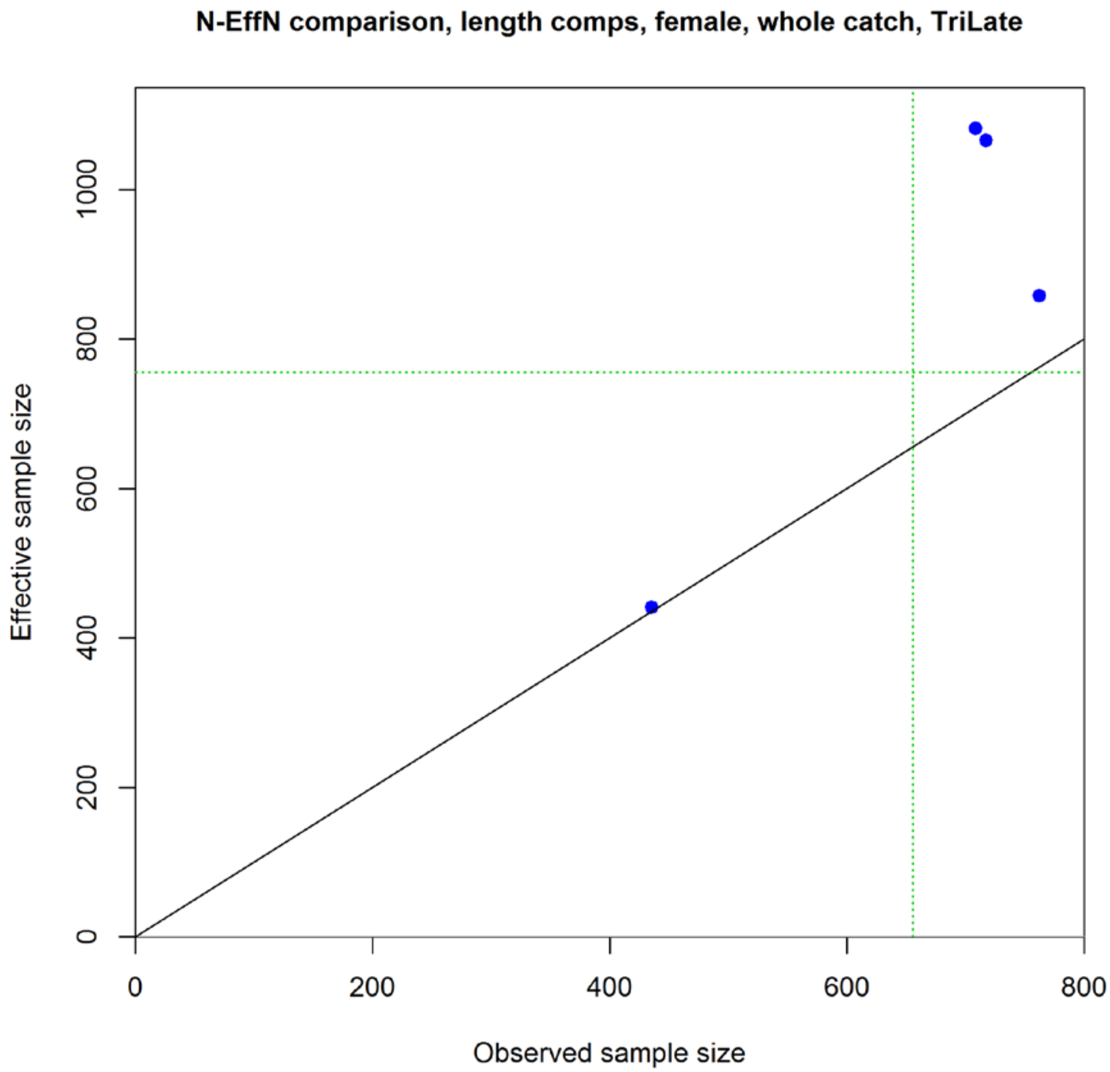


Figure 99. Observed and effective sample sizes for the late triennial survey length-frequency observations, females.

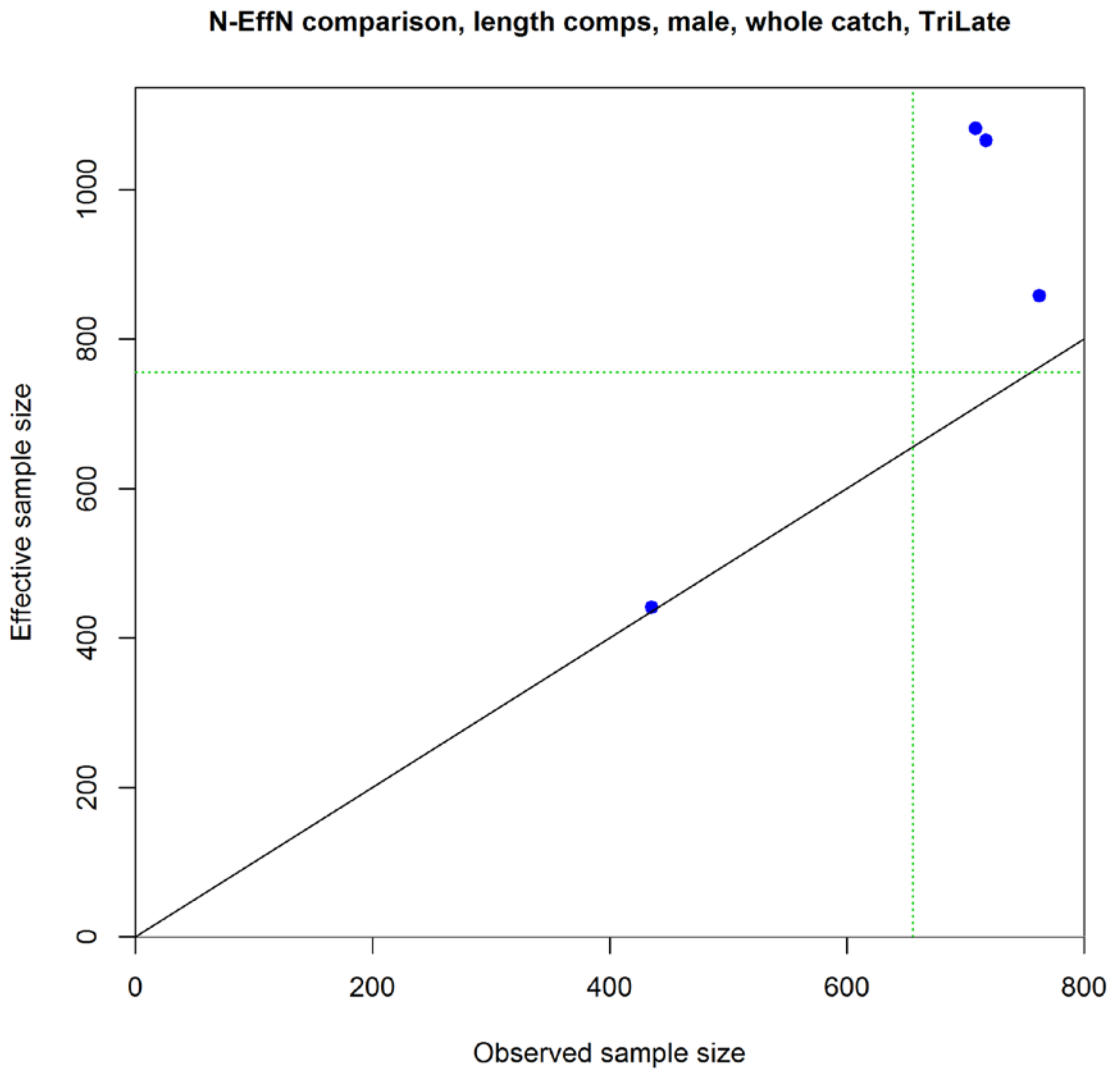


Figure 100. Observed and effective sample sizes for the late triennial survey length-frequency observations, males.

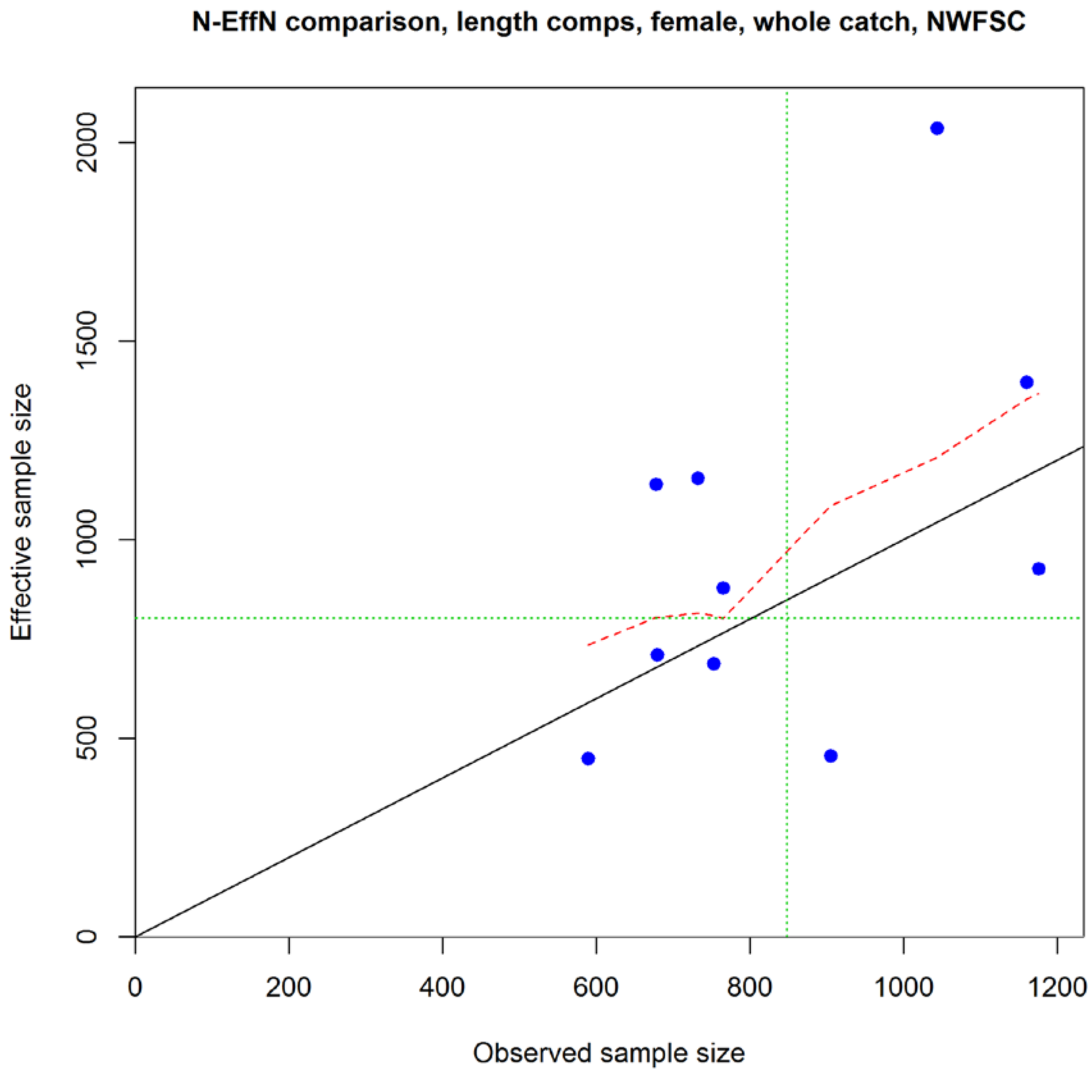


Figure 101. Observed and effective sample sizes for the NWFSC length-frequency observations, females.

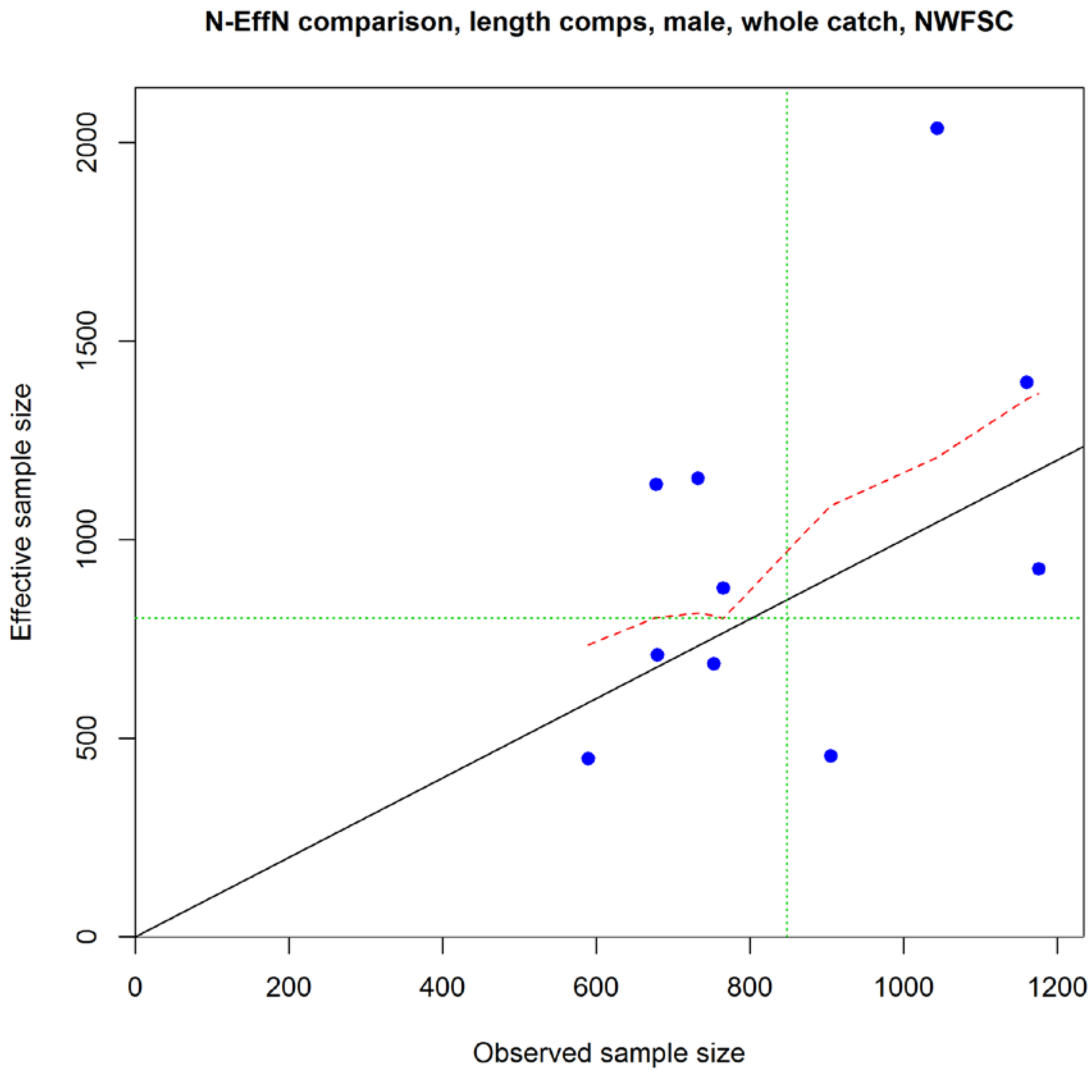
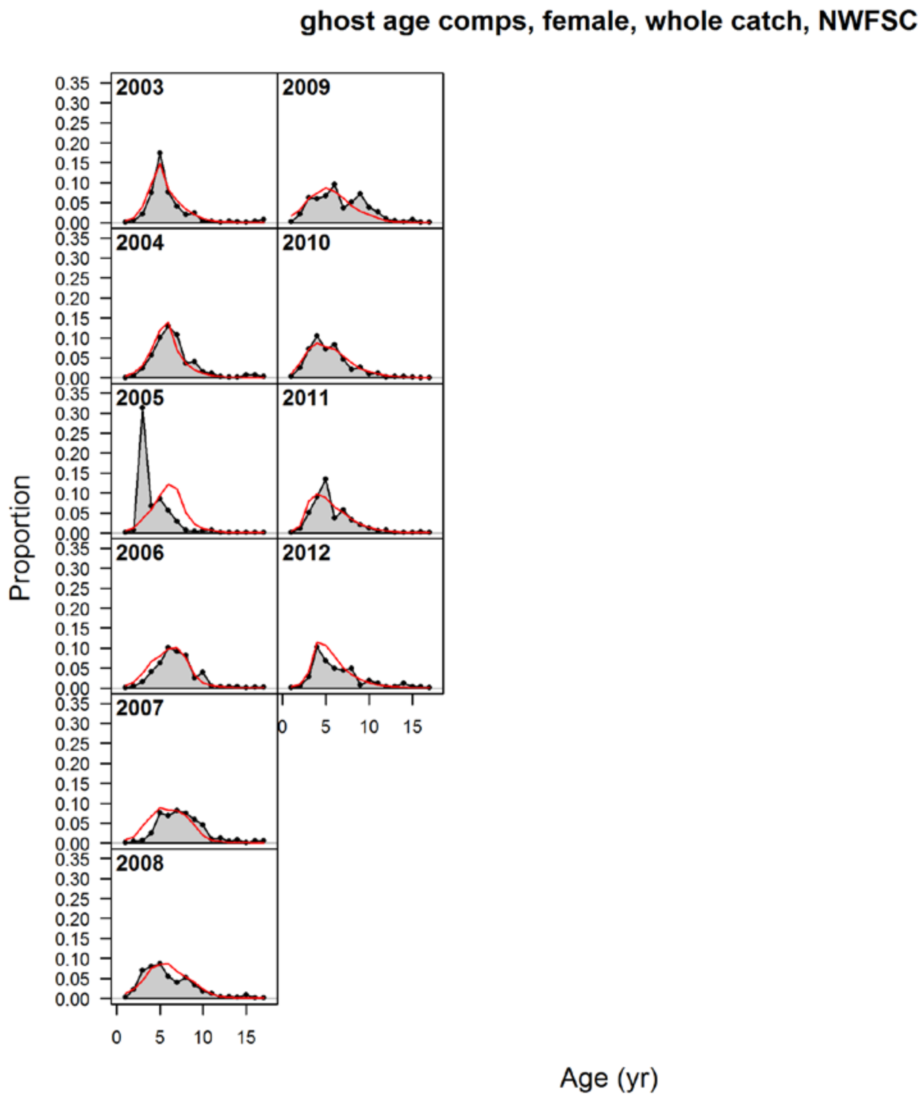


Figure 102. Observed and effective sample sizes for the NWFSC length-frequency observations, males.


ghost age comps, female, whole catch, NWFSC
Proportion
Age (yr)
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
5
10
15

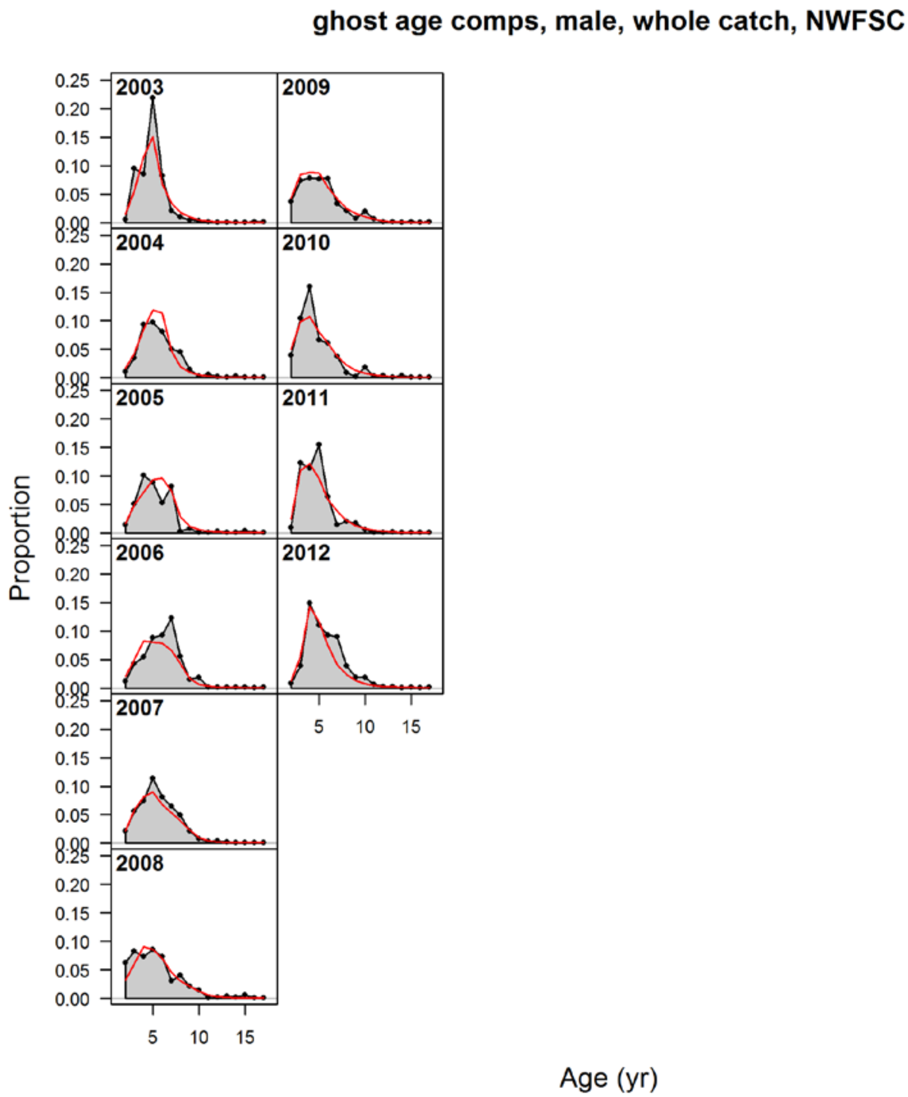
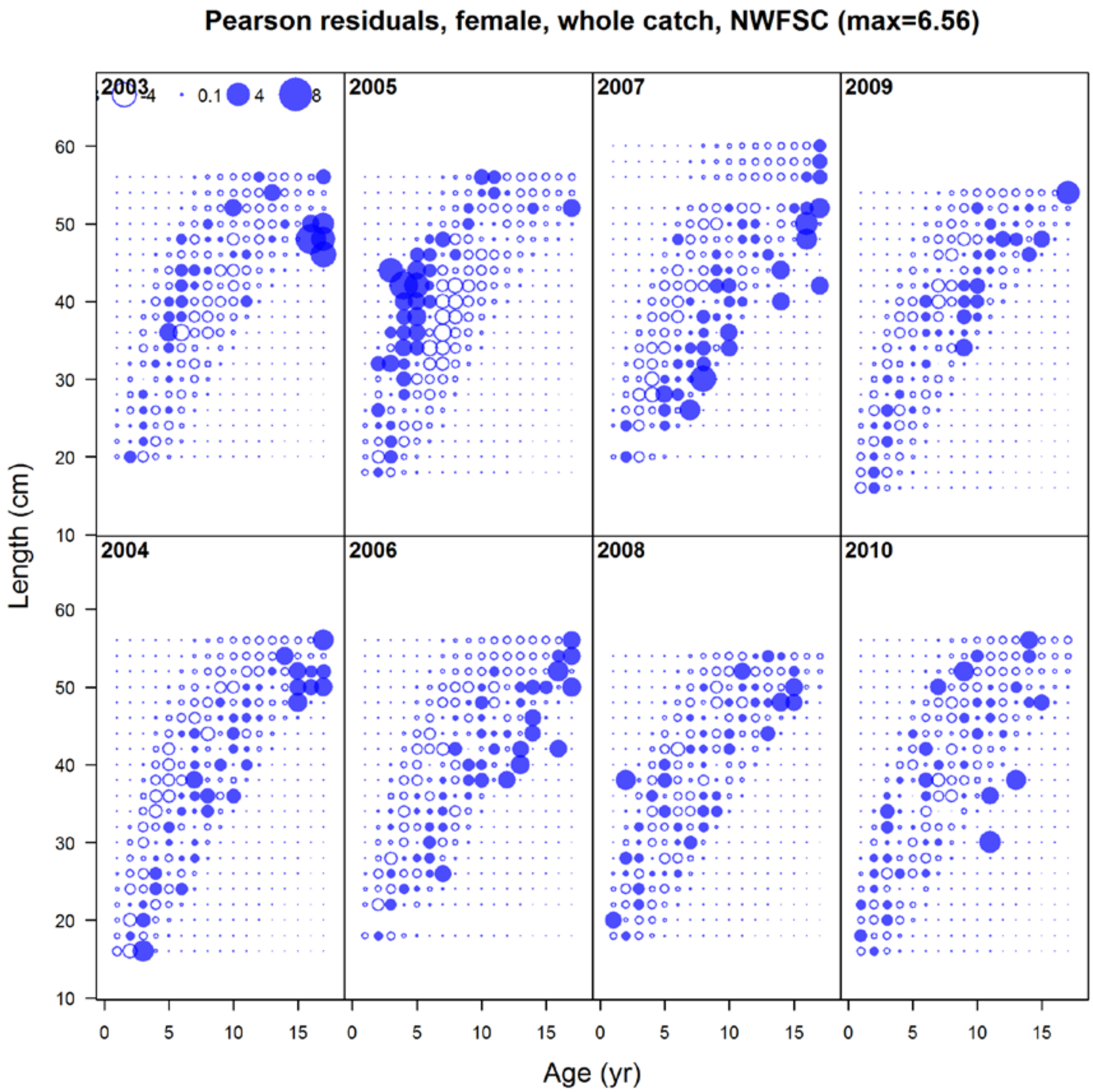
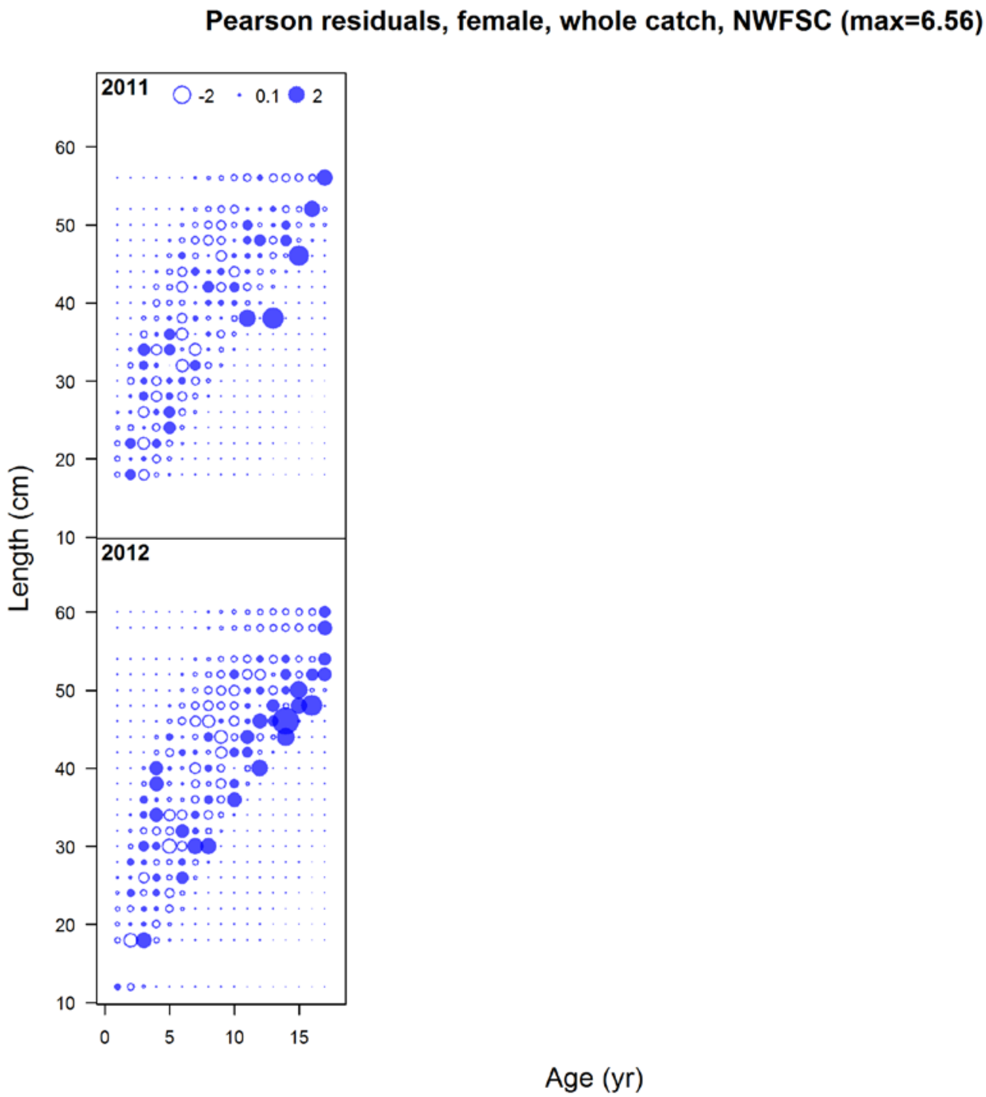
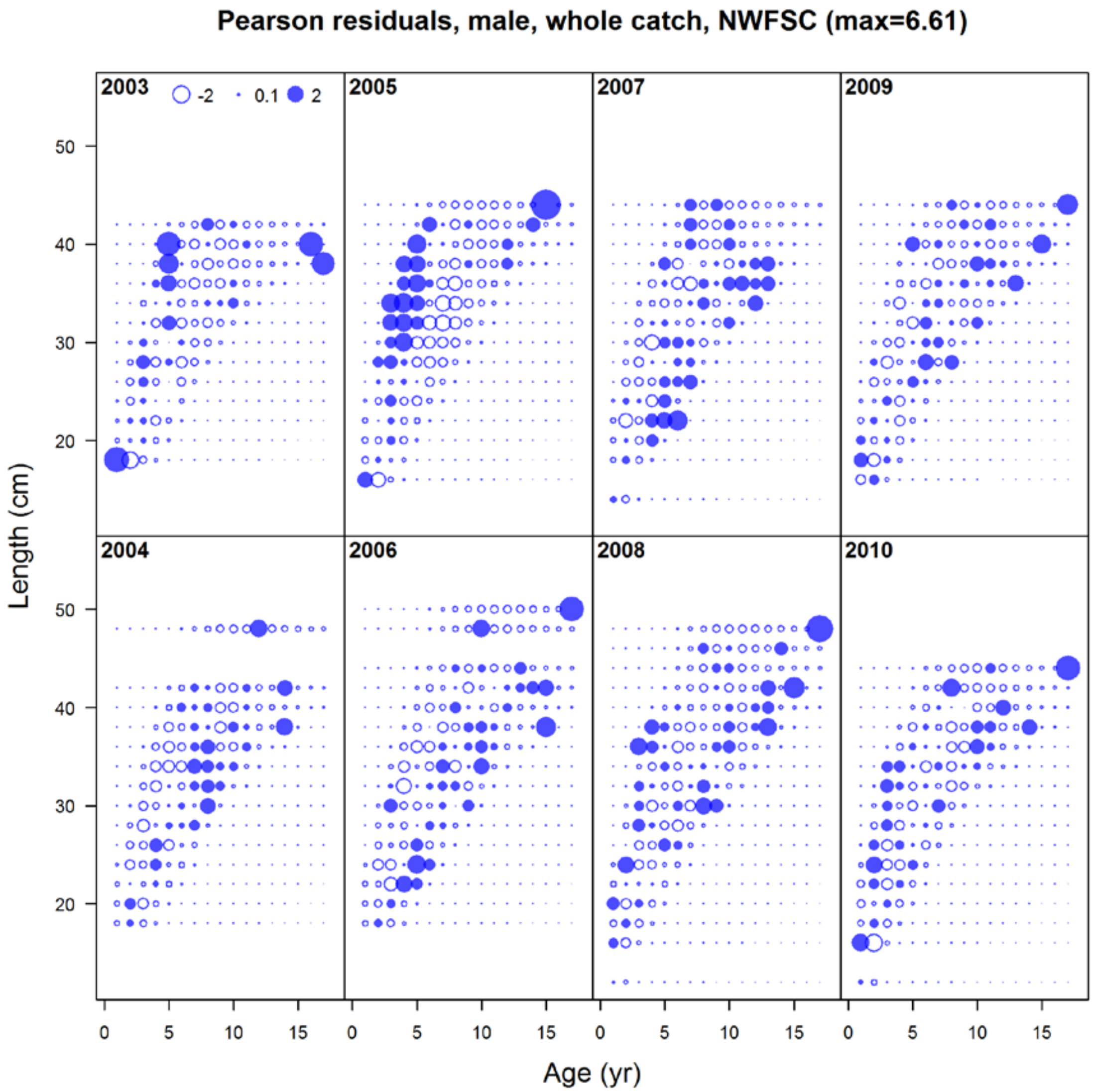


Figure 103. Model fits to the NWFSC marginal age-at-length data.


Pearson residuals, female, whole catch, NWFSC (max=6.56)
2003
2004
2005
2006
2007
2008
2009
2010
-4
0.1
4
8
Length (cm)
Age (yr)



Pearson residuals, female, whole catch, NWFSC (max=6.56)
2011
-2
0.1
2
2012
60
50
40
30
20
10
Length (cm)
0
5
10
15
Age (yr)



Pearson residuals, male, whole catch, NWFSC (max=6.61)
2003
-2
0.1
2
2005
2007
2009
2004
2006
2008
2010
Length (cm)
Age (yr)

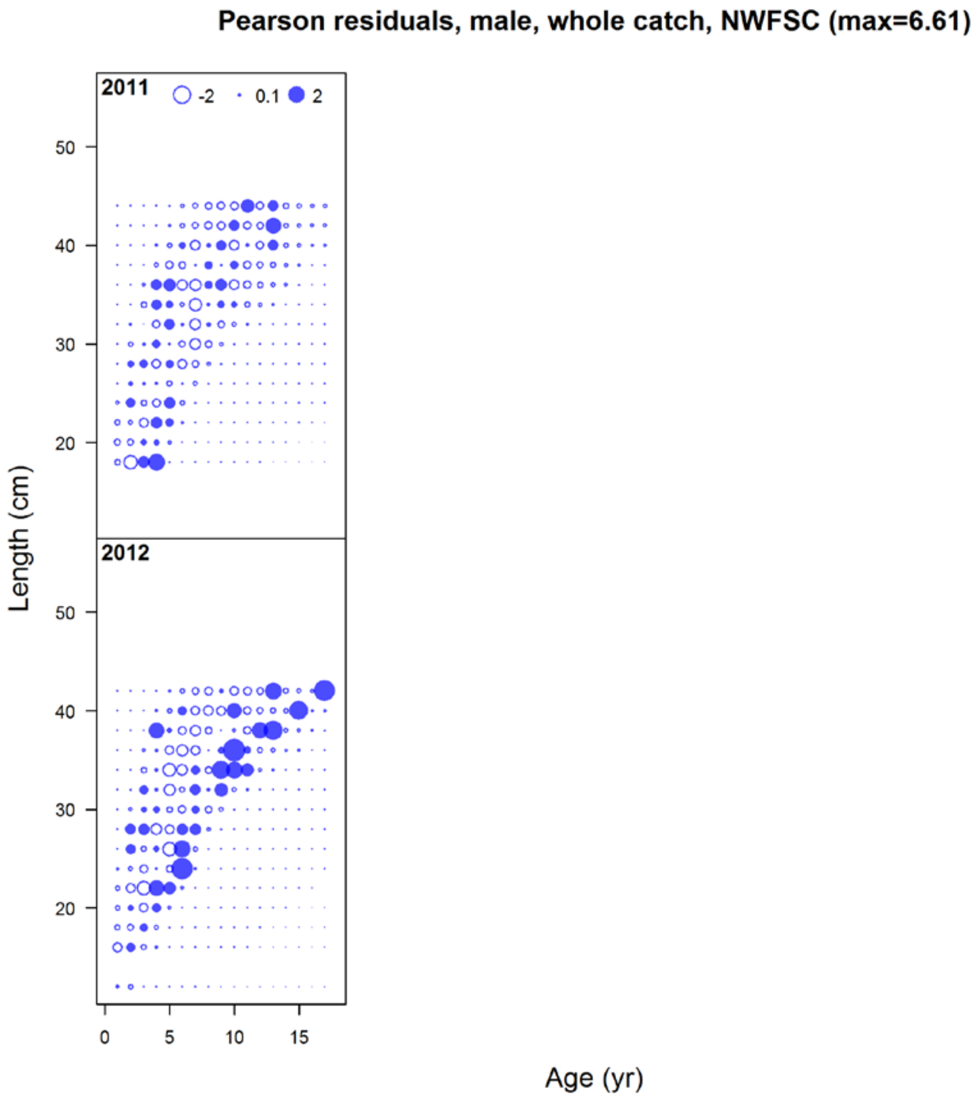
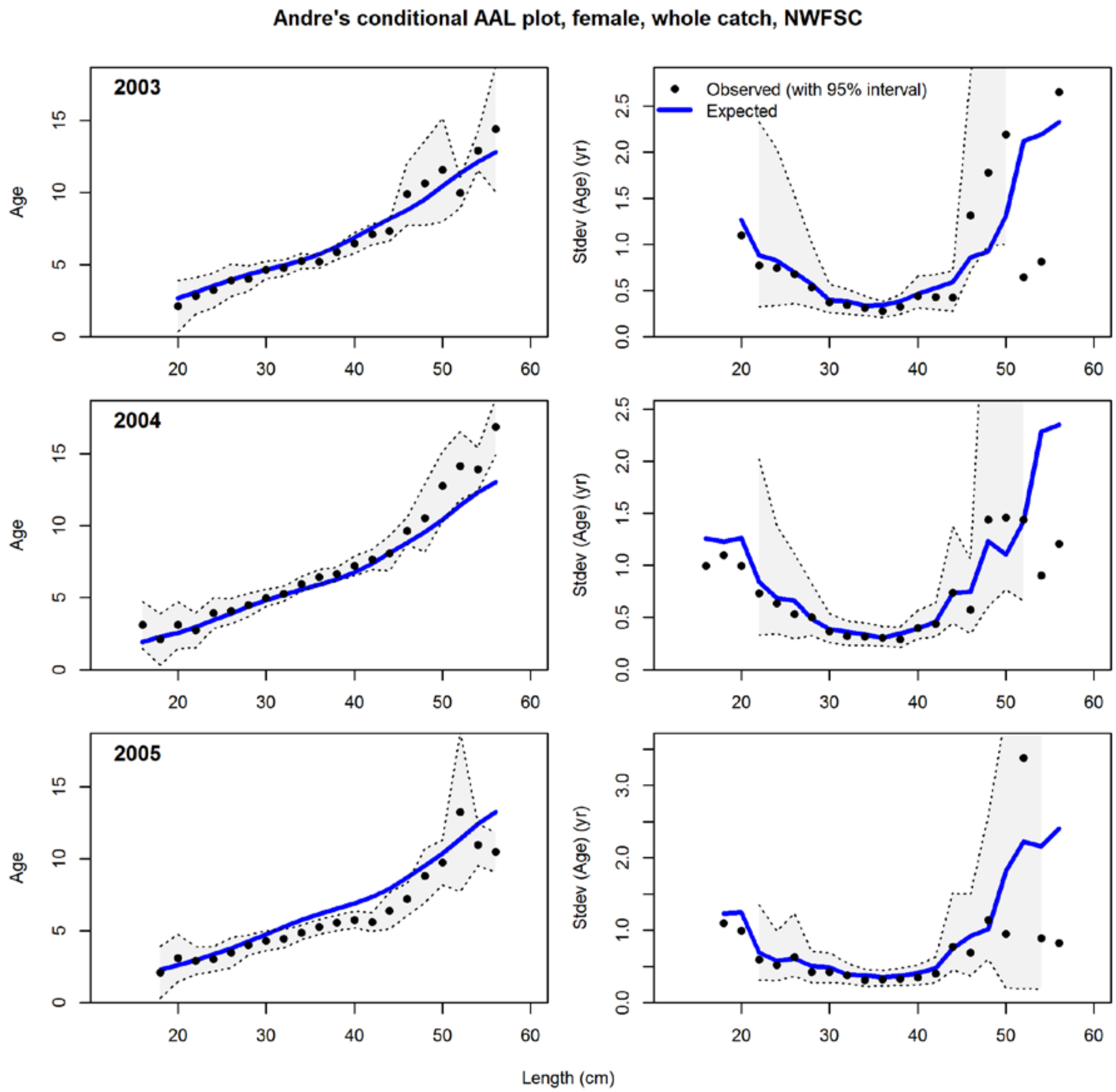
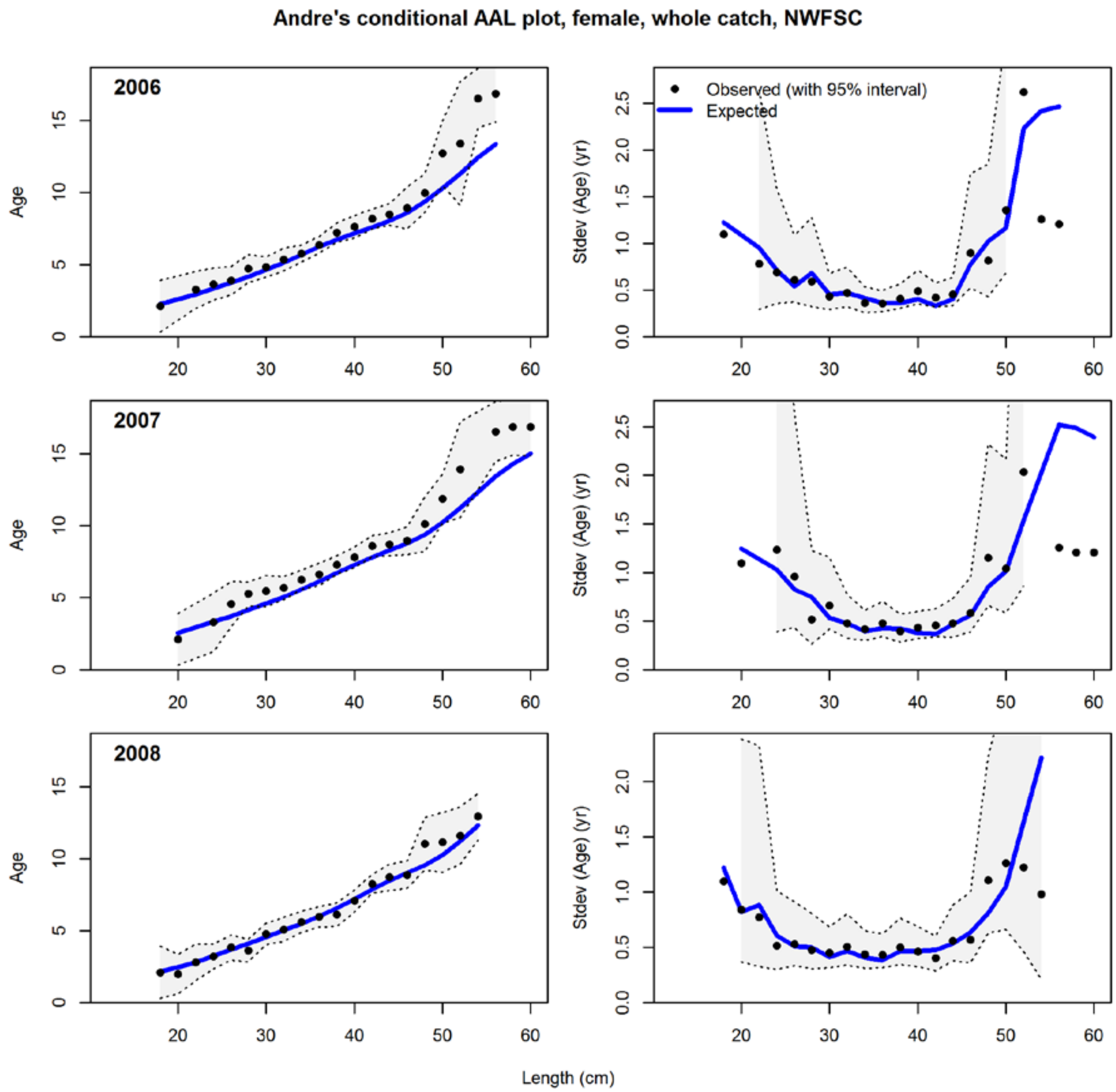
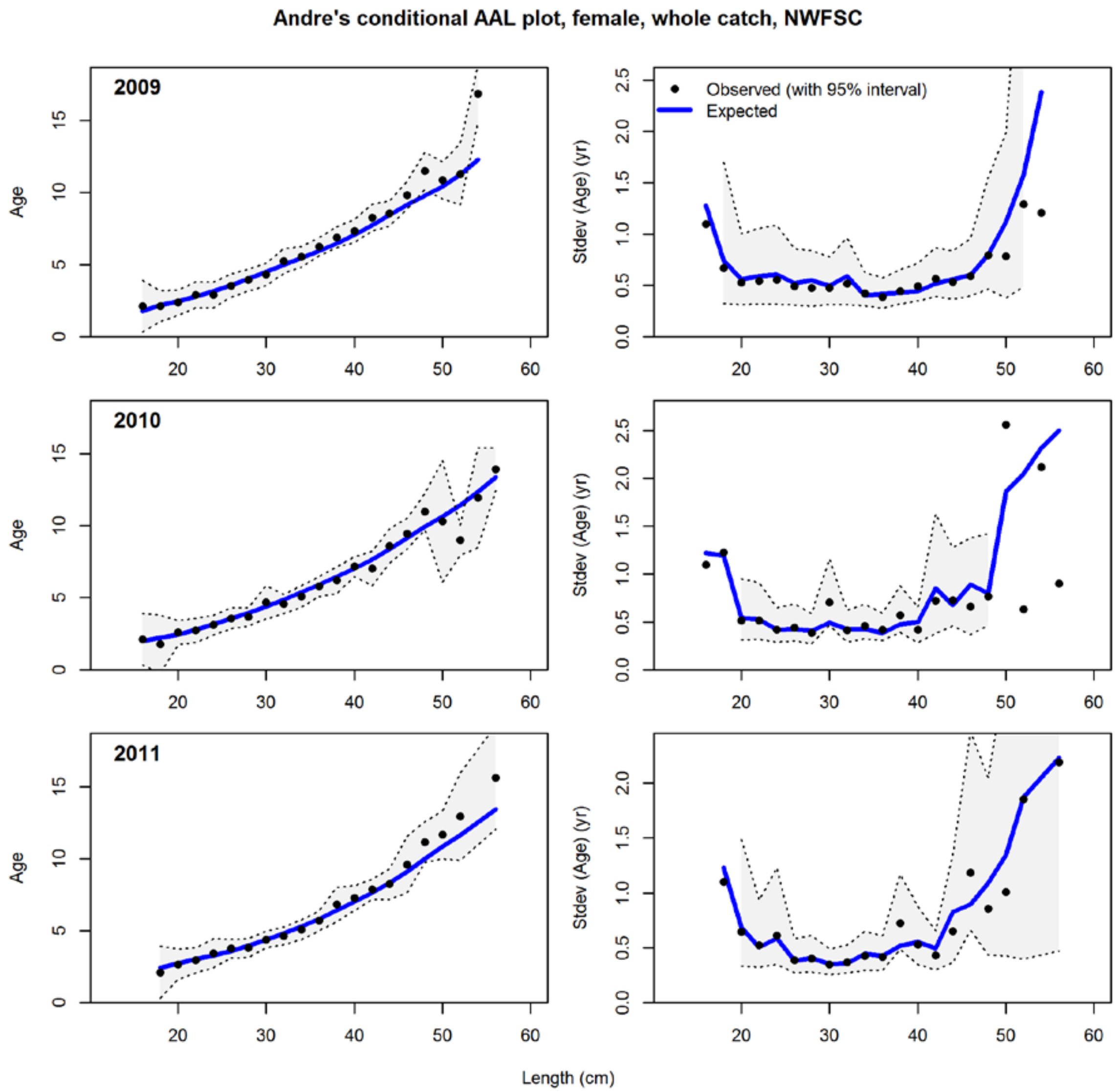


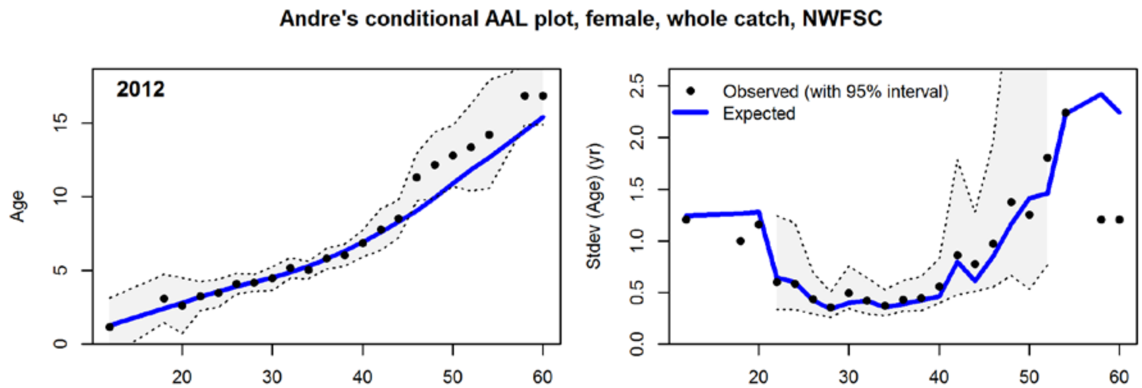
Figure 104. Pearson residuals for the fit to the NWFSC survey conditional age-at-length frequencies.

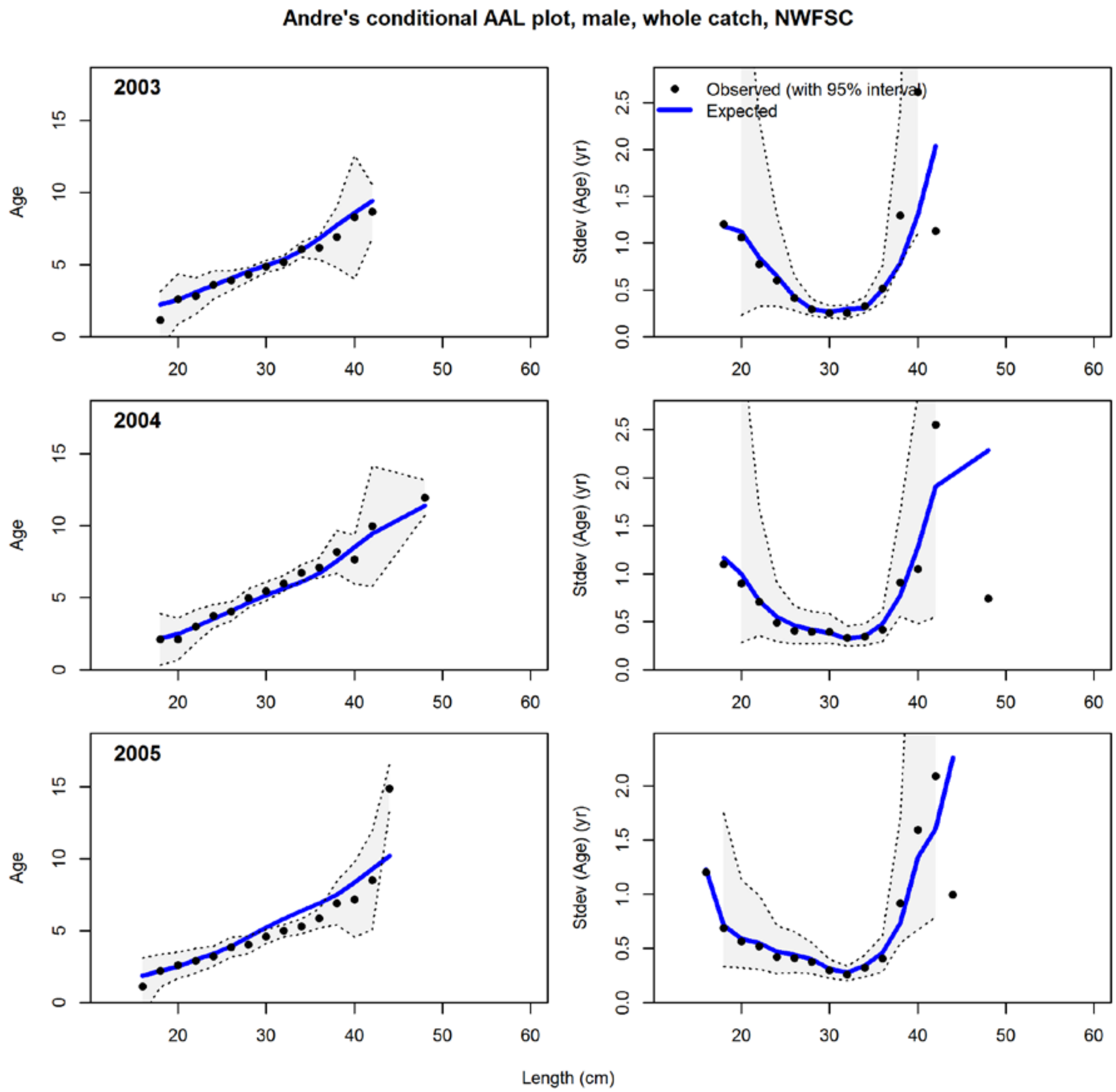

Andre's conditional AAL plot, female, whole catch, NWFSC
2003
2004
2005
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)

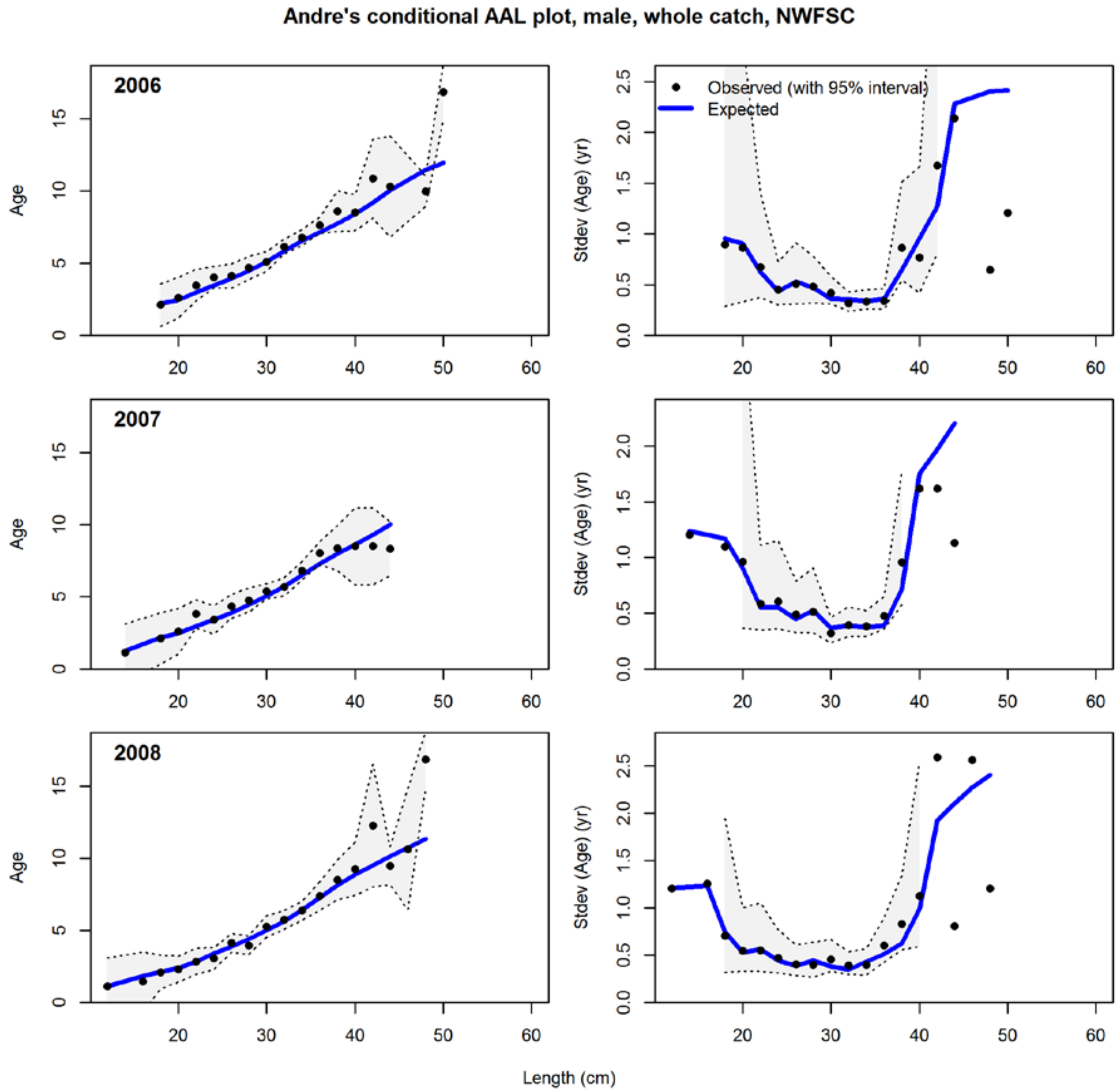

Andre's conditional AAL plot, female, whole catch, NWFSC
2006
2007
2008
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)

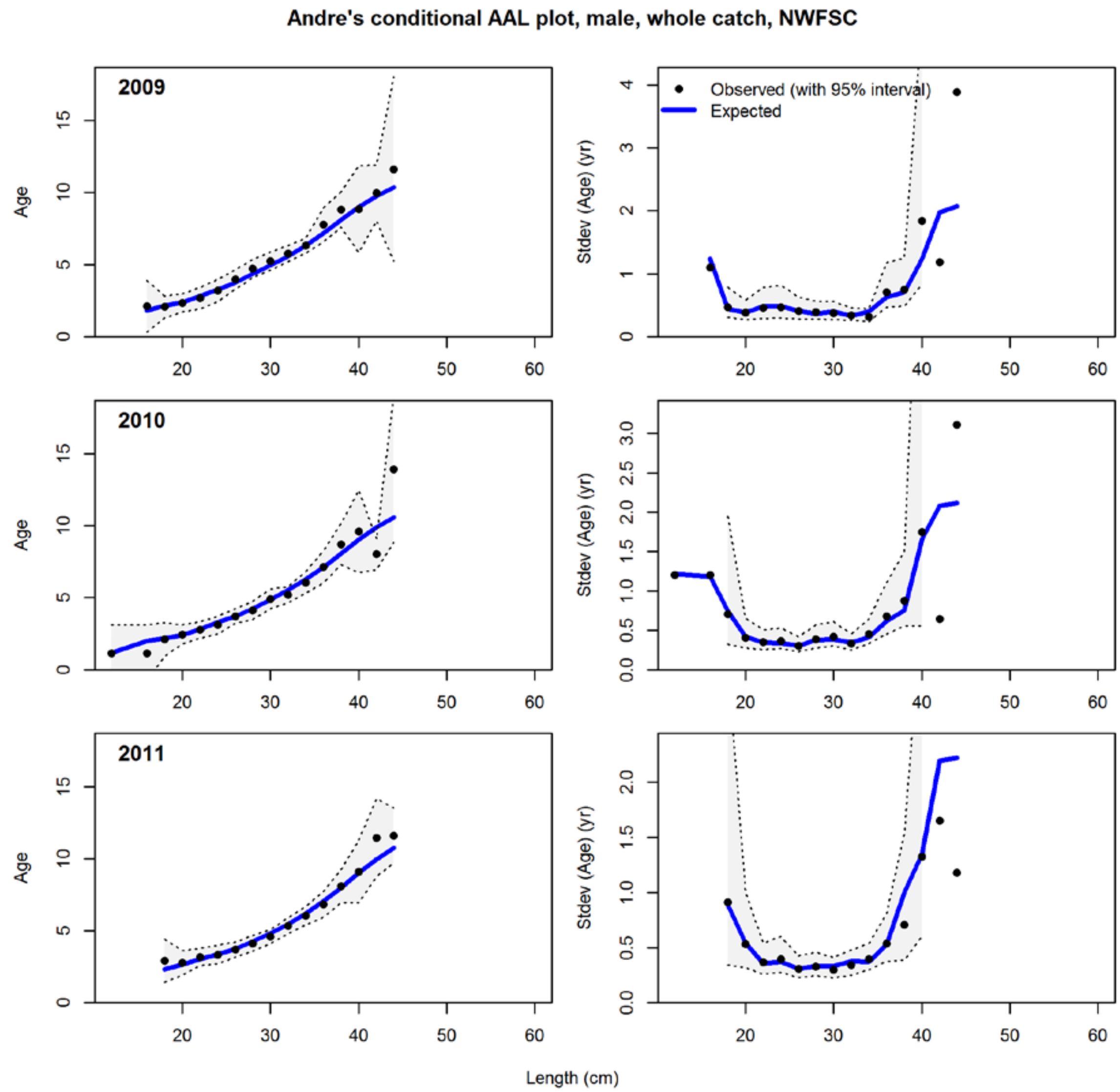


Andre's conditional AAL plot, female, whole catch, NWFSC
2009
2010
2011
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)


Andre's conditional AAL plot, female, whole catch, NWFSC
2012
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)


Andre's conditional AAL plot, male, whole catch, NWFSC
2003
2004
2005
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)


Andre's conditional AAL plot, male, whole catch, NWFSC
2006
2007
2008
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)


Andre's conditional AAL plot, male, whole catch, NWFSC
2009
2010
2011
Age
Stdev (Age) (yr)
Observed (with 95% interval)
Expected
Length (cm)
0
5
10
15
20
30
40
50
60
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1
2
3
4

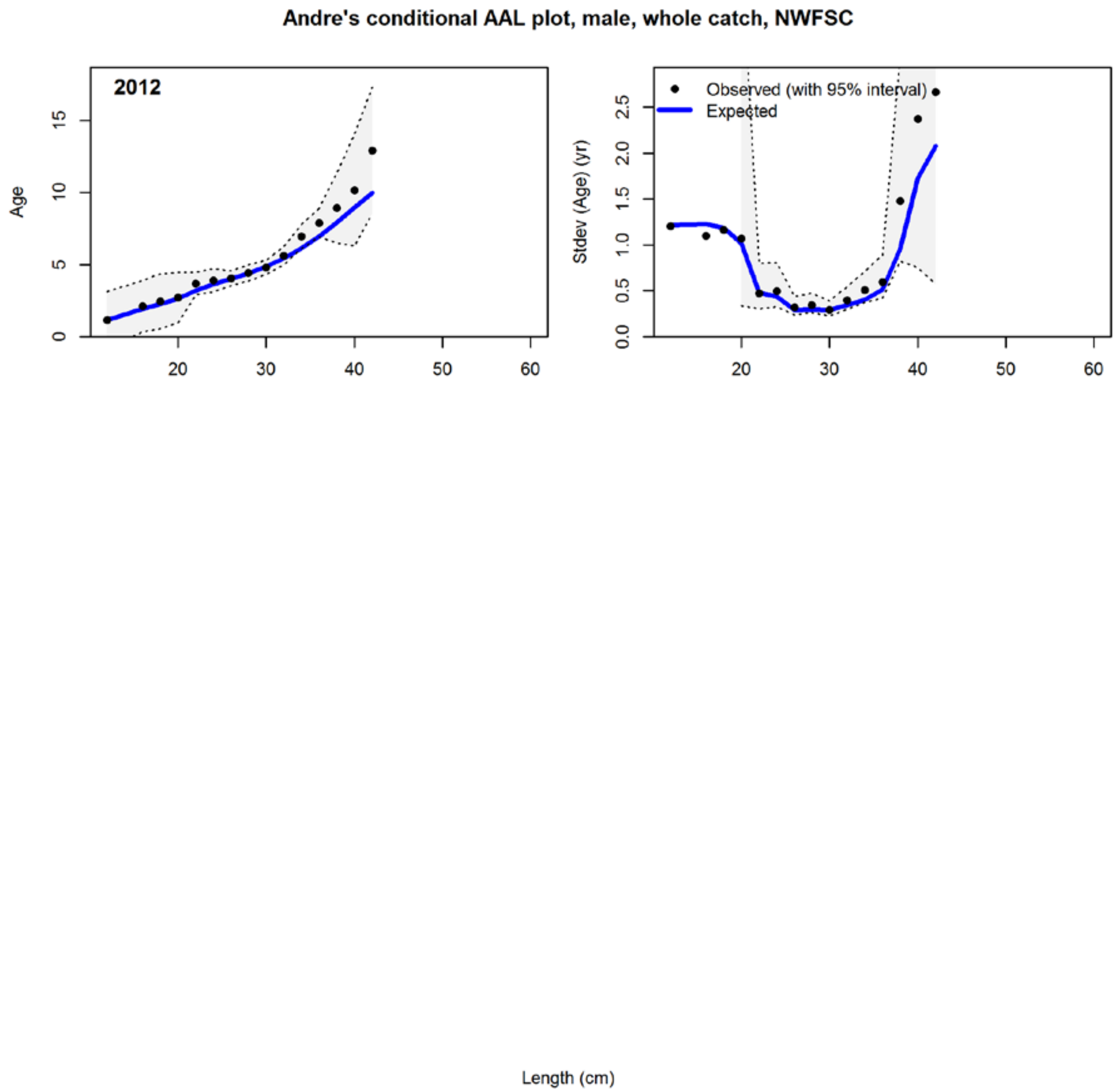


Figure 105. Conditional age-at-length and standard deviations of age-at-length for the NWFSC survey, females and males.

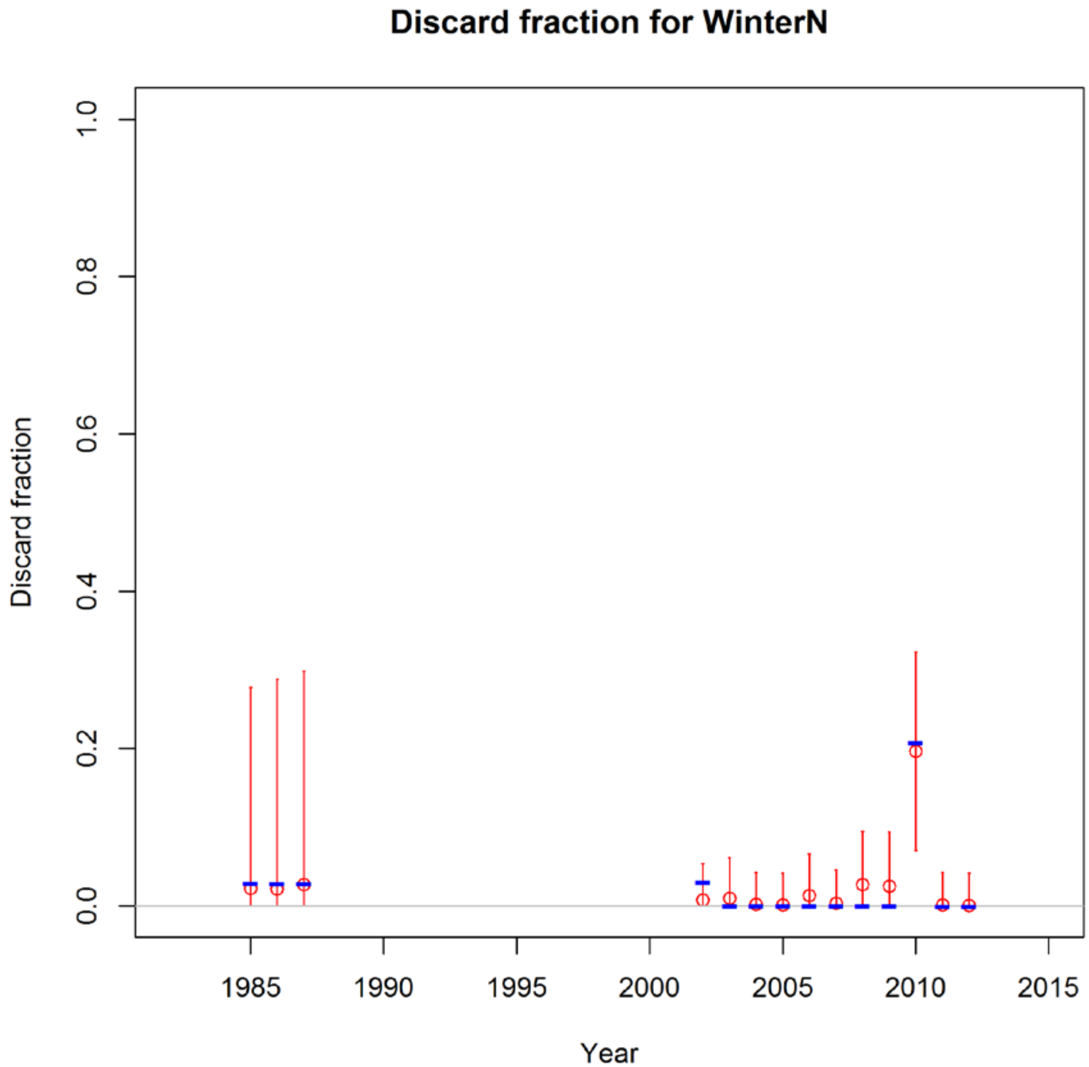


Figure 106. Winter north fits to the discard ratios.

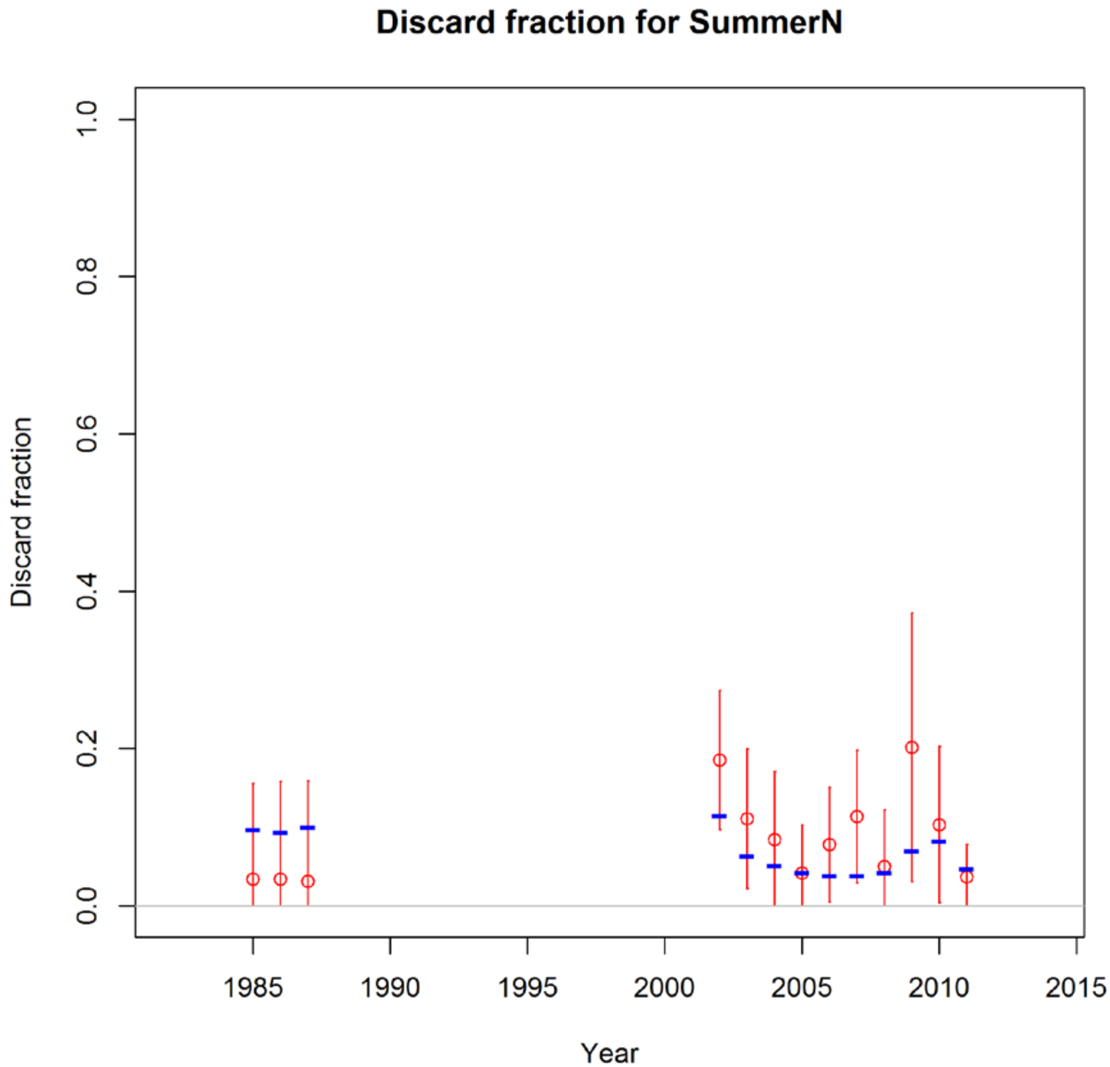


Figure 107. Winter north fits to the discard ratios.

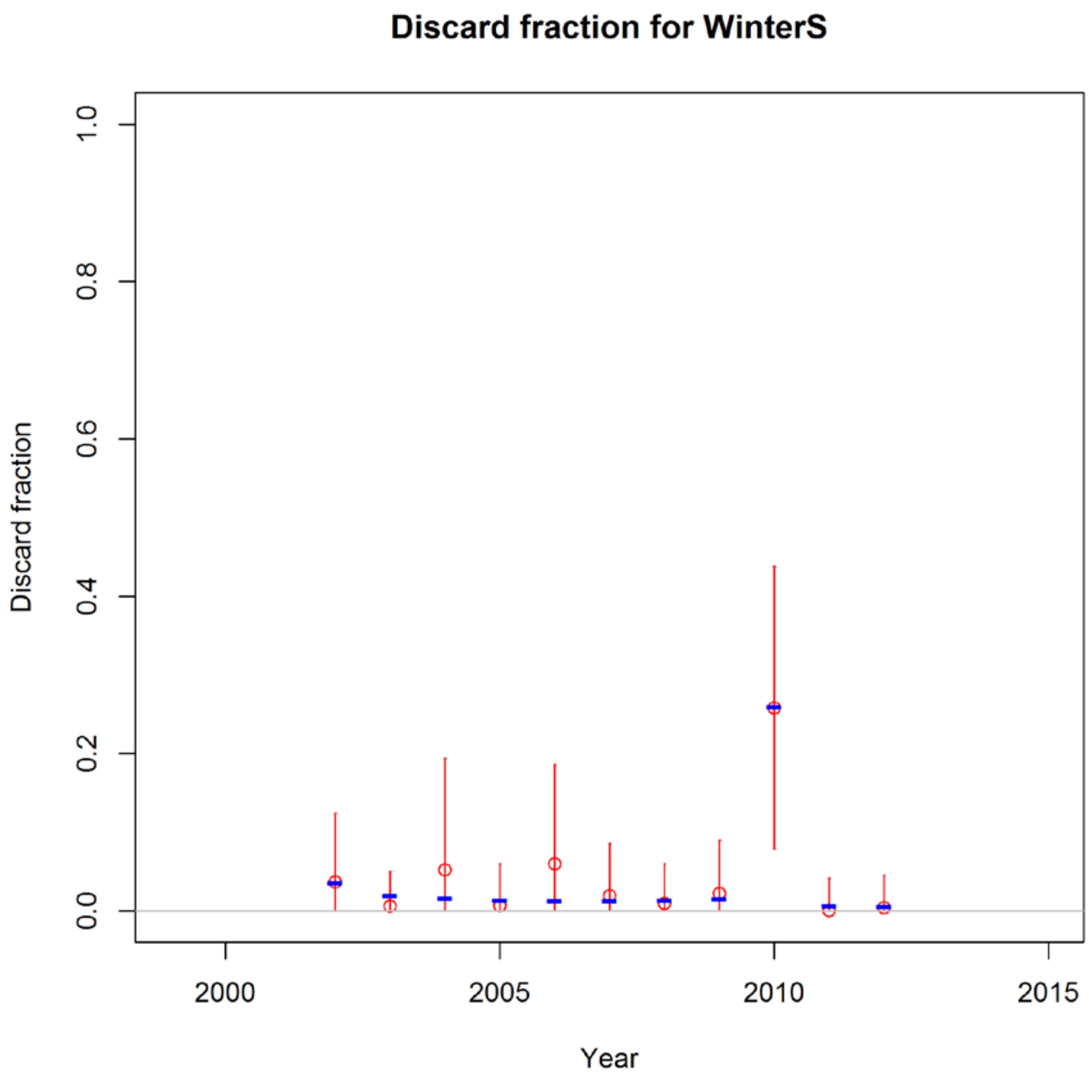


Figure 108. Winter south fits to the discard ratios.

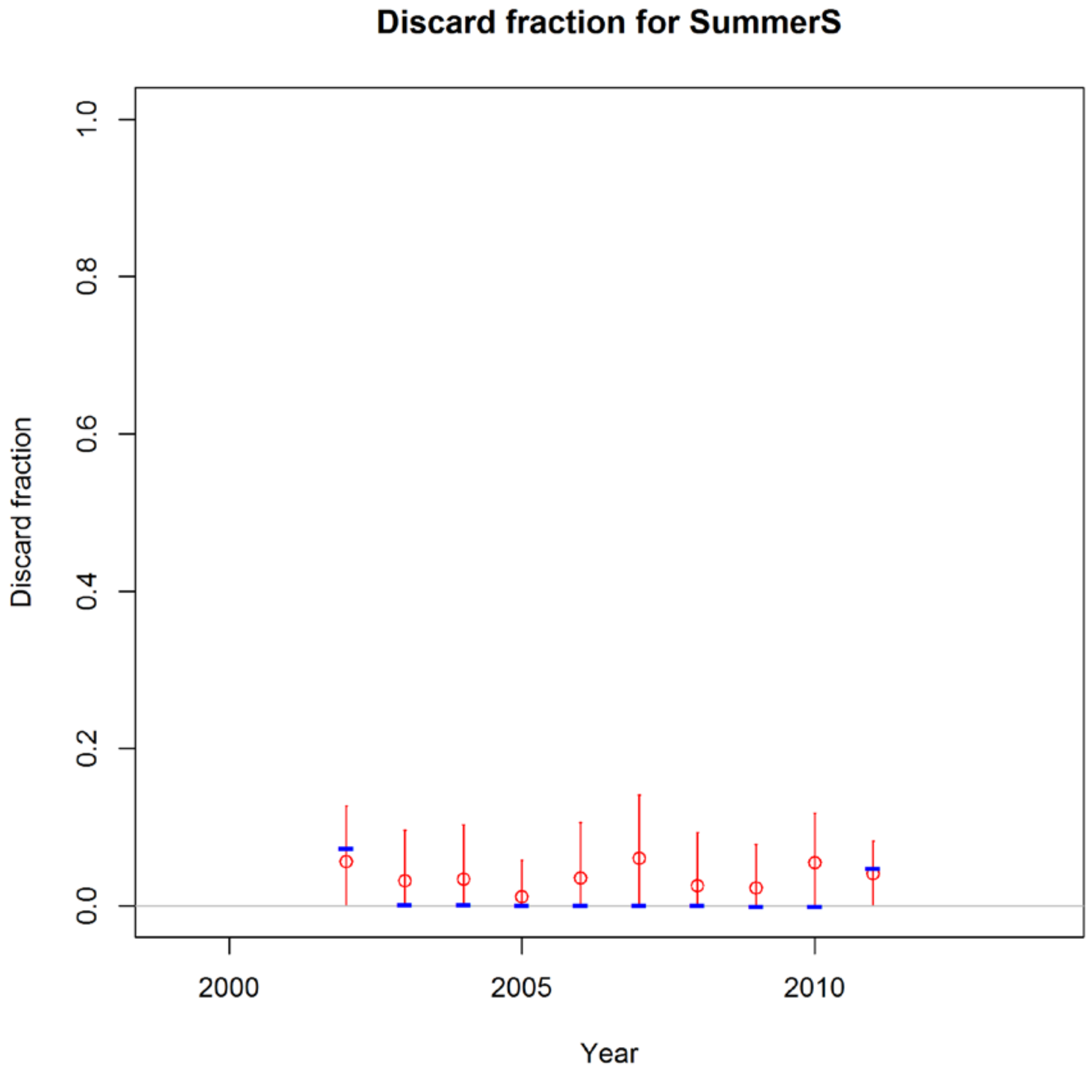


Figure 109. Winter south fits to the discard ratios.

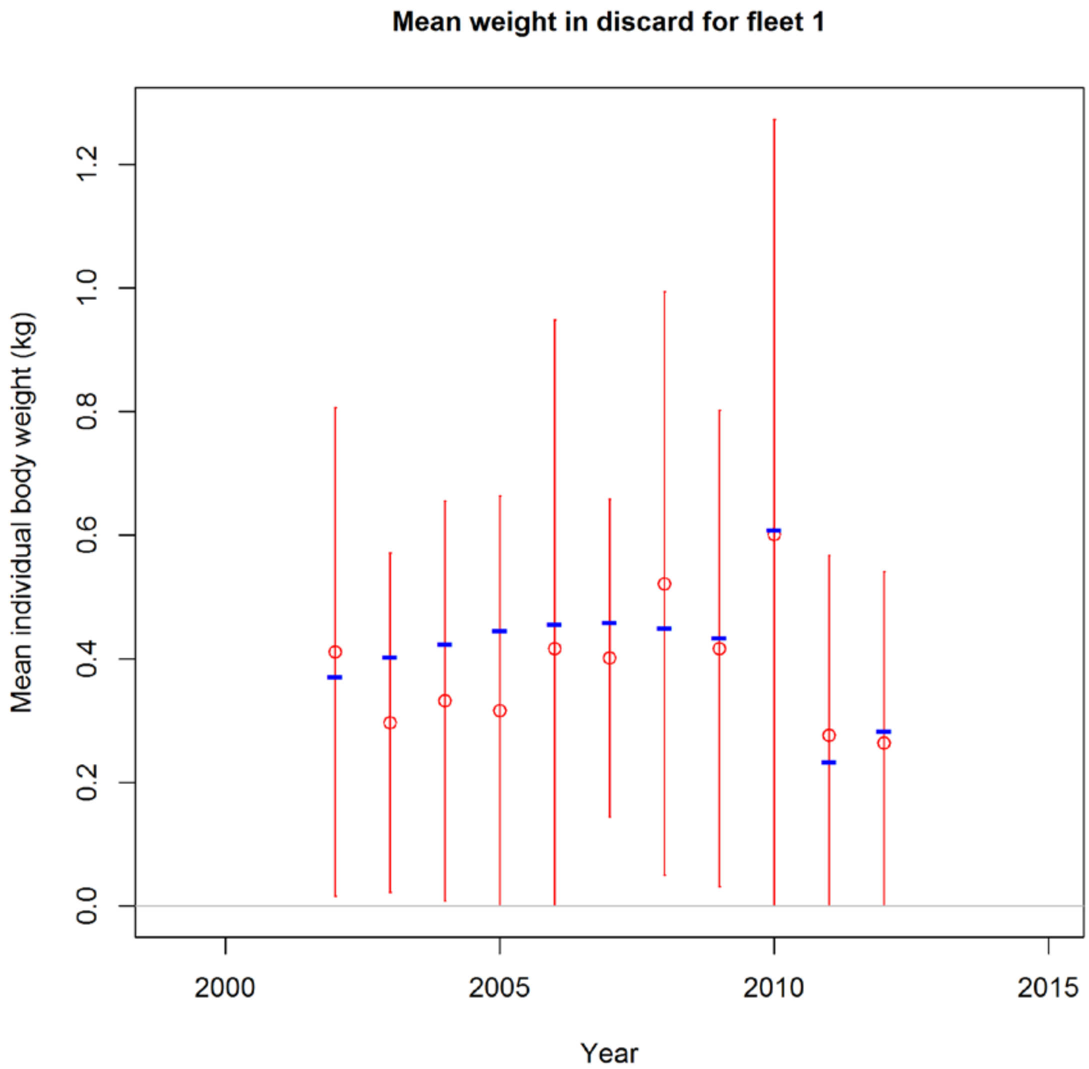


Figure 110. Winter north fit to the mean weight of the discards.

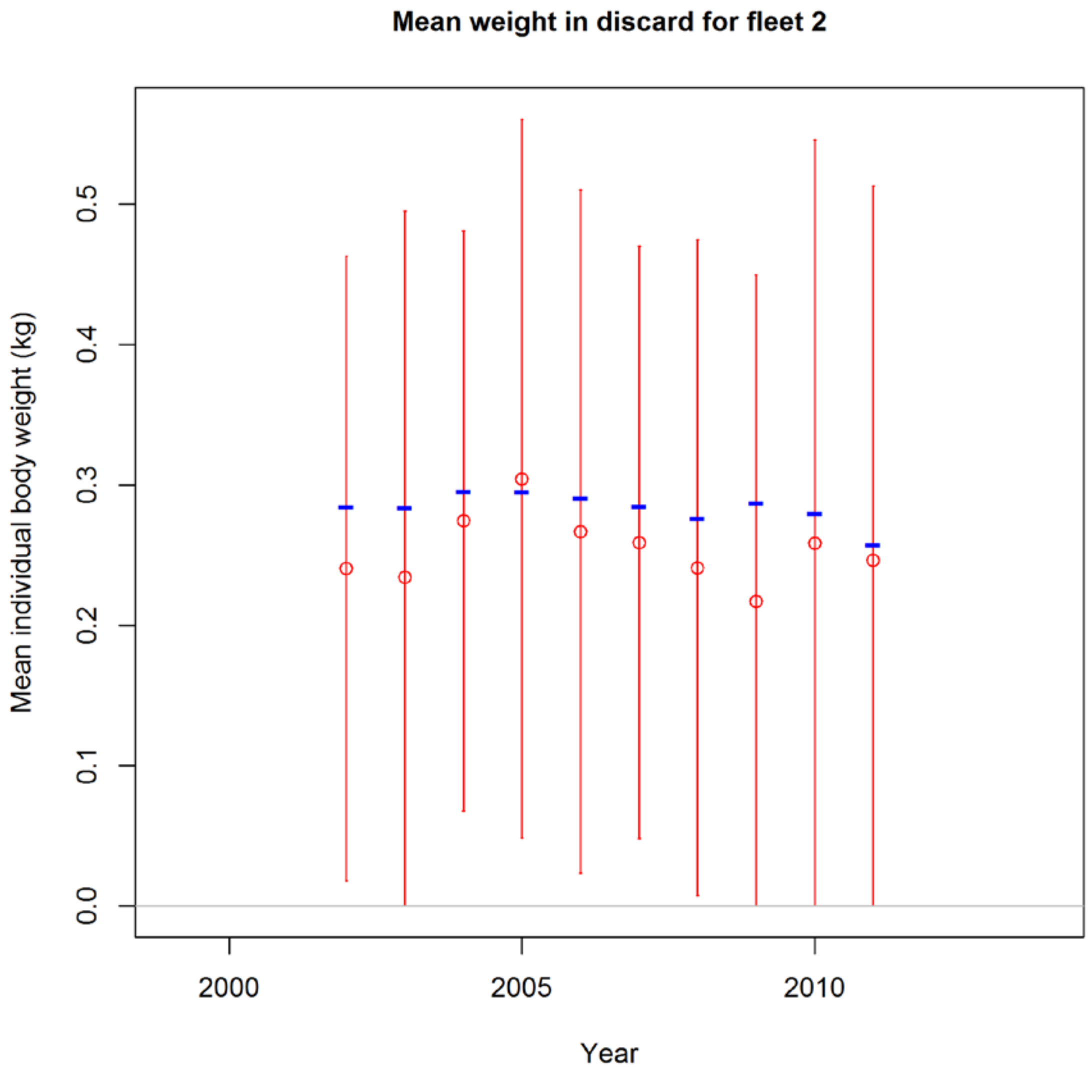


Figure 111. Summer north fit to the mean weight of the discards.

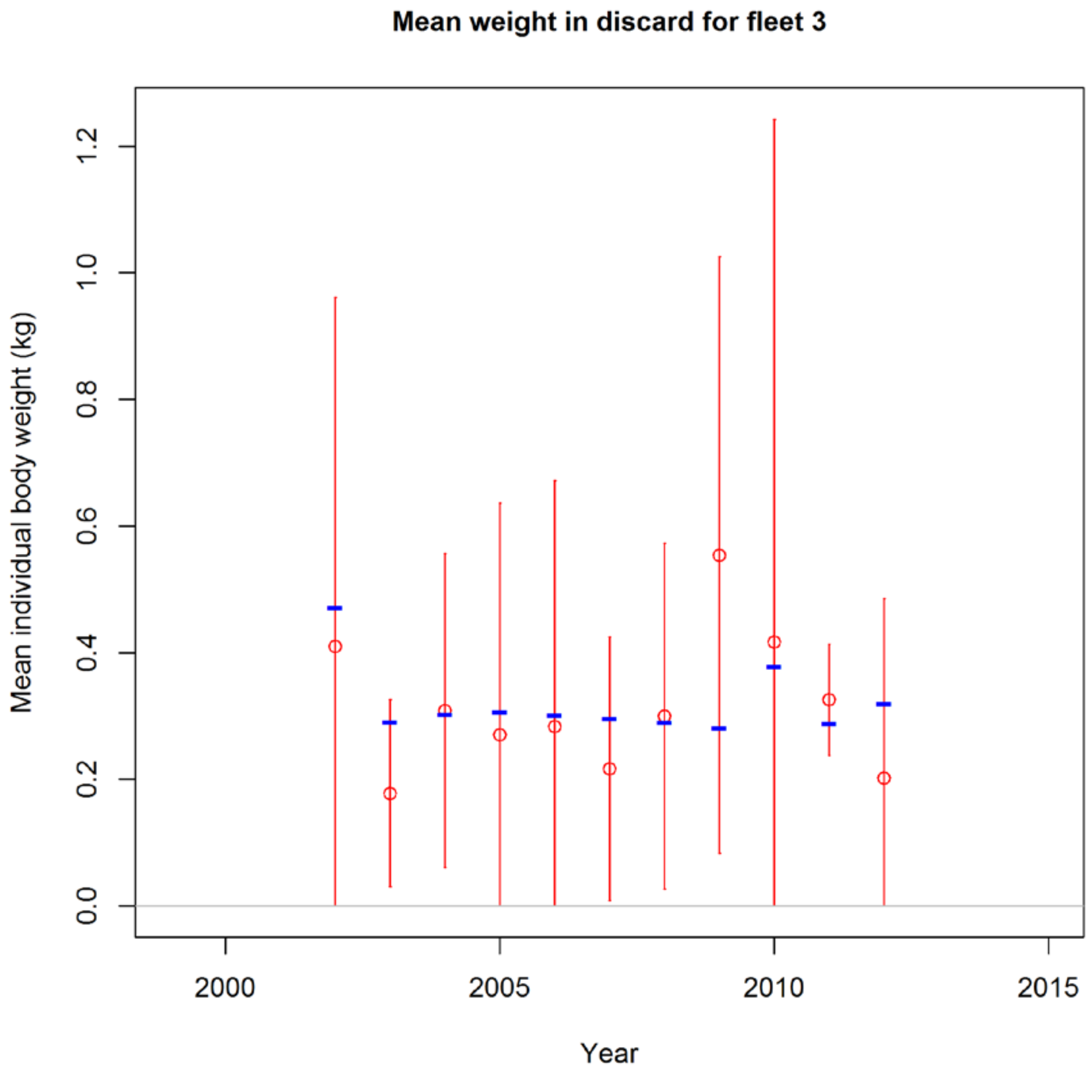


Figure 112. Winter south fit to the mean weight of the discards.

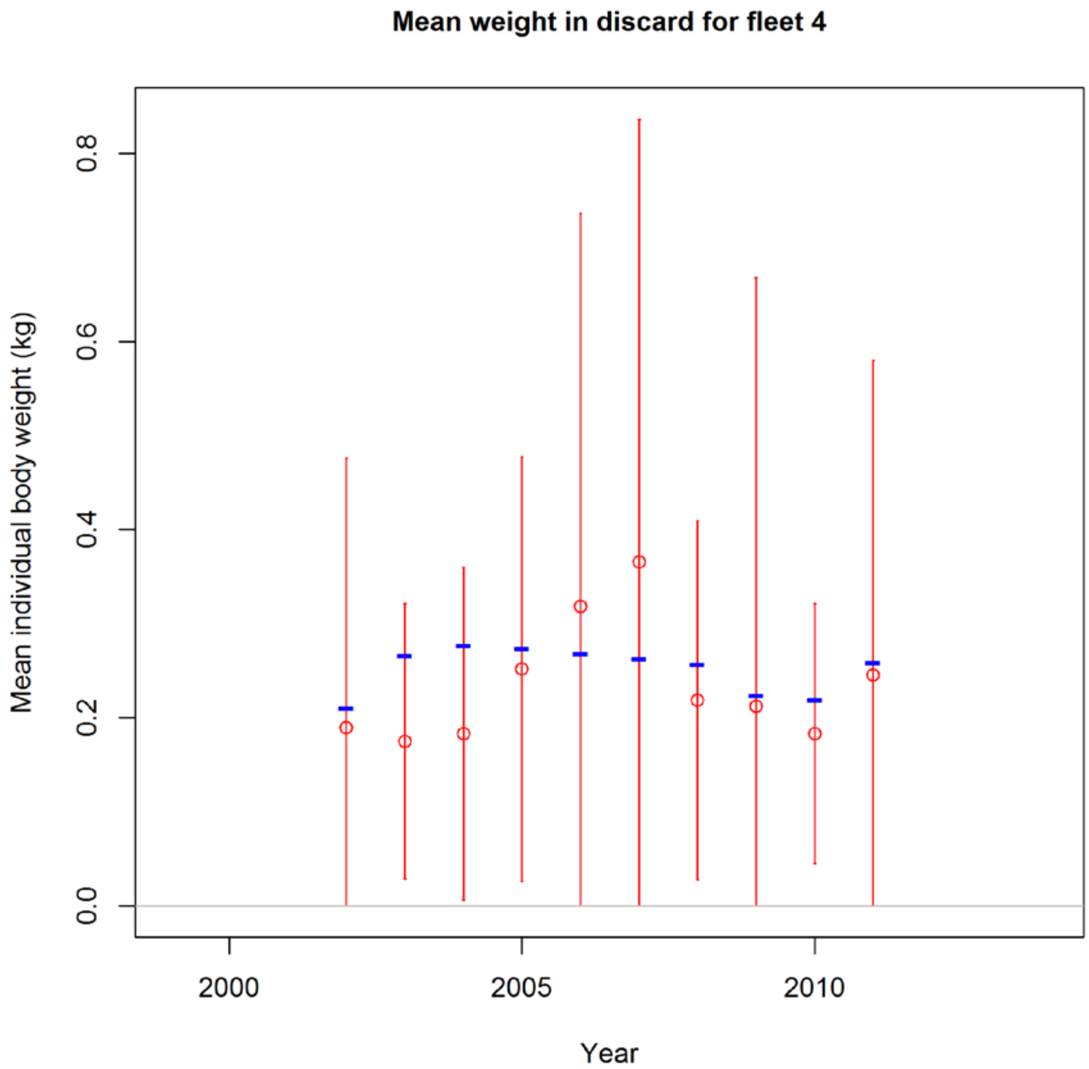


Figure 113. Summer south fit to the mean weight of the discards.

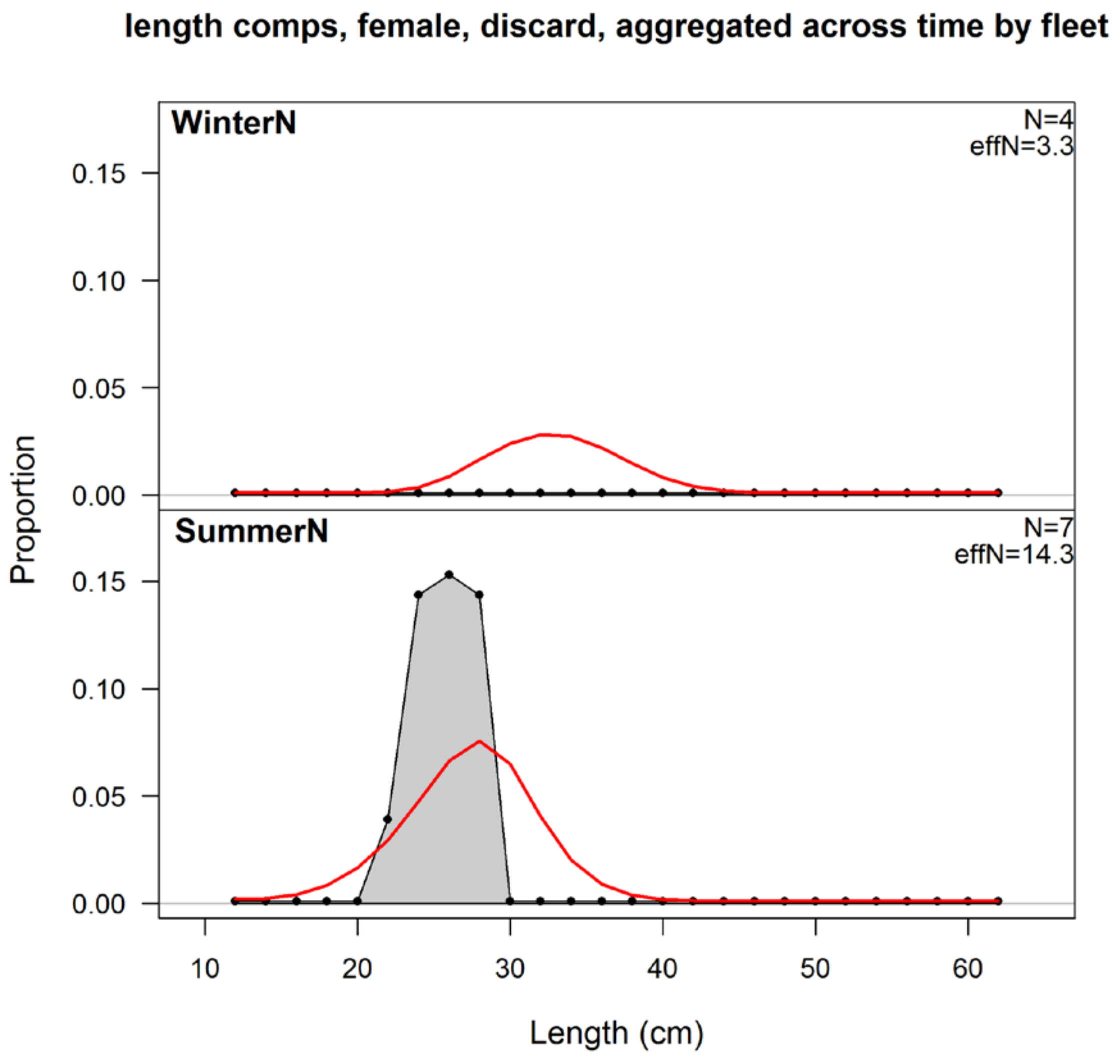


Figure 114. Winter north Pikitch discard length compositions fits, female.

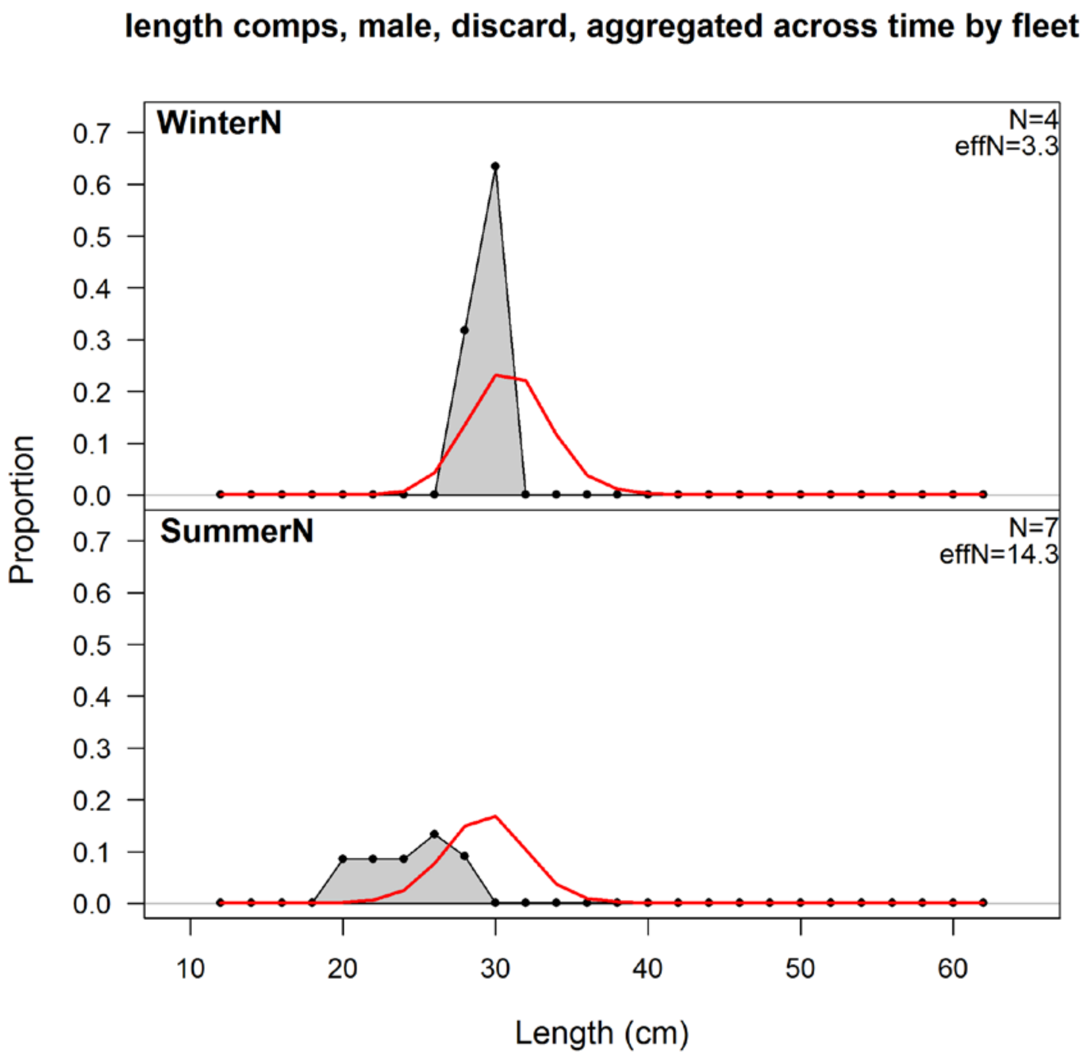


Figure 115. Summer north Pikitch discard length compositions fits, male.

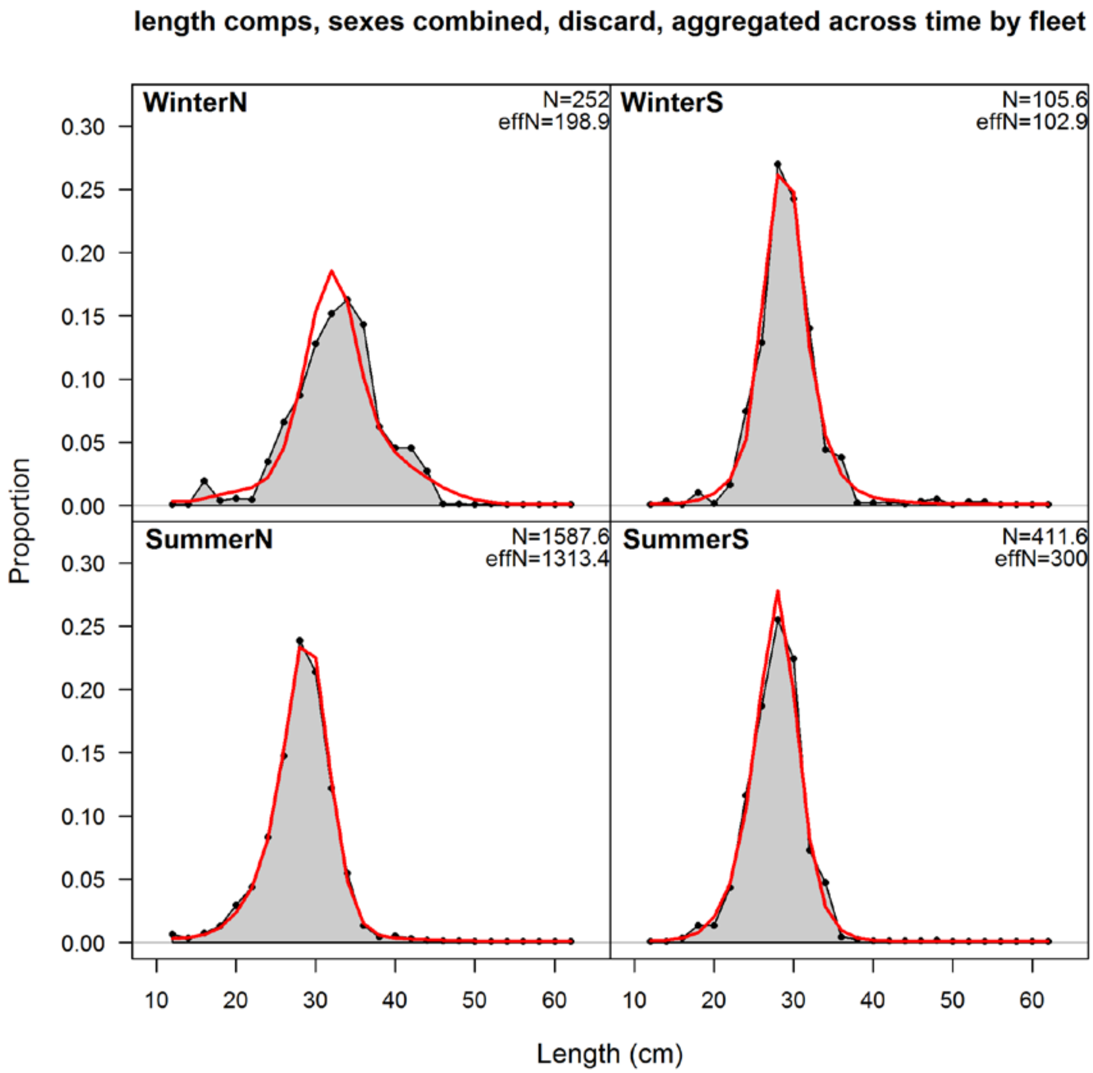


Figure 116. Composite WCGOP discard length compositions fits.

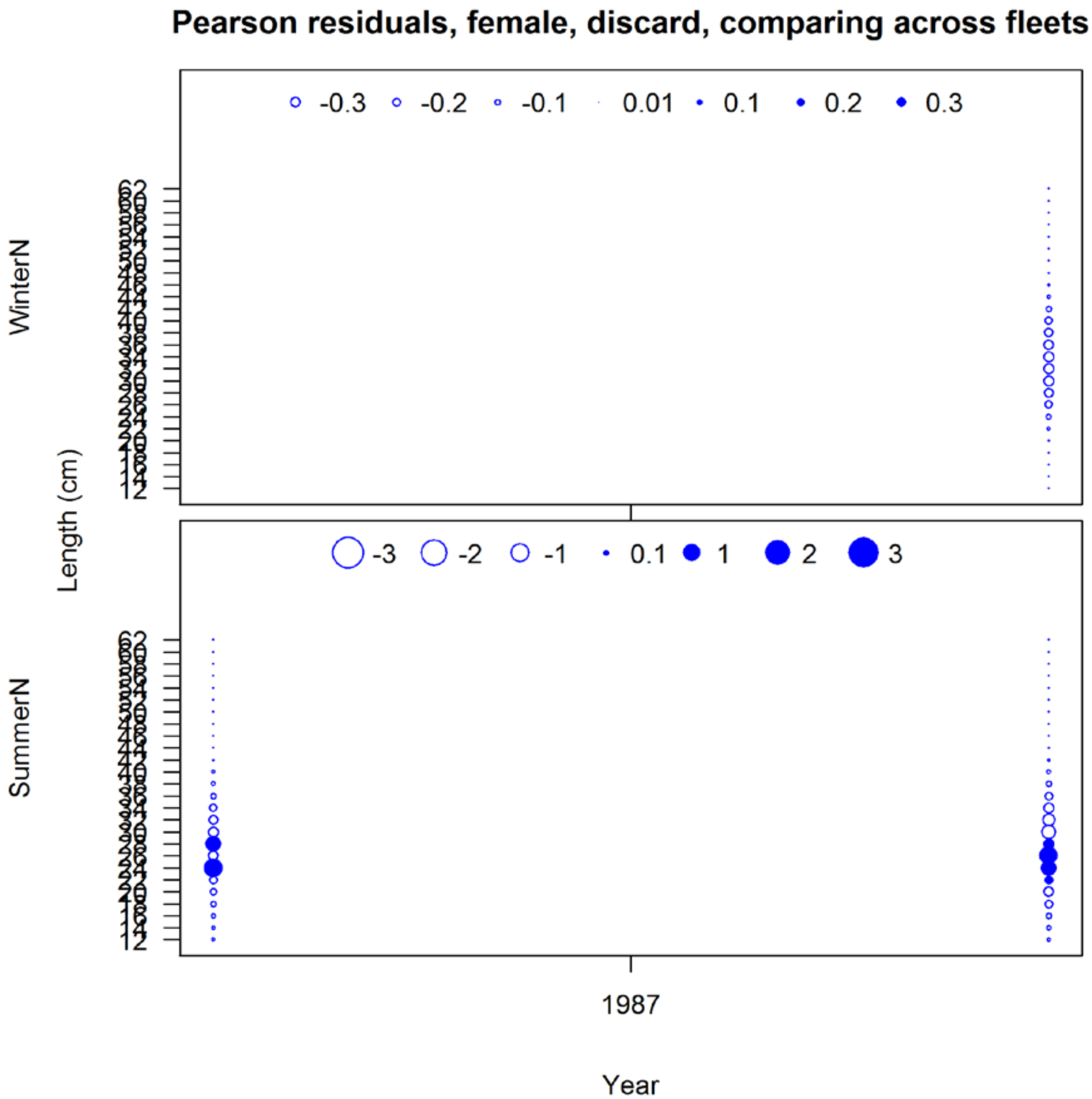


Figure 117. Pearson residuals Pikitch length compositions, females.

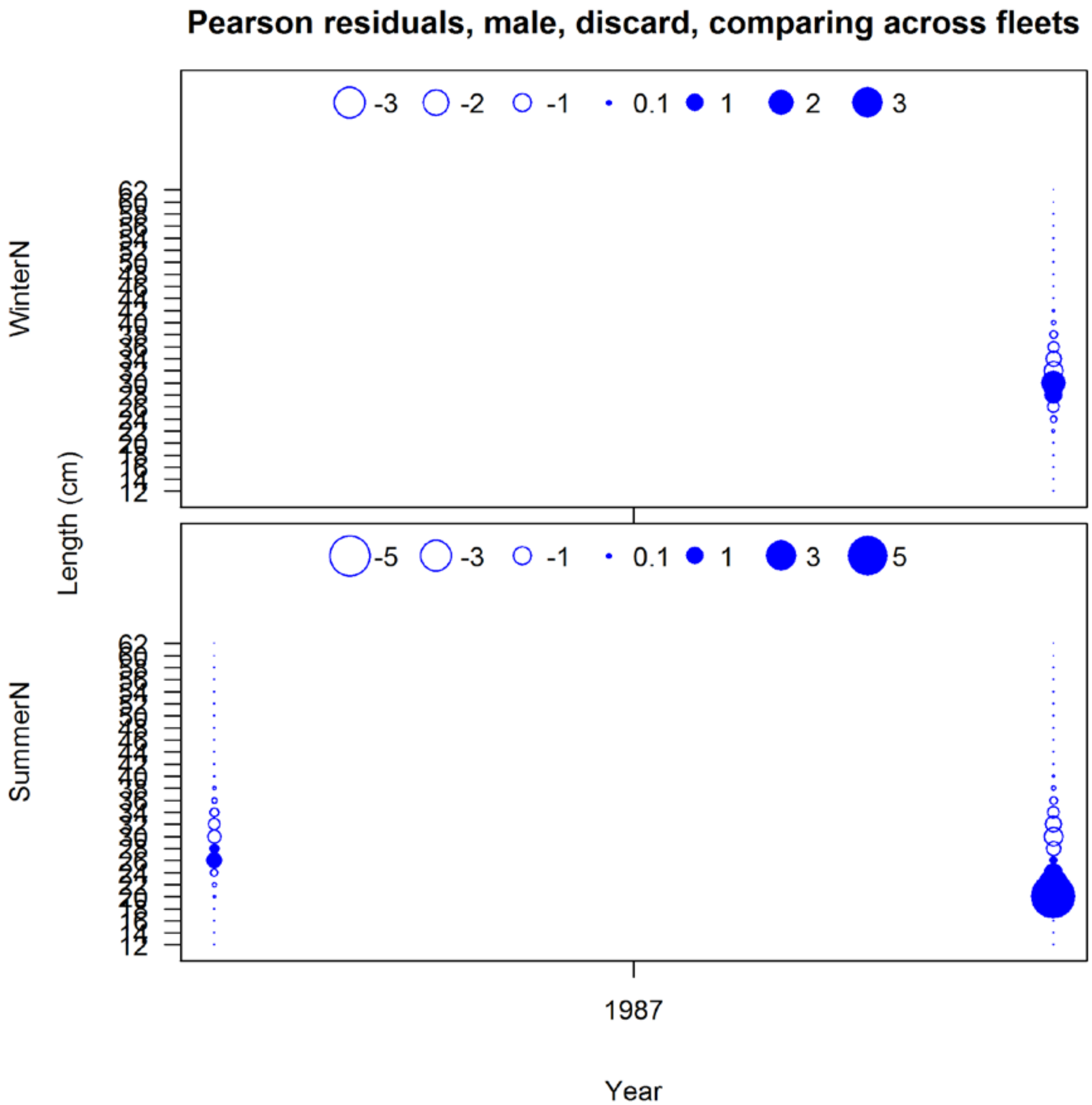


Figure 118. Pearson residuals Pikitch length compositions, males.

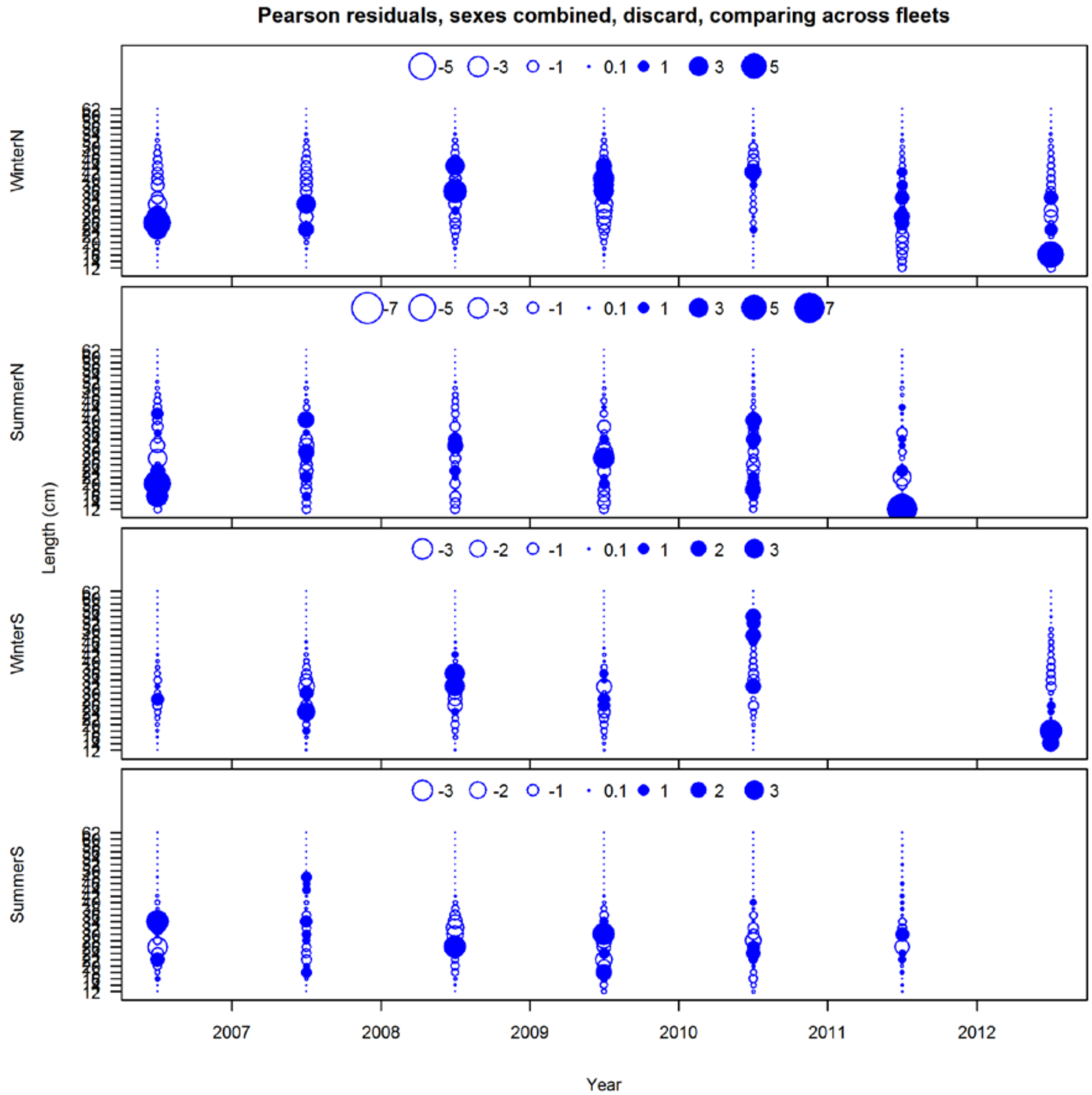


Figure 119. Pearson residuals WCGOP length compositions, all fishing fleets.

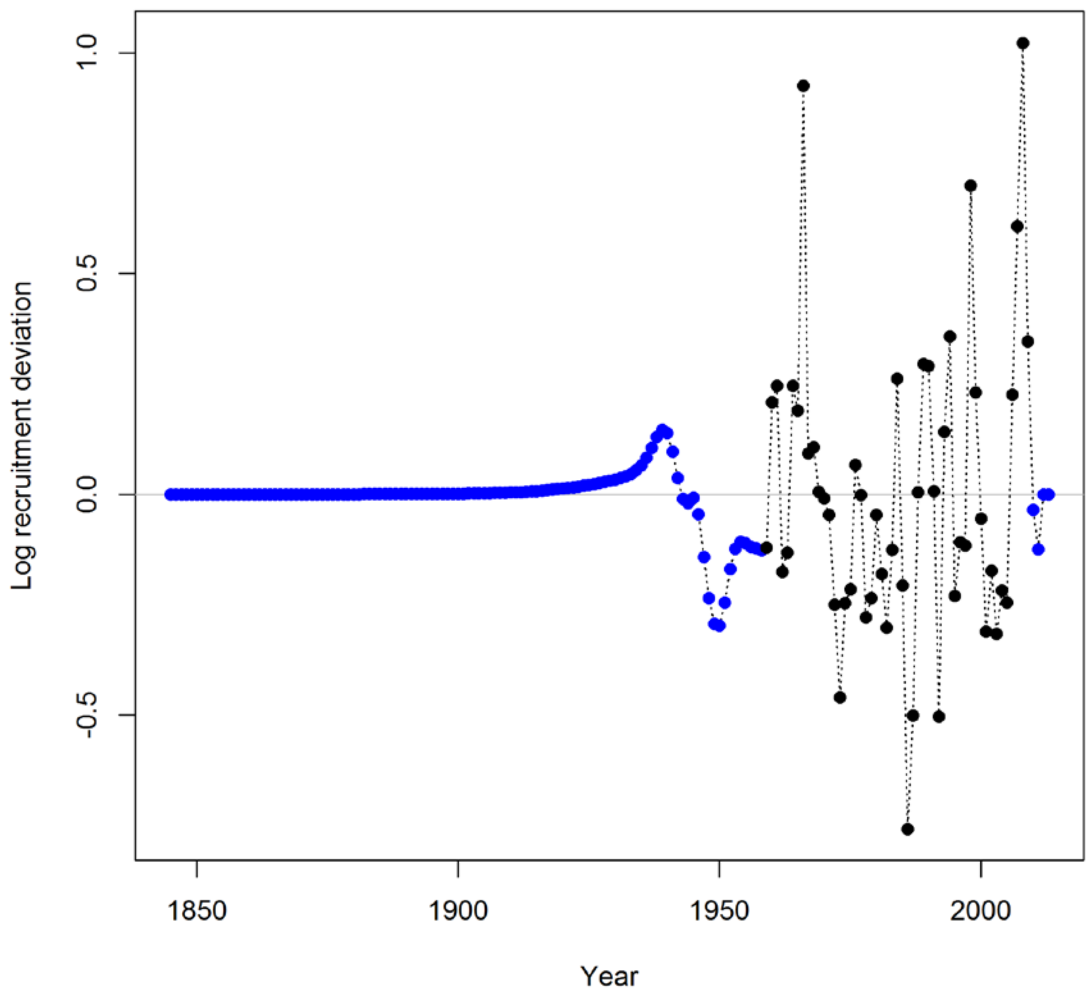


Figure 120 . Log recruitment deviations from the base case model run.

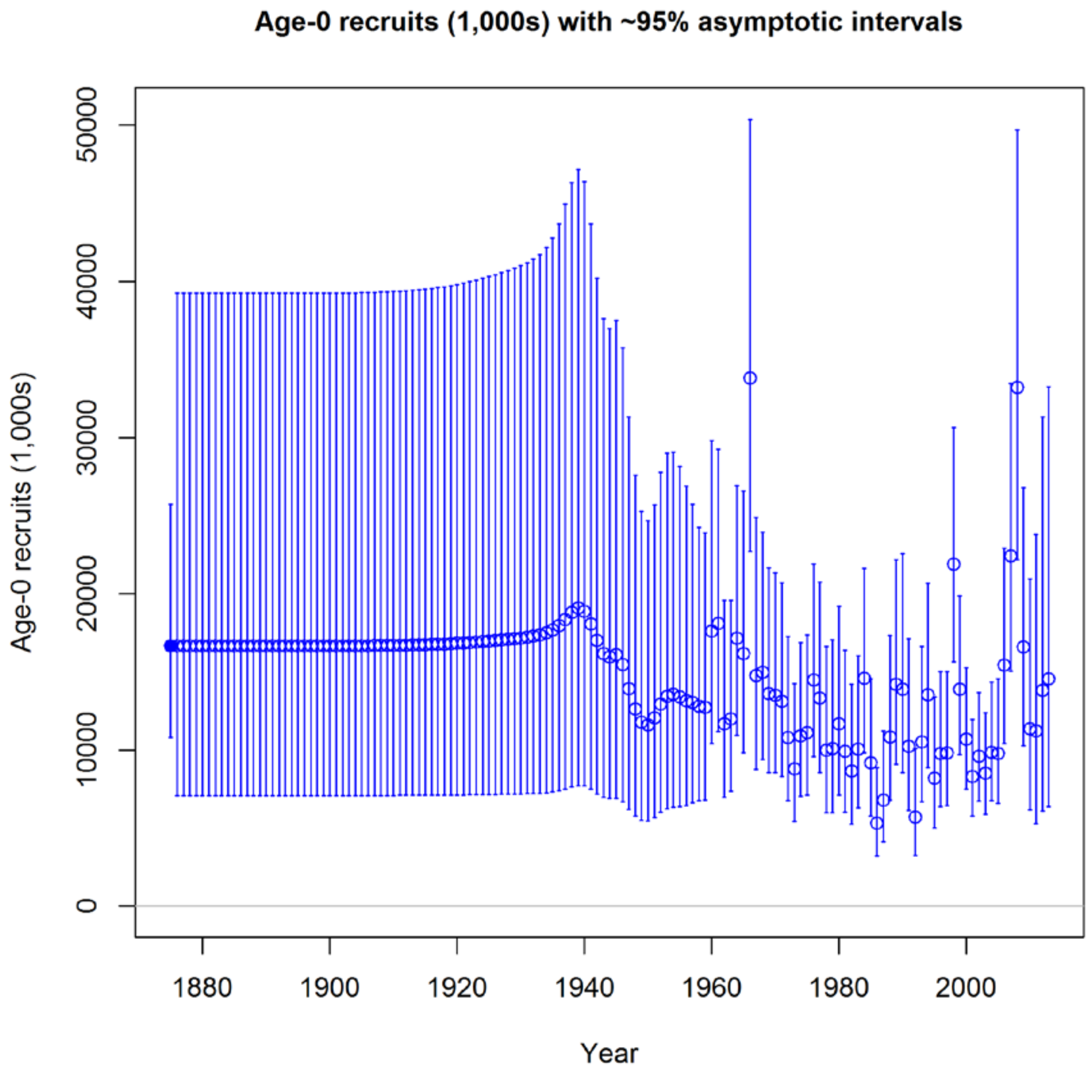


Figure 121. Time series of estimated petrale sole recruitments for the base case model (round points) with approximate asymptotic 95% confidence interval (horizontal lines).

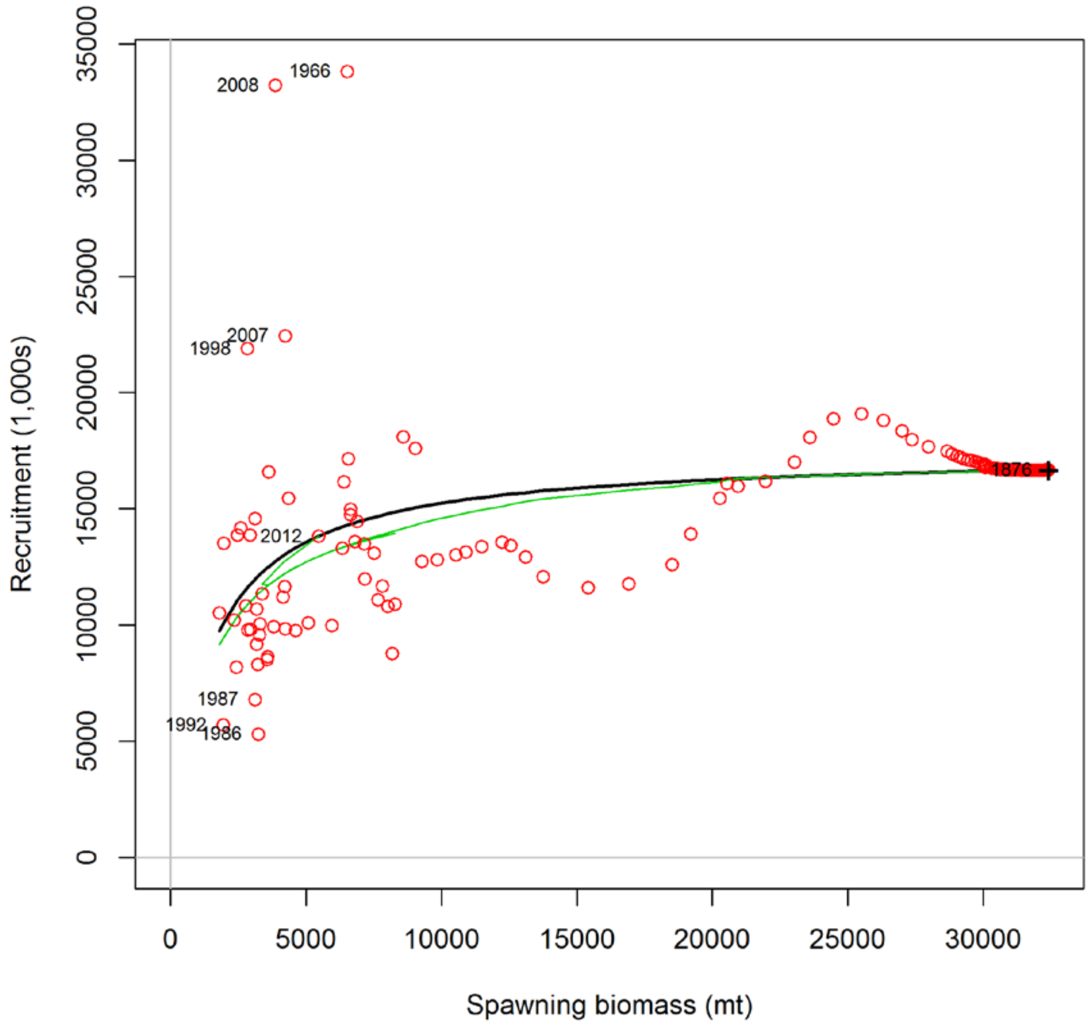


Figure 122. Stock-recruit function with predicted recruitments (points) and bias-corrected expectation (light line).

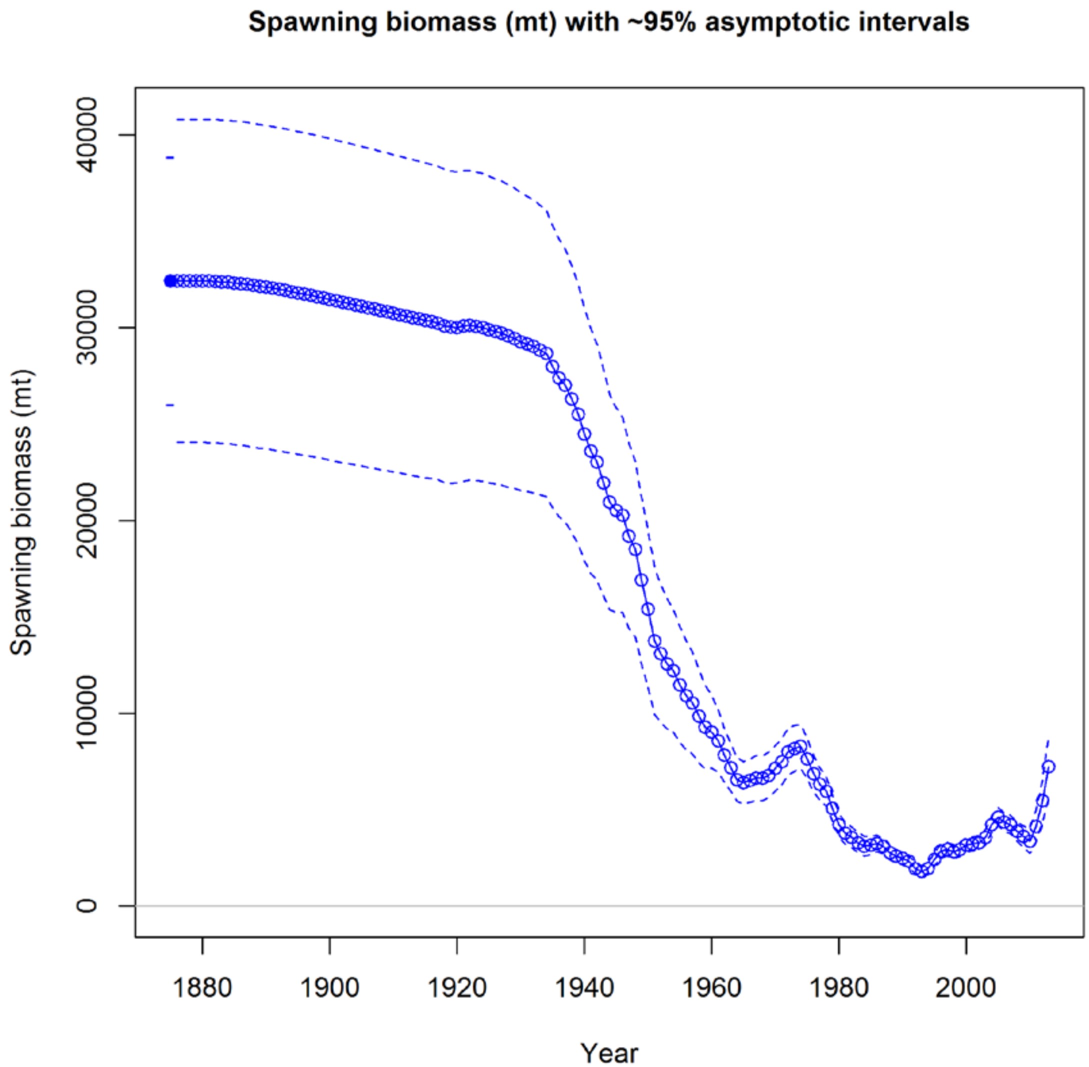


Figure 123. Estimated spawning biomass time-series for the base case model (solid line) with approximate asymptotic 95% confidence interval (dashed lines).

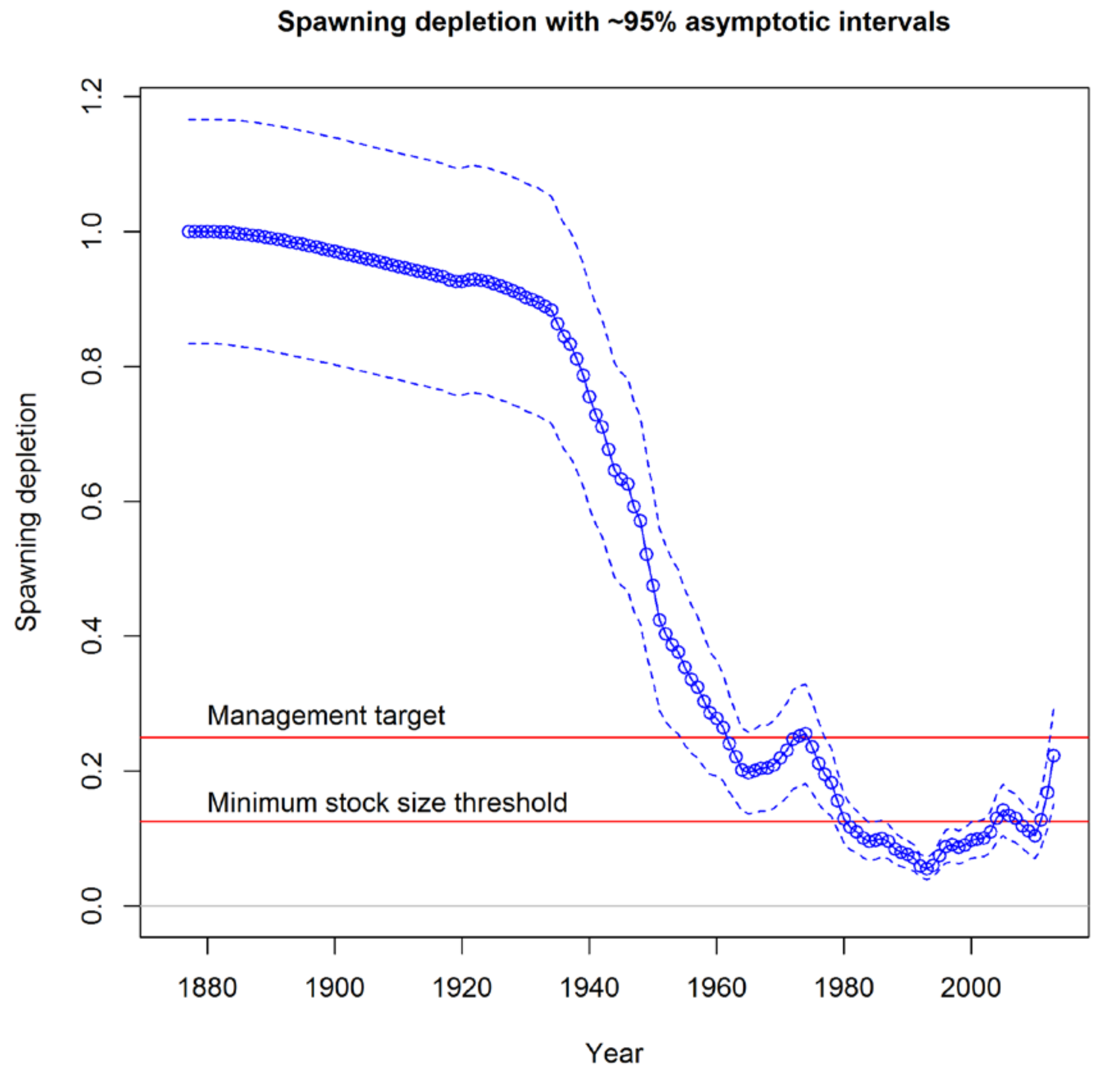


Figure 124. Time series of depletion level as estimated in the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines).

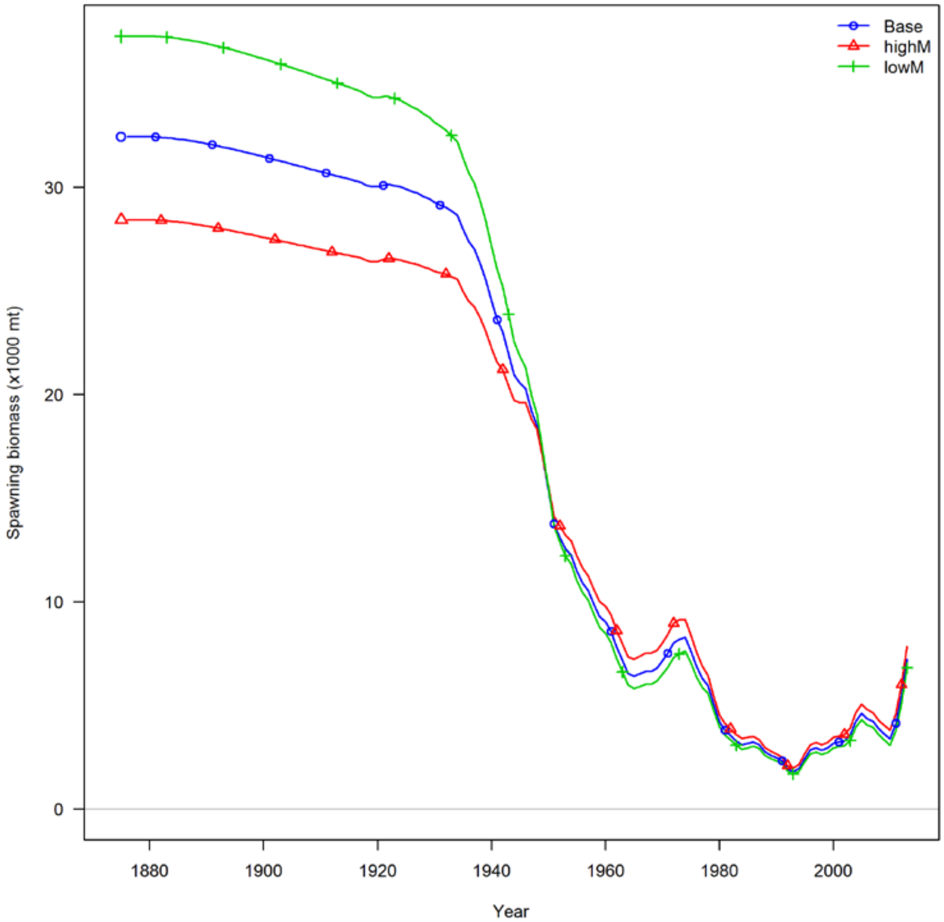


Figure 125. Spawning biomass for sensitivity to model structure for the base model (blue), model with high female M (red), and low female M.

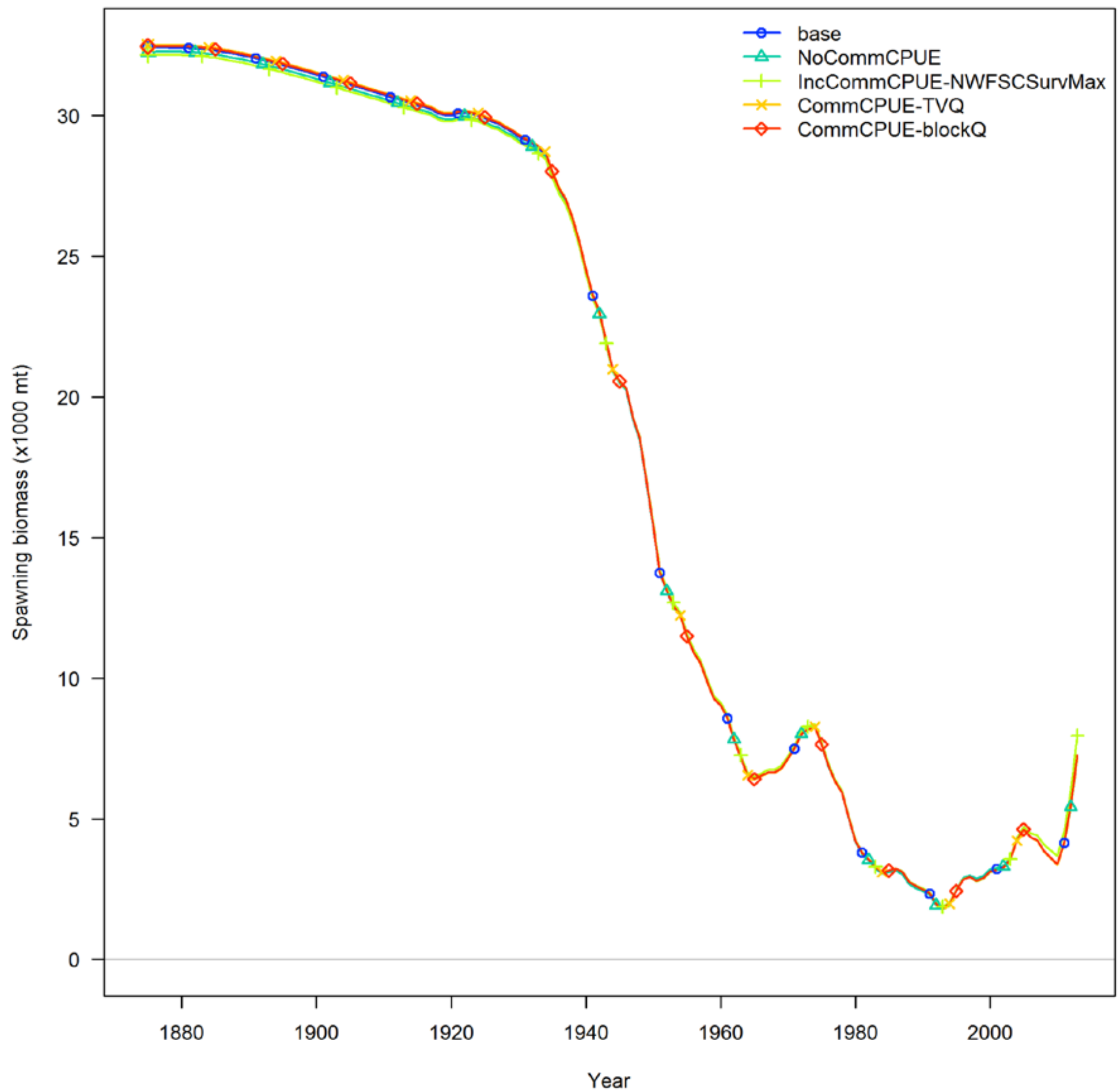


Figure 126. Spawning biomass for sensitivity to the treatment of the winter commercial CPUE for the base model (blue), the model removing the winter commercial CPUE (green), the model increasing the standard deviations from the bootstrap by adding the maximum value estimated for the NWFSC survey (light green), the model allowing for time varying q between 2006-2009 (ornange), and the model allowing for a time block in *q* between 2003 and 2004.

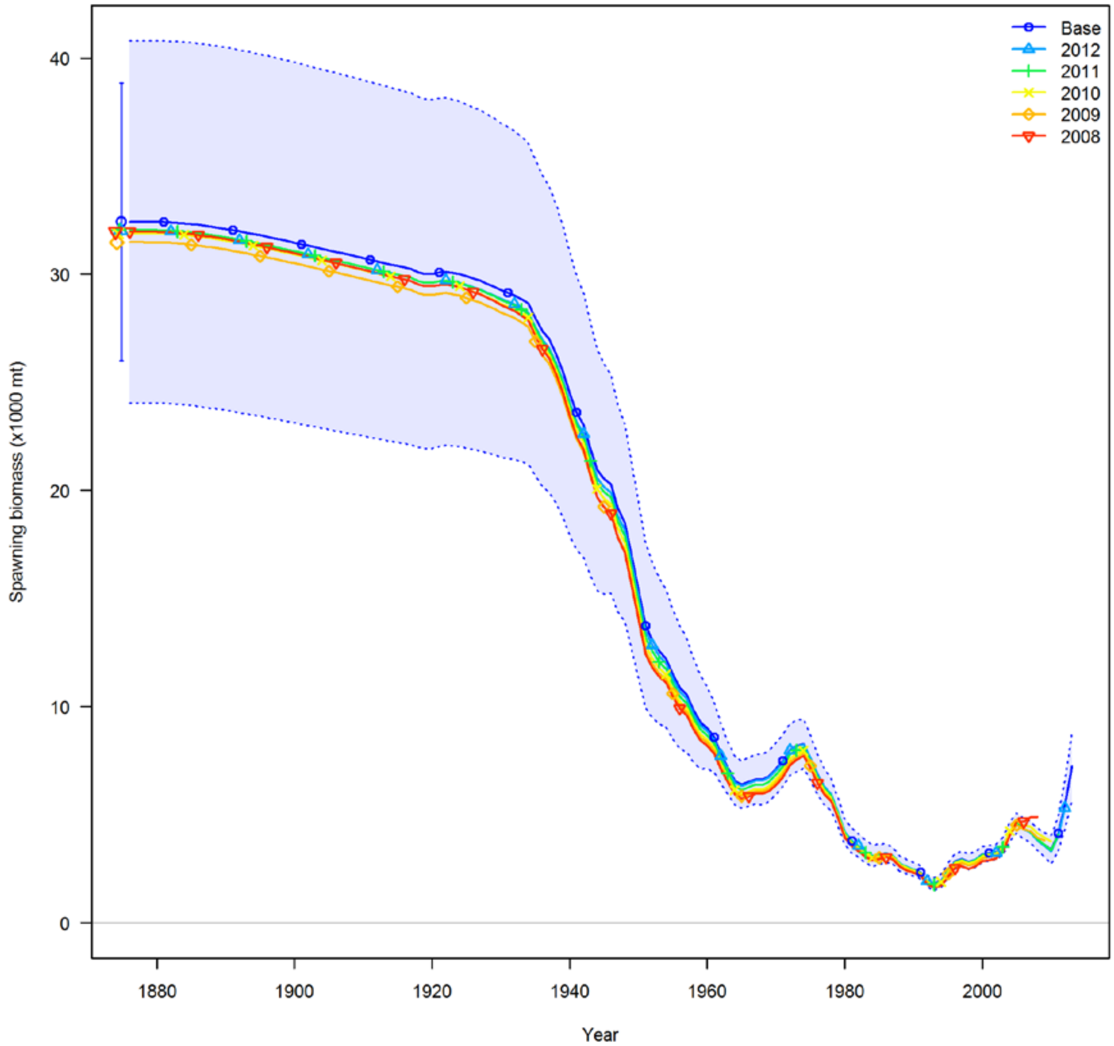


Figure 127. Retrospective analysis results for spawning biomass. Each year of retrospective is performed as if the assessment were conducted in that year (i.e., retrospective in 2012 includes data through 2011).

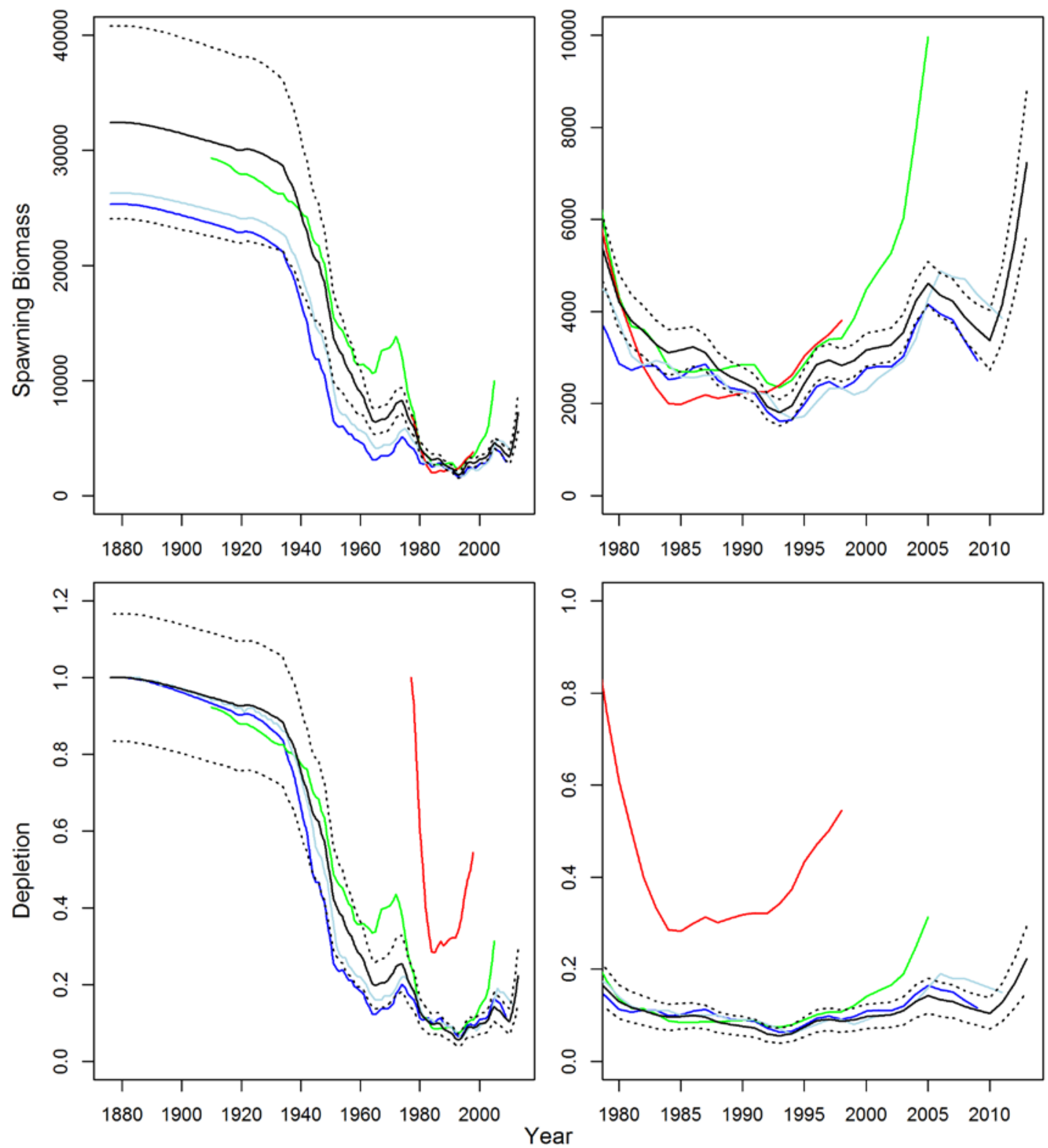


Figure 128. Comparisons of the model estimated spawning biomass and stock depletion for the 1999 (red), 2005 (green), 2009 (blue), 2011 (light blue), and 2013 (black) assessment models. The ~95% confidence intervals from the 2013 model are shown as broken lines.

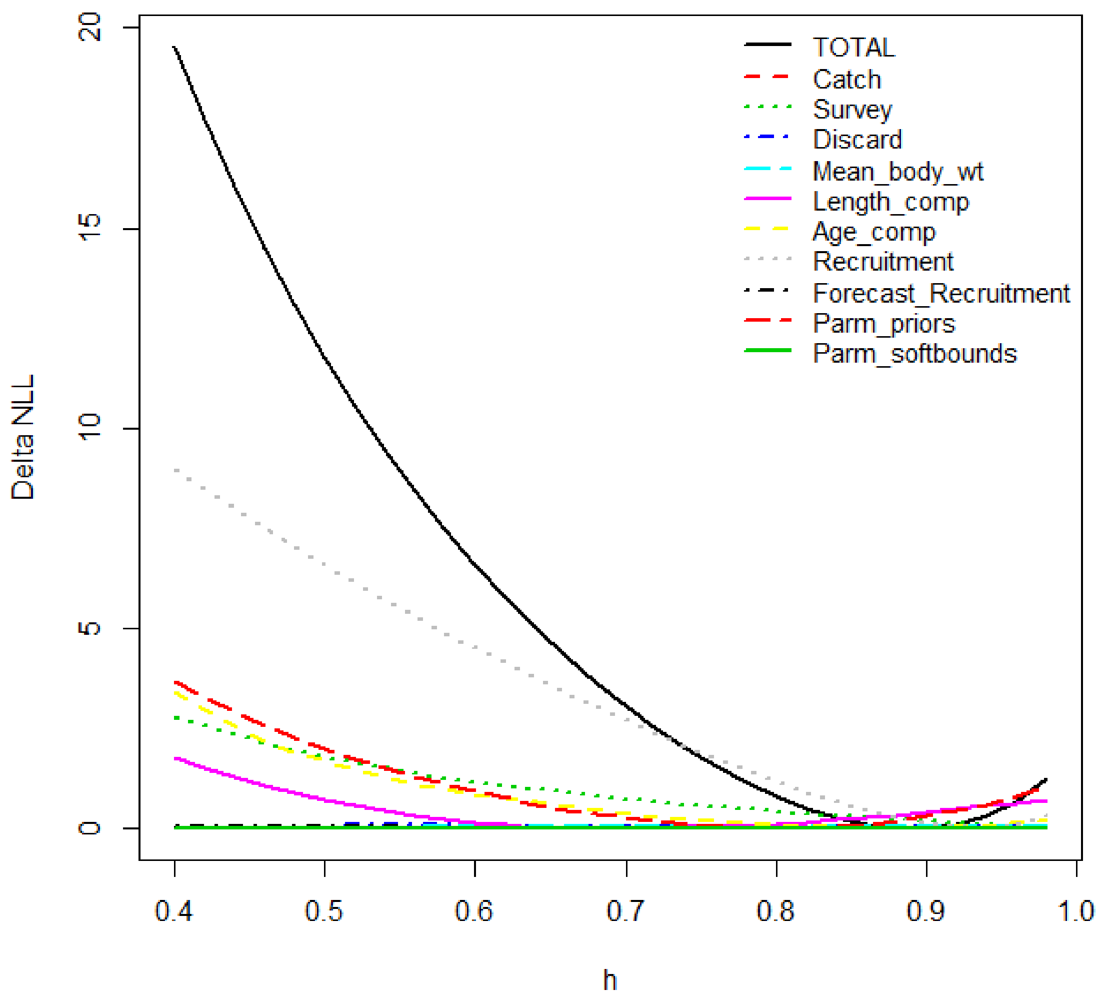


Figure 129. Likelihood profile for the stock-recruitment steepness (h).

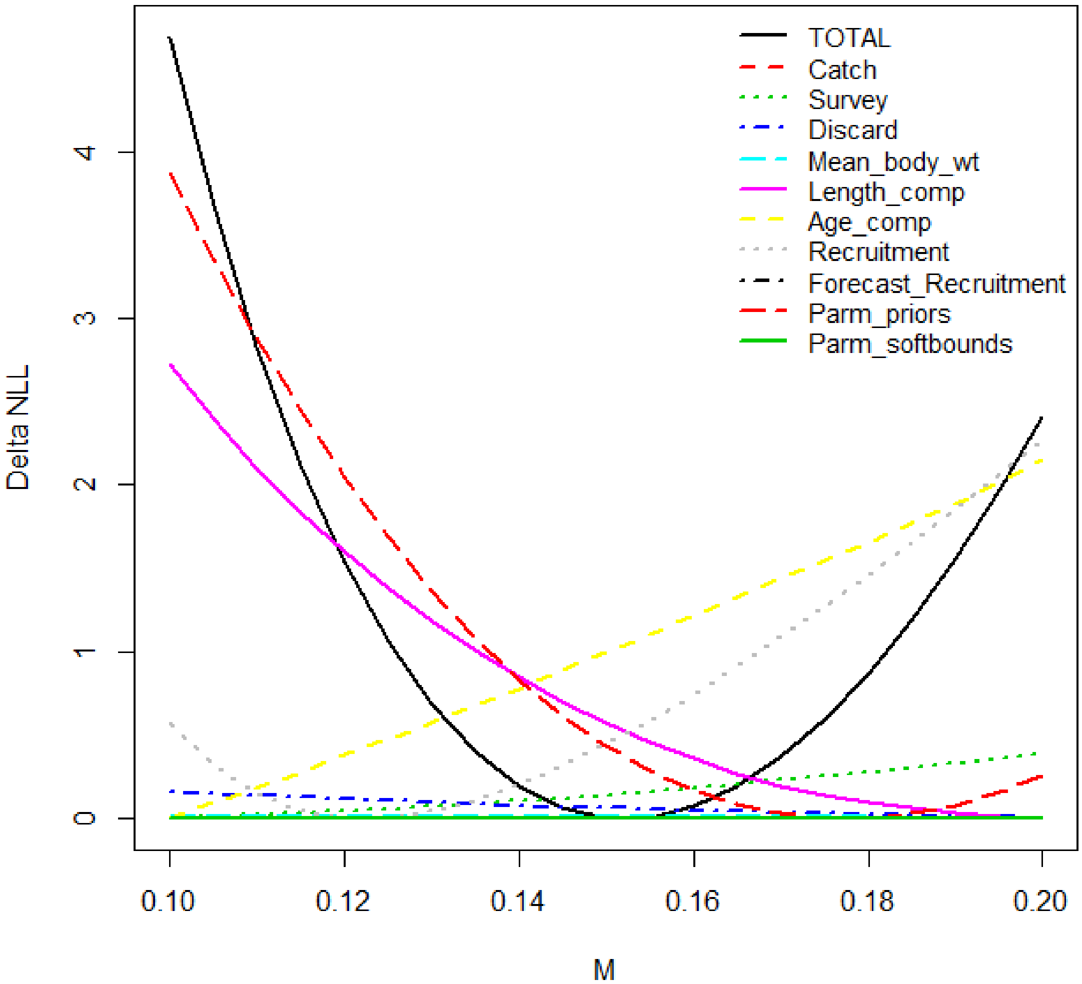


Figure 130. Likelihood profile for female natural mortality (M).

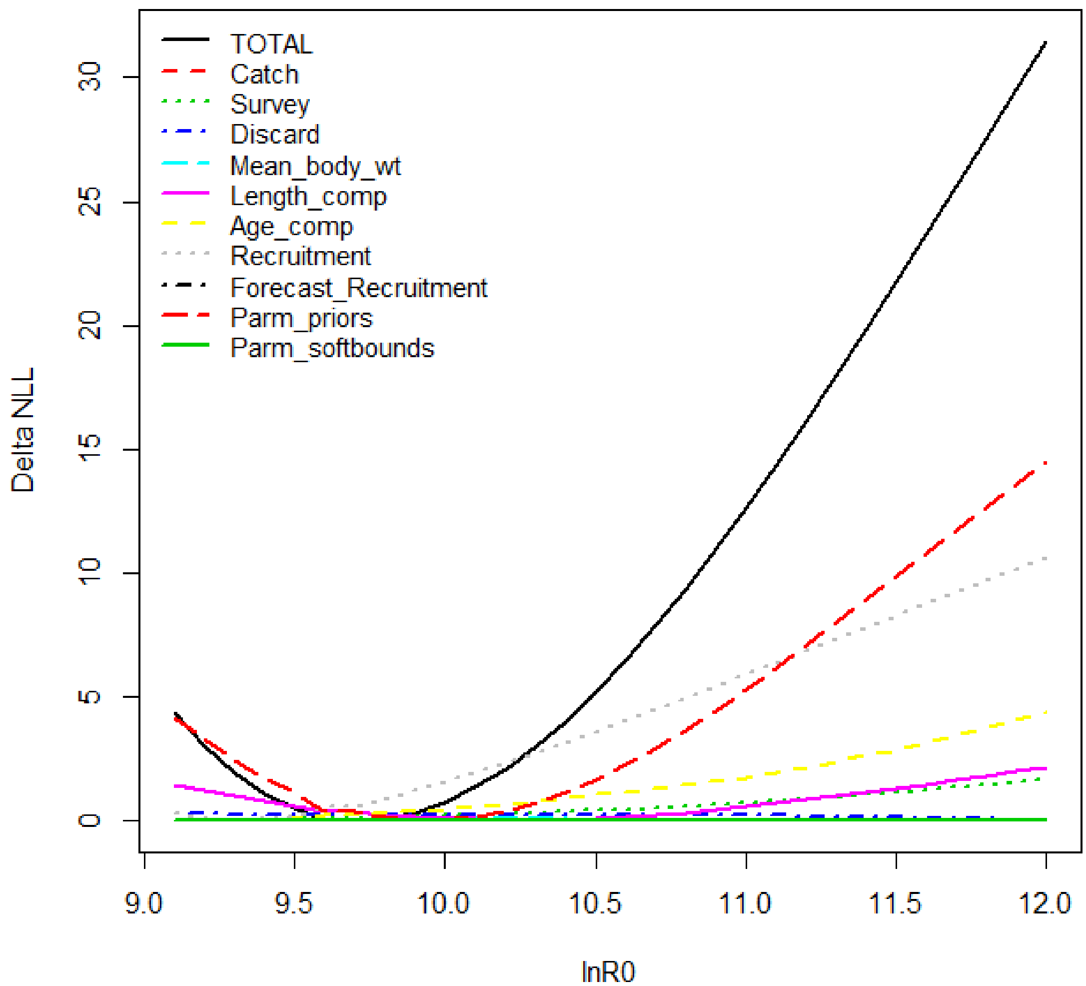


Figure 131. Likelihood profile for unfished recruitment (Ro) for total likelihoods.

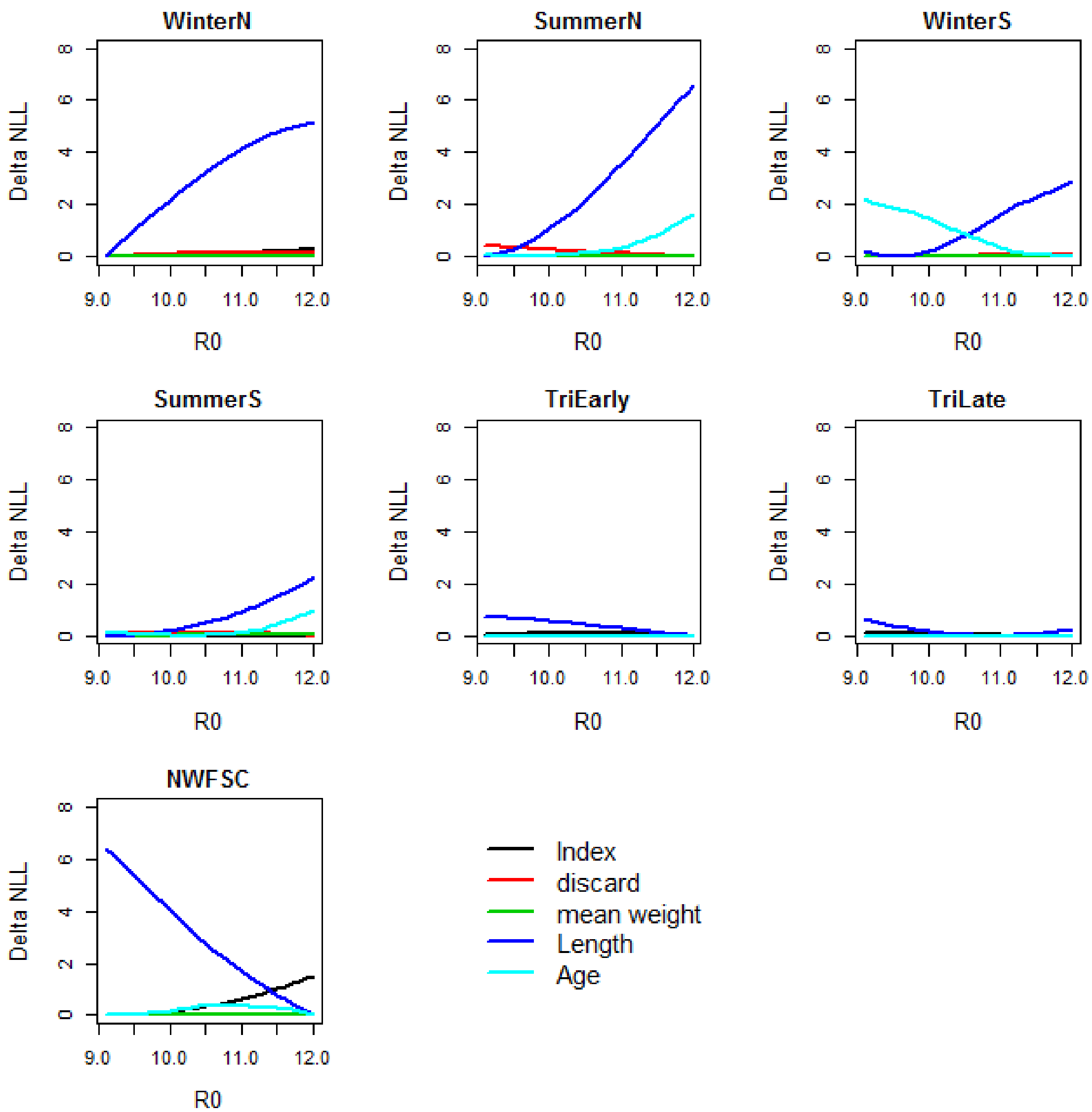


Figure 132. Likelihood profile for unfished recruitment (Ro) for likelihood components by fleet/survey.

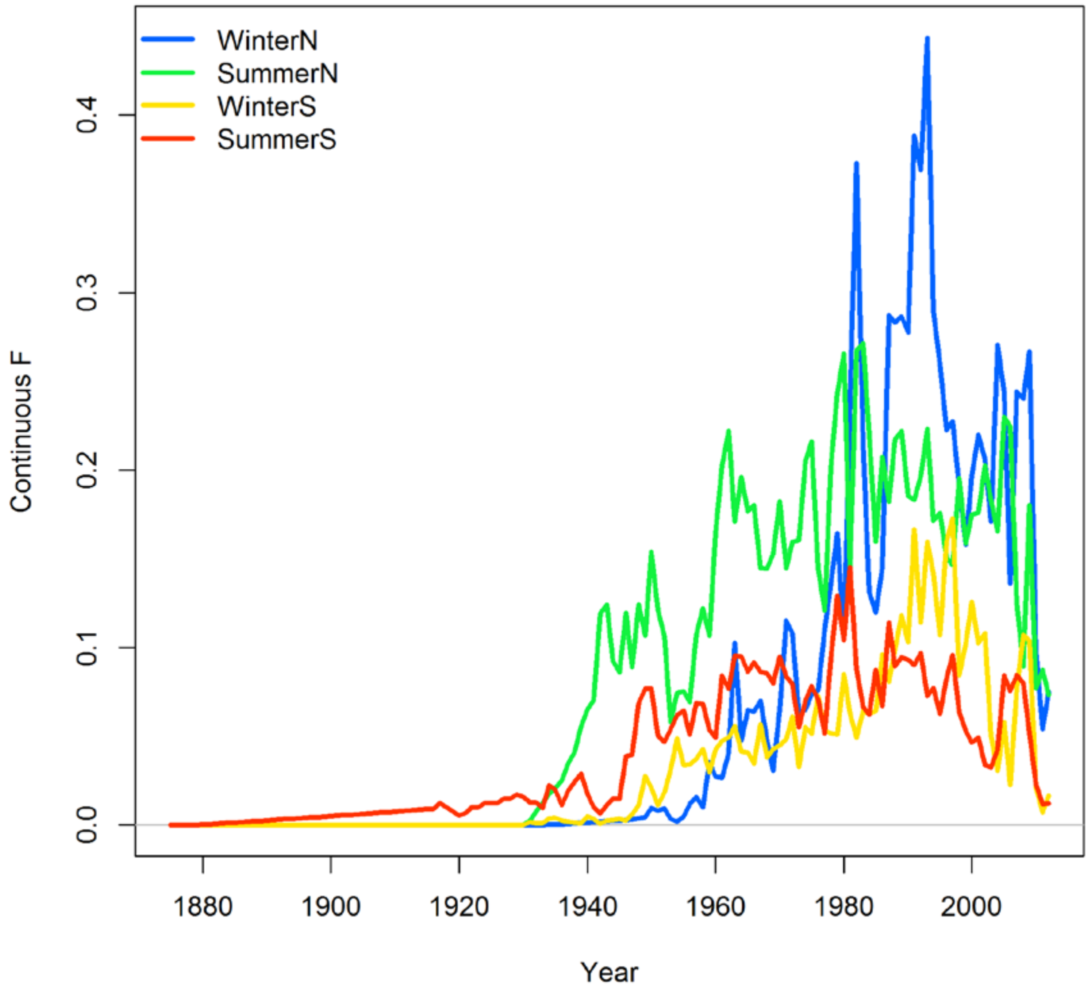


Figure 133. F time-series for each fleet.

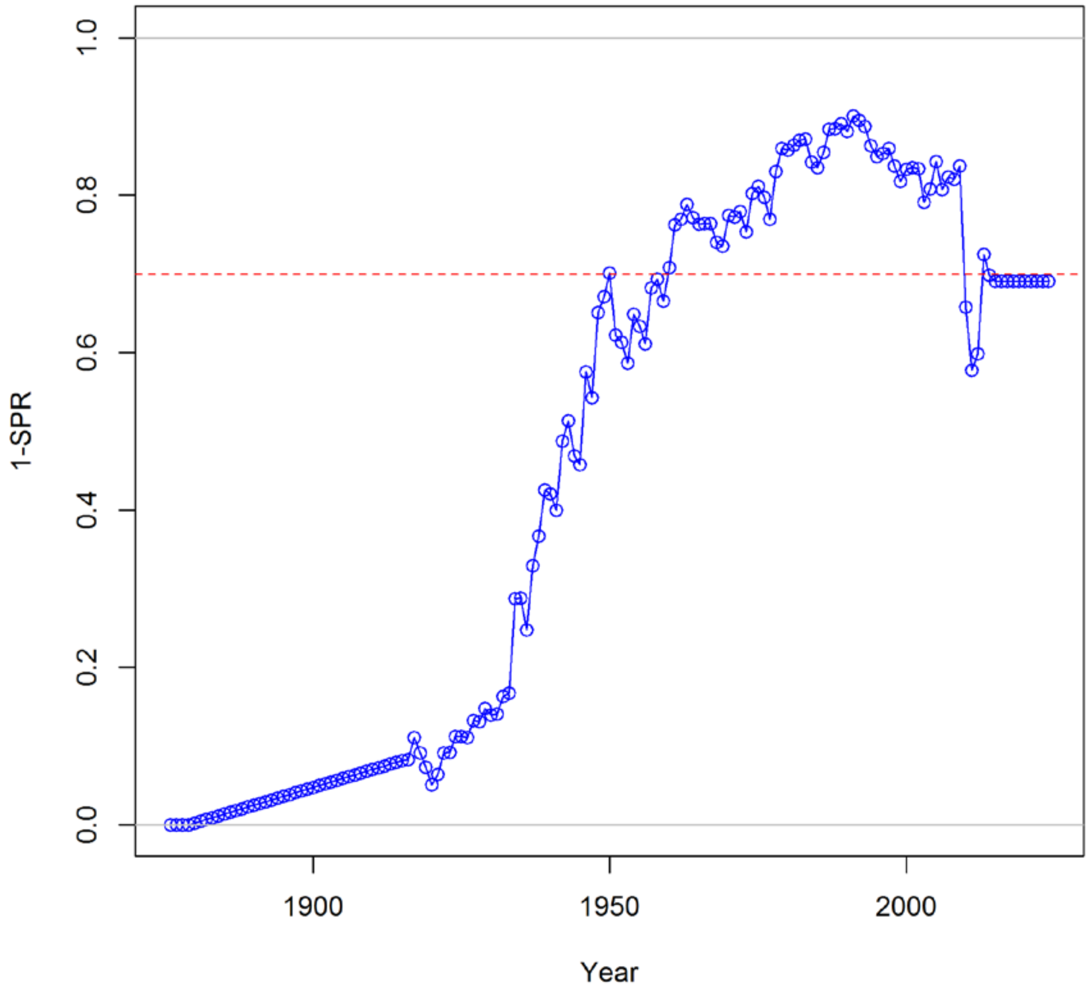


Figure 134. Time series of estimated spawning potential ratio (displayed as 1-SPR). Values of SPR above 0.7 reflect harvests in excess of the current overfishing proxy.

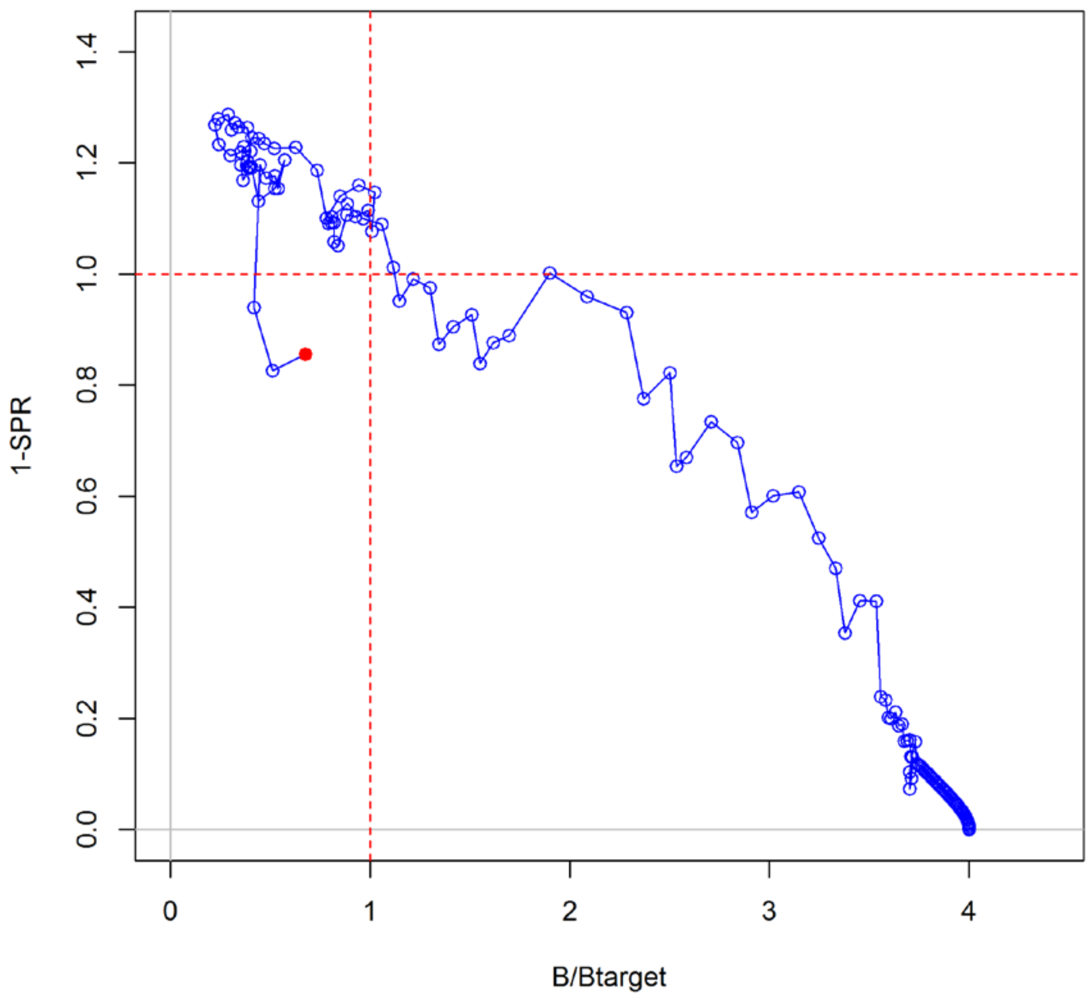


Figure 135. Phase plot of estimated fishing intensity vs. relative spawning biomass for the base case model. Fishing intensity is the relative exploitation rate divided by the level corresponding to the overfishing proxy (0.125). Relative spawning biomass is annual spawning biomass relative to virgin spawning biomass divided by the 25% rebuilding target.

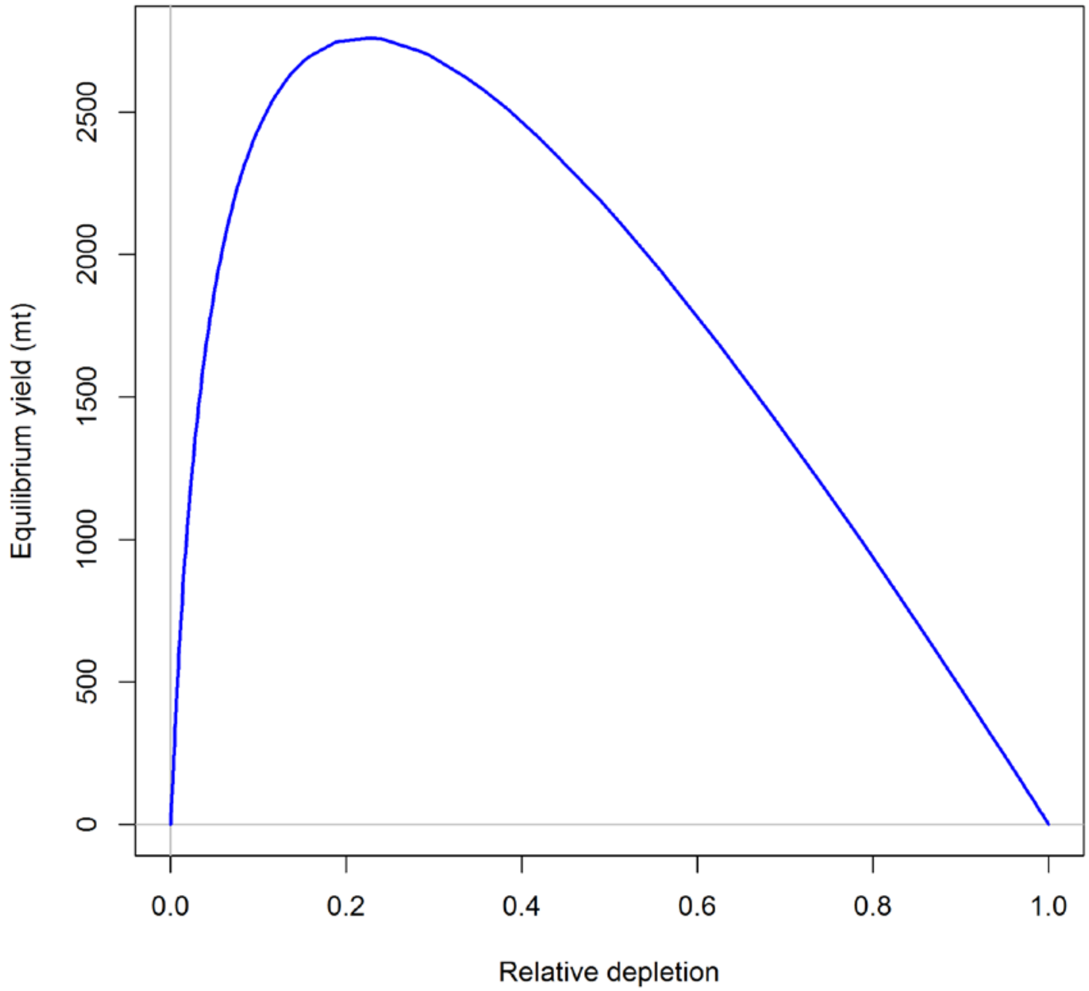


Figure 136. Equilibrium yield curve for the base case model. Values are based on 2012 fishery selectivity.

Appendix A. Survey post stratification

The default stratification from the Triennial and NWFSC surveys is not necessarily the best stratification when analyzing the survey data for Petrale sole. The last Petrale assessment (Lai et al) post-stratified the Triennial survey data based on a Bayesian change point analysis of the length as a function of depth. The reasoning behind the change point analysis was that Petrale show an ontogenetic migration to deeper water. Therefore the mean length would increase with depth until some point when the slope of the relationship would decrease due to mixing of adult fish. Their results showed median change points of 114 m and 144 m for females and males, respectively, and they chose to post-stratify the survey data into three strata (50–100 m, 100–155 m, and 155–700 m).

We chose to revisit the post-stratification because the NWFSC survey was not analyzed in the 2005 assessment. Lai et al (2005) used Bayesian statistics with uninformative priors and MCMC sampling to calculate the posterior distribution. However, we used a frequentist approach since there is no prior information for any of the parameters, and the problem in the frequentist paradigm allows for quick point estimates which are used as guidance for the strata definitions.

Piecewise linear regression is similar to linear regression except that the data are split into two parts by a breakpoint, and separate linear relationships describe each part. In mathematical terms,

$$L = \alpha_1 + \beta_1 d \quad d \le \delta$$
$$L = \alpha_2 + \beta_2 d \quad d \ge \delta$$

Furthermore, because we are assuming that the fish are migrating to deeper water, the relationship at the breakpoint (δ) should be continuous. In other words, the relationships to the two pieces are equal at the breakpoint.

$$\alpha_1 + \beta_1 \delta = \alpha_2 + \beta_2 \delta$$
$$\alpha_2 = \beta_1 + \delta(\beta_1 - \beta_2)$$

Substituting in and rearranging the equations we arrive at the same model used by Lai et al. (2005).

$$L = \omega + \beta_1 (d - \delta) \quad d \le \delta$$
$$L = \omega + \beta_2 (d - \delta) \quad d \ge \delta$$

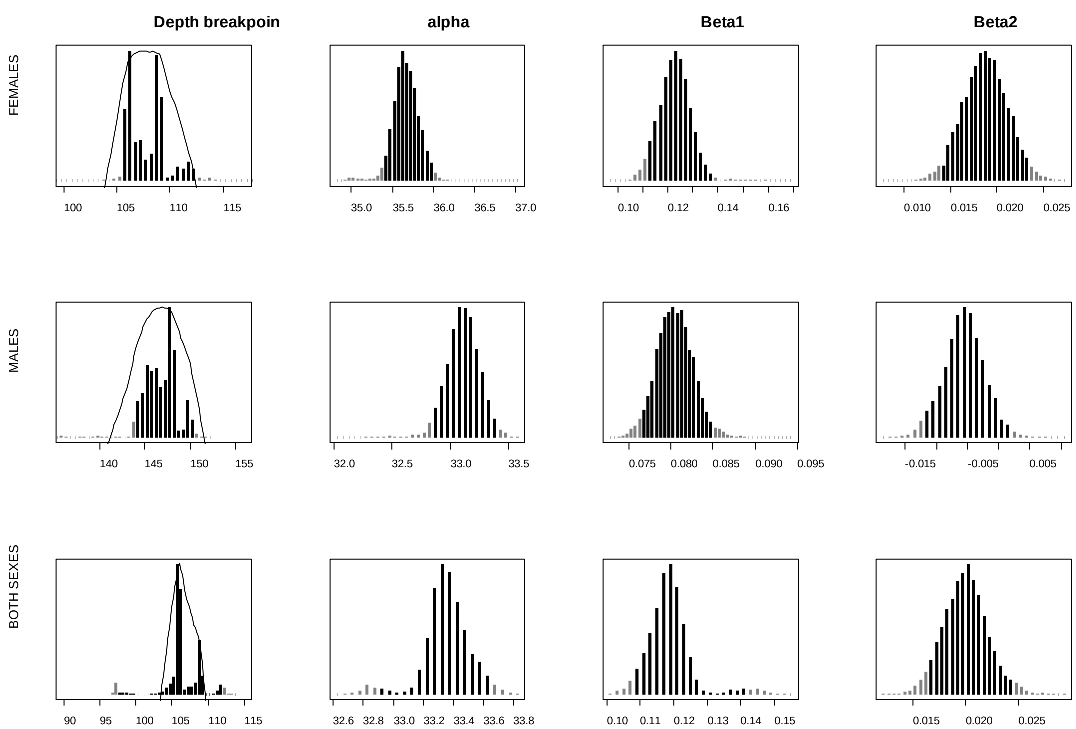
where $\omega = \alpha_1 + \beta_1 \delta = \alpha_2 + \beta_2 \delta$, or the length at the breakpoint. There are four parameters to estimate.

The parameters were estimated by minimizing the sum of the squared residuals and non-parametric bootstrapping was used to estimate the 95% confidence intervals. Furthermore, likelihood profiles were compared with these confidence intervals after assuming that the residuals were normally distributed with equal variance.

The results here agreed with the analysis performed by Lai et al (2005), and we also chose a breakpoint at 100 m. A breakpoint around 110 m may be more reasonable, but strata specific values, such as stratum area, is more easily available with a breakpoint at 100 m.

Table A3: 95% confidence intervals of the breakpoint from the likelihood profiles and bootstraps for each survey.

	Triennial		NWFSC	
	Profile	Bootstrap	Profile	Bootstrap
Female	**104.2–112.2**	**105.2–112.1**	**105.2–121.2**	**104.3–120.4**
Male	**141.2–151.4**	**143.7–150.0**	**146.0–159.8**	**144.2–160.8**
Both	**103.6–109.4**	**97.0–112.0**	**112.6–120.8**	**112.8–120.4**



FigureA1: Plot of the Triennial survey bootstrap results from piecewise regression for each sex and all years combined. The line in the depth breakpoint plot is a likelihood profile (the 95% CI is where the profile crosses zero).

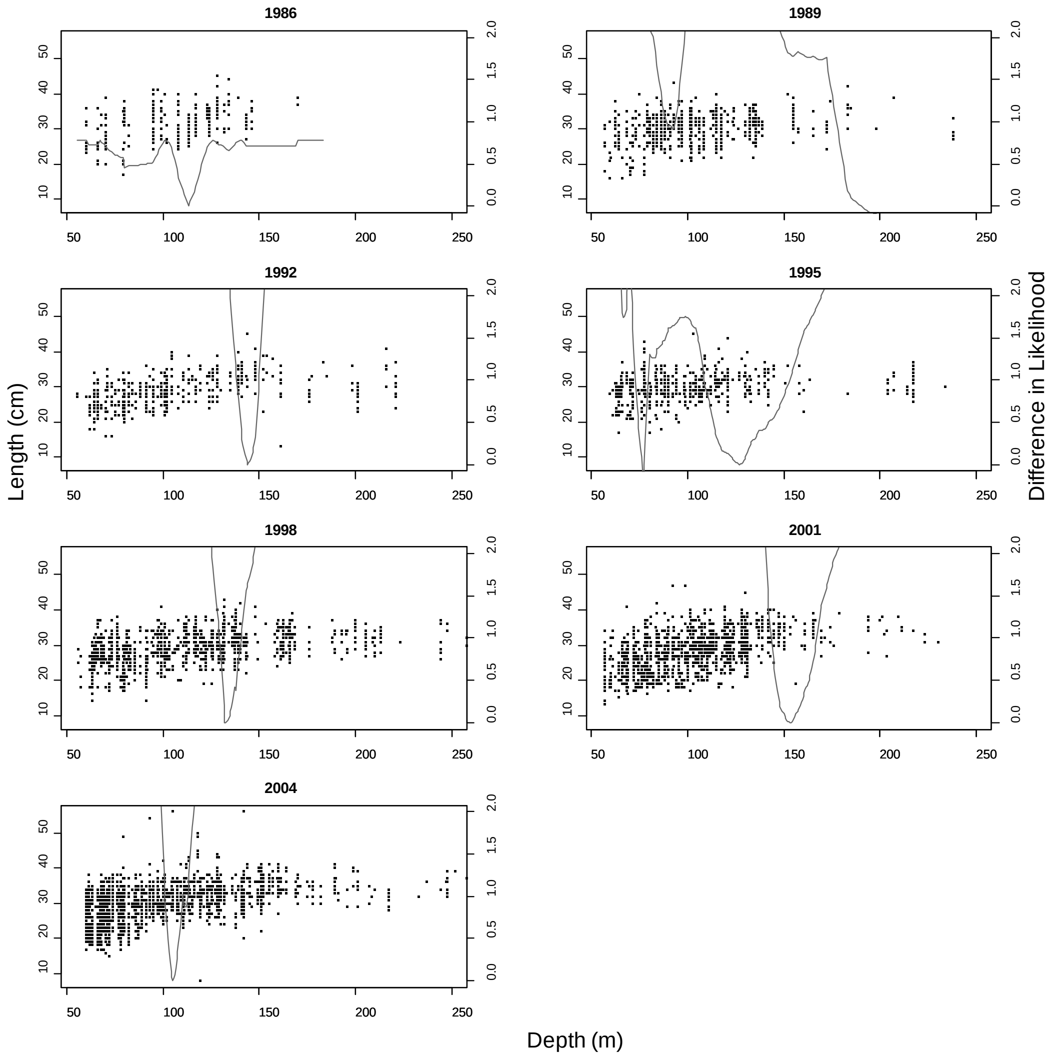


Figure A2: Plots of length vs. depth from the Triennial survey for each year and males only with the likelihood profile of the breakpoint overlayed.

NWFSC Survey

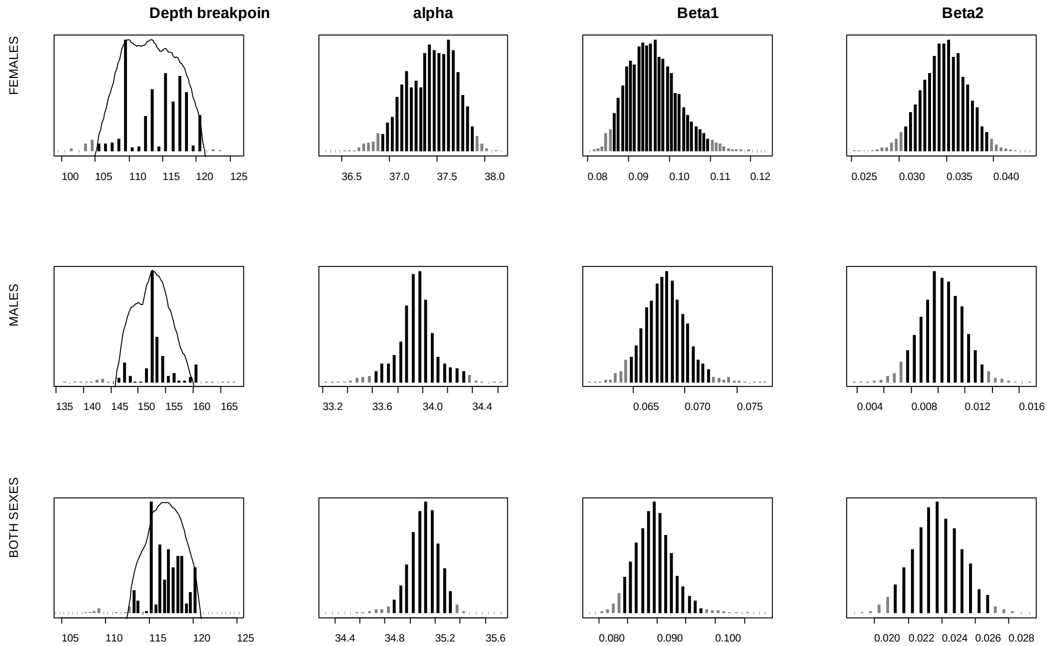


Figure A3: Plot of NWFSC survey bootstrap results from piecewise regression for each sex. The line in the depth breakpoint plot is a likelihood profile (the 95% CI is where the profile crosses zero).

Appendix B. Commercial logbook CPUE

Commercial logbook data for the west coast limited-entry groundfish fishery are archived in a regional Pacific Fisheries Information Network (PacFIN) database. These logbook data are used in a three step analysis to produce a CPUE index for each petrale sole fishing fleet from 1987-2009. Logbook data prior to 1987 were not considered because the spatial location of each tow was not available. The data for 2010 to present were not included due to restrictions on the petrale sole fishery due to its overfished status as well as the implementation of the West Coast Groundfish Trawl Catch Share Program. The summer season was defined as May-October, the same period that the NWFSC survey operates, while the winter was defined as November-February. The first step of the analysis is to define the spatial extent of recent petrale sole fishing grounds because spatial management measures began to impact the fleet during 2003 and have restricted the area open to fishing. The goal is to identify areas that have remained open to fishing for the duration over which standardized CPUE indices are desired, 1987 – 2009. The second step was to filter the data for quality, and based on information from the industry present at a 2011 pre-assessment workshop in Newport, OR. The final step was to conduct the CPUE standardization using a delta-GLM analysis.

Appendix B.1. Spatial analysis

Logbook records from PacFIN were queried for Washington, Oregon and California commercial fishing trips that caught petrale sole via bottom trawl gear from 2003 through 2008, a period of relatively stable management for petrale sole. Records include geographic positions where the vessel set and retrieved the trawl gear. Both set and up points were used to create line representations of each tow event. Any line intersecting the line representing the coastline or crossing seaward of the line representing the 700-fm isobath was flagged and removed from the data set. For each line, average vessel speed (knots) was calculated as a quotient of calculated linear distance between set and retrieval points versus recorded tow duration. Trawl events with calculated vessel speeds greater than 5 knots were removed, as were records with calculated straight-line distance greater than 20 nm.

Petrale fishing grounds that have remained open during 1987-2009 were identified using tows that caught petrale for both the summer and winter seasons. Only tows seaward of the 150-fathom line were retained in the winter and only tows shoreward of the 75-fathom line were retained in the summer to account for areas that have been closed in recent years. In order to investigate how sensitive the identification of fishing grounds are to the choice of positive catch rate data three criteria were investigated for each season: 1) using all tows with positive catch rates, 2) removing tows with the lowest 10% of the catch rates, and 3) removing tows with the lowest 20% of catch rates were investigated during the 2011 assessment (Table 1). Each of the six sets of fishing grounds (the above three fishing ground identification methods and 2 seasons) were identified using a convex hull minimum bounding geometry. A common analogy used to conceptualize convex hulls is an elastic band being stretched over a set of points (Fig. B1). Convex hulls were computed for each set of selected lines within a regular network of contiguous 10x10 km cells.

Once fishing grounds were identified logbook data from 1987 – 2009 was overlaid on the maps of fishing grounds. Tows that fell within the fishing grounds were retained for CPUE standardization. Based on feedback from the fleet and lack of sensitivity to the identification of fishing grounds the data set that removed the lowest 10% of catch rates were retained for both the 2011 and 2013 CPUE analyses.

Appendix B.2. Data filtering/preparation

The following data filters were applied for data quality:

1. Remove midwater trawl tows.

2. Remove records with large depth discrepancies (> 70 fathoms) between the logbook recorded catch and the GIS map depth.

3. Remove tows with a duration less than or equal to 0.2 hours as duration was incorrect for many of these records.

The following filters were applied based on knowledge of the petrale sole fishery. The tow duration and minimum number of years the vessel had been in the fishery were chosen based on discussions with industry members present at the 2011 pre-assessment workshop in Newport, OR.

1. Retain tows with depths less than or equal to 300 fathoms in summer and 400 fathoms in winter.

2. Retain tows with tow duration <= 4 hours during the summer and <= 6 hours during the winter.

3. Retain vessels fishing five or more years. This rule was chosen in order to capture skippers that have fished petrale sole for most of the time series that likely switched vessels during the vessel buyback program. Sensitivity of the model results to this parameter were examined.

Tows were assigned to states based on the state waters where the catch was taken such that the PSMFC areas 3A, 3B, 3S, 3C were assigned to Washington. PSMFC areas 2B,2C,2A,2E,2F are assigned to Oregon and PSMFC areas 1A,1B,1C were assigned to California. In the 2011 analysis, standardized CPUE was prepared for Washington, Oregon, and California to match the fleet structure in the 2011 stock assessment model. In the 2013 analysis, standardized CPUE was prepared for a northern area (Washington and Oregon combined) and California to match the fleet structure in the 2013 stock assessment model.

After filtering, the 2011 winter data contained 13,777 tows, from 179 distinct vessels, which delivered to 47 different ports. The tows were concentrated in Washington and Oregon compared to California (Figure B2). The winter fishery targets petrale on their spawning grounds, which is different from the summer fishery which catches a mixed species complex. The summer data contained 123,375 tows, from 295 distinct vessels, which delivered to 47 different ports.

For the 2013 analyses, the winter data contained 13,777 tows, from 179 distinct vessels, which delivered to 24 different ports (same as to the 2011 analyses). The 2013 summer data, on the other hand, contained less data points than the 2011 analyses with 96164 tows from 261 distinct vessels, which delivered to 30 different ports. This is due to some data filtering error in the 2011 analysis.

The fishery has undergone changes in gear type during the time period of interest, although these gear changes differ between the winter and summer fishery, and between states (Figure B3). The Washington and Oregon winter fisheries have been using rolling trawls almost exclusively since 2000. The California winter fishery switched from primarily groundfish otter trawls to groundfish trawls with a footrope greater than 8 inches between 2002 and 2004. In the summer, both the Washington and Oregon fishery went from a variety of gear types to almost exclusive use of selective flatfish trawl in 2005. Meanwhile the California summer fishery diversified gear in 2002, moving from mostly groundfish otter trawls to a variety of gear types.

The winter fishery is clustered around distinct fishing grounds whereas the summer fishery is conducted much more uniformly across latitude (Figure B2).

Appendix B.3. Analytical methods

CPUE is modeled as pounds per hour using the fish ticket-adjusted catch and the skipper's logbook entry of tow duration. All covariates are factors and include year, bimonthly period, port of landing, vessel ID, gear type, and fishing area, and in 2013 covariates for fishing target. Depth was not used a covariate because after spatial filtering the depth ranges of the remaining data sets were restricted.

The Delta-Lognormal approach (Maunder & Punt, 2004) was used to standardize the catch and effort data for each season (summer and winter) for each region (the 2011 analysis treated each state individually, the 2013 analysis groups Washington/Oregon and California). In 2013, WA and OR data were grouped together because these port landings data (used in the SS3 model) came from a mixture of catches in WA and OR waters and recent catch reconstructions do not compile the landings by both port of landing and catch area. For the Delta-Lognormal model, the presence-absence data was first analyzed using a logistic model assuming a logit link and binomial error distribution to estimate the probability that a tow (in 2011) or trip (in 2013) caught (and retained) petrale sole. Then the catch and effort data for the positive tows (in 2011) or trip (in 2013) was modeled using a linear model with a log link under the assumption of Gaussian errors to estimate the catch rate given the presence of petrale sole.

For all regions, seasons (summer and winter), and for both portions of the model (binomial and lognormal), a base model that included all the main effects was fit and compared with models with different combination of covariates. The most parsimonious model was then selected using the information theoretic approach (Burnham & Anderson, 1998) based on the Akaike Information Criterion (AIC, Akaike, 1974).

The final CPUE model selected in 2011 (used in the assessment) didn't include interaction terms for reasons including erratic and non-realistic behavior of the derived index of abundance, model convergence and problems dealing with missing interaction terms (Haltuch et al. 2011). Therefore, the 2013 CPUE standardization analysis considered the main effect models only but investigated the influence of interaction terms as sensitivity tests (although the same problems as in 2011 persist). Several additional changes were made for the 2013 CPUE modeling approach. These are described below and the influence of each change to the derived index of abundance is shown in a step by step manner in Figure B4 (the red line with dots represents the 2011 model result).

1. Some data filtering were not correctly applied to the 2011 summer data and a total of 27211 points were removed from the analysis as their geographic coordinates indicated a point outside of the identified fishing grounds. This reduced the total number of tows for the summer data from 123375 to 96164. To evaluate the impact of this change, we reran the 2011 model with this new data (the blue line in Figure B4).
2. A "reference" level was chosen for covariates retained in the model so that the derived index of abundance could be interpreted as CPUE per unit reference level of covariate (e.g. CPUE per reference gear, bimonth, etc…). The "reference" level was chosen as the most frequently observed level for a categorical variable (Punt et al. 2001) or the mean value for a continuous variable (Maunder and Punt 2004). In 2011, the "reference" level was chosen as the weighted average of the estimated coefficients obtained from the model fit. This later is statistically correct but is harder to interpret. The green line in Figure B4 is the resulting index of abundance using the 2011 data and selected model with the change in "reference" level calculations.
3. In order to calculate a prediction interval around the derived index of abundance, the standardized CPUE was divided by its geometric mean instead of the 2004 CPUE value as was done in the 2011 model. Again, this change was applied to the 2011 model after taking into account the modifications in points1-2. This resulted in the purple line (Figure B4).
4. The fishing grounds were divided into finer spatial grids (1 degree x 1 degree grid) within each region (WA, OR, CA) to capture more detailed population dynamics and the tow by tow data were aggregated to the trip level to respect the assumption of independent observations. By dividing the fishing grounds into finer grid cells it introduces some missing observation for a specific year and area combination but the latter didn't impact the final GLM result as the 'year:area' interaction was not modeled. All tows from the same vessel, trip, and area using the same gear were combined to create a single average catch per unit effort (lbs/hr) by trip. This reduced the number of data points two to three fold (Table 1). The impact of this change is shown by the light blue line in Figure B4. The model has the exact same covariates as the 2011 model and includes all the above changes in points 1-3. Sensitivity of the final index of abundance to the choice of spatial grid size was also examined.
5. New covariates that represent fishing tactics were included into the 2013 model to capture the targeting behavior of the vessels (following Winker et al. (2012) method). A principal component analysis (PCA) was performed on the squared root transformed trip by trip catch composition data (only 7 "species category" were present in the dataset: petrale sole, dover sole, thornyheads, widow rockfish,

sablefish, whiting and others) and the first 4 axes (that usually explained more than 90% of the total variation) were retained as new covariates in the model. The loadings of each data point to the PC axes were then determined and included in the data. These loadings provide information about the fishing tactics of each fishing trip. Model selection was performed using AIC in order to determine the best combination of covariates that parsimoniously explained variation in both the presence-absence model and the positive catch data model. The 2013 CPUE index was therefore calculated so that it represents a fishery with some “reference” unit of covariates that targets the petrale sole. The later was done by taking a fishing tactics that predicted a catch composition that was 100% (or close to 100%) petrale sole. The result of this step is shown by the pink line with dots in Figure B4.

6. Finally, the above model was re-written in a mixed effect model framework where the vessels were considered as random effect. A model selection using AIC was again performed to choose the best combination of covariates. The result of this step is shown by the line in orange in Figure B4.

For each of the models presented above the CPUE index was calculated following the methods of Maunder & Punt (2004).

Because each of these steps either changed the data or didn’t change the GLM model structure, information based model comparisons (e.g. AIC) between steps was not possible or did not change at all. Therefore between steps model comparison was done via examination of model residual structure (Figure B5a-f) and a goodness of fit measure (% deviance explained) (Table B2). Residual plots for the binomial model were not plotted due to the difficulty in interpreting them.

Once the above retrospective model comparison was done, we produced the 2013 final index of abundance for the WA/OR and CA regions by fitting a linear mixed effects model and performing model selection based on AIC (to choose the best combination of covariates) (Figure Table B3). Prediction intervals around the index of abundance were generated using parametric bootstrap sampling (for each bootstrap sample, a new dataset was generated by adding random errors (from both the random effect and the residuals) to the predicted data and the model was refit to produce the new bootstrap index of abundance) using a sample size of 999 (Figure B6).

Appendix B.4. Results

The indices of abundance derived for the 2013 AIC selected model show the same general trend as the NWFSC fishery independent survey during the period of overlap for both summer and winter time (Table B4). In the summer fishery, the index generally decreased from 1987 through the mid-1990s, then increased until 2004-2005 but decreased in the last few years for both regions. The winter indices follow the same general pattern but the winter California CPUE index trend was more variable and had greater uncertainty than the other CPUE indices (Figure B6, Table B4). For all models, the fishing tactics was an important factor explaining variations in CPUE (Table B3). In each one of them, the tactics targeting petrale sole came up as the most or the second most important tactics as seen by the dominance of petrale sole in the loadings of the first or the second principal component axis (Figure B7). Interestingly, some tactics commonly caught dover sole with petrale sole while others avoided them. Other main fishing tactics that came out from the analysis is a tactics targeting “other species” (probably composed of many rockfish species although we don’t have the data to confirm it) or sablefish (Figure B7). While the first 4 PC axes used in the analysis generally explained more than 90% of the total catch variation, the contribution of each axis differed significantly. The first PC axis generally explained more than 50% of the total variation, the second axis explained about 20%, and the other two axes explained about 10% and 5% respectively.

The winter fishery has been subject to more consistent spatial management measures than the summer fishery but it is also known that CPUE standardization based on spawning aggregation could lead to a CPUE index that is not proportional to stock abundance (e.g. Erisman et al. 2011). Therefore a nonlinear relationship between CPUE and abundance should be assumed within the stock assessment model. On the other hand, while the summer fishery has been subject to more changes in management measures the relationship between CPUE and index of abundance might be more linear although complex vessel, population and management dynamics could lead to a nonlinear relationship.

Appendix B.5. Sensitivity to the choice of the spatial stratification (0.5 vs 1 degree grid size)

The derived index of abundance was not sensitive to the size of spatial grid during the stratification process. The index of abundance had exactly the same shape (Figure B8). This is because the 2013 model didn’t include any interaction effect and we only estimated the marginal effect of each covariate.

Appendix B.6. Sensitivity to the number of years fishing in the fishery (5 vs 10years)

The derived index of abundance was not sensitive to the choice of minimum number of fishing years during the data filtering process. The index of abundance had exactly the same shape (Figure B9). The index of abundance couldn’t be calculated for CA due to the lack of contrast and too few data points.

Appendix B.7. Sensitivity to the inclusion of ‘year:area’ interaction term in the model

For each model (region and season combination), there were between 0 to 35% of missing year:area data. If fixed year:area interaction terms were to be included in the model, this would have involved a large amount of data imputation in order to properly derive the index of abundance. This data imputation could potentially impact the accuracy of the derived index of abundance and needs to be simulation tested before application to real data for use in a management context. Therefore, a model with existing year:area interactions (ignoring the missing interactions) was considered by treating the year:area interaction as random effect (Figure B10). The models didn’t show any major change in the abundance indices trends except the CA summer fishery. The model results for the CA summer fishery shows some differences with the non-interaction model during the early 90s and for the timing of peak abundance in the mid-2000s (Figure B9).

However a likelihood ratio test between the model with and without the year:area interaction term was performed and showed that the model without the interaction term was better (p.value≈1). The CA fishery is also relatively data poor compared to the other region-season combinations.

Appendix B.8. References:

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Appendix B.9. FIGURES

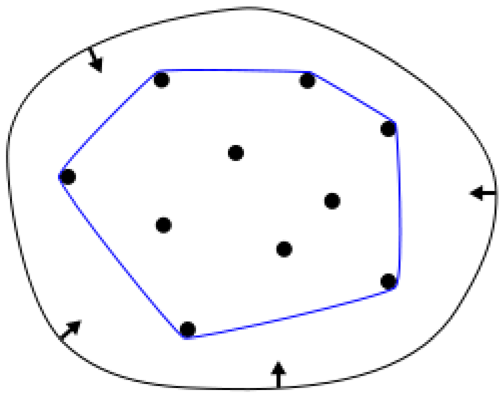
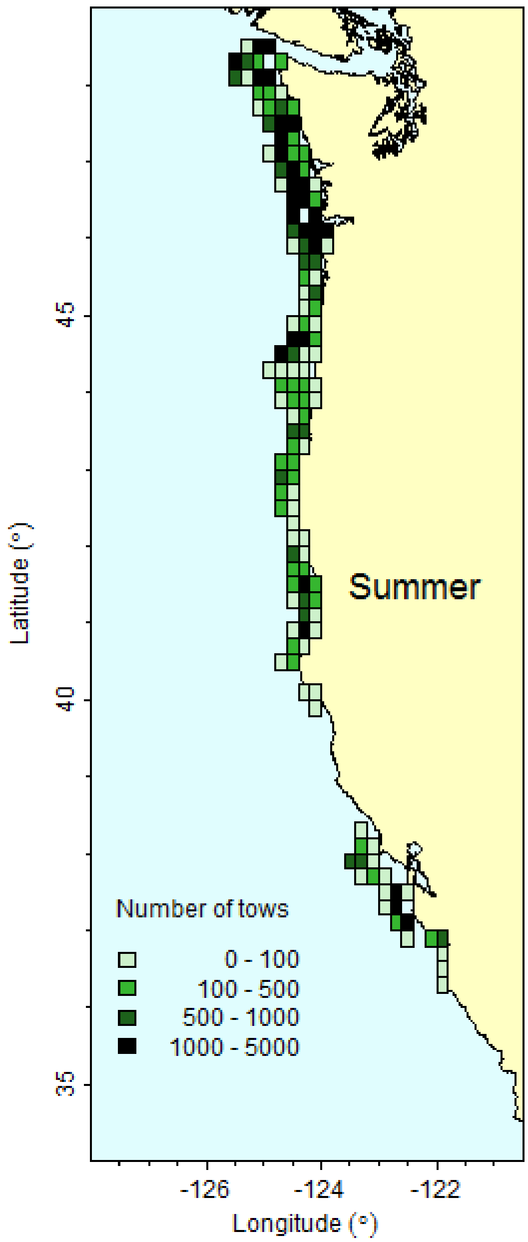


Figure B1. Example of a convex hull for a set of points. The curved outer line shows a conceptual elastic band contracting around a set of points. Image source: Wikipedia, "Convex hull".



Summer
Number of tows
0 - 100
100 - 500
500 - 1000
1000 - 5000
Latitude (°)
45
40
35
-126
-124
-122
Longitude (°)

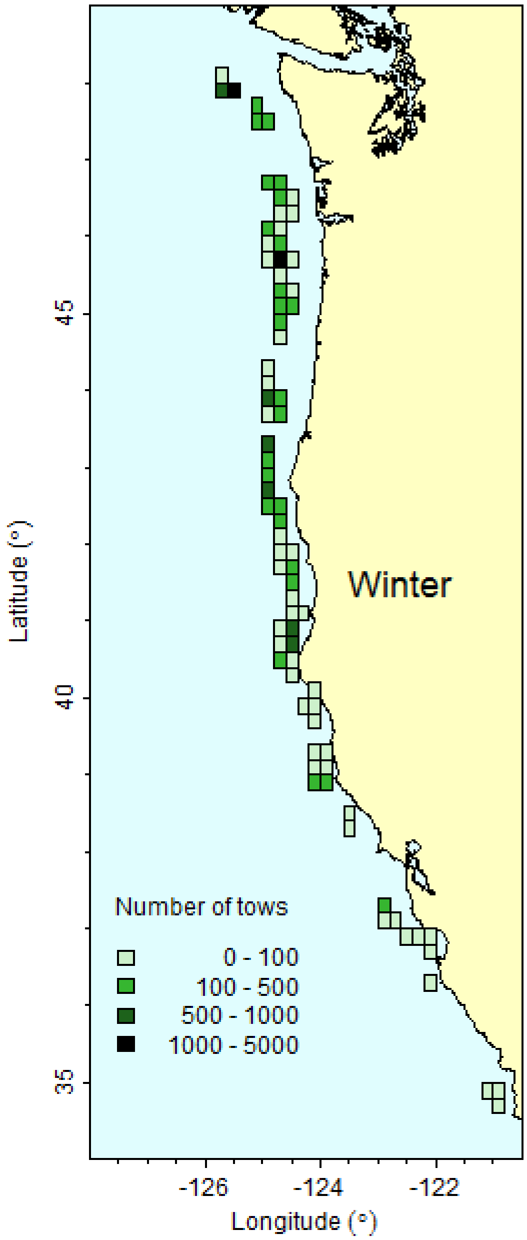


Figure B2: Tow number by areas during summer and winter

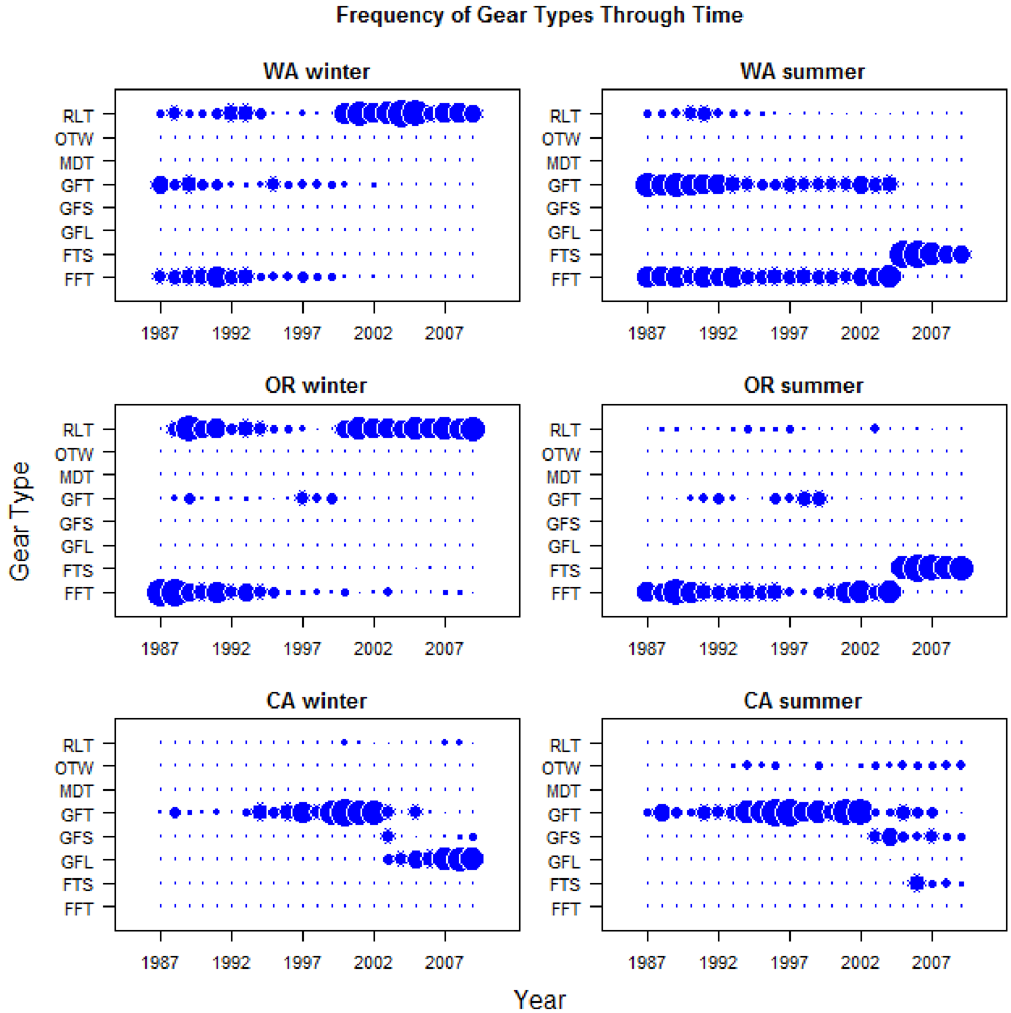


Figure B3. Frequency of gear used over time by state. The size of the circles corresponds to the percentage of tows in each year that used each gear type. RLT – roller trawl, OTW – other trawl gear, GFT – groundfish trawl (otter), GFS – groundfish trawl (footrope < 8in), GFL – groundfish trawl (footrope > 8in), FTS – selective flatfish trawl (small footrope), FFT – flatfish trawl.

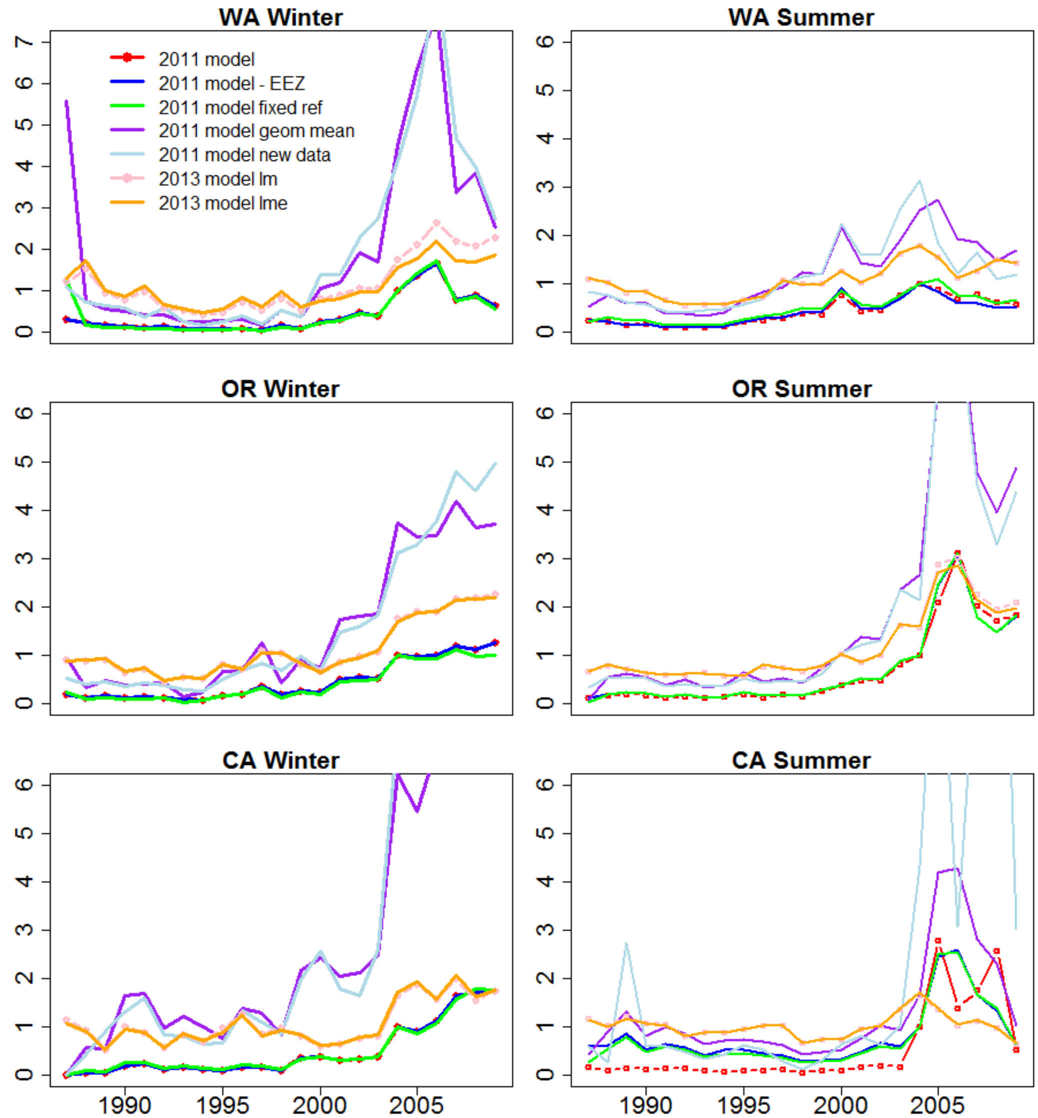


Figure B4: The influence of each modification made in the 2013 CPUE standardization on the final index of abundance. There are a total of 6 changes in addition to the 2011 model and they are described in the main text.

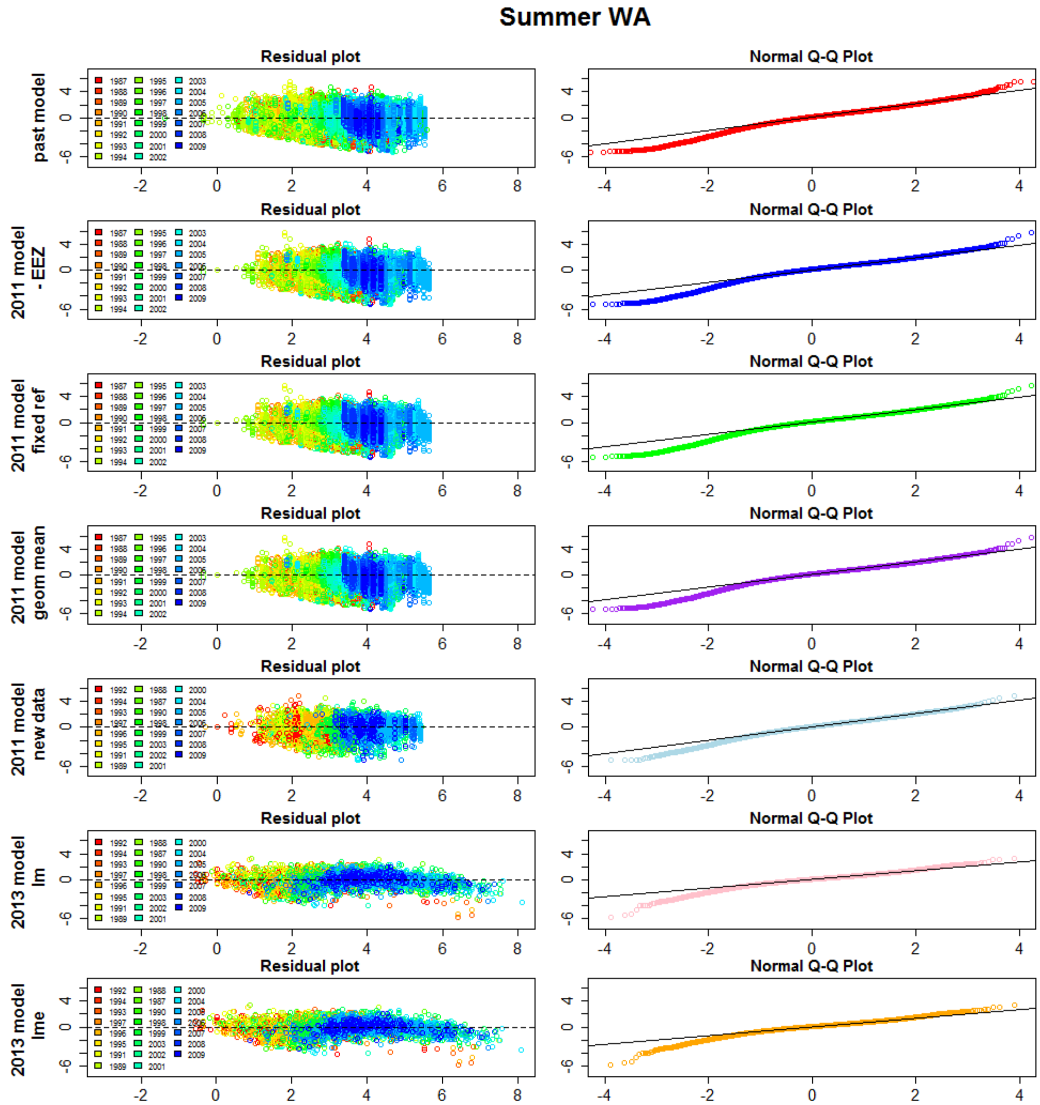


Figure B5a: Changes in residuals and QQ-plots pattern for the WA Summer fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

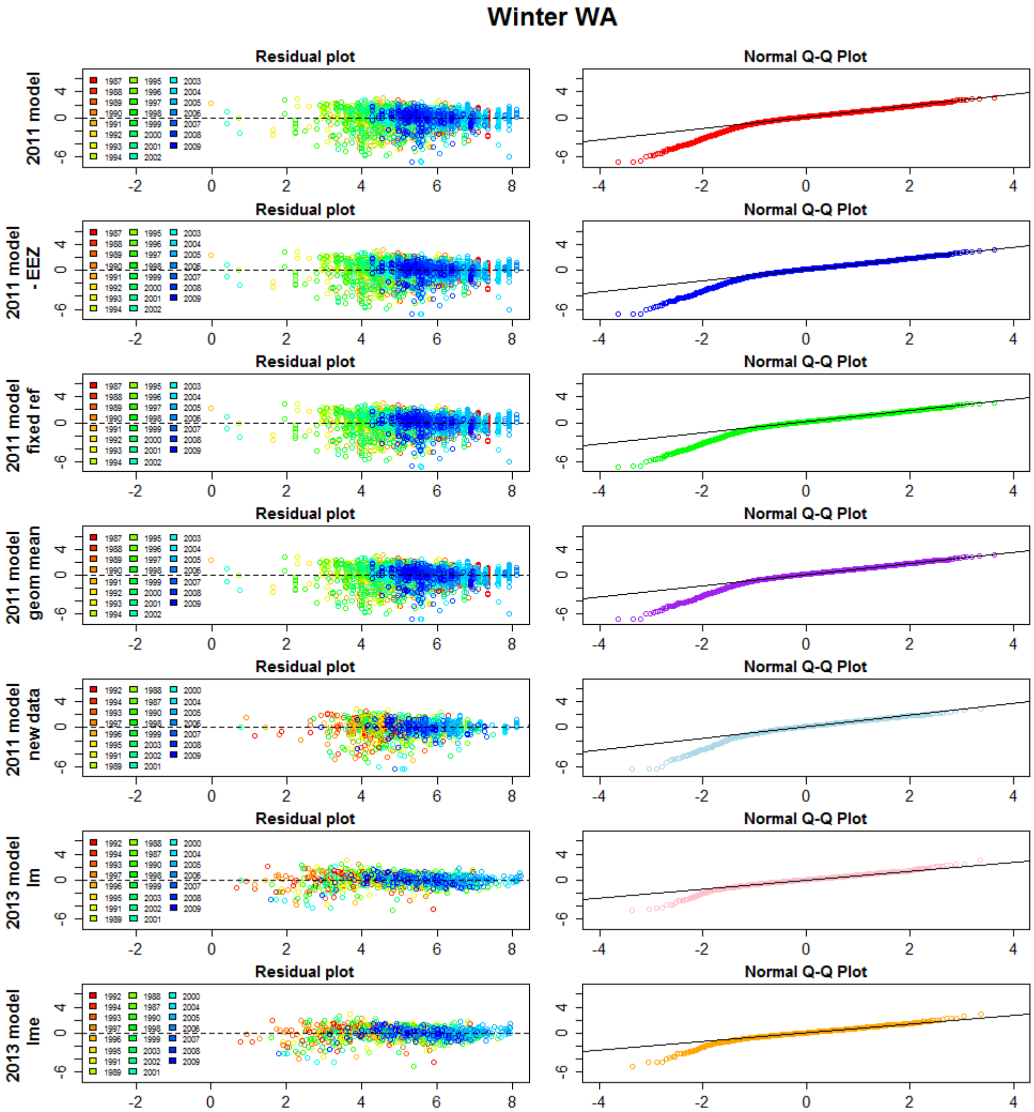


Figure B5b: Changes in residuals and QQ-plots pattern for the WA Winter fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

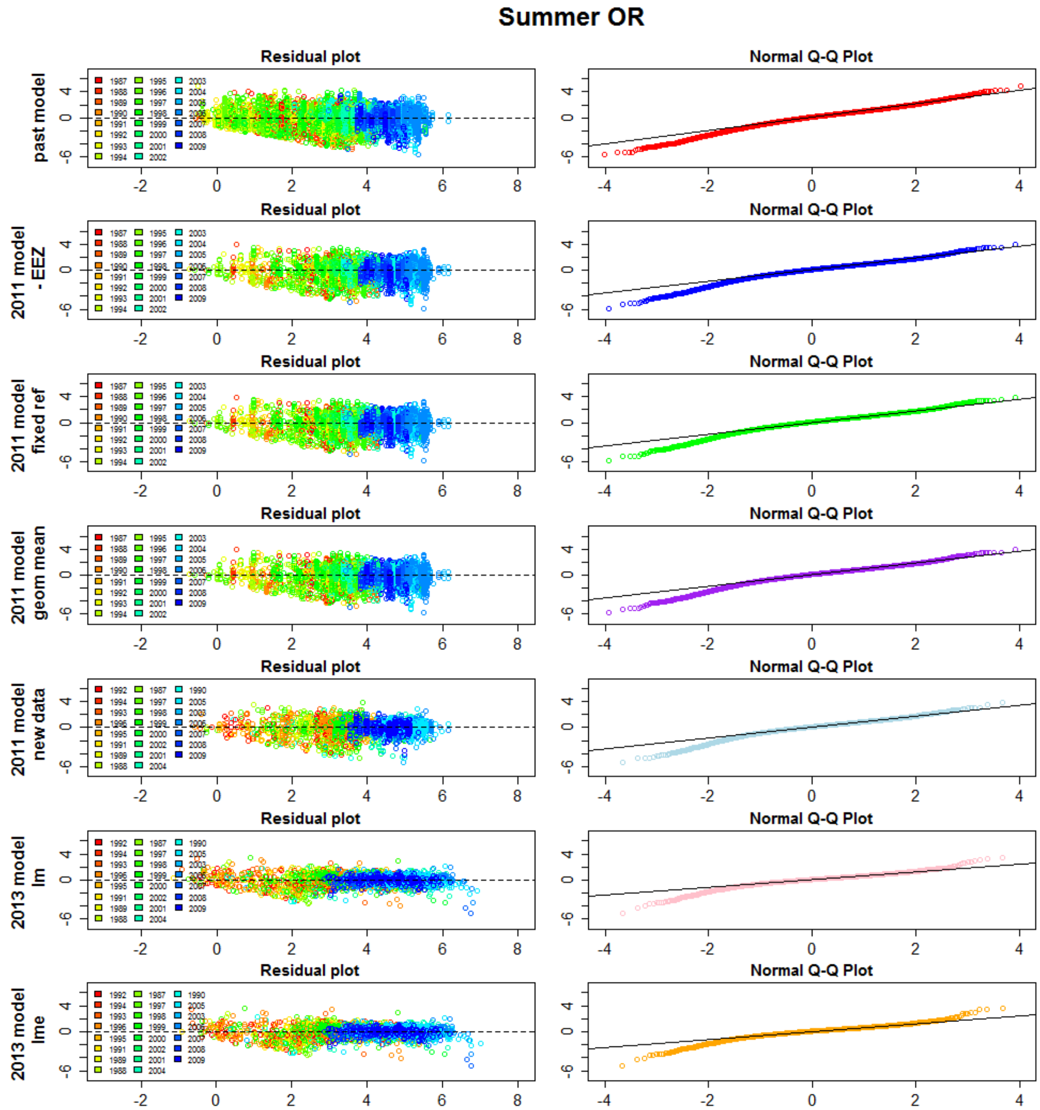


Figure B5c: Changes in residuals and QQ-plots pattern for the OR Summer fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

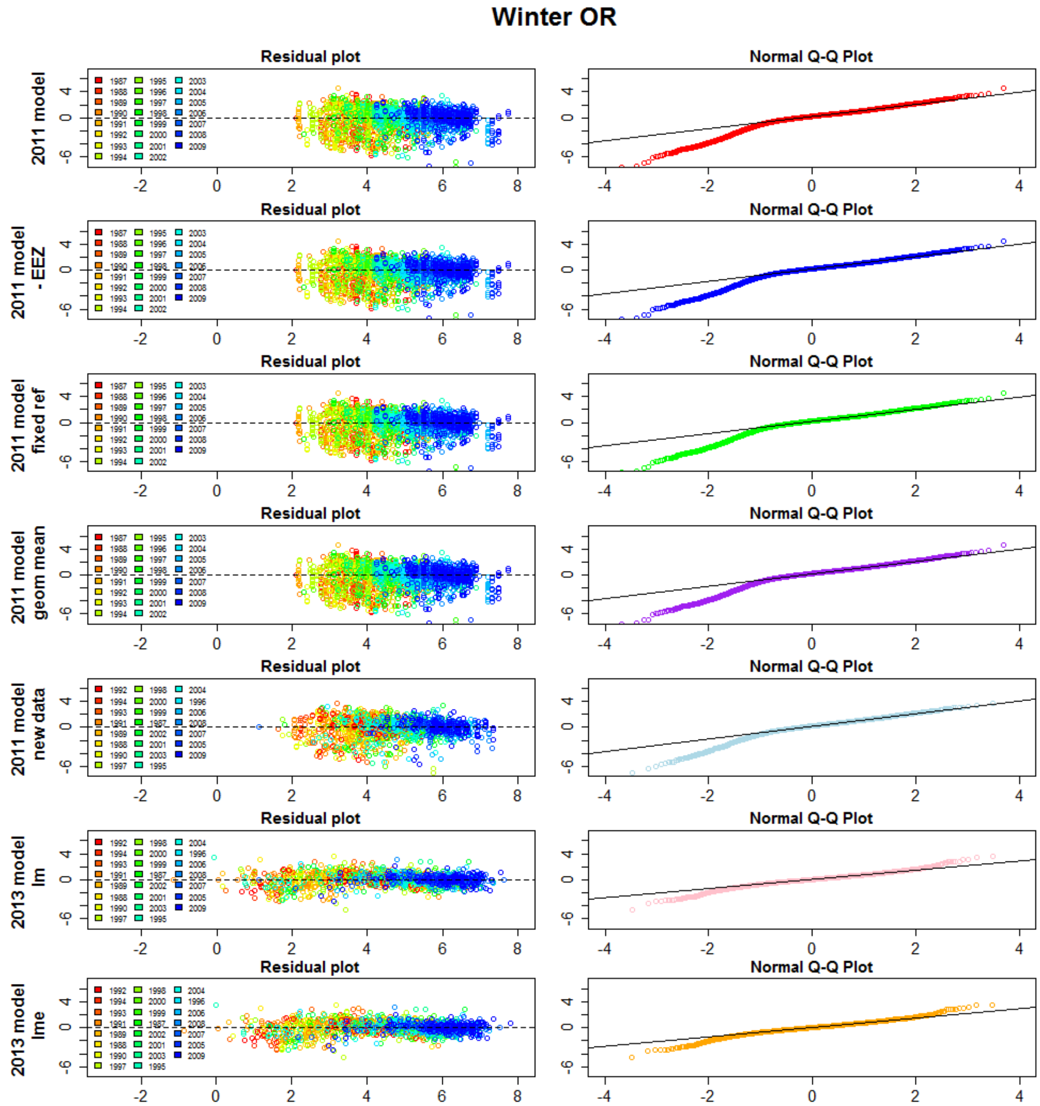


Figure B5d: Changes in residuals and QQ-plots pattern for the OR Winter fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

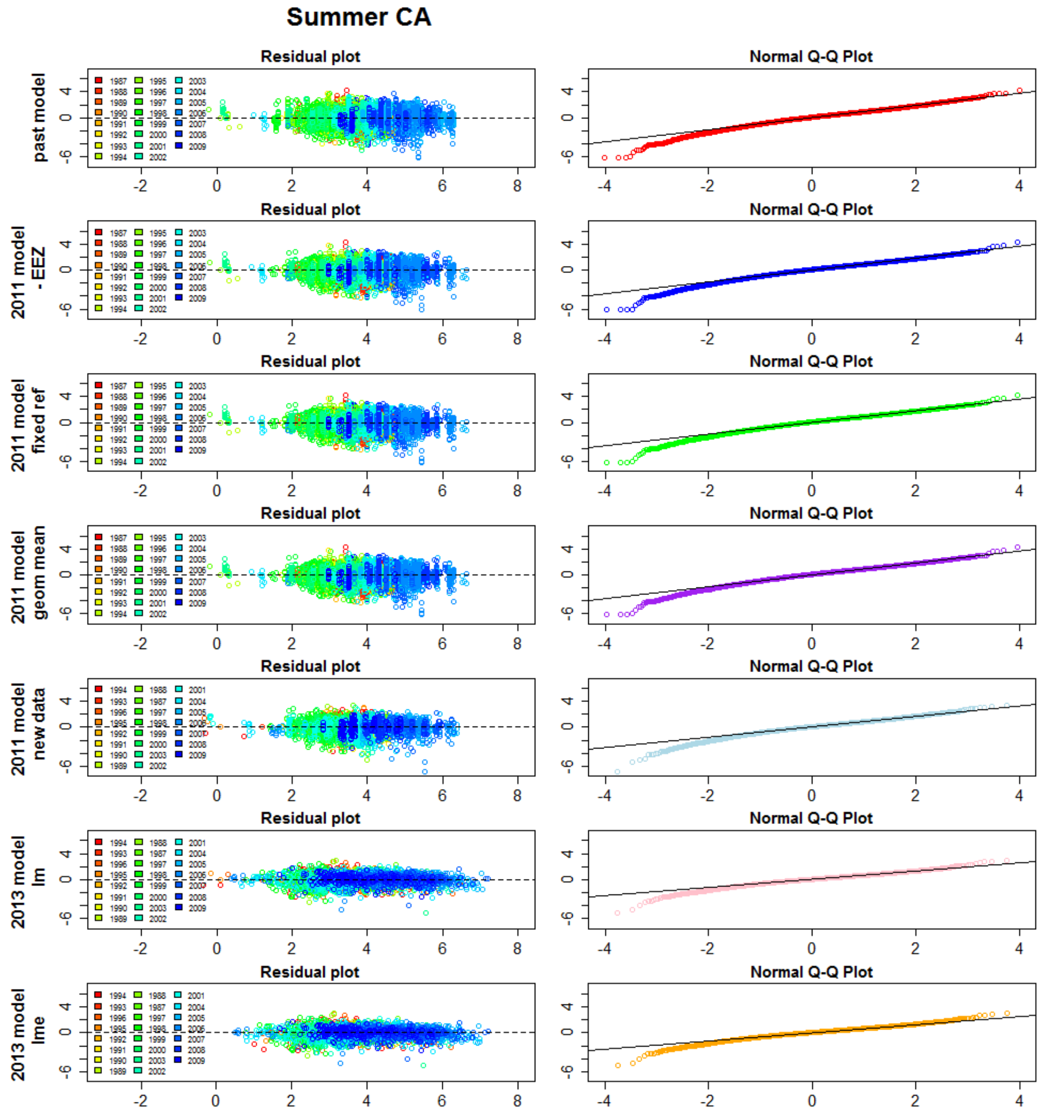


Figure B5e: Changes in residuals and QQ-plots pattern for the CA Summer fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

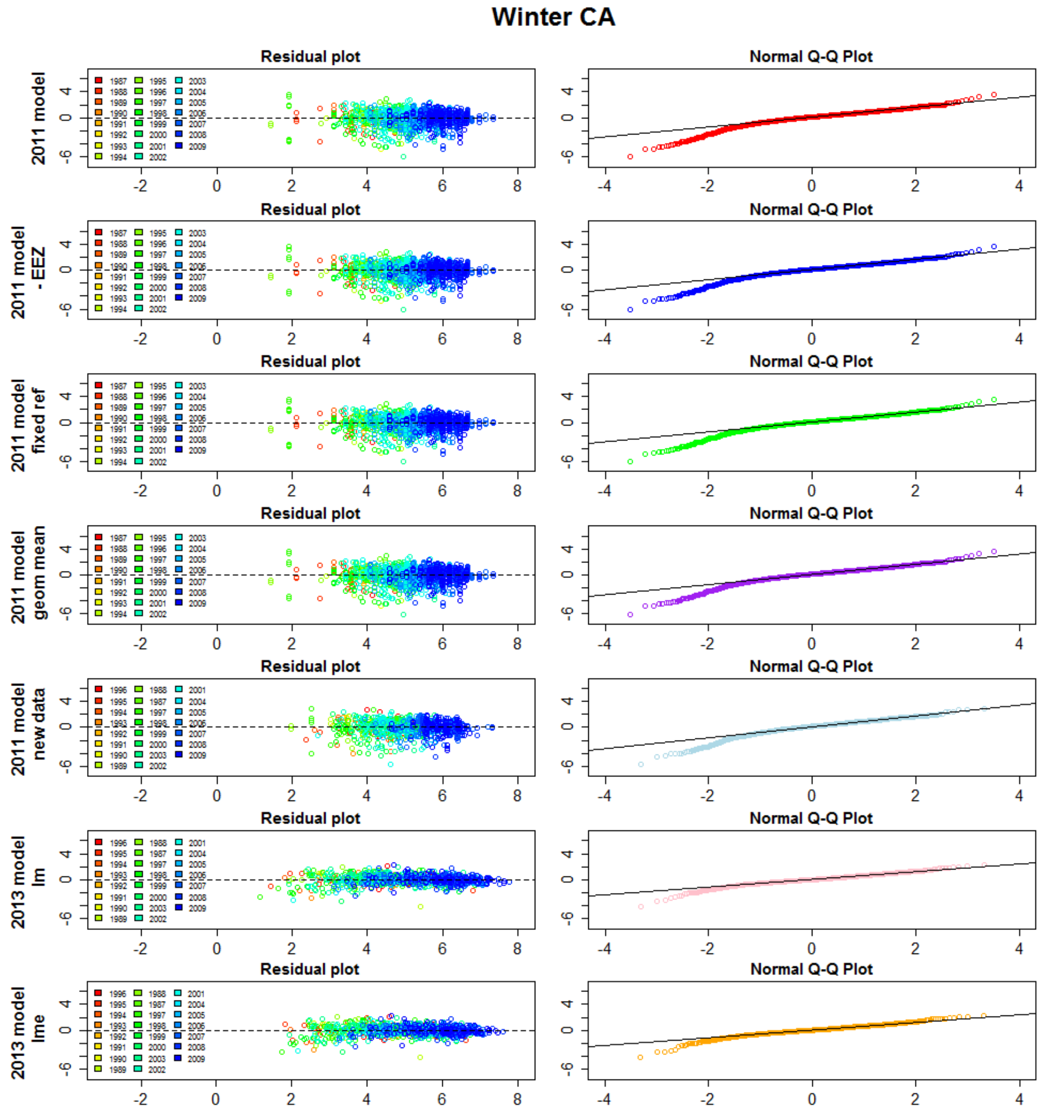


Figure B5f: Changes in residuals and QQ-plots pattern for the CA Winter fishery between the 2011 model and the 6 model updates described in the main text. The residual plot is coded in color.

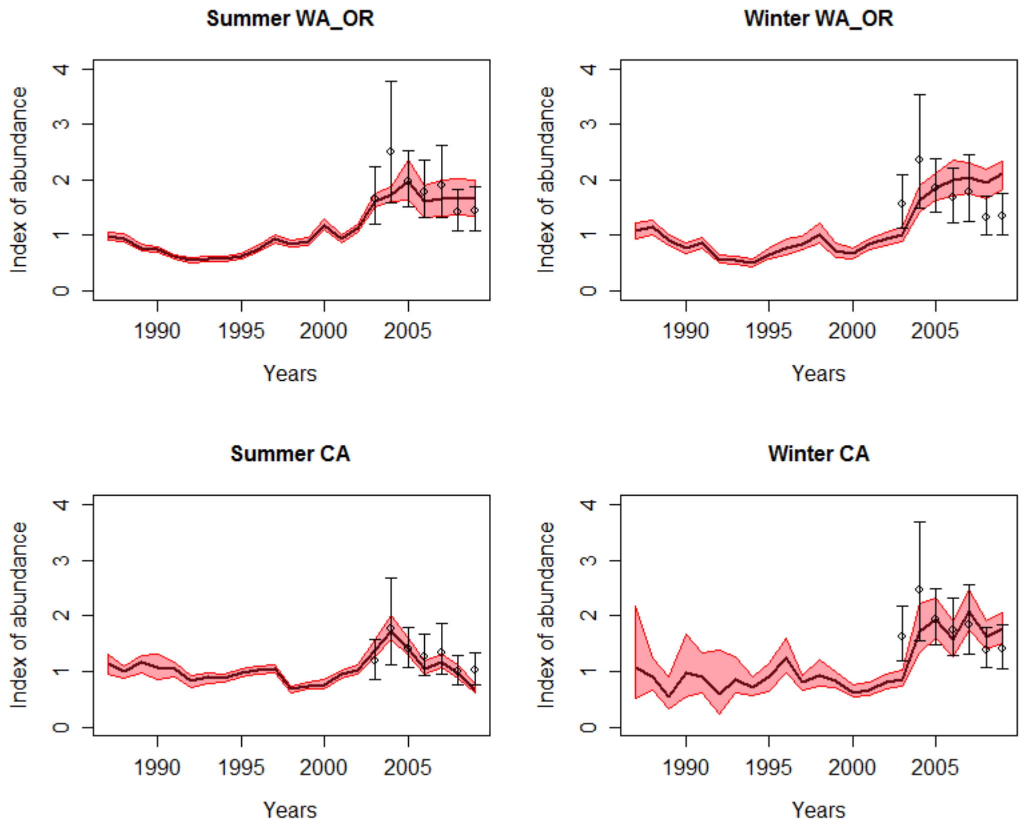


Figure B6: Final index of abundance based on the 2013 CPUE standardization model for the two regions (WA/OR and CA) and two seasons (summer and winter) with the prediction interval determined using a parametric bootstrap. The barplot corresponds to the survey CPUE index with its confidence interval. The later was standardized so that the 2005 survey and fishery CPUE have the same mean to facilitate visualization.

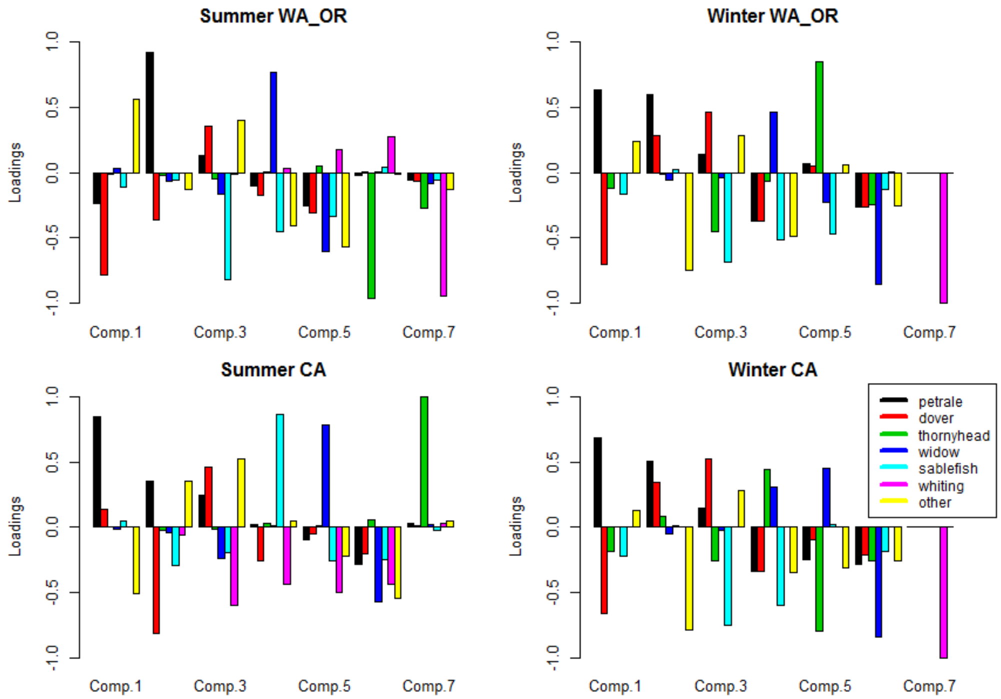


Figure B7: Model sensitivity to the size of the spatial grid (0.5 degree grid vs 1 degree grid)

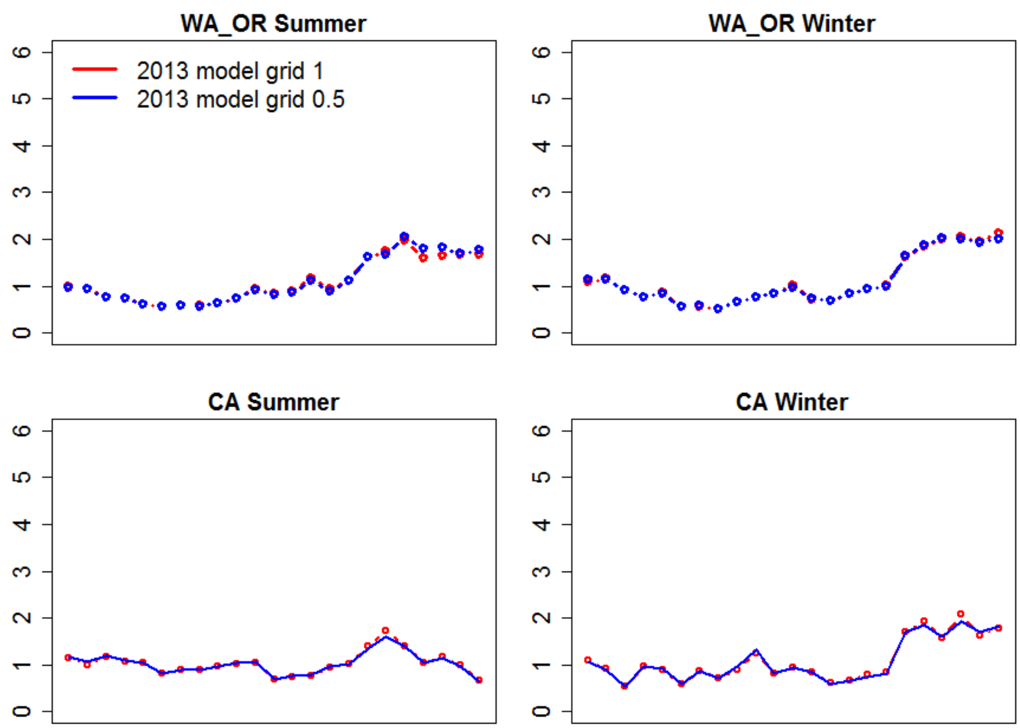


Figure B8: Model sensitivity to the size of the spatial grid (0.5 degree grid vs 1 degree grid)

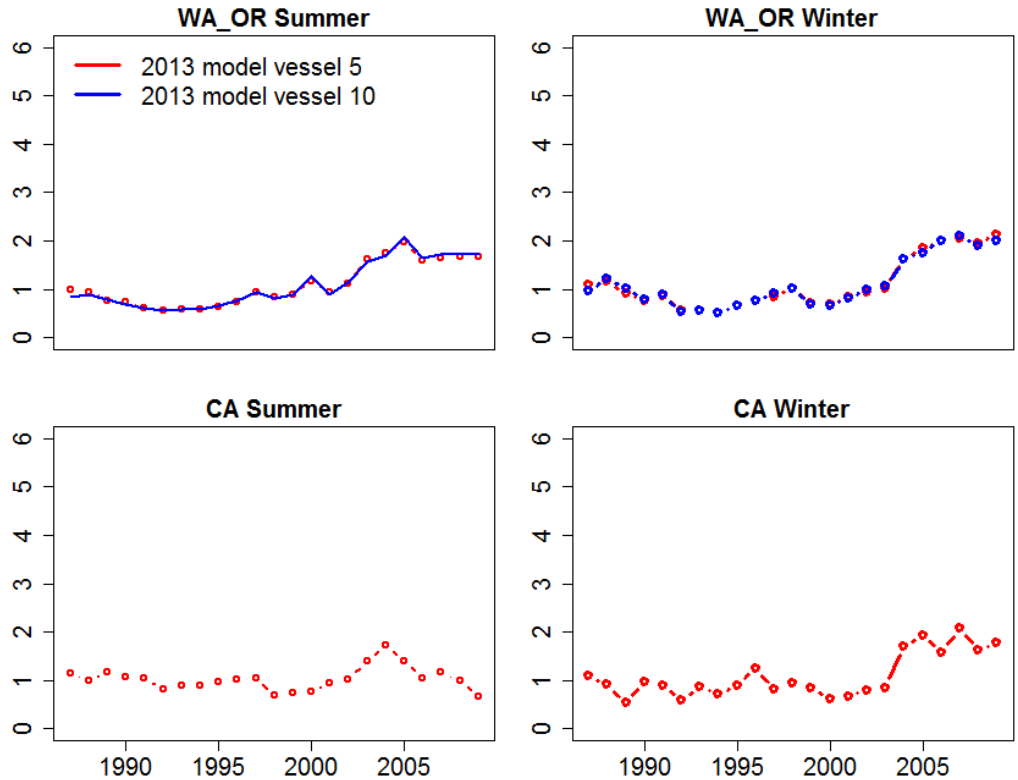


Figure B9: Model sensitivity to the choice of number of years a vessel had to be fishing to be included into the analysis (5 years vs 10 years)

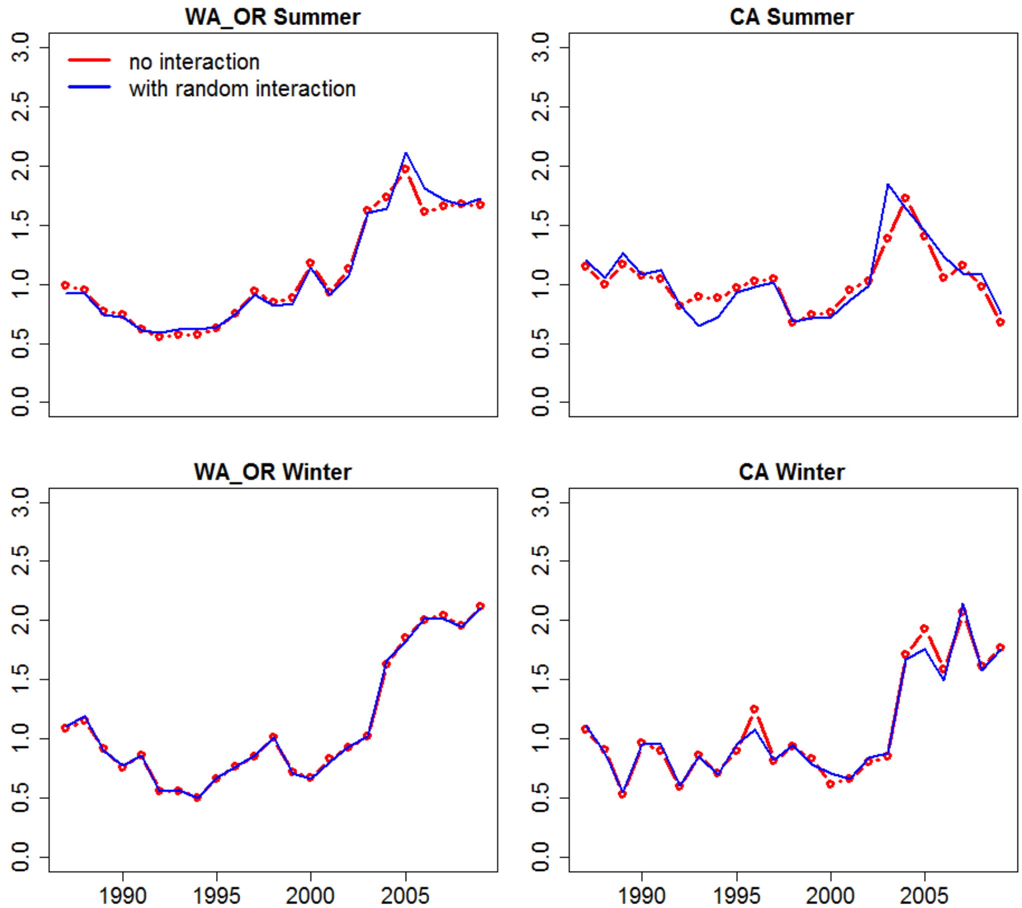


Figure B10: Model sensitivity to the use of random year:area interaction term for each region (WA/OR and CA) and season (summer and winter) combination.

Appendix B.10. TABLES

		Tow by tow data	Trip by trip data
Summer	WA	66834	13910
	OR	12918	4717
	CA	16405	6645
Winter	WA	4982	1613
	OR	5954	2370
	CA	2841	1307

Table 1: The number of data points within each type of data type (tow by tow *VS* trip)

Model name	**Summer**			**Winter**		
	WA	OR	CA	WA	OR	CA
2011 model	30%	52%	40%	43%	34%	40%
1. 2011 model – points outside of fishing grounds removed	27%	42%	40%	43%	34%	40%
2. 2011 model fixed reference	27%	42%	40%	43%	34%	40%
3. 2011 model geometric mean	27%	42%	40%	43%	34%	40%
4. 2011 model by trip	32%	47%	42%	34%	35%	34%
5. 2013 model with targeting covariates in lm	66%	71%	65%	66%	74%	72%
6. 2013 model with targeting covariates in lme	67%	71%	65%	44%	68%	74%

Table 2: Percent deviance explained by the final model for each of the 6 steps described in the main text and the 2011 model.

Season	Region	Model	Selected covariates for the 2013 model
Summer	WA/OR	Binomial	Year + Area + Bimonth + Port + PC1 + PC2 + PC3 + PC4 + (1|vessel)
		LogNornal	Year + Area + Gear + Bimonth + PC1 + PC2 + PC3 + PC4 + (1|vessel)
	CA	Binomial	Year + Area + Bimonth + PC1 + PC2 + PC3 + PC4 + (1|vessel)
		LogNornal	Year + Area + Gear + Bimonth + Port + PC1 + PC2 + PC3 + PC4 + (1|vessel)
Winter	WA/OR	Binomial	Year + Area + PC1 + PC2 + PC3 + PC4 + (1|vessel)
		LogNornal	Year + Area + PC1 + PC2 + PC3 + PC4 + (1|vessel)
	CA	Binomial	Year + Area + PC1 + PC2 + PC3 + PC4 + (1|vessel)
		LogNornal	Year + Area + PC1 + PC2 + PC3 + PC4 + (1|vessel)

Table B3: Covariates selection for the 2013 final models (both binomial and lognormal) for each season (Summer and Winter) and region (WA/OR and CA)

	Summer				Winter			
	WA/OR (mean)	WA/OR (sd)	CA (mean)	CA (sd)	WA/OR (mean)	WA/OR (sd)	CA (mean)	CA (sd)
1987	0.987	0.036	1.152	0.080	1.091	0.071	1.080	0.562
1988	0.950	0.038	0.999	0.043	1.155	0.064	0.908	0.170
1989	0.770	0.033	1.165	0.066	0.918	0.052	0.533	0.188
1990	0.743	0.031	1.077	0.115	0.759	0.049	0.963	0.367
1991	0.614	0.022	1.040	0.068	0.860	0.047	0.895	0.218
1992	0.555	0.022	0.821	0.054	0.556	0.042	0.592	0.408
1993	0.573	0.026	0.890	0.048	0.561	0.032	0.863	0.202
1994	0.574	0.028	0.878	0.034	0.503	0.044	0.713	0.102
1995	0.629	0.029	0.970	0.044	0.660	0.055	0.900	0.122
1996	0.748	0.033	1.026	0.039	0.767	0.082	1.250	0.184
1997	0.937	0.041	1.042	0.045	0.850	0.075	0.817	0.060
1998	0.844	0.036	0.676	0.035	1.009	0.113	0.933	0.140
1999	0.879	0.037	0.745	0.037	0.714	0.074	0.831	0.084
2000	1.177	0.057	0.757	0.046	0.674	0.050	0.618	0.067
2001	0.932	0.038	0.951	0.038	0.830	0.052	0.663	0.069
2002	1.126	0.043	1.026	0.044	0.930	0.066	0.799	0.079
2003	1.620	0.073	1.383	0.097	1.018	0.067	0.847	0.088
2004	1.737	0.075	1.726	0.143	1.629	0.137	1.711	0.258
2005	1.969	0.195	1.399	0.104	1.853	0.129	1.929	0.198
2006	1.608	0.151	1.050	0.067	2.007	0.183	1.584	0.172
2007	1.656	0.171	1.161	0.077	2.045	0.139	2.068	0.201
2008	1.675	0.179	0.981	0.066	1.955	0.124	1.616	0.154
2009	1.665	0.166	0.674	0.052	2.118	0.109	1.765	0.151

Table B4: Index of abundance for each region (WA/OR and CA) and season (summer and winter) with the associated standard deviation (sd).

Appendix C. Management actions impacting the petrale fishery prior to the implementation of the trawl ITQ program

Dan Erickson, ODFW Marine Resource Program, in collaboration with Brad Pettinger and members of industry compiled the following summaries of how management actions may have impacted the petrale sole fishery.

Major Management Shifts that could Impact Stock Assessments.

Effective October 18, 1982
- First trip limits established (widow rockfish and sablefish).

Effective January 1, 1992
- First **cumulative trip limits** for various species and species groups (widow RF; Sebastes complex; Pacific ocean perch; deepwater complex; non-trawl sablefish).

Effective May 9, 1992
- Increased the **minimum legal codend mesh size** for roller trawl gear north of Point Arena, California (40° 30' N latitude) from 3.0 inches to 4.5 inches; prohibited double-walled codends; removed provisions regarding rollers and tickler chains for roller gear with codend mesh smaller than 4.5 inches.

Effective January 1, 1994
- Divided the commercial groundfish fishery into two components: the **limited entry** fishery and the open access fishery.
    - A federal limited entry permit is required to participate in the limited entry segment of the fishery. Permits are issued based on the fishing history of qualifying fishing vessels.

Effective September 8, 1995
- The **trawl minimum mesh size** now applies throughout the net; removed the legal distinction between bottom and roller trawls and the requirement for continuous riblines; clarified the distinction between bottom and pelagic (midwater) trawls; modified chafing gear requirements;

Effective January 1, 1999:
- Dividing line between north and south management areas moved to 40° 10'.

Effective January 1, 2000
- **Chafing gear** may be used only on the last 50 meshes of a small footrope trawl, running the length of the net from the terminal (closed) end of the codend.

New rockfish categories in 2000.
- Rockfish (except thornyheads) are divided into new categories north and south of 40° 10' N. lat., depending on the depth where they most often are caught: nearshore, shelf, or slope. New trip limits have been established for "minor rockfish" species according to these categories.
    - Nearshore: numerous minor rockfish species including black and blue rockfishes.
    - Shelf: shortbelly, widow, yellowtail, bocaccio, chilipepper, cowcod rockfishes, and others.

- Slope: Pacific ocean perch, splitnose rockfish, and others

<u>New Limited Entry Trawl Gear Restrictions in 2000</u>.

- Limited entry trip limits may vary depending on the type of trawl gear that is onboard a vessel during a fishing trip: large footrope, small footrope, or midwater trawl gear.
    - **Large footrope trawl gear** is bottom trawl gear, with a footrope diameter larger than 8 in. (20 cm) (including rollers, bobbins or other material encircling or tied along the length of the footrope).
    - **Small footrope trawl gear** is bottom trawl gear, with a footrope diameter 8 in. (20 cm) or smaller (including rollers, bobbins or other material encircling or tied along the length of the footrope), except chafing gear may be used only on the last 50 meshes of a small footrope trawl, running the length of the net from the terminal (closed) end of the codend.
    - **Midwater trawl gear** is pelagic trawl gear, The footrope of midwater trawl gear may not be enlarged by encircling it with chains or by any other means.

<u>Effective during 2001</u>:

- First conservation area was established (Cowcod Conservation Area)
- The West Coast Observer Program was initiated
- It is unlawful to take and retain, possess or land petrale sole from a fishing trip if large footrope gear is onboard and the trip is conducted at least in part between May 1 and October 31

<u>Effective during 2002</u>:

- Darkblotched Conservation Area was established.

<u>Effective during 2003</u>:

- Vessel buyback program was initiated (December 4, 2003)
- Yelloweye Rockfish Conservation Area was established
- Rockfish Conservation areas for several rockfish species were established.

<u>Effective during 2004</u>:

- Vessel Monitoring System (VMS) was initiated.

<u>Effective during 2005:</u>

- Selective flatfish trawl required shoreward of the RCA North of 40^{o} 10’.

Petrale Sole – First Major Regulations

<u>Effective 1983</u>

- First established coast-wide ABC limits for annual harvest of petrale sole.

<u>Effective April 1, 1999 (April 16, 1999 for "B" platoon vessels)</u>

- Limited Entry and Open Access *Sebastes* complex: north and south of Cape Mendocino, if a vessel takes and retains, possesses, or lands any splitnose or chilipepper rockfish south of Cape Mendocino, then the more restrictive *Sebastes* complex cumulative trip limit applies throughout the same cumulative limit period, no matter where the *Sebastes* complex is taken and retained, possessed, or landed.

<u>Effective during 2000</u>:

- For Limited Entry: large footrope trawl gear may be used to take………petrale sole from January 1-February 29 and November 1-December 31……., but these exceptions apply only on a trip that is conducted entirely during the periods in which use of large footrope gear is authorized. The presence of rollers or bobbins larger than 8 in. (20 cm) in diameter on board the vessel, even if not attached to a trawl, will be considered to mean a large footrope trawl is on board. Dates will be adjusted for the "B" platoon.

Effective during 2001:

- It is unlawful to take and retain, possess or land petrale sole from a fishing trip if large footrope gear is onboard and the trip is conducted at least in part between May 1 and October 31

Effective 2002:

- First cumulative trip limits for petrale sole
    - In 2001, no restrictions except requirement for small footrope.
    - In 2002, monthly limit of 15,000 pounds during July and August.

Effective 2003:

- Bimonthly cumulative trip limits for summer petrale sole were initiated.

Effective 2004:

- Vessel buy back program came into effect. GAP members indicated that this resulted in a decrease in effort for petrale compared to earlier years.

Effective 2006-2009:

- Progressively decreasing trip limits implemented for the winter petrale fishery, however GAP members indicated that these trip limits were not actually restrictive because that were all well over 10,000 lbs, which is a typical winter petrale trip.

Table C1. Annual RCA depth boundaries 2002 – 2009 (does not include in-season changes).

<table>
<tr><th>Year</th><th>Location</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="10">2008</td><td>North 48 10</td><td colspan="2">0 - ^{m}200</td><td colspan="2">0 - 200</td><td colspan="6">0 - 150</td><td colspan="2">0 - ^{m}200</td></tr>
<tr><td>48 10 - 46 38.17</td><td colspan="2" rowspan="4">75 - ^{m}200</td><td colspan="2">60 - 200</td><td colspan="5">60 - 150</td><td rowspan="2">75 - 150</td><td colspan="2" rowspan="4">75 - ^{m}200</td></tr>
<tr><td>46 38.17 - 46 16</td><td colspan="4">60 - 200</td><td colspan="3">60 - 150</td></tr>
<tr><td>46 16 - 45 46</td><td colspan="2">75 - 200</td><td colspan="4">75 - 150</td><td colspan="2">75 - 200</td></tr>
<tr><td>45 46 - 43 20.83</td><td colspan="8">75 - 200</td></tr>
<tr><td>43 20.83 - 42 40.50</td><td colspan="2">0 - ^{m}200</td><td colspan="8">0 - 200</td><td colspan="2">0 - ^{m}200</td></tr>
<tr><td>42 40.5 - 40 10</td><td colspan="2">75 - ^{m}200</td><td colspan="2">75 - 200</td><td colspan="5">60 - 200</td><td>75 - 200</td><td colspan="2">75 - ^{m}200</td></tr>
<tr><td>40 10 - 34 27</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34 27 (mainland)</td></tr>
<tr><td>South 34 27 (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="8">2007</td><td>North 48 10</td><td colspan="2">0 - ^{m}200</td><td colspan="2">0 - 200</td><td colspan="6">0 - 150</td><td colspan="2">0 - ^{m}200</td></tr>
<tr><td>48 10 - 46 16</td><td colspan="2" rowspan="2">75 - ^{m}200</td><td colspan="2">60 - 200</td><td colspan="4">60 - 150</td><td colspan="2">75 - 150</td><td colspan="2" rowspan="2">75 - ^{m}200</td></tr>
<tr><td>46 16 - 43 20.83</td><td colspan="8">75 - 200</td></tr>
<tr><td>43 20.83 - 42 40.50</td><td colspan="2">0 - ^{m}200</td><td colspan="8">0 - 200</td><td colspan="2">0 - ^{m}200</td></tr>
<tr><td>42 40.50 - 40 10</td><td colspan="2">75 - ^{m}200</td><td colspan="8">75 - 200</td><td colspan="2">75 - ^{m}200</td></tr>
<tr><td>40 10 - 34 27</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34 27 (mainland)</td></tr>
<tr><td>South 34 27 (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="5">2006</td><td>North 40 10</td><td colspan="2">75 - ^{m}200</td><td colspan="4">75 - 200</td><td colspan="2">100 - 250</td><td colspan="2">75 - 250</td><td colspan="2">75 - ^{m}200</td></tr>
<tr><td>40 10 – 38</td><td colspan="2" rowspan="3">75 - 150</td><td colspan="4" rowspan="3">100 - 150</td><td colspan="2">100 - 200</td><td colspan="2">100 - 250</td><td colspan="2">75 - ^{m}250</td></tr>
<tr><td>38 - 34 27</td><td colspan="4" rowspan="2">100 - 150</td><td colspan="2" rowspan="2">75 - 150</td></tr>
<tr><td>South 34 27 (mainland)</td></tr>
<tr><td>South 34 27 (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="3">2005</td><td>North 40 10</td><td colspan="2">75 - ^{m}200</td><td colspan="7">100 - 200</td><td colspan="3" rowspan="2">0 - 250</td></tr>
<tr><td>40 10 – 38</td><td colspan="2" rowspan="2">75 - 150</td><td colspan="2">100 - 200</td><td colspan="5">100 - 150</td></tr>
<tr><td>38 – 36</td><td colspan="7">100 - 150</td><td colspan="3">0 - 200</td></tr>
</table>

	36 - 34 27						50 - 200	
	South 34 27 (mainland)							
	South 34 27 (islands)	0 - 150					0 - 200	
2004	North 40 10	75 - [m]200	60 - 200	60 - 150	75 - 150		0 - 250	
	40 10 – 38	75 - 150		100 - 150		75 - 150		
	38 – 36						0 - 200	
	36 - 34 27						0 - 150	
	South 34 27 (mainland)							
	South 34 27 (islands)	0 - 150						
2003	North 40 10	100 - [m]250	100 - 250	50 - 200	75 - 200	50 - 200		0 - [m]200
	40 10 – 38	50 - [m]250	60 - 250	60 - 200				
	38 - 34 27	50 - 150	60 - 150					
	South 34 27 (mainland)	100 - 150		100 - 200				0 - 200
	South 34 27 (islands)	0 - 150		0 - 200				
2002	North 40 10	Within DBCA - CLOSED TO TRAWLING;				Special footrope requirements outside DBCA		

[m]The "modified" depth" line is modified to exclude certain petrale sole areas from the RCA.

Appendix D. SS data file

#C 2013 Assessent of Petrale (Haltuch, Ono, Valero) run with SS3.24O
#_bootstrap file: 1
#year is from Nov-Oct
#Winter in yr 1 includes Nov-Dec from yr-1
1876 #_styr
2012 #_endyr
1 #_nseas
12 #_months/season
1 #_spawn_seas
4 #_Nfleet
3 #_Nsurveys
1 #_N_areas
WinterN%SummerN%WinterS%SummerS%TriEarly%TriLate%NWFSC
0.16 0.67 0.16 0.67 0.73 0.67 0.67 #_surveytiming_in_season
1 1 1 1 1 1 1 #_area_assignments_for_each_fishery_and_survey
1 1 1 1 #_units of catch: 1=bio; 2=num
0.01 0.01 0.01 0.01 #_se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3
2 #_Ngenders
40 #_Nages

0 0 0 0 #_init_equil_catch_for_each_fishery
137 #_N_lines_of_catch_to_read

#WinterN	SummerN	WinterS	SummerS	Year	Season
0.000	0.000	0.000	1.000	1876	1
0.000	0.000	0.000	1.000	1877	1
0.000	0.000	0.000	1.000	1878	1
0.000	0.000	0.000	1.000	1879	1
0.000	0.000	0.000	11.550	1880	1
0.000	0.000	0.000	22.100	1881	1
0.000	0.000	0.000	32.650	1882	1
0.000	0.000	0.000	43.200	1883	1
0.000	0.000	0.000	53.750	1884	1
0.000	0.000	0.000	64.300	1885	1

0.000	0.000	0.000	74.850	1886	1
0.000	0.000	0.000	85.400	1887	1
0.000	0.000	0.000	95.950	1888	1
0.000	0.000	0.000	106.500	1889	1
0.000	0.000	0.000	117.050	1890	1
0.000	0.000	0.000	127.600	1891	1
0.000	0.000	0.000	138.150	1892	1
0.000	0.000	0.000	148.710	1893	1
0.000	0.000	0.000	159.260	1894	1
0.000	0.000	0.000	169.810	1895	1
0.000	0.242	0.000	180.360	1896	1
0.000	0.198	0.000	190.910	1897	1
0.000	0.154	0.000	201.460	1898	1
0.000	0.150	0.000	212.010	1899	1
0.000	0.146	0.000	222.560	1900	1
0.000	0.142	0.000	233.110	1901	1
0.000	0.138	0.000	243.660	1902	1
0.000	0.133	0.000	254.210	1903	1
0.000	0.129	0.000	264.760	1904	1
0.000	0.125	0.000	275.310	1905	1
0.000	0.121	0.000	285.860	1906	1
0.000	0.117	0.000	296.410	1907	1
0.000	0.113	0.000	306.960	1908	1
0.000	0.108	0.000	317.510	1909	1
0.000	0.104	0.000	328.060	1910	1
0.000	0.100	0.000	338.610	1911	1
0.000	0.096	0.000	349.160	1912	1
0.000	0.092	0.000	359.710	1913	1
0.000	0.088	0.000	370.260	1914	1
0.000	0.083	0.000	380.810	1915	1
0.000	0.079	0.000	386.420	1916	1
0.000	0.075	0.000	526.410	1917	1
0.000	0.071	0.000	423.850	1918	1
0.000	0.067	0.000	333.440	1919	1
0.000	0.063	0.000	230.490	1920	1

0.000	0.058	0.000	293.760	1921	1
0.000	0.054	0.000	424.780	1922	1
0.000	0.050	0.000	427.360	1923	1
0.000	0.046	0.000	532.860	1924	1
0.000	0.042	0.000	528.470	1925	1
0.000	0.038	0.000	521.670	1926	1
0.000	0.035	0.000	632.040	1927	1
0.000	0.0005	0.000	620.090	1928	1
0.000	1.542	0.000	706.040	1929	1
0.000	1.225	0.000	658.830	1930	1
0.000	81.451	63.393	530.879	1931	1
1.990	250.878	36.396	519.912	1932	1
5.960	408.431	38.566	392.080	1933	1
9.930	567.855	139.408	896.363	1934	1
13.900	649.957	155.383	777.206	1935	1
15.880	769.786	95.492	431.506	1936	1
19.750	1051.408	74.525	741.046	1937	1
27.490	1186.868	47.860	890.000	1938	1
35.220	1544.538	30.839	1028.962	1939	1
39.090	1736.581	161.807	596.696	1940	1
41.400	1802.657	110.810	331.166	1941	1
46.000	2919.254	24.368	215.556	1942	1
50.610	2867.305	71.659	344.717	1943	1
55.210	2046.967	85.530	446.913	1944	1
59.820	1866.047	101.753	439.343	1945	1
64.430	2492.355	71.912	1115.569	1946	1
69.030	1777.987	153.680	1092.655	1947	1
73.640	2314.744	272.662	1778.018	1948	1
75.940	1808.645	616.958	1812.179	1949	1
156.210	2322.237	424.238	1638.087	1950	1
117.970	1665.615	208.450	992.794	1951	1
131.010	1390.431	326.309	881.699	1952	1
46.070	737.103	533.360	981.167	1953	1
26.560	903.363	800.580	1073.403	1954	1
57.140	862.592	525.579	1051.745	1955	1

137.251759.217508.296800.7301956 1
170.9471103.287 527.2121027.183 1957 1
99.180 1152.193 567.972957.2881958 1
332.103946.779379.043723.1701959 1
240.8681374.201 519.638643.7371960 1
216.6561546.633 542.0561028.728 1961 1
294.8551511.890 514.912859.3691962 1
663.2941038.412 534.032977.6391963 1
282.3191090.041 377.620926.7981964 1
370.455950.391373.691852.8821965 1
366.063971.694324.878924.6261966 1
408.625793.421532.275874.0791967 1
284.404810.617360.610870.7571968 1
190.3398 887.2988 421 848 1969 1
411.7056 1081.3056 472 1071 1970 1
742.6239 882.6067 540 1016 1971 1
730.4228 1016.8779 703 1000 1972 1
497.4696 1271.8321 417 742 1973 1
516.9943 1610.5252 665 893 1974 1
538.9519 1559.1587 561 901 1975 1
505.7288 951.1170 713 737 1976 1
682.0842 742.7714 484 495 1977 1
746.2496 1097.7504 419 801 1978 1
734.3089 1085.5609 353 945 1979 1
382.4983 976.2298 518 680 1980 1
760.671467.912359.662895.2191981 1
1041.185 770.688261.527502.0681982 1
696.317935.345272.602361.1191983 1
415.773739.012259.829328.9891984 1
392.131552.894273.264471.1291985 1
474.121714.443402.910355.0561986 1
854.042572.666311.090556.0801987 1
742.900610.432349.106411.0351988 1
695.992583.013392.604414.7321989 1
640.655459.820319.426372.6801990 1

792.584397.337448.010310.1171991 1
639.526365.974271.705307.2601992 1
685.385392.080237.092233.9851993 1
518.127355.428245.861299.4061994 1
591.366453.922235.561287.4251995 1
591.033439.746405.922393.9421996 1
621.054430.036447.633442.2781997 1
522.143577.351220.734300.4581998 1
463.344504.248286.802266.6431999 1
610.157585.531373.622241.4602000 1
691.412596.985308.335260.2952001 1
666.972713.850335.160195.1152002 1
544.484713.444256.210179.6702003 1
1009.912 749.507 177.237 267.160 2004 1
963.6821068.763 337.181 533.414 2005 1
537.4461011.620 125.283 453.537 2006 1
930.384536.108404.351474.8642007 1
842.461353.816519.444414.0242008 1
846.710641.747469.659250.3792009 1
258.086292.34377.602 120.9522010 1
221.604423.10539.585 77.704 2011 1
406.049477.707124.4597 107.6337 2012 1

#Abundance indices
65 #nobs
#_Fleet/Survey (explicitly entered for future capability), Units (0=num; 1=bio; 2=F), Error distribution (-1=normal; 0=lognorm; >0=df_T). 1-4 and 8-9 have all a normal error distribution because it was obtained from a GLM with parametric bootstrap so we should -1 BUT as we only use Winter N and CA indices, just use -1 for these. there is an error message when using normal error with the Q type. So we only put -1 to the one we actually use
1 1 0
2 1 0
3 1 0
4 1 0
5 1 0
6 1 0

7	1	0				
#Year	Seas	Fleet	Value	SE(log(B))		
#winter commercial			cpue for the 2013		assessment	
1987	1	1	1.091	0.275191152	#	N
1988	1	1	1.155	0.27307458	#	N
1989	1	1	0.918	0.273326837	#	N
1990	1	1	0.759	0.275069479	#	N
1991	1	1	0.86	0.272921696	#	N
1992	1	1	0.556	0.277838058	#	N
1993	1	1	0.561	0.273408906	#	N
1994	1	1	0.503	0.281294972	#	N
1995	1	1	0.66	0.280043585	#	N
1996	1	1	0.767	0.287869483	#	N
1997	1	1	0.85	0.281530226	#	N
1998	1	1	1.009	0.2897726	#	N
1999	1	1	0.714	0.286685059	#	N
2000	1	1	0.674	0.27747458	#	N
2001	1	1	0.83	0.274629538	#	N
2002	1	1	0.93	0.276636644	#	N
2003	1	1	1.018	0.275365709	#	N
2004	1	1	1.629	0.280271487	#	N
2005	1	1	1.853	0.276294839	#	N
2006	1	1	2.007	0.28245981	#	N
2007	1	1	2.045	0.275886433	#	N
2008	1	1	1.955	0.274806968	#	N
2009	1	1	2.118	0.272303222	#	N
1987	1	3	1.08	0.557798105	#	S
1988	1	3	0.908	0.325509688	#	S
1989	1	3	0.533	0.434469417	#	S
1990	1	3	0.963	0.455100518	#	S
1991	1	3	0.895	0.359359883	#	S
1992	1	3	0.592	0.678342845	#	S
1993	1	3	0.863	0.353331697	#	S
1994	1	3	0.713	0.302924029	#	S

1995	1	3	0.9	0.299520506	#	S
1996	1	3	1.25	0.304861401	#	S
1997	1	3	0.817	0.277277663	#	S
1998	1	3	0.933	0.306219382	#	S
1999	1	3	0.831	0.285779429	#	S
2000	1	3	0.618	0.288425341	#	S
2001	1	3	0.663	0.286839292	#	S
2002	1	3	0.799	0.285013103	#	S
2003	1	3	0.847	0.286776015	#	S
2004	1	3	1.711	0.306572346	#	S
2005	1	3	1.929	0.286329601	#	S
2006	1	3	1.584	0.288489098	#	S
2007	1	3	2.068	0.284440853	#	S
2008	1	3	1.616	0.283803782	#	S
2009	1	3	1.765	0.280707101	#	S
#early	triennial					
#Year	Season	Fleet	Value	seLogB		
1980	1	5	1863.939037	0.328810444		
1983	1	5	2299.824418	0.128134397		
1986	1	5	2192.978622	0.146227217		
1989	1	5	3234.011806	0.109135043		
1992	1	5	2125.822633	0.116710279		
#late	triennial					
1995	1	6	2407.101199	0.147946883		
1998	1	6	3547.914184	0.112120606		
2001	1	6	3831.630638	0.115111377		
2004	1	6	9713.248317	0.140543239		
# glmm	NWFSC index for the 2013 assessment					
#Year	Season	Fleet	Value	seLogB		
2003	1	7	18297.78731	0.156022881		
2004	1	7	27551.88827	0.22060519		
2005	1	7	21670.60066	0.132358805		
2006	1	7	19571.86613	0.14894693		
2007	1	7	20788.85206	0.172820929		
2008	1	7	15597.49455	0.133771849		

2009	1	7	15783.65562	0.140730792
2010	1	7	22573.61379	0.136966137
2011	1	7	30366.63363	0.12732552
2012	1	7	36852.04055	0.151725306

#_Discards
4 # N fleets with discard
#Fleet, Units#(1=biomass,2=fraction), Error
1 2 -1
2 2 -1
3 2 -1
4 2 -1

48 #nobs_disc
#Pikitch Winter

#Year	Seas	Fleet	Ratio	stdev
1985	1	1	0.0222	0.1103
1986	1	1	0.0215	0.1162
1987	1	1	0.0270	0.1186

#Pikitch Summer

#Year	Seas	Fleet	Ratio	stdev
1985	1	2	0.0346	0.0419
1986	1	2	0.0343	0.0432
1987	1	2	0.0315	0.0450

#WCGOP

#Years	Seasons	Fleet	Mean_ratio	STDEV_ratio			
2002	1	1	0.0077	0.0034	#2mo data	Jan-Feb	NCS
2003	1	1	0.0100	0.0064			
2004	1	1	0.0019	0.0008			
2005	1	1	0.0013	0.0009			
2006	1	1	0.0131	0.0073			
2007	1	1	0.0037	0.0015			
2008	1	1	0.0275	0.0146			
2009	1	1	0.0253	0.0151			
2010	1	1	0.1971	0.0444			

2011	1	1	0.0017	0.0000	#2mo data	Jan-Feb	CS
2012	1	1	0.0006	0.0000	#2mo data	Nov-Dec	CS
2002	1	2	0.1856	0.0253			
2003	1	2	0.1111	0.0252			
2004	1	2	0.0843	0.0244			
2005	1	2	0.0421	0.0112			
2006	1	2	0.0780	0.0171			
2007	1	2	0.1138	0.0232			
2008	1	2	0.0502	0.0167			
2009	1	2	0.2018	0.0673			
2010	1	2	0.1037	0.0308			
2011	1	2	0.0370	0.0000			
#2012	1	2	0.0000	0.0000			
2002	1	3	0.0372	0.0244	#2mo data	Jan-Feb	NCS
2003	1	3	0.0062	0.0026			
2004	1	3	0.0526	0.0521			
2005	1	3	0.0069	0.0071			
2006	1	3	0.0598	0.0446			
2007	1	3	0.0194	0.0139			
2008	1	3	0.0099	0.0056			
2009	1	3	0.0221	0.0147			
2010	1	3	0.2584	0.0717			
2011	1	3	0.0009	0.0000	#2mo data	Jan-Feb	CS
2012	1	3	0.0046	0.0000	#2mo data	Nov-Dec	CS
2002	1	4	0.0569	0.0158			
2003	1	4	0.0325	0.0126			
2004	1	4	0.0343	0.0153			
2005	1	4	0.0122	0.0035			
2006	1	4	0.0360	0.0157			
2007	1	4	0.0610	0.0209			
2008	1	4	0.0259	0.0147			
2009	1	4	0.0233	0.0082			
2010	1	4	0.0554	0.0119			
2011	1	4	0.0411	0.0000			
#2012	1	4	0.0000	0.0000			

#_Mean_BodyWt
42 #nobs_mnwt #N_observations
30 #Degrees of freedom for Student's T distribution
#must be in kilograms

#	YEAR	Season	Fleet	Partition	Wghtd.Ave_W_kg	CV
2002	1	1	1	0.41109668	0.470839818	
2003	1	1	1	0.296714264	0.453253348	
2004	1	1	1	0.331760125	0.477172719	
2005	1	1	1	0.316130396	0.537503426	
2006	1	1	1	0.416980449	0.623837895	
2007	1	1	1	0.401019299	0.31406069	
2008	1	1	1	0.52169398	0.442717768	
2009	1	1	1	0.416490854	0.45259457	
2010	1	1	1	0.601361841	0.546528198	
2011	1	1	1	0.276266811	0.51633137	
2012	1	1	1	0.264194046	0.512322722	
2002	1	2	1	0.240597372	0.45254476	
2003	1	2	1	0.234067327	0.545932003	
2004	1	2	1	0.27436362	0.368487531	
2005	1	2	1	0.304357202	0.411846662	
2006	1	2	1	0.266883914	0.446533464	
2007	1	2	1	0.259009322	0.398513855	
2008	1	2	1	0.241003278	0.474617864	
2009	1	2	1	0.217003824	0.524842144	
2010	1	2	1	0.258471662	0.544325765	
2011	1	2	1	0.246277526	0.529968419	
2002	1	3	1	0.409963075	0.658202015	
2003	1	3	1	0.178195615	0.40686274	
2004	1	3	1	0.308563012	0.393827606	
2005	1	3	1	0.270195088	0.664186516	
2006	1	3	1	0.28395648	0.668245725	
2007	1	3	1	0.216647402	0.470450153	
2008	1	3	1	0.300154174	0.44548394	
2009	1	3	1	0.554297324	0.415971442	

2010	1	3	1	0.416960247	0.969237939
2011	1	3	1	0.325914252	0.132070642
2012	1	3	1	0.201967068	0.686972489
2002	1	4	1	0.189944455	0.738276131
2003	1	4	1	0.175143939	0.408831844
2004	1	4	1	0.183139252	0.47245741
2005	1	4	1	0.251891827	0.438407262
2006	1	4	1	0.318454956	0.642855376
2007	1	4	1	0.365889327	0.629305567
2008	1	4	1	0.218877948	0.427333515
2009	1	4	1	0.212614882	1.049014551
2010	1	4	1	0.183166651	0.369473321
2011	1	4	1	0.245672185	0.666042157

#Population length bins
2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
2 # binwidth for population size comp
4 # minimum size in the population (lower edge of first bin and size at age 0.00)
78 # maximum size in the population (lower edge of last bin)

#Length bins
-1 #min_tail #min_proportion_for_compressing_tails_of_observed_composition
0.001 #min_comp #constant_added_to_expected_frequencies
0 #_combine males into females at or below this bin number
#_Length_Composition_Data

26 #nlength #N_length_bins

#len_bins(1,nlength) #_lower_edge_of_length_bins

12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50
52 54 56 58 60 62

#LENGTH_COMPOSITIONS

237 #nobs length

#lendata(1,nobsl,1,6+gender*nlength) #Sorted_by_year_fleet_mkt:_0:Survey_1:Discard_2:Fisheries
#year Season Fleet gender partition nSamps F12 F14 F16 F18 F20 F22 F24 F26 F28 F30 F32
F34 F36 F38 F40 F42 F44 F46 F48 F50 F52 F54 F56 F58 F60 F62 M12 M14
M16 M18 M20 M22 M24 M26 M28 M30 M32 M34 M36 M38 M40 M42 M44 M46 M48
M50 M52 M54 M56 M58 M60 M62
1955 1 1 3 2 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0.788954635 3.15581854 4.733727811 5.522682446 5.719921105 4.930966469 4.142011834
1.775147929 1.972386588 0.394477318 0 0 0 0 0 0 0 0 0 0 0
0 0 0.394477318 4.142011834 11.04536489 18.93491124 21.69625247 8.08678501 2.169625247
0.394477318 0 0 0 0 0 0 0
1956 1 1 3 2 1 0 0 0 0 0 0 0 0 0 0 0
0.432900433 1.01010101 0.721500722 1.731601732 2.741702742 5.339105339 7.215007215 8.802308802
7.647907648 4.906204906 1.443001443 0.432900433 0.432900433 0.144300144 0 0 0 0 0
0 0 0 0 0 0 0.288600289 0.865800866 3.463203463 5.772005772 9.523809524
17.74891775 12.6984127 4.184704185 2.308802309 0.144300144 0 0 0 0 0 0
1957 1 1 3 2 10 0 0 0 0 0 0 0 0 0 0 0 0
0.011355959 0.129897292 0.40190161 1.158393538 2.030338951 4.524230798 7.940308334 7.897405459
8.62573406 5.971472386 2.352581948 1.683024178 0.437690478 0.123473177 0 0 0 0 0
0 0 0 0.151566192 0 0.003160279 0.149325519 1.784554501 4.321016621 13.36858884
17.29184057 13.6538557 4.389940862 1.172677118 0.230525757 0.119356784 0 0.075783096 0 0
0
1958 1 1 3 2 1 0 0 0 0 0 0 0 0 0 0.432900433
0.432900433 4.329004329 3.03030303 5.194805195 4.329004329 1.731601732 1.298701299 1.298701299

2.597402597 0.865800866 1.298701299 0.432900433 0.432900433 0 0 0 0 0 0 0
0 0 0 0 0 0.432900433 5.627705628 7.792207792 14.71861472 6.493506494 9.956709957
15.15151515 11.68831169 0.432900433 0 0 0 0 0 0 0
1959 1 1 3 2 2 0 0 0 0 0 0 0 0 0.113249961 0.566249807
0.79146326 1.244463106 1.921389934 4.618805485 4.838873056 5.172190589 5.057654157 2.365384488
3.046170727 3.155561278 3.725670496 3.391066493 1.811999384 0.338463414 0.111963491 0 0 0
0 0 0 0 0 0 0.113249961 0.566249807 1.019249653 3.483732929 12.32884873
20.38893362 12.54762983 5.375534046 1.344848364 0.223926982 0.225213453 0.111963491 0 0 0
0 0 0
1964 1 1 3 2 4 0 0 0 0 0 0 0 0 0 0 0 0
0.080893299 2.153631437 3.459014096 6.604186039 7.365343009 9.814503092 4.935395577 4.039977739
1.651922699 0.137467235 0.548487413 0.53959007 0 0 0 0 0 0 0 0 0
0 0 0 0.54042377 4.467317854 14.12316621 22.51171618 10.91479623 4.185025007 1.927143043
0 0 0 0 0 0 0 0 0
1965 1 1 3 2 3 0 0 0 0 0 0 0 0 0 0 0 0
0 0.370246816 4.140363842 5.950662575 10.06140302 10.42324776 11.00290988 7.081870698 3.720025958
2.090272774 0.839922126 0.370246816 0 0 0 0 0 0 0 0 0 0 0
0 0 0.740493632 7.127544601 9.778519103 16.91446578 5.308843793 3.358934861 0.370246816 0
0.349779142 0 0 0 0 0 0
1966 1 1 3 2 2 0 0 0 0 0 0 0 0 0 0 0 0
0 0.524958883 2.362314976 7.005324848 4.199671068 3.412232743 5.873787003 0.524958883 0.524958883
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.262479442
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19.51219512 2.43902439 0 0 0 2.43902439 0 0 0 0 0 0 0 0
0
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0
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0.179079121 0 0 0 0 0
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4.374324087 2.88232543 1.625072426 0.51592045 0.288138903 0 0 0 0 0 0 0
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0.426589153 0 0 0 0 0
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```
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2010	1	4	3	2	52	0	0	0	0	0.035231214	0	0	0.476976484	0.82875936
	1.788580765	2.912497335	7.869853373	6.401626452	8.944100817	7.42866272	7.934918497	5.937167714
	4.037849283	3.336895372	1.59610001	0.175487812	0.430007931	0	0	0	0	0	0	0
	0	0.20725738	1.658052438	0.253215639	2.017638575	5.837490367	9.798729918	11.35463655	5.221674588
	1.783551907	1.226530543	0.506506949	0	0	0	0	0	0	0	0	0	0	0
2011	1	4	3	2	23	0	0	0	0	0	0	0	0	0	0.068241788
	1.373489278	1.642831872	0.032387149	2.307136599	1.256335963	0.009128291	2.566308262	1.702344423
	5.210196389	3.365816253	1.072015185	0.040837387	0	0	0	0	0	0	0	0	0
	0	0	0	2.918939368	29.75299203	22.21446174	11.13750474	9.325381778	2.973549866	0.980215928
	0	0.040598353	0	0.00928736	0	0	0	0	0	0	0
2012	1	4	3	2	40	0	0	0	0	0	0	0	0	0.300596441	0.808330314
	2.294989736	4.952535418	10.54910505	6.379249661	5.784504558	3.324031813	1.60928357	1.660359157
	0.582338045	0.307915776	0.144178097	0.033377863	0.003095026	0	0	0	0	0	0	0
	0	0	0	0.874424409	5.175556075	11.77776524	19.5030045	12.20624852	7.94622387	2.890794437
	0.854237965	0.037854456	0	0	0	0	0	0	0	0	0	0
#DISCARDS, Pikitch


						#
#Year	season	fleet	sex	prt	Nsamp	12	14	16	18	20	22	24	26	28	30	32	34
	36	38	40	42	44	46	48	50	52	54	56	58	60	62	12	14	16
	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62
# No Discards1986	1	1	3	1		0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
1987	1	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.333333333	0.666666667	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
1986	1	2	3	1	1	0	0	0	0	0	0	0.5	0	0.5	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
```

0 0 0 0 0.5 0.5 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1987 1 2 3 1 4 0 0 0 0 0 0.1 0.25 0.4 0.25 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0.222222222 0.222222222 0.222222222 0.222222222 0.111111111 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
DISCARDS WCGOP
Year Season Fleet gender partition Nsamps 12 14 16 18 20 22 24 26 28 30
32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62

2006 1 1 0 1 18 0 0 0 0 0 0 0.075895721 0.231680178
0.291933163 0.143608615 0.054401188 0.106566711 0.095914423 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0.075895721 0.231680178
0.291933163 0.143608615 0.054401188 0.106566711 0.095914423 0 0 0 0 0 0 0
0 0 0 0 0 0
2007 1 1 0 1 19 0 0 0 0 0 0 0.051270043 0.048805137
0.038945513 0.222827494 0.441711138 0.14812852 0.040917438 0.007394718 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0.051270043 0.048805137
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0 0 0 0 0 0 0
2008 1 1 0 1 21 0 0 0 0 0 0.001009861 0 0.017357068
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0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.004525793
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0.057703864 0 0 0 0 0 0 0 0 0
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0.141630623 0.102282787 0.125284375 0.013445067 0.00114775 0.001414192 0 0.001311714 0 0
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2011 1 1 0 1 6 0 0 0 0 0 0 0.060040161 0.301405622
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0 0 0 0 0
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0 0
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2009 1 4 0 1 47 0 0 0.015980749 0.067563054 0.011719216 0.010440756
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0 0 0 0 0 0 0 0 0 0 0 0.015980749 0.067563054 0.011719216
0.010440756 0.195633531 0.136583186 0.106753467 0.331209574 0.086992237 0.03712423 0 0 0
0 0 0 0 0 0 0 0 0 0 0
2010 1 4 0 1 36 0 0 0 0.015650049 0.057688853 0.125529186 0.249381589
0.304387378 0.099702285 0.088499484 0.030775967 0.023033985 0 0.002675612 0.002675612 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0.015650049 0.057688853
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0.002675612 0 0 0 0 0 0 0 0 0 0

```
2011 1 4 0 1 86 0.000164167 0.000328334 0 0.000820834 0.000755167 0.012474639
0.057607477 0.135052524 0.42357887 0.325180244 0.038456075 0.002134168 0.0004925 0.000656667
0.0004925 0.000656667 0.000164167 0.0004925 0 0 0.000328334 0 0 0.000164167 0
0 0.000164167 0.000328334 0 0.000820834 0.000755167 0.012474639 0.057607477 0.135052524
0.42357887 0.325180244 0.038456075 0.002134168 0.0004925 0.000656667 0.0004925 0.000656667
0.000164167 0.0004925 0 0 0.000328334 0 0 0.000164167 0 0
# Early Triennial
# year season fleet gender partition Nsamp F120 F140 F160 F180 F200 F220 F240 F260 F280 F300 F320
F340 F360 F380 F400 F420 F440 F460 F480 F500 F520 F540 F560 F580 F600 F620 M120 M140
M160 M180 M200 M220 M240 M260 M280 M300 M320 M340 M360 M380 M400 M420 M440 M460 M480
M500 M520 M540 M560 M580 M600 M620 # Nsamp
# 1980 1 5 3 0 3 0 0 0 0 0 0 0 0 0 6.25 6.25
12.5 6.25 0 0 6.25 12.5 12.5 6.25 12.5 0 0 0 0 6.25 0 0 0
0 0 0 0 0 0 0 6.25 0 6.25 0 0 0 0 0 0 0
0 0 0 0 0 0 0 # 3
# 1983 1 5 3 0 6 0 0 0 0 0 0 0 0 0 0 0
6.822302 0 3.231572 6.642723 6.822302 3.231572 3.231572 3.4111508 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 3.411151 3.411151
6.463144 13.285446 26.570891 0 13.4650245 0 0 0 0 0 0 0 0
0 0 0 # 6
1986 1 5 3 0 108 0 0 0 0 1.6596962 1.0041337 0.8354633
2.303782 4.058277 4.182472 4.791801 7.882887.350428 6.827802 5.986836 4.478384
3.434614 1.3090633 1.2332347 0.1166741 0.16013406 0.11667405 0 0.779496 0.4666962
0.3500223 0 0 0.3109241 0 1.740464 0.1373429 1.674172 3.482537 6.477298
7.342662 6.517345 5.345761 4.046476 2.4557747 0.8926017 0.08997406 0.15810508 0
0 0 0 0 0 0 0 0 # 108
1989 1 5 3 0 423 0 0 0 0.1052069 0.3588284 0.5028671 1.2169388
3.259815 6.730053 6.187266 7.194915 6.631582 6.421608 5.175934 2.302481 1.90465
1.934135 1.8950102 1.1990297 0.2007844 0.61579352 1.0539511 0.20778636 0 0.1142395
0 0 0 0.1828081 0.24676949 0.2584429 0.789397 3.079195 4.484612 9.072959
10.093828 8.410339 4.135139 2.788852 0.8127312 0.1065291 0.32552306 0 0 0
0 0 0 0 0 0 0 # 423
1992 1 5 3 0 348 0 0.32474368 0 0.1394901 0.8133533 2.4790727
3.320116 6.583255 6.061974 6.792717.625509 6.235333 2.576828 3.017801 2.67297
1.521939 1.628344 0.5814746 0.3306431 0.5680355 0.06839995 0 0 0 0 0
```

0.11792894 0 0.1749639 0.19041256 1.1222446 4.707394.696595 8.496584 8.701466.313356
5.073841 3.679695 1.466543 1.2328105 0.6198415 0 0.06434122 0 0 0 0
0 0 0 0 0 # 348
Late triennial
year season fleet gender partition Nsamp F120 F130 F140 F150 F160 F170 F180 F190 F200 F210
F220 F230 F240 F250 F260 F270 F280 F290 F300 F310 F320 F330 F340 F350 F360 F370 F380
F390 F400 F410 F420 F430 F440 F450 F460 F470 F480 F490 F500 F510 F520 F530 F540 F550
F560 F570 F580 F590 F600 F610 F620 M120 M130 M140 M150 M160 M170 M180 M190 M200 M210
M220 M230 M240 M250 M260 M270 M280 M290 M300 M310 M320 M330 M340 M350 M360 M370 M380
M390 M400 M410 M420 M430 M440 M450 M460 M470 M480 M490 M500 M510 M520 M530 M540 M550
M560 M570 M580 M590 M600 M610 M620
1995 1 6 3 0 435 0 0 0.07113167 0.3083666 0.3002779 1.0183571
1.615746 3.182806 4.682894 7.976058 9.403384 8.463475 7.125601 4.737101
4.117477 2.183041 2.379451 0.6279602 0.4756187 0.353512 0.17624917 0 0 0
0 0 0 0 0.1479033 0.06763529 1.0742453 1.6033388 2.028175 4.437839
10.357724 8.828668 5.842812 3.848924 1.624353 0.4160944 0.2297767 0.06059428
0.23341073 0 0 0 0 0 0 0 0 0 # 435
1998 1 6 3 0 708 0 0 0 0.1586272 0.6080436 1.2437724 2.2963795
4.126429 5.761948 7.596899 7.509087 6.218312 4.620368 3.801603 3.741353
3.456325 2.447267 1.0059622 0.262176 0.2705981 0 0.0443206 0 0 0 0
0 0.10668527 0.2330066 1.0904484 1.8345259 2.6689145 3.175284 6.063336 7.278262
7.960775 6.496724.838427 2.206804 0.675890.1366078 0.06484532 0 0 0 0 0
0 0 0 0 0 # 708
2001 1 6 3 0 762 0 0 0.32694347 0.9743474 2.105 2.515713.2258802
3.558763 4.257112 3.832461 4.541249 4.756083 5.675763 4.643002 3.300652
2.971125 1.746044 0.9005112 1.0294343 0.249347 0.02490968 0.02289351 0.02402995 0
0 0 0.04157596 0.10822993 0.4084969 2.58638596 3.2142443 4.7297788 5.427194
5.973989 6.624309 7.334986 5.207461 3.781314 2.034424 1.1740123 0.5313371
0.02555972 0.02484693 0.09059624 0 0 0 0 0 0 0 0 # 762
2004 1 6 3 0 717 0 0.02139436 0.08299942 0.5802772 1.0488736 1.1848177
2.3620079 2.879266 3.638375 4.819311 5.524271 7.105853 6.528354 5.366425 4.13232
3.020991.742089 1.3468938 0.3893162 0.3487207 0.12168253 0.05431382 0.04138902 0 0
0 0.01373919 0.01136348 0.215975 1.00410174 2.1033238 2.0606149 3.217523 5.016838
5.432054 8.442793 9.185533 6.038449 3.555717 0.7214951 0.3462715 0.14573032
0.04220321 0 0.02931007 0.0269788 0 0.02253336 0.02751366 0 0 0 # 717

NWFSC Survey
#	year	Season	Fleet	gender	partition	nSamps	F12	F14	F16	F18	F20	F22	F24	F26	F28	F30
F32	F34	F36	F38	F40	F42	F44	F46	F48	F50	F52	F54	F56	F58	F60	F62	M12
M14	M16	M18	M20	M22	M24	M26	M28	M30	M32	M34	M36	M38	M40	M42	M44	M46
M48	M50	M52	M54	M56	M58	M60	M62
2003	1	7	3	0	589	0	0	0	0.424100167	0.319529102	0.563595495	0.813488274
1.615674824	2.712507824	5.769492898	6.234768119	5.569111307	6.06493576	4.827237289	3.713920644
3.440910943	2.209292977	0.841428208	0.920977771	0.764590114	0.245729952	0.190300685	0.072022941	0
0	0	0	0	0	0.207001771	0.44827548	0.975233377	2.184496776	5.50919698	8.970057534
10.79016413	11.68445422	6.021151408	3.975138724	1.396100738	0.329151547	0.168784447	0	0.027177579
0	0	0	0	0	0	0	0
2004	1	7	3	0	678	0	0	0.056665384	0.137830878	0.293202759	0.933753947
1.587794745	1.712898469	3.484314325	3.811270434	4.983188179	6.078973093	6.895308785	5.74832426
4.590631511	4.068533985	2.760201997	1.364295823	0.813854326	0.840747825	0.345478381	0.118609311
0.09178123	0	0	0.021948813	0	0	0.042697547	0.462156738	0.595929454	1.566434693
3.236511546	4.289244754	5.697377297	8.167097015	9.99042531	8.344244014	4.61047793	1.480051563
0.434895545	0.247315528	0.021231473	0.039974812	0.03432632	0	0	0	0	0	0	0
2005	1	7	3	0	905	0	0	0.017867442	0.081489124	0.34546188	0.804915532
1.474441634	1.527869347	1.873948065	2.589279653	4.763935584	5.162726482	5.655278744	7.356713186
5.017972494	4.044375331	2.238017592	1.453529857	1.304427631	0.263771572	0.196099633	0.397526853
0.071883523	0.022722436	0	0	0	0	0.027268062	0.399775941	1.291255755	1.742113524
2.26629727	2.884263257	4.813791327	7.324271272	10.39898202	9.555416334	6.65494066	3.397545092
1.870444422	0.445012037	0.250252368	0	0	0.014117063	0	0	0	0	0	0
2006	1	7	3	0	765	0	0	0	0.388187659	0.247937425	0.99203782	1.301517323
2.188692613	2.257025726	3.409002937	4.123763473	5.414717262	5.660651304	6.699402402	5.635953692
5.890280937	3.651681483	1.818365755	1.206537069	0.692669476	0.502321217	0.243147079	0.106580484	0
0	0	0	0	0.051700192	0.8204982	1.164156376	1.653770655	3.294349683	3.637442388
4.392230183	5.864780895	7.27209512	8.86520691	6.8909193	2.205155893	0.995401026	0.298614384
0.111314283	0	0.023327019	0.028564356	0	0	0	0	0	0
2007	1	7	3	0	732	0	0	0	0.275661813	0.470355266	1.417292206	1.531377298
1.725134754	3.276290057	4.762498499	4.881883394	5.736263154	6.444902996	5.537581543	6.190850485
5.487222448	3.783859777	2.890068007	1.275161665	0.882434599	0.362011367	0.221483603	0.079938451
0.038826621	0.023950857	0	0	0.032049258	0	0.258607275	1.200923712	2.815654751	3.272151639
4.296193999	4.181858473	6.734003709	6.119185738	6.151548039	4.226814461	2.220805741	0.605292097

0.313975045 0.210223475 0.029582486 0.036081242 0 0 0 0 0 0 0

2008 1 7 3 0 679 0 0 0.070419581 0.585166223 1.310437963 1.514508362
3.027855982 3.366589837 4.225019855 4.980236708 3.799722786 4.836204641 5.477437869 4.59279985
3.57983941 3.551048151 2.912759835 2.134162786 1.439580137 1.031642554 0.354756937 0.157688885
0.049505534 0 0 0 0.043874034 0 0.333729226 1.083834675 1.835328193 2.393476994
4.565041895 5.279164298 6.306563422 5.933110595 6.362847421 5.382442905 3.90723449 2.035117275
0.965214966 0.343604156 0.133671485 0.069396611 0.028963475 0 0 0 0 0 0 0
2009 1 7 3 0 753 0 0 0.07870442 0.888481971 1.823425862 1.984771251
2.403341974 2.980443734 2.96627747 3.868397091 3.482600435 4.96923127 5.348374478 5.28063806
4.55962336 4.546440495 3.590124652 2.804279434 1.798471739 0.94796138 0.851709338 0.209334088
0.02738752 0 0 0 0 0.050924131 0.172224797 2.081483984 3.258692547 3.088679661
3.798250902 3.957221958 5.077357931 4.789437549 5.734829687 5.128081247 3.526915414 2.282516766
1.139121778 0.265384889 0.16327675 0.016578988 0.059000998 0 0 0 0 0 0 0
2010 1 7 3 0 1160 0 0.038361335 0.153941419 0.602970781 1.689476477 2.8765107
3.128893231 3.836446751 4.191894609 4.359944066 3.900164425 4.866337427 4.759797616 4.311143716
4.116257471 2.636000943 2.520076524 1.660274083 0.91307721 0.325585974 0.1710123 0.093818843
0.039077242 0.054976994 0.037423653 0 0.018271193 0.039896256 0.220789241 0.969388748 2.471505732
4.556715403 4.810378007 5.354148331 5.471570708 6.783182487 6.776466968 5.514587385 3.103204229
1.754194087 0.609575413 0.195203345 0.067458678 0 0 0 0 0 0 0 0 0
2011 1 7 3 0 1176 0 0 0.030461083 0.337255039 1.105257703 2.70184995
3.654667497 3.896869199 4.912841762 5.35357626 5.516320893 5.208139426 4.627569468 4.642703766
3.490224166 2.827080451 2.437257187 1.328191447 0.87187191 0.672686262 0.251381733 0.090703128
0.057967489 0 0 0 0 0.014396431 0.030745002 0.546671376 1.741268757 3.601475292
4.583940664 6.219455406 5.585754197 6.504167883 6.159798842 5.727083036 3.28246803 1.107873924
0.651445311 0.181911535 0.046668497 0 0 0 0 0 0 0 0 0
2012 1 7 3 0 1044 0 0 0 0.110178811 0.455459838 1.214930517 2.404958016
2.986348694 4.056630075 5.317829262 5.605263444 6.404336368 5.810001137 5.443091592 3.851027722
2.926445613 2.472394851 1.187298748 0.664285986 0.687212829 0.345537222 0.09805622 0.024897681
0.007788615 0.009875542 0 0 0 0.02518857 0.176253272 0.570787915 1.974273099 3.234176629
5.002516455 7.090356286 8.973921444 7.674192832 6.373080497 4.107163335 1.800852657 0.719553528
0.110992766 0.082841934 0 0 0 0 0 0 0 0 0

#_AGE_DATA
17 #n_abins #_N_agebins #(<=_#_of_age,_the_model_always_start_at_age_0)

#age_bins1(1,n_abins) #_lower_age_of_agebins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

#_Age_error

8 #N_ageerr
#age_err(1,N_ageerr,1,2,0,nages) #_vector_with_stddev_of_ageing_precision_for_each_AGE_and_type

#Age0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
35 36 37 38 39 40
#perfect_age_(ageerr=1_given_but_not_used)

-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
-1 -1 -1 -1 -1 -1
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
0.001 0.001 0.001 0.001 0.001 0.001

#CAP BB use this for Survey, ORComm 2007-present, CAComm 2005-present

0.261729 1.346392.406253.441874.453815.4426 6.408787.352878.275369.1767710.057610.918211.759212.580913.383814.168414.935
15.684116.416117.131317.830218.513119.180419.832420.469521.092 21.700322.294722.875523.443 23.997624.539425.068925.5862
26.091826.585727.068427.54 28.000828.451128.8912
0.169177 0.169177 0.228825 0.293411 0.363345 0.439070.521065 0.609848 0.705983
0.810078 0.922792 1.044841.176991.320081.475031.6428 1.824462.021162.234162.464782.7145 2.9849 3.277693.59472
3.938 4.309714.712195.147995.619886.130856.684127.2832 7.931888.634279.3948310.218411.110112.075613.121114.253215.479
#CAP Surface All data use this for CA1990-2005; OR2000-2006

0.159212 1.271442.353263.405514.428985.424486.392757.334568.250629.1416310.008310.851211.671212.468613.244313.998814.7327 15.446516.140816.816117.472918.111818.733219.337619.925520.497321.053521.594522.120722.632523.130323.614524.085524.5436 24.989225.422625.844126.254126.652927.040827.4181
0.118733 0.118733 0.179327 0.246288 0.320286 0.402060.492428 0.592293 0.702651 0.824607 0.959379 1.108311.2729 1.454781.655781.877892.123352.394612.694373.025633.3917 3.796244.243294.73732 5.283275.886596.553317.2901 8.104319.004099.9984211.097212.311513.653415.136416.775118.586120.587422.798925.242927.9438
CAP combo use this for OR commercial ages from 1981-1997 where a combination of methods were used

0.474933 1.4248 2.374663.324534.2744 5.224266.174137.123998.073869.023729.9735910.923511.873312.823213.773114.722915.6728 16.622617.572518.522419.472220.422121.372 22.321823.271724.221625.171426.121327.071228.021 28.970929.920830.870631.8205 32.770433.720234.670135.62 36.569837.519738.4696
0.127182 0.127182 0.254364 0.381546 0.508728 0.635910.763092 0.890274 1.017461.144641.27182 1.399 1.526181.653371.780551.907732.034912.162092.289282.416462.543642.670822.798 2.925193.052373.179553.306733.43391 3.5611 3.688283.815463.942644.069824.197 4.324194.451374.578554.705734.832914.9601 5.08728
#WDFW combo bias and stdev from WDFW combo method,post 1982 to 2008 , improved for 2011 assessment using WDFW reads of radiocarbon data

0.488313 1.464942.441563.418194.394825.371446.348077.324698.301329.2779510.254611.231212.207813.184514.161115.137716.1143 17.091 18.067619.044220.020820.997521.974122.950723.927324.904 25.880626.857227.833828.810529.787130.763731.740332.717 33.693634.670235.646836.623537.600138.576739.5534
0.133467 0.133467 0.266935 0.400402 0.533869 0.667337 0.800804 0.934271 1.067741.20121 1.334671.468141.601611.735071.868542.002012.135482.268942.402412.535882.669352.802812.936283.069753.203223.336683.47015 3.603623.737083.870554.004024.137494.270954.404424.537894.671364.804824.938295.071765.205225.33869
#WDFW Surface bias and stdev from WDFW surface age method, pre 1982 , new for 2011 assessment, estimated using WDFS reads of radiocarbon oties

These surface reads could be much better than those from the pre 1990s, sensitivity to using age error from CAP pre1990s should be explored, no WDFW surface double reads are available from the 80s

0.132002 1.322652.470423.576864.643465.671666.662837.618318.539399.4273 10.283211.108411.903812.670513.409714.122214.8091 15.471216.109616.724917.318 17.889818.441118.972419.484719.978520.454520.913321.355721.782122.193222.589422.971423.3397 23.694624.036824.366724.684724.991225.286825.5716

0.103143 0.103143 0.206285 0.309428 0.412570.515713 0.618856 0.721998 0.825141
0.928283 1.031431.134571.237711.340851.444 1.547141.650281.753421.856571.959712.062852.165992.269142.372282.47542
2.578562.681712.784852.887992.991143.094283.197423.300563.403713.506853.609993.713133.816283.919424.022564.1257
#WDFW BB bias and stdev from WDFW break and burn age method,post 2008 , new for 2011 assessment, estimated using WDFS reads of radiocarbon oties

0.503178 1.509532.515893.522244.5286 5.534956.541317.547678.554029.5603810.566711.573112.579413.585814.592215.598516.6049
17.611218.617619.623920.630321.636622.643 23.649424.655725.662126.668427.674828.681129.687530.693831.700232.706633.7129
34.719335.725636.732 37.738338.744739.751 40.7574
0.150528 0.150528 0.301056 0.451584 0.602112 0.752640.903168 1.0537 1.204221.354751.505281.65581
1.806341.956862.107392.257922.408452.558982.7095 2.860033.010563.161093.311613.462143.612673.7632 3.913734.064254.21478
4.365314.515844.666374.816894.967425.117955.268485.419015.569535.720065.870596.02112

#CAP surface early, pre1990s; use this for OR pre 1990s, CA pre1990s

0 0.711119 2.019953.241124.380515.443586.435467.360918.224389.030019.7816910.483 11.137411.747912.317612.849113.345
13.807714.239414.642215.018 15.368615.695816.001 16.285816.551616.799517.030817.246717.448 17.635917.811217.974818.1274
18.269818.402718.526618.642318.750218.850918.9448
3.77E-09 3.77E-09 0.0816479 0.167778 0.258636 0.354481 0.455587 0.562244 0.674755
0.793443 0.918645 1.050721.190051.337021.492061.655611.828142.010142.202142.404672.618312.843693.081443.33223
3.5968 3.875894.1703 4.480874.808485.154085.518665.903246.308946.736917.188367.664618.166998.696959.256 9.8457410.4679

#_AGE_COMPOSITIONS
534 #nobsa #ageerr:_2:imprecision_age(BB)_3:Biased_age(Surface)

3 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths

1 #_combine males into females at or below this bin number

#year Season Fleet gender partition ageErr LbinLo LbinHi nSamps F1 F2 F3 F4 F5 F6 F7 F8
F9 F10 F11 F12 F13 F14 F15 F16 F17 M1 M2 M3 M4 M5 M6 M7 M8
M9 M10 M11 M12 M13 M14 M15 M16 M17
1964 1 1 3 0 8 -1 -1 3 0 0 0 0 0.121264151 6.229284628
11.95147855 10.7397618 8.132150987 6.303707299 4.015014558 2.264809725 0.121264147 0 0.121264147
0 0 0 0 0 0.273374451 5.379338525 16.27507557 17.24288768 6.484210605 3.656735517
0.688377653 0 0 0 0 0 0 0
1965 1 1 3 0 8 -1 -1 3 0 0 0 0 0 2.980648708 11.58155603
7.35965932 13.47192024 5.880098011 4.782990738 3.113354149 0.249748606 0 0.330275712 0.249748606
0 0 0 0.318522766 0 3.62802351 11.09118953 17.70773815 10.47411947 3.970689511
1.034984633 0.739747672 0.716461867 0.318522765 0 0 0 0
1967 1 1 3 0 8 -1 -1 4 0 0 0 0 1.246972998 5.350066141
14.60468348 10.69593453 9.397383785 4.019928393 1.198496078 1.879943572 1.198496078 0 0.408094982
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0 0 0
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0

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0 0.370197191 0 0 6.364135505 19.35878447 19.02527457 2.57570301 1.141229004 0.583228757
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NWFSC Conditional age-at-length

NWFSC female year Season Fleet gender partition ageErr LbinLo LbinHi nSamps F1 F2 F3 F4 F5
F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F1.1 F2.1 F3.1 F4.1 F5.1
F6.1 F7.1 F8.1 F9.1 F10.1 F11.1 F12.1 F13.1 F14.1 F15.1 F16.1 F17.1
2003 1 7 1 0 2 20 20 1 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2003 1 7 1 0 2 22 22 7 0 28.57142857 71.42857143 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 28.57142857 71.42857143 0 0
0 0 0 0 0 0 0 0 0 0 0 0
2003 1 7 1 0 2 24 24 8 0 12.5 62.5 25 0 0 0 0 0
0 0 0 0 0 0 0 0 0 12.5 62.5 25 0 0 0 0 0
0 0 0 0 0 0 0 0

2003 1 7 1 0 2 26 26 11 0 0 45.45454545 27.27272727 27.27272727 0
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27.27272727 0 0 0 0 0 0 0 0 0 0 0 0
2003 1 7 1 0 2 28 28 16 0 0 31.25 43.75 25 0 0 0 0
0 0 0 0 0 0 0 0 0 0 31.25 43.75 25 0 0 0 0
0 0 0 0 0 0 0 0
2003 1 7 1 0 2 30 30 32 0 0 9.375 34.375 46.875 9.375 0 0 0
0 0 0 0 0 0 0 0 0 0 9.375 34.375 46.875 9.375 0 0 0
0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 2.941176471 35.29411765
50 11.76470588 0 0 0 0 0 0 0 0 0 0 0
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6.382978723 2.127659574 0 0 0 0 0 0 0 0 0 0 0 0
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0 0
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9.615384615 0 0 0 0 0 0 0 0 0 0 0 0 0 11.53846154
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14.28571429 4.081632653 2.040816327 0 0 0 0 0 0 0 0 0 0 0
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0 0 0
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22.22222222 11.11111111 2.777777778 0 2.777777778 0 0 0 0 0 0 0 0
0 0 22.22222222 38.88888889 22.22222222 11.11111111 2.777777778 0 2.777777778 0 0
0 0 0 0
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0 0
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16.66666667 25 25 16.66666667 0 0 0 0 0 8.333333333 0 0 0 0
0 0 8.333333333 16.66666667 25 25 16.66666667 0 0 0 0 0 8.333333333
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23.07692308 30.76923077 0 7.692307692 0 7.692307692 0 0 15.38461538 7.692307692 0
0 0 0 0 7.692307692 0 23.07692308 30.76923077 0 7.692307692 0 7.692307692
0 0 15.38461538 7.692307692
2003 1 7 1 0 2 50 50 8 0 0 0 0 0 0 0 25 12.5
12.5 12.5 0 0 12.5 0 12.5 12.5 0 0 0 0 0 0 0 25 12.5
12.5 12.5 0 0 12.5 0 12.5 12.5
2003 1 7 1 0 2 52 52 1 0 0 0 0 0 0 0 0 0
100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
100 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0
2004 1 7 1 0 2 22 22 8 0 37.5 62.5 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 37.5 62.5 0 0 0 0 0 0
0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 33.33333333 58.33333333
0 8.333333333 0 0 0 0 0 0 0 0 0 0 0

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0 0
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0
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0 0 27.27272727 18.18181818 9.090909091 0 18.18181818 9.090909091 9.090909091 0 0
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0 0 0

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25 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 50
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2010	1	7	1	0	2	56	56	1	0	0	0	0	0	0	0	0	0
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2011	1	7	1	0	2	18	18	1	0	100	0	0	0	0	0	0	0
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2011	1	7	1	0	2	20	20	10.6	0	43.39622642		56.60377358		0	0	0	0
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2011	1	7	1	0	2	26	26	34	0	5.882352941		38.23529412		38.23529412		17.64705882	
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2011	1	7	1	0	2	28	28	32	0	3.125	43.75	31.25	21.875	0	0	0	0
	0	0	0	0	0	0	0	0	0	3.125	43.75	31.25	21.875	0	0	0	0
	0	0	0	0	0	0	0	0									
2011	1	7	1	0	2	30	30	45	0	0	22.22222222		35.55555556		31.11111111		
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	35.55555556		31.11111111		11.11111111		0	0	0	0	0	0	0	0	0	0	0
2011	1	7	1	0	2	32	32	45	0	0	13.33333333		37.77777778		35.55555556		
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	0	0	0														
2011	1	7	1	0	2	34	34	31	0	0	9.677419355		12.90322581		51.61290323		
	22.58064516		0	3.225806452		0	0	0	0	0	0	0	0	0	0	0	
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	0	0	0														

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NWFSC male year Season Fleet gender partition ageErr LbinLo LbinHi nSamps M1 M2 M3 M4 M5 M6
M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M1.1 M2.1 M3.1 M4.1 M5.1 M6.1
M7.1 M8.1 M9.1 M10.1 M11.1 M12.1 M13.1 M14.1 M15.1 M16.1 M17.1
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0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2008 1 7 2 0 2 16 16 3 66.66666667 33.33333333 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 66.66666667 33.33333333 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0
2008 1 7 2 0 2 18 18 8 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
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2008 1 7 2 0 2 20 20 17.4 11.49425287 54.02298851 34.48275862 0 0 0
0 0 0 0 0 0 0 0 0 0 0 11.49425287 54.02298851 34.48275862
0 0 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 7 2 0 2 22 22 16 0 37.5 50 12.5 0 0 0 0 0
0 0 0 0 0 0 0 0 0 37.5 50 12.5 0 0 0 0 0
0 0 0 0 0 0 0 0
2008 1 7 2 0 2 24 24 25 0 32 44 20 4 0 0 0 0
0 0 0 0 0 0 0 0 0 32 44 20 4 0 0 0 0
0 0 0 0 0 0 0 0
2008 1 7 2 0 2 26 26 34 0 2.941176471 26.47058824 38.23529412 26.47058824
5.882352941 0 0 0 0 0 0 0 0 0 0 0 0 2.941176471
26.47058824 38.23529412 26.47058824 5.882352941 0 0 0 0 0 0 0 0 0
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2008 1 7 2 0 2 28 28 27 0 0 29.62962963 51.85185185 18.51851852 0
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18.51851852 0 0 0 0 0 0 0 0 0 0 0 0
2008 1 7 2 0 2 30 30 40 0 0 10 20 32.5 27.5 0 7.5 2.5
0 0 0 0 0 0 0 0 0 0 10 20 32.5 27.5 0 7.5 2.5
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2008 1 7 2 0 2 32 32 54 0 0 3.703703704 16.66666667 29.62962963
22.22222222 14.81481481 11.11111111 1.851851852 0 0 0 0 0 0 0 0 0
0 3.703703704 16.66666667 29.62962963 22.22222222 14.81481481 11.11111111 1.851851852 0 0
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2008 1 7 2 0 2 34 34 42 0 0 0 2.380952381 28.57142857 26.19047619
23.80952381 14.28571429 4.761904762 0 0 0 0 0 0 0 0 0 0 0
2.380952381 28.57142857 26.19047619 23.80952381 14.28571429 4.761904762 0 0 0 0 0
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2008 1 7 2 0 2 36 36 36 0 0 2.777777778 5.555555556 11.11111111
11.11111111 19.44444444 16.66666667 19.44444444 13.88888889 0 0 0 0 0 0 0
0 0 2.777777778 5.555555556 11.11111111 11.11111111 19.44444444 16.66666667 19.44444444
13.88888889 0 0 0 0 0 0 0
2008 1 7 2 0 2 38 38 26 0 0 0 3.846153846 7.692307692 7.692307692
11.53846154 19.23076923 15.38461538 23.07692308 0 3.846153846 7.692307692 0 0 0 0
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2008 1 7 2 0 2 40 40 11 0 0 0 0 0 9.090909091 9.090909091
18.18181818 18.18181818 27.27272727 0 9.090909091 9.090909091 0 0 0 0 0 0
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2008 1 7 2 0 2 42 42 3 0 0 0 0 0 0 0 0
33.33333333 0 0 0 33.33333333 0 33.33333333 0 0 0 0 0 0 0
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2008 1 7 2 0 2 44 44 2 0 0 0 0 0 0 0 0 50
50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 50
50 0 0 0 0 0 0 0
2008 1 7 2 0 2 46 46 3 0 0 0 0 0 0 0 33.33333333
0 33.33333333 0 0 0 33.33333333 0 0 0 0 0 0 0 0 0
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2008 1 7 2 0 2 48 48 1 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 100
2009 1 7 2 0 2 16 16 2 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2009 1 7 2 0 2 18 18 23 17.39130435 69.56521739 13.04347826 0 0 0
0 0 0 0 0 0 0 0 0 0 0 17.39130435 69.56521739 13.04347826
0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 7 2 0 2 20 20 33 6.060606061 63.63636364 30.3030303 0 0 0
0 0 0 0 0 0 0 0 0 0 0 6.060606061 63.63636364 30.3030303
0 0 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 7 2 0 2 22 22 21 0 42.85714286 57.14285714 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 42.85714286 57.14285714 0 0
0 0 0 0 0 0 0 0 0 0 0 0
2009 1 7 2 0 2 24 24 20.4 0 9.803921569 75.49019608 9.803921569 4.901960784
0 0 0 0 0 0 0 0 0 0 0 0 0 9.803921569 75.49019608
9.803921569 4.901960784 0 0 0 0 0 0 0 0 0 0 0 0
2009 1 7 2 0 2 26 26 31 0 0 38.70967742 35.48387097 22.58064516
3.225806452 0 0 0 0 0 0 0 0 0 0 0 0 0 38.70967742
35.48387097 22.58064516 3.225806452 0 0 0 0 0 0 0 0 0 0 0
2009 1 7 2 0 2 28 28 42 0 2.380952381 7.142857143 40.47619048 26.19047619
21.42857143 0 2.380952381 0 0 0 0 0 0 0 0 0 0 2.380952381
7.142857143 40.47619048 26.19047619 21.42857143 0 2.380952381 0 0 0 0 0 0
0 0 0
2009 1 7 2 0 2 30 30 37 0 0 2.702702703 21.62162162 40.54054054
24.32432432 10.81081081 0 0 0 0 0 0 0 0 0 0 0 0
2.702702703 21.62162162 40.54054054 24.32432432 10.81081081 0 0 0 0 0 0 0
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2009 1 7 2 0 2 32 32 59 0 0 1.694915254 13.55932203 25.42372881
38.98305085 13.55932203 5.084745763 0 1.694915254 0 0 0 0 0 0 0 0
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0 0 0 0 0 0
2009 1 7 2 0 2 34 34 49.4 0 0 0 0 24.29149798 36.43724696
29.14979757 8.097165992 2.024291498 0 0 0 0 0 0 0 0 0 0 0

0 24.29149798 36.43724696 29.14979757 8.097165992 2.024291498 0 0 0 0 0 0
0 0
2009 1 7 2 0 2 36 36 24 0 0 0 0 8.333333333 12.5 33.33333333
16.66666667 16.66666667 4.166666667 4.166666667 0 4.166666667 0 0 0 0 0 0
0 0 8.333333333 12.5 33.33333333 16.66666667 16.66666667 4.166666667 4.166666667 0
4.166666667 0 0 0 0
2009 1 7 2 0 2 38 38 23 0 0 0 0 4.347826087 13.04347826
8.695652174 13.04347826 13.04347826 30.43478261 13.04347826 4.347826087 0 0 0 0 0
0 0 0 0 4.347826087 13.04347826 8.695652174 13.04347826 13.04347826 30.43478261
13.04347826 4.347826087 0 0 0 0 0
2009 1 7 2 0 2 40 40 8 0 0 0 0 12.5 0 25 12.5 12.5
25 0 0 0 0 12.5 0 0 0 0 0 0 12.5 0 25 12.5 12.5
25 0 0 0 0 12.5 0 0
2009 1 7 2 0 2 42 42 2 0 0 0 0 0 0 0 0 50
0 50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 50
0 50 0 0 0 0 0 0
2009 1 7 2 0 2 44 44 3 0 0 0 0 0 0 0 33.33333333
0 33.33333333 0 0 0 0 0 0 33.33333333 0 0 0 0 0 0
0 33.33333333 0 33.33333333 0 0 0 0 0 0 33.33333333
2010 1 7 2 0 2 12 12 1 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2010 1 7 2 0 2 16 16 2 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2010 1 7 2 0 2 18 18 8 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2010 1 7 2 0 2 20 20 27 0 66.66666667 33.33333333 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 66.66666667 33.33333333 0 0
0 0 0 0 0 0 0 0 0 0 0 0
2010 1 7 2 0 2 22 22 41 0 46.34146341 41.46341463 12.19512195 0 0
0 0 0 0 0 0 0 0 0 0 0 0 46.34146341 41.46341463
12.19512195 0 0 0 0 0 0 0 0 0 0 0 0 0

2010 1 7 2 0 2 24 24 42 0 28.57142857 50 14.28571429 7.142857143 0
0 0 0 0 0 0 0 0 0 0 0 0 28.57142857 50 14.28571429
7.142857143 0 0 0 0 0 0 0 0 0 0 0 0
2010 1 7 2 0 2 26 26 53 0 7.547169811 32.0754717 49.05660377 11.32075472
0 0 0 0 0 0 0 0 0 0 0 0 0 7.547169811 32.0754717
49.05660377 11.32075472 0 0 0 0 0 0 0 0 0 0 0 0
2010 1 7 2 0 2 28 28 37 0 0 32.43243243 37.83783784 21.62162162
8.108108108 0 0 0 0 0 0 0 0 0 0 0 0 0 32.43243243
37.83783784 21.62162162 8.108108108 0 0 0 0 0 0 0 0 0 0 0
2010 1 7 2 0 2 30 30 40 0 0 12.5 32.5 25 17.5 12.5 0 0
0 0 0 0 0 0 0 0 0 0 12.5 32.5 25 17.5 12.5 0 0
0 0 0 0 0 0 0 0
2010 1 7 2 0 2 32 32 56 0 0 7.142857143 23.21428571 28.57142857
30.35714286 10.71428571 0 0 0 0 0 0 0 0 0 0 0 0
7.142857143 23.21428571 28.57142857 30.35714286 10.71428571 0 0 0 0 0 0 0
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2010 1 7 2 0 2 34 34 44 0 0 2.272727273 13.63636364 25 20.45454545
27.27272727 4.545454545 4.545454545 2.272727273 0 0 0 0 0 0 0 0 0
2.272727273 13.63636364 25 20.45454545 27.27272727 4.545454545 4.545454545 2.272727273 0 0
0 0 0 0 0
2010 1 7 2 0 2 36 36 25 0 0 0 0 16 28 28 8 0
16 4 0 0 0 0 0 0 0 0 0 0 16 28 28 8 0
16 4 0 0 0 0 0 0
2010 1 7 2 0 2 38 38 21 0 0 0 0 0 19.04761905 19.04761905
9.523809524 9.523809524 23.80952381 14.28571429 0 0 4.761904762 0 0 0 0 0
0 0 0 19.04761905 19.04761905 9.523809524 9.523809524 23.80952381 14.28571429 0 0
4.761904762 0 0 0
2010 1 7 2 0 2 40 40 5 0 0 0 0 0 0 20 20 20
0 0 40 0 0 0 0 0 0 0 0 0 0 0 20 20 20
0 0 40 0 0 0 0 0
2010 1 7 2 0 2 42 42 1 0 0 0 0 0 0 0 100 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 0
0 0 0 0 0 0 0 0

2010 1 7 2 0 2 44 44 2 0 0 0 0 0 0 0 0 0
0 50 0 0 0 0 0 50 0 0 0 0 0 0 0 0 0
0 50 0 0 0 0 0 50
2011 1 7 2 0 2 18 18 6 0 33.33333333 50 16.66666667 0 0 0
0 0 0 0 0 0 0 0 0 0 0 33.33333333 50 16.66666667 0
0 0 0 0 0 0 0 0 0 0 0 0
2011 1 7 2 0 2 20 20 16.4 0 39.02439024 54.87804878 6.097560976 0 0
0 0 0 0 0 0 0 0 0 0 0 0 39.02439024 54.87804878
6.097560976 0 0 0 0 0 0 0 0 0 0 0 0 0
2011 1 7 2 0 2 22 22 36 0 16.66666667 61.11111111 19.44444444 2.777777778
0 0 0 0 0 0 0 0 0 0 0 0 0 16.66666667 61.11111111
19.44444444 2.777777778 0 0 0 0 0 0 0 0 0 0 0 0
2011 1 7 2 0 2 24 24 33 0 12.12121212 60.60606061 18.18181818 9.090909091
0 0 0 0 0 0 0 0 0 0 0 0 0 12.12121212 60.60606061
18.18181818 9.090909091 0 0 0 0 0 0 0 0 0 0 0 0
2011 1 7 2 0 2 26 26 52 0 3.846153846 44.23076923 40.38461538 9.615384615
1.923076923 0 0 0 0 0 0 0 0 0 0 0 0 3.846153846
44.23076923 40.38461538 9.615384615 1.923076923 0 0 0 0 0 0 0 0 0
0 0
2011 1 7 2 0 2 28 28 47 0 2.127659574 25.53191489 40.42553191 29.78723404
2.127659574 0 0 0 0 0 0 0 0 0 0 0 0 2.127659574
25.53191489 40.42553191 29.78723404 2.127659574 0 0 0 0 0 0 0 0 0
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2011 1 7 2 0 2 30 30 51 0 0 7.843137255 43.1372549 37.25490196
11.76470588 0 0 0 0 0 0 0 0 0 0 0 0 0 7.843137255
43.1372549 37.25490196 11.76470588 0 0 0 0 0 0 0 0 0 0 0
2011 1 7 2 0 2 32 32 46 0 0 2.173913043 15.2173913 47.82608696
26.08695652 4.347826087 4.347826087 0 0 0 0 0 0 0 0 0 0 0
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2011 1 7 2 0 2 34 34 56 0 0 0 12.5 30.35714286 28.57142857
10.71428571 10.71428571 5.357142857 1.785714286 0 0 0 0 0 0 0 0 0
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0 0 0 0

2011 1 7 2 0 2 36 36 34 0 0 0 5.882352941 23.52941176 14.70588235
14.70588235 23.52941176 17.64705882 0 0 0 0 0 0 0 0 0 0 0
5.882352941 23.52941176 14.70588235 14.70588235 23.52941176 17.64705882 0 0 0 0 0
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2011 1 7 2 0 2 38 38 12 0 0 0 0 0 8.333333333 25
33.33333333 16.66666667 16.66666667 0 0 0 0 0 0 0 0 0 0 0
0 8.333333333 25 33.33333333 16.66666667 16.66666667 0 0 0 0 0 0 0
2011 1 7 2 0 2 40 40 8 0 0 0 0 0 12.5 0 25 37.5
0 12.5 0 12.5 0 0 0 0 0 0 0 0 0 12.5 0 25 37.5
0 12.5 0 12.5 0 0 0 0
2011 1 7 2 0 2 42 42 2 0 0 0 0 0 0 0 0 0
50 0 0 50 0 0 0 0 0 0 0 0 0 0 0 0 0
50 0 0 50 0 0 0 0
2011 1 7 2 0 2 44 44 3 0 0 0 0 0 0 0 0 0
0 66.66666667 0 33.33333333 0 0 0 0 0 0 0 0 0 0 0
0 0 0 66.66666667 0 33.33333333 0 0 0 0
2012 1 7 2 0 2 12 12 0.4 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2012 1 7 2 0 2 16 16 1 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 100 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2012 1 7 2 0 2 18 18 3 0 66.66666667 33.33333333 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 66.66666667 33.33333333 0 0
0 0 0 0 0 0 0 0 0 0 0 0
2012 1 7 2 0 2 20 20 5 0 60 20 20 0 0 0 0 0
0 0 0 0 0 0 0 0 0 60 20 20 0 0 0 0 0
0 0 0 0 0 0 0 0
2012 1 7 2 0 2 22 22 22 0 9.090909091 31.81818182 50 9.090909091 0
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9.090909091 0 0 0 0 0 0 0 0 0 0 0 0
2012 1 7 2 0 2 24 24 25 0 4 36 44 4 12 0 0 0
0 0 0 0 0 0 0 0 0 4 36 44 4 12 0 0 0
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2012 1 7 2 0 2 26 26 54 0 3.703703704 22.22222222 59.25925926 3.703703704
11.11111111 0 0 0 0 0 0 0 0 0 0 0 0 3.703703704
22.22222222 59.25925926 3.703703704 11.11111111 0 0 0 0 0 0 0 0 0
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2012 1 7 2 0 2 28 28 54 0 1.851851852 18.51851852 42.59259259 20.37037037
12.96296296 3.703703704 0 0 0 0 0 0 0 0 0 0 0 1.851851852
18.51851852 42.59259259 20.37037037 12.96296296 3.703703704 0 0 0 0 0 0 0
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2012 1 7 2 0 2 30 30 64 0 0 6.25 40.625 34.375 12.5 6.25 0 0
0 0 0 0 0 0 0 0 0 0 6.25 40.625 34.375 12.5 6.25 0 0
0 0 0 0 0 0 0 0
2012 1 7 2 0 2 32 32 53 0 0 3.773584906 20.75471698 26.41509434
24.52830189 16.98113208 3.773584906 3.773584906 0 0 0 0 0 0 0 0 0
0 3.773584906 20.75471698 26.41509434 24.52830189 16.98113208 3.773584906 3.773584906 0 0
0 0 0 0 0 0
2012 1 7 2 0 2 34 34 46 0 0 0 8.695652174 13.04347826 21.73913043
26.08695652 6.52173913 15.2173913 6.52173913 2.173913043 0 0 0 0 0 0 0
0 0 8.695652174 13.04347826 21.73913043 26.08695652 6.52173913 15.2173913 6.52173913
2.173913043 0 0 0 0 0 0
2012 1 7 2 0 2 36 36 35 0 0 0 2.857142857 8.571428571 14.28571429
17.14285714 17.14285714 11.42857143 25.71428571 2.857142857 0 0 0 0 0 0 0
0 0 2.857142857 8.571428571 14.28571429 17.14285714 17.14285714 11.42857143 25.71428571
2.857142857 0 0 0 0 0 0
2012 1 7 2 0 2 38 38 13 0 0 0 7.692307692 7.692307692 7.692307692
7.692307692 15.38461538 15.38461538 7.692307692 0 15.38461538 15.38461538 0 0 0 0
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2012 1 7 2 0 2 40 40 5 0 0 0 0 0 20 0 0 0
60 0 0 0 0 20 0 0 0 0 0 0 0 20 0 0 0
60 0 0 0 0 20 0 0
2012 1 7 2 0 2 42 42 4 0 0 0 0 0 0 0 0 25
0 0 0 50 0 0 0 25 0 0 0 0 0 0 0 0 25
0 0 0 50 0 0 0 25

0 #N mean size-at-age obs

0 #N_envvar
0 #N_envdata
0 #N sizefreq methods to read
0 #Do_TagData(0/1)
0 #no morphcomp data

999

ENDDATA

Appendix E. SS control file

```
#C 2013 Assessent of Petrale (Haltuch, Ono, Valero) run with SS3.24O
#_data_and_control_files: petrale13.dat // petrale13.ctl
1   #_N_Growth_Patterns
1   #_N_Morphs_Within_GrowthPattern
#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond  1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

#Recruitment occurs in season 2 (summer)
#1   # N recruitment designs goes here if N_GP*nseas*area>1
#0   # placeholder for recruitment interaction request
#1 2 1   # recruitment design element for GP=1, seas=2, area=1

#_Cond 0 # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

3 #_Nblock_Patterns
5 3 3 #_blocks_per_pattern
# begin and end years of blocks
1973 1982 1983 1992 1993 2002 2003 2010 2011 2012 # For selectivities of all fleets
2003 2009 2010 2010 2011 2012 # For retention of winter fleets
2003 2008 2009 2010 2011 2012 # For retention of summer fleets

0.5 #_fracfemale
0   #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
#2 #_N_breakpoints
# 4 15 # age(real) at M breakpoints


1   # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
2   #_Growth_Age_for_L1 (minimum age for growth calcs
17  #_Growth_Age_for_L2 (999 to use as Linf) (maximum age for growth calcs)
0.0 #_SD_add_to_LAA
```

```
0   #_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
1   #_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern
3   #_First_Mature_Age
1   #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0   #hermaphrodite
1   #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
1   #_env/block/dev_adjust_method (1=standard; 2=with logistic trans to keep within base parm bounds)

#_growth_parms
#GP_1_Female
#LO     HI      INIT    PRIOR   PR_type SD  PHASE   env-var use_dev dev_minyr dev_maxyr dev_stddev  Block   Block_Fxn
0.005    0.50   0.1549     -1.888  3     0.3333 6      0      0      0         0      0.5        0      0          #1 F_M_young
10      45      16.27  17.18  -1      10    2      0      0      0         0      0.5        0      0          #2 F_L@Amin (Amin is age entered above)
35      80      47.86    58.7   -1      10    3      0      0      0         0      0.5        0      0          #3 F_L@Amax
0.04    0.5     0.27   0.13   -1      0.8   2      0      0      0         0      0.5        0      0          #4 F_VBK
0.01    1.00    0.08   3.0    -1      0.8   3      0      0      0         0      0.5        0      0          #5 CV@LAAFIX
0.01    1.0     0.08    0.0     -1      1       4      0 0 0 0 0 0 0  # CV@LAAFIX2
#GP_1:::Male (Direct Estimation)
0.005    0.60   0.1749     -1.580  3     0.3326 6      0      0      0         0      0.5        0      0          #1 M_M_young
10      45      16.27  17.18  -1      10    2      0      0      0         0      0.5        0      0          #2 M_L@Amin (Amin is age entered above)
35      80      47.86    58.7   -1      10    3      0      0      0         0      0.5        0      0          #3 M_L@Amax
0.04    0.5     0.27   0.13   -1      0.8   2      0      0      0         0      0.5        0      0          #4 M_VBK
0.01    1.00    0.08   3.0    -1      0.8   3      0      0      0         0      0.5        0      0          #5 M_CV@LAAFIX
0.01    1.0     0.08    0.0     -1      1       4      0 0 0 0 0 0 0  # M_CV@LAAFIX2

#LW_female
#LO     HI      INIT        PRIOR       PR_type SD  PHASE   env-var use_dev dev_minyr dev_maxyr dev_stddev  Block   Block_Fxn
-3      3       2.08296E-06    2.08296E-06    0       0.8 -3      0       0       0   0   0.5 0   0   #WL_intercept_female
1       5       3.473703       3.473703       0       0.8 -3      0       0       0   0   0.5 0   0   #WL_slope_female
#Female_maturity
10      50      33.1        33.1        0       0.8 -3  0   0   0   0   0.5 0   0   #mat_intercept  #L50
-3      3       -0.743      -0.743      0       0.8 -3  0   0   0   0   0.5 0   0   #mat_slope  From Hannah et al 2002
#Fecundity___Assume_same_as_spawning_biomass
-3      3       1           1           0       1   -3  0   0   0   0   0.5 0   0   #mat_intercept  #L50
```

```
-3    3    0        0        0     1   -3  0   0   0   0   0.5 0   0   #mat_slope
#LW_Male
-3    3    3.05E-06    3.05E-06    0     0.8 -3  0   0   0   0   0.5 0   0   #WL_intercept_male
-3    5    3.360544     3.360544     0     0.8 -3  0   0   0   0   0.5 0   0   #WL_slope_slope_male

#LO   HI    INIT   PRIOR   PR_type SD  PHASE   env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
#Allocate_R_by_areas_x_gmorphs
0  1  1  0.2 0  9.8 -3  0  0  0  0  0.5 0  0  #frac to GP 1 in area 1
#Allocate_R_by_areas_(1_areain_this_case)
0  1  1  1  0  9.8 -3  0  0  0  0  0.5 0  0  #frac R in area 1
#Allocate_R_by_season_(2seasons_in_this_case)
#LO   HI    INIT     PRIOR     PR_type SD  PHASE   env-var use_dev dev_minyr dev_maxyr dev_stddev  Block   Block_Fxn
-4    4     0       1        0     9.8 -3    0     0        0     0        0.5    0  0   #frac R in season 1

#CohortGrowDev
#SS3 manual says it must be given a value of 1 and a negative phase
#LO HI  INIT   PRIOR   PR_type SD  PHASE   env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
0  1  1  1  -1 0  -4  0  0  0  0  0  0  0

#_Cond 0  #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

#_Cond 0  #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters

#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,L1,K,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters

#_Cond -4 #_MGparm_Dev_Phase

#_Spawner-Recruitment
3  #_SR_function
#_LO   HI  INIT   PRIOR   PR_type SD  PHASE
5     20  10     9     -1     10  1     #Ln(R0)
```

```
0.2     1   0.85    0.8     0      0.09  5       #steepness(h)
0       2   0.4     0.9     0       5       -99     #sigmaR
-5      5   0       0       0       1       -99     #Env_link_parameter
-5      5   0       0       0       0.2     -2      # SR_R1_offset
0       0   0       0       -1      0       -99     # SR_autocorr
0   #_SR_env_link
0   #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1   #do_recdev:  0=none; 1=devvector; 2=simple deviations

1959    # first year of main recr_devs; early devs can preceed this era
2009    # last year of main recr_devs; forecast devs start in following year
1   #_recdev phase
1   # (0/1) to read 13 advanced options
1845 #_Cond 0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
3   #_recdev_early_phase
0   #_Cond 0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1   #_Cond 1 #_lambda for prior_fore_recr occurring before endyr+1
1944    #_last_early_yr_nobias_adj_in_MPD
1964    #_first_yr_fullbias_adj_in_MPD
2009    #_last_yr_fullbias_adj_in_MPD
2012    #_first_recent_yr_nobias_adj_in_MPDadj_in_MPD (-1 to override ramp and set biasadj=1.0 for all estimated recdevs)
0.80   #max bias
0   #period of cycles in recruitment
-4  #min rec_dev
4   #max rec_dev
0 #67   #_read_recdevs
#_end of advanced SR options

#Fishing Mortality info
0.3 # F ballpark for tuning early phases
-2001   # F ballpark year (neg value to disable)
3   # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
4   # max F or harvest rate, depends on F_Method
# no additional F input needed for Fmethod 1
```

```
# read overall start F value; overall phase; N detailed inputs to read for Fmethod 2
# NUM ITERATIONS, FOR CONDITION 3
5   # read N iterations for tuning for Fmethod 3 (recommend 3 to 7)
#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)

#_initial_F_parms
#_LO HI INIT PRIOR PR_type  SD PHASE
0   1   0   0.0001  0       99  -1  #Fleet1_(WinterN)
0   1   0   0.0001  0       99  -1  #Fleet2_(SummerN)
0   1   0   0.0001  0       99  -1  #Fleet3_(WinterS)
0   1   0   0.0001  0       99  -1  #Fleet4_(SummerS)

#_Q_setup
#D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk)
#E=0=num/1=bio, F=err_type
#DISCUSS WHICH OPTION FOR Q (0 OR 1, OR 2)
#do power, env-var, extra SD, dev type
#do power for commercial CPUE, estimating extra SD, estimating q
1   0   0   4      #Fleet1_(WinterN)
0   0   0   0      #Fleet2_(SummerN)
1   0   0   4      #Fleet3_(WinterS)
0   0   0   0      #Fleet4_(SummerS)
0   0   1   0      #Fleet5 Triennial
0   0   1   0      #Fleet6 Triennial
0   0   0   0      #Fleet7 NWFSC

1 #_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
# LO HI INIT PRIOR PR_type SD PHASE
-5      5       0.38    0       -1      99      3       #               (log)   power   parameter N Winter
-5      5       0.16    0       -1      99      3       #               (log)   power   parameter S Winter
#parameter lines for extra SD for fishery CPUE and surveys
#Prior type -1 = none, 0=normal, 1=symmetric beta, 2=full beta, 3=lognormal
#-5     5       0.4      0.5     -1  99  5      #
#-5     5       0.4      0.5     -1  99  5      #
0.001   2       0.28    0.22    -1      99      5       #
```

```
0.001   2       0.15    0.16    -1      99      4       #
#-1     2       0  0.06 -1      99      5       #
#parameter lines for winter index q's
-20     5       -9      0       -1      99      1       #               estimate q parameter N Winter
-20 5   0 -1   -1  99 -1 #1988
-20 5   0 -1   -1  99 -1 #1989
-20 5   0 -1   -1  99 -1 #1990
-20 5   0 -1   -1  99 -1 #1991
-20 5   0 -1   -1  99 -1 #1992
-20 5   0 -1   -1  99 -1 #1993
-20 5   0 -1   -1  99 -1 #1994
-20 5   0 -1   -1  99 -1 #1995
-20 5   0 -1   -1  99 -1 #1996
-20 5   0 -1   -1  99 -1 #1997
-20 5   0 -1   -1  99 -1 #1998
-20 5   0 -1   -1  99 -1 #1999
-20 5   0 -1   -1  99 -1 #2000
-20 5   0 -1   -1  99 -1 #2001
-20 5   0 -1   -1  99 -1 #2002
-20 5   0 -1   -1  99 -1 #2003
-20 5   0 -1   -1  99 7 #2004
-20 5   0 -1   -1  99 -7 #2005
-20 5   0 -1   -1  99  -7 #2006
-20 5   0 -1   -1  99  -7 #2007
-20 5   0 -1   -1  99  -7 #2008
-20 5   0 -1   -1  99  -7 #2009

-20     5       -6      0       -1      99      1       #               estimate q parameter S Winter
-20 5   0 -1   -1  99 -1 #1988
-20 5   0 -1   -1  99 -1 #1989
-20 5   0 -1   -1  99 -1 #1990
-20 5   0 -1   -1  99 -1 #1991
-20 5   0 -1   -1  99 -1 #1992
-20 5   0 -1   -1  99 -1 #1993
-20 5   0 -1   -1  99 -1 #1994
```

```
-20 5    0 -1   -1  99 -1 #1995
-20 5    0 -1   -1  99 -1 #1996
-20 5    0 -1   -1  99 -1 #1997
-20 5    0 -1   -1  99 -1 #1998
-20 5    0 -1   -1  99 -1 #1999
-20 5    0 -1   -1  99 -1 #2000
-20 5    0 -1   -1  99 -1 #2001
-20 5    0 -1   -1  99 -1 #2002
-20 5    0 -1   -1  99 -1 #2003
-20 5    0 -1   -1  99 7 #2004
-20 5    0 -1   -1  99 -7 #2005
-20 5    0 -1   -1  99  -7 #2006
-20 5    0 -1   -1  99  -7 #2007
-20 5    0 -1   -1  99  -7 #2008
-20 5    0 -1   -1  99  -7 #2009

#Seltype(1,2*Ntypes,1,4)    #SELEX_&_RETENTION_PARAMETERS
#Size_Slectivity,_enter_4_cols
#N_sel  Do_retain   Do_male Special
24      1           3       0   #Fleet(WinterN)
24      1           3       0   #Fleet(SummerN)
24      1           3       0   #Fleet(WinterS)
24      1           3       0   #Fleet(SummerS)
24      0           3       0   #Triennial early
24      0           3       0   #Triennial late
24      0           3       0   #NWFSC

#Age_selectivity    #set_to_1
10      0           0       0   #Fleet(WinterN)
10      0           0       0   #Fleet(SummerN)
10      0           0       0   #Fleet(WinterS)
10      0           0       0   #Fleet(SummerS)
10      0           0       0   #Triennial early
10      0           0       0   #Triennial late
10      0           0       0   #NWFSC
```

```
#Selectivity parameters
#Size_selectivity for FISHERY WINTER N
#FEMALE
#LO HI INIT PRIOR PR_TYPE SD PHASE env-var use_dev dev_yr1 dev_yr2 dev_sd nblks blk_pat #
15 75 50 43.1 -1 5 1 0 0 0 0 0.5 1 1 #PEAK (see Selex24.xls)
-5 3 3.0 0.7 -1 5 -3 0 0 0 0 0.5 0 0 #TOP (see Selex24.xls)
-4 12 4 3.42 -1 5 2 0 0 0 0 0.5 0 0 #ASC_WIDTH (see Selex24.xls)
-2 15 14.0 0.21 -1 5 -3 0 0 0 0 0.5 0 0 #DSC_WIDTH (see Selex24.xls)
-15 5 -999 -8.9 -1 5 -4 0 0 0 0 0.5 0 0 #INIT (see Selex24.xls)
-5 5 -999 0.15 -1 5 -4 0 0 0 0 0.5 0 0 #FINAL (see Selex24.xls)
#RETENTION
10 40 26.47 15 -1 9 1 0 0 0 0 0 2 1 # Retain_1 Inflection
0.1 10 3.026 3 -1 9 2 0 0 0 0 0 2 1 # Retain_2 Slope
0.001 1 0.9945 1 -1 9 4 0 0 0 0 0 2 1 # Retain_3 Asymptote
-10 10 0 0 -1 9 -2 0 0 0 0 0 0 0 # Retain_4 Male offset (additive)
#...DO_MALE (AS OFFSET)
-15 15 -4 0 -1 5 3 0 0 0 0 0.5 0 0 #PEAK (see Selex24.xls)
-15 15 -1 0 -1 5 4 0 0 0 0 0.5 0 0 #ASC_WIDTH (see Selex24.xls)
-15 15 0 0 -1 5 -4 0 0 0 0 0.5 0 0 #DSC_WIDTH (see Selex24.xls)
-15 15 0 0 -1 5 -4 0 0 0 0 0.5 0 0 #FINAL (see Selex24.xls)
-15 15 1 0 -1 5 -4 0 0 0 0 0.5 0 0 #APICAL SEL (see Selex24.xls)
#Size_selectivity for FISHERY SUMMER N
#FEMALE
#LO HI INIT PRIOR PR_TYPE SD PHASE env-var use_dev dev_yr1 dev_yr2 dev_sd nblks blk_pat #
15 75 50 43.1 -1 5 1 0 0 0 0 0.5 1 1 #PEAK (see Selex24.xls)
-5 3 3.0 0.7 -1 5 -3 0 0 0 0 0.5 0 0 #TOP (see Selex24.xls)
-4 12 4.5 3.42 -1 5 2 0 0 0 0 0.5 0 0 #ASC_WIDTH (see Selex24.xls)
-2 15 14.0 0.21 -1 5 -3 0 0 0 0 0.5 0 0 #DSC_WIDTH (see Selex24.xls)
-15 5 -999 -8.9 -1 5 -4 0 0 0 0 0.5 0 0 #INIT (see Selex24.xls)
-5 5 -999 0.15 -1 5 -4 0 0 0 0 0.5 0 0 #FINAL (see Selex24.xls)
#RETENTION
10 40 30.869 15 -1 9 1 0 0 0 0 0 3 1 # Retain_1 Inflection
0.1 10 1.2977 3 -1 9 2 0 0 0 0 0 3 1 # Retain_2 Slope
0.001 1 0.9935 1 -1 9 4 0 0 0 0 0 3 1 # Retain_3 Asymptote
```

```
-10     10  0       0       -1      9  -2  0   0   0   0   0   0   0   # Retain_4 Male offset (additive)
#...DO_MALE (AS OFFSET)
-20     15      0    0  -1     -5    3   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-15     15      -1.0    0  -1     -5    4   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-15     15      0       0   -1      5   -4  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     15      0       0   -1      5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
-15     15      1       0   -1      5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)
#Size_selectivity for FISHERY WINTER S
#FEMALE
#LO     HI  INIT    PRIOR   PR_TYPE SD  PHASE   env-var use_dev dev_yr1 dev_yr2 dev_sd  nblks   blk_pat #
15      75  44.5116  43.1    -1      5   1   0   0   0   0   0.5 1   1   #PEAK (see Selex24.xls)
-5      3   3.0      0.7     -1      5   -3  0   0   0   0   0.5 0   0   #TOP (see Selex24.xls)
-4      12  4.5070   3.42    -1      5   2   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-2      15   14.0      0.21    -1      5   -3  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     5   -999     -8.9    -1      5   -4   0   0   0   0   0.5 0   0   #INIT (see Selex24.xls)
-5      5   -999     0.15    -1      5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
#RETENTION
10      40  27.716  15      -1      9   1   0   0   0   0   0   2   1   # Retain_1 Inflection
0.1     10  1.8483   3      -1      9  2   0   0   0   0   0   2   1   # Retain_2 Slope
0.001   1   0.999    1       -1      9 4   0   0   0   0   0   2   1   # Retain_3 Asymptote
-10     10  0       0       -1      9   -2  0   0   0   0   0   0   0   # Retain_4 Male offset (additive)
#...DO_MALE (AS OFFSET)
-15     15      -11.5284  0   -1   5   3   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-15     15      -2.5591   0   -1   5   4   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-15     15      0         0   -1   5   -4  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     15      0         0   -1   5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
-15     15      1         0   -1   5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)
#Size_selectivity for FISHERY SUMMER S
#FEMALE
#LO     HI  INIT    PRIOR   PR_TYPE SD  PHASE   env-var use_dev dev_yr1 dev_yr2 dev_sd  nblks   blk_pat #
15      75  39.7903  43.1    -1      5   1   0   0   0   0   0.5 1   1   #PEAK (see Selex24.xls)
-5      3   3.0      0.7     -1      5   -3  0   0   0   0   0.5 0   0   #TOP (see Selex24.xls)
-4      12  3.9017   3.42    -1      5   2   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-2      15   14.0      0.21    -1      5   -3  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     5   -999     -8.9    -1      5   -4   0   0   0   0   0.5 0   0   #INIT (see Selex24.xls)
```

```
-5      5   -999      0.15    -1     5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
#RETENTION
10      40  27.346  15      -1      9  1   0   0   0   0   0   3   1   # Retain_1 Inflection
0.1     10  1.68   3       -1      9   2   0   0   0   0   0   3   1   # Retain_2 Slope
0.001   1   0.9995   1       -1      9  4   0   0   0   0   0   3   1   # Retain_3 Asymptote
-10     10  0       0       -1      9   -2  0   0   0   0   0   0   0   # Retain_4 Male offset (additive)
#...DO_MALE (AS OFFSET)
-15     15      -5.6710   0   -1     5   3   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-15     15      -1.5100   0   -1     5   4   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-15     15      0         0   -1     5   -4  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     15      0         0   -1     5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
-15     15      1         0   -1     5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)
#Size_selectivity for TRIENNIAL SURVEY early
#FEMALE
#LO     HI  INIT    PRIOR   PR_TYPE SD  PHASE   env-var use_dev dev_yr1 dev_yr2 dev_sd  nblks   blk_pat #
15      61  35.4319   43.1    -1      5   1   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-5      3   3.0       0.7     -1      5   -2  0   0   0   0   0.5 0   0   #TOP (see Selex24.xls)
-4      12  4.2436    3.42    -1      5   1   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-2      15   14.0      0.21    -1      5   -2  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     5   -999      -8.9    -1      5   -4   0   0   0   0   0.5 0   0   #INIT (see Selex24.xls)
-5      5   -999      0.15    -1      5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
#...DO_MALE (AS OFFSET)
-15   15  -4.1823  0  -1      5   2       0       0       0       0       0.5     0       0       #PEAK (see Selex24.xls)
-15   15  -0.5322  0  -1      5   2       0       0       0       0       0.5     0       0       #ASC_WIDTH (see Selex24.xls)
-15   15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #DSC_WIDTH (see Selex24.xls)
-15   15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #FINAL (see Selex24.xls)
-15   15  1       0   -1      5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)
#Size_selectivity for TRIENNIAL SURVEY late
#FEMALE
#LO     HI  INIT    PRIOR   PR_TYPE SD  PHASE   env-var use_dev dev_yr1 dev_yr2 dev_sd  nblks   blk_pat #
15      61  38.3545  43.1    -1      5   1   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-5      3   3.0      0.7     -1      5   -2  0   0   0   0   0.5 0   0   #TOP (see Selex24.xls)
-4      12  4.8335   3.42    -1      5   1   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-2      15   14.0     0.21    -1      5   -2  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     5   -999     -8.9    -1      5   -4   0   0   0   0   0.5 0   0   #INIT (see Selex24.xls)
```

```
-5      5   -999     0.15    -1      5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
#...DO_MALE (AS OFFSET)
-15  15  -4.0542  0  -1      5   2       0       0       0       0       0.5     0       0       #PEAK (see Selex24.xls)
-15  15  -0.1367  0  -1      5   2       0       0       0       0       0.5     0       0       #ASC_WIDTH (see Selex24.xls)
-15  15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #DSC_WIDTH (see Selex24.xls)
-15  15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #FINAL (see Selex24.xls)
-15  15  1       0   -1      5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)
#Size_selectivity for NWFSC SURVEY
#FEMALE
#LO     HI  INIT    PRIOR   PR_TYPE SD  PHASE   env-var use_dev dev_yr1 dev_yr2 dev_sd  nblks   blk_pat #
15      61  42.7077   43.1    -1      5   1   0   0   0   0   0.5 0   0   #PEAK (see Selex24.xls)
-5      3   3.0       0.7     -1      5   -2  0   0   0   0   0.5 0   0   #TOP (see Selex24.xls)
-4      12  5.1017    3.42    -1      5   1   0   0   0   0   0.5 0   0   #ASC_WIDTH (see Selex24.xls)
-2      15   14.0      0.21    -1      5   -2  0   0   0   0   0.5 0   0   #DSC_WIDTH (see Selex24.xls)
-15     5   -999      -8.9    -1      5   -4  0   0   0   0   0.5 0   0   #INIT (see Selex24.xls)
-5      5   -999      0.15    -1      5   -4  0   0   0   0   0.5 0   0   #FINAL (see Selex24.xls)
#...DO_MALE (AS OFFSET)
-15   15  -7.3384  0  -1      5   2       0       0       0       0       0.5     0       0       #PEAK (see Selex24.xls)
-15   15  -0.5892  0  -1      5   2       0       0       0       0       0.5     0       0       #ASC_WIDTH (see Selex24.xls)
-15   15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #DSC_WIDTH (see Selex24.xls)
-15   15  0       0   -1      5   -3      0       0       0       0       0.5     0       0       #FINAL (see Selex24.xls)
-15   15  1       0   -1      5   -4  0   0   0   0   0.5 0   0   #APICAL SEL (see Selex24.xls)

1 #_custom block setup (0/1)
 -3 2 0 0 -1 99 4 # SizeSel_1P_1_WinterN_BLK1add_1973
 -3 2 0 0 -1 99 4 # SizeSel_1P_1_WinterN_BLK1add_1983
 -3 2 0 0 -1 99 4 # SizeSel_1P_1_WinterN_BLK1add_1993
 -3 2 0 0 -1 99 4 # SizeSel_1P_1_WinterN_BLK1add_2003
 -3 2 0 0 -1 99 4 # SizeSel_1P_1_WinterN_BLK1add_2011
 -3 2 0 0 -1 99 4 # Retain_1P_1_WinterN_BLK2add_2003
 -3 2 0 0 -1 99 4 # Retain_1P_1_WinterN_BLK2add_2010
 -3 2 0 0 -1 99 4 # Retain_1P_1_WinterN_BLK2add_2011
 -3 2 0 0 -1 99 4 # Retain_1P_2_WinterN_BLK2add_2003
 -3 2 0 0 -1 99 4 # Retain_1P_2_WinterN_BLK2add_2010
 -3 2 0 0 -1 99 4 # Retain_1P_2_WinterN_BLK2add_2011
```

-3 2 0 0 -1 99 4 # Retain_1P_3_WinterN_BLK2add_2003
-3 2 0 0 -1 99 4 # Retain_1P_3_WinterN_BLK2add_2010
-3 2 0 0 -1 99 4 # Retain_1P_3_WinterN_BLK2add_2011
-3 2 0 0 -1 99 4 # SizeSel_2P_1_SummerN_BLK1add_1973
-3 2 0 0 -1 99 4 # SizeSel_2P_1_SummerN_BLK1add_1983
-3 2 0 0 -1 99 4 # SizeSel_2P_1_SummerN_BLK1add_1993
-3 2 0 0 -1 99 4 # SizeSel_2P_1_SummerN_BLK1add_2003
-3 2 0 0 -1 99 4 # SizeSel_2P_1_SummerN_BLK1add_2011
-3 2 0 0 -1 99 4 # Retain_2P_1_SummerN_BLK3add_2003
-3 2 0 0 -1 99 4 # Retain_2P_1_SummerN_BLK3add_2009
-3 2 0 0 -1 99 4 # Retain_2P_1_SummerN_BLK3add_2011
-3 2 0 0 -1 99 4 # Retain_2P_2_SummerN_BLK3add_2003
-3 2 0 0 -1 99 4 # Retain_2P_2_SummerN_BLK3add_2009
-3 2 0 0 -1 99 4 # Retain_2P_2_SummerN_BLK3add_2011
-3 2 0 0 -1 99 4 # Retain_2P_3_SummerN_BLK3add_2003
-3 2 0 0 -1 99 4 # Retain_2P_3_SummerN_BLK3add_2009
-3 2 0 0 -1 99 4 # Retain_2P_3_SummerN_BLK3add_2011
-3 2 0 0 -1 99 4 # SizeSel_3P_1_WinterCA_BLK1add_1973
-3 2 0 0 -1 99 4 # SizeSel_3P_1_WinterCA_BLK1add_1983
-3 2 0 0 -1 99 4 # SizeSel_3P_1_WinterCA_BLK1add_1993
-3 2 0 0 -1 99 4 # SizeSel_3P_1_WinterCA_BLK1add_2003
-3 2 0 0 -1 99 4 # SizeSel_3P_1_WinterCA_BLK1add_2011
-3 2 0 0 -1 99 4 # Retain_3P_1_WinterCA_BLK2add_2003
-3 2 0 0 -1 99 4 # Retain_3P_1_WinterCA_BLK2add_2010
-3 2 0 0 -1 99 4 # Retain_3P_1_WinterCA_BLK2add_2011
-3 2 0 0 -1 99 4 # Retain_3P_2_WinterCA_BLK2add_2003
-3 2 0 0 -1 99 4 # Retain_3P_2_WinterCA_BLK2add_2010
-3 2 0 0 -1 99 4 # Retain_3P_2_WinterCA_BLK2add_2011
-3 4 0 0 -1 99 4 # Retain_3P_3_WinterCA_BLK2add_2003
-3 2 0 0 -1 99 4 # Retain_3P_3_WinterCA_BLK2add_2010
-3 2 0 0 -1 99 4 # Retain_3P_3_WinterCA_BLK2add_2011
-3 2 0 0 -1 99 4 # SizeSel_4P_1_SummerCA_BLK1add_1973
-3 2 0 0 -1 99 4 # SizeSel_4P_1_SummerCA_BLK1add_1983
-3 2 0 0 -1 99 4 # SizeSel_4P_1_SummerCA_BLK1add_1993
-3 2 0 0 -1 99 4 # SizeSel_4P_1_SummerCA_BLK1add_2003

```
 -3 2 0 0 -1 99 4 # SizeSel_4P_1_SummerCA_BLK1add_2011
 -3 2 0 0 -1 99 4 # Retain_4P_1_SummerCA_BLK3add_2003
 -3 2 0 0 -1 99 4 # Retain_4P_1_SummerCA_BLK3add_2009
 -3 2 0 0 -1 99 4 # Retain_4P_1_SummerCA_BLK3add_2011
 -3 2 0 0 -1 99 4 # Retain_4P_2_SummerCA_BLK3add_2003
 -3 2 0 0 -1 99 4 # Retain_4P_2_SummerCA_BLK3add_2009
 -3 2 0 0 -1 99 4 # Retain_4P_2_SummerCA_BLK3add_2011
 -3 2 0 0 -1 99 4 # Retain_4P_3_SummerCA_BLK3add_2003
 -3 2 0 0 -1 99 4 # Retain_4P_3_SummerCA_BLK3add_2009
 -3 2 0 0 -1 99 4 # Retain_4P_3_SummerCA_BLK3add_2011

2   #logistic bounding

# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters

1 #_Variance_adjustments_to_input_values
0 0 0 0 0 0 0  #_add_to_survey_CV
0.02 0.02 0.02 0.02 0 0 0 #_add_to_discard_stddev
0 0 0 0 0 0 0 #_add_to_bodywt_CV
2	1.4	1.6	1.2	1.3	1	1	#_mult_by_lencomp_N
7 1.7 1.9 1.4 1 1 0.3    #_mult_by_agecomp_N
1 1 1 1 1 1 1  #_mult_by_size-at-age_N

15 #_maxlambdaphase
1 #_sd_offset

10 # number of changes to make to default Lambdas (default value is 1.0)
# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey  phase  value  sizefreq_method
1 1 1 1.0 1  #Winter N CPUE
1 3 1 1.0 1  #Winter S CPUE
5 1 1 0.5 1  #commercial age comps
```

5 2 1 0.5 1 #commercial age comps
5 3 1 0.5 1 #commercial age comps
5 4 1 0.5 1 #commercial age comps
4 1 1 0.5 1 #commercial lgth comps
4 2 1 0.5 1 #commercial lgth comps
4 3 1 0.5 1 #commercial lgth comps
4 4 1 0.5 1 #commercial lgth comps

0 # (0/1) read specs for more stddev reporting
1 1 -1 5 1 5 # selex type, len/age, year, N selex bins, Growth pattern, N growth ages
-5 16 27 38 46 # vector with selex std bin picks (-1 in first bin to self-generate)
1 2 14 26 40 # vector with growth std bin picks (-1 in first bin to self-generate)

999

Appendix F. SS starter file

#C 2013 Assessent of Petrale (Haltuch, Ono, Valero)
petrale13.dat
petrale13.ctl
1 # changed from 1 to 0; 0=use init values in control file; 1=use ss3.par
1 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
0 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)
0 # 1 is example file; Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
1 # Number of bootstrap datafiles to produce: 1st is input, 2nd is estimates, 3rd and higher are bootstrap
10 # Turn off estimation for parameters entering after this phase
10 # MCMC eval burn interval
2 # MCMC thin interval
0.000 # jitter initial parm value by this fraction
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
1973 1976
0.001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
3 # min age for calc of summary biomass
1 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # 0.25 in example; Fraction (X) for Depletion denominator (e.g. 0.4)
4 # 3 in example; SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
1 # 4 in example; F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates); 4=true F for range of ages
4 20 #_min and max age over which average F will be calculated
0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999 # check value for end of file

Appendix G. SS forecast file

#C
for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # Forecast method, MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.3 # SPR target (e.g. 0.40)
0.25 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 0 0 0 0
2 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
1 # F scalar (only used for Do_Forecast==5)
#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
0 0 -10 0
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB))
0.25 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.05 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
0.956 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1-3) (fixed at 3 for now)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2013 #FirstYear for caps and allocations (should be after years with fixed inputs)
0.0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
1 # Do West Coast gfish rebuilder output (0/1)
2011 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
-1 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2

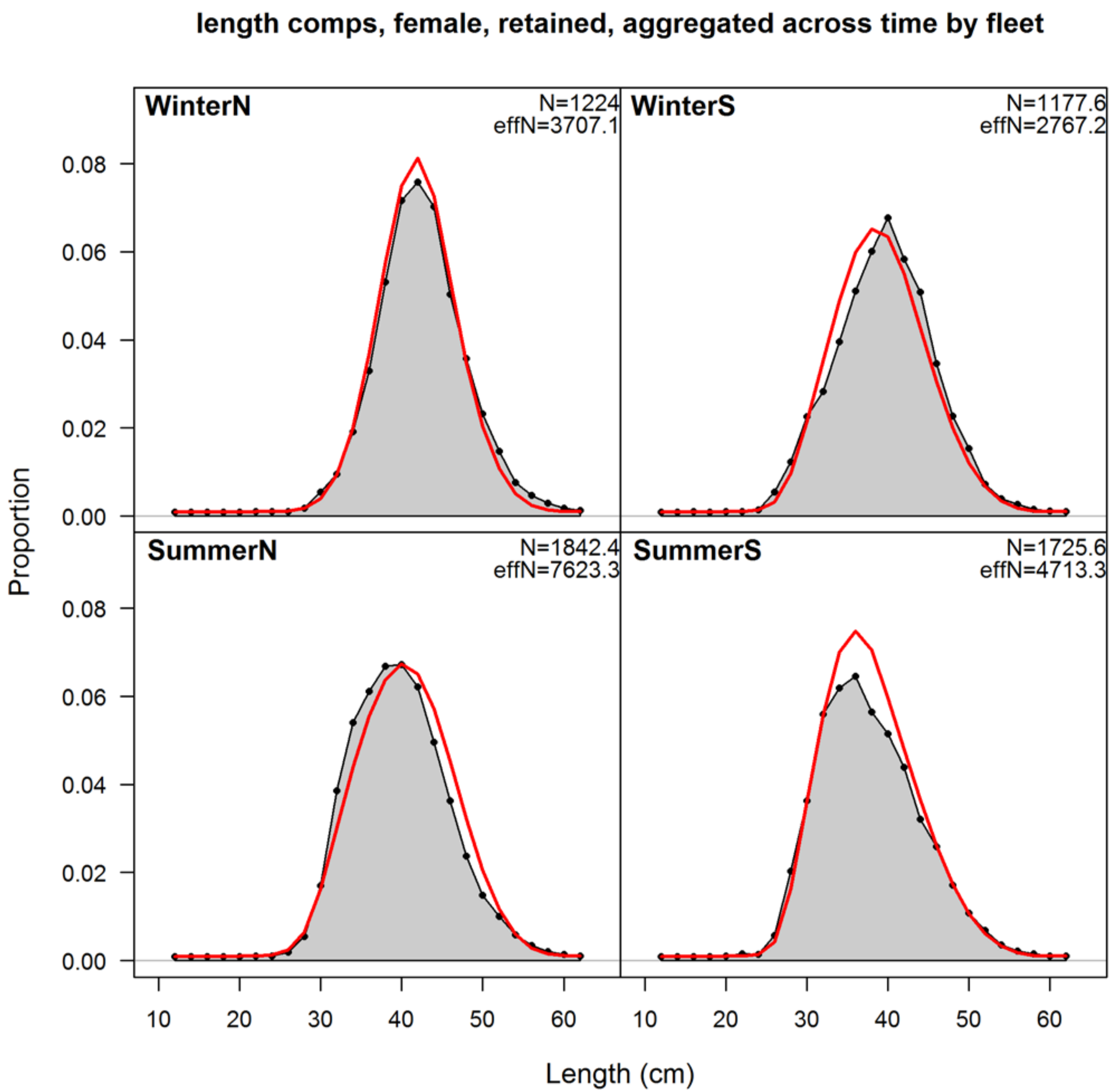
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY1 FISHERY2 FISHERY3
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
 -1 -1 -1 -1
max totalcatch by area (-1 to have no max)
 -1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
 0 0 0 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
8 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
#Year Seas Fleet Catch(or_F)
#allocation for each fleet is based on the average 2011-2012 landings for each fleet

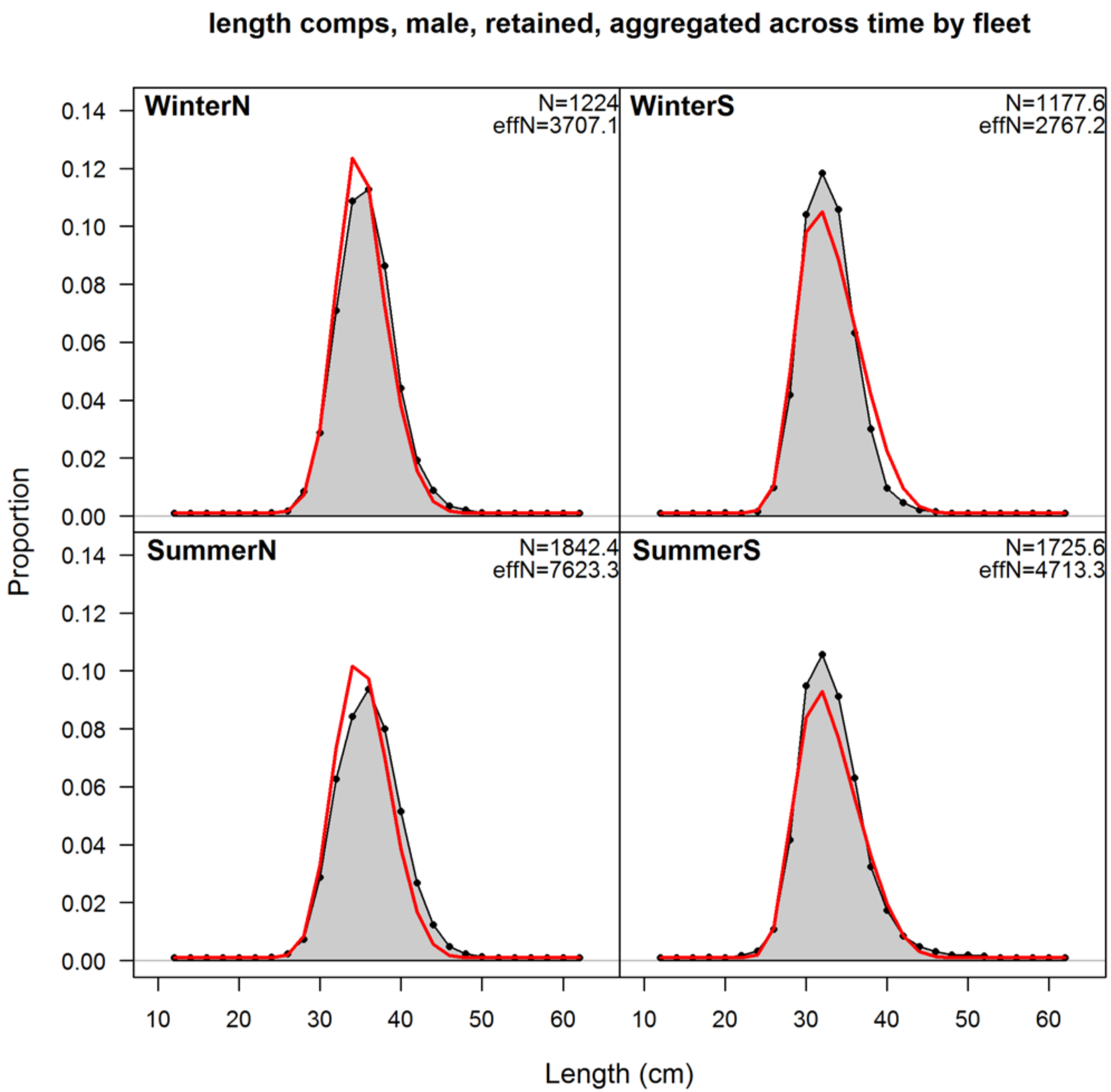
2013	1	1	866.35
2013	1	2	1243.39
2013	1	3	226.43
2013	1	4	255.82
2014	1	1	886.41
2014	1	2	1272.18
2014	1	3	231.67
2014	1	4	261.74

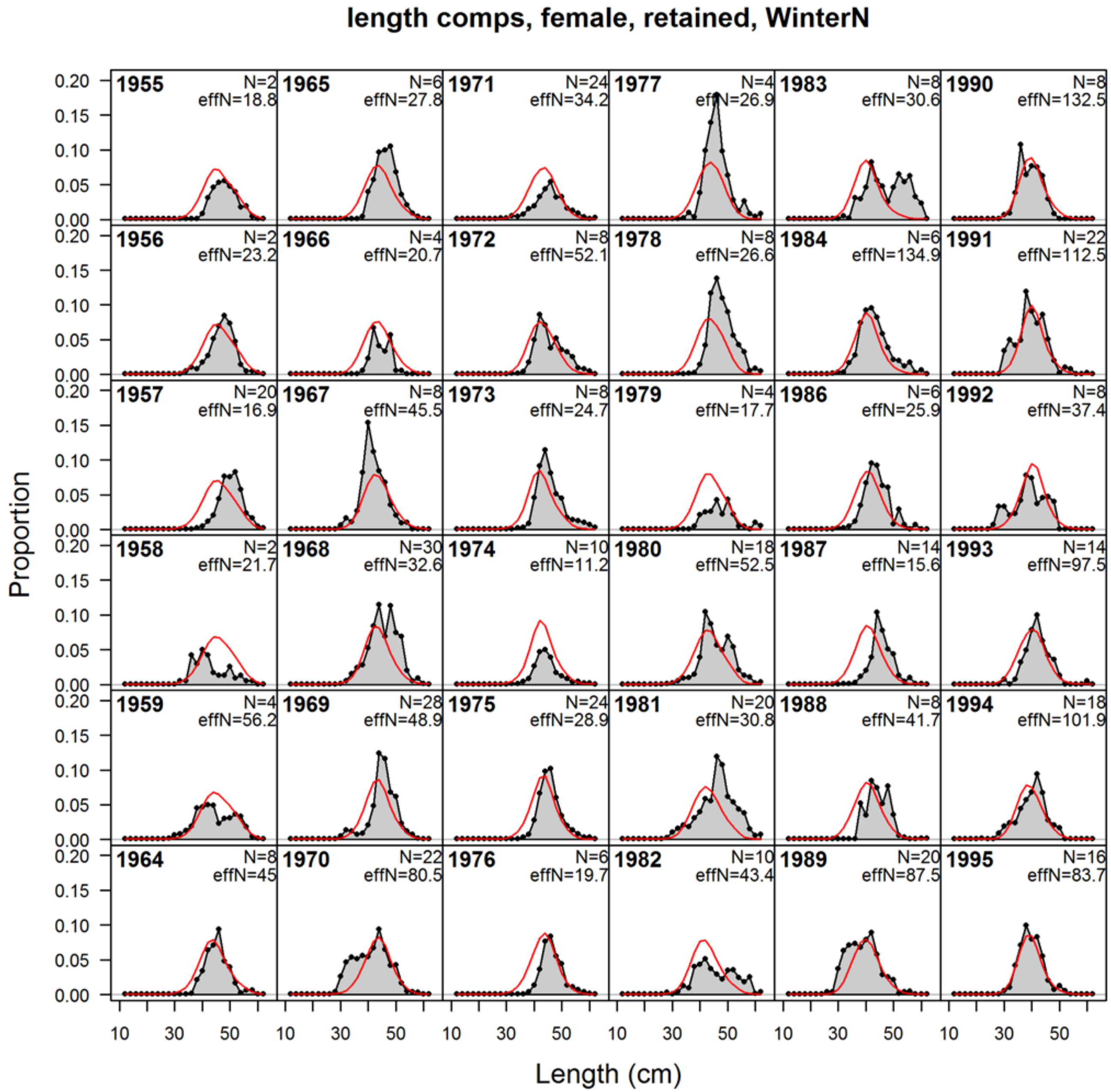
999 # verify end of input

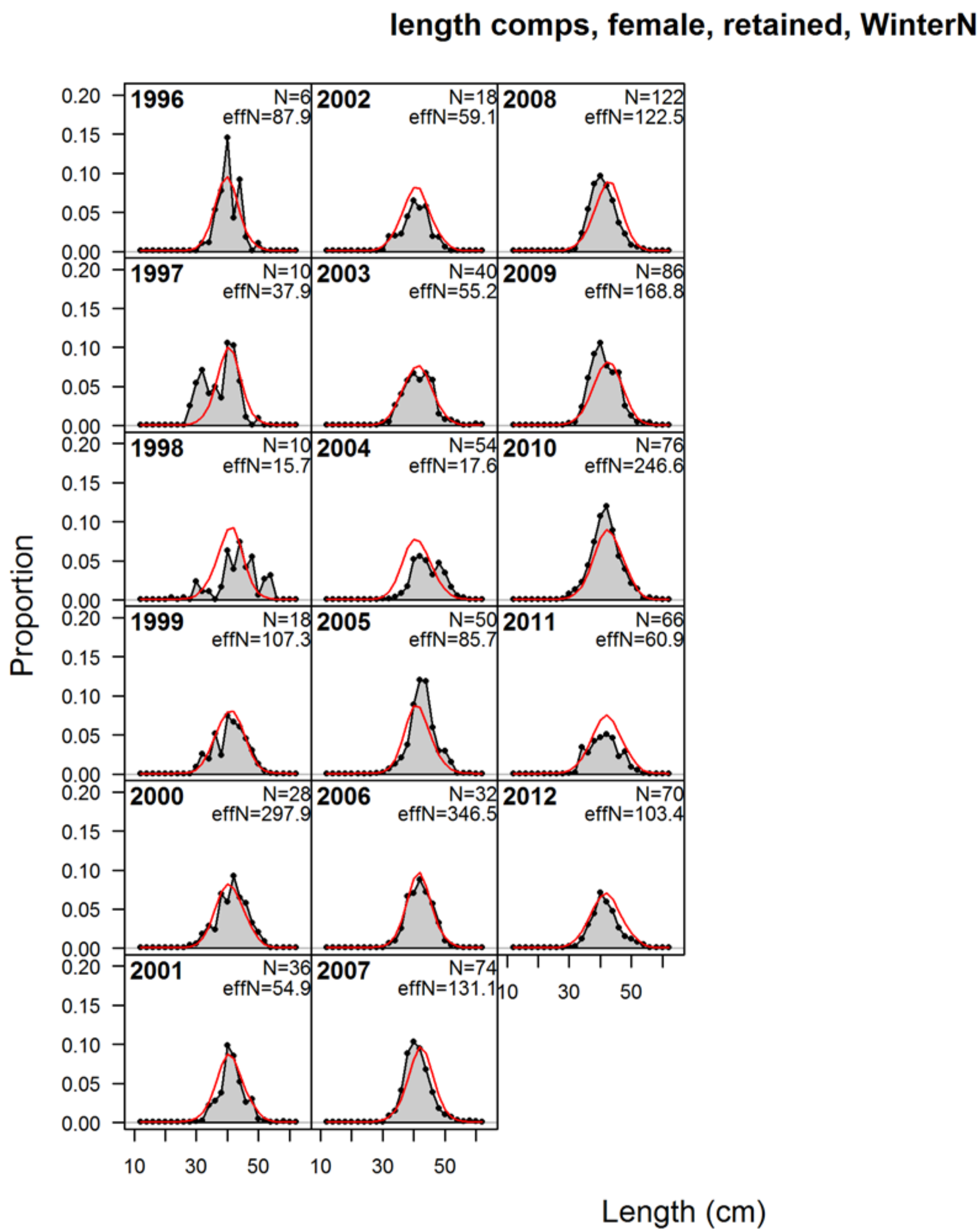
Appendix H. Fishery age and length composition fits

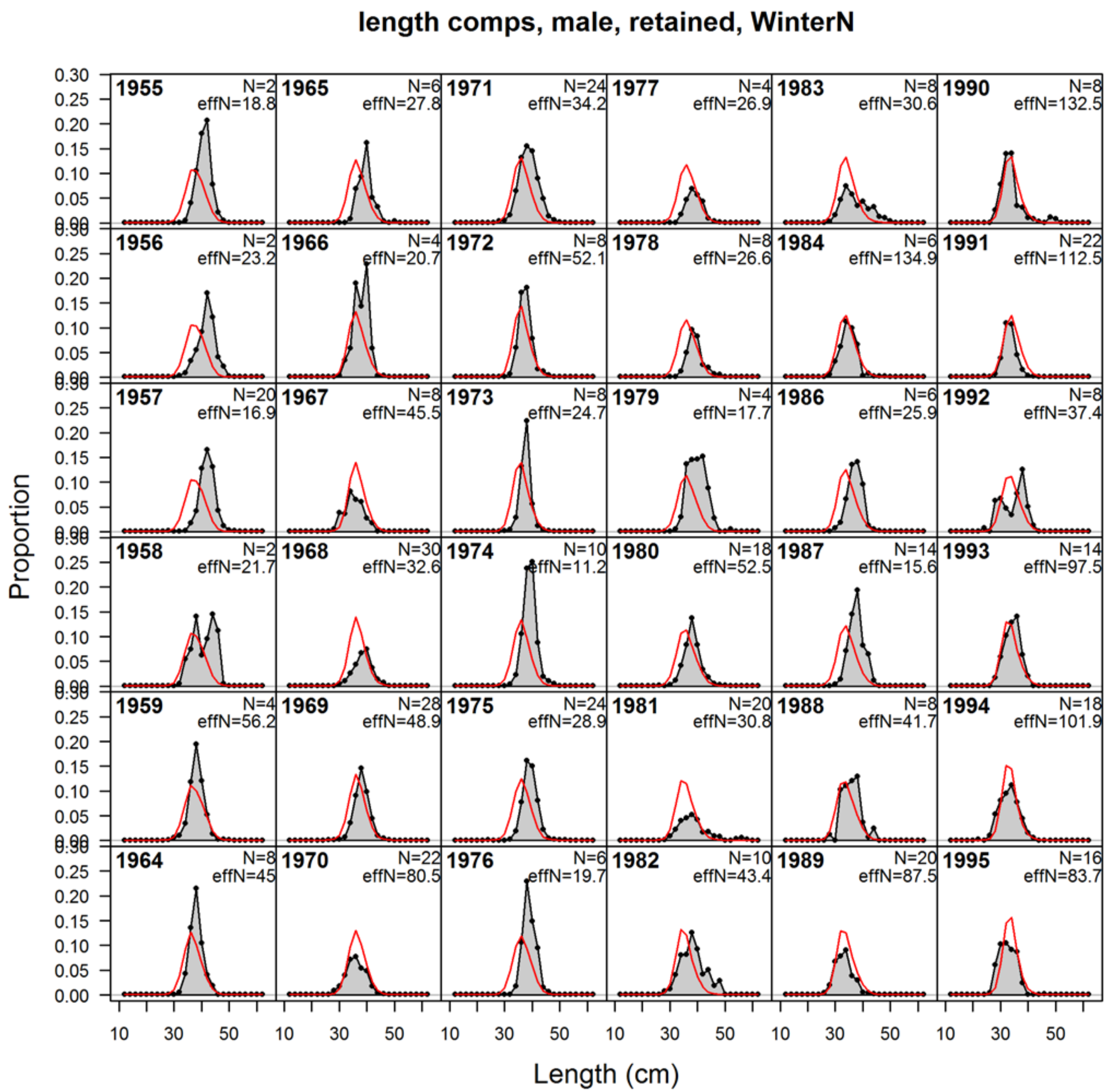
Appendix H.11. Fishery length composition fits

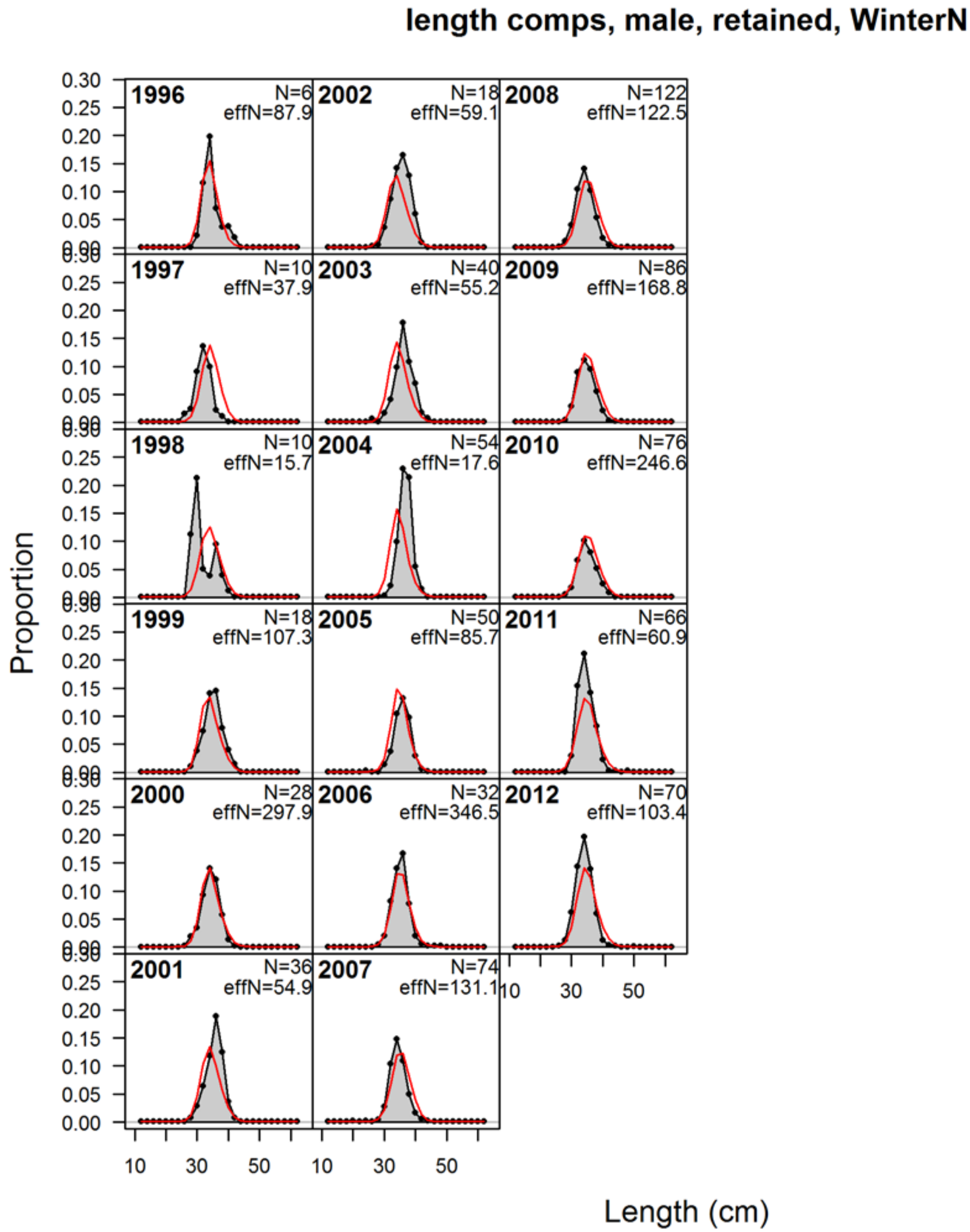

length comps, female, retained, aggregated across time by fleet
WinterN
N=1224
effN=3707.1
WinterS
N=1177.6
effN=2767.2
SummerN
N=1842.4
effN=7623.3
SummerS
N=1725.6
effN=4713.3
Proportion
0.00
0.02
0.04
0.06
0.08
10
20
30
40
50
60
Length (cm)


length comps, male, retained, aggregated across time by fleet
WinterN
N=1224
effN=3707.1
WinterS
N=1177.6
effN=2767.2
SummerN
N=1842.4
effN=7623.3
SummerS
N=1725.6
effN=4713.3
Proportion
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
10
20
30
40
50
60
Length (cm)


length comps, female, retained, WinterN
Proportion
Length (cm)
1955 N=2 effN=18.8
1965 N=6 effN=27.8
1971 N=24 effN=34.2
1977 N=4 effN=26.9
1983 N=8 effN=30.6
1990 N=8 effN=132.5
1956 N=2 effN=23.2
1966 N=4 effN=20.7
1972 N=8 effN=52.1
1978 N=8 effN=26.6
1984 N=6 effN=134.9
1991 N=22 effN=112.5
1957 N=20 effN=16.9
1967 N=8 effN=45.5
1973 N=8 effN=24.7
1979 N=4 effN=17.7
1986 N=6 effN=25.9
1992 N=8 effN=37.4
1958 N=2 effN=21.7
1968 N=30 effN=32.6
1974 N=10 effN=11.2
1980 N=18 effN=52.5
1987 N=14 effN=15.6
1993 N=14 effN=97.5
1959 N=4 effN=56.2
1969 N=28 effN=48.9
1975 N=24 effN=28.9
1981 N=20 effN=30.8
1988 N=8 effN=41.7
1994 N=18 effN=101.9
1964 N=8 effN=45
1970 N=22 effN=80.5
1976 N=6 effN=19.7
1982 N=10 effN=43.4
1989 N=20 effN=87.5
1995 N=16 effN=83.7

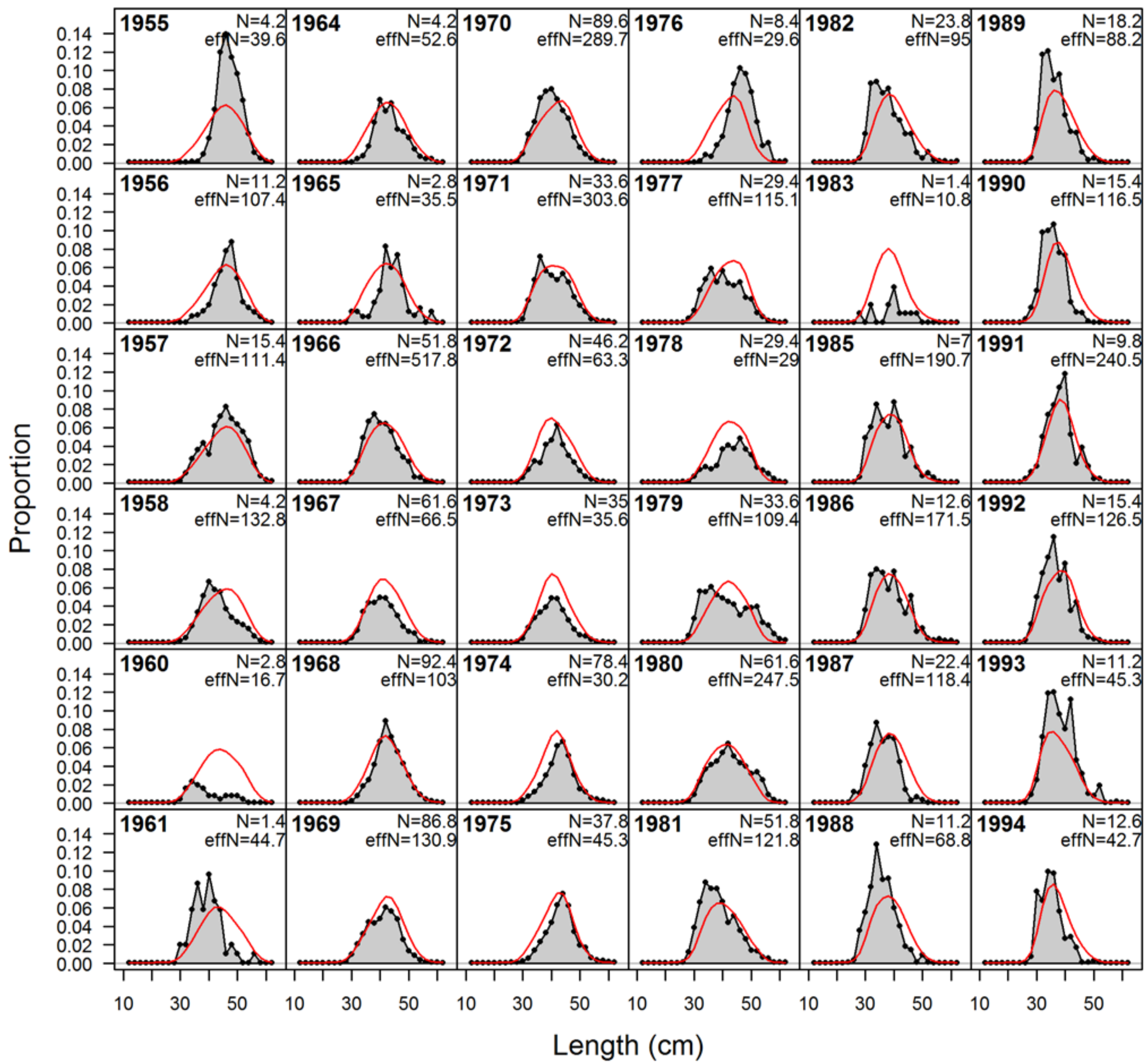

length comps, female, retained, WinterN
1996
N=6
effN=87.9
2002
N=18
effN=59.1
2008
N=122
effN=122.5
1997
N=10
effN=37.9
2003
N=40
effN=55.2
2009
N=86
effN=168.8
1998
N=10
effN=15.7
2004
N=54
effN=17.6
2010
N=76
effN=246.6
1999
N=18
effN=107.3
2005
N=50
effN=85.7
2011
N=66
effN=60.9
2000
N=28
effN=297.9
2006
N=32
effN=346.5
2012
N=70
effN=103.4
2001
N=36
effN=54.9
2007
N=74
effN=131.1
Proportion
Length (cm)
0.00
0.05
0.10
0.15
0.20
10
30
50

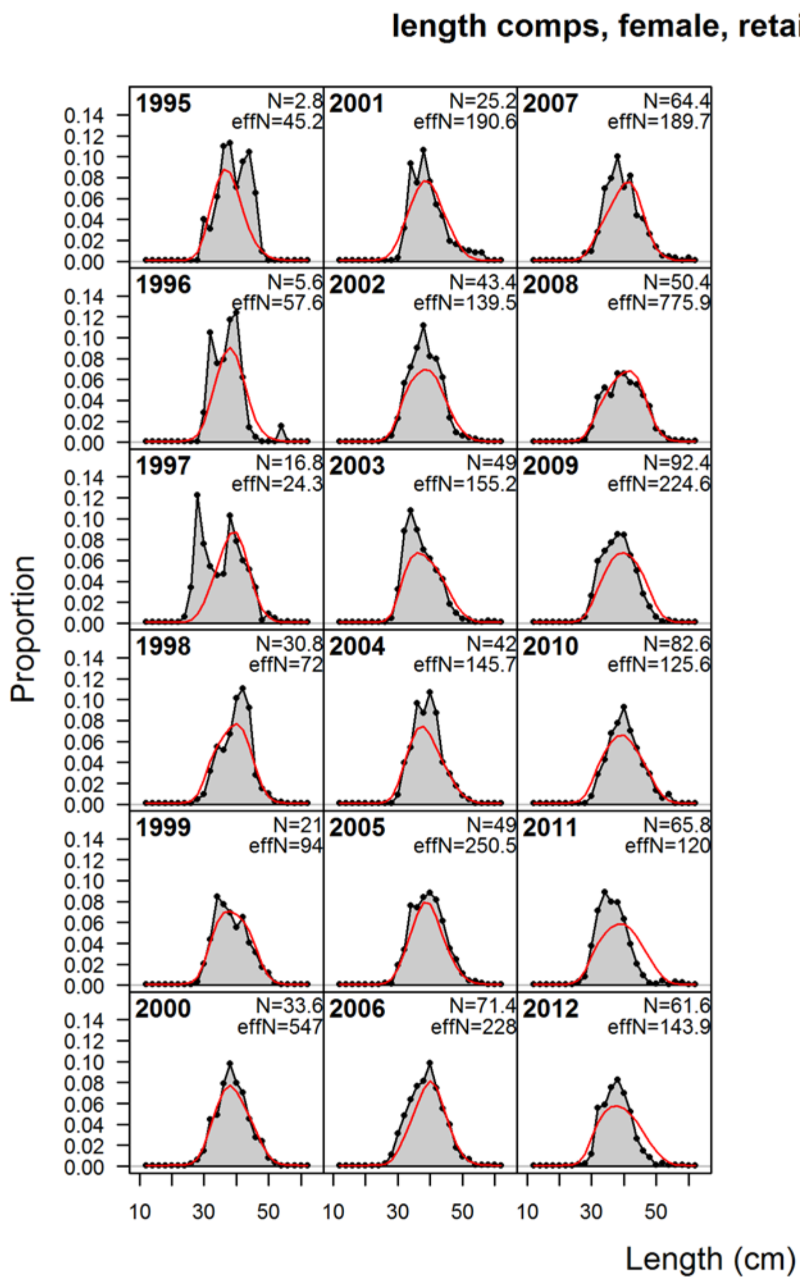

length comps, male, retained, WinterN
1955 N=2 effN=18.8
1965 N=6 effN=27.8
1971 N=24 effN=34.2
1977 N=4 effN=26.9
1983 N=8 effN=30.6
1990 N=8 effN=132.5
1956 N=2 effN=23.2
1966 N=4 effN=20.7
1972 N=8 effN=52.1
1978 N=8 effN=26.6
1984 N=6 effN=134.9
1991 N=22 effN=112.5
1957 N=20 effN=16.9
1967 N=8 effN=45.5
1973 N=8 effN=24.7
1979 N=4 effN=17.7
1986 N=6 effN=25.9
1992 N=8 effN=37.4
1958 N=2 effN=21.7
1968 N=30 effN=32.6
1974 N=10 effN=11.2
1980 N=18 effN=52.5
1987 N=14 effN=15.6
1993 N=14 effN=97.5
1959 N=4 effN=56.2
1969 N=28 effN=48.9
1975 N=24 effN=28.9
1981 N=20 effN=30.8
1988 N=8 effN=41.7
1994 N=18 effN=101.9
1964 N=8 effN=45
1970 N=22 effN=80.5
1976 N=6 effN=19.7
1982 N=10 effN=43.4
1989 N=20 effN=87.5
1995 N=16 effN=83.7
Proportion
0.00 0.05 0.10 0.15 0.20 0.25 0.30
10 30 50
Length (cm)



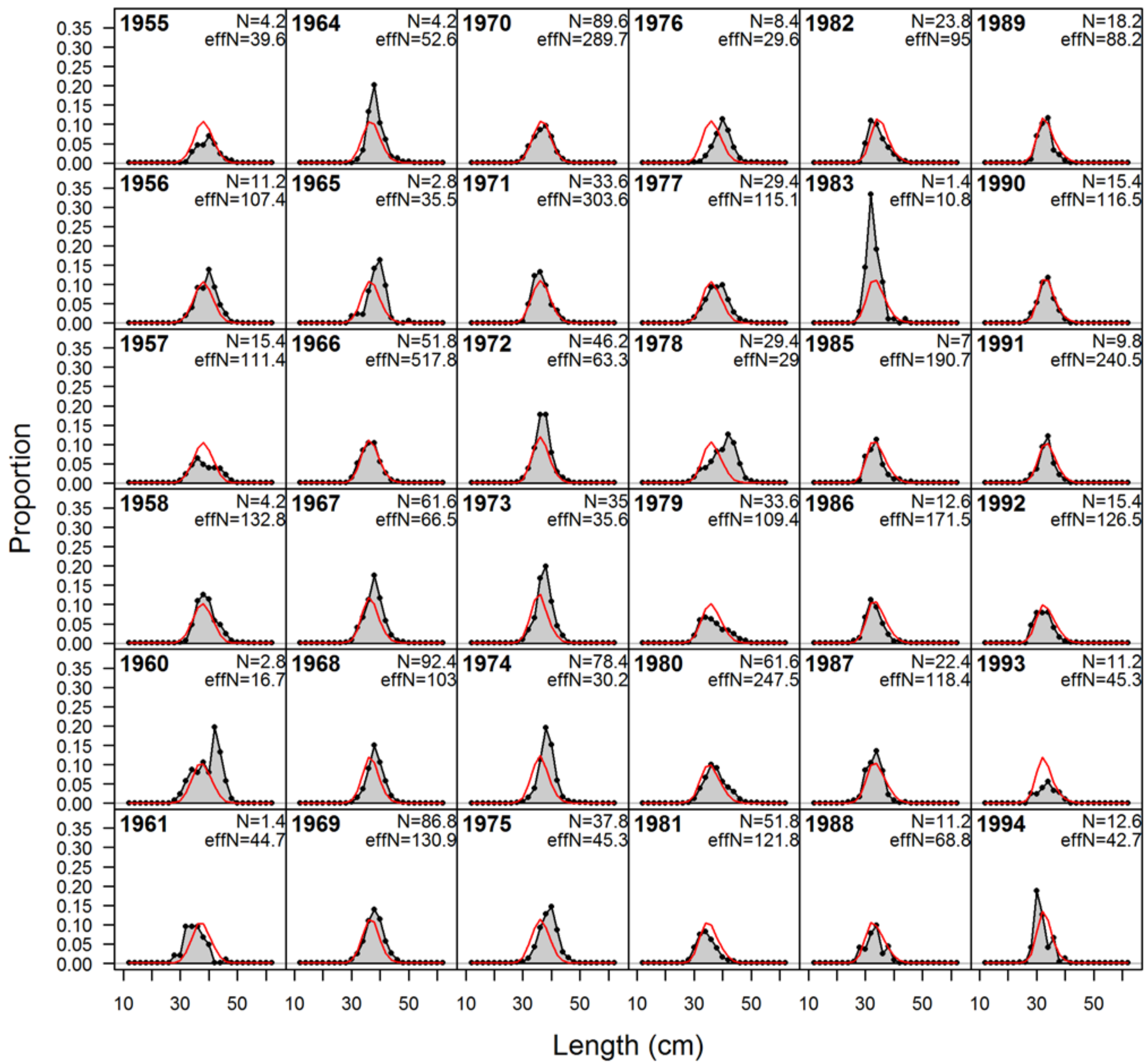
length comps, male, retained, WinterN
Proportion
Length (cm)
1996 N=6 effN=87.9
1997 N=10 effN=37.9
1998 N=10 effN=15.7
1999 N=18 effN=107.3
2000 N=28 effN=297.9
2001 N=36 effN=54.9
2002 N=18 effN=59.1
2003 N=40 effN=55.2
2004 N=54 effN=17.6
2005 N=50 effN=85.7
2006 N=32 effN=346.5
2007 N=74 effN=131.1
2008 N=122 effN=122.5
2009 N=86 effN=168.8
2010 N=76 effN=246.6
2011 N=66 effN=60.9
2012 N=70 effN=103.4

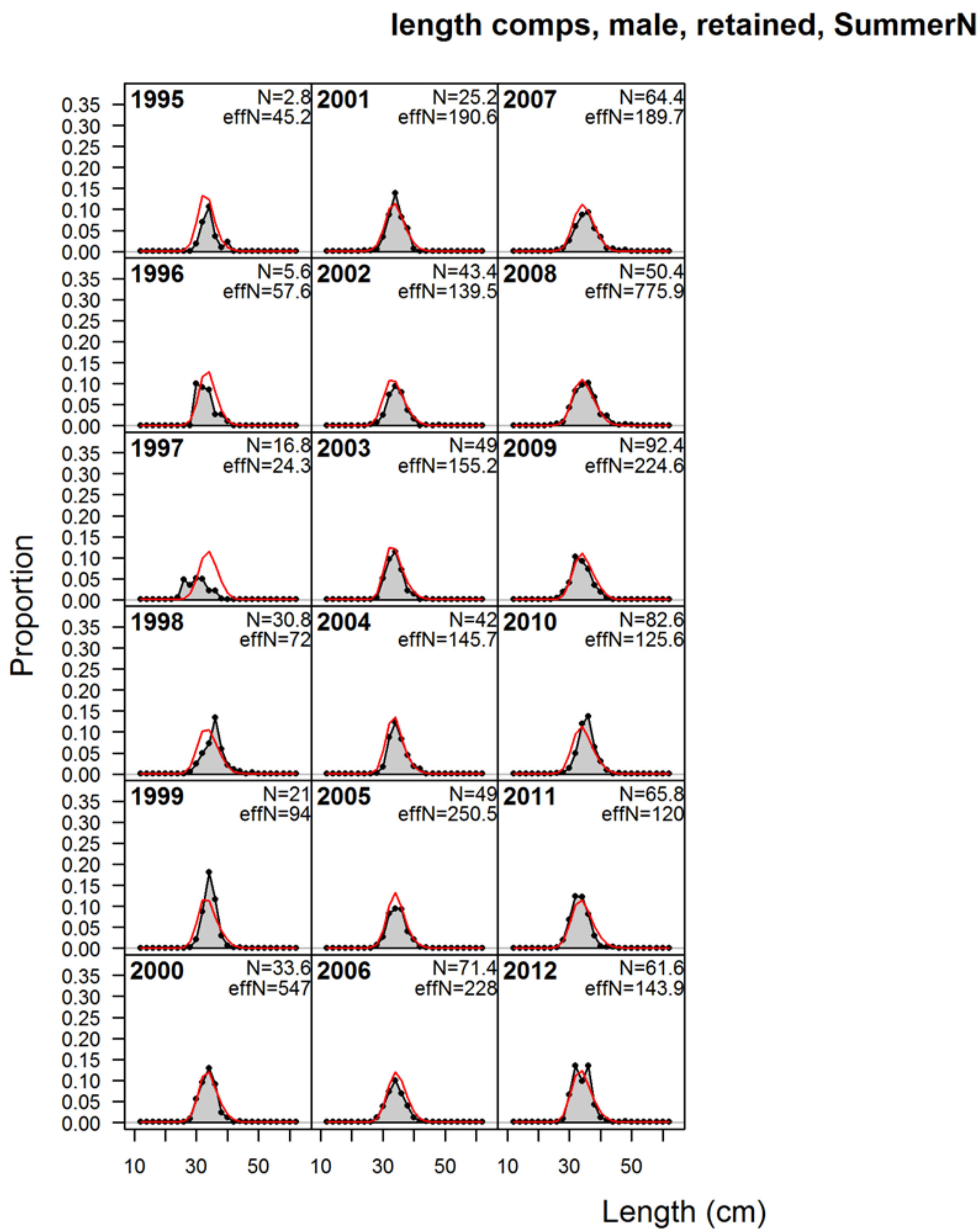
length comps, female, retained, SummerN

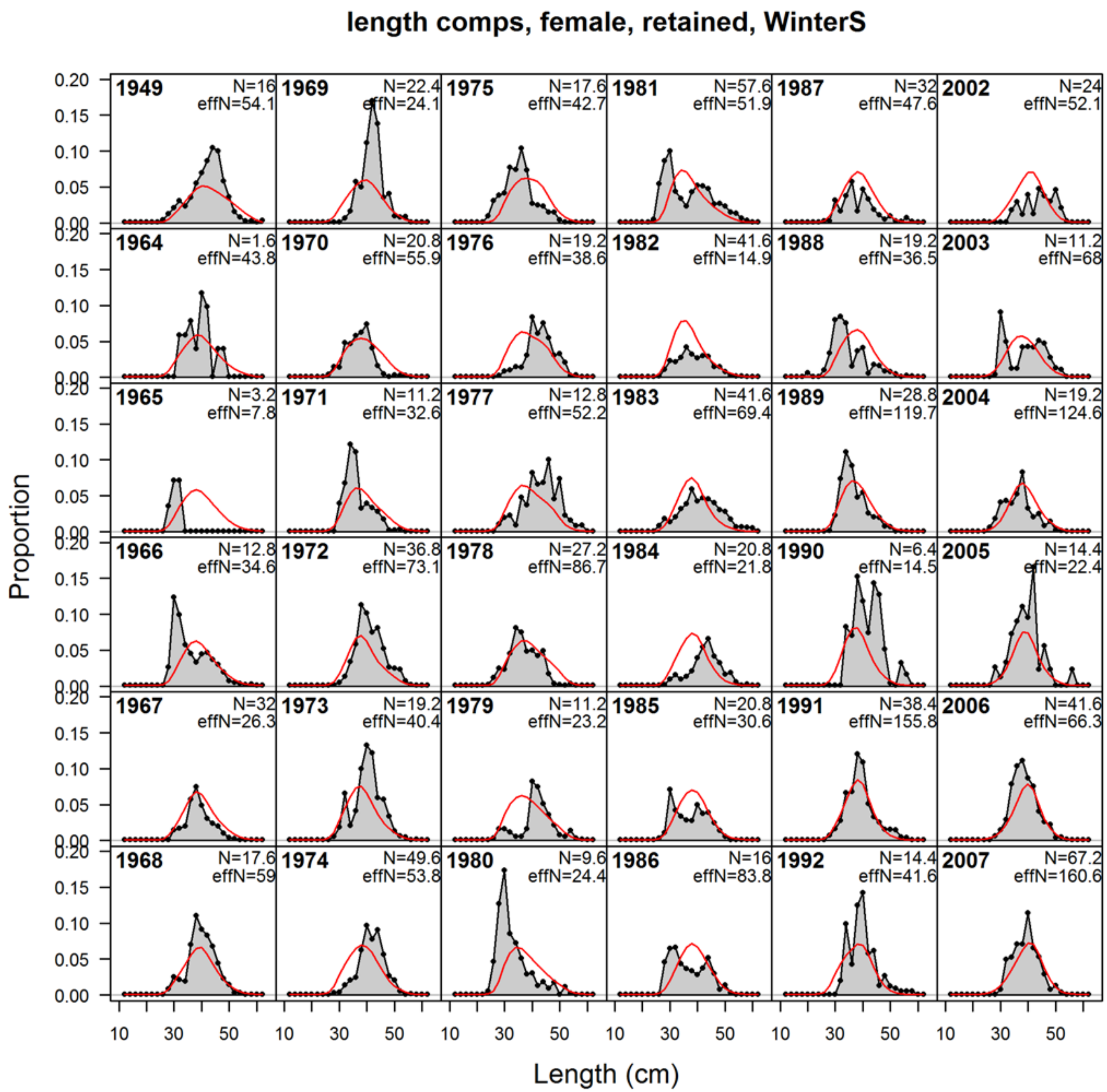


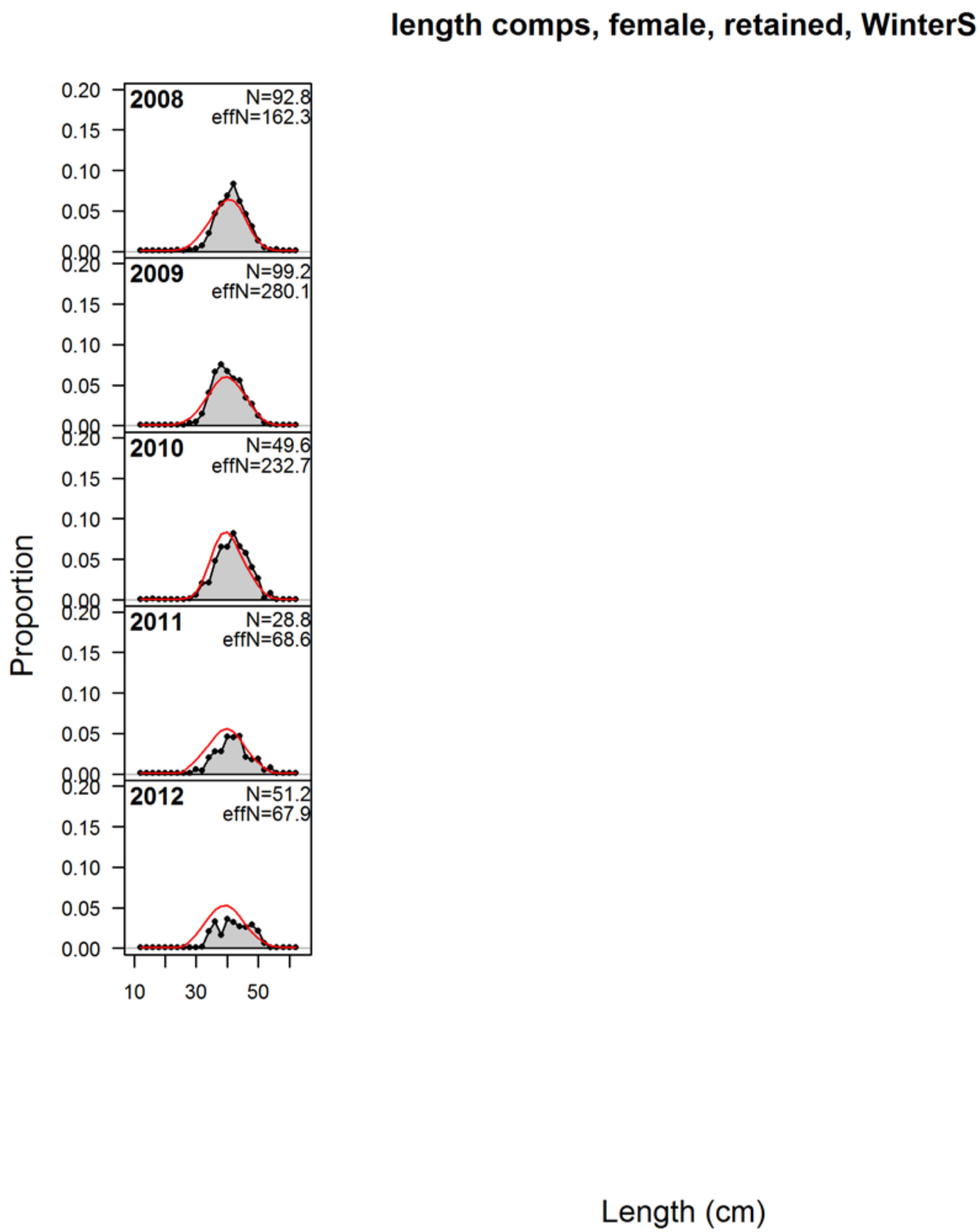

length comps, female, retained, SummerN
1995 N=2.8 effN=45.2
2001 N=25.2 effN=190.6
2007 N=64.4 effN=189.7
1996 N=5.6 effN=57.6
2002 N=43.4 effN=139.5
2008 N=50.4 effN=775.9
1997 N=16.8 effN=24.3
2003 N=49 effN=155.2
2009 N=92.4 effN=224.6
1998 N=30.8 effN=72
2004 N=42 effN=145.7
2010 N=82.6 effN=125.6
1999 N=21 effN=94
2005 N=49 effN=250.5
2011 N=65.8 effN=120
2000 N=33.6 effN=547
2006 N=71.4 effN=228
2012 N=61.6 effN=143.9
Proportion
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
10
30
50
Length (cm)

length comps, male, retained, SummerN

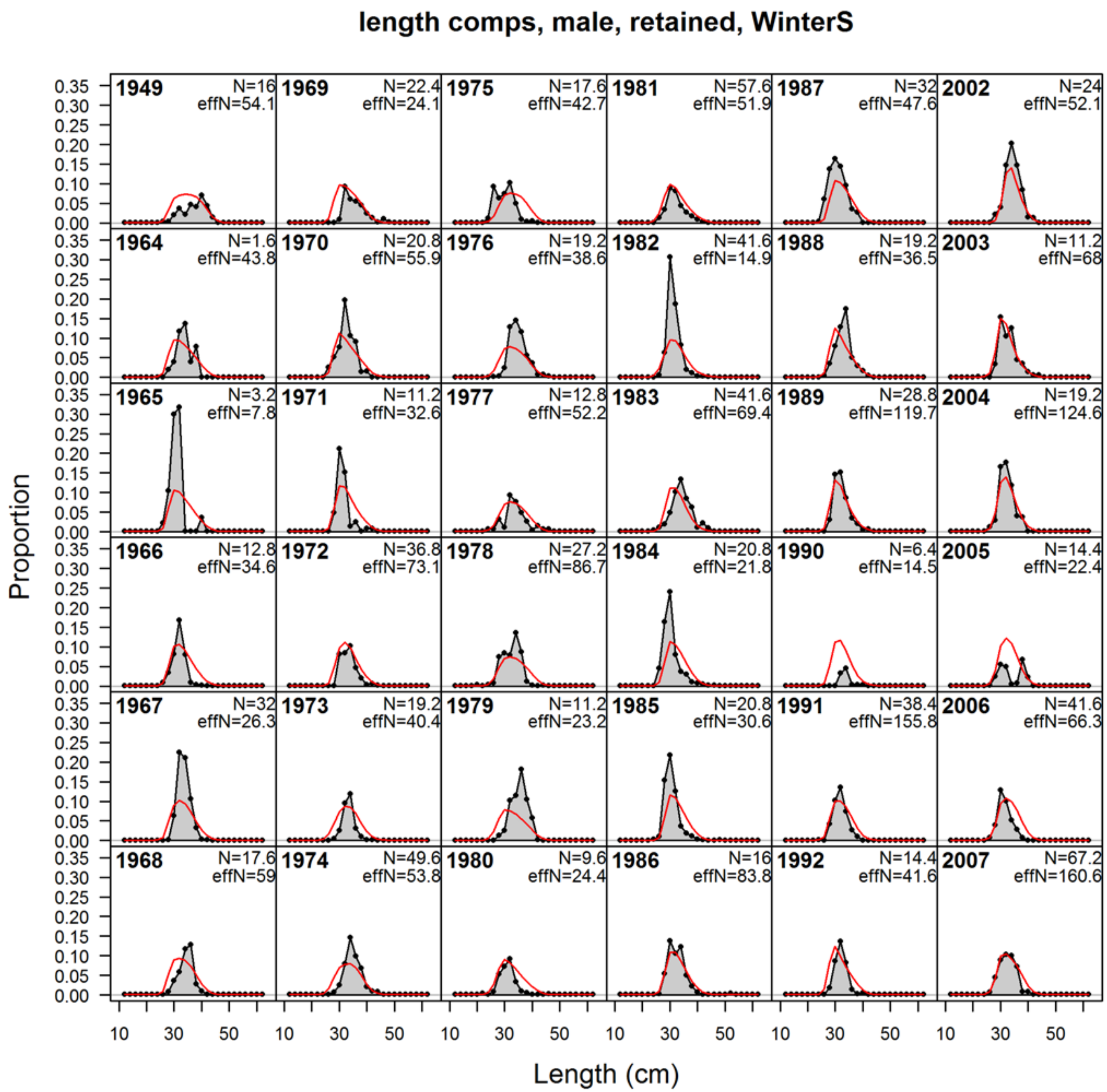


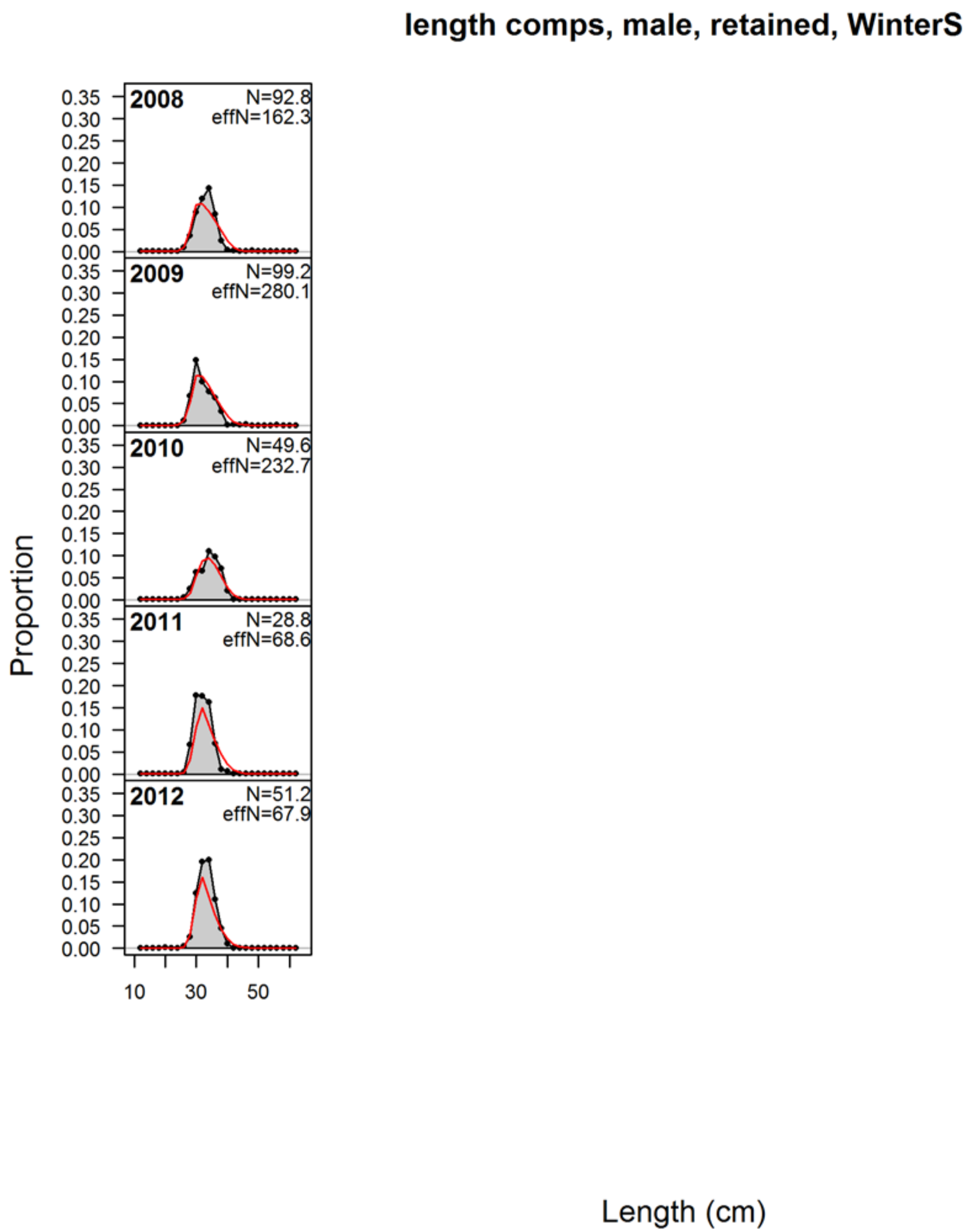

length comps, male, retained, SummerN
1995 N=2.8 effN=45.2
2001 N=25.2 effN=190.6
2007 N=64.4 effN=189.7
1996 N=5.6 effN=57.6
2002 N=43.4 effN=139.5
2008 N=50.4 effN=775.9
1997 N=16.8 effN=24.3
2003 N=49 effN=155.2
2009 N=92.4 effN=224.6
1998 N=30.8 effN=72
2004 N=42 effN=145.7
2010 N=82.6 effN=125.6
1999 N=21 effN=94
2005 N=49 effN=250.5
2011 N=65.8 effN=120
2000 N=33.6 effN=547
2006 N=71.4 effN=228
2012 N=61.6 effN=143.9
Proportion
Length (cm)

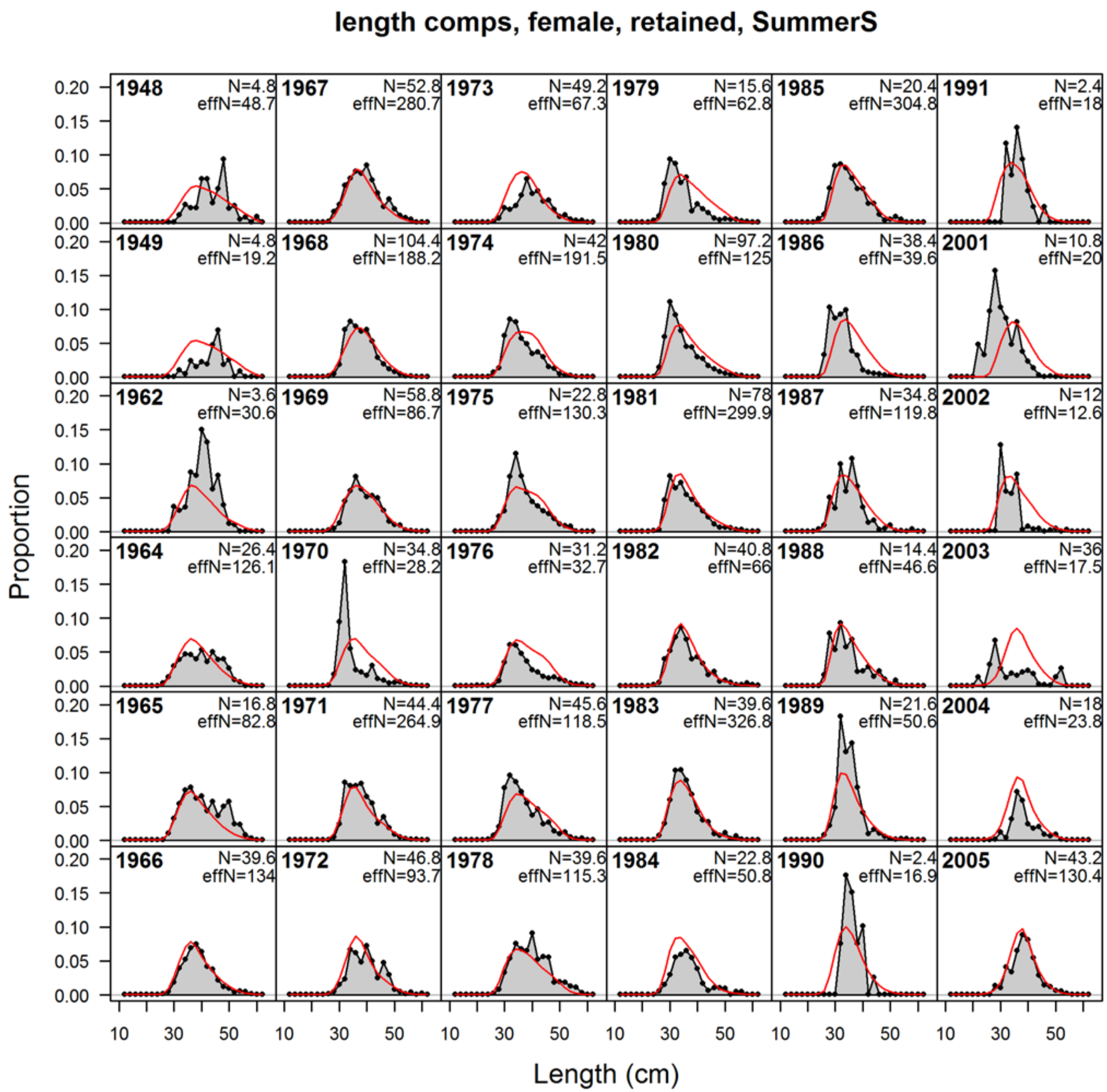

length comps, female, retained, WinterS
Proportion
Length (cm)
1949 N=16 effN=54.1
1969 N=22.4 effN=24.1
1975 N=17.6 effN=42.7
1981 N=57.6 effN=51.9
1987 N=32 effN=47.6
2002 N=24 effN=52.1
1964 N=1.6 effN=43.8
1970 N=20.8 effN=55.9
1976 N=19.2 effN=38.6
1982 N=41.6 effN=14.9
1988 N=19.2 effN=36.5
2003 N=11.2 effN=68
1965 N=3.2 effN=7.8
1971 N=11.2 effN=32.6
1977 N=12.8 effN=52.2
1983 N=41.6 effN=69.4
1989 N=28.8 effN=119.7
2004 N=19.2 effN=124.6
1966 N=12.8 effN=34.6
1972 N=36.8 effN=73.1
1978 N=27.2 effN=86.7
1984 N=20.8 effN=21.8
1990 N=6.4 effN=14.5
2005 N=14.4 effN=22.4
1967 N=32 effN=26.3
1973 N=19.2 effN=40.4
1979 N=11.2 effN=23.2
1985 N=20.8 effN=30.6
1991 N=38.4 effN=155.8
2006 N=41.6 effN=66.3
1968 N=17.6 effN=59
1974 N=49.6 effN=53.8
1980 N=9.6 effN=24.4
1986 N=16 effN=83.8
1992 N=14.4 effN=41.6
2007 N=67.2 effN=160.6

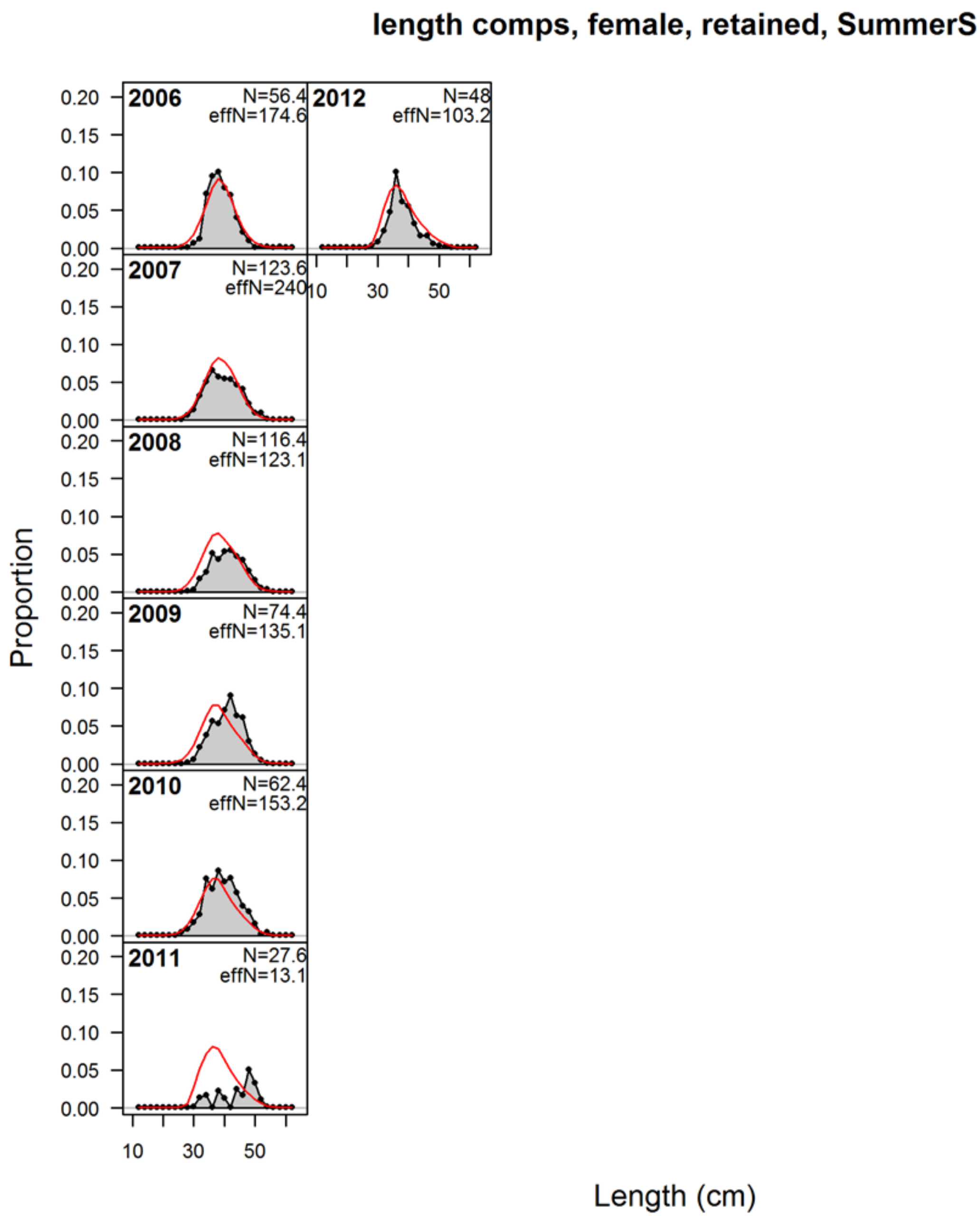


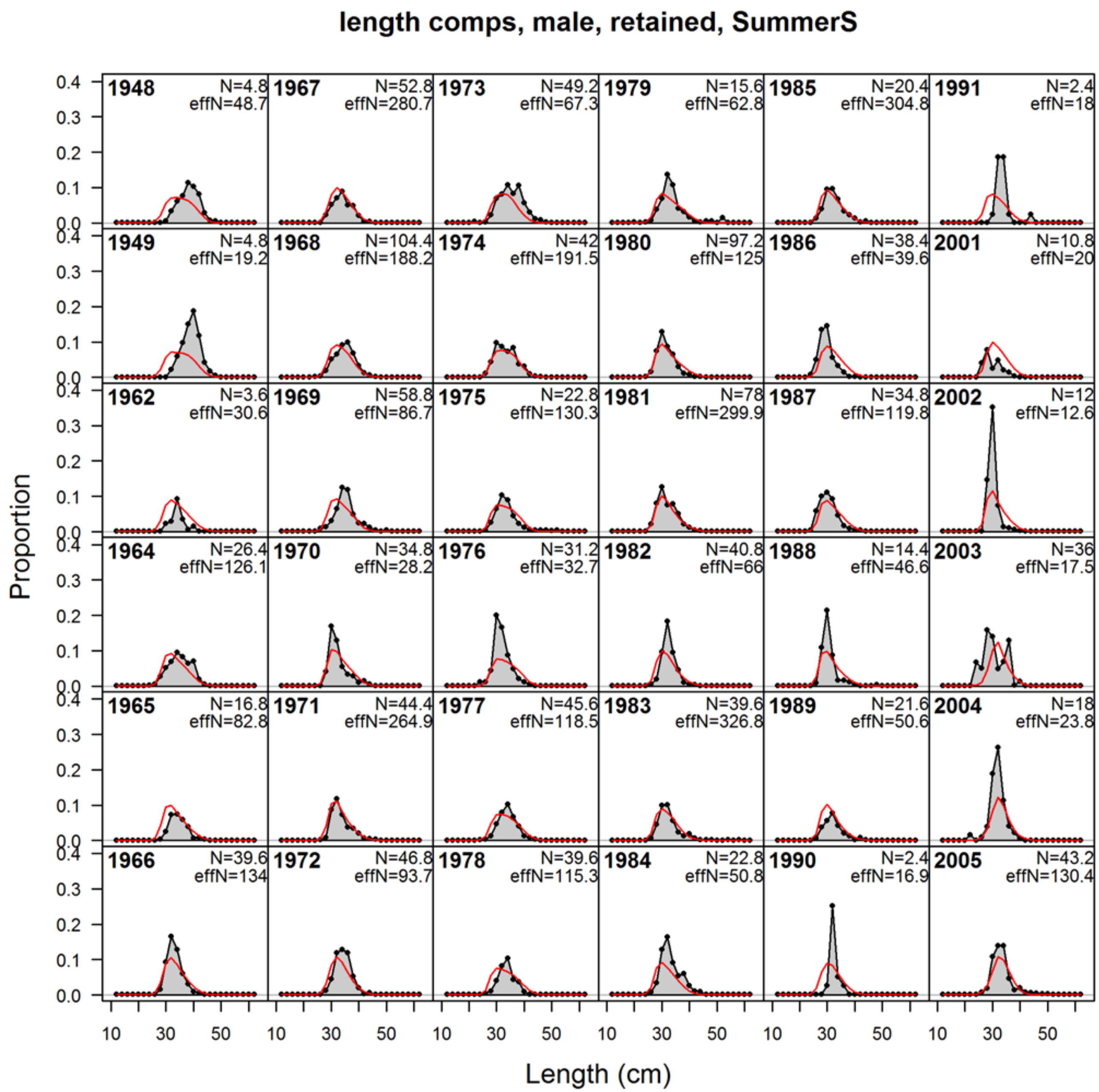
length comps, female, retained, WinterS
Proportion
Length (cm)
2008
N=92.8
effN=162.3
2009
N=99.2
effN=280.1
2010
N=49.6
effN=232.7
2011
N=28.8
effN=68.6
2012
N=51.2
effN=67.9
0.00
0.05
0.10
0.15
0.20
10
30
50

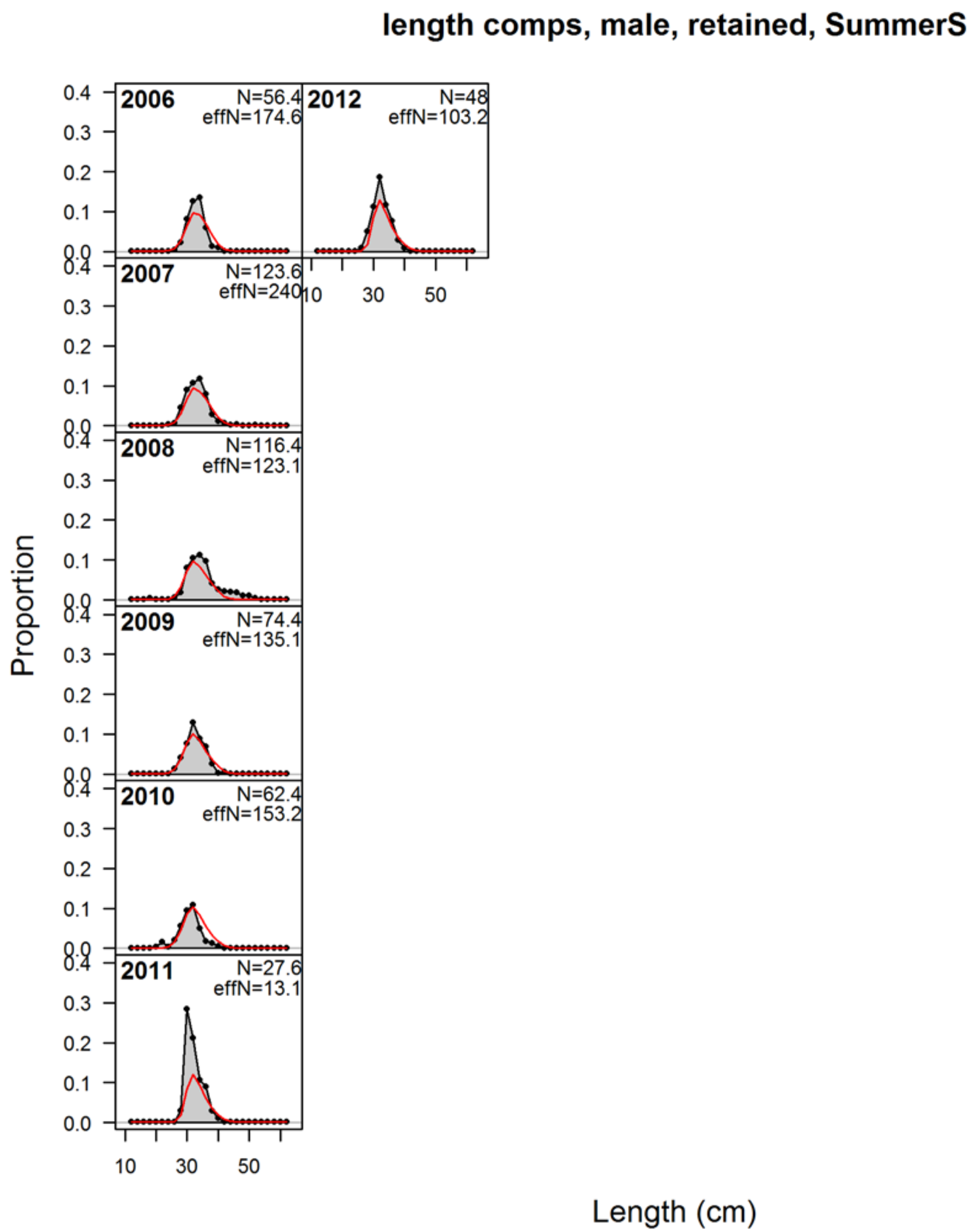

length comps, male, retained, WinterS
Proportion
Length (cm)
1949 N=16 effN=54.1
1969 N=22.4 effN=24.1
1975 N=17.6 effN=42.7
1981 N=57.6 effN=51.9
1987 N=32 effN=47.6
2002 N=24 effN=52.1
1964 N=1.6 effN=43.8
1970 N=20.8 effN=55.9
1976 N=19.2 effN=38.6
1982 N=41.6 effN=14.9
1988 N=19.2 effN=36.5
2003 N=11.2 effN=68
1965 N=3.2 effN=7.8
1971 N=11.2 effN=32.6
1977 N=12.8 effN=52.2
1983 N=41.6 effN=69.4
1989 N=28.8 effN=119.7
2004 N=19.2 effN=124.6
1966 N=12.8 effN=34.6
1972 N=36.8 effN=73.1
1978 N=27.2 effN=86.7
1984 N=20.8 effN=21.8
1990 N=6.4 effN=14.5
2005 N=14.4 effN=22.4
1967 N=32 effN=26.3
1973 N=19.2 effN=40.4
1979 N=11.2 effN=23.2
1985 N=20.8 effN=30.6
1991 N=38.4 effN=155.8
2006 N=41.6 effN=66.3
1968 N=17.6 effN=59
1974 N=49.6 effN=53.8
1980 N=9.6 effN=24.4
1986 N=16 effN=83.8
1992 N=14.4 effN=41.6
2007 N=67.2 effN=160.6


length comps, male, retained, WinterS
2008 N=92.8 effN=162.3
2009 N=99.2 effN=280.1
2010 N=49.6 effN=232.7
2011 N=28.8 effN=68.6
2012 N=51.2 effN=67.9
Proportion
Length (cm)

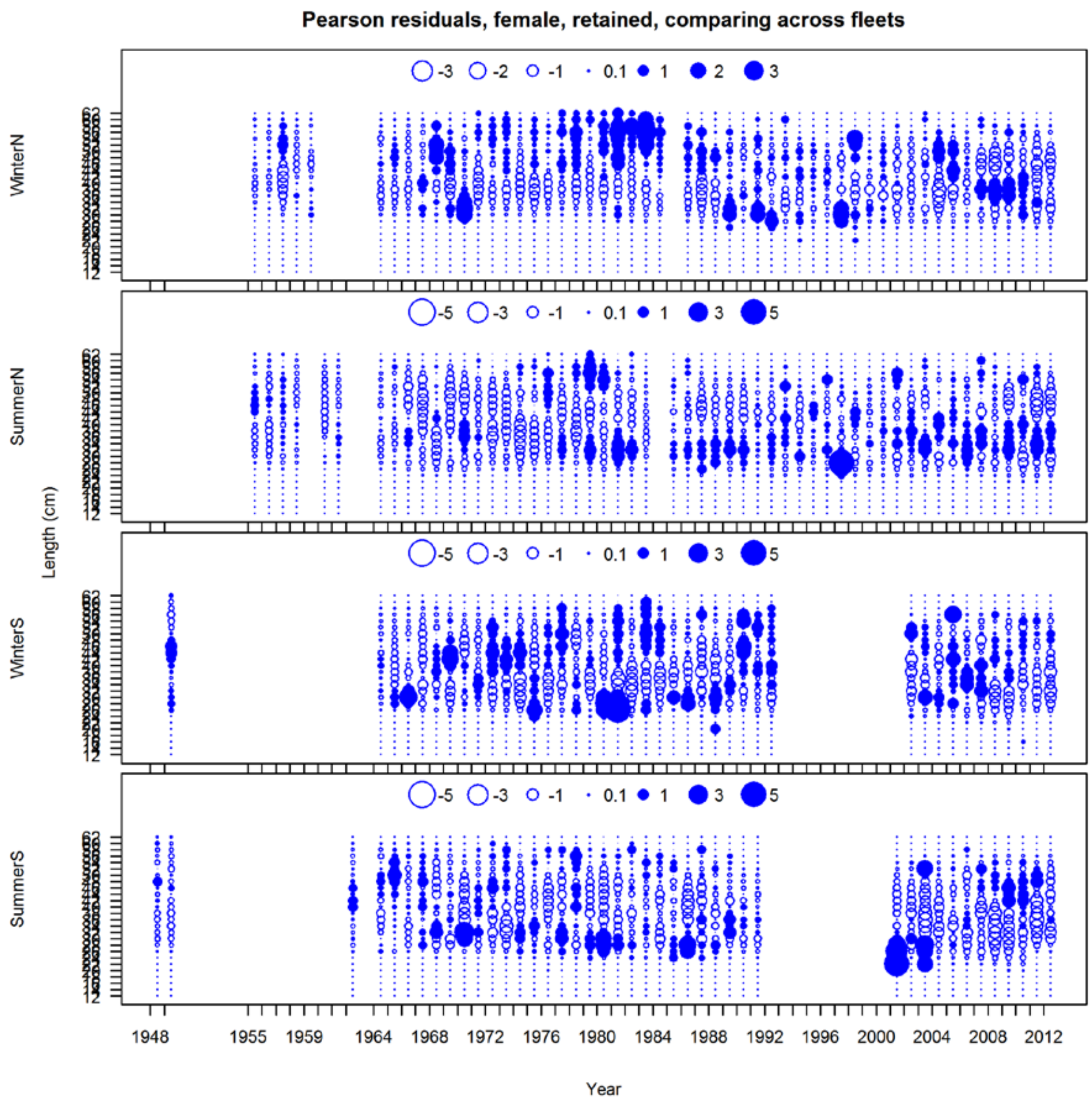

length comps, female, retained, SummerS
Proportion
Length (cm)
1948 N=4.8 effN=48.7
1967 N=52.8 effN=280.7
1973 N=49.2 effN=67.3
1979 N=15.6 effN=62.8
1985 N=20.4 effN=304.8
1991 N=2.4 effN=18
1949 N=4.8 effN=19.2
1968 N=104.4 effN=188.2
1974 N=42 effN=191.5
1980 N=97.2 effN=125
1986 N=38.4 effN=39.6
2001 N=10.8 effN=20
1962 N=3.6 effN=30.6
1969 N=58.8 effN=86.7
1975 N=22.8 effN=130.3
1981 N=78 effN=299.9
1987 N=34.8 effN=119.8
2002 N=12 effN=12.6
1964 N=26.4 effN=126.1
1970 N=34.8 effN=28.2
1976 N=31.2 effN=32.7
1982 N=40.8 effN=66
1988 N=14.4 effN=46.6
2003 N=36 effN=17.5
1965 N=16.8 effN=82.8
1971 N=44.4 effN=264.9
1977 N=45.6 effN=118.5
1983 N=39.6 effN=326.8
1989 N=21.6 effN=50.6
2004 N=18 effN=23.8
1966 N=39.6 effN=134
1972 N=46.8 effN=93.7
1978 N=39.6 effN=115.3
1984 N=22.8 effN=50.8
1990 N=2.4 effN=16.9
2005 N=43.2 effN=130.4
0.00 0.05 0.10 0.15 0.20
10 30 50


length comps, female, retained, SummerS
2006
N=56.4
effN=174.6
2012
N=48
effN=103.2
2007
N=123.6
effN=240
2008
N=116.4
effN=123.1
2009
N=74.4
effN=135.1
2010
N=62.4
effN=153.2
2011
N=27.6
effN=13.1
0.20
0.15
0.10
0.05
0.00
10
30
50
Proportion
Length (cm)

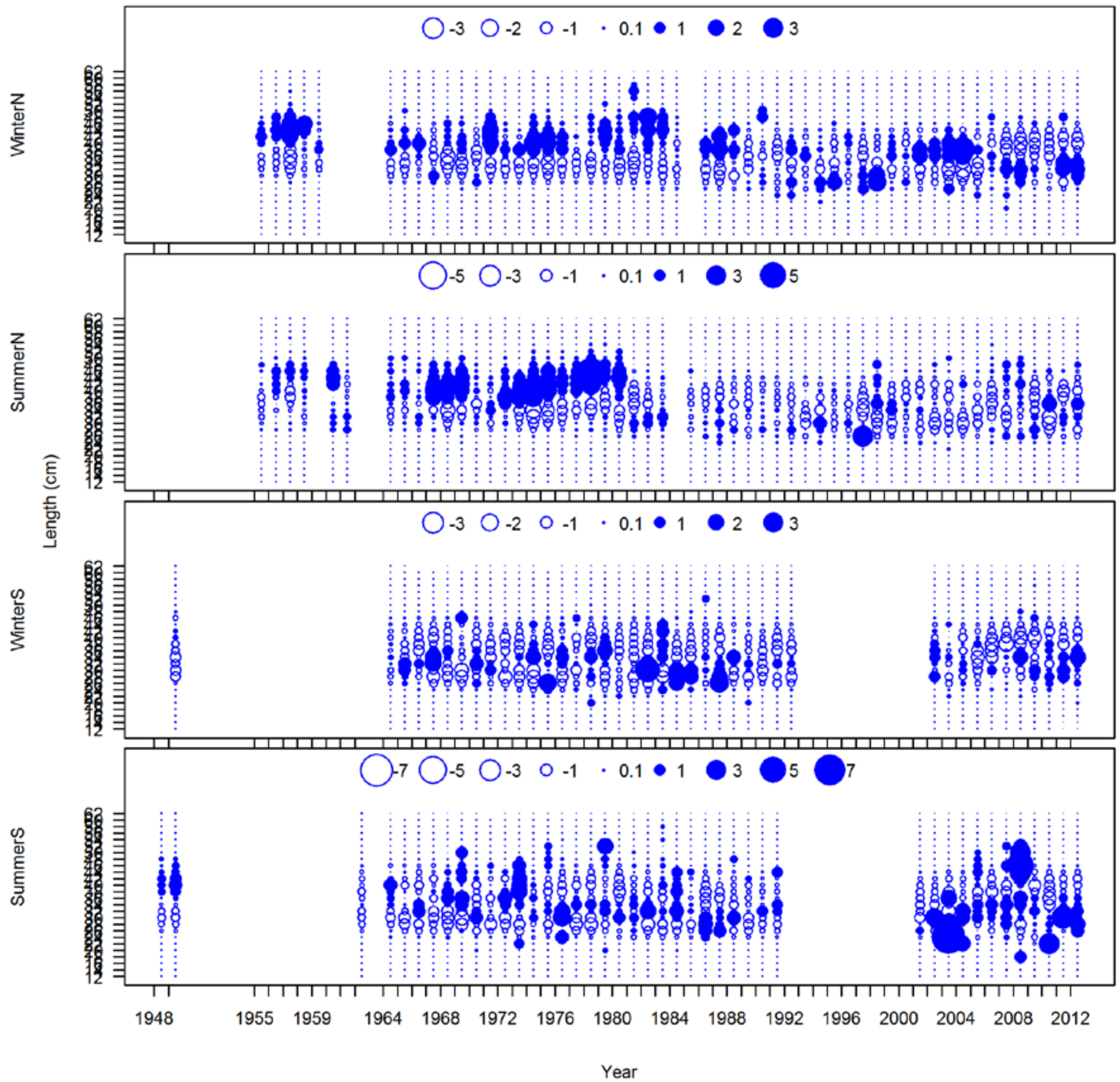

length comps, male, retained, SummerS
Proportion
Length (cm)
1948 N=4.8 effN=48.7
1967 N=52.8 effN=280.7
1973 N=49.2 effN=67.3
1979 N=15.6 effN=62.8
1985 N=20.4 effN=304.8
1991 N=2.4 effN=18
1949 N=4.8 effN=19.2
1968 N=104.4 effN=188.2
1974 N=42 effN=191.5
1980 N=97.2 effN=125
1986 N=38.4 effN=39.6
2001 N=10.8 effN=20
1962 N=3.6 effN=30.6
1969 N=58.8 effN=86.7
1975 N=22.8 effN=130.3
1981 N=78 effN=299.9
1987 N=34.8 effN=119.8
2002 N=12 effN=12.6
1964 N=26.4 effN=126.1
1970 N=34.8 effN=28.2
1976 N=31.2 effN=32.7
1982 N=40.8 effN=66
1988 N=14.4 effN=46.6
2003 N=36 effN=17.5
1965 N=16.8 effN=82.8
1971 N=44.4 effN=264.9
1977 N=45.6 effN=118.5
1983 N=39.6 effN=326.8
1989 N=21.6 effN=50.6
2004 N=18 effN=23.8
1966 N=39.6 effN=134
1972 N=46.8 effN=93.7
1978 N=39.6 effN=115.3
1984 N=22.8 effN=50.8
1990 N=2.4 effN=16.9
2005 N=43.2 effN=130.4

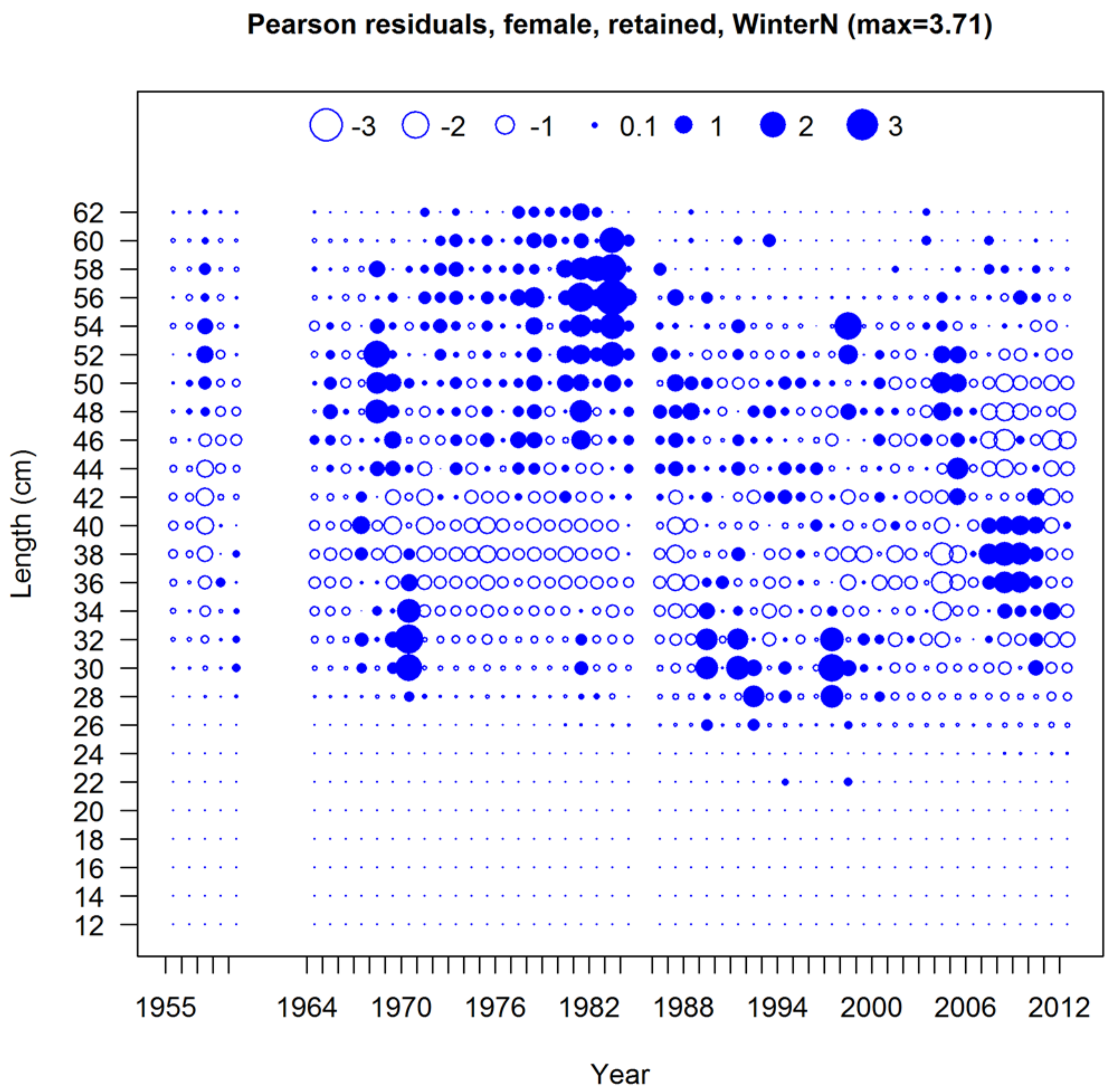

length comps, male, retained, SummerS
2006
N=56.4
effN=174.6
2012
N=48
effN=103.2
2007
N=123.6
effN=240
2008
N=116.4
effN=123.1
2009
N=74.4
effN=135.1
2010
N=62.4
effN=153.2
2011
N=27.6
effN=13.1
Proportion
Length (cm)

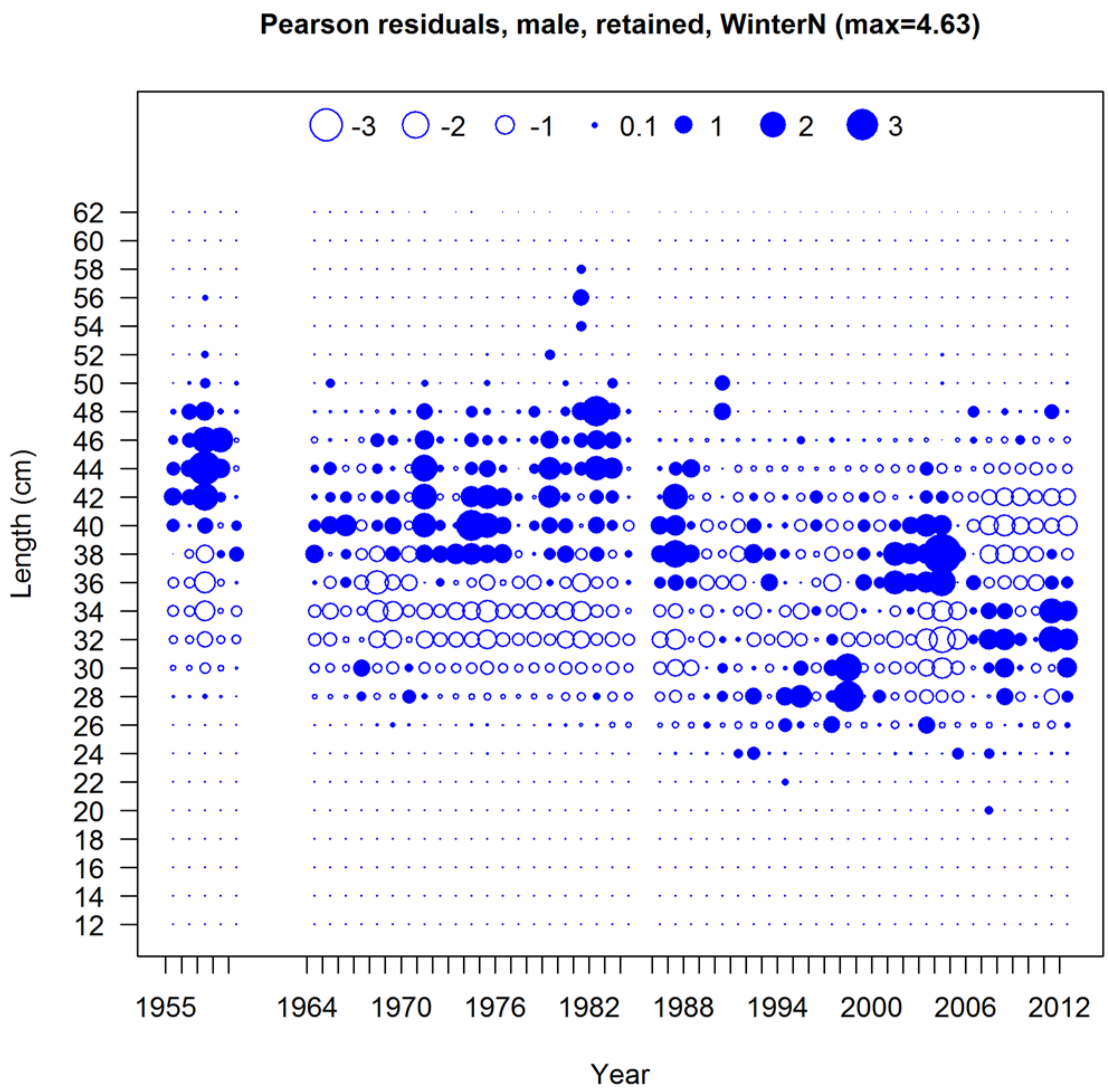
Appendix H.12. Fishery length composition Pearson residuals


Pearson residuals, female, retained, comparing across fleets
-3
-2
-1
0.1
1
2
3
-5
5
WinterN
SummerN
WinterS
SummerS
Length (cm)
Year
1948
1955
1959
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
2008
2012

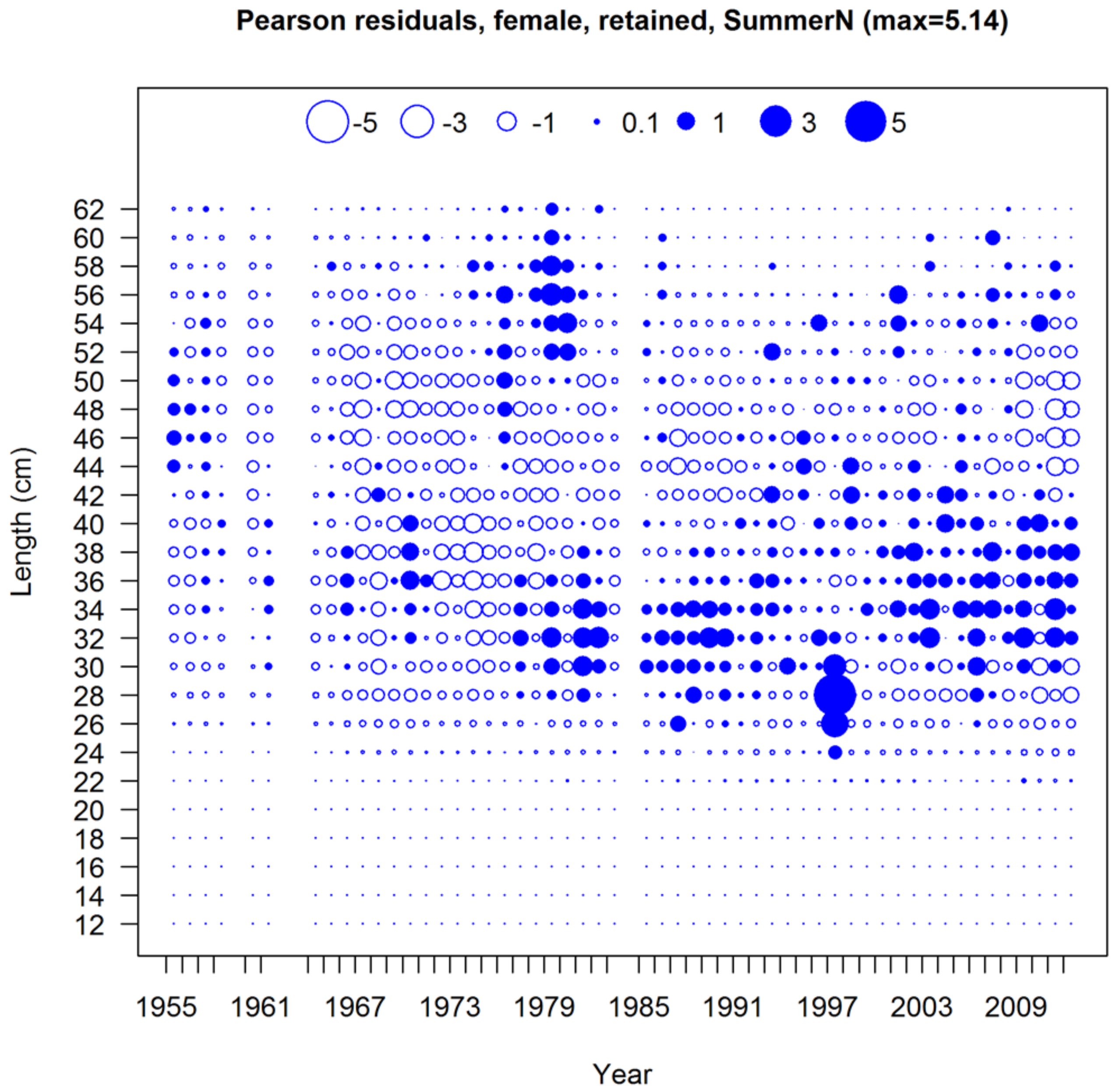
Pearson residuals, male, retained, comparing across fleets



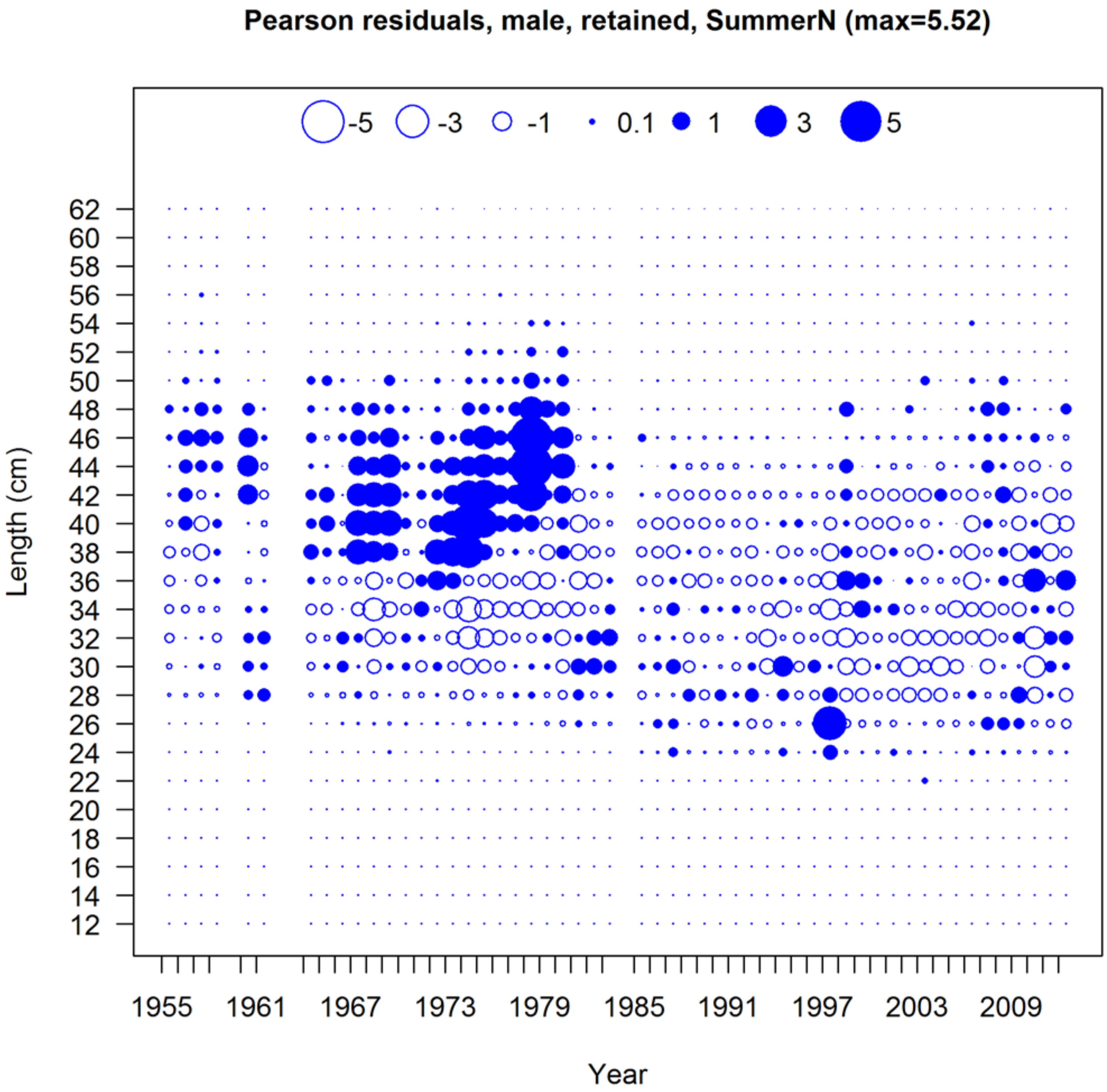

Pearson residuals, female, retained, WinterN (max=3.71)
-3
-2
-1
0.1
1
2
3
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1955
1964
1970
1976
1982
1988
1994
2000
2006
2012
Year

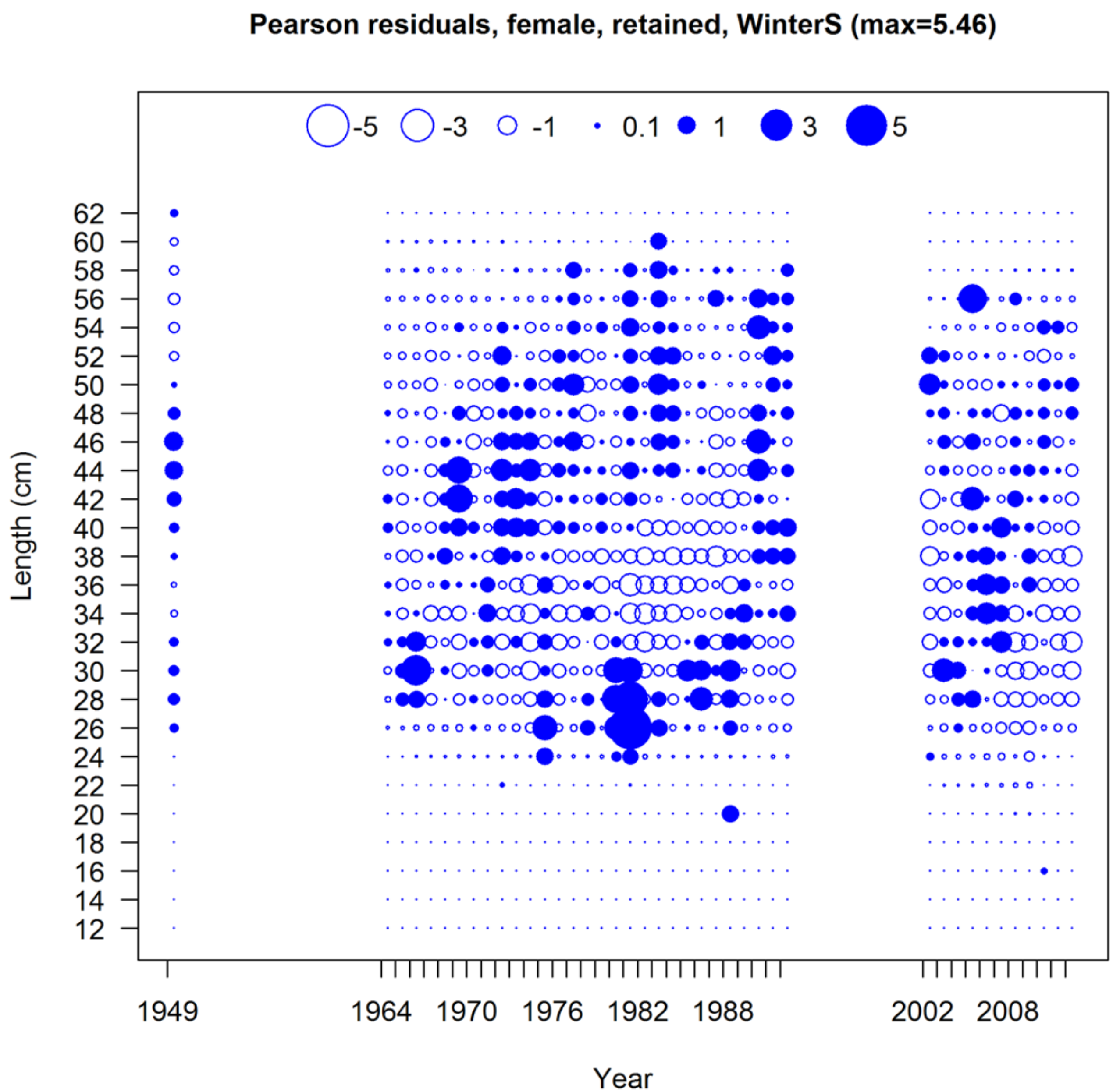


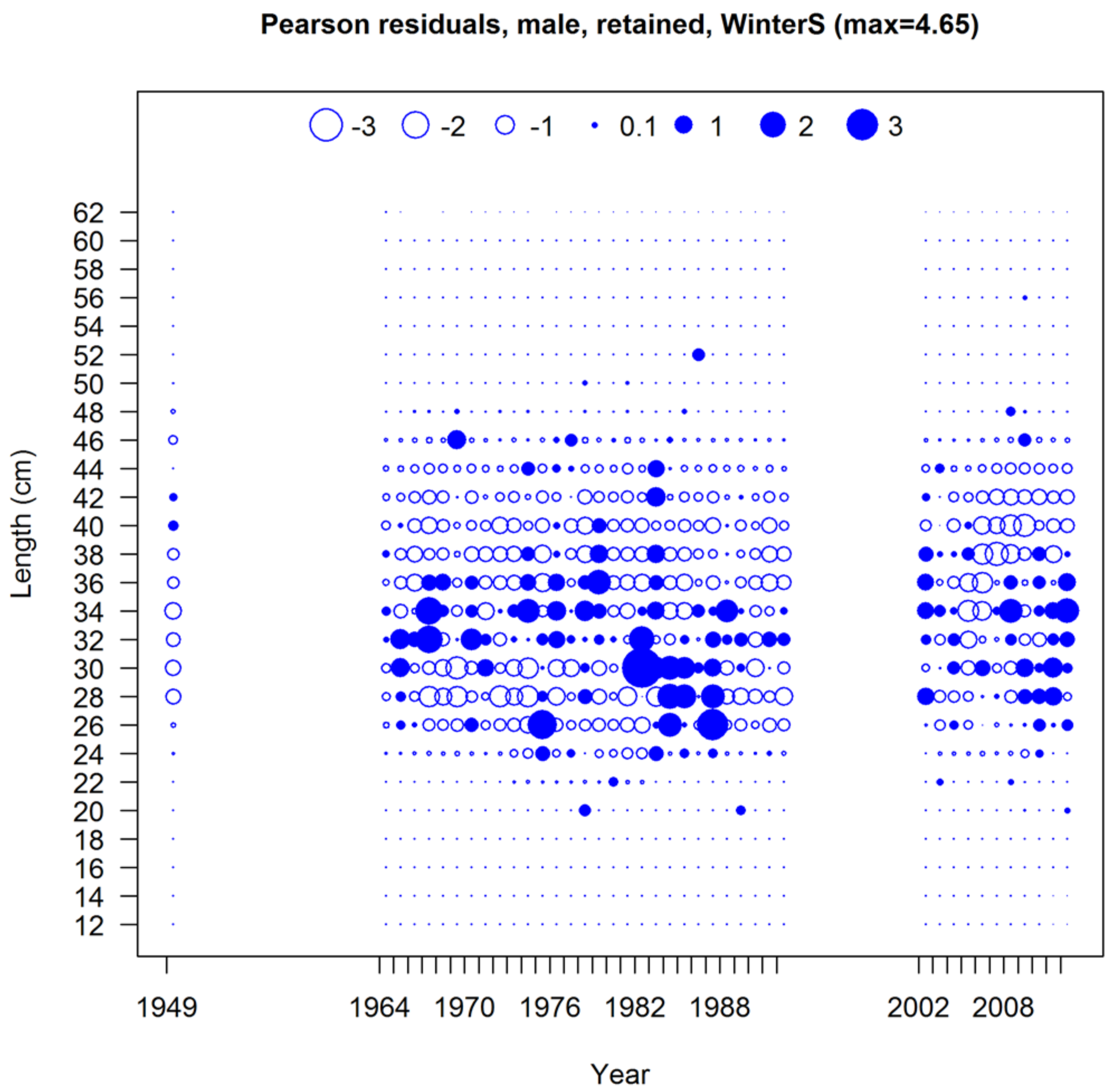
Pearson residuals, male, retained, WinterN (max=4.63)
-3
-2
-1
0.1
1
2
3
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1955
1964
1970
1976
1982
1988
1994
2000
2006
2012
Year



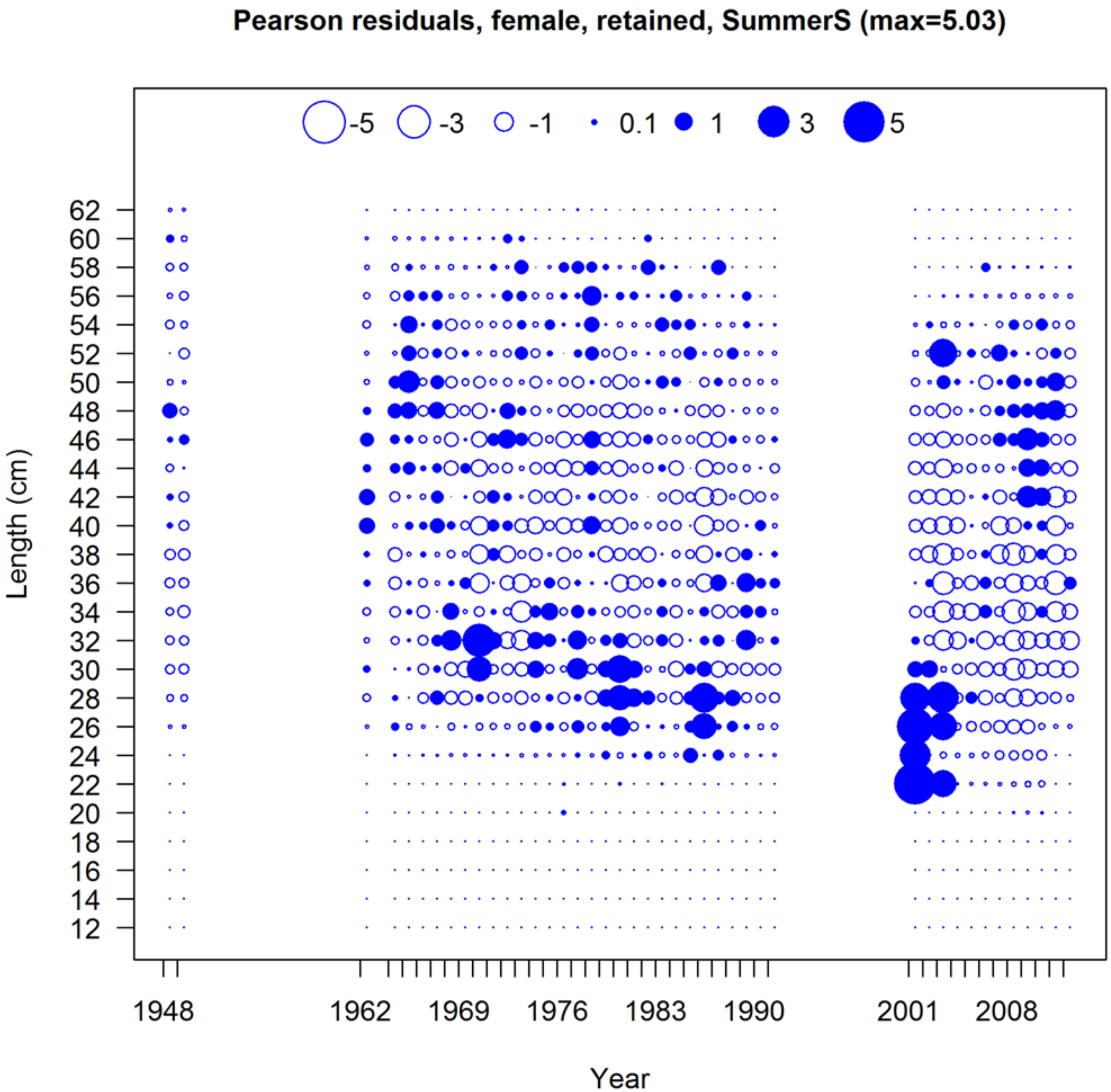
Pearson residuals, female, retained, SummerN (max=5.14)
-5
-3
-1
0.1
1
3
5
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
Length (cm)
1955
1961
1967
1973
1979
1985
1991
1997
2003
2009
Year

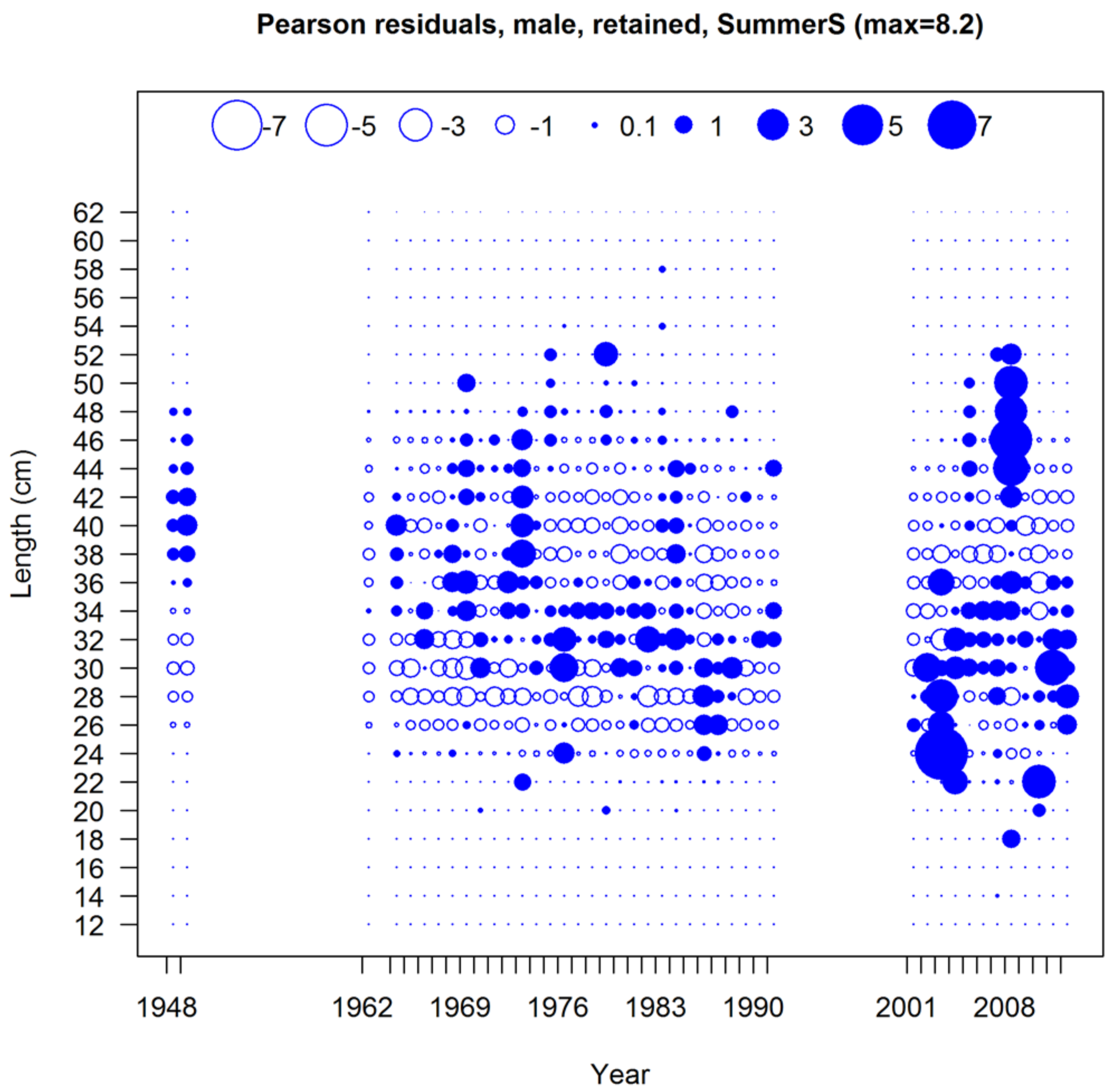

Pearson residuals, male, retained, SummerN (max=5.52)
-5
-3
-1
0.1
1
3
5
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1955
1961
1967
1973
1979
1985
1991
1997
2003
2009
Year


Pearson residuals, female, retained, WinterS (max=5.46)
-5
-3
-1
0.1
1
3
5
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1949
1964
1970
1976
1982
1988
2002
2008
Year

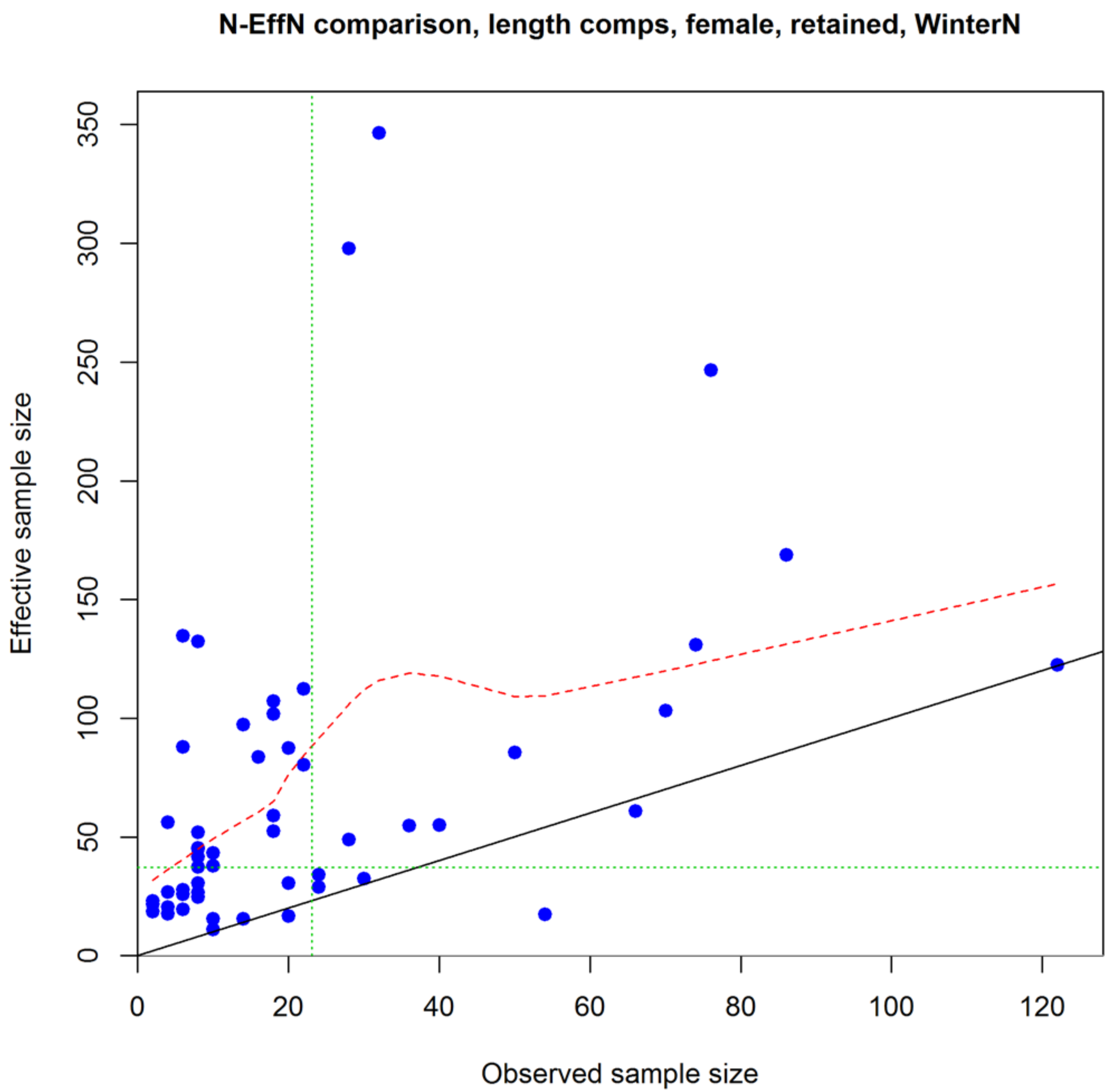


Pearson residuals, male, retained, WinterS (max=4.65)
-3
-2
-1
0.1
1
2
3
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1949
1964
1970
1976
1982
1988
2002
2008
Year

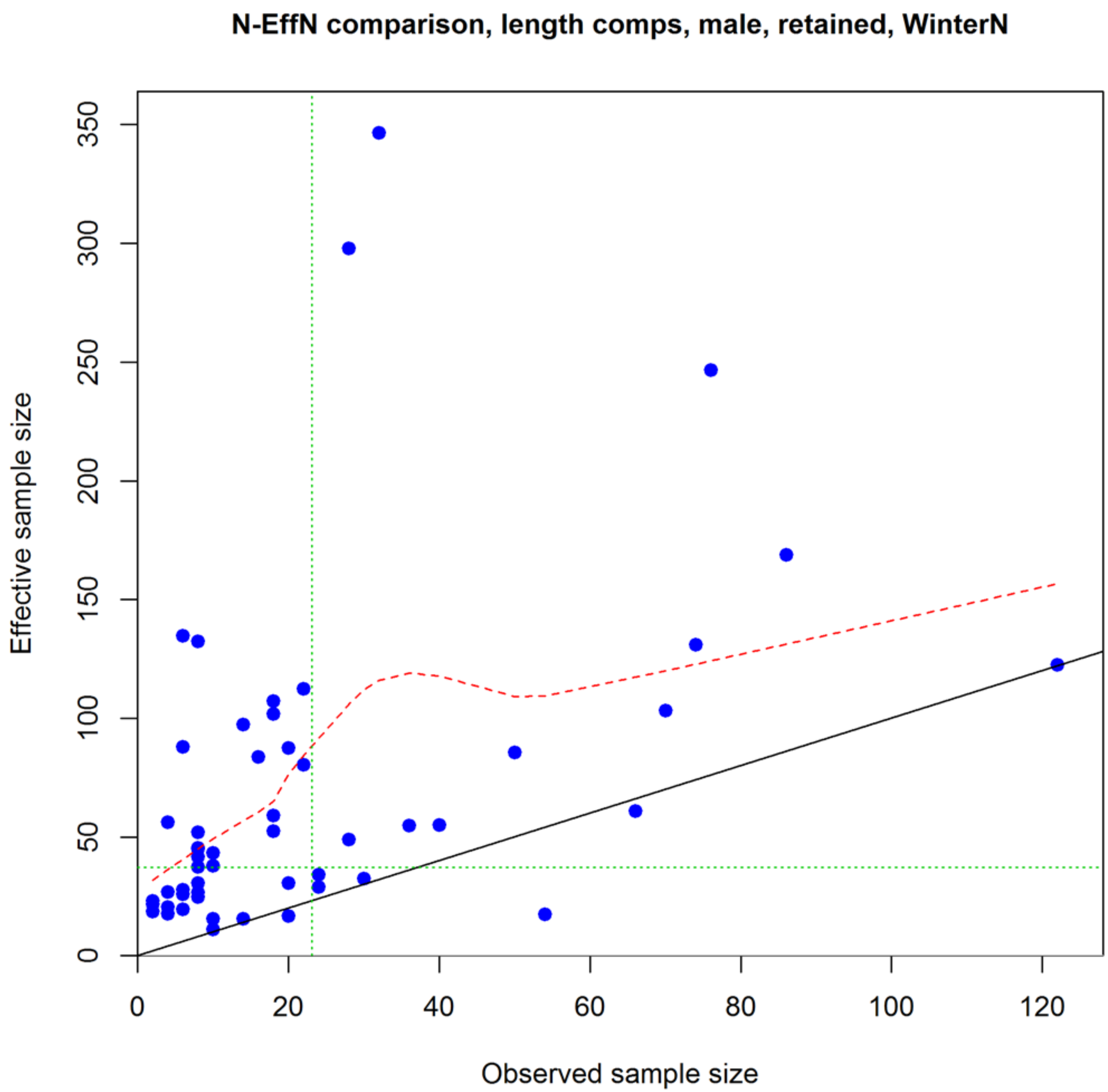

Pearson residuals, female, retained, SummerS (max=5.03)
-5
-3
-1
0.1
1
3
5
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1948
1962
1969
1976
1983
1990
2001
2008
Year


Pearson residuals, male, retained, SummerS (max=8.2)
-7
-5
-3
-1
0.1
1
3
5
7
Length (cm)
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1948
1962
1969
1976
1983
1990
2001
2008
Year

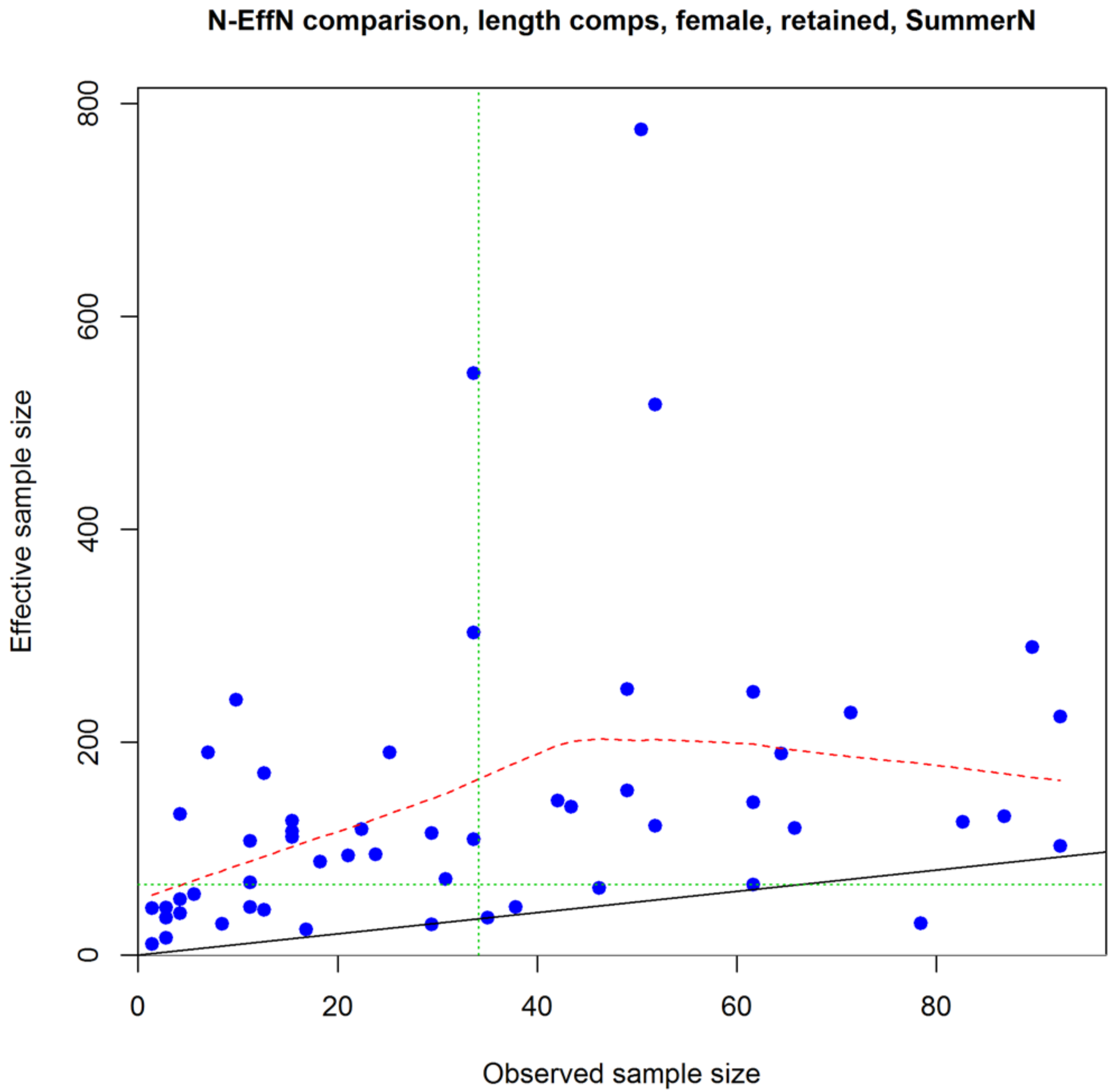
Appendix H.13. Fishery length composition effective sample sizes

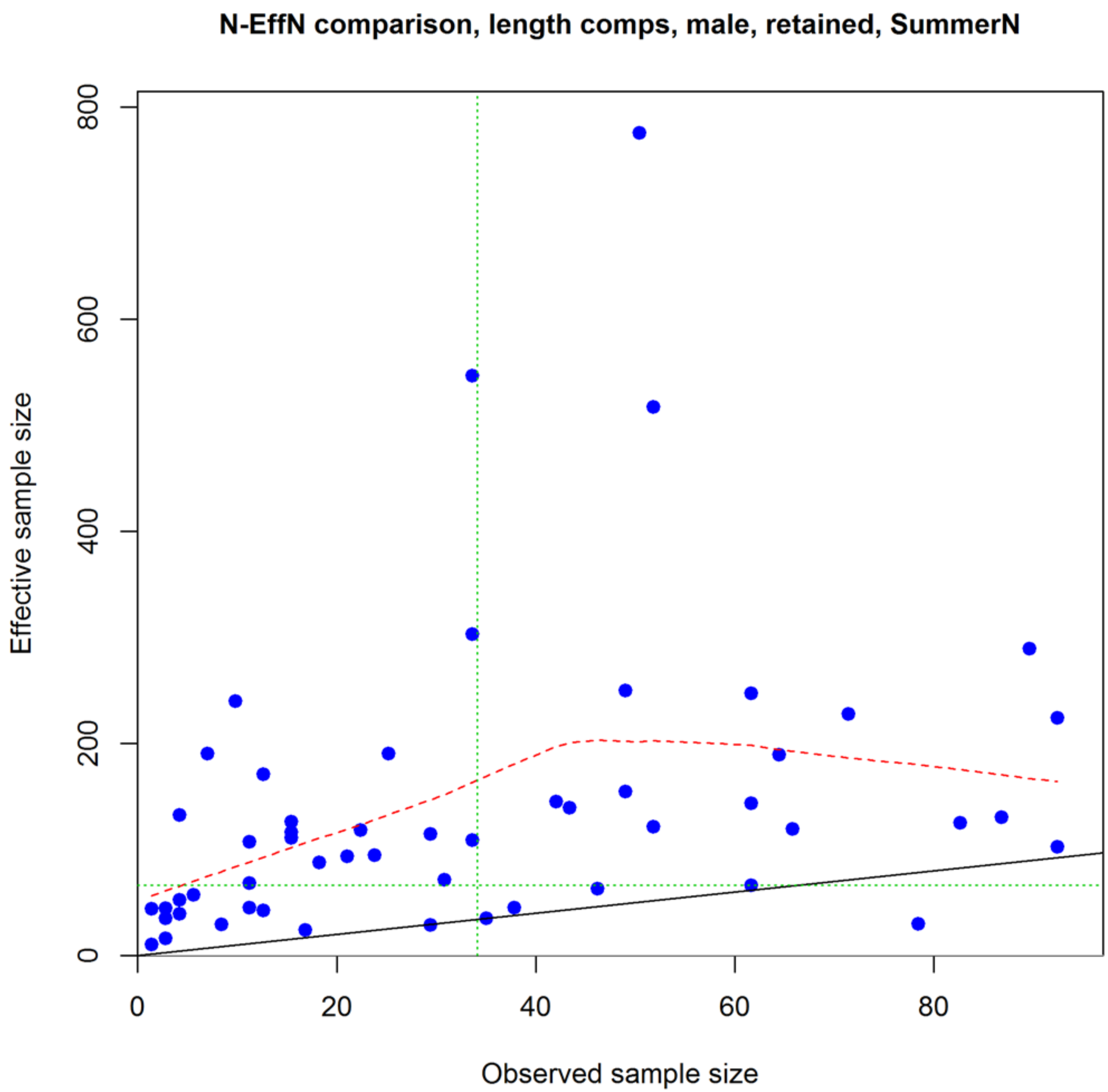


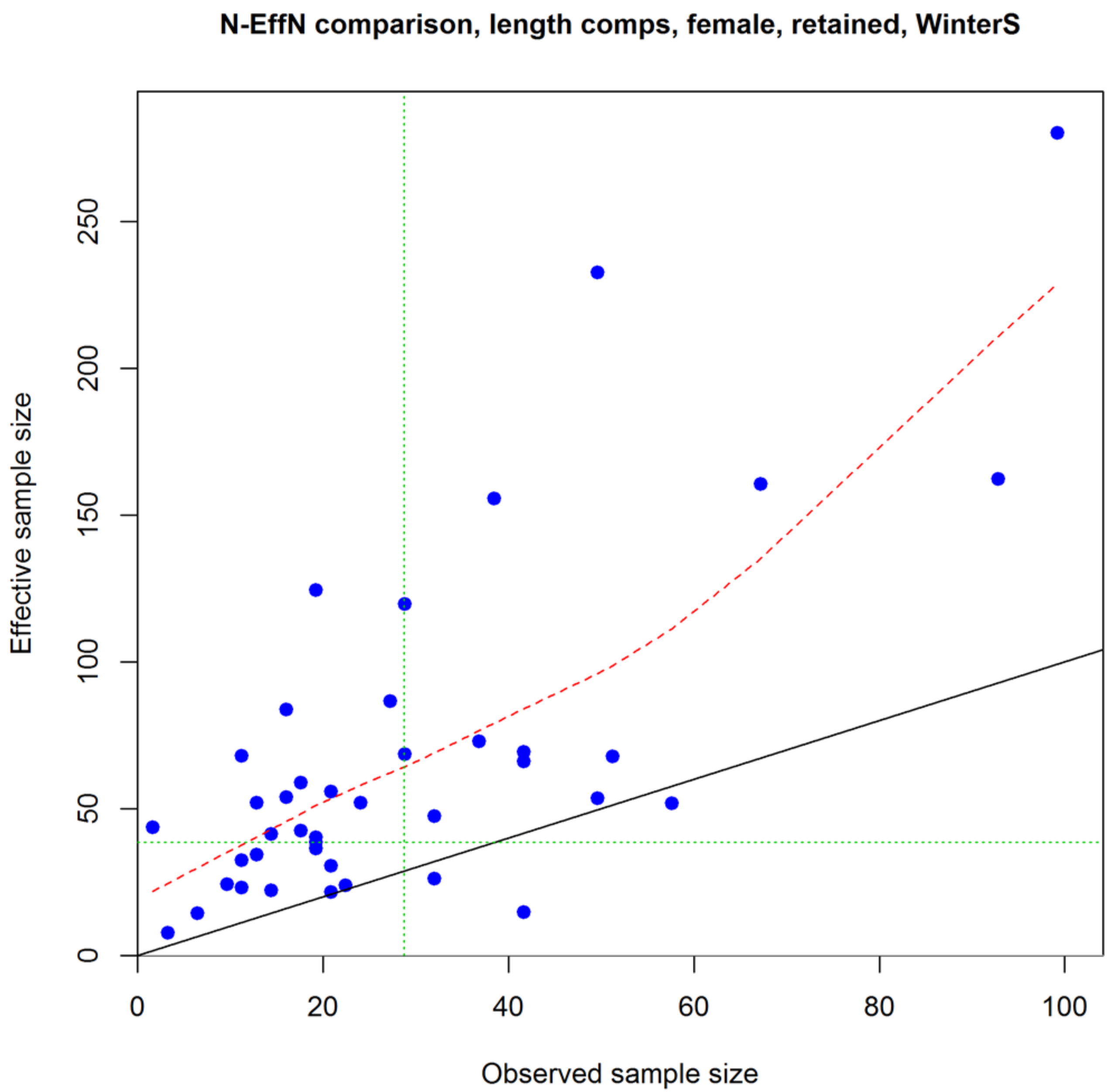
N-EffN comparison, length comps, female, retained, WinterN
Effective sample size
Observed sample size
0
50
100
150
200
250
300
350
0
20
40
60
80
100
120



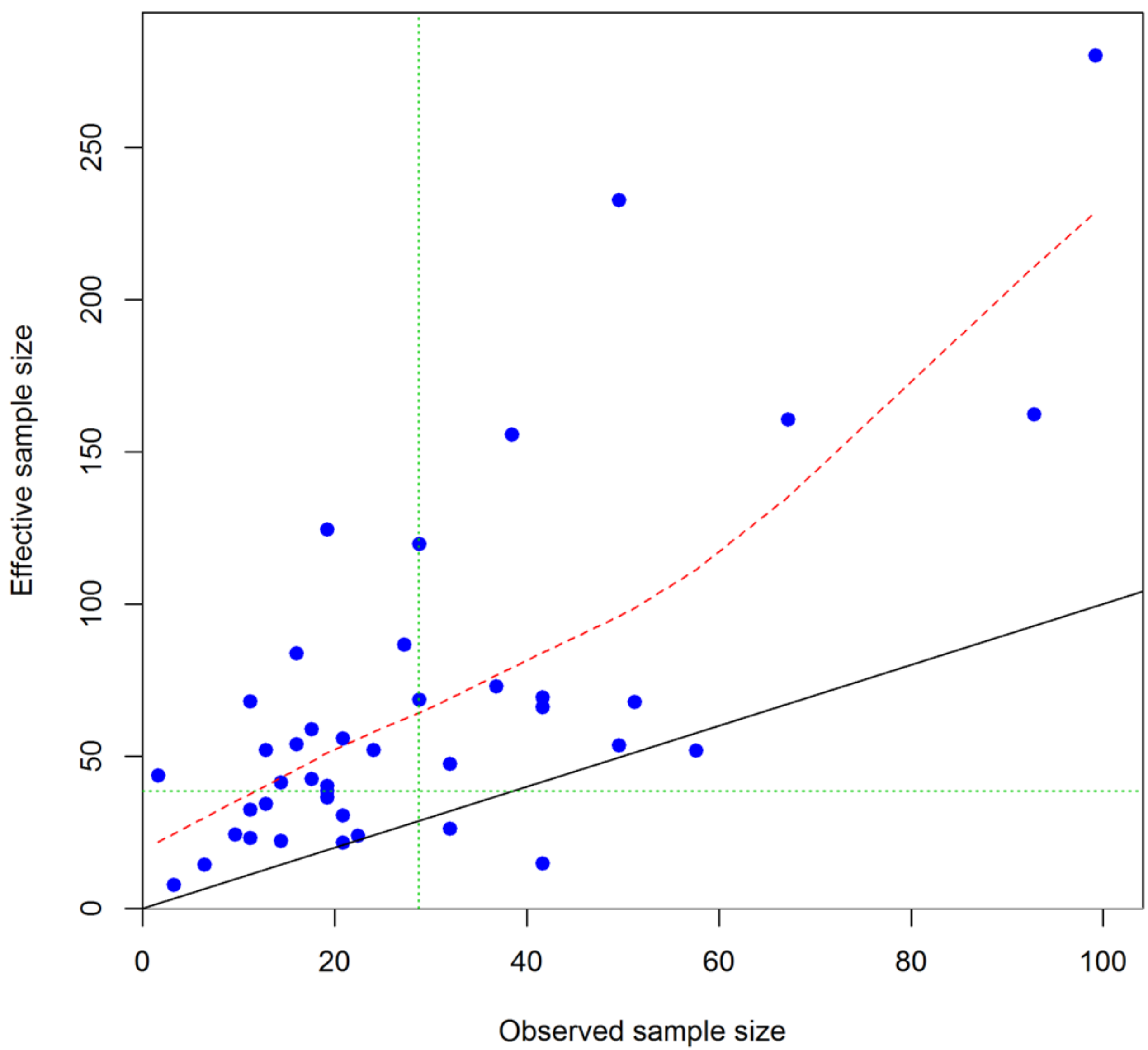
N-EffN comparison, length comps, male, retained, WinterN
Effective sample size
Observed sample size
0
50
100
150
200
250
300
350
0
20
40
60
80
100
120

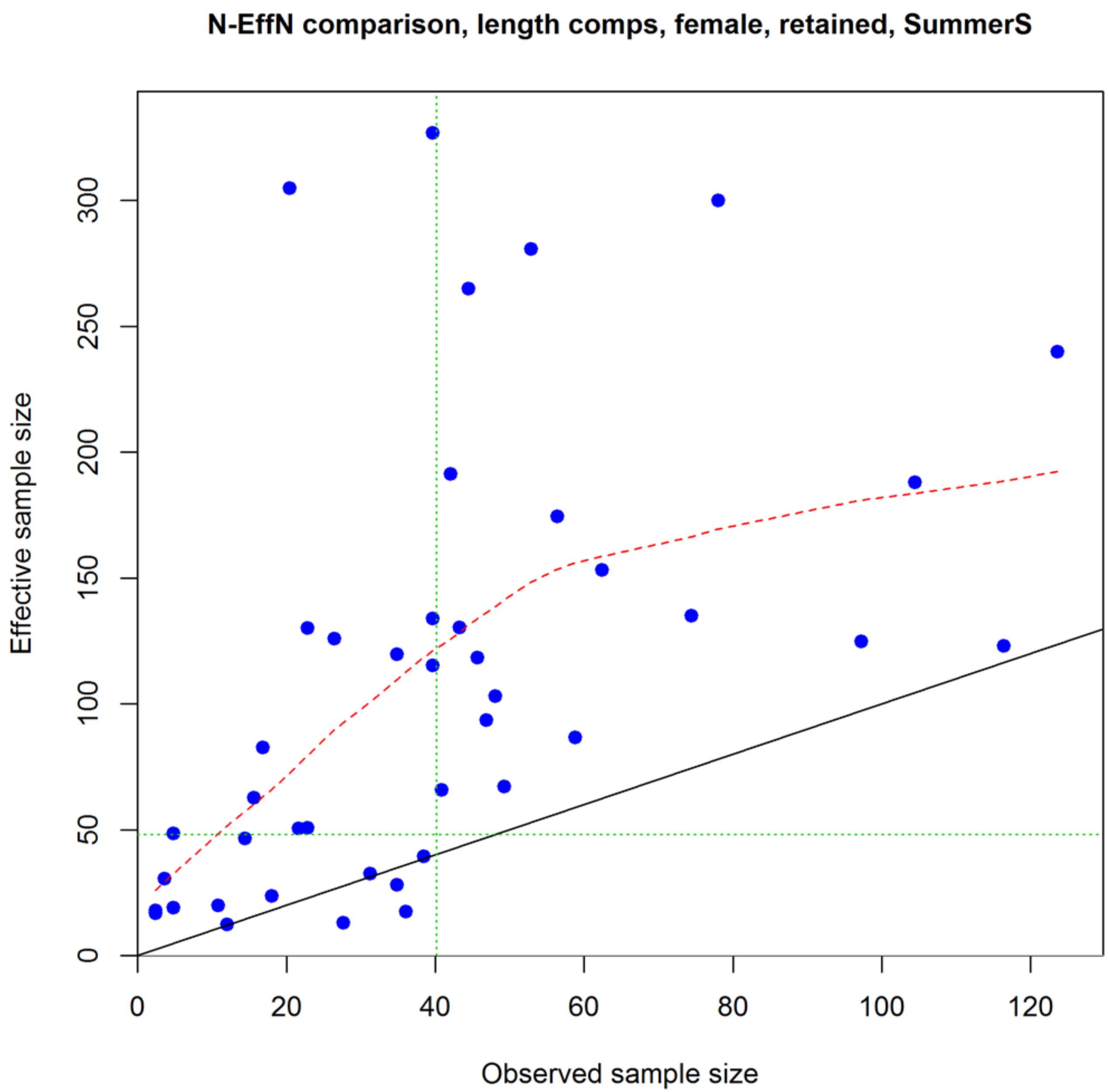

N-EffN comparison, length comps, female, retained, SummerN
Effective sample size
Observed sample size
0
200
400
600
800
0
20
40
60
80

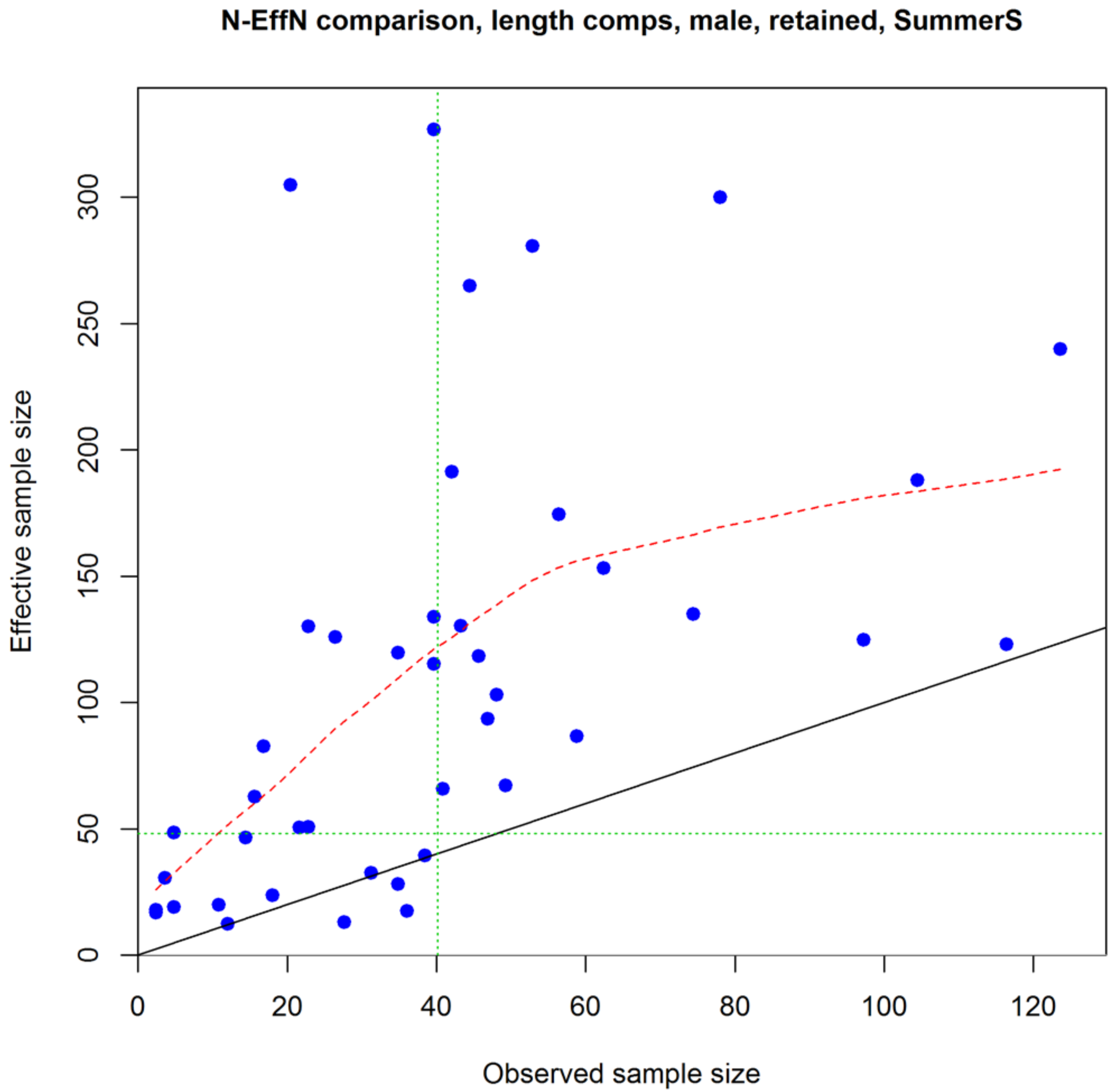

N-EffN comparison, length comps, male, retained, SummerN
Effective sample size
0
200
400
600
800
0
20
40
60
80
Observed sample size


N-EffN comparison, length comps, female, retained, WinterS
Effective sample size
Observed sample size
0
50
100
150
200
250
0
20
40
60
80
100

N-EffN comparison, length comps, male, retained, WinterS

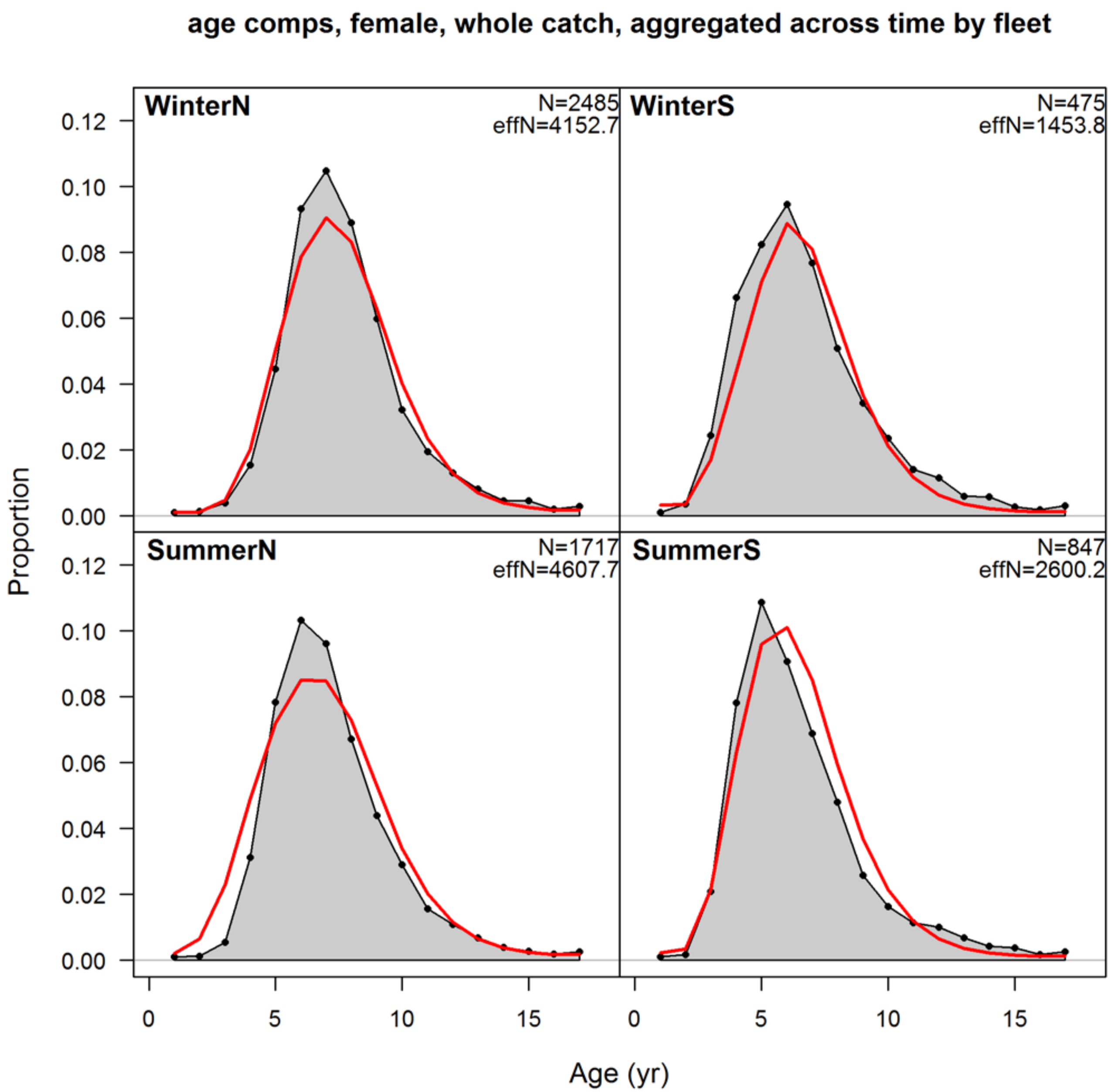


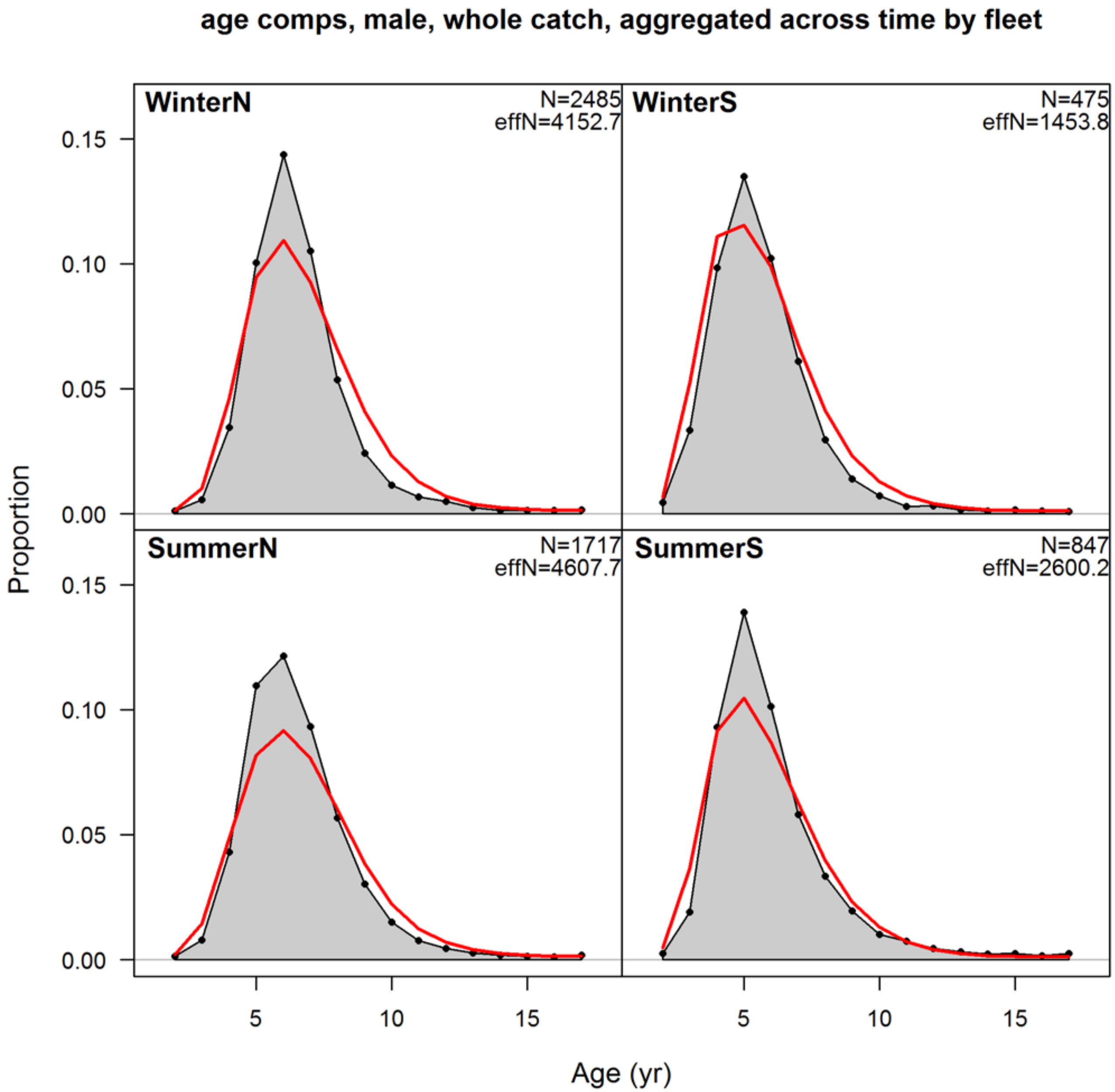

N-EffN comparison, length comps, female, retained, SummerS
Effective sample size
0
50
100
150
200
250
300
0
20
40
60
80
100
120
Observed sample size

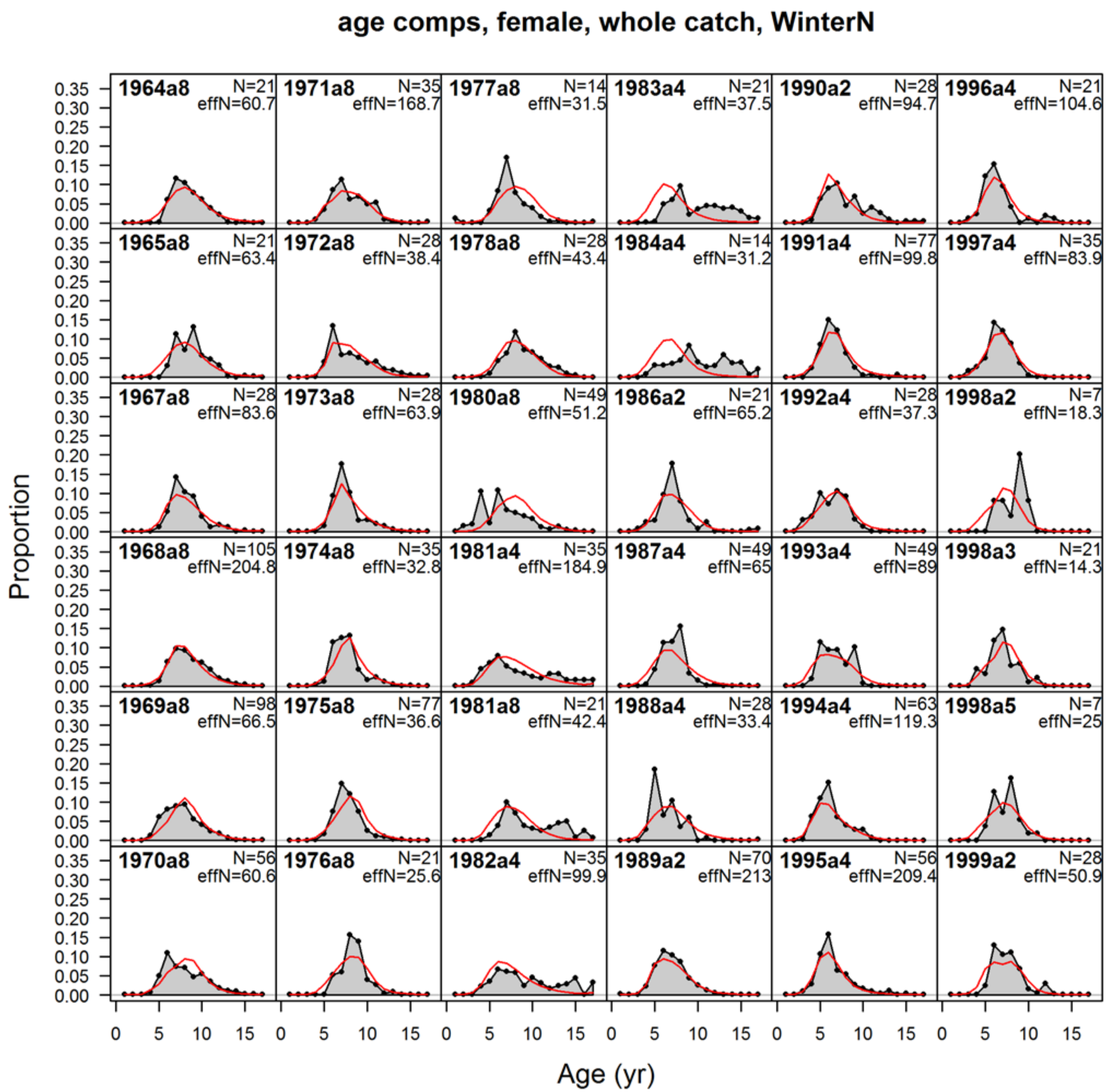


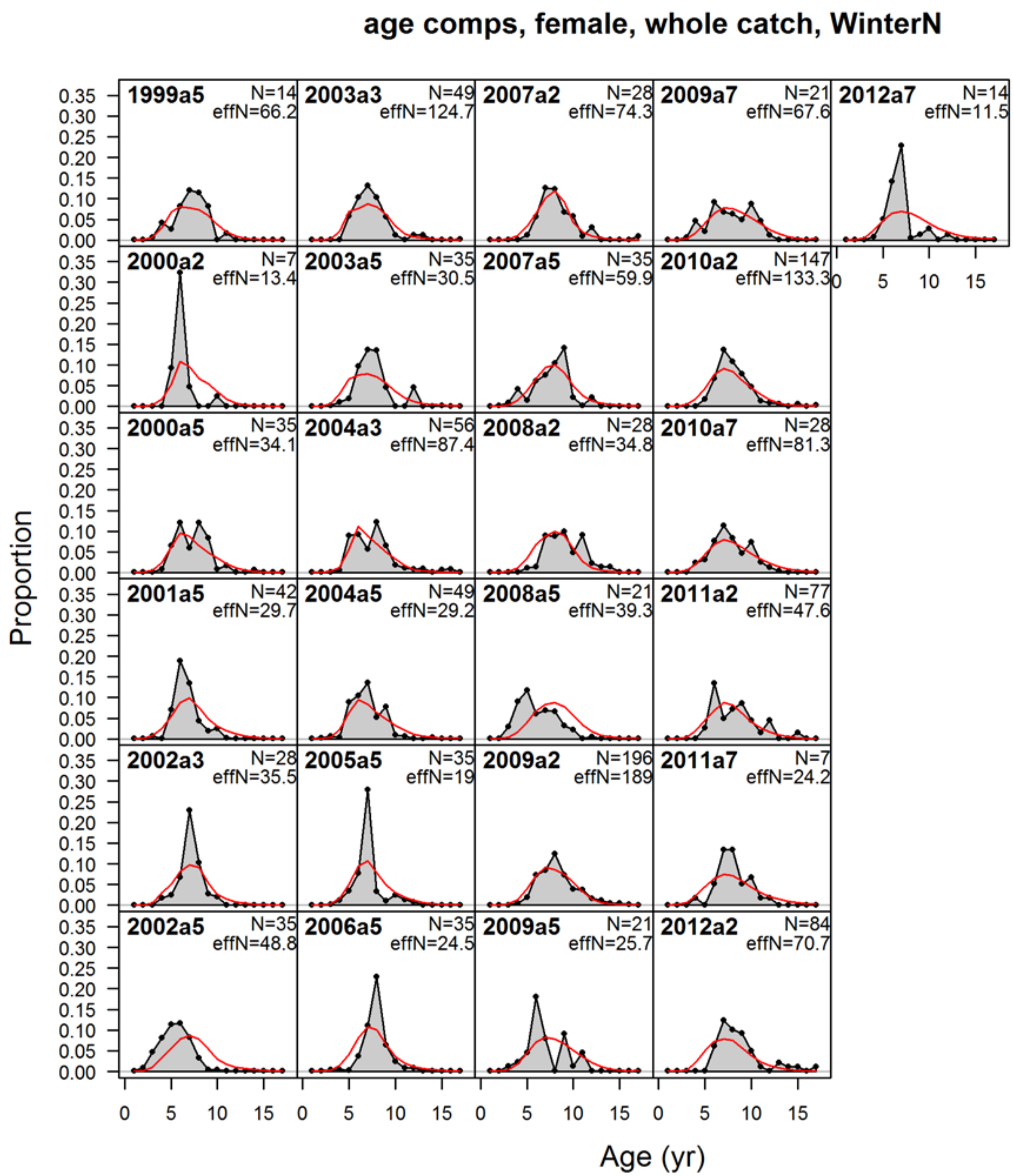
N-EffN comparison, length comps, male, retained, SummerS
Effective sample size
Observed sample size
0
50
100
150
200
250
300
0
20
40
60
80
100
120

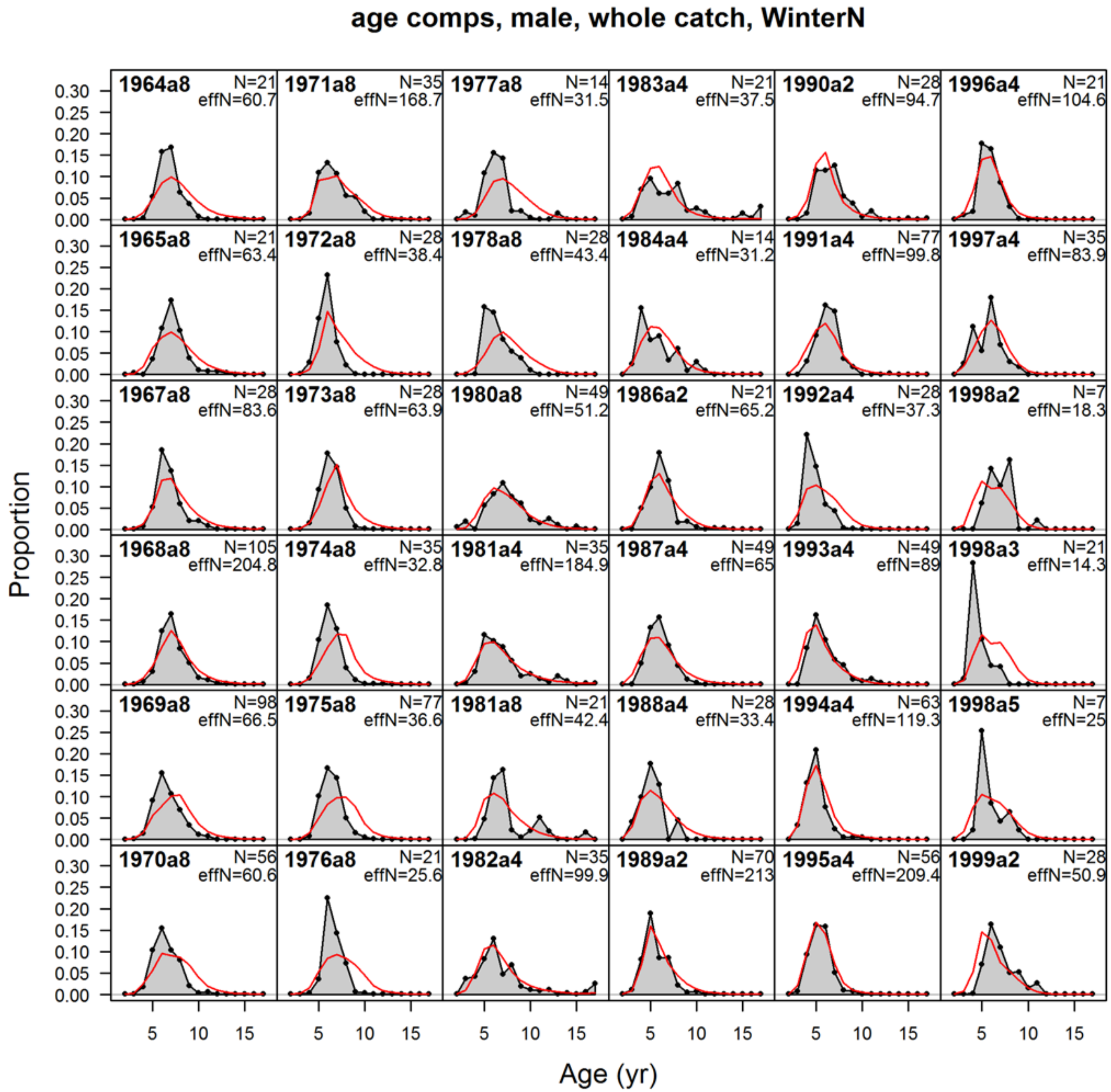
Appendix H.14. Fishery age composition fits

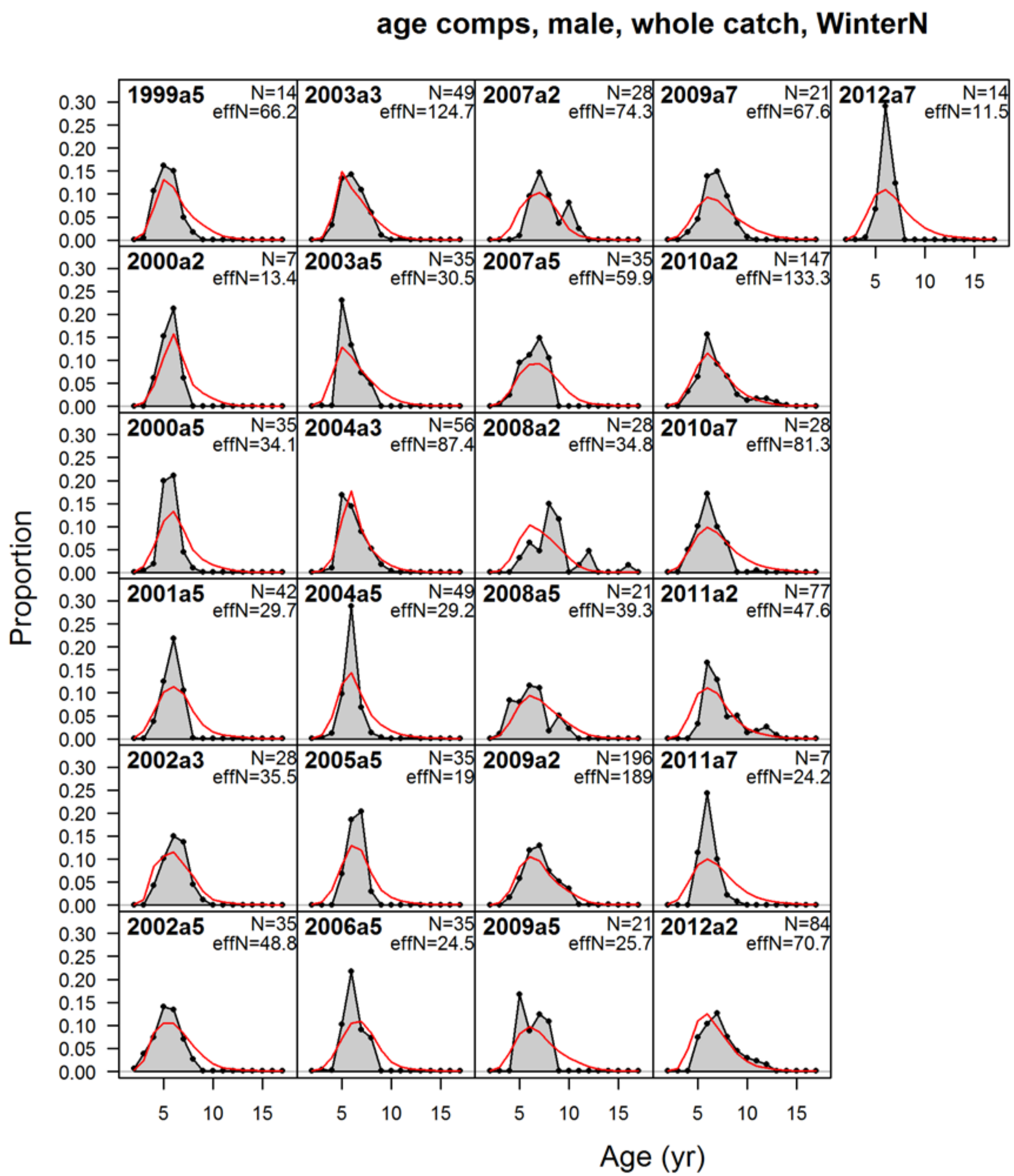

age comps, female, whole catch, aggregated across time by fleet
WinterN
N=2485
effN=4152.7
WinterS
N=475
effN=1453.8
SummerN
N=1717
effN=4607.7
SummerS
N=847
effN=2600.2
Proportion
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0
5
10
15
Age (yr)


age comps, male, whole catch, aggregated across time by fleet
WinterN
N=2485
effN=4152.7
WinterS
N=475
effN=1453.8
SummerN
N=1717
effN=4607.7
SummerS
N=847
effN=2600.2
Proportion
Age (yr)

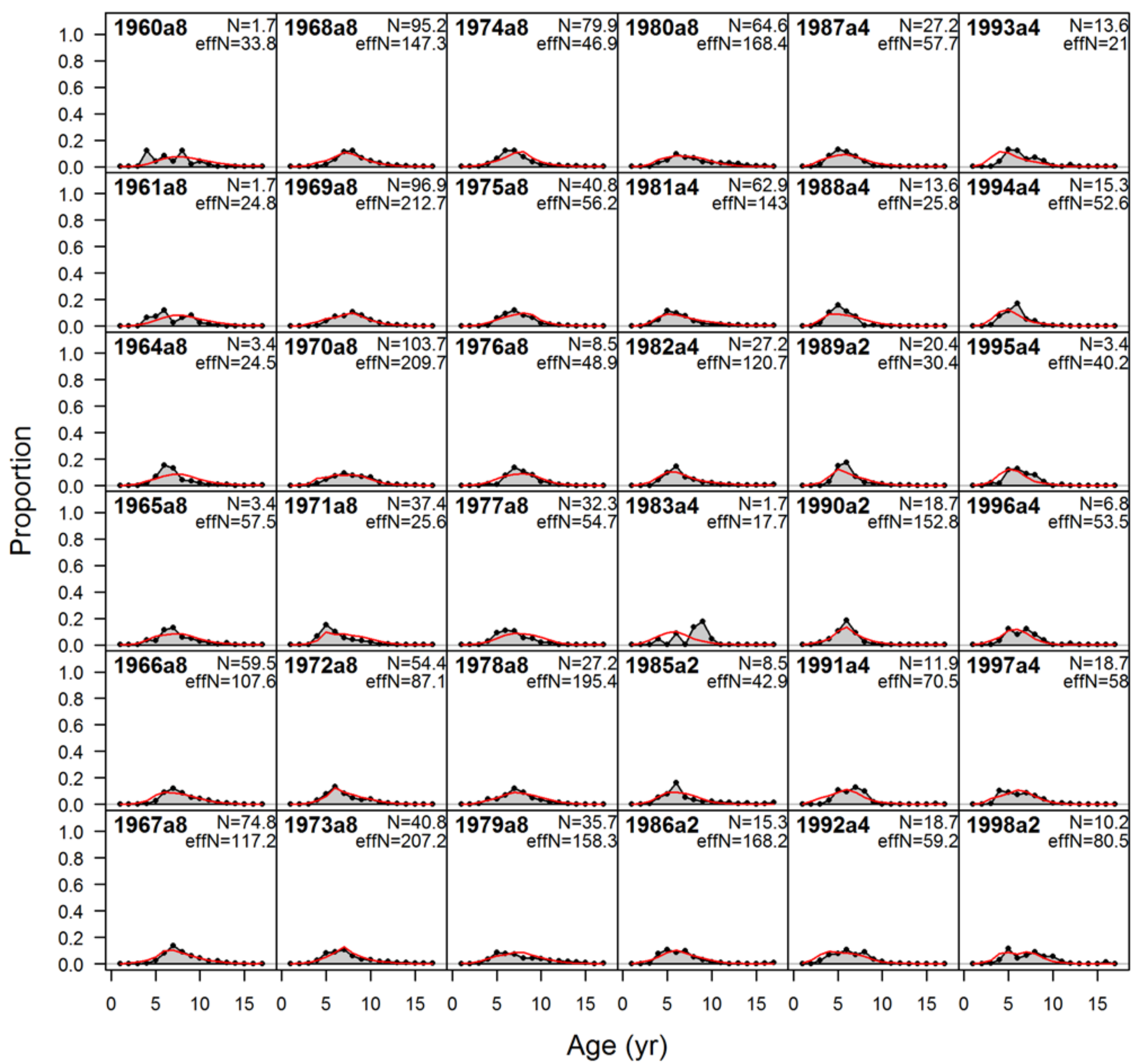

age comps, female, whole catch, WinterN
Proportion
Age (yr)
1964a8 N=21 effN=60.7
1971a8 N=35 effN=168.7
1977a8 N=14 effN=31.5
1983a4 N=21 effN=37.5
1990a2 N=28 effN=94.7
1996a4 N=21 effN=104.6
1965a8 N=21 effN=63.4
1972a8 N=28 effN=38.4
1978a8 N=28 effN=43.4
1984a4 N=14 effN=31.2
1991a4 N=77 effN=99.8
1997a4 N=35 effN=83.9
1967a8 N=28 effN=83.6
1973a8 N=28 effN=63.9
1980a8 N=49 effN=51.2
1986a2 N=21 effN=65.2
1992a4 N=28 effN=37.3
1998a2 N=7 effN=18.3
1968a8 N=105 effN=204.8
1974a8 N=35 effN=32.8
1981a4 N=35 effN=184.9
1987a4 N=49 effN=65
1993a4 N=49 effN=89
1998a3 N=21 effN=14.3
1969a8 N=98 effN=66.5
1975a8 N=77 effN=36.6
1981a8 N=21 effN=42.4
1988a4 N=28 effN=33.4
1994a4 N=63 effN=119.3
1998a5 N=7 effN=25
1970a8 N=56 effN=60.6
1976a8 N=21 effN=25.6
1982a4 N=35 effN=99.9
1989a2 N=70 effN=213
1995a4 N=56 effN=209.4
1999a2 N=28 effN=50.9

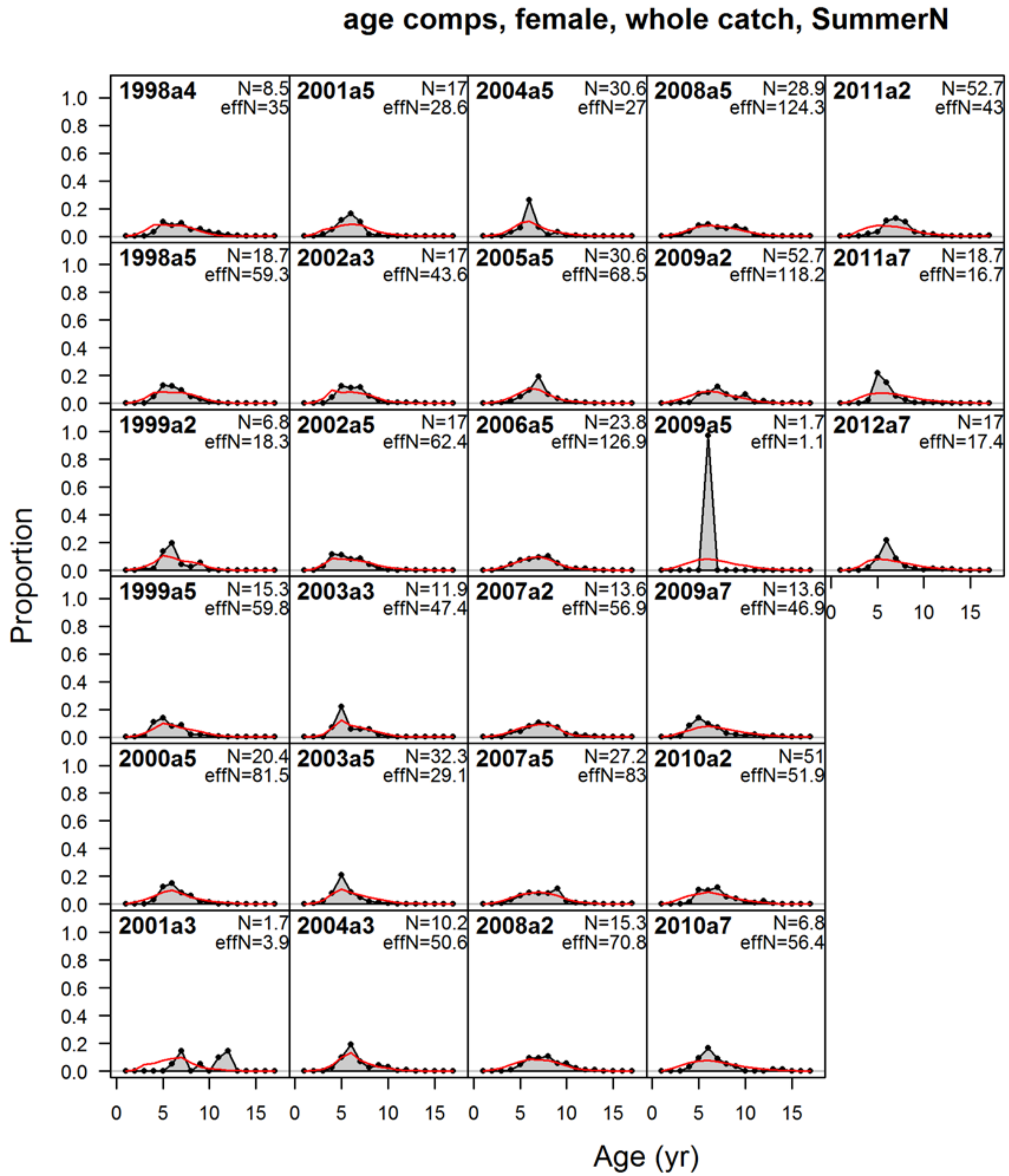

age comps, female, whole catch, WinterN
1999a5 N=14 effN=66.2
2003a3 N=49 effN=124.7
2007a2 N=28 effN=74.3
2009a7 N=21 effN=67.6
2012a7 N=14 effN=11.5
2000a2 N=7 effN=13.4
2003a5 N=35 effN=30.5
2007a5 N=35 effN=59.9
2010a2 N=147 effN=133.3
2000a5 N=35 effN=34.1
2004a3 N=56 effN=87.4
2008a2 N=28 effN=34.8
2010a7 N=28 effN=81.3
2001a5 N=42 effN=29.7
2004a5 N=49 effN=29.2
2008a5 N=21 effN=39.3
2011a2 N=77 effN=47.6
2002a3 N=28 effN=35.5
2005a5 N=35 effN=19
2009a2 N=196 effN=189
2011a7 N=7 effN=24.2
2002a5 N=35 effN=48.8
2006a5 N=35 effN=24.5
2009a5 N=21 effN=25.7
2012a2 N=84 effN=70.7
Proportion
Age (yr)

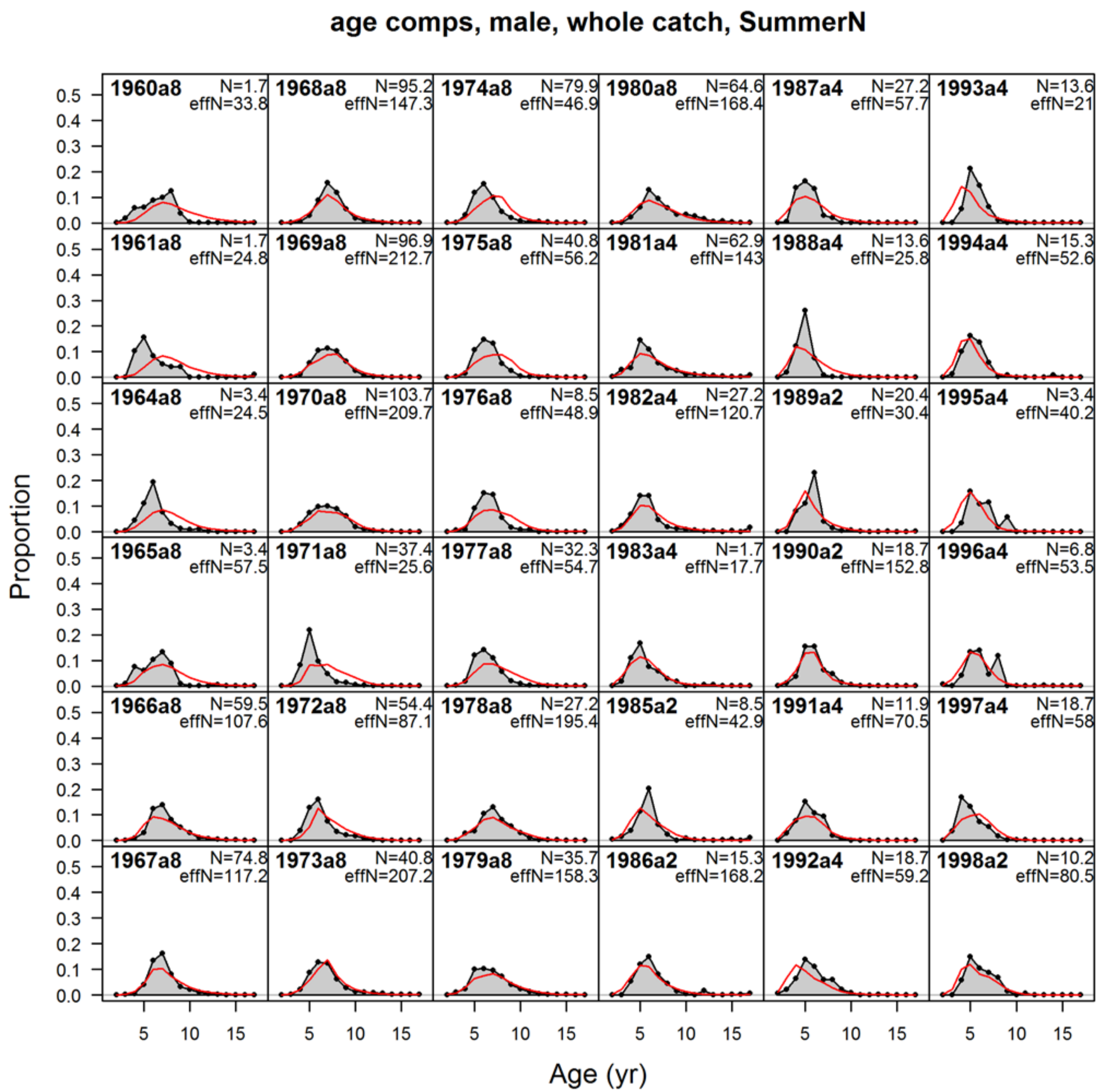

age comps, male, whole catch, WinterN
Proportion
Age (yr)
1964a8 N=21 effN=60.7
1971a8 N=35 effN=168.7
1977a8 N=14 effN=31.5
1983a4 N=21 effN=37.5
1990a2 N=28 effN=94.7
1996a4 N=21 effN=104.6
1965a8 N=21 effN=63.4
1972a8 N=28 effN=38.4
1978a8 N=28 effN=43.4
1984a4 N=14 effN=31.2
1991a4 N=77 effN=99.8
1997a4 N=35 effN=83.9
1967a8 N=28 effN=83.6
1973a8 N=28 effN=63.9
1980a8 N=49 effN=51.2
1986a2 N=21 effN=65.2
1992a4 N=28 effN=37.3
1998a2 N=7 effN=18.3
1968a8 N=105 effN=204.8
1974a8 N=35 effN=32.8
1981a4 N=35 effN=184.9
1987a4 N=49 effN=65
1993a4 N=49 effN=89
1998a3 N=21 effN=14.3
1969a8 N=98 effN=66.5
1975a8 N=77 effN=36.6
1981a8 N=21 effN=42.4
1988a4 N=28 effN=33.4
1994a4 N=63 effN=119.3
1998a5 N=7 effN=25
1970a8 N=56 effN=60.6
1976a8 N=21 effN=25.6
1982a4 N=35 effN=99.9
1989a2 N=70 effN=213
1995a4 N=56 effN=209.4
1999a2 N=28 effN=50.9

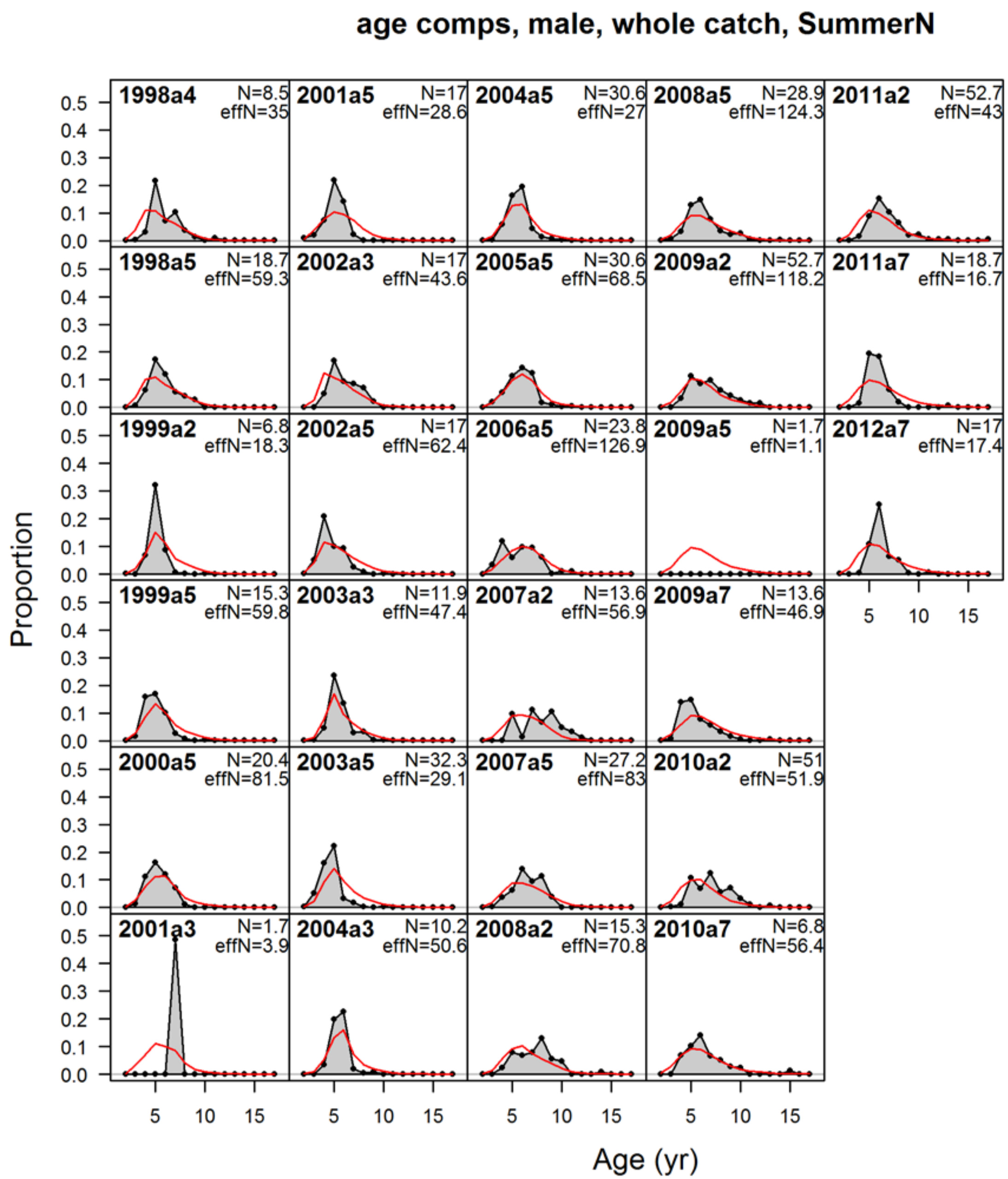

age comps, male, whole catch, WinterN
1999a5 N=14 effN=66.2
2003a3 N=49 effN=124.7
2007a2 N=28 effN=74.3
2009a7 N=21 effN=67.6
2012a7 N=14 effN=11.5
2000a2 N=7 effN=13.4
2003a5 N=35 effN=30.5
2007a5 N=35 effN=59.9
2010a2 N=147 effN=133.3
2000a5 N=35 effN=34.1
2004a3 N=56 effN=87.4
2008a2 N=28 effN=34.8
2010a7 N=28 effN=81.3
2001a5 N=42 effN=29.7
2004a5 N=49 effN=29.2
2008a5 N=21 effN=39.3
2011a2 N=77 effN=47.6
2002a3 N=28 effN=35.5
2005a5 N=35 effN=19
2009a2 N=196 effN=189
2011a7 N=7 effN=24.2
2002a5 N=35 effN=48.8
2006a5 N=35 effN=24.5
2009a5 N=21 effN=25.7
2012a2 N=84 effN=70.7
Proportion
Age (yr)

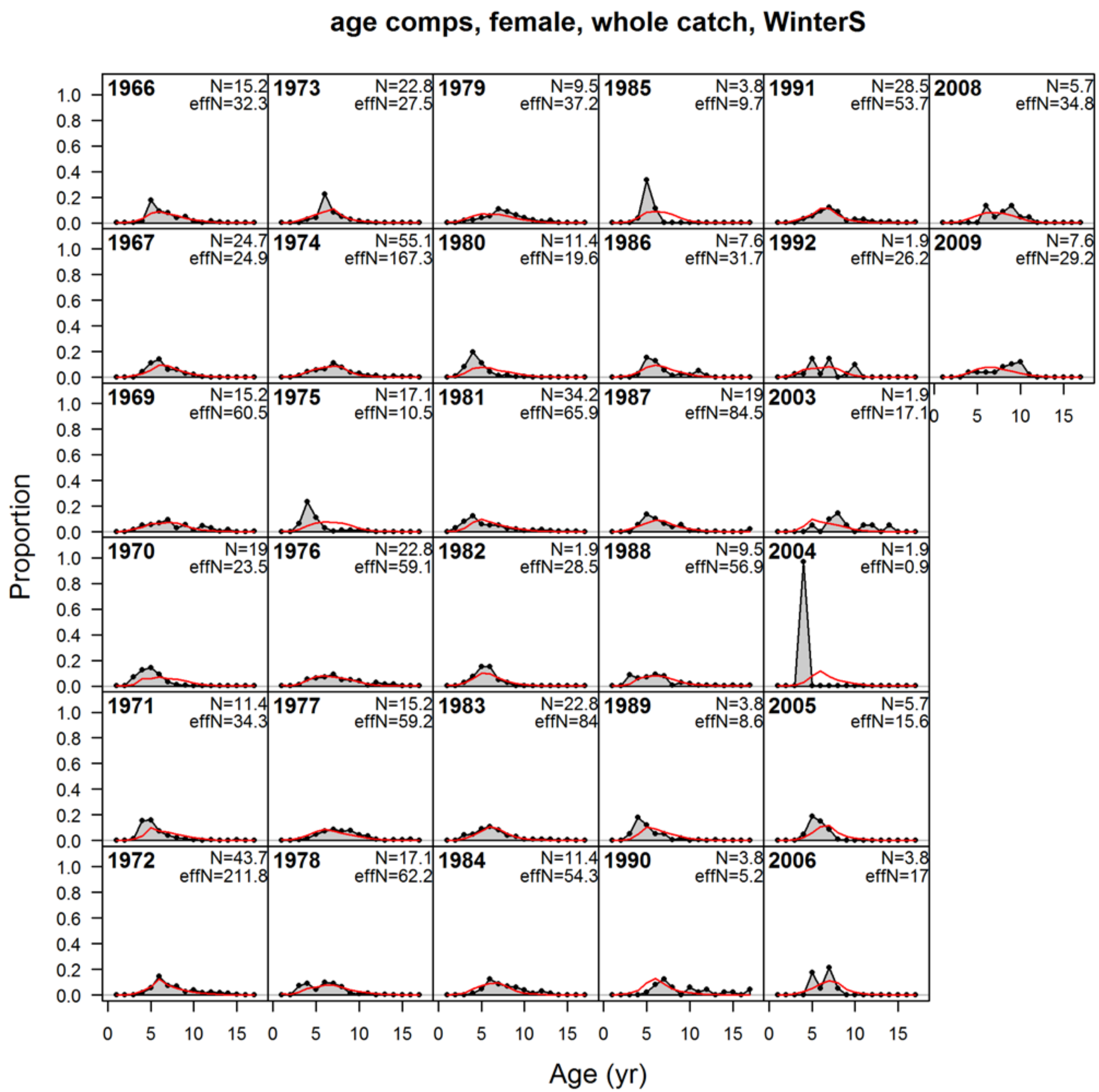
age comps, female, whole catch, SummerN

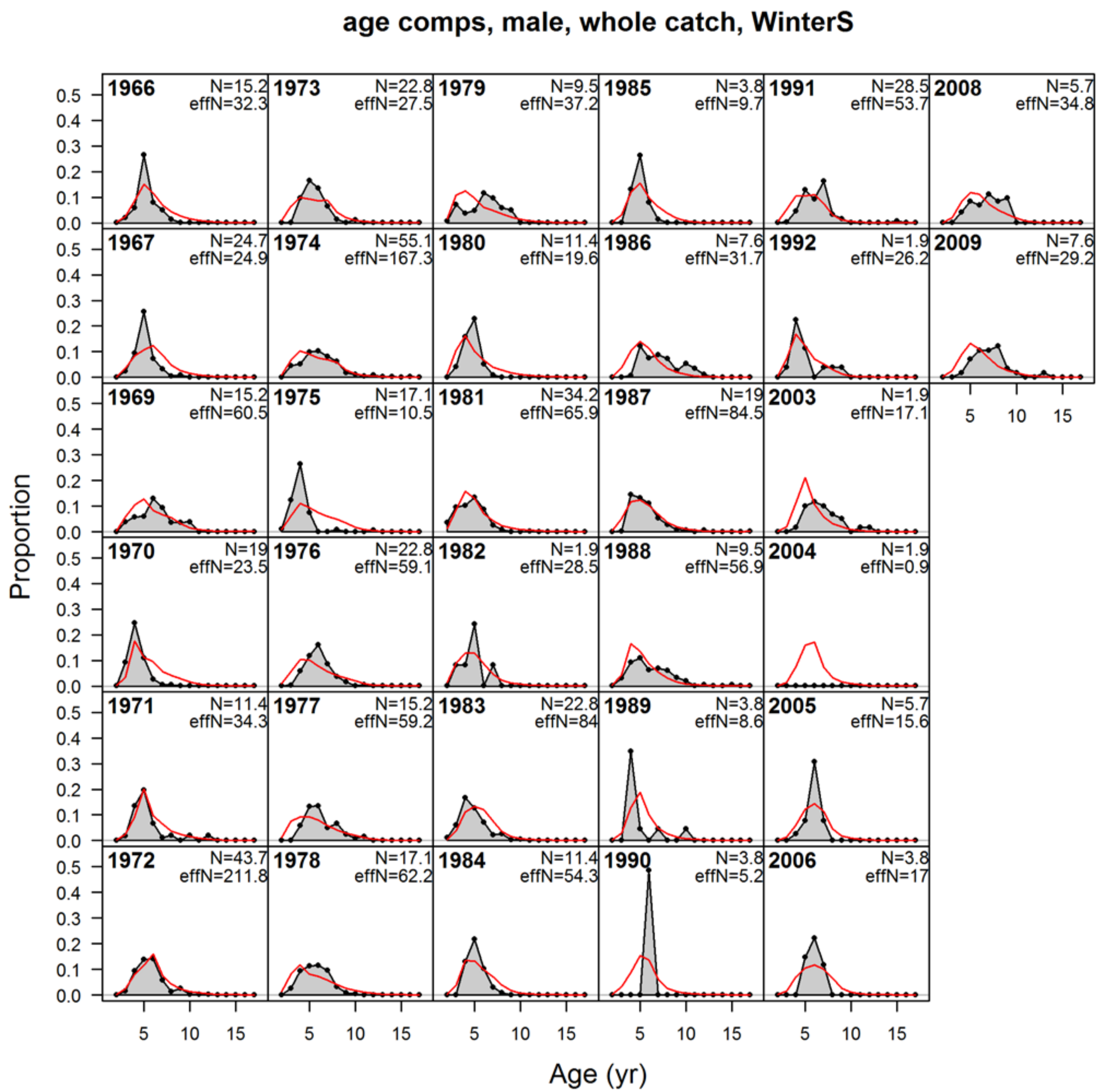



age comps, female, whole catch, SummerN
Proportion
Age (yr)
1998a4 N=8.5 effN=35
2001a5 N=17 effN=28.6
2004a5 N=30.6 effN=27
2008a5 N=28.9 effN=124.3
2011a2 N=52.7 effN=43
1998a5 N=18.7 effN=59.3
2002a3 N=17 effN=43.6
2005a5 N=30.6 effN=68.5
2009a2 N=52.7 effN=118.2
2011a7 N=18.7 effN=16.7
1999a2 N=6.8 effN=18.3
2002a5 N=17 effN=62.4
2006a5 N=23.8 effN=126.9
2009a5 N=1.7 effN=1.1
2012a7 N=17 effN=17.4
1999a5 N=15.3 effN=59.8
2003a3 N=11.9 effN=47.4
2007a2 N=13.6 effN=56.9
2009a7 N=13.6 effN=46.9
2000a5 N=20.4 effN=81.5
2003a5 N=32.3 effN=29.1
2007a5 N=27.2 effN=83
2010a2 N=51 effN=51.9
2001a3 N=1.7 effN=3.9
2004a3 N=10.2 effN=50.6
2008a2 N=15.3 effN=70.8
2010a7 N=6.8 effN=56.4

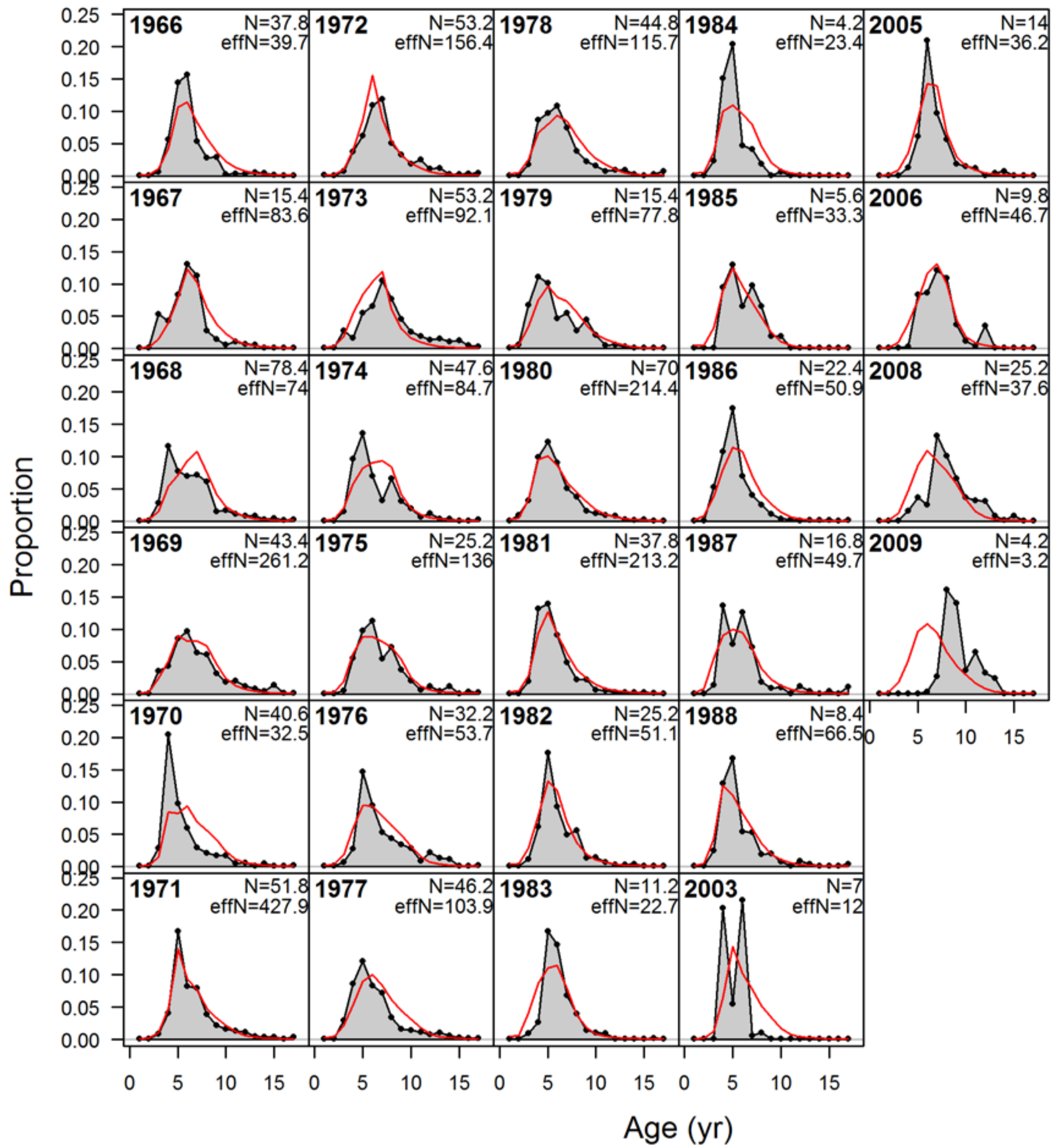

age comps, male, whole catch, SummerN
1960a8 N=1.7 effN=33.8
1968a8 N=95.2 effN=147.3
1974a8 N=79.9 effN=46.9
1980a8 N=64.6 effN=168.4
1987a4 N=27.2 effN=57.7
1993a4 N=13.6 effN=21
1961a8 N=1.7 effN=24.8
1969a8 N=96.9 effN=212.7
1975a8 N=40.8 effN=56.2
1981a4 N=62.9 effN=143
1988a4 N=13.6 effN=25.8
1994a4 N=15.3 effN=52.6
1964a8 N=3.4 effN=24.5
1970a8 N=103.7 effN=209.7
1976a8 N=8.5 effN=48.9
1982a4 N=27.2 effN=120.7
1989a2 N=20.4 effN=30.4
1995a4 N=3.4 effN=40.2
1965a8 N=3.4 effN=57.5
1971a8 N=37.4 effN=25.6
1977a8 N=32.3 effN=54.7
1983a4 N=1.7 effN=17.7
1990a2 N=18.7 effN=152.8
1996a4 N=6.8 effN=53.5
1966a8 N=59.5 effN=107.6
1972a8 N=54.4 effN=87.1
1978a8 N=27.2 effN=195.4
1985a2 N=8.5 effN=42.9
1991a4 N=11.9 effN=70.5
1997a4 N=18.7 effN=58
1967a8 N=74.8 effN=117.2
1973a8 N=40.8 effN=207.2
1979a8 N=35.7 effN=158.3
1986a2 N=15.3 effN=168.2
1992a4 N=18.7 effN=59.2
1998a2 N=10.2 effN=80.5
Proportion
Age (yr)

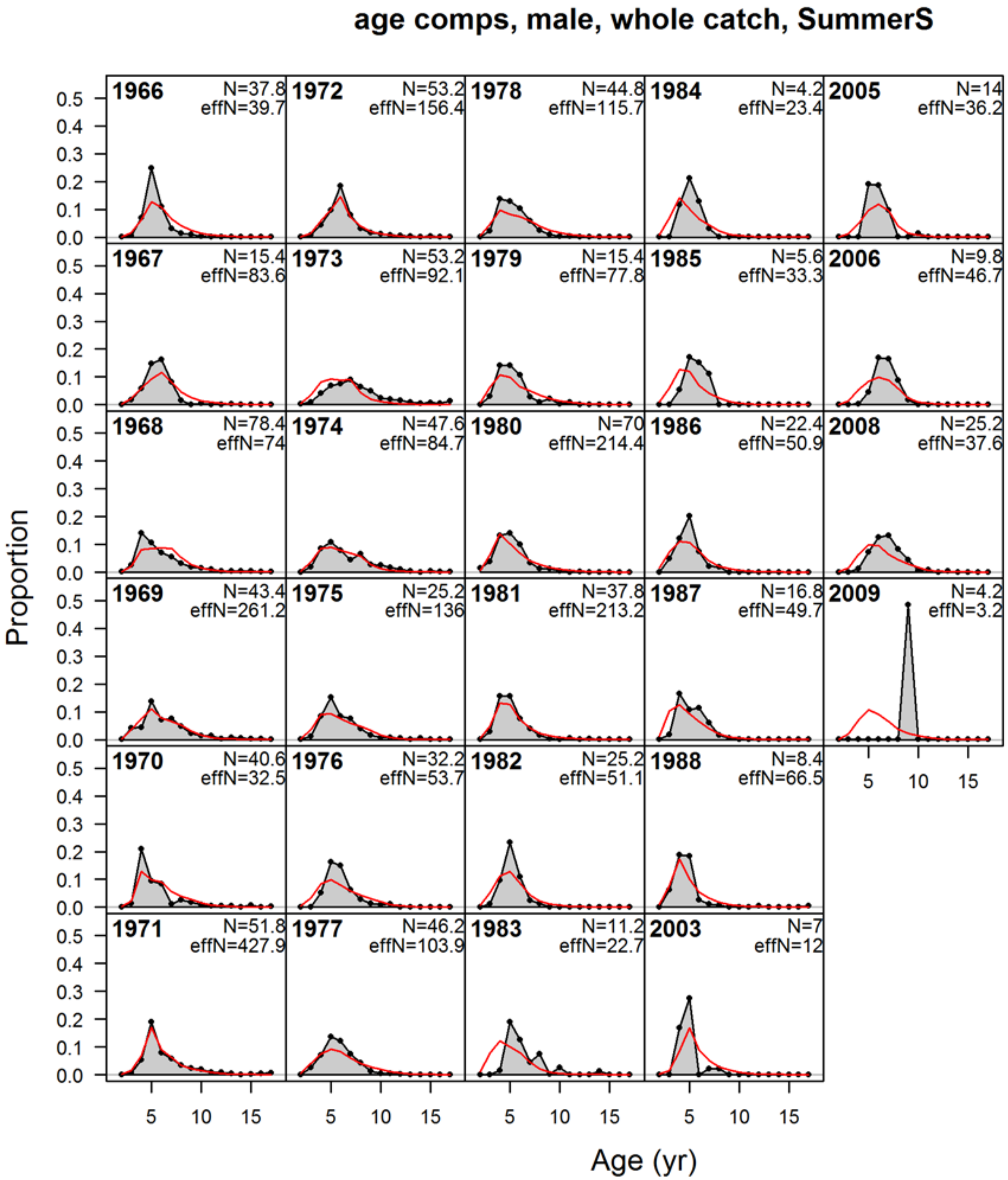

age comps, male, whole catch, SummerN
1998a4 N=8.5 effN=35
2001a5 N=17 effN=28.6
2004a5 N=30.6 effN=27
2008a5 N=28.9 effN=124.3
2011a2 N=52.7 effN=43
1998a5 N=18.7 effN=59.3
2002a3 N=17 effN=43.6
2005a5 N=30.6 effN=68.5
2009a2 N=52.7 effN=118.2
2011a7 N=18.7 effN=16.7
1999a2 N=6.8 effN=18.3
2002a5 N=17 effN=62.4
2006a5 N=23.8 effN=126.9
2009a5 N=1.7 effN=1.1
2012a7 N=17 effN=17.4
1999a5 N=15.3 effN=59.8
2003a3 N=11.9 effN=47.4
2007a2 N=13.6 effN=56.9
2009a7 N=13.6 effN=46.9
2000a5 N=20.4 effN=81.5
2003a5 N=32.3 effN=29.1
2007a5 N=27.2 effN=83
2010a2 N=51 effN=51.9
2001a3 N=1.7 effN=3.9
2004a3 N=10.2 effN=50.6
2008a2 N=15.3 effN=70.8
2010a7 N=6.8 effN=56.4
Proportion
Age (yr)


age comps, female, whole catch, WinterS
Proportion
Age (yr)
1966 N=15.2 effN=32.3
1973 N=22.8 effN=27.5
1979 N=9.5 effN=37.2
1985 N=3.8 effN=9.7
1991 N=28.5 effN=53.7
2008 N=5.7 effN=34.8
1967 N=24.7 effN=24.9
1974 N=55.1 effN=167.3
1980 N=11.4 effN=19.6
1986 N=7.6 effN=31.7
1992 N=1.9 effN=26.2
2009 N=7.6 effN=29.2
1969 N=15.2 effN=60.5
1975 N=17.1 effN=10.5
1981 N=34.2 effN=65.9
1987 N=19 effN=84.5
2003 N=1.9 effN=17.1
1970 N=19 effN=23.5
1976 N=22.8 effN=59.1
1982 N=1.9 effN=28.5
1988 N=9.5 effN=56.9
2004 N=1.9 effN=0.9
1971 N=11.4 effN=34.3
1977 N=15.2 effN=59.2
1983 N=22.8 effN=84
1989 N=3.8 effN=8.6
2005 N=5.7 effN=15.6
1972 N=43.7 effN=211.8
1978 N=17.1 effN=62.2
1984 N=11.4 effN=54.3
1990 N=3.8 effN=5.2
2006 N=3.8 effN=17

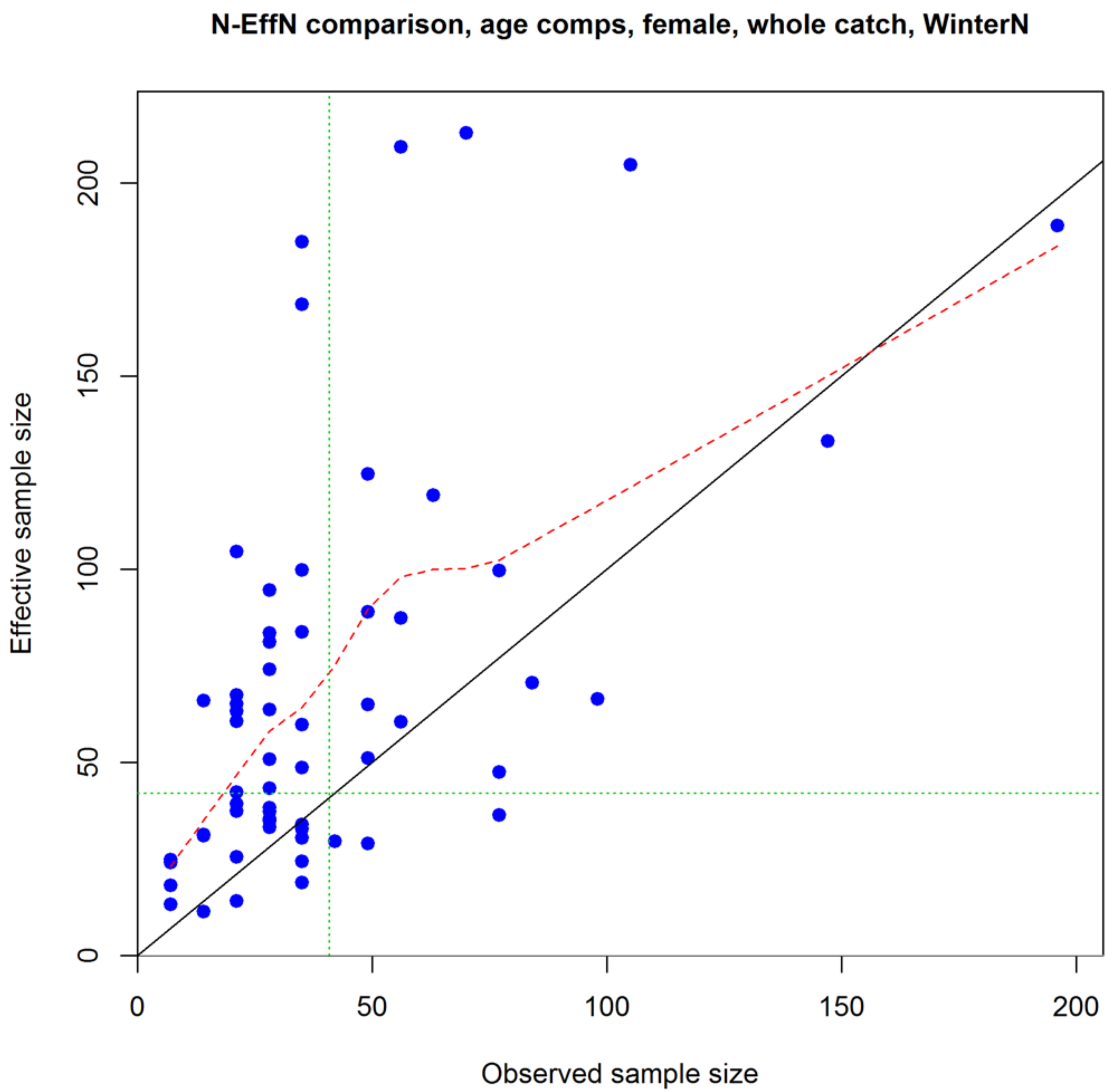

age comps, male, whole catch, WinterS
Proportion
Age (yr)
1966 N=15.2 effN=32.3
1973 N=22.8 effN=27.5
1979 N=9.5 effN=37.2
1985 N=3.8 effN=9.7
1991 N=28.5 effN=53.7
2008 N=5.7 effN=34.8
1967 N=24.7 effN=24.9
1974 N=55.1 effN=167.3
1980 N=11.4 effN=19.6
1986 N=7.6 effN=31.7
1992 N=1.9 effN=26.2
2009 N=7.6 effN=29.2
1969 N=15.2 effN=60.5
1975 N=17.1 effN=10.5
1981 N=34.2 effN=65.9
1987 N=19 effN=84.5
2003 N=1.9 effN=17.1
1970 N=19 effN=23.5
1976 N=22.8 effN=59.1
1982 N=1.9 effN=28.5
1988 N=9.5 effN=56.9
2004 N=1.9 effN=0.9
1971 N=11.4 effN=34.3
1977 N=15.2 effN=59.2
1983 N=22.8 effN=84
1989 N=3.8 effN=8.6
2005 N=5.7 effN=15.6
1972 N=43.7 effN=211.8
1978 N=17.1 effN=62.2
1984 N=11.4 effN=54.3
1990 N=3.8 effN=5.2
2006 N=3.8 effN=17

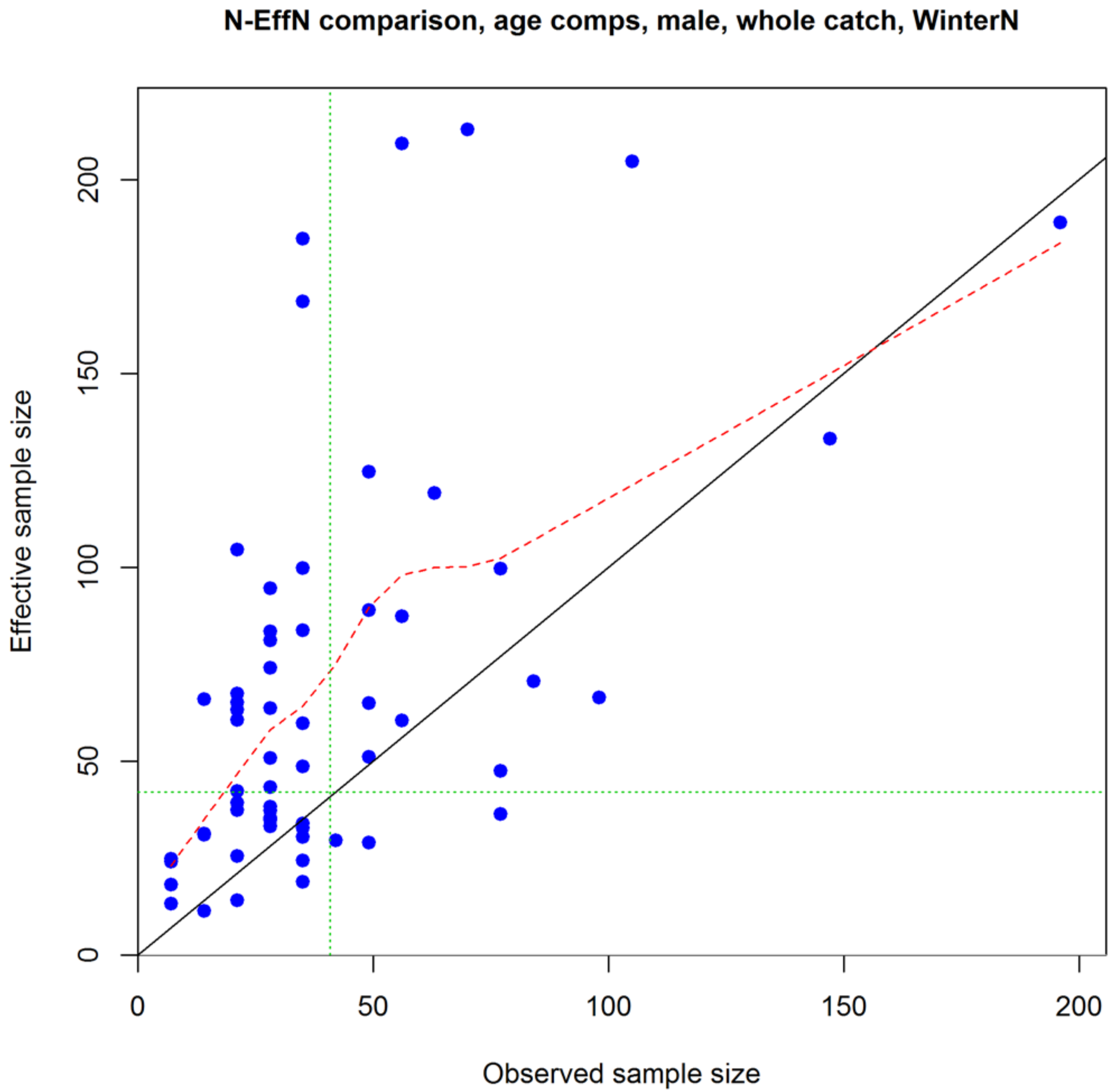
age comps, female, whole catch, SummerS

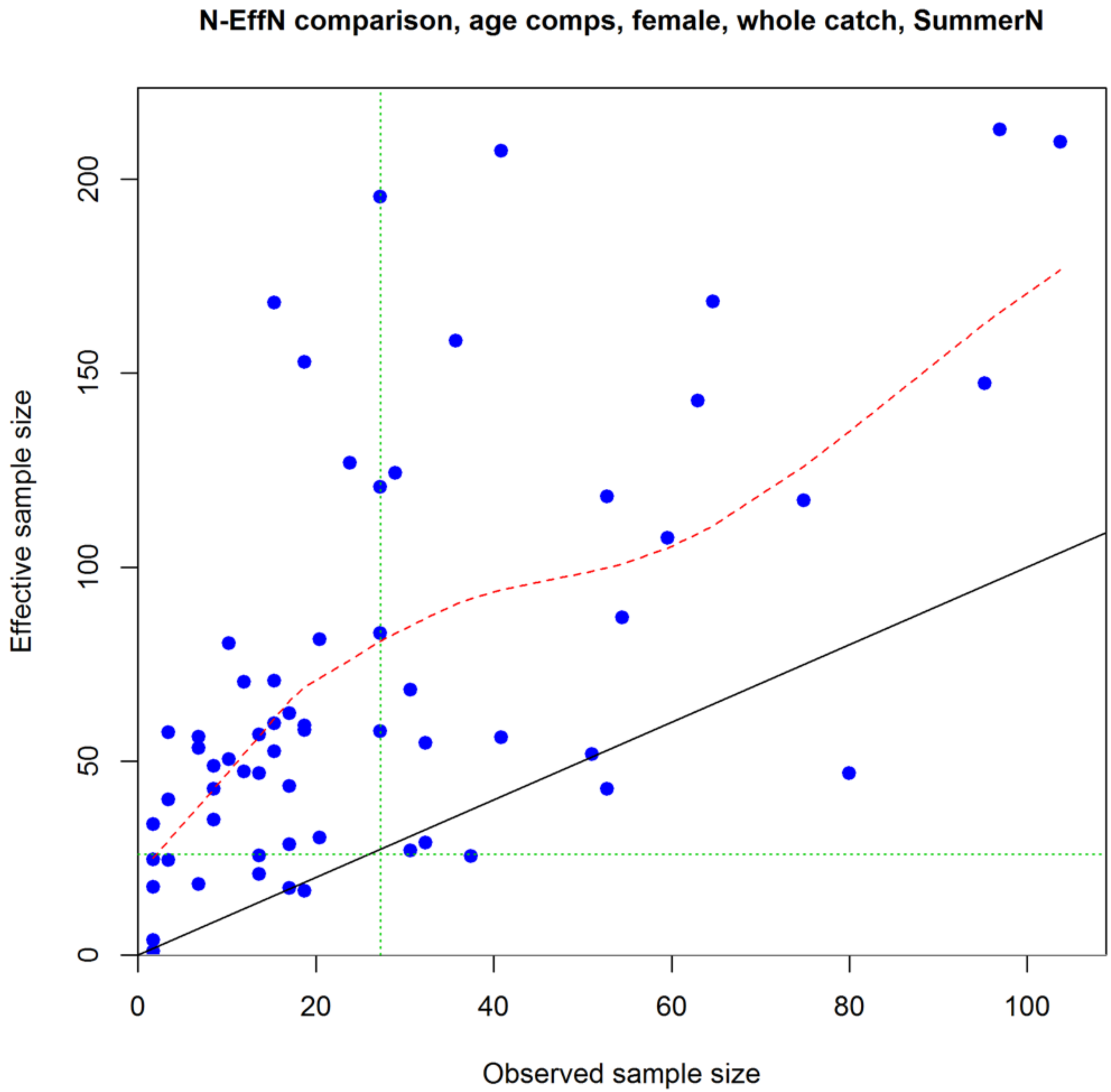


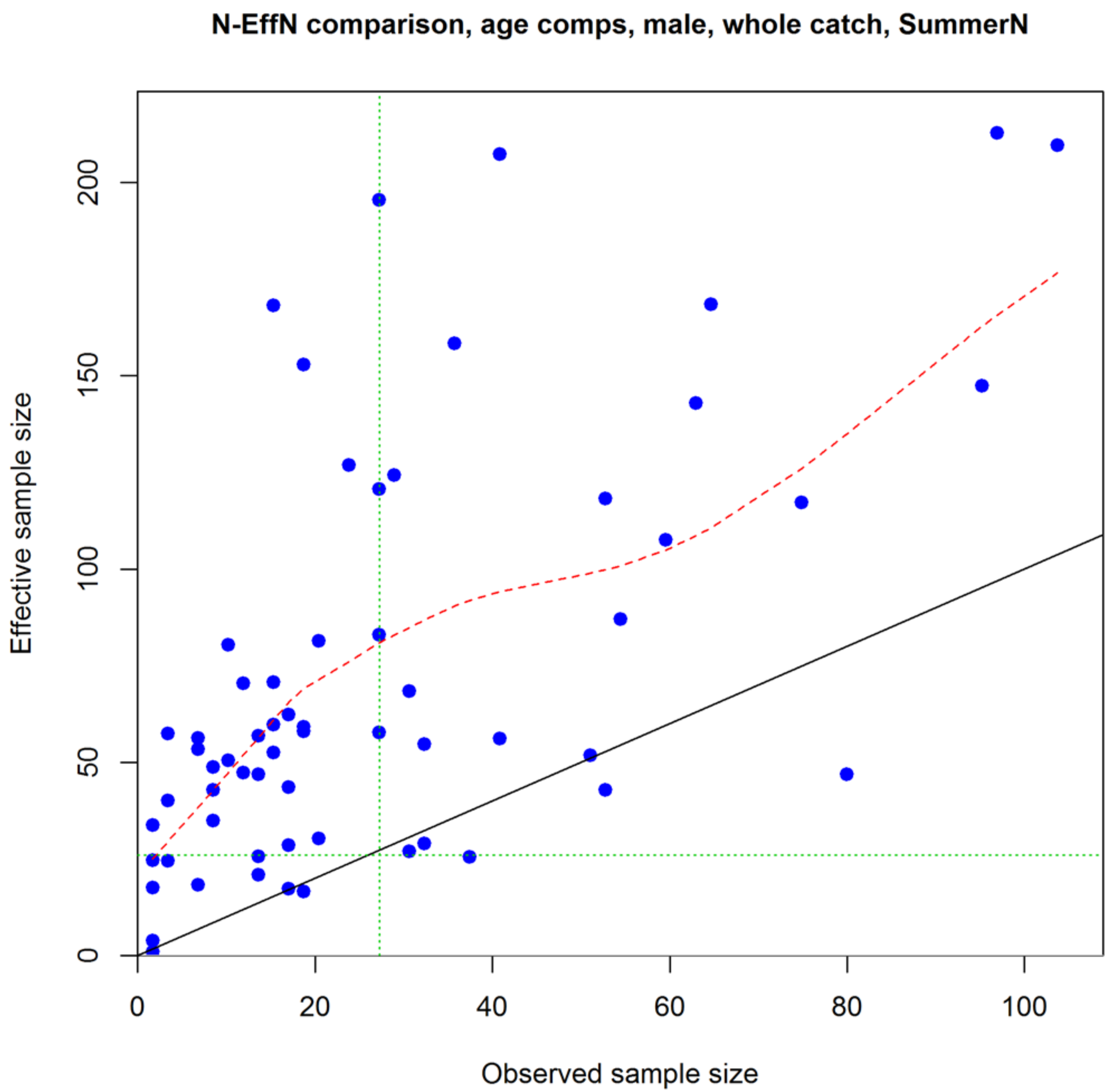

age comps, male, whole catch, SummerS
Proportion
Age (yr)
1966 N=37.8 effN=39.7
1972 N=53.2 effN=156.4
1978 N=44.8 effN=115.7
1984 N=4.2 effN=23.4
2005 N=14 effN=36.2
1967 N=15.4 effN=83.6
1973 N=53.2 effN=92.1
1979 N=15.4 effN=77.8
1985 N=5.6 effN=33.3
2006 N=9.8 effN=46.7
1968 N=78.4 effN=74
1974 N=47.6 effN=84.7
1980 N=70 effN=214.4
1986 N=22.4 effN=50.9
2008 N=25.2 effN=37.6
1969 N=43.4 effN=261.2
1975 N=25.2 effN=136
1981 N=37.8 effN=213.2
1987 N=16.8 effN=49.7
2009 N=4.2 effN=3.2
1970 N=40.6 effN=32.5
1976 N=32.2 effN=53.7
1982 N=25.2 effN=51.1
1988 N=8.4 effN=66.5
1971 N=51.8 effN=427.9
1977 N=46.2 effN=103.9
1983 N=11.2 effN=22.7
2003 N=7 effN=12

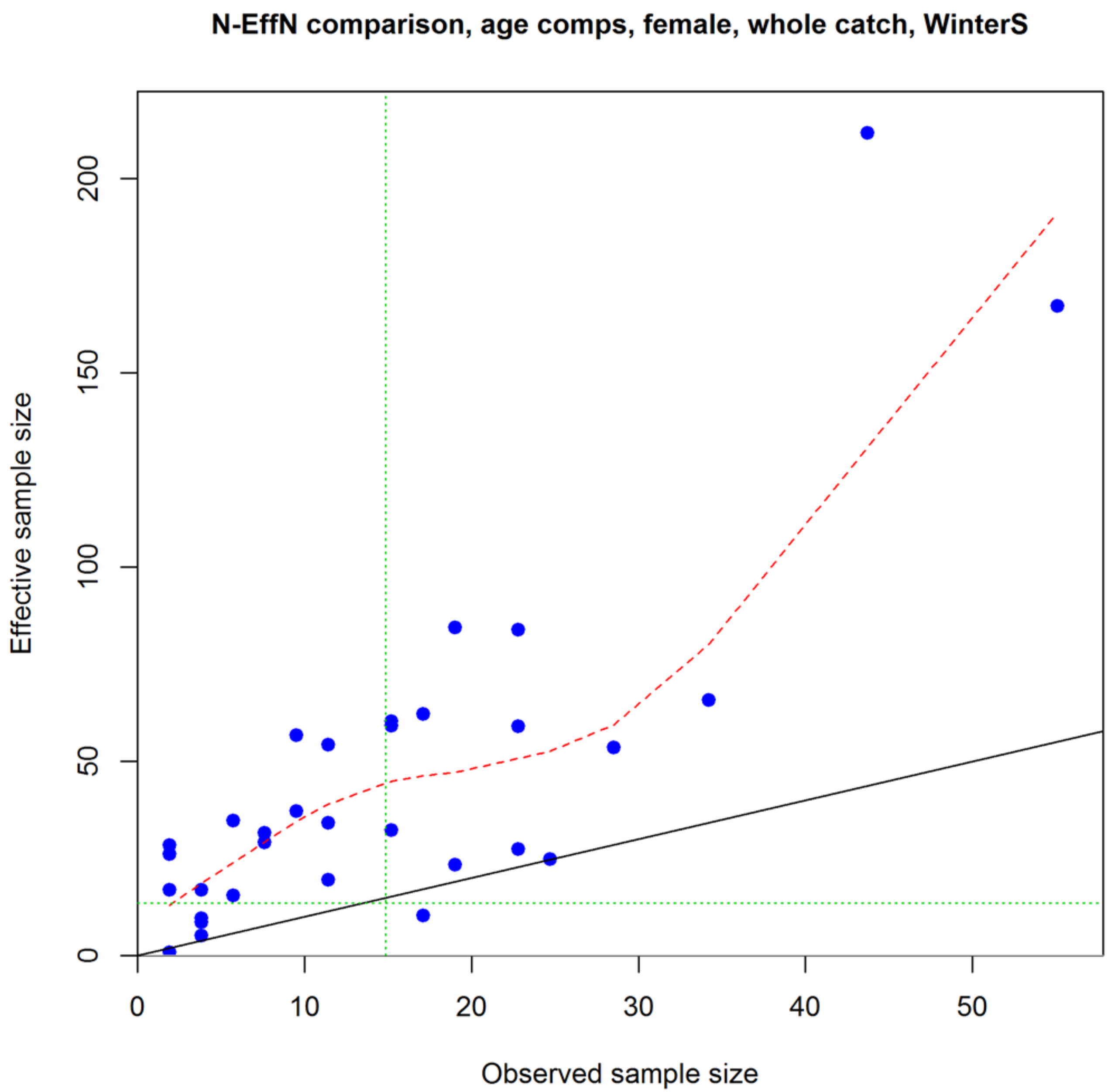
Appendix H.15. Fishery age composition effective sample sizes


N-EffN comparison, age comps, female, whole catch, WinterN
Effective sample size
Observed sample size
0
50
100
150
200
0
50
100
150
200

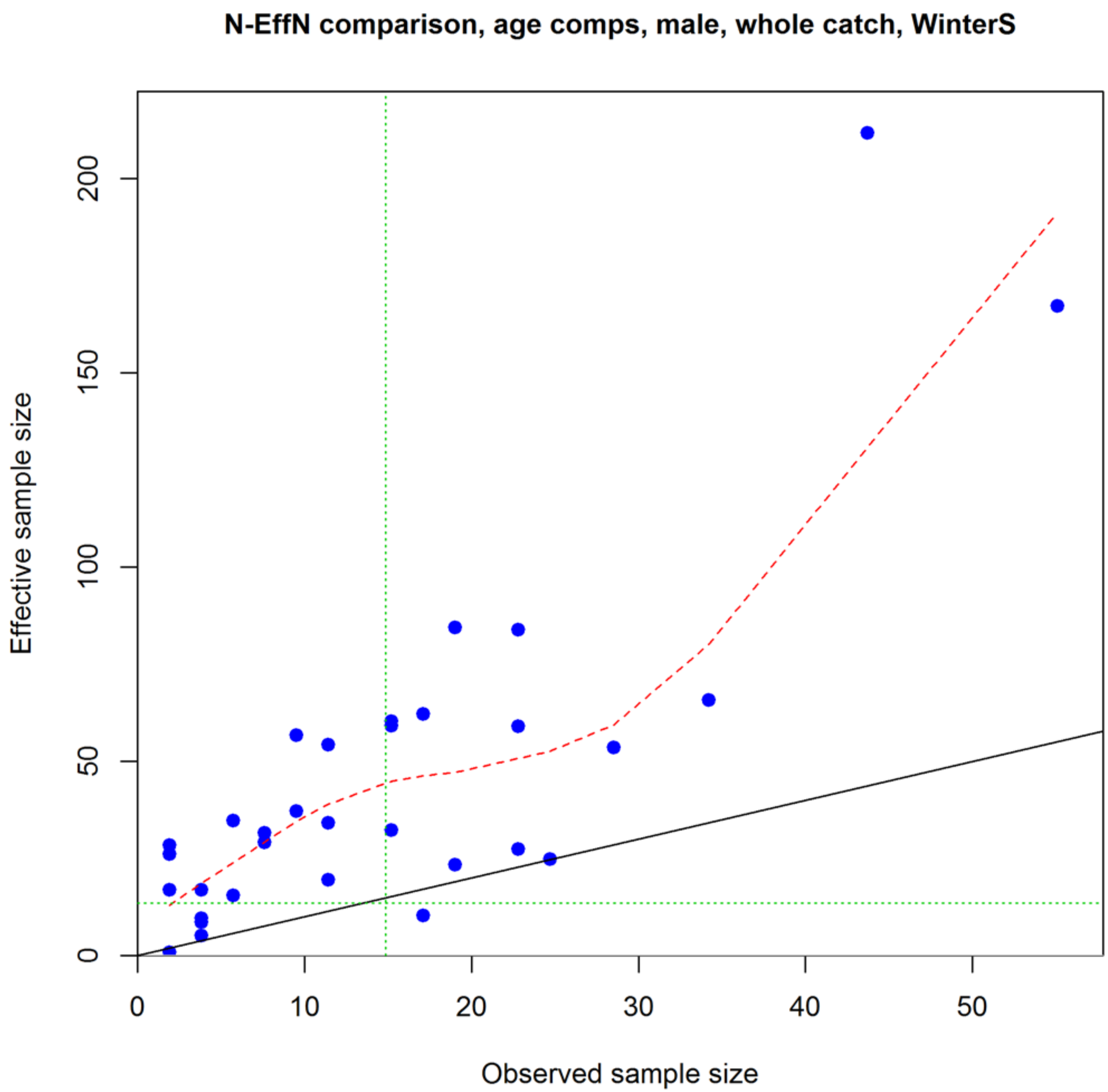

N-EffN comparison, age comps, male, whole catch, WinterN
Effective sample size
Observed sample size
0
50
100
150
200
0
50
100
150
200

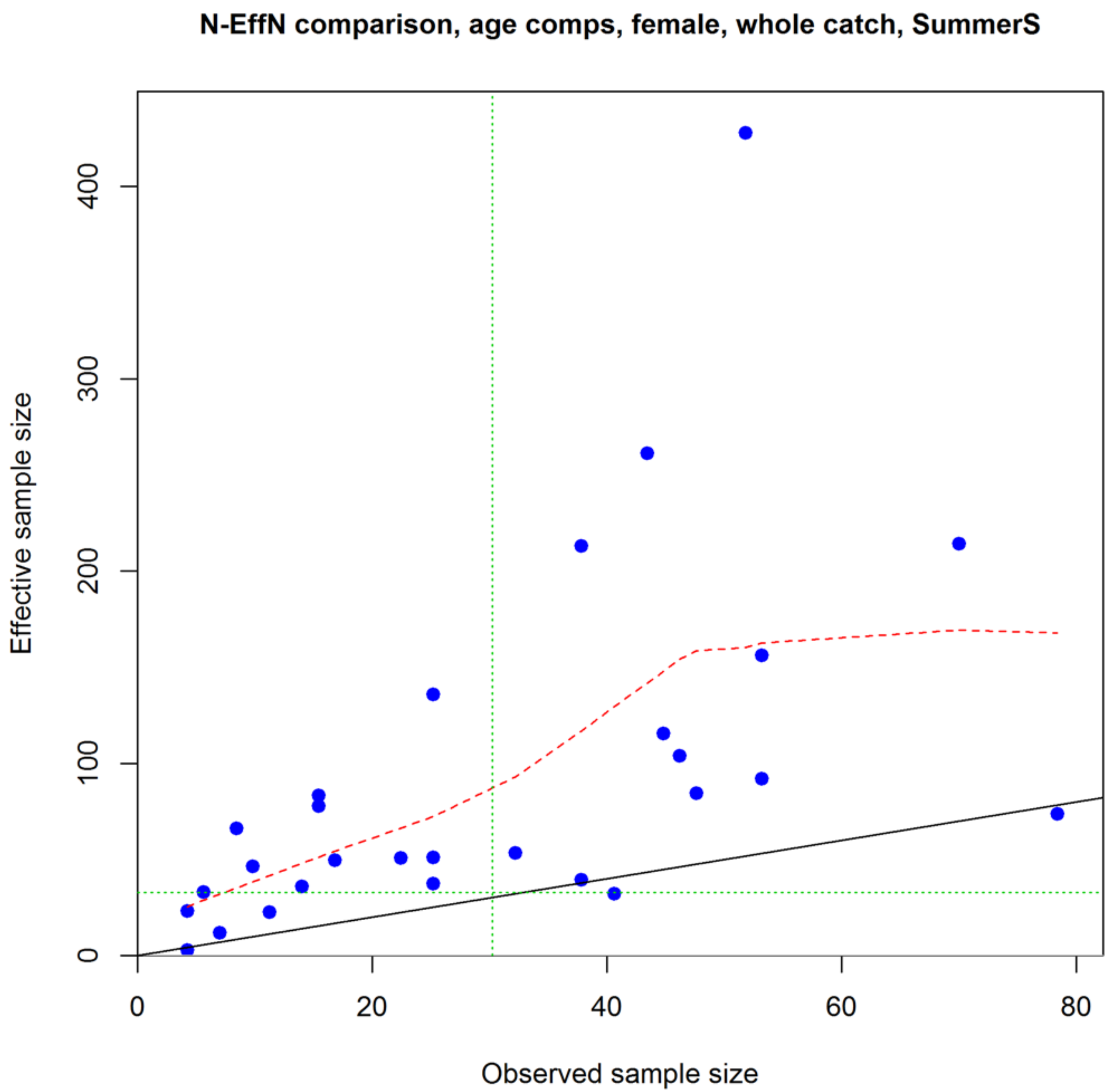

N-EffN comparison, age comps, female, whole catch, SummerN
Effective sample size
Observed sample size
0
50
100
150
200
0
20
40
60
80
100

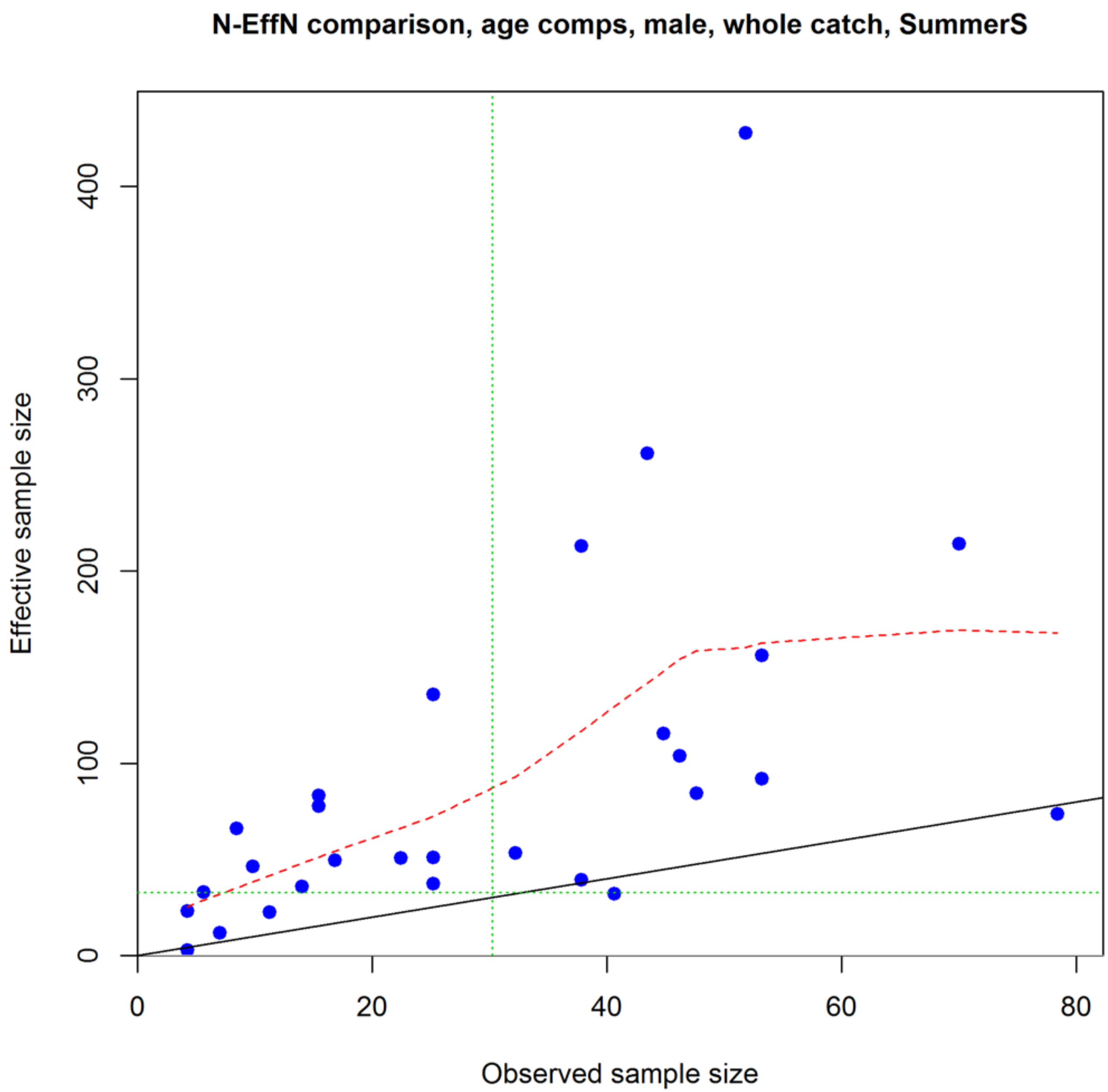

N-EffN comparison, age comps, male, whole catch, SummerN
Effective sample size
0
50
100
150
200
0
20
40
60
80
100
Observed sample size



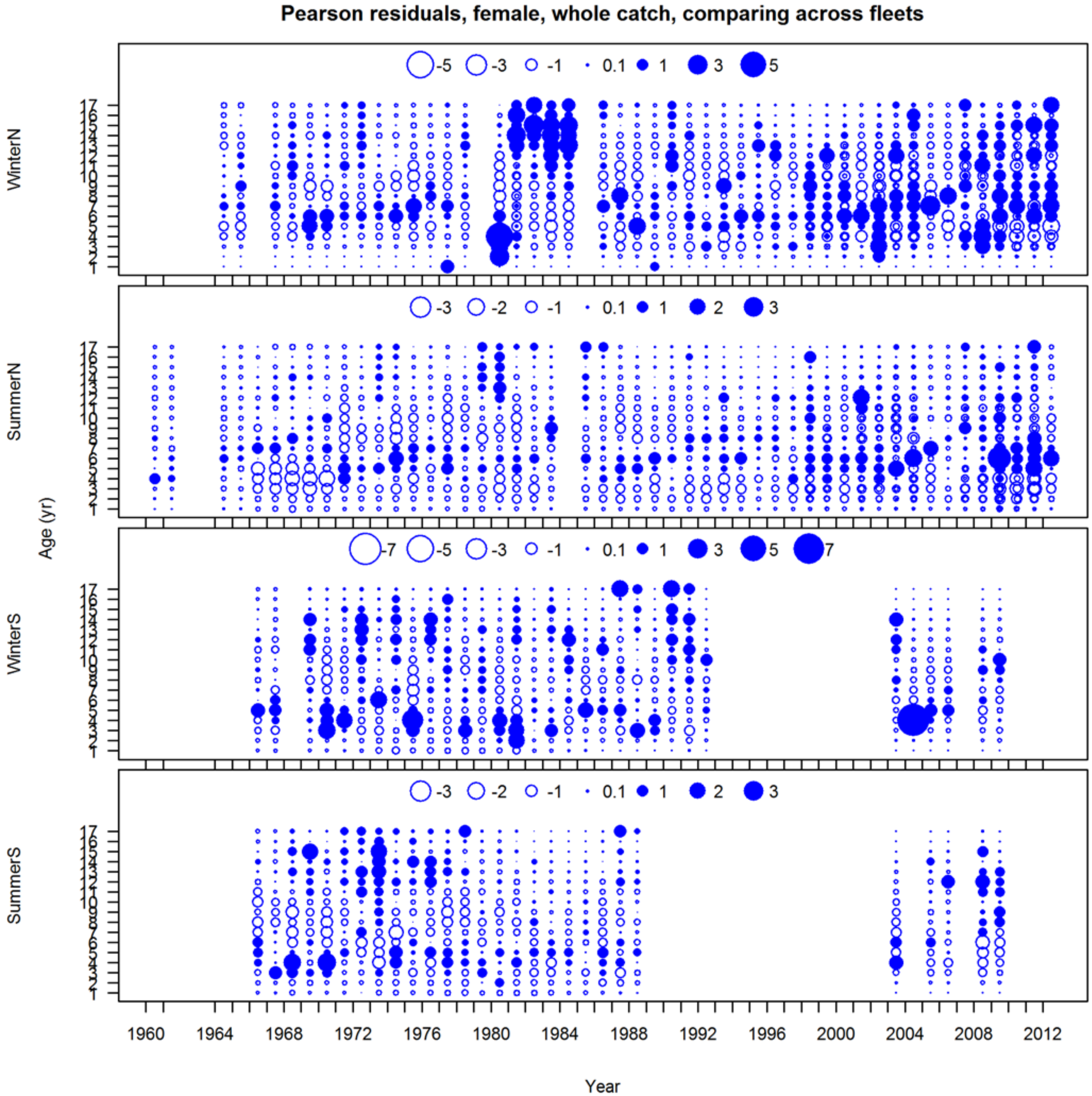
N-EffN comparison, age comps, female, whole catch, WinterS
Effective sample size
0
50
100
150
200
0
10
20
30
40
50
Observed sample size

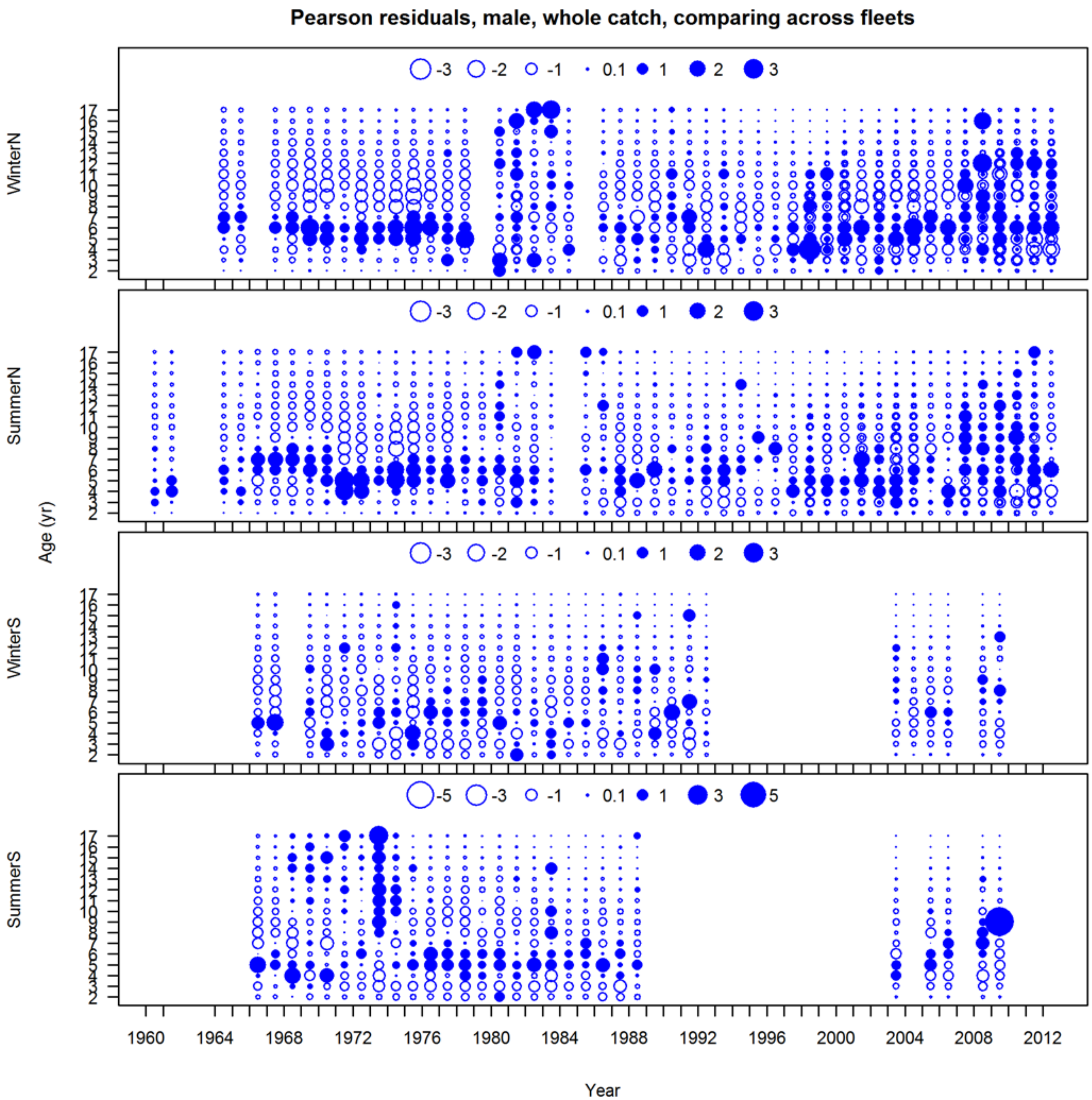

N-EffN comparison, age comps, male, whole catch, WinterS
Effective sample size
0
50
100
150
200
0
10
20
30
40
50
Observed sample size

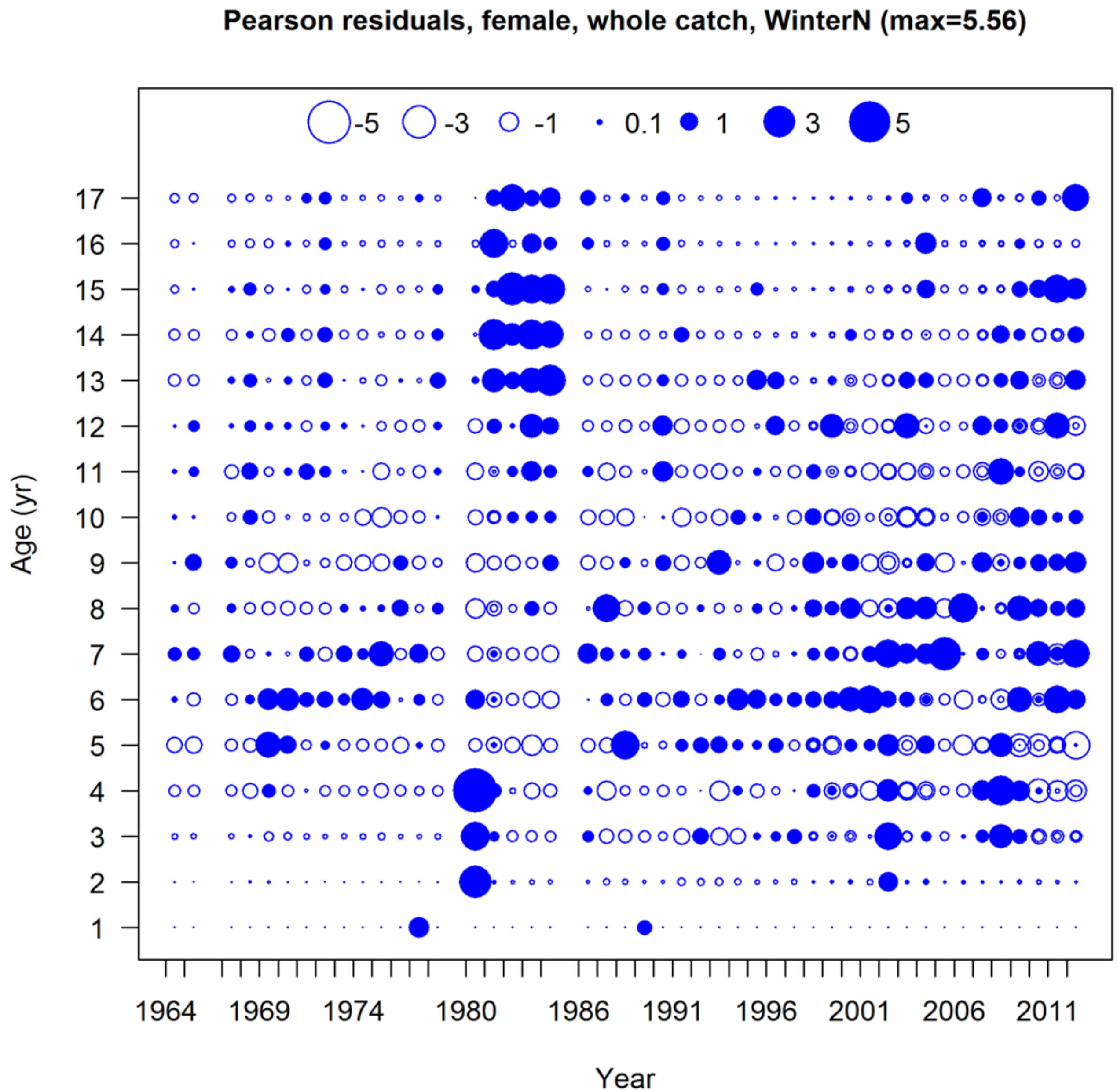

N-EffN comparison, age comps, female, whole catch, SummerS
Effective sample size
0
100
200
300
400
0
20
40
60
80
Observed sample size

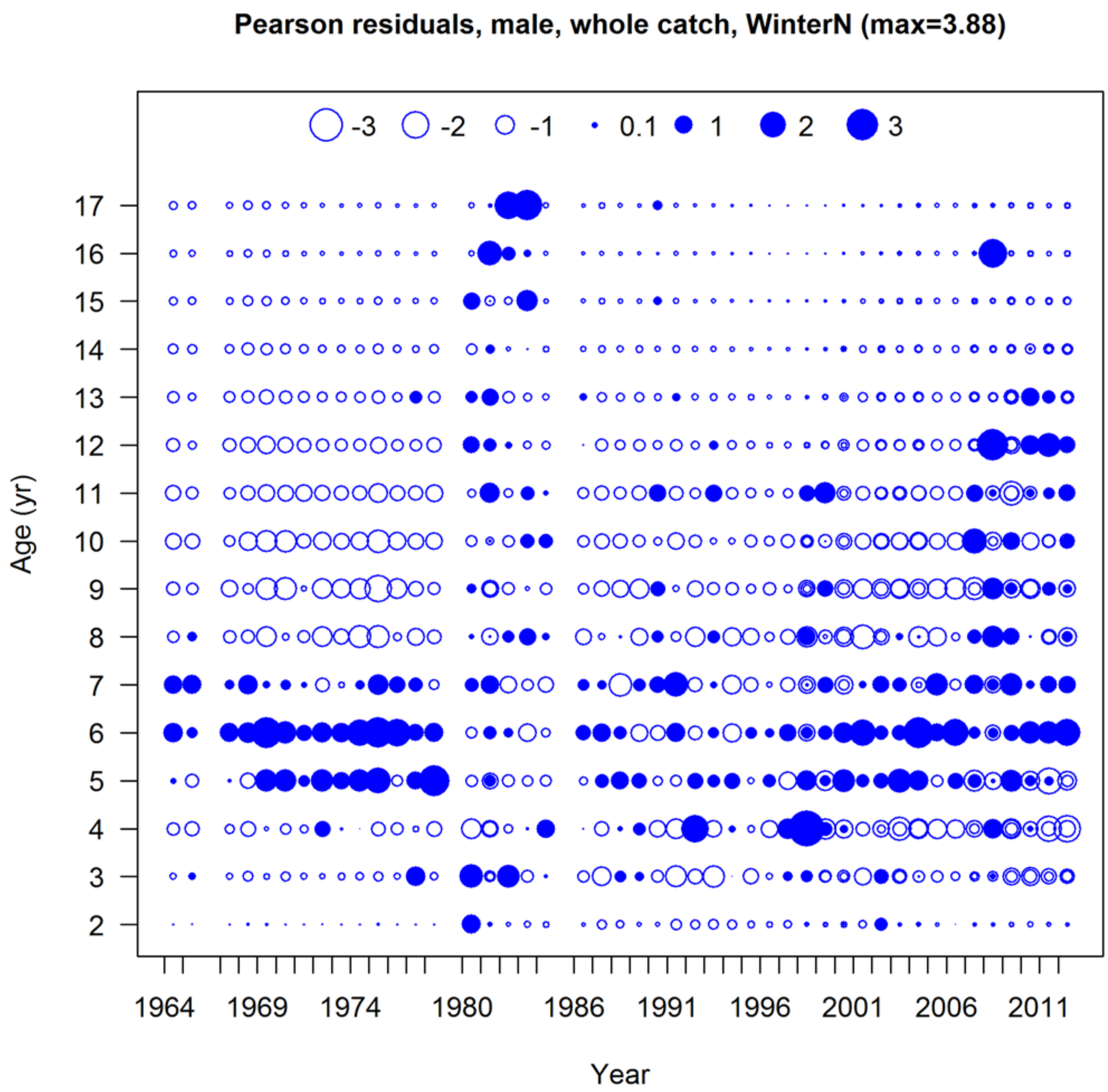

N-EffN comparison, age comps, male, whole catch, SummerS
Effective sample size
Observed sample size
0
100
200
300
400
0
20
40
60
80

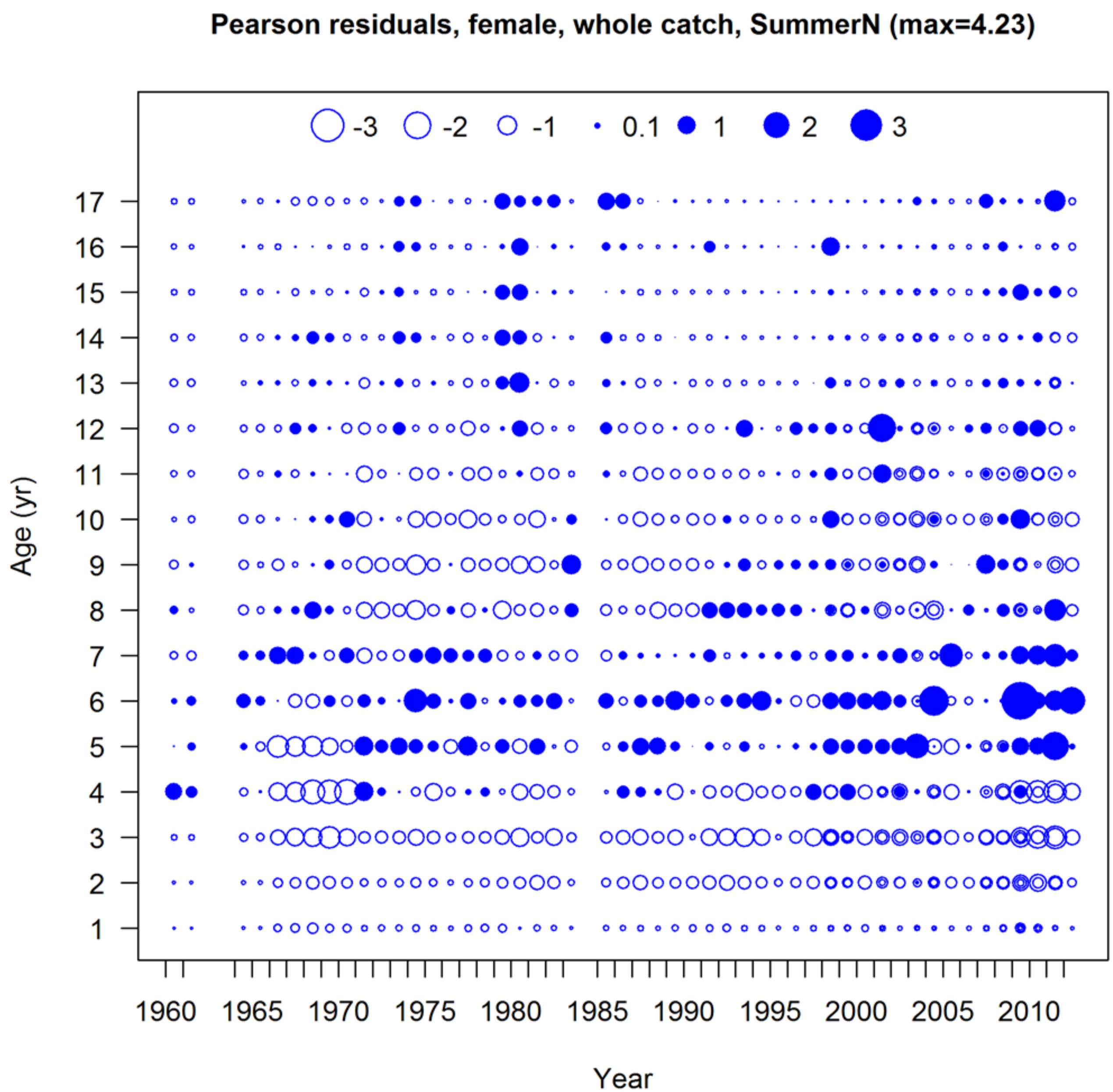
Appendix H.16. Fishery age composition Pearson residuals

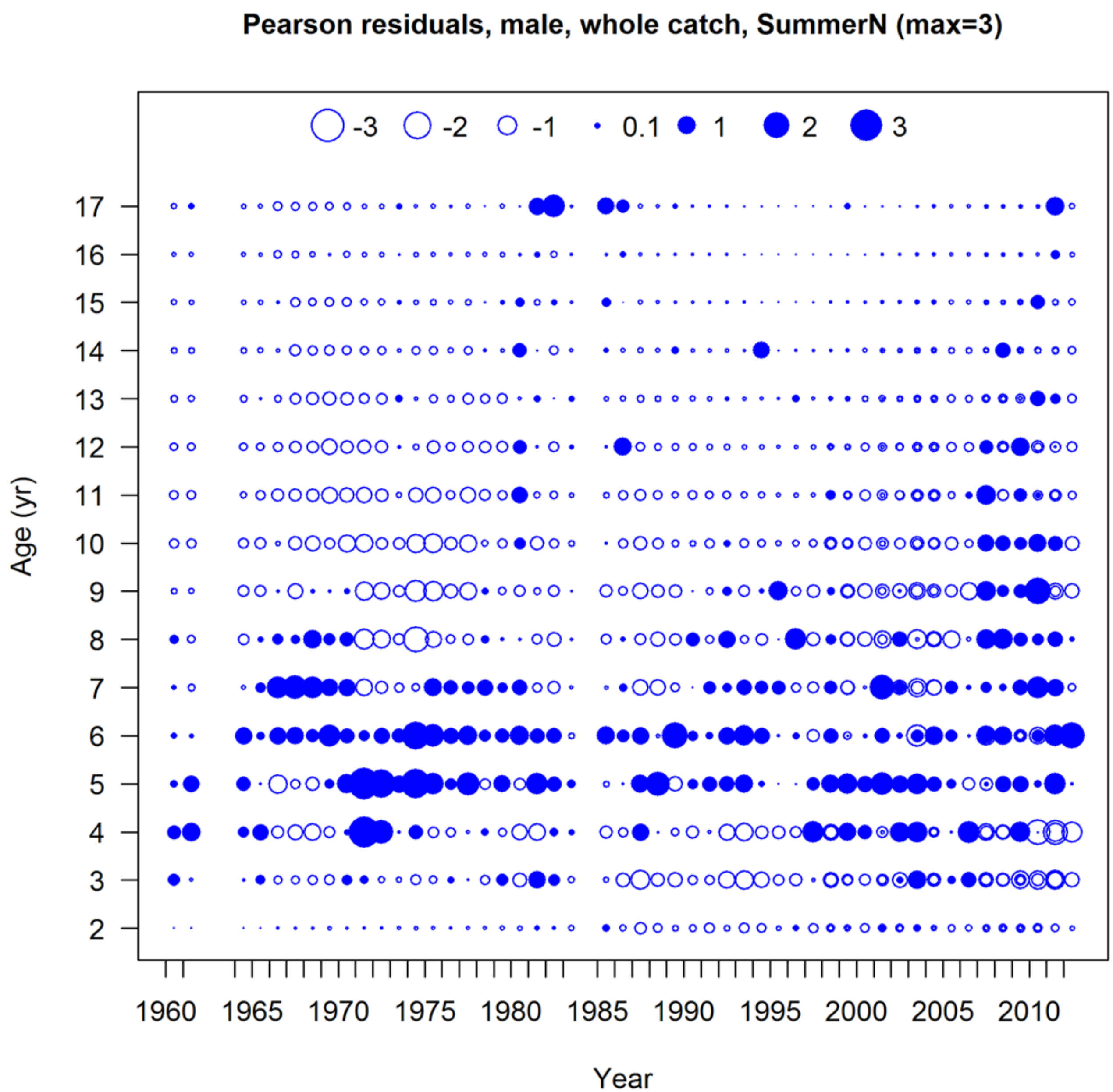

Pearson residuals, female, whole catch, comparing across fleets
WinterN
SummerN
WinterS
SummerS
Age (yr)
Year

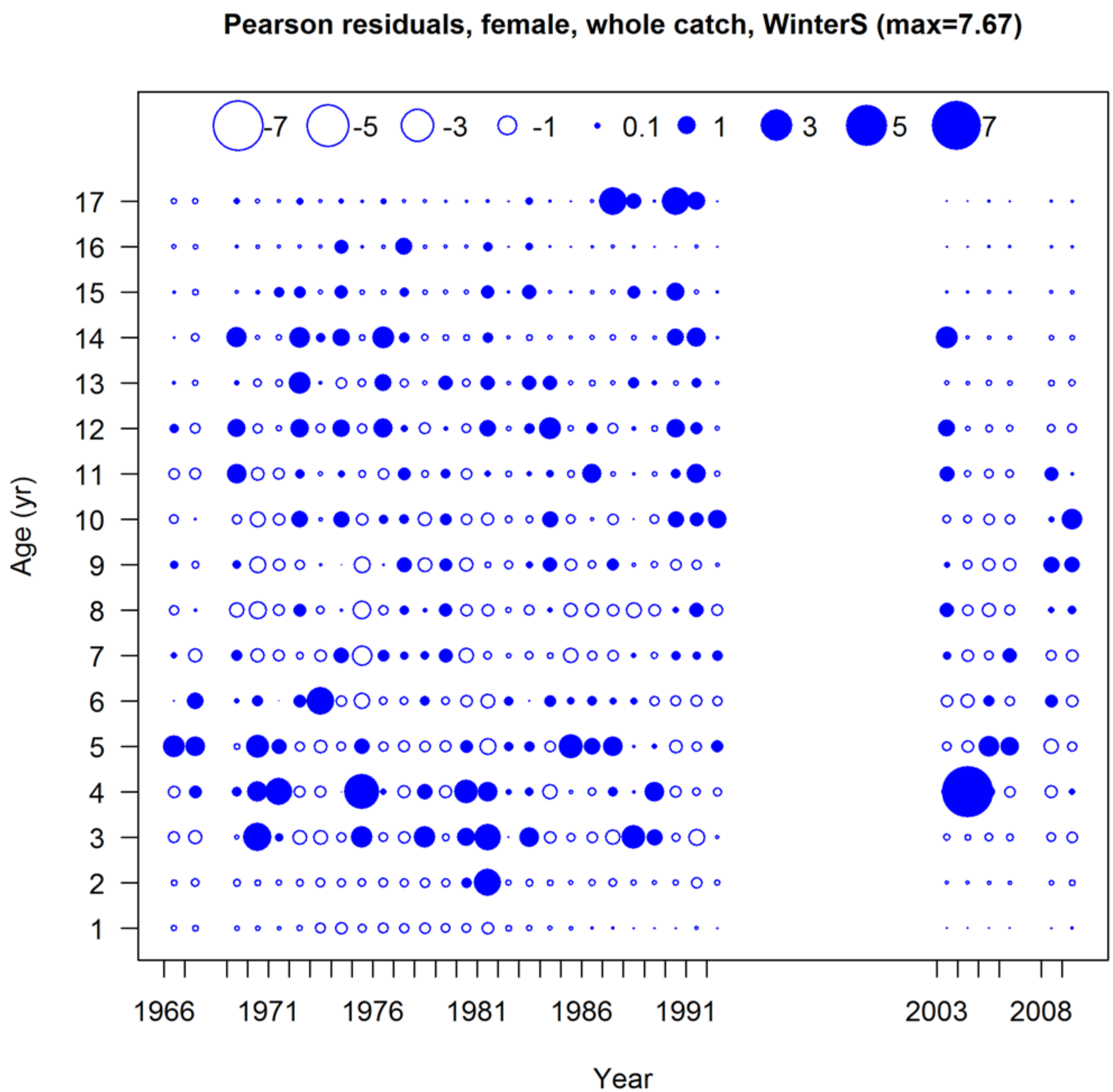

Pearson residuals, male, whole catch, comparing across fleets
-3 -2 -1 0.1 1 2 3
-5 -3 -1 0.1 1 3 5
WinterN
SummerN
WinterS
SummerS
Age (yr)
Year
1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012


Pearson residuals, female, whole catch, WinterN (max=5.56)
-5
-3
-1
0.1
1
3
5
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1964
1969
1974
1980
1986
1991
1996
2001
2006
2011
Year

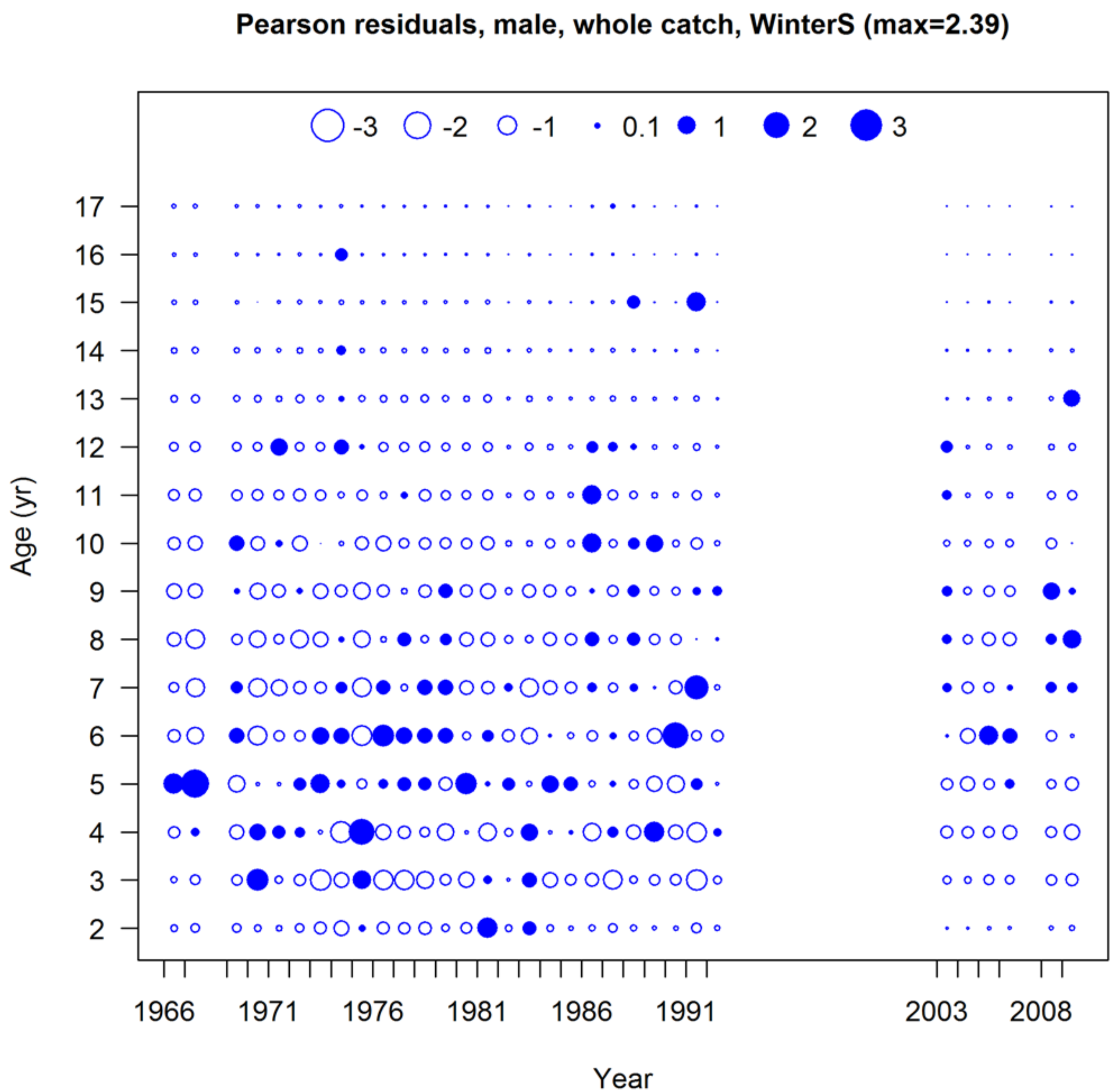

Pearson residuals, male, whole catch, WinterN (max=3.88)
-3
-2
-1
0.1
1
2
3
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1964
1969
1974
1980
1986
1991
1996
2001
2006
2011
Year


Pearson residuals, female, whole catch, SummerN (max=4.23)
-3
-2
-1
0.1
1
2
3
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

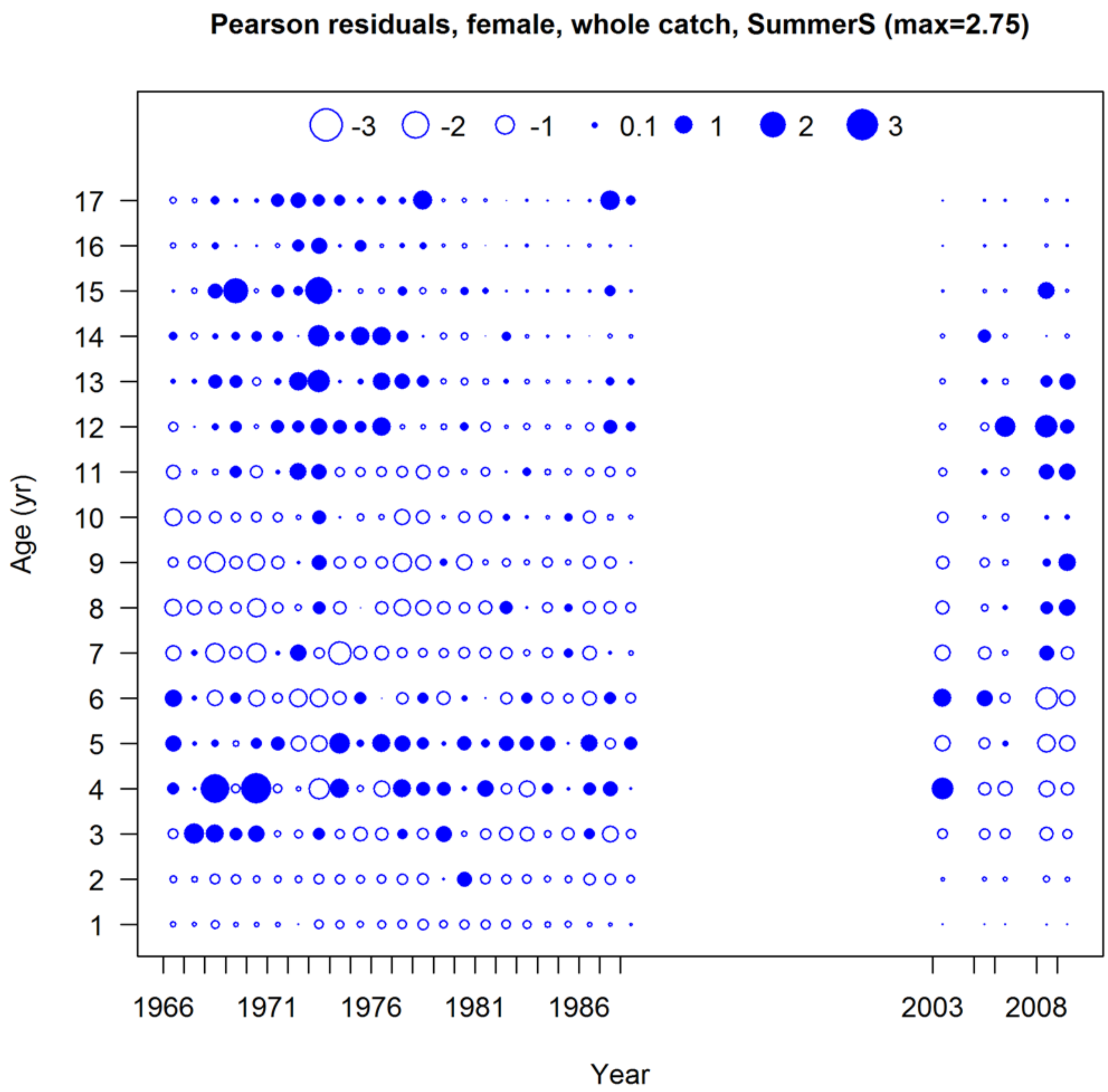

Pearson residuals, male, whole catch, SummerN (max=3)
-3 -2 -1 0.1 1 2 3
Age (yr)
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2
1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010
Year



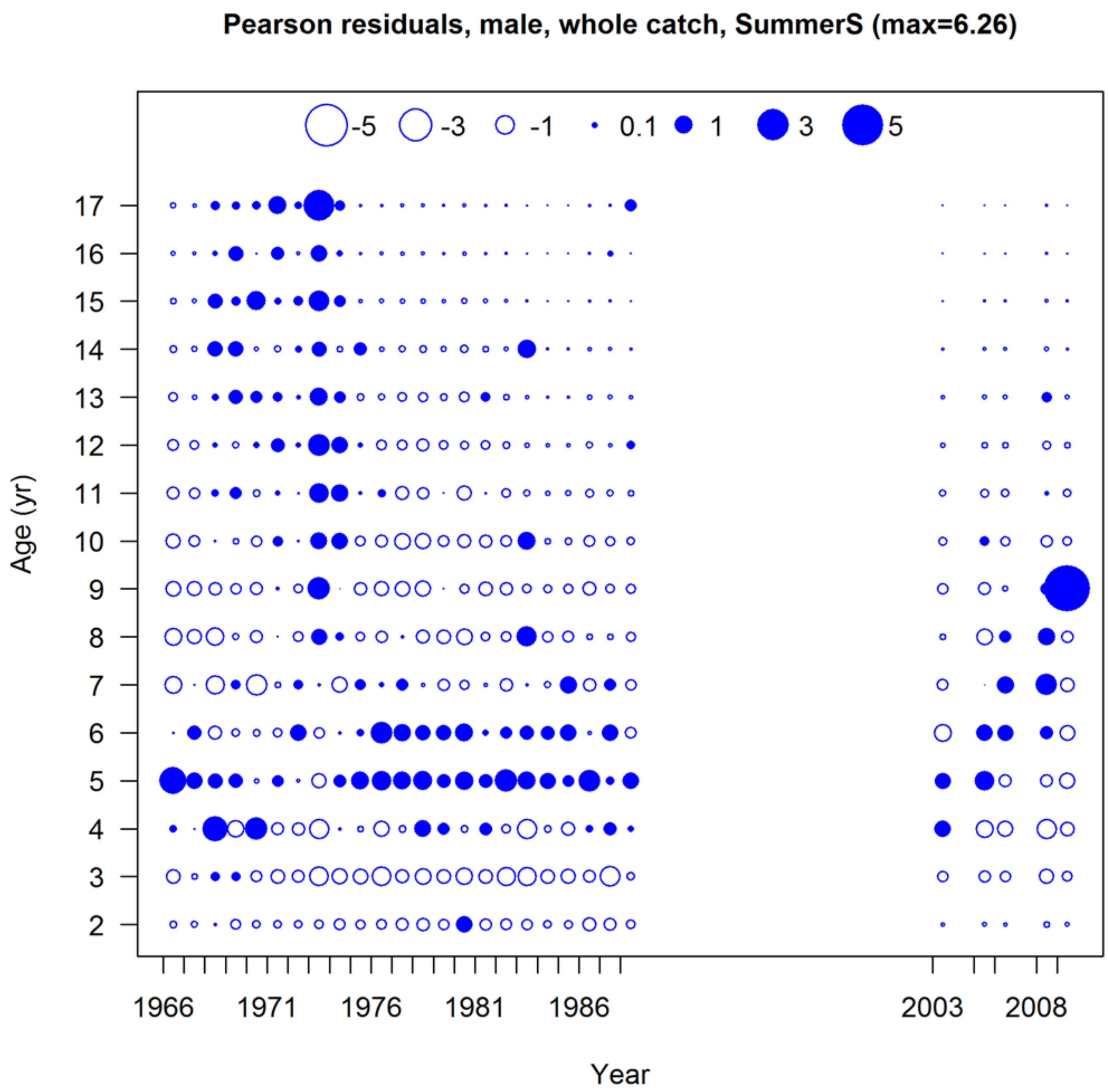
Pearson residuals, female, whole catch, WinterS (max=7.67)
-7
-5
-3
-1
0.1
1
3
5
7
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1966
1971
1976
1981
1986
1991
2003
2008
Year



Pearson residuals, male, whole catch, WinterS (max=2.39)
-3
-2
-1
0.1
1
2
3
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1966
1971
1976
1981
1986
1991
2003
2008
Year



Pearson residuals, female, whole catch, SummerS (max=2.75)
-3
-2
-1
0.1
1
2
3
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1966
1971
1976
1981
1986
2003
2008
Year


Pearson residuals, male, whole catch, SummerS (max=6.26)
-5
-3
-1
0.1
1
3
5
Age (yr)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1966
1971
1976
1981
1986
2003
2008
Year

Appendix I. Base model numbers at age

See Excel spreadsheet titled Petrale2013Base-NatAge

Petrale Sole

Stock Assessment Review (STAR) Panel Report

Silver Cloud University Inn
Seattle, Washington

13-17 May, 2013

STAR Panel Members

Noel Cadigan — Center for Independent Experts (CIE)
Yan Jiao — Center for Independent Experts (CIE)
Ian Stewart — International Pacific Halibut Commission (IPHC)
Tien-Shui Tsou (Chair) — Washington State Department of Fish and Wildlife, PFMC Scientific and Statistical Committee (SSC)

Pacific Fishery Management Council (PFMC) Advisors

John DeVore — PFMC Staff
Rob Jones — Northwest Indian Fisheries Commission, PFMC Groundfish Management Team (GMT)
Pete Leipzig — Fishermen's Marketing Association, PFMC Groundfish Advisory Subpanel (GAP)

Stock Assessment Team (STAT)

Melissa Haltuch — NMFS, Northwest Fisheries Science Center
Juan Valero — Center for the Advancement of Population Assessment Methodology
Kotaro Ono — University of Washington, Seattle

Overview

A draft assessment of the coastwide petrale sole (*Eopsetta jordani*) off the U.S. west coast using data through 2012 was reviewed by the STAR panel during May 13-17, 2013. This assessment used the Stock Synthesis platform version 3.24o and is structured as an annual model with the start of the fishing year on November 1 and ending on October 31. Fisheries are grouped into four fleets: North Winter, North Summer, South Winter, and South Summer. The North fleets include Washington and Oregon fisheries while the South encompasses California fisheries. Winter season is from November to February and summer season, from March to October. The draft assessment incorporated a variety of data sources into the candidate base model. Data from commercial trawl fisheries included landings, discards, and age- and length-composition data, and standardized winter fishery CPUE indices (1987-2009). Fisheries-independent information includes biological samples and abundance indices collected by the National Marine Fisheries Service (NMFS) early (1980, 1983, 1986, 1989, and 1992) and late (1995, 1998, 2001, and 2004) triennial bottom trawl survey and the Northwest Fisheries Science Center (NWFSC) trawl survey (2003–2012).

Petrale sole was last assessed in 2011. Significant differences in data sources and model configuration between the 2011 and current assessment include:

1. Landings summarized by port of landing rather than area of catch.
2. Combining the Washington and Oregon fleets into a single northern fleet.
3. Use of the Oregon historical landings reconstruction.
4. Addition of data for 2011 and 2012.
5. Revised commercial CPUE and survey indices

Multiple model runs were conducted and reviewed to examine model assumptions and structure, and to identify uncertainties in the assessment. The main focus of the discussion was to better understand the fishery CPUE standardization and survey GLMM analyses. There were no major changes made to the input data or base model structure. Both the STAT and the panel agreed that minor changes made during the review improved the model.

Stock Status – the terminal year depletion rate (SSB_{2013}/SSB_0) from the final base model is 22.3% of unfished biomass, slightly below the management target of 25%. Natural mortality is used to bracket the uncertainty in the states of nature depicted in the decision table.

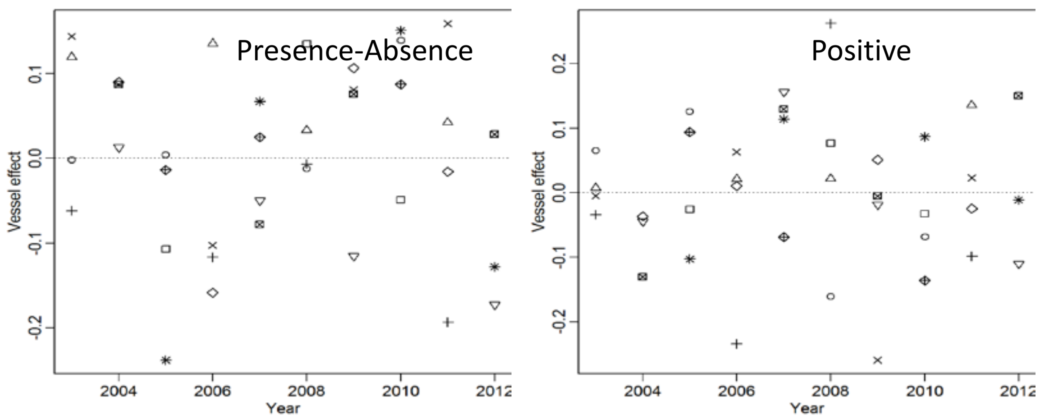
The STAR panel concluded that the petrale sole assessment was based on the best available data and that this new assessment constitutes the best available information for the management of petrale sole off the U.S. west coast. The STAR panel thanks the STAT team for their willingness to respond to panel requests and their dedication to addressing difficult assessment problems.

Discussion and Additional Analyses Requested by the STAR Panel

1. For the survey GLMM, plot random vessel-year effects versus year.

<u>Rationale</u>: Plots could reveal potential confounding between random vessel effects and actual trends in the stock over time

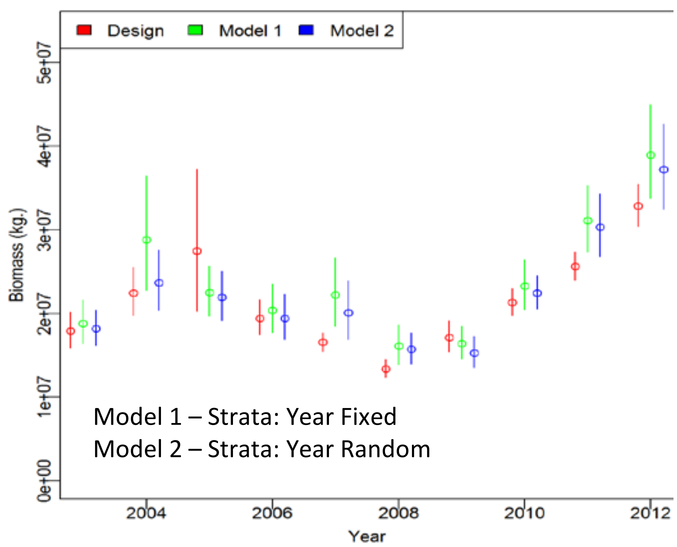
<u>Results</u>: Vessel effects were small and varied without trend over time which does not indicate a confounding problem.



2. Compare NWFSC indices and error bars when year-strata effects are random or fixed, and also compare with design-based indices.

<u>Rationale</u>: Error bars have implications on the weighting of indices in SS3.

<u>Results</u>: All models show similar trends.



3. Report what depth selection was used by fishery CPUE index.

Rationale: Clarity.

Results: The filters were depth ≤ 75 fm in the summer and 150 fm ≤ depth ≤ 400 fm in the winter.

4. Look at von Bertalanffy residuals by year.

Rationale: Examine for evidence of time variation in growth rates in the NWFSC survey data.

Results: Neither series of plots showed patterns indicating time-varying growth.

5. Set the NWFSC extra variance parameter to zero.

Rationale: The extra variance is to account for process error. The estimate from the draft base model was less than zero; and it is an improvement to either set this parameter to zero or set the prior with a lower bound of zero.

Results: Little effects on model outputs. The extra variance parameter will be set to zero in the final base model.

6. Provide a time-series plot of discarded catch by fleet.

Rationale: Discards are estimated in the model. The plot is useful to understand model output.

Results: Graphics showed the discards time series vs. a total catch time series. Discards were an order of magnitude less than total catches.

7. Check for convergence the sensitivity run removes NWFSC 2012 age composition data.

Rationale: There is a significant difference in B_0 after the NWFSC 2012 age composition data were removed. Checking for convergence will validate results from this sensitivity run.

Results: The version in the draft document was with ***all*** NWFSC survey age data removed. The correct outputs from the model run with only the 2012 age data removed showed low sensitivity to this change.

8. Report statistics on jitter analyses for the new base model.

Rationale: Validate results.

Results: A jitter of 0.01 for the base model was run 100 times. 75% of the jitter runs ended at the base case, 17.5% ended at local minima, and 7.5% of jitter runs crashed. This was a satisfactory jitter test although a more aggressive jitter could be done.

9. Provide M and h sensitivity analyses, based on range from hessian-based intervals.

Rationale: Improved understanding of potential axes of uncertainty for the decision table.

Results: The runs showed confounding of M and h, which is expected. However, there may be a concern with estimating both parameters with informative priors. A wider range of M and h should be considered that are ~1.2 negative log likelihood (NLL) points away from the base.

10. Provide a sensitivity run with no commercial CPUE.

Rationale: There is considerable uncertainty in how to standardize commercial catch rates.

Results: Removing the index fits the age composition slightly worse and the length composition slightly better. There are also small changes to M and h with this run. Growth parameters do not change. The population status in 2013 shown as SSB depletion changed from 0.289 to 0.222. It is noted that the "survey" component of the objective function is not comparable between these alternate models because it includes all indices of abundance, and CPUE data have been removed.

Label	Base	NoCommCPUE
TOTAL_like	1459.8	1502.2
Survey_like	-74.9	-22.2
Discard_like	-142.8	-143.2
Mean_body_wt_like	-75.8	-75.7
Length_comp_like	824.4	814.4
Age_comp_like	947.8	950.2
SR_BH_steep	0.84	0.85
NatM_p_1_Fem_GP_1	0.16	0.15
L_at_Amin_Fem_GP_1	15.8	15.9
L_at_Amax_Fem_GP_1	54.3	54.3
VonBert_K_Fem_GP_1	0.13	0.13
CV_young_Fem_GP_1	0.18	0.18
CV_old_Fem_GP_1	0.03	0.03
NatM_p_1_Mal_GP_1	0.18	0.17
L_at_Amin_Mal_GP_1	16.3	16.3
L_at_Amax_Mal_GP_1	42.5	42.5
VonBert_K_Mal_GP_1	0.21	0.21
CV_young_Mal_GP_1	0.13	0.13
CV_old_Mal_GP_1	0.05	0.05

11. If time permits, provide an explanation of what component(s) produced the increase in the total likelihood profile for R_0.

Rationale: Validate results.

Results: The priors' NLLs were missing in the original plot which was causing the total NLL curve to shift. A revised figure was presented.

12. Increase input standard error for commercial log CPUE. Make the standard error about the same as the standard error for the NWFSC survey log index. Do an SS3 run with extra standard error estimated, but with a lower bound of zero on the extra standard error.

Rationale: Although the extra variance parameter for each CPUE index in the draft base model was estimated, the panel wanted to confirm that input standard errors (SEs) were not influencing final model weighting. Generally, the input standard errors for the commercial CPUE seemed too small given the structural uncertainty associated with the CPUE standardization and method of bootstrapping performed. It seemed reasonable that fishery CPUE should be considered, *a priori*, no more precise than the NWFSC survey.

Results: The petrale STAT provided two runs in response. The first run added the average SE from the NWFSC survey and estimated the added SD. This run was essentially the same as the base model in the draft due to a value of zero estimated for the added SD. Therefore, the STAT did a second run with the maximum SD from the NWFSC survey added to the bootstrapped CPUE SDs and turned off the estimation of the added SD for the commercial CPUEs. Adding the maximum SE to the CPUE index degraded the fit to the index itself, but improved the fit to the length comps. All the other data fits were no different. This sensitivity reduced depletion to 0.275, and the run without extra SE reduced depletion further to 0.248. The bottom line is the addition of extra SE to commercial CPUE did not affect model results much.

Label	Base	NoComm-CPUE	IncCommCPUESd-NWFSCMean-EstExtraSD	IncCommCPUE-NWFSCSurvMax-NoEstExtraSD
TOTAL_like	1459.81		1459.45	1463.58
Survey_like	-74.88		-72.79	-63.91
Discard_like	-142.80	-143.21	-142.89	-143.06
Mean_body_wt_like	-75.83	-75.74	-75.82	-75.79
Length_comp_like	824.41	814.41	822.30	817.80
Age_comp_like	947.77	950.15	948.06	948.89
Parm_priors_like	0.18	0.36	0.21	0.30
SR_BH_steep	0.84	0.85	0.84	0.85
NatM_p_1_Fem_GP_1	0.16	0.15	0.16	0.16
L_at_Amin_Fem_GP_1	15.77	15.88	15.78	15.82
L_at_Amax_Fem_GP_1	54.30	54.26	54.30	54.29
VonBert_K_Fem_GP_1	0.13	0.13	0.13	0.13
CV_young_Fem_GP_1	0.18	0.18	0.18	0.18
CV_old_Fem_GP_1	0.03	0.03	0.03	0.03
NatM_p_1_Mal_GP_1	0.18	0.17	0.18	0.17
L_at_Amin_Mal_GP_1	16.30	16.34	16.30	16.32
L_at_Amax_Mal_GP_1	42.54	42.55	42.54	42.54
VonBert_K_Mal_GP_1	0.21	0.21	0.21	0.21
CV_young_Mal_GP_1	0.13	0.13	0.13	0.13
CV_old_Mal_GP_1	0.05	0.05	0.05	0.05

13. Change CPUE catchability model to include an unconstrained random walk in *q* since trip limits were implemented (since 2006).

Rationale: Trip limits may affect catchability. This is an attempt to apply the same logic/treatment of winter CPUE as summer CPUE. Data informing commercial CPUE indices were filtered to minimize the effect of management actions on the index. Winter indices were developed to include only trawl trips during January-February in waters seaward of 150 fm that were identified as petrale fishing grounds via spatial analysis. While there was agreement that management actions affecting the winter fishery were minimal in comparison to those impacting the summer fishery, two management actions were discussed during the STAR panel that were unable to be considered prior to the STAR panel. First, trip limits for petrale sole were specified for the years 2006-2009 (Table 1). The STAT was asked to explore the effect of these trip limits on the index by allowing time-varying catchability for the years 2006-2009.

Table 1. January-February petrale sole trip limits through 2009 for large footrope gear.

Prior to 2006	**2006**	**2007**	**2008**	**2009**
Unlimited	30,000 lb/mo.	50,000 lbs/2 mo.	40,000 lbs/2 mo.	25,000 lbs/2 mo.

Results: Time-varying unconstrained *q* unsurprisingly fits the CPUE index nearly perfectly, but with little improvement in the likelihood (overfitting) and without improving fits to the other data. Mr. Leipzig, the GAP representative, remarked this was not surprising since trip limits >10,000 lbs/mo. did not seem to affect the fishery; vessels rarely landed more than 10,000 lbs of petrale per delivery.

In addition to trip limits, the vessel buyback program was also discussed during the panel, a factor that had not been previously considered. The STAT therefore did an additional run with a *q* time block in 2006-2009 to address these potential effects (i.e., effort reduction) on CPUE. The Block-*q* run improved overall fits to the interim new base run with input commercial CPUE SEs equal to the bootstrap estimates plus the maximum from the NWFSC survey (total NLL reduced from 1463.58 to 1458.81). The fits improved for length compositions (NLL reduced from 817.8 to 815.0) and the survey index (NLL reduced from -63.91 to -66.68).

After the initial sensitivity runs were conducted, it was brought to the panel's attention that the time block should have been two years earlier, since the buyback was implemented in 2004. The time block for *q* was therefore moved back 2 years to the beginning of the buyback program in 2004. This improved the total NLLs by 4 points relative to the first Block-*q* model. This is the new proposed base model. The depletion is essentially identical to the Block-*q* 2006 model, which is below B_{MSY} (~22.3%).

The magnitude of the survey *q*'s generated much discussion in the 2009 and 2011 assessments of this stock. Values obtained for flatfish stocks off the east coast of Canada are presented in Appendix A. The panel concludes that, although the range provided in Appendix A is large, the value of *q* for petrale sole (3.4) is plausible.

14. Axis of uncertainty should include a range of M values derived from the likelihood profile. Make sure the range of M is wide enough to capture 1.2 NLL units. Verify how this range compares to the interval based on asymptotic normal approximation with Hessian-based standard error.

Rationale: There was a concern that the asymptotic interval was too narrow.

Results: See request 16.

15. Profile full suite of output for new base case.

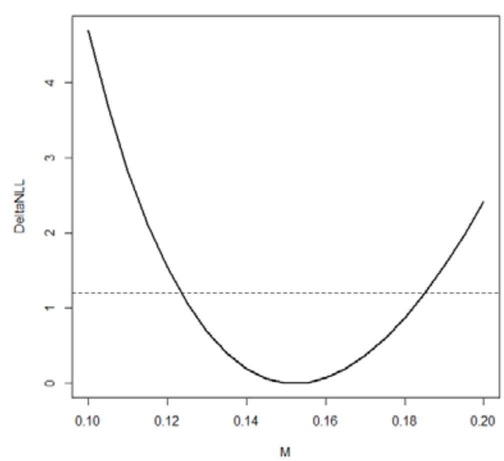
Rationale: Validate new base model outputs.

Results: Various diagnostic plots were presented. The new base model seems to perform well.

16. Rerun likelihood profile for M and update low- and high-M sensitivity runs.

Rationale: Runs requested to bracket the alternative states of nature.

Results: Based on the change of 1.2 NLL units in base model profile, low and high M are set at 0.12 and 0.19, respectively.



17. Projections based on models in request 16 using the catch stream assuming the default ABC buffer (ABC = OFL - 4.4%) and then application of the 25-5 ACL control rule.

Rationale: For constructing the decision table.

Results: The results appeared to show expected behavior and contrast among the states of nature, consistent with the sensitivity analyses previously presented. The panel concluded this decision table structure would be appropriate for management use.

			M low (0.12)		Base		M high (0.19)	
Rule	Year	Catch	SB	Depl	SB	Depl	SB	Depl
ABC 25:5	2015	2827.7	9095.5	0.244	9461.5	0.292	10016.9	0.352
	2016	2922.3	9519.4	0.255	9739.3	0.300	10136.5	0.357
	2017	2894.7	9530.6	0.256	9591.6	0.296	9818.8	0.346
	2018	2819.7	9393.1	0.252	9330.3	0.288	9427.3	0.332
	2019	2750.5	9254.6	0.248	9122.0	0.281	9145.0	0.322
	2020	2708.3	9158.9	0.246	9006.2	0.278	9004.5	0.317
	2021	2692.0	9103.2	0.244	8965.6	0.276	8970.6	0.316
	2022	2691.9	9072.2	0.243	8968.8	0.277	8993.5	0.316
	2023	2698.5	9051.6	0.243	8989.3	0.277	9032.8	0.318
	2024	2705.9	9033.1	0.242	9011.2	0.278	9065.7	0.319

Description of Base Model and Alternative Models Used to Bracket Uncertainty

The final base model assumes a U.S. coastwide stock and uses catch data split by sex, region (north and south), and winter and summer seasons. The catch history starts in 1876. The model estimates separate selectivity curves for each of the commercial fleets (region and season) over several periods with time blocks. The NWFSC survey and the Triennial survey data are used to develop indices of abundance. The model also fits to standardized CPUE indices from winter-north fleets, with an input SE equal to the values estimated via bootstrap of the data plus the maximum input value for the NWFSC shelf-slope survey, and separate catchability parameters for 1987-2003, and 2004-2009. Recruitment dynamics are assumed to follow the Beverton-Holt stock-recruit function. Length compositions and conditional age-at-length data from the surveys are fit, while length and age compositions (appropriately weighted) are fit for the commercial fleets. Discards are estimated. Updated priors are used for natural mortality and steepness.

Summary:
Start year of the model = 1876; one area; two genders; four fishery fleets (north and south, summer and winter, respectively); and discard estimated within the model.

Biology:
Natural mortality (M) for each sex is estimated separately in the model, assuming lognormal prior distributions based on Hamel’s method.
Von Bertalanffy growth, all growth parameters are estimated within the model for females and males separately;
Beverton-Holt stock-recruitment model, steepness (*h*) and recruitment deviations are estimated.

Selectivity:
Asymptotic length-based selectivity for fisheries and surveys.

Abundance indices:
AFSC triennial trawl survey (1980-2004), divided into two time series stratified in 1995;
NWFSC shelf-slope bottom trawl survey (2003-2012);

Winter north commercial CPUE, divided into two time series in 2004.

Length frequencies:
Trawl fisheries;
AFSC triennial trawl survey; and
NWFSC shelf-slope bottom trawl survey.

Age frequencies:
Trawl fisheries; and
NWFSC shelf-slope bottom trawl survey.

The base model estimate for 2013 spawning depletion (SSB_{2013}/SSB_0) is 22.3%. Uncertainty about the state of nature is bracketed by the estimated natural mortality using the likelihood profile. The base model estimate of M (0.15) was varied by 1.2 unit NLL resulting in values of 0.12 and 0.19 for the low and high states of nature, respectively in the decision table.

Comments on the Technical Merits of the Assessment

The petrale sole STAT team was well-prepared, communicated the draft analyses effectively, and provided a thorough response to all requests. The STAR panel discussion and requests focused primarily on better understanding the details of the survey GLMM and fishery CPUE analyses, and on the axis of uncertainty for the decision table. The changes made to the base model during the review were either minor (improving the treatment of the extra SD parameter for the survey) or based on new information/interpretation made available during the panel (treatment of the CPUE series). Both the STAT and STAR panel members agreed that these changes improved the assessment. The panel endorsed the base case model as the best available science for use in determining stock status and management decisions and the decision table results for describing the uncertainty about the base case.

Areas of Disagreement

There were no major areas of disagreement between the STAT and the STAR Panel.

Unsolved Problems and Major Uncertainties

Problems unresolved at the end of the meeting form the basis for some of the research recommendations below. They include uncertainty in catch (historical catch and transboundary issues), biological information (outdated and limited geo-coverage of maturity data), and statistical analyses for abundance indices.

Concerns Raised by the GMT and GAP Advisors During the Meeting

For those sensitivity runs that included no winter commercial CPUE index, the GMT and GAP advisors noted that there is important information in those data that may not be captured in the summer survey. They provided information on regulatory changes and possible effects of the buyback. The latter helped the STAT improve the fits to those data.

Prioritized Research Recommendations

1. The states of California and Oregon have completed comprehensive historical catch reconstructions. Washington historical data are not yet available. Completion of Washington historical catch reconstruction would provide a better catch series.

2. Update both the maturity and fecundity relationships using samples with wider geographic coverage to include California, and from more recent years for petrale sole would be beneficial.

3. Studies on stock structure and movement of petrale sole indicating transboundary movement of petrale sole between U.S. and Canadian waters, particularly with regard to the winter-summer spawning migration. It will be informative to include a time-series plot of fishery catch from Canadian waters in future assessment.

4. Increased collection of commercial fishery age data as well as re-aging any available historical samples from California would help reduce uncertainty. While some recent age data were made available from California, sample sizes could be increased and this data collection needs to continue into the future. Without good age data, the ability to estimate year-class strength and the extent of variation in recruitment is compromised.

5. Where possible, historical otolith samples aged using a combination of surface and break-and-burn methods should be re-aged using the break-and-burn method. Early surface read otoliths should also be re-aged using the break and burn method. Historical otoliths aged with a standard method will allow the further evaluation of the potential impacts of consistent under-aging using surface read methods, changes in selectivity during early periods without any composition information, and potential changes in growth.

6. The effect of the implementation of the IFQ (catch shares) program that began during 2011 on fleet behavior, including impacts on discards, fishery selectivity, and fishing locations, would benefit from further study.

7. The extent of spatial variability on productivity processes such as growth, recruitment, and maturity is currently unknown and would benefit from further research.

8. The Panel appreciated the delta-GLMM approach to derive an index of stock size from commercial CPUE data. However, there may still be factors other than stock size that affect time-trends in the standardized CPUE indices. The panel recommends:
    a. Investigate using effort as an offset in the model. That is, rather than modeling catch/effort = effects, use catch = effort*effects. When a log-link is used then log(effort) can be included as an additive offset, and most GLMM packages include this option. The advantage of this approach is that it is easy to investigate if catch is proportional to effort or not. For example, it may be that CPUE can be higher when effort is low than when effort is high.
    b. Include further consideration of the impacts of trip limits on CPUE. Such limits were gradually introduced since 2006 in the winter fisheries and this may impact

CPUE. This consideration should involve consultations with fleet members to understand how their fishing behavior was affected by trip limits.

Given that this CPUE series will not be extended and, following the changes made for the final base case model, the results showed little sensitivity to its treatment, the STAR panel concluded that additional work on the CPUE standardization should be considered low priority for future petrale assessments.

9. General recommendations for all species:
    a. Recommend that STAT teams present a sensitivity analysis (Tables and Figures) in the draft document for any axis of uncertainty that is likely to be considered for the decision table. This would facilitate efficient discussions during the meeting.

    b. It would be helpful to routinely include a time series of species-specific Canadian (B.C.) landings for comparison with U.S. landings and trends.

    c. The specific treatment and results of model tuning procedures should be reported in the document including all input/output sample sizes, effective sample sizes, sigmas, RMSEs (including recruitment deviations), that are applicable.

    d. For survey GLMM analyses, the STAT teams need to report a standard summary of the raw data, and fitting of the model including both results and diagnostics. Additional research should attempt to identify (and perhaps simulation test) a method for model selection including the error distribution, the treatment of random vs. fixed effects and the inclusion of ECE mixture distributions that can be reliably applied across all species.

    e. Maturity schedules are often largely determined by size and not age. An additional option is needed in Stock Synthesis to allow the modeling of maturity-at-length with an asymptote < 1.0 to reflect atresia or skip-spawning.

    f. General recommendation to identify where and when E.J. Dick's fecundity relationships are better than existing data for a given species.

Appendix A

Some Recent Estimates of *q* for Flatfish Stocks off the East Coast of Canada

The estimated catchability parameters (*q*'s) for survey indices of total stock size (aka swept-area *q*'s) may indicate model misspecification if the estimates fall outside of a reasonable range. That is, if the q's are too low this may indicate the assessment model has overestimated stock size overall, and vice-versa if the q's are too high this may indicate underestimation.

Estimates of q's from recent assessments for some flatfish stocks off the east coast of Canada are provided in Table 2 to help address the feasibility of the petrale sole q estimates. These east coast assessments use many surveys and only the fully selected *q*'s for contemporary surveys are provided. Some *q*'s are derived from age-aggregated production models and are not directly comparable to fully selected *q*'s from age-based models.

Note that catchability will depend on whether the survey covers the entire range of the stock and other factors such as diel variability, age-pattern in *q*, gear type and other configurations that may influence herding, etc. These factors should be considered when comparing *q*'s from different surveys and stocks.

Table 2. Estimates of survey swept-area catchability parameters (*q*'s) from recent assessments for some flatfish stocks off the east coast of Canada.

<table>
<tr><th>Stock</th><th>Area</th><th>Source</th><th>Model-type</th><th>Survey</th><th>q estimate</th></tr>
<tr><td rowspan="3">American plaice (Hippoglossoides platessoides)</td><td rowspan="2">Grand Banks (NAFO Divs. 3LNO)</td><td rowspan="2">Rideout et al. (2011)</td><td rowspan="2">Age-based ADAPT</td><td>Spring</td><td>6.16</td></tr>
<tr><td>Fall</td><td>9.51</td></tr>
<tr><td>South coast of NL (NAFO SubDiv. 3Ps)</td><td>Morgan, Dwyer, and Shelton (2013)</td><td>Bayesian production model</td><td>Spring</td><td>2.2</td></tr>
<tr><td rowspan="3">Yellowtail Flounder (Limanda ferruginea)</td><td rowspan="3">Grand Banks (NAFO Divs. 3LNO)</td><td rowspan="3">Parsons et al. (2011)</td><td rowspan="3">ASPIC production model</td><td>Spring</td><td>3.23</td></tr>
<tr><td>Fall</td><td>3.31</td></tr>
<tr><td>Spanish</td><td>1.29</td></tr>
<tr><td>American plaice (Hippoglossoides platessoides)</td><td>Southern Gulf of St. Lawrence (NAFO Div. 4T)</td><td>Morin and LeBlanc (2012)</td><td>Age-based* ADAPT</td><td>Summer</td><td>0.912</td></tr>
</table>

*A model with relatively high natural mortality (M) parameters

References

Morgan, M.J., Dwyer, K.S., and Shelton, P.A. 2013. Reference points and assessment update for American Plaice (*Hippoglossoides platessoides*) in NAFO SA2 + Div. 3K and Subdiv. 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/152. iii + 64 p.

Morin, R., et LeBlanc, S.G. 2012. Évaluation de la plie canadienne (*Hippogolossoides platessoides*) du sud du golfe du Saint-Laurent (division OPANO 4T). Secr. can. de consult. sci. du MPO. Doc. de rech. 2012/099. iv + 35 p.

Parsons, D. M., Morgan, M. J., Brodie, W. B., & Power, D. Serial No. N5918 NAFO SC SCR 11/033 SCIENTIFIC COUNCIL MEETING–JUNE 2011.

Rideout, R. M., Morgan, M. J., Parsons, D. M., Brodie, W. B., Healey, B. P., Power, D., & Dwyer, K. S. Serial No. N5917 NAFO SC SCR 11/032 SCIENTIFIC COUNCIL MEETING–JUNE 2011.

(**Entire Document Electronic Only**)

Agenda Item F.5.a
Attachment 8
June 2013

DRAFT

Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas as evaluated for 2013

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EXECUTIVE SUMMARY

Stock

This update of the 2011 stock assessment of the bocaccio rockfish (*Sebastes paucispinis*) reports the best estimate of bocaccio abundance and productivity off of the west coast of the United States, from the U.S.-Mexico border to Cape Blanco, Oregon (representing the Conception, Monterey and Eureka INPFC areas). This update conforms to the strict definition of an update as defined by the PFMC terms of reference, with respect to updating the 2011 model.

Catches

Bocaccio rockfish have long been one of the most important targets of both commercial and recreational fisheries in California waters, accounting for between 25 and 30% of the commercial rockfish (*Sebastes*) historical catch over the past century. However, this percentage has declined in recent years as a result of stock declines, management actions and the development of alternative fisheries. Since 2002 catches have generally been less than 200 tons per year, with the largest fraction of catches coming from the southern California recreational fishery.

Table E1. Recent catches (in metric tons) of bocaccio rockfish south of Cape Blanco

	Trawl south of 38° N	Trawl north of 38° N	Hook and line	Setnet	Rec south of 34.5° N	Rec north of 34.5° N	Total (S. of 43 ° N)
1999	19.00	53.00	26.00	20.70	7.20	71.00	196.90
2000	13.50	60.00	6.60	7.00	0.70	52.00	139.80
2001	9.20	49.00	4.40	7.80	0.90	60.00	131.30
2002	28.04	20.67	0.13	0.01	35.88	4.93	89.66
2003	5.07	0.31	0.00	0.00	5.53	1.87	12.78
2004	13.86	3.52	1.84	0.21	63.43	2.27	85.13
2005	24.64	0.43	1.50	0.17	69.90	10.70	107.34
2006	16.09	0.31	2.25	0.25	29.00	11.80	59.70
2007	4.06	1.58	3.39	0.38	44.20	8.92	62.53
2008	0.42	1.98	2.02	0.08	31.50	3.33	39.33
2009	1.12	4.85	1.50	0.03	40.30	9.70	57.50
2010	2.90	10.97	1.45	0.05	50.07	6.54	71.97
2011	1.30	4.93	2.39	0.01	99.26	4.06	111.95
2012	12.89	48.81	1.10	0.01	119.08	5.65	187.54

Data and Assessment

The last full assessment of bocaccio rockfish was done in 2009 using the SS3 assessment model, with an update (including several substantive model structural changes) in 2011. This update extends the time series included in that model for the CalCOFI larval abundance survey, the NWFSC Southern California Bight hook and line survey, the NWFSC combined trawl survey, the SWFSC juvenile abundance survey, and the power plant impingement index. No new length frequency data are available for commercial fisheries, however new length frequency data are available and included for southern and central/northern California recreational fisheries. An index for the recent (2003-2011) southern California recreational fishery was developed and included in the model documentation, but was not included in the model.

In the 2011 update it was found that the length composition data from the 2010 NWFSC trawl survey was dominated by small (Young-of-the-Year, YOY) individuals, which had an overly strong influence on the model results in the initial (pre-review) models. As a result, a narrow range of analyses were recommended by the SSC to address how best to address the potential magnitude of this year class. Ultimately, the STAT proposed a model in which it is assumed that the bottom trawl survey does not provide an accurate index of age 0 abundance. The index and associated length composition data were revised to remove age 0 fish (fish smaller than 22 cm), and age selectivity was fixed to be non-selective for age 0 fish. Additionally, in order to account for what appeared to be several strong incoming year classes at that time (2009, 2010), the 2011 model included an index of YOY abundance derived from southern California power plant impingement survey data. This index extends nearly 30 years, and was found to have a strong correlation with the model estimated recruitment time series, the index remains in this update.

Stock spawning output

For this update, trends in abundance and historical recruitment are only modestly changed from the 2009 and 2011 model results. The final result is nearly identical through the 2011 period, but is slightly more optimistic with respect to current (2013) depletion due to the increased estimated year class strength of the 2009 and 2010 year classes (31.4%, relative to ~28% in the 2011 update). These year classes were strongly evident in recreational length frequency data, in the NWFSC hook and line survey data (and length comps), in the power plant impingement dataset and in an index (not included) of recreational CPUE. However, the NWFSC combined trawl survey index continued to decline, suggesting that somehow fish were less available to this survey (although the length composition data from this survey also capture strong 2009 and 2010 year classes).

The most recent (2011) point in the CalCOFI index was comparable to a (recent) relative high point (2008), with the overall trend from this survey over the past ~5 years is relatively flat. This is to be expected as this index reflects spawning output, and thus does not yet capture the presumed increase in spawning output that will be associated with the strong 2009 and 2010 year classes. As these year classes mature, the stock spawning output is predicted to increase substantially, with the base model projection (under the assumption of the rebuilding SPR of 0.777) indicating that the stock is likely to be rebuilt by 2015 (expected to be ~43% of unfished spawning output).

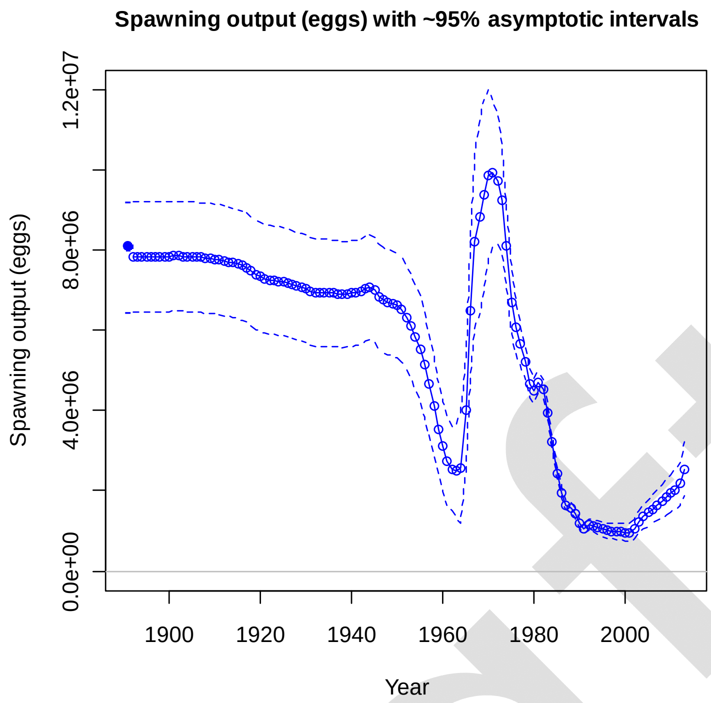


Figure E1. Estimated spawning output time series (1892-2013) for the base case, with approximate 95% confidence interval.

Table E2. Recent trends in estimated spawning output and relative depletion level

Year	Spawning output (10^9 larvae)	CV Spawning output	Depletion	Confidence interval depletion (~95%)
1999	975	0.11	12.01%	(0.093 - 0.146)
2000	961	0.11	11.84%	(0.091 - 0.145)
2001	956	0.12	11.78%	(0.09 - 0.145)
2002	1053	0.12	12.97%	(0.099 - 0.16)
2003	1233	0.12	15.19%	(0.116 - 0.187)
2004	1373	0.12	16.92%	(0.129 - 0.208)
2005	1454	0.12	17.91%	(0.136 - 0.221)
2006	1541	0.12	18.98%	(0.144 - 0.235)
2007	1644	0.12	20.25%	(0.153 - 0.251)
2008	1745	0.12	21.49%	(0.162 - 0.267)
2009	1850	0.12	22.78%	(0.171 - 0.283)
2010	1936	0.12	23.85%	(0.179 - 0.297)
2011	2022	0.13	24.91%	(0.186 - 0.311)
2012	2176	0.13	26.81%	(0.199 - 0.336)
2013	2551	0.13	31.43%	(0.231 - 0.396)

Recruitment

Recruitment for bocaccio is highly variable, with a small number of year classes tending to dominate the catch in any given fishery or region. Recruitment appears to have been at very low levels throughout most of the 1990s, but the 1999 year class was the highest since 1988, and led to a substantive increase in abundance during the early 2000s. Several year classes of moderate strength (2003, 2005) occurred in the mid-2000s, and two recent very strong year classes (2009 and 2010) are now estimated to be comparable to (2009) and roughly double (2010) the size of the 1999 year class. These strong year classes are already estimated to have resulted in an increase in abundance and spawning output, and should propel the stock spawning output to target levels by approximately 2015 as the 2010 year class continues to grow and mature. Preliminary estimates from the juvenile rockfish survey also indicate very strong abundance of young-of-the-year rockfish of many species (including bocaccio) in 2013, suggesting anecdotally that 2013 will also be a strong recruitment year for bocaccio, as well as for other species. However, these data are not yet incorporated into the 2013 update, which only includes data through 2012. Estimated recruitments and model derived confidence intervals for 1999 to 2012 recruitments are shown in Table E3 and Figure E3.

Table E3. Estimated recruitment with 95% confidence interval, 1999-2012

	Recruits (1000s)	CV Recruitment	Confidence interval recruitment (~95%)
1999	6690	0.12	(5024 - 8354)
2000	274	0.36	(74 - 474)
2001	249	0.36	(71 - 425)
2002	942	0.19	(581 - 1302)
2003	3302	0.14	(2408 - 4195)
2004	425	0.29	(177 - 672)
2005	3191	0.14	(2277 - 4103)
2006	927	0.24	(484 - 1369)
2007	1844	0.17	(1203 - 2484)
2008	2071	0.18	(1328 - 2813)
2009	5074	0.16	(3422 - 6725)
2010	14000	0.16	(9469 - 18529)
2011	2252	0.34	(736 - 3767)
2012	1881	0.60	(0 - 4156)

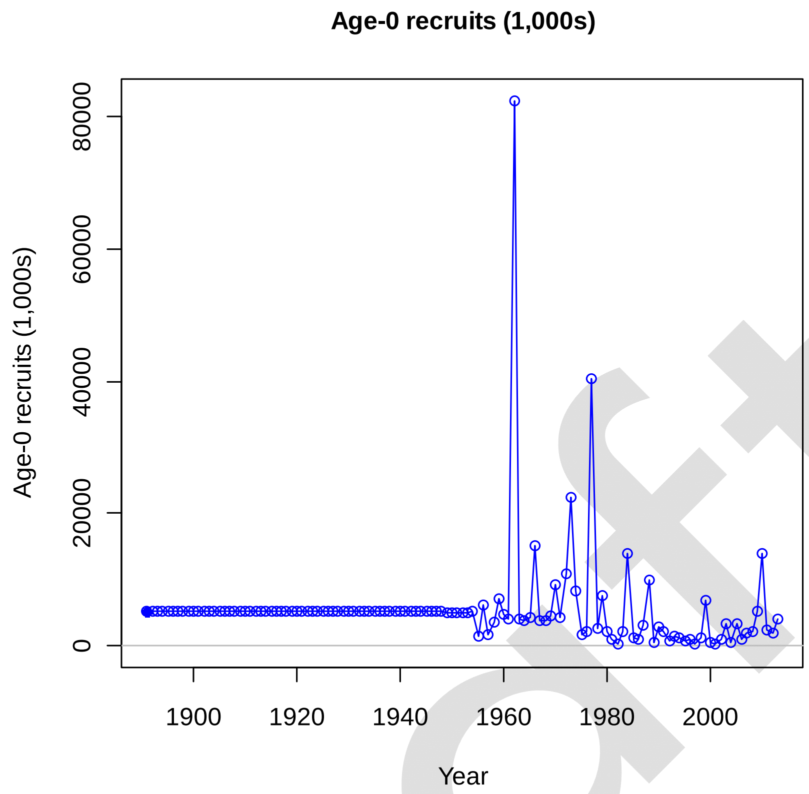


Figure E3. Estimated recruitment of bocaccio rockfish from 1892-2013

Reference Points

Reference points are presented in Table E4, including the unfished summary biomass, unfished spawning output, mean unfished recruitment, the proxy estimates for MSY based on the $SPR_{50\%}$ rate, the fishing mortality rate associated with a spawning stock output of 40% of the unfished level, and MSY estimated based on the spawner/recruit relationship. Reference points did not change substantively from previous estimates, although the slightly higher estimate of h in this update is reflected in slightly higher estimates of MSY and the MSY proxies. As with earlier models, the difference between the estimated MSY (1378) and the proxy MSY reference points (1341-1347) is minimal, despite a substantial decline in the SPR and spawning output associated with the estimated MSY value.

Table E4. Summary of reference points for bocaccio rockfish from the base model

Unfished Stock	Estimate	~ 95% Confidence Limits Lower	Upper
Summary (1+) Biomass (tons)	45476	37435	53517
Spawning Output (* 10^9)	8118	5302	10934
Equilibrium recruitment	5169	3370	6968

	Yield reference Points		
	$SSB_{40\%}$	SPR proxy	MSY est.
SPR	0.494	0.500	0.428
Exploitation rate	0.068	0.067	0.084
Yield (tons)	1347	1341	1378
Spawning output (x10^9)	3247	3307	2614
SSB/SSB_0	0.4	0.41	0.32

Exploitation Status

The 2013 spawning output is estimated to be at 31% of the unfished spawning output, and exploitation rates are estimated to have ranged from 0.04 to 0.08% over the past five years, with corresponding SPR ratios of approximately 0.11 to 0.21 of the default SPR of 0.5. (Table E5, Figures E5-E6).

Table E5. Base model estimated exploitation rate and spawning potential ratio (SPR)

Year	Total catch	Exploitation rate	SPR rate (rel. to 0.5)
1999	213	0.219	0.69
2000	160	0.167	0.55
2001	139	0.145	0.39
2002	90	0.085	0.21
2003	13	0.010	0.03
2004	85	0.062	0.19
2005	107	0.074	0.23
2006	60	0.039	0.13
2007	63	0.038	0.13
2008	59	0.034	0.11
2009	58	0.031	0.11
2010	75	0.039	0.14
2011	112	0.055	0.16
2012	188	0.086	0.21

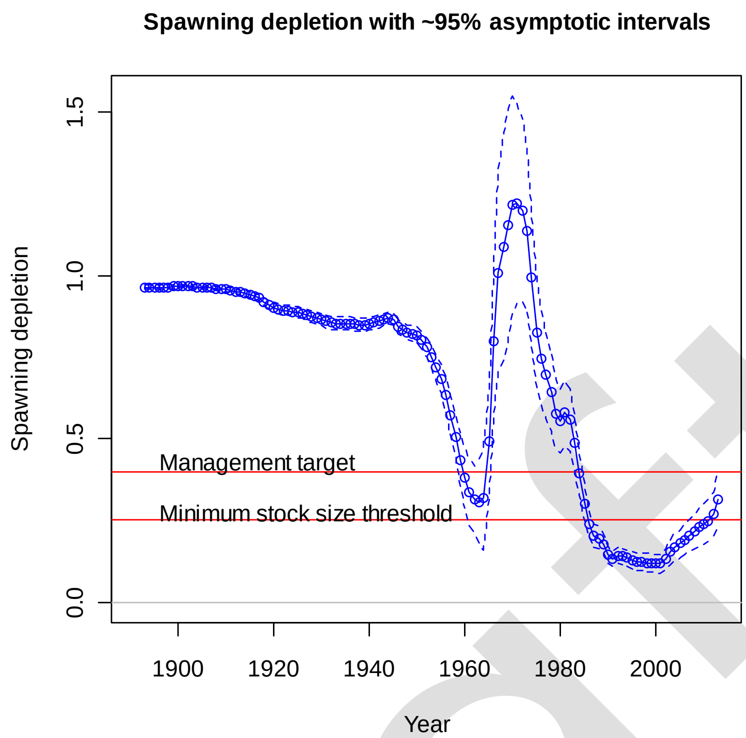


Figure E4. Time series of estimated depletion level of bocaccio from the STAT base model

Management Performance and forecast

Bocaccio rockfish were formally designated as overfished in March of 1999, and the OY/ACL has ranged from 218 to 337 tons since 2003 (Table E6), with actual catches (including discards) estimated to be less than half of that amount in most years. The current forecast is for sustained progress towards rebuilding as a result of the 2009 and 2010 year classes; under the deterministic projection from the base model, the stock is anticipated to rebuild in 2015.

Table E6. Management performance

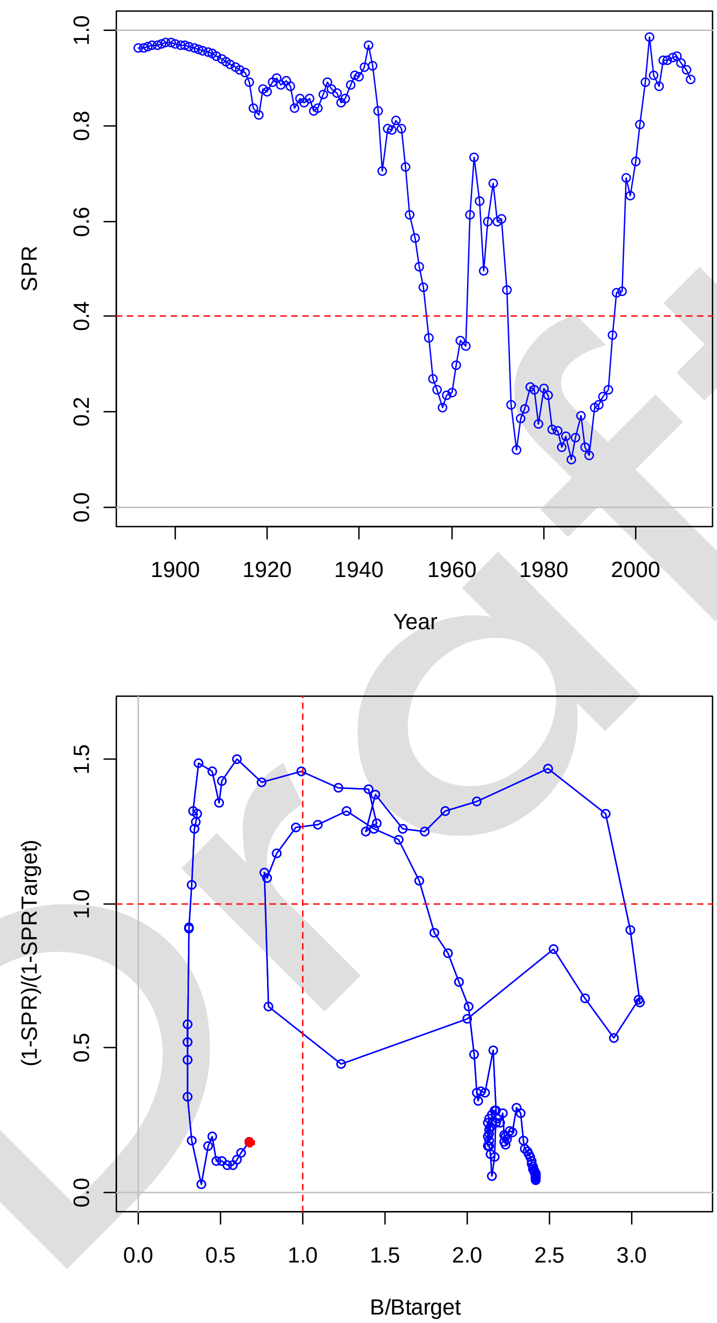
	Catch	ABC	OFL	OY/ACL
2003	12.78	244		20
2004	85.13	400		199
2005	107.34	566		307
2006	59.7	549		306
2007	62.53	602		218
2008	39.33	618		218
2009	57.5	793		288
2010	75.36	793		288
2011	111.95	737		263
2012	187.54	732		274
2013		845	884	320
2014		842	881	337

Table E7. Forecast of bocaccio ACL and OFL, with depletion estimates associated with each catch stream (ACL based on the SPR= 0.777, OFL is based on SPR=0.5, beginning 2015)

	SPR= 0.777 catches	Projected depletion with SPR= 0.777	OFL catches	Projected depletion with SPR= 0.50
2013	320	0.314	321	0.314
2014	337	0.377	338	0.377
2015	547	0.426	1536	0.426
2016	537	0.459	1437	0.441
2017	537	0.486	1379	0.449
2018	543	0.510	1348	0.454
2019	553	0.531	1332	0.457
2020	563	0.550	1321	0.457
2021	573	0.566	1314	0.457
2022	582	0.581	1309	0.456
2023	591	0.595	1305	0.454
2024	599	0.607	1301	0.452

Unresolved problems and major uncertainties

A major uncertainty for the 2011 update was the relative magnitude of the incoming 2010 year class. There is considerably greater certainty, as evidenced from several sources (impingement dataset, recreational length composition, NWFSC hook and line survey, CPFV CPUE indices that are not used in the model) that this year class is indeed very strong and is likely to see the stock to a rebuilt status as it matures. However, the extent to which this year class may be a largely "southern California" event, and the extent to which rebuilding is taking place in central and northern California waters, remains unclear. The ongoing pessimistic result of the NWFSC trawl survey index, which appears to be driven largely by a declining incidents of catches and catch rates in central and northern California waters, is cause for some concern with respect to abundance trends north of Point Conception. Similarly, as discussed in the 2009 assessment and the 2011 update, the CalCOFI data suggest that bocaccio abundance is relatively high levels within the Cowcod Conservation Areas (CCAs), and likely relatively lower levels outside of those areas, leading to concerns regarding the accuracy of indices based solely on effort expended outside of the CCAs. Thus, despite the largely optimistic outlook suggested by recent data and this update assessment result, the extent of spatial heterogeneity in abundance and abundance trends remains one of the most substantive problems in assessing status and trends for this stock.



Figures E5- E6. Spawner potential ratio (SPR) over time (top), with reference proxy for Sebastes (note reference should be 0.5, plotting has bug) and phase plot of SPR rate plotted against SSB, against target levels (bottom).

Decision Table

In the 2011 update, which faced a unique challenge related to uncertainty regarding the relative strength of the 2010 year class, the decision table was not comparable to the decision table from the 2009 assessment. The 2011 update instead bracketed optimistic and pessimistic results with respect to the relative strength of the 2010 year class. However, as the strength of this year class is considerably more resolved in this model, the decision table for this update is structured analogously to that in the 2009 assessment, with optimistic and pessimistic states of nature bracketing the base model derived from the relative weighting of two "optimistic" indices (the Southern California recreational CPUE index and the CalCOFI larval abundance time series) and two "pessimistic" indices (the trawl logbook time series and the triennial trawl survey time series). In the resulting (deterministic) projections, the 2013 and 2014 catches are set to the adopted 2013 and 2014 ACL's, and the 2015-2024 catches are set based on a projection of the current rebuilding SPR (0.777) for each of those scenarios. Additionally, a run with catches set at the OFL levels beyond 2014 is included for each of the three states of nature. Under the base model, the stock is projected to rebuild by 2015 (depletion of ~43%), while under the "optimistic" scenario the stock is estimated to have rebuilt in 2013. However, under the pessimistic scenario with base model catches, the stock is not anticipated to rebuild until 2022.

Research and Data Needs

Since large scale area closures and other management actions were initiated in 2001, the spatial distribution of fishing mortality has changed over both large and small spatial scales. Not only has this effectively truncated several abundance indices (recreational CPUE), this confounds the interpretation of survey indices for surveys that do not sample in the Cowcod Conservation Areas (CCAs), as insights from larval surveys suggest that the greatest abundance of bocaccio is found in that area. This, in turn, infers that fishing mortality is greater on the fraction of the stock currently outside of the CCAs. The declining trend in the NWFSC trawl survey index, which is inconsistent with trends observed in the CalCOFI index, the NWFSC hook and line survey index, the impingement time series, and a recently developed (but not included in this update) recreational CPUE index are cause for some concern, and may reflect a reduced rate of rebuilding and stock recovery in central and northern California waters. Other research and data needs are unchanged from the 2009 assessment. Recently, some progress has been made in developing age reading criteria for bocaccio, and age data are expected to be available for the next full assessment.

Table E8: Decision Table for the bocaccio update

Pessimistic catches		Pessimistic model	Base model	Optimistic model
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	324	0.27	**0.43**	**0.56**
2016	329	0.30	**0.46**	**0.61**
2017	341	0.32	**0.49**	**0.64**
2018	357	0.34	**0.52**	**0.67**
2019	374	0.36	**0.55**	**0.70**
2020	391	0.39	**0.57**	**0.72**
2021	407	**0.41**	**0.59**	**0.74**
2022	422	**0.43**	**0.61**	**0.76**
2023	436	**0.45**	**0.63**	**0.77**
2024	449	**0.47**	**0.65**	**0.78**
Base model catches		State 1	Base	State 2
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	547	0.27	**0.43**	**0.56**
2016	537	0.29	**0.46**	**0.60**
2017	537	0.31	**0.49**	**0.63**
2018	543	0.33	**0.51**	**0.66**
2019	553	0.34	**0.53**	**0.68**
2020	563	0.36	**0.55**	**0.70**
2021	573	0.38	**0.57**	**0.71**
2022	582	**0.40**	**0.58**	**0.73**
2023	591	**0.42**	**0.59**	**0.74**
2024	599	**0.44**	**0.61**	**0.74**
Optimistic catches		State 1	Base	State 2
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	632	0.27	**0.43**	**0.56**
2016	613	0.29	**0.46**	**0.60**
2017	603	0.30	**0.48**	**0.63**
2018	600	0.32	**0.50**	**0.66**
2019	601	0.34	**0.52**	**0.68**
2020	603	0.35	**0.54**	**0.69**
2021	605	0.37	**0.56**	**0.70**
2022	608	0.39	**0.58**	**0.71**
2023	610	**0.41**	**0.59**	**0.72**
2024	612	**0.42**	**0.61**	**0.73**
OFL catches (>2014)		State 1	Base	State 2
2013	*321*	0.20	0.31	**0.42**
2014	*338*	0.21	0.38	**0.47**
2015	1536	0.22	**0.43**	**0.51**
2016	1437	0.21	**0.44**	**0.53**
2017	1379	0.21	**0.45**	**0.54**
2018	1348	0.21	**0.45**	**0.55**
2019	1332	0.21	**0.46**	**0.55**
2020	1321	0.21	**0.46**	**0.55**
2021	1314	0.21	**0.46**	**0.56**
2022	1309	0.21	**0.46**	**0.56**
2023	1305	0.21	**0.45**	**0.56**
2024	1301	0.21	**0.45**	**0.56**

INTRODUCTION

This update of the 2011 stock assessment meets the terms of reference for an update, as there have been no significant changes to the model structure or data sources, and the results of this update are highly consistent with those in the 2011 and 2009 assessments. However, this update tracks the model structure of the 2011 assessment, which despite being generally an update, included several modest structural changes in order to avoid what the STAT found to be unrealistic results from the traditional update. The "unrealistic" result was an extremely strong 2010 year class inferred from the length frequency data of the NWFSC combined trawl survey. Although there were then (and are now) multiple signs of strong recruitment for bocaccio in 2009 and 2010 the magnitude of the 2010 recruitment estimate in the "strict" (terms of reference) 2011 model was essentially unprecedented and considered to be implausible by the STAT. As a result, in the final 2011 model, which was reviewed during the "mop-up" panel, the STAT excluded age 0 bocaccio from the NWFSC trawl survey index (fixing age selectivity for age 0 fish at 0, and excluding fish smaller than 22 cm from the length composition data). The STAT then added a time series of pre-recruit (age 0) abundance data which had been used in past assessments, the power plant impingement dataset. This update does not include the background information provided in the full 2009 assessment, for which the 2009 assessment should be referred to (Field et al. 2009). Moreover, dataset descriptions, diagnostics and model fits are included only for time series that were extended in this update, as the model results and fits through the year 2009 change only modestly for these datasets.

DATA

Fishery Dependent Data

Commercial and Recreational catches

Commercial bocaccio catch estimates were updated from 2010 through 2012 based on the NWFSC total mortality reports for 2011, and GMT scorecard estimates for 2012, consistent with the means by which catches were estimated in the 2011 update (Tables 1-2, Figure 1). A more rigorous evaluation of bycatch data and rates by gear type and region should be undertaken in the next full assessment.

Commercial Length Frequency Compositions

The number of length observations from commercial fisheries sources are inadequate to include as length composition information in this update. Consequently, no new commercial length frequency data are included in the update (as was the case in the 2011 update). Length frequency information of discards from the observer program was not incorporated in the 2009 assessment, and thus is not included in this update.

Recreational Length Frequency Data

New recreational length frequency data area available from the CRFSS monitoring program (accessed from the RecFIN website) for 2011-2012. The total number of clusters, fish sampled, and initial effective sample sizes are presented as Table 3, and the length compositions for 2011 and 2012 (as well as the average from 2008-2010) are presented as Figure 2. The southern recreational fisheries data are strongly indicative of a moderately strong 2009 year class and a very strong 2010 year class, there are some hints of the same in the central/northern fisheries data, but to a lesser degree (and there are less overall samples available).

Fishery-Dependent Indices

None of the fishery-dependent indices (trawl or recreational CPUE) were updated for this assessment as all of the time series have been effectively truncated by management actions. However, for exploratory purposes a recreational CPUE index was developed by Melissa Monk (FED, CSTAR/UCSC) based on data from the California Department of Fish and Wildlife (CDFW) Onboard Observer Program (1999-2011). The methods used are described in more detail in the data moderate assessment document and supporting documentation, as they are comparable to those used to develop indices of relative abundance for those assessments, but are summarized here for reference. Discussion of this index was included to provide some additional context for interpretation of the inconsistencies between the various indices that are included in the base model.

Data were analyzed at the drift level and catch was taken to be the sum of observed retained and discarded fish. Trips and drifts outside of U.S. waters, or in which 70% or more of the observed catch was not bottomfish, were excluded, as were those deeper than 60 fathoms (due to depth restrictions), those in conservation areas, those in San Diego Harbor, those missing both starting and ending location (latitude/longitude), and those identified as having possible erroneous location or time data. Fishing time and number of observed anglers were limited to include 95% of the data to remove potential outliers. Remaining drifts were between 5 and 119 minutes and observed anglers between 4 and 19 persons.

The following methods were applied to identify regions of suitable habitat, and to determine the number of drifts to include in the analysis. The locations of positive encounters were mapped, using the drift starting locations. Regions of suitable habitat were defined by creating detailed hulls (similar to an alpha hull) with a 0.01 decimal degree buffer around a location or cluster of locations (Data East 2003). Any portion of a region that intersected with land was removed. As an example of the buffers, a region with only one positive encounter has an ellipsoid area of 3.22km^2. Each drift (both positive and zero-catch) was assigned to the region with which it intersected. Drifts that did not intersect with a region were considered structural zeroes, i.e., outside of the species habitat, and not used in analyses.

To develop an index more directly comparable to the NWFSC hook and line survey, a second filter was applied to identify the common areas between the CDFW Onboard Program and that survey. Areas defined within the CDFW Onboard Program were retained if they intersected with or were within 2km of a fixed NWFSC Hook & Line Survey fixed station. To ensure suitable sample sizes and to test for YEAR:REGION interactions, the buffered areas were then aggregated into 2 regions; 1) Coastal locations north of San Pedro and 2) Coastal locations south of San Pedro. Data from the months of January and February were removed due to low sample sizes, as well as data from the year 1999. Data from 2003 were also removed because the bocaccio fishery was closed. Abundance was measured as catch per angler hour, and the distribution for positives was lognormal (which was strongly favored over gamma by a delta AIC). The binary model used a logit transformation which was which was indistinguishable from the alternatives. The resulting year effects index is shown as Figure 3, and although not used in this assessment, this index should be considered for inclusion in the next full assessment for this stock.

Fishery-Independent Data

CalCOFI larval abundance data

The CalCOFI larval abundance time series was updated with a small number of observations from (late) 2010, and new observations for all of 2011 (n= 243 n positives = 21, Table 4). Data for 2012 are not yet available. The index was developed with the same approach adopted in the past assessment, a delta-GLM model with the main (fixed) effects of interest being year (adjusted to spawning season), month and line-station effects. These estimates and the associated standard errors estimated from a jackknife routine were used in the model as a relative index of population spawning output (Figures 4). The year effects through 2010 were virtually identical from the most recent GLM results, the 2010 data point is little changed from the 2011 update, and the new datapoint for 2011 represents a return to approximately the 2008 high point for the recent period. As the 2009 and 2010 year classes were presumably not mature and spawning by 2011, we did not expect to see a dramatic increase for the 2011 datapoint. However, we would anticipate that 2012 and 2013 larval abundance indices should begin to reflect a substantive increase in spawning biomass as the 2009 and 2010 year classes mature.

Northwest Center Trawl Survey

The Northwest Fishery Science Center has conducted combined shelf and slope trawl surveys since 2003, based on a random-grid design from depths of 55 to 1280 meters. Additional details on this survey and design are available in the abundance and distribution reports by Keller et al. (2008, 2013). Bocaccio CPUE (kg/ha) and negative tows (in depths less than 350 m) for age 1+ catches pooled over all years (2003-2012) are shown as Figure 5a and b; catches of age 1+ fish for 2011 and 2012 are shown in Figures 6-7, and catches of age 0 abundance in 2011 and 2012 (which were excluded from the GLMM index) are shown in Figures 8-9. Additional data on the number of tows, number of positive tows, number of length measurements and mean CPUE rates by depth and INPFC area are provided in Tables 5. As in 2010, the 2012 survey encountered large numbers of young-of-the-year (YOY) rockfish in the northeast part of the Southern California Bight, suggesting both that 2012 may also be a strong year class, and that continuing the approach adopted in the 2011 update (excluding age 0 fishes) is likely to be a reasonable approach for model stability.

The 2009 assessment used a GLMM approach for the development of a relative abundance index (using standard depth strata and area, as well as year, as factors), this index was updated with the latest catch data. However, the GLMM package (based in R) has also been updated by NWFSC staff, and this updated package was used to develop an index for this assessment. This was necessary, as the package used in the 2011 assessment to develop the index could not be loaded into newer versions of R, and attempts to align the most appropriate R versions and packages with this software were not successful. The STAT does not consider this a major concern, as past updates have used new GLMM code (although this practice has also been questioned by the SSC), and as the year effects estimated in the recent package closely align with those from the index developed for the 2011 update. However, there was a difference in the model-estimated error around the index estimates. Specifically, the CV in the most recent GLMM was considerably greater (approximately 2.1, relative to approximately 0.4 in the last GLMM), representing a potentially significant change in the model. To account for this, the variance adjustment was tuned as to give the 2013 index the same model variance as used in the 2011 update for the first iteration of the model that included this dataset, and this was adjusted in the final variance adjustment stage. The model was relatively insensitive to this change, however, as the abundance of other time series, most of which are inconsistent with this time series, has traditionally led to a poor fit to the index trends for this index.

NWFSC Southern California Bight hook-and-line survey

The NWFSC hook and line survey (Harms et al. 2008, 2010) was used to develop an updated CPUE index by NWFSC staff (J. Harms and J. Wallace, pers. com.). The extended index (Figure 11a) and associated length frequency data (Figure 11b) are used in the model. The index suggested a slight decline from 2004-2008 in the last assessment, a steeper decline from 2009-2010, and a sharp increase in 2011-2012, for which both points are above all previously observed values. The length frequency data for 2011 and 2012 are highly consistent with a strong 2009 and very strong 2010 year class. As with the trawl survey index, the hook and line survey index does not include sampling in the Cowcod Conservation Areas where much of the spawning biomass of bocaccio is thought to reside.

Recruitment Indices

Two young-of-the-year (YOY) recruitment indices were used in the 2009 bocaccio assessment: the coastwide midwater trawl survey index (2001-2008) and a recreational pier fishery CPUE index that included historical data from the 1950s and 60s. The coastwide midwater trawl survey index was updated by K. Sakuma and S. Ralston, documentation of the update is included as Appendix A of this assessment. Only one new datapoint is available, as the 2011 survey coverage was limited, precluding the development of a coastwide index. Although the 2010 estimated recruitment was the highest in the coastwide time series, the 2012 data point was among the lowest. However, prelimary data from the 2013 survey suggest a very strong year class (of multiple species), with catch rates in the "core" survey area the second highest on record, and catch rates of bocaccio higher than they have been since the late 1980s (e.g., the 1984 and 1988 year classes). These data are not yet included in the assessment, but are anecdotally encouraging. Although the pier fishery index was updated in the 2011 update, there are insufficient data to update that index for this assessment.

A third juvenile index, based in power plant impingement data, had been used in previous assessments, and as discussed earlier was included in the 2011 model. This index represents data collected from coastal cooling water intakes at Southern California electrical generating stations from 1972 to the present, and have been previously described by Love et al. (1998), Miller et al (2009), and Field et al. (2010) with respect to trends in abundance of *Sebastes* species, queenfish (*Seriphus politus*), and bocaccio respectively. The dataset includes observations on as many as 1.8 million fish (off all species) encountered during heat treatments of water taken in intakes for cooling southern California power plants. Although the frequency of all of these sampling methods is irregular over the 28 year time series, as a result of changes in operating schedules, regulatory requirements and changes in ownership over time, the time series is uninterrupted at the annual scale from 1972-2012. Table 9 shows the sample sizes (number of observations), number of positive observations, and the year effects index with associated CV from a Delta-GLM as described in the 2011 assessment. The index is shown in Figure 11, together with recruitment estimates from the 2009 model (which did not include the index), for which the index compared very well (R^2 of 0.60 based on log scale). In contrast to the juvenile trawl survey index, the power plant index estimates strong recruitment in 2012, which are also suggested in the catches of age 0 bocaccio in the trawl survey (noting that these are not included in the model). Preliminary results for both the trawl survey and the impingement survey suggest very large numbers of young-of-the-year (YOY) bocaccio in 2013 as well.

Model Description

Modeling software

The 2009 assessment used the Stock Synthesis 3 (SS-V3.03A) modeling framework developed by Dr. Richard Methot (Methot 2009a; Methot 2009b). The 2011 assessment used version 3.20b, in order to better take advantage of the R4SS graphing package developed by the NWFSC, this assessment maintained the use of that version.

Base model results

The basic model outputs and likelihood values corresponding to the sequential addition of new data (as well as corresponding to the 2009 and 2011 results) are reported in Table 7. Most of the additional data had only modest impacts on overall model trends and results, with the more optimistic data (e.g., recent high data points in CalCOFI, strong year classes inferred in recruitment indices) having a slightly pessimistic result on relative status, as a consequence of the scaling downward of earlier recruitments. However, all of the new data were consistent with a (very slightly) more optimistic estimation of steepness (from 0.595 to 0.614) relative to the 2011 model (noting that the 2009 model had a point estimate of 0.573). Despite these modest changes, the overall trajectory of spawning output, relative spawning output, total biomass and recruitment are barely distinguishable as changed from the 2011 model (Figures 15-16), with the most important change being the relative strength of the 2010 year class.

A summary of the available data by type and year is included as Figure 17. Selectivity curves for all surveys and fisheries are shown in Figure 18-19. Fits to the updated relative abundance indices (CalCOFI, the NWFSC hook and line index, the NWFSC trawl survey index, the juvenile trawl survey index, the pier fishery CPUE index and the impingement index) are shown in Figures 20-24, in both arithmetic and log space, including plots of the observed vs. predicted values. Fits to the truncated time series (trawl CPUE, triennial survey and the recreational CPUE indices) are not included as they are essentially unchanged from the 2009 assessment. Note that the fits to the NWFSC trawl survey index are very poor. These indices estimate a declining trend in abundance while the model (based on CalCOFI, the hook and line survey, and other indices) estimates an increasing trend. These inconsistencies relate directly to what the STAT considers to be the greatest uncertainties and data needs; a better appreciation for the selectivity and catchability of bocaccio related to the trawl survey, which should not be assumed to fish bocaccio habitat adequately, and reconciliation of trend data from the areas solely outside of closed areas with those for the entire southern California Bight (e.g., CalCOFI).

Fits to the length composition data, along with plots of residual values and input relative to effective sample sizes, for the recreational fisheries and updated surveys are presented as Figures 25-32. The length composition data for the southern recreational fisheries data and the and the NWFSC hook and line survey are both indicative of the strong 2009 and very strong 2010 year classes, which are also evident in the NWFSC trawl survey length composition data and the central/northern California length composition data. Note that fisheries or surveys for which no new data are available were not included, as the historical fits have not changed significantly (as illustrated by the trivial changes in the likelihood values of length composition datasets, prior to tuning, for which no new data were available, Table 7).

The mean input RSME's and variance adjustments are reported in Tables 8 and 9. As discussed earlier, the only substantive change was the unusual use of a negative variance adjustment for the trawl survey data, as the new GLMM code resulted in a very similar trend, but a very different variance for this index (approximately 0.4 in the 2011 update, approximately 2.1 for this update). Although a reduction in variance is an atypical approach, and the previously mentioned poor fit and low influence of the trawl survey index in this model might justify inclusion of the most recent variance estimate, the STAT felt that for the purposes of an "update" a major change in the effective variance for this index would be inappropriate. Moreover, running the base model without the reduction in variance for this index led to no significant difference in the overall model result or in model projections.

Point estimates of parameters (including the recruitment deviation point estimate values) for the base model are reported in Tables 10 and 11, along with the corresponding estimates from the 2011 model. With the exception of the selectivity parameters for the NWFSC combined trawl survey that were made in the 2011 model, and the estimates of recent recruitment strength, the growth, recruitment and selectivity and productivity parameter values have changed very little since the 2009 assessment.

The base model results are shown as Figures 33- 39 (with values reported in Table 12), for summary biomass, spawning output, depletion, age-0 recruits, recruitment deviation estimates, the spawner-recruit curve, the equilibrium yield curve, and the estimated SPR (including phase plot against B target). The resulting estimates of unfished summary (age 1+) biomass, spawning output and mean age 0 recruitment are only modestly changed from the 2009 and 2011 results (see Table 7). The estimated steepness has increased modestly since the 2009 assessment (to 0.61 from 0.57 in 2009 and 0.60 in 2011). Biomass, spawning output and exploitation trends were virtually identical to the 2009 and 2011 models, with the primary differences respective to the 2009 and 2010 year classes and subsequent biomass and spawning output trajectories. The current model projection is considerably more optimistic than earlier models as a consequence of the strength of the 2010 year class, which is currently estimated to be the strongest since 1977 (although the point estimate of the total number of recruits is nearly identical, but slightly less than, the estimated strength of the 1984 year class). The relative spawning output (depletion) for 2013 is estimated to be 31.4% of the mean unfished level, with spawning output expected to increase sharply as the 2010 year class matures, such that under projections based on the currently adopted ACL's for 2013 and 2014, the stock is likely to be rebuilt (depletion of ~43%) in 2015.

Uncertainty and sensitivity analysis

In the 2009 stock assessment, both the STAT and the STAR Panel identified the major sources of uncertainty in the model as relating to the tension between two generally pessimistic indices (the triennial trawl survey and the trawl fishery CPUE index, both derived primarily from north of Point Conception, California) and two optimistic indices (the CalCOFI index and the Southern California recreational fishery CPUE index, both derived primarily from south of Point Conception). Consequently, the two alternative states of nature sequentially increased the emphasis on each of these groups to bracket uncertainty. However, in the 2011 assessment, the challenges associated with estimating the relative strength of the 2010 year class were considered a more substantive uncertainty for that assessment. For this update, given the greater certainty associated with the relative magnitude of the 2010 year class, we returned to the 2009 primary axes of uncertainty, which provide useful contrast between an apparent, but poorly understood, spatial dimension to relative abundance trends. In all of these runs, catches were based on the rebuilding SPR rate of 0.777 for each respective model.

Figures 40 and 41 shows a comparison of the base model estimated spawning biomass, spawning depletion, relative SPR rate and recruitment relative to the "optimistic" and "pessimistic" scenarios 2009 model estimates and ten year projections for spawning biomass, relative depletion, recruitment and recruitment deviation values. The subsequent decision table (Table 13) shows the estimated spawning depletion for each of the three scenarios between 2013 and 2024, based on the catch streams associated with the SPR of 0.777 for each of the three models, as well as the catch stream associated with the OFL SPR of 0.50 subsequent to the 2013-2014 period (for which the ACL's have already been adopted).

In the base model (as previously stated) the stock is projected to rebuild (depletion ~0.43) by 2015, an outcome that does not change with any of the catch streams as the 2013 and 2014 catches are assumed to be fixed at the current ACL's. For the optimistic model, the stock is expected to have achieved a rebuilt status by the current year (2013), however under the pessimistic scenario the current stock status is approximately 20% of the unfished level, and rebuilding is expected in 2022 (with only a year of improvement if the catch stream associated with the pessimistic model is adopted instead of the catch stream associated with the base model). Most of the other results in the decision table are intuitive.

Reference Points

Reference points are presented in Table 14, including the unfished summary biomass, unfished spawning output, mean unfished recruitment, the proxy estimates for MSY based on the SPR50% rate, the fishing mortality rate associated with a spawning stock output of 40% of the unfished level, and MSY estimated based on the spawner/recruit relationship. Reference points did not change substantively from previous estimates, although the slightly higher estimate of h in this update is reflected in slightly higher estimates of MSY and the MSY proxies. As with earlier models, the difference between the estimated MSY (1378) and the proxy MSY reference points (1341-1347) is minimal, despite a substantial decline in the SPR and spawning output associated with the estimated MSY value.

Retrospective Analysis

Retrospective analysis were conducted by removing the influence of the most recent two and four years of data and comparing the subsequent estimates of spawning output, depletion, recruitment and relative harvest levels (Table x, Figures 42-43). These two and four year periods correspond with the data available for 2011 and 2009 (most recent update and last full assessment) time frames. The most notable change in model output is a slight shift in the timing and magnitude of several early recruitments in the 1960s, a shift which has been previously noted to take place with subtle model changes as a consequence of instability in the likelihood surface regarding the timing of the recruitment events associated with the increase in larval abundance inferred by the 1960s CalCOFI data (Field et al. 2009). The other noticeable change is the estimated magnitude of the 2010 year class, which was intuitively not observed when data are limited to the time period through 2008 (4 year retrospective) and which is moderately notable in the 2 year retrospective as driven solely by the impingement time series. In the opinion of the STAT, the retrospective analyses indicate that the new data and current model results are wholly consistent with the 2009 and 2011 models and results.

Future Research Needs

Research needs are discussed comprehensively in the 2009 assessment and have changed little since that time. Since large scale area closures and other management actions were initiated in 2001, the spatial distribution of fishing mortality has changed over both large and small spatial scales. Not only has this effectively truncated several abundance indices (recreational CPUE), this confounds the interpretation of survey indices for surveys that do not sample in the Cowcod Conservation Areas (CCAs), as insights from larval surveys suggest that the greatest abundance of bocaccio is found in that area. This, in turn, infers that fishing mortality is greater on the fraction of the stock currently outside of the CCAs. The declining trend in the NWFSC trawl survey index, which is inconsistent with other data sources and the base model results, may reflect a reduced rate of rebuilding and stock recovery in central and northern California waters. Other research and data needs are unchanged from the 2009 assessment. Recently, some progress has been made in developing age reading criteria for bocaccio, and age data are expected to be available for the next full assessment.

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Table 1. Total catches (metric tons) and PFMC adopted ABC/OY values for bocaccio rockfish.

	Catch	ABC	OY
1999	196.90	230	230
2000	139.80	164	100
2001	131.30	122	100
2002	89.66	122	100
2003	12.78	244	20
2004	85.13	400	199
2005	107.34	566	307
2006	59.70	549	306
2007	62.53	602	218
2008	39.33	618	218
2009	57.50	793	288
2010	75.36	793	288
2011		737	263
2012		732	274

Table 2. Estimated domestic commercial landings and discards of bocaccio rockfish south of Cape Blanco, by region and gear type, 1999-2012 (metric tons).

	trawl south of 38° N	trawl north of 38° N	hook and line	setnet	rec south of 34.5° N	rec north of 34.5° N	total (S. of 43 ° N)
1999	19.00	53.00	26.00	20.70	7.20	71.00	196.90
2000	13.50	60.00	6.60	7.00	0.70	52.00	139.80
2001	9.20	49.00	4.40	7.80	0.90	60.00	131.30
2002	28.04	20.67	0.13	0.01	35.88	4.93	89.66
2003	5.07	0.31	0.00	0.00	5.53	1.87	12.78
2004	13.86	3.52	1.84	0.21	63.43	2.27	85.13
2005	24.64	0.43	1.50	0.17	69.90	10.70	107.34
2006	16.09	0.31	2.25	0.25	29.00	11.80	59.70
2007	4.06	1.58	3.39	0.38	44.20	8.92	62.53
2008	0.42	1.98	2.02	0.08	31.50	3.33	39.33
2009	1.12	4.85	1.50	0.03	40.30	9.70	57.50
2010	2.90	10.97	1.45	0.05	50.07	6.54	71.97
2011	1.30	4.93	2.39	0.01	99.26	4.06	111.95
2012	12.89	48.81	1.10	0.01	119.08	5.65	187.54

Table 3. Total number of length frequency observations, subsamples, and input effective sample size for recreational fisheries, 2008-2012 (see 2009 assessment for complete table).

	Southern California			Central/Northern California		
	obs	samples	Neff	obs	samples	Neff
2008	1811	484	400	163	88	110
2009	2085	444	400	216	90	120
2010	1869	368	400	185	88	114
2011	3240	543	400	188	98	124
2012	3950	595	400	237	111	144

Table 4. Total number of plankton tows, positive tows, and the mean cpue of positives for 2000-2011 (see 2009 assessment for complete table).

	Northern area (lines<77)			Southern area (lines>=77)		
	total tows	positive	ave cpue	total tows	positives	ave cpue
2000				96	8	0.77
2001				93	6	0.46
2002				118	10	1.04
2003	46	4	0.59	143	14	0.98
2004	46	3	1.28	99	11	4.85
2005				146	16	1.64
2006	28	4	1.60	149	13	0.72
2007	10	4	5.65	108	11	1.20
2008	20	1	0.27	176	13	1.83
2009	24	1	0.22	170	10	0.65
2010	***40***	***5***	***1.13***	***188***	***8***	***0.41***
2011	***61***	***3***	***0.74***	***182***	***18***	***1.12***

Table 5. Summary of all bocaccio catch information for NWFSC combined shelf-slope bottom trawl survey, by latitude and inside of 350 meters depth, 2003-2012

Total number of hauls, 50 to 350 m

lat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32	37	39	48	49	57	50	64	60	56	62
34.5	20	18	17	16	23	24	29	24	17	24
36	23	24	32	31	29	41	42	38	41	42
38	34	39	50	45	33	42	33	45	48	42
40.5	56	28	50	34	41	36	44	49	43	44
43	129	136	167	172	196	164	171	180	180	161

Number of positive tows

lat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32	9	9	13	11	12	2	8	16	11	25
34.5	7	4	2	2	6	3	6	10	5	7
36	6	7	12	9	6	8	4	6	2	5
38	8	10	8	12	1	8	5	3	2	6
40.5	4	0	3	1	2	1	1	0	0	0
43	5	0	2	3	3	4	0	1	2	5

Percent positive

lat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32	0.24	0.23	0.27	0.22	0.21	0.04	0.13	0.27	0.20	0.40
34.5	0.35	0.22	0.12	0.13	0.26	0.13	0.21	0.42	0.29	0.29
36	0.26	0.29	0.38	0.29	0.21	0.20	0.10	0.16	0.05	0.12
38	0.24	0.26	0.16	0.27	0.03	0.19	0.15	0.07	0.04	0.14
40.5	0.07	0.00	0.06	0.03	0.05	0.03	0.02	0.00	0.00	0.00
43	0.04	0.00	0.01	0.02	0.02	0.02	0.00	0.01	0.01	0.03

Mean CPUE (kg/ha) of positives

lat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32	2.0	3.0	1.7	1.8	6.1	2.3	0.8	1.1	1.5	7.3
34.5	1.0	5.8	1.7	29.0	3.7	1.7	4.7	2.2	2.7	80.3
36	2.1	66.0	14.3	2.1	4.7	11.4	3.2	1.2	0.7	3.5
38	3.5	4.0	3.2	3.4	1.9	4.8	2.5	1.8	2.3	3.2
40.5	2.7	0.0	2.7	0.3	2.7	0.0	4.5	0.0	0.0	0.0
43	5.0	0.0	1.4	27.1	6.8	5.1	0.0	0.7	5.8	2.3

Number of length measurements

lat	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
32	37	54	111	92	98	7	26	207	79	401
34.5	15	29	4	81	25	10	44	48	10	72
36	11	378	165	16	21	63	19	8	7	19
38	25	32	22	22	1	21	8	3	3	14
40.5	9	0	15	1	4	1	3	0	0	0
43	16	0	2	50	8	9	0	1	6	10

Table 6: Sample sizes, number of positives, % positive, CPUE index and CV for the Power Plant Impingement Index

	Sample size	Number positives	% positive	Index	CV
1972	38	23	0.61	805.6	0.47
1973	34	17	0.50	240.1	0.54
1974	42	18	0.43	169.1	0.40
1975	42	27	0.64	209.9	0.37
1976	59	12	0.20	20.8	0.40
1977	48	17	0.35	559.2	0.53
1978	38	18	0.47	82.5	0.41
1979	54	18	0.33	67.1	0.37
1980	47	12	0.26	23.1	0.49
1981	47	5	0.11	9.2	0.70
1982	43	3	0.07	1.9	0.74
1983	44	0	0.00	n/a	n/a
1984	39	4	0.10	10.6	0.88
1985	52	7	0.13	19.7	0.52
1986	54	5	0.09	6.4	0.53
1987	47	0	0.00	n/a	n/a
1988	45	16	0.36	215.5	0.48
1989	41	7	0.17	15.1	0.57
1990	47	3	0.06	7.0	0.69
1991	44	13	0.30	46.2	0.47
1992	60	6	0.10	36.5	0.62
1993	47	1	0.02	n/a	n/a
1994	52	0	0.00	n/a	n/a
1995	39	4	0.10	19.1	0.74
1996	54	4	0.07	5.6	1.15
1997	46	2	0.04	4.9	0.93
1998	44	0	0.00	n/a	n/a
1999	31	10	0.32	61.1	0.52
2000	44	7	0.16	8.6	0.57
2001	52	2	0.04	1.0	0.80
2002	45	8	0.18	16.3	0.41
2003	37	12	0.32	52.9	0.57
2004	34	4	0.12	2.6	0.81
2005	35	13	0.37	67.1	0.47
2006	26	0	0.00	n/a	n/a
2007	35	5	0.14	8.5	0.66
2008	33	5	0.15	6.4	0.56
2009	27	8	0.30	21.0	0.47
2010	27	9	0.33	52.5	0.51
2011	32	3	0.09	5.5	0.94
2012	7	2	0.29	74.5	0.76

Table 7: Key model outputs and likelihood values with sequential addition of new data sources.

	2009 base model	2011 update base model	Update catches, extend model to 2012	Update CalCOFI larval abundance time series	Update SCB hook and line index, LFs	Update NWFSC bottom trawl survey index and LFs	Update rec fishery LFs	Update juvenile indices (trawl survey and power plant)	Final base model (Post tuning, single iteration)
R0	5060	5106	5215	5400	5342	5265	5371	5196	5169
SSB0 ($x10^9$ larvae)	7861	7812	7979	8274	8199	8063	8203	7923	8118
Unfished biomass	44070	44116	45122	46771	46336	45610	46446	44888	45546
S2009/SSB0	0.281	0.247	0.247	0.236	0.239	0.237	0.236	0.230	0.228
S2011/SSB0		0.260	0.259	0.248	0.256	0.253	0.255	0.247	0.249
S2013/SSB0			0.286	0.271	0.319	0.315	0.322	0.308	0.314
H. est	0.573	0.595	0.577	0.596	0.597	0.599	0.608	0.614	0.614
Likelihoods	3102.1	3303.8	3303.9	3320.9	3340.6	3382.7	3461.5	3459.6	3825.2
Survey	85.4	143.1	143.7	161.8	138.6	149.7	152.5	147.2	129.9
Length_comp	2986.7	3126.2	3125.6	3126.0	3166.6	3196.7	3273.9	3275.2	3658.7
Recruitment	32.9	32.7	32.0	31.4	33.8	34.7	33.5	34.7	35.2
Parm_priors	1.4	1.5	2.6	1.6	1.6	1.6	1.5	2.5	1.5
Survey									
Trawl_south	7.6	7.2	7.4	7.1	6.9	6.8	6.9	6.6	8.1
RecSouth	7.7	8.0	8.0	8.0	8.0	8.1	8.1	8.2	8.0
RecCentral	10.1	10.8	10.6	10.8	11.0	11.1	11.0	11.4	10.1
CalCOFI	21.3	21.7	22.4	40.1	40.3	39.6	40.5	39.5	38.4
Triennial	4.1	3.8	3.9	3.8	3.7	3.7	3.7	3.5	4.1
CPFV_index	6.0	5.6	5.7	5.6	5.5	5.5	5.5	5.4	6.6
SCB_hook	2.4	32.3	32.1	32.5	8.4	8.3	8.5	8.3	4.6
Combo	2.9	3.8	3.8	3.8	4.1	16.3	16.6	16.3	5.5
Juv_trawl	3.9	5.7	5.7	5.7	7.2	7.2	7.3	7.3	5.9
Pier_index	19.4	20.5	20.5	20.7	20.9	20.8	21.4	21.1	20.1
Impingement	0.0	23.6	23.7	23.6	22.6	22.5	23.0	19.6	18.5
Length									
Trawl_south	468.1	466.5	466.7	467.0	466.6	466.5	465.4	465.0	496.3
hook-line	363.0	363.3	363.4	363.2	363.4	363.4	363.1	363.1	366.0
setnet	356.2	354.3	354.3	354.5	355.1	354.9	354.1	353.9	296.3
RecSouth	375.4	422.8	422.9	423.5	427.5	427.6	454.8	455.3	567.3
RecCentral	365.2	396.7	396.8	396.3	397.2	397.4	439.9	440.5	435.5
Trawl_north	365.4	369.2	369.0	368.6	368.6	369.4	370.2	371.2	681.1
CalCOFI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triennial	151.0	148.4	148.4	148.7	149.3	149.1	148.9	148.7	270.4
CPFV_index	213.1	215.3	215.2	214.9	214.1	214.4	214.0	214.4	135.5
SCB_hook	60.9	81.0	81.1	80.9	117.1	116.8	119.7	119.8	93.7
Combo	137.3	177.7	177.0	177.6	177.4	207.0	210.1	209.3	142.8
RecSouthObs	131.0	131.0	131.0	131.0	130.2	130.3	133.6	134.1	173.8

Table 8: Mean input RSME's and variance adjustments for 2013 update

Fleet	years	mean input rsme	2011 variance adjustment	input+ adjustment	2013 model rsme	new variance adjustment
trawlsouth	15	0.32	0.06	0.38	0.36	0.04
recSO	20	0.17	0.59	0.76	0.78	0.60
recCEN	20	0.15	0.60	0.75	0.79	0.64
CalCOFI	54	0.22	0.29	0.51	0.60	0.37
Triennial trawl survey	9	0.20	0.50	0.70	0.66	0.45
CPFV CPUE	12	0.15	0.22	0.37	0.35	0.20
NWFSC hook&line	9	0.12	0.15	0.27	0.39	0.27
NWFSC trawl survey	10	2.10	0.25	0.57	-0.99	-1.05
juvenile trawl survey	11	0.02	0.96	0.98	1.13	1.11
pier_juv	33	0.79	0.00	0.79	0.85	0.06
power.plant.index	35	0.60	0.37	0.97	1.04	0.43

Table 9: Mean input effective sample sizes and variance adjustments for LF data

Fleet	years	mean start effN	mean model effN	model effN/ input*var.adj
trawlsouth	26	156	154	0.98
hook and line	23	52	52	0.89
setnet	17	120	122	1.00
recSO	30	126	121	1.00
recCEN	29	89	91	1.00
trawlnorth	25	58	59	1.00
Triennial trawl survey	9	32	31	0.98
South CPFV observer	12	290	235	0.84
Central CPFV observer	9	148	292	0.71
NWFSC hook&line	10	58	103	0.94
NWFSC trawl survey	7	18	67	1.00

Table 10. Fixed and estimated parameter values with standard deviations for the base model.

Parameter	est.	11.value	13.value	st. dev
Natural mortality, both sexes	no			
Length@Amin, both sexes	no			
Length@Amax, females	yes	67.29	68.11	0.35
VonBert K females	yes	0.22	0.22	0.004
Length@Amax, males	yes	58.49	59.31	0.29
VonBert K males	yes	0.27	0.26	0.01
CV of size at Amin, both sexes	no			
CV of size at Amax, both sexes	no			
log R0	yes	8.54	8.55	0.09
Steepness (h)	yes	0.60	0.62	0.07
Sigma-R	no			
Initial F, hook and line fleet	yes	0.0100	0.0059	0.0006
length@peak_trawlsou	yes	43.25	43.46	0.17
Width of top_trawlsou	no	-4.82		
Ascending width_trawlsou	no	4.3		
Decending width_trawlsou	no	4.76		
Initial sel_trawlsou	no	-10.5		
final sel_trawlsou	no	-0.77		
length@peak_hook and line	yes	50.06	50.15	0.75
Width of top_hook and line	yes	-4.12	-4.28	2.62
Ascending width_hook and line	yes	4.32	4.32	0.12
Decending width_hook and line	yes	3.99	3.99	0.50
Initial sel_hook and line	yes	-9.38	-9.37	4.08
final sel_hook and line	yes	-0.66	-0.68	0.31
length@peak_setnet	yes	48.47	48.48	0.39
Width of top_setnet	yes	-7.48	-7.38	5.39
Ascending width_setnet	yes	3.44	3.43	0.11
Decending width_setnet	yes	4.14	4.12	0.20
Initial sel_setnet	yes	-6.03	-6.07	0.35
final sel_setnet	yes	-1.58	-1.54	0.23
length@peak_southern rec	yes	38.27	38.41	0.41
Width of top_southern rec	yes	-7.84	-7.79	5.07
Ascending width_southern rec	yes	4.58	4.52	0.08
Decending width_southern rec	yes	5.32	5.35	0.08
Initial sel_southern rec	yes	-4.65	-4.87	0.24
final sel_southern rec	yes	-3.05	-3.21	0.34
logistic, size infl_central rec	yes	33.70	33.64	0.42
logistic, width 95%_central rec	yes	11.03	10.67	0.52
logistic, size infl_northern trawl	yes	40.13	40.41	0.29
logistic, width 95%_northern trawl	yes	6.21	6.34	0.37
length@peak_triennial	no	24		
Width of top_triennial	no	-9.79		
Ascending width_triennial	no	6.11		
Decending width_triennial	no	5.56		
Initial sel_triennial	no	-2.86		
final sel_triennial	no	-1.25		
length@peak_SCB hook line	yes	47.81	45.50	2.30
Width of top_SCB hook line	yes	-1.46	-1.10	0.32
Ascending width_SCB hook line	yes	5.28	5.03	0.29
Decending width_SCB hook line	yes	2.61	2.36	1.61
Initial sel_SCB hook line	yes	-5.75	-6.59	1.59
final sel_SCB hook line	yes	-1.13	-1.15	0.48
logistic, size inflection_NWFSC combo	yes	9.91	15.65	6.52
logistic, width 95% inflect_NWFSC combo	yes	15.86	16.17	8.58

Table 11. Fixed and estimated parameter values for recruitment deviations for the base model.

Parameter	est.	11.value	13.value	st. dev
RecrDev_1954	yes	0.08	0.06	0.64
RecrDev_1955	yes	-1.29	-1.22	0.70
RecrDev_1956	yes	0.18	0.24	0.69
RecrDev_1957	yes	-1.23	-1.15	0.72
RecrDev_1958	yes	-0.36	-0.28	0.98
RecrDev_1959	yes	1.35	0.47	1.28
RecrDev_1960	yes	0.17	0.11	1.12
RecrDev_1961	yes	0.07	0.01	1.08
RecrDev_1962	yes	0.04	3.06	0.28
RecrDev_1963	yes	3.06	0.00	1.07
RecrDev_1964	yes	-0.03	-0.02	1.05
RecrDev_1965	yes	-0.08	-0.08	1.02
RecrDev_1966	yes	1.34	1.16	0.59
RecrDev_1967	yes	-0.19	-0.22	0.94
RecrDev_1968	yes	-0.17	-0.18	0.96
RecrDev_1969	yes	-0.01	0.03	1.06
RecrDev_1970	yes	0.39	0.78	0.79
RecrDev_1971	yes	0.09	0.05	0.98
RecrDev_1972	yes	1.16	1.07	0.24
RecrDev_1973	yes	1.90	1.85	0.11
RecrDev_1974	yes	0.92	0.92	0.14
RecrDev_1975	yes	-0.51	-0.69	0.25
RecrDev_1976	yes	-0.28	-0.37	0.22
RecrDev_1977	yes	2.54	2.62	0.07
RecrDev_1978	yes	-0.03	-0.11	0.32
RecrDev_1979	yes	0.95	0.98	0.09
RecrDev_1980	yes	-0.36	-0.36	0.17
RecrDev_1981	yes	-1.02	-1.19	0.20
RecrDev_1982	yes	-2.69	-2.85	0.34
RecrDev_1983	yes	-0.28	-0.24	0.10
RecrDev_1984	yes	1.72	1.69	0.05
RecrDev_1985	yes	-0.59	-0.68	0.16
RecrDev_1986	yes	-0.71	-0.81	0.16
RecrDev_1987	yes	0.50	0.47	0.11
RecrDev_1988	yes	1.61	1.64	0.10
RecrDev_1989	yes	-1.27	-1.29	0.30
RecrDev_1990	yes	0.43	0.48	0.15
RecrDev_1991	yes	0.39	0.30	0.17
RecrDev_1992	yes	-0.86	-0.89	0.30
RecrDev_1993	yes	-0.08	-0.25	0.18
RecrDev_1994	yes	-0.38	-0.41	0.18
RecrDev_1995	yes	-0.95	-1.06	0.24
RecrDev_1996	yes	-0.45	-0.58	0.18
RecrDev_1997	yes	-1.87	-2.10	0.33
RecrDev_1998	yes	-0.29	-0.36	0.20
RecrDev_1999	yes	1.57	1.52	0.15
RecrDev_2000	yes	-1.57	-1.66	0.36
RecrDev_2001	yes	-1.71	-1.76	0.35
RecrDev_2002	yes	-0.43	-0.49	0.20
RecrDev_2003	yes	0.62	0.68	0.13
RecrDev_2004	yes	-1.50	-1.43	0.28
RecrDev_2005	yes	0.51	0.56	0.13
RecrDev_2006	yes	-0.99	-0.71	0.22
RecrDev_2007	yes	-0.24	-0.05	0.15
RecrDev_2008	yes	-0.31	0.04	0.15
RecrDev_2009	yes	0.61	0.91	0.13
RecrDev_2010	yes	0.51	1.90	0.12
RecrDev_2011			0.05	0.32
RecrDev_2012			-0.16	0.59

Table 12. Time series of key model outputs for 2011 base model.

Year	Total biomass	Summar y biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR ratio (rel. 0.50)
Unfished	45543	45476	8117510	0.087	1.000	5169	0.087	0	0.000	0.00
Initial	44114	44046	7834240	0.090	0.965	5169	0.087	153	0.003	0.08
1892	44114	44046	7834240	0.090	0.965	5140	0.086	167	0.004	0.08
1893	44097	44030	7831880	0.090	0.965	5139	0.086	157	0.004	0.07
1894	44087	44019	7831080	0.090	0.965	5139	0.086	148	0.003	0.07
1895	44081	44014	7831400	0.090	0.965	5139	0.086	139	0.003	0.06
1896	44082	44015	7832400	0.090	0.965	5140	0.086	131	0.003	0.06
1897	44087	44020	7833920	0.090	0.965	5140	0.086	123	0.003	0.06
1898	44097	44030	7836140	0.090	0.965	5140	0.086	115	0.003	0.05
1899	44113	44046	7839170	0.090	0.966	5140	0.086	108	0.002	0.05
1900	44134	44067	7843100	0.089	0.966	5141	0.086	119	0.003	0.05
1901	44142	44074	7844730	0.089	0.966	5141	0.086	131	0.003	0.06
1902	44136	44069	7844110	0.089	0.966	5141	0.086	142	0.003	0.06
1903	44119	44052	7841340	0.089	0.966	5140	0.086	154	0.003	0.07
1904	44091	44023	7836560	0.089	0.965	5140	0.086	165	0.004	0.07
1905	44052	43985	7829900	0.089	0.965	5139	0.086	176	0.004	0.08
1906	44005	43938	7821530	0.089	0.964	5138	0.086	188	0.004	0.08
1907	43951	43884	7811590	0.089	0.962	5137	0.086	199	0.005	0.09
1908	43888	43821	7800230	0.089	0.961	5136	0.086	210	0.005	0.09
1909	43820	43753	7787560	0.089	0.959	5135	0.086	237	0.005	0.11
1910	43730	43663	7771180	0.090	0.957	5133	0.086	263	0.006	0.12
1911	43621	43554	7751230	0.090	0.955	5131	0.086	289	0.007	0.13
1912	43494	43427	7727890	0.090	0.952	5128	0.086	316	0.007	0.14
1913	43350	43283	7701370	0.090	0.949	5125	0.086	342	0.008	0.15
1914	43191	43124	7671920	0.091	0.945	5122	0.086	368	0.009	0.16
1915	43019	42952	7639740	0.091	0.941	5119	0.086	395	0.009	0.18
1916	42834	42767	7605060	0.091	0.937	5115	0.086	474	0.011	0.21
1917	42582	42516	7559450	0.092	0.931	5110	0.086	747	0.018	0.32
1918	42073	42007	7470060	0.093	0.920	5100	0.085	799	0.019	0.35
1919	41545	41478	7374800	0.094	0.909	5089	0.085	529	0.013	0.24
1920	41325	41259	7328850	0.095	0.903	5083	0.085	550	0.013	0.25
1921	41109	41042	7284270	0.095	0.897	5078	0.085	463	0.011	0.22
1922	41003	40936	7258650	0.095	0.894	5075	0.085	417	0.010	0.20
1923	40958	40892	7244470	0.095	0.892	5073	0.085	489	0.012	0.23
1924	40849	40783	7221120	0.096	0.890	5070	0.085	442	0.011	0.21
1925	40798	40732	7207830	0.096	0.888	5069	0.085	505	0.012	0.23
1926	40691	40625	7185980	0.096	0.885	5066	0.085	711	0.018	0.32
1927	40384	40318	7131560	0.096	0.879	5059	0.085	610	0.015	0.28
1928	40197	40131	7095810	0.097	0.874	5055	0.084	639	0.016	0.30
1929	39992	39926	7057470	0.097	0.869	5050	0.084	597	0.015	0.28
1930	39845	39779	7027410	0.097	0.866	5046	0.084	715	0.018	0.33
1931	39591	39525	6980300	0.098	0.860	5040	0.084	689	0.017	0.32
1932	39385	39319	6938700	0.098	0.855	5035	0.084	556	0.014	0.27
1933	39329	39264	6923090	0.098	0.853	5033	0.084	429	0.011	0.21
1934	39411	39345	6931300	0.098	0.854	5034	0.084	494	0.013	0.24

Table 12 (continued)

Year	Total biomass	Summary biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR ratio (rel. 0.50)
1935	39425	39360	6931050	0.098	0.854	5034	0.084	534	0.014	0.26
1936	39399.3	39333.6	6924670	0.098	0.853	5033	0.084	632	0.016	0.30
1937	39274	39208	6902810	0.098	0.850	5030	0.084	589	0.015	0.28
1938	39198	39132	6888190	0.098	0.849	5029	0.084	461	0.012	0.23
1939	39255	39189	6895330	0.098	0.849	5030	0.084	373	0.010	0.19
1940	39403	39337	6917230	0.097	0.852	5032	0.084	382	0.010	0.19
1941	39535	39470	6938450	0.097	0.855	5035	0.084	308	0.008	0.15
1942	39735	39669	6972000	0.096	0.859	5039	0.084	124	0.003	0.06
1943	40107	40041	7036160	0.095	0.867	5048	0.084	292	0.007	0.15
1944	40297	40231	7067660	0.095	0.871	5052	0.084	737	0.018	0.34
1945	40047	39981	7015010	0.095	0.864	5045	0.084	1413	0.035	0.58
1946	39155	39090	6839970	0.098	0.843	5022	0.084	880	0.023	0.41
1947	38823	38758	6771860	0.098	0.834	5013	0.083	890	0.023	0.41
1948	38507	38441	6706470	0.099	0.826	5004	0.083	766	0.020	0.38
1949	38320	38255	6672950	0.100	0.822	5000	0.083	828	0.022	0.41
1950	38074	38008	6631090	0.100	0.817	4994	0.083	1216	0.032	0.56
1951	37435	37370	6526020	0.102	0.804	4979	0.083	1759	0.047	0.76
1952	36271	36206	6327620	0.105	0.780	4950	0.083	1966	0.054	0.86
1953	34915	34851	6102670	0.109	0.752	4915	0.082	2271	0.065	0.98
1954	33298	33230	5827180	0.114	0.718	5195	0.616	2402	0.072	1.07
1955	31564	31546	5538350	0.120	0.682	1423	0.700	3053	0.097	1.28
1956	29058	28979	5149610	0.128	0.634	6046	0.667	3650	0.126	1.45
1957	25766	25747	4657940	0.138	0.574	1465	0.721	3566	0.139	1.49
1958	22599	22555	4107720	0.151	0.506	3377	0.983	3580	0.159	1.56
1959	19418	19328	3535940	0.166	0.436	6911	1.274	2847	0.147	1.51
1960	17307	17248	3101810	0.184	0.382	4585	1.136	2436	0.141	1.50
1961	16120	16068	2729090	0.206	0.336	3991	1.096	1924	0.120	1.39
1962	16794	15719	2542980	0.211	0.313	82414	0.212	1731	0.110	1.29
1963	22139	22090	2494890	0.239	0.307	3820	1.094	2008	0.091	1.31
1964	33345	33295	2569970	0.274	0.317	3774	1.077	1523	0.046	0.76
1965	45073	45019	4004610	0.177	0.493	4103	1.023	1746	0.039	0.52
1966	54436	54238	6492330	0.131	0.800	15150	0.577	3418	0.063	0.71
1967	59349	59299	8188450	0.133	1.009	3765	0.943	5331	0.090	1.00
1968	59879	59830	8829560	0.140	1.088	3776	0.957	3405	0.057	0.79
1969	60004	59946	9378930	0.130	1.155	4457	1.064	2347	0.039	0.63
1970	59442	59324	9866130	0.109	1.215	9057	0.779	2846	0.048	0.79
1971	57250	57196	9912790	0.095	1.221	4143	0.989	2497	0.044	0.78
1972	54998	54856	9723740	0.084	1.198	10881	0.223	3653	0.067	1.07
1973	51627	51335	9227200	0.072	1.137	22368	0.076	7201	0.140	1.55
1974	45901	45793	8086430	0.063	0.996	8226	0.114	9001	0.197	1.74
1975	39872	39852	6684710	0.060	0.823	1525	0.243	6404	0.161	1.61
1976	36542	36515	6061560	0.054	0.747	2050	0.210	6177	0.169	1.57
1977	32878	32351	5643970	0.047	0.695	40317	0.029	4861	0.150	1.48
1978	31518	31484	5206830	0.042	0.641	2586	0.319	4367	0.139	1.49
1979	32981	32882	4678600	0.041	0.576	7527	0.075	6116	0.186	1.63
1980	32476	32451	4485640	0.036	0.553	1946	0.164	5384	0.166	1.48

Table 12 (continued)

Year	Total biomass	Summary biomass	Spawning output	CV spawning	Depletion	Recruits (x 103)	CV recruits	Total catch	Exploit. rate	SPR ratio (rel. 0.50)
1981	31545	31533	4703570	0.029	0.579	853	0.188	5752	0.182	1.51
1982	28548	28546	4530030	0.025	0.558	161	0.338	6599	0.231	1.65
1983	23095.2	23067.6	3949030	0.024	0.486	2113.23	0.093	5598	0.243	1.66
1984	17896	17717	3205210	0.026	0.395	13759	0.026	4676	0.264	1.72
1985	13976	13961	2428170	0.030	0.299	1165	0.151	2864	0.205	1.68
1986	12810	12797	1937840	0.035	0.239	927	0.139	3121	0.244	1.78
1987	11459	11418	1645670	0.038	0.203	3105	0.075	2649	0.232	1.69
1988	10536	10409	1580560	0.038	0.195	9781	0.044	2304	0.221	1.60
1989	10068	10061	1447660	0.040	0.178	500	0.293	2756	0.274	1.73
1990	9422	9387	1184860	0.048	0.146	2649	0.105	2624	0.280	1.76
1991	8715	8688	1066010	0.056	0.131	2081	0.128	1714	0.197	1.56
1992	8663	8654	1152630	0.058	0.142	665	0.288	1832	0.212	1.55
1993	8104	8087	1132060	0.066	0.139	1249	0.151	1593	0.197	1.52
1994	7383	7370	1087470	0.076	0.134	1033	0.155	1294	0.176	1.49
1995	6682	6675	1038240	0.086	0.128	528	0.222	818	0.123	1.26
1996	6282	6271	1006170	0.095	0.124	836	0.159	547	0.087	1.09
1997	6008	6006	997959	0.102	0.123	181	0.327	498	0.083	1.08
1998	5680	5666	972721	0.109	0.120	1014	0.187	211	0.037	0.61
1999	5640	5553	975318	0.112	0.120	6690	0.124	213	0.038	0.69
2000	5911	5907	961259	0.115	0.118	274	0.364	160	0.027	0.55
2001	6667	6663	956309	0.117	0.118	249	0.356	139	0.021	0.39
2002	7392	7380	1053080	0.117	0.130	942	0.192	90	0.012	0.21
2003	8014	7970	1233330	0.117	0.152	3302	0.135	13	0.002	0.03
2004	8646	8640	1373430	0.117	0.169	425	0.291	85	0.010	0.19
2005	9216	9174	1454170	0.118	0.179	3191	0.143	107	0.012	0.23
2006	9718	9705	1540910	0.120	0.190	927	0.239	60	0.006	0.13
2007	10301	10277	1644130	0.121	0.203	1844	0.174	63	0.006	0.13
2008	10807	10780	1744770	0.122	0.215	2071	0.179	59	0.006	0.11
2009	11334	11267	1849530	0.123	0.228	5074	0.163	58	0.005	0.11
2010	12184	12001	1935940	0.124	0.238	14000	0.162	75	0.006	0.14
2011	13920	13891	2022350	0.126	0.249	2252	0.336	112	0.008	0.16
2012	16561	16537	2176180	0.127	0.268	1881	0.605	188	0.011	0.21
2013	*19077*	*19027*	*2551060*	*0.131*	*0.314*	*3855*				

Table 13: Decision table for base model

Pessimistic catches		Pessimistic	Base	Optimistic
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	324	0.27	**0.43**	**0.56**
2016	329	0.30	**0.46**	**0.61**
2017	341	0.32	**0.49**	**0.64**
2018	357	0.34	**0.52**	**0.67**
2019	374	0.36	**0.55**	**0.70**
2020	391	0.39	**0.57**	**0.72**
2021	407	**0.41**	**0.59**	**0.74**
2022	422	**0.43**	**0.61**	**0.76**
2023	436	**0.45**	**0.63**	**0.77**
2024	449	**0.47**	**0.65**	**0.78**
Base model catches		State 1	Base	State 2
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	547	0.27	**0.43**	**0.56**
2016	537	0.29	**0.46**	**0.60**
2017	537	0.31	**0.49**	**0.63**
2018	543	0.33	**0.51**	**0.66**
2019	553	0.34	**0.53**	**0.68**
2020	563	0.36	**0.55**	**0.70**
2021	573	0.38	**0.57**	**0.71**
2022	582	**0.40**	**0.58**	**0.73**
2023	591	**0.42**	**0.59**	**0.74**
2024	599	**0.44**	**0.61**	**0.74**
Optimistic catches		State 1	Base	State 2
2013	*320*	0.20	0.31	**0.42**
2014	*337*	0.24	0.38	**0.50**
2015	632	0.27	**0.43**	**0.56**
2016	613	0.29	**0.46**	**0.60**
2017	603	0.30	**0.48**	**0.63**
2018	600	0.32	**0.50**	**0.66**
2019	601	0.34	**0.52**	**0.68**
2020	603	0.35	**0.54**	**0.69**
2021	605	0.37	**0.56**	**0.70**
2022	608	0.39	**0.58**	**0.71**
2023	610	**0.41**	**0.59**	**0.72**
2024	612	**0.42**	**0.61**	**0.73**
OFL catches (>2014)		State 1	Base	State 2
2013	*321*	0.20	0.31	**0.42**
2014	*338*	0.21	0.38	**0.47**
2015	1536	0.22	**0.43**	**0.51**
2016	1437	0.21	**0.44**	**0.53**
2017	1379	0.21	**0.45**	**0.54**
2018	1348	0.21	**0.45**	**0.55**
2019	1332	0.21	**0.46**	**0.55**
2020	1321	0.21	**0.46**	**0.55**
2021	1314	0.21	**0.46**	**0.56**
2022	1309	0.21	**0.46**	**0.56**
2023	1305	0.21	**0.45**	**0.56**
2024	1301	0.21	**0.45**	**0.56**

Table 14: Base model reference points

		95% Confidence Limits	
Unfished Stock	Estimate	Lower	Upper
Summary (1+) Biomass	45476	37435	53517
Spawning Output (* 109)	8118	5302	10934
Equilibrium recruitment	5169	3370	6968

	Yield reference Points		
	$SSB_{40\%}$	SPR proxy	MSY est.
SPR	0.494	0.500	0.428
Exploitation rate	0.068	0.067	0.084
Yield (tons)	1347	1341	1378
Spawning output (x109)	3247	3307	2614
SSB/SSB_0	0.40	0.41	0.32

Table 15: Results of 2009 base model, 2011 update base model, this base model, and the two retrospective (2 and 4 year) runs conducted for sensitivity analysis.

	2009 base model	2011 update	2013 base model	retrospective (two year)	retrospective (four year)
R0	5060	5106	5169	5045	5066
SSB0 (x10^9 larvae)	7861	7812	8118	7982	8125
Unfished biomass	44070	44116	45546	44606	45072
S2009/SSB0	0.281	0.247	0.228	0.233	0.257
S2011/SSB0		0.260	0.249	0.252	0.265
S2013/SSB0			0.268	0.274	0.263
H. est	0.573	0.595	0.614	0.597	0.565
Likelihoods	3102.1	3303.8	3825.2	3673.4	3522.2
Survey	85.4	143.1	129.9	118.0	108.1
Length_comp	2986.7	3126.2	3658.7	3520.0	3379.0
Recruitment	32.9	32.7	35.2	33.9	33.6
Parm_priors	1.4	1.5	1.5	1.4	1.6
Survey					
Trawl_south	7.6	7.2	8.1	8.0	8.6
RecSouth	7.7	8.0	8.0	8.0	7.7
RecCentral	10.1	10.8	10.1	10.0	9.4
CalCOFI	21.3	21.7	38.4	36.5	34.8
Triennial	4.1	3.8	4.1	4.1	4.4
CPFV_index	6.0	5.6	6.6	6.6	7.0
SCB_hook	2.4	32.3	4.6	4.4	0.4
Combo	2.9	3.8	5.5	0.9	0.3
Juv_trawl	3.9	5.7	5.9	4.5	3.5
Pier_index	19.4	20.5	20.1	19.5	18.5
Impingement	0.0	23.6	18.5	15.4	13.6
Length					
Trawl_south	468.1	466.5	496.3	497.9	499.3
hook-line	363.0	363.3	366.0	366.3	366.4
setnet	356.2	354.3	296.3	297.0	298.6
RecSouth	375.4	422.8	567.3	523.1	469.4
RecCentral	365.2	396.7	435.5	394.3	361.1
Trawl_north	365.4	369.2	681.1	678.4	674.3
CalCOFI	0.0	0.0	0.0	0.0	0.0
Triennial	151.0	148.4	270.4	271.8	274.3
CPFV_index	213.1	215.3	135.5	136.3	134.8
SCB_hook	60.9	81.0	93.7	62.0	47.1
Combo	137.3	177.7	142.8	121.6	87.0
RecSouthObs	131.0	131.0	173.8	171.3	166.6

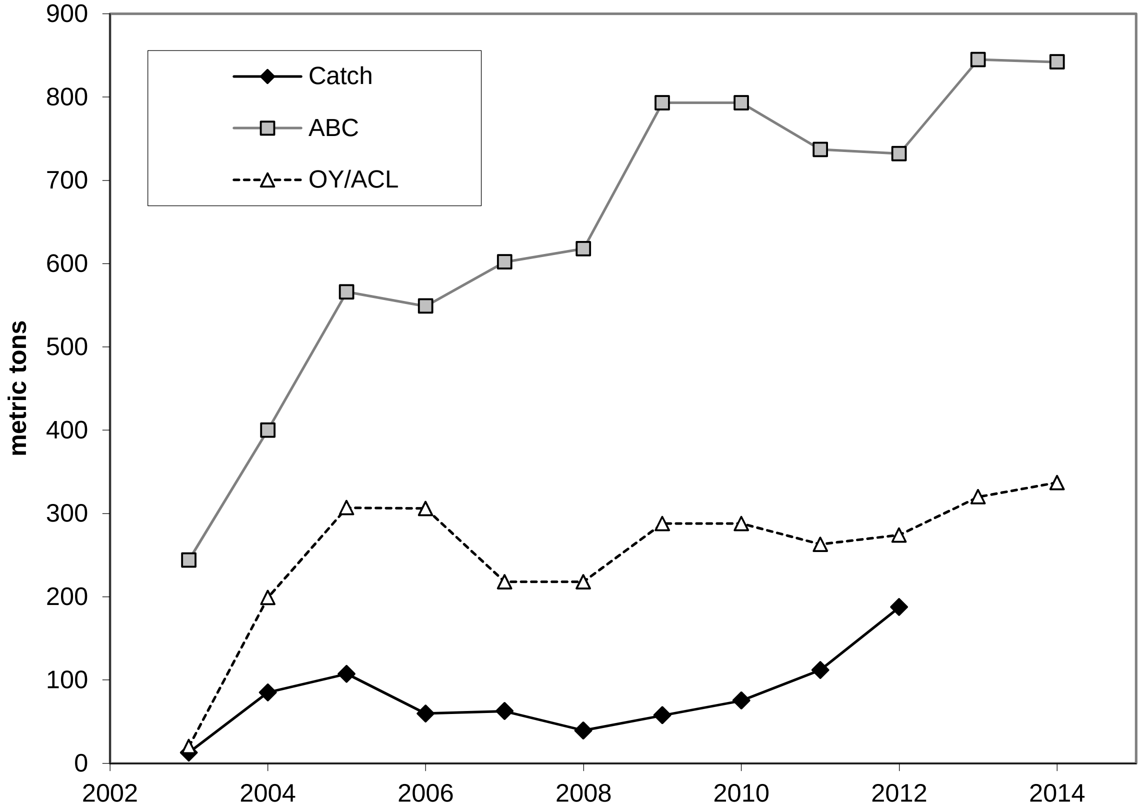


Figure 1: Management performance with PFMC adopted ABC and OY values relative to estimated catches from 2000-2014

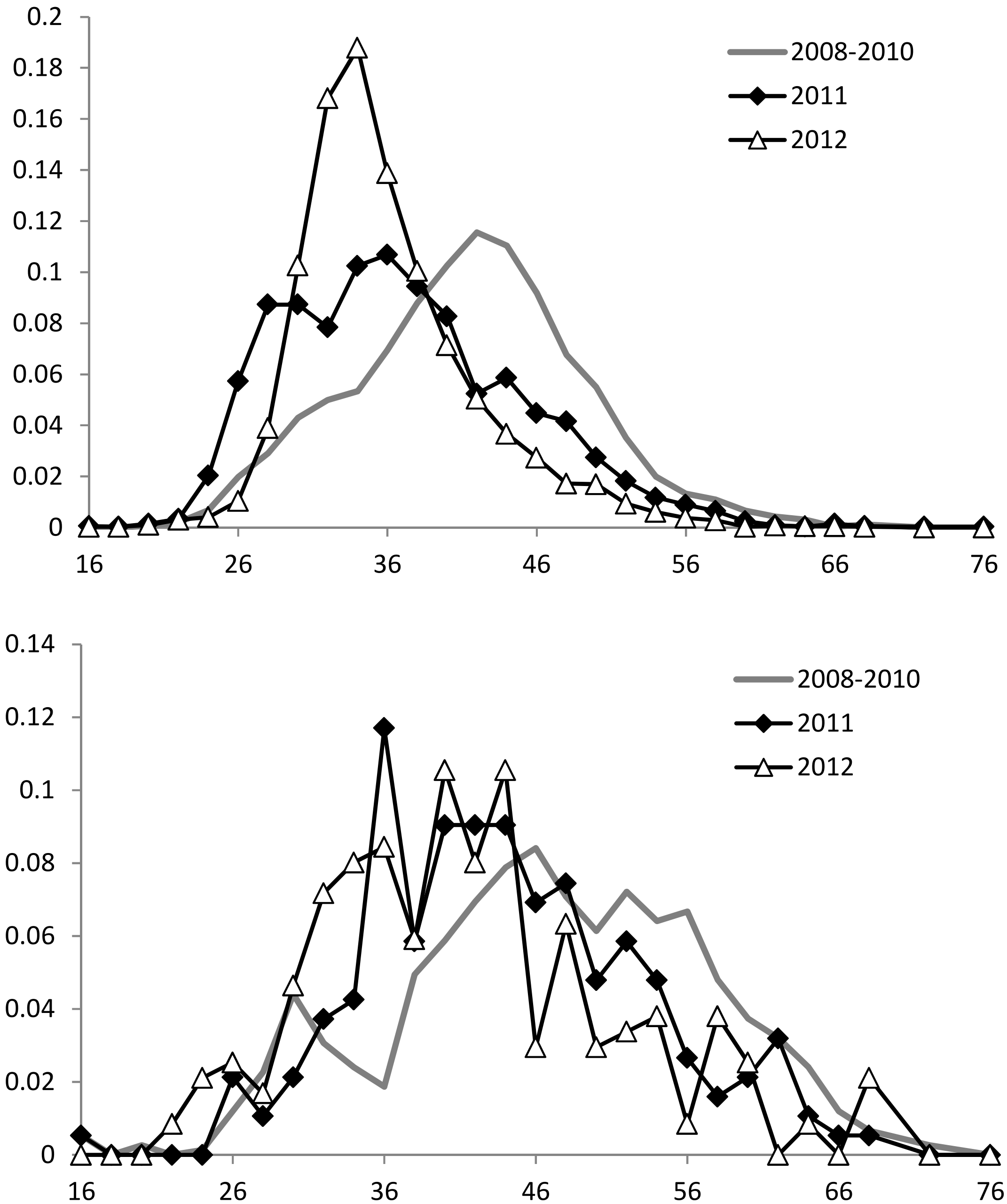


Figure 2: Length composition data for southern (top) and central/northern (bottom) California recreational fisheries.

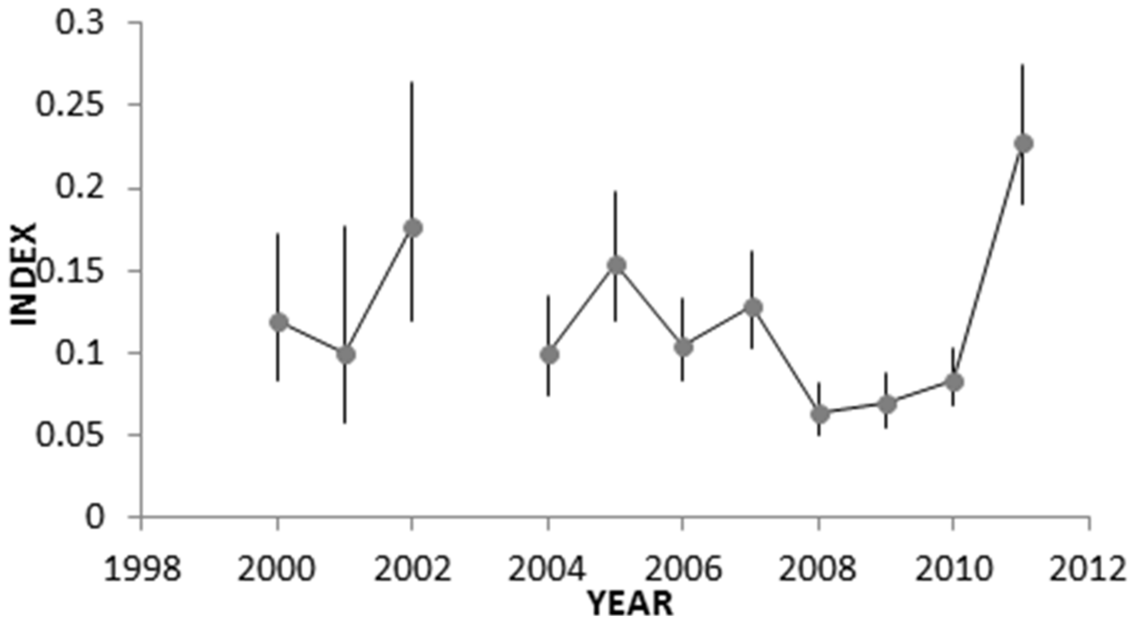


Figure 3: Southern California Recreational CPUE Index (for descriptive purposes only, not included in model).

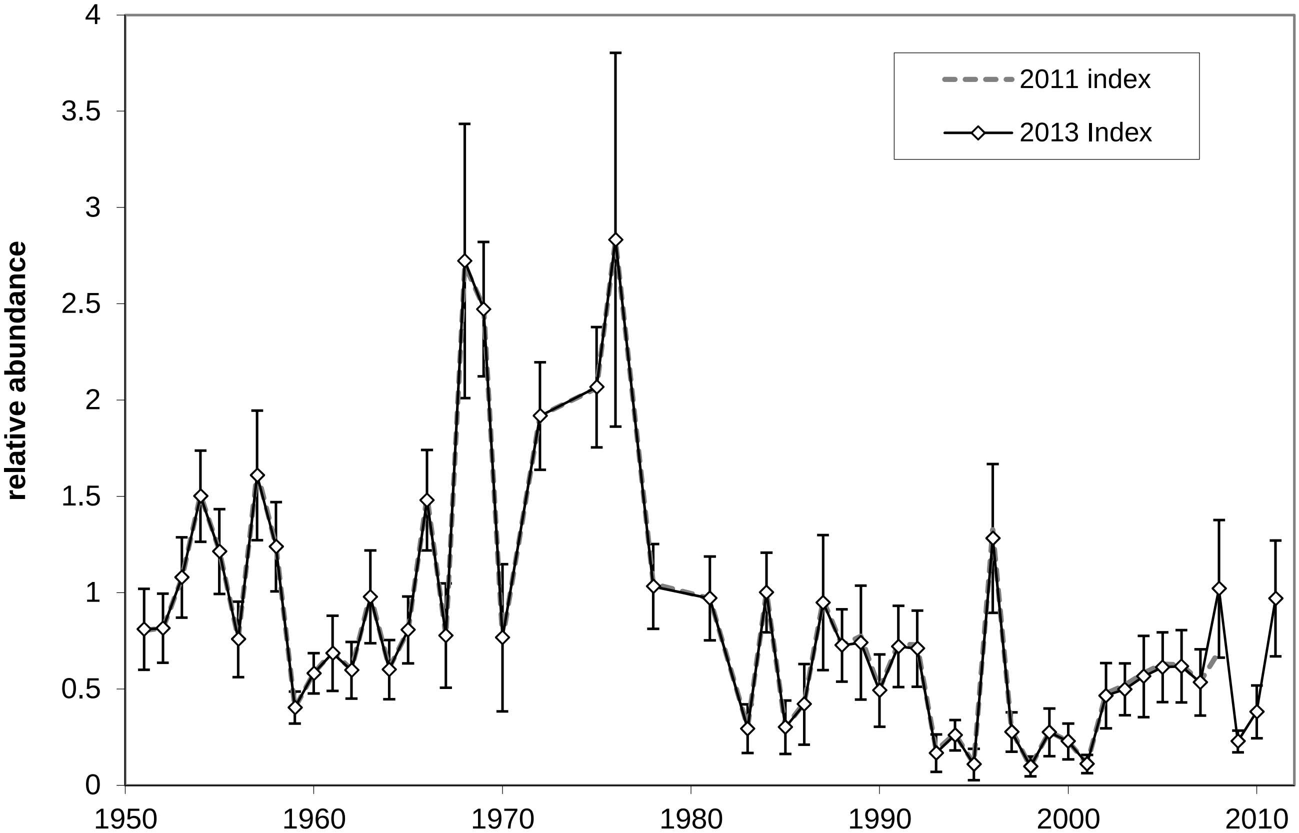


Figure 4: CalCOFI larval abundance indices for the coastwide bocaccio model updated through 2011 as compared to the 2011 model index (which included data through 2010).

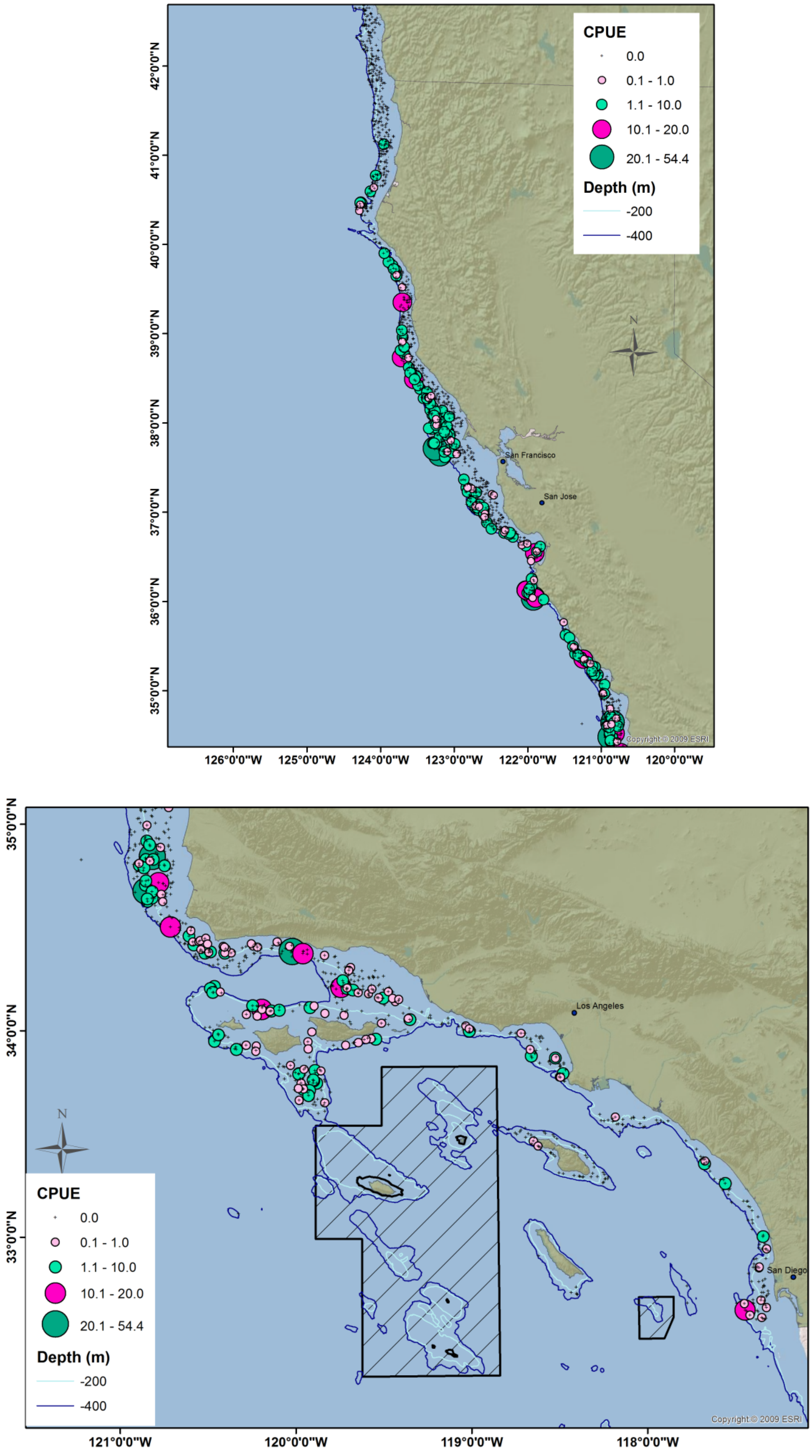
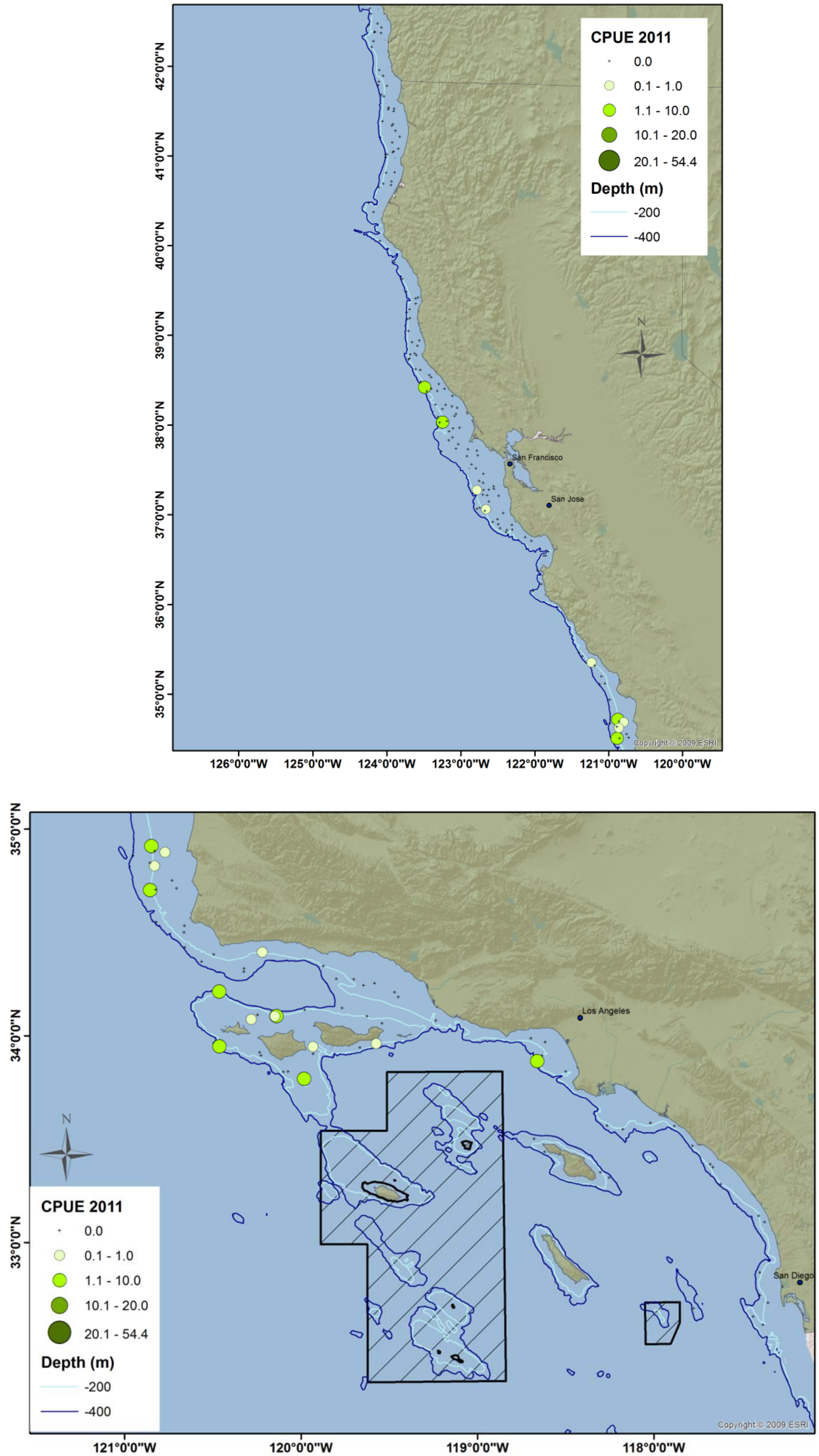
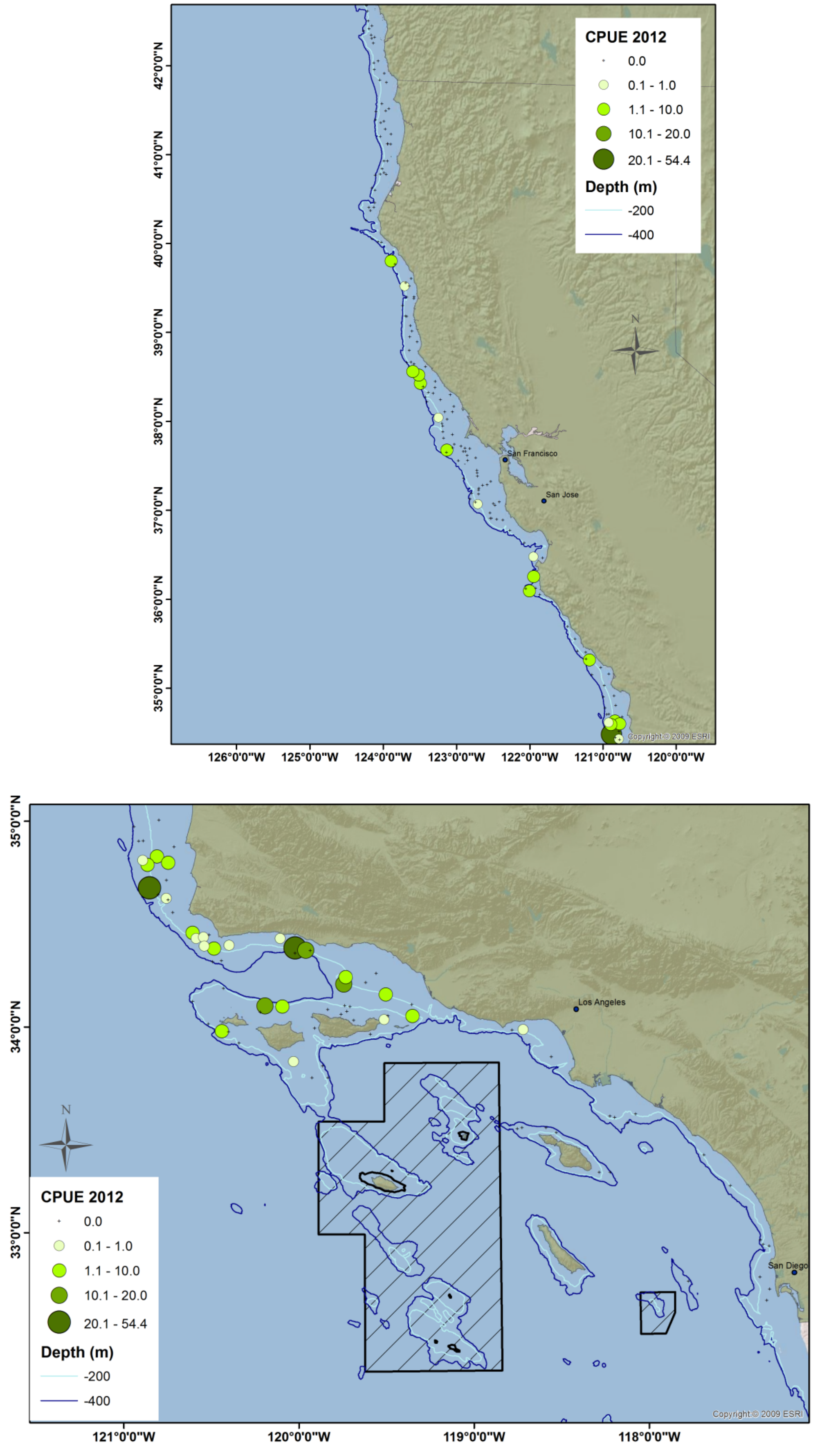


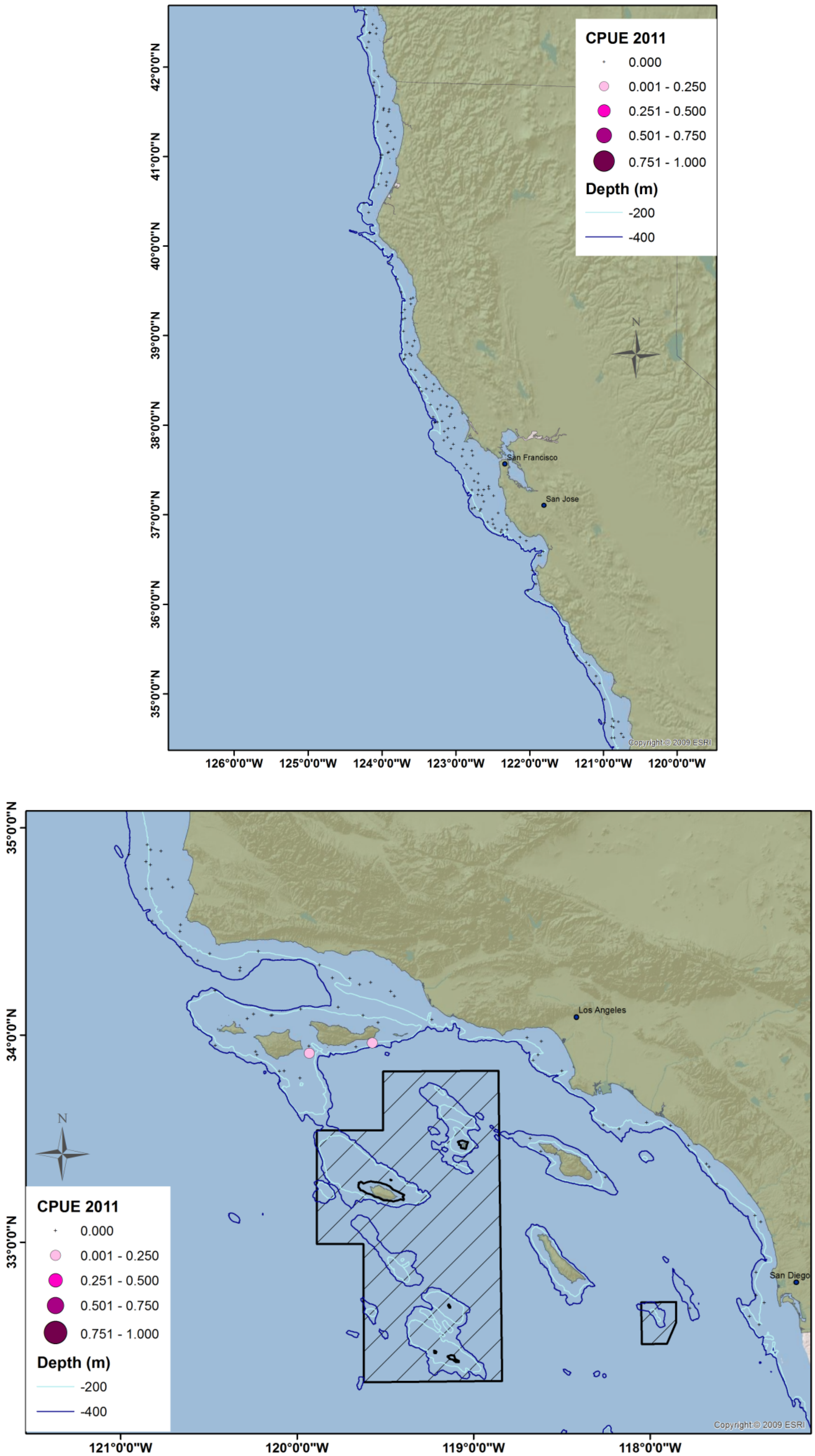
Figure 5a-b: NWFSC Combined shelf-slope survey CPUE for bocaccio rockfish (age 1+), all years (2003-2012) combined.



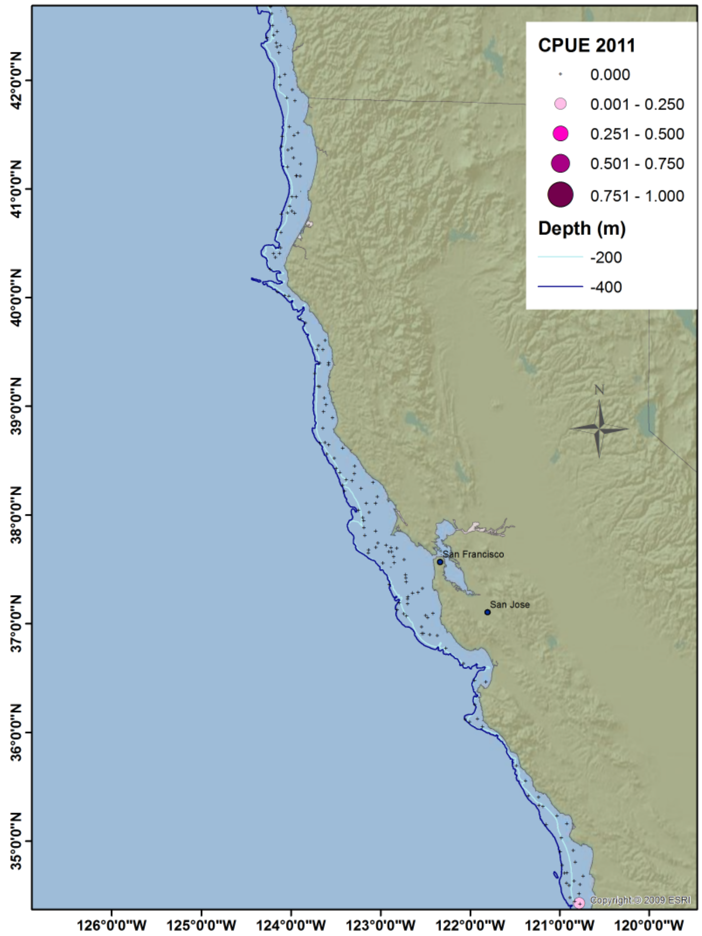
Figures 6a-b. Northwest Fisheries Science Center combined trawl survey catches of age 1+ (>20 cm) bocaccio during 2011.

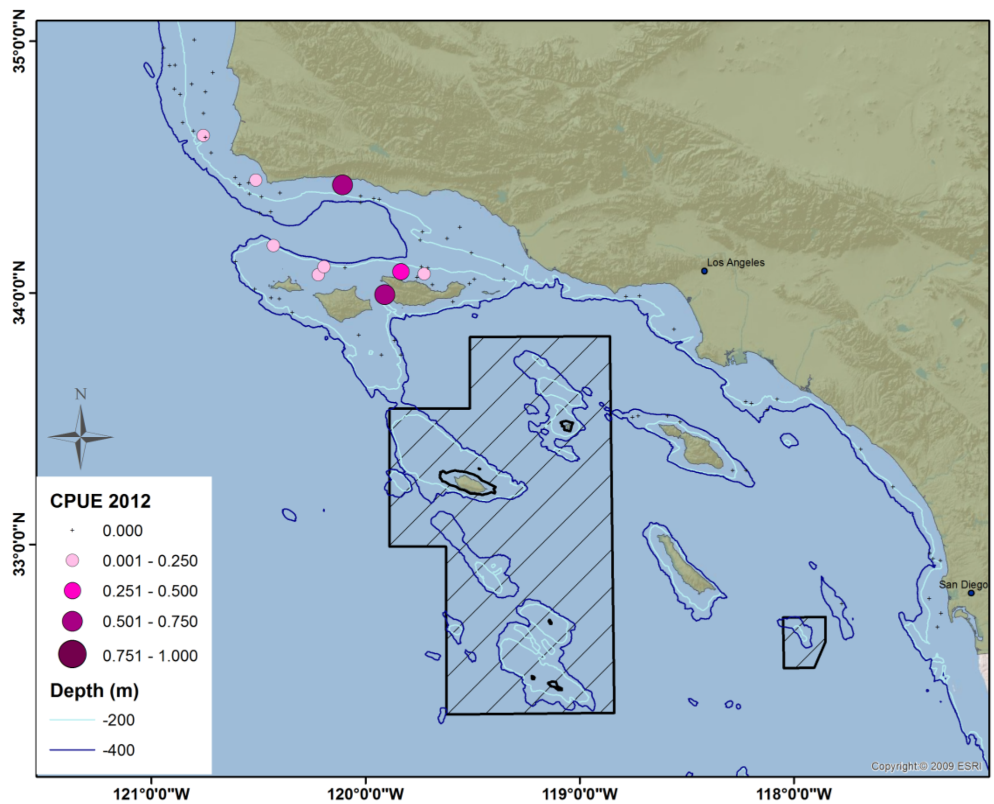


Figures 7a-b. Northwest Fisheries Science Center combined trawl survey catches of age 1+ (>20 cm) bocaccio during 2012.

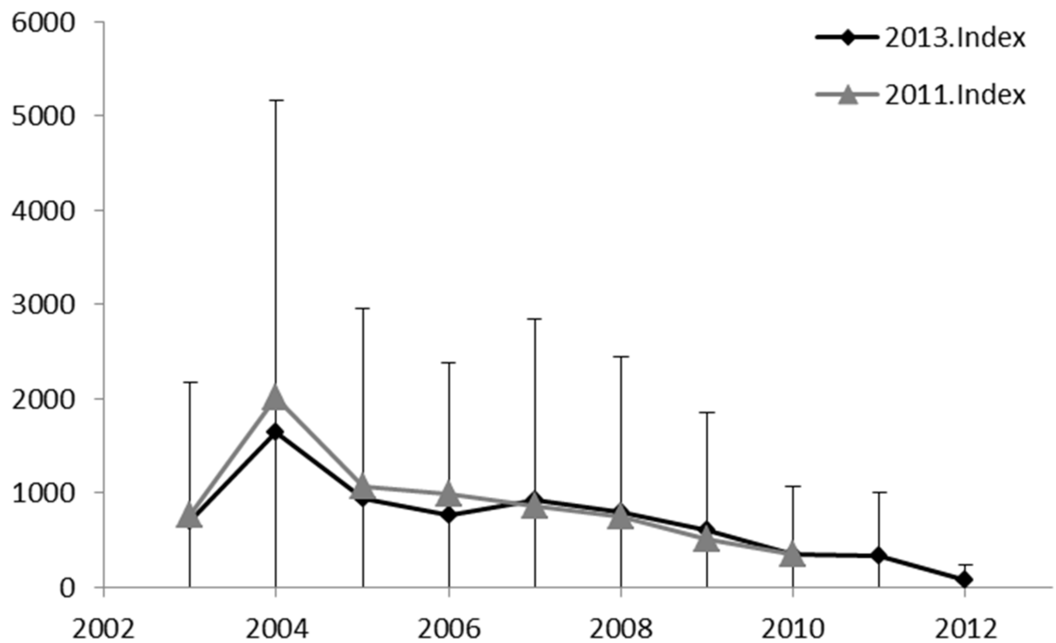


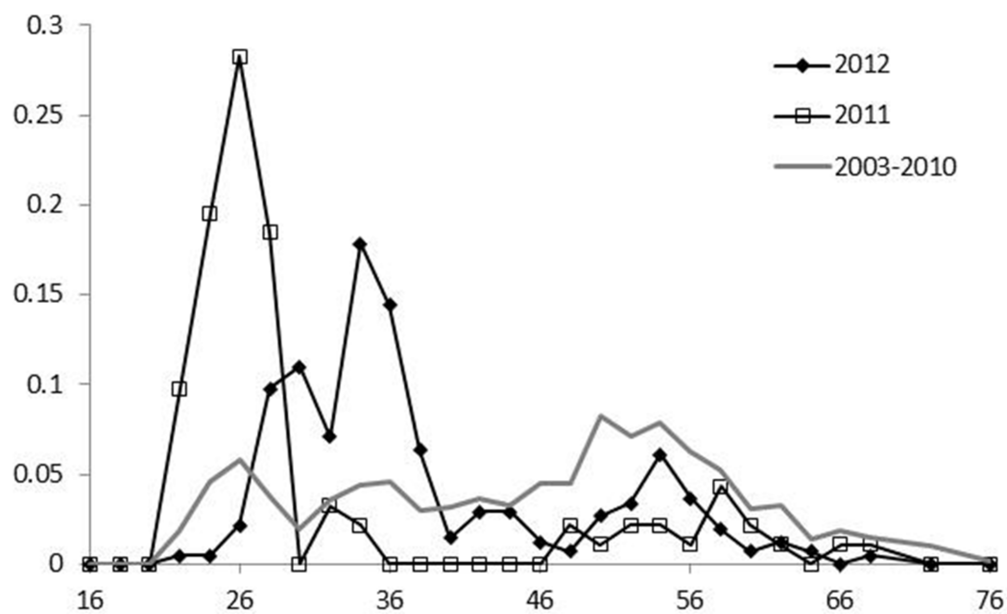
Figures 8a-b. Northwest Fisheries Science Center combined trawl survey catches of likely age-0 (<22 cm) bocaccio 2011.





Figures 9a-b. Northwest Fisheries Science Center combined trawl survey catches of likely age-0 (<22 cm) bocaccio in 2012.





Figures 10a-b. 5a (top), Comparison of the 2011 and updated 2013 GLMM indices from the NWFSC trawl survey. 10b (bottom), length composition data over 2003-2010 period compared to 2011 and 2012. Both figures represent indices and compositional data after removal of age 0 (<22 cm) fish.

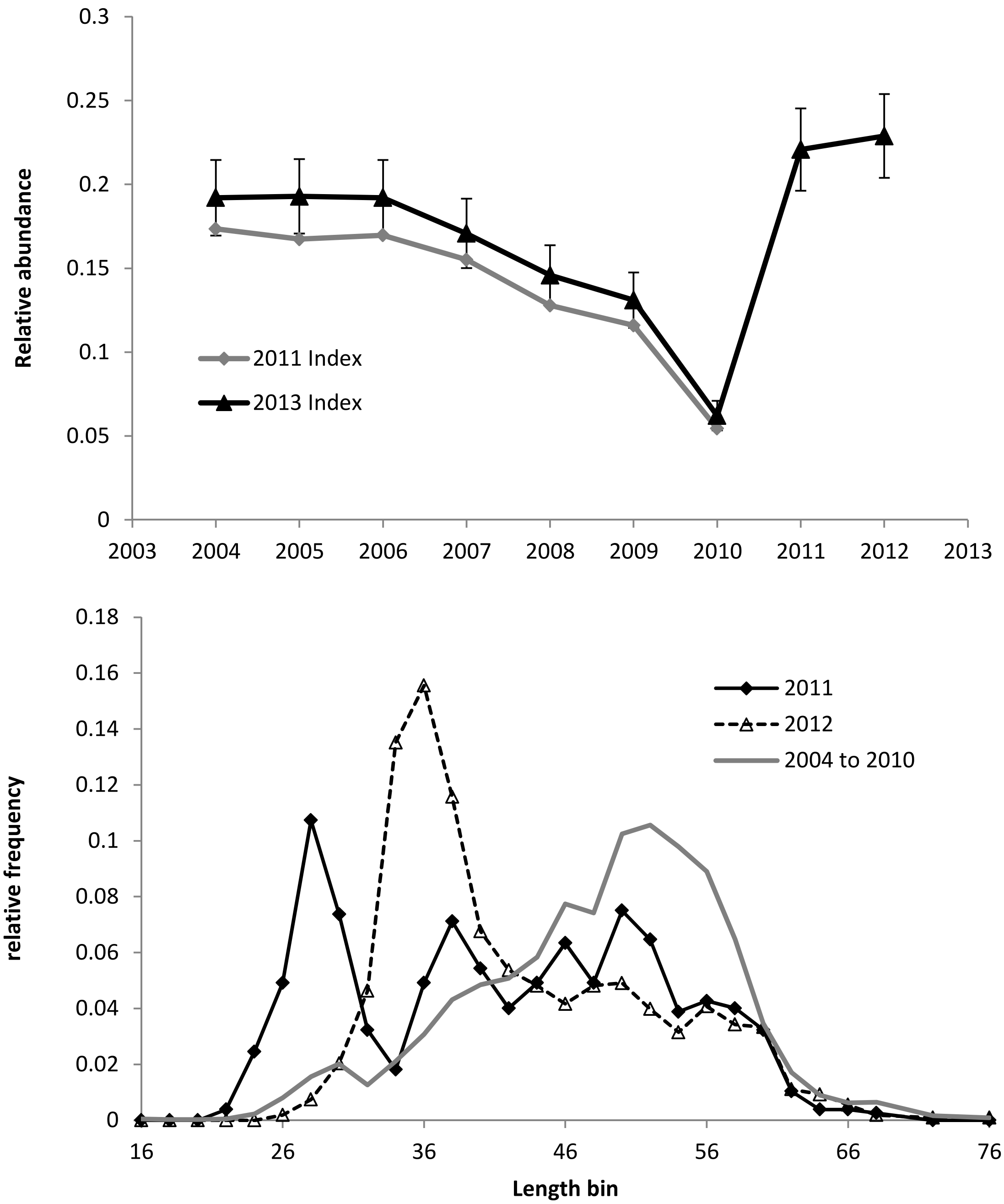


Figure 11a-b: Figure 11a (top) Comparison of the 20011 NWFSC hook and line survey CPUE index with the index developed for 2013 , and 11b (bottom) length composition data associated with the 2011 and 2012 (relative to all previous years) from the hook and lin esurvey.

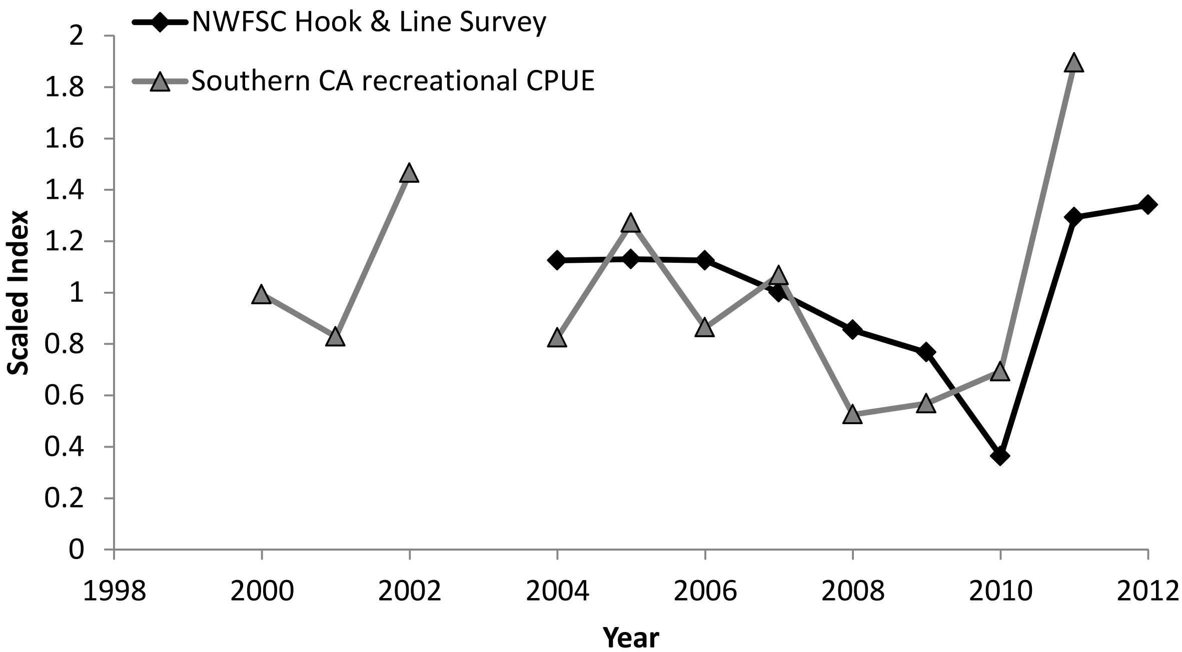


Figure 12: Comparison of the NWFSC hook and line survey index with an index developed from observer data onboard recreational CPFV vessels.

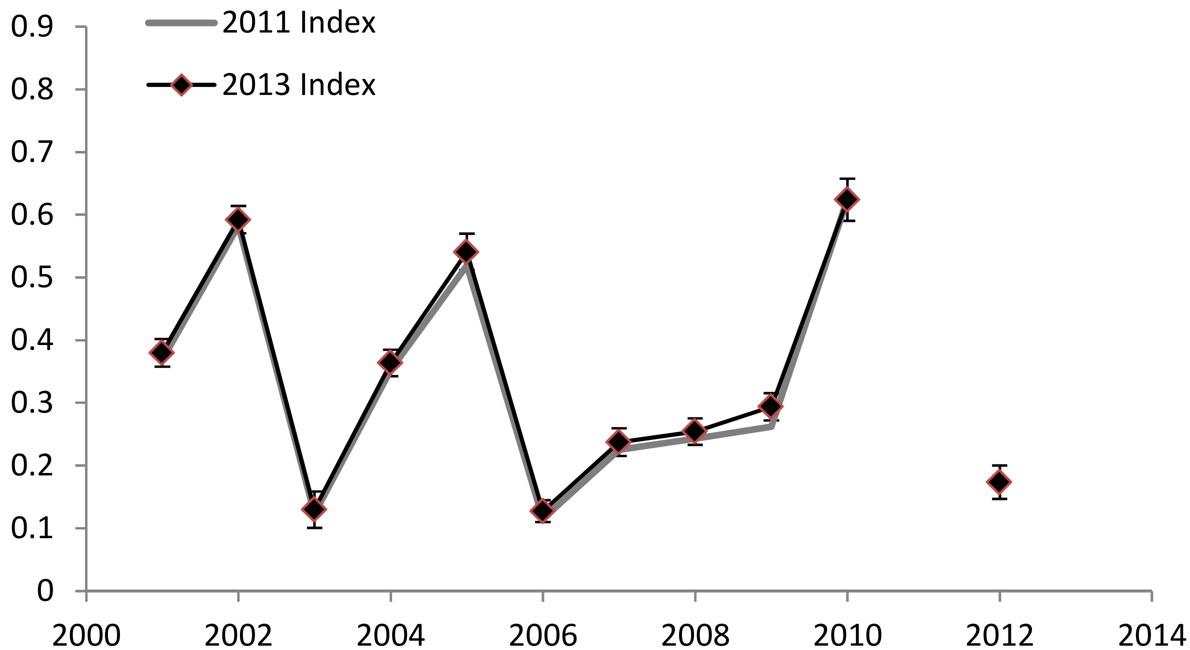
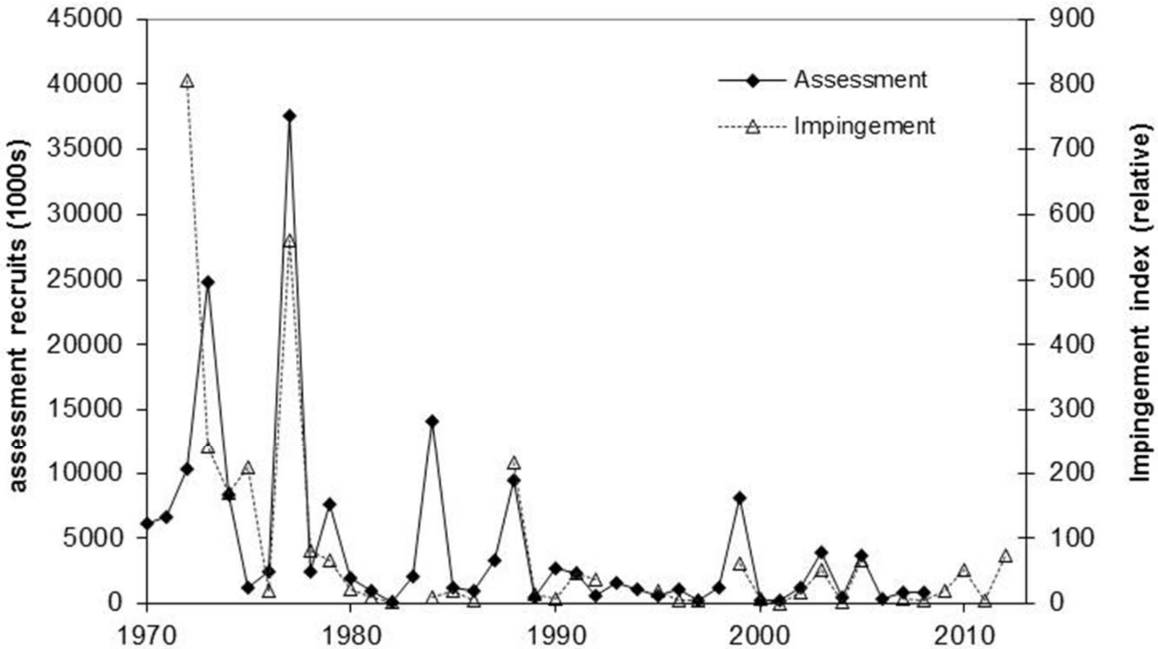


Figure 13: Juvenile rockfish survey estimates of young-of-the-year (YOY) abundance, compared to the index used in the 2011 update. Lack of data in the southern area precluded the ability to generate an index point for 2011.



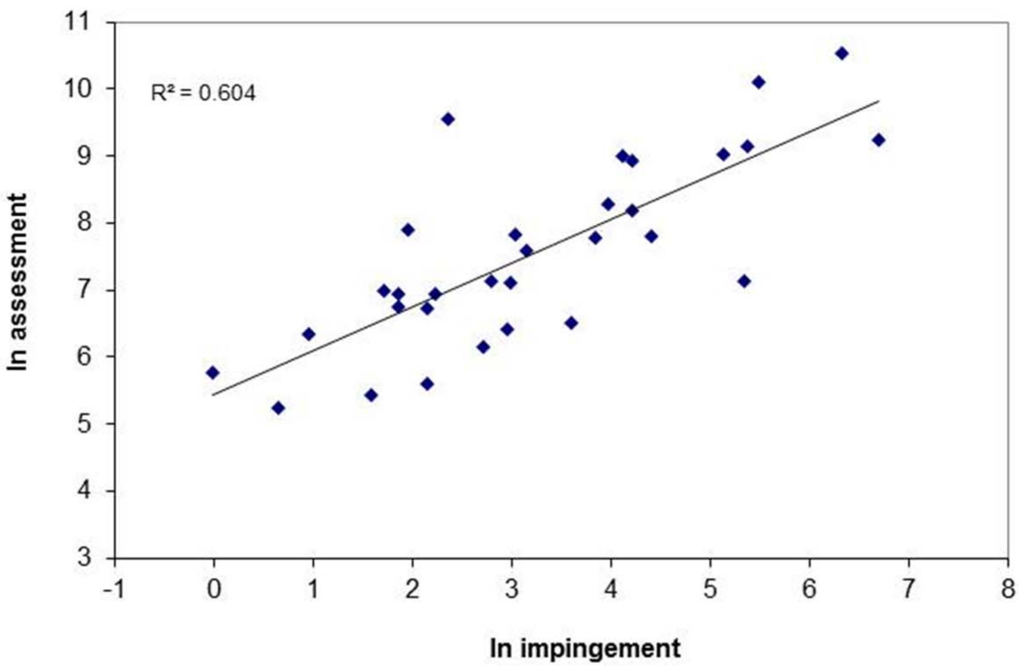


Figure 14: Comparison of the power plant impingement dataset for age 0 abundance with the 2009 base model estimates of recruitment (which did not include this dataset).

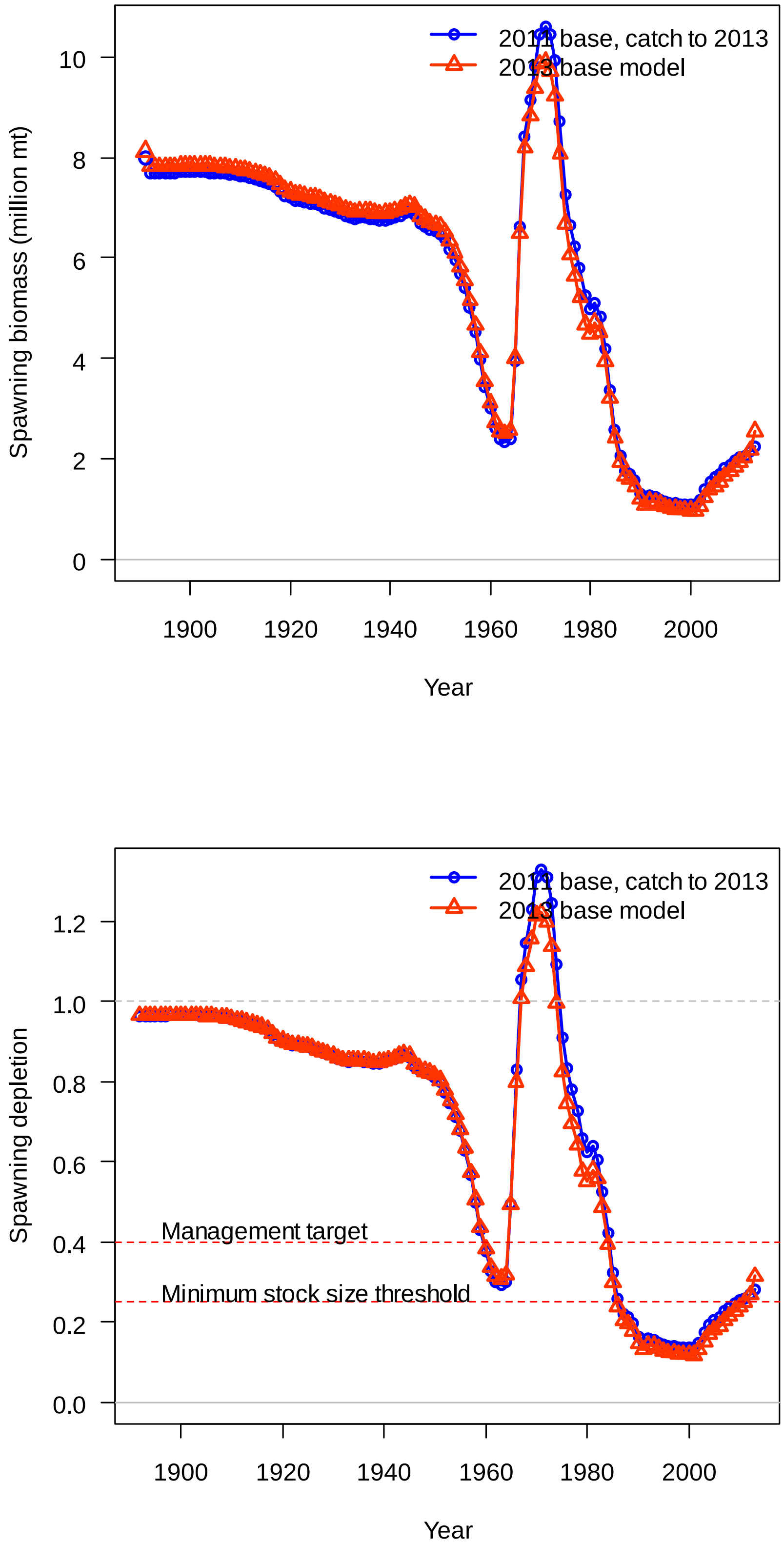


Figure 15: Comparison of spawning output and depletion estimates between the 2011 update (projected forward to 2013 with catches only) and the 2013 base model

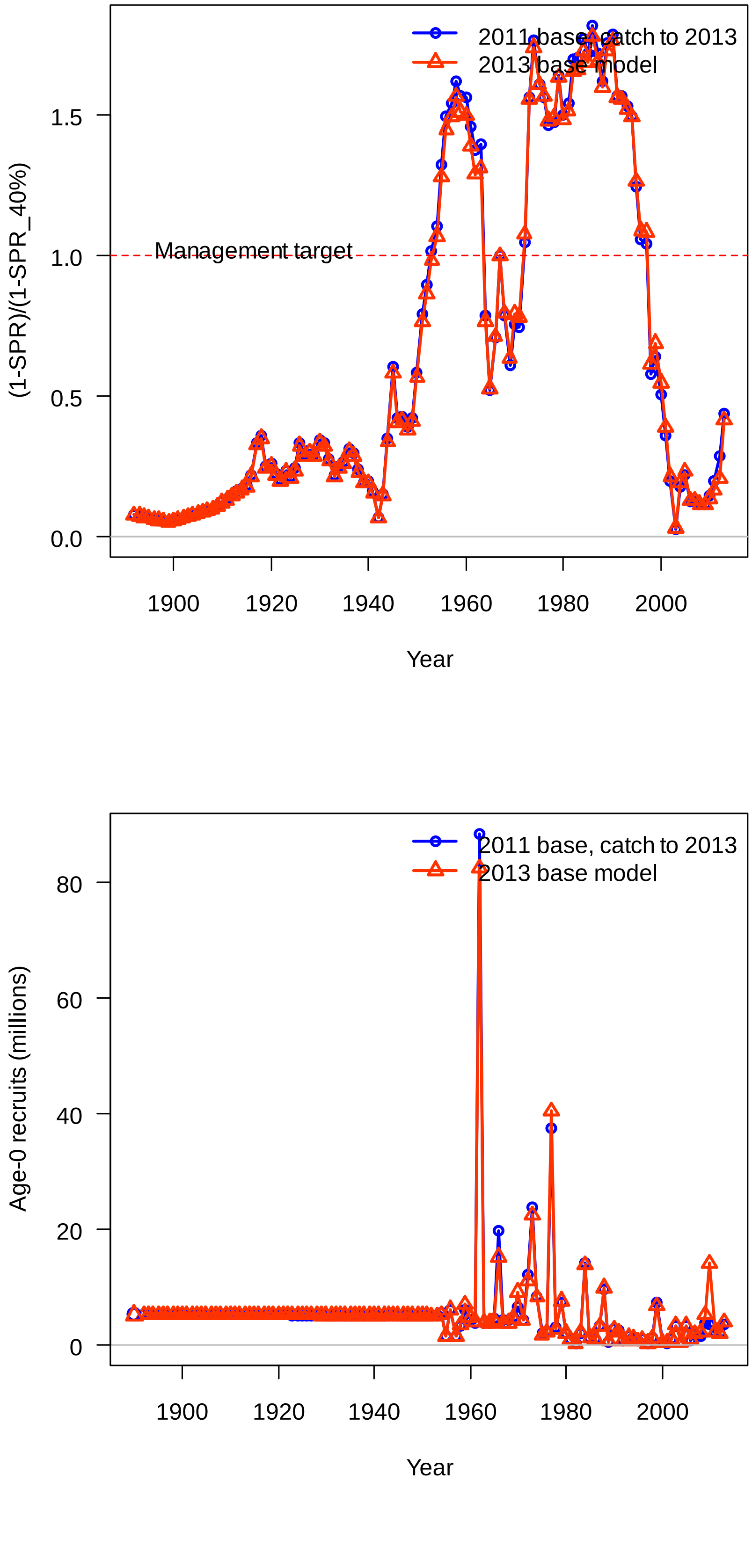


Figure 16: Comparison of recruitment and recruitment deviation estimates between the 2011 update (projected forward to 2013 with catches only) and the 2013 base model.

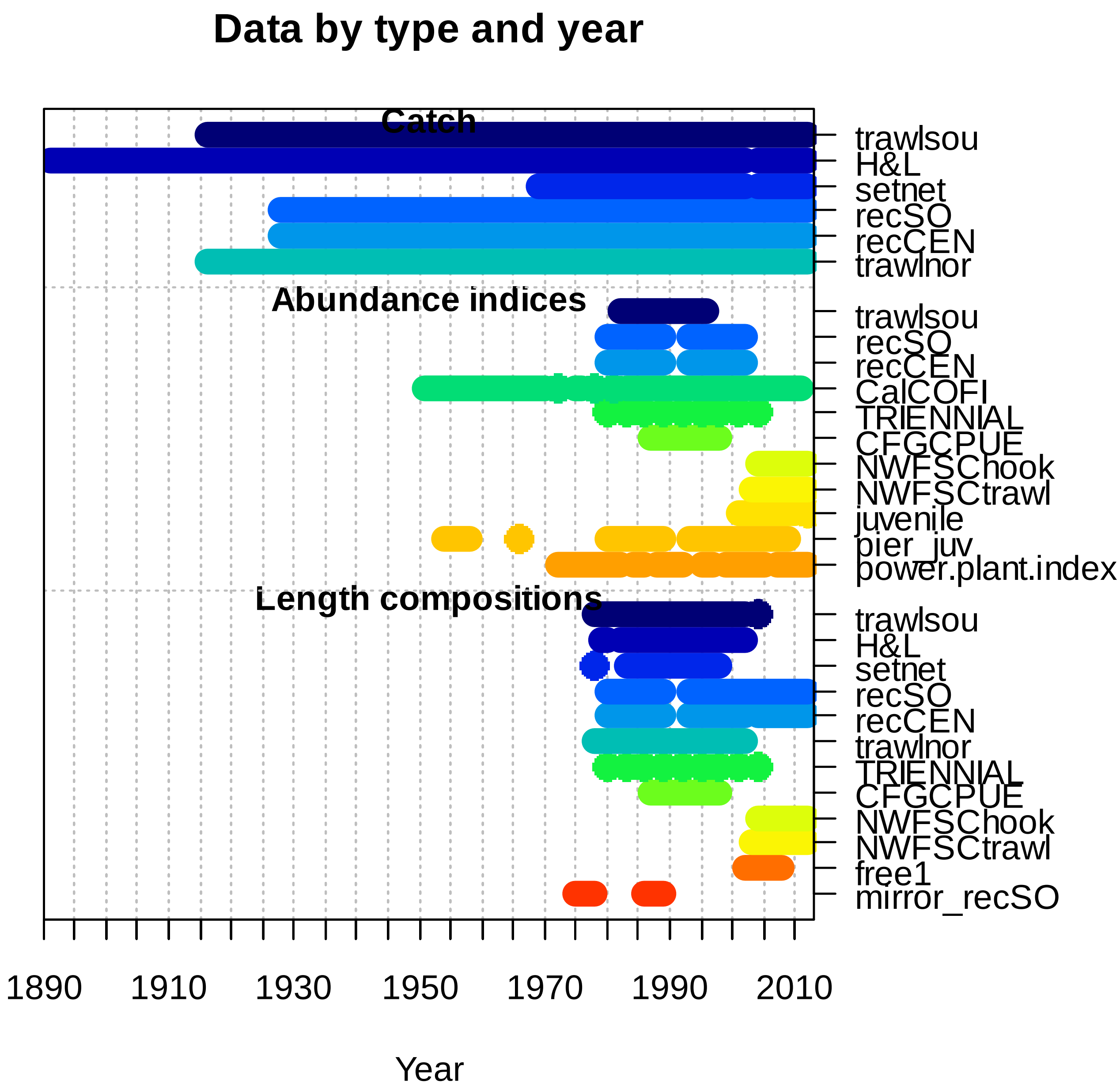
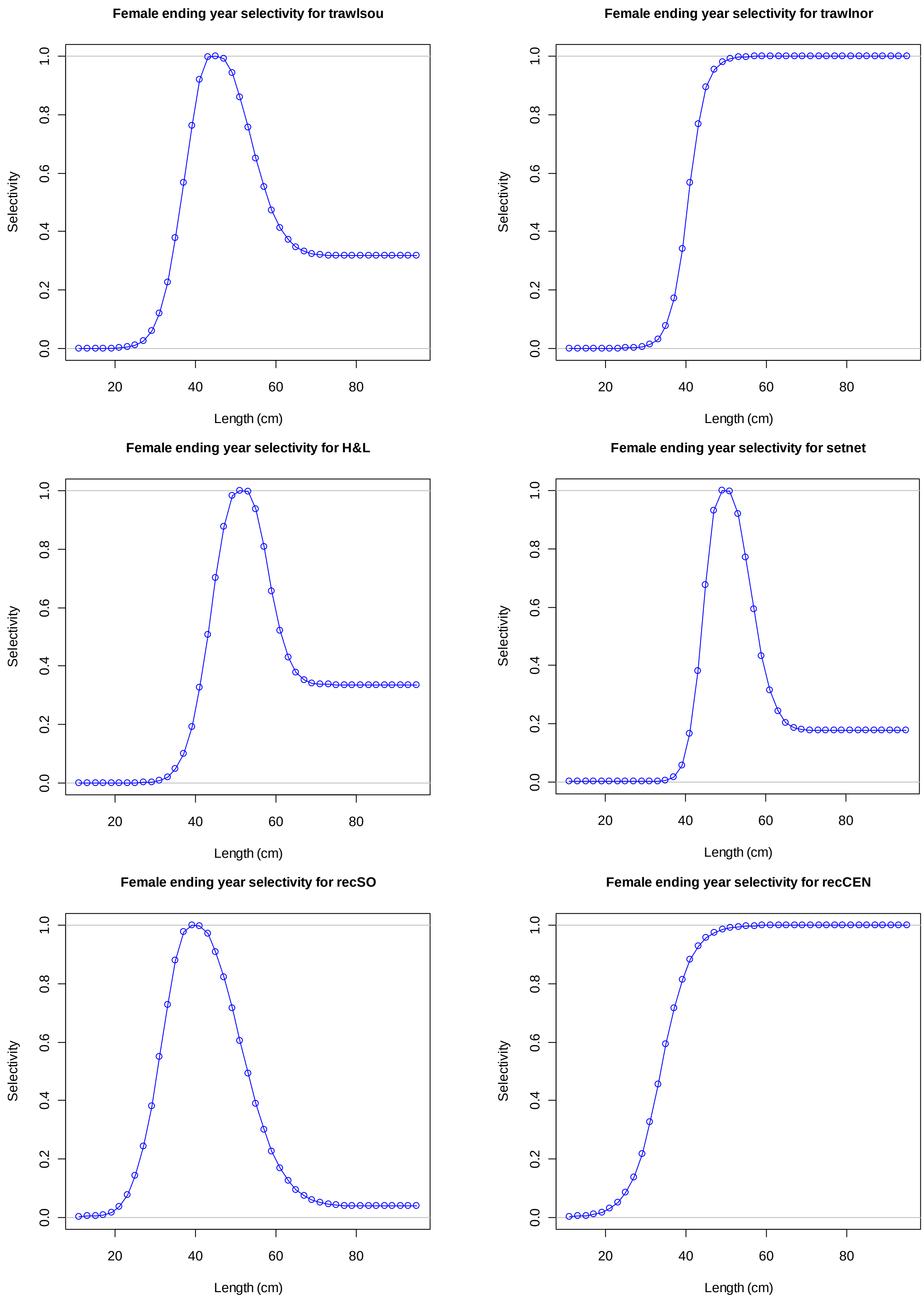
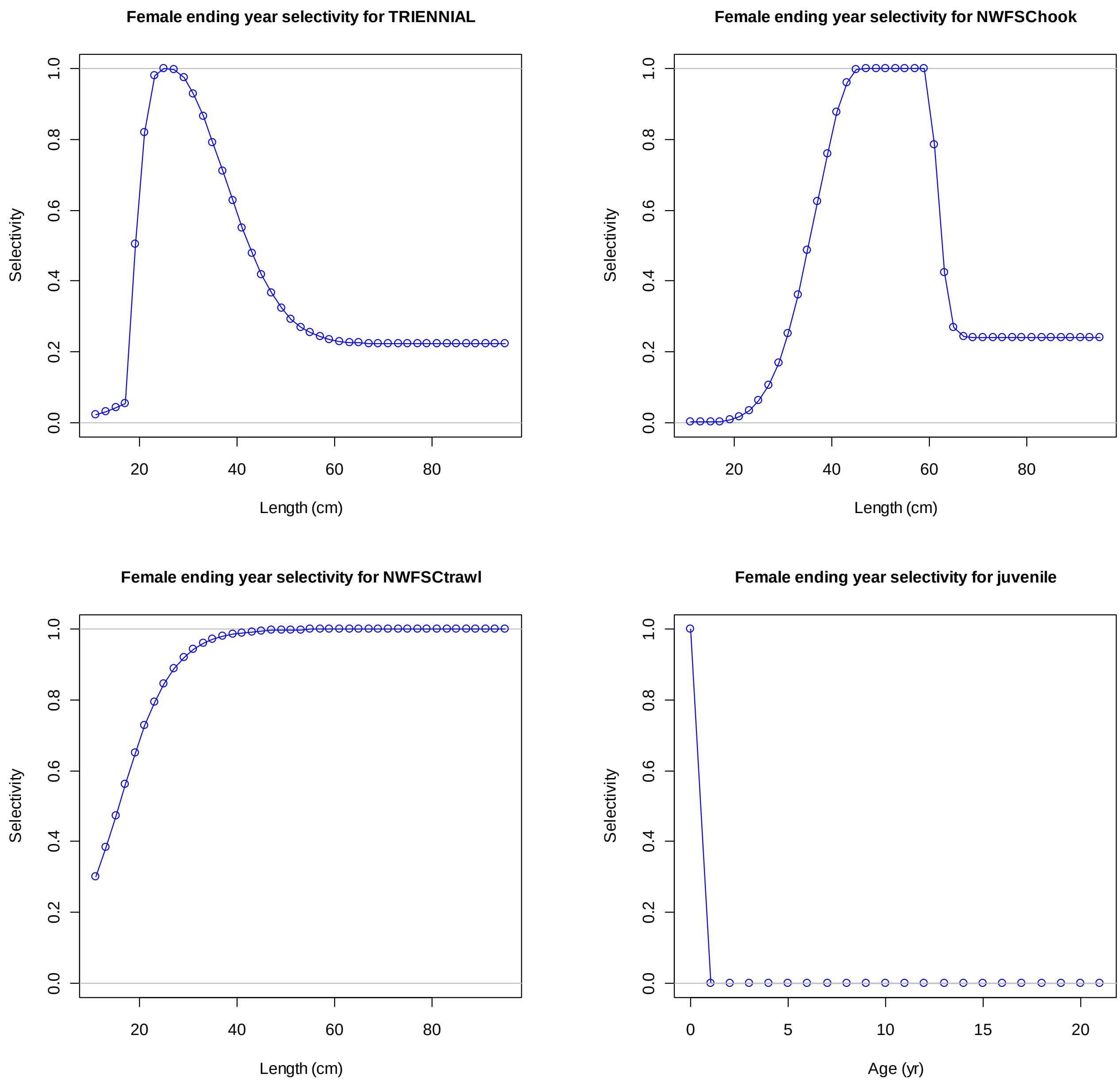


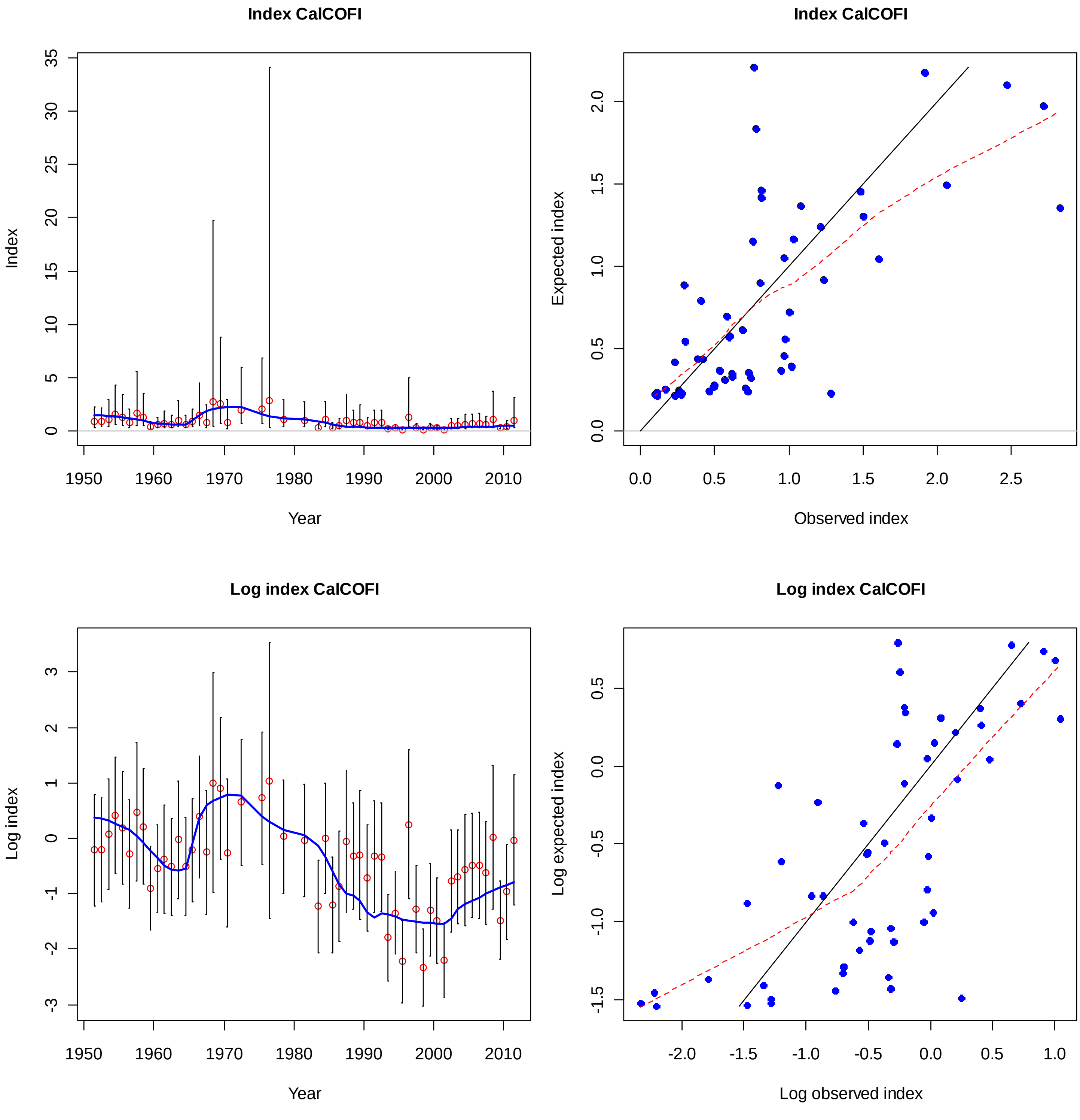
Figure 17: Summary of major sources of data used in the 2013 bocaccio model.



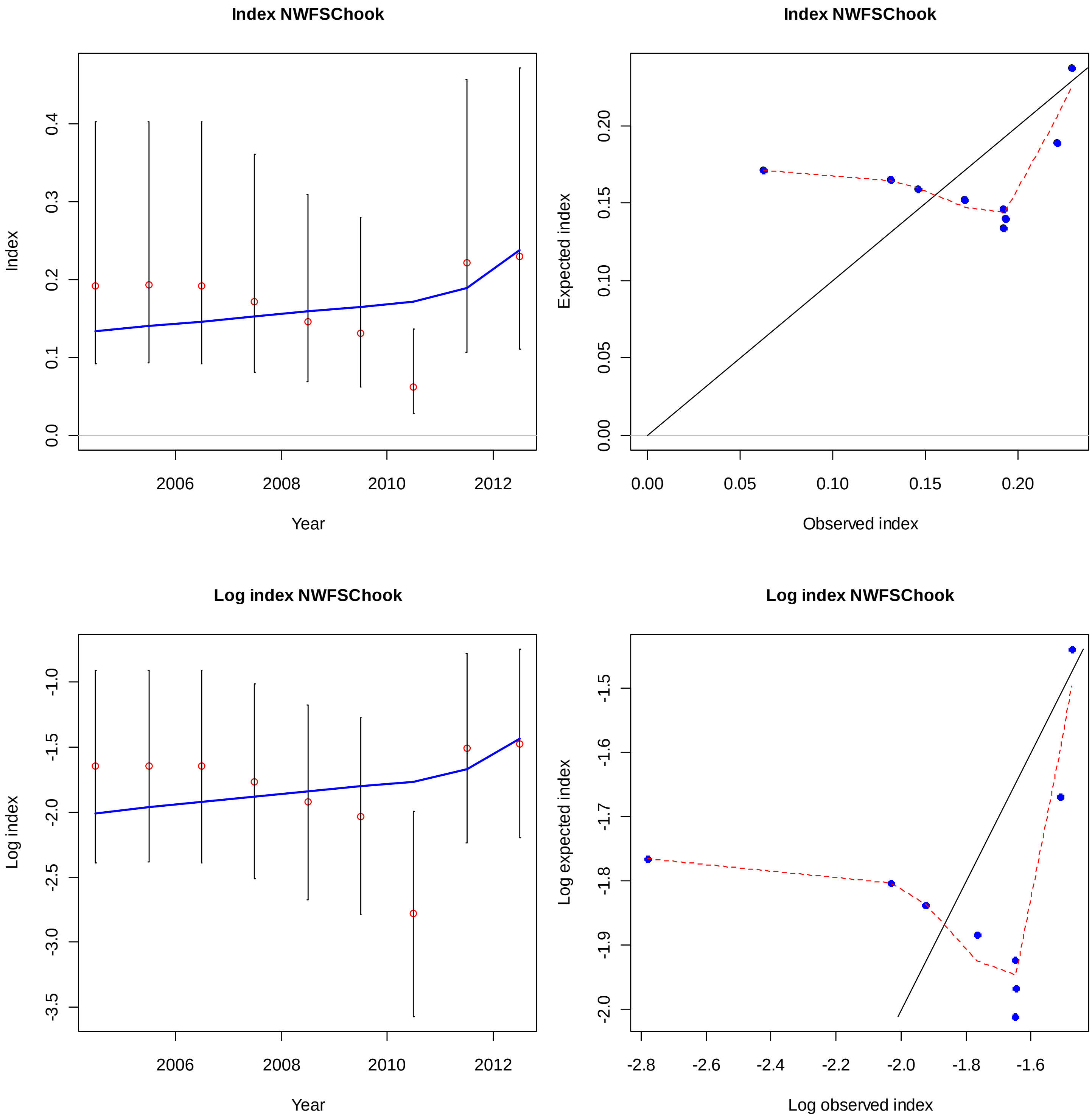
Figures 18 a-f. Selectivity curves for bocaccio in commercial and recreational fisheries as estimated in the 2013 base model.



Figures 19 a-d. Selectivity curves as estimated for fishery independent surveys from the 2013 base model.



Figures 20a-d. Arithmetic and log fits, with corresponding observed and predicted values, to the CalCOFI larval abundance time series of bocaccio abundance.



Figures 21a-d. Arithmetic and log fits, with corresponding observed and predicted values, to the NWFSC hook and line survey GLMM index of bocaccio abundance.

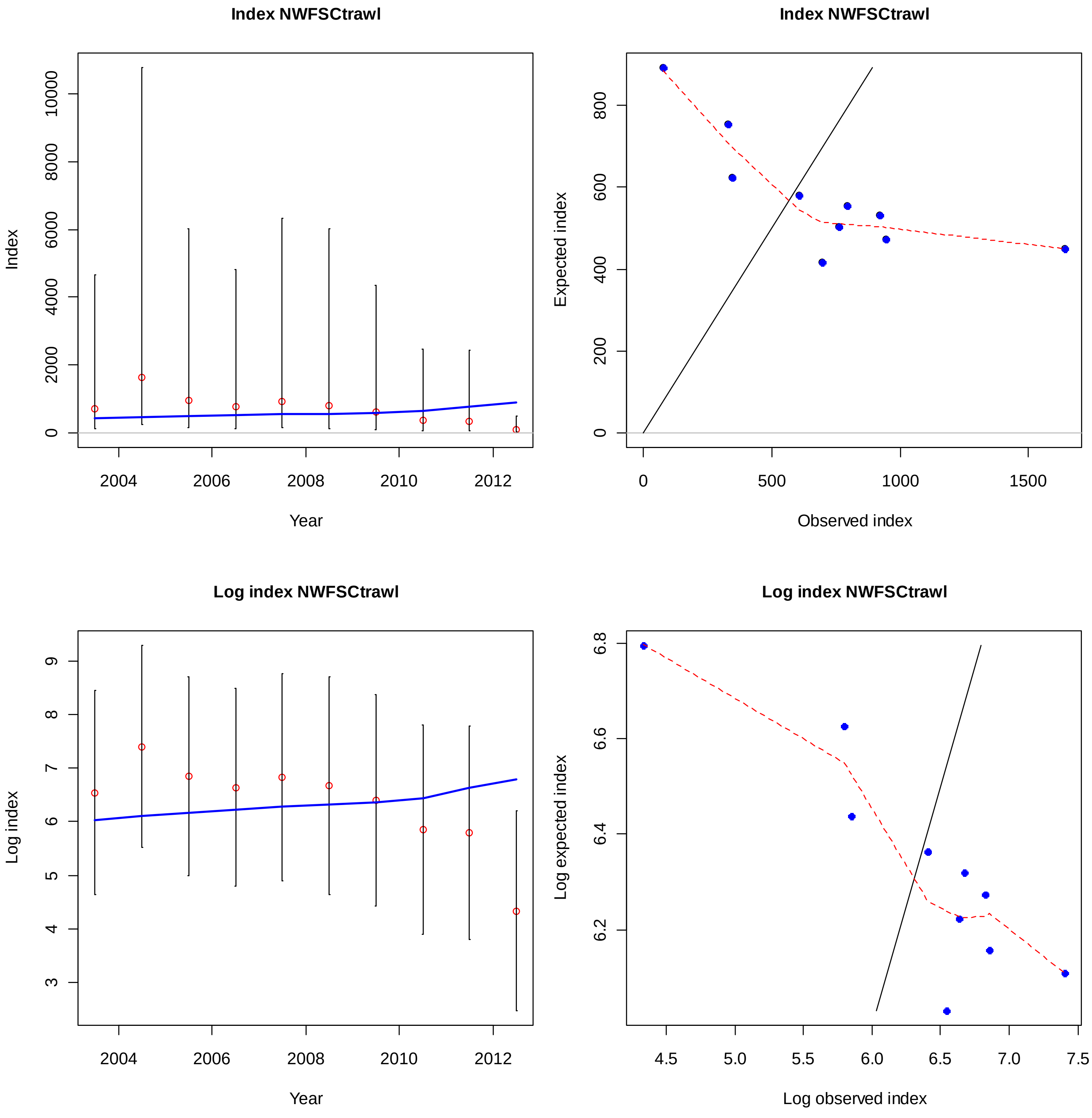


Figure 15a-d: Arithmetic and log fits, with corresponding observed and predicted values, to the NWFSC combined trawl survey index (revised to exclude age 0 fish, for STAT base model).

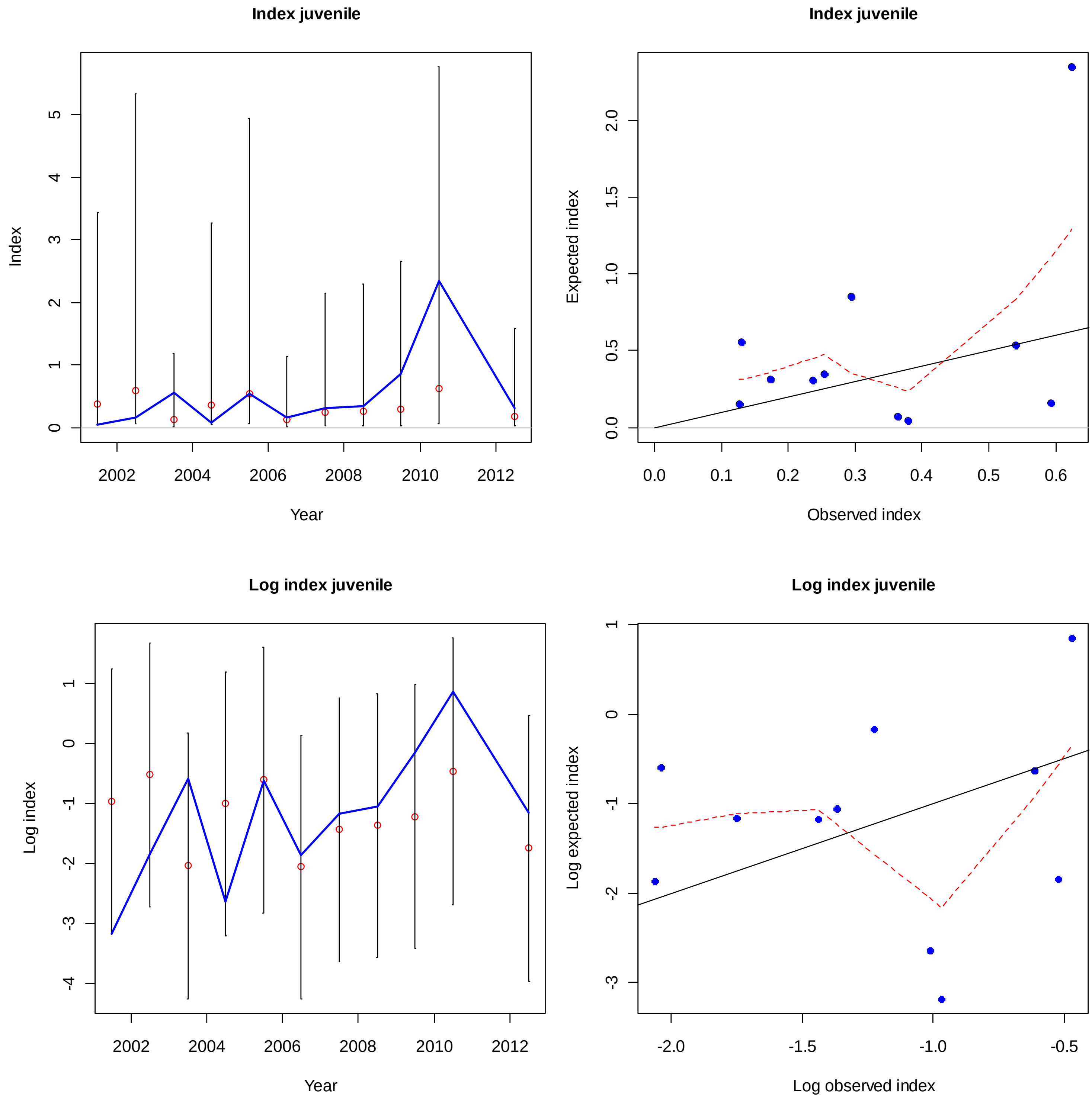


Figure 23a-d: Arithmetic and log fits, with corresponding observed and predicted values, to the SWFSC juvenile trawl survey index.

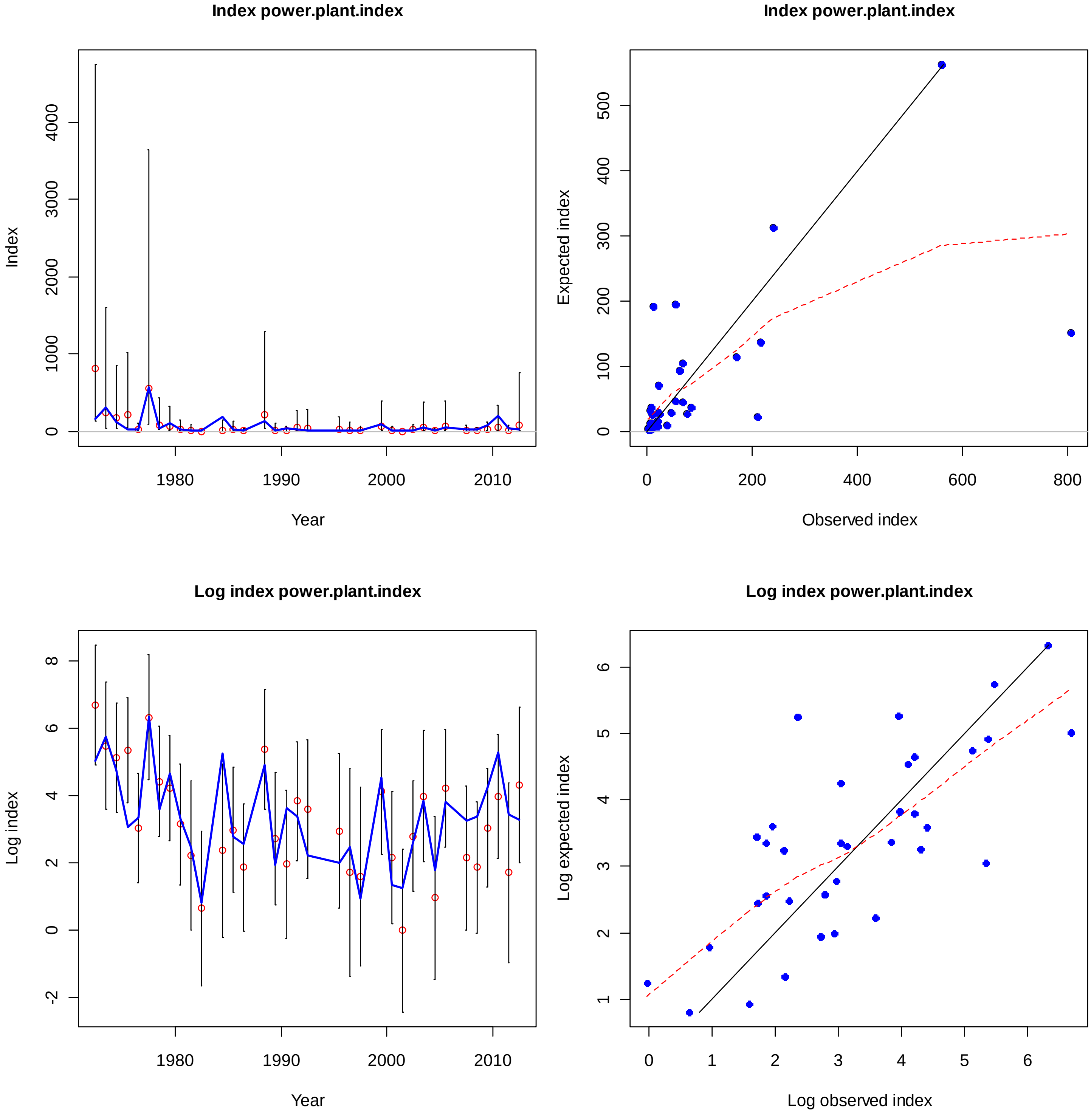


Figure 24: Arithmetic and log fits, with corresponding observed and predicted values, to the power plant impingement index.

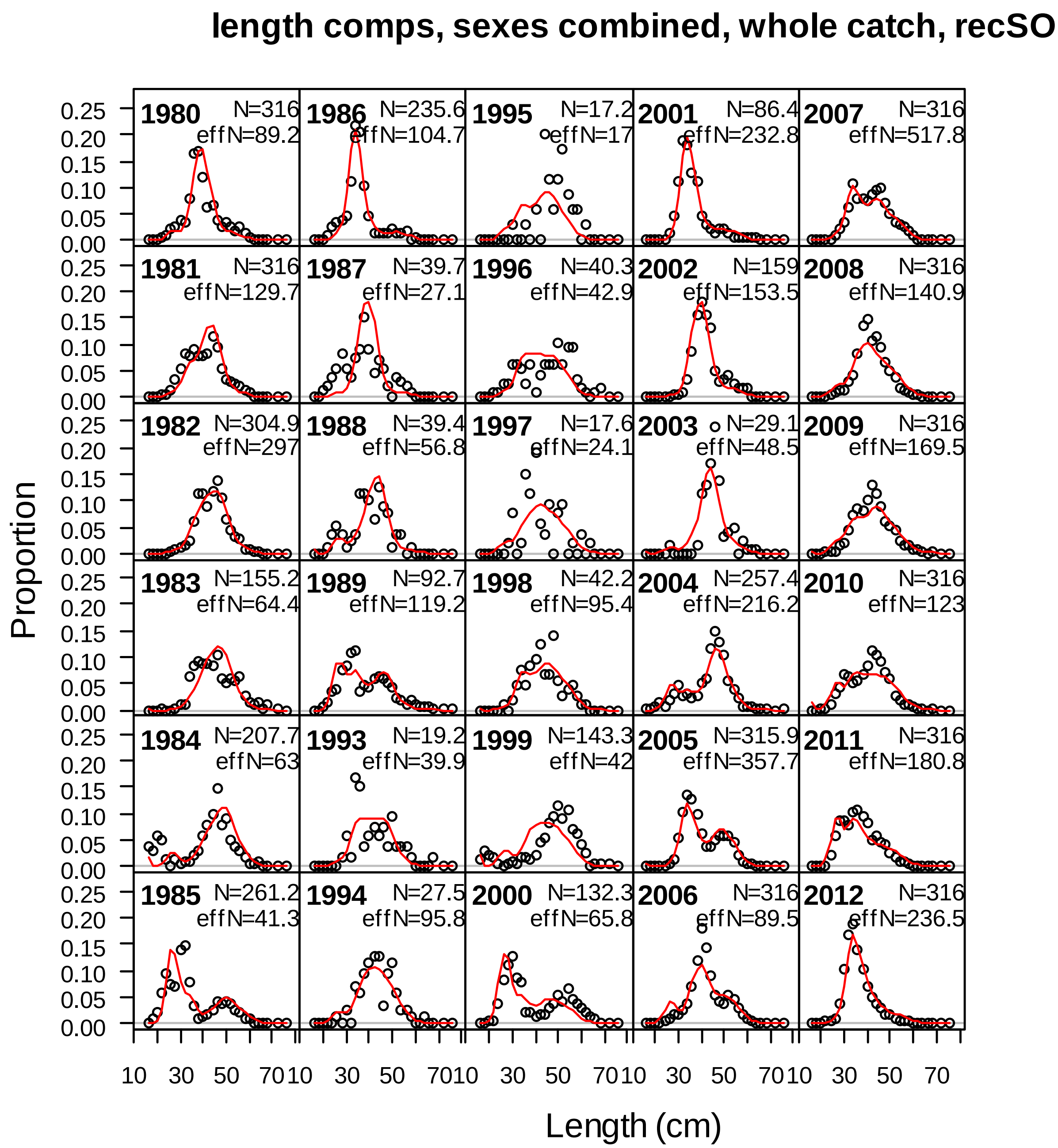
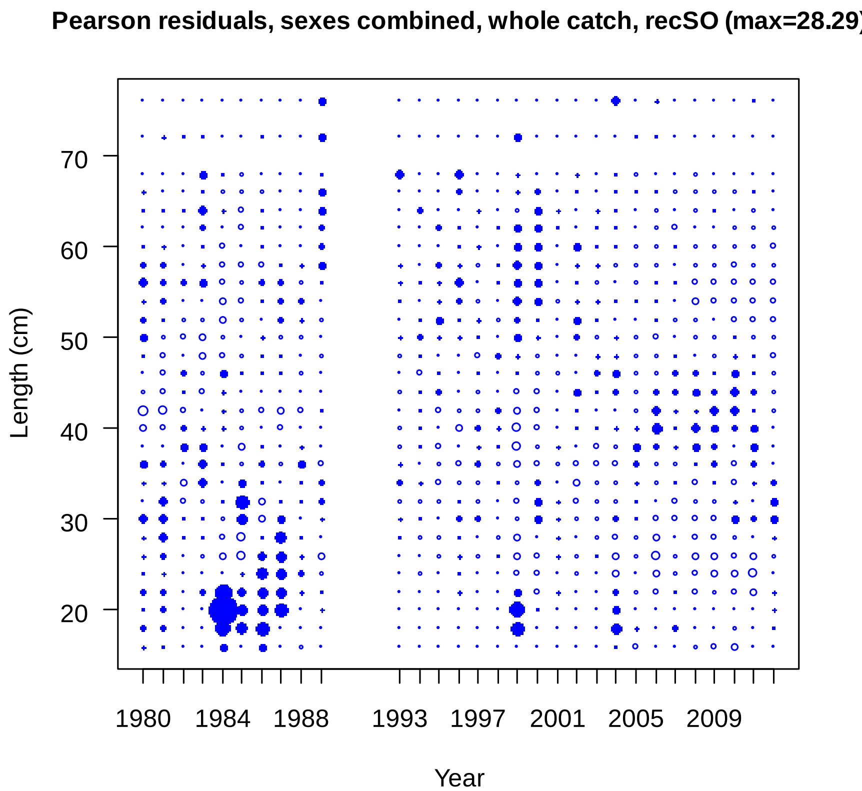


Figure 25: Fits to length frequency data (sexes combined) for the southern recreational fishery (2011 and 2012 data are new to update).



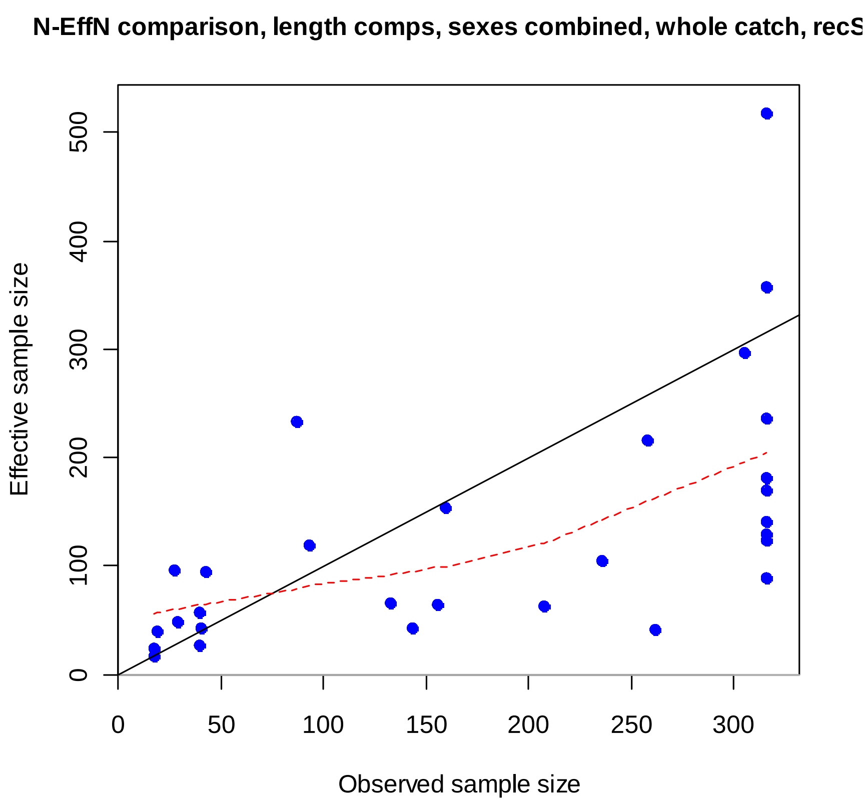


Figure 26: Residuals to length frequency fits and observed vs. effective sample sizes for the southern recreational fishery.

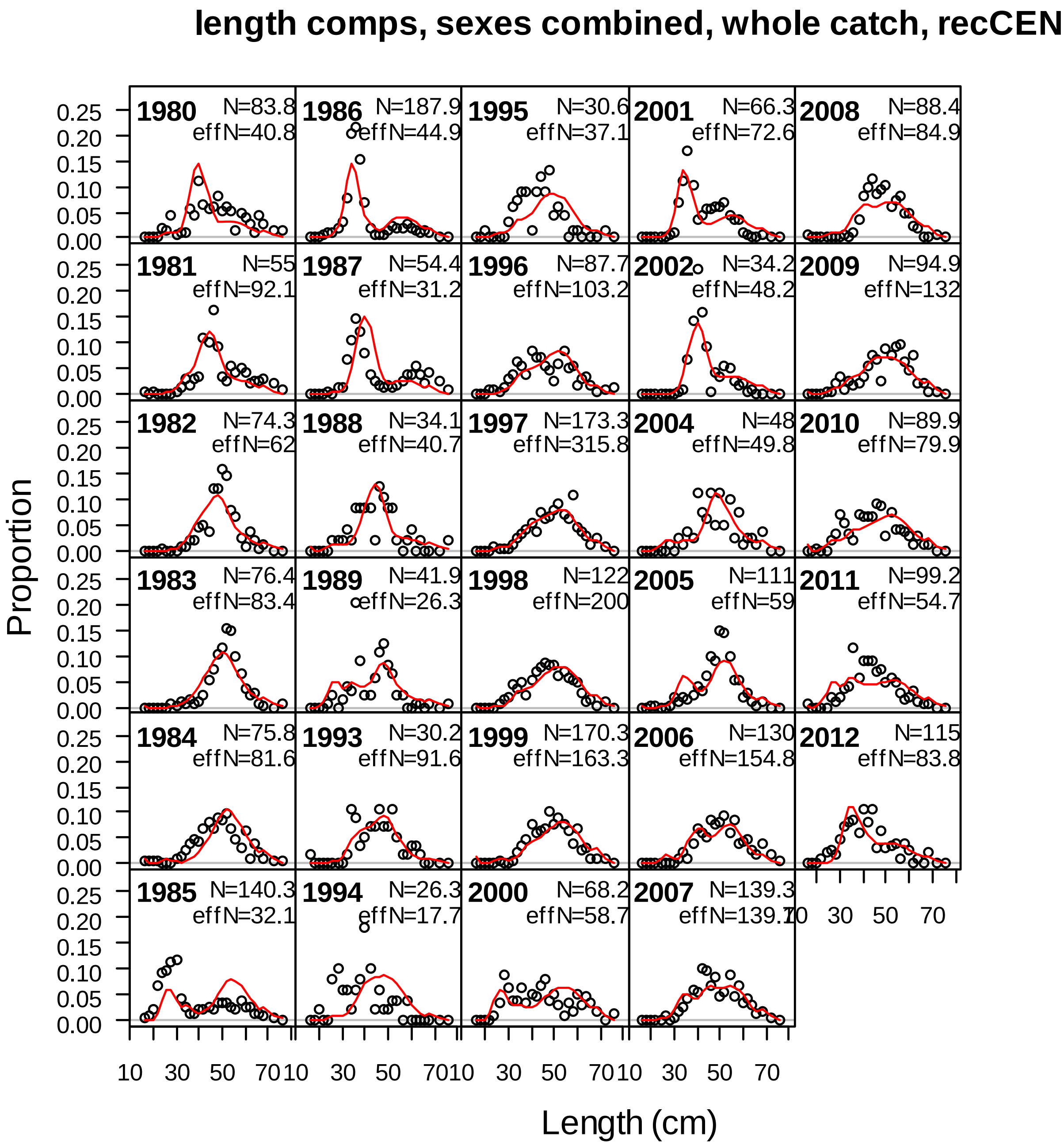
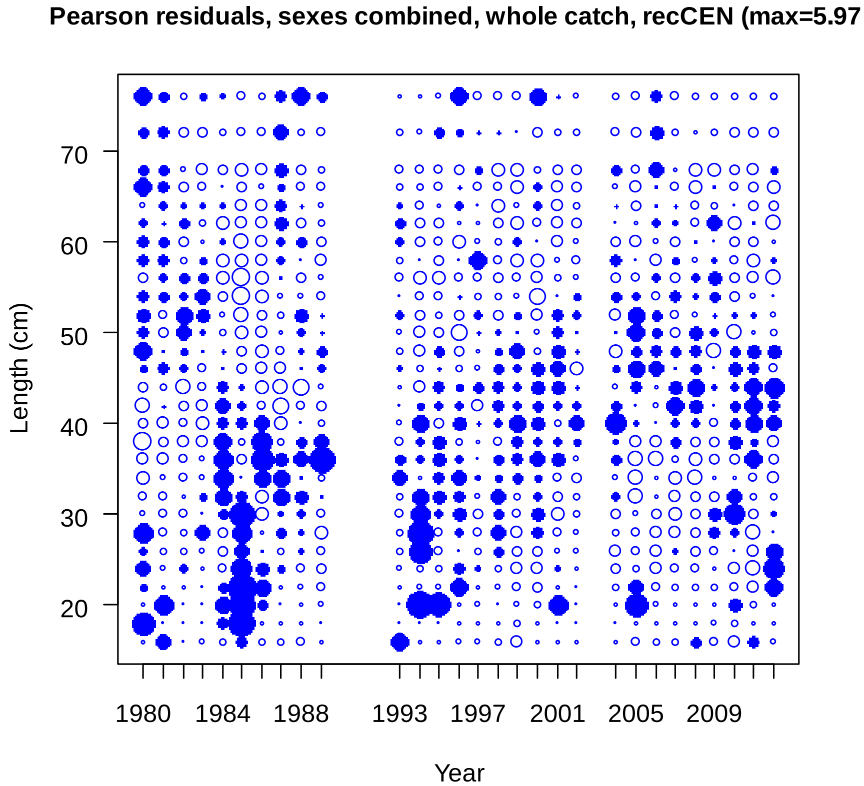


Figure 27: Fits to length frequency data (sexes combined) for the central California recreational fishery (2011 and 2012 data are new to update).



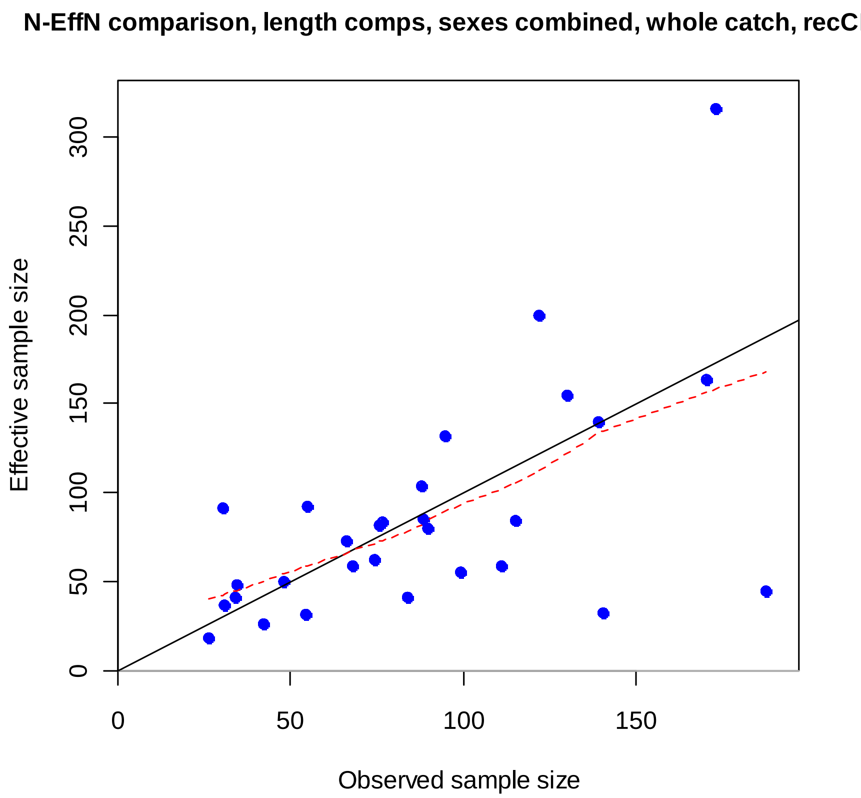


Figure 28: Residuals to length frequency fits and observed vs. effective sample sizes for the southern recreational fishery.

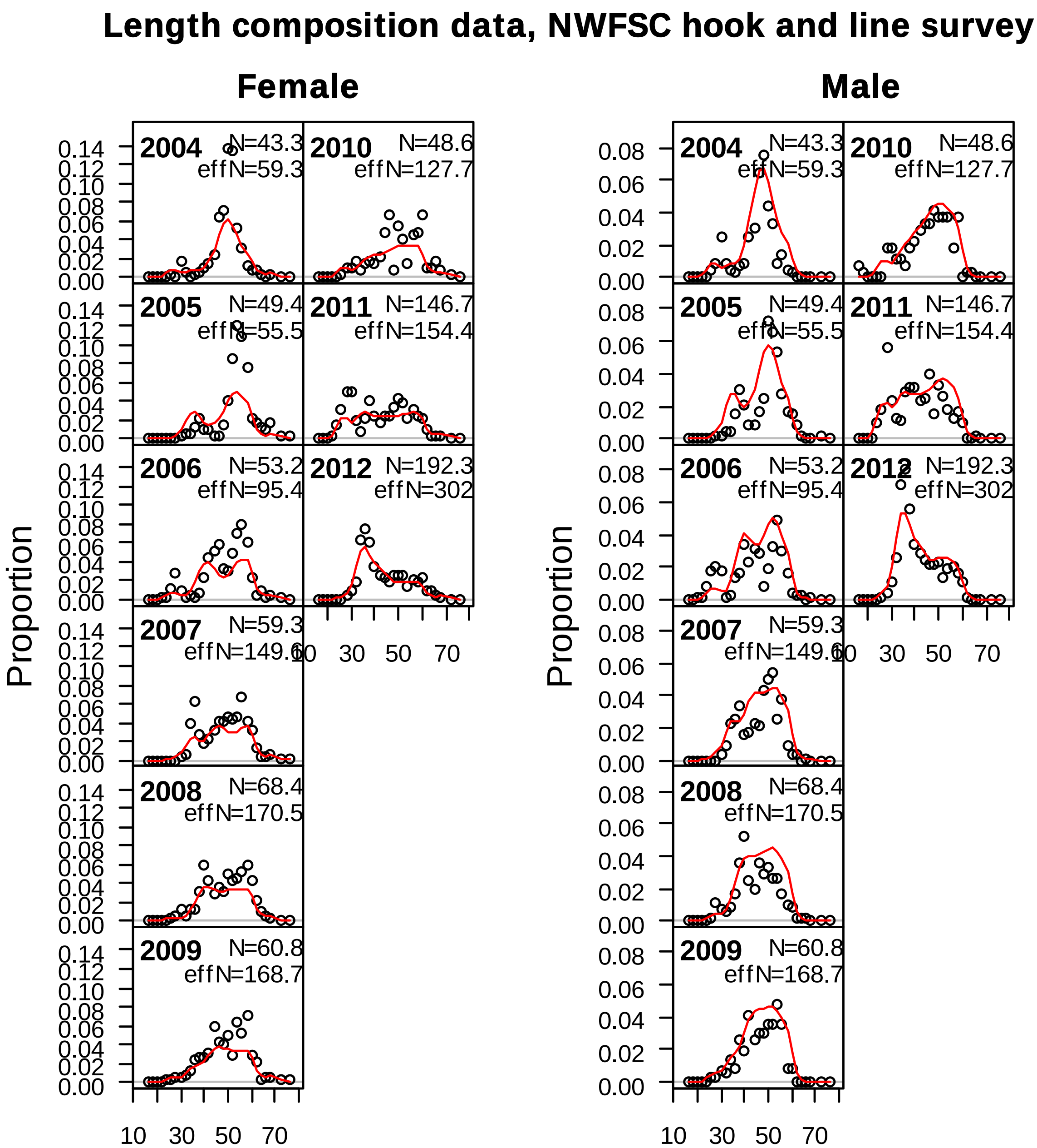


Figure 29: Fits to the NWFSC hook and line survey length frequency data.

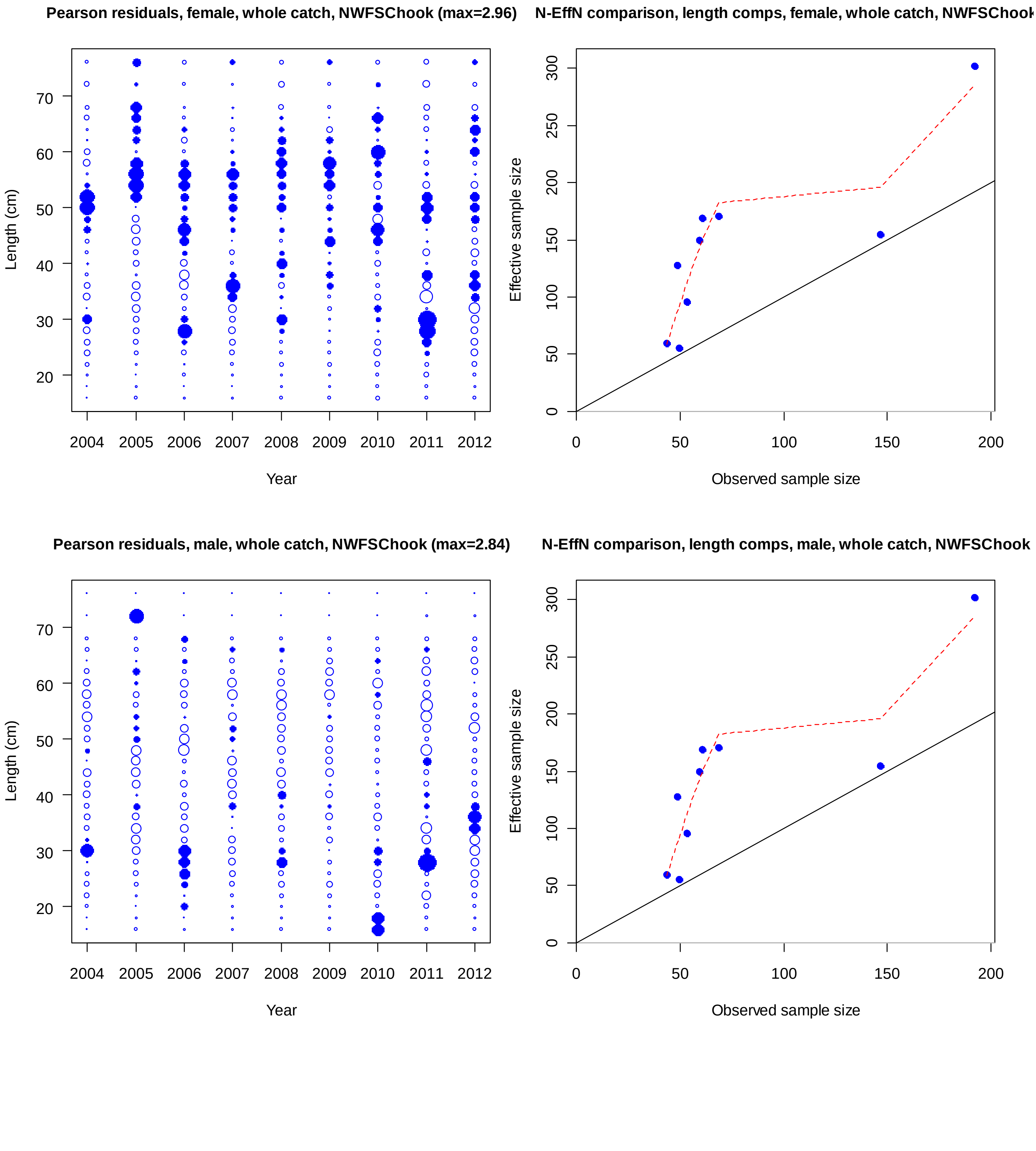


Figure 30: Residuals to length frequency fits and observed vs. predicted sample sizes for NWFSC hook and line survey data.

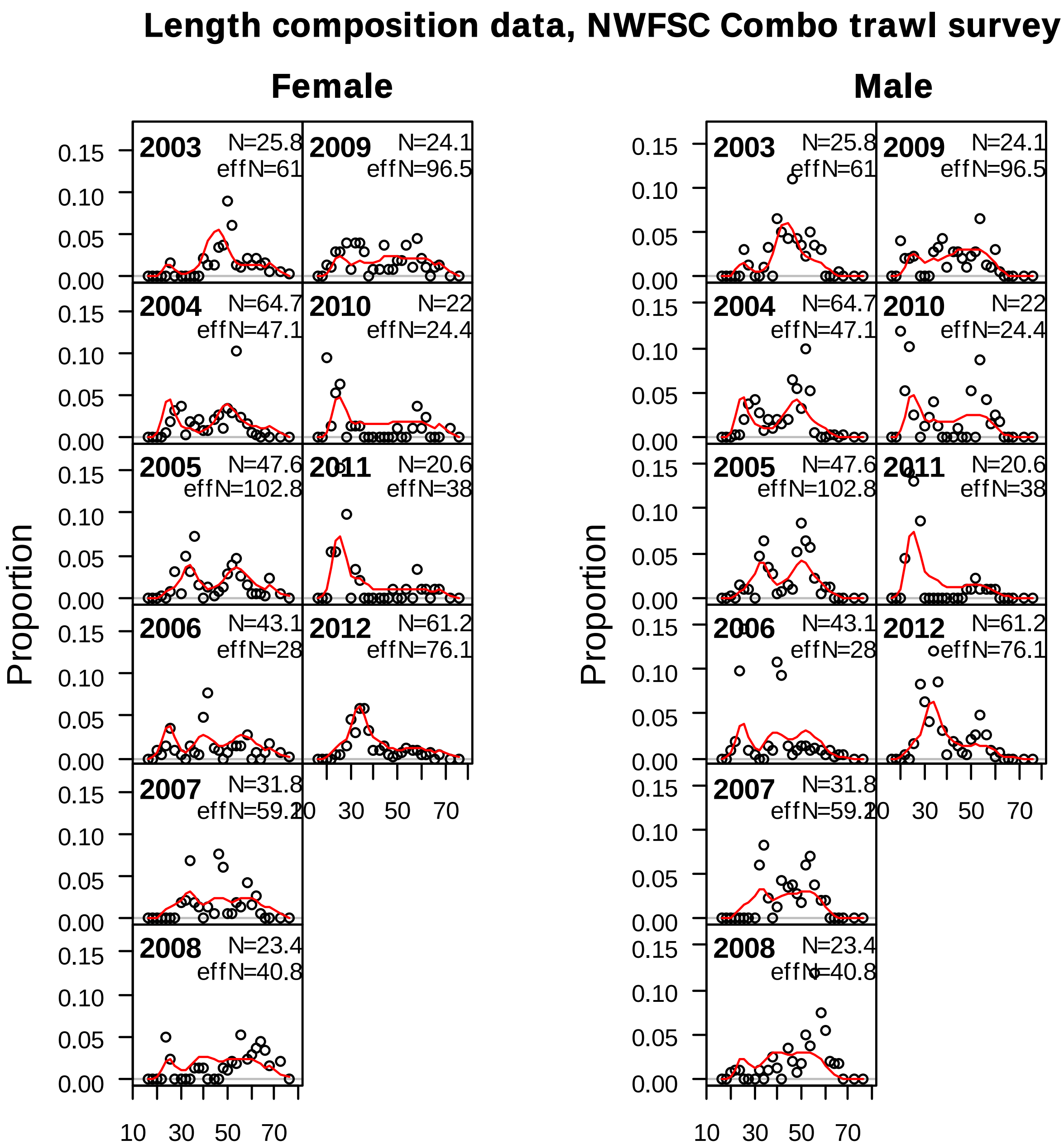


Figure 31: Fits to the NWFSC combined shelf-slope trawl survey length frequency data (for STAT model, sizes <20 cm removed, selectivity unselected for age-0 fish).

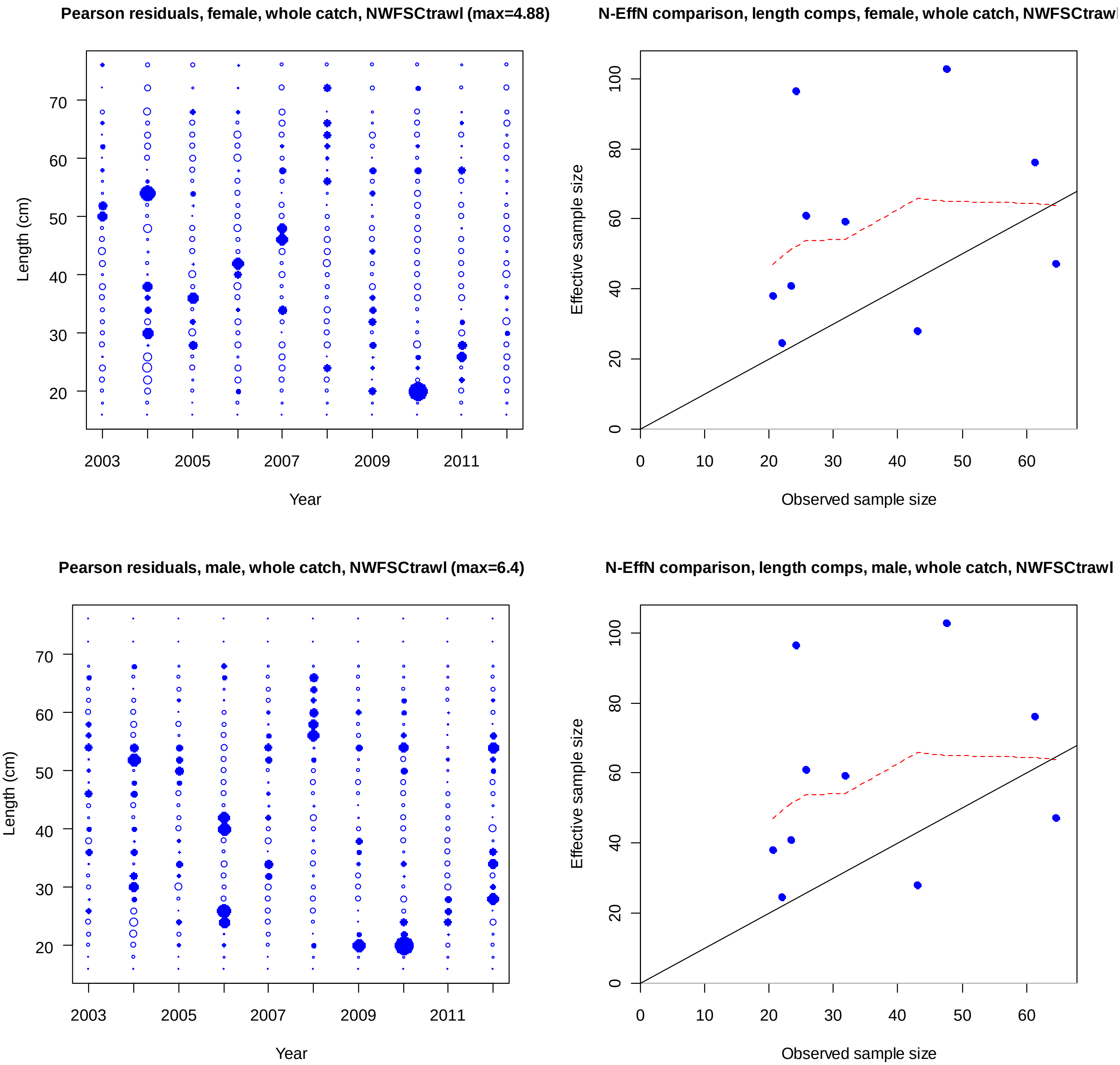


Figure 32: Residuals to length frequency fits and observed vs. predicted sample sizes for NWFSC shelf-slope bottom trawl survey data

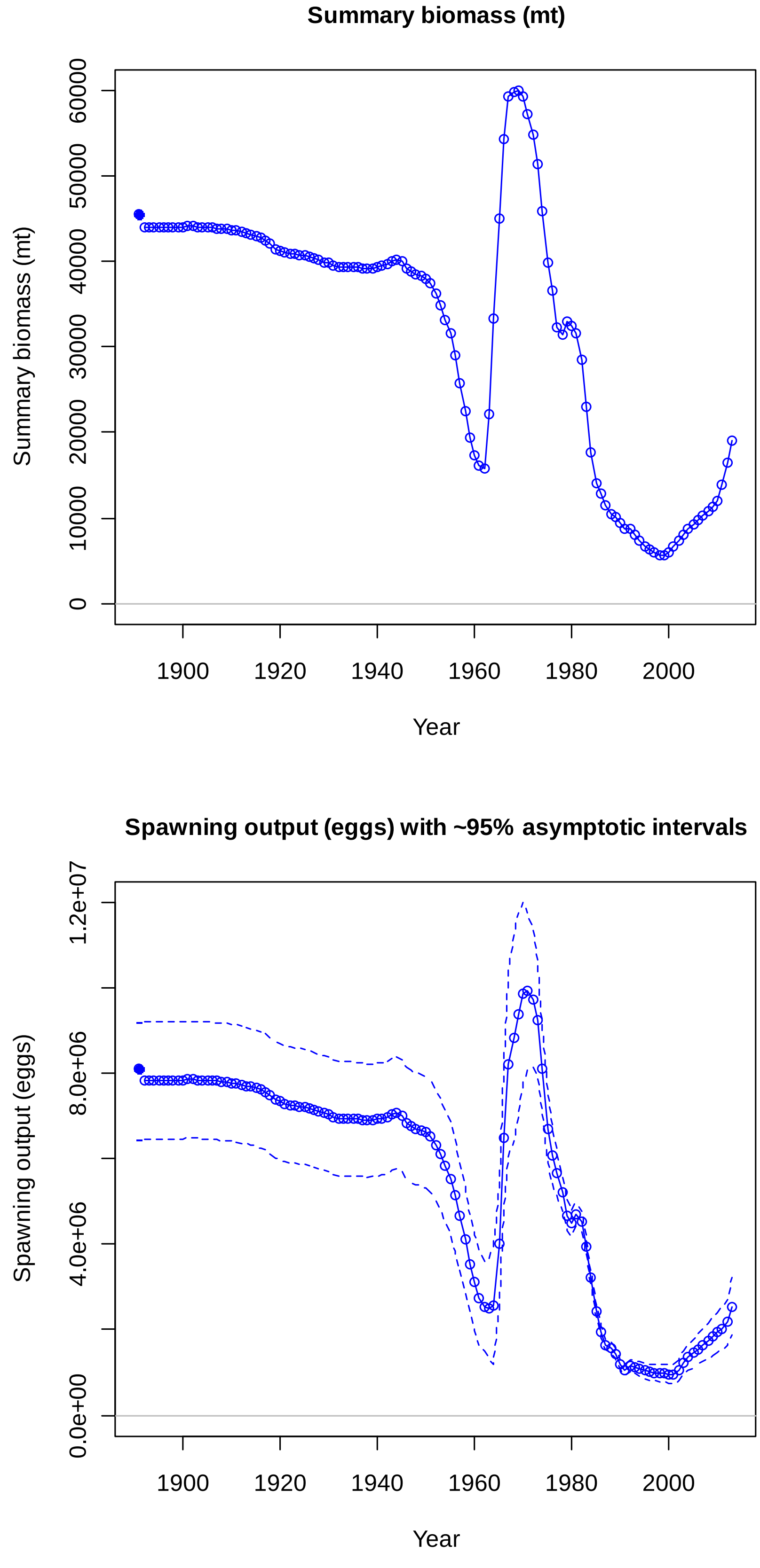


Figure 33: Summary biomass and spawning output for STAT base model.

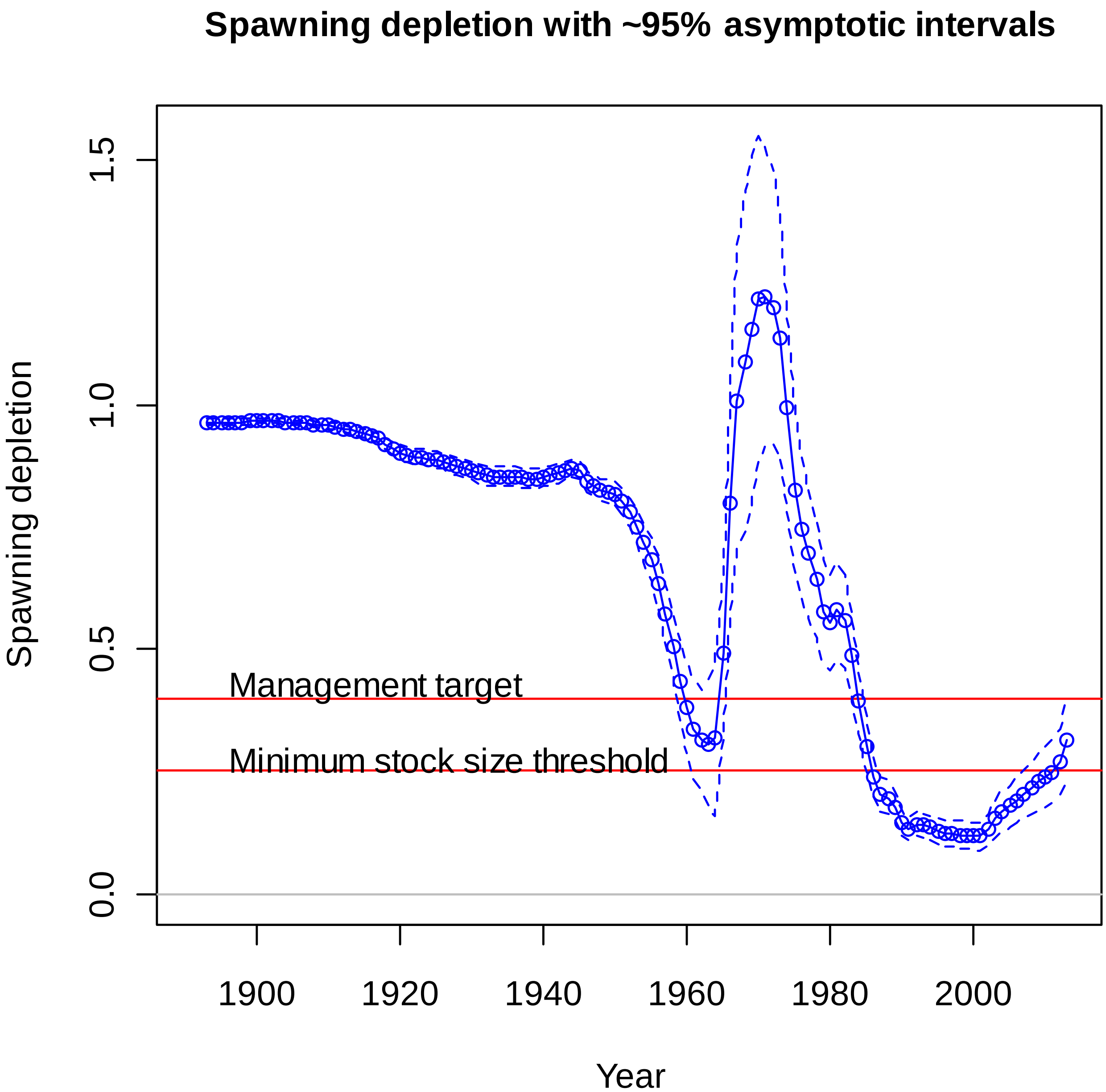
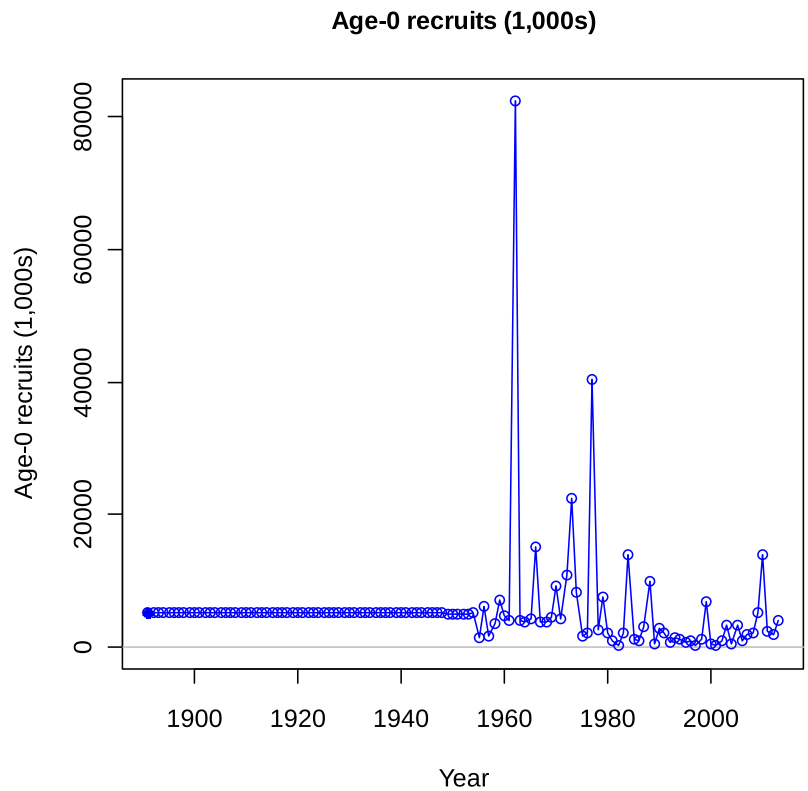


Figure 34: Relative depletion (top) with ~ 95% confidence limits (bottom) for base model.



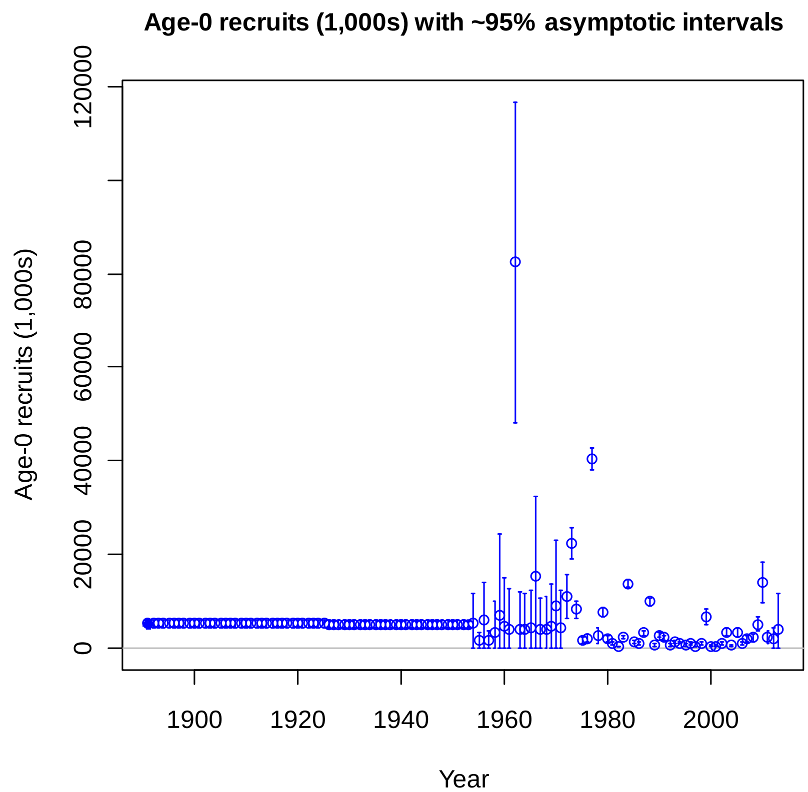
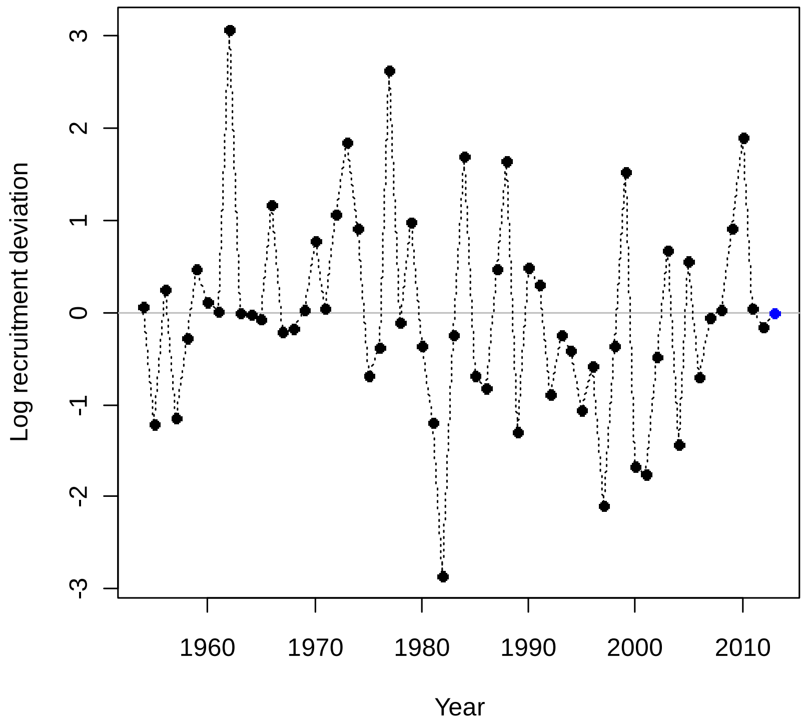


Figure 35: Recruitment estimates (top) with ~ 95% confidence limits (bottom) for base model.



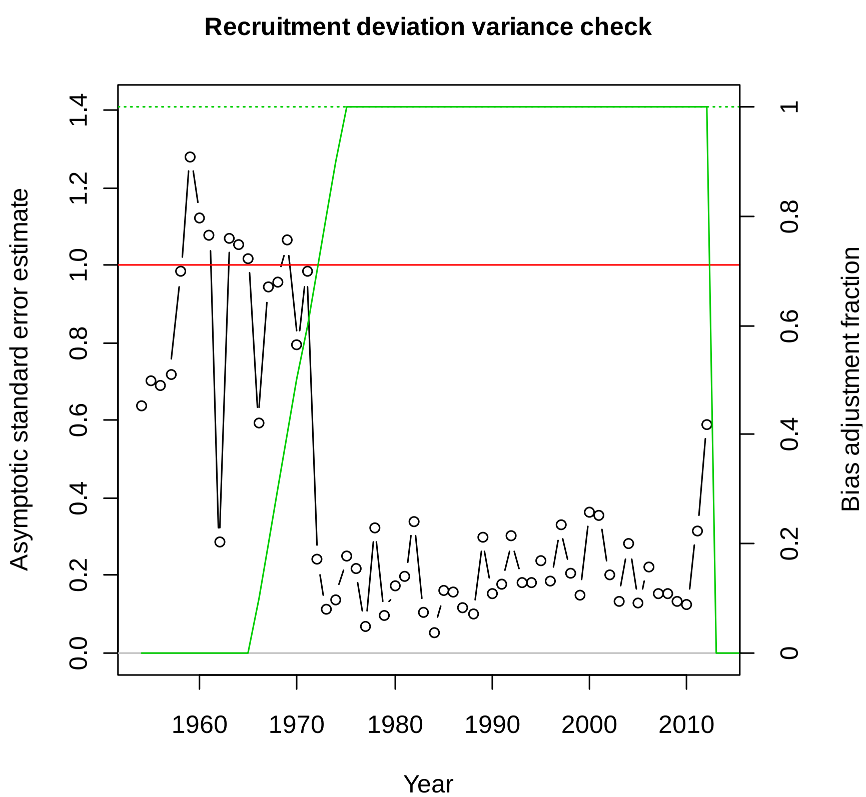


Figure 36: Estimated recruitment deviation parameter values (top) with approximate standard error estimates (bottom).

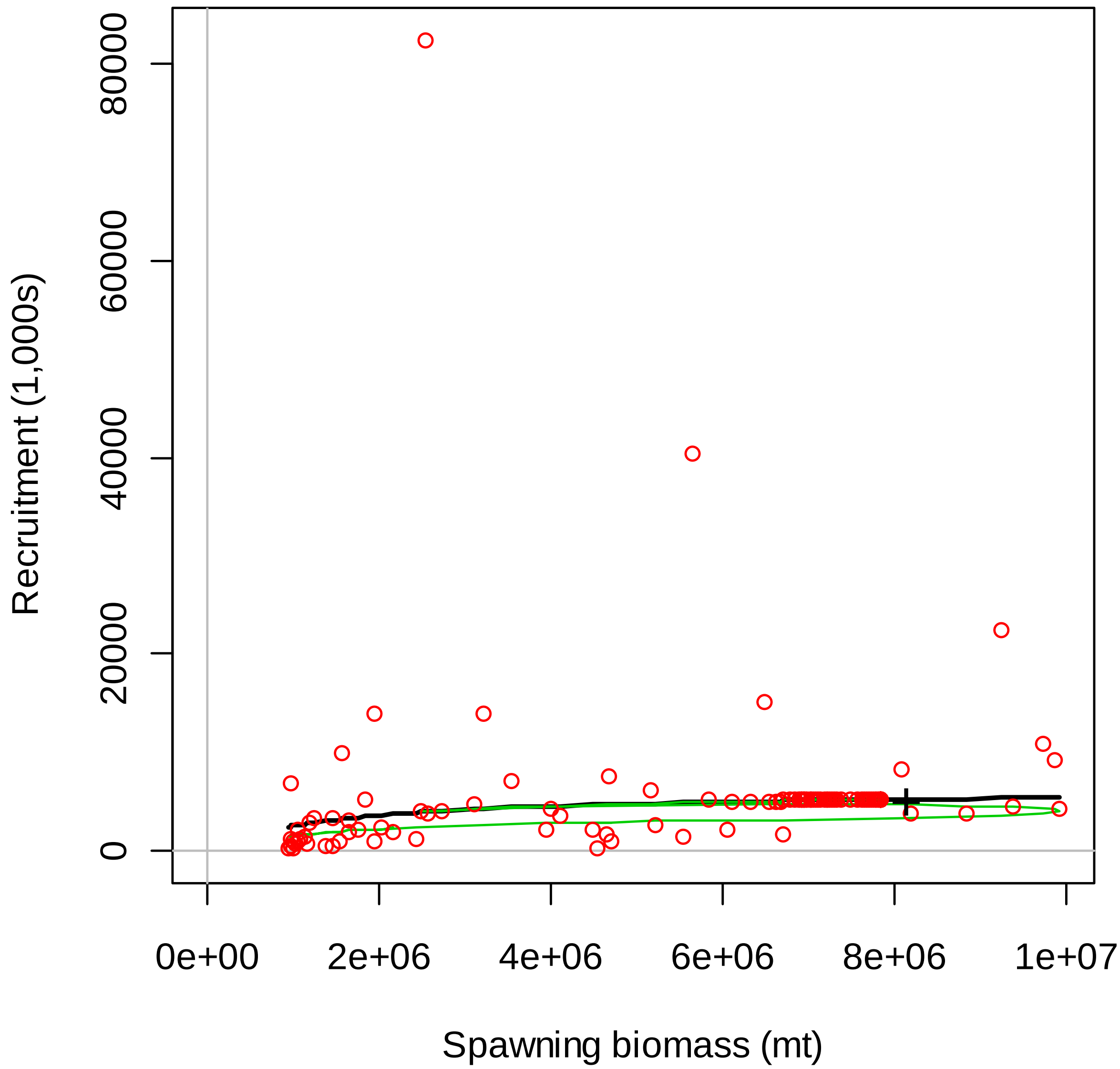


Figure 37: Estimated spawner-recruit relationship, with observed recruitments, for the base model

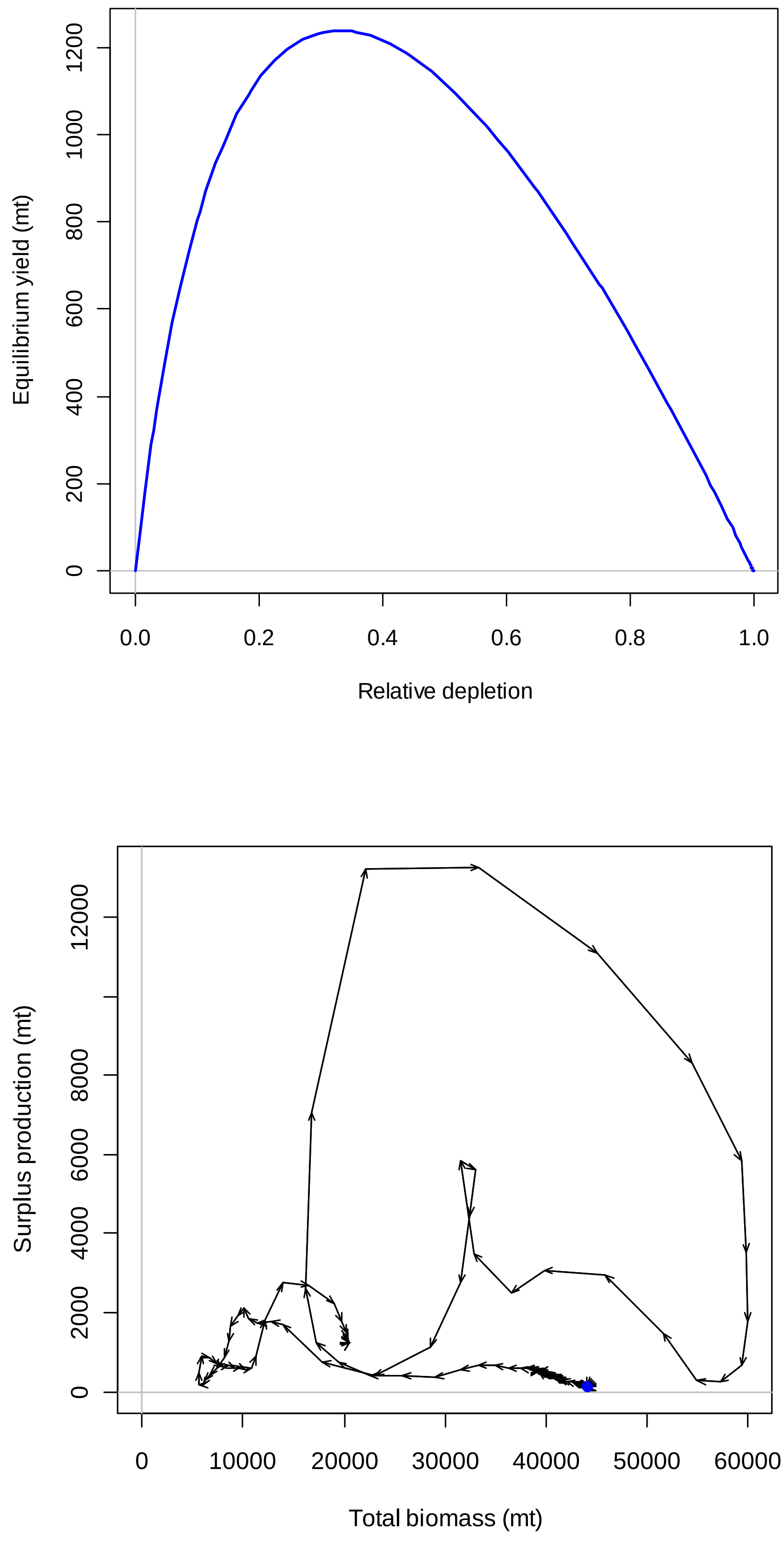


Figure 38: Estimated equilibrium yield curve (top) and phase plot of total biomass against surplus production (bottom) for base model

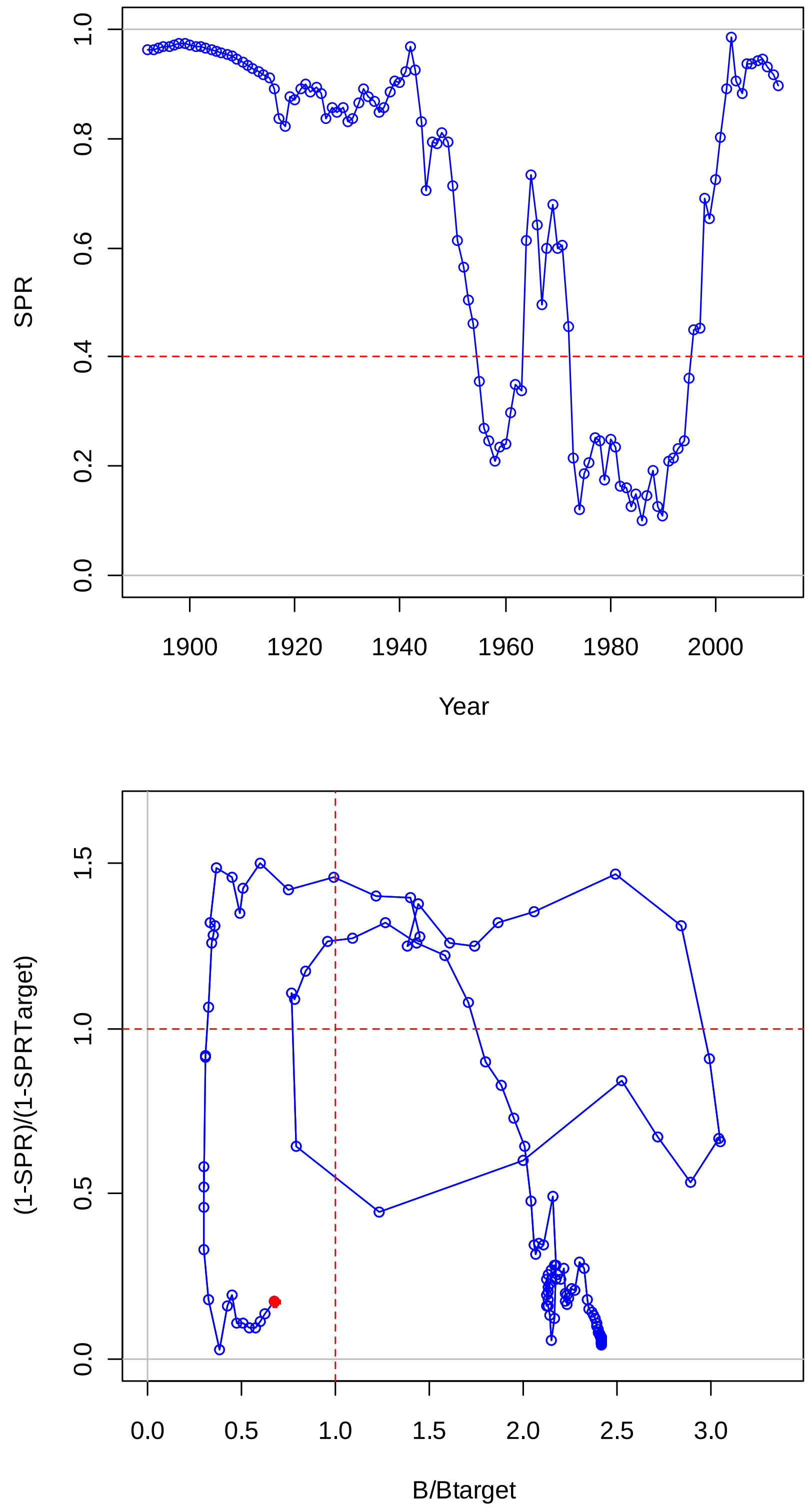


Figure 39: Base model estimates of SPR and relative SPR against biomass (relative to target)- NOTE SPR target incorrectly listed here as 0.4, should be 0.5.

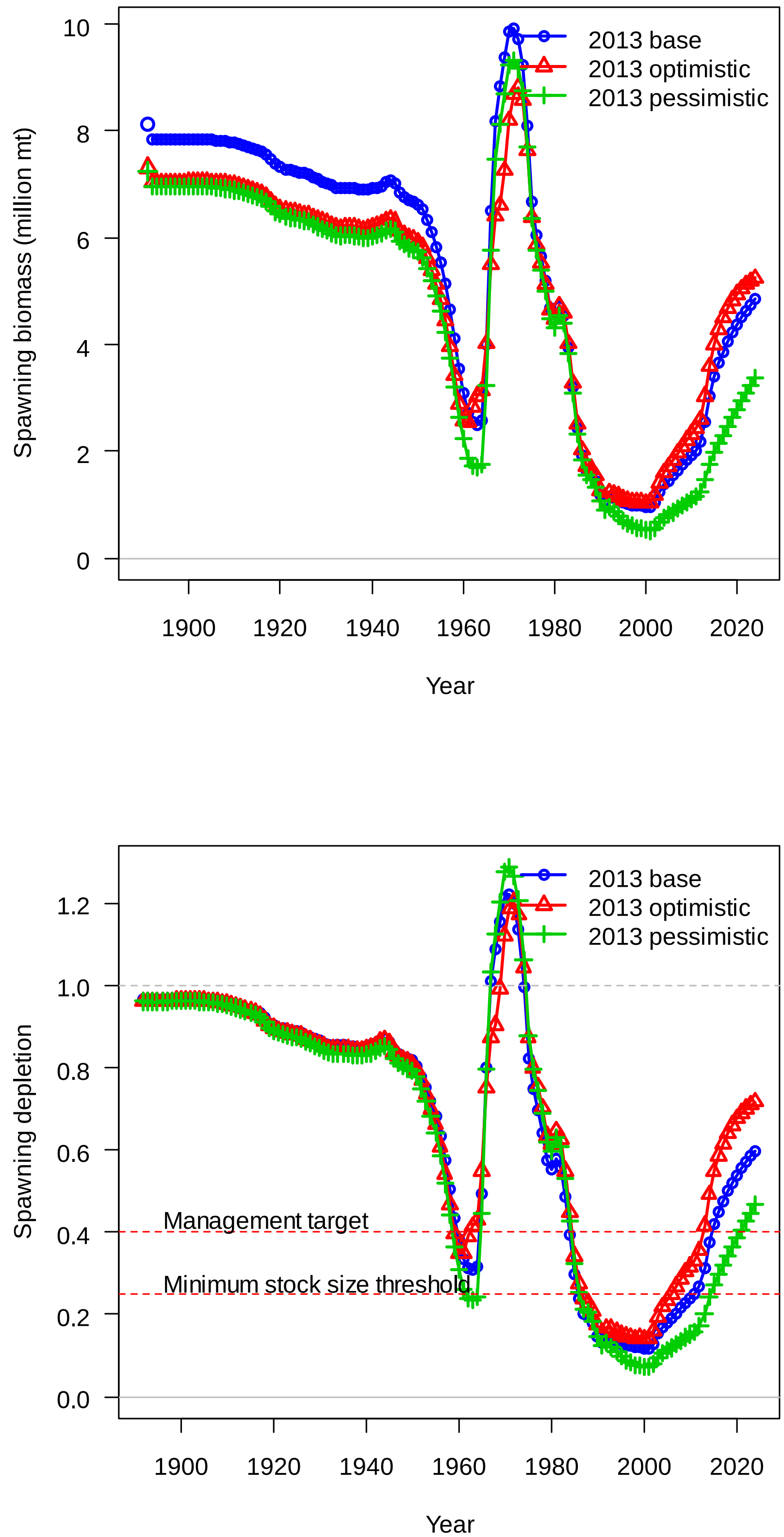


Figure 40: Comparison of base model spawning output and relative depletion results with alternative states of nature and 12 year forecast.

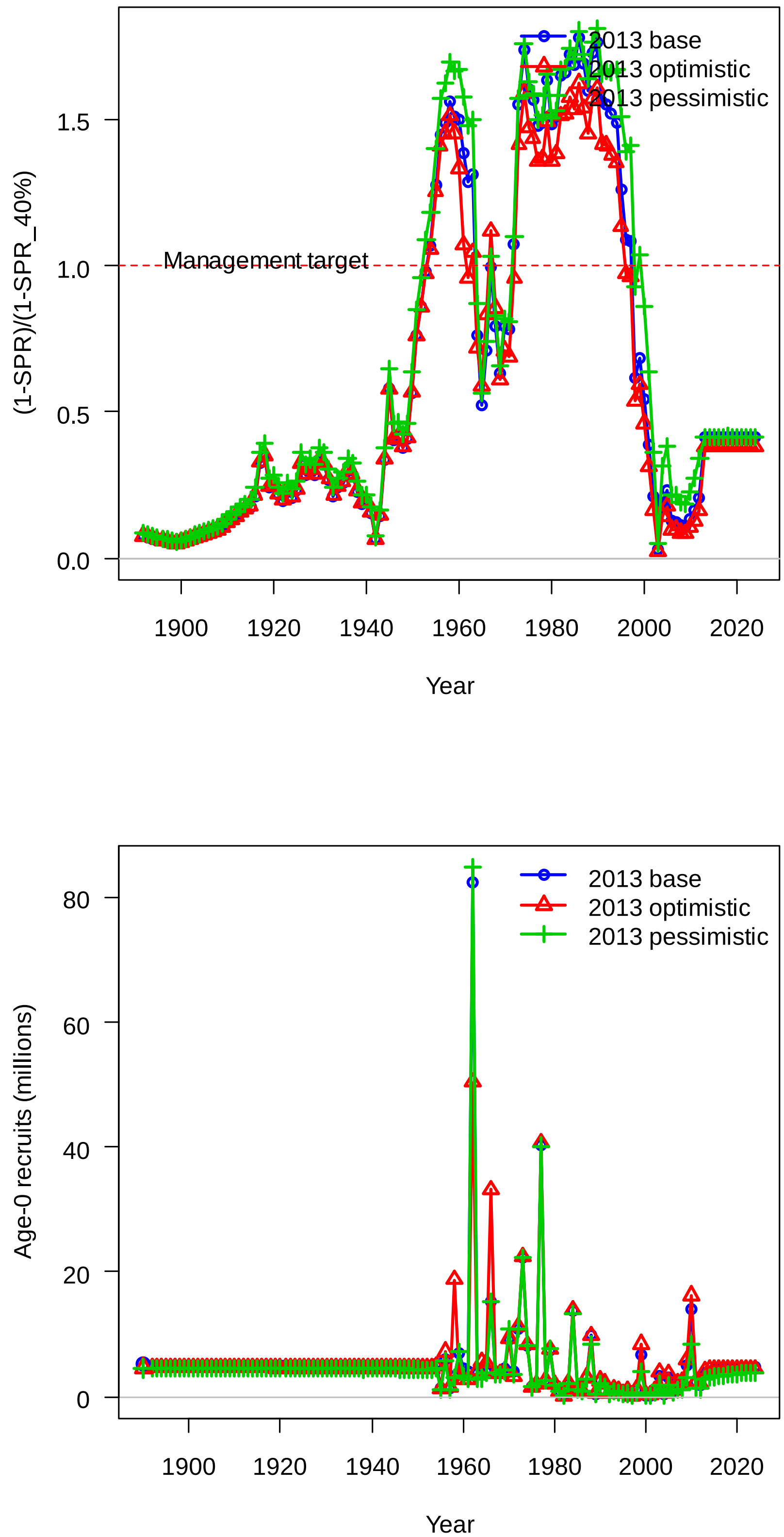
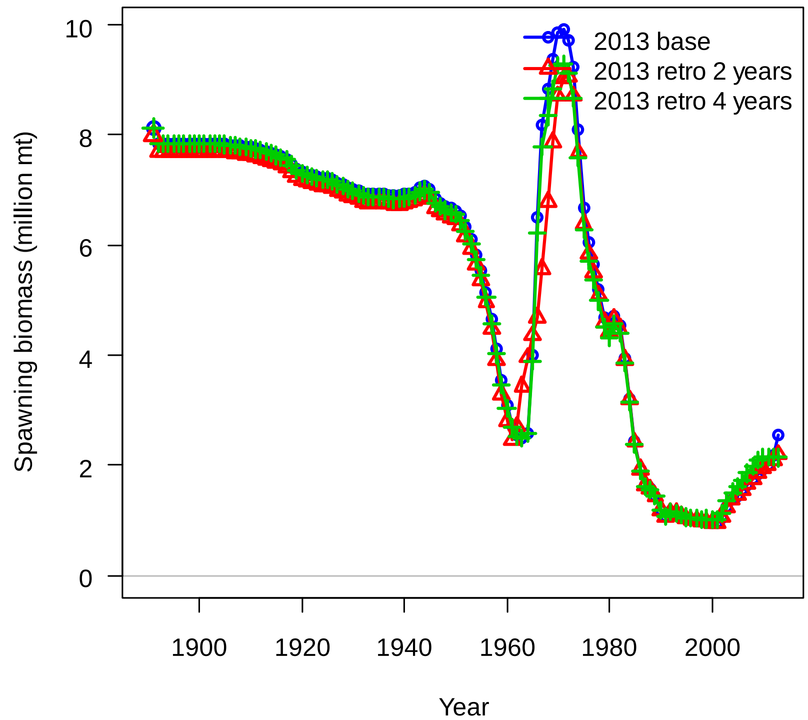


Figure 41: Comparison of base model relative harvest rate and recruitment estimates with alternative states of nature.



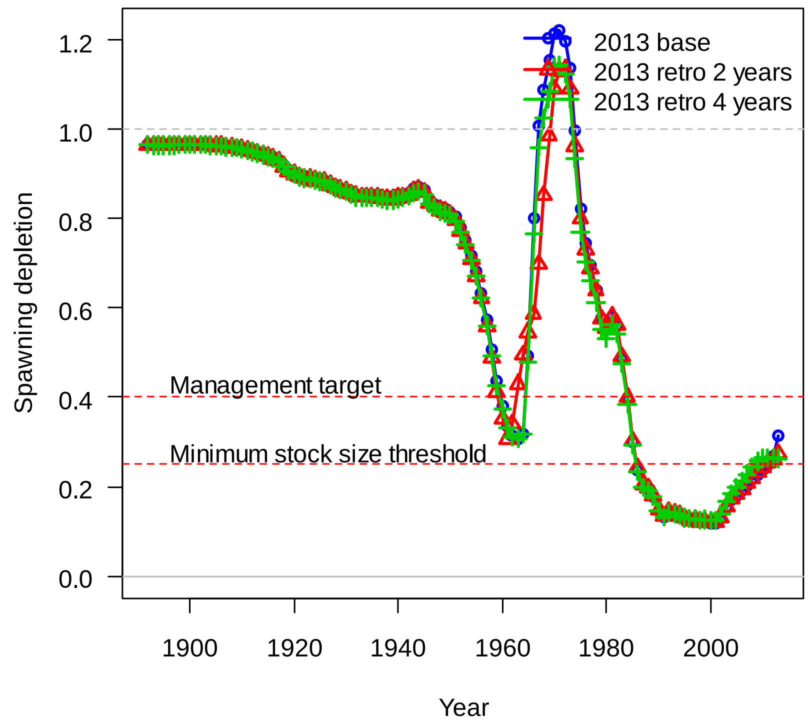


Figure 42: Comparison of base model spawning output and relative depletion with retrospective (2 and 4 year) analysis.

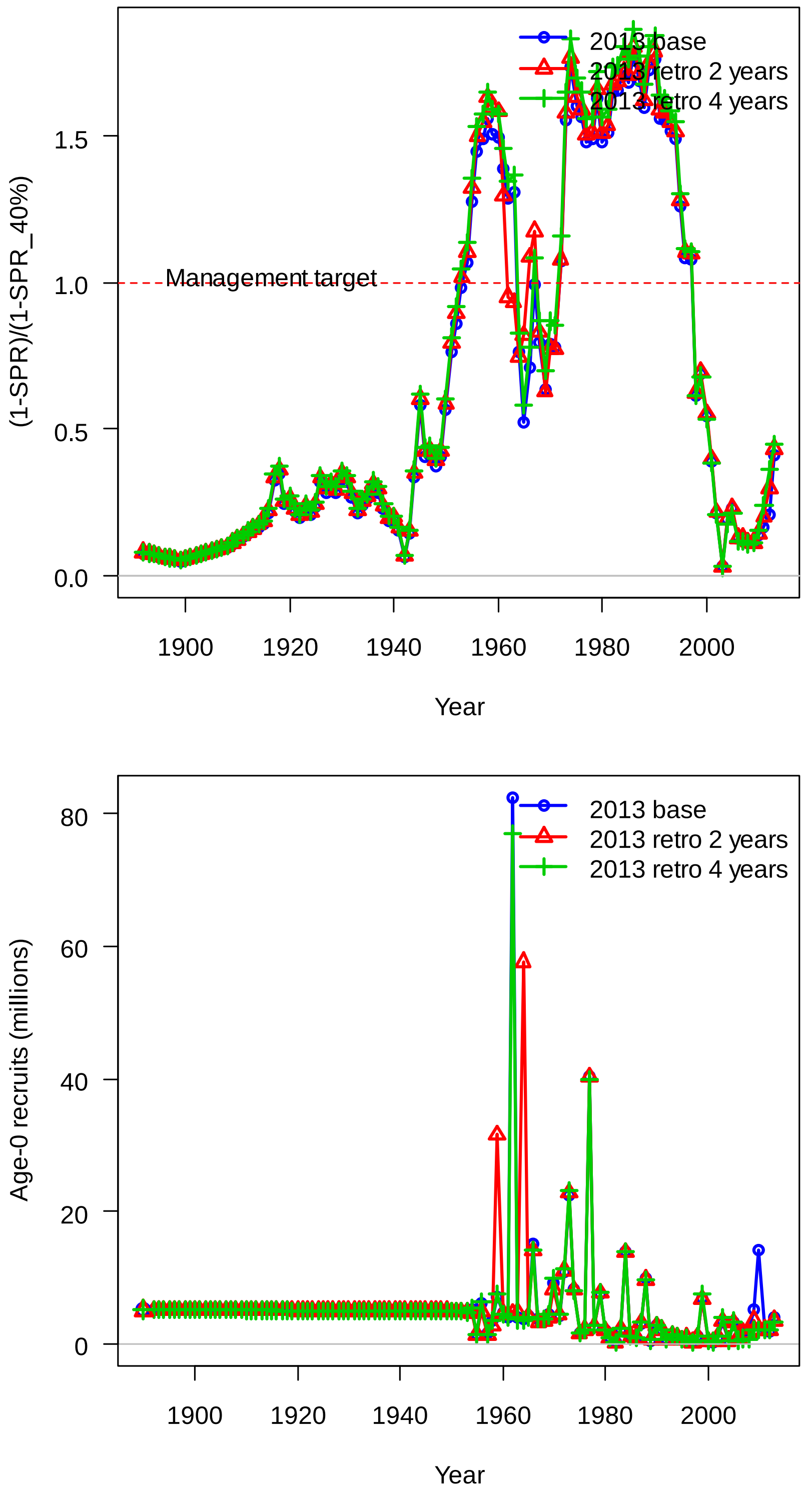


Figure 43: Comparison of base model harvest rate and recruitment estimates with retrospective (2 and 4 years) analysis.

Appendix A: Coastwide pre-recruit indices from midwatertrawl surveys (2001-2012)

Keith Sakuma and Stephen Ralston

This document updates the pre-recruit indices of abundance using data collected during Southwest Fisheries Science Center (SWFSC) and Pacific Whiting Conservation Cooperative (PWCC)/Northwest Fisheries Science Center (NWFSC) midwater trawl surveys for young-of-the-year (YOY) pelagic juvenile rockfish (*Sebastes* spp). Ralston (2010) provided coastwide indices of YOY abundance for 2001-2009 based on recommendations of the Pre-Recruit Survey Workshop (Hastie and Ralston 2007). One of the principal recommendations of the workshop was that data collected by the R/V *David Starr Jordan* (SWFSC survey vessel) and the F/V *Excalibur* (after 2001) be pooled to develop coastwide indices of abundance for YOY rockfish. It was also suggested that survey data collected in the historical "core" area of the SWFSC survey (i.e., 36°30'–38°20' N) from 1983-2000 were likely to present a biased and/or imprecise representation of YOY abundance due to significant interannual shifts in spatial distribution (Ralston and Stewart, in review). However, Ralston (2010) stated that calculating coastwide indices using the current (workshop recommended) ANOVA model was not possible in 2010 due to the lack of data for that year (no NWFSC survey took place). In addition, because the F/V *Frosti* was used for the SWFSC survey in 2010 with no inter-vessel calibration data (due to the absence of the NWFSC F/V *Excalibur*), a fixed vessel effect could not be estimated independently from the year effect.

	Latitude									
Year	32	34	36	38	40	42	44	46	48	Total
2001		6	70	58	22	19	19			194
2002		6	67	52	19	21	17			182
2003		8	73	71	21	22	19			214
2004	8	29	76	74	28	20	27	22		284
2005	13	28	92	62	35	17	22	21	12	302
2006	14	24	84	86	41	21	20	22	13	325
2007	11	17	79	86	38	25	22	22	16	316
2008	13	20	43	43	37	21	22	18	15	232
2009	7	19	59	79	30	24	23	23	16	280
2010	**6**	**15**	**44**	**52**	**16**					**133**
2011			**29**	**30**	**4**	*	*	*	*	**63***
2012	**3**	**13**	**51**	**27**						**94**

The table above shows the spatial and temporal distribution of midwater trawls completed by the combined SWFSC/PWCC/NWFSC surveys (Latitude = trawl start location rounded to the nearest 2^{o}). Note that while spatial sampling from 2001-2003 was substantially expanded from the core area (36-38^{o} N),coastwide coverage was not fully realizeduntil 2005. In addition, there were no NWFSC surveys in 2010 and 2012 resulting in the loss of spatial coverage to the north. While there was a NWFSC survey aboard the F/V*Excalibur* in 2011, the final data are not yet available, so these are marked with an *. The SWFSC survey in 2011 was also aboard the F/V*Excalibur* and due to a combination of vessel, weather, and budgetary constraints, the number of trawls and the spatial coverage were impacted resulting in the loss of coverage in the southern area. In 2012 the SWFSC survey was conducted aboard the NOAA R/V *Bell M. Shimada*, with bad weather impacting sampling in both the south and north (e.g. 40° N latitude bin not sampled). The last three years in the above table are shown in bold to highlight the lack of coastwide spatial coverage due to the various issues encountered during that time period. In addition, both the 2011 and 2012 SWFSC surveys were conducted on uncalibrated vessels. In 2011, the SWFSC used the F/V *Excalibur* for the first time, so while this vessel had been used historically by the PWCC/NWFSC, the potential for differences in gear deployment, sample sorting, etc. between the two surveys cannot be discounted. In 2012, no calibration information was available for the NOAA R/V *Bell M. Shimada* due to the cancellation of the NWFSC F/V *Excalibur* survey. In an appendices to his analysis, Ralston (2010) showed that: (1) a lack of data from north of Cape Mendocino (40° N) had a negligible effect on the indices of three southerly distributed species and (2) a mixed model employing vessel as a random effect was a feasible way to overcome vessel calibration concerns.

Data processing and analyses

The following procedures were first reported in Ralston (2010) and apply to both the original ANOVA and the current mixed model. All midwater trawl abundance data were converted to standard age fish, due to substantial interannual variation in the size distribution of fish collected. To accomplish this, the length of each specimen of a species in a haul was converted to an estimated age using a linear regression of ageN = $\boldsymbol{a}$ + $\boldsymbol{b}$≅SL, where age N is estimated age [d] and SL is standard length [mm]. Data used to fit all species □ year regressions were generated by sub-sampling fish and counting daily otolith increments (see Woodbury and Ralston 1991). The contribution of each fish was then age-adjusted according to: n = exp[-0.04(100-ageN)], which effectively standardizes the contribution of all fish to a common age of 100 d, i.e., younger fish are down-weighted and older fish are up-weighted. The weighting factor (-0.04 d^{-1}) is the estimated mortality rate of pelagic juvenile rockfish (see Ralston and Howard 1995). Standard age fish within hauls were then summed to yield the estimated number of fish in 100-day-old equivalents.
In addition, a 10-day calendar date or "period" effect was defined to account for the seasonal change in availability of YOY rockfish to midwater trawling and a bottom depth effect was defined, with trawling activity distributed on or off the continental shelf.

The crossed year and latitudinal effects were back-transformed to the arithmetic scale with bias-correction, i.e., exp(effect + mse/2). The variance of the estimate on log-scale ($s_{□}^2$) was used to calculate the CV of the estimate on arithmetic scale according to: CV = sqrt{exp($s_{□}^2$) - 1} (Johnson and Kotz 1970), which was then used to calculate the variance of the back-transformed estimates. The means and variances were then summed over latitudes and the year-specific estimates of integrated catch rate (CPUE) and its variance obtained. Lastly, the total variance was expressed as a CV of the catch rate statistic.

Mixed model estimates for southern species.

Although Hastie and Ralston (2007) recommended against developing pre-recruit indices unless coastwide coverage was available, this was based on the extreme shift in YOY rockfish distribution observed in 2005. In that year a number of species that were normally observed largely to the south of

Cape Mendocino (lat. 40°10' N) were found principally north of the Cape (Ralston and Stewart, in review). Ralston (2010) showed that for certain more southerly distributed species such as shortbelly rockfish (*S. jordani*) and bocaccio (*S. paucispinis*) a "southern species" index estimate was still feasible despite the lack of northern spatial coverage using a mixed modelapproach. In addition, Ralston (2010) proposed that a mixed model could also account for the lack of a fixed vessel effect due to the introduction of new survey platforms. Given that in 2011 the SWFSC spatial coverage was only slightly larger than the historical core area (which prior recommendations said should not be used to develop pre-recruit indices), it was decided that these data would be excluded from the updated analysis.

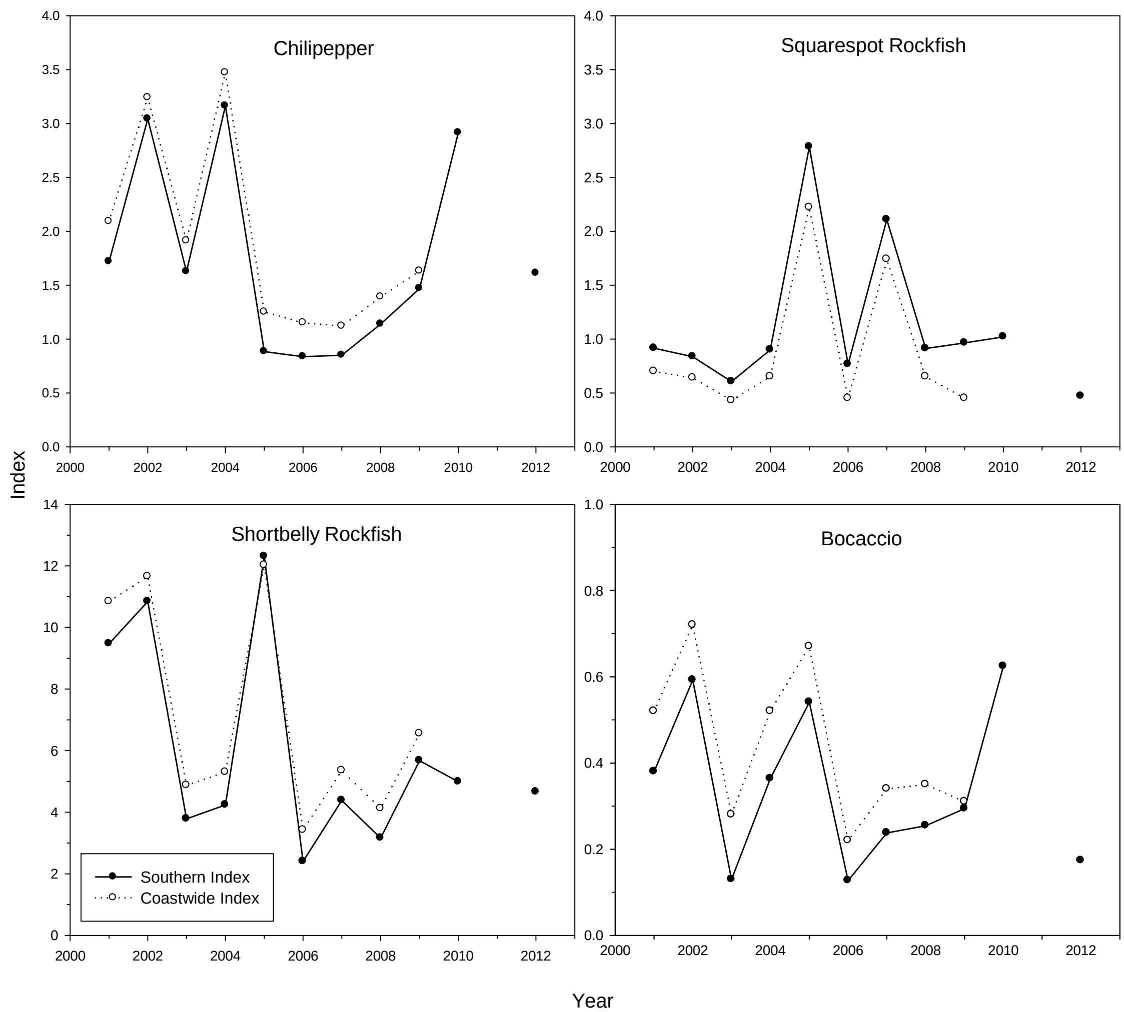
The data used spanned2001-2010 and 2012 and were collected aboard the NOAA R/V *David Starr Jordan* (SWFSC 2001-2008), NOAA R/V *Miller Freeman* (SWFSC 2009), F/V *Frosti* (SWFSC 2010), NOAA R/V *Bell M. Shimada* (SWFSC 2012), and F/V *Excalibur* (PWCC/NWFSC 2001-2009). A mixed model (Appendix B in Raslton 2010) was used with year and latitude as fixed interacting effects and vessel as a random effect. The full model that was fitted was:

$$\log(C_{i,j,k,l,m,n} + 1) = Y_i \times L_j + Z_k + D_l + V_m + \varepsilon_{i,j,k,l,m,n}$$

with all independent variables treated as categorical. Specifically Y_i is a fixed year effect $\{Y_i \in$ 2001, 2002, …, 2010, 2012$\}$, L_j is a fixed latitudinal effect $\{L_j \in$ 32, 34, …, 40$\}$, Z_k is a fixed depth effect $\{Z_k \leq$ 160 m or $Z >$ 160 m$\}$, D_l is a fixed calendar date effect $\{D_l \in$ 120, 130, …, 170$\}$, V_m is a random vessel effect $[V_m \sim N(0,\sigma_v)]$, and $\varepsilon_{i,j,k,l,m,n}$ is normal error term $[\varepsilon \sim N(0,\sigma_\varepsilon)]$ for the n^{th} observation in a stratum. As in the case of the traditional ANOVA model, interactions between latitude and year were explicitly modeled.

The model was fit to the data using PROC MIXED (SAS Institute Inc. 2004) and the year×latitude parameter estimates were bias-corrected, integrated over latitude, and error estimates summarized in a manner directly analogous to the traditional ANOVA approach. Indices were calculated for the three southerly distributed species from Appendix B in Ralston (2010), squarespot rockfish (*S. hopkinsi*), shortbelly rockfish (*S. jordani*), and bocaccio (*S. paucispinis*) as well as chilipepper (*S. goodei*)as this species has a similar southerly distribution (Love *et al*. 2002). Results are presented in the table and figure below. The figure shows the coastwide indices from Ralston (2010) for comparison.

Year	Chilipepper Index	CV	SquarespotRockfish Index	CV	ShortbellyRockfish Index	CV	Bocaccio Index	CV
2001	1.717849	0.090345	0.914425	0.038584	9.468956	0.098208	0.379758	0.021934
2002	3.041766	0.102529	0.837253	0.044508	10.84201	0.105865	0.592289	0.021449
2003	1.625238	0.090596	0.605126	0.0461	3.781709	0.117177	0.12986	0.029042
2004	3.16233	0.088158	0.898886	0.033705	4.235494	0.084968	0.363573	0.021282
2005	0.883917	0.085486	2.78386	0.049647	12.30722	0.148316	0.540822	0.028863
2006	0.835192	0.07965	0.764976	0.03371	2.402526	0.082176	0.127167	0.01748
2007	0.849912	0.083467	2.106744	0.053805	4.380148	0.105074	0.237335	0.02199
2008	1.138349	0.082882	0.911111	0.03703	3.163766	0.091105	0.254367	0.021193
2009	1.469123	0.088434	0.963517	0.062589	5.67454	0.121179	0.293869	0.021889
2010	2.913533	0.131208	1.020348	0.050884	4.984179	0.132695	0.624099	0.033701
2011	NA	NA	NA	NA	NA	NA	NA	NA
2012	1.610079	0.194409	0.470622	0.048428	4.661729	0.16161	0.173541	0.026769



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Appendix B: Data, control, starter and forecast files for 2011 bocaccio update

Starter file

```
#C starter comment here
boc9.dat
boc5.ctl
0  # 0=use init values in control file; 1=use ss3.par (takes last run's estimates as starting- much faster!!!)
0 # run display detail (0,1,2)
1 # detailed age-structured reports in REPORT.SSO (0,1)
0 # write detailed checkup.sso file (0,1)
0 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)
1
0 # Include prior_like for non-estimated parameters (0,1)
1 # Use Soft Boundaries to aid convergence (0,1) (recommended)
3 # Number of bootstrap datafiles to produce
#-1 # for running with fixed params
7 # Turn off estimation for parameters entering after this phase
10 # MCMC burn interval
2 # MCMC thin interval
#0.001 # jitter initial parm value by this fraction
0  # jitter off
-1 # min yr for sdreport outputs (-1 for styr)
-2 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs
0 # N individual STD years
#vector of year values
# 1973 1976
0.0001 # final convergence criteria (e.g. 1.0e-04)
0 # retrospective year relative to end year (e.g. -4)
1 # min age for calc of summary biomass
1 # Depletion basis:  denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
1 # Fraction (X) for Depletion denominator (e.g. 0.4)
3 # (1-SPR)_reporting:  0=skip; 1=rel(1-SPR); 2=rel(1-SPR_MSY); 3=rel(1-SPR_Btarget); 4=notrel
1 # F_std reporting: 0=skip; 1=exploit(Bio); 2=exploit(Num); 3=sum(frates)
3 # F_report_basis: 0=raw; 1=rel Fspr; 2=rel Fmsy ; 3=rel Fbtgt
999 # check value for end of file
```

Forecast file

```
#V3.21e
#C  generic forecast file
# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr
1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.777 # SPR target (e.g. 0.40)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 0 0 0 0
1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below
#
1 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar
12 # N forecast years
1.0 # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or values of 0 or -integer to be rel. endyr)
 0 0 -3 0
#  2001 2001 1991 2001 # after processing
1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.1 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)
```

0.05 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1.0 # Control rule target as fraction of Flimit (e.g. 0.75)
3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)
3 #_First forecast loop with stochastic recruitment
0 #_Forecast loop control #3 (reserved for future bells&whistles)
0 #_Forecast loop control #4 (reserved for future bells&whistles)
0 #_Forecast loop control #5 (reserved for future bells&whistles)
2024 #FirstYear for caps and allocations (should be after years with fixed inputs)
0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)
1 # Do West Coast gfish rebuilder output (0/1)
2000 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)
2011 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)
1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below
Note that fleet allocation is used directly as average F if Do_Forecast=4
2 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)
Conditional input if relative F choice = 2
Fleet relative F: rows are seasons, columns are fleets
#_Fleet: FISHERY1
1
max totalcatch by fleet (-1 to have no max) must enter value for each fleet
-1 -1 -1 -1 -1 -1
max totalcatch by area (-1 to have no max); must enter value for each fleet
-1
fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)
0 0 0 0 0 0
#_Conditional on >1 allocation group
allocation fraction for each of: 0 allocation groups
no allocation groups
0 # Number of forecast catch levels to input (else calc catch from forecast F)
2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)
Input fixed catch values
year season fleet catch 72
999 # verify end of input

Data file

#_bootstrap file: 1
1892 #_styr
2012 #_endyr
1 #_nseas
12 #_months/season
1 #_spawn_seas
6 #_Nfleet
10 #_Nsurveys
1 #_N_areas
trawlsou%H&L%setnet%recSO%recCEN%trawlnor%CalCOFI%TRIENNIAL%CFGCPUE%NWFSChook%NWFSCtrawl%juvenile%pier_juv%power.plant.index%free1%mirror_recSO
0.5 0.5 0.5 0.5 0.5 0.5 0.1 0.5 0.5 0.78 0.66 0.5 0.75 0.5 0.5 0.5 #_surveytiming_in_season
SCB hook and line, and NWFSC combo based on Julian days
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_area_assignments_for_each_fishery_and_survey
1 1 1 1 1 1 #_units of catch: 1=bio; 2=num
0.01 0.01 0.01 0.01 0.01 0.01 #_se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3
2 #_Ngenders
21 #_Nages
0 152.72 0 0 0 0 #_init_equil_catch_for_each_fishery
121 #_N_lines_of_catch_to_read

#_catch_biomass(mtons):_columns_are_fisheries,year,season

#TWL	HKL	NET	RecSou	RecNor	ORWA_all	year	season
0	166.77	0	0	0	0	1892	1
0	157.4	0	0	0	0	1893	1
0	148.03	0	0	0	0	1894	1
0	138.66	0	0	0	0	1895	1
0	130.93	0	0	0	0	1896	1
0	123.2	0	0	0	0	1897	1
0	115.47	0	0	0	0	1898	1
0	107.73	0	0	0	0	1899	1
0	119.2	0	0	0	0	1900	1
0	130.66	0	0	0	0	1901	1
0	142.12	0	0	0	0	1902	1
0	153.59	0	0	0	0	1903	1
0	165.05	0	0	0	0	1904	1
0	176.36	0	0	0	0	1905	1
0	187.68	0	0	0	0	1906	1
0	198.99	0	0	0	0	1907	1
0	210.3	0	0	0	0	1908	1
0	236.64	0	0	0	0	1909	1
0	262.98	0	0	0	0	1910	1
0	289.32	0	0	0	0	1911	1
0	315.66	0	0	0	0	1912	1
0	342	0	0	0	0	1913	1
0	368.34	0	0	0	0	1914	1
0	394.68	0	0	0	0	1915	1
54.77	418.96	0	0	0	0.160	1916	1
85.57	661.43	0	0	0	0.320	1917	1
96.66	701.13	0	0	0	0.720	1918	1
66	463.1	0	0	0	0.160	1919	1
67.82	482.28	0	0	0	0.220	1920	1
56.38	406.03	0	0	0	0.330	1921	1
49.37	367.12	0	0	0	0.250	1922	1
55.07	434.14	0	0	0	0.080	1923	1
36.97	405.15	0	0	0	0.270	1924	1
29.85	474.63	0	0	0	0.870	1925	1
83.2	627.09	0	0	0	0.810	1926	1
111.29	497.26	0	0	0	1.500	1927	1
150.62	482.9	0	1.99	2.39	1.210	1928	1
119.43	441.16	0	3.99	4.79	28.040	1929	1
135.62	551	0	5.99	5.51	16.700	1930	1
45.59	578.08	0	7.99	7.34	49.580	1931	1
68.87	430.61	0	9.99	9.18	37.280	1932	1
89.53	257.34	0	11.98	11.02	59.260	1933	1
108.88	316.57	0	13.98	12.85	41.380	1934	1
90.51	369.17	0	15.98	14.69	43.190	1935	1
107.86	473.58	0	15.98	16.53	17.690	1936	1
91.98	408.44	0	27.51	19.59	41.130	1937	1
76.46	295.45	0	22.18	19.27	47.540	1938	1
49.95	200.11	0	19.63	16.85	86.170	1939	1
45.57	238.49	0	14.07	24.27	59.720	1940	1
32.44	187.35	0	13	22.43	53.070	1941	1
7.9	72.1	0	6.91	11.91	25.550	1942	1
7.56	70.44	0	6.6	11.39	196.130	1943	1
2.94	83.63	0	5.42	9.35	635.220	1944	1
55.17	127.08	0	7.23	12.47	1211.05	1945	1
111.53	122.33	0	12.45	21.47	611.940	1946	1

5.57	198.21	0	37.32	16.99	631.600	1947	1
81.94	150.23	0	102.08	33.9	397.440	1948	1
94	176.56	0	132.83	43.94	380.480	1949	1
303.66	327.61	0	156.82	53.55	374.730	1950	1
765.29	262.44	0	135.78	63.17	532.060	1951	1
1310.96	180.88	0	151.62	54.97	268.000	1952	1
1678.25	70.2	0	171.23	46.81	304.510	1953	1
1597.98	89.11	0	410.71	58.19	245.780	1954	1
1764.99	122.87	0	760.57	69.38	334.950	1955	1
2006.22	299.57	0	917.14	77.46	349.930	1956	1
2219.46	271.26	0	529.88	76.8	468.870	1957	1
2459.84	213.5	0	301.14	123.49	482.050	1958	1
2062.66	125.38	0	177.61	102.75	378.690	1959	1
1731.86	92.91	0	185.13	81.26	344.610	1960	1
1297.35	80.89	0	211.89	68.5	265.670	1961	1
1147.09	68.25	0	204.46	80.38	230.360	1962	1
1314.09	85.06	0	194.38	88.71	326.220	1963	1
942.79	70.17	0	244.36	74.98	190.470	1964	1
965.94	81.03	0	319.14	106.55	273.070	1965	1
2410.23	129.52	0	564.3	118.21	196.070	1966	1
4036.28	117.9	0	770.19	111.44	294.710	1967	1
1996.47	80.71	0	832.18	103.9	391.890	1968	1
1132.64	78.02	17.41	785	110.52	223.000	1969	1
1341.14	82.39	15.06	1039.41	117.87	250.090	1970	1
961.36	81.56	58.73	966.96	104.45	323.740	1971	1
1648.11	122.56	70.95	1308.7	123.08	379.600	1972	1
4537.05	151.53	167.3	1510.62	186.09	648.420	1973	1
5956.32	164.1	261.65	1892.59	200.89	525.550	1974	1
3316.02	158.13	285.36	1865.23	200.29	578.560	1975	1
3424.73	218.88	123.1	1489.03	215.7	705.480	1976	1
2381.4	188.75	158.08	1265.09	193.57	673.610	1977	1
1878.87	247.93	124.75	1174.03	195.63	745.440	1978	1
3299.31	351.15	235.32	1713.94	230.22	286.170	1979	1
3054.87	320.49	215.88	942.92	264.04	586.080	1980	1
1779.75	312.34	353.03	908.12	234.52	2164.52	1981	1
2323.84	392.92	387.01	1225.49	371.85	1897.44	1982	1
1914.02	238.56	588.49	265.96	310.65	2280.14	1983	1
1891.75	367.29	547.07	181.6	67.14	1621.38	1984	1
582.41	143.01	1091.66	324.48	67.93	654.150	1985	1
789.66	258.99	1085.78	433.75	175.84	376.540	1986	1
650.4	277.14	967.86	91.7	106.14	555.370	1987	1
590	496.55	371.48	106.54	44.32	695.430	1988	1
594.21	362.92	981.88	182.16	81.71	553.310	1989	1
681.56	458.67	793.27	160.27	68.02	462.620	1990	1
498.36	266.28	457.6	160.27	68.02	263.310	1991	1
362.09	468.03	640.31	160.27	68.02	133.250	1992	1
358.87	417.33	430.18	115.71	68.02	202.860	1993	1
377.01	193.06	262.64	243.9	68.02	149.530	1994	1
215.41	56.74	281.15	34.24	68.02	162.450	1995	1
225.84	66.23	91.83	68.36	32.22	62.910	1996	1
136.26	53.37	34.94	68.71	111.26	93.850	1997	1
41.16	39.38	39.21	33.53	25.87	31.970	1998	1
19.01	20.68	7.18	80.06	60.21	25.980	1999	1
13.48	7.01	0.73	58.24	74.42	6.570	2000	1
9.21	7.82	0.88	62.68	53.84	4.440	2001	1
28.04	0.13	0.01	35.88	4.93	20.67	2002	1
5.07	0	0	5.53	1.87	0.31	2003	1

13.86	1.84	0.21	63.43	2.27	3.52	2004	1
24.64	1.5	0.17	69.9	10.7	0.43	2005	1
16.09	2.25	0.25	29	11.8	0.31	2006	1
4.06	3.39	0.38	44.2	8.92	1.58	2007	1
20.42	2.02	0.08	31.50	3.33	1.98	2008	1
1.12	1.50	0.03	40.30	9.70	4.85	2009	1
2.90	1.45	0.05	52.60	7.40	10.97	2010	1
1.30	2.39	0.01	99.26	4.06	4.93	2011	1
12.89	1.10	0.01	119.08	5.65	48.81	2012	1

228 #_N_cpue_and_surveyabundance_observations
#_Units: 0=numbers; 1=biomass; 2=F
#_Errtype: -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0 # fleet (fishery or survey) # 1
2 1 0 # fleet (fishery or survey) # 2
3 1 0 # fleet (fishery or survey) # 3
4 1 0 # fleet (fishery or survey) # 4
5 1 0 # fleet (fishery or survey) # 5
6 1 0 # fleet (fishery or survey) # 6
7 1 0 # fleet (fishery or survey) # 7
8 1 0 # fleet (fishery or survey) # 8
9 1 0 # fleet (fishery or survey) # 9
10 1 0 # fleet (fishery or survey) # 10
11 1 0 # fleet (fishery or survey) # 11
12 1 0 # fleet (fishery or survey) # 12
13 1 0 # fleet (fishery or survey) # 13
14 1 0 # fleet (fishery or survey) # 14
15 1 0 # fleet (fishery or survey) # 15
16 1 0 # fleet (fishery or survey) # 16
#_year seas index obs se(log)

1982	1	1	166.4	0.32	#areaweightedCPUEfromRalston
1983	1	1	73.1	0.32	#areaweightedCPUEfromRalston
1984	1	1	72.3	0.32	#areaweightedCPUEfromRalston
1985	1	1	30.7	0.32	#areaweightedCPUEfromRalston
1986	1	1	31.2	0.32	#areaweightedCPUEfromRalston
1987	1	1	44.4	0.32	#areaweightedCPUEfromRalston
1988	1	1	51.6	0.32	#areaweightedCPUEfromRalston
1989	1	1	35.8	0.32	#areaweightedCPUEfromRalston
1990	1	1	37.1	0.32	#areaweightedCPUEfromRalston
1991	1	1	26.9	0.32	#areaweightedCPUEfromRalston
1992	1	1	20.4	0.32	#areaweightedCPUEfromRalston
1993	1	1	19.7	0.32	#areaweightedCPUEfromRalston
1994	1	1	23.9	0.32	#areaweightedCPUEfromRalston
1995	1	1	15.2	0.32	#areaweightedCPUEfromRalston
1996	1	1	8.7	0.32	#areaweightedCPUEfromRalston

1980	1	4	3.401	0.071906949	#MRFsoCAL
1981	1	4	3.447	0.059646908	#MRFsoCAL
1982	1	4	3.173	0.073301426	#MRFsoCAL
1983	1	4	1.318	0.081365149	#MRFsoCAL
1984	1	4	1.034	0.084548676	#MRFsoCAL
1985	1	4	2.224	0.091706845	#MRFsoCAL
1986	1	4	1.91	0.105307369	#MRFsoCAL
1987	1	4	0.275	0.448819689	#MRFsoCAL
1988	1	4	0.169	0.387042386	#MRFsoCAL

1989	1	4	0.997	0.137842628	#MRFsoCAL
1993	1	4	1.631	0.255474245	#MRFsoCAL
1994	1	4	1.732	0.142670896	#MRFsoCAL
1995	1	4	0.448	0.358378941	#MRFsoCAL
1996	1	4	0.246	0.203184778	#MRFsoCAL
1997	1	4	0.395	0.38023361	#MRFsoCAL
1998	1	4	0.234	0.202021118	#MRFsoCAL
1999	1	4	0.566	0.091309348	#MRFsoCAL
2000	1	4	1.098	0.086438291	#MRFsoCAL
2001	1	4	1.28	0.113037949	#MRFsoCAL
2002	1	4	2.01	0.08355396	#MRFsoCAL

1980	1	5	0.917	0.118186092	#MRFnorth
1981	1	5	1.28	0.170552193	#MRFnorth
1982	1	5	1.326	0.131232941	#MRFnorth
1983	1	5	1.377	0.143163299	#MRFnorth
1984	1	5	0.388	0.126294711	#MRFnorth
1985	1	5	0.75	0.081166137	#MRFnorth
1986	1	5	1.39	0.07061189	#MRFnorth
1987	1	5	0.914	0.154768554	#MRFnorth
1988	1	5	0.294	0.1734864	#MRFnorth
1989	1	5	0.457	0.157321533	#MRFnorth
1993	1	5	0.202	0.345617372	#MRFnorth
1994	1	5	0.351	0.236456026	#MRFnorth
1995	1	5	0.482	0.197847986	#MRFnorth
1996	1	5	0.535	0.099354307	#MRFnorth
1997	1	5	0.42	0.125405334	#MRFnorth
1998	1	5	0.432	0.14513239	#MRFnorth
1999	1	5	0.802	0.066825326	#MRFnorth
2000	1	5	1.961	0.089420947	#MRFnorth
2001	1	5	2.022	0.115414586	#MRFnorth
2002	1	5	2.618	0.162618942	#MRFnorth

1951	1	7	0.80997937	0.21056802	#CalCOFIindex
1952	1	7	0.81579354	0.17934729	#CalCOFIindex
1953	1	7	1.07928086	0.20923253	#CalCOFIindex
1954	1	7	1.50137511	0.23725397	#CalCOFIindex
1955	1	7	1.21409072	0.2198817	#CalCOFIindex
1956	1	7	0.75840706	0.1960906	#CalCOFIindex
1957	1	7	1.6088996	0.33615535	#CalCOFIindex
1958	1	7	1.23864498	0.23123907	#CalCOFIindex
1959	1	7	0.40366315	0.08272799	#CalCOFIindex
1960	1	7	0.5814985	0.10425192	#CalCOFIindex
1961	1	7	0.68598533	0.19510882	#CalCOFIindex
1962	1	7	0.59720798	0.14752799	#CalCOFIindex
1963	1	7	0.97867727	0.24087498	#CalCOFIindex
1964	1	7	0.60152277	0.15367904	#CalCOFIindex
1965	1	7	0.80708434	0.17337833	#CalCOFIindex
1966	1	7	1.48032262	0.26121282	#CalCOFIindex
1967	1	7	0.77720292	0.27051851	#CalCOFIindex
1968	1	7	2.72253894	0.71136987	#CalCOFIindex
1969	1	7	2.47196295	0.34852935	#CalCOFIindex
1970	1	7	0.76655037	0.38214208	#CalCOFIindex
1972	1	7	1.91743927	0.27925963	#CalCOFIindex
1975	1	7	2.06721672	0.31213995	#CalCOFIindex
1976	1	7	2.83237345	0.97012251	#CalCOFIindex
1978	1	7	1.03258246	0.22076074	#CalCOFIindex

1981	1	7	0.97046575	0.21765083	#CalCOFIindex
1983	1	7	0.29392068	0.12666989	#CalCOFIindex
1984	1	7	1.00104634	0.20716653	#CalCOFIindex
1985	1	7	0.30121506	0.13879978	#CalCOFIindex
1986	1	7	0.42075657	0.20969015	#CalCOFIindex
1987	1	7	0.94855012	0.35018282	#CalCOFIindex
1988	1	7	0.72659073	0.18737437	#CalCOFIindex
1989	1	7	0.74106274	0.29535675	#CalCOFIindex
1990	1	7	0.49223573	0.18730814	#CalCOFIindex
1991	1	7	0.7209462	0.21125985	#CalCOFIindex
1992	1	7	0.70964848	0.19717228	#CalCOFIindex
1993	1	7	0.16745599	0.09712528	#CalCOFIindex
1994	1	7	0.26056901	0.07907314	#CalCOFIindex
1995	1	7	0.10830292	0.08153387	#CalCOFIindex
1996	1	7	1.28194744	0.38555548	#CalCOFIindex
1997	1	7	0.27686088	0.10260276	#CalCOFIindex
1998	1	7	0.09745691	0.05153568	#CalCOFIindex
1999	1	7	0.27542728	0.12372778	#CalCOFIindex
2000	1	7	0.22824411	0.09287831	#CalCOFIindex
2001	1	7	0.1106282	0.04728866	#CalCOFIindex
2002	1	7	0.46519996	0.16963343	#CalCOFIindex
2003	1	7	0.49832815	0.1341761	#CalCOFIindex
2004	1	7	0.56509142	0.21126562	#CalCOFIindex
2005	1	7	0.61316461	0.18177893	#CalCOFIindex
2006	1	7	0.61804412	0.18777228	#CalCOFIindex
2007	1	7	0.53393918	0.17208388	#CalCOFIindex
2008	1	7	1.02058087	0.35742994	#CalCOFIindex
2009	1	7	0.22835679	0.05642636	#CalCOFIindex
2010	1	7	0.38180692	0.13685177	#CalCOFIindex
2011	1	7	0.97028532	0.3000499	#CalCOFIindex

1980	1	8	2227.932433	0.149683111	#TRIENNIAL
1983	1	8	1849.416128	0.176692006	#TRIENNIAL
1986	1	8	723.6568073	0.159390796	#TRIENNIAL
1989	1	8	529.7149835	0.143672021	#TRIENNIAL
1992	1	8	319.1654707	0.228586262	#TRIENNIAL
1995	1	8	192.9998349	0.194757645	#TRIENNIAL
1998	1	8	56.92735471	0.301249017	#TRIENNIAL
2001	1	8	121.4857726	0.261983439	#TRIENNIAL
2004	1	8	439.3928644	0.214285691	#TRIENNIAL

1987	1	9	3.545	0.161148115	#VandenbergCPUE
1988	1	9	2.349	0.140405176	#VandenbergCPUE
1989	1	9	3.001	0.121154053	#VandenbergCPUE
1990	1	9	6.009	0.14611662	#VandenbergCPUE
1991	1	9	4.637	0.172508578	#VandenbergCPUE
1992	1	9	3.543	0.12570181	#VandenbergCPUE
1993	1	9	2.319	0.131726504	#VandenbergCPUE
1994	1	9	1.46	0.168399042	#VandenbergCPUE
1995	1	9	1.721	0.15083795	#VandenbergCPUE
1996	1	9	1.457	0.169280019	#VandenbergCPUE
1997	1	9	1.823	0.157419694	#VandenbergCPUE
1998	1	9	1.646	0.215088204	#VandenbergCPUE

2004	1	10	0.1921	0.1172	#S_Cal_Hook_line
2005	1	10	0.1929	0.1149	#S_Cal_Hook_line
2006	1	10	0.1921	0.1172	#S_Cal_Hook_line
2007	1	10	0.1708	0.1212	#S_Cal_Hook_line
2008	1	10	0.1459	0.1228	#S_Cal_Hook_line
2009	1	10	0.131	0.1257	#S_Cal_Hook_line
2010	1	10	0.0621	0.1421	#S_Cal_Hook_line
2011	1	10	0.2208	0.1114	#S_Cal_Hook_line
2012	1	10	0.2289	0.1088	#S_Cal_Hook_line

2003	1	11	693.9756932		2.135909736		#	NWFSC
2004	1	11	1641.45959		2.149693104		#	NWFSC
2005	1	11	944.7034509		2.13393055		#	NWFSC
2006	1	11	762.2533527		2.124374577		#	NWFSC
2007	1	11	919.8650271		2.09787073		#	NWFSC
2008	1	11	792.5139974		2.080726563		#	NWFSC
2009	1	11	603.9545403		2.079321204		#	NWFSC
2010	1	11	346.8134228		2.096583234		#	NWFSC
2011	1	11	328.3364805		2.073925934		#	NWFSC
2012	1	11	76.39655097		2.143648256		#	NWFSC

2001	1	12	0.379758	0.021934	#	pre-recruit	
2002	1	12	0.592289	0.021449	#	pre-recruit	
2003	1	12	0.12986		0.029042	#	pre-recruit
2004	1	12	0.363573	0.021282	#	pre-recruit	
2005	1	12	0.540822	0.028863	#	pre-recruit	
2006	1	12	0.127167	0.01748		#	pre-recruit
2007	1	12	0.237335	0.02199		#	pre-recruit
2008	1	12	0.254367	0.021193	#	pre-recruit	
2009	1	12	0.293869	0.021889	#	pre-recruit	
2010	1	12	0.624099	0.033701	#	pre-recruit	
2012	1	12	0.173541	0.026769	#	pre-recruit	

Pier Index

1954	1	13	0.1	0.72528
1955	1	13	0.01	0.88207
1956	1	13	0.1	0.72528
1957	1	13	0.01	0.88207
1958	1	13	0.01593	1.54141
1966	1	13	0.76471	0.74688
1980	1	13	0.1078	0.5675
1981	1	13	0.01668	0.71192
1982	1	13	0.01	0.88207
1983	1	13	0.01	0.88207
1984	1	13	0.08304	0.56998
1985	1	13	0.05492	0.61209
1986	1	13	0.06104	0.54481
1987	1	13	0.07279	0.54011
1988	1	13	0.14651	0.39676
1989	1	13	0.03599	0.8973
1993	1	13	0.09198	0.56186
1994	1	13	0.01	0.88207

1995	1	13	0.02682	0.8694
1996	1	13	0.01	0.88207
1997	1	13	0.01	0.88207
1998	1	13	0.01	0.88207
1999	1	13	0.08153	0.66772
2000	1	13	0.01	0.88207
2001	1	13	0.01	0.88207
2002	1	13	0.01	0.88207
2003	1	13	0.01713	0.70799
2004	1	13	0.01	0.88207
2005	1	13	0.05629	0.77327
2006	1	13	0.01	0.88207
2007	1	13	0.01	0.88207
2008	1	13	0.01	0.88207
2009	1	13	0.10024	0.63688

#impingement

1972	1	14	805.6121442	0.4747161	# impingement index
1973	1	14	240.09387	0.5386177	# impingement index
1974	1	14	169.1226377	0.3961104	# impingement index
1975	1	14	209.8875259	0.372252	# impingement index
1976	1	14	20.8471064	0.4000259	# impingement index
1977	1	14	559.195023	0.5255058	# impingement index
1978	1	14	82.4788873	0.4055168	# impingement index
1979	1	14	67.0802615	0.3691445	# impingement index
1980	1	14	23.1197951	0.485414	# impingement index
1981	1	14	9.2188438	0.6984769	# impingement index
1982	1	14	1.8976728	0.7401457	# impingement index
1984	1	14	10.5795262	0.8846814	# impingement index
1985	1	14	19.6694648	0.5247885	# impingement index
1986	1	14	6.4080057	0.5347214	# impingement index
1988	1	14	215.4896731	0.4798226	# impingement index
1989	1	14	15.1153588	0.5723617	# impingement index
1990	1	14	7.0278683	0.6924258	# impingement index
1991	1	14	46.1936181	0.4728202	# impingement index
1992	1	14	36.4736151	0.6190511	# impingement index
1995	1	14	19.0751409	0.7390126	# impingement index
1996	1	14	5.5782183	1.1523098	# impingement index
1997	1	14	4.9025485	0.9256709	# impingement index
1999	1	14	61.1116316	0.5229908	# impingement index
2000	1	14	8.6168784	0.5717008	# impingement index
2001	1	14	0.9799354	0.8012692	# impingement index
2002	1	14	16.2880076	0.4120672	# impingement index
2003	1	14	52.9363213	0.567561	# impingement index
2004	1	14	2.5860658	0.8071919	# impingement index
2005	1	14	67.1338463	0.4662601	# impingement index
2007	1	14	8.4959987	0.6617704	# impingement index
2008	1	14	6.4001348	0.563439	# impingement index
2009	1	14	20.9617859	0.4688793	# impingement index
2010	1	14	52.5360991	0.5114085	# impingement index
2011	1	14	5.5080604	0.9356007	# impingement index
2012	1	14	74.5185182	0.7570694	# impingement index

0 #_N_fleets_with_discard
#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)

#_discard_errtype: >0 for DF of T-dist(read CV below); 0 for normal with CV; -1 for normal with se; -2 for lognormal
#_Fleet units errtype
1 2 30 # FISHERY1
0 #_N_discard_obs

0 #_N_meanbodywt_obs
30 #_DF_meanwt

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector
2 # binwidth for population size comp
10 # minimum size in the population (lower edge of first bin and size at age 0.00)
94 # maximum size in the population (lower edge of last bin)

-1 #_comp_tail_compression
1e-007 #_add_to_comp
0 #_combine males into females at or below this bin number
29 #_N_LengthBins
16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 72 76

216 #_N_Length_obs
trawl fishery south of 38   26   currently#fish   Female

Male

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62	64	66	68	72	76	16
	18	20	22	24	26	28	30	32	34	36	38	40
	42	44	46	48	50	52	54	56	58	60	62	64
	66	68	72	76								
1978	1	1	3	0	196.8	0	0	0	0	0	4	20
	40	26	15	8	13	19	20	47	67	54	32	30
	19	26	17	15	12	8	10	6	3	1	0	0
	0	0	0	2	14	13	10	4	10	19	27	48
	80	60	60	23	22	23	17	10	3	4	0	0
	1	0	1									
1979	1	1	3	0	211.7	0	1	0	0	0	3	31
	55	64	75	66	42	27	20	17	29	41	48	52
	36	15	18	15	11	7	3	7	4	2	0	0
	1	0	0	1	4	3	16	26	19	18	12	17
	39	55	70	33	21	24	16	13	5	2	0	0
	1	0	0									
1980	1	1	3	0	244.8	0	0	0	0	0	0	0
	3	2	5	10	33	115	111	65	14	6	16	24
	30	20	17	13	10	11	9	15	6	5	0	0
	0	0	0	1	0	0	1	7	20	63	101	68
	23	23	33	24	27	20	16	7	9	7	1	0
	1	0	0									
1981	1	1	3	0	165	0	0	0	0	0	0	1
	6	7	2	2	4	9	35	87	80	32	8	4
	8	9	12	5	7	4	2	1	2	0	0	0
	0	0	0	0	0	3	3	4	8	6	26	79
	73	27	11	20	14	11	10	5	2	1	1	0
	0	0	0									

1982	1	1	3	0	342	0	0	0	0	0	0	1
	2	6	2	11	37	62	56	52	55	75	91	83
	47	19	18	27	26	20	18	7	5	9	0	0
	0	0	0	0	1	1	8	10	20	49	59	62
	91	162	116	58	40	42	27	20	12	4	4	0
	0	0	0									
1983	1	1	3	0	349	0	0	0	0	0	0	0
	0	1	1	6	11	16	33	70	74	71	73	142
	100	41	25	29	14	22	16	10	6	11	0	0
	0	0	0	0	1	2	1	3	9	11	25	66
	111	132	148	94	68	60	25	16	9	3	2	0
	0	0	0									
1984	1	1	3	0	400	0	0	0	0	0	0	0
	0	0	1	0	8	11	26	45	48	60	78	93
	97	110	71	47	26	27	20	16	12	13	0	0
	0	0	0	0	0	0	1	1	5	10	31	57
	94	134	155	165	133	100	53	23	16	9	3	2
	0	0	0									
1985	1	1	3	0	340.8	0	0	0	0	1	3	18
	22	35	15	1	5	8	8	15	31	43	40	58
	31	43	49	37	22	9	11	15	10	7	0	0
	0	0	0	6	9	12	21	7	3	3	11	33
	43	63	77	96	94	62	35	24	7	2	3	3
	0	0	0									
1986	1	1	3	0	369	0	0	0	0	0	0	1
	36	88	157	231	191	120	37	13	7	9	18	26
	28	16	24	24	15	8	4	2	3	0	0	0
	0	0	0	3	2	19	82	155	184	150	69	16
	11	13	20	35	23	22	18	6	3	1	1	0
	0	1	0									
1987	1	1	3	0	342.9	0	0	0	0	0	0	0
	0	5	30	53	83	173	227	173	64	6	11	9
	9	16	11	9	7	3	2	0	1	0	0	0
	0	0	0	0	1	5	17	42	59	124	215	203
	101	15	10	22	20	28	10	2	2	0	0	0
	0	0	0									
1988	1	1	3	0	258.3	0	0	0	0	0	1	1
	7	13	15	19	24	46	82	97	117	82	41	18
	10	8	7	9	5	7	3	2	1	0	0	0
	0	0	0	0	1	3	8	9	25	40	72	102
	152	83	36	9	15	18	5	2	1	0	0	1
	1	0	0									
1989	1	1	3	0	189.4	0	0	0	0	0	0	4
	13	15	27	43	27	16	15	22	28	25	42	28
	15	4	6	2	2	2	4	3	0	1	0	0
	0	0	0	2	4	11	22	27	29	28	29	28
	45	64	47	17	9	4	6	3	1	0	1	0
	0	0	0									
1990	1	1	3	0	314.4	0	0	0	0	0	0	2
	18	65	141	121	124	90	22	32	10	17	11	11
	24	13	8	7	2	0	4	2	1	0	0	0
	0	0	0	0	4	38	87	138	147	131	65	29
	23	22	31	19	15	10	6	5	1	0	0	0
	0	0	0									
1991	1	1	3	0	361.7	0	0	0	0	0	0	4
	8	5	7	24	95	194	211	133	71	40	20	16
	23	21	25	15	3	7	2	4	3	3	0	0

	0	0	0	2	6	10	5	10	49	156	259	181
	106	51	35	33	24	24	10	8	0	6	1	0
	1	0	0									
1992	1	1	3	0	260	0	0	0	0	0	1	2
	8	32	28	33	18	15	39	107	150	85	39	24
	14	22	20	22	15	10	6	2	3	2	0	0
	0	0	0	0	1	7	17	25	29	21	54	113
	149	89	49	46	19	20	10	13	4	5	2	0
	0	0	0									
1993	1	1	3	0	219.6	0	0	0	0	0	0	2
	15	30	19	17	53	57	43	51	55	56	48	28
	20	20	12	7	4	3	2	1	0	0	0	0
	0	0	0	0	1	8	22	19	31	46	60	71
	93	63	36	21	22	14	7	5	1	0	0	0
	0	0	0									
1994	1	1	3	0	94.1	0	0	0	0	0	0	0
	0	0	1	6	13	9	12	11	15	12	16	15
	8	4	0	4	1	2	1	0	1	1	0	0
	0	0	0	0	0	0	1	4	5	9	11	26
	29	43	22	9	9	8	0	2	1	1	1	0
	0	0	0									
1995	1	1	3	0	76.1	0	0	0	0	0	0	0
	0	0	0	0	0	2	4	5	13	13	8	27
	8	6	4	3	4	3	3	1	1	0	0	0
	0	0	0	0	0	0	0	1	1	1	4	9
	21	42	23	19	9	3	0	1	0	1	0	0
	0	0	0									
1996	1	1	3	0	82.1	0	0	0	0	0	0	0
	0	1	0	2	1	2	16	8	2	16	22	29
	18	17	14	10	5	1	0	1	0	0	0	0
	0	1	0	0	0	1	0	0	3	1	10	12
	19	30	59	21	9	11	4	2	1	0	0	0
	0	0	0									
1997	1	1	3	0	103.7	0	0	0	0	0	1	0
	0	0	0	2	2	3	3	8	12	13	20	31
	16	15	14	14	5	6	7	1	5	4	0	0
	0	0	0	0	0	0	0	1	1	7	8	14
	12	31	23	29	16	15	7	12	5	2	1	2
	0	0	0									
1998	1	1	3	0	59.7	0	0	0	0	0	0	0
	0	2	6	6	6	2	6	8	7	10	16	9
	10	13	9	8	3	2	8	1	0	0	0	0
	0	0	0	0	0	1	3	9	5	5	6	8
	9	19	23	27	10	13	8	0	2	0	0	1
	0	0	0									
1999	1	1	3	0	78.5	0	0	0	0	0	0	0
	0	0	0	4	17	27	16	10	8	13	15	15
	11	14	8	7	5	7	2	0	0	1	0	0
	0	0	0	0	0	1	1	5	4	22	17	16
	16	21	27	44	38	16	5	3	1	0	0	0
	0	0	0									
2000	1	1	3	0	25.2	0	0	0	0	0	0	0
	4	6	3	1	3	1	6	4	8	7	6	3
	1	0	3	0	1	1	0	0	0	0	0	0
	0	0	0	0	0	6	4	3	5	2	5	1
	7	6	4	1	1	0	0	0	0	0	0	0
	0	0	0									

2001	1	1	3	0	92.2	0	0	0	0	0	0	3
	10	39	31	17	34	15	9	2	9	15	12	17
	7	7	2	6	1	5	1	1	0	0	0	0
	0	0	0	0	2	15	42	23	21	19	6	7
	7	17	22	14	7	3	1	1	1	0	0	0
	0	0	0									
2002	1	1	3	0	38	0	0	0	0	0	0	0
	0	0	0	1	6	9	13	10	5	1	1	7
	7	6	3	3	6	6	0	0	0	1	0	0
	0	0	0	0	0	0	1	2	2	10	14	15
	5	6	4	8	5	2	1	0	0	0	0	0
	0	0	0									
#2003	1	1	3	0	1.2	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2004	1	1	3	0	33.2	0	0	0	0	0	0	1
	0	0	1	1	0	0	1	3	2	5	8	17
	18	13	1	6	2	4	0	1	0	0	0	0
	0	0	0	0	0	1	0	0	0	1	2	1
	3	3	9	8	5	1	0	0	0	0	0	0
	0	0	0									
#2005	1	1	3	0	1.5	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	1	0	0	0	0	0	0	0
	0	0	0									
#2007	1	1	3	0	5.3	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	1	0	0
	1	0	2	1	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	2	1	0	0	0	0	0	0
	0	0	0									
#2008	1	1	3	0	2.2	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
#												

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62	64	66	68	72	76	16
	18	20	22	24	26	28	30	32	34	36	38	40
	42	44	46	48	50	52	54	56	58	60	62	64
	66	68	72	76								
1979	1	2	3	0	5.3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	1	1
	1	0	0	0	0	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1

	0	1	1	4	0	1	1	1	1	0	0	0
	0	0	0									
1980	1	2	3	0	18.9	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	1	0	0	0
	1	3	1	1	4	4	3	2	1	6	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	1	1	1	4	6	4	3	1	0
	0	0	0									
1982	1	2	3	0	17.7	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	3	1
	0	2	2	1	2	1	0	0	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	1	0	2	0	0	0
	0	1	0									
1983	1	2	3	0	18.5	0	0	0	0	0	0	0
	0	0	0	0	0	2	0	1	3	1	2	5
	2	3	5	0	1	1	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	3
	1	2	1	3	5	4	3	3	0	1	0	0
	0	0	0									
1984	1	2	3	0	22.4	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	1
	2	3	3	0	3	2	2	1	2	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	2	5	7	5	4	0	2	0	0	0
	0	0	0									
1985	1	2	3	0	34.9	0	0	0	0	0	0	0
	0	0	1	0	3	2	2	6	9	4	5	9
	4	3	2	1	0	0	1	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	1	2	11
	2	5	3	5	7	3	2	0	0	0	0	0
	0	0	0									
1986	1	2	3	0	72.7	0	0	0	0	0	0	1
	0	0	2	1	4	6	4	2	3	17	9	14
	17	14	13	16	5	5	0	0	0	0	0	0
	0	0	0	0	0	1	3	4	3	2	3	3
	2	4	17	23	25	20	11	2	3	0	0	0
	0	0	0									
1987	1	2	3	0	56.3	0	0	0	0	0	0	0
	1	0	1	6	7	11	8	15	9	6	6	5
	11	5	6	3	1	2	0	0	0	0	0	0
	0	0	0	0	0	0	3	4	12	13	10	10
	13	6	16	12	6	6	3	4	3	0	1	1
	1	0	0									
1988	1	2	3	0	23.3	0	0	0	0	0	0	0
	0	0	0	0	2	1	1	8	5	9	9	4
	1	4	2	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	2	0	10
	7	5	3	5	2	1	0	1	0	0	0	0
	0	0	0									
1989	1	2	3	0	44.4	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	5	5	9	7	7
	10	4	7	1	3	0	1	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	2
	7	7	6	12	7	1	5	2	2	0	0	1
	0	0	0									

1990	1	2	3	0	23.3	0	0	0	0	0	0	0
	0	0	0	0	4	2	0	3	2	6	1	2
	7	0	2	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	3	4	4	3
	5	2	7	5	3	2	0	0	0	0	0	0
	0	0	0									
1991	1	2	3	0	49.8	0	0	0	0	0	0	0
	0	0	1	0	0	4	6	6	3	4	3	4
	3	6	7	4	5	1	0	2	0	1	0	0
	0	0	0	0	1	0	0	0	1	2	10	10
	4	8	1	3	8	6	3	1	1	0	2	1
	0	0	0									
1992	1	2	3	0	111.4	0	0	0	0	0	0	0
	0	0	5	8	8	2	10	25	46	37	15	5
	9	2	4	6	4	3	0	2	1	1	0	0
	0	0	0	0	0	0	0	1	9	2	4	16
	37	25	10	13	5	7	4	0	2	0	1	0
	0	0	0									
1993	1	2	3	0	109.9	0	0	0	0	0	0	0
	0	0	2	0	2	4	14	16	48	25	15	11
	5	3	4	1	2	2	0	0	0	0	0	0
	0	0	0	0	0	1	1	2	2	2	7	17
	19	11	10	8	3	0	2	0	0	0	0	0
	0	0	0									
1994	1	2	3	0	86.2	0	0	0	0	0	0	0
	0	0	0	0	0	4	2	10	13	8	21	28
	22	12	6	4	6	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	1	3	3
	9	14	19	8	10	4	1	2	0	0	0	0
	0	0	0									
1995	1	2	3	0	39.4	0	0	0	0	0	0	0
	0	0	0	0	0	0	3	5	1	3	11	10
	10	9	5	2	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	1	5
	2	10	5	2	1	0	0	2	1	0	0	0
	0	0	0									
1996	1	2	3	0	105.8	0	0	0	0	0	0	0
	0	0	1	1	0	7	10	10	15	24	33	26
	21	23	12	4	1	3	0	1	0	2	0	0
	0	0	0	0	0	0	0	2	4	2	9	12
	21	20	28	12	7	3	3	1	0	0	0	0
	0	0	0									
1997	1	2	3	0	76.5	0	0	0	0	0	0	0
	0	0	0	0	0	1	2	5	10	17	21	38
	44	25	17	10	5	2	2	3	1	0	0	0
	0	0	0	0	0	0	0	0	1	0	1	5
	4	12	12	14	5	5	2	1	0	0	0	0
	0	0	0									
1998	1	2	3	0	58.3	0	0	0	0	0	0	0
	0	0	0	1	1	1	5	8	13	16	14	17
	17	10	11	3	1	0	2	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	1	3	5
	11	10	12	8	8	5	3	0	1	0	3	0
	0	0	0									
1999	1	2	3	0	23.5	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	2	2	6	8	6
	9	11	4	2	2	2	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	1	0	0
	1	2	4	10	3	7	4	3	5	1	1	1
	0	0	0									
2000	1	2	3	0	16	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	1	1	1	2	2
	3	2	2	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	6	1	3	2	3	1	1	3	2	3	1	1
	0	0	0									
2001	1	2	3	0	40.9	0	0	0	0	0	0	0
	0	1	3	10	5	0	3	1	4	3	5	6
	11	5	8	4	5	3	2	0	2	0	0	0
	0	0	0	0	0	1	2	2	8	3	2	1
	3	7	3	6	6	7	5	5	7	3	0	0
	0	0	0									
2002	1	2	3	0	6.9	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	0	1	3	3
	2	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	3	0	0	0	0	0	0	0
	0	0	0									
#												

#Yr	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62	64	66	68	72	76	16
	18	20	22	24	26	28	30	32	34	36	38	40
	42	44	46	48	50	52	54	56	58	60	62	64
	66	68	72	76								
1978	1	3	3	0	19	0	0	0	0	0	0	0
	0	0	0	0	3	3	3	3	2	7	4	2
	2	2	1	1	1	1	1	1	2	1	0	0
	0	0	0	0	0	0	0	0	0	0	3	1
	4	9	5	4	1	2	1	1	0	0	1	0
	0	0	1									
#1979	1	3	3	0	3.7	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	2	0	0	0	0
	1	0	2	1	3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	2	2	3	1	0	1	0	0	0	0	0	0
	0	0	0									
#1982	1	3	3	0	2.2	0	0	0	0	0	0	0
	0	0	0	0	0	1	0	0	0	0	1	0
	0	1	0	0	1	0	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	1	0	0	0	0	0	0	1	0	0	0
	0	0	0									
1983	1	3	3	0	41.2	0	0	0	0	0	0	0
	0	0	0	0	1	0	2	3	2	5	3	3
	5	3	1	0	0	3	2	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	4	5	1	4	2	5	1	2	0	0	0	0
	0	0	0									

1984	1	3	3	0	88.3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	2	4
	2	2	1	1	3	1	0	0	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	2	4	7	2	5	5	0	1	0	0	0
	0	0	0									
1985	1	3	3	0	348.5	1	1	2	2	1	0	0
	1	0	0	1	4	8	14	38	35	47	38	32
	22	28	25	17	12	14	7	3	3	5	0	2
	3	0	5	0	0	1	0	0	1	3	4	23
	63	88	103	60	42	32	24	15	11	3	7	1
	0	0	0									
1986	1	3	3	0	338.8	0	0	0	0	0	0	0
	0	2	1	0	2	7	7	4	8	28	56	67
	80	99	67	37	21	14	7	8	2	9	0	0
	0	0	0	0	0	0	0	0	1	9	3	8
	10	24	91	133	158	159	84	30	12	7	4	0
	0	1	0									
1987	1	3	3	0	263.7	0	0	0	0	0	0	0
	0	0	0	0	4	16	42	65	45	20	20	28
	57	44	48	35	17	11	5	4	2	3	0	0
	0	0	0	0	0	0	0	0	5	7	35	63
	42	36	45	67	107	93	43	26	7	3	3	1
	0	0	0									
1988	1	3	3	0	225.4	1	0	0	0	0	0	0
	0	1	1	0	2	5	24	61	105	111	62	38
	20	16	10	14	8	7	4	4	1	1	0	0
	0	0	0	0	0	0	1	0	2	2	13	34
	104	113	72	34	31	19	10	12	8	5	2	0
	2	0	0									
1989	1	3	3	0	323.3	0	0	0	0	0	0	0
	2	0	4	3	4	4	12	43	89	130	120	117
	84	45	30	6	8	9	5	4	3	1	0	0
	0	0	0	0	0	1	1	0	0	1	13	28
	90	165	155	100	50	26	21	12	8	5	0	1
	0	1	0									
1990	1	3	3	0	232.4	0	0	0	0	0	0	0
	0	1	2	7	33	49	24	45	60	41	58	53
	60	35	25	11	11	4	4	3	1	0	0	0
	0	0	0	1	0	0	0	1	12	16	28	23
	46	61	76	60	39	15	5	5	1	0	0	0
	0	0	0									
1991	1	3	3	0	89.9	0	0	0	0	0	0	0
	0	0	1	2	5	21	51	51	34	21	10	8
	6	5	4	4	2	0	1	2	0	1	0	0
	0	0	0	0	0	0	0	4	1	8	26	28
	24	16	14	15	11	4	3	0	1	0	0	0
	0	0	0									
1992	1	3	3	0	234.6	0	0	0	0	0	0	0
	0	0	3	6	8	7	20	83	151	164	106	50
	20	12	16	6	11	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	3	3	8	15	64
	147	145	66	29	22	13	4	2	1	0	0	0
	0	0	0									
1993	1	3	3	0	111.6	0	0	0	0	0	0	0
	3	5	0	7	3	8	9	41	69	51	29	12
	19	11	15	3	5	0	1	0	0	0	0	0

	0	0	0	0	0	0	3	1	1	3	6	33
	37	31	13	10	11	6	1	0	0	0	0	0
	0	0	0									
1994	1	3	3	0	80	0	0	0	0	0	0	0
	0	0	0	0	0	1	2	7	14	29	24	20
	10	0	1	2	2	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	2	5
	19	21	15	11	4	3	1	0	0	0	0	0
	0	0	0									
1995	1	3	3	0	70.1	0	0	0	0	0	0	0
	0	0	0	0	0	1	1	6	3	12	16	31
	17	8	2	9	1	4	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	6
	16	27	24	8	6	2	2	0	0	0	0	0
	0	0	0									
1996	1	3	3	0	43.6	0	0	0	0	0	0	0
	0	0	1	0	0	0	0	0	3	10	12	19
	10	4	0	2	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	4	17	21	10	5	2	0	1	0	0	0	0
	0	0	0									
1997	1	3	3	0	24.5	0	0	0	0	0	0	0
	0	0	0	0	0	1	0	2	0	7	6	8
	8	6	1	4	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	3	10	12	7	3	2	2	0	0	0	0	0
	0	0	0									
1998	1	3	3	0	33.5	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	6	4	16	16
	10	9	3	5	1	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	2	1
	5	6	13	16	6	4	0	0	0	1	0	0
	0	0	0									
#1999	1	3	3	0	4.5	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	1	4	5
	7	5	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	1	0	0	0	0	0	0	0	0
	0	0	0									
#2002	1	3	3	0	4.4	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	2	0	7	11	4	0	0	0	0	0	0
	0	0	0									
#2004	1	3	3	0	4.3	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	2	0	4	2	3	3	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	0	0	0	0	0	0
	0	0	0									

#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42

	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
1980	1	4	0	0	400	4	2	3	20	30	63	64
	101	87	208	427	435	312	169	173	104	68	89	68
	52	64	33	15	5	4	5	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1981	1	4	0	0	400	1	1	2	7	13	31	74
	116	181	172	197	177	176	187	256	210	118	76	67
	60	45	31	18	6	6	1	1	3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1982	1	4	0	0	386	0	0	0	0	3	5	16
	25	27	44	108	207	208	164	213	253	190	121	83
	59	51	18	11	4	5	1	2	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1983	1	4	0	0	196.4	0	0	0	1	0	0	3
	7	8	45	59	66	61	62	59	73	42	35	42
	38	45	19	10	9	12	2	7	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1984	1	4	0	0	262.9	23	17	35	29	9	2	8
	4	6	6	14	17	35	48	59	87	46	53	30
	23	17	11	4	4	5	0	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1985	1	4	0	0	330.6	1	10	27	74	126	96	94
	185	194	104	42	11	17	22	35	53	49	57	49
	35	26	11	12	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1986	1	4	0	0	298.2	5	5	5	13	36	47	52
	60	145	284	264	133	63	16	18	19	20	27	19
	21	25	3	9	5	3	0	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1987	1	4	0	0	50.2	0	0	2	3	5	7	11
	7	5	10	12	20	12	6	9	7	3	0	5
	4	3	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1988	1	4	0	0	49.9	0	0	0	1	3	4	3
	1	2	3	9	9	8	5	10	7	6	1	3
	3	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

1989	1	4	0	0	117.4	0	0	3	8	18	19	37
	42	53	54	18	24	22	29	32	30	25	21	11
	9	5	9	5	4	4	3	1	2	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1993	1	4	0	0	24.3	0	0	0	0	0	0	1
	3	1	9	8	2	3	4	3	4	2	5	2
	2	2	1	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1994	1	4	0	0	34.8	0	0	0	0	0	1	0
	2	0	6	5	8	10	11	11	3	8	10	5
	2	2	1	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1995	1	4	0	0	21.8	0	0	0	0	0	0	0
	1	0	0	1	0	2	0	7	4	2	4	6
	3	2	2	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1996	1	4	0	0	51	0	0	0	1	1	3	3
	7	7	6	3	7	1	5	7	7	7	12	7
	11	11	4	2	1	0	1	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1997	1	4	0	0	22.3	0	0	0	0	0	0	1
	4	0	1	8	6	10	3	2	5	0	4	5
	0	1	0	2	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1998	1	4	0	0	53.4	0	0	0	0	0	1	0
	2	5	8	5	9	10	13	7	7	15	6	3
	4	5	3	1	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1999	1	4	0	0	181.4	7	13	11	8	3	0	2
	5	3	9	8	7	11	21	25	38	44	53	41
	50	33	28	19	12	1	3	3	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2000	1	4	0	0	167.5	0	0	2	2	20	43	58
	66	46	41	12	11	7	8	8	16	19	29	22
	35	24	19	16	11	7	4	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2001	1	4	0	0	109.4	0	0	0	1	0	6	18
	42	72	69	49	43	18	11	9	5	8	8	6
	3	3	3	2	2	2	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2002	1	4	0	0	201.3	0	0	0	0	0	0	3
	3	7	23	62	112	129	113	95	37	20	25	31
	18	12	11	13	2	1	1	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2003	1	4	0	0	36.8	0	0	0	0	0	2	0
	0	0	0	0	2	14	16	21	29	17	4	5
	6	0	3	1	1	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2004	1	4	0	0	325.8	1	3	5	14	8	17	27
	44	24	27	20	25	48	55	105	135	116	97	52
	37	21	8	8	5	4	2	2	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2005	1	4	0	0	399.9	0	2	0	0	3	6	20
	77	148	195	185	143	91	54	58	74	86	84	83
	68	34	17	8	6	3	3	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2006	1	4	0	0	400	1	0	1	2	8	17	28
	29	46	69	128	224	334	263	169	96	80	72	98
	82	56	28	13	6	2	4	2	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2007	1	4	0	0	400	2	3	0	5	5	18	44
	74	133	228	173	167	158	184	208	209	148	107	74
	68	58	38	24	3	6	0	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2008	1	4	0	0	400	0	0	0	0	7	15	23
	27	51	74	151	247	267	193	209	171	120	88	65
	31	25	20	12	11	2	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2009	1	4	0	0	400	0	0	1	4	5	12	33
	43	94	148	177	173	209	273	238	190	127	109	95
	51	30	30	14	14	10	1	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2010	1	4	0	0	400	0	0	2	6	20	62	83
	129	118	93	101	126	154	208	198	170	135	111	54
	35	23	17	12	4	6	0	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

2011	1	4	0	0	400	2	1	5	11	66	186	283
	283	254	332	346	306	268	170	190	145	135	89	59
	38	29	21	8	3	1	5	2	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2012	1	4	0	0	400	1	1	4	12	16	41	154
	405	664	742	548	397	282	199	145	108	68	67	37
	24	15	11	1	3	2	2	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

#

#"year	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62	64	66	68	72	76	16
	18	20	22	24	26	28	30	32	34	36	38	40
	42	44	46	48	50	52	54	56	58	60	62	64
	66	68	72	76								
1978	1	5	3	0	-98	0	0	0	0	2	4	2
	4	0	3	5	8	7	9	28	32	15	14	7
	3	9	13	10	4	8	11	20	9	2	1	0
	0	0	0	3	1	1	3	1	5	5	11	7
	19	18	20	16	22	19	17	14	12	12	13	3
	0	1	1									
1979	1	5	3	0	-22	0	0	0	0	0	3	1
	7	25	44	26	7	0	4	7	20	14	11	11
	7	9	11	17	18	12	23	32	13	12	0	0
	0	0	0	0	2	4	2	4	4	3	7	4
	14	10	22	14	16	17	26	34	34	35	16	13
	4	3	1									
1980	1	5	3	0	-86.7	0	0	0	0	0	0	1
	0	1	4	2	15	33	23	9	5	4	4	3
	8	6	3	7	5	2	8	7	6	0	0	0
	0	0	0	2	1	0	1	0	12	15	20	6
	6	3	8	4	4	5	8	5	4	8	4	3
	2	0	0									
1981	1	5	3	0	-59.3	0	0	0	0	0	0	1
	0	11	13	2	1	4	8	9	15	19	5	4
	6	4	6	2	2	3	5	3	2	1	0	0
	0	0	0	0	2	0	6	8	5	3	4	6
	17	11	8	7	8	4	9	6	7	1	3	1
	2	0	0									
1982	1	5	3	0	-63	0	0	0	0	0	1	0
	0	0	1	5	3	3	8	7	5	14	16	15
	9	6	6	10	3	3	2	7	2	2	0	0
	0	0	0	2	0	0	0	0	0	2	4	3
	5	14	20	8	7	7	5	7	6	2	1	2
	1	0	0									
1983	1	5	3	0	-40.7	0	0	0	0	0	0	0
	0	0	0	0	1	3	6	3	10	4	3	10

	7	8	4	2	2	4	4	1	0	1	0	0
	0	0	0	0	1	0	2	0	1	0	4	5
	5	11	9	3	12	7	8	4	2	1	5	1
	0	0	0									
1984	1	5	3	0	-20.7	0	0	0	0	0	0	0
	0	0	0	1	0	1	2	4	0	1	7	2
	3	2	10	4	2	1	3	2	0	1	0	0
	0	0	0	0	0	0	0	3	0	0	4	4
	2	3	3	3	4	5	2	4	3	2	0	1
	0	0	0									

#YEAR

1980	1	5	0	0	104.7	0	1	0	1	5	4	11
	2	3	3	14	11	28	16	14	15	21	13	15
	13	4	12	10	7	3	11	7	4	4	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1981	1	5	0	0	68.7	1	0	1	0	0	0	0
	1	3	8	4	8	9	28	25	41	23	9	7
	14	11	13	11	6	7	7	8	5	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1982	1	5	0	0	92.9	0	0	0	0	1	0	0
	0	3	3	7	7	14	15	11	38	38	49	46
	24	21	8	3	11	7	1	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1983	1	5	0	0	95.5	0	0	0	0	0	0	3
	1	4	3	5	2	4	9	19	26	37	42	55
	53	36	23	13	8	10	3	1	0	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1984	1	5	0	0	94.8	1	1	1	1	0	0	0
	2	3	5	7	9	8	13	15	13	17	16	18
	13	9	6	12	2	7	4	2	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1985	1	5	0	0	175.4	2	5	12	38	52	53	63
	65	24	15	7	7	13	13	15	13	20	19	19
	15	13	21	14	14	8	7	4	3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1986	1	5	0	0	234.9	0	0	1	5	8	8	18
	29	72	190	204	142	66	18	4	5	7	13	21

	17	19	24	19	15	11	14	8	3	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1987	1	5	0	0	68	0	0	0	0	1	0	3
	3	15	24	33	27	18	9	6	4	3	4	3
	4	6	9	9	12	9	5	10	6	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1988	1	5	0	0	42.6	0	0	0	0	0	1	1
	1	2	1	4	4	4	4	1	6	5	4	4
	1	0	1	2	0	1	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1989	1	5	0	0	52.4	0	0	0	0	1	3	0
	2	5	4	24	11	3	3	7	13	15	10	8
	3	3	0	0	1	1	0	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
#YEAR	16	18	20	22	168	26	28	30	32	34	36	38
	40	42	44	46	48	50	52	54	56	58	60	62
	64	66	68	72	76	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76		
1993	1	5	0	0	37.7	1	0	0	0	0	0	0
	0	1	6	5	2	3	4	4	6	4	4	6
	3	1	1	2	2	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1994	1	5	0	0	32.9	0	0	1	0	0	4	5
	3	3	1	3	4	9	5	1	3	1	1	2
	2	0	2	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1995	1	5	0	0	38.3	0	0	1	0	0	0	0
	2	4	5	6	6	1	6	8	6	9	3	4
	3	0	1	1	0	1	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1996	1	5	0	0	109.6	0	0	0	2	2	1	3
	7	9	15	13	9	19	16	16	13	11	6	14
	19	12	13	4	7	8	4	1	2	3	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1997	1	5	0	0	216.6	0	0	0	1	5	4	4
	2	10	21	25	32	44	31	60	48	53	63	71
	55	49	84	37	29	22	11	20	6	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1998	1	5	0	0	152.5	0	0	0	0	0	3	8
	9	22	18	24	13	26	35	40	43	41	41	31
	35	29	27	24	14	6	8	2	5	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1999	1	5	0	0	212.9	2	0	0	0	0	3	1
	2	3	14	22	30	49	38	39	43	63	47	55
	47	40	25	44	17	20	6	7	6	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2000	1	5	0	0	85.2	0	0	0	0	3	10	25
	18	11	11	18	10	14	13	19	22	11	14	8
	2	9	5	14	8	13	10	5	0	4	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2001	1	5	0	0	82.9	0	0	1	0	1	1	2
	3	23	36	55	33	12	14	18	19	20	20	22
	14	11	11	3	2	1	0	2	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2002	1	5	0	0	42.8	0	0	0	0	0	0	0
	0	1	2	12	26	44	29	17	1	8	6	10
	9	5	3	4	1	2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2004	1	5	0	0	60	0	0	0	0	0	0	1
	0	2	1	3	2	9	6	5	9	4	9	4
	8	2	6	1	2	2	1	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2005	1	5	0	0	138.7	0	0	1	1	0	0	1
	5	3	5	4	6	10	8	16	26	24	39	37
	26	14	14	5	7	3	1	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2006	1	5	0	0	162.5	0	0	0	0	0	1	1
	1	3	6	3	11	19	17	15	24	22	23	26
	17	24	11	12	13	7	5	11	5	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2007	1	5	0	0	174.1	0	0	0	0	0	2	0
	1	5	7	11	15	14	26	25	18	22	12	14
	23	12	18	9	11	8	3	5	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

2008	1	5	0	0	110.494	1	0	0	0	0	0	0
	0	1	0	2	6	13	16	19	14	15	17	10
	12	13	8	8	4	3	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2009	1	5	0	0	118.67	0	0	0	0	1	1	5
	7	2	6	4	5	7	12	16	15	6	19	16
	20	21	14	10	16	5	5	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2010	1	5	0	0	112.392	0	0	1	0	0	4	6
	13	10	6	4	13	12	12	12	17	16	5	14
	8	8	7	5	2	5	2	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2011	1	5	0	0	123.944	1	0	0	0	0	4	2
	4	7	8	22	11	17	17	17	13	14	9	11
	9	5	3	4	6	2	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2012	1	5	0	0	143.706	0	0	0	2	5	6	4
	11	17	19	20	14	25	19	25	7	15	7	8
	9	2	9	6	0	2	0	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

#

#year	Seas	Flt/Svy	Gender	Part	Stewart, max400		16	18	20	22	24	26
	28	30	32	34	36	38	40	42	44	46	48	50
	52	54	56	58	60	62	64	66	68	72	76	16
	18	20	22	24	26	28	30	32	34	36	38	40
	42	44	46	48	50	52	54	56	58	60	62	64
	66	68	72	76								
1978	1	6	3	0	179.5	0	0	0	0	1	1	0
	0	0	0	0	0	3	5	27	52	42	16	8
	4	15	15	16	9	17	18	19	12	5	0	0
	0	0	0	0	0	0	0	0	0	1	7	18
	51	53	19	12	24	23	37	27	14	9	3	1
	0	0	0									
1979	1	6	3	0	67.4	0	0	0	0	0	0	0
	1	2	5	1	0	1	0	1	1	7	8	11
	4	3	2	6	3	5	4	5	2	3	0	0
	0	0	0	0	0	1	2	4	2	0	1	0
	2	7	13	6	5	8	14	9	11	4	1	1
	0	2	2									
1980	1	6	3	0	220.9	0	0	0	0	0	0	0
	0	0	8	17	61	96	55	44	10	3	7	8
	11	10	6	2	2	6	4	1	4	5	0	0

	0	0	0	0	0	0	0	7	28	77	71	39
	14	4	9	9	13	12	4	4	12	0	3	0
	0	0	0									
1981	1	6	3	0	195.2	0	0	0	0	0	0	0
	0	1	0	0	4	12	35	83	104	65	24	2
	0	3	0	2	2	4	2	4	6	5	0	0
	0	0	0	0	0	0	0	0	7	12	24	73
	111	65	15	2	6	6	11	7	10	5	3	2
	2	0	0									
1982	1	6	3	0	243.8	0	0	0	0	0	0	0
	0	0	1	3	19	19	38	13	36	67	94	90
	49	15	2	4	6	4	1	2	5	9	0	0
	0	0	0	0	0	0	0	2	9	19	21	19
	38	98	97	39	18	8	8	19	20	6	5	2
	0	0	0									
1983	1	6	3	0	365.8	0	0	0	0	0	0	0
	0	0	0	2	9	16	39	36	46	41	50	54
	110	79	31	11	7	11	11	11	11	28	0	0
	0	0	0	0	0	0	1	0	1	4	16	36
	50	51	111	126	64	25	20	17	28	21	10	2
	1	0	0									
1984	1	6	3	0	245.7	0	0	0	0	0	0	0
	0	0	0	1	0	0	2	10	14	21	28	37
	34	78	68	33	13	9	12	10	6	36	0	0
	0	0	0	0	0	0	0	0	1	0	4	9
	16	28	64	105	108	54	23	16	26	22	6	3
	0	0	0									
1985	1	6	3	0	196.1	0	0	0	0	0	0	0
	0	0	0	1	0	3	0	1	6	2	18	23
	23	28	43	55	20	9	3	3	3	9	0	0
	0	0	0	0	0	0	0	0	0	2	0	3
	9	11	23	55	85	78	31	17	17	8	6	0
	0	0	0									
1986	1	6	3	0	167.2	0	0	0	0	0	0	0
	0	0	4	14	13	9	5	0	1	0	4	7
	11	20	20	38	29	26	9	4	4	3	0	0
	0	0	0	0	0	1	4	9	32	21	15	4
	0	0	5	22	36	78	50	19	11	9	6	1
	1	0	0									
1987	1	6	3	0	255.6	0	0	0	0	0	0	0
	0	0	2	7	27	64	118	101	50	16	2	2
	3	4	9	17	22	26	25	9	2	7	0	0
	0	0	0	0	0	1	1	1	12	65	113	112
	58	14	5	4	21	43	36	26	12	6	3	2
	0	0	0									
1988	1	6	3	0	178.3	0	0	0	0	0	0	0
	0	0	0	0	10	6	21	37	54	63	30	15
	3	1	1	3	8	10	10	3	3	3	0	0
	0	0	0	0	0	0	0	1	0	10	20	39
	89	101	26	13	6	11	31	17	6	7	3	1
	0	0	0									
1989	1	6	3	0	129.2	0	0	0	0	0	0	1
	1	2	3	1	0	1	1	6	15	27	26	25
	20	13	3	2	3	3	5	4	0	1	0	0
	0	0	0	0	0	0	2	3	2	3	1	5
	17	45	68	34	16	6	25	24	6	5	2	2
	0	0	0									

1990	1	6	3	0	160.1	0	0	0	0	0	0	0
	0	6	10	8	14	18	13	10	15	9	6	15
	14	21	13	5	1	1	5	10	4	4	0	0
	0	0	0	0	2	6	14	17	18	20	24	20
	16	21	20	44	36	26	21	20	10	8	5	2
	0	0	0									
1991	1	6	3	0	124	0	0	0	0	0	0	0
	0	0	4	1	5	28	39	45	21	22	8	4
	9	20	18	9	7	2	2	2	1	2	0	0
	0	0	0	0	1	0	0	3	2	22	49	68
	36	20	13	17	25	21	13	14	18	8	1	0
	0	0	0									
1992	1	6	3	0	45.9	0	0	0	0	0	0	0
	0	0	1	1	1	0	0	6	17	18	13	9
	13	1	4	9	5	3	2	2	2	3	0	0
	0	0	0	0	0	0	0	0	0	1	0	7
	8	19	18	6	5	10	9	5	8	2	1	1
	0	0	0									
1993	1	6	3	0	43.7	0	0	0	0	0	0	0
	0	0	0	0	0	1	1	2	3	10	10	19
	10	2	4	6	6	2	1	2	2	0	0	0
	0	0	0	0	0	0	0	0	1	0	3	5
	7	24	31	17	29	12	3	7	3	6	1	0
	0	0	0									
1994	1	6	3	0	53.5	0	0	0	0	0	0	0
	0	0	0	0	1	2	1	6	3	6	6	5
	10	14	8	7	4	4	6	1	4	1	0	0
	0	0	0	0	0	0	0	0	0	3	2	11
	18	11	22	35	29	14	10	11	7	5	4	1
	0	0	0									
1995	1	6	3	0	40.2	0	0	0	0	0	0	0
	0	1	0	0	0	1	1	1	1	2	2	2
	1	1	6	3	5	5	9	4	0	4	0	0
	0	0	0	0	1	0	1	1	1	0	0	3
	2	0	1	10	14	9	7	13	12	16	8	2
	4	0	0									
1996	1	6	3	0	18.1	0	0	0	0	0	0	0
	0	0	0	0	0	1	1	0	1	0	3	2
	3	3	4	4	0	0	2	3	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	2	1	0	2	3	8	5	4	2	1	1	1
	0	0	0									
1997	1	6	3	0	17.6	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0
	0	1	0	3	4	3	2	0	3	7	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	0	0	2	3	8	9	5	6	4	4	3
	1	0	0									
1998	1	6	3	0	21.6	0	0	0	0	0	0	0
	0	0	0	0	0	1	1	2	3	9	9	5
	2	0	0	2	7	8	5	5	2	3	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	3	1	1	1	3	3	8	12	5	1	2	1
	0	0	0									
1999	1	6	3	0	7.8	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	1	1	0	0	1	1	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	2	1	4	2	4	1	0
	0	0	0									
2000	1	6	3	0	13.9	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	3	0	1	0
	0	1	3	2	0	10	5	5	1	4	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	1	5	5	3	0	2	4	3	1	1	3	1
	0	0	0									
2001	1	6	3	0	7.2	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	1	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	0	0	0	1	3	3	1	1	0
	1	0	0									
2002	1	6	3	0	23.7	0	0	0	0	0	0	0
	1	0	0	0	6	21	11	6	5	0	1	0
	1	0	0	0	1	0	3	3	1	1	0	0
	0	0	0	0	0	0	0	1	2	15	10	7
	2	1	1	2	0	0	0	0	3	1	1	0
	0	0	0									
#2005	1	6	3	0	1.2	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	0	0									
#2007	1	6	3	0	2.2	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
#2008	1	6	3	0	9.8	0	0	0	0	0	0	0
	0	0	0	0	0	0	2	3	4	1	0	0
	1	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	2	0	1	0	2	1	1	0	0	0	1	0
	0	0	0									
#Yr	Seas	Flt/Svy	Gender	Part	Nsamp	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
#1977	1	8	3	0	163	0	0	0	0.001	0.001	0	0.001
	0.001	0.004	0.0071	0.0071	0.0307	0.0501	0.047	0.0409	0.0317	0.0358	0.0153	0.0143
	0.0266	0.0153	0.0225	0.0184	0.0255	0.0194	0.0174	0.0276	0.003	0.001	0	0
	0	0	0.002	0.001	0.004	0.002	0.0051	0.0081	0.0112	0.0225	0.0603	0.0552
	0.044	0.0327	0.0276	0.0358	0.0327	0.045	0.0307	0.045	0.0245	0.0276	0.0092	0.003
	0.004	0	0									
1980	1	8	3	0	81	0	0	0	0	0.0078	0.0216	0.0078
	0	0	0	0.0078	0.0451	0.1119	0.1375	0.1041	0.0176	0	0.0039	0.0039
	0.0058	0	0.0019	0.0019	0.0019	0	0	0	0	0	0	0
	0	0	0.0078	0.0353	0.0137	0.0019	0	0	0.0098	0.0648	0.1611	0.1335

	0.053	0.0039	0.0019	0.0019	0.0039	0.0019	0.0039	0.0078	0.0039	0.0039	0.0019	0
	0.0019	0	0									
1983	1	8	3	0	75	0	0	0	0	0	0	0
	0	0	0.002	0	0.002	0.0041	0.0062	0.0062	0.0083	0.0188	0.0167	0.0439
	0.0899	0.1087	0.0313	0.0062	0.0083	0.0083	0	0.0083	0.0062	0	0	0
	0	0	0	0	0	0	0	0	0.0041	0	0	0.0083
	0.0271	0.0271	0.0585	0.1778	0.1485	0.0606	0.0439	0.0376	0.0167	0.0083	0.0041	0
	0	0	0									
1986	1	8	3	0	39	0	0	0	0	0.019	0.0095	0.0047
	0.0047	0.019	0.0428	0.0523	0.0476	0.0238	0	0	0	0	0	0.0047
	0.0047	0	0.0095	0.0142	0.0333	0.0476	0.0285	0.0285	0	0.0047	0	0
	0	0	0.0047	0.038	0.0238	0	0.038	0.0761	0.1523	0.0761	0.0142	0
	0	0	0.0047	0	0.0238	0.0238	0.038	0.0238	0.0238	0.019	0.0142	0
	0.0047	0	0									
1989	1	8	3	0	400	0.0014	0	0	0.0044	0.0404	0.1596	0.1456
	0.0147	0.0066	0.0132	0.0206	0.0066	0.0007	0.0022	0.0007	0	0.0044	0.0103	0.0036
	0.0117	0.0036	0.0022	0.0014	0	0.0022	0.0014	0.0014	0	0	0.008	0.0007
	0	0.0103	0.0699	0.2008	0.142	0.0117	0.0044	0.011	0.0125	0.0044	0	0.0007
	0.0014	0.0095	0.0125	0.0183	0.0073	0.0014	0.0029	0.0051	0.0029	0.0007	0	0
	0.0007	0	0									
1992	1	8	3	0	78	0	0	0	0	0.0076	0.0329	0.0482
	0.0228	0.0228	0.0304	0.0203	0.0228	0.0101	0.0279	0.0609	0.0532	0.0507	0.0101	0
	0.005	0.0025	0.0076	0	0	0.0025	0.0025	0	0	0	0	0
	0.0025	0	0.0126	0.0532	0.0507	0.0152	0.0279	0.038	0.0964	0.0304	0.0406	0.0482
	0.0583	0.0304	0.0126	0.0203	0.0025	0.0076	0.0025	0	0	0.0025	0.0025	0
	0	0.0025	0									
1995	1	8	3	0	63	0	0	0.0178	0.0773	0.0952	0.0119	0.0178
	0.0238	0.0178	0.0178	0.0238	0	0	0	0.0059	0.0178	0.0178	0.0059	0.0119
	0.0059	0.0119	0.0297	0.0178	0.0119	0.0178	0	0.0178	0.0119	0	0	0.0178
	0.0476	0.0714	0.0535	0.0178	0.0178	0.0119	0.0357	0.0297	0.0119	0.0059	0	0.0059
	0.0059	0.0059	0.0357	0.0119	0.0357	0.0178	0.0297	0.0119	0.0178	0.0119	0	0
	0	0	0									
1998	1	8	3	0	31	0	0	0	0	0.0169	0	0
	0.0677	0.1525	0.1186	0.0508	0.0508	0	0	0	0.0338	0	0	0.0169
	0	0	0.0169	0	0.0169	0.0169	0	0.0169	0	0	0	0
	0.0169	0.0169	0	0	0.0338	0.0338	0.0677	0.0338	0.0169	0	0	0
	0	0.0169	0.0169	0.0847	0.0169	0	0.0169	0.0338	0	0.0169	0	0
	0	0	0									
2001	1	8	3	0	34	0	0.014	0.014	0.0281	0	0	0
	0.014	0.1267	0.0704	0.1267	0.014	0.014	0.014	0.014	0	0	0	0.014
	0	0	0.014	0	0	0	0	0.0281	0.014	0	0	0
	0	0	0	0	0	0.014	0.0563	0.0845	0.1408	0.014	0.0281	0
	0	0	0	0.0422	0.014	0.0281	0.014	0	0.014	0.014	0.014	0
	0	0	0									
2004	1	8	3	0	65	0.0045	0	0	0.0045	0.0273	0.0593	0.0045
	0	0	0	0	0	0	0.0091	0.0045	0.0182	0.0319	0.0228	0.0456
	0.073	0.0456	0.0273	0.0182	0.0182	0.0182	0.0136	0.0228	0.0091	0.0045	0	0
	0.0045	0.0182	0.0273	0.0547	0.0091	0.0045	0	0	0.0045	0	0	0.0091
	0.0091	0.0136	0.0136	0.073	0.0593	0.0319	0.0547	0.0182	0.0273	0.0228	0.0273	0.0182
	0.0136	0	0									

#CPFV observer LFs

#Year	Seas	Flt/Svy	Gender	Part	NSamp	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42

	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
1987	1	9	0	0	197.5	3	1	2	0	0	4	6
	6	16	33	69	107	101	101	111	76	65	29	26
	29	29	26	20	21	19	2	14	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1988	1	9	0	0	300.3	1	4	10	2	7	6	9
	16	30	22	54	78	92	140	198	129	130	80	44
	22	18	26	20	15	22	18	28	5	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1989	1	9	0	0	361	1	0	1	13	24	24	49
	57	63	55	55	59	45	65	114	133	186	126	111
	95	55	19	26	15	10	12	12	9	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1990	1	9	0	0	192.6	0	1	2	1	8	18	25
	83	157	124	58	58	80	53	31	44	42	55	47
	36	24	12	7	2	2	1	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1991	1	9	0	0	179.1	0	0	1	3	1	4	8
	1	3	6	18	24	54	103	123	75	66	57	57
	64	50	42	37	28	16	8	15	6	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1992	1	9	0	0	395.8	0	0	4	2	4	9	21
	34	59	50	41	49	78	109	191	196	181	132	122
	73	58	86	77	56	23	15	17	12	3	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1993	1	9	0	0	296.9	1	0	0	2	0	1	8
	21	25	25	28	41	43	45	66	72	143	113	122
	78	57	49	66	60	30	21	29	12	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1994	1	9	0	0	210.4	0	0	0	1	3	10	12
	6	8	13	25	57	50	48	66	58	63	63	49
	51	36	25	17	21	14	8	11	5	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1995	1	9	0	0	224.5	0	0	2	3	3	12	9
	22	18	32	33	41	32	42	60	72	84	73	50
	36	30	34	17	17	7	8	8	5	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

1996	1	9	0	0	185	1	0	0	0	1	4	5
	7	18	22	24	26	24	41	43	53	51	53	45
	32	38	25	22	17	13	5	10	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1997	1	9	0	0	257.5	0	0	0	1	5	4	9
	3	12	24	29	33	49	35	75	63	63	86	83
	82	76	67	52	47	29	16	28	11	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1998	1	9	0	0	124.7	0	0	0	0	0	1	5
	7	15	15	8	10	18	30	33	39	37	36	32
	33	29	27	21	10	10	6	3	7	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
#Year	Seas	Flt/Svy	Gender	Part	NSamp	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
2004	1	10	3	0	57	0	0	0	0	0	2	0
	13	5	1	2	5	9	12	20	50	57	108	106
	42	24	11	6	7	3	1	2	0	0	0	0
	0	0	1	4	7	20	7	4	3	6	7	20
	24	51	59	35	26	7	11	4	3	1	1	0
	0	0	0									
2005	1	10	3	0	65	0	0	0	0	0	0	0
	2	4	4	8	14	6	7	2	2	10	26	56
	79	72	50	14	11	8	7	11	2	2	0	0
	0	0	0	0	1	1	3	3	10	20	14	6
	6	11	16	48	43	35	18	11	10	6	1	0
	0	1	0									
2006	1	10	3	0	70	0	0	0	1	1	8	20
	7	2	3	1	5	18	33	38	44	25	22	37
	52	59	45	18	4	7	2	3	1	0	0	0
	1	1	6	13	15	13	1	2	10	12	25	17
	23	21	6	14	24	36	22	12	3	2	2	0
	1	0	0									
2007	1	10	3	0	78	0	0	0	0	0	0	0
	2	4	25	40	18	12	14	21	26	27	30	28
	30	43	27	20	8	3	3	4	1	1	0	0
	0	0	0	0	0	2	6	15	16	22	10	11
	15	14	28	32	35	16	24	6	2	2	0	1
	0	0	0									
2008	1	10	3	0	90	0	0	0	0	1	2	4
	8	4	9	8	21	39	28	20	24	21	34	28
	31	35	39	29	15	7	4	2	0	0	0	0
	0	0	0	1	8	5	4	6	11	24	35	17
	13	24	19	22	18	18	11	7	6	1	1	1
	0	0	0									
2009	1	10	3	0	80	0	0	0	0	1	2	3
	3	4	7	14	16	15	18	35	25	24	29	17

	38	31	42	17	13	2	3	3	1	1	0	0
	0	0	0	2	2	4	3	8	5	15	11	24
	15	18	18	21	21	28	21	5	5	0	0	0
	0	0	0									
2010	1	10	3	0	64	0	0	0	0	0	1	3
	3	5	2	4	5	4	6	13	18	2	15	11
	4	12	13	18	3	3	5	2	1	0	2	1
	0	0	0	0	5	5	3	3	2	5	6	8
	9	9	11	10	10	10	5	10	0	1	1	0
	0	0	0									
2011	1	10	3	0	193	0	0	0	2	11	24	38
	38	15	5	16	31	18	13	19	18	26	33	30
	16	23	18	17	8	3	2	2	0	0	0	0
	0	0	8	14	43	18	10	9	22	24	24	18
	19	31	12	25	20	14	10	13	8	0	0	1
	0	0	0									
2012	1	10	3	0	253	0	0	0	0	0	1	4
	11	21	69	82	65	37	27	25	21	28	28	29
	14	22	19	25	10	10	6	2	1	1	0	0
	0	0	0	1	4	11	28	77	86	60	36	31
	27	24	24	25	14	20	22	18	11	2	0	0
	0	0	0									
#year	Seas	Flt/Svy	Gender	Part	Nsamp	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
2003	1	11	3	0	38.454	0	0	0	0	0	14677	0
	0	0	0	0	0	19773	12373	12590	31816	33936	82649	55254
	12159	11412	19250.5	13105	20986	12487	14788	6029	5077	3832	0	0
	0	0	0	27911	12487	0	0	9024	30739	0	59320	45082
	38462	99249	39067	33419	21508	47151	33186	28779.5	0	0	0	6029
	0	0	0									
2004	1	11	3	0	96.516	0	0	0	9015	38855	151044	257610
	316953	22193	150585	119209	169096	63290	71791	176752	217938	83366	279525	250018
	840875	204934	131428	58799	34468	11301	44503	12658	0	0	0	0
	0	25368	23409	165924	320652	358702	232678	74084	171619	96158	168656	135720
	169682	542970	452187	266385	820258	429010	52210	12013	11301	21430	22378	0
	20332	0	0									
2005	1	11	3	0	71.054	0	0	0	6099	0	19905	93519
	11484	143365	95153	213206	44473	0	39619	10022	21842	36056	82164	114577
	135087	77615	46055	18435	18435	17562	10022	70913	13884	0	0	0
	6099	0	43348	26004	28896	0	137041	186601	103421	80779	11389	21363
	44058	32670	150622	248487	191348	167876	62870	16232	33745	34131	0	0
	0	0	0									
2006	1	11	3	0	64.256	0	0	22460	11717	34763	82996	20114
	11369	0	35756	18325	11150	114592	178976	30919	22877	0	18668	33384
	34315	34315	66592	0	16465	0	16465	39661	13721	6462	0	0
	23434	46601	229159	335595	20963	12159	0	0	33647	23597	252133	213932
	35560	11438	22877	33620	35036	20395	25396	22068	7259	18957	5235	10342
	8442	0	0									
2007	1	11	3	0	47.424	0	0	0	0	0	0	0
	32757	34745	112013	32559	22146	0	23370	11375	124584	97164	11685	11685
	33342	22115	68650	27640	45602	11682	0	0	0	0	0	0
	0	0	0	0	0	0	98696	135710	38700	0	20002	70111

	56177	61278	46741	30433	97274	113547	63830	35380	32807	0	0	0
	0	0	0									
2008	1	11	3	0	34.938	0	0	0	0	44005	20487	0
	0	0	0	12235	12235	12235	0	0	0	11621	9830	19264
	16848	46848	22030	26727	32181	39130	31938	14466	19560	0	0	0
	7464	10244	10244	0	0	0	10244	0	10244	22479	12235	0
	31800	17194	7944	15887	45376	34191	108031	66513	49869	18143	15887	15887
	0	0	0									
2009	1	11	3	0	35.972	0	0	11385	9159	23220	23285	30916
	7935	31479	31018	24075	0	7783	7783	29543	7783	6592	15878	16203
	28984	9897	36217	16717	9785	0	8606	11416	0	0	0	0
	31929	16726	16139	18415	0	0	0	23069	25929	33705	7783	21902
	22597	15566	7783	17568	21313	51157	9785	9159	24354	5301	0	0
	0	0	0									
2010	1	11	3	0	32.798	0	0	64452.5	9072	36288	43555	0
	9072	9057	9057	0	0	0	0	0	0	0	7267	0
	0	7267	25618	7267	15878	0	0	0	8101	0	0	0
	82932.5	36287	70194	17082	0	9072	15408	27171	9072	0	0	0
	7615	0	0	36403	0	60028	29069	9874	16723	12059	0	0
	0	0	0									
2011	1	11	3	0	30.696	0	0	0	5	5	14	9
	0	3	2	0	0	0	0	0	0	1	0	0
	1	0	3	1	1	0	1	1	0	0	0	0
	0	4	13	12	8	0	0	0	0	0	0	0
	0	0	1	1	2	1	1	1	1	0	0	0
	0	0	0									
2012	1	11	3	0	91.408	0	0	0	0	2	2	6
	19	12	24	24	13	4	4	6	2	1	2	3
	5	4	4	2	2	3	0	2	0	0	0	0
	0	2	0	7	34	26	17	49	35	13	2	8
	6	3	2	9	11	20	11	4	1	3	0	0
	0	0	0									

this is the Gotshall and Miller LF data from Central California sampling programs

#year	Seas	Flt/Svy	Gender	Part	#_samp	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
1959	1	14	0	0	-10	9	0	0	0	0	0	0
	0	0	3	3	4	5	12	19	28	24	40	24
	24	15	14	5	4	6	3	1	0	3	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1960	1	14	0	0	-95	0	1	2	1	0	0	0
	0	1	5	4	5	25	42	121	123	166	122	103
	105	58	26	20	14	5	5	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1961	1	14	0	0	-25	0	0	0	0	0	0	0
	0	6	2	2	2	1	5	22	44	51	57	25
	10	13	2	6	3	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1966	1	14	0	0	-30	140	3	2	1	1	3	5
	2	10	28	40	35	14	6	1	10	12	28	30
	25	15	13	21	3	4	3	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

this is the observer LF data

#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
2002	1	15	0	0	24.38	0	0	0	0	0	0	0
	0	0	0	1	1	8	19	10	16	9	15	11
	11	7	7	3	3	1	0	3	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2003	1	15	0	0	8.83	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	3	5	6	4
	6	2	4	0	0	0	0	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2004	1	15	0	0	60.36	0	0	12	4	7	0	2
	0	0	0	0	0	2	3	7	9	24	28	45
	40	21	26	24	18	14	11	9	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2005	1	15	0	0	123.2	0	0	0	0	0	2	1
	0	0	2	6	8	5	8	21	34	49	66	85
	88	88	56	50	35	32	16	22	8	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2006	1	15	0	0	38.80	0	0	0	0	0	0	0
	0	0	0	1	2	5	11	20	19	13	10	14
	27	14	11	13	9	7	4	5	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2007	1	15	0	0	44.46	0	1	0	0	1	1	0
	1	0	1	2	1	1	0	3	2	8	23	13
	17	21	15	14	12	12	10	8	1	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
2008	1	15	0	0	2.828	0	0	0	0	1	2	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
#Yr	Seas	Flt/Svy	Gender	Part	Neff	16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52
	54	56	58	60	62	64	66	68	72	76	16	18
	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52	54	56	58	60	62	64	66
	68	72	76									
1975	1	16	0	0	400	3	8	18	22	124	435	1059
	2645	3183	2660	2729	2587	1969	910	662	705	717	495	354
	236	129	69	57	41	19	10	12	7	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1976	1	16	0	0	400	7	5	9	35	91	160	381
	1136	2293	2505	2364	3574	3567	2634	1841	1329	1140	895	687
	463	292	154	131	87	43	31	31	14	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1977	1	16	0	0	400	35	86	114	66	36	48	126
	252	276	290	438	1081	1428	1372	1514	1256	815	587	485
	389	279	162	96	77	49	41	25	8	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1978	1	16	0	0	400	24	26	293	978	1346	1444	1622
	1729	1059	343	261	389	669	863	1218	1390	1348	1042	752
	625	464	295	189	106	41	34	21	6	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1986	1	16	0	0	400	3	1	17	23	25	60	139
	373	629	701	610	497	335	133	68	58	86	91	79
	72	47	38	13	8	2	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1987	1	16	0	0	400	1	0	0	1	3	15	36
	100	134	171	305	548	596	382	191	110	66	57	54
	48	45	31	29	13	6	3	3	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1988	1	16	0	0	341	7	6	7	14	1	17	38
	89	106	80	49	103	137	186	260	239	178	93	69
	73	26	22	30	12	11	7	8	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									
1989	1	16	0	0	400	9	11	33	167	289	286	390
	715	679	318	117	120	134	183	260	340	290	207	190
	113	65	33	33	16	16	7	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0									

21 #_N_age_bins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
0 #_N_ageerror_definitions
0 #_N_Agecomp_obs
1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1 #_combine males into females at or below this bin number
#Yr Seas Flt/Svy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

0 #_N_MeanSize-at-Age_obs
#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)

1 #_N_environ_variables
0 #_N_environ_obs
1 # N sizefreq methods to read
25 #Sizefreq N bins per method
1 #Sizetfreq units(bio/num) per method
1 #Sizefreq scale(kg/lbs/cm/inches) per method
1e-005 #Sizefreq mincomp per method
20 #Sizefreq N obs per method
#_Sizefreq bins

0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6
	2.8	3	3.2	3.4	3.6	3.8	4	4.5	5	5.5	6	6.5

#_Year season Fleet Partition Gender SampleSize <data>
southern California RecFIN

#	#Yr	Seas	Flt/Svy	Gender	Part	Nsamp	0.2	0.4	0.6	0.8	1	1.2
	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
	3.8	4	4.5	5	5.5	6	6.5	0.2	0.4	0.6	0.8	1
	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4
	3.6	3.8	4	4.5	5	5.5	6	6.5				
1	1980	1	4	0	0	-176	253	258	821	536	209	121
	81	81	66	55	41	35	21	10	5	4	4	2
	0	3	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1981	1	4	0	0	-148	211	395	367	302	316	240
	110	72	58	60	31	33	16	8	3	3	4	0
	0	0	2	2	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1982	1	4	0	0	-135	40	82	313	320	268	306
	174	115	71	54	39	19	9	6	1	4	3	0
	1	2	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1983	1	4	0	0	-99	8	58	123	103	79	80
	41	39	36	42	33	17	7	12	3	9	8	0
	1	4	2	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1984	1	4	0	0	-181	127	13	30	63	79	102
	47	45	30	19	8	14	4	3	2	3	3	0
	0	2	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1985	1	4	0	0	-147	669	281	30	29	49	63
	55	50	42	26	21	8	13	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1986	1	4	0	0	-119	253	567	266	41	24	20
	32	16	18	20	21	2	7	2	5	2	1	0
	1	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1987	1	4	0	0	-32	37	20	33	10	12	6
	1	4	1	5	2	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1988	1	4	0	0	-39	12	12	13	11	12	8
	4	2	3	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1989	1	4	0	0	-50	139	105	42	41	49	28
	26	14	7	6	4	8	5	1	4	1	4	2
	0	1	0	2	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				

Northern California RecFIN

#use	YEAR	Seas	Flt/Svy	Gender	Part	Nsamp	0.2	0.4	0.6	0.8	1	1.2
	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6
	3.8	4	4.5	5	5.5	6	6.5	0.2	0.4	0.6	0.8	1
	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4
	3.6	3.8	4	4.5	5	5.5	6	6.5				
1	1980	1	5	0	0	-70	24	4	27	42	16	16
	22	14	11	14	3	6	9	6	3	3	5	1
	3	12	2	5	0	1	3	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1981	1	5	0	0	-34	2	12	12	16	46	48
	21	6	6	13	10	12	6	8	5	3	4	6
	1	4	7	2	1	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1982	1	5	0	0	-50	1	7	13	22	18	48
	44	50	31	26	15	7	4	5	7	4	4	1
	0	4	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1983	1	5	0	0	-46	3	9	6	11	21	33
	47	44	46	48	29	17	13	8	7	6	5	1
	2	1	0	0	1	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1984	1	5	0	0	-69	6	8	16	15	21	17
	18	17	16	9	8	5	6	9	1	5	2	1
	4	1	0	1	1	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1985	1	5	0	0	-99	301	37	13	21	21	20
	17	18	17	11	12	16	9	13	10	8	2	4
	1	3	3	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1986	1	5	0	0	-105	84	365	266	45	5	10
	12	14	16	18	14	19	16	17	6	6	10	7
	3	6	3	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1987	1	5	0	0	-37	9	55	50	19	8	5
	2	2	5	4	4	7	5	11	7	8	2	3
	5	6	4	2	0	0	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1988	1	5	0	0	-36	3	10	10	7	4	8
	5	3	1	1	0	1	2	0	0	1	0	0
	0	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				
1	1989	1	5	0	0	-36	8	17	27	3	11	14
	16	8	8	2	1	0	0	0	1	0	1	0
	0	1	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0				

0 # no tag data
0 # no morphcomp data

999

ENDDATA

Control File

#C growth parameters are estimated
change log
boc2.dat, boc2.ctl - all data unchanged from 2011 update, model time period extended through 2012 (from 2010), 2010 catches put in 2011 and 2012 for placeholders

#_3.21 version
1 #_N_Growth_Patterns
1 #_N_Morphs_Within_GrowthPattern
#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)
#_Cond 1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

#_Cond 0 # N recruitment designs goes here if N_GP*nseas*area>1
#_Cond 0 # placeholder for recruitment interaction request
#_Cond 1 1 1 # example recruitment design element for GP=1, seas=1, area=1

#_Cond 0 # N_movement_definitions goes here if N_areas > 1
#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0
#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

3 #_Nblock_Patterns
11 6 18 #_blocks_per_pattern
begin and end years of blocks
1975 1977
1978 1980
1981 1983
1984 1986
1987 1989
1990 1992
1993 1995
1996 1998
1999 2001
2002 2004
2005 2008

1970 1979
1980 1988
1989 1991
1992 1998
1999 2003
2004 2008

1973 1974
1975 1976
1977 1978
1979 1980
1981 1982
1983 1984
1985 1986
1987 1988
1989 1990
1991 1992
1993 1994
1995 1996

1997 1998
1999 2000
2001 2002
2003 2004
2005 2006
2007 2008

0.5 #_fracfemale
1 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
2 #_N_breakpoints
1 5 # age(real) at M breakpoints
1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented
1.5 #_Growth_Age_for_L1
25 #_Growth_Age_for_L2 (999 to use as Linf)
0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)
1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern
1 #_First_Mature_Age
1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0
1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)
2 #_env/block/dev_adjust_method (1=standard; 2=with logistic trans to keep within base parm bounds)

#_growth_parms

#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-var	use_dev	dev_min	dev_max	dev_std	Block	Blk_Fxn		
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	#	NatM_p_1_Fem_GP:1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	#	NatM_p_2_Fem_GP:1
1	45	26	27	0	10	-4	0	0	0	0	0.5	0	0	#	L_at_Amin_Fem_GP_1
60	80	67.738	69	0	10	3	0	0	0	0	0.5	0	0	#	L_at_Amax_Fem_GP_1
0.15	0.25	0.21958	0.21	0	0.8	3	0	0	1970	2008	0.5	3	1	#	VonBert_K_Fem_GP_1
0.05	0.25	0.1	0.1	0	0.8	-6	0	0	0	0	0.5	0	0	#	CV_young_Fem_GP_1
0.05	0.25	0.08	0.1	0	0.8	-3	0	0	0	0	0.5	0	0	#	CV_old_Fem_GP_1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	#	NatM_p_1_Mal_GP:1
0.05	0.25	0.15	0.16	0	0.8	-3	0	0	0	0	0.5	0	0	#	NatM_p_2_Mal_GP:1
1	45	26	27	0	10	-4	0	0	0	0	0.5	0	0	#	L_at_Amin_Mal_GP_1
50	70	58.9149	61	0	10	3	0	0	0	0	0.5	0	0	#	L_at_Amax_Mal_GP_1
0.2	0.3	0.26418	0.2	0	0.8	3	0	0	1970	2008	0.5	3	1	#	VonBert_K_Mal_GP_1
0.05	0.25	0.1	0.1	0	0.8	-6	0	0	0	0	0.5	0	0	#	CV_young_Mal_GP_1
0.05	0.25	0.08	0.1	0	0.8	-3	0	0	0	0	0.5	0	0	#	CV_old_Mal_GP_1

-3	3	7.355E-06	2.44E-06	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Wtlen_1_Mal									
-3	4	3.11359	3.34694	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Wtlen_2_Mal									
30	60	39.9	37.7	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Mat50%_Fem									
-3	3	-0.359	-0.2876	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Mat_slope_Fem									
#-3	3	0.22475	0.25	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Eg/gm_inter_Fem									
#-3	3	0.03657	0	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Eg/gm_slope_wt_Fem									
-3	3	192.5	190	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Eg/gm_inter_Fem									
-3	3	49.3	36.57	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Eg/gm_slope_wt_Fem									
-3	3	7.355E-06	2.44E-06	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Wtlen_1_Mal									
-3	4	3.11359	3.34694	0	0.8	-3	0	0	0	0	0.5	0
	0	#	Wtlen_2_Mal									
0	0	0	0	-1	0	-4	0	0	0	0	0	0
	0	#	RecrDist_GP_1									
0	0	0	0	-1	0	-4	0	0	0	0	0	0
	0	#	RecrDist_Area_1									
0	0	0	0	-1	0	-4	0	0	0	0	0	0
	0	#	RecrDist_Seas_1									
0	0	0	0	-1	0	-4	0	0	0	0	0	0
	0	#	CohortGrowDev									

#_Cond 0 #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

big mouth rock fish
grows fast, often wormy
is paucispinis

1 #_Cond 0 #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters

#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4

-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4
-5	5	0	0	0	-5	-4

#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters

#_Cond -4 #_MGparm_Dev_Phase

#_Spawner-Recruitment
3 #_SR_function
#_LO HI INIT PRIOR PR_type SD PHASE
6 15 9.5 9 0 10 1 # SR_R0
0.2 1 0.736 0.73 0 0.186 5 # SR_steep
0 2 1 0.95 0 0.8 -4 # SR_sigmaR
-5 5 0 0 0 1 -3 # SR_envlink
-5 5 0 0 0 1 -4 # SR_R1_offset
0 0 0 0 -1 0 -99 # SR_autocorr
0 #_SR_env_link
0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 #do_recdev: 0=none; 1=devvector; 2=simple deviations
1954 # first year of main recr_devs; early devs can preceed this era
2012 # last year of main recr_devs; forecast devs start in following year
2 #_recdev phase

1 # (0/1) to read 11 advanced options
0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4 #_recdev_early_phase
0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1 #_lambda for prior_fore_recr occurring before endyr+1
1965 #_last_early_yr_nobias_adj_in_MPD
1975 #_first_yr_fullbias_adj_in_MPD
2012 #_last_yr_fullbias_adj_in_MPD
2013 #_first_recent_yr_nobias_adj_in_MPD
1.
0
-5 #min rec_dev
5 #max rec_dev

0 #_read_recdevs
#_end of advanced SR options
read specified recr devs
#_Yr Input_value

#Fishing Mortality info
0.26 # F ballpark for tuning early phases
1980 # F ballpark year (neg value to disable)
3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9 # max F or harvest rate, depends on F_Method

#need these three lines when doing option 2
#0.1 # start F
#1   # overall phase
#0   # N detailed inputs
#5 # need this for Fmethod 3, number if tuning iterations in hybrid F, 4 or 5 usually good
5

no additional F input needed for Fmethod 1
read overall start F value; overall phase; N detailed inputs to read for Fmethod 2
read N iterations for tuning for Fmethod 3 (recommend 3 to 7)
#Fleet Year Seas F_value se phase (for detailed setup of F_Method=2)

#_initial_F_parms
#_LO HI INIT PRIOR PR_type SD PHASE
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY1
0.0001 0.05 0.007 0.007 0 99 2 # InitF_1FISHERY2
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY3
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY4
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY5
0 0.1 0 0.01 1 99 -2 # InitF_1FISHERY6

#_Q_setup
A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand, 4=randwalk); E=0=num/1=bio, F=err_type
#A B C D
0 0 0 0 # fleet (fishery or survey) # 1
0 0 0 0 # fleet (fishery or survey) # 2
0 0 0 0 # fleet (fishery or survey) # 3
0 0 0 0 # fleet (fishery or survey) # 4
0 0 0 0 # fleet (fishery or survey) # 5
0 0 0 0 # fleet (fishery or survey) # 6
0 0 0 0 # fleet (fishery or survey) # 7
0 0 0 0 # fleet (fishery or survey) # 8
0 0 0 0 # fleet (fishery or survey) # 9
0 0 0 0 # fleet (fishery or survey) # 10
0 0 0 0 # fleet (fishery or survey) # 11
0 0 0 0 # fleet (fishery or survey) # 12
0 0 0 0 # fleet (fishery or survey) # 13
0 0 0 0 # fleet (fishery or survey) # 14
0 0 0 0 # fleet (fishery or survey) # 15
0 0 0 0 # fleet (fishery or survey) # 16

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index
#_Q_parms(if_any)
LO HI INIT PRIOR PR_type SD PHASE

#_size_selex_types
#_Pattern Discard Male Special
24 0 0 0 # FISHERY1 trawl
24 0 0 0 # FISHERY2 hookline
24 0 0 0 # FISHERY3 gillnet
24 0 0 0 # FISHERY4 southrec
1 0 0 0 # FISHERY5 cenrec
1 0 0 0 # Fishery6 trawlnorth
30 0 0 0 # SURVEY1 calcofi
24 0 0 0 # SURVEY2 triennial
5 0 0 5 # SURVEY3 deb w-v
24 0 0 0 # SURVE4 hookline
1 0 0 0 # SURVEY5 nwc combo
33 0 0 0 # SURVEY6 juvenile survey
0 0 0 0 # SURVEY7 pier index
0 0 0 0 # SURVEY8 60s MBay rec LFs
5 0 0 1 # SURVEY9 mirror southern trawl to look at LFs from observer fleet
5 0 0 4 # SURVEY10 - mirror southern rec (for CPFV obs. LFs)

#_age_selex_types
#_Pattern ___ Male Special
11 0 0 0 # 1 FISHERY1
11 0 0 0 # 1 FISHERY2
11 0 0 0 # 1 FISHERY3
11 0 0 0 # 1 FISHERY4
11 0 0 0 # 1 FISHERY5
11 0 0 0 # 1 FISHERY6
11 0 0 0 # 2 SURVEY1
11 0 0 0 # 3 SURVEY2
11 0 0 0 # 3 SURVEY3
11 0 0 0 # 3 SURVEY4
11 0 0 0 # 3 SURVEY5
11 0 0 0 # 3 SURVEY6
11 0 0 0 # 3 SURVEY7
11 0 0 0 # 3 SURVEY8
11 0 0 0 # 3 SURVEY9
11 0 0 0 # 3 SURVEY10

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
#_size_sel: trawl - try logistic-

15	60	45.5	46	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value								
-10	10	-4.822	5	0	10	-4	0	0	0	0	0.5	0
	0	#	TOP	logistic								
1	15	4.296	3.5	0	10	-4	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-1	9	4.76	2	0	10	-4	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-15	9	-10.5	-4.5	0	10	-4	0	0	0	0	0.5	0
	0	#	INIT	logistic								
-5	9	-0.766	2	0	10	-4	0	0	0	0	0.5	0
	0	#	FINAL	logistic								

size_se1: 1- male offsets- 4 lines

#1	60	16	20	0	100	-5	0	0	0	0	0.5	0
	0	#	size@dogleg									
#-10	0	0	0	0	10	-5	0	0	0	0	0.5	0
	0	#	log(relmalesel)at minL									
#-10	0	0	0	0	10	-5	0	0	0	0	0.5	0
	0	#	log(relmalesel)at dogleg									
#-10	0	0	0	0	10	-5	0	0	0	0	0.5	0
	0	#	log(relmalesel) at maxL									
# size_se1: 1- male offsets- 4 lines												
# fishery 2												
15	60	52.459	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value								
-10	10	-10	5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic								
1	15	4.096	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-1	9	4.744	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-15	9	-11.22	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic								
-5	9	-1	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic								
# fishery 3												
15	60	50.713	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value								
-10	10	-9.8	-5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic								
1	15	3.008	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-1	9	4.408	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-15	9	-11.22	-6	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic								
-5	9	-1.76	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic								
#_size_sel: 4 double logistic-												
15	60	36	40	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value								
-10	10	-7	-5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic								
1	15	4	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-1	9	5.2	5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
-15	9	-4	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic								
-5	9	-3.28	-4	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic								
# size_sel fishery 5 cenrec double logistic												
#15	80	54.68	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value								
#-10	10	5.1	5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic								
#1	15	6.1	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								
#-1	9	2.5	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp								

```
#-15	9	-2.86	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic
#-5	9	1.25	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic
#_size_sel: cenRec - try logistic-
5	50	40	35	0	50	3	0	0	0	0	0	0
	0 #
0.0001	35	10	15	0	10	3	0	0	0	0	0	0
	0 #

# size_sel fishery 6 trawlnorth double logistic
#13	80	54.68	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value
#-10	10	-9.792	5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic
#1	15	6.112	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
#-1	9	5.56	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
#-15	9	-2.86	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic
#-5	9	-1.25	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic

# size sel for fishery 6- northern trawl
5	50	40	35	0	50	3	0	0	0	0	0	0
	0 #
0.0001	35	10	5	0	10	3	0	0	0	0	0	0
	0 #
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial
# size selectivity survey 8 - triennial
#5	50	40	20	0	50	3	0	0	0	0	0	0
	0 #
#0.0001	35	10	5	0	10	3	0	0	0	0	0	0
	0 #

# sel survey 8 - triennial double logistic
15	80	24	25	0	20	-3	0	0	0	0	0.5	0
	0	#	PEAK	value
-10	10	-9.792	5	0	10	-3	0	0	0	0	0.5	0
	0	#	TOP	logistic3
1	15	6.112	3.5	0	10	-3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
-1	9	5.56	2	0	10	-3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
-15	9	-2.86	-4.5	0	10	-3	0	0	0	0	0.5	0
	0	#	INIT	logistic
-5	9	-1.25	2	0	10	-3	0	0	0	0	0.5	0
	0	#	FINAL	logistic
# size sel 9 cpfv, set to mirror northrec
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial


#_size_sel: 10 SCB hook line double logistic-
```

```
15	60	54	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value
-10	10	-3.9	-5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic
1	15	12.2	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
-1	9	5.2	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
-15	9	-1.7	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic
-5	9	-3.3	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic

# size sel. 11 - combo survey - mirror triennial
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY3 - min and max bins
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY3 - min and max bins# sel survey 8 triennial
5	50	30	25	0	50	3	0	0	0	0	0	0
	0 #
0.0001	35	10	15	0	10	3	0	0	0	0	0	0
	0 #
# size selectivity survey 11 - NWFSC combo survey
#13	60	28.52	55	0	20	3	0	0	0	0	0.5	0
	0	#	PEAK	value
#-10	10	-1.23	5	0	10	3	0	0	0	0	0.5	0
	0	#	TOP	logistic
#1	15	4.43	3.5	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
#-2	9	-1.5	2	0	10	3	0	0	0	0	0.5	0
	0	#	WIDTH	exp
#-15	9	-0.58	-4.5	0	10	3	0	0	0	0	0.5	0
	0	#	INIT	logistic
#-5	9	-0.03	2	0	10	3	0	0	0	0	0.5	0
	0	#	FINAL	logistic

# size selectivity survey 14 - 60s LFs from CenCal Rec fishery- mirror cen/north rec
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
#-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY
# size sel. 15 bycatch LF data from observer program, link to southern trawl fishery
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY
# size sel. 16 mirror southern rec for LF data from CPFV observer program
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_1_SURVEY
-1 20 -1 -1 -1 99 -3 0 0 0 0 0.5 0 0 # SizeSel_1P_2_SURVEY


0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY1
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY1
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY2
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY2
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY3
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY3
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY4
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY4
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY5
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY5
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_1_FISHERY6
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_1P_2_FISHERY6
```

```
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_1_SURVEY1
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY1
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_1_SURVEY2
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY2
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY3
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY3
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY4
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY4

# make NWFSC combo survey unselected for age 0 fish (don't mess with size selectivity)
0 21 1 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY5
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY5

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY6
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY6
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY7
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY7

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY8
0 21 0 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_2_SURVEY8

0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY9
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY9
0 21 0 5 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_3P_1_SURVEY10
0 21 40 6 0 99 -1 0 0 0 0 0.5 0 0 # AgeSel_2P_2_SURVEY10

#_Cond 0 #_custom_sel-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist
#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0  #_placeholder if no parameters

1 #_Variance_adjustments_to_input_values
#_1 2 3
# single-retuned variance adj for 2013 update
0.03 0 0 0.6 0.64 0 0.3 0.45 0.19 0.26 -1.1 1.1 0.06 0.43 0 0 #_add_to_survey_CV
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 #_add_to_discard_stddev
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 #_add_to_bodywt_CV
# Neff adj for LFs
0.81	1	0.67	0.79	0.8	0.96	1	0.59	0.58	0.76	0.67	1	1
	1	1	0.83
#  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_length comp_N
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_agecomp_N
 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 #_mult_by_size-at-age_N
# removed for SSv3.20: 30 #_DF_for_discard_like
# removed for SSv3.20: 30 #_DF_for_meanbodywt_like

4 #_maxlambdaphase
0 #_sd_offset

6 # number of changes to make to default Lambdas (default value is 1.0)
# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey  phase  value  sizefreq_method

1 1 1 10 1
1 8 1 10 1
```

```
1 14 1 1 1
4 15 1 0 1
6 4 1 0 1
6 5 1 0 1


# lambdas (for info only; columns are phases)
0 # (0/1) read specs for more stddev reporting
# runfaster using ss3 bat -nohess nox
# R output viewer commands- after loading routines
#myreplist <- SSv3_output(dir='c:\\SS3ver3\\bocstar\\', covar=F)
#SSv3_plots(replist=myreplist,plot=1:7)
#
999
```

Appendix C: Numbers at Age from the base model result

Females

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
VIRG	2584	2224	1915	1648	1418	1221	1051	904	778	670	577	496	427	368	316	272	234	202	174	149	129	795
INIT	2584	2224	1915	1647	1415	1212	1038	889	762	653	560	481	412	354	304	261	224	192	165	142	122	740
1892	2570	2224	1915	1647	1415	1212	1038	889	762	653	560	481	412	354	304	261	224	192	165	142	122	740
1893	2570	2212	1915	1647	1414	1212	1038	889	761	653	560	480	412	354	304	261	224	192	165	142	122	740
1894	2570	2212	1904	1647	1415	1212	1038	889	761	653	560	480	412	354	304	261	224	192	165	142	122	740
1895	2570	2212	1904	1638	1415	1212	1038	889	761	653	560	480	412	354	304	261	224	192	165	142	122	740
1896	2570	2212	1904	1638	1407	1213	1039	889	762	653	560	481	412	354	304	261	224	192	165	142	122	740
1897	2570	2212	1904	1638	1407	1207	1039	890	763	653	560	481	413	354	304	261	224	192	165	142	122	740
1898	2570	2212	1904	1638	1407	1207	1034	891	763	654	561	481	413	354	304	261	224	192	165	142	122	740
1899	2570	2212	1904	1638	1408	1207	1035	887	764	655	562	482	413	355	304	261	224	193	165	142	122	741
1900	2570	2212	1904	1638	1408	1208	1035	888	761	656	562	482	414	355	305	261	224	193	165	142	122	741
1901	2570	2212	1904	1638	1408	1208	1035	888	761	653	563	483	414	355	305	262	225	193	166	142	122	742
1902	2570	2212	1904	1638	1407	1207	1035	887	761	653	560	483	415	356	305	262	225	193	166	142	122	742
1903	2570	2212	1904	1638	1407	1207	1034	887	761	653	560	481	415	356	305	262	225	193	166	142	122	742
1904	2570	2212	1904	1638	1407	1206	1033	885	760	652	560	481	413	356	306	262	225	193	166	142	122	742
1905	2570	2212	1904	1638	1407	1205	1032	884	758	651	559	480	412	354	306	262	225	193	166	142	122	742
1906	2569	2212	1904	1638	1407	1205	1031	883	757	650	558	479	412	354	304	262	225	193	166	142	122	742
1907	2569	2211	1904	1638	1406	1204	1030	882	756	649	557	478	411	353	304	261	225	193	166	142	122	741
1908	2568	2211	1903	1638	1406	1204	1029	881	755	647	556	477	410	353	303	260	224	193	166	142	122	741
1909	2567	2210	1903	1637	1405	1203	1028	880	754	646	554	476	409	352	302	260	223	192	166	142	122	740
1910	2567	2210	1902	1637	1404	1201	1027	878	752	645	553	475	408	351	301	259	223	191	164	142	122	739
1911	2565	2209	1902	1636	1404	1200	1025	876	750	643	552	473	407	349	300	258	222	191	164	141	122	738
1912	2564	2208	1901	1636	1403	1198	1023	874	748	641	550	472	405	348	299	257	221	190	164	141	121	737
1913	2563	2207	1900	1635	1402	1196	1020	871	745	638	547	470	404	347	298	256	220	189	163	140	120	735
1914	2561	2206	1900	1634	1400	1195	1018	868	742	635	545	468	402	345	297	255	219	189	162	139	120	732
1915	2559	2204	1898	1633	1399	1193	1015	865	739	632	542	465	400	343	295	254	218	188	161	139	119	729
1916	2557	2203	1897	1632	1398	1191	1012	862	736	629	539	463	397	341	294	252	217	187	160	138	119	726
1917	2555	2201	1896	1630	1394	1186	1008	858	732	625	536	459	395	339	291	251	215	185	159	137	118	721
1918	2550	2199	1894	1627	1385	1173	994	846	722	617	529	454	390	335	288	248	213	183	157	135	117	714
1919	2544	2195	1892	1625	1381	1163	981	833	710	608	521	447	384	330	284	244	210	181	156	134	115	706
1920	2542	2190	1889	1625	1386	1169	982	829	705	603	517	444	381	327	282	242	208	179	154	133	114	700
1921	2539	2188	1885	1622	1385	1172	986	829	701	598	512	439	378	324	279	240	206	178	153	132	113	695
1922	2537	2185	1883	1619	1384	1175	992	835	703	596	509	436	375	322	277	238	205	176	152	131	112	690
1923	2537	2184	1881	1618	1383	1176	996	841	710	599	508	434	372	320	275	237	203	175	151	130	112	686
1924	2535	2183	1880	1616	1380	1172	994	843	713	603	509	432	370	317	273	235	202	174	149	129	111	681
1925	2534	2182	1879	1615	1380	1172	993	843	715	607	513	434	369	316	271	233	200	172	148	128	110	677
1926	2533	2181	1878	1614	1378	1169	990	839	714	607	516	437	370	314	269	231	199	171	147	127	109	671
1927	2530	2180	1877	1612	1372	1160	980	831	707	602	514	437	370	314	267	229	196	169	145	125	108	664
1928	2528	2177	1876	1611	1371	1158	976	826	702	598	511	436	371	315	267	227	195	167	144	124	107	657
1929	2525	2175	1874	1609	1368	1155	973	821	697	594	507	434	370	316	268	227	193	166	142	123	105	650
1930	2523	2173	1872	1607	1368	1155	972	820	694	590	503	430	369	315	269	228	193	165	141	121	104	644
1931	2520	2172	1870	1604	1363	1150	968	816	690	586	499	426	365	313	267	228	194	164	140	120	103	636
1932	2518	2169	1869	1605	1364	1148	965	813	687	583	495	423	362	310	265	227	194	165	140	119	102	629
1933	2517	2167	1866	1603	1366	1153	968	814	687	582	494	421	359	308	264	226	194	165	140	119	101	623
1934	2517	2166	1864	1601	1367	1159	977	821	692	585	496	421	359	307	263	225	193	165	141	120	102	618
1935	2517	2166	1864	1599	1363	1157	980	827	696	587	497	422	359	306	261	224	192	165	141	120	102	614
1936	2517	2166	1864	1598	1361	1153	977	828	700	590	499	423	359	306	261	223	191	164	140	120	102	611
1937	2515	2166	1864	1597	1357	1147	969	822	699	592	500	423	359	305	260	222	189	162	139	119	102	607
1938	2514	2165	1863	1597	1357	1145	966	817	695	592	502	425	360	305	260	221	189	161	138	119	102	604
1939	2515	2164	1862	1598	1361	1151	969	818	693	591	503	428	362	307	260	222	189	161	138	118	101	603
1940	2516	2164	1862	1598	1364	1157	977	824	696	591	504	429	365	309	262	222	189	161	138	118	101	601
1941	2518	2166	1862	1598	1365	1160	983	830	701	593	504	430	367	312	264	224	190	162	138	118	101	600
1942	2520	2167	1863	1599	1367	1163	988	837	708	598	506	430	367	313	267	226	191	163	138	118	101	600
1943	2524	2169	1865	1602	1373	1172	997	847	718	607	513	435	369	315	269	229	194	164	140	119	101	601
1944	2526	2172	1866	1603	1372	1173	1000	851	723	613	519	439	371	316	269	230	196	166	140	119	101	600
1945	2522	2174	1869	1602	1364	1160	989	843	717	610	517	438	370	313	266	227	194	165	140	119	101	592
1946	2511	2171	1871	1600	1348	1133	960	818	697	594	505	428	363	307	260	221	189	161	137	116	98	575
1947	2507	2161	1868	1602	1354	1132	949	804	686	586	499	425	360	305	258	219	186	159	136	115	98	567
1948	2502	2157	1859	1600	1357	1138	948	795	675	576	492	419	357	303	257	217	184	156	134	114	97	559
1949	2500	2154	1854	1586	1351	1139	955	797	670	569	486	416	354	302	256	217	184	156	132	113	96	555
1950	2497	2151	1849	1578	1335	1131	953	800	669	564	479	410	351	299	255	217	184	155	132	112	96	551

Females (continued)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1951	2490	2149	1846	1565	1311	1100	931	788	664	558	471	401	343	294	251	214	182	154	130	110	94	543
1952	2475	2143	1843	1550	1276	1056	887	756	644	545	459	388	331	284	243	208	177	151	128	108	92	529
1953	2458	2130	1836	1532	1239	1008	839	712	612	525	447	377	320	273	235	201	172	147	125	106	90	514
1954	2598	2115	1823	1511	1201	960	788	664	570	495	426	364	308	262	224	193	165	141	121	103	87	496
1955	711	2235	1802	1477	1163	915	740	618	528	458	400	346	297	252	214	184	158	135	116	99	84	479
1956	3023	612	1890	1414	1084	845	678	562	478	415	363	319	277	238	203	173	148	127	110	94	80	456
1957	733	2601	515	1443	989	747	596	493	420	364	320	282	250	218	188	160	137	117	101	87	74	426
1958	1689	630	2198	396	1003	671	517	426	362	314	276	245	217	193	169	146	125	107	92	79	68	391
1959	3456	1453	534	1686	269	657	449	358	303	263	232	206	184	164	146	128	111	95	81	70	60	351
1960	2293	2974	1235	415	1170	180	450	317	259	224	197	175	156	140	125	112	99	85	73	62	54	317
1961	1995	1973	2527	961	289	791	124	319	231	192	168	149	133	120	108	96	86	76	66	56	48	286
1962	41207	1717	1678	1995	694	204	567	91	240	176	148	131	116	104	94	84	76	68	60	52	44	264
1963	1910	35459	1462	1342	1481	505	151	427	70	186	138	117	103	92	83	75	67	60	54	48	41	246
1964	1887	1643	30262	1176	997	1073	370	112	324	54	144	107	91	81	73	65	59	53	48	43	38	228
1965	2052	1624	1409	25338	954	801	865	301	92	266	44	119	89	76	67	60	54	49	44	40	36	221
1966	7575	1766	1394	1192	21041	788	662	719	251	77	223	37	100	75	64	57	51	46	41	37	33	216
1967	1882	6519	1512	1163	966	16940	638	541	592	208	64	186	31	84	63	53	47	42	38	34	31	209
1968	1888	1620	5568	1236	905	744	13205	505	434	479	169	52	152	26	69	51	44	39	35	32	28	198
1969	2229	1624	1383	4598	989	721	598	10718	413	358	396	140	43	127	21	57	43	37	33	29	26	189
1970	4528	1918	1388	1150	3739	803	589	493	8900	345	299	332	118	37	107	18	48	36	31	27	25	182
1971	2072	3896	1632	1136	915	2971	645	479	405	7358	287	249	277	98	31	89	15	41	30	26	23	173
1972	5440	1782	3315	1336	905	728	2391	525	394	335	6115	239	208	232	82	26	75	13	34	25	22	165
1973	11184	4680	1507	2637	1017	687	562	1881	420	318	272	5000	196	171	191	68	21	62	10	28	21	154
1974	4113	9620	3924	1125	1763	667	465	396	1367	312	240	208	3842	151	133	149	53	16	48	8	22	137
1975	762	3537	7975	2737	664	1009	400	296	264	946	221	173	151	2820	112	98	110	39	12	36	6	119
1976	1025	656	2950	5855	1790	424	665	275	211	193	705	167	132	116	2163	86	76	85	30	10	28	97
1977	20158	881	550	2211	3929	1172	285	465	198	155	145	533	127	101	89	1664	66	58	66	24	7	97
1978	1293	17339	741	419	1539	2683	819	206	344	149	119	111	413	99	79	69	1304	52	46	52	18	82
1979	3763	1112	14555	564	291	1049	1868	588	151	258	114	91	86	320	77	61	54	1018	41	36	40	79
1980	973	3237	930	10703	365	183	678	1261	412	109	190	85	68	65	243	58	47	41	779	31	28	91
1981	427	837	2740	724	7547	249	127	483	922	307	82	144	65	53	50	188	45	36	32	605	24	93
1982	80	367	710	2163	519	5168	171	89	344	667	225	61	107	48	39	37	140	34	27	24	453	87
1983	1057	69	308	533	1431	327	3299	113	60	239	470	160	44	77	35	28	27	102	25	20	18	395
1984	6879	909	59	240	360	896	204	2107	74	40	162	322	110	30	54	24	20	19	71	17	14	289
1985	582	5919	772	45	154	210	521	123	1319	48	26	108	217	75	21	37	17	14	13	49	12	209
1986	464	501	4991	597	30	93	125	321	79	884	33	19	77	156	54	15	27	12	10	10	36	162
1987	1552	399	421	3776	374	16	48	68	187	49	567	22	12	52	107	37	10	19	8	7	7	139
1988	4891	1335	340	340	2608	222	9	28	42	121	33	386	15	9	37	75	26	7	13	6	5	104
1989	250	4208	1140	275	242	1694	141	6	19	29	84	23	274	11	6	26	54	19	5	10	4	79
1990	1325	215	3573	897	183	139	943	82	4	12	19	56	16	187	7	4	18	38	13	4	7	59
1991	1040	1139	183	2798	579	99	73	513	47	2	8	12	37	10	125	5	3	12	26	9	3	45
1992	332	895	971	147	2014	380	64	48	351	33	2	5	9	27	8	94	4	2	9	19	7	36
1993	624	286	763	786	107	1325	244	42	33	248	24	1	4	7	21	6	71	3	2	7	15	32
1994	517	537	244	618	576	72	875	165	29	24	181	18	1	3	5	16	4	54	2	1	5	36
1995	264	444	454	191	443	392	49	613	119	22	18	137	14	1	2	4	12	3	42	2	1	32
1996	418	227	380	376	149	327	286	36	462	91	17	14	107	11	1	2	3	10	3	33	1	26
1997	91	360	194	313	294	113	249	222	29	367	73	14	11	87	9	0	2	3	8	2	27	23
1998	507	78	307	159	245	226	87	195	175	23	293	58	11	9	70	7	0	1	2	6	2	40
1999	3345	436	67	259	132	201	185	72	161	145	19	245	49	9	8	59	6	0	1	2	5	35
2000	137	2878	372	55	210	107	164	152	59	134	121	16	205	41	8	6	49	5	0	1	1	34
2001	124	118	2458	310	46	173	88	136	127	50	112	102	13	173	34	6	5	42	4	0	1	30
2002	471	107	101	2073	260	38	145	74	115	107	42	95	86	11	146	29	5	5	35	4	0	26
2003	1651	405	92	86	1758	220	32	124	63	98	92	36	81	74	10	125	25	5	4	30	3	22
2004	213	1421	349	79	74	1510	189	28	106	55	84	79	31	70	63	8	108	22	4	3	26	22
2005	1595	183	1219	296	67	63	1283	161	24	91	47	72	68	27	60	54	7	92	18	3	3	41
2006	463	1373	157	1033	250	56	53	1090	137	20	78	40	62	58	23	51	46	6	79	16	3	38
2007	922	399	1180	134	880	213	48	45	933	118	17	67	34	53	50	19	44	40	5	68	14	35
2008	1036	794	342	1007	114	750	182	41	39	800	101	15	57	29	45	43	17	38	34	4	58	41
2009	2537	891	682	293	859	97	641	155	35	33	686	86	13	49	25	39	37	14	32	29	4	86
2010	7000	2184	766	583	250	733	83	548	133	30	29	588	74	11	42	22	34	31	12	28	25	77
2011	1126	6024	1875	653	496	213	625	71	469	114	26	25	505	64	9	36	19	29	27	11	24	88
2012	941	969	5167	1594	554	421	181	534	61	402	98	22	21	433	55	8	31	16	25	23	9	96

Males

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
VIRG	2584	2224	1915	1648	1418	1221	1051	904	778	670	577	496	427	368	316	272	234	202	174	149	129	795
INIT	2584	2224	1915	1647	1415	1214	1040	890	762	653	559	479	411	352	302	258	222	190	163	140	120	719
1892	2570	2224	1915	1647	1415	1214	1040	890	762	653	559	479	411	352	302	258	222	190	163	140	120	719
1893	2570	2212	1915	1647	1415	1214	1039	890	762	653	559	479	410	352	301	258	221	190	163	140	120	719
1894	2570	2212	1904	1647	1415	1214	1039	890	762	652	559	479	410	352	301	258	221	190	163	140	120	719
1895	2570	2212	1904	1638	1415	1214	1040	890	762	653	559	479	410	352	301	258	221	190	163	140	120	719
1896	2570	2212	1904	1638	1408	1214	1040	891	762	653	559	479	411	352	302	258	222	190	163	140	120	719
1897	2570	2212	1904	1638	1408	1208	1041	891	763	653	560	479	411	352	302	259	222	190	163	140	120	720
1898	2570	2212	1904	1638	1408	1208	1036	892	764	654	560	480	411	352	302	259	222	190	163	140	120	720
1899	2570	2212	1904	1638	1408	1209	1036	888	765	655	561	481	412	353	302	259	222	190	163	140	120	721
1900	2570	2212	1904	1638	1408	1209	1037	889	761	656	562	481	412	353	303	259	222	191	163	140	120	722
1901	2570	2212	1904	1638	1408	1209	1037	889	762	653	563	482	413	354	303	260	223	191	164	140	120	722
1902	2570	2212	1904	1638	1408	1208	1036	888	762	653	560	482	413	354	303	260	223	191	164	140	120	723
1903	2570	2212	1904	1638	1408	1208	1035	887	761	652	559	480	413	354	304	260	223	191	164	140	120	723
1904	2570	2212	1904	1638	1408	1207	1035	887	760	652	559	479	411	354	304	260	223	191	164	140	120	723
1905	2570	2212	1904	1638	1408	1207	1034	886	759	650	558	479	410	352	303	260	223	191	164	140	120	723
1906	2569	2212	1904	1638	1407	1207	1033	885	758	649	557	478	410	352	301	260	223	191	164	140	120	722
1907	2569	2211	1904	1638	1407	1206	1032	884	756	648	555	476	409	351	301	258	223	191	164	140	120	722
1908	2568	2211	1903	1638	1407	1205	1032	883	755	647	554	475	408	350	300	258	221	191	163	140	120	721
1909	2567	2210	1903	1637	1406	1205	1031	881	754	646	553	474	406	349	299	257	221	189	163	140	120	720
1910	2567	2210	1902	1637	1406	1204	1029	880	753	644	551	473	405	348	298	256	220	189	162	140	120	719
1911	2565	2209	1902	1637	1405	1202	1027	878	751	642	550	471	404	346	297	255	219	188	161	138	119	717
1912	2564	2208	1901	1636	1404	1201	1025	876	748	640	548	469	402	344	295	254	218	187	160	138	118	714
1913	2563	2207	1900	1635	1403	1199	1023	873	745	637	545	467	400	343	294	252	216	186	160	137	118	710
1914	2561	2206	1900	1635	1402	1198	1021	870	742	634	542	464	398	341	292	251	215	185	158	136	117	706
1915	2559	2204	1898	1634	1401	1196	1019	868	740	631	539	461	395	339	290	249	213	183	157	135	116	702
1916	2557	2203	1897	1633	1400	1194	1017	865	737	628	536	459	392	336	288	247	212	182	156	134	115	697
1917	2555	2201	1896	1630	1396	1190	1012	860	732	624	532	455	389	333	286	245	210	180	155	133	114	690
1918	2550	2199	1894	1628	1389	1178	999	848	721	614	524	448	383	328	281	241	206	177	152	130	112	679
1919	2544	2195	1892	1626	1385	1170	987	835	709	604	515	440	376	322	276	236	203	174	149	128	110	666
1920	2542	2190	1889	1626	1389	1175	989	833	705	600	511	436	373	319	273	234	200	172	148	127	109	659
1921	2539	2188	1885	1622	1388	1177	992	834	703	596	507	432	369	315	270	231	198	170	146	125	107	651
1922	2537	2185	1883	1619	1387	1180	997	840	706	595	505	430	367	313	268	229	196	168	144	124	106	644
1923	2537	2184	1881	1618	1385	1180	1001	845	712	599	505	429	365	312	266	228	195	167	143	123	105	639
1924	2535	2183	1880	1616	1383	1177	999	846	715	602	507	428	363	310	264	226	193	166	142	122	104	632
1925	2534	2182	1879	1615	1382	1176	998	846	717	606	511	430	364	309	263	225	192	164	141	121	103	627
1926	2533	2181	1878	1615	1381	1174	995	843	715	606	512	432	364	308	262	223	191	163	140	120	102	620
1927	2530	2180	1877	1612	1375	1166	986	834	707	600	509	431	364	307	260	221	188	161	138	118	101	610
1928	2528	2177	1876	1611	1374	1164	982	830	702	595	506	430	364	308	260	220	187	159	136	116	100	602
1929	2525	2175	1874	1609	1371	1160	979	825	697	591	502	427	363	307	260	219	186	158	135	115	99	593
1930	2523	2173	1872	1608	1371	1160	978	824	695	588	498	423	360	307	260	220	186	157	134	114	97	586
1931	2520	2172	1870	1605	1367	1156	973	819	691	583	494	419	356	304	258	219	185	157	133	113	96	577
1932	2518	2169	1869	1605	1368	1155	971	817	687	580	490	416	353	300	256	218	185	157	132	112	95	568
1933	2517	2167	1866	1604	1369	1159	975	819	689	580	490	414	351	299	254	217	185	157	133	112	95	562
1934	2517	2166	1864	1602	1370	1164	982	826	694	584	492	416	352	299	254	216	184	157	133	113	95	559
1935	2517	2166	1864	1599	1366	1161	984	830	698	587	494	417	353	299	253	216	184	156	133	113	96	556
1936	2517	2166	1864	1599	1363	1157	981	830	701	590	497	418	353	299	253	215	183	156	133	113	96	553
1937	2515	2166	1864	1598	1361	1152	974	824	698	590	497	419	353	298	252	214	182	155	132	112	96	549
1938	2514	2165	1863	1598	1360	1151	971	820	694	589	498	420	354	299	252	214	181	154	131	111	95	546
1939	2515	2164	1862	1598	1363	1155	974	821	694	588	499	422	356	300	254	214	181	154	131	111	95	545
1940	2516	2164	1862	1599	1366	1161	981	828	698	590	500	425	359	303	256	216	183	155	131	111	95	545
1941	2518	2166	1862	1599	1367	1163	986	833	703	593	502	425	361	306	258	218	184	155	132	112	95	545
1942	2520	2167	1863	1600	1369	1166	991	839	710	599	505	428	363	308	261	220	186	157	133	112	95	546
1943	2524	2169	1865	1602	1374	1174	1000	849	719	608	513	433	367	311	264	224	189	159	135	114	96	550
1944	2526	2172	1866	1603	1374	1174	1002	853	725	614	519	438	370	313	266	226	191	161	136	115	97	552
1945	2522	2174	1869	1603	1367	1163	992	845	719	611	518	438	369	312	264	224	190	161	136	115	97	548
1946	2511	2171	1871	1601	1353	1139	964	820	699	594	505	428	362	306	258	218	185	157	133	113	95	534
1947	2507	2161	1868	1603	1359	1139	956	808	687	586	499	424	359	304	257	217	183	156	132	112	95	528
1948	2502	2157	1859	1601	1361	1144	955	800	677	576	491	418	355	301	255	215	182	154	131	111	94	523
1949	2500	2154	1854	1587	1354	1144	960	801	672	569	484	413	352	299	254	215	181	153	130	110	94	520
1950	2497	2151	1849	1579	1338	1135	957	803	671	563	477	407	347	296	252	214	181	153	129	109	93	517

Males, continued

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1951	2490	2149	1846	1567	1317	1105	934	788	663	555	467	396	338	288	246	209	178	151	127	107	91	508
1952	2475	2143	1843	1554	1284	1063	889	753	638	538	452	381	323	276	236	202	172	146	123	104	88	491
1953	2458	2130	1836	1536	1249	1015	840	706	602	512	434	365	309	263	225	192	164	140	119	101	85	473
1954	2598	2115	1823	1517	1213	968	787	656	556	477	408	347	293	248	211	181	155	133	113	96	81	451
1955	711	2235	1802	1484	1175	923	739	607	510	436	376	324	276	234	198	169	145	124	106	91	77	429
1956	3023	612	1890	1423	1097	852	673	547	455	388	334	290	251	215	183	155	133	114	98	84	71	398
1957	733	2601	515	1454	1006	755	590	475	393	332	286	249	218	189	162	138	118	101	87	74	64	358
1958	1689	630	2198	399	1025	683	513	408	334	281	240	209	183	161	140	121	103	88	75	65	56	316
1959	3456	1453	534	1702	276	673	448	343	278	231	197	170	149	131	116	101	88	75	64	55	47	271
1960	2293	2974	1235	419	1200	186	453	307	239	196	166	142	124	109	96	85	75	65	55	47	41	236
1961	1995	1973	2527	970	297	813	126	312	215	170	141	120	104	91	80	71	63	55	48	41	35	206
1962	41207	1717	1678	2010	709	210	575	90	227	158	126	105	90	78	69	61	54	48	42	37	31	184
1963	1910	35459	1462	1350	1507	517	153	423	67	171	120	96	81	69	60	53	47	42	37	33	28	167
1964	1887	1643	30262	1183	1014	1095	375	112	313	50	129	91	73	62	53	46	41	36	32	29	25	151
1965	2052	1624	1409	25398	964	816	880	302	90	255	41	105	74	60	51	44	38	34	30	26	24	145
1966	7575	1766	1394	1193	21147	797	674	728	250	75	212	34	88	62	50	42	37	32	28	25	22	141
1967	1882	6519	1512	1166	971	17025	642	545	592	205	62	174	28	72	51	41	35	30	26	23	21	135
1968	1888	1620	5568	1241	913	748	13150	500	429	469	163	49	140	23	58	41	33	28	24	21	19	126
1969	2229	1624	1383	4611	997	727	597	10555	404	348	382	133	40	115	19	48	34	28	23	20	18	119
1970	4528	1918	1388	1152	3759	808	591	488	8672	333	288	317	111	34	96	15	40	28	23	19	17	114
1971	2072	3896	1632	1139	919	2980	644	474	394	7056	272	236	261	91	28	79	13	33	23	19	16	109
1972	5440	1782	3315	1340	911	731	2379	518	384	321	5772	224	194	215	75	23	65	11	27	19	16	103
1973	11184	4680	1507	2649	1025	689	557	1835	404	303	255	4601	179	156	173	61	18	53	9	22	16	96
1974	4113	9620	3924	1136	1796	671	455	376	1269	285	216	184	3353	131	115	128	45	14	39	6	16	83
1975	762	3537	7975	2777	685	1025	388	272	233	809	186	143	124	2271	89	79	88	31	9	27	4	69
1976	1025	656	2950	5915	1844	437	659	255	184	161	567	132	103	89	1644	65	57	64	23	7	20	54
1977	20158	881	550	2232	4028	1208	288	443	175	128	114	406	95	75	65	1203	48	42	47	17	5	55
1978	1293	17339	741	422	1573	2750	829	201	315	127	94	84	301	71	56	49	905	36	32	36	13	45
1979	3763	1112	14555	568	297	1072	1881	576	142	226	92	69	62	223	53	42	36	678	27	24	27	44
1980	973	3237	930	10818	374	187	676	1215	381	96	156	64	48	44	159	38	30	26	489	19	17	51
1981	427	837	2740	729	7742	257	128	468	854	272	69	113	47	36	32	118	28	22	20	364	14	51
1982	80	367	710	2178	531	5354	175	88	324	598	192	49	81	34	26	23	85	20	16	14	264	47
1983	1057	69	308	538	1469	338	3370	112	57	214	400	130	34	55	23	18	16	59	14	11	10	216
1984	6879	909	59	242	373	937	210	2099	70	36	138	261	85	22	37	15	12	11	39	9	7	152
1985	582	5919	772	45	160	223	541	122	1243	43	22	86	164	54	14	23	10	8	7	25	6	103
1986	464	501	4991	602	31	100	132	320	73	767	27	14	56	107	36	9	16	7	5	5	17	74
1987	1552	399	421	3814	392	18	52	68	170	40	431	15	8	33	64	22	6	10	4	3	3	56
1988	4891	1335	340	342	2732	244	10	29	39	100	24	265	10	5	21	41	14	4	6	3	2	38
1989	250	4208	1140	276	250	1824	156	6	19	26	66	16	177	6	4	14	28	9	3	4	2	28
1990	1325	215	3573	904	191	150	1023	87	4	11	15	40	10	109	4	2	9	18	6	2	3	19
1991	1040	1139	183	2824	609	109	79	533	46	2	6	9	23	6	65	2	1	5	11	4	1	13
1992	332	895	971	148	2082	411	71	51	348	31	1	4	6	16	4	45	2	1	4	8	3	10
1993	624	286	763	790	110	1413	266	45	33	230	20	1	3	4	11	3	32	1	1	3	5	9
1994	517	537	244	621	591	76	937	175	30	22	157	14	1	2	3	8	2	23	1	0	2	10
1995	264	444	454	193	453	408	52	639	121	21	16	113	10	0	1	2	6	1	17	1	0	9
1996	418	227	380	377	152	339	298	38	469	90	16	12	85	8	0	1	2	4	1	13	0	7
1997	91	360	194	314	297	116	258	228	29	363	70	12	9	67	6	0	1	1	3	1	10	6
1998	507	78	307	159	248	230	89	199	177	23	285	55	10	7	53	5	0	1	1	3	1	13
1999	3345	436	67	259	132	203	188	73	163	145	19	235	46	8	6	44	4	0	1	1	2	11
2000	137	2878	372	55	211	107	165	153	60	134	120	15	195	38	7	5	37	3	0	0	1	11
2001	124	118	2458	311	46	174	89	137	127	50	112	100	13	163	32	6	4	31	3	0	0	10
2002	471	107	101	2075	260	38	145	74	115	107	42	94	84	11	138	27	5	4	26	2	0	9
2003	1651	405	92	86	1761	220	32	123	63	98	91	36	80	72	9	117	23	4	3	22	2	8
2004	213	1421	349	79	74	1512	189	28	106	54	84	78	31	69	62	8	101	20	3	3	19	8
2005	1595	183	1219	296	67	63	1282	161	24	90	46	72	67	26	59	53	7	86	17	3	2	23
2006	463	1373	157	1034	250	56	53	1086	137	20	77	39	61	57	22	50	45	6	74	14	3	22
2007	922	399	1180	134	881	213	48	45	928	117	17	66	34	52	49	19	43	39	5	63	12	21
2008	1036	794	342	1007	114	750	182	41	39	793	100	15	56	29	45	42	16	37	33	4	54	28
2009	2537	891	682	293	859	97	640	155	35	33	679	86	13	48	25	38	36	14	32	28	4	71
2010	7000	2184	766	583	250	733	83	547	133	30	28	582	73	11	41	21	33	31	12	27	24	64
2011	1126	6024	1875	654	496	213	625	71	467	113	26	24	498	63	9	35	18	28	26	10	23	75
2012	941	969	5167	1595	554	421	181	532	60	399	97	22	21	426	54	8	30	16	24	23	9	84

Agenda Item F.5.a
Attachment 9
June 2013

Canary Rockfish Catch Report for 2011-12

This catch report updates the status of the canary rockfish (*Sebastes pinniger*) resource off the coast of the United States from southern California to the U.S.-Canadian border using data through 2012. There is currently no genetic evidence that there are distinct biological stocks of canary rockfish off the U.S. coast. The last full assessment was performed in 2007 (Stewart, 2008). Updates for canary rockfish were done in 2009 (Stewart, 2009) and 2011 (Wallace et al., 2011). The resource was modeled as a single stock using the most up-to-date version of Stock Synthesis available at the time.

Fishing mortality for 2010 and 2011 was estimated in West Coast Groundfish Observer Program (WCGOP) total mortality reports for 2010 (NWFSC, 2011) and 2011 (NWFSC, 2012). Observed discard rates for each species were directly expanded to a fleet-wide level of discard mortality through a deterministic approach. This discard mortality is added to landings data to give an estimate of total mortality. (Note that the most current canary rockfish assessment only had the Groundfish Management Team's (GMT's) scorecard available for an estimate of 2010 fishing mortality.)

The GMT's scorecard for 2012 was used for the fishing mortality in 2012 (GMT, 2012). The GMT's scorecard aggregates research, state, and tribal in-season catch estimates to track overfished species totals against current harvest specifications.

The fishing mortalities for 2010-2012 (Table 1) are all estimated to be under the Annual Catch Limits (ACLs) as set by the Pacific Fishery Management Council and approved by the National Marine Fishery Service (PFMC, 2010; PFMC, 2011; PFMC, 2012). The ACLs for 2013 and 2014 are 116 and 119 mt, respectively (PFMC, 2012).

The current target rebuilding year (T_{TARGET}) for canary rockfish is 2030 and the SPR harvest rate is $F_{88.7\%}$ (PFMC, 2012).

Table 1. Estimated annual fishing mortality and management reference points for canary rockfish in 2010-12.

Year	**Estimated fishing mortality (mt)**	**Management reference points (harvest specifications)**					
		ACL (2010 OY) (mt)	**Estimated mortality (% of ACL)**	**ABC (mt)**	**Estimated mortality (% of ABC)**	**OFL (2010 ABC) (mt)**	**Estimated mortality (% of OFL)**
2010	43	105	41%	-	-	940	5%
2011	52	102	51%	586	9%	614	9%
2012	80	107	75%	594	13%	622	13%

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Agenda Item F.5.a
Attachment 10
June 2013

Pacific Ocean Perch Catch Report for 2011-12

This catch report updates the status of the Pacific ocean perch (POP; *Sebastes alutus*) resource off the coast of the United States from Northern California to the U.S.-Canadian border using data through 2012. Composition data indicate that good recruitment years coincide in Oregon and Washington and no significant genetic differences have been found off the U.S. coast. The last full assessment was performed in 2011 (Hamel and Ono, 2011). The resource was modeled as a single stock using the most up-to-date version of Stock Synthesis available at the time.

Fishing mortality for 2010 and 2011 was estimated in West Coast Groundfish Observer Program (WCGOP) total mortality reports for 2010 (NWFSC, 2011) and 2011 (NWFSC, 2012). Observed discard rates for each species were directly expanded to a fleet-wide level of discard mortality through a deterministic approach. This discard mortality is added to landings data to give an estimate of total mortality. (Note that the most current POP assessment only had the Groundfish Management Team's (GMT) scorecard available for an estimate of 2010 fishing mortality.)

The GMT's scorecard for 2012 was used for the fishing mortality in 2012 (GMT, 2012). The GMT's scorecard aggregates research, state, and tribal in-season catch estimates to track overfished species totals against current harvest specifications.

The fishing mortalities for 2010-2012 (Table 1) are all estimated to be under the Annual Catch Limits (ACLs) as set by the Pacific Fishery Management Council and approved by the National Marine Fishery Service (PFMC, 2010; PFMC, 2011; PFMC, 2012). The ACLs for 2013 and 2014 are 150 and 153mt, respectively (PFMC, 2012).

The target rebuilding year (T_{TARGET}) for POP is 2051 and the SPR harvest rate is $F_{86.4\%}$ (PFMC, 2012).

Table 1. Estimated annual fishing mortality and management reference points for Pacific ocean perch north of 40º10' N lat. in 2010-12.

Year	Estimated fishing mortality (mt)	Management reference points (harvest specifications)					
		ACL (2010 OY) (mt)	Estimated mortality (% of ACL)	ABC (mt)	Estimated mortality (% of ABC)	OFL (2010 ABC) (mt)	Estimated mortality (% of OFL)
2010	159	200	80%	-	-	1,173	14%
2011	62	180	34%	981	6%	1,026	6%
2012	150	183	82%	962	16%	1,007	15%

References

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Yelloweye Rockfish Catch Report for 2011-12

This catch report updates the status of the yelloweye rockfish (*Sebastes ruberrimus*) resource off the coast of the United States from Southern California to the U.S.-Canadian border using data through 2012. The last full assessment was performed in 2009 (Stewart, 2009), and an update for yelloweye rockfish was done in 2011 (Taylor and Wetzel, 2011). The resource is modeled as a single stock, but with three explicit spatial areas: Washington, Oregon and California. The modeling was done with the most up-to-date version of Stock Synthesis available at the time.

Fishing mortality for 2010 and 2011 was estimated in West Coast Groundfish Observer Program (WCGOP) total mortality reports for 2010 (NWFSC, 2011) and 2011 (NWFSC, 2012). Observed discard rates for each species were directly expanded to a fleet-wide level of discard mortality through a deterministic approach. This discard mortality is added to landings data to give an estimate of total mortality. (Note that the most current yelloweye rockfish assessment only had the Groundfish Management Team's (GMT's) scorecard available for an estimate of 2010 fishing mortality.)

The GMT's scorecard for 2012 was used for the fishing mortality in 2012 (GMT, 2012). The GMT's scorecard aggregates research, state, and tribal in-season catch estimates to track overfished species totals against current harvest specifications.

The fishing mortalities for 2010-2012 (Table 1) are all estimated to be under the annual catch limits (ACLs) as set by the Pacific Fishery Management Council and approved by the National Marine Fishery Service (PFMC, 2010; PFMC, 2011; PFMC, 2012). The ACLs for 2013 and 2014 are both 18 mt (PFMC, 2012).

The current target rebuilding year (T_{TARGET}) for yelloweye rockfish is 2074 and the SPR harvest rate is $F_{76.0\%}$ (PFMC, 2012).

Table 1. Estimated fishing mortality and management reference points for yelloweye rockfish in 2010-12.

Year	**Estimated fishing mortality (mt)**	**Management reference points (harvest specifications)**					
		ACL (2010 OY) (mt)	**Estimated mortality (% of ACL)**	**ABC (mt)**	**Estimated mortality (% of ABC)**	**OFL (2010 ABC) (mt)**	**Estimated mortality (% of OFL)**
2010	8	17	47%	-	-	32	25%
2011	9	17	52%	46	19%	48	18%
2012	16	17	94%	46	35%	48	33%

References

Groundfish Management Team (GMT): Pacific Fishery Management Council (PFMC). 2012. Scorecard for November of 2012. Allocations and projected mortality impacts (mt) of overfished groundfish species for 2012. Lynn Mattes (personal communication).

Northwest Fisheries Science Center (NWFSC). 2011. Estimated discard and catch of groundfish species in the 2010 US West Coast Fisheries. West Coast Groundfish Observer Program. National Marine Fisheries Service, NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

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GROUNDFISH ADVISORY SUBPANEL REPORT ON APPROVE STOCK ASSESSMENTS

The Groundfish Advisory Subpanel (GAP) was briefed by Mr. John DeVore on the latest stock assessments for petrale sole, darkblotched rockfish, bocaccio rockfish, as well as those stocks that were assessed using data moderate methods. The GAP also reviewed the stock Assessment Review (STAR) Panel reports documenting the review of these assessments and the catch reports provided for canary rockfish, Pacific ocean perch and yelloweye rockfish. The GAP offers the following comments and recommendations.

The GAP supports the Scientific and Statistical Committee (SSC) recommendations to adopt the new data-moderate assessments for brown rockfish, China rockfish, copper rockfish, English sole, sharpchin rockfish, stripetail rockfish, rex sole, and yellowtail rockfish in the north; the new full assessments for darkblotched rockfish and petrale sole; and the new update assessment for bocaccio.

The GAP was also informed by Mr. John Budrick from the Groundfish Management Team (GMT) that there is consideration for re-doing the China rockfish assessment and reviewing it at the September mop-up panel. The GAP's understanding is that a revised assessment would evaluate a change in the nearshore rockfish management line from 40º10' N lat. to the California-Oregon border at 42º N lat. The GAP does not support re-doing this assessment this cycle due to the disruption this might cause in this year's stock assessment process. The GAP's biggest concern is that the same stock assessment team that did the China rockfish assessment will also be conducting the cowcod assessment scheduled for a STAR Panel review in August. The GAP does not recommend a change in this year's process since it may affect the quality of the cowcod assessment. However, the GAP does recommend a full assessment (if possible) for China rockfish in 2015 that would explore a change in the nearshore rockfish management line.

The GAP supports the use of these new assessments to inform management in 2015 and beyond; however, we note the B_{MSY} value for petrale sole, darkblotched rockfish, and bocaccio rockfish are much lower than the proxy target harvest levels. The Magnuson-Stevens Act (MSA) mandates a management limit of maximum sustainable yield (MSY). The National Standard 1 (NS1) guidelines expand upon this, suggesting that when MSY cannot be calculated, the use of a proxy is appropriate. Years ago, the calculation of MSY was not a standard output of the assessment model and the use of a proxy harvest target was the only option. In the case of these three species, the Stock Synthesis model used to calculate the current biomass now also estimates MSY. Further, the fishery management plan (FMP) allows the use of deterministic (i.e., model-based) MSY estimates from an approved stock assessment model. The deterministic B_{MSY} for petrale sole from the new assessment is 22% compared to its proxy target of 25%. Petrale stock depletion is currently estimated to be a 22.3% and therefore is actually rebuilt using the deterministic MSY estimate. Similarly, the deterministic B_{MSY} for darkblotched rockfish is 24% compared to the proxy target of 40%. Since the stock depletion is currently estimated to be 36% of initial biomass, it is now rebuilt using a deterministic MSY. Lastly, the deterministic B_{MSY} for bocaccio is 32% compared to the proxy target of 40% and is very near the deterministic target with a depletion of 31.4%. The GAP urges the Council to move to the use of a deterministic MSY as the harvest target for these species as allowed under the MSA and the groundfish FMP.

PFMC 06/22/13

Agenda Item F.5.b
Supplemental GMT Report
June 2013

GROUNDFISH MANAGEMENT TEAM REPORT ON STOCK ASSESSMENTS FOR 2015-2016 GROUNDFISH FISHERIES

The Groundfish Management Team (GMT) discussed the results of data moderate and full assessments as well as updates and catch reports conducted to date. The GMT recognizes and appreciates the efforts of those involved in the stock assessment process and progress made in developing data-moderate assessment methods. The only concerns expressed were relative to the data-moderate assessment of China rockfish north of 40º10'N. lat., which is currently at 33 percent depletion and declining at the current harvest rates. Later analysis by the GMT advisor to the Stock Assessment Review (STAR) panel determined that of the 129 mt of China rockfish taken between 2004-2012, only 13 percent or 17 mt was taken between 40º10' and 42º N. lat. in California waters, a pattern of differential exploitation extending back to the late 1980s. In addition, the indices of abundance were dominated by data from the Oregon commercial passenger fishing vessel fishery. The relatively low removals between 40º10' and 42º N. lat. and use of indices of abundance from data predominantly collected in Oregon make applicability of results of the assessment to California waters questionable to some on the GMT.

Each state has implemented different regulations for their nearshore fisheries, and removals differ between states, as may also be the case for the resulting stock status. Given the lower removals in California waters north of 40°10' N. lat, the indices of abundance from the assessment south of 40°10' N lat. may more accurately reflect the depletion within California waters than those to the north of the California-Oregon border at 42° N. lat. There is currently no evidence of population structure at Cape Mendocino that would necessitate stratification at 40°10' N lat. The Council may want to consider requesting an assessment with re-stratification of indices and catch history at 42° N. lat. instead of 40°10' N. lat. be conducted in time for review at mop-up for further consideration and comparison to the model stratified at 40°10' N. lat. This may help better inform the depletion in California waters and appropriate overfishing limits in each region. Such issues may arise in future assessments where the contribution of data across the assessed area is not proportional and depletion may vary within assessed regions. Development of indices of abundance from additional data sources as well as evaluation of the trends in indices and historical catch across ports or counties etc. would help address these issues to better inform relative abundance and stratification future assessments respectively.

Recommendations

1. Consider prioritizing the alternative stratification of the China rockfish assessment at 42º N. lat. for review at mop up.
2. Consider adopting the remaining data-moderate and full assessments recommended by the SSC for use in management in 2015-2016.

PFMC
06/21/13

Agenda Item F.5.b
Supplemental SSC Report
June 2013

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STOCK ASSESSMENTS

The Scientific and Statistical Committee (SSC) was briefed by its groundfish subcommittee regarding five items pertaining to groundfish stock assessments and Stock Assessment Review (STAR) Panel reviews for the 2015-2016 management cycle. These items included: 1) a report regarding assessments for data-moderate species, 2) an updated bocaccio rockfish assessment, 3) catch reports for three rockfish species, 4) a full assessment for petrale sole, and 5) a full assessment for darkblotched rockfish.

The data-moderate process produced successful assessments for eight species, none of which were estimated to be overfished. The full assessments for petrale sole and darkblotched rockfish, and the assessment-update for bocaccio rockfish, show that all three species are still rebuilding, and all are predicted to be rebuilt by 2015. Rebuilding analyses are not needed for these three species, given the 1 to 2-year timeframe for rebuilding. The catch reports for Pacific ocean perch, canary, and yelloweye rockfish show catches have been below the annual catch limit (ACL) for the last three years, and no new rebuilding analyses are needed for these three species. The SSC reiterates the importance of conducting data methodology review meetings in advance of STAR Panel reviews.

Key points following from the full SSC discussion, along with associated SSC recommendations follow.

Data-moderate Assessments

The Stock Assessment Team (STAT) considered applying one or both of the data-moderate assessment methods (XDB-SRA and exSSS) to each of the nine groundfish stocks that were recommended for data-moderate assessment: brown rockfish, China rockfish, copper rockfish, English sole, sharpchin rockfish, stripetail rockfish, rex sole, vermilion rockfish, and yellowtail rockfish; but this task proved to be overly ambitious. During the STAR Panel meeting it was agreed that the STAT would focus its efforts and apply the XDB-SRA method to the nearshore species (brown, China, and copper rockfish) and apply the exSSS method to the offshore species (sharpchin, stripetail, and yellowtail rockfish; and English and rex sole).

The assessment for vermilion rockfish was abandoned due to time-constraints and because recent research has established that the species previously known as vermilion rockfish is in fact a complex of two species with geographic overlap south of 40°10’ N. lat. There is potential for developing separate data-moderate assessments for the vermilion stock complex in future assessment cycles based on indices from the Northwest Fisheries Science Center (NWFSC) hook-and-line survey. The STAT also attempted, but abandoned, a data-moderate assessment for yellowtail rockfish south of 40°10’ N. lat., because the index data for this stock are too limited.

A document summarizing the compositional data available for the nine stocks that were assessed with data-moderate methods in 2013 is not yet complete. This document is intended to evaluate the availability of information to conduct full assessments for data-moderate stocks. A revised document will be reviewed at the September SSC meeting.

The SSC views the data-moderate assessment methods as being very useful tools for assisting the Council's groundfish management process and a substantial improvement over the Council's data-poor methods. The SSC concludes that 1) the assessments described in the table below represent the best available science, 2) they should be accepted as valid data-moderate stock assessments, and 3) they should be used as the basis for management decisions in the 2015-2016 groundfish management cycle.

Summary table of data-moderate stock assessment results.

Stock	Depletion [a]	Status		OFL [b]
Nearshore stocks:				
Brown rockfish (coastwide)	40%	Above target		Yes
China rockfish (N of 40°10')	33%	Below target, not overfished		Yes
China rockfish (S of 40°10')	72%	Above target		Yes
Copper rockfish (N of 34°27')	42%	Above target		Yes
Copper rockfish (S of 34°27')	84%	Above target		Yes
Shelf-slope stocks:				
Sharpchin rockfish (coastwide)	73%	Above target		Yes
Stripetail rockfish (coastwide)	> 77%	Above target		No
Yellowtail rockfish (N of 40°10')	69%	Above target		Yes
English sole (coastwide)	88%	Above target		Yes

Rex sole (coastwide)	80%	Above target		Yes

[a] Estimates for start of 2013; percentages reflect proportion of unfished spawning biomass.
[b] The assessment can be used to calculate OFL or OFL contribution.

The assessment for stripetail rockfish did not produce a reliable estimate for the scale of the stock's biomass. As a consequence, an OFL could not be estimated. However, the SSC agrees with the STAT and STAR Panel that the available data provide strong evidence that the stock is not below the biomass target and can be used for status determination.

In conclusion, the SSC regards the process of developing and reviewing the data-moderate assessments in the current assessment cycle has been highly successful. Data-moderate assessments fill an important gap in the assessment tools available to assessment scientists, and improve the Council's ability to assess and manage the stocks in the Council's groundfish FMP. These stocks have varying economic and ecological importance, and different types of data available for assessment. A range of assessment tools gives the Council and National Marine Fisheries Service (NMFS) the flexibility to set priorities for assessment and at the same time ensure that there is some minimal level of assessment that can be conducted for all stocks.

Bocaccio Rockfish

The most recent full assessment of bocaccio rockfish was conducted in 2009. Subsequently, updated assessments have been prepared in 2011 and again in 2013. The present assessment estimates depletion in 2013 of 31.4 percent; an improvement over that forecasted by the 2011 assessment (approximately 28 percent). Improvement in stock status is attributed to higher estimates of 2010 recruitment.

Bocaccio is predicted to be rebuilt by 2015; however, the SSC recommends that this be confirmed with a full assessment during 2015. For 2015 and 2016 management, the SSC recommends continuing to use the current rebuilding spawning potential ratio (SPR) to define the ACL. A rebuilding analysis is unnecessary and would provide no new information given the projected two-year timeframe for rebuilding.

The bocaccio update complies with the terms of references for assessment updates and represents the best available science for use in developing 2015-2016 management measures as a category 1 assessment.

Groundfish Catch Reports

The SSC discussed the groundfish subcommittee's review of catch reports that update the overfishing status of canary rockfish, Pacific ocean perch, and yelloweye rockfish off the US Pacific coast using data through 2012. Fishing mortality was reported in the West Coast Groundfish Observer Program total mortality reports for 2010 and 2011, and was based on the scorecards developed by the Groundfish Management Team for 2012. The scorecards for yelloweye and canary rockfish are based on harvest guidelines and probably are the upper bound of potential catch. The 2010-2012 fishing mortalities for all three species are estimated to be less than the annual catch limits (ACLs) as set by PFMC and approved by NMFS.

Given these results, and the lack of new information on biomass and recruitment, updated rebuilding analyses are not necessary for these three species.

Petrale Sole

Full assessments of petrale sole were conducted in 2009, 2011, and again in 2013. The 2009 assessment found the stock to be overfished; while the 2011 and present (2013) assessments concluded that the stock is above the Minimum Stock Size Threshold (MSST), but not yet rebuilt to B_{MSY}.

The base model from the 2013 stock assessment predicts that the stock will be rebuilt in 2014. Depletion in spawning biomass is estimated to be 22 percent at the start of 2013, above the 12.5 percent MSST for flatfish, but below the 25 percent B_{MSY} proxy. Compared to the 2011 assessment, which estimated that depletion was 18 percent in 2011, the new stock assessment indicates a less optimistic view (depletion of 13 percent in 2011).

The catch per unit of effort (CPUE) data are a key input to the assessment. The 2013 STAR Panel made two recommendations which reduced the weight assigned to these data. This down-weighting was in part due to the STAR Panel's lack of confidence in the CPUE data as an index of abundance; however, this was not explicitly stated in either the assessment document or the report of the STAR Panel. By contrast, the STAR Panel for the 2011 petrale sole assessment recommended that the CPUE index be included in the assessment. Use of CPUE indices in stock assessments is a topic where there is a range of scientific opinion, and STAR Panels may differ in what they consider to be the best approach. The SSC recommends that the CPUE index and its use in the assessment should be a major focus for the next assessment; any decision to not assume constant catchability and the coefficients of variation implied by the fit of the model to the data must be very clearly specified. Although the Panel justified its recommendation regarding the CPUE index, the SSC wishes this matter to be explored in more detail as part of the next assessment.

The SSC endorses the use of the 2013 petrale sole assessment as the best scientific information available for status determination and management in the Council process. The petrale sole spawning stock biomass is projected to be above the B_{MSY} proxy by 2014 under the "base case" and by 2016 under the "low" state of nature. However, the SSC recommends that this change in status should be confirmed by a new full assessment.

The SSC recommends that petrale sole be treated as a category 1 stock because the assessment is based on a fully developed age-structured model. There is no reason to conduct a rebuilding analysis for petrale sole this year given that it is predicted to rebuild to B_{MSY} in 2014 under current management.

Darkblotched Rockfish

A new full assessment of darkblotched rockfish was conducted in 2013. The most recent prior full assessment was conducted in 2007, which was subsequently updated in 2009 and again in 2011.

The new assessment results indicate that the west coast stock is currently at 36 percent of the unexploited level. This assessment estimates that the 2012 SPR is 86 percent, while the SPR-based management fishing mortality target is 50 percent. Overfishing has not occurred in the last 10 years. Natural mortality was used to bracket uncertainty in the states of nature in the decision table.

The SSC notes that the estimate of current depletion is highly uncertain and the assessment likely underestimates the extent of this uncertainty. The NWFSC trawl survey indices are relatively variable for darkblotched and show no overall trend over the past 10 years in contrast to the sharp increase in stock status estimated in the model over that period. It appears that the modeled improvement in stock status can be attributed primarily to: 1) reduced fishing mortality since the onset of the rebuilding program in 2000, 2) inferences that follow from more favorable perceptions of steepness, fecundity, and age at maturity of the stock, and 3) length and age data indicating relatively large recruitments in 1999, 2000 and 2008.

The SSC endorses the use of the 2013 darkblotched rockfish assessment as the best scientific information available for status determination and management in the Council process. The SSC recommends that darkblotched rockfish should be treated as a category 1 stock because the assessment is based on a fully developed age-structured model. The SSC is currently evaluating whether the default category 1 sigma value (vs. another approach) is appropriate for darkblotched rockfish.

Because the darkblotched rockfish assessment indicates that the stock will be rebuilt within 2 years (by 2015), the SSC recommends that the next assessment be a full assessment. The SSC notes that a new rebuilding analysis is not needed at this time, as the current assessment already provides the population projections needed to forecast population status through the next two years, and a new formal rebuilding analysis would be redundant. For 2015 and 2016 management, the SSC recommends continuing to use the current rebuilding SPR to define the ACL.

PFMC
06/22/13

Agenda Item F.6
Situation Summary
June 2013

TRAWL RATIONALIZATION TRAILING ACTIONS

Under this agenda item, the Council is scheduled to:

1. Check-in on the process for considering electronic monitoring (EM), including consideration of the appointment of an ad hoc workgroup;
2. Discuss plans for the September scoping process on trailing actions other than EM; and
3. Provide advice to NMFS on the implementation of the second program improvements and enhancement rule (PIE 2), including reconsideration of the Council recommendation on the end-of-year quota pounds (QP) trading suspension.

1. EM Regulatory Process

The Council decided at the April, 2013 Council meeting to move forward with consideration of the possible use of EM for the trawl catch share program (trawl rationalization). At that time, the Council decided that the primary focus of integrating EM into the trawl catch share program would be to achieve the compliance monitoring required for individual accountability of catch and bycatch, as opposed to using EM to meet needs or enhancements for biological data or other scientific information monitoring). A set of regulatory objectives and calendar for moving ahead were adopted (Agenda Item F.6.a, Attachment 1). In adopting the calendar, Council members noted that the calendar should not be construed as preventing the process from moving ahead sooner than indicated on the calendar, if circumstances allow. As part of the calendar, Council staff was directed to work with agency staff to develop a whitepaper on performance standards and other requirements that EM proposals might need to meet. A preliminary draft of that paper is provided as Agenda Item F.6.a, Attachment 2, and the Washington Department of Fish and Wildlife (WDFW) has submitted a report providing further guidance for the development of that paper (Agenda Item F.6.b, WDFW Report).

Also, at the April meeting:

- a set of recommendations on the 2013 EM field study was approved for forwarding to Pacific States Marine Fisheries Commission (PSMFC);
- Council staff was asked to explore the budget implication and other costs/benefits relative to three different possible ad hoc workgroup compositions (Agenda Item F.6.a, Attachment 1); and
- NMFS Northwest Region was asked to evaluate all aspects and repercussions associated with utilizing an out-of-cycle exempting fishing permit (EFP) for further testing the use of EM without the presence of observers on the vessel; this is expected to include the effect on NMFS internal workload and completion schedules for other priority endeavors, effects on the Council EM regulatory process, implications to the Council's EFP process, and specifics on new information expected to be gathered beyond data previously collected.

After the April Council meeting, Council staff submitted and NMFS approved a supplemental funding package to allow the Council to fully engage in timely consideration of EM. A staff officer dedicated to this task is in the process of being hired and the funds are available for the necessary ad hoc workgroup meetings. Additionally, PSMFC has submitted a final report on the 2012 field work testing electronic monitoring (Agenda Item F.6.b, PSMFC Report). Under this agenda item, the Council should discuss the seats for the ad hoc workgroup and potentially a technical advisory group on EM. Actual appointments should be considered under Agenda Item C.6.

2. September Scoping of Annual TR Trailing Actions

At its September 2010 meeting, the Council began a series of trailing actions for the trawl rationalization program and intersector allocation which have continued up through the present. These trailing actions address issues of concern which were outstanding as of the completion of the Council's initial work on the program (e.g. rules for the distribution of the quota set aside for the Adaptive Management Program and safe harbors from control rules for risk pools). The actions also address provisions needed to complete or clarify the final program and new concerns identified during and after program implementation. A process for developing these trailing actions has been developed under which scoping is conducted in September of each year, alternatives for analysis selected in November, analysis completed over the winter and preliminary and final action taken at the March and April Council meetings, so that implementation can be completed by the following calendar year. Trailing actions for a particular cycle are generally implemented together in omnibus rule packages (PIE rules). The current status of trailing actions is provided on the Council website: http://www.pcouncil.org/groundfish/fishery-management-plan/trailing-actions/, including those on which Council deliberation is in progress, delayed, or completed and those for which NMFS implementation is in progress, delayed, or completed. At its April meeting, the Council decided to have a discussion of its trailing action process for PIE Rule 3 at this meeting.

3. PIE 2 Clarifications

These agenda item provides an opportunity for NMFS to seek clarification on any issues which arise during its development of the PIE 2 proposed rule package. As of the time of briefing book publication, there are no PIE 2 issues on which NMFS is seeking clarification from the Council; however issues may still arise prior to the Council meeting. However, included in PIE 2 is a proposal to eliminate the end-of-year (December 15-31) QP trading prohibition on QP transfers between vessel accounts (§660.140(e)(3)(iii)(B)). In April it was proposed that the Council's previous recommendation be modified to not only eliminate the end-of-year QP trading prohibition but to also allow the trading of QP issued for a previous year to occur in the current year up until the last landings data for the previous year is in the catch and QP accounting system, with particular reference to carryover issuance implications.

Allowing trading of previous year QP during the current year requires a change to different regulations and has different impacts than elimination of the end of year trading prohibition. The end-of-year trading prohibition is explicitly stated in a single sentence in §660.140(e)(3)(iii)(B) while the prohibition on trading after the end of the year is based on 660.140(e)(5)(i), which provides: "Any amount of QP or IBQ pounds in a vessel account and in excess of the carryover amount will expire on December 31 each year and will not be available for future use." No "future use" of any QP in the account is allowed, including use for trading, until a determination of the amount in excess of the carryover is made; however, at the same time, such QP are available to cover previous year catch, as catch data is finalized for prior year harvest. The nature of the impacts would also be different in that allowing surplus QP to be traded from one vessel account to cover a previous year deficit in another vessel account would allow the fleet to collectively rebalance the distribution of QP among accounts, changing the overall amounts of QP potentially available for carry over. Additionally, allowing trading of prior year QP would reduce certainty of the information available to the Council when it makes its recommendation on carryover and require a large amount of computer programming for transfer transactions related to vessel accounts. On the basis of considerations which include these factors, NMFS has indicated that this proposal would not be considered an adjustment to the Council's previous recommendation but instead needs to be considered as a new action and a new analysis provided.

Council Action:

1. **Receive updates on EM processes and provide guidance, as necessary.**
2. **Provide guidance on September trailing action scoping process for PIE 3, as needed.**
3. **Provide guidance on PIE 2, as needed, including possible revisions to previous Council recommendation eliminating end-of-year QP trading.**

Reference Materials:

1. Agenda Item F.6.a, Attachment 1: Electronic Monitoring – Objectives, Calendar, and Advisory Body Budget.
2. Agenda Item F.6.a, Attachment 2: Initial Draft Whitepaper: Electronic Monitoring and Performance Standards.
3. Agenda Item F.6.b, WDFW Report: Washington Department of Fish and Wildlife Report on Trawl Rationalization Trailing Actions.
4. Agenda Item F.6.b, PSMFC Report: Final Report, Electronic Monitoring Program: Review of the 2012 Season.

Agenda Order:

a. Agenda Item Overview — Jim Seger
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action**: Receive updates on electronic monitoring processes and provide guidance as necessary; Provide Guidance on Process Improvement and Enhancements 3 Process and; Consider Other Trailing Action Issues as Needed, Including End-of-Year Quota Pounds Trading

PFMC
05/30/13

ELECTRONIC MONITORING – OBJECTIVES, CALENDAR, AND ADVISORY BODY BUDGET

EM Objectives

The regulatory objectives for this action are closely tied to the purpose and need and would be intended to further the policy goals and objectives of the Magnuson-Stevens Act (MSA) and the groundfish fishery management plan (FMP) including Amendment 20. The regulatory objectives for this action pertain to catch share program compliance monitoring and, as proposed by workshop participants, would be to:

1. reduce total fleet monitoring costs to levels sustainable for the fleet and agency;
2. reduce observer costs for vessels that have a relatively lower total revenue;
3. maintain monitoring capabilities in small ports;
4. increase national net economic value generated by the fishery;
5. decrease incentives for fishing in unsafe conditions;
6. use the technology most suitable and cost effective for any particular function in the monitoring system; and
7. reduce the physical intrusiveness of the monitoring system by reducing observer presence; while
8. maintaining current individual accountability for catch and preserving equitable distribution of monitoring coverage among members of the fleet,
9. supporting the collection of biological information necessary for managing the fishery, for stock assessments, and to meet other needs for scientific data, with no degradation relative to pre-trawl catch share program standards,
10. taking into account agency budgets and abilities to support any new policy,
11. maintaining capabilities for annual catch limit (ACL) management (e.g. for non-quota species), and
12. following an implementation path most optimal for the fishery.

Note: These regulatory objectives are for an action to develop an Electronic Monitoring (EM) program for trawl catch share program compliance monitoring, not for the collection of scientific data. The first seven items in the above list are direct regulatory objectives, i.e. reasons for considering EM. Items eight through twelve in this list are constraints, i.e. the Council would not be undertaking this action in order to achieve items eight through twelve but rather in pursuing the first seven objectives will be bounded by the concerns listed in items eight through twelve. These objectives do not displace the original objectives for the trawl catch share program (Amendment 20 objectives) or the groundfish FMP.

EM Calendar

The following is the process adopted by the Council for its deliberations on EM. Highlighting indicates the changes the Council made to the process recommended by the February 2013 EM workshop.

EM Calendar	
Dates	**Process Considerations**
	• PSMFC continues preliminary planning for 2013 season and in anticipation of likely Council guidance.
Apr 2013	• Consider results of EM workshop and recommendations • Adopt goals and objectives. • Provide guidance on development of scoping package. • Request *special studies,* as needed. • Consider results of the 2012 PSMFC EM study. • Provide comment on the 2013 PSFMC EM study design. • Adopt regulatory process plan.
Spring 2013	• NMFS/PSMFC finalize 2013 study design (starting in April – w/Council meeting results).
June 2013	• ~~Full scoping session on EM.~~ • Appointment of workgroup on this issue.
Summer 2013	• Execute at-sea and shoreside field studies
Sept 2013	• Review results from *special studies* and provide guidance on alternative development (if necessary). • Draft whitepaper performance standards for Council review. • Scoping session on EM
Nov 2013	• Consider initial results of NMFS/PSFMC 2013 field season[a/] • Finalization of whitepaper. • Adopt alternatives for analysis.
June 2014	• Consider full analysis of alternative. • Select preliminary preferred alternative.
Sept 2014	• Select final preferred alternative.
Sept 2014 through 2015	• Secretarial approval process and implementation, including ○ regulation drafting and paperwork reduction act submissions, ○ securing contracts for video review, ○ commercial installation and testing, and ○ observer program adjustments.

a/ Staff Note: based on the 2012 field season, significant results may not be available until the spring of 2014.

Ad Hoc Advisory Body (Workgroup) Budget

At the April 2013 Council meeting, there were three proposals for the composition of the ad hoc workgroups to develop the EM proposals. These recommendations are provided in the right hand column of Table 1. Past experience in developing the groundfish rationalization policy indicates the importance of early and engaged participation by agency personal that will be responsible for various aspects of implementing and administrating the program. Therefore, Council staff has included a proposal for an ad hoc technical advisory group that may meet both jointly and separately from the constituent advisors. At this time it appears that state participation might be needed at only three of the technical advisory meetings. Cost estimates are provided in Table 2.

Table 1. Possible ad hoc advisory body compositions (alternatives discussed in April).

<table>
<tr><th>Constituent Advisors</th><th>Technical Advisors</th></tr>
<tr><td>Groundfish Advisory Panel (GAP) Recommendations

PSMFC Chair

2 bottom trawl
2 midwater trawl
1 fixed gear
1 processor

Technical advisors from Council and agency staff in attendance.</td><td rowspan="3">• PSMFC
• NMFS Northwest Region
• NMFS Northwest Fishery Science Center
• NMFS Office of Law Enforcement
• NOAA General Counsel
• States – 3 meetings only</td></tr>
<tr><td>Enforcement Consultant Recommendations

[PSMFC Chair]

At-sea whiting
Shoreside midwater trawl
Shoreside bottom trawl
IFQ Fixed gear

Technical advisors from Council and agency staff in attendance.</td></tr>
<tr><td>GAP Composition – Trawl/Fixed Gear (processor or conservation?)

[PSMFC Chair]

Bottom Trawl
Midwater Trawl
Trawl At-Large
Trawl At-Large

Plus, one of the three Fixed Gear At Large seats</td></tr>
</table>

Table 2. Cost estimates for each ad hoc advisory body alternatives.

	No. of Travelers	Council Meeting	Outside of Meeting[a/]	# of days	Cost per person per meeting [b/] Cncl Mtg	Outside Mtg
GAP Recommendation						
Constituent Advisory [c/]	7	3,022.25	4,597.25	3 days	431.75	656.75
Staff	1	656.75	-		656.75	-
Estimate of Total		*$ 3,679.00*	*$ 4,597.25*			
EC Recommendation						
Constituent Advisory [c/]	5	2,338.75	3,283.75	3 days	467.75	656.75
Staff	1	656.75	-		656.75	
Estimate of Total		*$ 2,995.50*	*$ 3,283.75*			
GAP Composition - Trawl and Fixed Gear						
Constituent Advisory [c/ d/]	6	2,680.50	3,940.50	3 days	446.75	656.75
Staff	1	656.75	-		656.75	-
Estimate of Total		*$ 3,337.25*	*$ 3,940.50*			
Technical Advisors [e/]	4	$ 1,682.00	$ 2,383.00	3 days	420.50	595.75

a/ Outside meetings being held in Portland.

b/Cost Estimates are based on: Per Diem $61.00, hotel - 113.00, airfare estimate $315.00 per person, taxes and additional expenses are not included in the estimates

c/ Most members are currently on an advisory body so majority of costs would be already funded. Actual composition of members may change the amounts.

d/ Does not include a processor or a conservation representative.

e/ Meet jointly with constituent advisors or at separate meeting held in Portland (therefore no additional staff officer travel).

PFMC
05/30/13

Agenda Item F.6.a
Attachment 2
June 2013

Initial Draft Whitepaper: Electronic Monitoring and Performance Standards

May 29, 2013

Initial Draft Whitepaper: Electronic Monitoring and Performance Standards

Table of Contents

1. INTRODUCTION

In 2011, NMFS implemented a Council developed catch share program for the West Coast limited entry groundfish trawl fishery. The program requires that each vessel acquire quota pounds (QP) to cover its catch (including discards) of nearly all groundfish species.[1] Proper functioning of the program requires some form of at-sea monitoring to ensure that discards are counted. The catch share program specified that this monitoring function be achieved through 100% at-sea observer coverage. The cost of this observer coverage is a burden on industry that is currently being born largely through government subsidies. Those subsidies are phasing out and there are concerns about the impacts that bearing a greater portion of the observer costs will have on industry. Electronic monitoring (EM) is being explored as a potential technically and economically viable substitute for the use of human observers in the function of compliance monitoring for the catch share program. A more complete description of the problem is available in an appendix to the report of the February 2013 Council sponsored workshop on EM (see Council website: http://www.pcouncil.org/wp-content/uploads/D7b_EM_WKSHOP_RPT_APR2013BB.pdf)

During the EM workshop there was a discussion of the potential regulatory requirements for an EM system and the need for regulatory flexibility, both with respect to technologies employed and processes. The needed flexibility would allow private industry to develop efficient and effective monitoring system and to continue to innovate as new technologies become available over time. It was suggested that rather than being prescriptive, regulations should specify performance standards which must be met. This recommendation is in line with Executive Order 12899, which requires that each agency "identify and assess alternative forms of regulation and shall, to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt."

[1] Exceptions were made for some species rarely caught in the trawl groundfish fishery.

In April, 2013, the Council charged Council staff to work with agencies to "develop a whitepaper that would identify monitoring performance standards and other requirements that EM proposals would have to meet." This document provides a preliminary draft of that paper.

The catch share program itself is a performance standard specified within a market-based regulatory framework that includes a monitoring function. The proposal to be developed by the Council would change the means by which that monitoring function is fulfilled from one in which observers ride aboard vessels to one based on EM, in which EM is used to gather data on discard events. Under an EM system, vessels would enter discard data into electronic logbooks and video review would be used to validate the logbook information. However, the purpose of this paper is not to explore the viability of EM but rather to explore the possible use of performance standards rather than prescriptive mandates in the specification of the regulations for the EM function.

Three sections comprise this paper: the first explores different types of regulatory regimes, including regimes based on performance standards; the second begins more specific exploration of EM specifications based on performance standards; and the third provides excerpts from NMFS' recently released policy on EM.

2. TYPES OF REGULATORY REGIMES

2.1 Overview

Regulations are needed when the actions of individuals do not adequately take into account social concerns (i.e. underproduce social goods or overproduce social bads) (Viscusi, Vernon & Harrington 2000 as cited in Coglianese & Lazer, 2003, p. 3). For Federal fisheries, social outputs of concern include those which diminish achievement of the Magnuson-Stevens Act National Standards,[2] which might be broadly characterized as ultimately relating to biological and human community sustainability (including factors such as overfishing, efficiency, equity, and human safety). Where specific social bads

[2] The MSA National Standards relate to .....

can be traced to individual entities which can then be held accountable for damages, and which have the resources to cover monetary damages, then the court system itself provides adequate means for ensuring social values will be taken into account in private decision process (Hueth and Melkonyan, 2007). Consequently, in such situation there is little need for additional regulation. When regulations are necessary, as is the case in fishery management, "the ultimate goal ...is...to change the production of social outputs" (Coglianese & Lazer, 2003, p. 3).

Different authors use different terminologies and different groupings for classifying types of regulations. Generally, regulations run a range from being prescriptive (specifying the technologies and processes that must be employed) to being performance based (limiting or requiring certain output without regard to the technologies and processes used to achieve that result (Coglianese, et.al, 2003, p. 713). Numerous terms are used to describe variations on these end-points and the hybrids of regulatory systems that array themselves on the gamut between. For example, performance-based systems include a variation with performance incentives: Pigouvian taxes (a tax on negative externalities, e.g. pollution), and other output trading (e.g. emissions trading) (Hueth and Melkonyan, 2007). The catch share program would be considered a performance incentive system which relies on markets.[3] "[M]arket-based regulation still measure firms' performance for the purpose of either assessing taxes or determining if firms possess an adequate number of tradable permits" (Coglianese & Lazer, 2003, p. 2) Coglianese and Lazer identify three stages of production (planning, action, and output) and a regulatory classification system which maps onto these three stages (Table 1).

Table 1. Stages of organization production and types of regulations.

Stage of Production	Planning ➔	Acting ➔	Outputs (both good and bad)
Type of Regulation	Management Based	Technology Based	Performance Based

Reproduced from Coglianese & Lazer, 2003, p. 4.

Coglianese and Lazer's technology-based regulations generally encompass those regulations which are described as prescriptive or command-and-control, but also include other terms and sub-categories of regulation, including design standards and action or process regulations. Terminology and groupings used by other authors can be mapped onto the groupings developed by Coglianese and Lazer based on stages of production (Table 2). For the purpose of this paper, the terms *prescriptive* or *technology-based* will be used for the categories of regulation encompassed within Coglianese and Lazer's technology-based regulations.

[3] There are also "information-based" systems which require only the divulgence of information (e.g. labeling laws which allow consumer response to encourage firms to better account for the externalities of their production); and risk-based systems, which involve risk assessment modeling to determine compliance and might be considered a type of performance based regulation.

Management-based regulations do not prescribe technologies or behavior (prescriptions), or specific outputs (performance), but "[r]ather... requires firms to engage in their own planning and internal rule making efforts that are supposed to aim toward the achievement of specific public goals" (Bardach & Kagan, 1982 as cited in Coglianese and Lazer, 2003, p. 2). The design of management-based regulations includes determining: the degree of agency involvement in the internal planning process of the regulated entity, whether agency approval of the plan is required, and whether implementation and monitoring of the plan developed by the firm is required. The current trawl catch share program includes what might be considered a management-based component: requirement that first receivers develop a catch monitoring plan and have that plan approved by NMFS (§ 660.140(f)(3)(iii), subpart D).[4] However, for this provision there are very specific performance standards that the plan must meet and through the specificity of these standards an element of prescription enters into the regulation.[5] In general the management-based approach is intended to focus on the internal planning process with an openness to outcomes that provide substantial flexibility for a firm to identify alternative technologies and processes for meeting the social objectives that the agency is pursuing.

Whereas prescriptive regulations largely specify the how by which the problem of meeting a social need is addressed and management-based regulations require a firm to engage in mandated problem solving process to determine the how, performance standards leave the how alone and specify only the output which must be produced. Whether regulations provide prescriptive, management-based, or performance-based standards, a key element of success is monitoring and verification. The Council's current effort is an exploration of whether compliance with catch shares (a performance-based system) can be monitored and verified through a regulatory compliance system which is itself built on performance-based criteria.

[4] 660.140(f)(3)(iii), subpart D (iii) A catch monitoring plan. All IFQ first receivers must prepare and operate under a NMFS-accepted catch monitoring plan for each specific physical location. A proposed catch monitoring plan detailing how the IFQ first receiver will meet each of the performance standards in paragraph (f)(3)(iii)(C) of this section must be included with the application. NMFS will not issue a first receiver site license to a person that does not have a current, NMFS-accepted catch monitoring plan.

[5] A detailed list of performance standards is provided in 660.140 Section (f)(3)(iii)(C) and covers the topics of: (1) catch sorting; (2) monitoring for complete sorting; (3) scales used for weighing IFQ landings; (4) production of printed record; (5) weight monitoring; (6) delivery points; (7) observation area; (8) lockable cabinet; (9) plant liaison; (10) first receiver diagram (showing delivery point(s);the observation area; the lockable cabinet; the location of each scale used to weigh catch; and each location where catch is sorted); and (11) electronic fish ticket submittal.

Table 2. Regulatory terminology and groupings for different authors, organized based on Coglianese and Lazer, 2003.

Authors	Regulatory Types		
Coglianese & Lazer, 2003	Management -based	Technology-based/prescriptive	Performance-based
Coglianese, et. al. 2003		Prescriptive (of behaviors, technologies, procedures, or processes) Design standard Technology--based standard[i]	Performance-based (including market-based)
Hueth & Melkonyan, 2007	Management-based[ii]	Command and control Design Standards[iii] – technology to use[iv] Action Process[v] – steps to follow, implementation[vi]	Performance-based
Gunningham, 1999	Systems-based Process-based	Command and control (also termed “specification” and “prescriptive”)	Performance-based
May, 2011	Processes(system-based regulations)	Technology-based regulation Prescriptive regulation	Performance-based

i Coglianese, et. al. (2003) describe the difference between this category and performance based standards as follows: “In contrast to a design standard or a technology-based standard that specifies exactly how to achieve compliance, a performance standard sets a goal and lets each regulated entity decide how to meet it.” (p. 709).

ii Hueth and Melkonyan describe management-based regulation described by Coglianese and Lazer as “conceptually akin to our process standard” (p. 5). However, Coglianese and Lazer emphasize regulations requiring managers to go through an internal planning processes to design systems that meet regulatory objectives. That planning process entails both determining the technologies to be used and processes to be followed during implementation.

iii Imposes a particular mitigation plan choice which then impacts action choice. (Hueth & Melkonyan, 2007, p. 3.)

iv Example: gear regulations.

v “Specifies (and enforces) the efficient action for a given plan” and enforces a particular action, “which in turn affects the firm’s ex ante plan choice” (Hueth & Melkonyan, p. 3). “Process (monitoring implementation) standards” (Hueth & Melkonyan, p. 3)

vi Example: declaration requirements, fishing outside of closed areas.

2.2 Performance-Based Regulations

This section looks more closely at the design considerations and pros and cons of performance-based regulations. There are a number of precautions in the literature indicating that performance-based regulations should be approached with care. Federal regulators participating in a 2002 workshop “noted a general absence of empirical studies evaluating the effectiveness of performance-based standards, let alone systematic work showing when, and how well performance-based standards work in various regulatory settings” (Coglianese, et. al, p. 714).[6] The authors of this document are in the process of

[6] Coglianese et. al. (2003) also “conducted extensive searches in the academic literature, asked colleagues who were not at the conference, and solicited input via a global Internet listserv devoted to regulatory

reviewing the literature to determine whether more recent assessments have remedied this shortage of performancebased regulation evaluations. However, May (2011) found it still relevant to cite Deighton-Smith's (2008) statement: "the lack of critical assessment [of performance-based and process-based regulatory regimes] has lead[sic] to indiscriminate adoptions of these regulatory approaches" (as cited by May, p. 379). There are some notable failures in the use of performance-based regulations (May 2011), so careful attention to their design is warranted. A key area for attention may be accountability (monitoring and verification). While accountability is essential for any regulations, May notes "accountability is the Achilles' heel of performance-based regulation (p. 380).

As discussed above, "[p]erformance-based regulation is predicated on the notions that regulation should focus on achievement of regulatory objectives and leave it to regulated entities to determine how best to achieve them." (May. 2011, p. 373). The reasons for leaving decisions to the regulated entities (i.e. for use of performance standards) are multiple and include:

1. When prescriptive regulations must be very detailed to be effective
    a. they become costly to implement
    b. enforcement becomes arbitrary (may be based on what is most easily or what a particular regulatory enforcer feels is most important).
2. Industry has better information than agencies on the most effective ways to meet social goals.[7]
3. There is substantial heterogeneity across entities or through time, such that determination of a best set of prescriptive regulations for all firms across time is problematic to impossible.

There are a variety of different forms of performance-based regulations and those forms are a function of

1. Regulatory comprehensiveness and associated variation in specificity of regulatory performance, and
2. The blending of performance-based approaches with prescriptive approaches (May, 2011, p. 374)

2.2.1 Regulatory Comprehensiveness and Variation in Specificity

May identifies the following as factors which determine regulatory comprehensiveness and degrees of specificity

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policy" but "In the end, ... were unable to locate any systematic empirical study evaluating the impact of performance standards relative to other regulatory approaches." (p. 713, fn 21)

[7] "Prendergast (2002) shows that output-based incentives are preferable to input-based incentives when there is uncertainty regarding the appropriate technology for a given task ..." (Prendergast as cited by Hueth and Melkonyan, 2007)

- Desired outcomes that constitute the goals to be achieved
- Desired level of achievement of those goals that constitute acceptable performance
- Assessment of actual performance (May, 2011, p. 274)

Each of these can vary based on level of specificity and quantification.

Desired Outcomes

Desired outcomes can be stated with varying degrees of comprehensiveness (May, 2011):

for the system as a whole or its parts,

(example: performance standards for the seabird avoidance regulations cover only parts of the system, e.g. "single streamer line must be deployed in such a way that streamers are in the air for a minimum of 40 m aft of the stern and within 2m horizontally of the point where the main groundline enters the water") (CITE)

over broad or limited spatial areas,

(example: regulations covering just state waters, state and Federal, or state, Federal and international waters)

for a broad or narrow target group,

(example: a groundfish IFQ program just for shoreside trawlers or one that covers the entire commercial groundfish fishery).

There may be multiple performance goals within a particular system and the performance goals may have differing levels of specificity (May, 2011). In most countries, the basic framework for developing performance related goals is to:

1. State goals or objectives
2. Identify what they mean in terms of functional performance
3. Delineate criteria (performance standards)
4. Specify the methods for verifying compliance (May 2011, p. 376)

In general, identifying the measures of performance and desired levels (standards) is more difficult that stating the performance goal (Gormley, 2000 as cited by May, 2011, p. 374). Included in the consideration of the specified standards are issues of safety margins and potential legal challenges (May, 2011).

Acceptable Levels of Achievement

The specificity of standards relates to the problem of identifying the ways in which performance will be measured and the standards that must be achieved against those measures. For example, a performance objective for EM of *monitoring for discards from a vessel* is relatively easy to specify. However, determining how to measure achievement of this objective and the level of achievement a vessel is required to attain (as determined against that measure) is more difficult. Standards can be expressed qualitatively or quantitatively (May, 2011). OFL levels are examples of quantitative performance measures to which fishery managers must regulate. An example of a qualitative standard from building codes is a requirement that certain equipment: "shall be installed so that they will not become a source of ignition" (International Code Council, 2001 as cited by May, 2011).

Assessment of Performance

As discussed in the opening paragraph to this section (Section 2.2), accountability is a key element of performance standards. Accountability requires the ability to assess performance. Performance can be assessed through

- direct assessment (observation of outcomes) or
- through prediction (modeling) (May, 2011).

For example, drinking water quality can be assessed through measurement while assessment of nuclear power plant safety generally relies on predictive modeling such as probabilistic risk assessments (May, 2011). Monitoring the catch share fishery is generally done through direct measurement[8] but the primary output for the EM system is what the EM system is supposed to monitor. It may be that assessment of the performance of an EM system developed under performance-based regulations will require some form of a predictive assessment by regulators (a formal or informal qualitative or quantitative model). Uncertainty in assessment enters both with respect to the predictions and the validity of the prediction methods. The complexity of potential interactions in some systems and unanticipated humans response within the systems modeled makes predictive modeling even more challenging (May, 2011).

In some regulatory systems third parties are responsible for certifying performance. This approach has been discussed for the electronic monitoring program. May (2011) notes that in such situations, accountability of these third party providers must also be taken into account.

[8] The catch share program is currently monitored based on an implied model which assumes the equivalent of continuous monitoring of discards by the observer (and complete monitoring of landings on shore). In fact, observers are unable to provide continuous and comprehensive monitoring because on both spatial scope (limited viewing field) and temporal scope (needs which prevent the observer from providing 24/7 observation).

2.2.2 Blending Of Performance-Based Approaches with Prescriptive Approaches

Regulations not only range between being prescriptive and performance based but can include elements that are more prescriptive and elements, which are more performance based. Additionally, the management-based regulatory approach discussed above is another variation which adds variety to the forms that performance-based regulations may take.

While Coglianese and Lazer (2013) break regulatory scheme types along dividing lines between each of the three phases stages of organization of production (Table 1), the stages themselves are comprised of multiple steps which may provide control points for achieving regulatory objectives. Different types of regulations might be applied to different control points or the same control point. For example, for a particular control point there could be a planning requirement that results in both a prescriptive element and a performance-standard.

Regulatory systems can also be blended by allowing firms with a good compliance record more latitude in how they meet regulatory objectives. The EPA's Project XL (eXcellence in Leadership) provides an example (Wiessner, 2002; Coglianese, et. al., 2003, p. 707; also see, Motor carrier Regulatory Relief and Safety Demonstration Project, 63 Fed. Reg. 37,619 (July 13, 1998)).

2.2.3 Advantages of Performance-Based Regulations

Cost Effectiveness. Performance-based regulations allow cost-effective innovation. Cost effectiveness refers to the achievement of a given result (standard) at minimum costs (CITE).

Accounting for Diversity. Performance standards may work well when regulating a diverse industry. Under such circumstances the prescriptive requirements most appropriate for one firm to achieve a regulatory objective may not be appropriate for another firm. An example is the different compliance challenges that larger and smaller vessels face when it comes to the requirements to carry an observer. A performance standard opens more options for achieving with the regulatory objectives (CITE).

Accommodating Practices that Change Over Time. Performance standards may work well when the technologies and processes for achieving a regulatory objective may change rapidly over time, creating opportunities to achieve greater levels of cost effectiveness (CITE).

Leveling Playing Field Among Providers. Performance standards level the playing field among the suppliers of equipment and technologies, as compared to a prescriptive approach in which use of the devices or technologies (e.g. software) of a particular manufacturer may be required (May, 2011).

Highlighting Existing Regulatory Issues. Even the process of considering performance-based standards can bring to light uncertainties in the specification of existing prescriptive standards. For example, careful consideration of the basis for proposed performance standards may bring to light shortcomings in the basis for existing prescriptive regulations (CITE).

2.2.4 Disadvantages of Performance-Based Regulations

Costs of Searching for Compliance Methods. Performance-based standards may impose costs on businesses that must do research and design to come up with a system that meets the standards. For some firms, it may be more cost effective, and less risky, to have prescriptive standards which tell them exactly what must be done (Coglianese, et. al., 2003, p. 712). Some of this cost can be reduced through the establishment of nonbinding codes--compliance guidance (Coglianese, et. al., 2003, p. 712).

Ambiguity. While providing flexibility, performance-based standards can also generate ambiguity and leave room for uncertainty related to the regulators discretion. Many firms may be anxious to avoid this. (Coglianese, et. al., 2003, 719). This ambiguity would be more likely to occur when non-quantitative performance standards are used and particularly when system modeling is used to evaluate performance. The ambiguity can also increase difficult for enforcement (Coglianese, et. al., 2003, p. 714).

Uncertainty and Assessments Based on Models. In some situations models are used to evaluate performance. These models may include both system performance and risk of adverse events (e.g. models for nuclear power plant safety). Limitations of predictive models are often not understood, unrecognized, or ignored. (Coglianese, et. al., 2003, p. 715). Predictive models can lead to "legitimate self-delusion" on the part of regulated entities (Coglianese, et. al., 2003, p. 716).

Costs of Determining Standards. For some standards, determination of optimal thresholds can require several levels of modeling and analysis (e.g. relating health to air quality to emission standards). For fish stocks, some of this modeling is already achieved through stock assessments and determination of annual catch limits. The modeling challenge might be greater if an effort were made to develop performance standards for levels of habitat impact.

Costs of Monitoring Performance. Regulated outputs must be monitored and assessed. Depending on circumstances it "is often difficult or prohibitively expensive to assess critical outputs" (Ayres & Braithwaite, 1992). The monitoring requirements can also lead back toward significant government intrusion in the day-to-day operations of the firm (Coglianese, et. al., 2003, p. 718). The observer requirement for the trawl catch share program arguably provides an example of this type of a result. However in some cases, the requirements for enforcement of prescriptive and performance-based regulations can be similar in terms of governmental requirements for information.

Unintended Behaviors: "Performance-based regulations may engender adverse, unintended behaviors. In other words, the flexibility that performance-based standards provide to firms may be used in ways that cause undesirable side effects, even if the firms still meet the performance goal. Therefore, letting industry choose its own path always presents the possibility of generating new or even larger risks" (Coglianese, et. al., 2003, p. 720).

Capturing the Spirit. "Even assuming that all the affected parties understand and agree with the spirit of a given regulation, it is often difficult to find the exact words to capture that spirit without leaving room for interpretation or manipulation, and thereby creating uncertainty" (Coglianese, et. al., 2003, p. 717).

2.2.5 Shortcomings of Performance-Based Regulations

These considerations are separated from the "disadvantages" category because they are factors that are not necessarily overcome by alternative regulatory approaches. They are, however, considerations that may affect the design of performance-based regulations, particularly with respect to advantages of including a market component to performance-based regulation (in situations where such inclusion is possible).

No Incentive to Excel. Performance-based measures do not provide incentive to find ways to exceed the requirements of the performance standards (Gunningham, 1999, p. 196-197). For example, a manufacturing plant that meets air quality standards may not have incentives to reduce emissions further, unless performance standards are coupled with a market trading program of some sort. The trawl IFQ program provides for trading. The opportunity to trade increases vessels' incentive to avoid some high demand limiting species (e.g. yelloweye), not only so that they can catch more target species but also to provide themselves with the opportunity to increase profits by selling quota they do not need.

Limited Scope of Incentive for Innovation. While performance-based regulations stimulate cost savings innovations for the equipment and processes industry uses to meet the performance standards, these innovations do not take government costs into account. For example, in an electronic monitoring program in which the government bears the cost of reviewing video there would not necessarily be an incentive for industry to develop and adopt technologies that reduce the costs of video review.

Inappropriate Uniformity of Standards. Performance-based standards require firms with very different cost structures to achieve similar levels of compliance (Coglianese & Lazer, 2003, p. 9). This problem can be addressed by combining performance standards with market-based approaches. For example, by allowing firms to trade pollution credits, firms that can reduce emissions cheaply can sell their credits to firms for which it would be much more expensive to control emissions, reducing the overall cost of achieving a given level of aggregate reduction in pollution (Coglianese & Lazer, 2003, p. 9-10).

3. A Two Tier Implementation and Performance Standard Approach

Societal shifts in acceptance of technology have occurred in recent years, and numerous applications improving the functionality of technology in our daily lives have changed the way humans interact with each other and their environments. Fisheries management has been slower to adopt these evolutions in technology than other commercial sectors commonplace in today's emerging global economy. Currently, EM technology tested in West Coast groundfish fisheries that are immediately available for implementation may not take full advantage of these societal shifts, which include cloud-based computing and recent improvements in integrated hardware solutions, or fully consider the ways in which social media and web-based applications may be able to improve fisheries accountability and management in the future. However, EM solutions are needed now, while more research occurs on other technologies. At the same time, private research and development efforts are not likely to move forward to develop and implement technologies that primarily benefit the public good (e.g. increase the certainty with which unreported or misreported discards are detected) unless there is also substantial private benefit. Once a set of regulatory requirements is developed (whether prescriptive or based on performance standards) the private incentive of which we can be certain is to research and develop more cost effective ways to meet the requirements of those regulations. There is an incentive to achieve even higher levels of data collection and validation only to the degree that the private needs for such data overlap with the public/social/collective need. Even where an overlap exists, there may be an under-investment in research and development because private parties will not account for the full measure of that potential social benefit. On this basis, it may be appropriate to consider development of an EM policy in two tiers:

- Tier 1 policies would address EM technology tested and immediately available for implementation, and
- Tier 2 policies would address creating incentives and flexibility to develop and test technologies that further both the private and collective need.

The term *collective need* is used here to encompass both the public and the fishermen's collective need for a resource that is managed well and with low administrative costs.[9] Performance-based standards may be of value in policy for both of these tiers.

Allowing EM technologies and monitoring strategies into the fishery to help supplement the 100 percent monitoring coverage on a shorter time frame (<5 years) should also help to increase industry and management driven collaboration and innovation. By allowing for a manner in which currently proven Tier 1 solutions can be integrated into the fishery,

[9] Individual fishermen incentives do not match fishermen's collective needs, as indicated by the arguments of Harden's "Tragedy of the Commons" (1968).

market-based incentives and improved accountability will likely benefit the effort to improve ecosystem information acquisition and monitoring strategies in the future (>5 years) as cooperative tier 2 R&D pilot projects have had a fair chance to evolve *with* the fishery and new technologies develop. [10]

3.1 EM Tier 1:

Currently Tested EM Equipment/Strategies and Operational Requirements (30,000' level)

The goal of Tier 1 would be to keep it simple and immediate. Change what needs to be changed based on what's been proven thus far. Currently available technology and the regulatory/management strategies that depend upon these technologies have already been well tested and proven in a variety of global fisheries, although few have been implemented via regulation in US fisheries. Although new technologies may allow for greater capabilities in the near future, there may be benefits to embarking on a strategy using existing proven strategies in the short term, such as to provide some relief to the fishery.[11]

This paper assumes that currently available and tested hardware technologies are adequate, and explores whether regulations that would allow those technologies to be used for catch monitoring can be specified as performance standards. Specification as performance standards would allow industry to develop more cost effective equipment and processes without requiring revisions to the regulations to allow the use of that equipment and those processes. Additionally, if regulations for all fisheries utilizing EM as a monitoring strategy are drafted as performance standards, the regulatory flexibility may benefit the efficiency of the Council and regulatory process by reducing the need for regulatory changes.

Performance-Based Regulation

Performance standards can be stated in a number of ways including by specifying particular outcome or output (including a measurement standard) or by specifying particular equipment or processes and appending the phrase "or better." Electronic monitoring is itself a technology to be employed to verify accurate measurement of a vessel output (catch) in a performance-based program (the catch share program). Consequently, catch data cannot be used to verify the performance of EM, unless there is another source for that data (such as through observers, as is occurring in current field

[10] Additionally, Cooperative Research grant opportunities should enable fishermen to retain Tier 2 R&D equipment as forms of financial compensation for participation in the cooperative research, as the outcomes of such research could have significant long-term financial benefits to industry participants, as long as the equipment will still satisfies Tier 1 EM obligations.

[11] Beginning a Tier 1 EM strategy will be particularly beneficial in rural communities, where the ability to take advantage of shortened weather windows in between storms in winter months could provide much needed economic opportunities. Additionally, with quota share trading under the TRAT program allowed in January 2014, more cost effective monitoring means may help to conserve the integrity of small fishing businesses.

tests). Therefore, performance standards for electronic monitoring must be specified in the form of intermediate outputs (visual images with adequate spatial scope, continuity, quality, and context data—such as time, date, location and vessel identification—etc.) and processes (both fish and technology handling processes on the vessel as well as review processes). And, there must be an evaluation or model of some kind (qualitative conceptual, risk model, etc.) by which managers determine that a system that meets these standards for individual components is likely to ensure adequate catch monitoring.

It is highly likely that performance-based regulations for EM will include prescriptive elements and may also include management-based elements. Prescriptive regulations or performance standards might be developed for individual pieces of equipment and particular processes but what may be most important is how all the pieces work together in a system that is able to adequately detect discard events and determine whether such events have been properly recorded in logbooks. Because of the uniqueness of circumstances for each vessel, it is likely that a monitoring plan will be required for each vessel (as is currently done for first receivers in the catch share program and was proposed in the strawmen proposals endorsed at the February EM workshop).

Management-Based Regulations

Development of a monitoring plan for agency approval might be considered more of a management-based regulatory approach. As discussed in the first section of this paper, a management-based approach emphasizes individual firms making plans for how to meet public/agency objectives, in this case discard monitoring. The management-based approach used here would likely require approval of the individual vessel's plans and some form of verification of its implementation. Under a management-based approach, the vessel might be afforded considerable latitude. For example, assume that with current technologies it is determined that review of 20% of the video is necessary to reasonably ensure compliance with requirements to record all discards in a logbook.

Under a management-based approach with prescriptive elements, if a vessel were able to develop equipment and processes that provide a substantially higher degree of certitude of compliance with the logbook requirements, or technologies that allowed a video review to substantially narrow the amount of video that that needs to be reviewed for possible unrecorded discards, then lower sampling rates of video review might be possible. For example, work is ongoing now to develop computer detection of any deck activity that might possibly involve a discard. If such a technology is developed, but a 20% minimum sampling rate is required in regulation, then regulatory changes would be required to take full advantage of the innovation. However, if the sampling rate is specified as a modifiable default that may be altered in an approved individual vessel monitoring plan, then the regulatory barrier to innovation is reduced.

Specific Elements for Specification

Vessel Monitoring Plan: The current strawmen alternatives call for individual vessel monitoring plans. Assuming that such plans would be an element of EM, two of the first things to decide may be

- the degree to which design latitude might be provided through a vessel monitoring plan and
- the criteria by which the adequacy of such a plan will be judged.

Depending on the degree of flexibility allowed in equipment and processes specified in the vessel monitoring plans, the process for approval can require considerable agency resources and judgment calls on the part of individuals responsible for administrating the program. Careful specification of the approval process and criteria and full documentation of the decisional basis can control the amount of resources consumed and reduce the chances of arbitrary decisions. Conversely, very specific criteria may be difficult to develop without the criteria becoming arbitrary. A multi-agency/division approval panel might be considered a possibility for reducing potential biases and increase the likelihood of consistent determinations. The approval processes might even include a requirement for an agency personnel ride-along on the vessel to confirm effectiveness of a plan. As new technologies are developed and plans approved or disapproved, careful documentation over time may allow the identification and development of specific decision rules and criteria. Vessel monitoring plans may be approved on a contingent or temporary basis until enough experience is developed to allow the Council and agency to codify more specific criteria.

Discards (Full/Maximum Retention): Based on current technologies it appears that

- For trawl vessels, discards will need to be minimized (term to be defined) and adequate deck and water lighting provided during all fish handling activities.
- For longline vessels, discards will need to pass down a mechanism on which there is adequate lighting and camera coverage.
- For fishpot vessels, discards will need to pass down a mechanism on which there is adequate lighting and camera coverage.

Additional specificity might be added to this list. While criteria like these might be applied in the practice of approving a vessel monitoring plan, the regulations might incorporate a performance standard alternative. For example:

> Discards by trawl vessels will be either be minimized (maximum retention) or the vessel must have an approved vessel monitoring plan which specifies the means by which the species and weight will be adequately determined for any above minimum level discards. The function of such a system must be verified by agency personnel in the field and a vessel monitoring plan may be revoked if

during data review processes it is determined that either species or weight of discards cannot be adequately determined.

General Camera Coverage: Based on current technologies it appears that for all vessels, cameras will need to be placed such that any discard event will be recorded on camera and sufficient context data (time, location, etc.) captured to determine whether or not an event was recorded in the vessel logbook. Camera performance standards might specify

Image resolution and quality
Video frame rate (frames per second, FPS)
Scope of camera coverage
Continuity of video record
Tamper evident/proof equipment.

Control Point Camera Coverage: A variation on general camera coverage to be developed.

Video Review: As conceived in the strawman alternatives forwarded from the February EM workshop, vessels would be required to enter discard information in a vessel logbook, which would serve as the primary data source for information on discarded catch. Video would be reviewed to verify whether or not data has been entered accurately. Substantial exploration of video review requirements will need to occur during the Council policy development process. The differences between, for example, a10% audit review standard and a 100% computer/human review census approach will have a substantial bearing on program costs. However, as indicated in the example provided in the above section on management-based regulation, it might be feasible to specify a regulation with a default review level modifiable based on the vessel monitoring plan.

Video review requirements will have a strong effect on EM program costs. , Many existing EM cost estimates assume a 10% audit review strategy (which may, or may not best represent the intent of the TRAT program). Short-term EM cost savings as compared with observer cost data may not be realized if 100% human review is maintained. Maintaining 100% human EM review will mean that existing EM cost comparisons will have to be revisited. However, it is also important to note that increases in flexibility of operating without waiting for an observer provides financial benefit to fishermen, especially in rough weather conditions, and for small rural fishing businesses.

Other Provisions to be Developed: The development of EM prescriptive and performance standards will require continued discussion, covering issues such as the need to establish appropriate Tier 1 standards for the establishment of: (1) a regulatory process for approval of EM Individualized Vessel Monitoring Plans; (2) well defined standards for how and when an EM system or strategy may allow for discarding through well defined "control points," and; (3) Well established "Crew Handling Protocols (including observers)" using currently tested technology strategies.

Additionally, regulatory specifications of the Individual Vessel Monitoring Plans need to be further developed:

- to ensure that all selective discarding must pass through "Control Points" which ensure that the weight and species of all discards is accounted for**;**

- to ensure that the system collects sufficient EM data from an entire trip;

- to specify accepted data transmission and data archival strategies;

- to ensure that effort, and catch events are captured in a manner that is sufficient for effective accountability monitoring;

- to define what level of lighting during daytime and approved nighttime fishing activities is considered accountable;

- to define logbook requirements, including differentiation between paper and E-Logbook requirements with any EM strategy;

- to clearly define *all* quantifiable forms of reviewable discard for review purposes, including "bleeding" events; and

- To specify what constitutes adequate EM "tamper-evident" hardware.

Other Issues to Consider in Developing an EM Proposal

- Determine appropriate funding streams.

- Establish the roles that EM Cooperatives may play in ensuring compliance by providing disincentives and consequences for violations, or when a vessel needs to cease fishing operations.

- Consider a process by which vessel owners have continuous access to any EM data generated, by NMFS-approved system components and configuration.

- Consider additional regulatory requirements between gear types approved for use with EM.

- Consider required levels of human observing that shall still be required for each fishery or gear-type under consideration (i.e., Bottom trawl, Whiting midwater trawl, Non-whiting rockfish-directed midwater trawl, longline, pot, vertical longline, etc.).

- Investigate opportunities for improved coordination between NWFSC, industry, and management (including international bodies such as IPHC).

3.2 EM Tier 2:

Initiate a three-Year Review during Tier 1 implementation in order to implement Tier 2 in Five Years.

As discussed above, the purpose of EM Tier 2 is to consider whether policy can be developed that would encourage improvements in the quality or scope of data captured or efficiencies in the data review system, beyond that for which the industry has private incentive. To some degree the scope of the services and equipment paid for by industry will determine the scope of the incentive to seek efficiencies. For example, if the industry is not paying for video review,[12] then there would not necessarily be a significant incentive for the private sector to focus on innovations to improve the efficiency and accuracy of that video review.

The Council might set a policy to revisit EM regulations within three years of Tier 1 implementation. At that time, the Council could review newly available technologies and strategic opportunities for improvement in:

- Scientific data acquisition.
- Integration of VMS/ EM technologies into one overarching strategy.
- Increased accountability of rare events detection.
- More cost-effective automated data transmission and review strategies.
- Ways to reduce costs for management and industry, while also increasing compliance accountability.

Private Incentives

After implementation of Tier 1, research and development would be expected to continue as a result of private incentives for cost minimization. Further alignment between industry and the public is likely to occur in a manner that allows for future Council consideration of improved management strategies defined by Tier 2 performance standards. As investments in technology become an increasing beneficial catalyst and component of enabling fisheries management to improve automated real-time (and near real time, NRT) information streams, this will allow inclusion of these models in the EM program to be considered.

Data information providers have valuable long-term understandings of the fisheries they purvey, and the Council may benefit from creating a development environment that seeks to provide transition opportunities to private data information provider interests through defining Tier 2 performance standards in advance. By providing incentive to form partnerships with software start-ups and surveillance and computer hardware manufacturers, private interests will likely realize Tier 2 Council-guided public

[12] And, assuming program costs are well above the 3% of exvessel value maximum that can be charged to industry.

incentives, because they are able to plan for them. Alternately, Council defined incentives may create new opportunities for recruiting new information providers (hardware and software) with no fisheries experience (although with potentially higher information gathering skill sets) from other disciplines (data-mining, health care, military, surveillance, etc.) into the fisheries data acquisition business. Additionally partnerships with Non-Governmental Organizations and industry may increase in such a climate in meeting Council-guided public/private incentives in a shorter amount of time as that preferred by the Council. Vessels that comply with Tier 2 performance standards sooner than five years may find it possible to realize increased economic benefits and improved sustainability of their fisheries of interest.

Provide Improved Public & Private Incentive Integration

A few key starting concepts for 5-year Tier 2 public incentives, enabled by innovations in improved technologies and improved strategies through current EM implementation, could consist of the following Tier 2 standards:

1. Reduce EM monitoring costs to industry and management, including all back-end expenses.

2. Outline opportunities for improved integration of EM and VMS units for collection and archiving of EM data. Include data from fisher logs, observer and electronic logs and unloading slips.

3. Improve timeliness and validation of IFQ credit/deductions.

4. Improvements allowing at-sea accountability of discards, to reduce groundfish mortalities where feasible; in a manner that preserves full catch accountability.

5. Improve tamper-proofing.

6. Improve NRT & real-time automated species, length, and weight capabilities for shoreside First Receiver landings and at-sea vessel "control points."

7. Inclusion of underwater net sensory technologies.

8. Improved First Receiver EM/computational vision-based monitoring systems to insure full-circle fishery accountability and data poor market category complex sub-speciation.

9. Improved ocean biodiversity Informatics data acquisition compatibility.

10. Improvements in sensory resolution (including video).

11. Provide increased vessel safety.

4. NMFS POLICY ON ELECTRONIC TECHNOLOGIES AND FISHERY-DEPENDENT DATA COLLECTION

On May 3, 2013, NMFS released its Policy on Electronic Technologies and Fishery Dependent Data Collection to " adoption of electronic technology solutions in fishery-dependent data collection programs" (NMFS, 2013). A complete copy of this policy has been posted on the EM page of the Council web site (http://www.pcouncil.org/groundfish/trawl-catch-share-program-em/). The objective for this policy is stated as follows:

> It is the policy of the National Oceanic & Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NOAA Fisheries) to encourage the consideration of electronic technologies to complement and/or improve existing fishery-dependent data collection programs to achieve the most cost-effective and sustainable approach that ensures alignment of management goals, data needs, funding sources and regulations.

There are eight statements related to achievement of the objective (bolding added):

> 1. NOAA Fisheries **encourages the consideration** of all electronic technology options to meet science, management, and compliance data needs.
>
> 2. Fishery-dependent **data collection programs will be designed and periodically reviewed** by NOAA Fisheries regions to ensure effective, efficient monitoring programs that meet industry and government needs, increase coordination between regions, and promote sharing of research, development and operational outcomes.
>
> 3. Fishery-dependent data collection **programs may be comprised of a combination of methods and techniques** including self-reporting, on-board observers, and dockside monitoring, as well as the use of electronic technologies including electronic reporting and video monitoring.
>
> 4. **Where full retention regulations and associated dockside catch accounting measures are in place,** NOAA Fisheries supports and **encourages the evaluation/adoption of video cameras** to meet monitoring and compliance needs in federally managed fisheries.
>
> 5. NOAA Fisheries encourages the use of electronic technologies that **utilize open source code or standards** that facilitate data integration and offer long-term cost savings rather than becoming dependent on proprietary software.
>
> 6. NOAA Fisheries, in consultation with the Councils and subject matter experts, will **assemble guidance and best** practices for use by Regional Offices, Councils and

stakeholders when they consider electronic technology options. Implementation of electronic technologies in a fishery-dependent data collection program is subject to the Magnuson-Stevens Act and Council regulatory process, other relevant state and federal regulations, and the availability of funds.

7. No electronic technology-based fishery-dependent data collection program will be approved by NOAA if its provisions create an **unfunded or unsustainable cost of implementation or operation contrary to applicable law or regulation**. Funding of fishery-dependent data collection programs is expected to consider the entire range of funding authorities available under federal law, including those that allow collection of funds from industry.

8. Where **cost-sharing** of monitoring costs between the agency and industry is deemed appropriate and approved under applicable law and regulation, NOAA Fisheries will work with Councils and stakeholders to develop transition plans from present to future funding arrangements.

Authorities and responsibilities within NMFS are assigned, including responsibilities assigned to regional offices for "initiating consultations in FY 2013 with their respective Science Centers, Councils, States, Commissions, industry, and other stakeholders on the consideration and design, as appropriate, of fishery-dependent data collection programs that utilize electronic technologies for each Federal fishery."

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UNOFFICIAL PARTIAL TRANSCRIPTS FROM THE APRIL 2013 COUNCIL MEETING, INCLUDING BOTH AGENDA ITEMS D.7.f (TRAWL RATIONALIZATION TRAILING ACTIONS – ELECTRONIC MONITORING REGULATORY PROCESS) AND B.7.d (FUTURE MEETING AGENDA AND WORKLOAD PLANNING)

Selected segments of the audio record of Council discussion related to the whitepaper on performance standards and calendar.

From sound files:
ftp://ftp.pcouncil.org/pub/R1304_April_2013_Recordings/4-9-13pm3Copy.mp3
ftp://ftp.pcouncil.org/pub/R1304_April_2013_Recordings/4-10-13am1Copy.mp3
ftp://ftp.pcouncil.org/pub/R1304_April_2013_Recordings/4-11-13pm1Copy.mp3

APRIL 9, 2013 – AGENDA ITEM D.7.f

Motion 19: I move that the Council

1. Confirm that the primary focus of integration of EM into trawl catch share monitoring is to address compliance monitoring needs

2. Adopt the regulatory objectives contained in the Agenda Item D.7.b EM Workshop report as modified by the recommendations in the Agenda Item D7.d Supplemental GAP report.

3. Direct the Council staff to work with federal and state agencies to develop a white paper that would identify monitoring performance standards and other requirements that EM proposals would have to meet.

4. Develop a initial scoping package that would include, the strawman proposals contained in the EM Workshop reports as initial EM alternatives (splitting pot and longline as recommended in the Supplemental GAP Report), as well as an option of electronic monitoring participation agreements, the information resulting from the information requests in the report as available and an initial list of the issues and tradeoffs that will need to be addressed

Moved by: Dorothy Lowman Seconded by: Gway Kirchner

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{Start Time: 0:03:27}

Wolford: Discussion
Lowman: I think we've had a lot of discussion about what's the primary focus and that we're not looking to, we recognize that our monitoring program needs to be a combination of observers as necessary to meet our science needs for stock assessments and other science needs as well as trying to provide for some alternative tools, as possible to meet some of the compliance monitoring needs. I also think that we made a good start, I think that I like our regulatory

objectives that came out of the workshop, as modified by the GAP. I would expect that perhaps these would be refined or added to through a scoping process, but this is a good start. I do think, and I agree with Michele in that we've got some work to do to understand what are our standards, what are our monitoring requirements that any proposal would have to address. I would like to get us down the road on that by having Council staff work with the Federal and state agencies to develop a whitepaper that would identify monitoring performance standards and other requirements that would come back to the Council that the Council would look at add to work on refining.

Finally, I think we need to get started and I would like to see an initial scoping package developed that would include the strawmen that are contained in the workshop reports. I think pot and longline are different enough that it would be helpful split them into two. We had some discussions about some different ways to have some participation agreements. But I also think the step in #3 will also provide an opportunity for some other creative ways that might come up that will come out of the scoping process. Finally, there was a list of information requests, some of which we got some information from the center today, I'm not sure we'll have them fully completed before we start scoping but we will have a beginning, I would like whatever information is available to be part of that scoping package as well as I think we do need to start to outline, because there are a little issues and tradeoffs that need to be considered, so I think they should be included an initial list of some of the issues and tradeoffs that will need to be addressed. We don't have to answer all of them but I think we should identify them up front.

Culver: Just a question, first on the motion. On item number 4. Who did you see developing the initial scoping package? Is that the Council staff with the Federal and state agencies or is that just through the normal Council process and the entire Council?

Lowman: I'm thinking of a scoping package as the first start and that then leads a discussion through the whole normal process and gets refined but it's kind of a paper that helps us start our scoping process. So, I would see Council staff putting it together with assistance as needed from state and Federal agencies. In other words, something that would be sent out for people to consider as providing scoping comments etc. And then would be the start of the scoping process.

Culver: With that, I would like to offer an amendment that would "delay the development of the initial scoping package until item #3 was completed. As part of that scoping package the strawman proposals could be considered but there might be things that come out of the whitepaper that we might want to have as a different starting point, rather than those proposals." Lincoln seconded.

Amndmnt 1: For item #4, delay the development of the scoping package until item #3 is completed. The strawman proposals could be considered (things that come out of the whitepaper) that we might want as a starting point rather than those proposals.

Moved By: Michele Culver Seconded by: Rich Lincoln

Wolford: Discussion?

Lockhart: You're not saying that activity on scoping couldn't continue, it's just that it should be informed by #3 and then not completed until #3 is done.

Culver: Yes and while we still might want the straw proposals we might want to tweak those a little bit or have different proposals depending on what we come up with for the whitepaper in #3. So #3 would inform the proposals that are considered in the scoping.

Lowman: Maybe it's a semantics of process but to me I saw these as a package still and you'd have these as a startup point, then we'd have additional proposals coming through the Council meeting that we had the beginning of scoping. Those would again be incorporated into the next package that went on to be fleshed out further by whatever group is working on it. To me, and maybe it was part of what Frank was saying, I don't see waiting to put together packages, I saw them as two parts of a package that would inform the first meeting that we started to focus to flesh out our package. At that time, additional people might bring additional proposals that would come because of what the performance standards were. They would go into the next iteration.

Hanson: I'm not sure what the "until item 3 is completed" means. Does it mean it's been totally vetted by the Council or they've finished with the thing and its ready to come to the Council in June but then they can start working on it on the next phase or, what are thinking for schedule?

Culver: I'd like an opportunity to speak to my amendment. I'm trying to address these questions so maybe this would help. I saw item #4 in line with the comments that I made earlier of the cart before the horse, and thinking that the Council should develop our performance standards and clearly communicate those, the side boards if you will, before we move forward with having proposals go out there for further scoping or to get further public input. The intent that I considered whether to just simply strike item #4 but I didn't want to give the impression that I disagreed with developing a scoping package. It's just the timing of when that package would be developed. And so rather than strike #4 I am saying that this group of Council staff and agency staff would develop a whitepaper that would come before the Council. There would be some Council discussion and agreement on what those performance standards would be and then potentially a review of those straw proposals to see whether or not the meet those performance standards, and if not, how they may need to be changed and then have those proposals go out in an initial scoping package. And so it's trying to have Council guidance on the sideboards developed first before industry spends time reacting to the straw proposals or developing new proposals only to have us say no those are not the rocks we had in mind.

McIsaac: A question following up on Dr. Hanson's, looking at the schedule that is in the workshop report, it shows a full scoping session for the June 2013 Council meeting. In the amendment then you are calling for the item #3 to be discussed at the June Council meeting and delay the scoping session until after June?

Culver: I'm definitely saying delay the scoping until after June. I'm not speaking to whether or not the whitepaper is completed for June.

[Amendment 1 to Motion 19 passed unanimously.]

Lockhart. Question on #1, and this gets at performance standards and what this actually means in light of #1. Compliance monitoring needs, I think that is different from science needs but it's also a pretty broad definition of what could potentially be looked at. Is that compliance-is the world open on what that means? To give you some examples, compliance could be with bringing everything back to shore, no discards, maximized retention. Compliance could also be handling discards in a certain way. If that's the case then if it is a wide open field then identifying monitoring performance standards would have to address that entire range of possibilities in all of the scenarios we've been talking here. Is there a need to narrow this down or was the maker of the motion intended to be fairly broad at this stage?

Lowman: what I was speaking of when I said "Compliance monitoring needs" is what we need in order to be sure that we have catch accounting. That we had enforcement capabilities, of enforcing our regulations. I would say some of these other examples of full retention might be some of the monitoring requirements related to some end performance [unintelligible] they'd be addressed in that whitepaper.

Lockhart: Also the last part of #3, "that EM proposals would have to meet" this seems to be setting up a process to where we will develop, set compliance monitoring as our overall goal and then having monitoring performance standards developed and then an EM proposal process would be created. How do you see that playing out? Who develops the proposals?

Lowman: Perhaps proposal could be substituted by alternatives. As we're having these strawmen, someone else may have a different kind of a strawman or one of these ways we could use some of these concepts of risk pools for addressing some of these issues, that is what I was using the word proposals to mean.

Grebel: Just a quick question again on #3 directing Council staff to work with state and Federal agencies. Just curious how you saw that playing out again. How the white paper would be developed. Do you see Council staff taking the lead the states coming back and helping to provide edits or are we talking in person meetings?

Lowman: I was thinking that the Council staff would take the lead, they would work informally, calls, working with e-mail exchanges etc. with the different groups. Not a workgroup kind of concept.

{Stop Time: 0:18:45}

Council discussion of Amendment 2 is not included here.

Myers made a motion relevant to the issue of what compliance means.

Amendment 2: Strike the word "*needs*" and insert "*to achieve individual accountably of catch and bycatch*"

Moved By: Dale Myer | Seconded by: Michele Culver

Amendment 2 carried unanimously.

There was a discussion that what constituted catch/bycatch/discards/total catch might be part of performance standards paper.

[Motion 19 carried unanimously, as amended twice]

Council discussion of Motion 20 and its amendments are not included here.

Motion 20: I move that the Council

1. Forward the recommendations from the EM Workshop found on page vi of the Workshop report.
2. Request NMFS and PSMFC work together to determine what should be included in "total catch" for catch accounting purposes and provide this information to the Council as well to assure that consistent definitions are used during the 2013 study.

Moved by: Dorothy Lowman Seconded by: Gway Kirchner

Amendment 1: change #2 striking the original language and replace with "*PSMFC conform to the NFMS definition of "total catch" for catch accounting purposes in this study.*"

Moved By: Michele Culver Seconded by: Joanna Grebel
Amendment 1was not voted on

Amendment 2: as a substitute to Amendment 1: for part two: "*Request PSMFC conforms to NMFS definition of "total catch" for catch accounting for purposes of this study to the maximum extent practicable*"

Moved By: Dave Hanson Seconded by: Herb Pollard
Amendment 2 carried (Culver, Myer and Lincoln voted no)
Motion 20 carried unanimously

Motion 21: Council

1. Move forward the process and schedule shown on page vii of the Workshop report recognizing that attainment of the schedule will be dependent on budget and workload considerations with the following changes have the performance standards WP at the June 13 meeting; move full scoping to Sept 13.

2. Request that NMFS NW Region evaluate the implications on staff workload and ability to address other important trailing action needs should an out of cycle "EFP" avenue be explored to begin to allow testing EM usage without an observer prior to completion of the full regulatory package.

3. Explore the relative budget implications and other costs/benefits relative to having a workgroup be appointed with the characteristics described in recommendations of the GAP and the EC, or to have a subgroup of the GAP be tasked with the responsibilities that would be assigned to the workgroup.

Moved by: Dorothy Lowman Seconded by: Gway Kirchner

{Start Time: 0:41:15}

Wolford, Do you want to speak to this please?

Lowman: Yes In terms of the first one, I have heard loud and clear the concerns of everyone about the fact that we need to move forward as rapidly as possible. I do also think that the performance standards are really an important step. And of course that was recognized in our first motion but I think we want to keep going as fast as possible. It is an ambitious schedule. And again we may find the budget and workloads, like many schedules they sometimes slip some. But I think we should try to do this because it is very important. \

{Stop Time: 0:41:51}

{Start Time: 0:44:39}

Grebel: . . . .Relative to number 1 and having the whitepaper come back at the June meeting, I thought that we've heard that there is quite a very large meeting in May in DC, so I'm just curious as to the ability for that product to actually be produced and have state and Federal staff input on time to meet the deadlines for that June meeting.

McIsaac: Well let me speak to several references to workload and financial considerations that are involved here. This is a major major effort. I think someone here said earlier that this is about a big as Amendment 20 or it's in that zone. {Stop Time: 45:24} … [extended description of workload and financial considerations]… {Start Time: 48:24} So with regard to the narrow piece of time during the month of May and whether a whitepaper could be done as described earlier, I don't know. I guess I'd like a little time to huddle with Jim and come back under B.7 as to exactly how much time that would take and huddle with NMFS about what kind of quickness that might be involved during the middle of April so that someone could be provided to help, rather immediately.

Crabbe: So just the way I'm reading this motion all of the flexibility that you are asking for is available it's just sort of sending the message that we would like to move as quickly as possible but if it's not possible we have the flexibility to adjust.

McIsaac: I think the answer to that is generally yes. I think the first thing that people have been looking for is: does the Council want to move forward with electronic monitoring or not? The previous motions demonstrated that as yes. As we fine tune this we'll do our best to try to carry out what you'd like to do and let you know under B.7 more exactly about what can be done, particularly in the near term.

Culver: I do think that looking at electronic monitoring, we should further discuss that as a Council and with the industry and move forward with doing that. I do think we accomplished that with the first motion. I do think developing the performance standards is going to take a little bit more time than what would be available to us between now and the June Council meeting. I think the briefing book deadline was in early June. And we do have quite a bit going on already in the month of May. I'm also not quite sure what the process is to approve those performance standards, so I didn't necessarily think that that was a one Council meeting process. And whether those performance standards would be incorporated into a Council operating procedure or how we would somehow formalize those performance standards for electronic monitoring. I kind of thought the Council would have a chance to look at them as draft, maybe get some comment from the advisory bodies and the public before finalizing those. So I looked it as a two meeting process. And so, I'm suggesting perhaps that be September and November. Once we have those performance standards defined and have back and forth with some industry and stake holders it would be good to hear from them whether they still support EM as one of their highest priorities, now that they know what performance standards have to be met and how much it might cost and whether they will be able to see the benefits of cost reduction that their anticipating. So it would be good to get that feedback as well before we say yes for sure we want to go forward with scoping and developing alternatives and following the rest of the process outlined here. But having said that I do think that we have heard that this is important to industry and I do think that at this point we should give them our best guess as to how quickly it could happened and to outline a schedule that if everything fell into place here is the timing of that, from a reasonable standpoint and so I guess I would see the September November schedule being the whitepaper on the performance standards moving the scoping session on EM to begin either in June or September of 2014.

{Stop Time: 0:53:14}

Amendment 1: under part 1 strike out "*have the performance standards WP at the June 13 meeting; move full scoping to Sept 13*". And replace with "*whitepaper on performance standards considered in draft at the Sept 13 meeting; finalized at Nov 13 meeting. Scoping to begin in the summer of 2014; this would push the other items described in the table to the selection of a FPA to Nov 2015.*"

Moved By: Michele Culver Seconded by: Frank Lockhart

[Administrative discussion related to stating the motion and getting it properly phrased on the screen]

{Start Time: 0:56:07}

Wolford: Michele

Culver: So working from the language that's captured in number one, it would be move forward the process and schedule shown on page 7 of the workshop report recognizing that attainment of the schedule will be dependent on the budget and workload considerations with the following changes. And then strike have the performance standards and replace it with what's in yellow and the rest of the motion would stand

Wolford: OK. So I think that's fairly clear.

[the motion was seconded]

Wolford: Further discussion.

Culver: Yes, if I may.

Again, I do think we've heard the message clearly that this is important for industry and represents a priority for them. I don't want to, you know, shine the light on NMFS but there are some items that the Council has approved that they have not been able to move forward on implementation with, which also represented priority issues for the industry. And then, this week we've also heard from the GAP other priority issues that would be new initiatives include the widow QS allocation and the removal of the RCA boundaries. And so I'm trying to balance, kind of all of these competing priorities that industry has and I'm not sure I got a clear answer in public testimony as to where folks saw EM fitting into all of those priorities. And I think at the March Council meeting we had a considerable discussion here about looking ahead at the 15-16 spex cycle that we're about to embark upon, the completion of the amendment 24 tier 1 EIS which we recognize might not be done by June but we're still hoping, we're still striving to get it done by that time. So I think we've got a lot on our plate already. When I look ahead at the year-at-a-glance and Council meeting and Council discussion. I also think that when I look at the items on the table here and I'm on page 7 over the workshop report, and I think that we do

need to have some information from field studies or EFPs that help us make an informed decision about whether to develop EM alternatives and maybe for which sectors of which portions of the fishery. And set some priorities from that standpoint. And we're really not going to have the results of those studies or EFPs until this later time frame. So I do think that while it's good to allow NMFS to allow EFPs potentially to continue as their developing the full regulatory package, I want some information up front. So the way I see this is we're actually getting a request from the industry that they want an exemption to observer coverage. They want an EFP for the entire industry right not to be exempt from observer coverage and to have the flexibility to take either an observer or a camera and I think that before the Council decides that we want that to happen we need to have some data, some science, some insurance that we're going to be able to achieve this individual accountability of catch and bycatch. And we also need to be able to talk about whether we are going to be able to achieve it to varying degrees by sector or by fishery. And are there some sectors or fisheries we might want to move forward with, first and then consider others later perhaps as the technology catches up with our performance standards. And, again I think even with the, my proposed revised schedule, it is still ambitious because there are a lot of issues and nuances that we will need to consider in building this package.
{Stop Time 1:00:50}

[See page 10 for amendment to the motion on the floor at the end of the day.]

ADJOURNED FOR DAY

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{Start Time 0:01:50}
Crabbe: ...The wording in the amendment is fairly prescriptive but the information above that allows room for flexibility. I was wondering if it was allowing room for flexibility to move faster than the prescriptive language. So that was my question to the maker of the amendment.

Wolford: Michelle

Culver: Well, yes. Flexibility goes both ways and so what I'm trying to do with the amendment is to be a little bit more realistic so that there are not higher expectations on the part of the public that we're going to get something done sooner and so I am trying to put together a realistic schedule understanding that it is flexible one way or another. If we got done earlier, well bonus, that's great. My understanding from side conversations with NMFS is that the schedule as presented on page 7 is such that NMFS rulemaking final for implementation probably would not occur until late 2016 maybe even early 2017. And under my proposed amendment I think that's the exact same schedule, would be pretty much implementation late 2016 early 2017. So my understanding is that the bottom line in terms of implementation really doesn't change because of the workload that's involved in all of the steps and the small amount of staff that we have to dedicate to this. But I've also heard that perhaps the Council is expecting or is going to receive some funds from NMFS to hire a couple of additional staff to work on this item. And that that needs to happen here in 2013. So maybe Frank could speak to both the timing of implementation and those funds that are coming to the Council for this effort and when that needs to happen.
{Stop Time 0:04:17}

[Lockhart: responded
McIsaac: Asked from some clarity on the calendar on page 7 of the workshop report.
Seger: Reviewed the calendar and responded to a question from the chair and from Ms. Culver on the reference to special studies in the workshop calendar.]

{Start Time 0:15:48}
Lowman: Just so we are really clear, because, Frank you said that it can take up to two years, but we have 16 months in this schedule for 2016, so even 2 years would be partly through 2016 if it slipped a little bit in this schedule. In the schedule which is in the amendment where you would have the FPA selected in November of 2015 my math says that these is no way you could have the same start date as this schedule because that is an additional year and one or two months where then your one 16 mo. to two year process would start. So I don't see how they can be implemented at the same time if you drop the selection of an FPA by a year and two months.

Lockhart: I'm not sure that as a question but right now this one gives us 16 months to hopefully have something in place at the beginning of 2016 and the other schedule has us starting in 2015. Again given what I know about these equipment based things I do think once a final decision is made it takes up to two years to do it . but again it depends on what the final decision is. So...

Lowman: So it does seem like you would have a delay of at least of a year because your making your...So, I have one other clarification for Jim, in terms of, I know you've had some discussions on developing performance standards and what you might be able to report back in June and perhaps refine, thinking of this as a special study in September.

Seger: Yes we've been talking about: first, one of the things is what's available for the production of the whitepaper, keeping in mind that there were 7 national white papers that were turned out and presented at the CCC meeting, talking with Dayna Matthews and Colby Brady, two of the people who would be working on the whitepaper. They feel there is a substantial amount of material in those documents that we'd be able to draw on. And we have some staff that would be working on that document. And the feeling in those discussions is that we can produce, at a minimum a policy document that would have substantial information for you and perhaps some areas where we would need some additional guidance from the Council by June, if not a complete document by June. Keeping in mind that when we talk about performance standards, that's a very nebulous concept. There are a lot of different ways to specify performance standards so there might be some questions that would come back in June. We think we could have a substantial document for you at the June meeting and at that time you could see whether or not that met all your needs.

Culver. When I spoke the amendment yesterday before we broke for the evening, what I was trying to describe is that I didn't think that in reality even if we had this schedule on paper on page 7, that we would be prepared to select a final preferred alternative in September of 2014. And the types of things I was taking into consideration were just the fact that we would have very little information available to us. We would not have had any EFPs perhaps or maybe we would have one year of EFP by September of 2014. There'd be very little data for which we would be able to base a decision on in terms of saying yes, electronic monitoring will accomplish the goals and objectives that we've identified. Added to that I also thought that the Council had some fairly large workload items on its plate relative to the 15-16 spex. And the amendment 24 tier 1 EIS. As well as implementation of the items that we've already adopted. And so I didn't see I guess, this was my question to Frank, was I understand two years from the time we take a final action, but my question was more given your staff resources do you see us being able to reach a final action by September of 2014. And I'm thinking in reality given everything that is on our plate I don't see that happening. So again, the purpose of my amendment is to try and give industry a little bit more of a realistic picture of expectation of that then their not coming if our schedule should slip, their not coming to us and saying hey, you said you were going to get this done 6 months ago or a year ago, why haven't you don't it yet. I'd rather they say hey great you got it done a meeting or two early, that would be nice to hear for once.

Kirchner: So I just wanted to make sure that I understood Frank's answer on implementation timing. And so if we make a decision in September 2014, then reasonable implementation we would have would be maybe June of 2016, September 2016, somewhere in there. IF we make a final decision in November 2015, 5r4easonable implementation timing would be maybe June-July of 2017 of November 2017, something like that.

Lockhart:...it depends and do I'm not trying to be facetious but ...if you were to assume the same decision, just for argument sake, the Council comes to the same decision and that decision involves setting either doing a type approval or setting some sort of a minimum standards for a reasonably complex system, yes, that's going to take well over a year. In the past it's taken two years. If at the end of that time period the council comes to a very simple electronic monitoring system, potentially that could be quicker, how much quicker I don't' know. But yes, using past history once on these types of issues coming up with a regulatory package that addresses all the things that we need to address to set up something that people could go out and have some sort of a electronic monitoring system takes about two years.

{Stop Time: 0:23:56}

[Crabbe: could different sectors move at different paces?
Lockhart: yes
McIsaac: discussed commission field season.
Crabbe: Council should send message we're listening, message with original language is we are going as fast as we can. Spoke to industry priorities.
Lowman: Spoke in opposition to the amendment.]

Amendment 1a: to strike from Amendment 1 "*Scoping to begin in the summer of 2014; this would push the other items described in the table to the selection of a FPA to Nov 2015"*

Moved By: Dale Myer	Seconded by: Michele Culver
Amendment 1a	Amendment 1

[Myers spoke to amendment.]

{Start Time: 0:32:33}

Culver: ...The real purpose of my amendment that I tried to get at was just making sure we had sufficient time to develop the whitepaper for the performance standards which is captured in the first sentence. By keeping this on the Council schedule and having this come back in September and November allows us to have a discussion in November about where to we go from here. And, as I mentioned after we develop the performance standards we might get a different reaction from industry or from some sectors of the industry about whether or not they think electronic monitoring is still a high priority for their sector. And I think we'll get those kinds of comments once we've set up some performance standards and some sideboards so right now industry's having these discussions but their not clear about because we haven't made it clear. But their not clear about what the sideboards are what kind of penalties and consequences there could potentially be, what kind of structure we might put to this program whether we'd have full retention or not, what they'd have to retain. Does that include dogfish or not. Those types of questions and so once we set up here's how it could work perhaps they could have a more informed discussion about whether or not that would work for them. And so I think this is a good compromise which kind of gets us at the initial steps but doesn't really speak to kind of how long the entire process is going to take, which is difficult to decide now when we don't even have the performance standards developed.

Wolford: Gway

Kirchner: Thank you Mr. Chairman, so if what we got in September was just a fantastic document that didn't need any further review, do we have the flexibility to then move scoping up?

Wolford: Frank:

Lockhart: I was going to ask this question but its very pertinent what she's saying. This amendment if approved …envisions scoping starting in June. So scoping has already been moved up before September. With that amendment, that's the effect of it.

Wolford: Dr. McIsaac

McIsaac: Thank you Mr. Chairman. Mr. Lockhart would literally be correct, based on move forward the process as shown on page 7 , however, I think yesterday there was a motion passed that said begin scoping in September. So if this amendment passes we were going to bring up that point of clarification. Because it looks like there's a conflict, so we'd want some resolution consolidating what is listed on the schedule of June and September into September or is the intent of the maker to be exact as to moving forward the process as shown. So there would b e a conflict but it depends on if this amendment passes. I think there may even be more clarifications.

Culver: Thanks. I would answer the question, Gway's question as yes, we could actually move up scoping and begin sooner if we thought performance standards were fine in September. But this is, I guess I would go back tot he question I raised yesterday to NMFS that I don't recall if I got an answer, was whether or not this needed a two meeting process, that is to have a two meeting process to adopt performance standards for electronic monitoring….[continued by identifying some alternatives for Lockhart to respond to]

Lockhart: ....In my mind these performance standards were essentially a policy statement and not a final decision. The real final decision is when the Council selects a final preferred alternative. To me the Council does not need a two meeting process to develop performance standards. In fact, I think how it's going to work is that there will be performance standards and they will be

modified as the discussion occurs and we learn more. So I don't think it would require a two meeting process.
{Stop Time: 0:37:57}

Crabbe: [question on scoping doc in June and what could happen. Addressed to Myer.]

{Start Time: 0:39:13}
Myer: ...I'm just assuming the scoping document would, we could start in September. I don't know if the scoping document could be done, but I think it has to be started in September.

Lowman: ....In my mind that would be appropriate. We'd have these performance standards, hopefully they'd be so great we wouldn't want to make any modifications but I think the scoping could inform our discussion on the standards too as we're sort of giving final direction for what that will be those basis. So, I think that makes sense to me.
{StopTime: 0:40:08}

[Amendment to amendment (Amendment 1a) passed unanimously.]

[Wolford – Noted the importance of catch accounting to the IQ Program and the urgencies from the fleets pending assumption of costs for observers.
McIsaac stated – implication of motion, scoping not begin until November but let staff review.
Seger – reviewed motion from previous day.
***Kirchner asked what "completed" means.**]*

{Start Time: 0:44:16}
Culver: I would assume that when we had the performance standards that the Council would have some sort of action taken to approve them as these are the ones we are going forward with. That is what I would assume would be completed.

Wolford: In fact, I think that is my recollection of the discussion we had. That it would in fact come to the Council and the Council would essentially say it was completed.

Kirchner: So number 3 says to direct the Council staff to "develop" a white paper and then we delay scoping until the whitepaper is developed. Developed means it's presented to the Council? The Council actually adopts fully the performance measures that we'll move forward on? I'm not seeing a connection.

Wolford: Dorothy

Lowman: So when I voted for the amendment on this first one I was thinking that we were not doing this until we developed, we were doing the development of the whitepaper, we weren't waiting until we finally said "yes" these are our final ones. On our previous discussion on this amendment, we talked about how if we got that in September and we initiated scoping, which would have some little scoping document that would be part of initiating scoping in September, that those two would go together and we'd be talking about them and both would. We'd get an initial scoping and we would get some Council discussion and refinement of the performance standards in September. So I don't see it that we would have to wait until the Council finally felt completely comfortable at the last revision they ever wanted on performance standards before we even began development of scoping. So I saw from our discussion that we would essentially be starting scoping in September and whatever preparatory materials would be done in time for the September meeting.

Wolford: Gway

Kirchner: That was how I understood it as well so I wanted to be clear on it.

McIsaac: Good clarity.

Wolford [now back on amendment]

Culver: Thank you Mr. Chairman, I appreciate, I don't disagree with Dorothy and Gway and their interpretation. But, we do have the caveat that we kept here at the beginning of #1 so presumably as we set Council agenda in June for September, we can talk about whether or not we're ready to initiate scoping. Where we are with the whitepaper, whether that's going to be ready. And schedule it accordingly for September or November. But we'll have that conversation. There's flexibility here.

Wolford: Dorothy

Lowman: I totally agree and I also think we talked about a check-in in June on how it's progressing, any questions and when we get to future agenda planning we'll have more discussion on that.
{Stop Time: 0:48:05}

[Amendment 1 and Motion 21 carried unanimously.]

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*[During staff overview, McIsaac referenced Sept and Nov, initial performance standards in Sept, complete in Nov **(Time 32:30)**; and referenced June EM check-in on how things are going **(Time 37:00)**.]*

[Culver asked, with respect to trawl trailing actions]

{Time 43:01}
Culver: Is what's envisioned in June on the guidance on regulation development. Would we then also be discussing our priorities and whether we want in September to scope PIE 3 and gear workshop and AMP and all of that?
McIsaac: I think there's enough time for that to be an eligible state of discussion. What is in designed in September is the more routine annual process of September, November and beyond."

[Reports and public comment. Council action. In her summary at the end Ms. Culver describes the June action with respect to PIE 3 as]

{Time 1:48:40}
Culver: “a prioritization of trailing actions in general to come in September and beyond.”

[McIsaac: agreed except with respect to the June Check-in and PIE 3]

{Start Time 1:50:18}
McIsaac: “on the matter of trawl rationalization and consideration of priorities. In September is the annual call for priorities, what’s out there. And it’s listed here as PIE 3 but it’s kind of viewed generally as the next go round. Scope what priorities there are. AMP is scheduled as a consideration there. So when you initially spoke to that it is some sort of a preview of what is coming in September. When you spoke to it before I wasn’t sure if it was anything different form a preview.
Culver: No just a preview.
Lowman: So just to expand on that because I do think we are going to be needing to do a really thoughtful decision about what our priorities are. I don’t think we should be, I think it’s fine to do a preview, talking about the kind of data we’d need to do a very measured cost benefit prioritization, a little bit about what we think is the most important to go forward first in September but I wasn’t seeing that [in June] we’d make hard decisions about what would come off [the list] in September.
Culver: Just a better understanding of what they are.
{End Time 1:51:35}

F.6 Trawl Rationalization Trailing Actions

1. Check-in on EM, Council guidance.
   - Ad hoc workgroup composition
   - Preliminary draft whitepaper
   - NMFS on EFP possibilities
   - PSMFC Final Report on 2012
2. September scoping process, Council guidance.
   - Situation summary provides
     - a description of our standard process
     - link to a list of issues
3. PIE 2 clarifications and a reconsideration
   - No clarifications required
   - End-of-year trading, proposed reconsideration too far from previous action

Electronic Monitoring

- Agenda Item F.6.a, Attachment 1
  - Pg. 1 – Objectives adopted in April
  - Pg. 2 – Calendar adopted in April
  - Pg. 3 – Alternative compositions for an ad hoc workgroup
  - Pg. 4 – Budget implications for alternative compositions

Conceptual Overview: Discard Monitoring Parallels

At-Sea Monitoring	Observer Monitoring	Electronic Monitoring
Data Stream on Discards	Observer Reports	Electronic Logbooks
Quality Control/ Verification	Observer Debriefings	Cameras and Video Review

Process Overview

- Given the identified objectives, on the whole does electronic monitoring perform better than human observer coverage?
- Alternative EM programs to be developed and analyzed
  - Types of regulatory elements
    - Prescriptive
    - Performance standards
    - Management standards

Objectives for the Rest of This Presentation

- Differences between the types of regulations
- Types are a continuum and different types of regulations can work together (not an either/or)
- Different regulatory approaches (types) can be applied at different levels within a program.
- Performance Standards: Regulatory vs. Policy
- Process by which performance standards are developed.

Type of regulation

- Prescriptive Regulations
  - Design standards

    Examples
    - gear regulations
    - For EM: requirements for use of a particular type of camera
  - Process standards

    Examples
    - hailing requirements
    - RCAs
    - For EM: amounts of video review required

Type of regulation

- Performance Standards
  - Regulations specified as a standard of performance (end result) **directly linked to a policy objective**
  - Minimal specification of how
  - Incentive for cost effectiveness
  - Workshop recommended: for flexibility
  - Examples
    - National Standard 1 – applying to fishery managers
    - Trawl catch share program – applying to vessels

Development of Performance: Typical Process

	Typical Process	
1	State the performance goal or objective	
2	Identify what they mean in terms of functional performance	
3	Delineate criteria (performance standards)	
4	Specify the methods for verifying compliance.	

Example: MSA National Standard

	Typical Process	Fishery Management
1	State the performance goal or objective	NS 1 - Sustainable stocks
2	Identify what they mean in terms of functional performance	Biomass Levels
3	Delineate criteria (performance standards)	ACLs/OFLs
4	Specify the methods for verifying compliance.	Mortality Monitoring and Stock Assessments

Type of regulation

- Management Standards
  - Require regulated entity to
    - Develop a plan
    - Receive agency approval
    - Comply with its own plan
  - E.g. first receiver site plan for catch monitoring

Prescriptive – Performance – Management

- A continuum between the different types
- Regulatory programs can include elements from multiple categories
  - Catch share program
    - Quota (performance standard – main regulatory framework)
    - Observer carrying requirements (prescriptive - process standard)
    - Gear regulations (prescriptive - design standard)
    - RCAs (prescriptive - process standard)
    - First receive site plan (management standard)

Level of Application for Performance Standards

- As main regulatory framework (e.g. catch shares)
  - Performance standards for the EM system as a whole (maximum technological flexibility)

- For elements within a prescriptive framework
  - Performance standards for discrete functions within the EM system (more restricted flexibility)

Performance Standards for Elements Within

Highly prescriptive:

A sensor box connected to a monitor and keyboard to allow the user to view recorded EM imagery and conduct system checks to test system functionality

More performance based:

A means to allow the user to view recorded EM imagery and conduct system checks to test system functionality.

Regulatory or Policy Performance Standards

- Regulatory Performance Standards – apply to the regulated entity – provides flexibility.
- Policy Performance Standards – apply to the policy makers – provides criteria which a policy or alternatives must achieve.
- Both relate to regulatory objectives.
- Policy performance standards could result in a policy composed entirely of prescriptive regulations.

Review

- Differences between the types of regulations
- Types are a continuum and different types of regulations can work together (not an either/or)
- Different regulatory approaches (types) can be applied at different levels within a program.
- Performance Standards: Regulatory vs. Policy

- Process by which performance standards are developed.

F.6 Trawl Rationalization Trailing Actions

1. Check-in on EM, Council guidance.
   - Ad hoc workgroup composition
   - Preliminary draft whitepaper
   - NMFS on EFP possibilities
   - PSMFC Final Report on 2012

2. September scoping process, Council guidance.

3. PIE 2 clarifications and a reconsideration

Agenda Item F.6.b
PSMFC Report
June 2013

Final Report
Electronic Monitoring Program: Review of the 2012 Season

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Contents

Overview/History

In 2012, Pacific States Marine Fisheries Commission (PSMFC) received funds to test the feasibility of using electronic monitoring for catch accounting in the newly implemented Pacific Trawl Rationalization Program within the west coast groundfish fishery. In order to effectively and accurately debit discarded catch from individual fishing quota (IFQ) holder account, the Pacific Fishery Management Council (PFMC) instituted 100% human compliance monitor coverage on all trips for all vessels participating in the IFQ fishery. The cost of this program was regulated to transition from federally subsidized to industry funded over the course of the first 3 years of the program. The industry is interested in finding a less costly and more flexible method to monitor catch and discards at sea. The electronic monitoring project is meant to address some key questions, including; can video monitoring be used effectively to track an individual's catch to be debited from a quota account? And how much would such a program cost the industry as compared to the human compliance monitor program?

The expectation is that the West Coast Groundfish Observer Program (WCGOP) will continue to administer a level of scientific observer coverage to provide stock assessors and other scientists the necessary scientific data for effective management of the various west coast fisheries. This program is not meant to replace scientific observers. This program is solely meant to explore the ability of electronic monitoring systems to capture the at-sea discards of vessels for the purposes of effectively debiting quota accounts throughout the fishing season, therefore replacing the need for 100% at-sea human compliance monitor coverage.

PSMFC contracted with Archipelago Marine Research (AMR) to provide and install electronic monitoring (EM) systems on 11 volunteer fishing vessels (6 whiting and 5 fixed gear), collect data drives from the vessels, provide Electronic Monitoring Interpret™ Pro (EMI) software for converting the raw data into usable catch information, training PSMFC video reviewers, and providing logistical support.

The on-board AMR system includes sensors for drum movement, hydraulic pressure, and GPS locations from which the speed of the vessel is calculated, and 1-4 cameras. A GPS location along with any sensor data was recorded every ten seconds during a trip. Sensor data was recorded at all times that the vessel's power was on. Gaps therefore occurred when in port and the vessel was powered down or the system was turned off manually to prevent the system from draining the vessel's battery when in port. On hake vessels, the system was configured to trigger recording video when the vessel moved outside of a "port area" designated by AMR and continue recording imagery until they returned to port. On fixed gear vessels, systems were configured to trigger recording video when the hydraulic pressure exceeded a threshold that was set by the technician that installed the equipment and was specific to each vessel. Imagery recording would then continue for 20 minutes past the last use of those hydraulics to allow for all catch handling to be captured for each haul.

When the raw sensor and video data were received by PSMFC, annotations were made using the AMR software EMI. Start and end dates, times and locations, for trips and hauls as well as gear and catch information were captured using EMI. The annotation data were imported into a Microsoft Access Database for analysis.

Finalized 2012 at-sea compliance monitoring data were received from the WCGOP for comparison to the video data. Since retained catch is weighed and accounted for by fish dealers at the dock, discards were the main concern for at-sea catch accounting of IFQ species on this project. While analysis of both retained and discarded data are presented in this report, the discard analysis should be more closely scrutinized for this reason.

Fixed Gear

Methods

The electronic monitoring system was installed on 5 volunteer fixed gear vessels fishing IFQ quota out of Morro Bay and Half Moon Bay, California the week of August 21st 2012. All 5 fishing vessels carried the EM system for the remainder of the fishing year. Four of the five vessels fished pot gear solely. One fished both pot and longline gear.

Compliance monitor and video trips were matched using vessel ID and departure date. The quality of the match was then confirmed manually in excel.

Two definitions for fixed gear hauls are presented in the WCGOP manual for the IFQ fishery:

> "A set begins at a buoy and ends at a buoy. The set includes all of the hooks or pots in between the two buoys." (NWFSC 2012, Section 5-8)
>
> "Small pieces of gear with individual buoys are often set haphazardly in a general area or fishing spot. The gear is frequently set and retrieved over and over again, with individual pieces of gear soaking for as little as 5 minutes between retrievals. If each retrieval was considered a set, one day of fishing could have over fifty sets, with each set only having one or two fish caught. Obviously, this would create an unreasonable quantity of paperwork for the amount of data collected. Therefore, individual pieces of gear can be grouped to form a single set using a standard set of criteria." (NWFSC 2012, Section 6-10)

Since strings of gear were distinguishable by the EM system, the former definition was used. It appears the compliance monitor used the second method to define a haul on most of the corresponding trips.

All pot strings had 10 pots or less. On most trips, the haul count in the compliance monitor data was much lower than the count from the video data (Table 1). The number of pots counted on each trip by both programs was very similar (Table 2). This difference in haul definition at the data level led to an inability to assess catch counts at the haul level and thus counts were compared to compliance monitor data at the trip level. All 73 trips monitored electronically had corresponding trips in the compliance monitor data. One trip was missing electronic data entirely.

Of the 73 trips for which electronic data were collected, one had no video data associated with it. The trip was the first trip of the season for this vessel and the problem was resolved before the second trip. On 11 trips, a minimum of one haul during the trip was given a video quality score of "low". The majority of these low scores were not due to equipment failure but due to fisherman or compliance monitor behavior. For this study, fishermen were not given feedback on how to maximize data quality for the video project. Thus, there were instances where the fishermen or the compliance monitors stood with their backs to the camera while sorting, or sorting of catch was conducted out of camera view, which made counting and classifying catch into species groupings impossible.

In this fishery, weights were not directly estimated by the video reviewer. Instead, counts of individual pieces for each species or grouping were recorded. All fish seen on the video were counted by the reviewer including fish that dropped off of the line before being pulled onto the fishing vessel and fish that were damaged or partially eaten. Fish whose fate could not be determined due to being taken or thrown out of camera view or the video ending before fish being put into the hold or discarded were assumed to be retained and recorded as such.

Existing video technology does not allow for effective species identification of difficult to differentiate species such as many rockfishes, thornyheads, or flatfishes. Compliance monitor data therefore contained more species specific information than was possible to collect from the video data. To accommodate this difference, both the compliance monitor and video data were aggregated to a species grouping level for direct comparisons of the counts.

Ten of the trips included at least one haul where compliance monitor data were expanded to the haul level due to subsampling of the haul. Since these numbers were not true counts, we excluded them from the count comparison. Unfortunately, even if only one haul of a trip was expanded, the whole trip had to be removed due to the inability to compare at the haul level.

Retained and discarded counts of fish were compared to compliance monitor data at the trip and species grouping level. Rockfish and thornyheads were combined into one grouping due to the difficulty to differentiate them on video. Results for the IFQ groupings sablefish, rockfish + thornyheads, and flatfish are reported in this document.

Since only one vessel used longline gear, results could not be reported by fixed gear types (pot vs. longline) due to confidentiality rules. Both pot and longline gears were therefore reported on the same figures. Counts of fish on trips where both gears were used were aggregated together into one value for the trip.

Results

For the three groups reported, sablefish, rockfish + thornyheads, and flatfish, compliance monitor catch counts overall and on a trip bases tended to be greater than video counts for both retained and discarded catch (Table 3, Figures 1-3).

Despite the pattern that compliance monitor total counts were generally greater, the minimum, maximum, mean and median counts per trip were very similar and counts were generally qualitatively similar. Discards of IFQ fish were consistently low, with median discard per trip falling at zero or 1 fish for all three groupings (Table 3).

The similarity of counts between the compliance monitor and video data and pattern of compliance monitor counts being on average larger than video counts is demonstrated in figures 1-3.

Discussion

Video counts of fish were similar to the compliance monitor counts at the trip and species group level in the fixed gear fishery. This indicates that the video is generally seeing the fish that the compliance monitor is seeing. The video system is not yet able to assess weights of fish, or species of rockfish, thornyheads or flatfish. Weights and species are important, since quotas are given to quota holders in weight of IFQ species or grouping. If the EM system cannot assess weight of discards and the species of discard, it would be impossible to accurately debit a fisherman's quota or assess accuracy of logbooks. PSMFC is working with the Alaska Fisheries Science Center to develop methods to resolve these issues moving forward.

Communication with fishermen will be more immediate in the future when behavioral changes need to be made to improve data quality, such as sorting fish one or two at a time so that the viewer can get an accurate count, or ensuring that discards take place within camera view.

Hake

Methods

The electronic monitoring system was installed on 6 volunteer hake trawl vessels fishing IFQ quota out of Newport and Astoria, Oregon the week of May 9th 2012. All 6 fishing vessels carried the EM system for the remainder of the fishing year and made both shoreside and mothership deliveries.

Retained catch, or catch transferred to the mothership, was calculated by video reviewers by counting the number of straps of the codend that contained fish. This number was then multiplied by an estimated weight per strap to get the total weight of retained fish in the codend.

Compliance monitors are advised to use skipper hailed weights recorded in the vessel's logbook for retained catch when they are available and to make individual estimates of the catch only when a vessel logbook is not available (Ryan Shama, personal communication, March 19, 2013).

There were two categories of discards; selective and nonselective. A selective discard was recorded if the deckhands deliberately removed a fish or group of fish from the haul. An example of a selective discard is a 300 pound shark that was pulled aside when the net came up. Nonselective discards were discards that were not deliberately sorted. Examples or nonselective discards are spillage out of the mouth of the codend as the deckhands tied the net off for transfer to a mothership, or fish that were gilled in the net and were then hosed off the deck of the vessel. Nonselective discard weights were recorded based on qualitative volume estimates.

Compliance monitor and video trips were initially matched using vessel ID and departure date. The quality of the match was then confirmed manually in excel. Hauls were then matched based on order within individual fishing days. For example, haul 3 of a fishing day in the compliance monitor data was matched to haul 3 of the same fishing day in the previously matched trip in the video data. This was necessary since there could be multiple hauls in a day and the haul times did not match exactly. Again, the quality of the match was confirmed manually in excel, and adjustments were made where necessary. Adjustments were only necessary if a time gap occurred in the electronic data that led to the EM system missing a haul, a haul occurred near the midnight time mark causing a different date in each of the datasets or if the EM data recorded a net cleaning where the observer data did not.

Of the 172 trips monitored electronically, 169 trips had corresponding trips in the compliance monitor data. Of the three that did not, two were NOAA research trips and one was a short trip where the vessel left the dock and conducted a single net cleaning haul before returning to port. Of all the hake trips, 15 were mothership catcher-vessel trips and 154 were shoreside delivery hake trips. One trip in the dataset included one mothership delivery haul and the catch from the remaining hauls of the trip was stored onboard and delivered shoreside.

41 trips were missing electronic data entirely, 31 of which came from one vessel. Three were the last three trips of the year for a different vessel. Two were at the end of a data drive suggesting the drive on the vessel was full and had not been replaced in a timely fashion. The last 5 occurred between recordings on a trip suggesting the box had been disconnected or the skipper forgot to switch the box on for a particular trip.

Most hauls had corresponding hauls in the compliance monitor data. It was therefore possible to compare catch at the haul level.

16 trips were classified as problem trips. On these trips, a minimum of one haul during the trip was given a video quality score of "low". The majority of these low scores were due to poor deck lighting, camera angles, or water on the lens of the camera.

Official haul level catch amounts delivered to motherships were available from NORPAC data in PacFIN. Since fish tickets are not available for this fishery, the NORPAC dataset is the best estimate for total catch amounts delivered from the catcher vessels to the motherships. The delivered catch weight was calculated by taking the NORPAC official total catch weight which includes all species, and deducting the WCGOP discard amount, which was made on the catcher vessels prior to codend transfer.

Official trip level landed weights were available for the shoreside deliveries from the state landing receipts in PacFIN. These were matched based on vessel ID and return date. All hauls or trips had corresponding official retained catch amounts.

To address concerns voiced in the PFMC Electronic Monitoring Workshop about quality of EM discard estimation with night light versus day light, hauls brought on board in day light and night light were differentiated in the figures where possible. Hauls brought onboard between 6 AM and 6 PM were labeled day hauls, and hauls brought onboard between 6 PM and 6 AM the next day were labeled night hauls.

Results

Mothership Catcher Vessels

Discard

The video data contained a larger number of discard events than the compliance monitor data, and those discard events were estimated by the video to be larger than the compliance monitor estimate (Table 4 and Figure 4). Most discard events were very small. The relationship of video to compliance monitor discard estimates was consistent regardless of whether the haul was retrieved in night-time or day-time lighting.

Retained

Retained catch estimated by the video compared to the compliance monitor data and the official catch data from NORPAC had very similar patterns (Figure 5). Again, the relationship of video to compliance monitor discard estimates was consistent regardless of whether the haul was retrieved in night-time or day-time lighting. The relationship between video and compliance monitor retained estimates fell across the video = compliance monitor/NORPAC reference line. Video retained catch estimates tended to be higher than compliance monitor estimates on loads smaller than 50,000 pounds, and tended to be lower than compliance monitor estimates on loads larger than 50,000 pounds (Figure 5).

Shoreside Hake

Discard

The video data contained a larger number of discard events than the compliance monitor data. The total amount of discarded weight captured by the video was estimated to be almost double the discarded weight captured by the compliance monitor (Table 4). Most discard events were very small (Figure 6). Only six observations of discards occurred during the night and all were from the compliance monitor dataset. There were only 9 hauls where discards were recorded in both datasets.

Retained
Retained catch estimated by the video compared to the compliance monitor data and the official catch data on fish tickets from PacFIN had very similar patterns (Figure 7). In both cases the trend line qualitatively tracked the video = compliance monitor reference line closely with the line hovering just above the reference line.

Discussion

Mothership Catcher Vessels

For the mothership catcher vessel fishery, video retained catch estimates tended to be higher than compliance monitor estimates on loads smaller than 50,000 pounds, and tended to be lower than compliance monitor estimates on loads larger than 50,000 pounds (Figure 5). Vessels targeting hake use different codends when fishing with the intent to deliver to motherships than if the intent is to deliver to shoreside processors. No information was obtained from the vessels about the capacity of their nets or the dimensions of their vessel to aid in catch estimation from the camera view prior to video reviewing. Obtaining this information would likely help with the accuracy of estimation of retained catch weight in codends.

Discard events were much more abundant in the video data than in the compliance monitor data for this fishery. The majority of the discard events recorded in the video data were of a magnitude smaller than 2000 pounds. This suggests that compliance monitors were not recording discards in most instances when the magnitude was considered small. There were five large discard events above 2000 pounds, ranging from 5000 to 16000 pounds not reported in the compliance monitor data. All five of these events were net bleeds due to the codend being over full making it impossible to tie the codend off prior to transfer to the mothership.

Shoreside Hake

The shoreside hake retained weights were on average (using the trend line as a gauge) accurate but had variability when assessing at the trip level (Figure 7). This was likely due to vessel to vessel variability of nets and codend capacity and the lack of information about each vessel that the video reviewers had available to them when estimating catch. Measurements like width and depth of trawl alley, estimated catch weight when codend is full and the vessel's hold capacity would assist video reviewers in their catch estimates. Therefore, the variability in the accuracy of estimation of retained catch is not necessarily due to a shortfall of the EM system, but rather could likely be resolved by providing additional information from skippers about their vessels to video reviewers.

The discarded catch estimates were more variable with only 9 of the 38 total discard observations in both datasets overlapping (Table 4). Most of the discard observations were only detected in one of the two datasets. The magnitude of most of these discard events were generally small at less than 2000 pounds (Figure 6). There were four discard events that were larger than 2000 pounds that were recorded by the video but not the compliance monitor. Two of these were blowout panel discards prior to the net boarding the vessel. The other two were due to deck washing of fish. The one discard event recorded in the compliance monitor data but not in the video data that was larger than 2000 pounds was also a deck washing event. The blowout panel events recorded by the video reviewer but not the compliance monitor resurfaces the regulatory question: when is a fish considered caught? It is clear that video can detect and quantify these discard events if needed for catch accounting. The deck washing events indicate a difficulty for the video reviewer to assess whether fish are being washed into a hold (retained) or off the vessel (discard). This may be resolved by adjustment of camera angles, or changes in fisher behavior.

Acknowledgements

We would like to thank the owners, skippers, and crew of the 11 volunteer fishing vessels for volunteering and helping this project move forward. We would like to thank the West Coast Groundfish Observer Program for providing data for this report.

References

Northwest Fisheries Science Center (NWFSC). 2012. West Coast Groundfish Observer Program 2013 Catch Shares Training Manual. West Coast Groundfish Observer Program. NWFSC, 2725 Montlake Blvd. East, Seattle, Washington, 98112.

Tables

Table 1. Summary of data including: number of vessels, number of trips, data quality of trips, trip length, number of hauls, video data quality of hauls, and reason for low video data quality.

Number of Vessels	Fixed Gear	Mothership Catcher Vessel	Shoreside Hake
Total	5	6	6

Trips

Number of Trips	Fixed Gear	Mothership Catcher Vessel	Shoreside Hake
Compliance Monitor	74	17	193
Video	73	15	154
Trip Data Quality			
Low Video Quality (at least one haul on trip had low video quality)	11	3	15
No Video Data Recorded	1	1	10
Compliance Monitor Data Expanded - Trips not included in comparison	10	0	0
One or both ends of trip based on timegap	10	3	6
No Data Quality Problems	41	8	123
Sea Days Per Trip			
Minimum	1	4	1
Median	1	12	3
Mean	1	12	3
Maximum	3	18	5
Total	105	178	402

Hauls

Number of Hauls	Fixed Gear	Mothership Catcher Vessel	Shoreside Hake
Compliance Monitor	289	313	396
Video	879	307	393
Haul Video Data Quality			
High	619	185	263
Medium	205	87	94
Low	49	33	19
No Video	6	2	17
Low Haul Video Data Quality Reason			
Camera Failure - No data	0	0	1
Corrupt Video Files	1	0	2
Crew Catch Handling - Not in Camera View	34	0	0
Poor Image Quality - Glare	1	0	0
Poor Image Quality - Night Lighting	6	7	15
Poor Image Quality - Poor Camera Angles	4	24	1
Poor Image Quality - Water Spots	0	2	0
No Reason Given	1	0	0
Unclosed Video Files	2	0	0
Total	49	33	19

Table 2. Comparison of number of pots counted per trip by compliance monitor and video.

Pot counts	Video	Compliance Monitor
Minimum	12	12
Median	37	38
Mean	47	48
Maximum	140	140
Total	3,376	3,448

Table 3. Comparison of counts of fish per trip of three broad IFQ groups by compliance monitor and video.

	Sablefish		**Rockfish and Thornyheads**		**Flatfish**	
Discarded	**Video**	**Compliance Monitor**	**Video**	**Compliance Monitor**	**Video**	**Compliance Monitor**
Minimum	0	0	0	0	0	0
Median	1	2	0	1	0	0
Mean	6	7	2	3	2	2
Maximum	52	58	28	31	12	12
Total	401	405	139	175	109	123
Retained						
Minimum	42	42	0	0	0	0
Median	463	513	1	1	0	0
Mean	605	628	51	55	1	1
Maximum	3,143	3,108	380	414	7	9
Total	37,530	38,948	3,155	3,397	51	70

Table 4. Summary of number of discard events (haul counts) in the compliance monitor and video data, and the catch weight that they represent in the mothership catcher vessel and shoreside hake fisheries.

	Mothership Catcher Vessel		Shoreside Hake	
Total Number of Discard Events in Each Dataset	**Number of Discard Events**	**Discard (lbs)**	**Number of Discard Events**	**Discard (lbs)**
Compliance Monitor	26	29,650	22	77,189
Video	140	136,742	25	134,931
Hauls with Discards in the Compliance Monitor Dataset but not the Video Dataset				
Compliance Monitor	4	5,000	13	12,059
Hauls with Discards in the Video Dataset but not the Compliance Monitor Dataset				
Video	118	83,902	16	55,931
Hauls with Discards in both the Video and Compliance Monitor Datasets				
	22		9	
Compliance Monitor		24,650		65,130
Video		52,840		79,000

Figures

Figure 1. Fixed Gear Fishery. Comparison of compliance monitor and video total counts of: a. discarded and b. retained sablefish aggregated to the trip level. Each point represents a trip. Trips where compliance monitor expansions were applied were removed from the plots. The dashed line is the video = compliance monitor line. If video and compliance monitor counts agreed for a trip, the point for that trip would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor counts tend to be larger than video counts. If the trend line falls above the video = compliance monitor line, compliance monitor counts tend to be smaller than video counts.

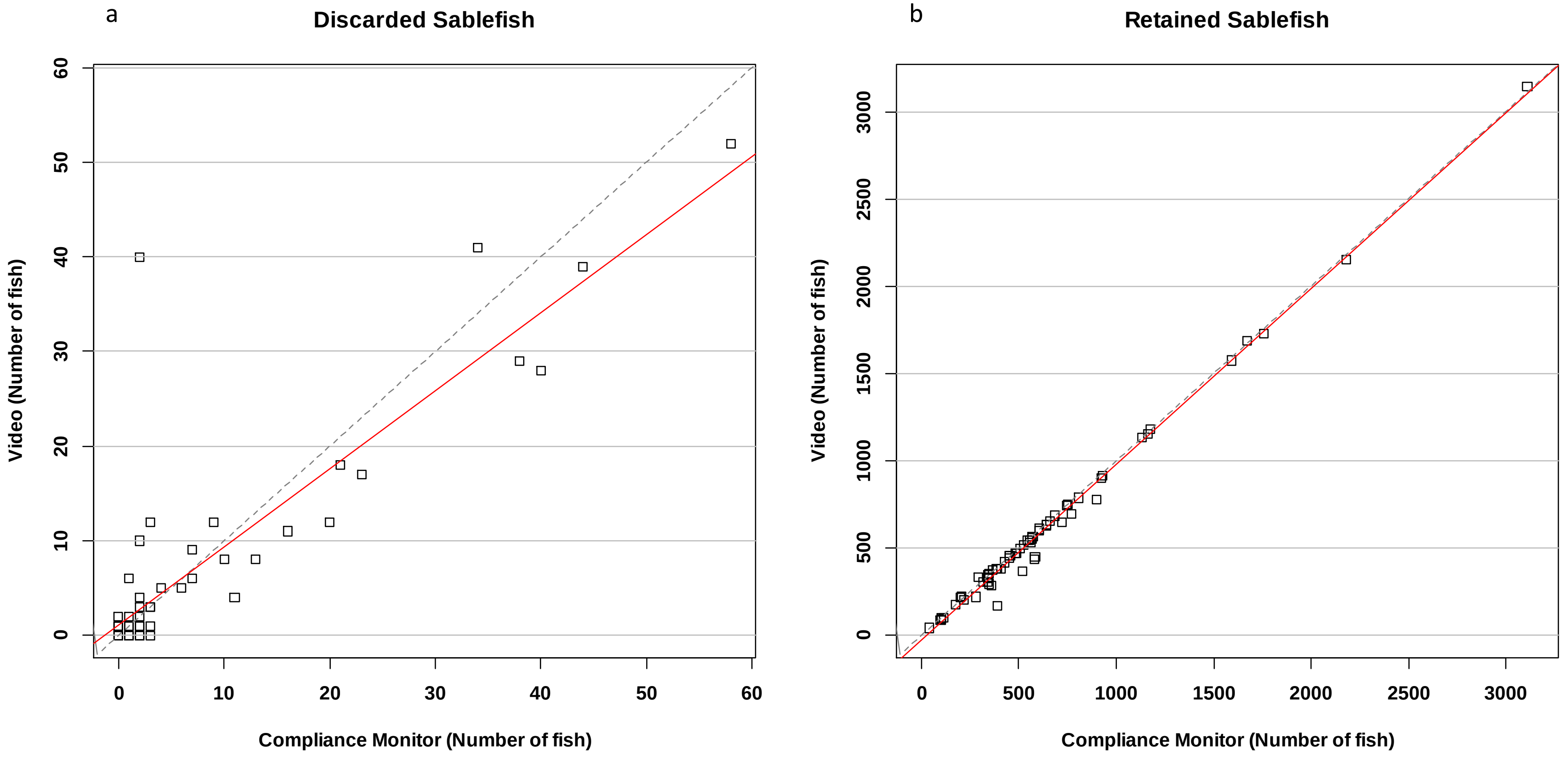


Figure 2. Fixed Gear Fishery. Comparison of compliance monitor and video total counts of a. discarded and b. retained rockfish and thornyheads aggregated to the trip level. Each point represents a trip. Trips where compliance monitor expansions were applied were removed from the plots. The dashed line is the video = compliance monitor line. If video and compliance monitor counts agreed for a trip, the point for that trip would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor counts tend to be larger than video counts. If the trend line falls above the video = compliance monitor line, compliance monitor counts tend to be smaller than video counts.

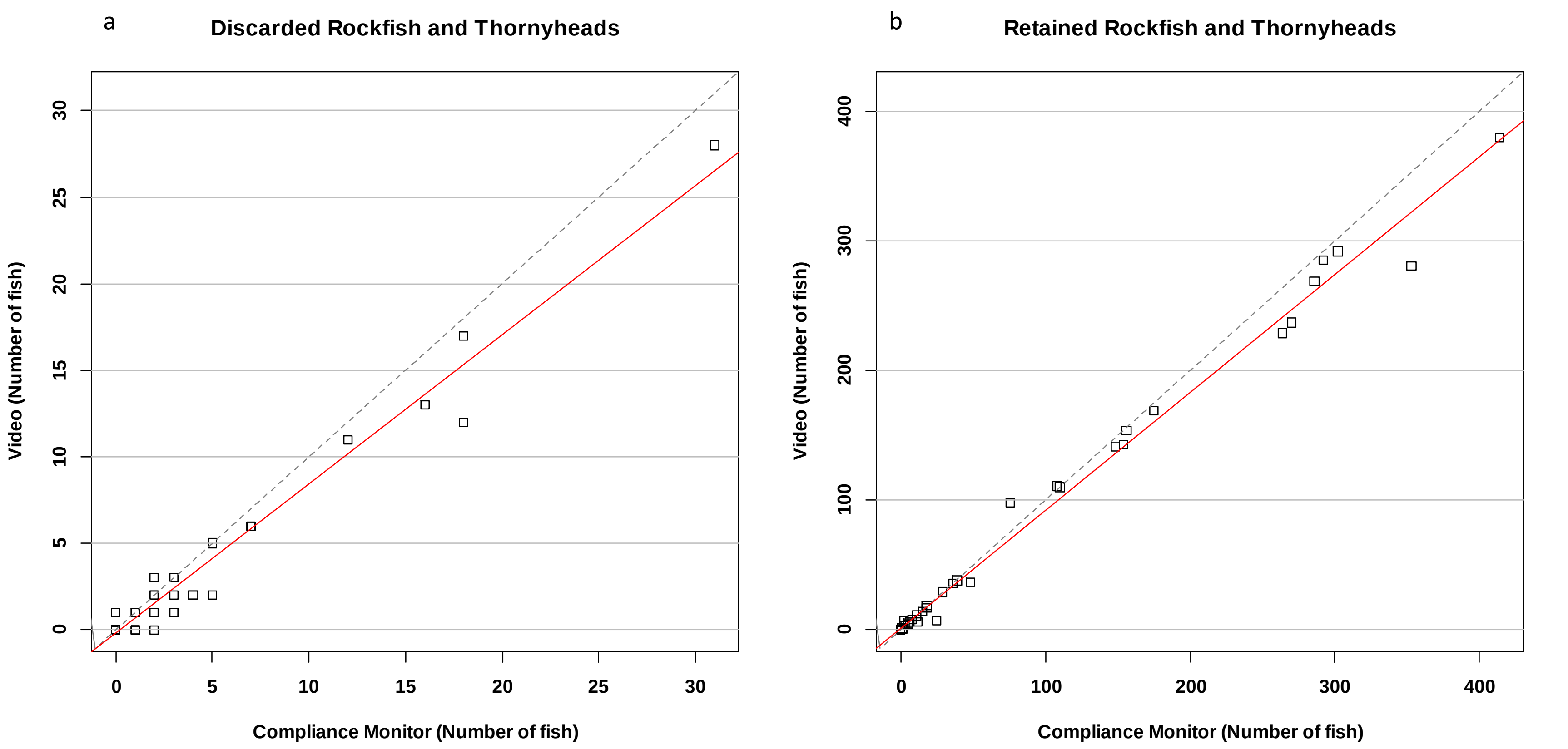


Figure 3. Fixed Gear Fishery. Comparison of compliance monitor and video total counts of a. discarded and b. retained flatfish aggregated to the trip level. Each point represents a trip. Trips where compliance monitor expansions were applied were removed from the plots. The dashed line is the video = compliance monitor line. If video and compliance monitor counts agreed for a trip, the point for that trip would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor counts tend to be larger than video counts. If the trend line falls above the video = compliance monitor line, compliance monitor counts tend to be smaller than video counts.

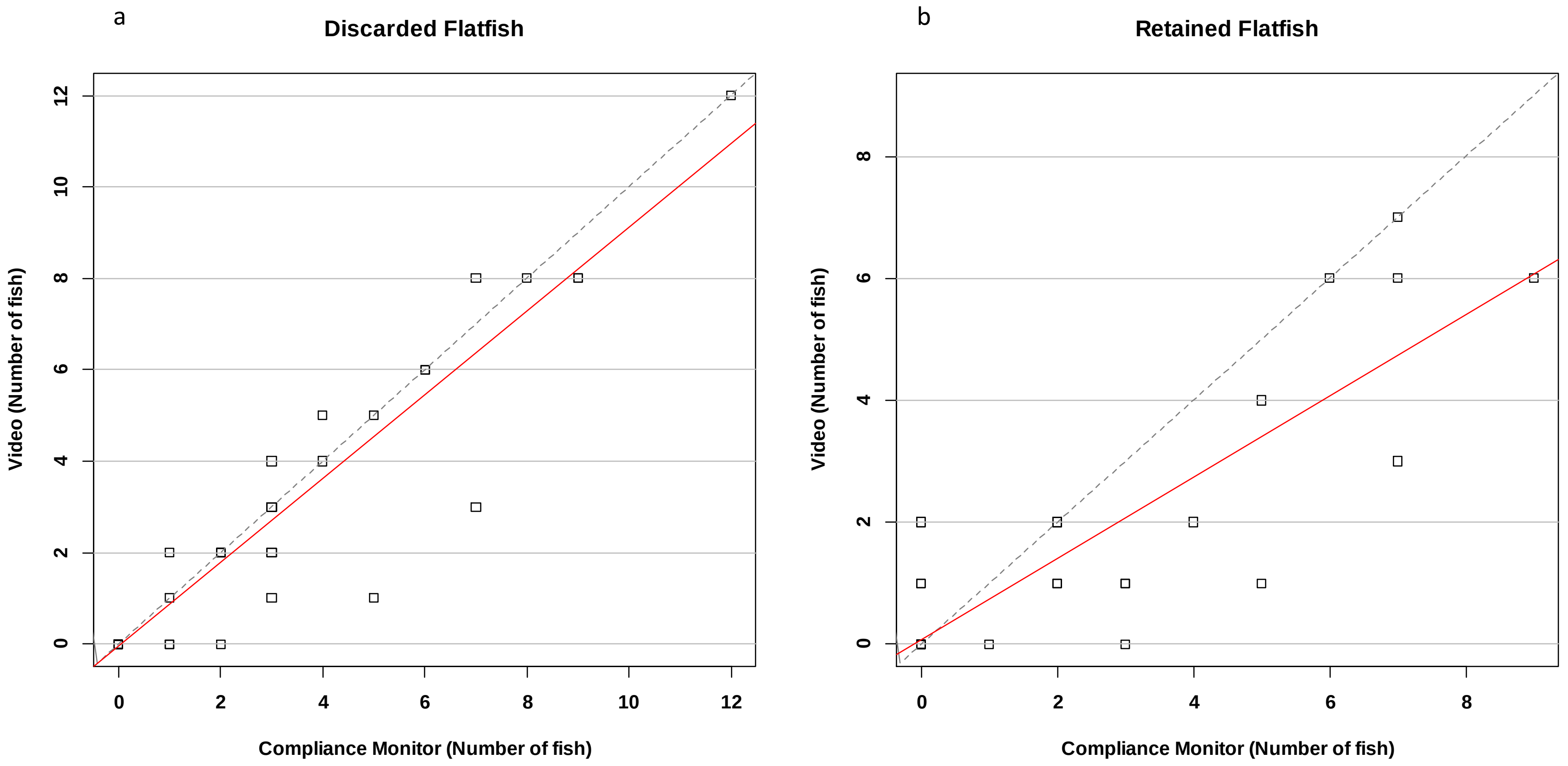
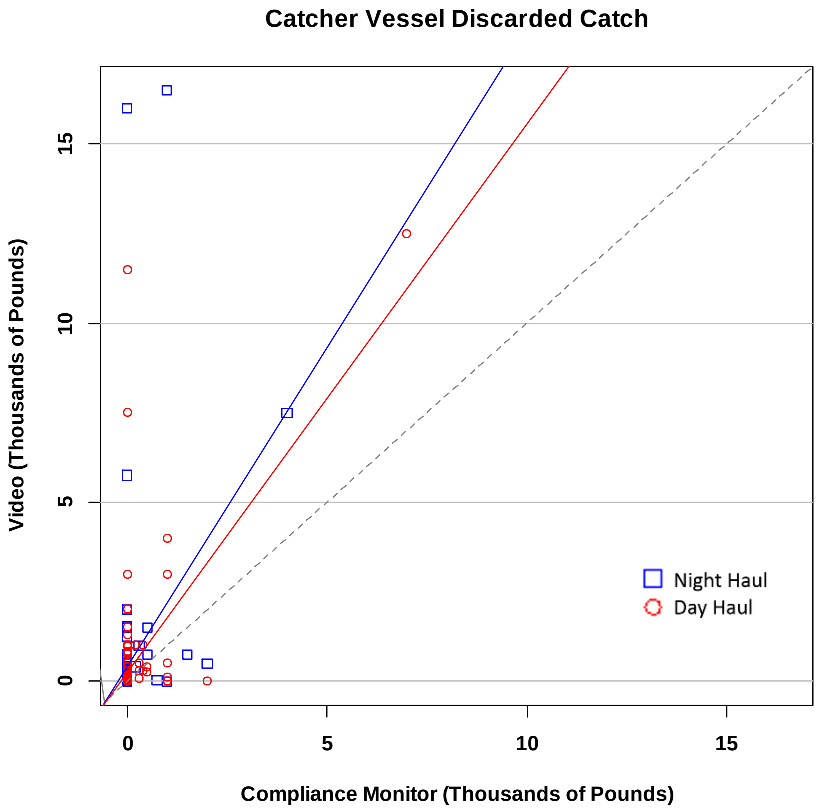


Figure 4. Mothership Catcher Vessel Fishery. Comparison of compliance monitor and video discarded catch weight of all species aggregated to the haul level. Figure b. is the same data as figure a. with different axis scales to show the data clustered in the bottom left corner of figure a. Each point represents a haul. Blue squares represent hauls brought onboard in the dark, red circles represent hauls brought onboard in daylight. The dashed line is the video = compliance monitor line. If video and compliance monitor weights agreed for a haul, the point for that haul would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor weights tend to be larger than video weights. If the trend line falls above the video = compliance monitor line, compliance monitor weights tend to be smaller than video weights.

a



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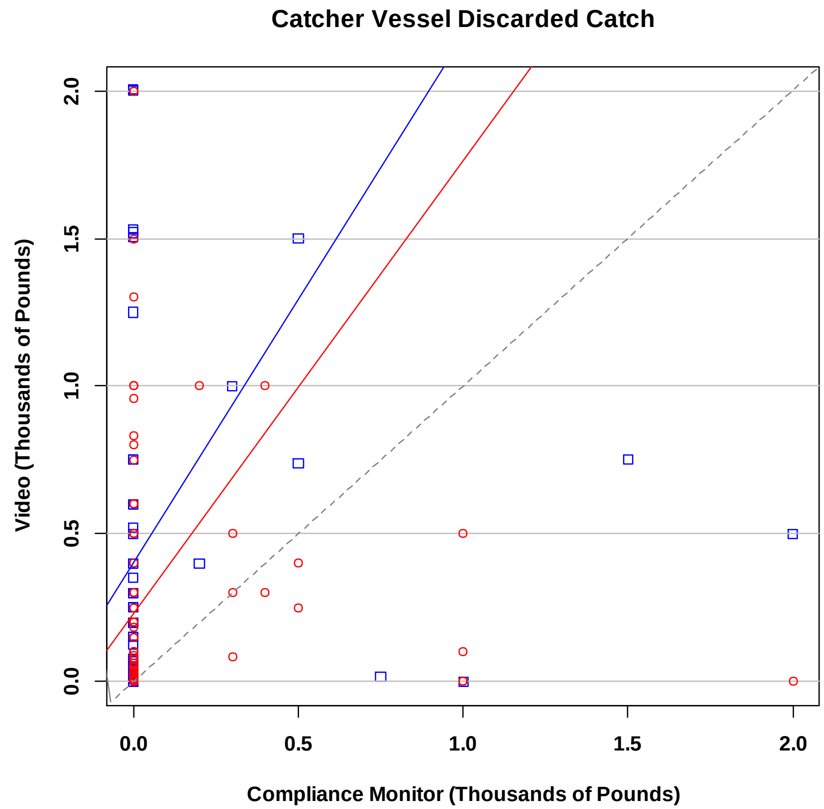


Figure 5. Mothership Catcher Vessel Fishery. Comparison of video retained catch weight to: a. compliance monitor and b. official catch from NORPAC retained catch weight of all species aggregated to the haul level. Each point represents a haul. Blue squares represent hauls brought onboard in the dark, red circles represent hauls brought onboard in daylight. The dashed line is the video = compliance monitor line. If video and compliance monitor weights agreed for a haul, the point for that haul would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor or official weights tend to be larger than video weights. If the trend line falls above the video = compliance monitor line, compliance monitor or official weights tend to be smaller than video weights.

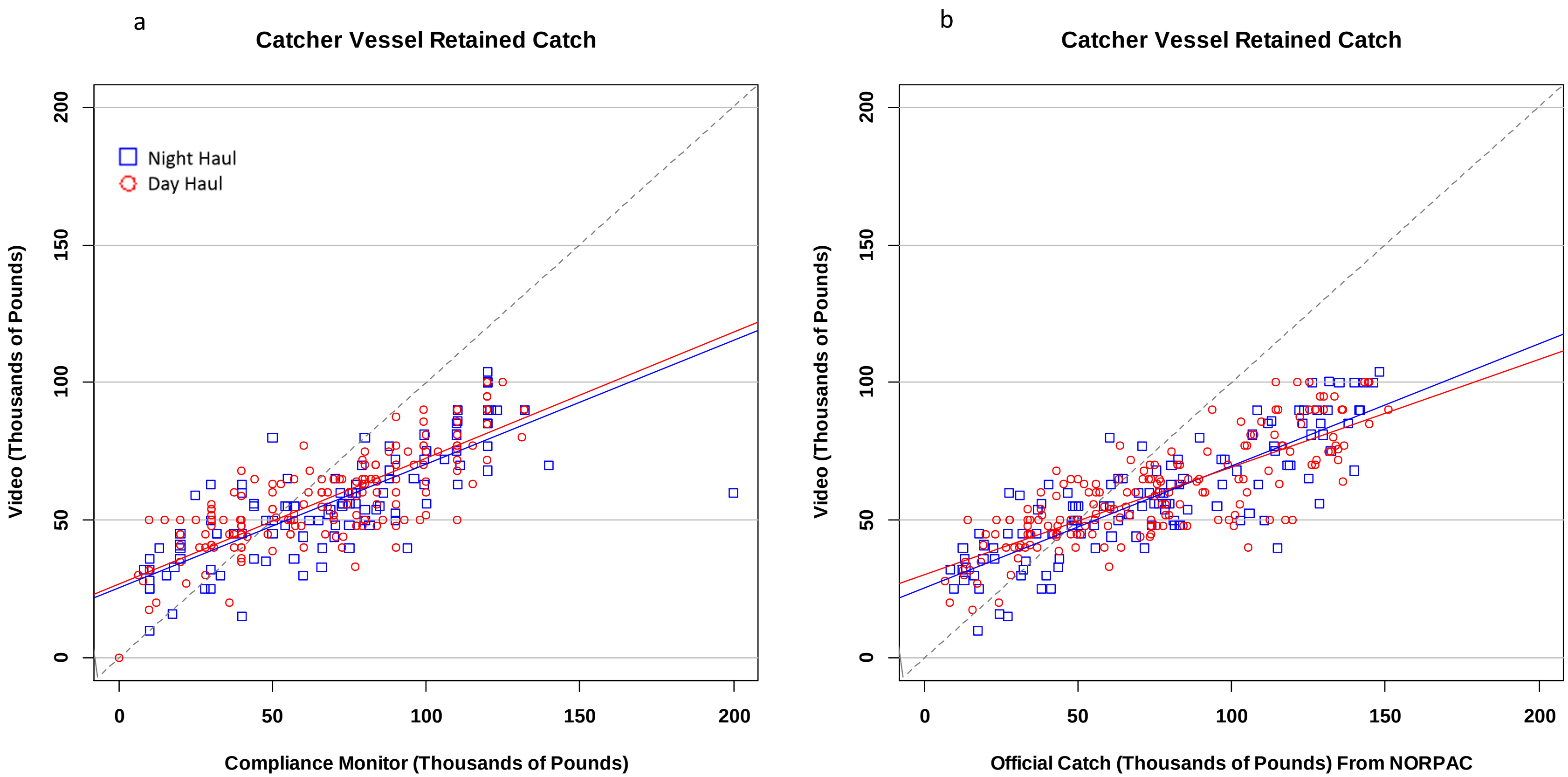
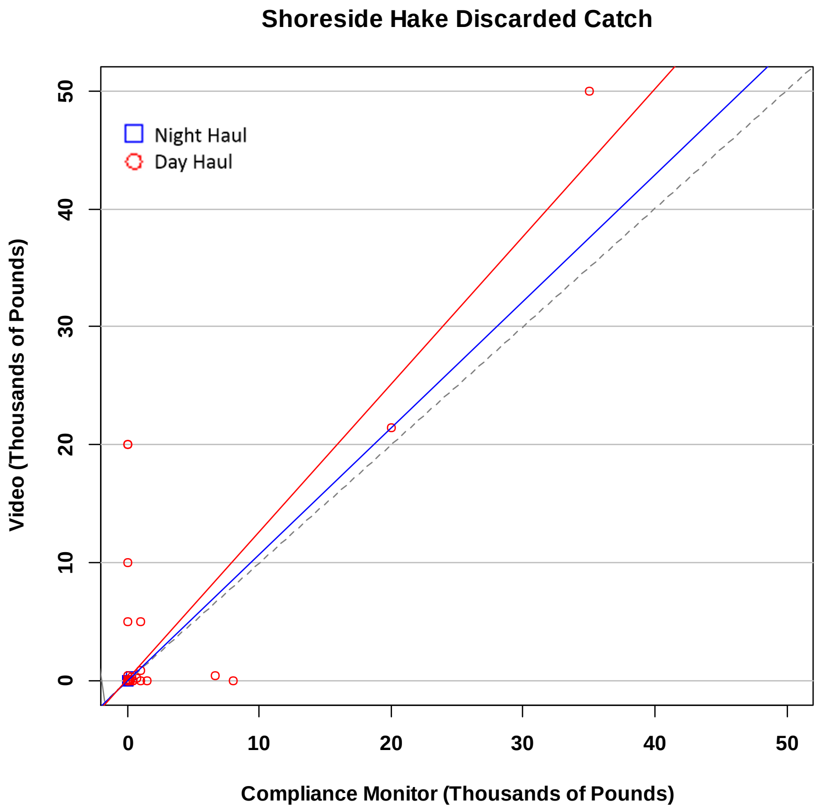


Figure 6. Shoreside Hake Fishery. Comparison of compliance monitor and video discarded catch weight of all species aggregated to the haul level. Figure b. is the same data as figure a. with different axis scales to show the data clustered in the bottom left corner of figure a. Each point represents a haul. Blue squares represent hauls brought onboard in the dark, red circles represent hauls brought onboard in daylight. The dashed line is the video = compliance monitor line. If video and compliance monitor weights agreed for a haul, the point for that haul would fall on the dashed line. If the data point falls below the video = compliance monitor line, compliance monitor weights are larger than video weights for that haul. If the data point falls above the video = compliance monitor line, compliance monitor weights tend to be smaller than video weights for that haul.

a



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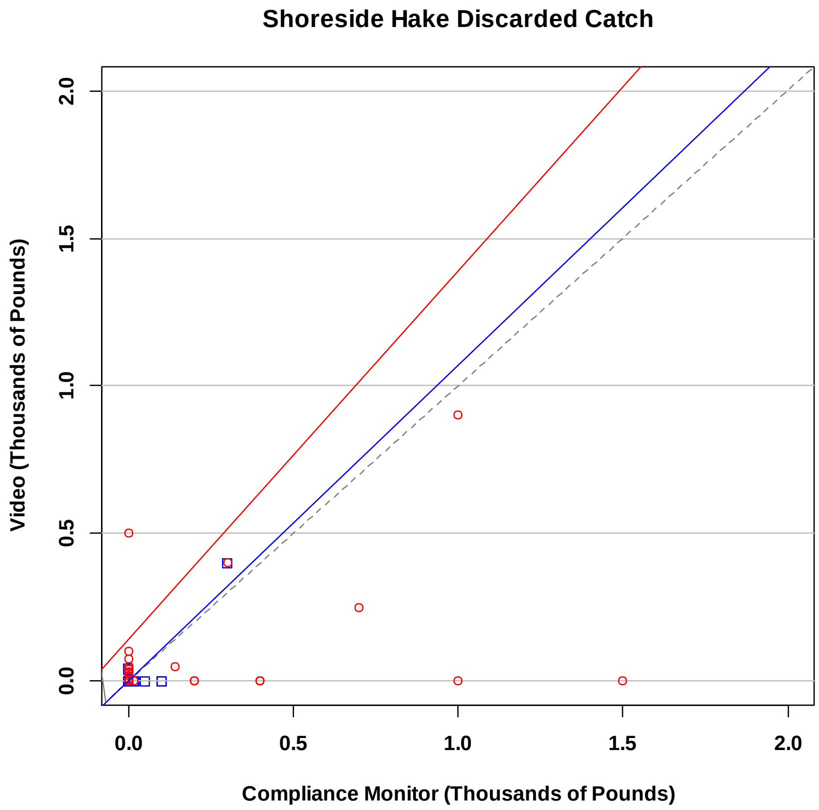
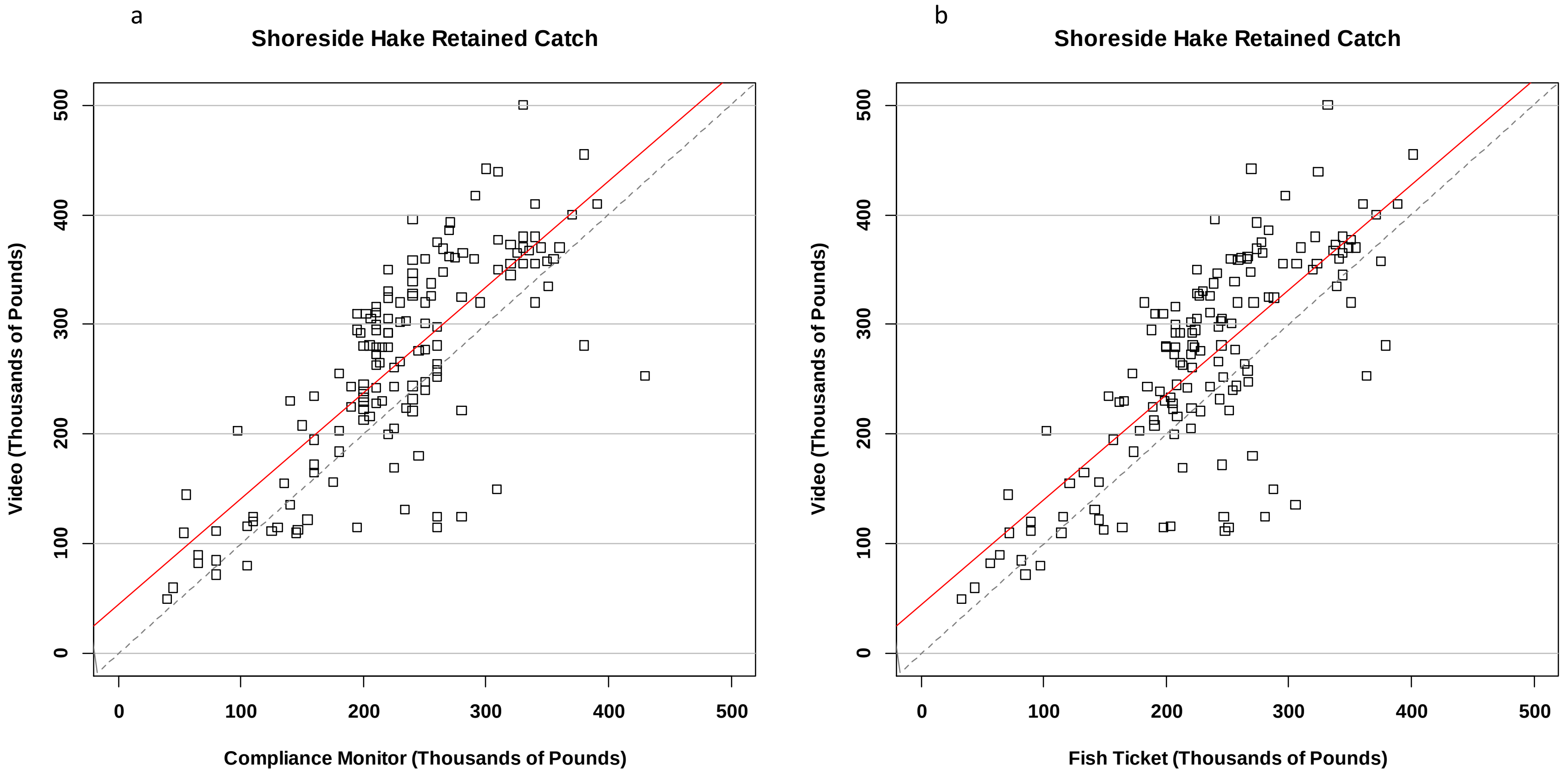


Figure 7. Shoreside Hake Fishery. Comparison of video retained catch weight to: a. compliance monitor and b. official fish ticket or landing receipt retained catch weight of all species aggregated to the trip level. Each point represents a trip. The dashed line is the video = compliance monitor line. If video and compliance monitor weights agreed for a trip, the point for that trip would fall on the dashed line. The solid line is a fitted trend line to give a snapshot of the relationship between the two datasets. If the trend line falls below the video = compliance monitor line, compliance monitor or fish ticket weights tend to be larger than video weights. If the trend line falls above the video = compliance monitor line, compliance monitor or fish ticket weights tend to be smaller than video weights.



GROUNDFISH ADVISORY SUBPANEL REPORT ON TRAWL RATIONALIZATION TRAILING ACTIONS

The Groundfish Advisory Subpanel (GAP) received a report from Mr. Jim Seger and Ms. Jaime Goen on trawl trailing action issues including the process for considering electronic monitoring (EM), the composition of the ad hoc EM workgroup, National Marine Fisheries Service's (NMFS) proposal for a more comprehensive review of pre- and post-trawl rationalization regulations, and Program Improvements and Enhancement (PIE) 2 clarifications. The GAP offers the following comments and recommendations.

Process for considering electronic monitoring

The GAP has commented on electronic monitoring numerous times. To paraphrase our previous statements, electronic monitoring remains a major priority for the GAP, and we feel that it can maintain or improve accountability, increase flexibility, and reduce costs.

Before making specific recommendations, the GAP offers the following overarching considerations:

- EM development should be approached with the primary purpose of bringing down costs of accountability and costs associated with missing trips when observers are not available.
- An EM system should not supplant the observer program. There should always be an opportunity to take an observer in lieu of using EM.
- The EM system should not be one size fits all. There will likely need to be different standards and requirements depending on gear type or fishery.
- We need to clarify our definition of discard. This issue is discussed in more detail in our April statement on trailing actions (Supplemental GAP Report, Agenda Item D.7.d, page 2, April 2013, attached).
- The EM system should be flexible and able to incorporate new technologies when they come on line.

The GAP reviewed the initial white paper and strongly supports the Tier 1/Tier 2 process and standards described therein. The GAP believes that performance standards are critical, as they present the opportunity to meet the needs of a monitoring program most flexibly and creatively and will allow for new technological developments to be incorporated into the system. The initial white paper is on the right track and will be incredibly useful in developing the framework for an EM system.

The GAP also reviewed the WDFW report on trailing actions. Overall, the GAP felt that the considerations and standards were well-thought out. However, the GAP has concerns about items 9-12 on page 3. The following comments illustrate GAP concerns:

#9 – Requiring a vessel to stay at the dock until a logbook is reviewed is unnecessary and much more stringent than our current process with observer data. Observer data is revised for months after a trip, yet fishing is allowed in the interim. What risk is alleviated by requiring users of an EM system to remain at dock until video review is complete? Any overages would still need to be covered as they need to be under the current system.

#10 – 10 percent may be the right number but other numbers should be considered as well. However, the GAP believes that fishing should be authorized upon submission of the video rather than review of the video.

#11 – The GAP believes that the trigger for 100 percent review should be unreported discard events rather than reporting outside the Washington Department of Fish and Wildlife proposed 10 percent accuracy standard. If the reviewed discard weights are under- or over-reported, the reviewer should simply input the correct value.

#12 – Another alternative to the issue of multiple logbook accuracy or non-report events may simply be to require the fisherman to carry an observer.

In summary, any or all of these requirements have the effect of creating an overly and unnecessarily onerous system that could prevent fishermen from fishing for long durations with little purpose.

Makeup of working group
The GAP supports its recommendation from April with two modifications. First, the GAP recommends inclusion of the GAP conservation representative on the working group. Second, the GAP recommends including an EM provider on the work group or technical team. Further, the GAP supports the formation of a formal technical team to advise the workgroup and ensure that appropriate officials are apprised of and involved in the conversations as they unfold.

Proposal to review pre and post trawl rationalization regulations
The GAP wholeheartedly supports NMFS' proposal to move away from piecemeal regulation modifications toward a more comprehensive approach to streamline the catch share program. The GAP believes it is imperative that gear regulation modifications, comprehensive Rockfish Conservation Area revisions, and other revisions that can enhance the conservation and economic outcomes of the program be considered and implemented as efficiently as possible, and this process will help us get there.

The GAP recommends clarifying the timeline between initial scoping (September 2013) and implementation (January 2015) to define when a final recommendation should be submitted.

PIE 2 clarifications
The GAP supports the proposal to eliminate the end-of-year (December 15-31) quota pound (QP) trading prohibition on QP transfers between vessel accounts. Recognizing that the proposal to allow trading of last year's quota in the current year is a new proposal and could not be included with PIE 2, the GAP recommends consideration of that option in PIE 3 or under the comprehensive approach mentioned above.

Agenda Item D.7.d
Supplemental GAP Report
April 2013

GROUNDFISH ADVISORY SUBPANEL REPORT ON Trawl Rationalization Trailing Actions – Electronic Monitoring Regulatory Process

Mr. Jim Seger briefed the Groundfish Advisory Subpanel (GAP) on the electronic monitoring (EM) regulatory process and provided a report on the February EM Workshop. The GAP offers the following comments and recommendations. The GAP would like to thank Mr. Seger and the Council for holding the February Workshop, and all of the attendees and presenters, especially Mr. Dave Colpo and Mr. Dayna Matthews. GAP members in attendance felt that it was a productive meeting and were heartened to see everyone working together toward a viable, cost-effective, flexible solution to the problem of high observer costs in the fishery. The GAP urges the Council to continue that momentum by voting to begin a formal EM process at this meeting, dedicating resources to scoping and analysis, and scheduling EM onto future Council meeting agenda so that it can be implemented as soon as possible.

Goals and objectives

In general, the GAP supports the goals and objectives described in the February Workshop Report (Agenda Item D.7.b, EM Workshop Report, April 2013). However, the GAP suggests modifying the workshop recommendation as follows:

- Move line 2, placing it between lines 9 and 10, and change the language to read "reducing observer costs for vessels that have relatively lower total revenue."

There was significant discussion about this line at the workshop. The GAP appreciates the intent behind it (i.e., to recognize fleet diversity), but recommends that it be a consideration while developing an EM program rather than one of the primary goals.

- Insert a new line 2 that reads, "increase flexibility for fishermen to time trips to weather windows and market opportunities;"

There has been a longstanding misconception that the fleet's interest in EM is based entirely on cost concerns and the inconvenience of having an extra person on board. While those are important considerations, many fishermen have also experienced difficulty in scheduling and obtaining observers leading to missed trips and lost revenue. Some fishermen have expressed interest in moving forward with EM even if costs are comparable to current observer rates. On that point, it should be noted that many of the preliminary discussions comparing human observer costs to EM have focused on the current costs of human observers. We have already seen those costs increase in the first two years of this program. Human observer costs have increased even more dramatically in other regions, and over time we can expect they will continue to increase in this region. In contrast, after the initial costs of EM program development and hardware, EM costs are likely to be relatively stable over time.

Guidance on developing a scoping package

In general, the GAP supports the recommendations and information requests found on pages iii-v of the Executive Summary of the EM Workshop Report.

Strawmen proposals

The GAP feels, however, that it is difficult to determine whether the proposals are adequate or how they might be modified to be more efficient without having a concrete understanding of the standards they were designed to meet. Therefore, the GAP recommends that the proposals be included when considering initial alternatives for public review and comment, but the GAP further recommends that the Council outline clear performance standards that a program must meet. This would not only facilitate discussion of ways the current proposals might be improved to best achieve the goals, but would also allow for consideration of completely new proposals that may prove more effective (and cost-effective).

The GAP notes that the language contained in the bottom trawl proposal on page 24 of the EM Workshop Report seems to make assumptions about whether or not EM will ultimately prove viable for bottom trawl vessels. The GAP does not feel that language is appropriate and requests that it be removed before the proposal go forward.

The GAP further notes that the fixed gear proposal described on page 25 of the report fails to differentiate between pot and longline gear. Because the operations are different, it may be necessary to have a separate proposal for each, but again, without clear performance standards it is hard to know.

Co-ops

The GAP appreciates the creative thinking that has gone into the co-op concept and believes it is something that should go forward for analysis. The devil will be in the details and the GAP firmly believes that this concept is one that should be carefully vetted by industry and other stakeholders.

Comments on PSMFC Study

The GAP supports the recommendations in the EM Workshop report, but adds one additional recommendation. We heard from Mr. Colpo that one of the principle reasons for discrepancies in the year-one PSMFC test between the EM data and the observer data is that it is not clear when fish should be counted against individual fishing quota (IFQ). The fundamental question is when is a fish caught? For example, what about fish that shake off at the rail? Or just below the rail? Or at the surface of the water? Or underwater but clearly visible? What about whiting that come out of the bag well behind the boat due to sloshing in rough weather? Or small fish that escape from the mesh when the net is coming up?

The EM system seems to be counting a different number of discard events and a different amount of pounds per event than human observers. It is therefore critical that before the EM data is compared to observer data for the year-two PSFMC test, that we have a clear understanding of the answer to this question. Otherwise, we will not have a fair comparison between EM and observer data, and any information gleaned will be almost useless for decision making purposes.

The GAP also heard that many of the initial vessels that had agreed to participate in PSMFC's 2013 bottom trawl EM study have backed out. Several members of the GAP have committed to line up replacement vessels for the study so that it can go forward in a meaningful way.

Adopting a regulatory process for moving forward

The GAP would like to see EM implementation as quickly as possible. In the timeline outlined on page vii of the Executive Summary of the EM Workshop Report, it looks like the earliest EM could be implemented is 2016, and only then if we perfectly meet all of the regulatory hurdles. At the same time, we understand that the observer subsidy is likely to decrease dramatically in 2014 (and possibly disappear entirely by 2015), and Amendment 20 cost recovery is likely to come into effect. Meanwhile, catch of target species remains low relative to overall actual catch limits. Taken in combination, negative repercussions for the fleet could be profound. With that in mind, the GAP urges the Council to think about ways to accelerate this EM development timeline.

One suggestion would be to consider an out of cycle EFP for the whiting fishery, and for fixed gear if it is ready to move forward on the same timeline. The GAP previously raised concerns with moving to a two-year EFP process for EFPs that don't require set asides, because we believe doing so "would likely impair flexibility and the opportunity to accelerate management improvement." (Agenda item E.4.b, Supplemental GAP Report, June 2011). Without taking action on the issue, several Council members recognized the concern of the GAP and recommended it be considered at a later date. The GAP believes the time is now.

On the issue of the workgroup to be appointed at the June meeting, the GAP recommends a small group of interested stakeholders (2 bottom trawl members, 2 midwater trawl, 1 fixed gear, 1 processor, chaired by PSMFC) with technical advisors coming from Council and Agency staff. Large groups are cumbersome and will not facilitate effective or timely decision making.

Other recommendations and comments

- The focus of EM needs to be on compliance monitoring.

- We don't need a Cadillac. We need an EM program that can be implemented in the near term that will bring down management costs and improve flexibility. At the same time, the program needs to be able to accommodate new technology as it comes online without having to go through a cumbersome amendment process.

- The GAP notes that any advances in EM by participants in the IFQ trawl program using fixed gear could facilitate and streamline later adoption of EM in the tiered sablefish program.

Conclusion

The GAP requests that the Council maintain EM as a high priority trailing amendment by voting to move forward with a formal process and scheduling EM on future Council meeting agendas. The GAP recommends convening a small group of interested and knowledgeable stakeholders to work on the issue. Finally, the GAP recommends clarifying who will lead the process, and highlights the importance of close coordination between that body and stakeholders.

PMFC
04/08/13

GROUNDFISH MANAGEMENT TEAM REPORT ON TRAWL RATIONALIZATION TRAILING ACTIONS

The Groundfish Management Team (GMT) had a presentation and discussion with the authors of the Initial Draft White Paper: Electronic Monitoring and Performance Standards (Agenda Item F.6.a, Attachment 2). The GMT had limited time for discussion and writing and only offer limited feedback at this time.

The paper provides a good overview of performance standards and how they compare to other regulatory approaches. Yet we do not think this is a matter of using performance standards or not, which is the way some discussions seem to go. An electronic monitoring (EM) program would involve several design elements and there would likely be a mixture of performance standards and other approaches from element to element. A structured program development approach where goals are made more specific and then looked at for how well they can be achieved and measured (for example with performance standards vs. prescriptive regulations) would be helpful for structuring discussions. Jim Seger (Council staff) had such an approach in the presentation he gave to the team. As noted in the Washington Department of Fish and Wildlife (WDFW) report (Agenda Item F.6.b, WDFW Report), the term “performance standard” can mean different things to different people. Even in our brief discussion, differences in terminology popped up.

We had some discussion about the proposed composition of the work groups. The GMT suggests that the composition of these groups will be dependent on decisions that the Council makes. For example, if the Council chooses to consider all individual fishing quota (IFQ) sectors to use EM technology, then it would be worthwhile to have representatives from all IFQ sectors as well as an observer provider representative involved. If the work groups include hardware providers, the GMT sees benefit in having more than one. The proposed calendar is similarly dependent on what the Council decides.

PFMC
06/21/13

Agenda Item F.6.b
Supplemental NMFS Report
June 2013

PROPOSAL TO REVIEW PRE- AND POST-TRAWL RATIONALIZATION REGULATIONS

Before implementation of the trawl rationalization program in 2011, regulations governing the groundfish trawl fleet were built around monthly, bi-monthly, and per vessel trip limits to address a variety of Council concerns, including: minimizing bycatch, maintaining a year-round fishing season, better accounting for total groundfish catch, and administrative challenges associated with managing licensed and unlicensed fisheries. The trawl rationalization program replaced the need for some, but not all, of the trip limit structure in the regulations. Some of the remaining trip limit framework regulations may be less efficient and effective under an individual quota framework.

NMFS is supportive of continuing the Council's efforts to revise the regulations and gain flexibility and efficiency in the program. In an effort to implement trawl trailing actions in a timely manner, NMFS proposes a process where trawl program changes are considered more comprehensively with similar provisions analyzed and implemented together– rather than reviewing regulations one-by-one, each with its own analysis. Taking into account the recommendations of the Council's Trawl Rationalization Regulatory Evaluation Committee (TRREC) and public feedback at Council meetings, NMFS proposes to conduct a broad review of federal regulations applying to the groundfish trawl fishery (Figure 1) to assess:

- The utility of particular regulations in addressing conservation and management priorities;
- Whether measures remaining from the old trip limit framework unnecessarily decrease flexibility, reduces efficiency, or increase regulatory complexity and, if so, how those measures might be amended.

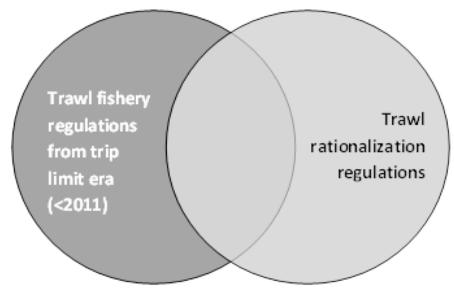


Figure 1: Current federal trawl regulations subject to review for flexibility, efficiency, and complexity

To begin this review, NMFS proposes the following for consideration by the Council, its advisory bodies, and the public at the September 2013 Council meeting during scoping for future trawl trailing actions:

> A draft Purpose and Need statement for Council deliberation on an action to increase flexibility, improve efficiency, and reduce regulatory complexity. The NMFS report on this "trawl flexibility" action would include a summary of current trawl regulations that restrict the fishery to start the Council discussion on the scope of this action. In general, the summary of regulations would be organized by the following restrictions: how much fish can be caught, when fish can be caught, where fish can be caught, who can catch (and process) the fish, and what gear can be used to catch the fish. The current trawl regulations in the report would also include a list of corresponding Council recommendations not yet implemented and TRREC recommendations.

NMFS would review and discuss these documents with Council staff before the September 2013 Council meeting. Depending on the outcome from the September 2013 meeting, the Council could make draft and final recommendations in 2014, with the earliest potential effective date of January 1, 2015.

In 2013, NMFS suggests moving away from annual program improvement and enhancement (PIE) rules that include all trawl trailing actions (see 5 rulemakings in Agenda Item F.1.b, Supplemental NMFS Report). This "trawl flexibility" action would continue the transition away from annual PIE rules. The PIE rules could continue as minor changes or corrections to the regulations. Ultimately, if Amendment 24 separates analysis of groundfish management measures from the harvest specifications, then management measures for all groundfish sectors, including the trawl fishery could be evaluated together.

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON TRAWL RATIONALIZATION TRAILING ACTIONS

Mr. Jim Seger (PFMC) and Mr. Colby Brady (NWR) briefed the Scientific and Statistical Committee (SSC) regarding the "Initial Draft White Paper: Electronic Monitoring and Performance Standards". The SSC also reviewed the "Final Report for the Electronic Monitoring Program: Review of the 2012 Season" prepared by the Pacific States Marine Fisheries Commission.

The white paper provides a synthesis of considerations regarding the use of performance standards versus more traditional types of regulations. This is a rather large and complex topic, and the authors of the white paper should be commended for their efforts to clearly summarize many of the relevant issues. In theory, regulating through performance standards may be relatively advantageous in terms of cost effectiveness. However, as the white paper points out, the verification of compliance with performance standards may be difficult or costly to implement. The SSC recommends that the next draft of the white paper, expected at the September 2013 Council meeting, focus more sharply on this issue.

The white paper indicates there is little information available regarding similar regulations in other fisheries, or analyses that compare the costs and outcomes associated with different regulatory approaches. Given the enormity and importance of these topics, the SSC recommends the authors make a concerted effort to discover any relevant information, if it exists. Without more information it is difficult to provide guidance on how these regulatory approaches may work in actual practice.

The cost of the human observer program is an important driver in the exploration of electronic monitoring. A comprehensive benefit-cost analysis of the alternatives, taking into account all significant factors, would be necessary to determine the net relative advantages of the various options. The total cost should be evaluated, including a delineation of costs borne by industry and costs borne by the public. This is necessary so the total societal cost and its distribution can be evaluated.

The Final Report for Electronic Monitoring does not address the primary question the SSC raised in our April 2013 statement, namely why are there differences between catch (both retained and discarded) measured by electronic monitoring and human observers. In addition, because no additional information was provided to the SSC for this Council meeting, it is unclear whether the electronic monitoring testing being conducted this summer will address the comments we provided previously regarding the efficacy of the system at the April 2012 Council meeting (Agenda Item I.4.c, Supplemental SSC Report, April 2012).

PFMC
06/22/13

Agenda Item F.6.b
WDFW Report
June 2013

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON TRAWL RATIONALIZATION TRAILING ACTIONS

At its April meeting, the Pacific Fishery Management Council discussed the potential for allowing vessels to use electronic monitoring systems (i.e., video cameras) as a means of fulfilling the mandatory observer coverage requirement of the Trawl Rationalization Program. At that meeting, the Washington Department of Fish and Wildlife (WDFW) proposed, and the Council unanimously accepted, creating an ad hoc workgroup comprised of agency staff to develop a white paper that would discuss ideas for performance standards for the Electronic Monitoring (EM) Program for the September meeting.

In reviewing the issue, we felt like the Council left some ambiguity in the term "performance standards" with it potentially referring to various features and goals of an EM Program. There was little discussion and guidance provided by the Council about what the white paper should address. WDFW suggests that the Council provide that guidance at this meeting.

As we expressed in April, the mandatory observer coverage requirement is key to achieving the Trawl Rationalization Program's primary benefits of groundfish conservation and individual accountability. It is imperative that an EM Program be thoughtfully designed, carefully considered, and stringently applied so as to not compromise these objectives.

An EM Program can be structured and implemented with varying degrees of success. There are many factors to consider in designing and implementing an EM Program, including differences in gear types and vessel operations, and the strength of accompanying management measures, including disincentives and consequences for violations. Whether an EM Program can be successfully designed and prosecuted in a cost-effective manner, or in a way that results in cost savings to vessel operators, is an outstanding question.

In order to preserve the conservation and accountability aspects of the Program, the EM Program must accurately capture discard events (i.e., whether discard has occurred), amount of discard (i.e., volume in weight and size of individual fish), disposition of discard (i.e., if we are to consider providing survivability credit for released fish, such as halibut), and do so even for rare events (e.g., catch and discard of rebuilding rockfish, by species). The Council should develop and adopt performance standards to ensure these highest level monitoring goals are met.

In addition, when considering the design of an EM Program and discussing performance standards, the Council must consider the economic incentives to misreport or underreport catches and mortalities of overfished rockfish and Pacific halibut. Individual accountability in the fisheries will hold only so far as monitoring programs are able to counteract these incentives. As such, having adequate enforcement to ensure compliance with the EM Program with strong consequences in place for violations are keys to success. We think it will be very important to provide the law enforcement perspective upfront during the design of the program.

Again, in an effort to begin the thought process and conversation about an EM Program with the Council, its advisory bodies, and the public, we offer the following items for consideration relative to potential management measures, camera requirements, and a video compliance monitoring process. We would recommend that the white paper on performance standards discuss the following issues:

<u>Possible Elements/Conditions of Participating in an EM Program</u>

1. Mandatory retention of all rockfish.
    a. Maximum limit on tow time;
    b. Intentional or unintentional "bleeding" of the net not allowed, not even minimal;
    c. If a bleeding event does occur, magnitude of event should be estimated and quota deducted from the vessel's account.

2. Other groundfish discard could be allowed if discarded in a controlled manner, e.g. a designated discard platform so that discarded fish pass under the view of a camera, so that species and weight can be determined.

3. Mandatory recording of discards in logbooks with estimated weights given for each species.
    a. Disincentives for underreporting (e.g., 10% or more difference between logbook and video estimates, by species)

4. Disincentives for tampering with video equipment or turning camera off.

5. Provisions for camera failures or inoperability.

<u>Camera Requirements</u>

6. Number and placement of cameras must be capable of detecting potential discard events from any deck or surface of the vessel.

7. Camera resolution must be sufficient to accurately determine amount (volume in weight) of discard by individual species (i.e., size of individual fish and volume of groups of fish).

8. Camera and software must accurately capture activities occurring at night or times of low visibility (e.g., motion detecting).

Video Review Process

9. Mandatory (high percentage of trip time) review of video to compare logged discard events to video (at vessel account holder expense); vessel cannot commence another fishing trip until video has been reviewed and trip logbook is certified.

10. Logbook certification is achieved if video review determines that logbook amounts are within 10% accuracy of video review, by species (e.g., logbooks record 500 lbs and video estimates 550 lbs).

11. If logbook amounts do not meet 10% accuracy standard, then a 100% video review is triggered (at vessel account holder expense); vessel cannot commence another fishing trip until video has been reviewed and vessel account has been debited.

12. If the 100% video review is triggered more than twice within a six-month time period, then 100% video review is in effect for all fishing trips for the six months following the commencement of fishing activity.

CONSIDERATION OF 2015-2016 AND BEYOND HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES

At the June meeting, in odd years the Council has adopted a detailed process and schedule governing the development of harvest specifications and related management measures for the ensuing biennial period. For a variety of reasons, since 2003 the National Marine Fisheries Service (NMFS) has determined that this action should be evaluated in an environmental impact statement (EIS) pursuant to the National Environmental Policy Act (NEPA). Combined with the procedures required for NMFS to issue regulations and, in most cases, to review and approve an amendment to the Pacific Coast Fishery Management Plan as part of the action, timely implementation has become difficult, if not impossible.

In response, over the past few years the Council and NMFS have been examining these process problems and considering methods to both simplify Council decision-making and the related analyses required by the Magnuson-Steven Fishery Conservation and Management Act, NEPA, the Administrative Procedure Act, and other applicable laws. This has culminated in proposing several changes to the Council decision-making and NEPA processes. First, the 2015-2016 harvest specifications EIS will include an evaluation of the long-term environmental impacts of setting harvest specifications and management measures (along with the impacts of specifications and management measures for 2015-16). This long-term impact analysis is expected to allow streamlined evaluation of future harvest specification actions (staring with the 2017-18 biennial period). Second, a framework for computing "default" harvest specifications, which would serve as a starting point for Council decision-making, would be incorporated into the FMP through Amendment 24, also part of the proposed action. Clearly specifying this framework in the FMP is expected to allow the Council to consider a narrower range of alternatives for harvest specifications. Third, through revisions to Council Operating Procedure 9, the Council would commit to only recommend adjustments to "routine" management measures (those already in regulation) with limited scope to recommend new management measures needed to address immediate stock conservation problems. Since the routine measures have been previously analyzed, such adjustments require less analysis. Non-routine new management measures would be separated from the normal binomial process and occur via a distinct, non-concurrent process. While the EIS evaluation of long-term impacts would pay off in future biennial cycles, the Council should be able to use the default harvest specification framework and narrowed scope of management measures for this cycle. At the March 2013 meeting the Council confirmed its intent to move forward with these initiatives.

Because of the Council's interest in the analytical approach that will be used in the EIS to evaluate the specific actions for the 2015-2016 cycle and the long-term impacts of setting harvest specifications, Council and NMFS staffs have developed a detailed annotated outline of the EIS at this early stage (Attachment 1). Since the April meeting, subject matter experts from NMFS Northwest Region, the Northwest Fisheries Science Center, and the Groundfish Management Team have been asked to review a draft of the EIS table of contents and an annotated outline the analytical framework. The current version reflects revisions responding to their comments. In particular, the Council should review the range of alternatives described in the outline, because subsequent major modifications or additions could make it more difficult to complete the EIS in time.

Over the past year, the Scientific and Statistical Committee's (SSC) Economics and Groundfish Subcommittees have been reviewing the projection models used to evaluate biological and socioeconomic impacts of groundfish harvest specifications and associated management measures. A summary of these reviews will be provided as a supplemental attachment. It is expected that the full SSC will review this report and provide recommendations on the use of these models.

The proposed schedule for Council decision-making on these initiatives and subsequent implementation is contained in Attachment 3. This schedule is closely patterned after that used for the 2013-2014 harvest specifications. Note that, like the cycle, the draft EIS (DEIS) would be circulated before the June 2014 Council meeting, when final action is scheduled. If the Council's final preferred alternative represents "substantial changes in the proposed action that are relevant to environmental concerns" (40 CFR 1502.9(c)) NMFS may have to recirculate the DEIS, delaying implementation. Council staff will continue working with NMFS to find efficiencies that would allow the DEIS to come out after the June 2014 meeting but allow the regulations to become effective by January 1, 2015. Doing so would reduce the chance that he DEIS would have to be recirculated. As alluded to above, more streamlined NEPA analyses for future biennial harvest specifications are intended to reduce the amount of time needed between Council final action and NMFS implementation of the regulations. It is expected that in future cycles this type of constraint would not be imposed on the June final action.

While the Council will formally adopt revisions to the groundfish management process by changing Council Operating Procedure 9 under Agenda Item D.6, the proposed revisions are introduced here as Attachment 2. This allows the Council and its advisory bodies to provide substantive input at this point on the proposed changes. In the intervening time between agenda items F.7 and D.6, a revised draft could be prepared for consideration of final action to be taken under Agenda Item D.6.

Council Action:

1. **Review the EIS Annotated Outline and Range of Alternatives Adopted in March 2013.**
2. **Approve Projection Models for Use in Evaluating Harvest Specifications and Management Measures.**
3. **Adopt a Schedule for the Development of 2015-2016 Harvest Specifications and Management Measures and Associated Analysis of Long-Term Impacts.**
4. **Review and Discuss Proposed Revisions to Council Operating Procedure 9.**

Reference Materials:

1. Agenda Item F.7.a, Attachment 1: Draft Annotated Outline for the Harvest Specifications EIS.
2. Agenda Item F.7.a, Attachment 2: Proposed Revisions to COP 9.
3. Agenda Item F.7.a, Attachment 3: Schedule for Developing Groundfish Harvest Specifications and Management Measures.
4. Agenda Item F.7.b, WDFW Report.

Agenda Order:

a. Agenda Item Overview — Kit Dahl
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action**: Review Environmental Impact Statement Approach and Range of Alternatives for Amendment 24 Harvest Control Rules; Approve Relevant Projection Models; Adopt Schedule for Deciding 2015-2016 Harvest Specifications and Management Measures; and Consider Council Operating Procedure 9 Modifications

PFMC
06/03/13

Draft Annotated Outline / Analytical Framework

GROUNDFISH HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES AND AMENDMENT 24: DRAFT ENVIRONMENTAL IMPACT STATEMENT

Evaluation of Harvest Specifications and Management Measures For the 2015-2016 Biennial Management Period and Biennial Periods Thereafter
And
Amendment 24 to the Pacific Coast Groundfish Fishery Management Plan Establishing a Process for Determining Default Harvest Specifications

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Acknowledgements

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1 Introduction

1.1 How this Document is Organized

This document provides information about, and analyses of, setting groundfish harvest specifications and establishing related management measures for 2015 and subsequent years for fisheries covered by the Pacific Coast Groundfish Fishery Management Plan (FMP), which are developed by the Pacific Fishery Management Council (Council) in collaboration with the National Marine Fisheries Service (NMFS). Groundfish harvest specifications are set every 2 years for a 2-year period. In addition to harvest specifications and management measures for the 2015-16 biennial period, this document evaluates the impacts of setting harvest specifications and management measures over the long term. These actions must conform to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the principal legal basis for fishery management within the Exclusive Economic Zone (EEZ), which extends from the outer boundary of the territorial sea to a distance of 200 nautical miles from shore. The states manage their fisheries, including nearshore rockfish fisheries in the territorial sea, in a manner consistent with, or more restrictive than, the Groundfish FMP and Federal implementing regulations.

In addition to addressing MSA mandates, this document is an environmental impact statement (EIS), pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended. This document is organized so that it contains the analyses required under NEPA. The proposed action must also comply with other applicable laws, which are enumerated in Chapter 6. While this EIS provides supporting information, the procedural and analytical requirements for legal mandates other than NEPA (including findings made by NMFS) may be addressed in other documents (see Chapter 6).

The EIS is organized in the following chapters and appendices:

- Chapter 1 explains why the action is being considered for the groundfish fisheries in 2015-16 and subsequent biennial cycles, including revisions to established groundfish rebuilding plans. The purpose and need statement defines the scope of the subsequent analysis.

- Chapter 2 outlines the No Action and action alternatives that have been considered to address the defined purpose and need. The Council recommends a preferred alternative from among these alternatives, which provides the basis for establishing or revising the harvest specifications and management measure regulations governing groundfish fisheries in 2015–16. These alternatives also serve as the basis for evaluating the long-term impacts of setting harvest specifications and management measures.

- Chapter 3 describes the environmental components affected by the proposed action, which are groundfish and other marine fish, fishery sectors, fishing communities, protected species, essential fish habitat (EFH), and the marine ecosystem.

- Chapter 4 describes the direct, indirect, and cumulative effects of the proposed action, including the No Action and preferred alternatives, on the environmental components described in Chapter 3.

- Chapter 5 details how this action meets 10 National Standards set forth in the MSA (Section 301(a)) and groundfish FMP goals and objectives, as well as MSA-related scoping requirements and public meeting opportunities afforded through the Council process.

- Chapter 6 provides information on those laws and executive orders, in addition to the MSA, with which an action must be consistent. This chapter also describes in greater detail the NEPA process for this action, including all of the steps (Notice of Intent, scoping process under NEPA, etc.) required by the Council on Environmental Quality (CEQ) and NOAA Administrative Order (NAO) 216-6.

- Chapter 7 is the bibliography.

- Appendix A, Model Documentation, documents the models and methods used to estimate potential catches (harvest impacts) under the alternatives, and related effects on personal income and employment in fishing communities.

- Appendix B, FMP Amendment Language, contains changes to the Groundfish FMP proposed by the Council as part of the proposed action.

When implemented, the 2015-16 harvest specifications and management measures will succeed those established for the 2013-2014 biennial period.

1.2 Proposed Action, Purpose and Need

1.2.1 The Proposed Action

Using the "best available scientific information," the proposed action is to establish harvest specifications every 2 years, including the overfishing limits (OFLs), acceptable biological catches (ABCs), and annual catch limits (ACLs) for each management unit[1], consistent with the policies and procedures the Council has established for these actions and the requirements of the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP); the Magnuson-Stevens Act (MSA)—particularly the 10 National Standards enumerated in §301(a) of the MSA; and other applicable law.

To evaluate environmental impacts, estimates of harvest specification values for a 10-year period (2015-24) are evaluated in Chapter 4. Because harvest specifications must be based on the best available science, and one or more new or updated stock assessments become available every 2 years, NMFS has determined that harvest specifications will be published in Federal regulations every 2 years for the subsequent 2-year period. However, the evaluation of the long-term impacts of setting harvest specifications and related management measures for the foreseeable future is intended to encompass the range of likely impacts that could occur over more than just the next biennial management period (2015-16). Section 6.6 discusses the methods that will be use to evaluate unforeseen environmental impacts in future biennial periods (2017-18 and subsequent).

Seven Pacific Coast groundfish species are currently "overfished" and managed under rebuilding plans implemented by secretarial amendment. Within the rebuilding plans, T_{TARGET} is the key rebuilding parameter. T_{TARGET} is the projected year by which an overfished species will be rebuilt. Any change to T_{TARGET} must be demonstrated by the need to rebuild the stock in as short a time as possible, taking into account the status and biology of the stock, the needs of fishing communities, and the interaction of the stock within the marine ecosystem.

Every 2 years the Council will consider the best available scientific information (principally new or updated stock assessments) and determine whether it is necessary to adjust any of the existing harvest

[1] Management units are stocks occurring throughout the west coast EEZ ("coastwide"), geographic subdivisions of stocks in the EEZ, and geographically subdivided stock complexes composed of more than one managed species.

specifications or management measures necessary to achieve but not exceed ACLs.[2] Adjustments to harvest specifications may involve changing the underlying harvest control rule. These adjustments must be consistent with the MSA and the Groundfish FMP.

In the absence of explicit Council action, harvest specification values based on default harvest control rules for one or more stocks may be published in Federal regulations. The Council is establishing criteria for determining these default rules through Amendment 24 to the Pacific Groundfish FMP, which is part of this proposed action. During any biennial decision-making process the Council may depart from these default values by deciding to modify the harvest control rule for one or more management unit.

1.2.2 Purpose and Need

The purpose of the proposed action is to conserve and manage Pacific Coast groundfish fishery resources to prevent overfishing, to rebuild overfished stocks, to ensure conservation, to facilitate long-term protection of essential fish habitat (EFH), and to realize the full potential of the Nation's fishery resources (MSA §2(a)(6)). These harvest specifications are set consistent with the optimum yield (OY) harvest management framework described in Chapter 4 of the Groundfish FMP.

In addition to the above conservation objective, the use of default harvest control rules (Amendment 24) coupled with the evaluation of the long-term impacts of the action is needed to streamline the administrative and regulatory processes involved in setting specifications for the Pacific Coast groundfish fishery, while, at the same time, maintaining consistency with the MSA and other applicable law. Evaluating the environmental impacts of setting harvest specifications and apportionment of harvest levels (described in Groundfish FMP Chapter 5) and related fishery regulations (described in Groundfish FMP Section 6.2), as needed, over the long term will make the regulatory process more efficient and provide more information to stakeholders about the future status and management of fisheries. The application of default harvest control rules is expected to reduce the scope of evaluation required by NEPA in subsequent biennial cycles. The initial evaluation of the range of impacts expected over the long term will be followed up with focused evaluation when regulations are periodically adjusted. The long-term identification of harvest specifications should meet the following objectives:

- Maintain or improve the timeliness of scientific input into the decision-making process.
- Articulate and apply adaptive management principles, which are embodied in the Groundfish FMP, when evaluating the effects of periodic changes.
- Build workload assessment and priority setting into the process for identifying and recommending management measures, consistent with administrative resources and conservation objectives.
- Incorporate guidance on preparing efficient and timely NEPA reviews, including tiering of environmental documents and incorporation by reference.[3]
- Include decision-making procedures for setting harvest specifications that allow reasonably accurate forecasts of impacts for a period longer than 2 years. This could involve the Council adopting default procedures for setting harvest specifications (which the Council could override if circumstances warrant).
- Present information to decision-makers and the public in an effective and usable format.

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[2] "Harvest control rule" means the methods adopted to determine harvest specifications, based on criteria in the MSA and Groundfish FMP. Harvest specifications are the numerical values determined by applying the harvest control rule (or harvest policy) to the best available scientific information about the status and characteristics of a stock or management unit.

[3] See the March 6, 2012 Memorandum from Nancy H. Sutley, Chair, Council on Environmental Quality, on this topic.

- Ensure a transparent process where decisions and their rationale are clearly explained to the public and the public has the opportunity to provide meaningful input.
- Build an administrative record that effectively explains the rationale for the decision.

To the degree possible, periodic adjustments to these harvest specifications should involve small changes from the harvest management objectives of the previous period so as to minimize socioeconomic disruption.

1.2.3 The Action Area

Federally-managed Pacific groundfish fisheries occurring within the EEZ off the coasts of Washington, Oregon, and California (WOC) establish the geographic context for the proposed action. West coast communities engaged in these fisheries are also part of the context (see Figure 1-1). Although this is the Federal action area, the states manage the fisheries in the territorial sea to meet the goals and objectives of the Pacific Groundfish FMP.

Figure 1-1.The action area, showing major coastal communities and groundfish management areas.

1.3 Background on Issues Addressed in this EIS

1.3.1 Long-term Analysis

The adoption and adjustment of regulations for managing the groundfish fishery (including harvest specifications and management measures) is an ongoing, adaptive process. Changes in the type and intensity of environmental impacts tend not to differ substantially from one period to the next. With this view in mind, this document evaluates the impacts of the ongoing action over a longer time period than 2 years. Biennial changes to the management program that fall outside the scope of analysis of this document would then be subject to more focused analyses based on Council on Environmental Quality (CEQ) guidelines for supplementing (See 40 CFR 1502.9(c)(1)) and/or tiering from a previously prepared NEPA document (40 CFR 1502.20).

When harvest specifications (and related management measures) are periodically adjusted NMFS will determine whether to supplement the long-term impact analysis in this EIS or prepare a tiered NEPA analysis.

1.3.2 Amendment 24 and Default Harvest Specifications

Federal regulations state "Harvest specifications include OFLs [overfishing limits], ABCs [acceptable biological catch], and the designation of OYs and ACLs [annual catch limits]. Management measures necessary to keep catch within the ACL include ACTs [annual catch target], harvest guidelines (HGs), or quotas for species that need individual management, and the allocation of fishery HGs between the trawl and nontrawl segments of the fishery, and the allocation of commercial HGs between the open access and limited entry segments of the fishery. These specifications include fish caught in state ocean waters (0–3 nm offshore) as well as fish caught in the EEZ (3–200 nm offshore). Harvest specifications are provided in Tables 1a through 2d of this subpart." (50 CFR 660.65)

Current policies for setting harvest specifications as outlined in Chapter 4 of the Groundfish FMP are:

- The F_{MSY} harvest rate is applied to projected exploitable biomass for determining the OFL.
- The OFL is reduced to the ABC by applying P* and sigma. The Council determines P* on a case-by-case basis for each biennial cycle. Sigma is determined by the SSC and may be periodically revised based on new scientific information.
- For healthy stocks (above the B_{MSY} proxy, $B_{40\%}$ for non-flatfish or $B_{25\%}$ for flatfish), the ACL is set equal to the ABC.
- For stocks in the precautionary zone (below the B_{MSY} proxy but not overfished and managed under a rebuilding plan), the ACL is determined using the 40-10 rule for non-flatfish and the 25-5 rule for flatfish.
- For overfished/rebuilding stocks (fell below the minimum stock size threshold and not yet rebuilt to B_{MSY} proxy), a rebuilding plan identifies a target rebuilding year (T_{TARGET}) and associated harvest control rule (e.g., SPR harvest rate). Rebuilding plans may be revised in the following circumstances:
    - If new information shows that the target year in the rebuilding plan is less than the recomputed value of $T_{F=0}$ (the minimum possible rebuilding time) or greater than T_{MAX} (the maximum permissible rebuilding time).
    - If new information shows the harvest control rule specified in the rebuilding plan would result in a target year later than the currently specified year (but less than T_{MAX}) (or put another way, the probability of rebuilding by the current target year is less than 50%).
    - If new information indicates that the rebuilding plan is likely to result in disastrous short-term consequences to fishing communities.

According to Groundfish FMP section 4.6.3.3, "the year in which the stock would be rebuilt is based on the application of stock rebuilding measures that achieve rebuilding as soon as possible, taking into account the status and biology of the stock, the needs of fishing communities, and the interaction of the overfished stock within the marine ecosystem (T_{TARGET})."

Amendment 24 would incorporate into the Groundfish FMP a description the process for establishing and changing default harvest control rules as part of the biennial management framework. An FMP framework that incorporates default harvest control rules could substantially reduce the workload associated with adopting new harvest specifications. These defaults are a way to characterize "no action" as the application of current harvest control rules (harvest policies) to "new science." For any stock (or other management unit) the Council does not need to take explicit action if they want to continue the current harvest policy. In these cases the current harvest control rule (i.e., that used in the previous biennial period) is applied to the best available scientific information to determine the numerical values of the harvest specifications for each stock. However, the Council may take explicit action to depart from default harvest control rules (those from the previous biennial period with adjustments for changes in stock status), based on relevant considerations. Prior to adopting harvest specifications, the Council will announce for which stocks they intend to take explicit action.

1.3.3 New Stock Assessments including Data Moderate Assessments

This section proves a brief inventory of new stock assessments and catch reports, and describes the data moderate assessment methodology.

Table 1-1. Summary of new stock assessments and catch reports conducted in 2013 to inform management for 2015 and beyond.

Stocks with Full Assessment	Stocks with Data-Moderate Assessment	Stocks with Update Assessment	Stocks with Catch Reports
Aurora Rockfish	Brown Rockfish	Bocaccio S of 40º10' N lat.	Canary Rockfish
Cowcod S of 40º10' N lat.	China Rockfish		Pacific Ocean Perch
Darkblotched Rockfish	Copper Rockfish		Yelloweye Rockfish
Longspine Thornyheads	English Sole		
Pacific Sanddabs	Rex Sole		
Petrale Sole	Sharpchin Rockfish		
Rougheye Rockfish	Stripetail Rockfish		
Shortspine Thornyheads	Vermilion Rockfish		
	Yellowtail Rockfish		

1.3.4 Reorganization of Stock Complexes

The action will be evaluated in a separate NEPA document. The results of Council decisions on stock complex reorganization will be summarized here.

1.3.5 Rebuilding Plan Revisions [and/or new rebuilding plans]

This section summarizes any required rebuilding plan changes. Also describe any SSC recommendations related to revising rebuilding plans.

1.3.6 Changes to the Groundfish Trawl Fishery Management Program and Related Allocations

This section summarizes relevant new regulations for trawl rationalization implemented in 2013-14 or expected to be implemented in 2015-16.

1.3.7 Accountability (Management) Measures

As part of the biennial process the Council indentifies those accountability (management) measures (AMs) necessary for the groundfish fishery to achieve but not exceed ACLs. The Council may identify routine management measures, meaning the Council has determined they are likely to be adjusted on an annual or more frequent basis. For a measure to be classified as routine, the Council will determine that the measure is appropriate to address the issue at hand and may require further adjustment to achieve its purpose with accuracy. Section 6.2.1 in the Groundfish FMP describes the types of measures that have been classified as routine. Since the environmental impacts of these measures were analyzed at the time of Council adoption, additional environmental impact analysis when they are subsequently adjusted may not be necessary. Most routine measures, such as trip limits, time/area closures, and gear limits, are intended to control catch so that ACLs are achieved but not exceeded. During the biennial process the Council looks first to these measures to achieve harvest objectives. However, if current routine measures are insufficient to meet this purpose, or any other conservation purpose requiring immediate attention, the Council may propose such new management measures as deemed necessary during the biennial process.

1.3.7.1 Deductions from the ACL and Allocations to Fishery Sectors

AMs include the allocation of fishing opportunity among different user groups, or sectors, in the groundfish fishery. First, deductions from the ACL (also called set-asides) are made to account for groundfish mortality for certain activities outside the regular allocation scheme. These activities are:

- Tribal fisheries pursuant to Indian treaty rights, which reserve the right for a number of Pacific Northwest Indian tribes to take fish in their usual and accustomed fishing grounds and stations (see Groundfish FMP section 6.2.5) based on amounts in the January 1, 2014, regulations supplemented by tribal requests
- Research such as the NMFS trawl survey, IPHC longline survey, and other Federal and state research based on historical catch except for rarely-caught overfished species where the amounts are set with a precautionary buffer
- Groundfish caught in fisheries not targeting groundfish (also called incidental open access set-asides) based on historical catch in these fisheries
- Catches from fishing authorized under an exempted fishing permit as recommended by the Council; EFP applications include an estimate of groundfish that will be caught as part of the activity
- Sablefish caught in recreational fisheries north of 36° N. latitude based on historical catch in these fisheries

The ACL less the set-asides is called the fishery harvest guideline (HG) or commercial HG (sablefish north of 36° N. latitude and Pacific whiting), which is the amount available for fishery-sector-specific allocations. Sector allocations include formal long-term allocations (described in Groundfish FMP section 6.3) and short-term allocations implemented for the biennial period.

Fishery managers frequently view groundfish fisheries in terms of fishery "sectors." These sectors are defined by the permit status of participating vessels, gear type, target species, and various other factors.

The Council allocates fishing opportunity (or the amount of fish vessels in a particular sector may harvest) either as part of the biennial process or through rules that have been established in the Groundfish FMP. Fishery sectors may receive a fixed allocation of the ACL for particular management units (stocks, geographic subdivisions of stocks, and stock complexes); in other cases fishery managers may identify a catch amount as a management objective (e.g., an "HG") or simply as an accounting mechanism to prevent ACLs from being exceeded.

The 2013-14 Groundfish Harvest Specifications FEIS describes the methods and rationale for determining set-asides and short-term allocations and is incorporated by reference. The Groundfish SAFE includes the calculations made to arrive at the fishery allocations listed here. Summary information in tabular form is presented on:

- Set asides
- Long-term allocations
- Short-term (2-year) allocations
- Unallocated stocks.

1.3.7.2 Overview of Routine Measures Used to Meet Harvest Objectives

The following categories of measures are currently used in commercial groundfish fisheries:

- Limited access (or limited entry) permits which restrict the number of vessels that may use specified gear types to catch allocated groundfish. Limited entry permits define the groundfish trawl sector (further subdivided among vessels delivering catch shoreside, catcher vessels delivering Pacific whiting to at-sea mothership processors, and at-sea Pacific whiting catcher-processors) and the limited entry fixed gear sector, which uses longline and pot gear, mainly to catch sablefish.
- Groundfish closed areas, principally RCAs imposed to exclude fishing vessels from areas of high overfished species bycatch. Enforcement of these closed areas is supported by requirements for vessels to participate in a vessel monitoring system (VMS) and carry a unit that transmits their position to enforcement officials.
- Catch control tools including IFQs in the shoreside trawl sector, co-ops and associated allocations in the at-sea whiting sectors, permit and vessel-specific sablefish allocations in the limited entry fixed gear sector (called "tier limits"), and 2-month cumulative landing limits used in all sectors for certain species and/or at certain times of the year.

Deployment of at-sea observers is another critical management, control, and surveillance (MCS) tool used in commercial groundfish fisheries. Observer coverage is implemented by NMFS through the WCGOP. The principal purpose of observers is to document fish discarded at sea ("bycatch") so that fishery managers may reasonably account for total catch in line with ACL objectives. Beginning in 2011, both the at-sea and shoreside components of the groundfish trawl sector have complete (100 percent) observer coverage. WCGOP has a target coverage rate for non-trawl groundfish fisheries of 20 percent.

Recreational catch is principally managed by bag limits and time-area closures.

Table XX in the Groundfish SAFE describes routine management measures implemented and adjusted, 2011-2013.

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2 Alternatives

The alternatives presented here are structured around potential amendments to the Groundfish to describe how default harvest control rules and resulting harvest specifications would be used in the Council decision-making process. These alternatives also serve as the framework for evaluating both the short-term impacts of setting harvest specifications and management measures for the next biennial period (2015-16) and the long-term impacts of the biennial management process and catch-based management.

2.1 Harvest Specifications Alternatives

2.1.1 No Action – Rollover Current Harvest Specification Values Described in Federal Regulations

For all management units (including overfished species and non-overfished species) the harvest specification values (OFLs, ABCs, and ACLs) in Table 2a to Part 660, Subpart C published in the Code of Federal Regulations for 2014 would be carried forward for the next 10 years.

Management measures (including apportionments and allocations) in place in December 2014 would be rolled over. Periodically, these measures may be adjusted through full notice-and-comment rulemaking or inseason action to achieve but not exceed the rolled over 2014 ACLs.[4]

This characterization of No Action is consistent with the guidance in February 19, 2013, Policy Directive (as revised) on NEPA Compliance for Council-Initiated Fishery Management Actions under the Magnuson-Stevens Act:

> …there are two distinct interpretations of "no action" that may be utilized, depending on the nature of the proposal being evaluated. If the "no action" alternative will literally result in the sunsetting of a management measure, it may be reasonable to consider the "no action" alternative to be the fishery absent the management measure that would sunset. If, on the other hand, the underlying management will not sunset, and "no action" means that current management measures will remain in place, it is reasonable to use a continuation of the status quo, or baseline, as the "no action" rather than the hypothetical scenario of no federal management. This determination depends on the circumstances. The key is to provide a meaningful analysis of anticipated results of the proposed action relative to the status-quo fishery management regime.[5]

Currently, the Groundfish FMP does not describe how harvest specifications would be adjusted in the absence of a Council recommendation. In the past, primarily due to delays in the rulemaking process, NMFS has resorted to briefly rolling over the previous biennial harvest specifications into the next period until new regulations become effective. While this characterization of No Action is not very realistic over the long-term, it provides a point of comparison for the action alternatives described below. The amendments to the Groundfish FMP proposed under the action alternatives described below are intended to characterize how harvest specifications would be set in the absence of explicit action by the Council and may be the basis for the No Action alternative in future NEPA evaluations of biennial harvest specifications.

The Groundfish FMP is not amended under this alternative.

[4] Section 6.2 in the Groundfish FMP describes Council and regulatory procedures for establishing and revising management measures.

[5] At the request of the Council Coordinating Committee, NMFS withdrew the February 19 version of the Policy Directive and accepted edits proposed by the CCC. The quoted text reflects the revised version.

2.1.2 Alternative 1: Default Harvest Control Rules Based on Existing Rules

2.1.2.1 Methodology for Determining Default Harvest Specifications under Alternative 1

As the Council prepares for each biennial management period, the harvest control rules (or harvest policies) from the previous biennial period would be used to determine default harvest specifications for the upcoming biennium, using the most recent scientific information available on the statuses of managed stocks (principally new stock assessments and/or rebuilding analyses). These default harvest specifications will be presented to the Council, so that the Council may consider whether it wishes to revise the default harvest control rules from the prior biennial management period. Under this alternative, the Council must take explicit action to change any default harvest control rule (i.e., any harvest control rule used in the previous cycle) for use in future biennial periods. Normally, the Council would set the list of stocks for which they may consider changes to default harvest control rules at the first meeting (usually November) of the biennial decision cycle. Default harvest control rules from the previous biennial period would be applied to all other stocks without further Council deliberation. At the second meeting (usually April) during the biennial process, the Council would take final action on any potential changes harvest control rules. If a new stock assessment shows a change in stock status, the FMP's harvest control rule for the stock's new status would be applied as the default. Specifically:

- For a stock falling from healthy status to precautionary zone status, the precautionary reduction (40-10 or 25-5 rule) would be applied.
- Likewise, for stocks changing status from overfished/rebuilding or precautionary zone status to healthy status, the harvest control rule for healthy stocks (ACL equal to ABC) would be applied.

The default harvest control rules (those used in 2013-14) and the policy rationale for them are described in the Groundfish SAFE. The use of default harvest control rules is expected to reduce the scope and complexity of required analyses during subsequent biennial decision cycles.

Overfished species will be managed according to rebuilding plan objectives (described by the target year and harvest control rule). When objectives are forecast not to be met, the need to revise the rebuilding plan is based on SSC advice. In general, rebuilding plan objectives are determined by taking into account the need to achieve rebuilding as soon as possible, the status and biology of the stock, the needs of fishing communities, and the interaction of the overfished stock within the marine ecosystem.

Upon reviewing the default harvest specifications values, the Council may take explicit action to change the harvest control rule and resulting 2015-16 harvest specifications for any or all stocks, consistent with the framework described in Chapter 4 of the Groundfish FMP.

2.1.2.2 Default Harvest Specification Values for 2015-16 under Alternative 1

The rationale for the harvest control rules used during the 2013-14 biennial period was presented to the Council in September 2013 and incorporated into the Groundfish SAFE published in November 2013. This information is incorporated by reference and summarized here.

- Cases where the ACL is set equal to the ABC
- Cases where the precautionary reduction is applied
- Cases where a constant catch value is used
- Harvest specifications for stock complexes
- Harvest specifications for overfished species
- Harvest specifications for new stock complexes

Table XXX lists harvest specification values for the alternatives described above.

2.1.3 Alternative 2 Special Default Harvest Control Rule Methods for Newly Assessed Stocks

2.1.3.1 Methodology for Determining Default Harvest Specifications under Alternative 2

For stocks without a new stock assessment, the harvest control rules (or harvest policies) from the prior biennial period would be used to determine default harvest specifications for the upcoming biennium. For these stocks, Alternative 2 is the same as Alternative 1.

Alternative 2 differs from Alternative 1 with respect to setting harvest specifications for newly assessed stocks. For each newly assessed stock, the Council will choose the appropriate P* value (not to exceed 0.45 as specified in the FMP) to determine the ABC from a range of P*/ABC values presented to them. Based on this decision ACL values are based on stock status:

- For healthy stocks (i.e., those stocks where biomass is estimated to be above the B_{MSY} target), the ACL is set equal to the ABC.
- For precautionary zone stocks (i.e., those stocks where biomass is estimated to be below the B_{MSY} target), the precautionary reduction is applied. (See section 4.6.1 of the Groundfish FMP for a description of precautionary reduction methods.)
- For overfished stocks determined to meet their rebuilding objective, the harvest control rule in the current rebuilding plan is applied. The SSC would advise whether a calculated deviation from the objective represents a true change in status.)

These procedures are used to determine default harvest specification values for newly assessed stocks except for stocks managed under a rebuilding plan where, based on SSC advice, the Council determines the rebuilding plan objective is not being met. In those cases, the Council will consider revisions to the current rebuilding plan.

As with Alternative 1, once the default values are determined, the Council may take explicit action to choose different harvest specifications for the next biennial period, beginning with 2015-16.

2.1.3.2 Default Harvest Specification Values for 2015-16 under Alternative 2

2.1.4 Elements of the Proposed Action Common to both Alternative 1 and Alternative 2

2.1.4.1 New Harvest Control Rules

This section describes any new harvest control rules adopted by the Council, and the rationale. If the changed harvest control applies to a stock with a new assessment, the procedure under Alternative 2, where a range of P*/ABC values are presented, would be invoked.

2.1.4.2 New Rebuilding Plans and Revisions to Existing Rebuilding Plans

This section describes any rebuilding plan alternatives determined necessary to adequately evaluate the proposed action. (Candidate stocks for rebuilding plan revisions are bocaccio, cowcod, and darkblotched. Candidates for an overfished declaration, requiring a new rebuilding plan, have not yet been determined.)

2.1.4.3 Management Measures Including New Measures to be Classified as Routine as Part of the Biennial Process

Management measures (including apportionments and allocations) that could be applied under any of the alternatives are described and evaluated. Periodically, these measures may be adjusted through full notice-and-comment rulemaking or inseason action in order to achieve but not exceed ACLs. Procedural changes for Council action on management measures are described in Council Operating Procedure #9 (as revised in June 2012).

3 Affected Environment

Chapter 3 is about the past. What activities have occurred and how have they affected environmental components? This establishes the *environmental baseline* for describing the effects of the proposed action that will occur in the future (discussed in Chapter 4).

The baseline period for presenting historical data is 2003-2012, a 10-year period that is intended to demonstrate the range of effects that may occur in the projection period (2015-2024) used in the impact analysis. However, qualitative characterization of historical effects may assume a longer historical period.

Material from referenced documents (also see Section 6.3) will be briefly summarized (40 CFR 1502.21).

3.1 Groundfish Stock Status

In past EISs this section has been organized around the following subheadings:

- Healthy Stocks
- Precautionary Zone Stocks
- Overfished Stocks

See the introduction to Chapter 4 for the identification of key stocks based on socioeconomic importance, overfished status, vulnerability, or 2013 assessment. Information in this section may be prioritized for these key stocks.

This section would briefly summarize the following indicators, possibly in tabular format with minimal explanatory text.

- Assessment history (most recent assessment, flag if unassessed)
- Sources of error (uncertainty) in stock assessments
- Biomass estimate relative to target/limit (current status)
- Fishing mortality relative to target/limit
- Historical trends in biomass and status
- Historical attainment of OY/ACL

For newly assessed (2013) stocks:

- Changes in status
- Changes in biological parameters (e.g., steepness, B0) substantially affecting "our understanding" of characteristics such as status, productivity, distribution, etc.
- Uncertainties captured in decision tables?

This section could also contain a summary of data moderate assessment techniques and their use in management. This could be tied to any necessary amendments to the FMP with respect to the determination of harvest specifications (FMP Chapter 4). Although included in the proposed action covered by this EIS, these changes do not "individually or cumulative have a significant effect on the human environment." Therefore, this EIS need not include a separate analysis of the effects of criteria for the use of data moderate assessments that may be incorporated into the Groundfish FMP.

Narrative summaries of stock assessment results, like those included in the 2013-14 EIS (section 3.1.1), could be included in the Groundfish SAFE. Stock assessments, STAR Panel Reports, and where relevant, rebuilding analyses, can be downloaded from the Council website and can be referenced accordingly.

3.2 California Current Ecosystem

In April 2013 the Council adopted the Pacific Coast Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem (Pacific Coast FEP). This document contains a wealth of information on characteristics of the California Current large marine ecosystem where the groundfish fishery occurs and the types of impacts fisheries and other anthropogenic activities have on ecosystem dynamics and marine habitat. Information from this document is incorporated by reference and summarized below. Previous EISs prepared for biennial harvest specifications also contain information about this ecosystem and fishery effects.

3.2.1 Overview of California Current Large Marine Ecosystem and Groundfish EFH Characteristics

The following information is summarized from Pacific Coast FEP, sections 3.1 and 3.2.

The California Current Ecosystem (CCE) is composed of a major eastern boundary current, the California Current, which is dominated by strong coastal upwelling, and is characterized by fluctuations in physical conditions and productivity over multiple time scales (Parrish et al. 1981, Mann and Lazier 1996). Food webs in these types of ecosystems tend to be structured around coastal pelagic species that exhibit boom-bust cycles over decadal time scales (Bakun 1996, Checkley and Barth 2009, Fréon et al. 2009). By contrast, the top trophic levels of such ecosystems are often dominated by highly migratory species such as salmon, tuna, billfish and marine mammals, whose dynamics may be partially or wholly driven by processes in entirely different ecosystems, even different hemispheres. Ecosystems analogous to the CCE include other shelf and coastal systems, such as the currents off the western coasts of South America and Spain.

As shown in Figure 3-1 from Field et al. (2006), the CCE contains a diverse array of species, most of which make a relatively modest contribution to the energy flow within the ecosystem. Because the flow of energy is more of a “food web” than a “food chain”, the species of the CCE do not neatly divide into clearly delineated trophic levels (for example, an organism may eat a prey item and also eat items that its prey eats), except at the highest and lowest levels. Most CCE species do not occupy a single trophic level and may occupy multiple trophic levels, particularly when considering changes that occur over the course of their life as they change both their size and feeding preferences.

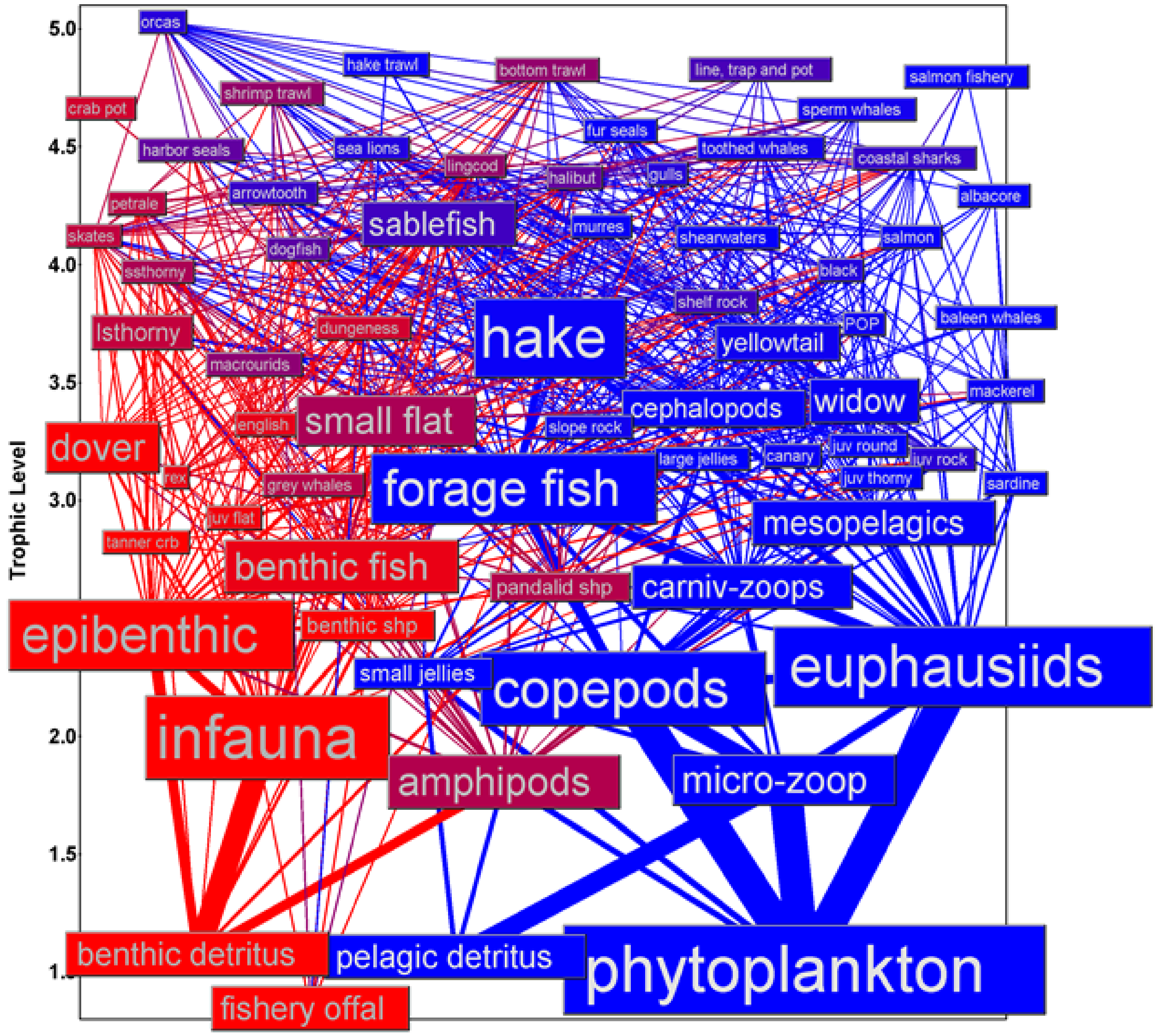

Figure 3-1: The significant food web of the Northern CCE. Height of boxes is scaled to standing biomass of species or groups names, width of lines between groups represents biomass flux of prey to predators. Benthic energy pathways are shown in red, while pelagic energy pathways are shown in blue. This "snapshot" represents the model values for the 1960 time period, as reported in Field et al. (2006).

Groundfish occupy a range of trophic niches and habitats, but most species are considered to be at either middle or higher trophic levels. Large groundfish (e.g., cowcod, bocaccio, yelloweye and shortraker, as well as Pacific halibut, California halibut, arrowtooth flounder, Petrale sole, sablefish, lingcod, cabezon, shortspine thornyheads, skates) are almost exclusively piscivorous, feeding largely on juvenile and adult stages of other groundfish, as well as forage fishes, mesopelagic fishes, and squid. A broader range of species, including most rockfish, are ominovorous mid-trophic level predators that may be piscivorous at times but also feed on krill, gelatinous zooplankton, benthic invertebrates and other prey. Pacific hake, the most abundant groundfish in the CCE, shows strong ontogeny in food habits, since younger, smaller hake feed primarily on euphausiids and shrimps, switching to an increasing proportion of herring, anchovies and other fishes (as well as other hake) as they reach 45-55 cm length, and are almost exclusively piscivorous by 70-80 cm.

Higher trophic level predators have a potential to play a structuring role in the ecosystem, particularly over smaller spatial scales (e.g., individual reefs or habitat areas). Despite the rarity of piscivorous rockfish relative to more abundant omnivorous or planktivorous rockfish, visual surveys have shown that the piscivorous species can be relatively abundant in many isolated and presumably lightly fished rocky reef habitats (Jagielo, et al. 2003; Yoklavich, et al. 2002; Yoklavich, et al. 2000). In rocky reefs, concentrations of smaller, fast-growing rockfish are considerably lower, while reefs thought to have undergone heavier fishing pressure tend to have greater numbers of smaller, fast-growing, and early-maturing species. Similar large-scale community changes are described by Levin et al. (2006), who found broad-scale changes in CCE groundfish assemblages sampled by the triennial bottom trawl surveys on the continental shelf between 1977 and 2001. Levin et al. (2006) found declining rockfish catches, from over 60 percent of the catch in 1977 to less than 17 percent of the catch in 2001, with greater declines of larger species, while flatfish catches increased by a similar magnitude. The potential for intra-guild competition or top-down forcing, in both small-scale rocky reef systems and throughout the larger ecosystem, is also supported by theoretical considerations and simulation models. For example, Baskett et al. (2006) developed a community interactions model that incorporated life history characteristics of pygmy and yelloweye rockfish to consider community dynamics within a marine reserve. Without interspecific interactions, the model predicted that larger piscivores would recover given minimal levels of dispersal and reserve size. However, when community interactions were taken into account, initial conditions like the starting abundance of the piscivores and the size of the reserve became more important with respect to the ultimate stable state, such that under some circumstances (low piscivore biomass, or high planktivore biomass) recovery could be unlikely. Such results are consistent with similar simulations of the potential consequences of community interactions in marine systems (MacCall 2002, Walters and Kitchell 2001), and speak to the importance of considering such interactions in the design, implementation and monitoring of recovery efforts for rebuilding species.

3.2.2 Effects of Managing to B_{MSY}

This section summarizes what is known about the ecological effects of managing fished populations to level below unfished biomass. This includes trophic effects (predatory/prey relationships) and stock-specific effects (genetic structure) focusing on groundfish stocks directly affected by the proposed action. This review presents available information and should include a discussion of incomplete or unavailable information per 40 CFR 1502.22.

3.2.2.1 Effects of Other Anthropogenic Activities

Information in the Pacific Coast FEP about the effects of anthropogenic activities on various ecosystem components will be summarized in this sections. Other details on the effects of anthropogenic activities can be found in the Anthropogenic Pressures section of the 2012 California Current Integrated Ecosystem Assessment (CCIEA).

- The Executive Summary of the Anthropogenic Pressures section in the 2012 CCIEA) should be used to characterize the overall status and trends of these pressures. A manuscript (author: Kelly Andrews, NWFSC should also be available that provides subsequent analyses that are not in the FEP or the 2012 CCIEA.
- The Annual State of the California Current Ecosystem Report developed by the Ecosystem Plan Development Team (EPDT) may be referenced. Many of the “Human Dimensions” indicators identified in Section 4 of this report are anthropogenic pressures from the 2012 CCIEA. As appropriate more up to date information will be incorporated into this descriptions.

3.2.2.2 Climate Change and System Forcing

This section will draw on information from section 4.1.3 and 4.2.3 from the Pacific Coast FEP and updated information from the CCIEA.

3.3 Essential Fish Habitat

3.3.1 Overview of EFH Designations under Council FMPs

3.3.2 Characterization of Groundfish Essential Fish Habitat

Materials developed by the EFH Review Committee include updated data on the distribution of substrate, physical and biogenic habitats, modeled species occurrence, and fishing and non-fishing impacts. This information will be incorporated by reference to characterize baseline conditions.

3.3.3 Effects of Fishing on Essential Fish Habitat

As above, materials developed by the EFH Review Committee will be incorporated by reference.

3.3.4 Non-Fishing Impacts

This section incorporates and summarizes past and present adverse effects on EFH due to human activities other than fishing. Information sources include the Amendment 19 (Groundfish EFH) FEIS and materials developed by the EFHRC.

3.3.5 Measures Currently in Place to Mitigate Impacts on Essential Fish Habitat

- Marine protected areas
- EFH conservation areas
- Effects of fishery time/area closures
- Gear restrictions

3.4 Non-groundfish Species

The 2013-14 EIS provided summaries organized as follows

- Stocks Managed Under other Council FMPs:
  - Coastal Pelagic Species (CPS)
  - Highly Migratory Species (HMS)
  - Salmon
- State Managed Stocks:
  - California Halibut
  - Dungeness Crab
  - Greenlings (other than kelp greenling), Ocean Whitefish, and California Sheephead
  - Pink Shrimp
  - Sea Cucumber
  - Ridgeback and Spot Prawns
- Pacific Halibut

- Unmanaged Species
    - Miscellaneous Non-groundfish Flatfish, Skates, and Tanner Crab

The level of detail included in the 2013-14 EIS, which discussed status and biology of non-groundfish stocks and known catch in groundfish fisheries, seems unnecessary. Non-groundfish species should be screened according to how relevant catch is in groundfish fisheries using available information from the WCGOP. If available data show no catch in groundfish fisheries or the catch is negligible relative to stock size, then the species need not be discussed. For the species included after this screening the following information will be presented:

- Catch in groundfish fisheries relative to total catch or stock biomass
- Economic importance
- How they are managed outside the Groundfish FMP
- Stock distribution and susceptibility to different gear types.

3.5 Protected Species

This section will primarily incorporate information and findings from the Biological Opinion for the Pacific Coast Groundfish Fishery. In particular, key metrics such as the incidental take statement (ITS) and any standards set for reinitiation of the Endangered Species Act (ES) section 7 consultation will be discussed. The following categories of protected species have been included in previous harvest specifications EISs:

- ESA-listed salmon and steelhead
- Green sturgeon
- Eulachon
- Marine mammals
- Seabirds
- Sea turtles

The descriptive information in the following section is taken from the 2013-14 Harvest Specifications FEIS to exemplify brief summaries of the status of protected species. These descriptions will be updated with material from the most December 7, 2012, NMFS Biological Opinion on the Continued Operation of the Pacific Coast Groundfish Fishery (PCTS #NWR-2012-876) and the November 21, 2012, USFWS Biological Opinion on the Continued Operation of the Pacific Coast Groundfish Fishery (Reference Number 01EOFW00-2012-F-0086).

The West Coast Groundfish Observer Program (WCGOP) manages fisheries observer data and estimates bycatch of protected species in commercial fisheries. The bycatch ratios can be found in Jannot, et al. (2011) for marine mammals, seabirds, and sea turtles; and in Al-Humaidhi, et al. (2011) for green sturgeon and eulachon. Pacific salmon bycatch and impacts models can be found in the groundfish Amendment 20 EIS, and Bellman et al. (2011).

3.5.1 Pacific Salmon

Oceanic conditions in particular affect migration patterns spatially and temporally, as does prey availability and other factors. For Chinook, NMFS completed a supplemental biological opinion (NMFS 2006), which establishes take limits of 11,000 Chinook salmon in the whiting fishery and 9,000 in the nonwhiting groundfish bottom trawl fishery. For other salmonid species, incidental take limits have not yet been established. This opinion remains in effect.

Pacific salmon, during the adult (ocean) phase of their lifecycle, occur throughout the US EEZ, from southern California northward to Canadian and Alaskan marine waters. Although seasonally more abundant in nearshore areas, this varies among stocks.

3.5.2 Green sturgeon

The Southern distinct population segment (DPS) of the North American green sturgeon (*Acipenser medirostris*) was listed as threatened in April, 2006, with Critical Habitat designated October 9, 2009. Documented interactions with the California halibut trawl fishery provide background for a qualitative assessment of the potential impacts to green sturgeon. However, quantitative modeling or bycatch estimates have not yet been developed. Al-Humaidhi et al. (2011) contains bycatch estimates for green sturgeon interactions with the groundfish fishery, and NWFSC (2011) contains detailed information on biology, range, fishery impacts, habitat, and trophic effects.

NMFS has issued a biological opinion for the Pacific groundfish fishery. This biological opinion concludes that there may be up to 330 take interactions with green sturgeon, and mostly likely less than 19 lethal takes, because most are released alive.

3.5.3 Eulachon

The Southern DPS of Eulachon (*Thaleichthys pacificus*), or Columbia River smelt, was listed as threatened under the ESA in 2010 (75 FR 13012). A status review (NMFS 2010) describes the most likely threats to eulachon recovery, allowing for a qualitative assessment of the potential significance of impacts to eulachon from the US West Coast commercial groundfish fishery. The status review identified many potential threats, including climate change, bycatch, dredging, shoreline construction, and others. NMFS initiated consultation for eulachon in early 2012, and issued a Biological Opinion in February. The biological opinion concluded that the fishery is not likely to jeopardize the continued existence of the species (NMFS 2012).

Eulachon are incidentally caught in groundfish trawl fisheries and in the at-sea hake fishery as well. In both fisheries, the bycatch rates are described in terms of total number of individuals (21 in 2010). Table 3-xx depicts bycatch of eulachon in groundfish fisheries. NWFSC (2011) contains detailed information on eulachon biology, range, fishery impacts, habitat, and trophic effects. Although scientific estimates of spawning stock biomass (SSB) in US waters are unavailable, the Fraser River (Canada) stock seems to be experiencing a downward trend (NWFSC 2011). Bycatch of eulachon in the groundfish bottom trawl fishery is extremely small, measured in the number of individuals, and the fishery is not likely to have a discernible impact on eulachon.

3.5.4 Marine mammals

The WCGOP documents fishery interactions with marine mammals. Several species are protected under the ESA and the MMPA. In the 2011-12 Groundfish Harvest Specifications EIS, a qualitative approach was used to assess the significance of the impacts to marine mammal populations, based on reported interactions and, when available, the Potential Biological Removal (PBR) established for a species. Recently, the NWFSC issued a risk assessment (NWFSC 2011) that summarizes biological, trophic, habitat, and bycatch information.

NMFS prepared a Biological Opinion in 1990 that concluded the groundfish fisheries are not likely to jeopardize the continued existence of listed marine mammals. The effects of the harvest limit alternatives on endangered and threatened marine mammal species are difficult to quantify, but recent WCGOP data (Heery, *et al.* 2010) provide some ability to make inferences about potential relative impacts of various management scenarios. Jannot et al. (2011) contains more detailed information on fishery interactions.

Groundfish fishery management measures that displace fishing effort may have impacts to marine mammals. In particular, species more prevalent in nearshore waters are more likely to be impacted by a shift of fishing effort shoreward of the RCA. Species more likely to be encountered offshore are commensurately more likely to be impacted by displaced fishing pressure resulting from seaward RCA shifts. Table 3-xx lists protected species by their distribution relative to the RCAs.

Although some interactions are expected, the NMFS biological opinion (NMFS 2012) concludes that the 2012 Pacific groundfish fishery is not likely to jeopardize the continued existence of the humpback whale or Steller sea lion populations. NMFS (2012) further concludes that the Pacific Coast groundfish fishery is not likely to adversely affect sei whales, North Pacific right whales, blue whales, fin whales, sperm whales, southern resident killer whales, Guadalupe fur seals.

3.5.5 Seabirds

Seabird species with documented interactions with the US West Coast commercial groundfish fishery represent a diverse suite of life histories, migration patterns, and reproductive strategies. Three distinct spatial/temporal seasons have been identified for the West Coast: the Upwelling, Oceanic, and Davidson Current seasons (Ford et al. 2004). Distribution of seabird species also varies latitudinally. These seasons coincide with winter (January-April), summer (May-August) and fall (September-December).

Based on information available for the December 2005 EFH FEIS (NMFS 2005, section 4.6.2), seabird interactions in the West Coast groundfish fishery were described as “rare and infrequent.” NMFS recently initiated consultation with USFWS on listed seabirds. In addition, NWFSC (2011) contains detailed information on seabird biology, habitat, life history, and bycatch information.

There were two recent fishery interactions with short tailed albatross, including a take that occurred in the LE sablefish fishery. [Describe seabird mitigation actions].

A risk assessment recently completed by NMFS (2012) evaluates impacts to several protected species, including marine mammals, seabirds, sea turtles, and selected fish. A US Fish and Wildlife Service ESA consultation was initiated recently, although a biological option is still pending.

3.5.6 Sea turtles

The WCGOP reported one documented interaction with a leatherback sea turtle, in 2008. The rarity of documented interactions precludes meaningful analysis of bycatch estimates.

Based on information available for the December 2005 EFH FEIS (NMFS 2005, section 4.6.4), west coast groundfish trawl and longline fisheries could adversely affect sea turtles; however, the relative effects of fisheries occurring under the Groundfish FMP on sea turtles are difficult to assess. Species specific discussions are available in the EFH FEIS (section 4.6.4). There is very little information available to estimate total mortalities of sea turtles, with the exception of the drift gillnet fishery, which is not a part of the Groundfish FMP; therefore, the effects of the harvest limit alternatives on endangered and threatened sea turtle species are unknown. NMFS prepared a Biological Opinion in 1990 that concluded fisheries conducted under the Groundfish FMP are not likely to jeopardize the continued existence of listed sea turtles.

Groundfish fishery management measures may have adverse effects on sea turtles if fishing effort intensifies in areas where sea turtles congregate. However, the effects of management measures on effort displacement are not predictable and the effects of the alternatives are unknown. To date, sea turtle interactions with groundfish fisheries have been rare and infrequent. Therefore, it is unlikely that modest spatial shifts in fishing effort would result in any additional fishery interactions with sea turtles.

The NMFS biological opinion (NMFS 2012) concludes that while the 2012 Pacific groundfish fishery may result in sea turtle interactions, it will not appreciably reduce the survival or recovery of leatherback turtles.

3.6 Socioeconomic Environment

Detailed tables of catch, ex-vessel revenue by species and fishery sector will be incorporated in a Groundfish SAFE document to be produced in conjunction with the biennial harvest specifications process. These tables will provide source material to summarize the status of fisheries and fishing communities.

3.6.1 Groundfish Fishery Sectors

3.6.1.1 Commercial Fisheries

- At-sea whiting
- Shoreside IFQ fishery
- Non-nearshore fixed gear fishery
- Nearshore fixed gear fishery
- Other fisheries catching groundfish

Factors affecting profitability

- Costs
- Ex-vessel prices

3.6.1.2 Tribal Groundfish Fisheries

Section 5.2.7 of the 2008 SAFE document, sections 2.2.1.1 and 7.2.6 of the 2009-2010 Groundfish Harvest Specifications FEIS, and section 3.15 of the Amendment 20 FEIS describe tribal fisheries. Section 6.2.5 in the Groundfish FMP describes the special status of these fisheries. Several Pacific Northwest Indian tribes have treaty rights to fish for groundfish in their usual and accustomed fishing grounds. The Federal government has accommodated these fisheries through a regulatory process described at 50 CFR 660.50.

Management and Regulation

Under treaty arrangements, tribes manage fisheries prosecuted by their members. Their management is coordinated through the Council process so catches can be accounted for when developing management measures. West coast treaty tribes in Washington State have formal allocations for sablefish, black rockfish, and Pacific whiting. For other species without formal allocations, the tribes propose trip limits to the Council, which the Council tries to accommodate while ensuring that catch limits are not exceeded. Whether formally allocated or not, tribal catches are accounted through set-asides, which are amounts taken "off the top" of the overall catch limit.

Landings and Revenue

Because tribes have sovereign rights to manage their fisheries, the tribal sectors do not have an equivalent regulatory dimension like the commercial sectors discussed above. These sectors have been identified more for data presentation purposes, although they do relate to target strategy.

The Makah tribe participates in whiting fisheries with both a mothership and shorebased component. On average, the treaty fisheries have accounted for 12 percent of total whiting landings and at-sea deliveries since 2005, generating an average of about $4 million (inflation-adjusted) per year.

The Tribal nonwhiting sector is defined by groundfish landings other than whiting and thus includes a variety of gear types. Hook-and-line gear represents by far the largest portion of average annual revenue for the 2003-2012 period at xx percent, followed by bottom trawl, accounting for xx percent. In terms of species composition characterized in terms of revenue from groundfish, sablefish accounts for xx percent during the 2003-2012 period, followed by rockfish at xx percent. This is similar to the commercial nonwhiting sectors (especially fixed gear) where sablefish is usually the most important component of nonwhiting revenues.

While all four coastal tribes have longline fleets, only Makah currently has a trawl fleet. Note that, beginning in 2008, the tribes have been using their own Treaty Online Catch Accounting System (TOCAS) database to record fish ticket landings. Since 1999, Pacific whiting have comprised the vast bulk of tribal landings. It is also worth noting that overall groundfish landings and revenue have been reduced in recent years due to increasing restrictions designed to rebuild overfished rockfish. The Makah Tribe's trawl fleet has reduced from 10 vessels to 5 active (8 eligible) vessels due in part to reduced markets. Buyers in Neah Bay have reduced the number of trucks taking fish to processors since the area shoreward of the RCA north of Cape Alava closed to limited entry trawl went into place.

3.6.1.3 Recreational Fisheries

Section 7.1.3 of the 2009-2010 Groundfish Harvest Specifications FEIS describes west coast recreational fisheries. Recreational fisheries are an important part of fishery-related economic activity.

The Groundfish SAFE document will show recreational angler trips (combining both charter and private) by region and the percent of those trips that were targeted for bottomfish or groundfish. This information will be summarized here and used to characterize historical and regional trends in participation.

3.7 Fishing Communities

The proposed Groundfish SAFE will contain summary descriptive statistics of landings by IOPAC port group. (See Table 9 in NOAA Technical Memorandum NMFS-NWFSC-111 for ports included in these port groups. The IOPAC Input-Output Model for Pacific Coast Fisheries is used to evaluate personal income impacts of proposed management measures.) Figure 3-2 shows these port groups. The 14 port groups used in IOPAC are grouped under 10 regions for the descriptive summary in this section:

- Washington State:
    1. Puget Sound

2. The Washington Coast

- Oregon:
  3. Astoria and Tillamook (including any landings at other Columbia River ports in Oregon)
  4. Newport
  5. Coos Bay and Brookings
- California[6]:
  6. Crescent City and Eureka (North Coast)
  7. Fort Bragg and Bodega Bay (North-Central Coast)
  8. San Francisco (North-Central Coast)
  9. Santa Cruz, Monterey, and Morro Bay (South-Central Coast)
  10. Santa Barbara, Los Angeles, and San Diego (South Coast)

These port groups and regions are also used to organize the evaluation of impacts to fishing communities in Chapter 4.

The 2006-2007 Harvest Specifications FEIS and 2011-201 Harvest Specifications FEIS included a community vulnerability index based on commercial and recreational ex-vessel revenue and selected community demographic statistics. The NWFSC has also been assessing community vulnerability. An updated community vulnerability analysis could be prepared for this EIS based on the recent available fisheries and demographic data. Summary results would be included in this section. The purpose of the vulnerability index is to identify communities that may be disproportionately affected by adverse impacts.

[6] These California regions are intended to approximately correlate with state reporting regions for recreational fisheries.

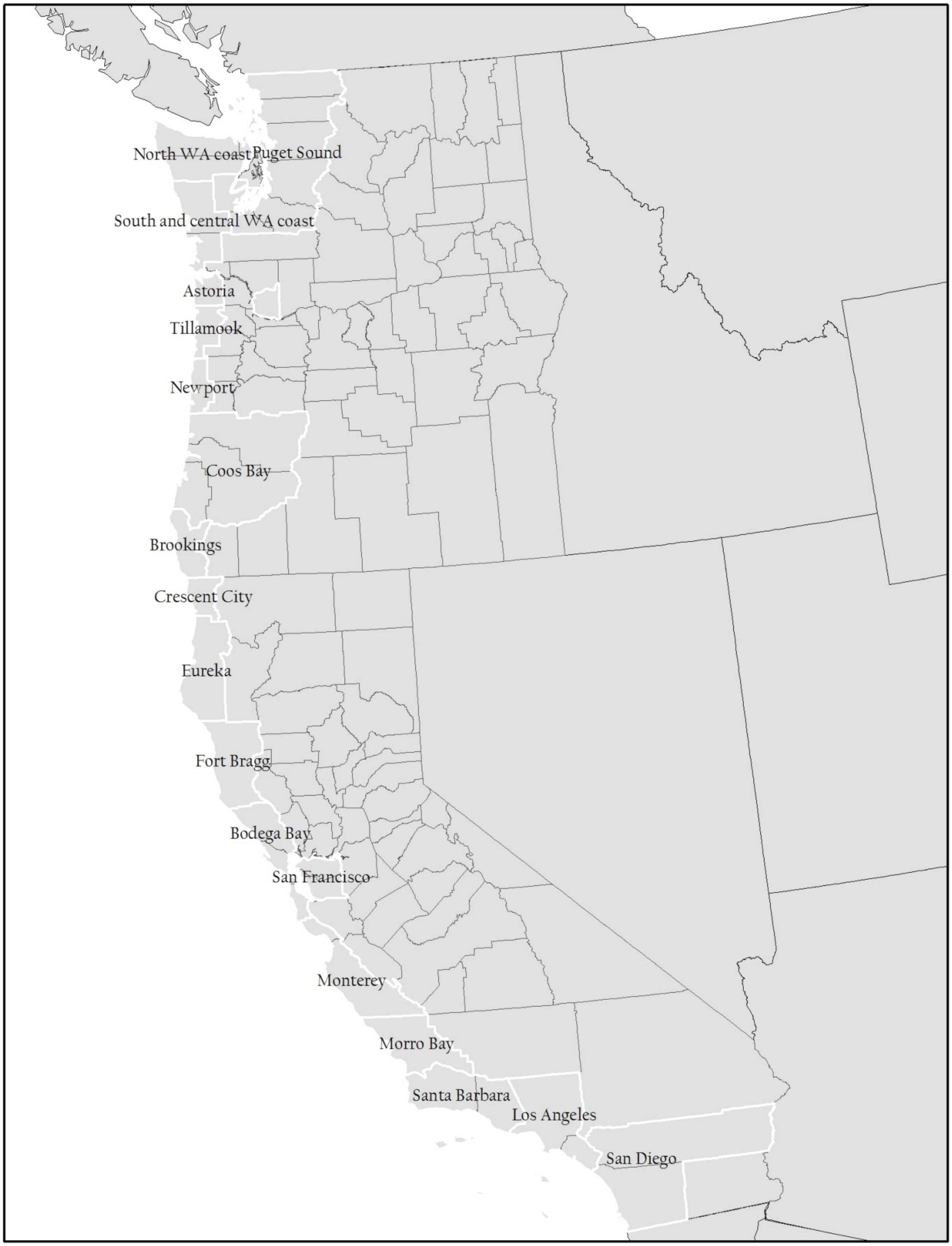

Figure 3-2. IOPac port group areas.

4 Impacts of the Alternatives

This chapter looks at the future. If the proposed action is implemented (action alternatives) how will conditions be different than if it is not implemented (no action)? As discussed below, if impacts to an environmental component cannot be forecast, they can be evaluated qualitatively in comparison to baseline conditions described in Chapter 3.

Generally, the ability to predict trends in environmental components that are not the object of the proposed action (non-groundfish, marine ecosystem, and protected species) is limited. The evaluation of long-term impacts to these components is based on the supposition that changes in the magnitude and spatio-temporal patterns of the groundfish fishery exceeding what occurred during the baseline period are unlikely. Therefore, characterizing these historical effects can approximate impacts during the projection period. Available information on potential sources of change is presented and discussed to qualify characterizations based on historical conditions.

4.1 Effects of Setting Harvest Specifications and Related Management Measures on Groundfish Species

4.1.1 Forward Projection of Stock Trends

The analysis uses 10-year projections of stock biomass for all assessed stocks and resulting harvest specifications, where available, to evaluate long-term biological (and socioeconomic) impacts. For unassessed stocks and stock complexes containing unassessed species baseline (2003-2012) harvest specifications will be applied for forward projections. Detailed economic analyses are done only for the key target and incidentally caught stocks that significantly affect the fishery and the fishery-dependent communities on the west coast. Table 4-1 shows the key stocks that will be the focus of the impact analysis. The choice of key stocks is based on the following criteria:

- Socioeconomic: Comprised more than 10% of ex-vessel revenue in one or more commercial fishery sectors, or attracted a substantial portion of recreational fishing effort, during the baseline period
- Overfished: Currently overfished stocks
- Vulnerable: Vulnerability score ≥2.0 (rated as high or major concern in the most recent productivity and susceptibility analysis, see section 4.1.1.2 of the 2013-14 harvest specifications FEIS)
- Newly assessed: Stocks assessed in 2013 not falling under one of the other criteria

Various factors that could affect actual stock biomass trends and prompt changes in these projected harvest specifications are discussed. Scientific uncertainty could cause mis-specification of harvest levels resulting in stock conservation objective not being met. The methodology used to determine the precautionary reduction from the OFL to the ABC is intended to address such sources of uncertainty. The estimate of uncertainty (sigma) and the risk tolerance for overfishing (P*) can be used to evaluate the range of impacts of mis-specification. Unpredicted and unaccounted for environmental variability is another source of uncertainty about actual biomass trends during the projection period.

To approximate these uncertainties, stock assessment decision tables for key stocks are used for the forward projections, where available. These decision tables are matrices of alternate states of nature and management strategies showing catch, depletion (spawning biomass relative to unfished spawning biomass), SPR relative to the OFL, and a quantity estimate of spawning biomass. The decision table projections in existing stock assessments have been updated to include estimates of the ACL based on the default harvest control rules (2013-14 harvest control rules) and, as necessary to extend the projection period to 2024. Figure 4-1 graphs the catch projections for three management scenarios from the most recent sablefish assessment decision table while Figure 4-2 graphs projected depletion levels under three states of nature from the decision table. The assessment describes these state of nature scenarios as follows: “Low and high columns are based on the 12th and 87.5th percentiles of the distribution [labeled less likely] about the maximum likelihood estimates [labeled more likely] for: depletion, relative SPR (in reverse order to match depletion; i.e., larger values implying greater relative fishing intensity are reported first) and spawning biomass from the base-case model.” The minimum stock size threshold (MSST) for determining overfished status and B_{MSY}, the management target, are also shown for comparison.

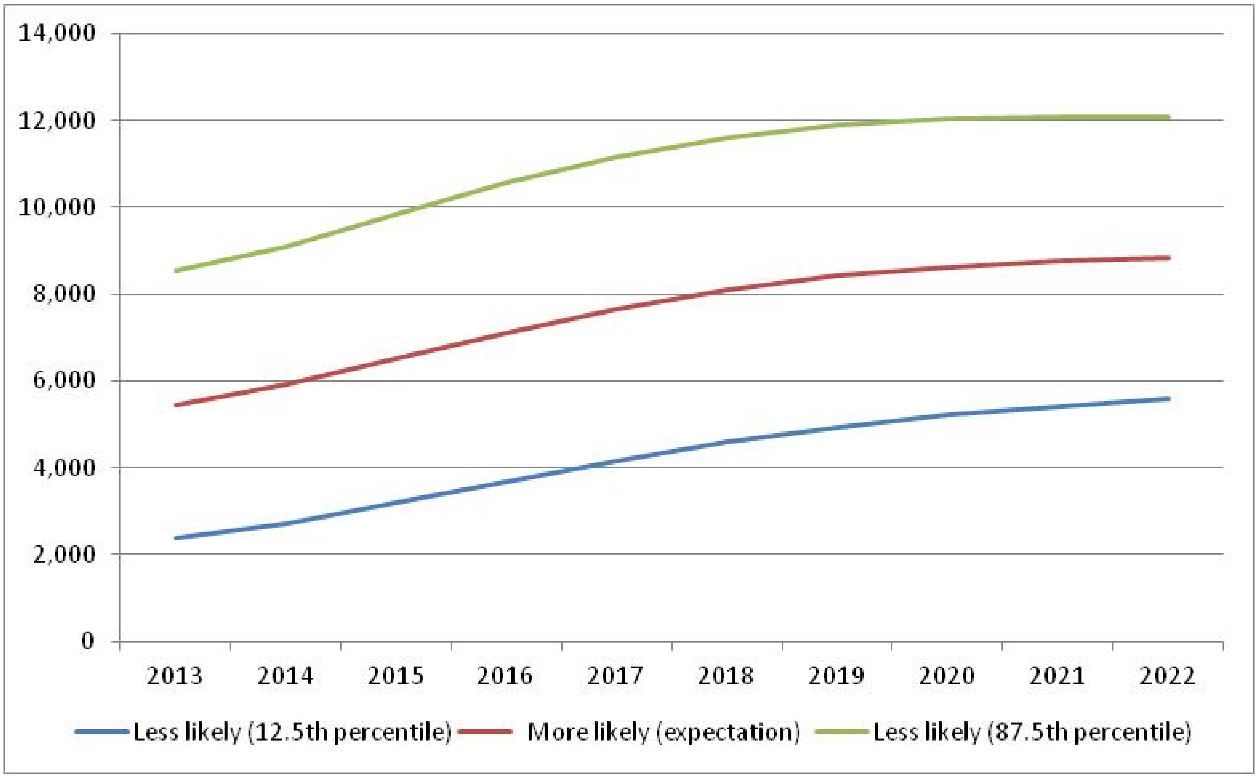

Figure 4-1. Example of projected catch (mt) under three management alternatives from the decision table in the 2011 sablefish assessment.

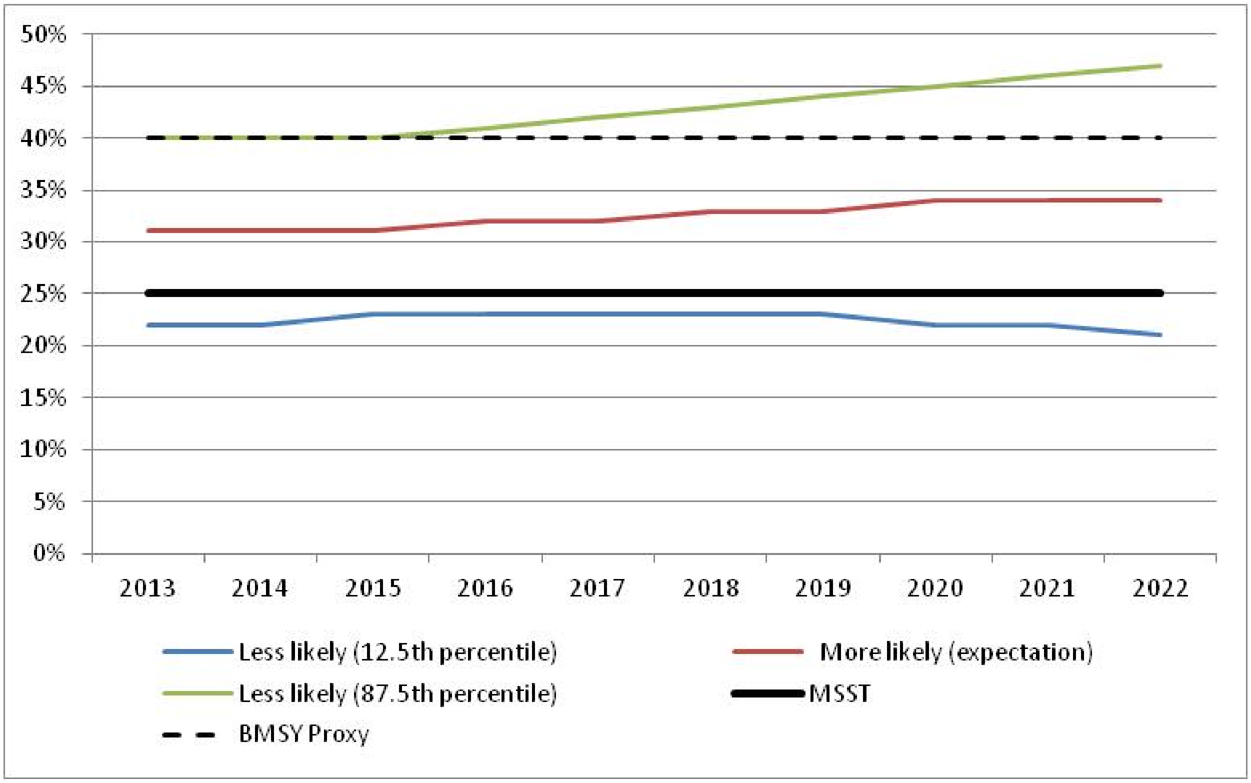

Figure 4-2. Example of projected depletion under three states of nature scenarios and the 40-10 harvest control rule from the decision table in the 2011 sablefish assessment. MSST is the threshold for considering a stock overfished and B_{MSY} is the management target.

For key stocks, assessment authors are requested to provide forward projections through 2024 based on default (2013-14) harvest control rules. The following outputs will be available:

- Status indicators (e.g., depletion) for the projection period
- Estimated ACLs and OFLs for the projection period
- Catch streams assuming ACL removals or recent year average catches for each year.

In addition, projections will be made for the No Action alternative, i.e. constant catch at the 2014 ACL level.

Table 4-1. Key stocks for impact analysis.

Stock / Stock Complex	Source of Forward Projection	Basis for Identification
Arrowtooth flounder		Socioeconomic
Aurora rockfish	2013 assessment	2013 assessment
Black rockfish	2007 OR/CA assessment	Socioeconomic
Bocaccio (S of 40˚10' N lat.)	2013 assessment / rebuilding analysis	Overfished (2013 update assessment)
Brown Rockfish	2013 data moderate assessment	2013 data moderate assessment
Cabezon	2009 assessment (CA/OR)	Socioeconomic
Canary rockfish	2013 catch report / rebuilding analysis	Overfished (2013 catch report)
China Rockfish	2013 data moderate assessment	2013 data moderate assessment
Copper Rockfish	2013 data moderate assessment	2013 data moderate assessment
Cowcod (S of 40˚10' N lat.)	2013 assessment / rebuilding analysis	Overfished / 2013 assessment
Darkblotched rockfish	2013 assessment / rebuilding analysis	Overfished / 2013 assessment
Dover sole	2011 assessment	Socioeconomic
English sole	2013 data moderate assessment	Socioeconomic (2013 data moderate assessment)
Lingcod	2009 assessment	Socioeconomic
Longspine thornyhead	2013 assessment	2013 assessment
Pacific ocean perch (N of 40˚10' N lat.)	2013 catch report / rebuilding analysis	Overfished (2013 catch report)
Petrale sole	2013 assessment / rebuilding analysis	Socioeconomic / Overfished / 2013 assessment
Rex Sole	2013 data moderate assessment	2013 data moderate assessment
Rougheye rockfish (N of 40˚10' N lat.)	2013 assessment	2013 assessment
Sablefish	2011 assessment	Socioeconomic
Sharpchin Rockfish	2013 data moderate assessment	2013 data moderate assessment
Shortspine thornyhead	2013 assessment	Socioeconomic / 2013 assessment
Stripetail Rockfish	2013 data moderate assessment	2013 data moderate assessment
Vermilion Rockfish	2013 data moderate assessment	2013 data moderate assessment
Widow rockfish	2011 assessment	Vulnerability score of 2.05
Yelloweye rockfish	2013 catch report / rebuilding analysis	Overfished (2013 catch report)
Yellowtail Rockfish (N of 40˚10' N lat.)	2013 data moderate assessment	2013 data moderate assessment

4.1.2 Long-term Effects of Setting Harvest Specifications

The long-term impact analysis will address the following questions, either on a stock-specific basis (for key stocks) or in a more general assessment for cases where the difference in impacts among stocks cannot be identified.

- What is the stock biomass trend for overfished species? How likely is it they will maintain a stable trajectory to the rebuilding target?
- How likely is it that overfishing will occur?
    - P* represents risk tolerance, or the probability that overfishing will occur due to mis-specification of the OFL

- How likely is it that stocks will become overfished? What are the main reasons a stock could become overfished? Which stocks exhibit a higher risk? Lower risk? Use the results of productivity and susceptibility assessment of stocks to overfishing. Will this analysis be re-done in 2013-14? Should the results be put in the SAFE document with conclusions provided here?
- What are the major sources of uncertainty in stock assessments that could lead to mis-specification errors?
- What are the sources of management error (e.g., catch monitoring error; lag times in reporting)?
- What are the effects on stock structure and productivity of managing to B_{MSY}? (Incorporate information from FEP)

In addition to the effect on stock status, these factors would also—through the management response—affect fishing opportunity and thus the socioeconomic impacts of the proposed action. Section 4.6 describes these impacts.

4.1.2.1 Management Responses Based on New Information

This section contains a brief overview of the management system. In using these projections in the analysis it must be acknowledged that the Council will adaptively manage the fishery to prevent stock biomass from dropping below the B_{MSY} and rebuild stocks below this biomass target proxy (whether in the precautionary zone or managed under a rebuilding plan). To do so, they may recommend changes to harvest control rules. To the degree possible, the factors that could prompt a change in harvest specifications are discussed. Foremost, perhaps due to mis-specification, new information reveals a change in stock status requiring a management response. Competing policy objectives, such as the need to address the needs of fishing communities, could also result in changes in harvest control rules.

4.1.2.2 No action

Under No Action, 2014 harvest specification values are held constant for the 10-year projection period. Catch of key stocks is estimated based on historical attainment of ACLs/OYs during the baseline period. These catch projections are compared to forward projections of catch and stock status in the stock assessment decision tables. Cases where overfishing would occur (based on stock assessment projections) under these specifications are identified. The socioeconomic impact analysis will identify cases where under-harvest would occur relative to catch projections under the default harvest control rule.

4.1.2.3 Alternative 1

The evaluation will focus on the application of default harvest control rules, which are 2013-2014 HCRs. If the Council decides to depart from 2013-14 HCRs for one or more stocks the rationale is discussed below in section 4.1.3.3. Forward projections for key stocks under new HCRs will be presented and evaluated. The list of questions above will be used for this evaluation.

4.1.2.4 Alternative 2

Alternative 2 uses the same default HCRs for stocks without a new stock assessment. For newly assessed stocks (2013), the Council will consider alternative P* values to determine “default” HCRs. These are not truly “default” in the sense of ‘in the absence of explicit action.’ Therefore, the type of necessary evaluation needs to be determined for these cases. Since the Council would only be choosing P* star values, it would make sense that the impact analysis focus on this. A range of P* values could be identified (e.g., 0.45, 0.40, 0.35, 0.30) as a basis for the analysis. These alternative values would be applied to the 2013 assessments to derive 10-year ABC projections and related harvests.

Consider how to handle stock complexes as reorganized in terms of long-term impacts.

4.1.3 Actions in 2015-16 Harvest Specifications Affecting Long-term Stock Status

4.1.3.1 New Rebuilding Plans and Revisions to Existing Plans

If new rebuilding plans or revisions are required, it will be necessary to determine the type of analysis and how it is integrated into this analytical structure. In previous EISs "integrated alternatives" or "strategic rebuilding alternatives" were included to support analysis of alternative rebuilding plan objectives (target year and related harvest control rule).

4.1.3.2 Reorganization of Stock Complexes

Most unassessed species are managed as part of several stock complexes. National Standard 1 Guidelines define a stock complex as "a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar" (50 CFR 600.310(d)(8)). In the 2015-16 decision-making cycle the Council is considering reorganizing these stock complexes consistent with this definition. The impact analysis in this document focuses on those species that received a vulnerability score equal to or greater than 2.0, which is described as either a major or high concern.

We are assuming a separate NEPA analysis will be prepared for the reorganization of stock complexes decision (see Agenda Item D.3.a, Attachment 1, April 2013, for preliminary analysis). This section would summarize the results of that NEPA document. The harvest specifications for new complexes will be reported in Chapter 2.

4.1.3.3 Adoption of New Harvest Control Rules

The Council may adopt HCRs different from the 2013-14 HCRs (the "default" HCRs) for one or more stocks to be applied to determine harvest specifications for the 2015-16 biennium. The rationale for these changes is discussed and evaluated in this section.

4.1.4 Long-term Effects of Management Measures Related to Harvest Specifications

It is not possible or necessary to evaluate every possible adjustment in routine management measures (e.g., changes to RCA configuration with boundaries previously published in regulations, trip limit adjustments, bag and sub-bag limits). Many or most changes in routine measures result in impacts of the same type and intensity. Furthermore, differences in the impacts of different management measure configurations are too small to identify or predict. NEPA doesn't require that every impact be anticipated.[7] Instead, this analysis will look at categories of management measures (e.g., trip limits, time/area closures, gear restrictions, and bag and boat limits in recreational fisheries) as applied to particular fisheries (e.g., shoreside IFQ, nearshore fixed gear, state recreational). The evaluation will be based on the following questions:

- What is the objective of the measure (e.g., for catch control measures, catch of which species)?

[7] Scoping shall "identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review…" (40 CFR 1501.7(3), but include "a brief presentation of why they will not have a significant effect"). Every possible impact need not be discussed but only those "that are 'likely' (or 'foreseeable' or 'reasonably foreseeable')" such that "a person of ordinary prudence would take it into account in reaching a decision" (*Wilderness Watch v. U.S. Forest Service,* 143 F Supp.2d 1186 1209 (D. Mont. 2000)).

- How do adjustments to the measure affect impacts (e.g., lowering a limit reduces fishing mortality)?
- What other biological impacts may occur outside of the objective (e.g., area-specific reduction in adverse impacts to EFH, other indirect effects based on changes in fishing effort by gear type)?

The analysis will also discuss in general terms the relationship between stock-specific ACLs and adjustments to management measures.

- What are the stock-specific ACL thresholds that are likely to trigger substantially more restrictive management measures? Is this non-linear, is there a breakpoint?
- What types of new management measures would be triggered in response to an ACL reduction?

4.1.4.1 At-sea Whiting Fisheries

Routine Measures

Routine management measures are those that the Council determines are likely to be adjusted on an annual or more frequent basis. The Council classifies measures as routine when proposing new management measures to be implemented through the rulemaking process under the APA. Adjustments to routine measures may be made through abbreviated rulemaking processes. This subsection (and those for fisheries sectors as listed below) will provide a generalized evaluation of the effects of routine measures and their adjustment within the adaptive management paradigm.

New Measures

New management measures have not been implemented yet and may be classified as routine by the Council. Obviously, what measures may be implemented are unknown, but a general assessment of reasonably foreseeable (likely) new measures may be identified. The evaluation will focus on those measures related to harvest specifications, i.e., to achieving but not exceeding, ACLs. The questions listed above would form the basis of these fishery-specific evaluations.

4.1.4.2 Shoreside IFQ (Whiting Trawl, Nonwhiting Trawl, Nonwhiting Non-trawl)

Routine Measures

New Measures

4.1.4.3 Non-nearshore Fixed Gear

Routine Measures

New Measures

4.1.4.4 Nearshore Fixed Gear

Routine Measures

New Measures

4.1.4.5 Other Directed Open Access Fisheries and Fisheries Catching Groundfish Incidentally

Routine Measures

New Measures

4.1.4.6 Recreational Fisheries

Washington

Routine Measures

New Measures

Oregon

Routine Measures

New Measures

California

Routine Measures

New Measures

4.2 California Current Marine Ecosystem

4.2.1 Long-term Effects

Chapter 3 (baseline description) provides information for the above assessment of effects that may be different (in either type or intensity) in the future. The evaluation in this section is organized similarly:

- Effects of managing fisheries to B_{MSY}
- Effects of other anthropogenic activities
- Climate change and system forcing

An overall question to frame the analysis is whether future harvest specifications and related management measures will result in effects substantially different than what has been documented in the past (baseline period, 2003-2012, or longer). Based on consultation with subject matter experts metrics and thresholds may be identified to specify what is considered a "substantially different effect."

The analysis will take into account factors that may be different in the future such as:

- Council use of integrated ecosystem assessment products in decision-making for the biennial process
- Is trawl rationalization allowing increased harvest of groundfish species (e.g., yellowtail rockfish)? What are potential trophic effects of that increased harvest?
- What are the potential trophic effects of fewer vessels participating in trawl fishery due to trawl rationalization (e.g., a lower overall number of trawl hours)?[8]
- How would changes in fishing effort affect greenhouse gas emissions?
- Will mammals or seabirds see improved opportunities to achieve their optimum population levels, and if so, how might that affect trophic interactions within the CCE?
- How will meso-scale climate change (warm/cool phases) and global warming interact with managing fisheries to B_{MSY}? (King et al. 2011 provide an excellent overview of potential climate change impacts in California Current. *ICES J. Mar. Sci. (2011) 68 (6): 1199-1216.*)[9]

4.2.2 Short-term (2015-16) Effects

Groundfish fishery removals in 2015-16 are expected to result in effects consistent with the types of long-term effects discussed above. The 2013-14 Harvest Specifications FEIS concluded that the proposed action (harvest specifications and management measures for the previous biennial period) is "unlikely to have a discernible impact on the [CCE] and other oceanographic and climate functioning" (page 379). (This statement should be interpreted in terms of a relatively recent historical baseline, because over the long term managing stocks to BMSY has had discernible impacts on the CCE.) Because fishery removals and related patterns of fishing in 2015-16 are not expected to differ substantially from the 2013-14 period, the same conclusion may be reached with respect to short-term (2015-16) impacts of the proposed action on ecosystem and habitat. However, evaluating short-term impacts in isolation risks creating a "shifting baseline" where incremental effects are not acknowledged. Short-term effects need to be contextualized in terms of long-term and cumulative effects.

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[8] Lian, Singh, and Weninger (2010) predicted an eventual halving of fleet size under ITQs. See Marine Resource Economics, Volume 24, pp. 329–359

[9] Also see: 1. Ainsworth, C., Samhouri, J., Busch, D., Cheung, W. W. L., Dunne, J., and Okey, T. A. 2011. Potential impacts of climate change on Northeast Pacific marine foodwebs and fisheries. ICES Journal of Marine Science: Journal du Conseil, 68: 1217–1229; 2. Cheung et al 2013. Signature of ocean warming in global fisheries catch. Nature 492: 365-369; doi:10.1038/nature12156 (which shows data for the west coast indicating that catch has been affected by climate change. Mean temperature preference of the catch has been increasing). 3. Pinsky and Fogarty (2012) have identified northward shifts in both fish stocks and fisheries, in response to warming waters in the Northeast US.

4.3 Essential Fish Habitat

4.3.1 Long-term Effects

Groundfish EFH is primarily benthic and the effects of fishing relate to the distribution of fishing effort and the type of fishing gear used. The following factors are likely to cause changes in the distribution and intensity of adverse effects:

- Increased gear switching in the shoreside IFQ fishery
- Fleet consolidation in the shoreside IFQ fishery
- Change in the configuration of fishery time/area closures (RCAs, etc.) affecting EFH
- Changes in the distribution of fishing effort, if possible to forecast. (For example, fishery effort data from 2011-2012, the first two years of the shoreside IFQ fishery, may show a shift to offshore areas; the effect may be less overlap with nearshore overfished rockfish species, potentially reducing impacts on nearshore habitat and species.)

No projections are available to evaluate changes in the distribution and intensity of fishing effort; potential changes from baseline conditions will be assessed qualitatively. [10]

Nonfishing impacts are not a direct/indirect effect of the proposed action and are evaluated as a cumulative impact (section 4.7).

4.3.2 Short-term (2015-16) Effects

Groundfish fishery removals in 2015-16 are expected to result in effects consistent with the types of long-term effects discussed above.

4.4 Non-groundfish Species

4.4.1 Long-term Effects

Will future harvest specifications and related management measures result in effects substantially different than what has been documented in the past (baseline period, 2003-2012, or longer)? What factors may be different in the future that would affect non-groundfish? Based on consultation with subject matter experts metrics and thresholds may be identified to specify what is considered a "substantially different effect."

What other factors will affect non-groundfish stocks in a synergistic or cumulative way? E.g., non-groundfish fisheries.

According to the 2013-14 Groundfish Harvest Specifications FEIS:

[10] If the future distribution of fishing effort is expected to differ substantially from earlier years (because of trawl rationalization implementation for example), simple approaches can be used to qualitatively translate changes in fishing effort into impacts on habitat. Kaplan et al. 2012 used qualitative scoring of impacts per gear and habitat, provided through the 2005 EFH process, to calculate a metric of habitat integrity for various scenarios of fishing effort and closed areas. This work could be revisited, with revised information from the more recent EFH work, and recent fishing effort data. (See Kaplan, I.C., Horne, P.J., Levin, P.S. 2012. Screening California Current Fishery Management Scenarios Using the Atlantis End-to-End Ecosystem Model. Progress in Oceanography 102: 5-18.)

> The nature of impacts to non-groundfish species will vary depending on the nature of the fishery and the life history behavior of the particular species or population. Changes will likely result in changes to bycatch and other interactions with protected species. However, the impacts will not be uniform across the spectrum of species, due to the variability in the behavior and susceptibility to various fishing practices of each species.
>
> Catch control measures proposed under the alternatives (IFQ, trip limits, and RCAs) are only for groundfish species and therefore would have no direct impacts on non-groundfish species. The measures may indirectly affect non-groundfish species if they induce changes in the magnitude of fishing effort and its spatial and temporal distribution. In addition, gear switching in the shoreside IFQ fishery could result in the mix of non-groundfish species caught. However, it is not possible to predict changes in these metrics due to the proposed action… (page 381)

4.4.2 Short-term (2015-16) Effects

Non-groundfish fishery removals in 2015-16 are expected to result in effects consistent with the types of long-term effects discussed above.

4.5 Protected Species

4.5.1 Long-term Effects

Will future harvest specifications and related management measures result in effects substantially different than what has been documented in the past (baseline period, 2003-2012, or longer)? What factors may be different in the future that would affect protected species? Based on consultation with subject matter experts metrics and thresholds may be identified to specify what is considered a "substantially different effect."

What other factors will affect protected species in a synergistic or cumulative way?

From 2013-14 EIS:

> Although the incidental take of Chinook salmon cannot be predicted, it is likely to be within the range of incidental take experienced in the recent past. With regard to variable impacts to Pacific salmon resulting from the Alternatives considered, it is unlikely that any management scenarios under the Alternatives would have a negative impact on Pacific salmon. The exception may be in cases where fishing pressure is displaced shoreward during seasons when Pacific salmon are more prevalent.

4.5.2 Short-term (2015-16) Effects

Takes (as defined in the ESA and MMPA) of protected species by groundfish fisheries in 2015-16 are expected to result in effects consistent with the types of long-term effects discussed above.

4.6 Socioeconomic Consequences

4.6.1 Long-term Effects

Analysis of long-term socio-economic impacts is based on 10-year catch projections derived from stock assessments for key stocks. Estimated landings for other stocks or stock complexes are based on average baseline values (values based on the CVs could be used to bracket averages).

A basic approach would apply historical patterns of landings to project landings by fishery sector and port group. This would assume these patterns will be static over the projection period. Comparison to the baseline period would only be meaningful in terms of changes in projected landings. Alternatively, temporal trends over the baseline period could be explored. The likelihood of any identified trends persisting in future would be evaluated qualitatively. Figure 4-3 shows the results of evaluating trends in landings from the nonwhiting trawl sector (and accounting for gear switching in the IFQ fishery) by IOPAC port group. The table identifies years when groundfish landings were more than one standard deviation above the 10-year historical mean, the correlation coefficient (R-squared) highlighting values above 0.5, the slope of the trend line (indicating a positive or negative change) and each port group's share of the sector's landing for the entire baseline period. Similar plots will be developed for other commercial fishery sectors and commercially important groundfish species. These data can be used to identify possible historical trends. Recreational fisheries trends will be assessed similarly based on historical effort metrics (angler trips). The likelihood that such trends could persist in the future will be evaluated qualitatively taking into factors, such as changes in costs and demand, that could affect fishing effort and the distribution of landings among ports.

	Above/Below 1 Std Dev										RSQ	Slope	Coastwide Share
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012			
01Puget Sound	-	-	High	-	-	-	-	-	-	-	0.216703	-0.36%	5.30%
02North WA coast	High	-	-	-	Low	Low	Low	Low	Low	Low	0.790179	-0.50%	1.22%
03South and central WA coast	Low	Low	Low	Low	Low	Low	-	Low	High	High	0.796423	0.76%	3.92%
04Astoria	Low	Low	Low	-	Low	-	-	-	High	High	0.728229	1.23%	31.81%
05Tillamook	High	-	Low	-	Low	Low	-	Low	Low	Low	0.595663	-0.02%	0.08%
06Newport	Low	Low	Low	Low	-	High	High	-	Low	Low	0.014522	-0.10%	10.46%
07Coos Bay	Low	Low	Low	-	-	-	-	High	Low	Low	0.029986	-0.08%	13.83%
08Brookings	-	Low	Low	Low	-	-	Low	High	-	High	0.552019	0.25%	4.76%
09Crescent City	High	-	-	-	-	-	-	Low	Low	Low	0.589808	-0.31%	2.73%
10Eureka	Low	Low	Low	-	High	-	Low	Low	-	Low	0.036665	0.09%	11.02%
11Fort Bragg	-	-	High	Low	Low	Low	Low	-	-	Low	0.11197	-0.06%	6.91%
12Bodega Bay	High	Low	Low	-	-	-	Low	Low	Low	Low	0.325317	-0.06%	0.27%
13San Francisco	-	High	Low	Low	High	-	Low	Low	Low	Low	0.593156	-0.34%	3.39%
14Monterey	High	-	-	-	Low	Low	Low	Low	Low	Low	0.488803	-0.38%	2.48%
15Morro Bay	High	High	-	Low	Low	Low	Low	Low	-	High	0.027867	-0.11%	1.83%
16Santa Barbara	Low	High	Low	Low	Low	Low	Low	Low	Low	Low	0.163121	0.00%	0.00%

Figure 4-3. Trend analysis for nonwhiting trawl (and nontrawl IFQ, 2011-2012) fishery landings by IOPAC port group.

No Action and the historical baseline serve as a point of comparison to judge whether future harvest specifications and related management measures result in substantially different effects. This comparison will be supplemented with a qualitative evaluation of factors affecting groundfish fisheries and fishing communities that may be different in the future.

4.6.2 Short-term (2015-16) Effects

The short-term evaluation would be similar to what was done in previous EISs, although the range of alternatives would be narrower. (The need to evaluate impacts of rebuilding plan adoption/revision could increase the range of alternatives evaluated.)

- Commercial and Tribal Fisheries: Change in total ex-vessel revenue and accounting net revenue from No Action
- Recreational Fisheries: Change in marine angler trips from No Action
- Communities: Change in personal income and employment from No Action and change in ex-vessel revenue from the 2003-2012 baseline
- Processors: Change in purchases

- Other Impacts: NMNU, vessel safety, social welfare

4.6.2.1 Fishing Community Income

Personal income impacts derived from IOPAC will be presented by port group and region, comparing No Action harvest specifications to action alternative harvest specifications.

4.7 Cumulative Effects

CEQ regulations at 40 CFR 1508.25 identify three types of impacts that must be considered in an EIS: direct, indirect, and cumulative effects. Direct effects are directly related to the action (occurring at the same time and place); for indirect effects there is some intermediate cause-and-effect between the proposed action and the actual effect being evaluated (occurring at a distance in time and/or place). The regulations also define a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or nonfederal) or person undertakes such actions.” Although the regulations and guidance identify cumulative effects as a separate, third class of impacts, all effects can be viewed as cumulative to the extent they are part of some causal chain that results in an ultimate effect on an environmental component. Therefore, to arrive at the final, cumulative effect on an environmental component, the effects in a causal chain are traced out and measured qualitatively or quantitatively, in terms of the metrics that have been identified in this EIS. The phenomena contributing to cumulative effects are baseline conditions (e.g., all relevant past and present actions), reasonably foreseeable future actions (RFFAs), the effects of the proposed action, and any mitigation that is proposed separately from the alternatives. Some of the baseline conditions of the affected environment are described in Chapter 3. Sections xx describe the direct and indirect impacts of the alternatives on fish stocks, fishery sectors, fishing communities, protected species, EFH, and the ecosystem.

4.7.1 The Scope and Types of External Actions and Trends Relevant to the Proposed Action

4.7.1.1 Geographic Boundaries

The analysis of impacts focuses on actions related to the harvest of Pacific Coast groundfish. The core geographic scope for each of the potentially impacted resources is focused on the Eastern Pacific Ocean (section xx). The core geographic scopes for the managed resources are the waters of the EEZ off of the coasts of Washington, Oregon, and California. For non-groundfish species, those ranges may be expanded and would depend on the biological range of each individual nontarget species in the Eastern Pacific Ocean. For habitat, the core geographic scope is focused on EFH within the EEZ, but includes all habitat utilized by groundfish and other non-groundfish species in the Eastern Pacific Ocean. The core geographic scope for endangered and protected species can be considered the overall range of these species in the Eastern Pacific Ocean. For human communities, the core geographic boundaries are defined as those U.S. fishing communities directly involved in the harvest or processing of the managed resources, which were found to occur in coastal states from Washington through California (section xx).

4.7.1.2 Temporal Boundaries

The temporal scope of past and present actions for the potentially affected resources is primarily focused on actions that have occurred after FMP implementation (PFMC 2011, originally implemented on October 5, 1982). For endangered and other protected resources, the scope of past and present actions is on a species-by-species basis and is largely focused on the 1980s and 1990s through the present, when NMFS began generating stock assessments for marine mammals and sea turtles that inhabit waters of the

U.S. EEZ. The temporal scope of future actions for all relevant resources extends 10 years into the future to provide a reasonable timeframe.

4.7.1.3 Past, Present, and Reasonably Foreseeable Future Actions and Ongoing Trends

Section 4.3 in the 2013-14 Groundfish Harvest Specifications FEIS describes the ongoing and reasonably foreseeable "external actions" and "ongoing trends" that contribute to the effects of the proposed action under the different alternatives to produce a cumulative effect. This information is summarized here with respect to actions and trends with continuing effects in 2013 and beyond.

Fishing-related Actions (including Past, Present, and Reasonably Foreseeable Future Actions)

Past and future harvest specifications. Groundfish fisheries are managed to prevent total catch exceeding ACLs, which are set at or below the ABC and therefore represent a precautionary reduction from the overfishing limit to account for scientific uncertainty and to rebuild overfished and other stocks whose biomass is below the MSY target level (or its proxy). The policy objective is to attain or maintain MSY over the long term, which depends on the continuous reapplication of ACLs during past, present, and future biennial management cycles. Harvest specifications also indirectly control the amount of fishing effort expended in regulated fisheries and the distribution of effort among groundfish sectors and gear types through the allocation of fishing opportunity. This indirectly affects EFH and the relative level of protected species take, due to the differential effects of different gear types.

Non-groundfish fisheries. Other fisheries contribute to mortality of environmental components also affected by groundfish fisheries, particularly protected species. (Catch of groundfish in non-groundfish fisheries is regulated and accounted for through the biennial management process and therefore directly affected by the proposed action.) Adverse impacts from other gear types may also combine with impacts to EFH from groundfish gear. Fishery removals from all sources also have long-term effects on the trophic structure of the California Current ecosystem.

Section 7 consultation on the Groundfish FMP pursuant to the ESA. NMFS NWR Sustainable Fisheries Division consulted with the Protected Resources Division to determine if fishing authorized under the Groundfish FMP is likely to jeopardize the continued existence of any species listed under the ESA. This consultation concluded that operation of the groundfish fishery is not likely to jeopardize the continued existence of ESA-listed species found in the action area or result in the destruction or adverse modification of designated critical habitat. NMFS has also consultied with the USFWS on the effects of operation of the fishery on listed species under USFWS jurisdiction. Past consultations have been done for the groundfish trawl fishery with respect to ESA-listed Chinook salmon ESUs. A bycatch threshold of 11,000 Chinook salmon was established for trawl fisheries targeting Pacific whiting; exceeding the threshold in any one year may trigger re-initiation of consultation. (No equivalent threshold has been established for nonwhiting groundfish trawl, because the level of take in this fishery has not yet been determined to be an ESA issue.)

Catch share management. IFQ and co-op management in trawl sectors were implemented at the beginning of 2011, based on Groundfish FMP Amendment 20. Regulatory changes to improve program performance and implement cost recovery provisions allowed for in the MSA are ongoing. A regulatory package was implemented on January 1, 2012, and comparable regulatory packages will likely be implemented in future years. The current moratorium on quota share trading was originally scheduled to expire at the beginning of 2012 but has been extended in response to ongoing litigation. The shoreside IFQ fishery may now use any legal groundfish gear (previously they were restricted to using only trawl gear). Although trawl gear is likely to remain the dominant gear type, harvesters may increasingly use fixed gear in certain areas and time periods. Coincident with catch share management, fixed allocations between the IFQ and whiting co-op fisheries and other nontrawl groundfish fisheries were established. This makes it easier to determine QP and co-op share distributions during each management period but also reduces the scope of decision-making about fishing opportunity among different sectors of the fishery. Cost recovery measures and the end of subsidies to pay for observer coverage in the IFQ fishery will shift some costs from government to fishery participants.

Non-Fishing Actions (including Past, Present, and Reasonably Foreseeable Future Actions)

Non-fishing activities that introduce chemical pollutants, sewage, changes in water temperature, salinity, dissolved oxygen, and suspended sediment into the marine environment pose a risk to all of the identified resources. Human-induced non-fishing activities tend to be localized in nearshore areas and marine project areas where they occur. Examples of these activities include, but are not limited to agriculture, port maintenance, beach nourishment, coastal development, marine transportation, marine mining, dredging, and the disposal of dredged material. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease habitat quality and, as such, may indirectly constrain the sustainability of groundfish species, non-groundfish species, and protected species. Decreased habitat suitability would tend to reduce the tolerance of these resources to the impacts of fishing effort. Mitigation of this outcome through regulations that would reduce fishing effort could then negatively impact human communities. The overall impact to the affected species and their habitats on a population level is unknown, but likely neutral to low negative, since a large portion of these species have a limited or minor exposure to these local nonfishing perturbations.

In addition to guidelines mandated by the MSA, NMFS reviews these types of effects through the review processes required by Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for certain activities that are regulated by Federal, state, and local authorities. The jurisdiction of these activities is in "waters of the U.S." and includes both riverine and marine habitats.

For many of the proposed nonfishing activities to be permitted under other Federal agencies (such as beach nourishment, offshore tidal and wind power facilities, etc.), those agencies would conduct examinations of potential impacts on the resources. The MSA (50 CFR 600.930) imposes an obligation on other Federal agencies to consult with the Secretary of Commerce on actions that may adversely affect EFH. The eight Regional Fishery Management Councils are engaged in this review process by making comments and recommendations on any Federal or state action that may affect habitat, including EFH, for their managed species and by commenting on actions likely to substantially affect habitat, including EFH.

In addition, under the Fish and Wildlife Coordination Act (Section 662), “whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatsoever, including navigation and drainage, by any department or agency of the U.S., or by any public or private agency under Federal permit or license, such department or agency first shall consult with the USFWS, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular state wherein the” activity is taking place. This Act provides another avenue for review of actions by other Federal and state agencies that may impact resources that NMFS manages in the reasonably foreseeable future.

In addition, NMFS and the USFWS share responsibility for implementing the ESA. The ESA requires NMFS to designate "critical habitat" for any species it lists under the ESA (i.e., areas that contain physical or biological features essential to conservation, which may require special management considerations or protection) and to develop and implement recovery plans for threatened and endangered species. The ESA provides another avenue for NMFS to review actions by other entities that may impact endangered and protected resources whose management units are under NMFS’ jurisdiction.

Ongoing Trends

Change in the use of ocean areas. Habitat protection measures (e.g., MPAs) and offshore energy projects (e.g., wind and wave power) could further limit the area open to fisheries.

Changes to coastal economies and land use. Increasing population and rising living standards can increase demand for nonfishery-related economic activities and land use in coastal areas. This may increase costs to fishery participants for shoreside infrastructure such as dock space.

Changing demand affecting real prices. Population growth and rising living standards globally are likely to increase demand for fishery products. This could lead to price increases unless aquaculture increases supply at lower cost than wild-caught fish (and consumers consider the two products substitutable). Higher ex-vessel prices would benefit harvesters while higher wholesale prices (depending on changes in ex-vessel prices) would benefit processors.

Increased consumer awareness affecting purchasing decisions. Certification and consumer awareness programs may affect buying decisions. Consumers may become more aware of or form opinions about how effectively a fishery is managed both in terms of the status of target stocks and the effect of a particular fishery on other resources (e.g., protected species). Consumer awareness may have a marginal effect on demand for specific products (based on source) over the long term.

Changes to stock productivity due to climate forcing or other environmental factors. Stock productivity determines whether a given level of fishing mortality allows a stock to remain at or achieve MSY, but is not under human control. Harvest rates in rebuilding plans account for productivity, but this may change over time due to environmental factors. Periodic stock assessments usually indicate a need to change harvest rates based on stock status. Although policy and practice is to prevent overfishing, undetected changes in stock productivity (due to ocean regime, for example), change in understanding or estimates of stock reference points (e.g., unfished biomass), or assessment of previously unassessed stocks could reveal that overfishing has occurred and catch must be reduced to rebuild the stock and maintain it at the target biomass (B_{MSY} or proxy).

Cyclical and ongoing climate change. Cyclical events (e.g., El Niño-Southern Oscillation, Pacific Decadal Oscillation) and long-term climate change affect the relative productivity of different marine organisms with attendant ecosystem effects. As discussed above, such changes can also affect the allowable level of catch under harvest specifications; it can also influence the relative impact of fisheries on protected species and other ecosystem components (because a less productive stock will be relatively more adversely affected by a given level of fishery take, for example).

4.7.2 Evaluation of the Cumulative Impacts of the Proposed Action

5 Consistency with the Groundfish FMP and MSA National Standards

The following narrative responses are from the 2013-14 Harvest Specifications FEIS. They will be revised as necessary for the current EIS.

5.1 FMP Goals and Objectives

The Groundfish FMP contains 3 broad goals and 17 objectives intended to achieve those goals. Past EISs for rebuilding plans and harvest specifications describe how the actions address each objective. The proposed actions evaluated in the current EIS address the goals and objectives in a similar fashion as described in the previous groundfish harvest specifications EISs.

5.2 National Standards

An FMP or plan amendment and any pursuant regulations must be consistent with ten national standards contained in the MSA (§301). These are:

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the OY from each fishery for the United States fishing industry.

The harvest specification action alternatives are consistent with the OY harvest management framework described in Chapter 4 of the Groundfish FMP. Chapter 4 describes OY as "a decisional mechanism for resolving the Magnuson Stevens Act's multiple purposes and policies, implementing an FMP's objectives and balancing the various interests that comprise the national welfare." The OY harvest management framework (as revised by Amendment 23 to the Groundfish FMP) is consistent with revised National Standard 1 Guidelines. In this EIS, Section 2.1 describes how the proposed harvest specifications were developed in relation to the OFL, ABC, and ACL reference points. The OFL is the estimate of catch level above which overfishing is occurring, or the estimate of MFMT applied to a stock's abundance. The ABC is a level of annual catch that accounts for the scientific uncertainty in the estimate of OFL and any other scientific uncertainty. Chapter 4 in the Groundfish FMP describes an ABC control rule, ABC values described in this document were determined following that control rule. The ACL is the level of annual catch that serves as the basis for invoking Accountability Measures. The ACL may equal but may not exceed the ABC. The ACL may be set lower than the ABC to account for a wide range of factors. The application of the OY harvest management framework to the specifications described in this document should result in ACLs that reduce the likelihood of overfishing.

The revised National Standard 1 guidelines set forth principles on which stock complexes should be organized, including that stocks within a complex should be similar in terms of geographic distribution, life history, and vulnerability to the fishery. Stock complexes are being reexamined, and as necessary, reorganized, incrementally as scientific information and institutional resources allow. Until the stock complexes can be reorganized the current stock complexes will remain in place. At this time the current configuration of the stock complexes has not shown to allow overfishing on any species therefore allowing them to remain in place thorough the Council's reexamination does not pose a threat to the ongoing sustainability of any of the species in any complex. As part of this biennial cycle the Council is considering new sorting requirements in commercial fisheries for aurora, rougheye, and shortraker rockfish, which are part of the Minor Slope Rockfish complex north or 40°10' N. latitude. This requirement would provide information on the susceptibility of these species to groundfish fisheries.

Future reorganization of stock complexes based on common biological characteristics, such as vulnerability, would benefit from this information.

Because of past overfishing seven groundfish stocks are currently declared overfished. Widow rockfish was determined to be rebuilt in 2011 and will no longer be managed under a rebuilding plan beginning in 2013. Petrale sole was declared overfished in 2010 based on a revision to the OY harvest management framework that incorporates estimates of B_{MSY} of $B_{25\%}$ and MSST of $B_{12.5\%}$ for flatfish. Petrale sole is estimated to be rebuilt in 2013, but will be managed under its rebuilding plan for the 2013-14 biennial cycle.

Of the remaining overfished species four will be managed under the current, default rebuilding plans, maintaining the same SPR harvest rate and target year. The best available scientific information indicates that there is a less than 50 percent probability that canary rockfish and POP can be rebuilt by the target years currently in their rebuilding plans, even in the absence of fishing (zero ACL at $T_{F=0}$). Therefore, the target years in these rebuilding plans must be revised. The preferred alternatives for these stocks maintains the default SPR harvest rate but revises the target year based on the median rebuilding year estimated in the most recent rebuilding analysis. For canary rockfish, the revised target year is 2030, 3 years later than the current target year but only 2 years later than the re-estimated $T_{F=0}$ zero harvest level. The re-estimated target year for POP based on the default harvest rate is 2051, 31 years after the current rebuilding target year but only 8 years after the estimated rebuilding year under zero harvest.

Section 304(e) introduces a tradeoff formulated as specifying a time to rebuild “as short as possible, taking into account the status and biology of any overfished stocks, the needs of fishing communities, … and the interaction of the overfished stock of fish within the marine ecosystem…” The proposed action is evaluated based on these considerations in Chapter 4 of this EIS.

National Standard 2 states that conservation and management measures shall be based on the best scientific information available.

The best available science standard applies to the following areas in relation to this proposed action: stock assessments, rebuilding analyses, and methods for determining management reference points (OFL, ABC, ACL, etc.), which forms the basis for determining harvest levels, and the evaluation of socioeconomic impacts. The supporting science is discussed below.

The harvest specifications (specifically, ACLs) considered under the proposed action (the action alternatives, including the Preferred Alternative), are based on the most recent stock assessments, developed through the peer-review STAR process. As part of the management cycle the Council recommends which stocks should be assessed in advance of current decision-making. Only a small proportion of the 80+ managed groundfish species are regularly assessed, because of a combination of factors. For many stocks there may not be enough data to support a full assessment (the FMP describes a classification system based on the availability of data). For unassessed stocks proxy methods must be used to determine reference points. Stocks may be subjected to little or no fishing pressure, or determined to have low vulnerability, and thus less in need of regular assessment. Finally, there is a limit on the institutional resources needed to carry out the assessments (i.e., fishery scientists). In some cases a previous assessment may be updated; this means that the underlying model is not reevaluated but the model is re-run with the addition of more recent data from the period since the last full assessment. Section 2.1 reviews the basis for alternative harvest specifications and references the stock assessments that were used.

The No Action Alternative specifications do not benefit from the new assessments and updates conducted as part of the current management cycle. For those stocks No Action does not represent the best available science.

Section 4.1 describes the methods that were used to determine reference points for harvest specifications (OFL, ABC, ACL, etc.) for stocks and stock complexes.

The NWFSC has developed a model application, called IO-Pac, for estimating personal income impacts of commercial fishing on the west coast. This model is documented in Appendix A.

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Groundfish ACLs are set for management units, which include stocks, stock complexes, or geographic subdivisions thereof. Stock complexes group co-occurring species, many of which have not been formally assessed. Section 2.1.3 describes how ACLs for stock complexes are developed based on ABC estimates of component stocks. Stocks within these complexes are not managed individually for a variety of reasons including the lack of assessments, lack of reliable catch data at the species level, or they constitute a small portion of catches. If a stock within a complex is individually assessed it may be managed under a separate harvest limit, when practicable.

Stocks with their own ACLs are managed throughout the range of that stock (as opposed to the species), although issues do arise in the case of stocks straddling international borders. For this reason, allocation of the harvestable surplus of Pacific whiting between the U.S. and Canada is subject to international agreement.

Separate ACLs may be set for geographic subcomponents of a stock for management purposes. However, the development of subcomponent ACLs is based on managing these stocks throughout their range within U.S. waters. As part of the proposed action the Council is considering a change in the scope of subcomponent ACLs for lingcod that would better reflect biological and fishery characteristics. Currently lingcod is managed in two area components, north and south of 42° N. latitude. Under the proposed action the dividing line would be moved to 40°10’ N. latitude, near Cape Mendocino. Cape Mendocino is a biogeographic boundary and as such 40°10’ N. latitude is commonly used in groundfish fishery management for the differential application of management measures.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishers, such allocation shall be (A) fair and equitable to all such fishers; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The proposed measures will not discriminate between residents of different states.

Allocation decisions are also made as part of the biennial harvest specifications process for those stocks for which formal allocations have not been established under the FMP. Section 2.2.2 describes these allocation decisions. Emphasis is placed on equitable division while ensuring conservation goals. Decision-making on these allocations occurs through the Council process, which facilitates substantial participation by state representatives. Generally, state proposals are brought forward when alternatives are crafted and integrated to the degree practicable.

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

Measures have been taken to reduce fishing capacity in the limited entry trawl fleet and nontrawl fleets, including: fixed gear permit stacking program implemented by FMP Amendment 14, the trawl vessel buyback program, and catch share management implemented by FMP Amendment 20. Reducing excess capacity is expected to improve the efficiency in the utilization of fishery resources as well as reduce the levels of incidental catch.

Catch share management in the at-sea whiting sectors and the shoreside IFQ fishery promote efficiency of utilization by reducing regulatory discards. Vessels in these fisheries are subject to 100 percent observer coverage, which improves catch accounting.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

Management measures reflect differences in catch, and in particular bycatch, of overfished species, among different fisheries. For example, different RCA configurations are established for different gear types (trawl versus fixed gear) and the catch control tools also differ. For example, at-sea whiting fisheries are managed by co-ops, the shoreside IFQ fishery by IFQs, and limited entry fixed gear fishery for sablefish by vessel-level allocations (permit stacking). Within these fisheries and in the open access sector cumulative trip limits are used for particular management units and/or during certain times of the year. Recreational fisheries are managed with area closures and bag limits proposed by the states and appropriate to the catches and characteristics of each state's recreational fishery.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

Generally, by coordinating management, monitoring, and enforcement activities between the three west coast states, duplication, and thus cost, is minimized. Appendix C evaluates proposed management measures in detail, including consideration of associated costs and duplication.

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), … take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

This document evaluates the effects of the alternatives on fishing communities (see section 4.3). These effects were taken into account in choosing the preferred "integrated alternative" (incorporating harvest specifications and related management measures). The alternatives are structured to allow a comparison of the tradeoffs between the requirements of the MSA. The requirements in Section 304(e)(4)(A) of the MSA include rebuilding overfished stocks in as short a time possible, taking into account the needs of fishing communities, and minimizing adverse economic impacts to fishing communities. Each integrated alternative contains a suite of ACLs for overfished species associated with a particular rebuilding strategy (target year and harvest rate) and management measures needed to constrain catches to these harvest levels. Target species catch for each alternative is projected based on these management measures, which allows an estimate of resulting ex-vessel revenue and personal income impacts at the community level (with the port group area the unit of analysis for community impacts). In this way the 'rebuild in as short a time as possible' standard can be contrasted with the 'needs of fishing communities' standard to demonstrate what level of catch or bycatch of overfished species is necessary to address adverse impacts to fishing communities.

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

Minimizing bycatch, of overfished species in particular, is an important component of the alternatives. Through the use of GCAs fishing effort is reduced in areas where overfished species are most abundant, thereby reducing potential bycatch. As noted above, catch share management, particularly in the shoreside IFQ fishery, has reduced bycatch by eliminating most regulatory discards (some non-target species are managed with cumulative trip limits, which may induce some level of regulatory discards). Nontrawl sectors use cumulative trip limits as the principal catch control tool. Because trip limits are based on landings, when they are set at a low level to discourage directed and incidental catch of overfished species, this can result in regulatory discards.

The petrale sole rebuilding plan established objectives reflecting that it is an important target species for vessels using groundfish bottom trawl gear (managed under the shoreside IFQ fishery). The rebuilding plan allows a limited target fishery to continue, which in concert with IFQ management minimizes discards.

The at-sea whiting sectors are managed under bycatch limits for selected overfished species. Mandatory co-ops in the mothership sector are allocated a portion of these sector bycatch limits and are accountable for keeping catch of these species within their allocation. The catcher-processor operates as a single, voluntary co-op responsible for the bycatch limit assigned to the sector.

As noted above, the at-sea whiting sectors and shoreside IFQ fishery are subject to 100 percent observer coverage. While necessary for catch accounting under IFQ/co-op management, observers also allow complete monitoring of total catch (including bycatch). The limited entry fixed gear sector and directed open access fisheries are subject to partial observer coverage. This observer data is used to develop bycatch rate estimates, which can be used to forecast and account for total catch of all managed species.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

RCAs may affect safety if more vessels elect to fish seaward of the closed areas and are more exposed to bad weather conditions. Individual accountability under catch share management has resulted in vessels fishing more often seaward of the RCA in order to avoid catch of species such as canary and yelloweye rockfish, for which the allocations and resulting available QP are limited. As harvesters gain experience with the management program they may be able to develop opportunities to fish shoreward of RCAs while avoiding catch of these species, resulting in more inshore fishing.

The moratorium on quota share trading is expected to sunset beginning in 2013, which may lead to further capacity reduction and increased profits in the trawl sector. This may result in more investment in vessels and equipment that would enhance safety. Less efficient vessels are expected to leave the trawl fishery as part of this consolidation, which may eliminate older, less safe vessels.

For vessels electing to increase the amount of time fishing seaward of RCAs, implementing a VMS capable of sending distress calls could provide some mitigation. Although units with this capability have been approved for use, vessel owners are not required to purchase a unit with this capability. Also, by providing near real-time vessel position data, VMS could aid in search and rescue operations.

5.3 Other Applicable MSA Provisions

Harvest specifications are set based on targets established in overfished species rebuilding plans, which conform to Section 304(e) Rebuild Overfished Fisheries. Rebuilding plans contain the elements required by Section 304(e)(4) and discussed in the NS1 Guidelines (50 CFR 600.310).

NMFS prepared an EIS evaluating programmatic measures designed to identify and describe west coast groundfish EFH (NMFS 2005), and minimize potential fishing impacts on west coast groundfish EFH. The Council took final action amending the groundfish FMP to incorporate new EFH provisions in November 2005. NMFS partially approved the amendment in March 2006. Implementing regulations became effective in June 2006. The effects of the proposed actions on groundfish EFH are within the scope of effects evaluated in the programmatic groundfish EFH EIS. The Council commenced a 5-year review of its groundfish EFH designation in December 2010. Section 4.1.4 in this EIS describes impacts of the proposed action on EFH, consistent with the EFH assessment requirements of 50 CFR 600.920 (e)(3).

5.4 Public Scoping under MSA

The Council process, which is based on stakeholder involvement and allows for public participation and public comment on fishery management proposals during Council, subcommittee, and advisory body meetings, is the principal mechanism to scope the biennial specifications process. The advisory bodies involved in groundfish management include the GMT, with representation from state, Federal, and tribal fishery scientists; and the Groundfish Advisory Subpanel (GAP), whose members are drawn from the commercial, tribal, and recreational fisheries, fish processors, and environmental advocacy organizations. Meetings of the Council and its advisory bodies constitute the Council scoping process, involving the development of alternatives and consideration of the impacts of the alternatives. In addition to Council-sponsored meetings, the Washington Department of Fish and Wildlife (WDFW), ODFW and CDFG held public hearings to solicit input on the formulation of management measures.

Table 5-1 summarizes Council decision-making steps in developing biennial harvest specifications and management measures.

Table 5-1.Summary of Council decision-making during biennial harvest specifications process.

Council meeting	Council Actions
June 20-25, 2013	Set schedule for developing 2013-14 harvest specifications and conduct preliminary review of stock status information.
September 12-17, 2013	Adopt new stock assessments for use in management, OFLs, and a range of ABC values; prioritize a range of new management measures for preliminary analysis.
November 1-6, 2013	Adopt overfished species rebuilding analyses; adopt ABCs for analysis; identify tentative range of allocation alternatives. Review exempted fishing permits for 2015-16. Adopt new management measures for detailed analysis.
March 8-13, 2014	
April 5-10, 2014	Adopt preferred alternative ACLs and narrow the range of allocations and management measures under consideration.
June 20-25, 2014	Adopt final preferred alternative including all elements for the 2015-16 management program.

6 NEPA and Other Applicable Laws

This chapter will be updated as necessary.

6.1 National Environmental Policy Act

The CEQ has issued regulations specifying the requirements for NEPA documents (40 CFR 1500 – 1508), and NOAA's agency policy and procedures for NEPA can be found in NOAA Administrative Order 216-6 (NAO 216-6). The required elements of an Environmental Impact Statement (EIS) and the public process associated with an EIS are specified in both CEQ's regulations and NAO 216-6.

The required elements of an EIS are as follows (as per NAO 216-6 5.04b):

- A cover sheet and table of contents;
- A discussion of the purpose and need for the action;
- A summary of the EIS, including the issues to be resolved, and in the FEIS, the major conclusions and areas of controversy including those raised by the public;
- Alternatives, as required by Sections 102(2)(C)(iii) and 102(2)(E) of NEPA;
- A description of the affected environment;
- A succinct description of the environmental impacts of the proposed action and alternatives, including cumulative impacts;
- A listing of agencies and persons consulted, and to whom copies of the EIS are sent;
- A ROD, in the case of a FEIS, and;
- An index and appendices, as appropriate.

Comments received on this DEIS will be considered and responded to in the FEIS. After the comments are considered, NMFS will publish a Notice of Availability for a 30-day public comment period for the FEIS and will conclude the NEPA process with a Record of Decision documenting whether to approve, partially approve, or disapprove this proposed action under the MSA.

6.2 Notice of Intent and Public Scoping Under NEPA

The National Marine Fisheries Service in coordination with the Pacific Fishery Management Council published a Notice of Intent (NOI) on Month, day, 2013, to announce the intent to develop and prepare an EIS. This EIS will include analysis of the long-term impacts of setting harvest specifications (including OFLs, ABCs, and ACLs) and management measures including the 2015-16 biennial period, pursuant to the Pacific Coast Groundfish Fishery Management Plan.

The purpose of the NOI was to alert the interested public of the commencement of the scoping process and to provide for public participation in compliance with the National Environmental Policy Act. The scoping process is the first and best opportunity for the public to raise issues and concerns for the Council and NMFS to consider during the development of the harvest specifications and management measures. The Council and NMFS rely on input during scoping to both identify management measures and develop alternatives that meet the objectives of the Pacific Coast Groundfish FMP.

The public comment period was open for thirty days, ending on Month, day, 2013. A summary of public comments received during the thirty-day public comment period will be included here.

6.3 Related NEPA documents

The following NEPA documents provide information and analyses related to the effects of this proposed action:

- Trailing Actions for the Pacific Coast Groundfish Trawl Rationalization Program, Including 1. Pacific Halibut Trawl Bycatch Mortality Limit (Amendment 21-1); 2. Exemption from the Prohibition on Processing At Sea in the Shorebased IFQ Program, DRAFT Environmental Assessment. Published by the Pacific Fishery Management Council in July 2011. (http://www.pcouncil.org/groundfish/fishery-management-plan/amendment-21-1/)
- Proposed Harvest Specifications and Management Measures for the 2013-2014 Pacific Coast Groundfish Fishery and Amendment 21-2 to the Pacific Coast Groundfish Fishery Management Plan; Final Environmental Impact Statement. Published by the Pacific Fishery Management Council and NMFS in September 2012. (http://www.pcouncil.org/groundfish/fishery-management-plan/amendment-21-2/)
- Amendment 23: Considerations for a New Harvest Specification Framework that Incorporates Revised National Standard 1 Guidelines to Prevent Overfishing, Environmental Assessment. Published by the Pacific Fishery Management Council and NMFS in September 2010. (http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-amendment-23/)
- Allocation of Harvest Opportunity between Sectors of the Pacific Coast Groundfish Fishery (Amendment 21 to the Groundfish FMP); Final Environmental Impact Statement Including Regulatory Impact Review and Initial Regulatory Flexibility Analysis. Published by the Pacific Fishery Management Council and NMFS in June 2010.(http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-amendment-21/)
- Rationalization of the Pacific Coast Groundfish Limited Entry Trawl Fishery (Amendment 20 to the Groundfish FMP); Final Environmental Impact Statement Including Regulatory Impact Review and Initial Regulatory Flexibility Analysis. Published by the Pacific Fishery Management Council and NMFS in June 2010. (http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-amendment-20/#EIS)

Information may be incorporated by reference from these documents into this EIS. Council on Environmental Quality (CEQ) regulations (40 CFR 1502.21) state "Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described." When information from the above document is incorporated, these procedures are followed within the body of this EIS.

6.4 Preparers and Listing of Agencies and Persons Consulted

The following people wrote the EIS:

- Kelly Ames, Pacific Fishery Management Council: Sections
- Christopher "Kit" Dahl, Pacific Fishery Management Council: Sections
- John DeVore, Pacific Fishery Management Council: Sections
- Kerry Griffin, Pacific Fishery Management Council: Sections
- Becky Renko, National Marine Fisheries Service, Northwest Region: Sections
- Edward Waters, Contracting Economist: Sections

This EIS was prepared and evaluated in consultation with the National Marine Fisheries Service and the Pacific Fishery Management Council. In addition, members of the Groundfish Management Team (GMT) and the Scientific and Statistical Committee (SSC) prepared and reviewed portions of the analyses and provided technical advice during the development of the EIS. Members of Council advisory bodies are listed in rosters available at http://www.pcouncil.org/council-operations/council-and-committees/council-and-committee-rosters/. In addition the following persons were consulted or were involved in reviewing drafts of the document:

- Sarah Biegel, NMFS NWR, NEPA Coordinator
- Ryan Couch, NOAA GC, Attorney
- Kevin Duffy, NMFS NWR, Groundfish Section
- Mariam McCall, NOAA GC, Attorney
- Sarah Williams, NMFS NWR, Groundfish Section
- Becky Renko, NMFS NWR, Groundfish Section
- Others TBD

6.5 DEIS Distribution List

The Council makes the EIS available on its website so anyone with computer access may download a copy of the document. Electronic copies on CD-ROM and paper copies are made available upon request. The Council distributes a notice of availability for the EIS through its electronic mail list, which includes state and Federal agencies, tribes, and individuals. Copies of the FEIS are sent to anyone who comments on the DEIS. In addition, NMFS distributes copies of the EIS to the following agencies:

- Department of Interior,
- Department of State,
- U.S. Coast Guard Commander Pacific Area,
- Marine Mammal Commission,
- Pacific States Marine Fisheries Commission, and
- Environmental Protection Agency.

As part of the review process for consistency with applicable laws such as the CZMA, NMFS also distributes the EIS to the following coastal states and agencies:

- Washington Coastal Zone Management Program, Shoreline Environmental Assistance, Department of Ecology, Washington State;
- Ocean-Coastal Management Program, Department of Land Conservation and Development, State of Oregon; and
- California Coastal Commission.

Members of the public may also request to be on the distribution list. The following individuals have requested copies of the EIS:

TBD

In addition, a Notice of Availability of the DEIS is also published in the *Federal Register*. The DEIS is available for a 45-day public comment period. During this time, any member of the public may call the Council office and request a copy of the DEIS for their review.

Questions concerning this document and requests for additional copies of this document may be addressed to:

Ms. Becky Renko
National Marine Fisheries Service, Northwest Region
7600 Sand Point Way
Seattle, WA 98115
becky.renko@noaa.gov
(206) 526-6110

6.6 Addressing NEPA in Subsequent Biennial Cycles

The adoption and adjustment of regulations for managing the groundfish fishery (including harvest specifications and management measures) is an ongoing, adaptive process. Changes in the type and intensity of environmental impacts tend not to differ substantially from one period to the next. With this view in mind this EIS evaluates the impacts of the ongoing action over a longer time period than 2 years. Biennial changes to the management program may then be subject to more focused analyses, as described below based on Council on Environmental Quality (CEQ) guidelines for supplementing and/or tiering from a previously prepared NEPA document.

When harvest specifications (and related management measures) are periodically adjusted, NMFS will determine whether to supplement this EIS or prepare a tiered NEPA analysis. These methods and the circumstances where they could be applied are discussed below.

CEQ regulations identify two conditions that trigger the need to “supplement” a NEPA document: (1) Has the agency made substantial changes in the proposed action that are relevant to environmental concerns?; (2) Are there significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts? (See 40 CFR 1502.9(c)(1)). If the answer to these questions is “no,” then no additional NEPA analysis is needed. The rationale for the agency’s “no” finding must be adequately documented in the administrative record. Agencies, including NMFS, have used a “supplemental information report” (SIR) format to document these findings. Circumstances where this EIS would be supplemented could arise if the Council makes substantial changes to harvest policies, such as changing proxy values for F_{MSY} or adopting several new rebuilding plans for key stocks.

Alternatively, if circumstances have changed such that additional NEPA documentation may be required, the concept of “tiering,” introduced in CEQ regulations, would be used: “Whenever a broad environmental impact statement has been prepared (such as a program or policy statement) and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy (such as a site specific action) the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action.” (40 CFR 1502.20) If, when harvest specifications and management measures are periodically adjusted, it is determined that this EIS does not address the environmental impacts of the proposed action, a subsequent tiered NEPA document would be prepared. The tiered NEPA document would be narrowly focused on those aspects of the proposal that may have environmental impacts different from those identified in this EIS. For example, the tiered NEPA document could focus on changes to harvest control rules that were not analyzed in this EIS.

6.7 Administrative Procedure Act

The Administrative Procedures Act, or APA, governs the Federal regulatory process and establishes standards for judicial review of Federal regulatory activities. Most Federal rulemaking, including regulations promulgated pursuant to the MSA, are considered “informal,” which is determined by the controlling legislation. Provisions at 5 U.S.C. 553 establish rulemaking procedures applicable to the proposed action. Section 6.2 in the Groundfish FMP (PFMC 2011) specifies that biennial harvest specifications and management measures require ‘full notice-and-comment rulemaking’ to implement the regulations necessary to implement the Council recommendation. The rulemaking associated with this proposed action will be conducted in accordance with the APA and procedures identified in section 304 of the MSA.

6.8 Additional Laws and Executive Orders Applicable to the Proposed Action

In addition to the Magnuson-Stevens Act (see Chapter 5), the National Environmental Policy Act, and the Administrative Procedure Act there are other laws and Federal Executive Orders that may impose substantive and procedural requirements on the proposed action. These other laws and executive orders are described below.

6.8.1 Coastal Zone Management Act:

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all Federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. A determination as to whether the proposed action is would be implemented in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved coastal zone management programs of Washington, Oregon, and California will be submitted to the responsible state agencies for review under Section 307(c)(1) of the CZMA. The relationship of the groundfish FMP with the CZMA is discussed in Section 11.7.3 of the Groundfish FMP. The Groundfish FMP has been found to be consistent with the Washington, Oregon, and California coastal zone management programs.

6.8.2 Endangered Species Act

The Endangered Species Act of 1973 (ESA) was signed on December 28, 1973, and provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA replaced the Endangered Species Conservation Act of 1969; it has been amended several times.

A “species” is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future.

Federal agencies are directed, under section 7(a)(1) of the ESA, to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Federal agencies must also consult with NMFS or USFWS, under section 7(a)(2) of the ESA, on activities that may affect a listed species. These interagency consultations, or section 7 consultations, are designed to assist Federal agencies in fulfilling their duty to ensure Federal actions do not jeopardize the continued existence of a species or destroy or adversely modify critical habitat. Should an action be determined to jeopardize a species or result in the destruction or adverse modification of critical habitat, NMFS or USFWS will suggest Reasonable and Prudent Alternatives (RPAs) that would not violate section 7(a)(2).

Biological opinions document whether the Federal action is likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of critical habitat. Where appropriate, biological opinions provide an exemption for the "take" of listed species while specifying the extent of take allowed, the Reasonable and Prudent Measures (RPMs) necessary to minimize impacts from the Federal action, and the Terms and Conditions with which the action agency must comply.

This section will be updated with finding from the most recent BiOps.

6.8.3 Marine Mammal Protection Act

The MMPA of 1972 is the principle Federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of 153 stocks of whales, dolphins, porpoise, as well as seals, sea lions, and fur seals; while the USFWS is responsible for walrus, sea otters, and the West Indian manatee.

Off the west coast, the Steller sea lion (*Eumetopias jubatus*) eastern stock, Guadalupe fur seal (*Arctocephalus townsendi*), and Southern sea otter (*Enhydra lutris*) California stock are listed as threatened under the ESA. The sperm whale (*Physeter macrocephalus*) Washington, Oregon, and California stock, humpback whale (*Megaptera novaeangliae*) Washington, Oregon, and California - Mexico Stock, blue whale (*Balaenoptera musculus*) eastern north Pacific stock, and Fin whale (*Balaenoptera physalus*) Washington, Oregon, and California stock are listed as depleted under the MMPA. Any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA.

Pursuant to the MMPA, the List of Fisheries (LOF) classifies U.S. commercial fisheries into one of three Categories according to the level of incidental mortality or serious injury of marine mammals:

I. frequent incidental mortality or serious injury of marine mammals
II. occasional incidental mortality or serious injury of marine mammals
III. remote likelihood of/no known incidental mortality or serious injury of marine mammals

The Marine Mammal Protection Act (MMPA) mandates that each fishery be classified by the level of serious injury and mortality of marine mammals that occurs incidental to each fishery is reported in the annual Marine Mammal Stock Assessment Reports for each stock. On the 2012 List of Fisheries the WA/OR/CA sablefish pot fishery is listed as a category II fishery due to interactions with humpback whales. All other west coast groundfish fisheries are listed as category III fisheries. (See http://www.nmfs.noaa.gov/pr/interactions/lof/final2012.htm. [update with Final 2013 LOF when available].)

Commercial fishing vessels participating in Category I or II fisheries must be covered by a Federal permit under the MMPA. For most fisheries, including all west coast fisheries, a blanket permit is issued for all Federal or state permits authorizing participation in the fishery.

6.8.4 Migratory Bird Treaty Act

The MBTA of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished the populations of many native bird species. The MBTA states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The MBTA prohibits the directed take of seabirds, but the incidental take of seabirds does occur.

6.8.5 Paperwork Reduction Act

The Paperwork Reduction Act requires that agency information collections minimize duplication and burden on the public, have practical utility, and support the proper performance of the agency's mission.

6.8.6 Regulatory Flexibility Act

The Regulatory Flexibility Act requires government agencies to assess the effects that regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those effects. A fish-harvesting business is considered a "small" business by the Small Business Administration if it has annual receipts not in excess of $4.0 million. For related fish-processing businesses, a small business is one that employs 500 or fewer persons. For wholesale businesses, a small business is one that employs not more than 100 people. For marinas and charter/party boats, a small business is one with annual receipts not in excess of $6.5 million. If the projected impact of the regulation exceeds $100 million, it may be subject to additional scrutiny by the Office of Management and Budget

6.8.7 Executive Order12866 (Regulatory Impact Review)

EO 12866, Regulatory Planning and Review, covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. It directs agencies to choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach. The agency must assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only after reasoned determination the benefits of the intended regulation justify the costs. In reaching its decision, the agency must use the best reasonably obtainable information, including scientific, technical and economic data, about the need for and consequences of the intended regulation. NMFS requires the preparation of a regulatory impact review (RIR) for all regulatory actions of public interest. The purpose of the analysis is to ensure the regulatory agency systematically and comprehensively considers all available alternatives, so the public welfare can be enhanced in the most efficient and cost-effective way. The RIR addresses many of the items in the regulatory philosophy and principles of EO 12866.

6.8.8 Executive Order 12898 (Environmental Justice)

EO 12898 obligates Federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at Section 7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision-making purposes." Agencies should also encourage public participation, especially by affected communities during scoping, as part of a broader strategy to address environmental justice issues.

6.8.9 Executive Order 13132 (Federalism)

EO 13132, which revoked EO 12612, an earlier federalism EO, enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the EO directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published must be accompanied by a "federalism summary impact statement."

6.8.10 Executive Order 13175 (Consultation and Coordination with Indian Tribal Government)

EO 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. In Section 302(b)(5), the MSA reserves a seat on the Council for a representative of an Indian tribe with Federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes the four Washington coastal tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish for groundfish. In general terms, the quantification of those rights is 50 percent of the harvestable surplus of groundfish available in the tribes' U and A fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives.

6.8.11 Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)

EO 13186 supplements the MBTA (above) by requiring Federal agencies to work with the USFWS to develop memoranda of agreement to conserve migratory birds. NMFS is in the process of implementing a memorandum of understanding. The protocols developed by this consultation will guide agency regulatory actions and policy decisions in order to address this conservation goal. The EO also directs agencies to evaluate the effects of their actions on migratory birds in environmental documents prepared pursuant to the NEPA.

6.9 Findings

The Council process and this EIS are intended, where possible, to meet the public involvement requirements and provide the information and analysis necessary to address the mandates described above. Mandates that require additional analysis, documentation, and process not met through NEPA are discussed in section 6.10 below. The information and analysis in this EIS supports the following findings with respect to other applicable law.

Coastal Zone Management Act: Harvest specifications and management measures for 2015-2016 are not expected to affect any state's coastal management program.

ESA: NMFS and USFWS conducted a section 7 consultations to determine whether activities authorized under groundfish regulations in 2013 and subsequent years are likely to jeopardize the continued existence of any species listed under the ESA. Findings (Incidental Take Statements, Reasonable and Prudent Measures, etc.) are summarized here.

Marine Mammal Protection Act: Section 4.x describes new information about the incidental take of marine mammals and section 4.x assesses the effects of the proposed action on marine mammals. Although the operation of groundfish fisheries may differ from previous management cycles there is insufficient information to predict whether the effects on marine mammals will differ from previous management cycles.

Migratory Bird Treaty Act: The proposed action is unlikely to cause the incidental take of seabirds protected by the Migratory Bird Treaty Act to differ substantially from levels in previous years. Past EISs evaluating the impact of groundfish harvest specifications (PFMC 2006; PFMC 2008; PFMC and NMFS 2011) evaluated impacts to seabirds and concluded that the proposed action will not significantly impact seabirds. (Section 4.x evaluated impacts of the proposed action on protected species)

Paperwork Reduction Act: The proposed action, as implemented by any of the alternatives considered in this EIS, does not require collection-of-information subject to the Paperwork Reduction Act.

Executive Order 12898 (Environmental Justice): The proposed action will not result in disproportionate adverse impacts to low income and minority communities (see section 4.x).

Executive Order 13132 (Federalism): The proposed action does not have federalism implications subject to EO 13132.

Executive Order 13175 (Consultation and Coordination with Indian Tribal Government): Harvest specifications and management measures for 2015-2016 have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds): See the finding for the Migratory Bird Treaty Act, above.

6.10 Mandates Addressed Through Separate or Parallel Processes

6.10.1 ESA

NMFS Northwest Region Sustainable Fisheries Division consulted with the Protected Resources Division and with the USFWS pursuant to section 7(a)(2) of the ESA on the effects of the operation of the Pacific coast groundfish fishery in 2013 and subsequent years. Outcomes implemented outside of the biennial harvest specifications process are summarized here.

6.10.2 Executive Order 12866 (Regulatory Impact Review) and the Regulatory Flexibility Act

NMFS develops the necessary analysis and documentation needed to address these mandates as part of the Federal rulemaking process implementing groundfish harvest specifications and management measures. These analyses rely substantially on the contents of this EIS and the socioeconomic impact evaluation in Chapter 4 and baseline information in Chapter 3, which have been developed in conjunction with NMFS NWR staff to provide information needed for the Regulatory Impact Review and Regulatory Flexibility Act analyses.

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Agenda Item F.7.a
Attachment 2
June 2013

The following is an excerpt related to the biennial management cycle and activities for groundfish management (Schedule 1) from Council Operating Procedure 9. The original text can be found here http://tinyurl.com/lbu2q7v.

COUNCIL OPERATING PROCEDURE 9
Management and Activity Cycles

Approved by Council: 07/10/85
Revised: 09/16/87, 04/06/95, 11/03/99, **03/11/05**

PURPOSE

To establish management and activity cycles conducted by the Pacific Fishery Management Council (Council), its advisory entities, staff for the groundfish, salmon, coastal pelagic species, halibut, and highly migratory species fisheries, and administrative matters.

MANAGEMENT AND ACTIVITY CYCLES

Schedule 1 Biennial management cycle and activities related to groundfish management.

SCHEDULE 1. Biennial management cycle and activities related to groundfish management.

Year	Month	Entity and Management Activity
Year 1	September	To begin development of specifications for the next biennial management period (Years 3 and 4), the ***Groundfish Management Team (GMT) and Scientific and Statistical Committee (SSC)*** review and incorporate new impact assessment methodologies, including new observer data from January through December of the previous year, approve stock assessments completed in Year 1, and recommend appropriate harvest specifications. ***GMT and Groundfish Advisory Subpanel (GAP)*** meet to review current fishery status and develop inseason management recommendations, as necessary. GMT and GAP provide recommendations to inform Council action on harvest specifications and management measures for Years 3 and 4.

		Council adopts final modeling methodologies, stock assessments for the next biennial period (Years 3 and 4), final preferred overfishing limits (OFLs) and sigmas, as recommended by the SSC.[1] The Council will also adopt a range of P*/acceptable biological catches (ABCs), if applicable, including preliminary preferred values. ***Council*** will provide initial fishery management guidance, including a preliminary range of new management measures to address conservation concerns.
	September	*SSC Groundfish Subcommittee* meets to review overfished species rebuilding analyses as well as any stock assessments approved for further review by the Council.
	October	*GMT* meets to review new stock assessments and rebuilding analyses. ***GMT*** drafts a recommended range of annual catch limits (ACLs) and preliminary management measures for consideration at the November Council meeting.
	November	***GMT and GAP*** meet to review current fishery status and develop inseason management recommendations, as necessary. ***GMT and GAP*** provide recommendations to inform Council action on harvest specifications and management measures for Years 3 and 4. ***Council*** adopts rebuilding analyses and any assessments sent to the SSC Groundfish Subcommittee for review. ***Council*** adopts final preferred P*/ABCs, preliminary preferred non-overfished species ACLs, a range of overfished species ACLs, if necessary, and preliminary preferred ACLs for overfished species. ***Council*** selects a range of 2-year allocations, final range of new management measures to address conservation concerns, and preliminary exempted fishing permit (EFP) applications for Years 3 and 4.
Year 2	January	***GMT*** meets to review and analyze Council actions relative to harvest specifications and management measures provided in Year 1, if necessary.
	March	***GMT and GAP*** meet to review current fishery status and inseason management recommendations, as necessary.

[1] Council action could be postponed from September to November for any stock assessments recommended for further review by the SSC.

GMT and ***GAP*** provide recommendations to inform Council action on harvest specifications and management measures for Years 3 and 4.

Council receives an informational briefing on selected results of the harvest specifications and management measures analysis. The ***Council*** may be asked to provide guidance or take action on emerging issues, as necessary.

April

GMT and GAP meet to review Pacific whiting harvest specifications and management measures as well as current fishery status and inseason management recommendations.

GMT and ***GAP*** provide recommendations to inform Council action on harvest specifications and management measures for Years 3 and 4.

Council recommends inseason management adjustments as necessary.

Consistent with the U.S./Canada agreement, the ***Council*** considers the harvest specifications recommended by the Joint Management Committee and confirms or recommends a lower U.S. TAC. The ***Council*** recommends set-asides and any adjustments to management measures for the Pacific Whiting fishery in Year 2.

Council adopts preliminary management measures for public review and final harvest specifications for Years 3 and 4.

June

GMT and GAP meet to review current fishery status and inseason management recommendations, as necessary.

GMT and ***GAP*** provide recommendations to inform Council action on harvest specifications and management measures for Years 3 and 4.

Council recommends inseason management adjustments as necessary.

Council adopts final EFP applications and management measures as well as any corrections to harvest specifications for implementation by NMFS for Years 3 and 4.

Council recommends a prioritized list of new management measures to be analyzed outside of the harvest specifications and management measures process (i.e., those measures not directly related to conservation objectives).

	July	Council staff and ***GMT*** complete analyses and NEPA documents, as necessary, for biennial management specifications and submit them to NOAA.
	September	***GMT, GAP, and Council*** participate in inseason management activities and off-year activities, as appropriate.
	November	***GMT, GAP, and Council*** participate in inseason management activities and off-year activities, as appropriate.
Year 3[1]	January	***U.S. Department of Commerce*** implements harvest level specifications and management measures for next biennial management period (Years 3 and 4).
	March	***GMT, GAP, and Council*** participate in inseason management activities and off-year activities, as appropriate.
	April	***GMT and GAP*** meet to review Pacific whiting harvest specifications and management measures as well as current fishery status and inseason management recommendations, as necessary. Consistent with the U.S./Canada agreement, the ***Council*** considers the harvest specifications recommended by the Joint Management Committee and confirms or recommends a lower U.S. TAC. The ***Council*** recommends set-asides and any adjustments to management measures for the Pacific Whiting fishery in Year 3.
	June and September	***GMT, GAP, and Council*** participate in inseason management activities and off-year activities, as appropriate.
	November	Repeat management activities of November in Year 1 to begin development of next biennial cycle.

[1] GMT generally meets in January, July, and October to review and discuss groundfish management issues, including stock assessments and STAR Panel reviews.

PROPOSED SCHEDULE FOR DEVELOPING THE 2015-2016 AND BEYOND GROUNDFISH HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES

Non-italicized font in the table below represents the proposed Council schedule for the activities associated with implementing the 2015-2016 and beyond harvest specifications and management measures. Bold font dates represent Council meeting dates.

Italicized font represents a draft schedule for the National Marine Fisheries Service (NMFS) review and implementation process, including procedures and public comment periods required by the National Environmental Policy Act (NEPA) and the Administrative Procedures Act (APA). This schedule is premised on the preparation of an environmental impact statement (EIS), which has statutorily defined minimum time periods for public comment. Note that, like the last cycle, the draft EIS (DEIS) would be circulated before the June 2014 Council meeting, when final action is scheduled. If the Council's final preferred alternative represents "substantial changes in the proposed action that are relevant to environmental concerns" (40 CFR 1502.9(c)) NMFS may have to recirculate the DEIS, delaying implementation.

Start Date	**End Date**	**Task**
April 22, 2013	April 26, 2013	Data Moderate Stock Assessment Review (STAR) (Santa Cruz, CA): brown rockfish, China rockfish, copper rockfish, English sole, rex sole, sharpchin rockfish, stripetail rockfish, vermilion rockfish, and yellowtail rockfish. One GMT and GAP representative attended.
May 13, 2013	May 17, 2013	STAR Panel (Seattle, WA): Petrale sole and darkblotched rockfish. One GMT and GAP representative attended.
June 18, 2013	June 18, 2013	SSC Groundfish Subcommittee meets to review: 1. Data moderate stock assessments. 2. Petrale sole stock assessment. 3. Darkblotched rockfish stock assessment. 4. Bocaccio rockfish update. 5. Canary rockfish catch report. 6. Pacific ocean perch catch report. 7. Yelloweye rockfish catch report.

Start Date	End Date	Task
June 19, 2013	June 20, 2013	SSC meets to discuss and/or reach recommendations on: 1. Data moderate assessments recommended by the STAR Panel and the SSC Groundfish Subcommittee. 2. Bocaccio update and catch reports recommended by the SSC Groundfish Subcommittee. 3. Stock assessments for petrale sole and darkblotched rockfish recommended by the STAR Panel. 4. Impact projection models for use in the NEPA analysis.[1] 5. Proposed analytical framework for the NEPA document. 6. Recalculating sigmas for stock categories. 7. Alternatives for stock complex aggregations.
June 20, 2013	**June 25, 2013**	The Council meets and adopts: 1. A final schedule, process, and work plan for developing groundfish harvest specifications and management measures for 2015-2016 and beyond. 2. Data moderate assessments, as recommended by the SSC. 3. Updates and catch reports as recommended by the SSC. 4. Stock assessments for petrale sole and darkblotched rockfish recommended by the SSC. 5. Adopt the preliminary preferred alternatives (PPA) for stock complex aggregations.[2] 7. Projection models for use in the NEPA analysis. 8. Changes to the Council Operating Procedure 9 based on Council action in March 2013.
	July-August 2013	*Notice of Intent to prepare an EIS is published; 30-day public comment period. DEIS will address any comments received or, if no comments received, state so.*

[1]The SSC Economic Subcommittee reviewed the following models: The Washington, Oregon, and California recreational impact projection models, the nearshore and non-nearshore impact projection models, the Landings Distribution model, and the Input-Output Model for Pacific Coast Fisheries (IOPAC).
[2]Stock complex alternatives are being analyzed in a separate NEPA document than the 2015-16 and beyond specifications EIS. The proposed stock complex decision-making schedule is necessary to align the 2015-2016 and beyond analysis and for timely implementation of new regulations on January 1, 2015.

Start Date	End Date	Task
July 8, 2013	July 12, 2013	STAR Panel (Seattle, WA): Rougheye rockfish and aurora rockfish. One GMT and GAP representative to attend.
July 22, 2013	July 26, 2013	STAR Panel (Seattle, WA): Shortspine thornyheads and longspine thornyheads. One GMT and GAP representative to attend.
August 5, 2013	August 9, 2013	STAR Panel (Santa Cruz, CA): Cowcod and Pacific sanddabs. One GMT and GAP representative to attend.
September 11, 2013	September 13, 2013	SSC meets[3] to reach recommendations on: 1. OFLs. 2. Stock categories (i.e., categories 1, 2, and 3). 3. Sigma values. 4. Six full assessments, as recommended by the STAR panels. 5. Alternatives for stock complex aggregations. 6. Preliminary considerations for rebuilding plan revisions. 7. Elasmobranch F_{MSY}.

[3]SSC meeting dates are estimated based on past meeting schedules.

Start Date	End Date	Task
September 12, 2013	**September 17, 2013**	The Council meets and adopts: 1. Stock assessments for the six species subject to summer STAR panels.[4] 2. Adopt the final preferred alternatives (FPAs) for stock complex aggregations. 3. FPA for OFLs recommended by the SSC. 4. FPA sigma values recommended by the SSC. 5. A range of P* values, including PPA P* values, if applicable. 6. A range of acceptable biological catches (ABCs), including PPA ABCs levels, if applicable. 7. Preliminary policy for rebuilding plan revisions. 8. Preliminary range of new management measures to address conservation concerns for preliminary analysis.[5]
September 23, 2013	September 27, 2013	The SSC Groundfish Subcommittee meets to review rebuilding analyses prepared for overfished species as well as any stock assessments approved for further review by the Council (Seattle, WA). One GMT and GAP representative to attend.
September 30, 2013	October 4, 2013	The GMT meets to review new stock assessments and rebuilding analyses. The GMT, NMFS NWR, NOAA GC, and NMFS NEPA coordinator draft a recommended range of 2015-2016 harvest specifications and preliminary management measures for analysis (Seattle, WA or Portland, OR).
October 31, 2013	November 1, 2013	SSC meets[6] to reach recommendations on: 1. Rebuilding analyses. 2. Any stock assessments relegated to "mop-up" reconsiderations completed at the September 23-27 SSC Groundfish Subcommittee meeting. 3. Final considerations for rebuilding plan revisions.
November 1, 2013	**November 6, 2013**	The Council meets and adopts:

[4]Council action could be postponed from September to November for any stock assessments recommended for further review by a 2013 STAR panel and/or the SSC (i.e., those assessments the Council authorizes to be sent to the September 23-27 mop-up panel).
[5]New management measures are those management measures that have not been analyzed or implemented in a previous cycle. In March 2013, the Council decided to focus on management measures necessary to achieve conservation purposes during normal biennial cycles.
[6]SSC meeting dates are estimated based on past meeting schedules.

Start Date	End Date	Task
		1. Rebuilding analyses and any assessments sent to the mop-up panel and recommended by the SSC. 2. Final policy for rebuilding plan revisions. 3. PPA for default harvest control rules (Amendment 24). 4. FPA for P* values. 5. FPA for ABCs. 6. PPA for non-overfished species ACLs. 7. A range of overfished species ACLs, if necessary, and PPA ACLs. 8. A tentative range of two-year allocation alternatives.[7] 9. Final range of new management measures to address conservation concerns for detailed analysis. 10. Preliminary selection of exempted fishing permits for 2015-16.
November 7, 2013	April 4, 2014	Opportunity for state and tribal agencies to hold constituent meetings to obtain input on final harvest specifications and preliminary management measures in preparation for the April meeting.
November 7, 2013	February 17, 2014[8]	The Council staff, GMT, and subject matter experts prepare the DEIS.
January 1, 2014	February 15, 2014	If necessary, convene the Ad-Hoc Groundfish Allocation Committee (GAC) for a one to two day meeting prior to the March Council meeting (i.e., the meeting will occur at some point between the start and end date). The GAC will consider the results of the analysis and generate recommendations for Council consideration.
February 25, 2014	*May 27, 2014*	*DEIS reviewed and cleared by:* • *NMFS NWR* • *NOAA GC* • *PPI* *EIS project team addresses comments to allow clearance*
March 8, 2014	**March 13, 2014**	At the March Council meeting, the Council and

[7] Allocations to be reviewed for tentative adoption include both the trawl and non-trawl allocations as well as the within non-trawl sector apportionments and accountability measures (e.g., recreational harvest guidelines). Specifically, this includes two-year allocation alternatives for species not allocated under Amendment 21 (e.g., bocaccio, canary, cowcod, yelloweye and some non-overfished species (e.g., black rockfish in Oregon and California)).

[8] February 17, 2014 is the estimated briefing book deadline for the March 2014 Council meeting.

Start Date	End Date	Task
		advisory bodies will receive an informational briefing on selected results and provide guidance or take action on emerging issues, as necessary.
	March 19, 2014[9]	Preliminary DEIS submitted for the April meeting advance briefing book for Council, advisory body, and public review.
April 5, 2014	**April 10, 2014**	The Council meets and adopts: 1. FPA for ACLs. 2. PPA for management measures from the range adopted at the November Council meeting.[10] 3. PPA for two-year allocations. 4. FPA for default harvest control rules (Amendment 24).
April 11, 2014	May 26, 2014	Council staff, GMT, and analytical team validate and refine analysis, consequent to the April Council meeting actions, as necessary.
May 27, 2014	*June 1, 2014*	• *Prepare DEIS* • *File DEIS with Environmental Protection Agency*
	June 6, 2014	*EPA publishes Notice of Availability starting 45-day public comment period on DEIS.*
June 20, 2014	**June 25, 2014**	The Council meets and adopts: 1. Corrections to the FPA for harvest specifications, if needed. 2. Final exempted fishing permits for 2015-16. 3. FPA for allocations. 4. FPA for management measures. 5. A prioritized list of management measures to be analyzed outside of the harvest specifications and management measures process (i.e., those measures not directly related to conservation objectives).
July 7, 2014	July 11, 2014	The GMT meets to finalize analysis of the Council's FPA for the EIS, if necessary.
July 9, 2014	*August 5, 2014*	• *NWR initiates iterative process by sending draft regulations to Council staff and GMT for review.* • *Council and NMFS staffs reach consensus on*

[9]Estimated briefing book deadline for the April 2014 Council meeting.
[10]Additional management measures that require limited analysis could be added, if necessary; however, the January 1, 2015 fishery start date may be compromised.

Start Date	End Date	Task
		draft regulation language. Council staff & GMT send draft regulations comments to NWR. • *NWR provides Council staff with near complete regulations text for deeming.*
	July 23, 2014	*45-day NEPA public comment period on DEIS ends.*
July 24, 2014		*Prepare FEIS:* • *EIS project team organizes public comments and responses to comments, and revises DEIS based on public comments and final action by the Council, and prepares draft FEIS* • *NWR SFD staff, Regional NEPA Coordinator, and GC conduct concurrent and expedited reviews of draft FEIS* • *EIS project team addresses comments* • *PPI review of draft FEIS*[11] • *EIS project team addresses comments and prepares draft FEIS for public release* • *NWR clearance of draft FEIS* • *PPI clearance of draft*
August 5, 2014	*August 26, 2014*	• *NWR sends draft proposed rule package to GC, Issues Advisory to headquarters (HQ)* • *NWR sends draft proposed rule to Edits Unit for review* • *NWR makes Edits Unit changes and sends draft proposed rule and FMP amendment package (if necessary) to HQ*
	August 24, 2014	• *Council staff provides draft FMP language to NWR, if necessary* • *GC & Sustainable Fisheries Division simultaneous review of FMP language* • *NWR & Council staff reach consensus on rule and FMP language*
	August 30, 2014	*Council Executive Director transmits final FMP recommendation and final regulations deemed necessary and appropriate for 2013-14 groundfish fisheries.*
	September 7, 2014	• *Prepare and send FEIS package to EPA (will need to overnight FEIS or request HQ to hand deliver FEIS)* • *File FEIS with EPA*
September 9, 2014	*October 8, 2014*	*Proposed rule publishes, 30-day proposed rule*

[11]NMFS will have needed to secure expedited review and clearance processes agreement with PPI well in advance.

Start Date	End Date	Task
		public comment period required by APA ends.
September 19, 2014	*October 19, 2014*	*FEIS 30-day public comment period.*
October 2, 2014	*November 16, 2014*	*Preparation of Final Rule under APA:* • *SFD drafts final rule and sends package to GC for review* • *GC completes review and sends to SFD* • *SFD completes revisions and sends to Edits Unit* • *SFD completes Edits Unit changes and sends package to HQ*
October 19, 2014	*November 27, 2014*	*NMFS prepares Record of Decision:* • *Review any comments received during 30-day cooling off period and prepare draft record of decision (ROD).* • *Finalize draft ROD* • *NWR SFD staff, Regional NEPA Coordinator, and GC conduct concurrent and expedited reviews of draft ROD* • *Project team addresses comments* • *NWR clearance of draft ROD* • *Draft ROD submitted to HQ for review* • *HQ signs ROD (must be submitted with final rule package)*
	December 2, 2014	*Final Rule Publishes under the APA.*
	January 1, 2015	*30-day cooling off period required by APA ends; FMP amendment and regulations effective and groundfish fishery begins under new regulations.*

GROUNDFISH ADVISORY SUBPANEL REPORT ON CONSIDERATION OF 2015-2016 AND BEYOND HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES

The Groundfish Advisory Subpanel (GAP) was briefed by Mr. John DeVore and Dr. Christopher Dahl about this agenda item. The primary decision points at this meeting appear to be: review of the analytical approach and range of alternatives described in the draft Environmental Impact Statement (EIS) outline (Agenda Item F.7.a, Attachment 1); revisions to Council Operating Procedure (COP) 9 detailed in Agenda Item F.7.a, Attachment 2; and the proposed schedule in Agenda Item F.7.a, Attachment 3. The GAP appreciates the staff overview of the issues at hand and identification of Council decision points.

As an overarching comment, the GAP strongly reiterates our past recommendation that maintaining the January 1 groundfish fishery start date is critical and that every effort should be made to ensure that the specifications process is completed on time. Moreover, the GAP highlights that the Council is considering other groundfish issues this week that have significant workload, most notably, restructuring groundfish stock complexes. The GAP cautions the Council to be careful in taking on additional, significant workload that could hinder the specifications development process and delay the January 1 start date.

Specific to the Council tasks, the GAP supports the proposed structure of the draft EIS and considers the range of alternatives adequate. The GAP also supports the proposed specifications development schedule and proposed revisions to COP 9 to facilitate that schedule. Finally, the GAP supports exploring development of a long-term approach that uses both the Amendment 24 framework for computing default harvest specifications and the tiered analysis described in the draft EIS outline. The long-term approach should also consider revitalization of the groundfish Stock Assessment and Fishery Evaluation document to inform the tiered analysis. The GAP thinks these latter tools are critical to facilitate timely and flexible management in response to new information or changing conditions in the fishery.

PFMC
06/22/13

GROUNDFISH MANAGEMENT TEAM REPORT ON CONSIDERATION OF 2015-2016 AND BEYOND HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES

The Groundfish Management Team (GMT) reviewed the items in the briefing book under Agenda Item F.3. Additionally, Dr. Kit Dahl (Council staff) presented information to the GMT; we thank him for his time and information. Due to time constraints, the GMT focused our discussions on the Draft Annotated Outline/Analytical Framework for the Harvest Specifications and Management Measures and Amendment 24: Draft Environmental Impact Statement (DEIS; Agenda Item F.7.a. Attachment 1) and the Schedule for Developing Groundfish Harvest Specifications and Management Measures (Agenda Item F.7.a. Attachment 3).

Annotated Outline/Analytical Framework for the Harvest Specifications and Management Measures and Amendment 24

Some members of the GMT were sent an early version of the draft annotated outline/analytical framework of the DEIS and were given the opportunity to provide comments and edits. We appreciate the opportunity to provide early feedback and feel that good improvements to the document were made, particularly with regard to long term impacts to the environment. The GMT as a whole reviewed the updated annotated outline and had a discussion with Dr. Dahl, and provides the following additional input intended to further improve the analysis of setting harvest specifications and management measures over the long term (e.g., 10 year period).

The GMT had a constructive discussion with members of the Project Team on the draft annotated outline/analytical framework. Time restrictions require us to leave many comments unwritten and to focus only on the concerns that members of the team felt were important to express.

On the Draft Annotated Outline, our comments focus on two main topics. First is the structure of the Preliminary Alternatives. And second, we offer brief comments on the proposed Tier 1 EIS analyses of impacts ("impacts analysis").

The Structure of the Preliminary Alternatives

We have comments on both the proposed No Action Alternative and the proposed Action Alternatives. Our comments are focused on how the two relate and then how they relate to the impacts analysis. We are proposing a different approach to both that involves a new set of Alternatives from what are proposed in the Draft Annotated Outline. The differences to the Preliminary Alternatives are not large, yet several members of the team found them important enough to mention. We explain the differences first before describing the new Alternatives.

The Baseline Issue and Suggested Approach

The first difference arises from the question of what is meant by "No Action" in the Draft Annotated Outline. In the classic National Environmental Policy Act (NEPA) model, the No Action Alternative is meant to serve as the environmental baseline against which the Action Alternatives are then compared for their effects on the environment. Yet the question of what represents the "baseline" can be more difficult when analyzing a "program" that is ongoing (and so the baseline has already been affected by the program and the proposed action does not involve consideration of stopping the program) than the more common situation of a one-time "project" (where No Action means the baseline is the environment without the project in it). This is the very issue we see here with the current Tier 1 EIS. As part of that, we do not think the Preliminary No Action Alterative provides a meaningful baseline to compare and contrast the merits of doing something different.

To explain, as noted in Section 2.1.1 of the Draft Annotated Outline, guidance from the Council on Environmental Quality (CEQ) suggests that the No Action Alternative should represent "'no change' from current management direction or level of management intensity." And from the GMT perspective, the current No Action Alternative does not do that. More so, the preliminary No Action Alternative assumes that the Council would ignore the best available science for 10 years and keep harvest specification "numbers" in place instead of updating them based on new science. We understand the intent of this approach--which is to create a scenario that can be contrasted against the other Alternatives--yet we think there is a better way of serving that need with the Action Alternatives.

This option starts with the CEQ guidance mentioned above and using a baseline that best reflects how the Council has managed groundfish. To do so, we would suggest choosing a window period (e.g., 2003-12) and using the actual performance of the fisheries over that period as the baseline. This would involve representing our best understanding of those actual events in various ways by using actual estimates of catch and stock status to describe economic and other impacts. And then comparison would be to what we expect to change over the next 10 years under the Action Alternatives, as to environmental impacts and other factors.

This is, in fact, what the Draft Annotated Outline proposes doing in Chapter 3 in the description of the Affected Environment. The problem is that the baseline used there does not match the Preliminary No Action Alternative. The reason for the mismatch arises, as we understand it, from the worry that "No Action" would mean "not amending" the fishery management plan (FMP) with what have been referred to as "default rules." So the preliminary Tier 1 Alternatives have arisen out of varying concerns about the need for contrasting scenarios and to amend the FMP to clarify that starting point of each biennial cycle.

It is a question of law and National Marine Fisheries Service (NMFS) NEPA policy—that is, outside of the GMT's purview—yet the intent of our suggestion is that No Action can be described as the 2003-12 baseline, and then have another way of creating the contrasting analysis scenario for which the preliminary No Action is meant to serve.

The Action Alternatives

The issues with the Preliminary Action Alternatives are related. One concern is that we do not think it could be said that there would be any real difference between preliminary Alternatives 1 and 2, because there is no way of forecasting how the Council's decisions would be different between the two. The Council's harvest specifications decisions from cycle to cycle are driven by information--from assessments and other sources--and policy considerations that could only be assumed to be the same under either Action Alternatives.

Another concern is that the Preliminary Alternatives 1 and 2 do not match to the "bookends" in the proposed Tier 1 impact analysis, which is different than the typical NEPA model that involves comparing and contrasting the impacts between Alternatives (i.e. the bookends and what they bracket map to multiple alternatives). The Project Team has come up with a creative way of exploring impacts, yet the concern some team members share is that the setup may be interpreted to being analyzing the effects of “no change” from the harvest policies the Council has followed over recent cycles. And again, doing so by comparing those effects against a “No Action” scenario that leaves harvest specifications unchanged for 10 years. This strikes some of us as problematic.

The proposal presented here is meant to address the perceived problematic parts of the setup without changing the overall plan for analyzing impacts. To create the needed contrast in the analysis scenarios, the recommendation involves creating two alternatives. For non-rebuilding stocks the alternatives would set up a range of P-star values between 0.45 and 0.25. For rebuilding stocks, the contrast would come from comparing and contrasting the rebuilding policies in place for 2013-2014 with a different approach that is likely to be analyzed as part of the Management Strategy Evaluation (MSE) that the Scientific and Statistical Committee (SSC) is considering to help the Council consider what are being referred to as Rebuilding Revision Rules.

Many of us had been under the impression, until this meeting, that the matter had been settled. We do our best to provide specifics, yet time has been short. We see several advantages of ranging the Alternatives using P-star, yet cannot explain them or the differences from the Draft Annotated Outline in much detail. In brief, P-star is an easy policy choice to range over and do so consistently between stocks. And it would also provide more analysis of the P-star approach, which has been of interest to many since it was added to the FMP with Amendment 23.

The other point we emphasize is that the differences on the impacts analysis proposed by the Project Team would be minimal. The proposal is more for a structure that better matches that analysis to the Council’s recent management history with the FMP and the traditional NEPA model of comparing and contrasting alternatives to an existing baseline.

The Effect on the Council’s Policy Discretion

As before, the Council may be worried that bracketing a range of P-star values might limit the policy discretion. We do not have time to say any more than that the proposal described here would not affect that discretion any more than would the analysis of Preliminary Alternatives 1 or 2. For that matter, we would say that Preliminary Alternatives 1 and 2 cannot be distinguished on their effect on the Council’s policy discretion. And, again, the main reason is because we do not expect that the results of the impacts analysis will differ between any of the alternatives.

A Sketch of the Proposed Alternatives

	No Action/Baseline	Alternative 1	Alternative 2
Non-rebuilding stocks	2003-12 Window Period	Set harvest using P-star of 0.45	Set harvest using P-star of 0.25
Rebuilding		Set SPR rate on a biennial basis to maintain probably of T_{target} = 0.5 (chase noise)	Consider holding SPR rate as long as probability of T_{target} remains between 0.4 and 0.6.

The Difference Between a Strategic and Tactical Policy Change

Lastly, we look to the terms “strategic” and “tactical” for a helpful distinction. While we may be using the terms somewhat loosely, considering a “tactical” change is one we would describe as evaluating alternative options for achieving a fixed goal. A strategic change, in contrast, would be one where the alternatives considered are meant to evaluate changes in the policy goals themselves.

The distinction has been helpful because it identifies the decisions that the Council makes on harvest specifications each biennial cycle as mostly “tactical” in nature. And it helps differentiate the “strategic” goals as those that are embodied by the FMPs F_{msy} and B_{msy} harvest policies.
Given the uncertainty in the science, the biennial tactical decisions are very important. Described another way, the Council considers adaptive adjustments when feedback for doing so becomes available. That feedback often causes things to jump around relative to the last forecast of where a stock might be, and this creates new policy decisions every cycle. Yet those policy decisions are tactical in nature because they are focused, in most part, on achieving the FMP’s F_{msy} and B_{msy} policies. The uncertainty in these tactical decisions means that they are often difficult and open to considerable differences in policy judgment about the best course of action.

The distinction between strategic and tactical is also helpful in that it helps us describe our understanding of the Council’s intent for the Tier 1 EIS. We understand the Council’s interest to be in using the Tier 1 EIS to analyze impacts over a series of biennial cycles instead of just one. In other words, the analysis would be of a series of tactical decisions that are made toward the same general strategic goals.

The GMT also discussed ways of structuring the EIS so as to analyze changes that were more strategic in nature. We did not think the Council was interested in them at this time because of the main workload problem being addressed. We do wish to highlight, however, that strategic changes in fisheries management are being discussed more and more (e.g. “pretty good yield” and the “mixed stock exception”) around the Council’s advisory bodies and at the national level. The distinction between strategic and tactical has also helped us to differentiate these discussions from those the Council undertakes regularly every biennial cycle.

Lastly, if there were more time to design a “strategic” oriented Tier 1 EIS, the team might have suggested doing so. Analytical methods are available for undertaking such analysis. And key input data for such analysis is available as well. Yet, while the basic inputs and tools are available, the team recognizes it would be a much more substantial effort--for workload, analysis needs, and review--than the Council can take on at this point in time.

The Impacts Analysis

As expressed the last time we wrote on this issue, there is interest among GMT members in connecting to ecosystem experts on this Tier 1 EIS. The Project Team solicited comments from such experts on the Draft Annotated Outline, yet as we understand it, it wasn't the feedback that we had interest in asking for. We did not have time to be specific in this report about the questions we would ask of those experts. Yet, we still recommend that there be an opportunity, in some forum, for a conversation between members of the Integrated Ecosystem Assessment team, the GMT, the SSC, and others with appropriate expertise in the fisheries on how this Tier 1 EIS could be designed.

Schedule for 2015-2016 and Beyond Harvest Specifications and Management Measures

The GMT reviewed the Proposed Schedule for Developing the 2015-16 and Beyond Groundfish Harvest Specifications and Management Measures (Agenda Item F.3.a. Attachment 3) and note that the schedule is similar to the front-loaded schedule that was used for 2013-2014. We believe this schedule is workable, given our experiences with the 2013-2014 process, and have the following thoughts for Council consideration. As we noted last cycle, all benchmarks or deadlines must be met to achieve the subsequent deadlines to attain the January 1 fishery start date. A delay in any one place could derail the timeline for everything after it.

During the 2013-2014 process, the Council adopted a narrow scope of action for management measures, intended to reduce the analysis, writing, and review time that was required. However the EIS still contained detailed analysis of 19 management measures and the expected efficiencies were not achieved. This proposed process would limit the number of new management measures for analysis during the biennial process and proposes that all other management measures be considered for prioritization in June of the even years. Those new management measures eligible for consideration in the biennial process must be needed to: a) keep catch within the annual catch limit (ACL), b) address a habitat or Essential Fish Habitat (EFH) concern, or c) address a protected resources concern. Management measures currently available in regulation can still be adjusted in the biennial process to achieve the ACL (e.g., season dates, bag and trip limits, etc.). Measures not meeting these criteria would be considered by the Council in June of the even years and a regulation implementation schedule would need to be developed.

After discussing the new process for considering management measures, the GMT recommends that those criteria be clearly outlined in the DEIS or other appropriate document, including examples of which measures are eligible for consideration within the biennial process. Further, the GMT recommends that the delineation not simply be referred to as those achieving or not achieving "conservation objectives" but rather are referred to by the criteria by which they are evaluated.

When adopting the schedule for 2015-2016, the Council should be aware of the data that will be available for work to begin on the projection models, if the process begins in November, compared to what would be available for analysis that begins in February. In most cases, data to inform commercial models would be through 2011 if the analyses commenced in November 2013. In contrast, postponing the analysis until February 2014 would allow for inclusion of data from 2012. For the recreational fisheries, data to inform models would be through 2012 and may consider part of 2013 if the analysis commenced in November. If the analyses were conducted in February data from 2013 could be used. An additional consideration for the Council is the GMT's overwinter workload and the prioritization of non-harvest specifications and management measures analysis projects assigned to the GMT by the Council.

The GMT notes that the Council may also want to consider the implications of the proposed schedule change that is outlined in the Washington Department of Fish and Wildlife (WDFW) report (Agenda Item F.7.a. WDFW Report) with a DEIS available for review in March, rather than June. This would allow additional review and comment time for States and constituents.

Ecosystem Consideration Workgroup

In March 2013 the GMT recommended that the Council consider requesting a working group to advise the Project Team on the design of the Tier 1 EIS and the best available information available to inform it (http://www.pcouncil.org/wp-content/uploads/H4b_SUP_GMT_MAR2013BB.pdf). We continue to support the concept of involving members of the GMT, Scientific and Statistical Committee (SSC), Ecosystem Plan Development Team (EPDT), and others with expertise on the fishery management plan (FMP) and ecosystem issues in the discussion of the best approach for incorporating ecosystem information into the Tier 1 EIS. Specifically, ecosystem models could be used to explore relative impacts of alternative groundfish harvest levels on other trophic levels to increase the understanding of the differences between the proposed range of alternatives. With regard to the proposed schedule for developing the 2015-2016 and beyond, the GMT suggests that two or more meetings could be added to the schedule in early portion of the time period between November 7, 2013 and February 17, 2014 when the DEIS is being prepared, to facilitate this discussion.

Council Operating Procedure 9 (COP 9)

Due to other workload priorities, the GMT did not have the opportunity to review and discuss in detail the draft Council Operating Procedure 9 (COP 9) language. The Council could delay finalization of the COP 9 language until September. The GMT discussed whether a delay in finalizing COP 9 could have a ripple effect on the upcoming harvest specifications and management process. The GMT believes that if the Council adopts a detailed process and schedule at this meeting (i.e., Attachment 3) then there should not be a disruption.

There were two items that the GMT identified in our brief overview of COP 9. The COP states that in September of Year 1, the GMT will receive the last West Coast Groundfish Observer Program (WCGOP) data. The GMT typically receives two data products from WCGOP which informs the biennial analyses - the annual Groundfish Mortality Reports and bycatch models updated with the most recent bycatch rates. In recent years, the Groundfish Mortality Report has been delivered at the November Council meeting and the projection models in January. **The GMT recommends the COP be updated to reflect those delivery dates.**

Similar to the comments made above regarding the schedule, **the GMT also recommends that the criteria used to delineate which management measures are eligible for inclusion in the harvest specification and management measures process be outlined specifically in the COP** and not simply referred to as those achieving or not achieving "conservation objectives."

Projection Models

The GMT did not receive the Scientific and Statistical Committee (SSC) report on their review of the groundfish projection models in time to review and address the SSC's comments and concerns under this agenda item. Therefore, the GMT will review the report over the summer and work on addressing the SSC comments and concerns. The GMT plans to have the models ready in time to be used in the 2015 and beyond harvest specifications and management measures analysis.

Supplemental Public Comment

The GMT believes that contents of the letter from Mr. Bill James and the Port San Luis Commercial Fishermen's Association (Agenda Item F.7.c Supplemental Public Comment) should be included in the harvest specification and management measures discussion at the September Council meeting. Some of these measures may fit the new criteria for inclusion in the biennial analyses while others may be more appropriate for the June 2014 prioritization. Such determination should be made in September.

Agenda Item F.7.b
Supplemental SSC Report
June 2013

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON CONSIDERATION OF 2015-2016 AND BEYOND HARVEST SPECIFICATIONS AND MAANAGEMENT MEASURES

The Scientific and Statistical Committee (SSC) reviewed and discussed topics relating to Agenda Item F.7 "Consideration of 2015-2016 and Beyond Harvest Specifications" including the proposed process and schedule (Agenda Item F.7.a, Attachment 3), the proposed analytical framework (Agenda Item F.7.a, Attachment 1), and a report from the Economics and Groundfish subcommittees of the SSC (Appendix A, attached to this report). Dr. Kit Dahl and Mr. John DeVore of the Council staff were available to answer questions and contributed to the discussions.

Proposed process and schedule

The list of SSC tasks in the proposed process and schedule is similar to previous harvest specification cycles, and the SSC expects that it will be able to fulfill its review and advisory role as before. The schedule indicates that the SSC will make recommendations regarding a default F_{MSY} proxy for elasmobranchs at its September meeting. A review of available information that were thought to provide a basis for developing a suitable F_{MSY} proxy proved to be less informative than anticipated. The SSC is planning to work on this issue this summer with the goal of providing a recommendation to the Council in September.

Proposed analytical framework

The SSC focused on Chapter 4 "Impacts of the Alternatives" of the "Draft Annotated Outline for the Harvest Specifications EIS". The Council's approach to managing groundfish is an adaptive approach, in which new information from stock assessments is used to assess status and modify ACLs appropriately. The proposed approach for the EIS is to use catch projections from alternative "states of nature" contained in decision tables in stock assessments. These catch projections will be used to evaluate economic and ecological impacts. The high and low stock projections represent extreme cases, but should be adequate for the purposes of the EIS.

There was discussion of whether the EIS should include quantitative analyses of the potential impacts of management measures to the ecosystem or to essential fish habitat (EFH). The SSC recommends that this approach only be used after careful consideration. The available ecosystem and EFH impact models that might be used for this task have not been reviewed by the SSC and may not show useful distinctions across the range of EIS alternatives. While fully tested and reviewed models of these sorts may eventually inform cumulative impacts, qualitative evaluations of impacts on the environment and essential fish habitat are more suitable for the EIS.

Economic Subcommittee review of projection models

In 2012 and 2013 the SSC Economics and Groundfish Subcommittees (SSC-E/GF) conducted a series of reviews of datasets and models that underlie the specifications socioeconomic analysis. The purpose of these reviews was to provide a more thorough evaluation of each socioeconomic component than could be accomplished within a single specifications cycle. Details of these reviews are provided in the SS-E/GF's report (Appendix A attached to this statement). The SSC endorses the results of those reviews.

Two types of analysis are desirable for analyzing the socioeconomic effects of management alternatives considered in the specifications process: (1) an analysis of community effects, including impacts on regional employment and income that occur as money generated from commercial and recreational fisheries circulates through the economy, and (2) an analysis of costs and benefits incurred by affected commercial and recreational participants (rather than the economy as a whole). In past specifications cycles, the socioeconomic analysis focused largely on economic impacts. In recent years, economic survey data have become available that also allow analysis of costs and benefits for all commercial fishery sectors.

Models and datasets reviewed by the SSC-E/GF in 2012-13 are as follows:

- projection models for California, Oregon and Washington recreational fisheries developed by the three states and used by the Groundfish Management Team (GMT)
- projection models for nearshore and non-nearshore fixed gear fisheries used by the GMT
- a regional economic impact model (IO-PAC) developed by Northwest Fisheries Science Center (NWFSC) economists
- the mandatory Economic Data Collection (EDC) program developed by NWFSC economists for participants in the groundfish catch share program.

A key input for socioeconomic analysis of recreational fisheries is fishing effort, which combined with economic data collected in specialized angler surveys, is used to estimate the economic effects of each management alternative. Recreational effort projections provided by the GMT have formed the basis for socioeconomic analysis in past specifications cycles. Underlying these projections are assumptions regarding how effort is affected by regulations such as depth closures. It is important to note that a basic purpose of the GMT models is to avoid exceeding species allocations; while less attention has been paid to verifying the accuracy of effort projections.

A key input for socioeconomic analysis of commercial fisheries is harvest by sector, which combined with available economic data, is used to estimate economic effects of each management alternative on each sector. A major purpose of the nearshore and non-nearshore models used by the GMT is to provide projections of bycatch, discard, and discard mortality by fixed gear vessels. Catch projections are based on data collected in the West Coast Groundfish Observer Program and pooled across years due to small samples of overfished species encounters. The sample size issue (and thus the need for pooling) makes it difficult to determine trends that could be useful for evaluating model performance; this is most problematic for the nearshore model.

The recent availability of EDC data makes it possible to analyze socioeconomic effects not just for shoreside catcher vessels but also for motherships, catcher vessels delivering to motherships, catcher-processors, and shorebased first receivers/processors. EDC data are important inputs into the IO-PAC model, which was previously reviewed by the SSC in 2009. IO-PAC has been subject to a number of improvements, including addition of a recreational component and additional commercial sectors, data updates, and changes in model construction and assumptions.

The SSC endorses the three recreational models, the nearshore and non-nearshore models, the updated IO-PAC model and the EDC as best available science and appropriate for use in the 2015-16 specifications process. Use of these models in the 2015-16 specifications process should be accompanied by adequate documentation, including documentation of the behavioral assumptions underlying the comparison of alternatives and indicators of past model performance. Over the longer term recreational effort and commercial catch projection methods should be specifically designed to reflect potential effects of management regulations; these may differ from the methods used by the GMT to avoid exceeding species allocations. A new trawl catch model is being developed to replace the trawl bycatch model that the SSC reviewed a decade ago. The SSC looks forward to reviewing that model when it is completed.

The SSC also has some procedural recommendations:

- Given the various models and analyses that have to be integrated in the specifications socioeconomic analysis, the SSC recommends that planning for the 2015-16 specifications EIS include identification of responsible parties, a central coordinator, and a schedule that provides adequate opportunity to review the socioeconomic analysis.

- Some of the longer-term issues identified in reviews conducted by the SSC-E/GF (e.g., improved methods of projecting recreational effort) should be included among the candidate topics for off-year discussion.

- The GMT and NWFSC provided considerable documentation regarding the data and models reviewed in 2012 and 2013. The SSC recommends that these documents be made publicly available on the Council website. In addition, documentation is needed regarding how effort and landings projections provided by the GMT are distributed among ports for use in the IO-PAC model (i.e. documentation of the landings distribution model).

- The SSC-E/GF met with the GMT on April 2, 2012 to discuss issues raised by the GMT regarding socioeconomic as well as biological effects of rebuilding plans. Some of the issues raised at that time should also be considered as candidates for further discussion in off-years of the specifications cycle.

The SSC thanks all of the individuals who provided documentation and participated in the reviews, and also thanks Council staff for their involvement in planning these reviews.

Recalculating Sigmas for Stock Categories

The schedule for developing the new harvest specifications indicates that the SSC would recommend the default measures of scientific uncertainty (sigma) for calculating ABCs at the September meeting. While the sigma for category 1 stocks could be redone using information from more recent stock assessments and the original method, it would be unlikely to change substantially. The original method needs improvement because the analysis was based on ending biomass rather than the OFL, and does not reflect increased uncertainty due to the stock projection. The SSC would like to defer work on recalculating sigma to next year. The SSC recommends that the ABC calculations for the 2015-2016 harvest specifications use the existing Category 1, 2 and 3 default sigma values.

STATEMENT OF THE SSC ECONOMICS AND GROUNDFISH SUBCOMMITTEES' REVIEWS CONDUCTED IN 2012-13 OF DATA AND MODELS TO BE USED IN THE SOCIOECONOMIC ANALYSIS FOR THE 2015-16 GROUNDFISH BIENNIAL SPECIFICATIONS PROCESS

The Council's groundfish harvest specification (Spex) process requires preparation of an extensive regulatory analysis. The socioeconomic portion of that analysis is broad in scope – covering all relevant commercial and recreational fishery sectors – and relies on a sizeable number of datasets and models. In 2012-2013 the SSC Economics and Groundfish Subcommittees (SSC-E/GF) conducted a series of reviews of the datasets and models that underlie the Spex socioeconomic analysis. The purpose of those reviews was to provide a more thorough evaluation of each socioeconomic component than could be accomplished within a single Spex cycle.

Two types of analyses are desirable for analyzing the socioeconomic effects of management alternatives considered in the Spex process: (1) an analysis of community effects, including economic impacts on regional employment and income that occur as money generated in commercial and recreational fisheries circulates through the regional economy, and (2) an analysis of costs and benefits incurred in affected commercial fisheries (measured by net revenues) and recreational fisheries (measured by net revenues for charter boat operators, and consumer surplus for recreational anglers). In past Spex cycles, the socioeconomic analysis focused largely on economic impacts. In recent years, economic survey data have become available that allow costs and benefits of management alternatives to be analyzed for the trawl, fixed gear, catcher-processor and processor sectors of the commercial fishery.

The following chart describes the data and models that will serve as the basis for the economic impact analysis and the cost-benefit analysis in the 2015-16 Spex process.

In 2012-13 the SSC-E/GF reviewed a number of the datasets and models shown in the chart, as follows:

- Oregon Recreational Model – reviewed March 3, 2012
- Washington and California Recreational Models – reviewed September 15, 2012
- Non-Nearshore and Nearshore Impact Projection Models – reviewed March 8, 2013
- IO-PAC Model and Economic Data Collection (EDC) Program – reviewed April 7, 2013

SSC recommendations regarding components of the chart that were not reviewed in 2012-13 are as follows:

- The SSC Economics Subcommittee reviewed the Landings Distribution Model in September 2011. Results of that review are provided in the SSC Minutes in the Council's November 2011 Briefing Book. **Based on that review, the SSC-E/GF recommends that the 2015-16 Spex socioeconomic analysis include information regarding the predictive performance of LDM projections by port area and sector.**
- The SSC reviewed the voluntary cost-earnings surveys in November 2009. Further review of these surveys is a low priority at this time, given that the methodologies have not changed substantially since 2009.
- The SSC reviewed an earlier version of the Trawl Bycatch Model a decade ago. Due to major changes in the fishery since that time (most notably catch shares), **review of the current Trawl Bycatch Model is a high priority.**
- The most recent NMFS angler expenditure survey was completed in 2011. A charter operator survey was completed in Oregon and Washington in 2007 and a similar survey

is currently underway in California. **Reviews of the angler expenditure and charter operator surveys remain to be done, but are a lower priority than the Trawl Bycatch Model.**

SSC statements regarding each of the reviews conducted during 2012-13 are attached. In addition to the specific recommendations in these reviews, the SSC-E/GF has some additional procedural recommendations as follows:

- The attached reviews include recommendations regarding analyses that the SSC-E/GF would like to see in the EIS for the 2015-16 Spex. **The SSC-E/GF recommends that planning for the 2015-16 Spex EIS include identification of responsible parties and a schedule that provides adequate opportunity to review the socioeconomic analyses.**
- The attached reviews identify data and modeling issues that could more feasibly be resolved over the longer term. The Council has a process for considering technical issues to be addressed in off-years of the Spex cycle. **The SSC-E/GF recommends that some of the longer-term issues identified in the 2012-13 reviews be included among the candidate topics for off-year discussion.**
- The SSC-E/GF met with the GMT on April 2, 2012 to discuss issues raised by the GMT regarding socioeconomic as well as biological effects of rebuilding plans. **The SSC-E/GF recommends that technical issues raised by the GMT in the context of rebuilding also be considered as candidates for discussion in off-years of the Spex cycle.**
- The GMT and NWFSC have provided considerable documentation regarding the data and models reviewed in 2012-13. **The SSC recommends that these documents be made publicly available on the Council website or some other suitable venue.**

The SSC-E/GF thanks all of the individuals who provided documentation and participated in reviews, and also thanks Council staff for their involvement in the planning these reviews.

ATTACHMENT 1

Statement of SSC Economics and Groundfish Subcommittees

Oregon Recreational Model

The Economic and Groundfish Subcommittees of the Scientific and Statistical Committee (SSC-E/GF)[1] met on 3 March 2012 in Sacramento, California to review a report on models for estimating groundfish impacts by the recreational fisheries off the coast of Oregon. The *Oregon Recreational Groundfish Model* report, prepared by staff from the Oregon Department of Fish and Wildlife (ODFW), was circulated to the SSC-E/GF several weeks prior to the meeting. Mr. Patrick Mirick (ODFW) presented slides summarizing the ODFW report, and answered questions about Oregon's recreational groundfish models. During the first few hours of the meeting Ms. Lynn Mattes, ODFW's representative on the Groundfish Management Team (GMT), and some other members of the GMT were also available to address questions. The SSC-E/GF discussed topics for future socioeconomic model reviews prior to concluding the meeting.

The ODFW report discussed several models involved in calculating harvest impacts (landings plus mortal discards). Most of these models are used internally by ODFW to inform pre- and in-season management decisions, but some of them also feed into the IO-PAC model. Included in the report, and discussed during the review meeting, were models for (1) estimating harvest and discard mortality, (2) projecting harvest and discard mortality in the recreational fishery for non-halibut groundfish, (3) projecting harvest and discard mortality in the recreational fishery for halibut, and (4) projecting the impacts of changes to bag limits. There was also an exploration of models that used multiple independent variables (e.g., gas prices, weather conditions, and landings in other recreational fisheries) to predict harvest impacts for yelloweye rockfish, a major constraining species. The report and presentation included example applications of the models and some evaluations of model performance.

Oregon's Recreational Boat Survey

The fundamental source of information for all the Oregon recreational fishery models is the Oregon Recreational Boat Survey (ORBS). The survey crews interview anglers at Oregon ports to collect data by species on angler catch rates and discard rates (fish per angler-day), as well as to measure biological characteristics of the landed fish. Daily logbooks from charter vessels and counts of bar crossings by private boats together provide a near census of the boat-level fishing effort. However, the ORBS program conducts limited sampling from minor ports or during winter months. Also, ODFW has not collected data on estuary or bank fishing activities since 2002.

Estimating harvest and discard mortality

The ORBS samplers have collected information on fishing depths since March 2009. Prior to March 2009, data on fishing depths were only available from a limited number of observed

[1] SSC participants included Vladlena Gertseva, Owen Hamel, André Punt, David Sampson, Cindy Thomson, and Theresa Tsou.

charter boat trips. The availability of fishing depth information has allowed ODFW to use the GMT's "death-by-depth" mortality rate table to estimate the depth-specific numbers of released fish that subsequently died. To estimate the overall weight of the dead fish by species, the mortality numbers for a species are multiplied by the average weight of released fish for that species. The average fish weights by species, which are based on a long-term accumulation of data, are periodically re-estimated as more data become available.

The ODFW calculations of harvest and discard mortality do not include estimates of standard errors or other measures of variability. Given the design of the ORBS system, it should be feasible to develop approximate variance estimators that could then be used to evaluate sampling efficiency. It may be possible to achieve increased sampling efficiency by rebalancing of sampling effort (e.g., shifting sampling effort among months or ports). **The SSC-E/GF therefore recommends that measures of uncertainty be developed and reported.**

Projecting harvest and discard mortality

The availability of fishing depth information from ORBS also allowed ODFW to project the potential effects of changing the maximum fishing depth restriction, which is the primary management tool that ODFW uses to reduce impacts by the recreational fishery on overfished species, particularly yelloweye rockfish. For example, if fishing were to be restricted to waters shallower than 30 fathoms, the proportion of fishing effort that ORBS found in depth-bins deeper than 30 fathoms would be redistributed to the shallower depth-bins to project the resulting landings and associated release mortalities. The model does not attempt to project changes in fishing effort resulting from a new depth restriction, but instead uses the average value from recent years. This procedure may over-estimate impacts if the number of angler days declines when regulations become more restrictive. However, the procedure is intended for purposes of conservative management rather than accuracy in effort projections. Also, the model works on a statewide basis rather than projecting port-level impacts. **The SSC-E/GF recommends that ODFW consider whether the distribution of effort by depth-bin varies by port. If so, effort projections may be better done at the port level, with port-specific results aggregated to derive statewide estimates.**

Projecting harvest and discard mortality in the halibut fishery

The recreational fishery for halibut in the waters off Oregon, which is limited to a few short open seasons each year, has some impacts on the overfished stocks of yelloweye rockfish and canary rockfish. However, linear regressions of yelloweye rockfish bycatch versus halibut harvest and canary rockfish bycatch versus halibut harvest indicate no significant relationships. Given that the halibut fishery would not catch rockfish if there was no halibut season, it would be sensible to force the regression line to go through the origin. Nonetheless, the scatterplot of the data indicates that the projections of rockfish bycatch during the halibut fishery will be highly uncertain irrespective of the chosen model.

Projecting the effects of bag limit changes

The ODFW also uses daily bag-limits to regulate the pace of the marine recreational fishery off Oregon. There is an overall bag-limit for an angler's daily landed catch of rockfish, greenling and cabezon (the RGC limit), and there are separate daily bag-limits for lingcod and flatfish other than Pacific halibut. Given that Oregon's recreational fisheries are primarily constrained by the catch limits available for yelloweye rockfish and canary rockfish, the RGC bag-limit is the one most pertinent for current conditions. The RGC bag-limit was 10 fish-per-angler-day for all of 2004, 8 fish-per-angler-day at the start of 2005, 6 fish-per-angler-day at the starts of 2006-2009, and 7 fish-per-angler-day at the starts of 2010 and 2011. There were mid-season downward adjustments of the bag-limit in 2005 and 2008, and an upward adjustment in 2009.

The ODFW report described an approach for predicting the effects of bag-limit changes that used a multiplier table derived from observed angler catches under different bag-limits. The approach produced some unusual predictions. The multiplier table for black rockfish, for example, predicted that dropping the bag-limit from 5 fish to 4 fish would produce an increase in the harvests of black rockfish. **A smoothing or interpolating model should be applied to the observed angler catch data to fill in cells in the multiplier table for which there were no data and thereby avoid illogical results.** However, predictions for cells that lie outside the range of the observed data are likely to be highly uncertain no matter what prediction method is used.

Predicting how anglers will react to a change in bag-limit is difficult. Past fishing seasons only provide observations for a limited number of particular bag-limit change combinations (e.g., from 10 fish to 8 fish, but not from 10 to 9, 10 to 7, or 10 to 6, etc.). Further, with an aggregate bag-limit such as the RGC group of species, the limit is most likely to affect fishing behavior associated with the most abundant species, for which the bag-limit is most likely to become binding. The aggregate limit will have only an indirect effect on rare species. Also, a decrease in a bag-limit may have little effect on fishery impacts of constraining species if anglers discard the fish that put them over the bag-limit or if they high-grade their retained catch. **The SSC-E/GF recommends that ODFW consider the effects of bag limit changes on discarded as well as retained catch.**

There are relatively few published works that address the issue of predicting the effects of changes in bag-limits. The workshop that explored Recreational CPUE Statistics, held in Santa Cruz during June 2004, included a presentation by Dr. Alec MacCall that reviewed several approaches to adjusting CPUE data for changes in bag-limits. Predictions outside of the range of the observed data are likely to be highly uncertain, however.

Overall conclusion of review

Of the three ODFW projection models reviewed during this meeting, the SSC-E/GF conclude that **the model for projecting harvest and discard mortality uses appropriate data and methods and provides a sound basis for making management decisions. The model for projecting harvest and discard mortality in the halibut fishery, with some small modifications as indicated above, also uses appropriate data and methods and provides a sound basis for management decisions.** Projecting the effects of bag limit changes, however, is a difficult task for which there is little theory and limited empirical data. **This projection model requires additional development and review.** Of the recommendations made above, the **highest priority is the development of variance estimates for harvest and discard mortalities**.

Issues for future reviews

Several questions arose during the meeting that could not be answered by anyone present. It would be beneficial if the questions below could be addressed during the process of documenting the Council's groundfish harvest specification process.

- What information (e.g., raw data, estimates of impacts and effort, or projected impacts for different scenarios) do the state fishery agencies provide to the IO-PAC model? What is the process used for moving the states' data into IO-PAC?
- How does RecFIN estimate the recreational fishery landings of groundfish for each of the states? Are RecFIN estimates of impacts and effort different from the data that underlie the IO-PAC projections? The SSC-E/GF understands that ODFW staff had been unable to exactly reproduce the discard mortality that RecFIN had estimated for Oregon.
- How do methods used by the GMT for pre-season projections differ from the methods used for projections in the IO-PAC model?

ATTACHMENT 2
Statement of the SSC Economics and Groundfish Subcommittees
Washington and California Recreational Groundfish Models

The SSC Economics and Groundfish Subcommittees (SSC-E/GF)[2] met on September 15, 2012 in Boise, Idaho to review the Washington and California recreational groundfish models. These models are important inputs to the estimation of groundfish economic impacts, and their review is part of a continuing SSC review process that began with the Oregon recreational groundfish model in March 2012. There were three separate presentations at the review meeting. Dr. Ed Waters described how fishery projections from the state models feed into regional (community) economic impact assessments. Ms. Heather Reed of the Washington Department of Fish and Wildlife (WDFW) presented the Washington model. Mr. John Budrick of the California Department of Fish and Wildlife (CDFW) presented the California RecFISH model. The SSC-E/GF thanks all three presenters for providing review materials and for their clear and informative presentations.

Information and Process Used for Regional Impact Estimation

Dr. Ed Waters provided the SSC-E/GF with a presentation to clarify the information and process used to estimate regional economic impacts. These include the key inputs to the NWFSC's IO-PAC model, which is the model used in the Council process to estimate regional economic impacts. The IO-PAC model itself will be reviewed by the SSC at the April 2013 Council meeting.[3]

For recreational fisheries, the regional economic impacts resulting from alternative management actions are driven by changes in angler trips, which in turn drive changes in angler expenditures, which are then fed into the IO-PAC model. Thus, changes in IO-PAC outputs (income and employment) are only affected by alternatives that affect (or are modeled to affect) the number of angler trips (days fished).

Each state forecasts changes in angler trips by mode for each management alternative. Total trip expenditures are estimated by multiplying the angler trip forecast for each state and mode by an estimate of expenditures per angler trip for the same state and mode. The per-angler-trip estimates are based on an angler expenditure survey conducted by NMFS Headquarters, with the assistance of NMFS Science Centers, and license files provided by the states. The most recently available survey data are from 2008. The survey was updated in 2011, and thus more current expenditure data are expected to be available for the next Spex cycle (2015-16). One potential source of bias in the expenditure data is incomplete license files for some modes in some states. For example, charter operators in the state of Washington may issue licenses to charter anglers without recording the angler's address or other contact information. If anglers who purchase their licenses through the charter operator have different expenditure profiles (e.g., are more likely to reside out of state or to be less avid) than anglers who purchase licenses through the

[2] SSC participants included Dan Huppert, Todd Lee, André Punt, David Sampson, Cindy Thomson,
[3] The review of the IO-PAC Model is contained in Attachment 4.

state's computerized system, their expenditure profile will be biased. The size and direction of any possible bias is not known.
Recommendations:

- In order to facilitate future SSC reviews of recreational economic impacts, **all analyses and procedures need to be fully documented.** The documentation should be sufficient to allow a third party to replicate the analysis and results. **Such documentation should include a description of state effort projections and any modifications made to those projections before they are relayed to the NWFSC for input into the IO-PAC model.** This work would likely need to be coordinated by Council staff and should be completed in time to be included in the draft EIS for the 2015-16 Spex.

- Angler expenditure data collected during 2011 will be used to estimate regional economic impacts for the recreational fishery in the 2015-16 Spex process. **Documentation should include a description of potential sources of bias in the data and bias correction procedures – or an explanation why such procedures cannot be applied.**

<u>Washington Model</u>

The SSC-E/GF reviewed the WDFW report "Recreational Impact Projection Methods", dated August 2012. Ms. Heather Reed provided the SSC-E/GF with a presentation.

WDFW's Ocean Sampling Program (OSP) is the primary data input to Washington estimates of catch (retained and released) and effort. Sampling is stratified by port (primarily four ports) and day type (weekday and weekend), and post-stratified by state management area (Areas 1-4) and trip type. Yelloweye and canary rockfish are the most constraining stocks in the Washington recreational fishery. Catch of these species is managed through ACLs, depth restrictions and area closures. Regulations tend to be more restrictive in the North Coast area, due to higher yelloweye encounter rates. Regulations within each management area have been fairly stable in recent years.

Washington has relied on an *ad hoc* approach to estimate the effects of management measures on catch and effort, based on historical data. If the ACLs for overfished species do not change, it is assumed that catch will not change. This was the approach used in the 2013-14 Spex cycle. If the ACLs changes, or if depth or area restrictions change, as was the case during the 2011-12 Spex cycle, changes in catch, driven by changes in overfished species catch, are projected using historical data.

Effort projections are not linked to catch. Instead, changes in depth restrictions are assumed to affect the spatial distribution of effort but leave the overall level of effect unchanged. Thus, effort projections tend to be very similar from one year to the next.

The SSC-E/GF agrees that this approach is reasonable so long as fishery-related drivers of effort are relatively constant. These drivers include not just area/depth restrictions but also catch rates, bag limits, size distribution, catch composition, season length, and conditions in other (substitute or complimentary) fisheries. Economic impacts are also insensitive to fishery-related drivers and thus relatively invariant among the alternatives because the effort projections are the basis for estimating the regional economic impacts of management alternatives considered in the Spex cycle,

Recommendations:

- **The SSC-E/GF recommends a retrospective analysis of how effort projections based on this approach compare with post-season effort estimates for past Spex cycles to better understand the past performance of Washington's *ad hoc* approach to projecting effort. The SSC-E/GF would like to see the results of this retrospective analysis when it reviews the draft EIS for the 2015-16 Spex.**
- Even if the *ad hoc* approach has projected effort fairly well in recent Spex cycles (due to stable trends in fishery-related drivers), the approach may not work so well if area/depth restrictions and other drivers were to change more substantially in future years. **Over the longer term, it would be useful to develop models that predict the effect of fishery-related drivers on angler effort.** Such models would allow the Council to more accurately consider the economic impacts of management alternatives.

<u>California RecFISH Model</u>

The SSC-E/GF reviewed the "California Recreational Groundfish Model for 2013/14". Mr. John Budrick provided the Economic Subcommittee with a presentation.

The California RecFISH model is a catch-based model which is used to estimate catch (mortality) and effort for alternative management scenarios, or conversely determine what season and depth restrictions would be necessary to constrain mortality within management limits. The data for the model are primarily from the Marine Recreational Fishery Statistics Survey (1980-2003) and the California Recreational Fisheries Survey (CRFS) (2004-present), supplemented with some data from Oregon to provide sufficient data coverage for California's Northern management area.

The general catch projection framework involves determining what the baseline catch would have been without depth and time closures. Baseline catch is determined for each of the five management areas, four modes and six two-month waves on the basis of historical catch data collected in years prior to depth and time closures. The depth and time closures are then applied, which redistribute catch to open depths within a management area. Mortality is calculated using depth-dependent mortality rates.

The effects of effort shifts on mortality are calculated only when depth closures occur at 30 fathoms (fm) or less. Specifically, effort and mortality are assumed to increase in open shallower-water areas by 27.6% and 39.3% when depth restrictions occur inside 30 fm and 20 fm, respectively. This is intended to help predict potential effects of such closures on shallow water species. Effort also changes when the duration of the season changes, based on the assumption that effort that would have occurred in a management area during closed months disappears rather than shifting to an open month. Other factors that affect catch such as size and bag limits and area closures (e.g., Yelloweye Rockfish Conservation Area) may be taken into account, though not in a systematic manner.

Recommendations:

- The California RecFISH model includes a number of assumptions regarding how effort is influenced by regulations pertaining to season length, depth restrictions, and the like. These assumptions are important, as the effort projections are what drive the projections of regional economic impacts of management alternatives considered in the Spex cycle. The assumption that **certain types of depth closures cause effort to increase in shallower waters by specific percentages** originates with the contractor who developed the RecFISH model; the basis for this assumption is unclear. The assumption that **all of the effort that historically occurred in a given month would disappear if the fishery were closed in that month** is rather restrictive. **Both of these assumptions should be validated. This validation could be extended to more broadly examine how the proportion of effort varies by time (month) and depth, using recent historical data.**
- The SSC-E/GF appreciated the work that went into the retrospective analysis, which was very informative. However, to better understand how the model performs in relation to its use in IO-PAC, it would be necessary to **redefine the areas so that they correspond to the areas used in the Spex process and focus the analysis on effort rather than catch.** The SSC-E/GF also recommends other model diagnostics and reporting as follows:
  - Since there are a large number of projections (bins) in the model, **a useful summary statistic is the number of correct predictions (with "correct" defined within a given bound).**
  - **Since there are CVs associated with the data used in the model, these could be carried through the model to show measures of uncertainty in the final output.**

The SSC-E/GF would like to receive an analysis showing progress-to-date for implementing the above recommendations when it reviews the draft EIS for the 2015-16 Spex.

ATTACHMENT 3
Statement of the SSC Economics and Groundfish Subcommittees
Non-Nearshore and Nearshore Impact Projection Models

Members of the SSC Economics and Groundfish Subcommittees (SSC-E/GF)[4] met on March 8, 2013 in Tacoma, Washington to review the Non-Nearshore and Nearshore Impact Projection Models used by the Groundfish Management (GMT). Key participants at the meeting included Messrs. Corey Niles (WDFW), Dan Erickson (ODFW), and Bob Leos (CDFW). Additional substantive input was also provided by Ms. Marlene Bellman and Mr. Jason Jannot (NWFSC West Coast Groundfish Observer Program). The SSC appreciates the time spent by each of these individuals in preparing for and participating in these reviews.

Non-Nearshore Impact Projection Model

Mr. Corey Niles (WDFW) provided the SSC-E/GF with documentation regarding the Non-Nearshore Impact Projection Model (*Description of the Groundfish Management Team's Non-Nearshore Bycatch Projection Model, Prepared for the SSC Economics Subcommittee Review*) as well as a presentation summarizing highlights of the Model. The purpose of the model is to project bycatch under alternative Rockfish Conservation Area (RCA) configurations. The management use is to determine the smallest closed areas that are likely possible without exceeding the allocation of overfished species. Yelloweye is the most important overfished species addressed by the model, though projections for other species, primarily canary, are also calculated. The bycatch projections are for fixed gear vessels targeting sablefish (hook-and-line and pot) seaward of the RCA north of 36^{o} N, though the model is primarily used to project changes in the RCA in four management areas north of 40^{o} 10'. It covers both the limited entry and the open access fisheries. To date, the model has been successful at ensuring allocation of overfished species are not exceeded.

The model projections are currently based on observer data from 2002-11. The key mathematical calculation for the model projections is the ratio of observed catch of a particular bycatch species to the observed retained sablefish catch. Currently this ratio is calculated as a grand mean for the entire time span of the data (2002-11). The grand mean was used in the model initially because, when the model was first constructed, there was not an adequate sample of data without aggregating across all years. The practice of using the grand mean has continued.

Output from this model does not currently affect economic measures that are used as part of the biennial specification process, including IO-PAC regional economic impacts and vessel profitability. This is due to the fact that it is assumes the entire allocation of target species is caught. However, the SSC-E/GF notes that changes in the RCA could affect several variables that have a bearing on economic performance. These include changes in the ports of landing, fish quality or size, and the cost of fishing. A more complete analysis of these changes would better clarify the effects of changes in the RCA.

[4] SSC participants included Daniel Huppert, Todd Lee, André Punt, David Sampson and Cindy Thomson.

The SSC-E/GF has the following recommendations for investigating model performance and improving model reporting:

- **The SSC-E/GF recommends that further data analysis be conducted to determine if there is a trend in the data, and to also better understand the year-to-year variation in the data.** The outcome of this analysis should be used to determine which years of the data should be used and if data weighting should be used (e.g., weight more recent years higher that more distant years).
- **A measure of variability should be developed and included with the projection estimates.** This could be accomplished through a Monte Carlo analysis.
- The model uses retained sablefish catch. **Due to possible highgrading of the catch, this could be a source of error if retained catch has a different bycatch rate than discarded catch. This issue should be explored to the extent possible.**

Nearshore Impact Projection Model

Messrs. Dan Erickson (ODFW) and Bob Leos (CDFW) provided the SSC-E/GF with documentation regarding the Nearshore Impact Projection Model (*Groundfish Management Team's Commercial Nearshore Bycatch Projection Model, 02-13-2013*) as well as a presentation summarizing highlights of the model. The Nearshore Model is used to estimate bycatch, discard and discard mortality of overfished species that constrain fixed gear vessels operating shoreward of the non-trawl RCA in Oregon and California. Yellowtail and canary rockfish are the major constraining species for these vessels.

Bycatch estimates for overfished species are derived on the basis of landings of nearshore species in three area strata (from PacFIN). Landings in each area are allocated among three depth bins based on depth distribution data collected in the NWFSC's West Coast Groundfish Observer Program (WCGOP). Catch of overfished species as a proportion of total landings is estimated for each area and depth from available WCGOP data (currently 2003-2011) as a grand mean, that is by dividing the cumulative weight of each overfished species by the cumulative weight of retained nearshore species. Discard mortality by depth is estimated by applying recreational discard mortality rates to overfished species caught with 'recreation-like' gear (jig, rod-and-reel, pole) and a 100% mortality rate to catches made with 'non recreation-like' gear (i.e., all other commercial fixed gears). The proportion of 'recreation-like' versus 'non recreation-like' gear deployed at each depth is estimated for Oregon and California on the basis of 2004-2006 Oregon logbook data.

Due to the high degree of variability in nearshore species landings, multi-year averages are deemed to provide better estimates of future year's landings than landings in a single previous year. For the 2013-14 Spex, Oregon and California nearshore landings were projected by dropping the year with the lowest landings during 2008-2011 for each state and calculating an average for the remaining three years. This average was then adjusted upward as warranted to reflect fishing conditions expected for 2013-14 (e.g., if the 2013-14 annual catch limit for a particular species was higher than what was experienced during 2008-2011). This exercise was intended to help ensure that overfished species limits are not exceeded.

Comparison of Nearshore Model projections versus WCGOP estimates of yelloweye and canary rockfish mortalities (Table 2 of the Nearshore Model documentation) reveals an unusually large discrepancy for canary in 2011 (3.2 mt based on the Nearshore Model, 15.5 mt based on the

WCGOP). However, the ability of CDFW to determine the cause of such discrepancy is limited by their lack of access to WCGOP data.

The SSC-E/GF has the following comments and recommendations regarding the Nearshore Model:

- Coverage of nearshore vessels in the WCGOP is hampered by factors such as the inability of some vessels to carry an observer. **The SSC E/GF recommends that the GMT consider ways of evaluating the representativeness of nearshore vessels included in the WCGOP – for instance, by comparing the species composition of their landed catch with species comps for non-WCGOP vessels.**
- Using a grand mean to estimate overfished species catch ratios implicitly gives greater weight to years with more WCGOP samples, and is not helpful for evaluating trends or determining what drives model outcomes. A better way to evaluate trends would be to take running averages of annual ratios. However, due to small sample sizes, outliers could have an undue influence on such calculations and also make interpretation of trends difficult.
- While the Non-Nearshore Model bases overfished species catch estimates on landings of a single and highly desired species (sablefish), the Nearshore Model bases its overfished species catch estimates on landings of multiple nearshore target species. Thus, interpreting changes in overfished species catch ratios is complicated by the fact that the denominator includes a mix of species that are differentially priced in the market and whose availability to the fishery is affected by depth restrictions that change over time.
- Small samples of nearshore vessels in the WCGOP have hampered the GMT's ability to evaluate and improve the performance of the Nearshore Model. Lack of access to WCGOP data is also an issue for CDFW.
- Increasing the number of area strata may allow management to be more finely tuned in terms of protecting overfished stocks while reducing negative community effects. However, finer stratification may also suggest that the model can do more than it actually can, given the sample size constraints.
- Relying on 2004-2006 Oregon gear compositions by depth to characterize the California fishery may be problematic, due to the interaction between gear type and depth-dependent mortality. However, CDFW lacks the data needed to make similar calculations of its own.
- The practice of deleting the lowest-of-four recent landing years in projecting future nearshore landings is an indirect way of demonstrating risk tolerance. **A more transparent way to do this would be to identify explicit buffers (e.g., one standard deviation) that are sufficiently wide to avoid exceeding allocations for overfished species.**
- Given the high degree of uncertainty in the Nearshore Model, it is important to explicitly address how that uncertainty affects the overfished species catch estimates. The GMT has devised a method of calculating coefficients of variation that are being reviewed by the WCGOP. **The SSC-E/GF welcomes this development and would like to review the method as well.**

ATTACHMENT 4

Statement of the SSC Economics and Groundfish Subcommittees

IO-PAC Model and the Economic Data Collection Program

Members of the SSC Economics and Groundfish Subcommittees (SSC-E/GF)[5] met with Northwest Fisheries Science Center (NWFSC) economists on April 7, 2013 in Portland, Oregon to review the IO-PAC model and the Economic Data Collection (EDC) Program.

IO-PAC Model

The IO-PAC model is used in the groundfish Spex process to evaluate the regional economic impacts of management alternatives. In October 2009, the NWFSC sponsored a CIE review of an earlier version of IO-PAC, which the SSC also reviewed in November 2009. Subsequent changes to the model have been substantial enough to warrant a new review at this time. Dr. Jerry Leonard (NWFSC) provided the SSC-E/GF with documentation and a presentation of the updated IO-PAC model.

A number of changes to IO-PAC have occurred since the SSC's last review. These changes include addition of a recreational component, data updates, addition of more commercial fisheries (at-sea groundfish, crab, salmon, and shrimp) and a processing sector, major changes in model construction, and some changes in model assumptions. **The SSC-E/GF supports these changes as improvements to the model and endorses use of the model for management.**

SSC-E/GF review focused on the accuracy of specific assumptions in IO-PAC, the sensitivity of model results to those assumptions, and which assumptions are likely to have the greatest influence on model outputs.

The SSC-E/GF makes the following recommendations regarding documentation and application of the IO-PAC Model:

- IO-PAC can be used to estimate income and employment impacts at port group, State and coastwide levels**. Impacts estimated for each port group within a state do not add up to state-level impacts, nor do state-level impacts add up to coastwide impacts.** This is a logical function of how IO-PAC (as well as other regional impact models) are structured. **This should be clearly explained whenever IO-PAC results are provided.**
- The geographical distribution of purchases by processors and the distribution of sales are difficult to track. **The SSC-E/GF recommends that the IO-PAC authors conduct a sensitivity analysis showing which assumptions regarding the underlying distribution of fishing and processing costs have the greatest influence on the economic impact estimates.**
- **Whenever major changes are made to the IO-PAC model, the SSC recommends that the authors demonstrate the effects of these changes by running the same fishery change through the older and newer versions of the model.**
- IO-PAC (like other regional impact models) is based on assumptions such as constant returns to scale, no input substitution, no supply constraints, and no price or wage adjustments. Thus employment and income impacts produced by IO-PAC should be interpreted as a short-term response rather than a long-term adjustment to infusions of

[5] SSC participants included Martin Dorn, Daniel Huppert, Todd Lee, André Punt, David Sampson and Cindy Thomson.
5

money into the economy. **This should be clearly explained whenever IO-PAC results are provided.**

- IO-PAC is sensitive to assumptions regarding fishing behavior (e.g., whether regulatory restrictions cause a decline in angler spending or a diversion of spending to other activities, whether spending on alternative activities occurs inside versus outside the local economy). **The IO-PAC analysis used in the 2015-16 Spex should include documentation and justification of the behavioral assumptions underlying the model.**

Economic Data Collection Program

The SSC-E/GF received presentations from Dr. Todd Lee and Ms. Erin Steiner (NWFSC) on the Economic Data Collection (EDC) Program, and discussed with them the progress the program has made to date. The EDC Program was established as part of the Council's trawl catch shares program, specifically to monitor the economic effects of the catch share program. The EDC Program has been collecting information from four classes of participants in the catch share program: (1) catcher vessels, (2) motherships, (3) catcher-processor vessels, and (4) first receivers and shore-based processors. All participants must submit economic information as requested by the EDC Program as a condition of the catch shares program. The EDC information base includes annual economic data submissions collected using survey forms, with follow-up interviews to resolve questions regarding the data. The EDC Program is a significant advance in scope and quality over previous activities to gather economic data, which were conducted using voluntary surveys of costs and earnings. The SSC-E/GF commends the hard work and diligence of the EDC staff members for developing this ambitious program and its impressive system for data quality assurance and quality control.

The SSC-E/GF reviewed five EDC draft reports: an *Administration and Operations Report*; a *Catcher-Vessel Report*; a *Mothership Report*; a *Catcher-Processor Report*; and a *First Receiver and Shorebased Processor Report*. The EDC Program will regularly publish similar reports as additional information accumulates. The types of summary information and analyses provided in the EDC reports, which have never previously been available, should be very useful in the Council's biennial process for developing groundfish management specifications.

The SSC-E/GF offers the following comments, suggestions, and recommendation to further improve the quality of the data that the EDC Program collects and the usefulness of the reports it produces.

Data Quality Assurance / Quality Control

- In general it is difficult to verify the accuracy of self-reported information, whether the data are collected by in-person interviews or by means of an on-line survey. One mechanism for verifying self-reported data is to collect information that can be cross-checked against other sources. For example, self-reported information on annual landings and value of groundfish could be compared to fish ticket information, and discrepancies could lead to follow-up interviews to resolve potential problems. The EDC program currently uses a cross-check approach for data from motherships, first receivers and shore-based processors. **The SSC-E/GF recommends that the EDC Program implement some similar validation approach for the catcher vessels and catcher-processors.**

- **Ratios of different categories of costs could be used to flag potential outliers or misreported data in the collected information.**

Categories of Fisheries

- Because most fishing activities catch multiple species of fish, there is no single best approach for tabulating economic information by "fishery". The EDC reports summarize the available data for a relatively small number of different fisheries (e.g., at-sea whiting, shoreside whiting, DTS trawl, shrimp, crab, Alaska).
- It seems likely that many potential users of the EDC information would have their own special fisheries for which they would like summarized data. A flexible web-based system for querying the database would be advantageous to such users, but the software would need to be carefully constructed to protect the confidentiality of the information. **The SSC encourages the EDC Program to work towards providing the information as flexibly as possible.**

Disaggregating Costs to Fisheries

- The information on annual costs, which for catcher vessels is reported at the level of 23 expense categories (e.g., fuel, food, ice, freight, observer costs), cannot generally be assigned to a single type of fishing activity, such as fishing for canary rockfish. However, the anticipated future catches of limiting species such as canary rockfish provide the framework for analyzing the potential impacts of management alternatives. Hence, cost disaggregation is an important technical aspect of the biennial specifications analysis that underpins the Council's decisions for groundfish management. Cost disaggregation is also fundamental in calculations of fishery profitability (profits = net revenues = landed value minus costs).
- The EDC Program's cost accounting system does not assign to West Coast fisheries any of a vessel's transit costs for those vessels that operate in both West Coast and Alaskan fisheries. Nor does the program account for administrative costs (e.g., finance costs, taxes, legal fees). Thus estimates of net revenue provided by the EDC Program are over-estimates, since the only costs collected are those directly related to the operation of the vessels.
- The EDC Program staff explored four methods for developing estimates of the disaggregated costs of the fishing operations of catcher vessels, based on: (1) days-at-sea (trip-level assignment to fishery based on the dominant landed value); (2) ex-vessel landed value; (3) landings (weight); and (4) a mixed method that uses: (a) ex-vessel revenues to disaggregate one set of cost categories (e.g., wages for captain and crew); (b) retained catch weight to disaggregate a second set of cost categories (e.g., offload fees, trucking expenses); and (c) days-at-sea to disaggregate a third set of cost categories (e.g., food, ice, insurance). When applied to three fisheries (at-sea Pacific whiting, shoreside Pacific whiting, and DTS trawl), three of the four methods produced very similar estimates for fixed costs, variable costs, and net revenue. The days-at-sea approach produced somewhat divergent results.
- Cost disaggregation for the other classes of catch share participants (catcher-processors, motherships, and first receivers and shorebased processors) requires slightly different methods because of the types of information that are available. The weight of the fish

caught or processed is the only data type that is available across all four classes of catch share participants.

- The EDC Program currently treats first receivers and shorebased processors as a single class of participants, but it seems likely that first receivers versus shorebased processors could have quite different economic impacts, especially at a regional scale. **The SSC-E/GF recommends that analyses of costs and net revenues of first receivers and shorebased processors be conducted separately to the extent practicable.**
- The SSC-E/GF recognizes the technical challenges associated with estimating disaggregated costs and endorses the approaches being considered by the EDC Program. Disaggregating processing costs by fishery or by individual species is particularly challenging. In addition to the methods explored to date by the EDC Program, there may be benefits to developing statistical models to estimate some cost categories, especially when information becomes available for additional years. **The SSC-E/GF recommends that analyses of costs and net revenue include some measure of the sensitivity of the results to the methodology used for cost-disaggregation** because there is unlikely to ever be a clear-cut "best" approach**.**

Reporting

- The tables in the draft reports that summarized the survey data did not include any measures of variability. **The SSC-E/GF recommends that future reports include some simple metric of dispersion, such as a code depicting the magnitude of the coefficient of variation.**

TRIBAL STATEMENT ON CONSIDERATION OF 2015-2016 HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES AND BEYOND

It is the understanding of the Coastal Treaty Tribes that under the proposed schedule for developing harvest biennial harvest specifications and management measures (in Attachment 3), preliminary allocations, set-asides, and management measures specific to treaty Indian fisheries will need to be initiated in writing prior to the November PFMC meeting during odd years. Refinements to those allocations, set-asides, and management measures, if any, would need to be submitted in writing prior to the June PFMC meeting in even years.

The Coastal Treaty Tribes and NMFS Northwest Region will continue discussions as to whether this schedule should be reflected in Council Operating Procedure 9 or through MOUs with affected tribal governments or other appropriate means.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON CONSIDERATION OF 2015-2016 AND BEYOND HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES

As we mentioned at the March Council meeting, the Washington Department of Fish and Wildlife (WDFW) supports moving forward with having a revised schedule in place for the 2015-16 biennial groundfish specifications and management process, and with moving forward with Amendment 24 for the longer term. However, we also identified some concerns with Amendment 24 that we would like to reiterate and elaborate on.

Background

One of the key potential benefits of Amendment 24 is a programmatic approach to groundfish management that could save staff time and resources in future biennial management cycles. In order to successfully achieve this efficiency outcome, the Tier 1 Environmental Impact Statement (EIS) needs to include a thorough, broad defensible analysis of environmental—including ecological, biological, and economic—impacts, individually and cumulatively, over the long-term, which will take considerable effort to produce. Such effort should also produce NEPA analyses that are more useful for the Council's conservation and management decisions and the public's understanding and engagement in them.

In an effort to begin to reap the efficiency benefits sooner, Council staff has made it clear that they would like to complete the Tier 1 EIS in concert with the 2015-16 biennial process, which would have final Council approval scheduled for June 2014. Given the critical need for a comprehensive long-term environmental impacts analysis, WDFW questions whether this timeline will allow for an analysis that can be completed, read, and understood by the Council and deemed defensibly strong and sufficiently robust in its thoroughness to remain valid and useful over a number of cycles.

While considering the need for Amendment 24, the Council also finalized its Fishery Ecosystem Plan (FEP) and considered how to further incorporate ecosystem considerations into its management processes. The Council recognized the connections between the FEP and the Tier 1 EIS and, at the Council's request, the Ecosystem Plan Development Team developed Initiative 9, which was provided to the Council in April. This initiative describes a proposed method to complete this critical analysis. To be robust, the Tier 1 EIS must incorporate many of the efforts the Council has heard discussed under its ecosystem related agenda items. And if, as planned, the EIS is to cover four biennial cycles following the approval of the amendment, then it should also be a tool to further the Council's progress toward ecosystem based fisheries management.

In order for WDFW's delegation to have sufficient time to read, understand and digest the EIS for final approval in June, we believe that a near-final EIS would be needed by March. Backing up the schedule from there, in order for the Council staff who have been tasked with writing this draft EIS to meet that timeline, we think it is necessary for them to have assistance, primarily NOAA Fisheries Science Center staff who are conversant with the Integrated Ecosystem Assessment or other ecosystem models and ecological indicators of the California Current Ecosystem the Council has been considering.

In recognition of this, WDFW proposed, and the Council unanimously approved, a motion in March to revise its Amendment 24 Workgroup to include ecosystem experts from the Scientific and Statistical Committee (SSC) and the NOAA Fisheries Science Centers. However, later that week, the Council decided that, given Council workload and other activities, such as the Managing the Nation's Conference, this revised workgroup would not need to meet in the near-term (i.e., before the June meeting). In April, the Council also discussed how the Amendment 24 Workgroup may not be the best fit for this task given its charge.

Recommendation

WDFW continues to believe that the long-term environmental impacts analysis—its usefulness and strength— and would benefit from having additional scientific expertise and input into the design and production of the Tier 1 EIS. At the same time, we recognize there are costs associated with expanding the current Amendment 24 Workgroup in terms of travel expense and coordination time from staff. To that end, we propose expanding the "project team" to include ecosystem experts from the SSC and the NOAA Fisheries Science Centers and request that the SSC identify four or five individuals that they would recommend for this effort at this meeting.

The expanded "project team" would be charged with: providing an independent peer review of the current draft EIS and guidance on the overall approach relative to accounting for environmental impacts; discussing the available data and resources for the long-term impact analysis; and recommending revisions to the EIS outline and contents, as needed.

We also propose that this expanded "project team" hold two work sessions, which would be open to the public to attend and observe—one between the June and September Council meetings and another between September and January—and that they provide status reports in September and March. We understand that the timing of these work sessions may not be ideal, given this is an "on-year" for science and STAR panel reviews, but believe it is necessary in order to complete a near-final EIS by March.

We also request that the SSC review the draft EIS and provide their report to the Council in March relative to the usefulness and strength of the long-term environmental impacts analysis. More detailed questions for the SSC may be identified after we receive the initial report from the expanded "project team."

Agenda Item F.7.c
Supplemental Public Comment
June 2013

---------- Forwarded message ----------
From: **Bill James** <Halibutbill@live.com>
Date: Thu, Jun 13, 2013 at 4:01 AM
Subject: Agenda Item F.7 2015-2016 Harvest Specs and Management Measures
To: "pfmc." <pfmc.comments@noaa.gov>
Cc: Bill James <Halibutbill@live.com>

Mr. Dan Wolford
Chairman
Pacific Fishery Management Council

Dear Chairman Wolford, My name is Bill James and I am writing on behalf of Port San Luis Commercial Fishermen's Association. Our Port is Port San Luis (Avila) just a few miles south of Morro Bay. The majority of the commercial fishermen from Port San Luis have one or both of the "Shallow Nearshore Species Fishery" and, or, "Deeper Nearshore Species Fishery" permits. This fishery is the most important fishery in both dollars (ex-vessel) and in participation (# of trips) at Port San Luis in the last five years. Port San Luis is one of the two highest producing ports of "Live Nearshore Finfish Species" in California. The other high producing port is Morro Bay just north of Port San Luis.

We request for the 2015-2016 Harvest Specs. and Management Measures cycle:

1) Have an additional latitude line at Ano Nuevo (37 degrees 07.00') be included in the upcoming analysis for the Nearshore Finfish fishery concerning the observed bi-catch of Canary Rockfish in the current management area of 40:10 to 34:27. Separate into two distinct areas for analysis.

2) Have an analysis of bi-monthly trip limits of 1000lbs./ 2 months for all 5 open periods (closed march-April) for both Shallow Nearshore Species permits and Deeper Nearshore Species permits for the area of Ano Neuvo 37 07.00' to Point Conception 34:27.

3) Open Lingcod during Dec Jan Feb (currently closed) with monthly limits during Dec, Jan, Feb of 200lbs.per month or half of the monthly limit during the period of May- November.

4) Please increase the allocation of Canary Rockfish for the "Directed Open Access commercial fishermen in California.

PSLCFA and myself thank the Council for the opportunity to comment. If you have any questions about these requests please contact me at 503-428-4028. Thank you, Bill James

Agenda Item F.8
Situation Summary
June 2013

ADOPT PRELIMINARY STOCK COMPLEX AGGREGATIONS

The 2006 reauthorization of the Magnuson-Stevens Act (MSA) included a mandate to end overfishing. The revised National Standard 1 (NS1) guidelines of 2009 recommended a framework for accomplishing the MSA mandate, including criteria for managing stocks in a complex to reduce the risk of overfishing. Stock complex means a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar. The framework recommended in the revised NS1 guidelines was incorporated in the groundfish fishery management plan (FMP) under Amendment 23, which was implemented in 2011.

The Council considered strawman stock complex alternatives for six species groups (nearshore rockfish, shelf rockfish, slope rockfish, flatfish, elasmobranchs, and roundfish) at the April 2013 meeting (see Agenda Item D.3.a, Attachment 1). The Council decided to maintain consideration of these alternatives and prioritize analysis of the alternatives for slope rockfish, elasmobranchs, and roundfish. They also recommended the addition of alternatives as deemed informative by the Groundfish Management Team (GMT) and Council staff. Agenda Item F.8.a, Attachment 1 provides a description of the alternatives presented in April with the addition of another alternative for the slope rockfish complexes and analysis not presented in April. The GMT also provides additional analysis in Agenda Item F.8.b, GMT Report.

The Council task at this meeting is to adopt preliminary preferred alternatives for each species group for public review, so as to enable a decision on final preferred alternatives for stock complexes at the September meeting. Accomplishing this will facilitate a more orderly process for deciding 2015-2016 harvest specifications, which is slated to start in September. The Council should consider Scientific and Statistical Committee advice on the analyses presented in Attachment 1 and the GMT Report, as well as the recommendations of the GMT, Groundfish Advisory Subpanel, and public before taking action on this item.

Council Action:

Adopt preliminary preferred alternatives for restructuring stock complexes for public review.

Reference Materials:

1. Agenda Item F.8.a, Attachment 1: Considerations for Restructuring West Coast Groundfish Stock Complexes: Preliminary Alternatives and Analyses.
2. Agenda Item F.8.b, GMT Report: Groundfish Management Team Report on Methods and Results That May Be Used to Evaluate Alternatives for Stock Complex Reorganization.
3. Agenda Item F.8.b, ODFW Report: Oregon Department of Fish and Wildlife Report on the Oregon Commercial Sampling Program and Potential Changes to Species Complexes.

Agenda Order:

a. Agenda Item Overview John DeVore
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Adopt Preliminary Stock Complex Aggregations for Public Review

PFMC
05/31/13

CONSIDERATIONS FOR RESTRUCTURING WEST COAST GROUNDFISH STOCK COMPLEXES

PRELIMINARY ALTERNATIVES AND ANALYSES

PREPARED BY
THE PACIFIC FISHERY MANAGEMENT COUNCIL
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June 2013

CHAPTER 1 INTRODUCTION

1.1 Background and Introduction

The Magnuson-Stevens Act (MSA) was reauthorized in 2006 with a mandate to end overfishing. National Standard 1 (NS1) guidelines, the National Marine Fisheries Service (NMFS) guidance on how to meet the conservation objectives of the MSA, were revised in 2009 in response to the MSA reauthorization. The revised NS1 guidelines proposed a harvest management framework that specified a number of management reference points and precautionary buffers to reduce the risk of overfishing (i.e., exceeding the level of harvest estimated to achieve maximum sustainable yield (MSY)). The revised NS1 guidelines recommended specification of an overfishing limit (OFL), the MSY harvest level; a buffer between the OFL and the acceptable biological catch (ABC) to account for scientific uncertainty in estimating the OFL; and the annual catch limit (ACL), which may be set equal to the ABC or lower to accomplish other objectives. These precepts and other recommendations from the revised NS1 guidelines were incorporated in the groundfish fishery management plan (FMP) under Amendment 23, which was implemented in 2011.

The revised NS1 guidelines and Amendment 23 also incorporated a framework for managing stock complexes, which are aggregations of stocks managed in a single unit under harvest specifications decided for the complex in its entirety. Stocks managed in a complex should be sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar. At the time a stock complex is established, the FMP should provide a full and explicit description of the proportional composition of each stock in the stock complex, to the extent possible. Stocks may be grouped into complexes for various reasons, including where stocks in a multispecies fishery cannot be targeted independent of one another and MSY cannot be defined on a stock-by-stock basis; where there is insufficient data to measure their status relative to status determination criteria (SDC); or when it is not feasible for fishermen to distinguish individual stocks among their catch. The vulnerability of stocks to the fishery should be evaluated when determining if a particular stock complex should be established or reorganized, or if a particular stock should be included in a complex.

Stock complexes may be comprised of: one or more indicator stocks, each of which has SDC and ACLs, and several other stocks; several stocks without an indicator stock, with SDC and an ACL for the complex as a whole; or one of more indicator stocks, each of which has SDC and management objectives, with an ACL for the complex as a whole. An indicator stock is a stock with measurable SDC that can be used to help manage and evaluate more poorly-known stocks that are in a stock complex. If an indicator stock is used to evaluate the status of a complex, it should be representative of the typical status of each stock within the complex, due to similarity in vulnerability. If the stocks within a stock complex have a wide range of vulnerability, they should be reorganized into different stock complexes that have similar vulnerabilities; otherwise, the indicator stock should be chosen to represent the more vulnerable stocks within the complex. In instances where an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery. More than one indicator stock can be selected to provide more information about the status of the complex. When indicator stock(s) are used, periodic re-evaluation of available quantitative or qualitative information (e.g., catch trends, changes in vulnerability, fish health indices, etc.) is needed to determine whether a stock is subject to overfishing, or is approaching (or in) an overfished condition. Under the proposed action, more consideration will be needed to understand how to best use indicator stocks in managing stock complexes.

1.2 Proposed Action

Using the "best available scientific information," the proposed action is to restructure the current groundfish stock complexes that comprise species of more equivalent ecological distributions, more equivalent vulnerabilities to overfishing, and that are caught together in the fishery. This action would align stock complexes to more closely comport with NS1 guidelines and the tenets of the FMP.

The proposed action also considers adding a few non-FMP species into the FMP. Considerations for adding new species are they are caught in the groundfish fishery in amounts that may not be considered incidental and adding species that are landed together with FMP species in general market categories facilitates estimating harvest specifications for the complex using approved catch-based methods.

The proposed action also considers designating some FMP stocks as Ecosystem Component (EC) species. EC species are not in the fishery and therefore not actively managed. EC species are not targeted in any fishery and are not generally retained for sale or personal use. EC species are not determined to be subject to overfishing, approaching an overfished condition, or overfished, nor are they likely to become subject to overfishing or overfished in the absence of conservation and management measures. While EC species are not considered to be in the fishery, the Council should consider measures for the fishery to minimize bycatch and bycatch mortality of EC species consistent with National Standard 9, and to protect their associated role in the ecosystem. EC species do not require specification of reference points but should be monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery. The candidate species for an EC designation under the proposed action contribute no or negligible catch to the estimated catch-based OFLs used to determine harvest specifications.

The proposed action also considers removing some species from the FMP because they are not in the fishery. In cases where there is uncertainty whether candidate species are in the fishery or not, the proposed action is to designate such species as EC species.

The proposed action considers different ways to restructure stock complexes for six different species groups. In some cases, the relative productivity and vulnerability of component stocks is the key attribute for alternative stock complexes (e.g., nearshore and slope rockfish complexes) and in other cases, the depth distributions of component stocks is the key attribute (e.g., shelf rockfish, flatfish, cartilaginous fish, and roundfish complexes). While consideration of aligning stocks managed in alternative complexes is done for all complexes, the productivity and vulnerability attributes of component stocks in the nearshore and slope rockfish complexes are the main factor in proposing alternative complexes since some of those stocks have the highest vulnerability to overfishing of all FMP stocks.

1.3 Purpose and Need

The purpose of the proposed action is to conserve and manage Pacific Coast groundfish fishery resources to prevent overfishing, to rebuild overfished stocks, to ensure conservation, to facilitate long-term protection of essential fish habitat (EFH), and to realize the full potential of the Nation's fishery resources (MSA §2(a)(6)) by restructuring current stock complexes. The harvest specifications for stock complexes are set consistent with the harvest management framework described in Chapter 4 of the Groundfish FMP.

There is a need to evaluate and consider changes to the current structure of stock complex groupings to ensure that the species in each complex are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that management impacts are similar.

CHAPTER 2 DESCRIPTION OF THE ALTERNATIVES

The alternatives described here are intended to evaluate aggregations of species that represent a better management alignment of species according to their ecological distributions, interactions with the fishery, and relative vulnerabilities to overfishing. Alternatives are stratified into six major species groups (Nearshore Rockfish, Shelf Rockfish, Slope Rockfish, Flatfishes, Roundfishes, and Cartilaginous Fish). Considerations for restructuring stock complexes for these six groups of species can be decided independently and are thus presented and analyzed independently.

There are considerations for incorporating new species into the FMP since they are caught in the groundfish fishery in relatively high amounts analogous to catches of closely related FMP species. Incorporating these species into the FMP will also enable more accurate estimates of OFLs for some FMP species using the data-poor catch-based methods employed for unassessed species. This is because some of these species are landed in market categories representing an aggregation of similar species with little or no species composition data available to differentiate landing to species (e.g., Pacific grenadier landed in an "unspecified grenadiers" market category).

There are also considerations for designating some species as EC species, as well as removing some species from the FMP. There is a consideration for removing species from the FMP in cases where the species does not occur on the West Coast and has no catch history (e.g., dusky rockfish) or is solely caught in state-managed fisheries (e.g., leopard shark). Stocks that are not targeted and have a negligibly small catch history (e.g., calico rockfish) are candidates for an EC designation.

2.1 Nearshore Rockfish Alternatives

2.1.1 Status Quo Nearshore Rockfish Alternative

Table 1. Status quo nearshore rockfish stocks and stock complexes.

Nearshore Rockfish Stocks	Nearshore Rockfish Stock Complexes	
	N of 40°10'	**S of 40°10'**
Non-overfished Stocks	Black and yellow	**Shallow NS Species**
Black rockfish (OR-CA)	Blue	Black and yellow
Black rockfish (WA)	Brown	China
	China	Gopher
	Copper	Grass
	Gopher	Honeycomb
	Grass	Kelp
	Kelp	**Deeper NS Species**
	Olive	Blue
	Quillback	Brown
	Treefish	Calico
		Copper
		Olive
		Quillback
		Treefish

2.1.2 Nearshore Rockfish Alternative 1

One action alternative is considered for restructuring the nearshore rockfish stock complexes based on the relative productivity and vulnerability to overfishing of affected stocks (Table 2). Honeycomb rockfish is currently managed in the southern shelf rockfish complex. However, the depth distribution of honeycomb rockfish ranks it ecologically as a nearshore rockfish. The proposed alternative for honeycomb rockfish is to designate it as an EC species since it contributes no historical catch to the catch-based OFL. In the event honeycomb rockfish is not designated as an EC species, there should be consideration for managing this stock in the Southern Nearshore Rockfish complex.

Table 2. Alternative 1 nearshore stocks and stock complexes aggregated by relative vulnerability (strikeout denotes a stock moving from a status quo category; italics denotes a stock moving into a new category).

Nearshore Rockfish Stocks	Stock Complexes			
	N of 40^{0}10’		S of 40^{0}10’	
	Nearshore RF	Vul. Nearshore RF	Nearshore RF	Vul. Nearshore RF
Non-overfished Stocks Black rockfish (OR-CA) Black rockfish (WA)	Black and yellow a/ Blue Brown China Copper Gopher a/ Grass Kelp a/ Olive Quillback Treefish	China Copper Quillback	**Shallow NS Species** Black and yellow China Gopher Grass Honeycomb b/ Kelp **Deeper NS Species** Blue Brown Calico b/ Copper Olive Quillback Treefish	China Copper Quillback

a/ Remove from complex since there is no or low presence.
b/ Specify as an Ecosystem Component species.

2.2 Shelf Rockfish Alternatives

2.2.1 Status Quo Shelf Rockfish Alternative

Table 3. Status quo shelf rockfish stocks and stock complexes.

Shelf Rockfish Stocks	Shelf Rockfish Stock Complexes	
	N of 40^{0}10’	**S of 40^{0}10’**
Overfished Stocks	Bank	Bank
Bocaccio S of 40^{0}10’	Bocaccio	Bronzespotted
Canary	Bronzespotted	Chameleon
Cowcod S of 40^{0}10’	Chameleon	Dusky
Yelloweye	Chilipepper	Dwarf-red
Non-overfished Stocks	Cowcod	Flag
Chilipepper S of 40^{0}10’	Dusky	Freckled
Shortbelly	Dwarf-red	Greenblotched
Widow	Flag	Greenspotted
Yellowtail N of 40^{0}10’	Freckled	Greenstriped
	Greenblotched	Halfbanded
	Greenspotted	Harlequin
	Greenstriped	Mexican
	Halfbanded	Pink
	Harlequin	Pinkrose
	Mexican	Puget Sound
	Pink	Pygmy
	Pinkrose	Redstripe
	Puget Sound	Rosethorn
	Pygmy	Rosy
	Redstripe	Silvergray
	Rosethorn	Speckled
	Rosy	Squarespot
	Silvergray	Starry
	Speckled	Stripetail
	Squarespot	Swordspine
	Starry	Tiger
	Stripetail	Vermilion
	Swordspine	Yellowtail
	Tiger	
	Vermilion	

2.2.2 Shelf Rockfish Alternative 1

One action alternative (Table 4) is considered for restructuring the shelf rockfish stock complexes based on the depth distributions of component species (Table 22 and Table 23). A number of species in the shelf rockfish complexes are proposed for an EC designation (e.g., freckled rockfish) regardless of the Council’s decision to reorganize the shelf rockfish complexes by depth distribution of the component species. A few species are recommended to be removed from the northern or southern complexes (e.g., pygmy rockfish in the north) since there is no or very low presence of the species in the affected area.

Table 4. Alternative 1 shelf rockfish stocks and stock complexes (strikeout denotes a stock moving from a status quo category; italics denotes a stock moving into a new category).

Shelf Rockfish Stocks	Shelf Rockfish Stock Complexes			
	N of 40°10’		S of 40°10’	
	Shallow Shelf RF	**Deeper Shelf RF**	**Shallow Shelf RF**	**Deeper Shelf RF**
Overfished Stocks Bocaccio S of 40°10’ Canary Cowcod S of 40°10’ Yelloweye	Chilipepper ~~Dwarf-red~~ a/ Flag ~~Freckled~~ a/ ~~Greenspotted~~ a/ ~~Halfbanded~~ a/ ~~Pygmy~~ b/ Rosy Speckled Squarespot ~~Starry~~ a/ ~~Swordspine~~ a/ Vermilion	~~Bank~~ a/ ~~Bronzespotted~~ a/ Bocaccio ~~Chameleon~~ a/ ~~Cowcod~~ a/ ~~Dusky~~ b/ ~~Greenblotched~~ a/ Greenstriped ~~Harlequin~~ b/ ~~Mexican~~ a/ ~~Pink~~ a/ ~~Pinkrose~~ a/ ~~Puget Sound~~ b/ Redstripe Rosethorn Silvergray Stripetail Tiger	~~Dwarf-red~~ b/ Flag ~~Freckled~~ a/ Greenspotted ~~Halfbanded~~ a/ ~~Pygmy~~ a/ Rosy Speckled Squarespot ~~Starry~~ b/ ~~Swordspine~~ b/ Vermilion Yellowtail	*Bank* Bronzespotted ~~Chameleon~~ a/ ~~Dusky~~ a/ Greenblotched Greenstriped ~~Harlequin~~ a/ Mexican Pink ~~Pinkrose~~ b/ ~~Puget Sound~~ a/ Redstripe Rosethorn Silvergray Stripetail ~~Tiger~~ b/
Non-overfished Stocks Chilipepper S of 40°10’ ~~Shortbelly~~ a/ Widow Yellowtail N of 40°10’				

a/ Remove from complex since there is no or low presence.
b/ Specify as an Ecosystem Component species.

2.3 Slope Rockfish Alternatives

Two alternatives to status quo are considered to better manage those slope rockfish species with high vulnerabilities to overfishing in a more precautionary manner.

2.3.1 Status Quo Slope Rockfish Alternative

Table 5. Status quo slope rockfish stocks and stock complexes.

Slope Rockfish Stocks	**Slope Rockfish Stock Complexes**	
	N of 40^{0}10’	**S of 40^{0}10’**
Overfished Stocks	Aurora	Aurora
Darkblotched	Bank	Bank
POP N of 40º10’	Blackgill	Blackgill
Non-overfished Stocks	Redbanded	POP
Longspine thornyhead N and S of 34º27'	Rougheye	Redbanded
Shortspine thornyhead N and S of 34º27'	Sharpchin	Rougheye
Splitnose S of 40^{0}10’	Shortraker	Sharpchin
	Splitnose	Shortraker
	Yellowmouth	Yellowmouth

2.3.2 Slope Rockfish Alternative 1

Slope rockfish alternative 1 contemplates managing a vulnerable slope rockfish complex north of 40º10’ N lat. by aggregating blackgill, rougheye, and shortraker rockfish (Table 6). This alternative considers removing a component species from a northern or southern complex due to lack of presence (e.g., bank rockfish in the north) regardless of whether the Council decides to restructure the slope rockfish complexes based on relative vulnerabilities of component species. Alternative 2 also contemplates removing bank rockfish from the southern slope rockfish complex and moving it to the southern shelf or southern deeper shelf rockfish complex since it is more present on the shelf than the slope (Table 22 and Table 25).

Table 6. Alternative 1 slope rockfish stocks and stock complexes (strikeout denotes a stock moving from a status quo category).

Slope Rockfish Stocks	Slope Rockfish Stock Complexes		
	N of 40^{0}10’		S of 40^{0}10’
	Slope RF	Blackgill/Rougheye/ Shortraker RF	Slope RF
Overfished Stocks	Aurora	Blackgill	Aurora
Darkblotched	~~Bank~~ a/	Rougheye	~~Bank~~ b/
POP N of 40º10’	~~Blackgill~~	Shortraker	Blackgill
Non-overfished Stocks	Redbanded		~~POP~~ a/
Longspine thornyhead N and S of 34º27'	~~Rougheye~~		Redbanded
Shortspine thornyhead N and S of 34º27'	Sharpchin		~~Rougheye~~ c/
Splitnose S of 40^{0}10’	~~Shortraker~~		Sharpchin
	Splitnose		~~Shortraker~~ c/
	Yellowmouth		Yellowmouth

2.3.3 *Slope Rockfish Alternative 2*

Slope rockfish alternative 2 contemplates managing vulnerable slope rockfish complexes north and south of 40º10’ N lat. with aurora, blackgill, rougheye, and shortraker comprising these two complexes (Table 7).

Table 7. Alternative 2 slope rockfish stocks and stock complexes aggregated by relative vulnerability (strikeout denotes a stock moving from a status quo category).

Slope Rockfish Stocks	Slope Rockfish Stock Complexes			
	N of 40^{0}10’		S of 40^{0}10’	
	Slope RF	Vul. Slope RF	Slope RF	Vul. Slope RF
Overfished Stocks	~~Aurora~~	Aurora	~~Aurora~~	Aurora
Darkblotched	~~Bank~~ a/	Blackgill	~~Bank~~ b/	Blackgill
POP N of 40º10’	~~Blackgill~~	Rougheye	~~Blackgill~~	Rougheye
Non-overfished Stocks	Redbanded	Shortraker	~~POP~~ a/	Shortraker
Longspine thornyhead N and S of 34º27'	~~Rougheye~~		Redbanded	
Shortspine thornyhead N and S of 34º27'	Sharpchin		~~Rougheye~~	
Splitnose S of 40^{0}10’	~~Shortraker~~		Sharpchin	
	Splitnose		~~Shortraker~~	
	Yellowmouth		Yellowmouth	

a/ Remove from complex since there is no or low presence.
b/ Move to Southern Shelf Rockfish or Southern Deeper Shelf Rockfish complex.

2.3.4 *Slope Rockfish Alternative 3*

Table 8. Alternative 3 slope rockfish stocks and stock complexes (strikeout denotes a stock moving from a status quo category).

Slope Rockfish Stocks	Slope Rockfish Stock Complexes	
	N of $40^{0}10'$	**S of $40^{0}10'$**
	Slope RF	**Slope RF**
Overfished Stocks	~~Aurora~~	~~Aurora~~
Darkblotched	~~Bank~~ a/	~~Bank~~ b/
POP N of 40º10’	Blackgill	Blackgill
Non-overfished Stocks	Redbanded	~~POP~~ a/
Aurora	~~Rougheye~~	Redbanded
Longspine thornyhead N and S of 34º27'	Sharpchin	~~Rougheye~~
Rougheye N of $40^{0}10'$	Shortraker	Sharpchin
Shortspine thornyhead N and S of 34º27'	Splitnose	~~Shortraker~~ c/
Splitnose S of $40^{0}10'$	Yellowmouth	Yellowmouth

a/ Remove from complex since there is no or low presence.
b/ Move to Southern Shelf or Southern Deeper Shelf complex.
c/ Specify as an Ecosystem Component species.

2.4 Flatfish Alternatives

Flatfish stocks are currently managed with stock-specific harvest specifications or within the Other Flatfish complex. Flatfish alternatives contemplate adding two non-FMP species (slender sole and deepsea sole) into the FMP and the creation of two flatfish complexes into shallow and deeper species groups.

2.4.1 *Status Quo Flatfish Alternative*

There is one status quo flatfish stock complex comprised of unassessed species (Table 9).

Table 9. Status quo flatfish stocks and stock complex.

Flatfish Stocks	Flatfish Stock Complex: Other Flatfish
Overfished Stocks	Butter sole
Petrale sole	Curlfin sole
Non-overfished Stocks	Flathead sole
Arrowtooth flounder	Pacific sanddab
Dover sole	Rex sole
English sole	Rock sole
Starry flounder	Sand sole

2.4.2 *Flatfish Alternative 1*

Flatfish alternative 1 contemplates adding two non-FMP species (deepsea sole and slender sole) to the current Other Flatfish stock complex (Table 10).

Table 10. Alternative 1 flatfish stocks and stock complex (bold denotes non-FMP stocks proposed to be incorporated in the FMP).

Flatfish Stocks	Flatfish Stock Complex: Other Flatfish
Overfished Stocks	Butter sole
Petrale sole	Curlfin sole
Non-overfished Stocks	**Deepsea sole**
Arrowtooth flounder	Flathead sole
Dover sole	Pacific sanddab
English sole	Rex sole
Starry flounder	Rock sole
	Sand sole
	Slender sole

2.4.3 *Flatfish Alternative 2*

Flatfish alternative 2 contemplates adding two non-FMP species (deep sea sole and slender sole) to the FMP and creating two flatfish stock complexes defined by depth group (Table 11). Flatfish alternative 2 also would bring arrowtooth flounder into the Deep Flatfish stock complex as an indicator stock.

Table 11. Alternative 2 flatfish stocks and stock complexes (bold denotes non-FMP stocks incorporated in FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Flatfish Stocks	Flatfish Stock Complexes	
	Shallow Flatfish	**Deep Flatfish**
Overfished Stocks	Butter sole	Arrowtooth flounder
Petrale sole	Curlfin sole	**Deep sea sole**
Non-overfished Stocks	Flathead sole	Rex sole
Arrowtooth flounder	Pacific sanddab	
Dover sole	Rock sole	
English sole	Sand sole	
Starry flounder	**Slender sole**	

2.5 Cartilaginous Fish Alternatives

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing. All the action alternatives contemplate a complete restructuring of the status quo Other Fish complex since that aggregation of disparate stocks does not meet the purpose and need to manage stocks with similar distributions, similar fishery interactions, similar life histories, and similar vulnerabilities to potential overfishing. The cartilaginous fish are comprised of elasmobranch species (e.g., sharks and skates) and chimaeras (e.g., ratfish).

The cartilaginous fish alternatives contemplate managing cartilaginous fish either in separate skate and miscellaneous cartilaginous fish complexes (Alternatives 1 and 2) or together in aggregate complexes (Alternatives 3 and 4). Skates and the other miscellaneous cartilaginous fish species are further managed in shallow and deep groups (Alternatives 2 and 4).

The cartilaginous fish alternatives also offer consideration for specifying some of the component species as EC species (e.g., soupfin shark) or removing some stocks from the FMP (e.g., leopard shark). The alternatives also contemplate moving some species from stock-specific harvest management into a complex to serve as an indicator stock for managing the complex (e.g., longnose skate) and moving a stock from management in a complex to single stock management (e.g., spiny dogfish).

2.5.1 *Status Quo Cartilaginous Fish Alternative*

The cartilaginous fish stocks in the FMP, including those managed in the status quo Other Fish complex, are depicted in Table 12.

Table 12. Status quo cartilaginous fish stocks and stock complex.

Cartilaginous Fish Stocks	Cartilaginous Fish in the Other Fish Complex
Non-overfished Stocks Longnose skate	Big skate California skate Leopard shark Ratfish Soupfin shark Spiny dogfish

2.5.2 Cartilaginous Fish Alternative 1

Cartilaginous Fish alternative 1 contemplates eliminating the Other Fish complex and managing those stocks in two complexes (Skate and Miscellaneous Cartilaginous Fish) (Table 13). Alternative 1 also contemplates adding non-FMP species to the FMP (Aleutian skate, Bering/sandpaper skate, black/roughtail skate, and all other endemic skates to the Skates complex). Longnose skate would be added to the Skates complex as an indicator stock. All endemic skates other than Aleutian skate, Bering/sandpaper skate, big skate, black/roughtail skate, California skate, and longnose skate would be designated EC species. Soupfin shark would also be designated an EC species.

Table 13. Alternative 1 cartilaginous fish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Cartilaginous Fish Stocks	Cartilaginous Fish Stock Complexes		
	~~**Cartilaginous Fish in the Other Fish Complex**~~	**Skates**	**Misc. Cartilaginous Fish**
Non-overfished Stocks Longnose skate	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** **Bering/sandpaper skate** Big skate **Black/roughtail skate** California skate Longnose skate **All other skates**	Ratfish Spiny dogfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

2.5.3 Cartilaginous Fish Alternative 2

Cartilaginous Fish alternative 2 is the same as alternative 1, except the Skates complex is divided into two depth-based complexes (Shallow Skates and Deep Skates) (Table 14).

Table 14. Alternative 2 cartilaginous fish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Cartilaginous Fish Stocks	Cartilaginous Fish Stock Complexes			
	~~**Cartilaginous Fish in the Other Fish Complex**~~	**Shallow Skates**	**Deep Skates**	**Misc. Cartilaginous Fish**
Non-overfished Stocks Longnose skate	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** Big skate Longnose skate **All other skates**	**Bering/sandpaper skate** **Black/roughtail skate** California skate	Ratfish Spiny dogfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

2.5.4 Cartilaginous Fish Alternative 3

Cartilaginous Fish alternative 3 contemplates eliminating the Other Fish complex and managing those stocks in one Cartilaginous Fish complex (Table 15). Cartilaginous Fish alternative 3 also contemplates adding non-FMP species to the FMP (Aleutian skate, Bering/sandpaper skate, black/roughtail skate, all other endemic skates, and brown catshark to the Cartilaginous Fish complex). All endemic skates managed in the Cartilaginous Fish complex other than Aleutian skate, Bering/sandpaper skate, big skate, black/roughtail skate, and California skate would be designated EC species. Soupfin shark would also be designated an EC species. Spiny dogfish would be managed with stock-specific harvest specifications.

Table 15. Alternative 3 cartilaginous fish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex or vice versa, strikeout denotes a stock moving from a status quo category).

	Cartilaginous Fish Stock Complexes	
Cartilaginous Fish Stocks	**~~Cartilaginous Fish in the Other Fish Complex~~**	**Cartilaginous Fish**
Non-overfished Stocks Longnose skate Spiny dogfish	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** **Bering/sandpaper skate** Big skate **Black/roughtail skate** California skate **All other skates** **Brown catshark** Ratfish

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

2.5.5 Cartilaginous Fish Alternative 4

Cartilaginous Fish alternative 4 is the same as alternative 3, except the Cartilaginous Fish complex is divided into two depth-based complexes (Shallow Cartilaginous Fish and Deep Cartilaginous Fish) (Table 16).

Table 16. Alternative 4 cartilaginous fish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

	Stock Complexes		
Cartilaginous Fish Stocks	**~~Cartilaginous Fish in the Other Fish Complex~~**	**Shallow Cartilaginous Fish**	**Deep Cartilaginous Fish**
Non-overfished Stocks Longnose skate Spiny dogfish	~~Big skate~~ ~~California skate~~ ~~Leopard shark~~ a/ ~~Ratfish~~ ~~Soupfin shark~~ b/ ~~Spiny dogfish~~	**Aleutian skate** Big skate **All other skates** **Brown catshark** Ratfish	**Bering/sandpaper skate** **Black/roughtail skate** California skate

a/ Remove from FMP.
b/ Specify as an Ecosystem Component species.

2.6 Roundfish Alternatives

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing. All the action alternatives contemplate a complete restructuring of the status quo Other Fish complex since that aggregation of disparate stocks does not meet the purpose and need to manage stocks with similar distributions, similar fishery interactions, similar life histories, and similar vulnerabilities to potential overfishing.

The roundfish alternatives contemplate managing roundfish stocks in separate groups that vary by depth and vulnerability to potential overfishing. The roundfish alternatives also offer consideration for specifying some of the component species as EC species (e.g., finescale codling).

2.6.1 Status Quo Roundfish Alternative

The roundfish stocks in the FMP, including those managed in the status quo Other Fish complex, are depicted in Table 17.

Table 17. Status quo roundfish stocks and stock complex.

Roundfish Stocks	Roundfish in the Other Fish Complex
Non-overfished Stocks Cabezon (CA) Cabezon (OR) California scorpionfish Lingcod N and S of 40º10' Pacific cod Pacific whiting Sablefish N and S of 36º	Cabezon (WA) Finescale codling Kelp greenling Pacific grenadier

2.6.2 Roundfish Alternative 1

Roundfish alternative 1 contemplates eliminating the Other Fish complex and managing the component roundfish stocks in two complexes (Grenadiers and Nearshore Roundfish) (Table 18). Roundfish alternative 1 also contemplates adding non-FMP species to the FMP (giant grenadier and all other endemic grenadiers to the Grenadiers complex). All endemic grenadiers other than Pacific and giant grenadiers would be specified as EC species. Finescale codling would also be designated an EC species. The Oregon substock of cabezon would be added to the Nearshore Roundfish complex as an indicator stock.

Table 18. Alternative 1 roundfish stocks and stock complexes (bold denotes non-FMP stocks to be incorporated in the FMP, strikeout denotes a stock moving from a status quo category).

Roundfish Stocks	Roundfish Stock Complexes		
	~~Roundfish in the Other Fish Complex~~	**Grenadiers**	**Nearshore Roundfish**
Non-overfished Stocks Cabezon (CA) Cabezon (OR) California scorpionfish Lingcod N and S of 40º10' Pacific cod Pacific whiting Sablefish N and S of 36º	~~Cabezon (WA)~~ ~~California skate~~ ~~Finescale codling~~ a/ ~~Kelp greenling~~ ~~Pacific grenadier~~	Pacific grenadier **Giant grenadier** **All other grenadiers**	Cabezon (WA) Cabezon (OR) Kelp greenling **All other greenlings**

a/ Specify as Ecosystem Component species.

2.6.3 *Roundfish Alternative 2*

Roundfish alternative 2 contemplates eliminating the Other Fish complex and managing those stocks in two complexes (Nearshore Roundfish and Deep Roundfish) (Table 19). Roundfish alternative 2 also contemplates adding non-FMP species to the FMP (giant grenadier, all other endemic grenadiers, and California slickhead to the Deep Roundfish complex). Finescale codling would be managed in the Deep Roundfish complex. The California and Oregon substocks of cabezon and California scorpionfish would be added to the Nearshore Roundfish complex as indicator stocks. All endemic grenadiers other the Pacific and giant grenadiers would be designated EC species.

Table 19. Alternative 2 roundfish stocks and stock complexes (bold denotes non-FMP stocks proposed to be incorporated in the FMP, italics denotes stocks moving from stock-specific management to a complex, strikeout denotes a stock moving from a status quo category).

Roundfish Stocks	**Roundfish Stock Complexes**		
	~~Roundfish in the Other Fish Complex~~	**Nearshore Roundfish**	**Deep Roundfish**
Non-overfished Stocks Cabezon (CA) Cabezon (OR) California scorpionfish Lingcod N and S of 40º10' Pacific cod Pacific whiting Sablefish N and S of 36º	~~Cabezon (WA)~~ ~~California skate~~ ~~Finescale codling~~ ~~Kelp greenling~~ ~~Pacific grenadier~~	Cabezon (CA) Cabezon (OR) Cabezon (WA) California scorpionfish Kelp greenling **All other greenlings**	Pacific grenadier **Giant grenadier** **All other grenadiers** California slickhead Finescale codling

CHAPTER 3 AFFECTED ENVIRONMENT

3.1 Description of Affected Species

To be included later. Reference 2013 SAFE.

3.2 Description of Catch Accounting Systems Potentially Affected by Stock Complex Restructuring

The WCGOP places observers on trawl and fixed gear vessels at sea to sample the discarded portion of the catch at the species, not complex, level. Coverage rates vary by fishery, year, and area and are described by sector below. Species identification is not always possible due to the dynamic fishing environment. For example, rockfish may fall off a longline prior to observer sampling, in which case reporting would be aggregated to include several species (e.g., shortraker/rougheye) or the entire complex (e.g., slope rockfish).

Federal regulations require sorting prior to first weighing for all species with trip limits, HGs, or ACLs/OYs. All commercial landings are recorded on state fish landing receipts (hereinafter fish tickets). State fish tickets are completed and are uploaded to the Pacific Fisheries Information Network (PacFIN), a database managed by the Pacific States Marine Fisheries Commission (PSMFC). Commercial landings are uploaded to PacFIN monthly (Washington and Oregon) or bimonthly (California) approximately 2-3 months after the landing date. Additionally, vessels that participate in the shorebased IFQ fishery must also submit an electronic fish ticket. Landings are sorted and reported on electronic (shorebased IFQ only) or state fish tickets to the rockfish complex levels (i.e., nearshore, shelf, and slope rockfish north and south) with a few exceptions. Federal regulations require all commercial landings in California of blue rockfish, which is managed in the nearshore rockfish complexes north and south, to be sorted to species. Also, south of 40º10’ N lat., Federal limited entry and open access trip limits are specified for minor shallow and deeper nearshore rockfish. Therefore, nearshore rockfish landings must be reported to this level.

In some instances, state regulations may include additional reporting requirements. In California state regulations require catch accounting at the species level, not the complex level, and reported on the fish ticket (CDFG Code sections 8043 and 8045). In Oregon, state law requires sorting and reporting of the nearshore species catch and not an aggregate catch accounting at the complex level (see ORS 635-004-0033).

State port biologists sample commercial landings with coverage levels varying by state, port, month, etc. Port biologists collect biological data (e.g., length, weight, and age) as well as species composition of the market categories (i.e., which species comprise the complex or market category). Species composition samples are generally stratified by gear, port, quarter, market category, and area (INPFC areas).

The species composition data collected by port biologists are submitted to PacFIN as proportions that are used to distribute pounds of fish ticket market category landings to actual species. The proportions are derived as monthly or quarterly aggregates by area, gear, and port and are applied to the fish ticket market category landings in the PacFIN database.

State regulations also require logbooks for limited entry groundfish trawl vessels which include data on the start and haul locations, time of tow, duration of trawl tow, as well as the total catch for the species and complexes that have Federal sorting requirements. Additionally, Oregon state law requires fixed gear logbooks for vessels participating in the fixed gear fisheries (i.e., nearshore, non-nearshore, and shorebased IFQ under the gear switching provisions). These data are maintained in a state agency database and are available for use in management.

3.2.1 Shorebased IFQ Fishery

WCGOP observers collect species level discard data at sea from all vessels in the shorebased IFQ fishery. Currently, discard data is available inseason at the IFQ management unit level. Since quotas are issued at the stock complex level, inseason information on discards of the complexes are available, but not for the component stocks. Once data from 2011 are finalized, discard data from 2011 and landed catch from the 2012 fishing year can be used inseason to estimate total mortality.

When the catch is offloaded, catch monitors verify the sorting and weighing of IFQ species at the IFQ management unit level. Since quotas are issued at the stock complex level, no information on the component stocks is provided on the electronic fish ticket. Landings data are reported via electronic fish ticket and are available 24 hours after offload.

State fish tickets are also completed and are uploaded to PacFIN monthly (Washington and Oregon) or bimonthly (California) approximately 2-3 months after the landing date. Generally, species are reported at the complex level unless state law dictates otherwise (see above discussion) or if there is a noteworthy difference in price.

State port biologists sample commercial landings with coverage levels varying by state, port, month, etc. Port biologists collect information that informs the species composition of the complexes (i.e., which species comprise the complex and in what proportion). The species composition data collected by port biologists are submitted to PacFIN as proportions that are used to distribute pounds of fish ticket market category landings to actual species. The proportions are derived as monthly or quarterly aggregates by area, gear, and port and are applied to the fish ticket market category landings in the PacFIN database.

Landings estimates, derived from the species composition samples collected by the state port biologists, for component species are available through the PacFIN database for inseason reporting, even though the estimates are not currently reported on the publically available QSM reports. Species-specific discard data from WCGOP are publically available on a one year lag and could be used to estimate discard inseason.

3.2.2 At-Sea Whiting

At-sea whiting vessels (motherships and catcher-processors) operate north of 40º10’ N lat. and have 100 percent observer coverage. Observers sample unsorted catch to determine species composition of the individual hauls (in contrast to WCGOP observers who sample sorted catch and focus on the discarded portion). Some observations are whole-haul samples (a census) while others are partial-haul samples (i.e., a portion of the haul is randomly sub-sampled). Generally, the samples are a large proportion of each haul (30 percent or more of an individual haul) with nearly 100 percent of all hauls being sampled. Currently, data are aggregated at the complex level for inseason reporting; however, species level data at the haul level are available in the NORPAC database.

3.2.3 Non-Trawl Commercial Fisheries

A portion of the non-trawl commercial fisheries are observed at sea by the WCGOP. Between 2006 and 2012, 9-43 percent of all limited entry sablefish fixed gear landings, 4 -15 percent of all non-sablefish limited entry fixed gear landings, and 1-4 percent of all open access landings were observed by the WCGOP (see data at http://www.nwfsc.noaa.gov/research/divisions/fram/observer/sector_products.cfm). The WCGOP sampling priority is on the discarded portion of the catch and data is reported at the species level, when possible.

Federal regulations require landings to be sorted and reported on state fish tickets to the rockfish complex levels (i.e., nearshore, shelf, and slope rockfish complexes north and south) with the few exceptions mentioned above. Fish tickets are submitted to the state and are uploaded to PacFIN monthly (Washington and Oregon) or bimonthly (California) approximately 2-3 months after the landing date. Species composition data collected by port biologists are submitted to PacFIN as proportions that are used to distribute pounds of fish ticket market category landings to actual species. The proportions are derived as monthly or quarterly aggregates by area, gear and port and are applied to the fish ticket market category catch values in the PacFIN database.

Landings estimates, derived from the species composition samples collected by the state port biologists, for component species are available through the PacFIN database for inseason reporting, even though the estimates are not currently reported on the publically available QSM reports. Species-specific discard data from WCGOP are publically available with a one year lag and can be used to estimate discard inseason.

3.2.4 Recreational

In the recreational fisheries, data on released and landed fish are provided at the species level (not complex level). Coverage (or observation) levels vary by state, port, month, etc. Recreational samplers collect biological data (e.g., length, weight, age) on landed catch as well as record angler reported estimates of discard. These data are reported to the Recreational Fisheries Information Network (RecFIN), a database managed by the PSMFC. Recreational catches are available on RecFIN on a two-month lag. Additionally, publically available reports are available on the RecFIN website to enable inseason tracking of species with an ACL as well as component species comprising stock complexes. Mortality estimates for all component species comprising the nearshore complexes and some species in the slope complexes are available inseason for Council consideration.

CHAPTER 4 EFFECTS OF THE ALTERNATIVES

4.1 Overview of the Analyses

The Groundfish Management Team (GMT) scored the relative productivity and susceptibility of species to being caught in the fishery in a Productivity and Susceptibility Assessment (PSA) to score their relative vulnerability to potential overfishing (PFMC and NMFS 2012). Productivity and vulnerability scores from the GMT PSA analysis are used in the analysis of effects of managing FMP stocks in alternative stock complexes.

Some of the stocks managed in the status quo complexes have been subject to apparent overfishing. The term "apparent overfishing" is used since overfishing is actually exceeding an OFL set for the complex; the context for "apparent overfishing" is when the OFL contribution of a component stock is exceeded. Occasionally exceeding a component stock's OFL contribution, especially by a small magnitude, may not be a conservation concern, especially for long-lived stocks (e.g., slope rockfish). In the analyses presented in this chapter, a longer term (2003-2011) evaluation of catches against contributing OFL values is provided.

The West Coast Groundfish Observer Program also developed a database (2003-2011) and the GMT developed an analysis using that database of annual removal data to evaluate a component stock's catch contribution to an OFL estimate for a stock complex. While there is concern for component stocks that contribute an inordinately larger catch contribution to the complex (i.e., inflator stocks), this concern is accentuated when there is high interannual variation in those catches. The presence of inflator stocks in a complex can risk overfishing of other stocks in the complex since it inflates the complex OFL. This is especially concerning for those stocks in the complex with high vulnerability to overfishing. The GMT analysis of catch data probes those effects for proposed alternative stock complexes. Two important concepts are the scale of removals and the ratio of stock removal to overall stock complex removals. An ideal stock complex would a) avoid removals above any component OFLs; b) not have large scale differences in the OFL components; therefore, allowing for potential overages; and c) if large scale differences are apparent, consistent removal ratios indicating a consistent contribution of catches to the complex is desired. The GMT identified several removal-based metrics to help evaluate these standards for status quo and proposed alternative complexes:

> *Maximum and minimum cumulative removals of the status quo alternative.* These measures evaluate scale and are calculated as differences between stock-specific cumulative removals for years 2003-2011 and the sum of component OFLs (assumed at the 2013 OFL value in each year). Large maximum values indicate the complex has allowed overfishing relative to the 2013 OFL. Large minimum values indicate "inflator species"— species that add a large amount of latent component OFL that could be applied to other species in the complex. Both of these are indicators that a complex is misaligned as far as catch being applied to component species. For each complex, one is looking for low maximum and minimum values.

Evenness. Evenness is another measure of scale that quantifies the inequality/imbalance among the component OFLs in a given stock complex. Pielou's measure of evenness (Jost 2010) was used and is calculated as H'/ln(S) where H' is Shannon-Weiner diversity index (Krebs 1999) and S is the number of stocks in the complex. A value of 1 indicates every stock contributes equally; a value of 0 means one stock contributes everything. Evenness is reported for annual catches (with the median value over all years reported) and for the 2013 OFL. Values closest to 1 are desired.

Slope of removal ratios. This measure looks at how many stocks demonstrate non-significant trends in the slope of stock catch/total complex catch for each year. A simple linear model is used to fit the time series of removal ratios, with a conservative p-value < 0.1 indicating slopes significantly different than 0. The number of stocks with slope non-significantly different than 0 are reported, so values closest to 1 (1 meaning all stocks in a complex have constant removal ratios) is desired.

The analysis of effects also considers how alternative stock complexes may interact with the management system and the fisheries by sector. There are formal allocations for some of these species which has a direct effect on how well the rationalized trawl sectors and other sectors of the groundfish fishery are managed to accomplish the conservation and socioeconomic objectives of the MSA and FMP.

Co-occurrence of affected stocks by depth and latitude is inferred from survey distributions (e.g., the AFSC survey distribution of slope rockfish, Figure 5). More importantly for the actions contemplated in this analysis, co-occurrence of affected stocks by depth and latitude in the fishery is inferred by determining the relative CPUE of stocks in fishing efforts by sector (e.g., the relative CPUE of slope rockfish in the bottom trawl fishery, Figure 12). The relative CPUEs of stocks in the fishery were determined by analyzing haul level catch data (discards from the WCGOP matched with landings from fish tickets and, in the case of bottom trawl, trawl log books). Further detail on these methods can be found in the June, 2013 GMT report to the Council (Agenda Item F.8.b, GMT Report).

4.1.1 Socioeconomic Impacts

4.1.1.1 **Fisherman and Processors**

Under the action alternatives, processors (and most likely fishermen) would be required to sort and report more species than under no action prior to first weighing, after offloading. Failure to sort these species correctly is subject to enforcement under both Federal and state regulations. The requirement "prior to the first weighing after offloading" allows vessels and buyers some flexibility in whether fish are sorted onboard the vessel or during offloading. Despite this flexibility, the sorting requirement would be expected to increase the existing workload and reporting requirements for fishery participants. Circumstances differ between vessels and buying and processing facilities and so would affect individuals and businesses to different degrees. Some vessels may have more ability to sort and store fish into more categories onboard than others. Many vessels will not sort the catch completely until the time of delivery.

Operations at most processing facilities involve sorting based on visual inspection of large volumes of fish on a fast moving sorting belt. Accurate rockfish identification can require the handling and deliberate examination of individual fish. Adding additional stocks to the sorting requirement would be expected to increase the number of fish needing examination and increase the overall time needed for sorting. Such increased handling may result in decreased product value and delays in processing operations could reduce the overall profitability of the offload. These potential impacts to fish buyers and processors cannot be quantified with available information.

4.1.1.2 **Management Agencies**

There is no impact to the WCGOP since observers currently strive to identify all discarded catch to the species and not complex level. The impact of a sorting requirement to the catch monitor program is anticipated to be minimal under the action alternatives. Catch monitor and program staff duties would include outreach to processors (i.e., first receivers) and enhanced species identification training to enable species identification under the action alternatives.

Under the action alternatives, Federal and state groundfish programs may need to invest time and money into outreach programs to increase the accuracy of species identification within the processing community. Increased enforcement may also be necessary to ensure accurate sorting for use in management. For example, current state regulations in California require landings to be reported at the species, not complex level. However, from 2005-2011, an average of 13 percent of the fish tickets reported data at the complex level, instead of the species level. In recent years (2009-2011), the average has declined to 9 percent. From 2005-2011, an average of 40 percent of dealers reported data at the complex level, instead of the species level. In recent years (2009-2011), that average has declined to 31 percent. However, the most commonly reported category is slope rockfish. Historically, given the large number of species landed, the priority was to enforce sorting at the Federal level (i.e., species with an ACL or trip limit) with a secondary priority for enforcing the state sorting requirements (i.e., all species). Enforcement priorities could be modified under both the No Action and the action alternatives. The costs of outreach and enforcement efforts are expected to be minimal to moderate.

Modifications to the electronic fish ticket and the state landing receipt databases would need to accommodate species-specific reporting under some of the action alternatives. For example, Slope Rockfish Alternative 3 contemplates managing aurora rockfish (coastwide) and rougheye rockfish north of 40º10’ N lat. with species-specific harvest specifications. Currently, Oregon has species codes for aurora and rougheye rockfish. California would need to add codes for rougheye for those landings that occur north of 40º10’ N lat. Washington would need to add codes for both species. Codes for these species are used in each state already as part of the port sampling programs and the species composition data that is uploaded to the PacFIN database. The burden of adding new codes should be minimal.

Some of the affected stocks are scheduled for assessment this year, either as full assessments (aurora rockfish, rougheye rockfish, and Pacific Sanddabs) or as data-moderate assessments (brown rockfish, China rockfish, copper rockfish, English sole, rex sole, sharpchin rockfish, stripetail rockfish, vermilion rockfish, and yellowtail rockfish). These stocks are all managed in status quo stock complexes with the exception of English sole and yellowtail rockfish north of 40º10' N lat., which are managed with stock-specific harvest specifications. The Council's final preferred alternative for stock complexes could affect management of these stocks in one of three ways: 1) continue management using status quo aggregations in stock complexes, 2) move one or more of these stocks from a status quo complex to a new, reorganized complex, or 3) move one or more of these stocks out of a status quo complex to be managed with stock-specific harvest specifications. Each of these options has different management implications that are explored in this document.

4.2 Effects of the Alternatives by Species Group

4.2.1 Nearshore Rockfish

Table 20. Nearshore rockfish stocks ranked by relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Kelp rockfish	1.94	High	1.59	Low
Black-and-yellow rockfish	1.89	High	1.7	Low
Olive rockfish	1.69	High	1.87	Med
Treefish rockfish	1.67	High	1.73	Low
Brown rockfish	1.61	High	1.99	Med
Grass rockfish	1.61	High	1.89	Med
Gopher rockfish	1.56	High	1.76	Low
Blue rockfish	1.39	Low	2.01	High
Copper rockfish	1.36	Low	2.27	Highest
Honeycomb rockfish	1.36	Low	1.97	Med
Black rockfish	1.33	Low	1.94	Med
China rockfish	1.33	Low	2.23	Highest
Quillback rockfish	1.31	Low	2.22	Highest

4.2.1.1 **Nearshore Rockfish North of 40º10' N lat.**

The catch histories of species in the status quo Minor Nearshore Rockfish North complex does not show problematic component OFL overages (Table 21), but does indicate the presence of an inflator stock. Blue rockfish is the inflator stock in the Minor Nearshore Rockfish North complex, which presents an overfishing risk for the more vulnerable stocks in the complex (i.e., China, copper, and quillback rockfish) (Figure 1). The OFL evenness is improved in the status quo complex by simply removing the species from the complex that have no or low presence north of 40º10' N lat. or are proposed for an EC species designation (Table 2 and Table 21). Alternative 1 shows a trade-off between greatly improving evenness and removal ratios for vulnerable species, while decreasing the performance of these measures in the non-vulnerable complex. Taking this species out of this complex would greatly improve complex evenness and removal ratios. Managing blue rockfish with stock-specific harvest specifications would also reduce risk of overfishing the stock which has a relatively high vulnerability. Blue rockfish has the fourth highest vulnerability score in the status quo complex behind China, copper, and quillback rockfish. Another alternative not explored in this analysis would be adding blue rockfish to the Vulnerable Northern Nearshore Rockfish Complex as described under Alternative 1. However, it would still be an inflator stock in the vulnerable complex if it were managed there and would create a greater risk of overfishing the other vulnerable species.

4.2.1.2 Nearshore Rockfish South of 40º10' N lat.

The catch histories of species in the status quo Minor Nearshore Rockfish South complex do not show problematic component OFL overages (Table 21), but does indicate the presence of inflator stocks (gopher, blue, brown, copper, and olive rockfish) (Figure 2). None of the evenness metrics are improved in the status quo complex by simply removing the species from the complex that have no or low presence north of 40º10' N lat. or are proposed for an EC species designation (Table 2 and Table 21). Overall, alternative 1 provides the best improvement in evenness and removal ratios, while taking into consideration better management of vulnerable species.

Table 21. Summary of status quo (SQ) and proposed nearshore rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
Nearshore North	SQ	-	2	-262	0.56	0.59	0.56
	SQ - EC spp.	-	1	-262	0.63	0.66	0.57
	Alt. 1	+			0.18	0.25	0.25
	Alt. 1 V	+			0.98	0.88	0.67
Nearshore South	SQ	-	0	-2340	0.74	0.80	0.67
	SQ - EC spp.	-	0	-2340	0.74	0.80	0.67
	Alt. 1	+			0.79	0.84	0.50
	Atl. 1 V	+			0.78	0.44	1.00

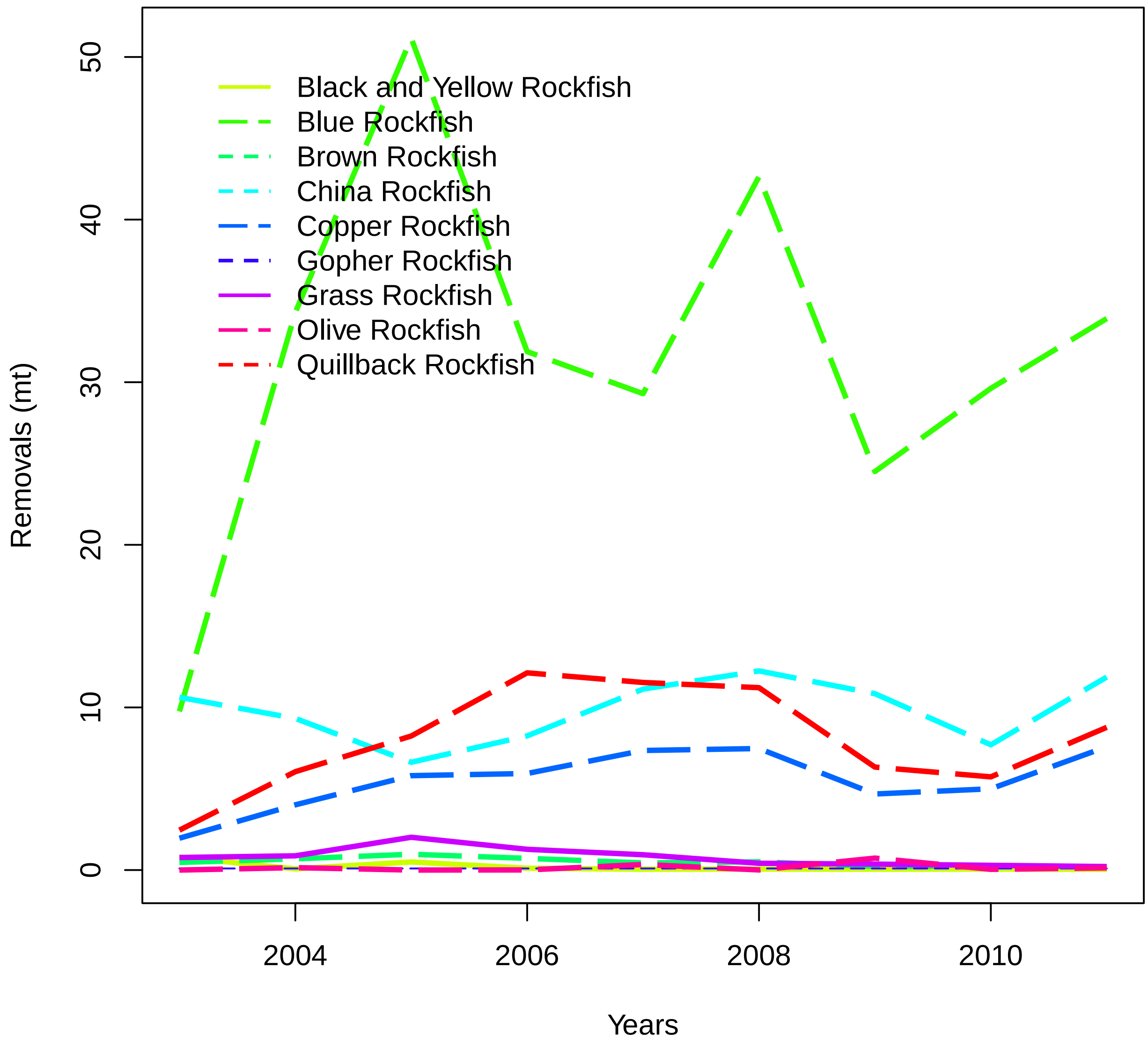

Figure 1. Annual total mortality (minus research catches) of nearshore rockfish stocks in the Minor Nearshore Rockfish North stock complex, 2003-2011.

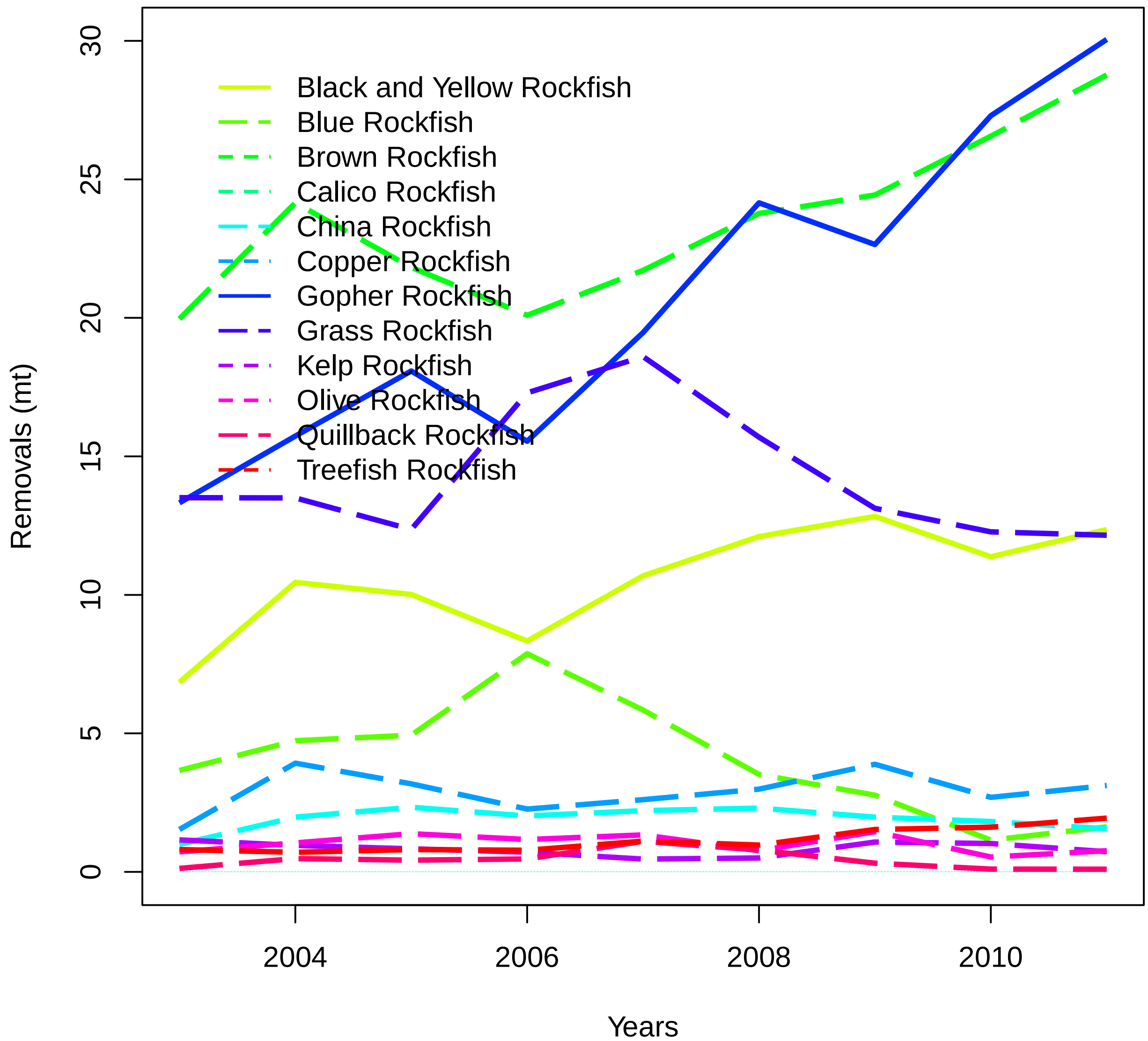

Figure 2. Annual total mortality (minus research catches) of nearshore rockfish stocks in the Minor Nearshore Rockfish South stock complex, 2003-2011.

4.2.1.3 **Historical Catch By Sector**

To be completed.

4.2.1.4 **Management Measures and Inseason Response**

The limited entry and open access FMP allocations[1] for nearshore rockfish are suspended due to overfished species constraints. The nearshore rockfish complexes are managed by the west coast states.[2] California and Oregon implement commercial and recreational allocations through state regulations.

Management measures that control nearshore rockfish landings in the trawl sector include trip limits for the shorebased IFQ fishery. Additionally, Oregon and California state regulations limit the amount of nearshore rockfish that can be landed without a state-issued nearshore permit. Generally, vessels with a limited entry trawl permit do not also have a state nearshore permit. Additionally, few nearshore rockfish have been historically landed by the trawl sector (Table X – to be completed). The at-sea sectors typically do not encounter nearshore species; therefore, no management measures affecting nearshore species are designed for this sector (Table X – to be completed).

In the non-trawl commercial sectors, the primary management measures that control nearshore rockfish mortality are trip limits for the limited entry and open access fixed gear fleets. Adjustments to the non-trawl RCA boundaries are also available and may be effective at controlling nearshore rockfish mortality; however, the shoreward adjustments may need to be extensive which could potentially close entire areas to fishing. Groundfish conservation areas (e.g., nearshore MPAs off California) may also be effective for reducing nearshore rockfish catch.

Recreational management measures to control catch of nearshore rockfish include adjustments to bag limits, season lengths, and depth-based closures. Groundfish conservation areas (e.g., nearshore MPAs off California) may also be effective for reducing nearshore rockfish catch.

Discussion by alternative to be completed.

[1] Nearshore species were not subject to trawl and non-trawl allocations since the majority of catch is in the non-trawl sector (i.e., trawl sector catches were low enough that formal allocations and issuance of IFQ was unnecessary).
[2] Washington does not allow commercial fishing in its territorial waters.

4.2.2 Shelf Rockfish

Table 22. Shallow shelf rockfish stocks ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Halfbanded rockfish	2	High	1.26	Low
Dwarf-red rockfish	1.83	High	1.54	Low
Chilipepper	1.83	High	1.35	Low
Freckled rockfish	1.78	High	1.44	Low
Pygmy rockfish	1.78	High	1.42	Low
Calico rockfish	1.75	High	1.46	Low
Rosy rockfish	1.61	High	1.89	Med
Squarespot rockfish	1.61	High	1.86	Med
Greenspotted rockfish	1.39	Low	1.98	Med
Speckled rockfish	1.33	Low	2.1	High
Flag rockfish	1.33	Low	1.97	Med
Swordspine rockfish	1.33	Low	1.94	Med
Yellowtail rockfish	1.33	Low	1.88	Med
Canary rockfish	1.28	Low	2.01	High
Starry rockfish	1.25	Low	2.09	High
Vermilion rockfish	1.22	Low	2.05	High
Yelloweye rockfish	1.22	Low	2	High

Table 23. Deeper shelf rockfish stocks ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Shortbelly rockfish	1.94	High	1.13	Low
Puget Sound rockfish	1.89	High	1.35	Low
Mexican rockfish	1.5	High	1.8	Low
Chameleon rockfish	1.39	Low	2.03	High
Darkblotched rockfish	1.39	Low	1.92	Med
Stripetail rockfish	1.39	Low	1.8	Low
Sharpchin rockfish	1.36	Low	2.05	High
Pink rockfish	1.33	Low	2.02	High
Harlequin rockfish	1.31	Low	1.94	Med
Pinkrose rockfish	1.31	Low	1.82	Med
Redstripe Rockfish	1.31	Low	2.16	High
Widow rockfish	1.31	Low	2.05	High
Bocaccio	1.28	Low	1.93	Med
Dusky rockfish	1.28	Low	1.99	Med
Greenblotched rockfish	1.28	Low	2.12	High
Greenstriped rockfish	1.28	Low	1.88	Med
Bank rockfish	1.25	Low	2.02	High
Tiger rockfish	1.25	Low	2.06	High
Bronzespotted rockfish	1.22	Low	2.12	High
Silvergray rockfish	1.22	Low	2.02	High
Rosethorn rockfish	1.19	Low	2.09	High
Cowcod	1.06	Low	2.13	High

4.2.2.1 **Shelf Rockfish North of 40º10’ N lat.**

The catch histories of species in the status quo Minor Shelf Rockfish North complex do not show problematic component OFL overages (Table 24), but does indicate the presence of a huge inflator stock (greenstriped rockfish) (Figure 3). Evenness is improved in the status quo complex by simply removing the species from the complex that have no or low presence north of 40º10’ N lat. or are proposed for an EC species designation (Table 4 and Table 24). The Alternative 1 Deep Shelf complex improves evenness and removal ratios while also aligning better with vulnerability scores, but at the expense of the Shallow Shelf complex, which shows decreased improvement in all measures because chilipepper is the overwhelming contributor to that complex.

4.2.2.2 **Shelf Rockfish South of 40º10’ N lat.**

The catch histories of species in the status quo Minor Shelf Rockfish South complex do not show problematic component OFL overages (Table 24), but does indicate the presence of a huge inflator stock (yellowtail rockfish) (Figure 4). The removal of the proposed EC stocks from the status quo complex improves all removal-based diagnostics (Table 24). Improvement in OFL evenness and removal ratios are also seen under Alternative 1, although status quo minus the EC stocks seems to give the best overall improvement.

Alternative 1 (both north and south) is structured to consider a further stratification of rockfish complexes by depth. The further depth stratification of the current shelf rockfish complexes into Shallow Shelf and Deeper Shelf complexes might better align the shelf rockfish complexes with the current fishery. Under Rockfish Conservation Area (RCA) management, fisheries are somewhat segregated into nearshore effort shoreward of the RCA and deeper efforts seaward of the RCA. The species aggregated in the Shallow Shelf Rockfish complex are primarily caught in nearshore fisheries (e.g., recreational, nearshore commercial, and shallow "beach" trawl efforts) in association with many of the nearshore rockfish species. In this regard, it might make sense to manage nearshore and shallow shelf rockfish in a combined complex; however, this is not proposed since it may disrupt the California and Oregon state limited entry systems and allocations in place for nearshore fisheries. The species aggregated in the Deeper Shelf complex are primarily caught in deep water fisheries such as those targeting sablefish in fixed gear fisheries and trawl efforts targeting Dover sole, thornyheads, and sablefish (DTS) species. The species in the Deeper Shelf complex are often caught in association with slope rockfish in deep water fisheries along the shelf-slope break. An alternative that combines the Deeper Shelf and Slope complexes was not proposed. The harvestable surplus of the slope rockfish complexes are formally allocated with long-term sector allocations, while the shelf rockfish complexes are not (sector allocations are made every two years in the biennial process). Combining these assemblages of species may pose some allocation challenges since the Amendment 21 allocations for slope rockfish are significantly different than the 2013-14 allocations for shelf rockfish.

Table 24. Summary of status quo (SQ) and proposed shelf rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$\text{Removals}_{\text{median}}$	OFL	%Slope = 0
Shelf North	SQ	-	0	-10841	0.53	0.45	0.83
	SQ - EC spp.	-			0.65	0.53	0.77
	Alt. 1 shallow	-			0.34	0.20	0.33
	Alt. 1 deep	+			0.70	0.60	0.86
Shelf South	SQ	-	1	-11218	0.46	0.48	0.80
	SQ - EC spp.	-			0.50	0.51	0.88
	Alt. 1 shallow	-			0.39	0.54	0.86
	Alt. 1 deep	+			0.17	0.40	1.00

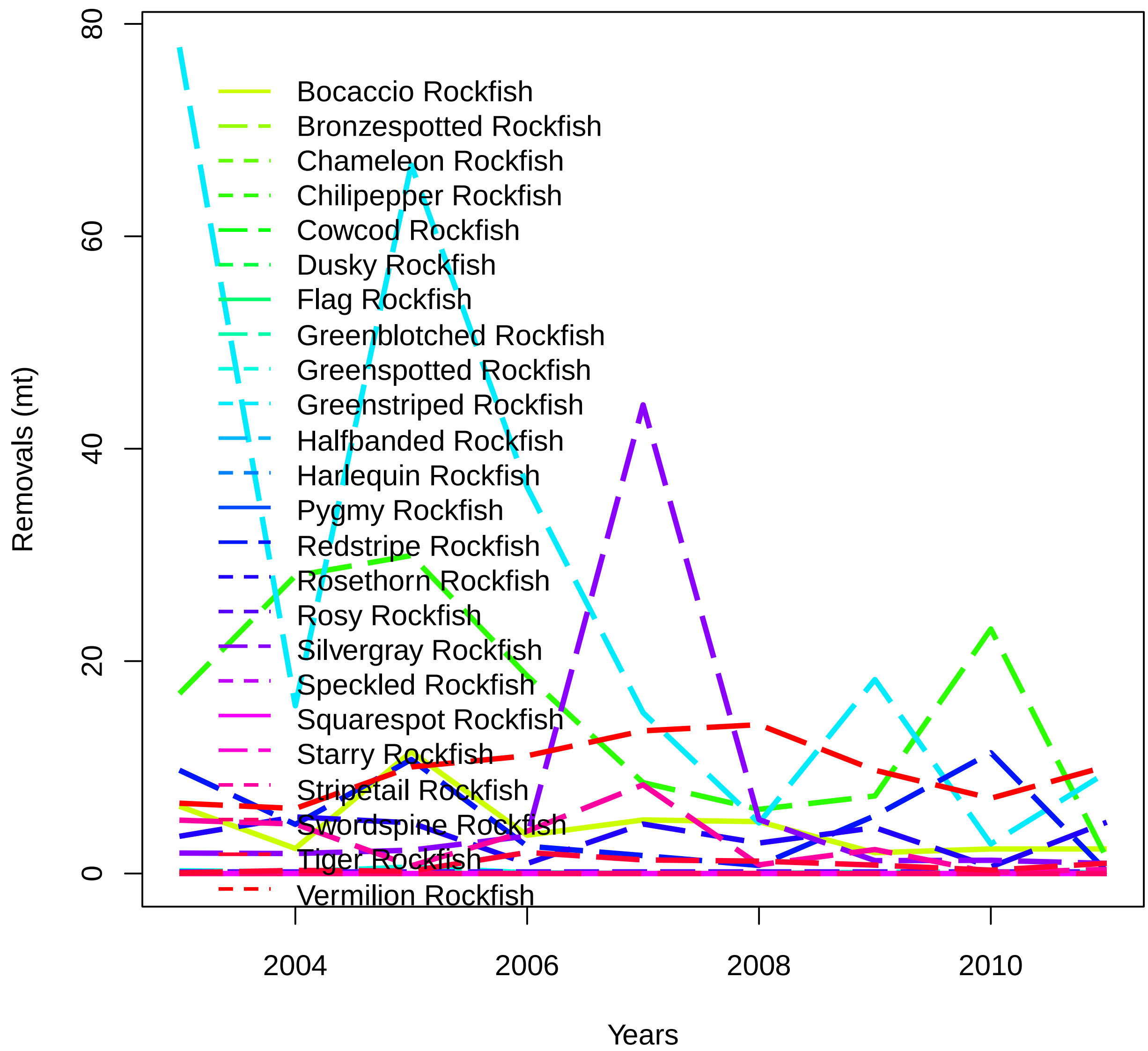

Figure 3. Annual total mortality (minus research catches) of shelf rockfish stocks in the Minor Shelf Rockfish North stock complex, 2003-2011.

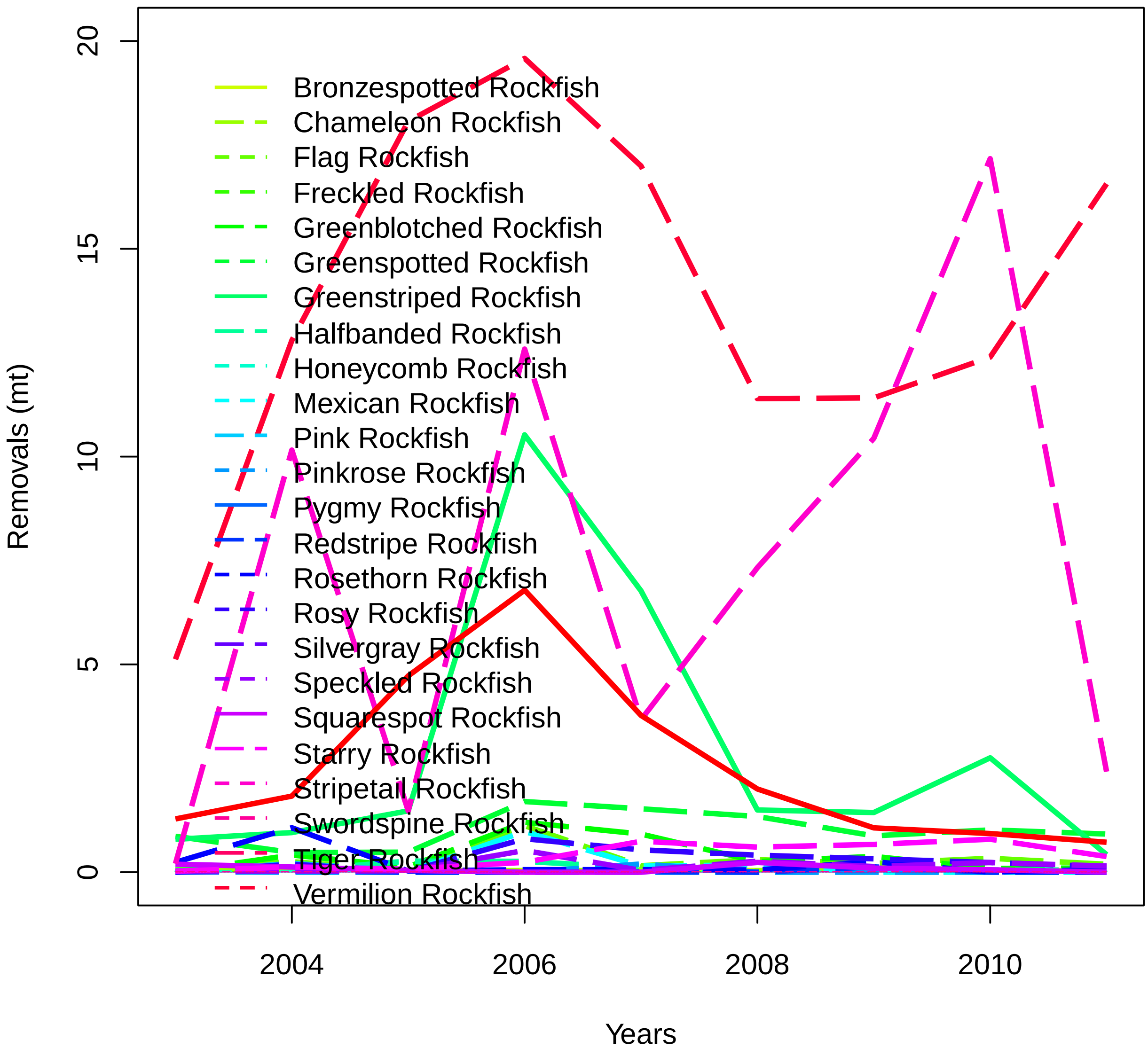

Figure 4. Annual total mortality (minus research catches) of shelf rockfish stocks in the Minor Shelf Rockfish South stock complex, 2003-2011.

4.2.2.3 **Historical Catch By Sector**

Historical catch by sector is provided in Table X (To be completed).

4.2.2.4 **Management Measures and Inseason Response**

The limited entry and open access FMP allocations for shelf rockfish are suspended due to overfished species constraints since access is limited by the RCAs and the need to limit overfished species catches. In 2013-2014, a two-year trawl and non-trawl allocation was established. The northern shelf rockfish fishery HG was allocated 60.2 percent to trawl and 39.8

percent to non-trawl for both years. The southern shelf rockfish fishery HG was allocated 12.2 percent to trawl and 87.8 percent to non-trawl for both years. These percentages are based on the average mortality of shelf rockfish north and south of 40º10’ N lat. from 2005-2008.

Management measures that control shelf rockfish mortality in the trawl sectors include individual fishing quota (IFQ) for the shorebased IFQ fishery and co-op management for the at-sea sectors (catcher-processors and motherships). In the non-trawl sectors, the primary management measure that controls shelf rockfish landings are bimonthly cumulative limits (hereinafter trip limits) for the limited entry and open access fixed gear fleets. RCAs are also available for both sectors which are effective at controlling shelf rockfish mortality (Figure X – to be completed). Shelf rockfish are also included in the recreational bag limits for the three states; however, they are currently not the most common target in recreational fisheries.

4.2.3 Slope Rockfish

The slope rockfish complexes contain species with different relative vulnerabilities to overfishing, including two species with the highest vulnerabilities scored (rougheye and shortraker rockfish) and two species with very high vulnerabilities (aurora and blackgill rockfish) (Table 25).

Table 25. Slope rockfish stocks ranked by relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Stock	P	Relative P	V	Relative V
Yellowmouth rockfish	1.61	High	1.96	Med
Longspine Thornyhead	1.47	High	1.54	Low
Pacific ocean perch	1.44	High	1.69	Low
Aurora rockfish	1.33	Low	2.1	High
Shortspine thornyhead	1.33	Low	1.8	Low
Redbanded Rockfish	1.28	Low	2.02	High
Splitnose rockfish	1.28	Low	1.82	Med
Blackgill rockfish	1.22	Low	2.08	High
Shortraker rockfish	1.22	Low	2.25	Highest
Blackspotted rockfish	1.17	Low	1.97	Med
Rougheye rockfish	1.17	Low	2.27	Highest

Some of the slope rockfish managed in the status quo complexes have been subject to apparent overfishing. Occasionally exceeding a component stock's OFL contribution, especially by a small magnitude, is not a conservation concern for the long-lived slope rockfish stocks. It is also not a concern from apparent overfishing if the component stock is a very minor component of a complex due to a low presence and catch contribution in the management area. Rougheye and shortraker rockfish south of 40°10' N lat. and blackgill rockfish north of 40°10' N lat. are examples of minor component stocks in the management area (Figure 5). In some cases, the alternative may be to remove the stock from the complex or designate the stock as an EC stock (e.g., shortraker south of 40°10' N lat.). However, there is a concern for some of the component stocks that are significant components to a complex in terms of catch and OFL contribution due to high vulnerability to overfishing and chronic apparent overfishing (e.g., rougheye rockfish north of 40°10' N lat.).

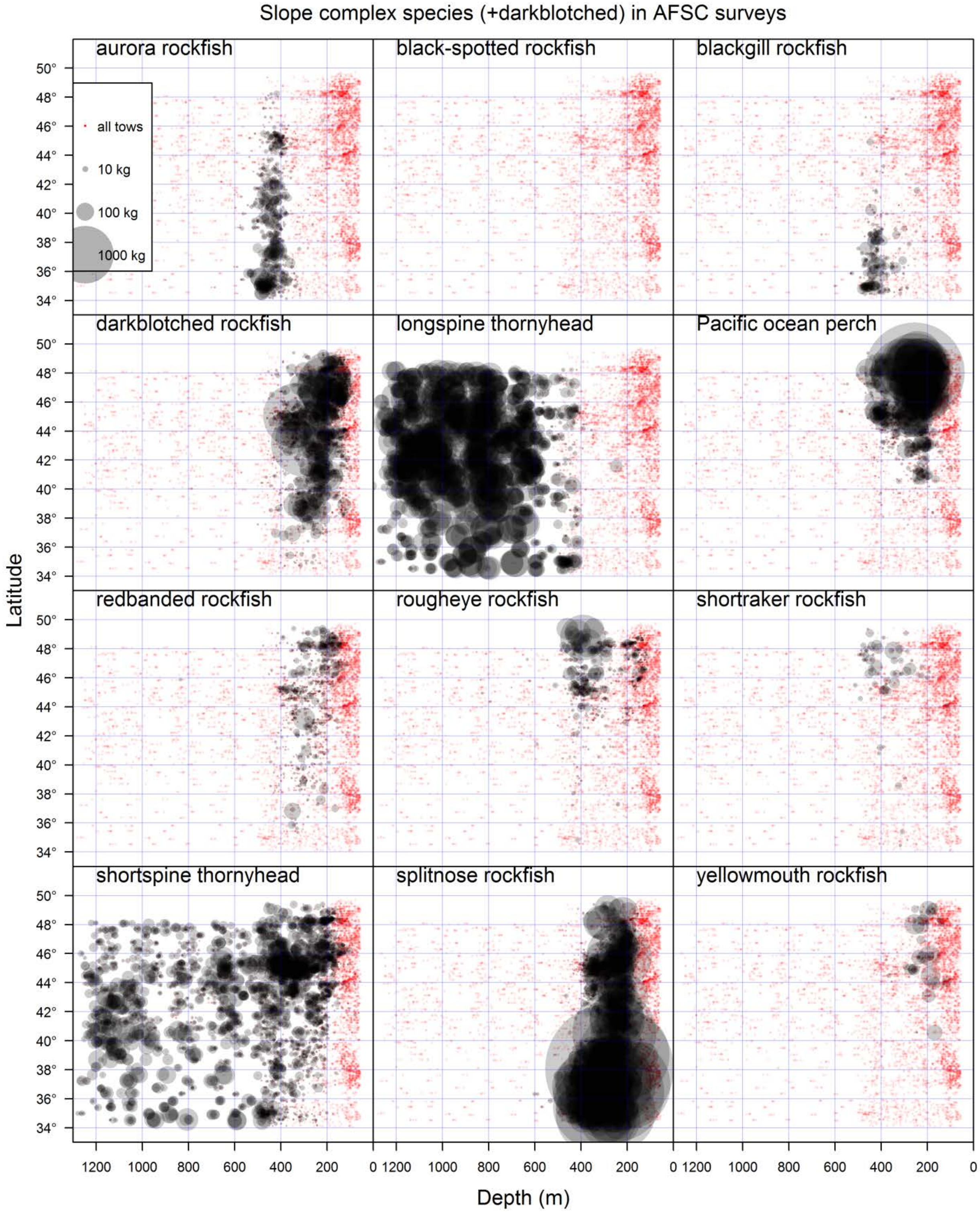

Figure 5. Distribution of west coast slope rockfish species as determined by CPUE (catch/tow) in the Alaska Fisheries Science Center survey.

4.2.3.1 **Slope Rockfish North of 40º10’ N lat.**

The catch histories of species in the status quo Minor Slope Rockfish North complex indicate big concerns in both OFL overages (e.g., rougheye rockfish) (Table 26) and inflator species (e.g., rougheye and splitnose rockfish) (Figure 6). Rougheye rockfish catches have chronically exceeded the contribution OFL with a median catch in 2003-2011 of 98.7 mt over the stock’s contribution OFL (Figure 7). It is noted that rougheye rockfish will be assessed for the first time in 2013 and there may be consideration for removing the stock from the complex and managing it with its own harvest specifications as is contemplated under Alternative 3. Shortraker rockfish, a highly vulnerable stock like rougheye, has also had catches greater than the stock’s OFL contribution in recent years; however, the cumulative catch in that period did not exceed the cumulative OFL contribution (Figure 8). Blackgill rockfish catches north of 40º10’ N lat. have also exceeded its contribution OFL (Figure 9); however, this is a minor stock in the northern slope rockfish complex and is less of a concern (Figure 5). None of the other stocks managed in the northern slope rockfish complex have exceeded their OFL contribution.

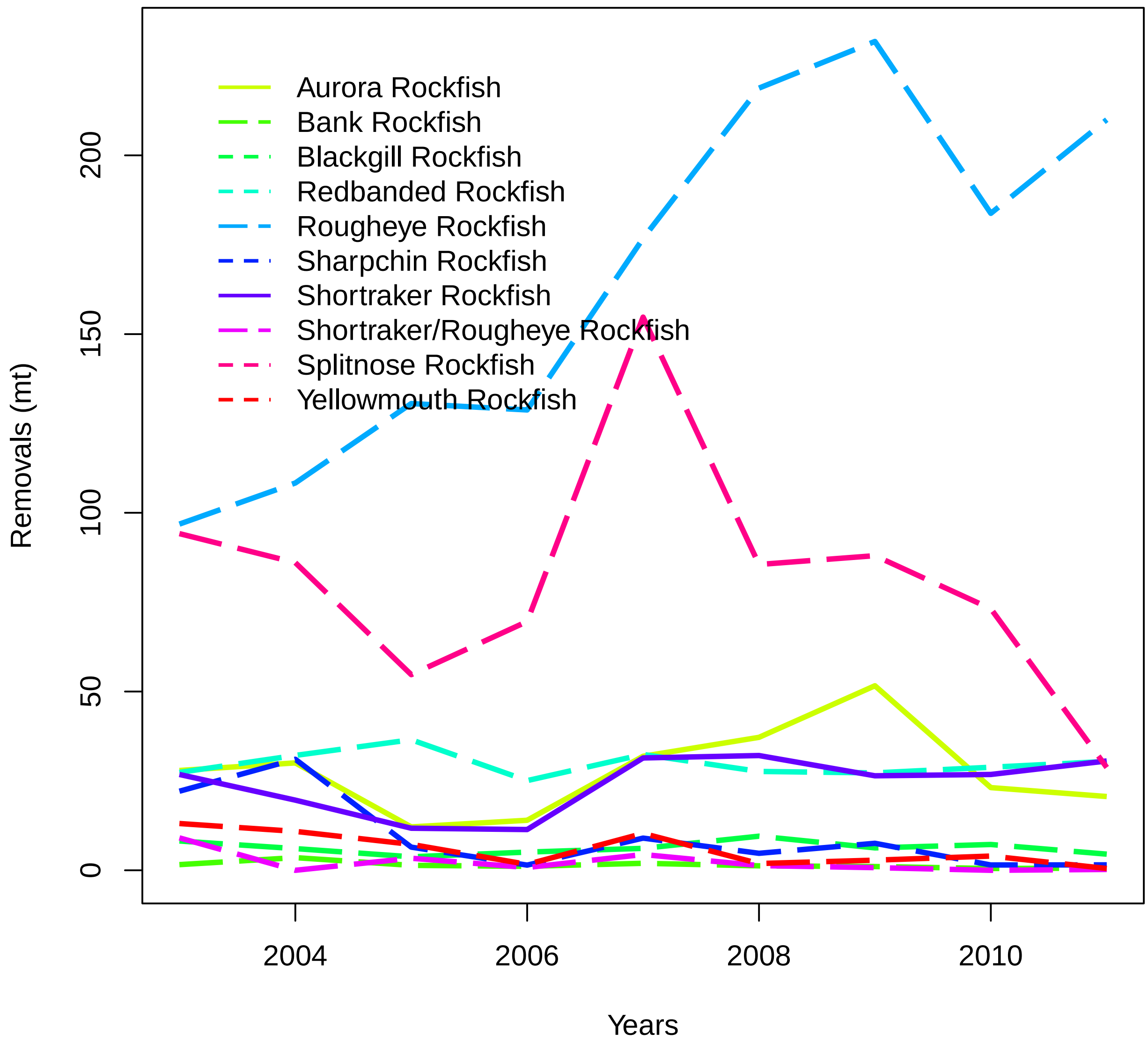

Figure 6. Annual total mortality (minus research catches) of slope rockfish stocks in the Minor Slope Rockfish North stock complex, 2003-2011.

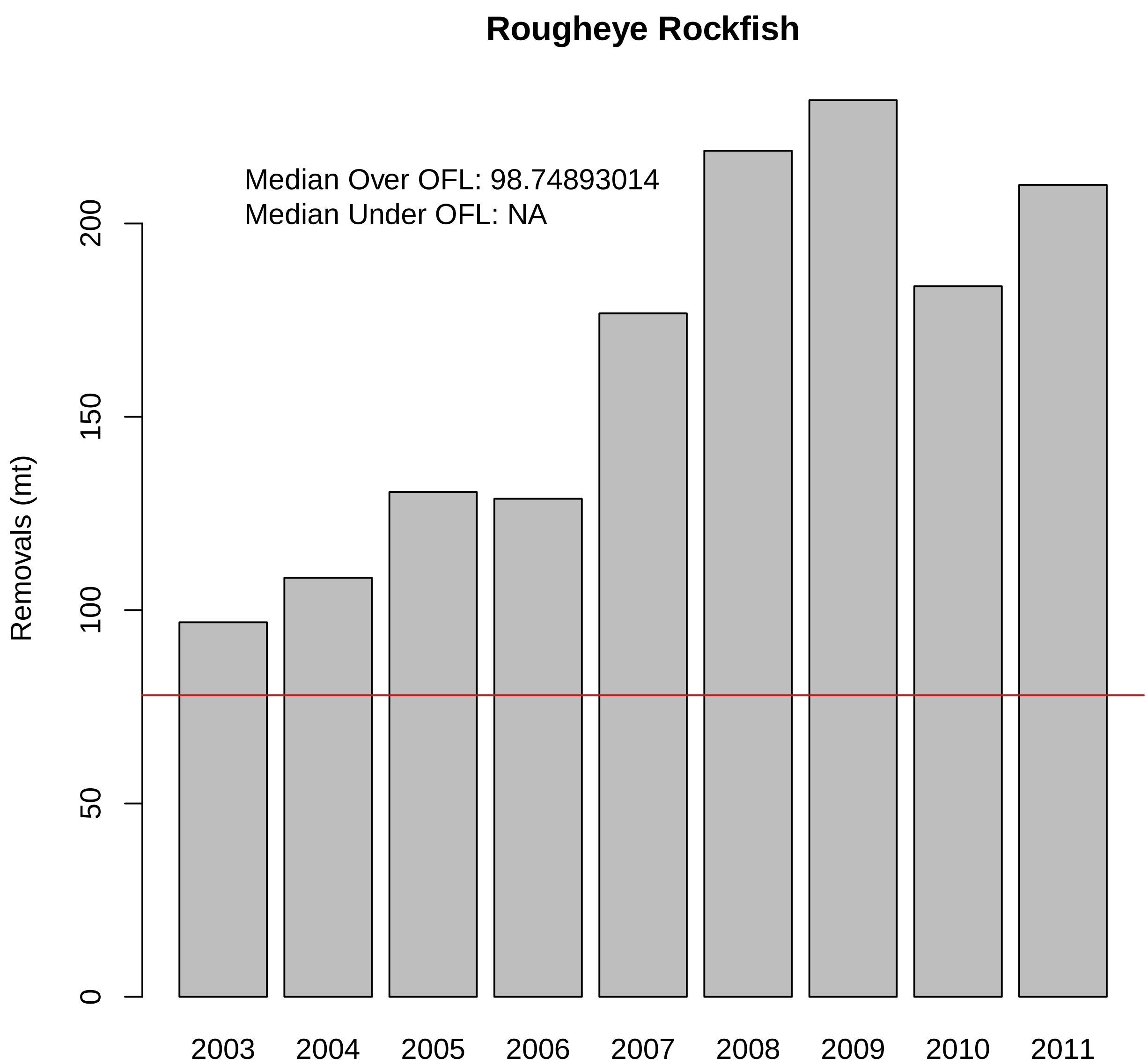

Figure 7. Estimated annual total mortality of rougheye rockfish north of 40º10’ N lat. in 2003-2011 relative to the stock’s contribution OFL specified for 2013 (red line).

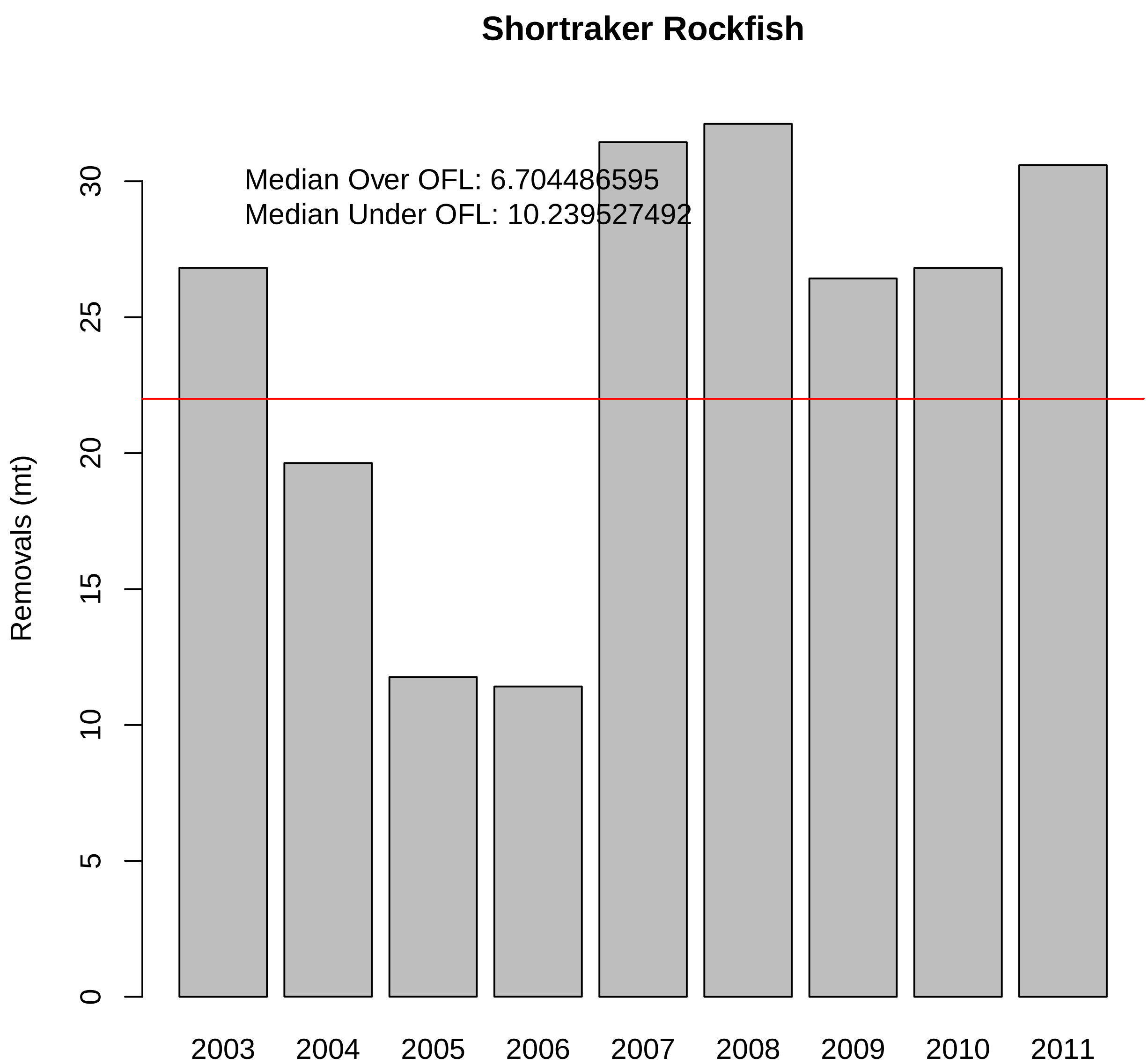

Figure 8. Estimated annual total mortality of shortraker rockfish north of 40º10' N lat. in 2003-2011 relative to the stock's contribution OFL specified for 2013 (red line).

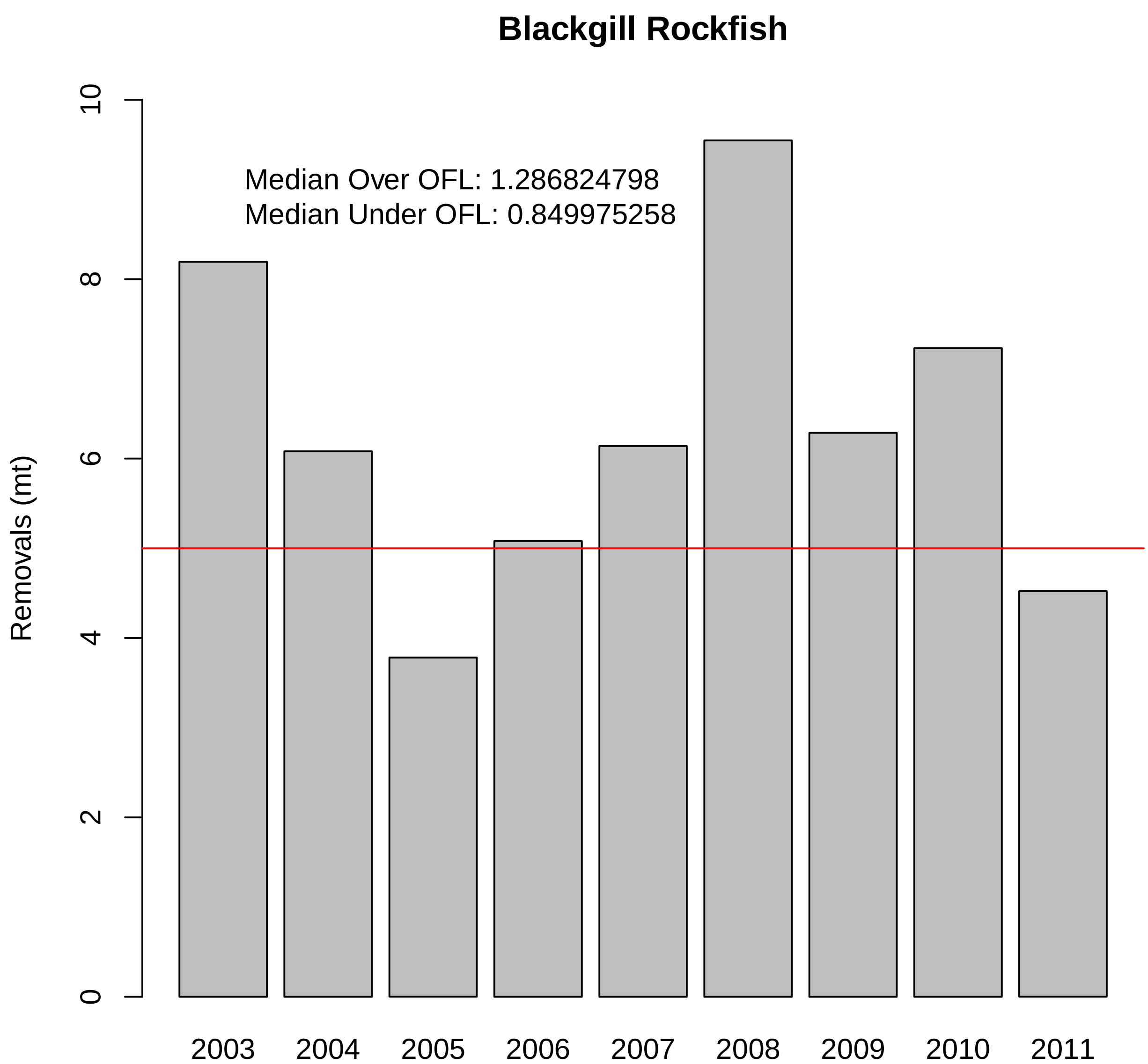

Figure 9. Estimated annual total mortality of blackgill rockfish north of 40º10' N lat. in 2003-2011 relative to the stock's contribution OFL specified for 2013 (red line).

The removal of the proposed EC stocks from the status quo complex shows little improvement. Alternative 2 seems to give the best overall increase in performance among evenness and removal ratios.

Alternatives 1 and 2 better align the more vulnerable stocks and therefore present less risk to these stocks than status quo.

4.2.3.2 **Slope Rockfish South of 40º10’ N lat.**

The catch histories of species in the status quo Minor Slope Rockfish South complex shows less concern over component OFL overages than the north (Table 26), but it also shows significant inflator species (e.g., bank and blackgill rockfishes) (Figure 10). Aurora rockfish, a highly vulnerable stock like rougheye and shortraker, has also had catches greater than the stock’s OFL contribution in recent years; however, the cumulative catch in that period did not exceed the cumulative OFL contribution (Figure 11). There have been slight catch overages of rougheye, shortraker, and POP relative to their very small component OFLs; however, these stocks are such a minor component to the southern slope rockfish complex, this is not a conservation issue south of 40º10’ N lat. (Figure 5). None of the other component stocks have exceeded their OFL contribution.

The removal of the proposed EC stocks from the status quo complex species does not improve the complex. While Alternative 2 improves removal ratios, the status quo complex seems overall the best of these proposed complexes. All complexes show relatively poor evenness because of the inclusion of blackgill. Removal of blackgill could improve any of the proposed alternatives.

Alternative 2 does better align the more vulnerable stocks and therefore presents less risk to these species than status quo or Alternative 1, both of which do not aggregate the vulnerable stocks in their own complex. Since rougheye and shortraker are rarely if ever caught south of 40º10’ N lat., the Alternative 2 Vulnerable Slope Rockfish complex is mainly comprised of aurora and blackgill rockfish. Blackgill would be an inflator stock in that complex compelling a precautionary ACL contribution for blackgill in the future if the Southern Vulnerable Slope Rockfish complex is created. Although it wasn’t proposed in this analysis, Alternative 1 may be more informative if aurora and blackgill were pulled out of the southern complex and managed with stock-specific harvest specifications. Blackgill was assessed in 2011 with a depletion ratio placing this stock in the precautionary zone. Aurora, which has one of the highest vulnerability scores analyzed, will be assessed in 2013. Since there are concerns with both aurora and blackgill, this different structure for Alternative 1 should be considered.

Table 26. Summary of status quo (SQ) and proposed slope rockfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Complex	Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
			Maximum	Minimum	$Removals_{median}$	OFL	%Slope = 0
Slope North	SQ	-	784	-7338	0.63	0.57	0.40
	SQ - EC spp.	-	784	-7338	0.65	0.57	0.44
	Alt. 1	-			0.74	0.64	0.40
	Alt 1 V	+			0.37	0.50	0.50
	Alt. 2	+			0.60	0.70	0.50
	Alt 2 V	+			0.51	0.62	0.60
Slope South	SQ	-	6	-4640	0.47	0.38	0.80
	SQ - EC spp.	-	-5	-1402	0.36	0.38	0.60
	Alt. 1	-			0.32	0.30	0.75
	Alt. 2	+			0.14	0.15	1.00
	Alt 2 V	+			0.33	0.21	0.60

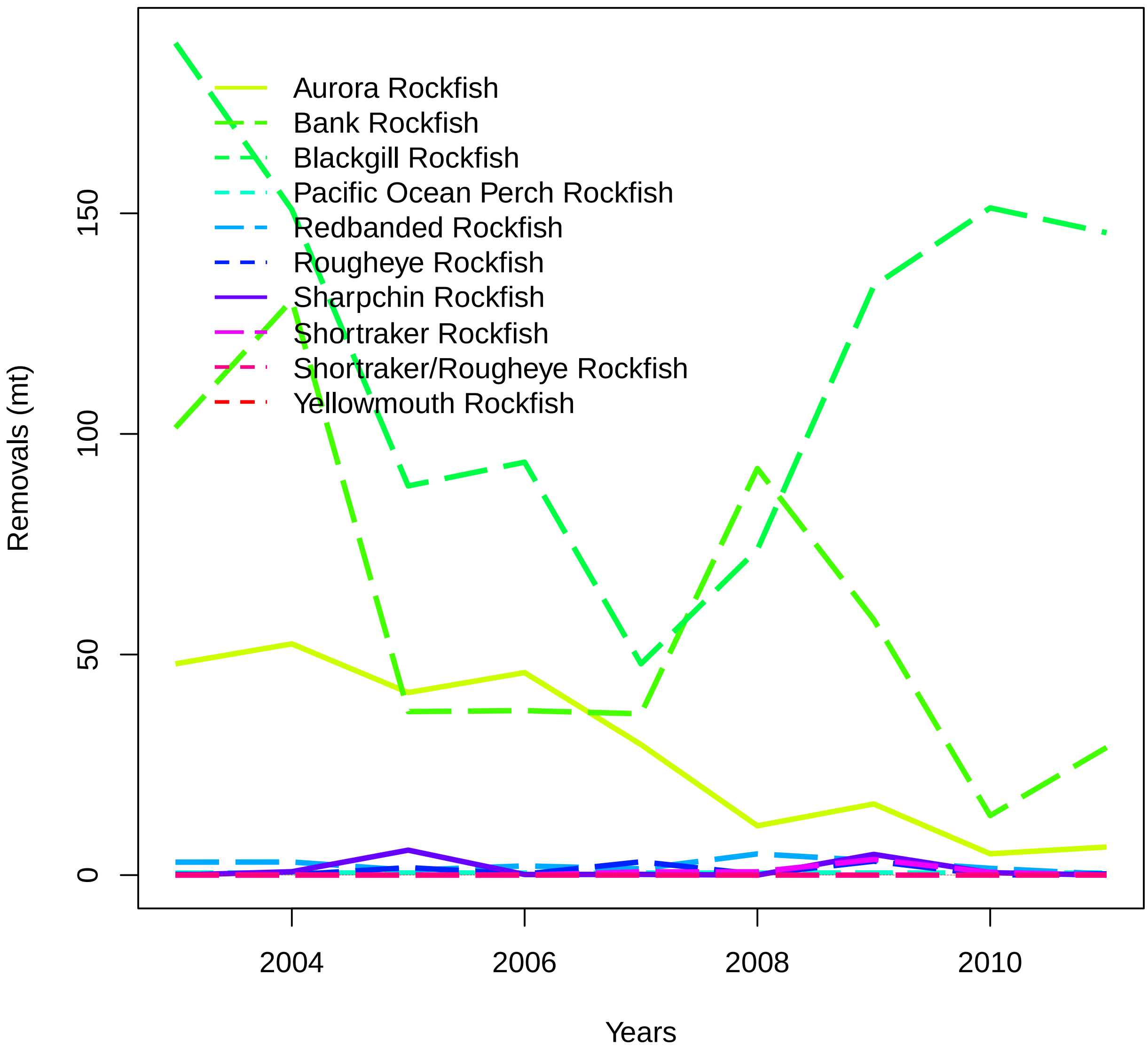

Figure 10. Annual total mortality (minus research catches) of slope rockfish stocks in the Minor Slope Rockfish South stock complex, 2003-2011.

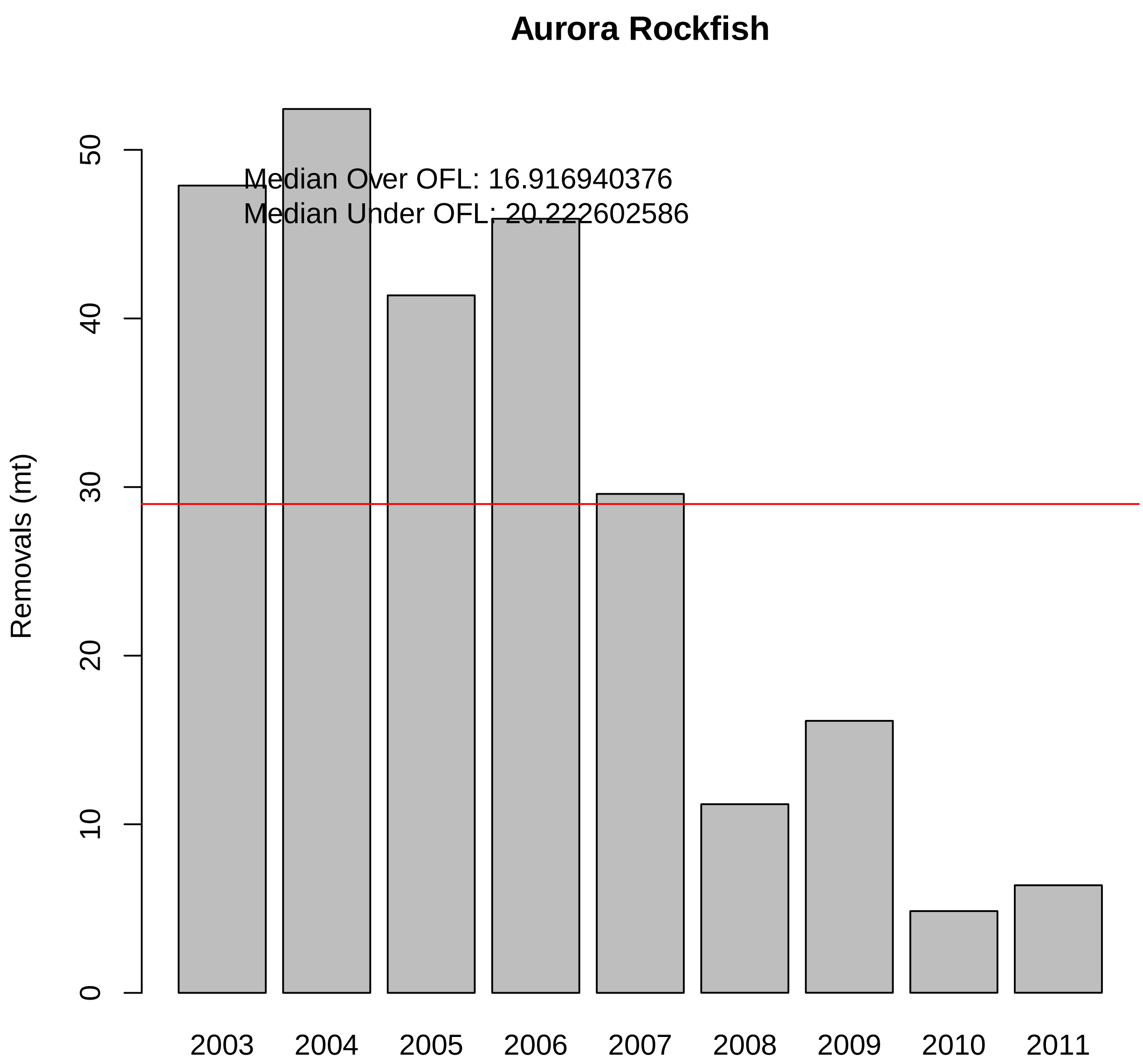

Figure 11. Estimated annual total mortality of aurora rockfish south of 40º10' N lat. in 2003-2011 relative to the stock's contribution OFL specified for 2013 (red line).

4.2.3.3 **Historical Catch By Sector**

Historical catch by sector for slope species north and south of 40º10’ N lat. are provided in Table 27 and Table 28.

4.2.3.4 **Management Measures and Inseason Response**

Federal regulations (50 CFR 660.55) and the FMP (Section 6.3.2.3) specify slope rockfish allocations north and south of 40º10’ N lat. For slope rockfish north, 81 percent of the fishery HG is allocated to the trawl sector and 18 percent to the non-trawl sector. For slope rockfish south, 63 percent of the fishery HG is allocated to the trawl sectors, and 37 percent to the non-trawl sectors.

Management measures that control slope rockfish mortality in the trawl sectors include individual fishing quota (IFQ) for the shorebased IFQ fishery and co-op management of set-asides for the at-sea sectors (catcher-processors and motherships). In the non-trawl sectors, the primary management measure that controls slope rockfish landings are bimonthly cumulative limits (hereinafter trip limits) for the limited entry and open access fixed gear fleets. RCAs are also available for both sectors which would be effective at controlling slope rockfish mortality (Figure 12, Figure 13, and Figure 14). Slope rockfish are also included in the recreational bag limits for the three states; however, they are not the most common target in recreational fisheries.

Two slope rockfish alternatives contemplate a vulnerable slope rockfish complex north of 40º10’ N lat. (Alternative 1) and one north and south of 40º10’ N lat. (Alternative 2), which would include blackgill, rougheye, and shortraker rockfish. Slope Rockfish Alternative 3 proposes to manage aurora rockfish and rougheye north of 40º10’ N lat. with species-specific harvest specifications. Slope rockfish have formal FMP trawl and non-trawl allocations, which could remain under the action alternatives (i.e., the same trawl:non-trawl Amendment 21 allocations for the status quo slope rockfish complexes could be considered for restructured slope rockfish complexes). The action alternatives would require new IFQ management units for the shoreside sector. Current regulations at §660.140(c)(3)(vii) address reallocation with changes in management areas and subdivision of species groups for quota share in quota share accounts. Further, the at-sea sectors would have new set-asides (north of 40º10’ N lat.) under the action alternatives. For example, under Alternative 1, in addition to the slope rockfish 40º10’ N lat. set-aside, there would be a vulnerable species set-aside. For the non-nearshore fixed gear sector, trip limit models would need to be developed and adjustments to the existing trip limits may be needed to keep catch within the complex specifications under the action alternatives.

The slope rockfish alternatives also propose specifying selected slope rockfish as EC species or removing them from a complex. No additional management measures would be necessary under these circumstances.

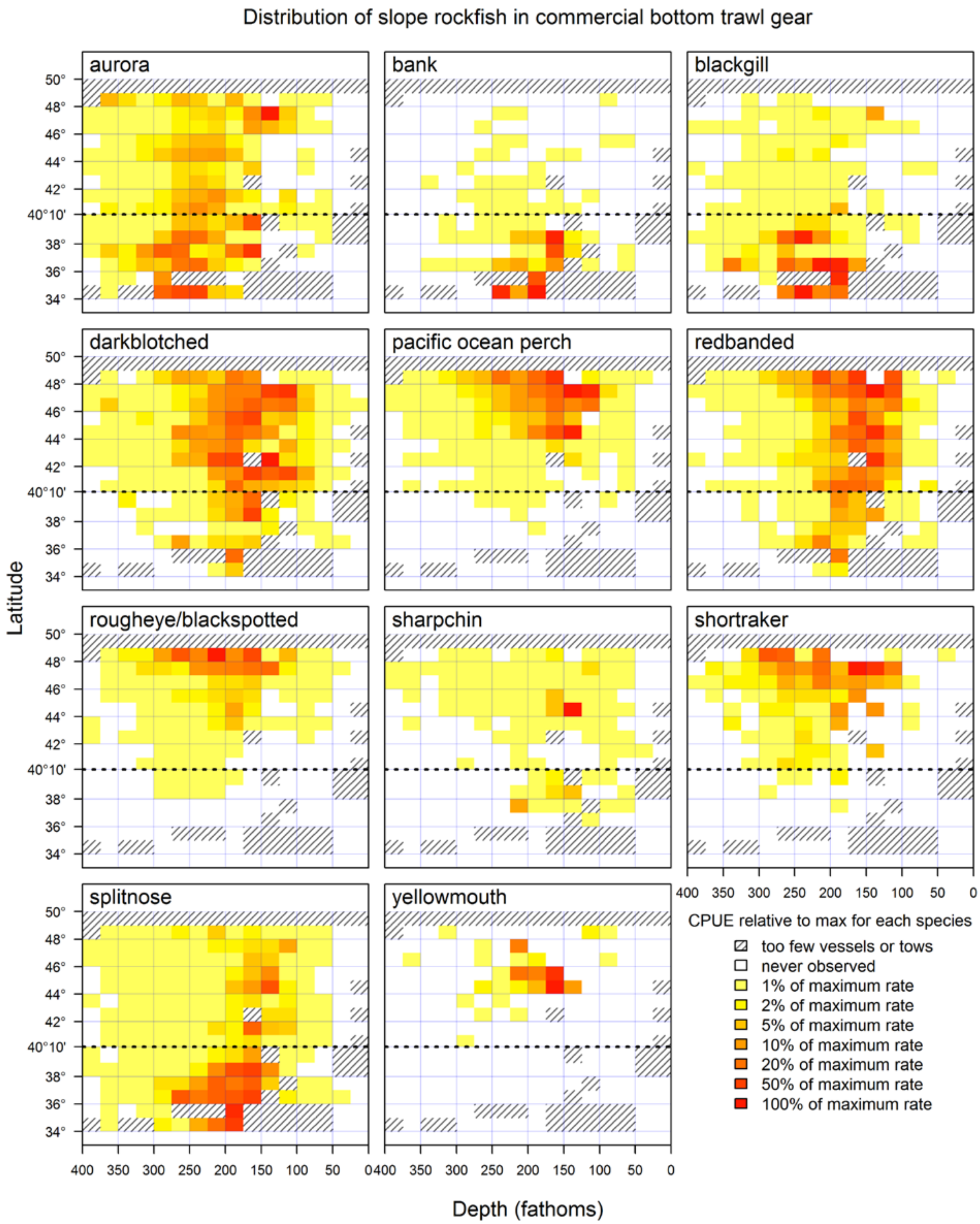

Figure 12. Observed relative CPUE of slope rockfish species by depth and latitude in the west coast bottom trawl fishery.

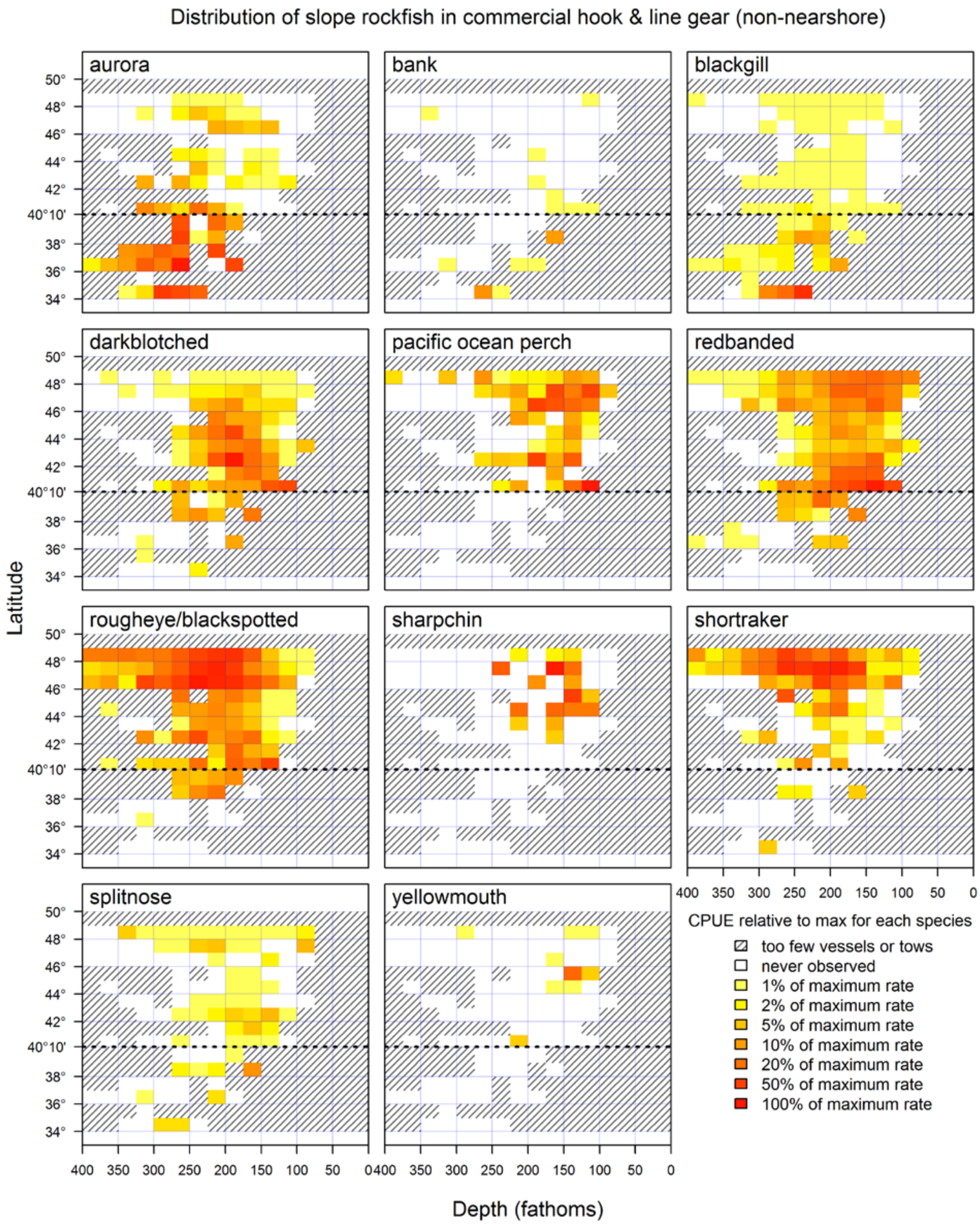

Figure 13. Observed relative CPUE of slope rockfish species by depth and latitude in west coast commercial non-nearshore hook-and-line fisheries.

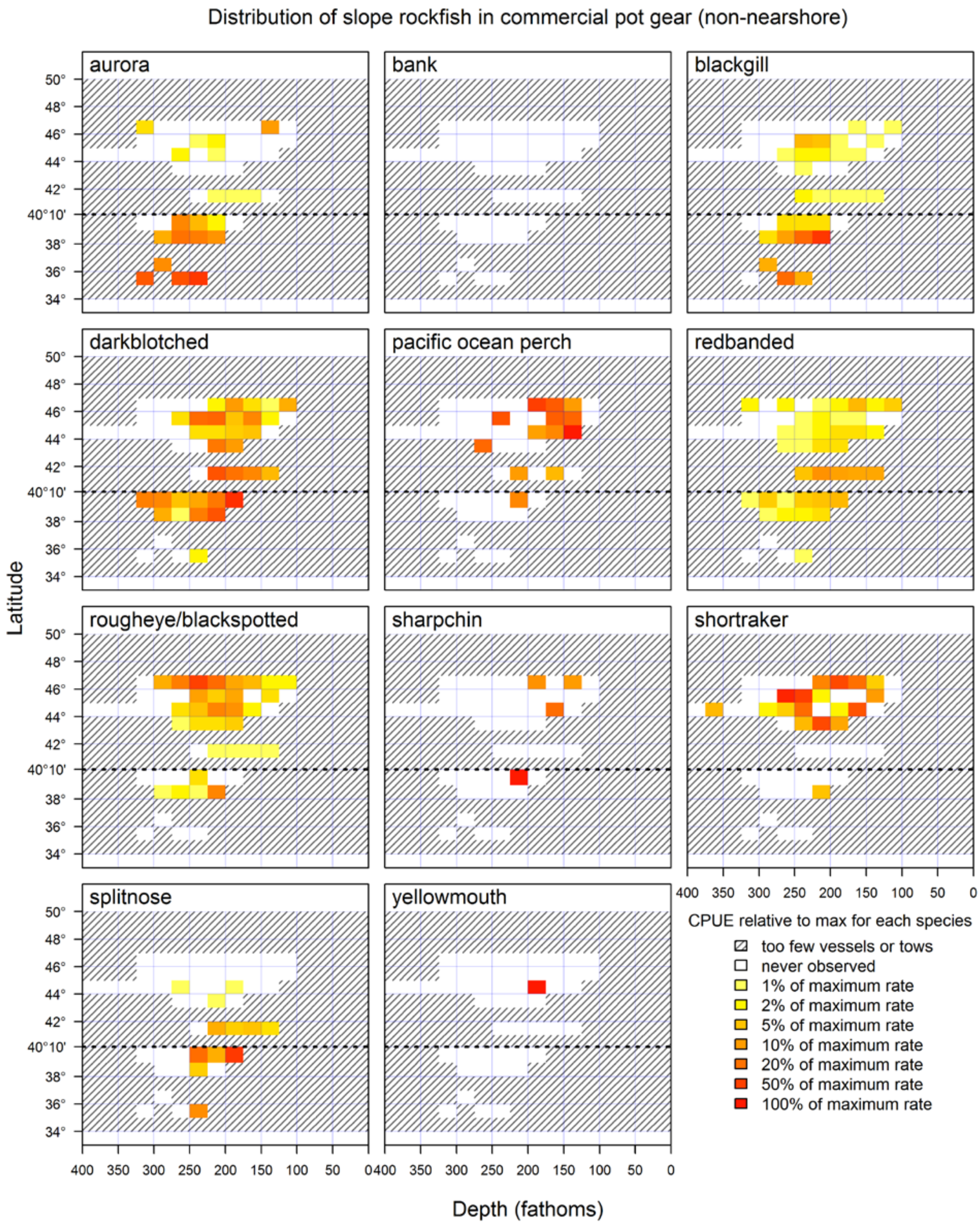

Figure 14. Observed relative CPUE of slope rockfish species by depth and latitude in west coast commercial non-nearshore pot gear fisheries.

Table 27. Slope Rockfish North Mortality by Sector (mt) from 2002-2011.

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Aurora Rockfish	**7.60**	**27.95**	**30.09**	**12.13**	**14.01**	**34.38**	**37.39**	**52.19**	**36.63**	**20.52**	**272.89**
Incidental		0.03	0.27	0.00	0.00	0.01	0.00		0.00	0.00	0.31
LE Trawl Permit - Fixed Gear										0.02	0.02
LE Entry Trawl Permit - Trawl Gear	7.53	27.25	29.48	11.85	13.97	31.54	36.92	51.52	23.42	19.84	253.30
Nearshore Fixed Gear	0.00	0.01		0.01				0.00	0.00		0.01
Non-nearshore Fixed Gear	0.02	0.11	0.09	0.17	0.03	0.10	0.12	0.34	0.08	0.10	1.18
Non-Tribal At-Sea Hake	0.01	0.00	0.02	0.03	0.00	0.01			0.03	0.10	0.19
Pink Shrimp			0.02			2.42	0.32	0.29	0.00	0.12	3.17
Shoreside Hake	0.00	0.02	0.21	0.02	0.01	0.29	0.03	0.03	13.10	0.28	14.00
Tribal Shoreside	0.03	0.53	0.01	0.04	0.00	0.02	0.01	0.00	0.00	0.05	0.70
Bank Rockfish	**0.23**	**1.58**	**3.57**	**1.39**	**1.13**	**1.97**	**1.27**	**1.04**	**0.55**	**0.56**	**13.29**
Incidental			0.00			0.01		0.00		0.00	0.01
LE Entry Trawl Permit - Fixed Gear										0.04	0.04
LE Entry Trawl Permit - Trawl Gear	0.09	1.58	3.41	1.35	0.92	1.16	1.06	1.01	0.42	0.22	11.22
Nearshore Fixed Gear						0.00	0.00	0.00	0.00		0.00
Non-nearshore Fixed Gear	0.03		0.03	0.01	0.11	0.58	0.12	0.03	0.05	0.23	1.19
Non-Tribal At-Sea Hake	0.11		0.09	0.03	0.02	0.21	0.09	0.00	0.07	0.02	0.64
Pink Shrimp										0.00	0.00
Shoreside Hake			0.03		0.07	0.01	0.01		0.01	0.04	0.17
Tribal Shoreside										0.01	0.01
Blackgill Rockfish	**16.00**	**8.20**	**6.39**	**3.83**	**5.08**	**6.96**	**9.71**	**6.40**	**12.29**	**4.63**	**79.48**
Incidental	0.08	0.16	0.19	0.00	0.02	0.02	0.01	0.03	0.00	0.01	0.51
LE Entry Trawl Permit - Fixed Gear										0.33	0.33
LE Entry Trawl Permit - Trawl Gear	6.07	5.43	4.90	2.01	3.84	5.26	6.52	4.80	6.29	2.93	48.04
Nearshore Fixed Gear	1.42	0.13		0.03				0.00	0.00	0.00	1.58
Non-nearshore Fixed Gear	8.15	2.18	0.94	1.60	1.16	1.64	2.97	1.39	5.86	1.35	27.23
Non-Tribal At-Sea Hake	0.00	0.04	0.01	0.02		0.01	0.03		0.03	0.00	0.16
Pink Shrimp				0.01				0.00		0.00	0.02

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Shoreside Hake	0.00	0.00	0.06	0.00	0.00	0.00	0.02	0.02	0.08		0.19
Tribal Shoreside	0.28	0.27	0.29	0.16	0.06	0.02	0.16	0.16	0.02	0.00	1.43
Blackspotted Rockfish							**0.17**	**0.84**	**1.24**	**1.09**	**3.34**
Incidental							0.00	0.01	0.00	0.00	0.02
LE Entry Trawl Permit - Fixed Gear										0.01	0.01
LE Entry Trawl Permit - Trawl Gear							0.10	0.16	0.28	0.65	1.19
Non-nearshore Fixed Gear							0.07	0.55	0.82	0.29	1.73
Shoreside Hake										0.12	0.12
Tribal Shoreside							0.00	0.12	0.13	0.02	0.27
Red Banded Rockfish	**0.00**	**0.04**		**0.02**			**0.01**		**0.04**	**0.00**	**0.10**
Non-Tribal At-Sea Hake	0.00	0.04		0.02			0.01		0.04	0.00	0.10
Rougheye Rockfish	**74.42**	**98.90**	**115.11**	**135.68**	**130.07**	**186.53**	**221.42**	**233.62**	**264.00**	**206.85**	**1,666.60**
Incidental	2.37	5.04	2.59	1.52	0.51	2.03	0.98	2.17	0.50	0.27	17.98
LE Entry Trawl Permit - Fixed Gear										14.96	14.96
LE Entry Trawl Permit - Trawl Gear	43.64	67.39	58.41	45.34	60.37	88.69	85.50	119.81	143.21	51.54	763.90
Nearshore Fixed Gear	0.04	0.19		0.63	0.01	0.00		0.00	0.00	0.00	0.87
Non-nearshore Fixed Gear	20.71	12.48	23.86	32.11	41.65	42.94	43.04	67.28	75.36	40.33	399.76
Non-Tribal At-Sea Hake	0.73	2.16	13.69	35.95	6.64	29.02	72.72	8.64	21.56	78.54	269.66
Pink Shrimp			1.45	0.19		0.11	0.01	0.00	0.01	0.01	1.79
Shoreside Hake	0.00	0.00	0.82	0.19	0.00	1.92	0.63	1.61	5.11	2.74	13.03
Tribal At-Sea Hake						0.06	2.86	0.65	0.00	2.41	5.97
Tribal Shoreside	6.93	11.63	14.28	19.75	20.88	21.76	15.68	33.45	18.26	16.06	178.69
Sharpchin Rockfish	**28.63**	**22.11**	**31.49**	**6.54**	**1.45**	**10.31**	**4.83**	**7.55**	**8.46**	**1.55**	**122.92**
Incidental	0.61	0.02	0.52	0.06	0.01		0.00	0.00	0.00		1.22
LE Entry Trawl Permit - Trawl Gear	27.49	18.78	29.83	6.08	1.37	8.17	4.64	7.46	8.33	1.50	113.64
Non-nearshore Fixed Gear	0.00	0.00	0.00	0.01		0.01	0.04	0.01	0.10		0.18
Non-Tribal At-Sea Hake	0.14	2.49	0.34	0.03	0.03	0.84	0.00		0.00	0.01	3.88
Pink Shrimp			0.42	0.08		1.29	0.08	0.00	0.01	0.03	1.91
Shoreside Hake	0.05		0.00				0.00	0.04	0.00	0.01	0.11

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Tribal At-Sea Hake	0.00		0.00						0.00		0.00
Tribal Shoreside	0.34	0.82	0.38	0.28	0.03	0.00	0.08	0.04	0.02	0.00	1.99
Shortraker Rockfish	**18.86**	**27.10**	**19.71**	**14.80**	**11.70**	**31.81**	**34.75**	**27.81**	**33.35**	**28.23**	**248.13**
Incidental	0.64	1.39	0.49	0.01	0.02	0.20	0.05	0.09	0.04	0.01	2.94
LE Entry Trawl Permit - Fixed Gear										0.43	0.43
LE Entry Trawl Permit - Trawl Gear	15.35	24.12	14.32	9.39	7.95	27.37	27.89	23.72	26.35	21.56	198.02
Nearshore Fixed Gear				0.11							0.11
Non-nearshore Fixed Gear	1.75	0.91	3.17	3.82	1.87	1.66	4.65	2.72	4.19	3.03	27.77
Non-Tribal At-Sea Hake	0.08	0.11	0.52	0.34	0.41	0.32	0.29	0.17	0.22	0.18	2.62
Pink Shrimp				0.17		0.02	0.07				0.26
Shoreside Hake		0.00	0.58			1.24	0.21	0.08	1.45	1.75	5.32
Tribal At-Sea Hake						0.01		0.01	0.02		0.04
Tribal Shoreside	1.04	0.57	0.63	0.96	1.45	0.98	1.60	1.03	1.08	1.26	10.61
Splitnose Rockfish	**103.29**	**94.20**	**130.58**	**60.12**	**69.59**	**168.96**	**98.29**	**89.75**	**121.80**	**26.22**	**962.81**
Incidental	0.91	0.99	0.25	0.00	0.00	0.03	0.00	0.00	0.00	0.00	2.18
LE Entry Trawl Permit - Fixed Gear										0.02	0.02
LE Entry Trawl Permit - Trawl Gear	90.85	81.13	77.94	38.96	66.00	137.05	81.97	85.74	58.15	9.00	726.80
Nearshore Fixed Gear	0.00	0.00	0.01	0.06	0.00	0.00		0.00	0.00	0.00	0.08
Non-nearshore Fixed Gear	0.03	0.05	0.04	0.02	0.10	0.36	0.41	1.34	0.18	0.20	2.71
Non-Tribal At-Sea Hake	11.47	12.00	7.25	15.08	1.06	2.19	0.93	0.09	43.54	11.93	105.54
Pink Shrimp			44.49	5.40		14.06	13.79	1.68	0.12	1.11	80.66
Shoreside Hake	0.00	0.00	0.59	0.57	2.42	14.61	0.04	0.76	19.79	3.69	42.48
Tribal At-Sea Hake						0.00	0.00	0.00		0.19	0.19
Tribal Shoreside	0.03	0.02	0.00	0.03	0.00	0.67	1.14	0.14	0.03	0.08	2.14

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Yellowmouth Rockfish	**8.26**	**13.10**	**10.91**	**7.26**	**1.64**	**10.32**	**2.67**	**2.88**	**5.19**	**0.51**	**62.74**
Incidental	0.00	0.00	0.28		0.00	0.00	0.01	0.00	0.07		0.37
LE Entry Trawl Permit - Fixed Gear										0.02	0.02
LE Entry Trawl Permit - Trawl Gear	7.63	13.09	10.59	7.26	1.57	10.01	1.23	2.45	3.84	0.36	58.04
Non-nearshore Fixed Gear	0.01	0.00	0.02		0.05	0.05	0.89	0.38	1.20	0.05	2.66
Non-Tribal At-Sea Hake	0.60	0.00	0.01		0.02	0.02	0.06	0.00	0.06	0.07	0.86
Pink Shrimp									0.00		0.00
Shoreside Hake						0.22	0.11				0.33
Tribal At-Sea Hake									0.00	0.00	0.01
Tribal Shoreside	0.01	0.00	0.00			0.02	0.36	0.04	0.00		0.44
Grand Total	**257**	**293**	**348**	**242**	**235**	**451**	**411**	**422**	**484**	**290**	**3,432**

Table 28. Slope Rockfish South Mortality (mt) by Sector from 2002-2011.

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Aurora Rockfish	**47.42**	**47.01**	**53.50**	**41.70**	**45.22**	**29.59**	**11.34**	**16.13**	**4.50**	**6.72**	**303.12**
California Halibut	0.00										0.00
Incidental	0.02		0.06	0.10	0.02		0.01	0.13	0.09		0.43
LE Entry Trawl Permit - Fixed Gear										0.06	0.06
LE Entry Trawl Permit - Trawl Gear	46.12	43.96	51.53	41.02	44.86	29.29	10.34	8.95	3.63	6.01	285.70
Nearshore Fixed Gear	0.00	0.01	0.00		0.00		0.00	0.00	0.00		0.01
Non-nearshore Fixed Gear	1.25	3.04	1.75	0.58	0.34	0.31	0.98	7.05	0.78	0.65	16.73
Pink Shrimp			0.17								0.17
Shoreside Hake	0.02			0.00							0.02
Bank Rockfish	**290.36**	**101.36**	**130.32**	**37.05**	**37.28**	**36.62**	**92.17**	**57.88**	**13.43**	**28.92**	**825.40**
California Halibut	0.02										0.02
Incidental	18.61	14.84	19.44	10.44	11.33	7.50	1.06	0.14			83.34
LE Entry Trawl Permit - Trawl Gear	246.62	85.47	109.78	24.20	22.09	27.90	90.80	57.49	13.33	27.82	705.48
Nearshore Fixed Gear	0.14	0.01	0.05	0.28	0.16	0.07	0.00	0.02	0.02	0.00	0.75
Non-nearshore Fixed Gear	2.33	1.06	1.05	1.76	3.71	1.15	0.31	0.24	0.09	1.10	12.78
Pink Shrimp	0.00										0.00
Shoreside Hake	22.65			0.38							23.03
Blackgill Rockfish	**149.73**	**193.79**	**153.01**	**88.39**	**95.37**	**48.27**	**74.34**	**135.49**	**152.02**	**151.65**	**1,242.07**
California Halibut	0.00										0.00
Incidental	1.25	9.91	1.85	0.33	1.22	0.17	3.05	0.54	5.58		23.90
LE Entry Trawl Permit - Fixed Gear										1.77	1.77
LE Entry Trawl Permit - Trawl Gear	71.37	54.69	80.40	52.14	36.15	25.72	37.58	53.36	61.16	14.27	486.85
Nearshore Fixed Gear	4.38	4.12	3.22	2.02	3.83	0.31	0.38	2.44	0.55	0.37	21.64
Non-nearshore Fixed Gear	72.73	125.07	67.53	33.89	54.17	22.07	33.32	79.15	84.73	135.24	707.89
Pink Shrimp	0.00										0.00
Shoreside Hake	0.00				0.01						0.01

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Pacific Ocean Perch Rockfish	**0.09**	**0.03**	**1.35**	**0.04**	**0.06**	**0.16**	**0.21**	**0.11**	**0.02**	**0.03**	**2.09**
Incidental				0.01							0.01
LE Entry Trawl Permit - Trawl Gear	0.09	0.03	1.05		0.00	0.16	0.20			0.03	1.55
Nearshore Fixed Gear			0.05		0.02			0.00			0.07
Non-nearshore Fixed Gear				0.03	0.04		0.00	0.11	0.00		0.18
Pink Shrimp			0.25						0.02		0.27
Rougheye Rockfish	**0.88**	**0.16**	**0.08**	**1.72**	**0.21**	**3.03**	**0.20**	**3.15**		**0.36**	**9.79**
LE Entry Trawl Permit - Trawl Gear	0.34	0.04	0.08				0.00	0.00		0.02	0.49
Nearshore Fixed Gear		0.00			0.00			0.00			0.01
Non-nearshore Fixed Gear	0.53	0.12		1.72	0.21	3.03	0.20	3.15		0.34	9.29
Sharpchin Rockfish	**7.43**		**0.78**	**5.65**	**0.15**	**0.15**		**4.49**	**0.22**	**0.01**	**18.87**
LE Entry Trawl Permit - Trawl Gear	7.43		0.76	5.65	0.15	0.15		4.45	0.22	0.01	18.81
Non-nearshore Fixed Gear								0.04			0.04
Pink Shrimp			0.02								0.02
Shortraker Rockfish	**0.00**		**0.01**			**0.74**	**0.74**	**3.54**	**0.63**		**5.67**
LE Entry Trawl Permit - Trawl Gear	0.00		0.01			0.74	0.74	3.33	0.63		5.45
Non-nearshore Fixed Gear								0.21			0.21
Yellowmouth Rockfish					**0.01**			**0.04**			**0.05**
Nearshore Fixed Gear					0.00			0.00			0.00
Non-nearshore Fixed Gear					0.01			0.04			0.05
Grand Total	**495.91**	**342.35**	**339.05**	**174.55**	**178.31**	**118.56**	**178.99**	**220.83**	**170.83**	**187.68**	**2,407.06**

4.2.4 Flatfish

Flatfish stocks have relatively high productivities and are therefore not as vulnerable to overfishing (Table 29). The stocks managed in the Other Flatfish complex are all of relatively close vulnerability scores but do vary in their depth distributions.

Table 29. Flatfish stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Nearshore	Curlfin sole	2.45	High	1.23	Low
	Butter Sole	2.45	High	1.18	Low
	Pacific sanddab	2.4	High	1.25	Low
	Sand sole	2.35	High	1.23	Low
	Starry flounder	2.15	High	1.04	Low
Shelf	Flathead sole	2.3	High	1.26	Low
	Slender sole	2.25	High	1.14	Low
	English Sole	2.25	High	1.19	Low
	Rock sole	1.95	Low	1.42	Low
	Petrale sole	1.7	Low	1.94	Med
Slope	Deepsea sole	2.3	High	1.34	Low
	Rex sole	2.05	Low	1.28	Low
	Arrowtooth flounder	1.95	Low	1.21	Low
	Dover sole	1.8	Low	1.54	Low

The status quo Other Flatfish complex has small overages (Table 30), but massive inflator species (rex sole and sand sole) (Figure 15). Alternative 1 has the most overall improvement in removal-based diagnostics over status quo, although the Alternative 2 Shallow Flatfish complex shows the best improvement in removal ratios. Evenness is generally poor for all complexes.

The status quo and action flatfish alternatives are satisfactory in terms of relatively close correspondence of estimated productivities and vulnerabilities of component stocks (Table 29 and Table 30). However, the ecological and depth distributions of component stocks are dissimilar. Flatfish alternative 2 seeks to stratify new complexes by depth distribution by creating a Shallow Flatfish and a Deep Flatfish complex . Arrowtooth flounder would be added to the Deep Flatfish complex as an indicator stock for managing that complex since it is an assessed stock. Two other stocks (rex sole and Pacific sanddabs) are scheduled for assessment in 2013 and, if the assessments are endorsed and adopted, could be indicator stocks for alternative flatfish complexes.

Both flatfish alternatives contemplate adding two non-FMP species (slender sole and deepsea sole) into the FMP. Both species have relatively high west coast catches (Figure 15) and are thus considered to be in the groundfish fishery. Managing these two stocks in the FMP would reduce the risk of potential overfishing of these two stocks.

The depth-based complexes under alternative 2 may be more risk-averse in preventing potential overfishing. Harvest specifications in each complex could be better tailored to the fishery with Shallow Flatfish catches primarily occurring shoreward of RCAs and Deep Flatfish catches primarily occurring seaward of the RCA.

Flatfish stocks managed in the status quo Other Flatfish complex are trawl-dominant with over 90 percent of historical landings from bottom trawl gear (PFMC 2010). The formal sector allocations for the Other Flatfish complex decided under Amendment 21 are 90 percent trawl and 10 percent non-trawl, with a set-aside from the trawl allocation specified biennially for the at-sea whiting sectors. The Amendment 21 allocations are the default for restructured flatfish complexes and should meet the needs of the fishery under the proposed flatfish stock complex alternatives since the two species proposed for FMP management under the action alternatives are also predominantly caught in bottom trawls. There could be consideration for a different initial allocation of quota shares to IFQ permits than used to allocate quota for the Other Flatfish complex under alternative 2 since vessels specializing in shallow water efforts (i.e., beach trawlers) are more likely to catch shallow flatfish than deep flatfish and vessels specializing in deep water efforts are more likely to catch deep flatfish. However, once quota share trading and sales are allowed, quota shares will distribute according to the needs of the permit holders.

Table 30. Summary of status quo (SQ) and proposed flatfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$\text{Removals}_{\text{median}}$	OFL	%Slope = 0
SQ	+	61	-39730	0.51	0.50	0.43
Alt 1	+			0.52	0.44	0.56
Alt 2 shallow	+			0.46	0.26	0.71
Alt 2 deep	+			0.43	0.49	0.33

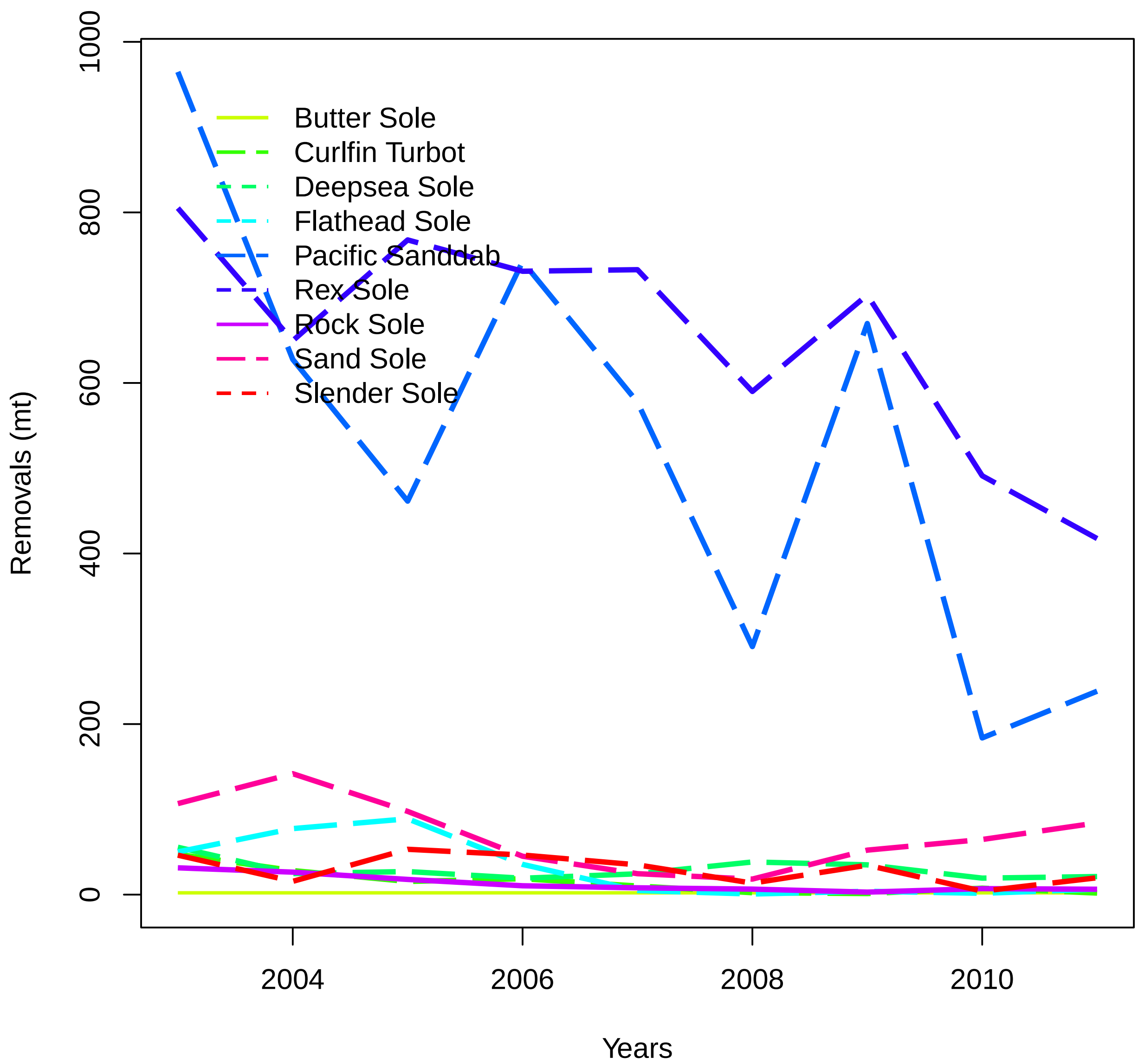

Figure 15. Annual total mortality (minus research catches) of flatfish stocks in the Other Flatfish stock complex, including the two non-FMP species (deepsea sole and slender sole) proposed to be added under the action alternatives, 2003-2011.

4.2.4.1 **Historical Catch By Sector**

To be completed.

4.2.4.2 **Management Measures and Inseason Response**

Federal regulations (50 CFR 660.55) and the FMP (Section 6.3.2.3) specify flatfish allocations coastwide. The fishery HG is allocated 90 percent to trawl and 10 percent to non-trawl.

Management measures that control flatfish mortality in the trawl sectors include IFQ for the shorebased IFQ fishery and co-op management for the at-sea sectors (catcher-processors and motherships). In the non-trawl sectors, the primary management measure that controls flatfish landings are bimonthly trip limits for the limited entry and open access fixed gear fleets. RCAs are also available for both sectors which could be effective at controlling flatfish mortality. Flatfish are also included in the recreational bag limits for the three states; however, they are not the most common target in recreational fisheries.

4.2.5 *Cartilaginous Fish*

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing (Table 31).

Table 31. Cartilaginous fish stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Shallow	Longnose skate	1.53	High	1.68	Low
	Aleutian skate	1.42	High	1.71	Low
	Big skate	1.37	High	1.99	Med
	Brown catshark	1.37	High	1.84	Med
	Leopard shark	1.26	High	2	High
	Spiny dogfish	1.11	Low	2.13	High
	Soupfin shark	1.11	Low	2.02	High
Deep	Black/roughtail skate	1.45	High	1.68	Low
	Bering/sandpaper skate	1.37	High	1.8	Low
	California skate	1.21	Low	2.12	High

The actual status quo alternative for this group of species is the Other Fish complex. However, this complex is so misaligned and poorly constructed with disparate species of different life histories, different distributions, different productivities, and different vulnerabilities that analyzing the Other Fish complex as a viable alternative was not even contemplated. Therefore, the status quo complex alternative for cartilaginous fish analyzed in this document is comprised of only the cartilaginous fish that are currently managed in the Other Fish complex (Table 12).

The status quo aggregation of cartilaginous fish shows one huge inflator species (spiny dogfish) (Figure 16). As a result, evenness is poor in any alternative that contains either spiny dogfish or species with no OFL contribution (i.e., most of the skates). Alternative 1 shows the best improvement in removal ratios, while Alternative 3 shows the best improvement in removal evenness. Overall, Alternatives 1 and 4 arguably provide the best balance of improvement in both evenness and removal ratios over status quo.

While none of the cartilaginous fish were subject to apparent overfishing, spiny dogfish has come closest to exceeding the stock's OFL contribution (Table 33). Total mortality estimates provided by the NWFSC prior to 2012 assume 100 percent mortality for discarded spiny dogfish among all gear types. For comparison and future projections, spiny dogfish mortality estimates were provided assuming 50 percent discard mortality for fixed gear and 100 percent mortality for all other gears, as recommended by the SSC (see Agenda Item F.2.b, Revised Supplemental SSC Report, March 2012).

In terms of aggregating stocks with similar productivities (and vulnerabilities), status quo and Alternative 3 fail in that the component stocks are mismatched for those attributes (Table 32). Alternative 1 matches the Miscellaneous Cartilaginous Fish suitably, but aggregating all the endemic skates in one complex mismatches their relative productivities and vulnerabilities.

Alternatives 2 and 4 aggregate cartilaginous fish by their depth distributions and better align component stocks with similar productivities and vulnerabilities.

Table 32. Summary of status quo (SQ) and proposed cartilaginous fish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$\text{Removals}_{\text{median}}$	OFL	%Slope = 0
SQ	-	1881	-6800	0.43	0.20	0.17
Alt 1 skates	-			0.43	0.00	0.55
Alt 1 ratdog	+			0.31	0.00	0.33
Alt 2 shallow skates	+			0.39	0.00	0.50
Alt 2 deep skates	+			0.53	0.00	0.33
Alt 2 ratdog	+			0.31	0.00	0.33
Alt 3	-			0.62	0.00	0.42
Alt 4 shallow cart. fish	+			0.57	0.00	0.44
Alt 4 deep cart. fish	+			0.53	0.00	0.33

Table 33. West coast groundfish total mortality estimates (mt) for spiny dogfish under two discard mortality assumptions, 2006-2010.

Year	**Estimated dogfish mortality (mt) assuming 100% discard mortality**	**Estimated dogfish mortality (mt) assuming 50% discard mortality for fixed gear**
2006	1,407	1,222
2007	1,504	1,346
2008	2,497	2,393
2009	1,207	1,032
2010	1,215	1,093

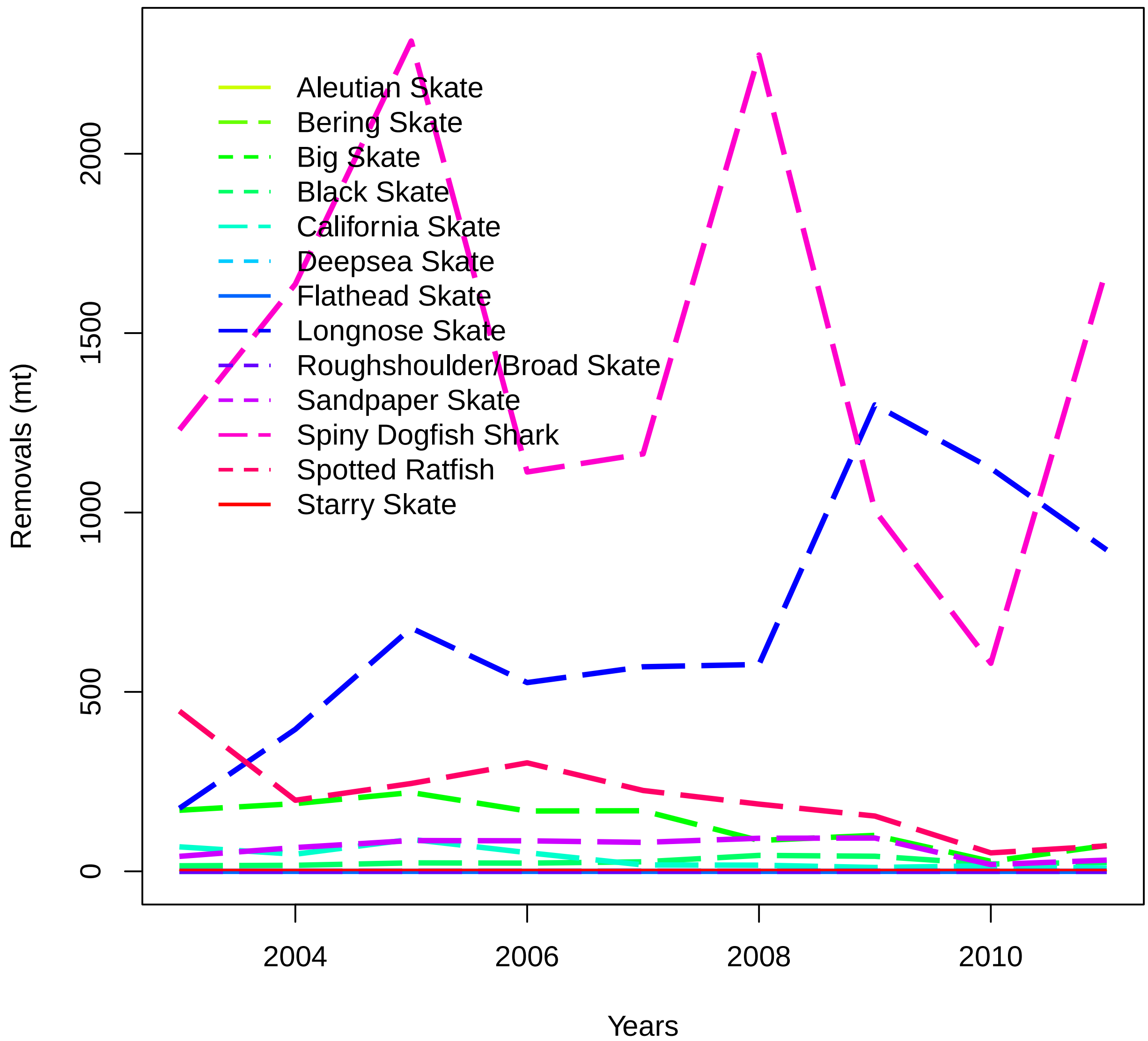

Figure 16. Annual total mortality (minus research catches) of cartilaginous fish stocks in the Other Fish stock complex, including the addition of the non-FMP species proposed under the action alternatives, 2003-2011.

4.2.5.1 **Historical Catch By Sector**

Historical catch by sector for cartilaginous fish is provided in Table 34.

4.2.5.2 **Management Measures and Inseason Response**

Cartilaginous fish stocks managed in the Other Fish complex are managed to the complex ACL and are not currently allocated by sector.

Management measures that control cartilaginous fish mortality in the trawl sectors include trip limits for the shorebased IFQ fishery and co-op management of set-asides for the at-sea sectors. In the non-trawl sectors, the primary management measure that controls cartilaginous fish landings are bimonthly trip limits for the limited entry and open access fixed gear fleets. RCAs are also available for both sectors which could be effective at controlling cartilaginous fish mortality (Figure 17, Figure 18, and Figure 19). Cartilaginous fish species are also included in the recreational bag limits for the three states; however, they are not the most common target in recreational fisheries.

In the 2013-2014 EIS, new management measures and adjustments to existing measures were explored to reduce catch of spiny dogfish (currently managed in the Other Fish complex) and longnose skate (species-specific harvest specifications) (PFMC and NMFS 2012). The final preferred alternative was to rely on routine adjustments to trip limits and RCAs to keep catch within the harvest specifications.

Action alternatives contemplate managing cartilaginous species either in separate skate and miscellaneous cartilaginous fish complexes (Alternatives 1 and 2) or together in aggregate complexes (Alternatives 3 and 4). Skates and other miscellaneous cartilaginous fish are further managed in shallow and deep groups (Alternatives 2 and 4). Under all action alternatives, new skate species are proposed to be included in the FMP, which would increase the skate contributions to the complex. Generally speaking, based on historical catch levels (Table 34) the limited entry bottom trawl sector and to some extent the at-sea whiting and non-nearshore fixed gear fisheries would be impacted by the proposed alternatives for skates and miscellaneous cartilaginous species. Spiny dogfish is caught by the limited entry bottom trawl, non-nearshore fixed gear, and at-sea whiting sectors.

Under Alternative 1, longnose skate would be included in the skate complex as an indicator species to represent the more vulnerable species within the complex. National Standard 1 recommends that if an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery. Longnose skate are considered less vulnerable than several of the skates in the proposed complex (Table 31). A longnose skate trip limit model that would apply to all skate species may need to be developed to constrain catch. Further, subsequent trip limit adjustments for all sectors may need to be developed since the current limits are unlimited. RCA adjustments, similar to the adjustments contemplated in 2013-2014 may be needed. ***Need further discussion on the use of indicator species.***

Alternative 1 also contemplates designating all endemic skates, except Aleutian skate, Bering/sandpaper skate, big skate, black/roughtail skate, California skate, and longnose skate, as EC species. Soupfin shark would also be designated as an EC species. Such designations would not result in adjustments to management measures.

Two species, spiny dogfish and spotted ratfish, are proposed to be managed in a Miscellaneous Cartilaginous Fish complex under Alternative 1. Management measures in the limited entry bottom trawl, at-sea whiting, and non-nearshore fishery may be needed to be modified to keep catch within the complex specifications. The first step may be to establish a two-year allocation to provide sector-specific management targets. Depending on the allocation to each sector, adjustments to trip limits (limited entry bottom trawl and non-nearshore fishery) or set-asides in the at-sea whiting fishery may be needed. RCA adjustments or area closures may be successful at reducing catch, if necessary. New management measures may also be contemplated (e.g., shorebased IFQ) to provide a more efficient fishery and better catch accountability.

Alternative 2 is the same as Alternative 1, except the skate complex is divided into two depth-based complexes. The changes to management measures would be similar to those described under Alternative 1; however, additional management measures may be needed as the skate complexes are further divided to deep and shallow complexes (i.e., dividing complexes results in management to a lower harvest specification). This may require the development of a skate trip limit model.

Alternative 3 contemplates a Cartilaginous Fish complex, stock-specific harvest specifications for spiny dogfish, and similar EC species designations as described under Alternatives 1 and 2. Management measure adjustments for spiny dogfish are expected to be similar to those described under Alternatives 1 and 2 and analyzed in the 2013-2014 EIS (PFMC and NMFS 2012). Management measures for the Cartilaginous Fish complex would be similar to those described under Alternative 1 for skates; however, longnose skate would no longer be an indicator species.

Alternative 4 is the same as Alternative 3, except the Cartilaginous Fish complex is divided into two depth-based complexes. The changes to management measures would be similar to those described under Alternative 3; however, additional management measures may be needed as the Cartilaginous Fish complexes are further divided (i.e., dividing complexes results in management to a lower harvest specification).

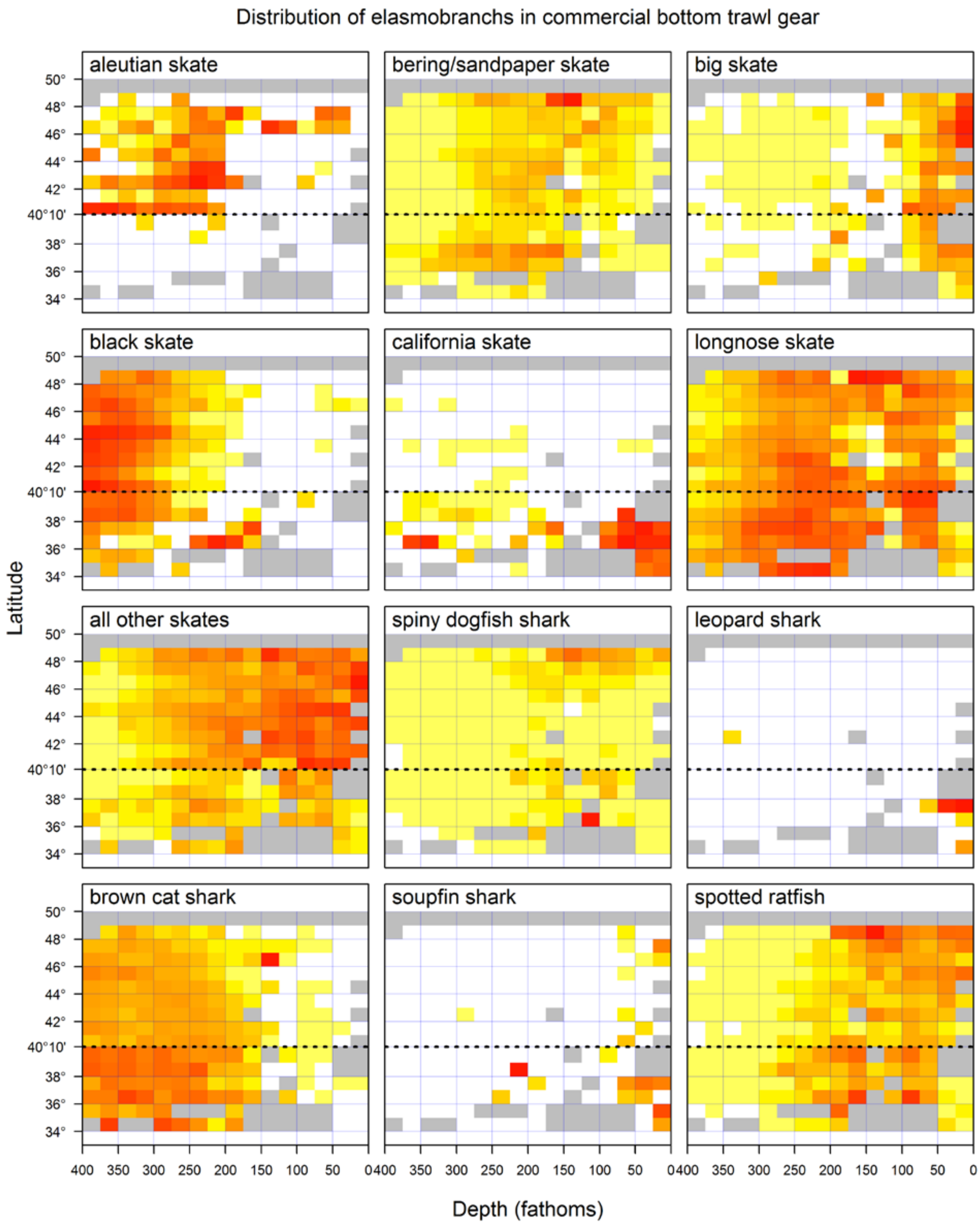

Figure 17. Observed relative CPUE of cartilaginous fish species by depth and latitude in the west coast bottom trawl fishery.

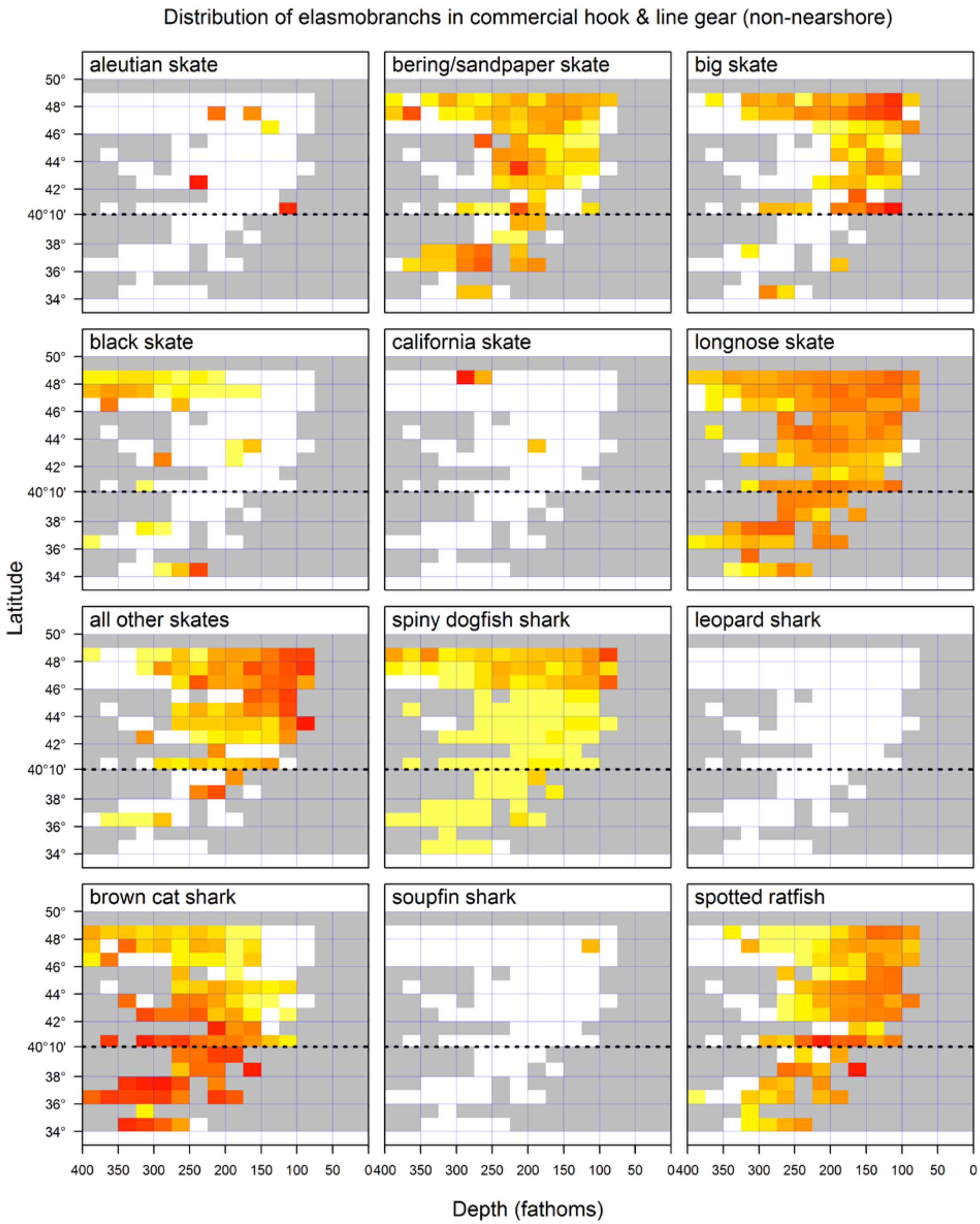

Figure 18. Observed relative CPUE of cartilaginous fish species by depth and latitude in the west coast commercial non-nearshore hook-and-line fisheries.

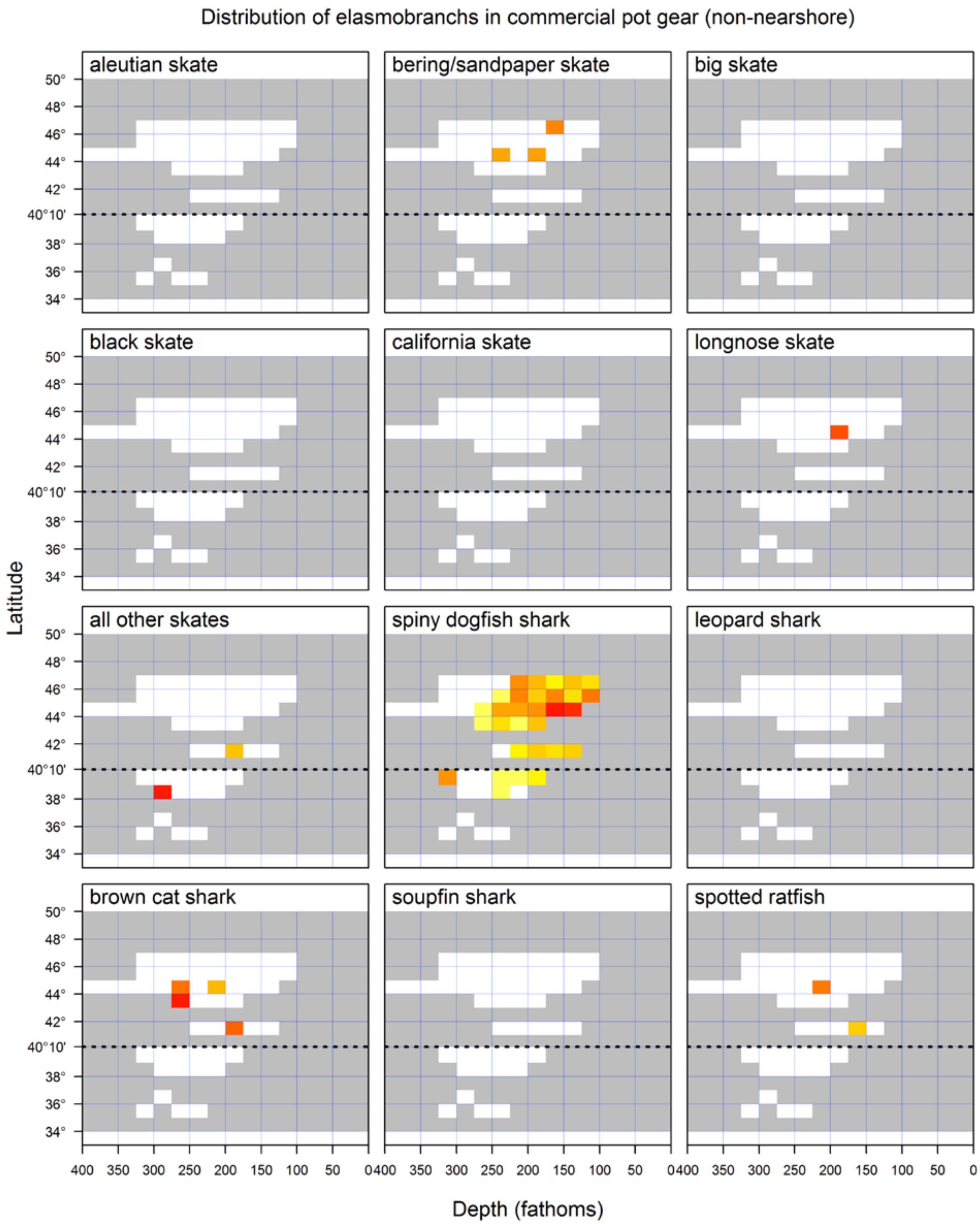

Figure 19. Observed relative CPUE of cartilaginous fish species by depth and latitude in west coast commercial non-nearshore pot gear fisheries.

Table 34. Cartilaginous Species Mortality (mt) by Sector from 2002-2011.

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Aleutian Skate				**0.40**	**1.04**	**2.57**	**3.27**	**3.08**	**5.87**	**1.66**	**17.90**
LE Entry Trawl Permit - Fixed										0.01	0.01
LE Entry Trawl Permit - Trawl				0.40	1.04	2.42	3.20	3.08	5.76	1.65	17.55
Non-nearshore Fixed Gear						0.15	0.07		0.11		0.33
Non-Tribal At-Sea Hake				0.00							0.00
Pink Shrimp						0.00			0.00	0.00	0.00
Bering Skate									**0.03**		**0.03**
Non-nearshore Fixed Gear									0.03		0.03
Big Skate	**42.32**	**168.43**	**189.64**	**250.64**	**173.58**	**170.30**	**89.52**	**106.23**	**32.06**	**75.09**	**1,297.81**
California Halibut	0.93	90.65	49.95	73.26	23.81	10.90	24.39	22.03	25.11	39.87	360.90
Incidental							0.06	0.00	0.00	0.00	0.07
LE Entry Trawl Permit - Fixed										0.01	0.01
LE Entry Trawl Permit - Trawl	40.72	75.35	137.88	145.80	143.62	157.20	60.45	78.16	5.24	31.45	875.87
Nearshore Fixed Gear		1.25	0.07	0.25			0.01			0.02	1.60
Non-nearshore Fixed Gear	0.67	0.96	0.83	30.64	5.50	0.35	4.09	5.94	1.42	3.03	53.42
Non-Tribal At-Sea Hake		0.02	0.52	0.66	0.60	0.69	0.51	0.05	0.22	0.17	3.44
Pink Shrimp			0.06	0.00		1.12	0.00	0.00	0.01	0.22	1.43
Shoreside Hake								0.00		0.24	0.24
Tribal At-Sea Hake		0.20	0.33	0.03	0.04	0.04		0.05	0.05	0.08	0.83
Black Skate	**61.25**	**16.27**	**17.34**	**23.60**	**23.29**	**28.95**	**44.95**	**48.13**	**63.34**	**32.89**	**360.00**
LE Entry Trawl Permit - Fixed										0.61	0.61
LE Entry Trawl Permit - Trawl	16.82	15.50	16.88	23.45	22.80	26.68	44.35	42.03	57.01	24.12	289.65
Non-nearshore Fixed Gear	44.43	0.78	0.46	0.15	0.48	2.26	0.60	6.10	6.30	8.14	69.70
Pink Shrimp									0.03		0.03
Shoreside Hake								0.00		0.01	0.01

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Brown Cat Shark	**67.10**	**74.99**	**50.99**	**53.51**	**55.45**	**45.87**	**74.59**	**87.52**	**119.29**	**122.38**	**751.70**
California Halibut									0.69	0.00	0.69
LE Entry Trawl Permit - Fixed										0.36	0.36
LE Entry Trawl Permit - Trawl	60.27	54.62	41.83	26.74	28.92	33.29	51.70	78.48	38.43	30.81	445.08
Non-nearshore Fixed Gear	6.51	19.51	5.43	12.54	15.91	4.08	5.95	4.32	5.41	4.93	84.58
Non-Tribal At-Sea Hake	0.32	0.87	3.73	14.23	10.63	8.50	16.83	4.67	63.49	82.91	206.18
Shoreside Hake									11.27	3.25	14.52
Tribal At-Sea Hake							0.12	0.06		0.12	0.29
California Skate	**7.49**	**69.40**	**47.83**	**89.15**	**50.65**	**17.69**	**17.15**	**10.59**	**15.80**	**9.21**	**334.96**
California Halibut	1.34	22.75	37.37	53.71	24.91	9.81	13.08	7.46	12.37	6.82	189.61
Incidental							0.01				0.01
LE Entry Trawl Permit - Fixed										0.00	0.00
LE Entry Trawl Permit - Trawl	6.14	44.62	10.41	35.44	25.74	7.81	4.05	3.10	3.16	2.39	142.85
Nearshore Fixed Gear		1.33	0.02						0.02		1.37
Non-nearshore Fixed Gear	0.01	0.71	0.02			0.07		0.03	0.26		1.10
Pink Shrimp			0.01				0.01				0.02
Leopard Shark	**13.67**	**11.72**	**11.82**	**20.64**	**15.72**	**11.97**	**5.68**	**2.98**	**3.17**	**7.95**	**105.32**
California Halibut	0.72	2.28	0.98	7.79	4.94	1.22	2.76	1.24	0.49	5.60	28.02
Incidental	6.86	5.92	4.89	5.53	7.10	7.91	1.84	1.25	1.79	1.98	45.08
LE Entry Trawl Permit - Trawl	0.01	0.06	0.03	0.89	0.02	0.02				0.03	1.06
Nearshore Fixed Gear	0.23	0.20	0.22	0.51	1.06	1.03	0.35	0.15	0.21	0.18	4.14
Non-nearshore Fixed Gear	5.77	3.22	5.64	5.93	2.59	1.78	0.73	0.34	0.66	0.16	26.83
Pink Shrimp	0.07	0.05	0.06		0.01				0.03		0.21

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Longnose Skate	**231.50**	**216.39**	**455.78**	**774.21**	**670.66**	**651.90**	**648.16**	**1,468.38**	**1,323.18**	**1,006.04**	**7,446.20**
California Halibut	10.50	9.61	11.17	2.20	1.39	0.39	0.95		0.11	0.23	36.56
Incidental								1.25	2.18	1.07	4.50
LE Entry Trawl Permit - Fixed										15.08	15.08
LE Entry Trawl Permit - Trawl	174.94	156.74	384.08	675.29	522.05	565.61	555.83	1,284.27	1,209.04	846.74	6,374.58
Nearshore Fixed Gear			0.17			0.01		0.04	0.06	0.07	0.36
Non-nearshore Fixed Gear	46.06	50.04	58.47	94.55	147.11	83.80	90.02	180.50	109.45	138.06	998.05
Non-Tribal At-Sea Hake			0.42	0.63	0.11	0.57	0.11	0.04	0.55	0.41	2.83
Pink Shrimp			1.44	1.54		1.31	1.26	2.05	0.31	0.49	8.39
Shoreside Hake								0.09	0.15	0.18	0.43
Tribal At-Sea Hake			0.04			0.20		0.13		0.01	0.38
Tribal Shoreside									1.34	3.70	5.04
Sandpaper Skate	**29.89**	**41.72**	**67.04**	**87.48**	**85.63**	**81.29**	**90.78**	**93.36**	**52.65**	**33.06**	**662.90**
California Halibut			0.06	0.53	0.13	0.08			0.01		0.81
LE Entry Trawl Permit - Fixed										0.10	0.10
LE Entry Trawl Permit - Trawl	29.85	41.48	66.22	85.29	84.86	80.12	90.26	91.93	50.99	31.28	652.27
Non-nearshore Fixed Gear	0.03	0.25	0.69	1.58	0.64	1.07	0.49	1.38	1.63	1.66	9.43
Non-Tribal At-Sea Hake				0.01		0.00	0.01		0.00	0.00	0.02
Pink Shrimp			0.06	0.07		0.02	0.02	0.05	0.02	0.02	0.27

Species and Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Soupfin Shark	**32.14**	**36.63**	**27.56**	**28.94**	**31.28**	**17.87**	**7.89**	**4.48**	**3.43**	**5.17**	**195.39**
California Halibut		0.42	0.30	2.49	0.43	0.16	0.08	0.02	0.06	1.71	5.66
Incidental	30.68	34.19	25.09	24.22	25.52	16.47	6.98	3.52	1.83	1.97	170.47
LE Entry Trawl Permit - Fixed										0.00	0.00
LE Entry Trawl Permit - Trawl	0.31	0.60	1.27	0.77	1.06	0.13	0.18	0.22	0.19	0.57	5.31
Nearshore Fixed Gear	0.42	0.32	0.22	0.17	1.13	0.09	0.24	0.38	0.32	0.05	3.36
Non-nearshore Fixed Gear	0.58	0.74	0.42	0.38	0.44	0.35	0.25	0.08	0.25	0.25	3.73
Non-Tribal At-Sea Hake		0.12	0.03	0.42	0.94	0.53	0.12		0.20	0.12	2.48
Pink Shrimp	0.12		0.08		0.01						0.22
Shoreside Hake	0.02		0.15		1.74	0.14	0.04	0.16	0.59	0.51	3.34
Tribal At-Sea Hake		0.24		0.50				0.09			0.83
Spiny Dogfish Shark	**2,106.88**	**1,297.44**	**1,781.44**	**2,451.75**	**1,415.84**	**1,457.33**	**2,448.81**	**1,185.13**	**1,155.25**	**1,597.64**	**16,897.51**
California Halibut	2.79	6.22	34.84	24.94	8.33	2.97	3.21	3.20	3.00	1.58	91.09
Incidental	134.01	170.48	98.32	7.72	6.38	0.18	15.34	1.26	1.23	0.08	435.01
LE Entry Trawl Permit - Fixed										27.12	27.12
LE Entry Trawl Permit - Trawl	1,009.62	624.28	643.81	1,591.34	730.43	633.70	1,017.63	658.53	446.90	366.96	7,723.19
Nearshore Fixed Gear	0.01	0.59	0.04	0.17	0.03	0.27	0.78	0.49	0.10	0.27	2.75
Non-nearshore Fixed Gear	630.42	217.09	316.26	369.76	501.03	493.87	373.42	212.15	251.95	107.69	3,473.64
Non-Tribal At-Sea Hake	37.18	11.22	338.43	70.14	23.27	86.12	512.54	34.61	155.77	726.51	1,995.78
Pink Shrimp	0.02		4.85	1.19		0.74	4.12	0.47	15.98	0.10	27.46
Shoreside Hake	29.50	4.30	30.33	95.60	34.33	51.38	59.50	20.74	151.46	181.04	658.17
Tribal At-Sea Hake	262.16	259.46	274.50	285.23	35.26	68.89	159.39	128.24	121.96	58.57	1,653.66
Tribal Shoreside	1.18	3.79	40.06	5.66	76.78	119.20	302.88	125.45	6.90	127.72	809.62
Grand Total	**2,592.24**	**1,932.98**	**2,649.43**	**3,780.33**	**2,523.14**	**2,485.75**	**3,430.80**	**3,009.89**	**2,774.09**	**2,891.09**	**28,069.73**

4.2.6 Roundfish

The species comprising the Other Fish complex have disparate life histories, ecological relationships, distributions, and vulnerabilities to overfishing (Table 35).

Table 35. Roundfish stocks (non-FMP stocks in bold) ranked by depth group and relative productivity. Productivity (P) and vulnerability (V) scores are from the GMT's PSA analysis.

Depth group	Stock	P	Relative P	V	Relative V
Nearshore	California scorpionfish	1.83	High	1.41	Low
	Kelp greenling	1.83	High	1.62	Low
	rock greenling	1.78	High	1.77	Low
	Cabezon	1.72	High	1.68	Low
Shelf	Pacific cod	2.11	High	1.34	Low
	Pacific whiting	2	High	1.69	Low
	Lingcod	1.75	Low	1.55	Low
	Ratfish	1.63	Low	1.72	Low
Slope	California slickhead	2.06	High	1.14	Low
	Finescale codling	1.72	High	1.48	Low
	Sablefish	1.61	High	1.64	Low
	Pacific grenadier	1.44	Low	1.82	Med
	Giant grenadier	1.33	Low	1.87	Med

The actual status quo alternative for this group of species is the Other Fish complex. However, this complex is so misaligned and poorly constructed with disparate species of different life histories, different distributions, different productivities, and different vulnerabilities that analyzing the Other Fish complex as a viable alternative was not even contemplated. Therefore, the status quo complex alternative for roundfish analyzed in this document is comprised of only the roundfish stocks that are currently managed in the Other Fish complex (Table 17). Given this, status quo complex demonstrates large inflator species (e.g., Pacific grenadier) (Figure 20). Alternatives 2 and 3 demonstrate the best improvement over status quo, although this group is still a bit of a mixed species assemblage. The evenness in the Grenadier or Deep Roundfish complex is poor because Pacific grenadier dominates.

All roundfish alternatives consider the addition of non-FMP species, including all grenadiers and all greenlings. Most grenadiers and greenlings landed in West Coast fisheries are landed in general market categories of “unspecified grenadiers” and “unspecified greenlings”, respectively; therefore, adding all endemic grenadiers and greenlings to the FMP will allow more accurate OFL estimates using approved catch-based methods. Of the non-FMP grenadiers contemplated for inclusion in the FMP, giant grenadier is present in greater densities than the other endemic grenadiers according to trawl survey CPUEs.

The status quo assemblage of roundfish stocks does not align the relative productivities (and vulnerabilities) of component stocks well due to the lower productivity and higher vulnerability of grenadier (Table 35 and Table 36). All of the action alternatives better align the productivities and vulnerabilities of component stocks since the grenadiers are either managed in their own complex (Alternative 1) or included in an assemblage of deeper roundfish (Alternative 2).

Table 36. Summary of status quo (SQ) and proposed roundfish complexes in relation to several removal-based diagnostics. See text for descriptions of each measure.

Alternative	P	Cumulative removal difference (mt)		Evenness		Ratios
		Maximum	Minimum	$\text{Removals}_{\text{median}}$	OFL	%Slope = 0
SQ	-	87	-9955	0.83	0.48	0.25
Alt 1 cab-greenlings	+			0.36	0.39	0.40
Alt 1 grenadiers	+			0.30	0.00	0.73
Alt 2 NS roundfishes	+			0.41	0.59	0.67
Alt 2 deep roundfishes	+			0.34	0.00	0.67

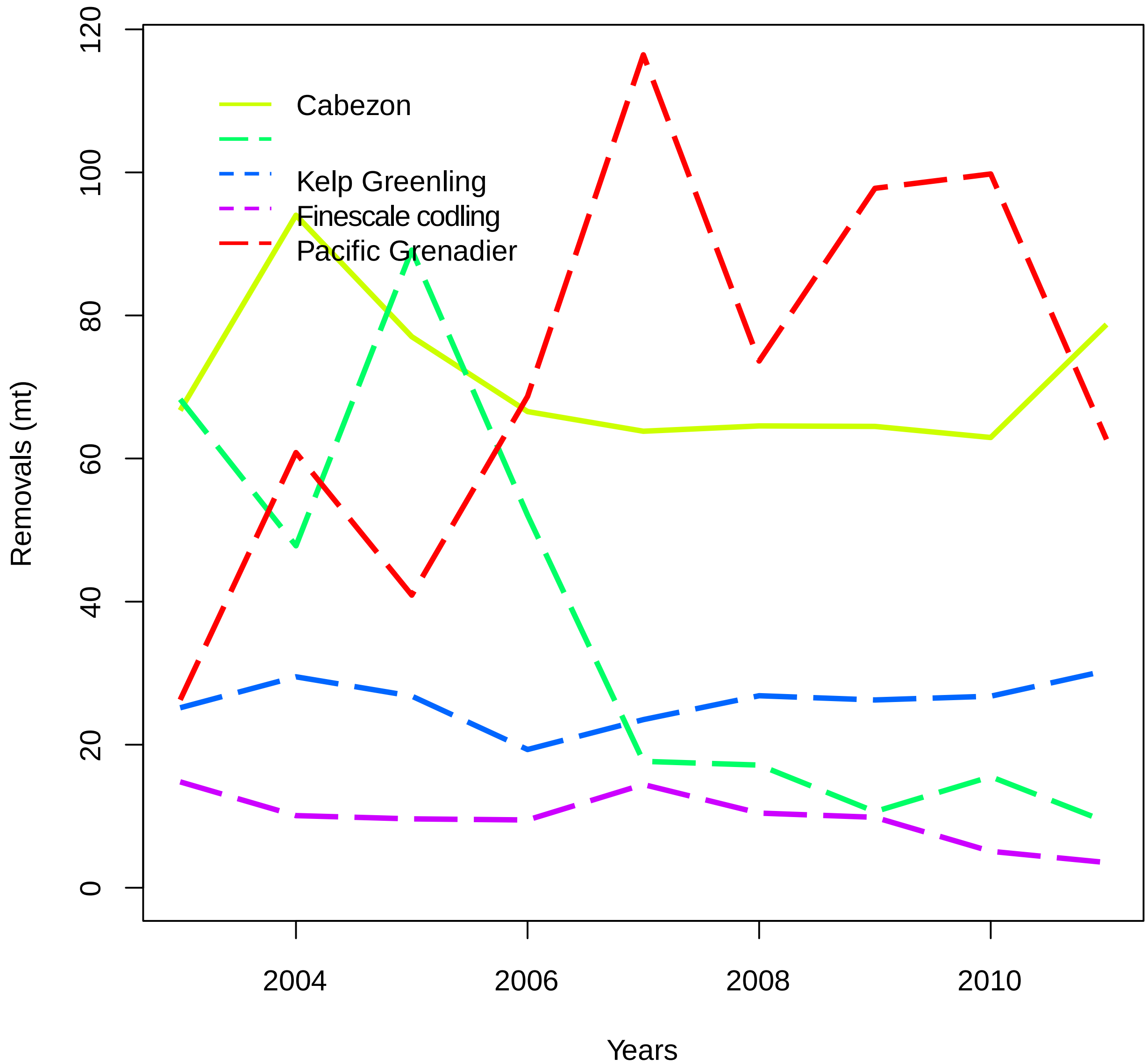

Figure 20. Annual total mortality (minus research catches) of roundfish stocks in the Other Fish stock complex, 2003-2011.

4.2.6.1 Historical Catch By Sector

Historical catch by sector for roundfish species is provided in Table 37.

4.2.6.2 Management Measures and Inseason Response

Roundfish stocks managed in the Other Fish complex are managed to the complex ACL and are not currently allocated by sector.

Management measures that control roundfish mortality in the trawl sectors include trip limits for the shorebased IFQ fishery and co-op management of set-asides for the at-sea sectors. In the non-trawl sectors, the primary management measure that controls roundfish landings are bimonthly trip limits for the limited entry and open access fixed gear fleets. RCAs are also available for both sectors which could be effective at controlling roundfish mortality (Figure 21, Figure 22, and Figure 23). Roundfish species are also included in the recreational bag limits for the three states; however, only the shallow species (i.e., kelp greenling and cabezon) are targeted in recreational fisheries.

Roundfish Alternative 1 contemplates managing roundfish in two complexes – grenadiers and nearshore roundfish. The alternative also proposes to add Giant grenadier and all other endemic grenadiers to the FMP. All endemic grenadier, except Pacific and giant grenadier, would be specified as EC species. Finescale codling would be added as an EC species. The EC species designation is not anticipated to result in any changes to management measures.

Grenadiers are primarily caught by the limited entry bottom trawl sector and to a lesser extent the non-nearshore fixed gear fisheries (Table 37). As such, the proposed Grenadier complex under Alternative 1 would primarily affect those sectors. Recent catches have not approached the OFL estimates; therefore, no adjustments to management measures are anticipated to be needed. In the event catch of grenadier needs to be reduced, trip limit adjustments may be somewhat ineffective, given that a large proportion of the historical catch is discarded. Grenadiers are also ubiquitous in deeper waters and thus seaward adjustments to RCAs would likely be ineffective. This may not be an issue since grenadier are distributed in depths much greater than the 700 fm limit specified for the bottom trawl fishery, the sector with the largest grenadier bycatch.

Alternative 1 proposes to add the Oregon cabezon stock to the nearshore roundfish as an indicator stock to represent the more vulnerable species within the complex. The California and Oregon substocks of cabezon and California scorpionfish would be added to the nearshore roundfish complex as an indicator stocks under Alternative 2. National Standard 1 recommends that if an indicator stock is less vulnerable than other members of the complex, management measures need to be more conservative so that the more vulnerable members of the complex are not at risk from the fishery. Cabezon have similar vulnerabilities to the other species in the nearshore roundfish complex (Table 35). Discussion topics: How would the management measures work? Would the TLs apply to all species in that complex?

All endemic grenadier, other than Pacific and giant grenadier, would be designated as EC species. The EC species designation is not anticipated to result in any changes to management measures.

The limited entry bottom trawl sector and to a lesser extent the non-nearshore fixed gear fisheries would be most affected by the Deep Roundfish complex, which contains grenadier, finescale codling, and California slickhead (Table 37). The depth distribution of grenadiers is much deeper than the bottom trawl fishery is allowed and deeper than any of the current non-trawl fisheries tend to operate. Therefore, the effect of establishing a Deep Roundfish complex on management is anticipated to be negligible.

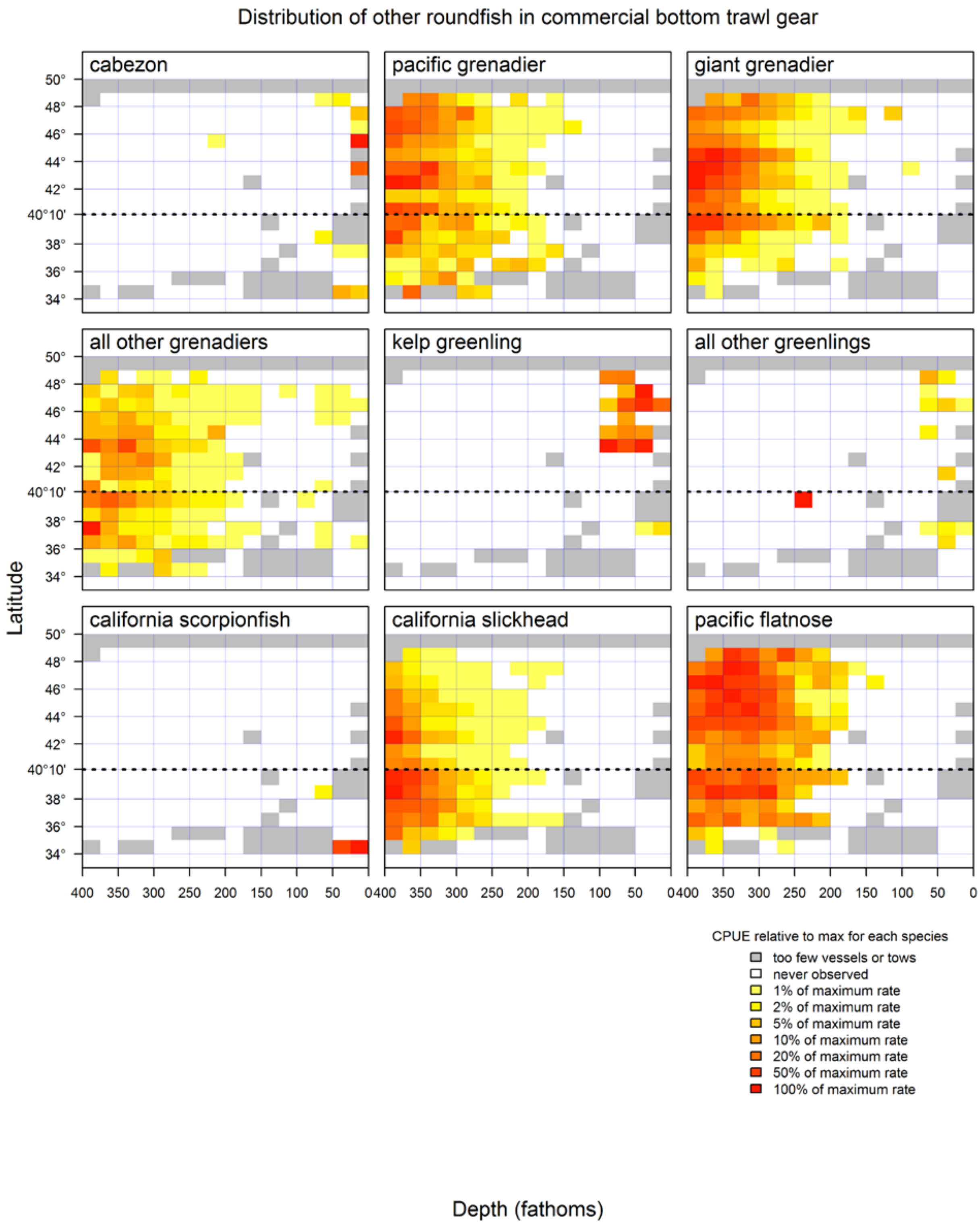

Figure 21. Observed relative CPUE of roundfish species by depth and latitude in the west coast bottom trawl fishery.

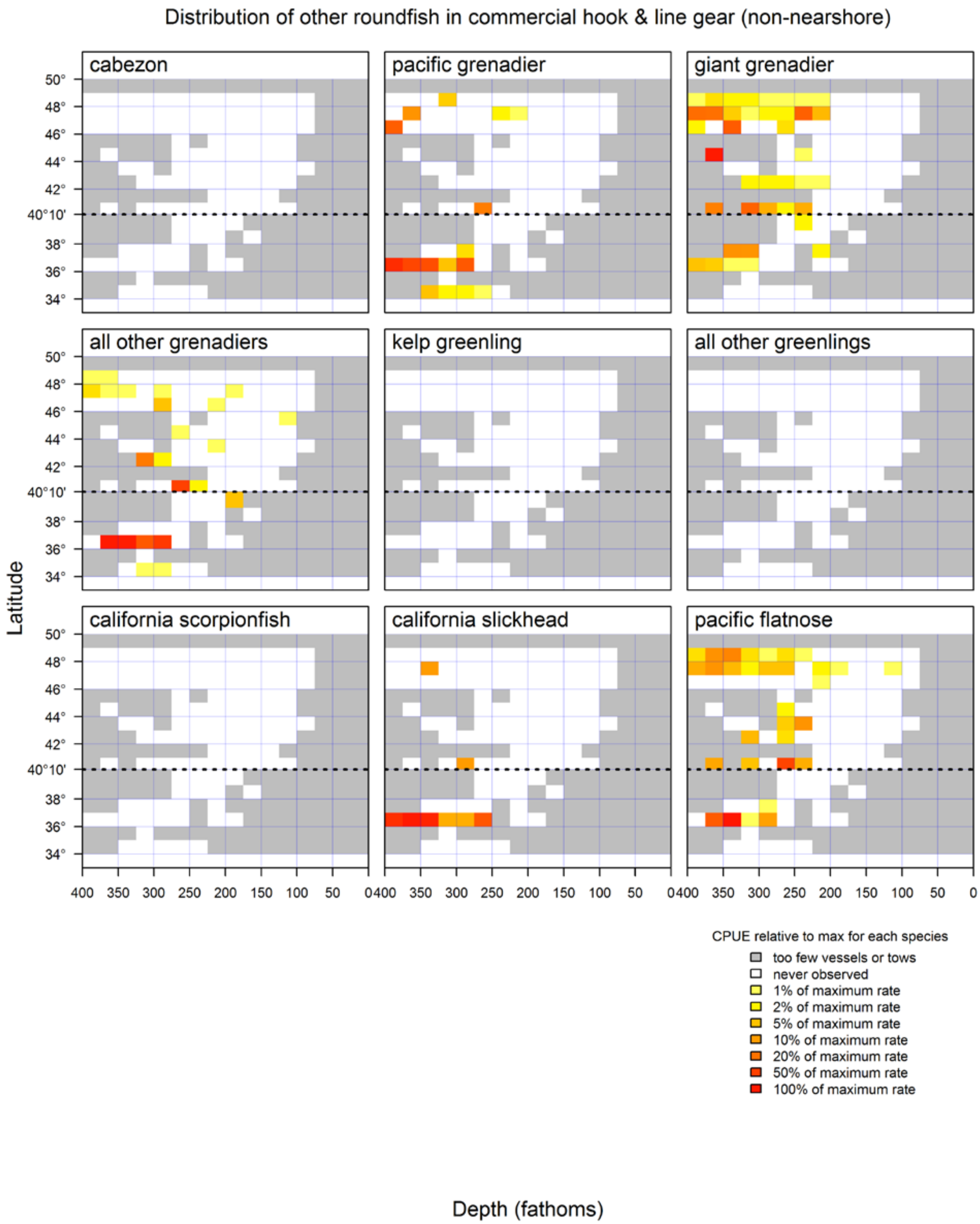

Figure 22. Observed relative CPUE of roundfish species by depth and latitude in the west coast commercial non-nearshore hook-and-line fisheries.

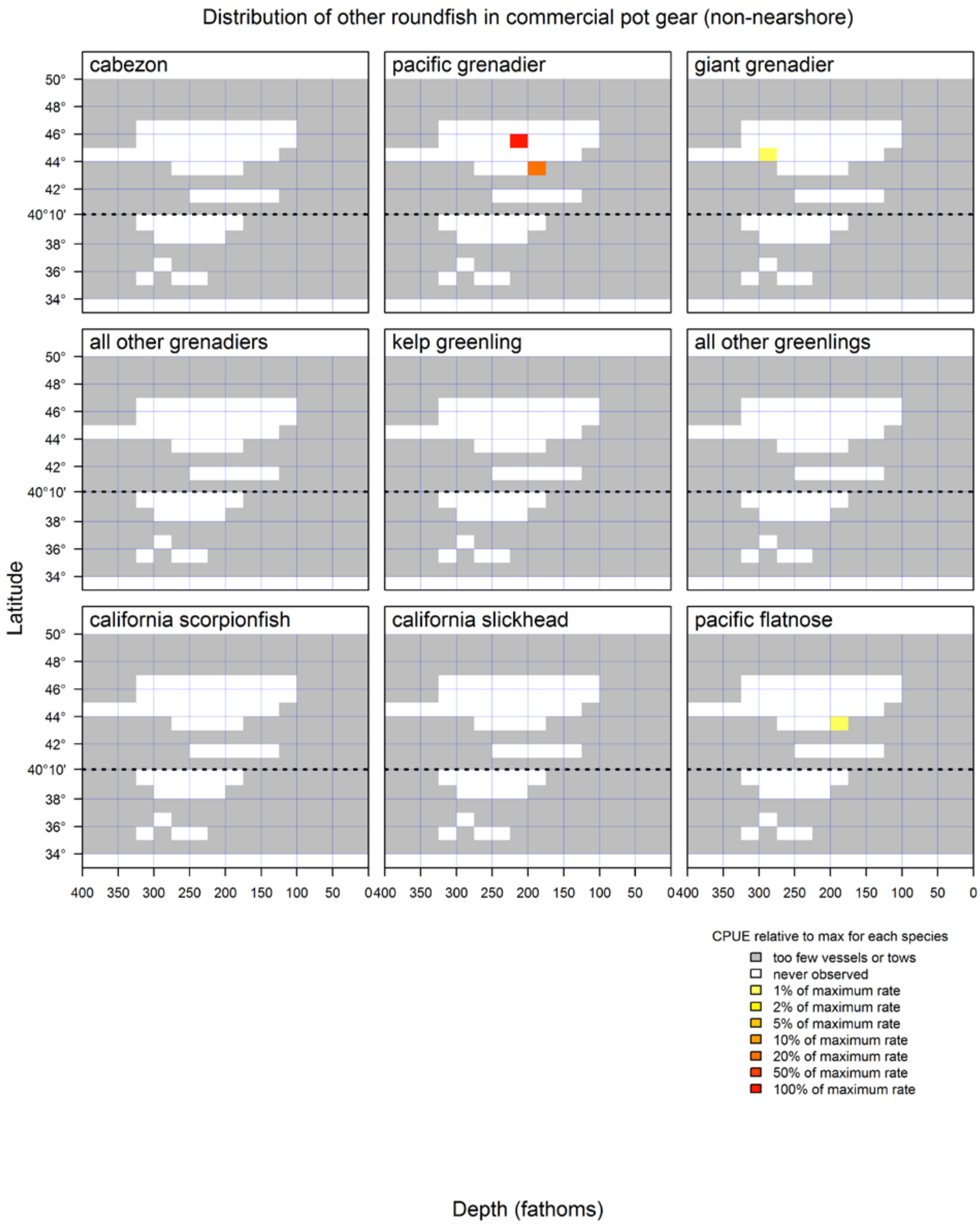

Figure 23. Observed relative CPUE of roundfish species by depth and latitude in west coast commercial non-nearshore pot gear fisheries.

Table 37. Roundfish Species Mortality (mt) by Sector from 2002-2011.

Species and Sectors	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Cabezon	**96.25**	**69.29**	**77.96**	**60.74**	**52.05**	**48.38**	**48.38**	**49.06**	**46.93**	**62.34**	**611.39**
California Halibut		0.07	0.00	0.03	0.01	0.01					0.12
Incidental	0.36	0.11	0.13	0.14	0.12	0.16	0.13	0.03	0.05	0.08	1.31
Limited Entry Trawl Permit - Trawl Gear	0.07	0.05	0.03	0.11	0.10	0.10	0.13	0.05	0.01	0.00	0.66
Nearshore Fixed Gear	95.82	68.80	77.79	60.46	51.62	48.10	48.12	48.97	46.87	62.26	608.83
Non-nearshore Fixed Gear		0.25			0.20						0.44
Pink Shrimp				0.01		0.01		0.01	0.00		0.02
California Scorpionfish	**13.52**	**9.55**	**5.63**	**5.96**	**2.69**	**4.11**	**4.47**	**4.66**	**4.24**	**4.82**	**59.65**
California Halibut	0.01	0.04	0.15	0.01		0.58	1.02	0.01	0.38	0.28	2.49
Incidental	2.19	0.37	0.64	0.70	0.44	0.26	0.30	0.14	0.19	0.24	5.48
Limited Entry Trawl Permit - Trawl Gear	0.04	0.01									0.05
Nearshore Fixed Gear	10.10	6.38	2.47	2.25	0.86	1.91	2.46	4.25	3.57	3.25	37.50
Pink Shrimp	1.17	2.75	2.36	3.00	1.39	1.36	0.68	0.27	0.10	1.05	14.13
California Slickhead	**30.21**	**28.47**	**21.89**	**14.88**	**17.06**	**20.34**	**26.28**	**30.60**	**43.16**	**17.46**	**250.35**
Limited Entry Trawl Permit - Fixed Gear										0.01	0.01
Limited Entry Trawl Permit - Trawl Gear	30.11	28.19	21.85	14.25	16.72	19.78	26.22	30.39	42.23	16.99	246.72
Non-nearshore Fixed Gear	0.10	0.28	0.04	0.63	0.35	0.57	0.06	0.21	0.93	0.45	3.62
Giant Grenadier	**410.08**	**265.25**	**118.30**	**89.67**	**142.93**	**162.21**	**161.97**	**212.46**	**197.03**	**117.84**	**1,877.74**
Limited Entry Trawl Permit - Fixed Gear										4.09	4.09
Limited Entry Trawl Permit - Trawl Gear	405.04	253.96	115.08	86.34	141.18	160.59	151.39	194.36	176.64	86.89	1,771.47
Non-nearshore Fixed Gear	5.05	11.30	3.22	3.33	1.74	1.62	10.57	18.10	20.39	26.77	102.09
Non-Tribal At-Sea Hake							0.01			0.08	0.09

Species and Sectors	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Grenadier Unid	**626.67**	**603.17**	**326.26**	**189.16**	**125.05**	**132.86**	**132.05**	**122.86**	**142.97**	**143.09**	**2,544.16**
California Halibut				0.00							0.00
Incidental	2.46	0.15		2.94	0.19				0.42		6.16
Limited Entry Trawl Permit - Fixed Gear										8.56	8.56
Limited Entry Trawl Permit - Trawl Gear	530.11	484.54	250.28	118.11	91.82	93.64	72.89	96.31	110.03	97.76	1,945.47
Nearshore Fixed Gear	0.21								0.10	0.61	0.92
Non-nearshore Fixed Gear	93.89	118.48	75.97	68.12	33.03	39.21	59.13	26.55	32.41	36.02	582.81
Non-Tribal At-Sea Hake	0.01	0.00	0.00			0.01	0.03		0.01	0.14	0.21
Pink Shrimp			0.00							0.00	0.00
Shoreside Hake			0.00		0.02						0.02
Kelp Greenling	**61.86**	**25.76**	**25.78**	**23.13**	**17.58**	**20.27**	**24.11**	**23.16**	**20.40**	**23.72**	**265.77**
California Halibut				0.01							0.01
Incidental	0.02	0.01	0.00	0.00	0.00	0.02	0.01			0.01	0.07
Limited Entry Trawl Permit - Trawl Gear	0.26	0.00	0.11	0.14	0.04	0.16	0.00	0.03	0.00	0.06	0.80
Nearshore Fixed Gear	61.58	25.75	25.67	22.98	16.93	20.09	24.09	23.13	20.40	23.65	264.27
Non-nearshore Fixed Gear					0.61						0.61
Non-Tribal At-Sea Hake				0.00	0.00						0.00
Pacific Flatnose	**14.29**	**26.49**	**11.09**	**11.33**	**9.75**	**15.21**	**14.10**	**11.33**	**18.56**	**6.62**	**138.77**
Limited Entry Trawl Permit - Fixed Gear										0.58	0.58
Limited Entry Trawl Permit - Trawl Gear	13.77	14.79	10.08	9.63	9.47	14.44	10.43	9.85	12.06	2.95	107.47
Non-nearshore Fixed Gear	0.52	11.70	1.01	1.70	0.28	0.77	3.66	1.48	6.50	3.10	30.72
Non-Tribal At-Sea Hake			0.00				0.00				0.00
Pacific Grenadier	**164.00**	**27.81**	**65.93**	**43.76**	**76.09**	**126.08**	**78.52**	**117.09**	**212.19**	**120.46**	**1,031.93**
Limited Entry Trawl Permit - Fixed Gear										11.08	11.08
Limited Entry Trawl Permit - Trawl Gear	162.59	26.27	60.83	40.89	68.68	116.43	73.62	97.77	189.45	51.53	888.06
Non-nearshore Fixed Gear	1.41	1.54	5.10	2.86	7.41	9.65	4.90	19.32	22.74	57.82	132.75
Non-Tribal At-Sea Hake					0.00					0.03	0.03

Species and Sectors	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Rock Greenling			**0.52**			**0.00**		**0.01**	**0.03**	**0.00**	**0.57**
Nearshore Fixed Gear			0.52			0.00		0.01	0.03	0.00	0.57
Grand Total	**1,416.88**	**1,055.79**	**653.36**	**438.65**	**443.21**	**529.46**	**489.87**	**571.23**	**685.52**	**496.35**	**6,780.33**

CHAPTER 5 LITERATURE CITED

PFMC (2010). Allocation of harvest opportunity between sectors of the Pacific coast groundfish fishery [FMP Amendment 21]; Final environmental impact statement. Pacific Fishery Management Council. Portland, OR, Pacific Fishery Management Council and National Marine Fisheries Service.

PFMC and NMFS (2012). Proposed Harvest Specifications and Management Measures for the 2013-2014 Pacific Coast Groundfish Fishery and Amendment 21-2 to the Pacific Coast Groundfish Fishery Management Plan, Final Environmental Impact Statement. Pacific Fishery Management Council and National Marine Fisheries Service. Seattle, National Marine Fisheries Service, Northwest Region.

FIGURES AND TABLES DEPICTING AT-SEA HAKE AND RECREATIONAL FISHERY CATCH AND EFFORT DATA FOR SLOPE ROCKFISH, CARTILAGINOUS FISHES, AND ROUNDFISHES: SUPPLEMENTAL TO "CONSIDERATIONS FOR RESTRUCTURING WEST COAST GROUNDFISH STOCK COMPLEXES: PRELIMINARY ALTERNATIVES AND ANALYSES"

The following tables and figures provide catch and effort data for the at-sea hake and recreational fisheries for the species in the slope rockfish complexes and those in the Other Fish complex (e.g., cartilaginous fishes and roundfishes).

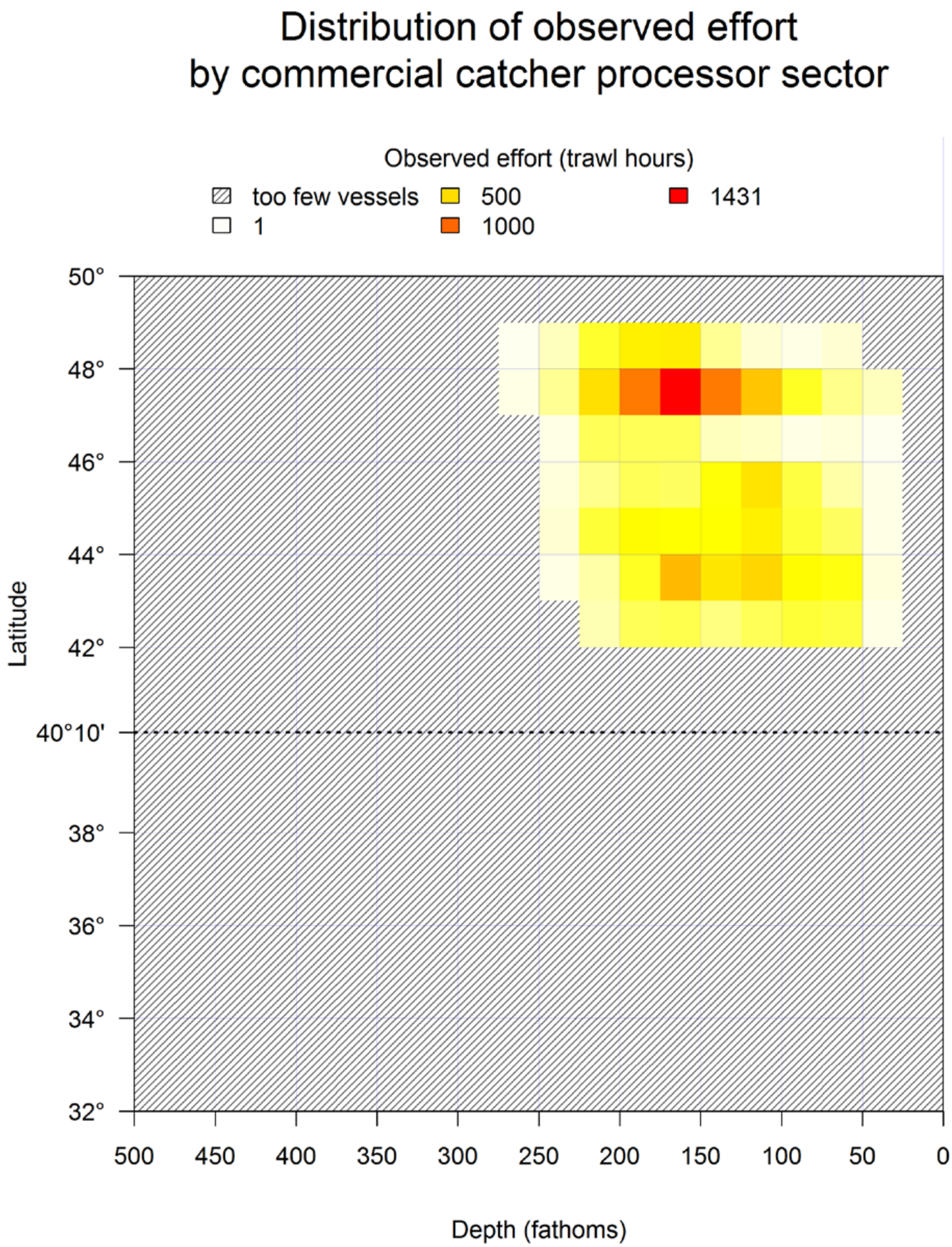

Figure 1. Distribution of observed effort in the catcher-processor sector, 2002-2011.

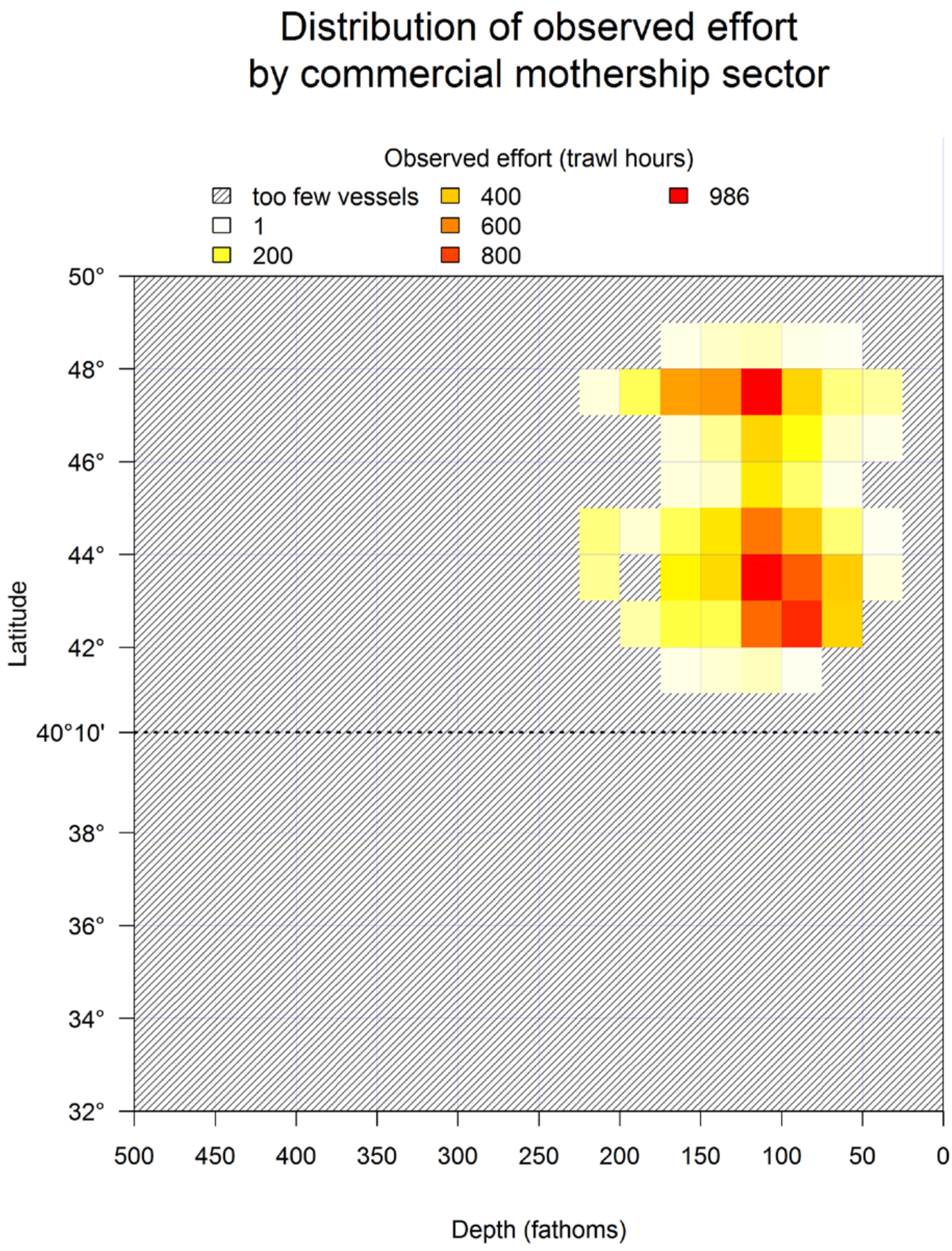

Figure 2. Distribution of observed effort in the mothership sector, 2002-2011.

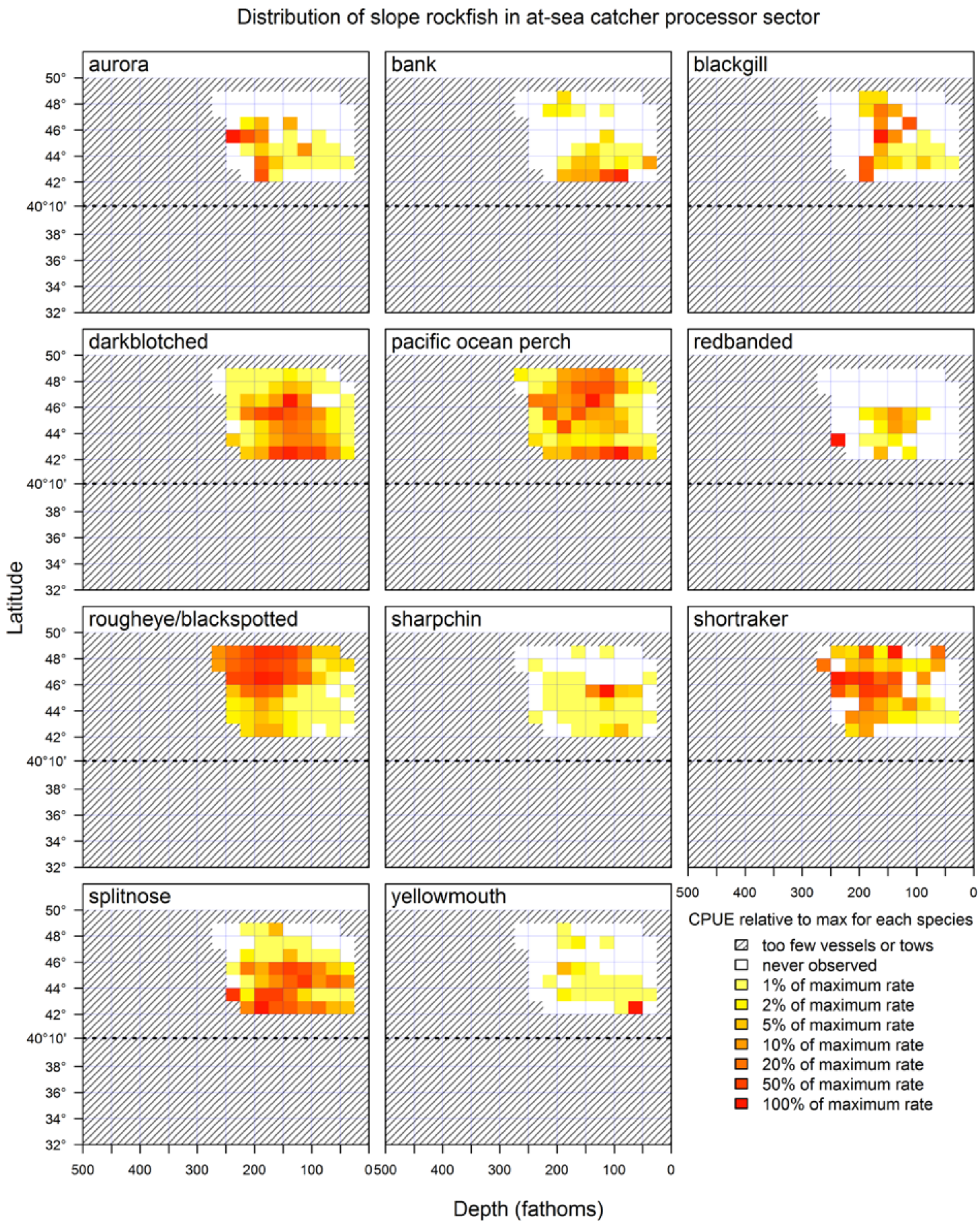

Figure 3. Distribution of observed catch of slope rockfish in the catch-processor sector, 2002-2011.

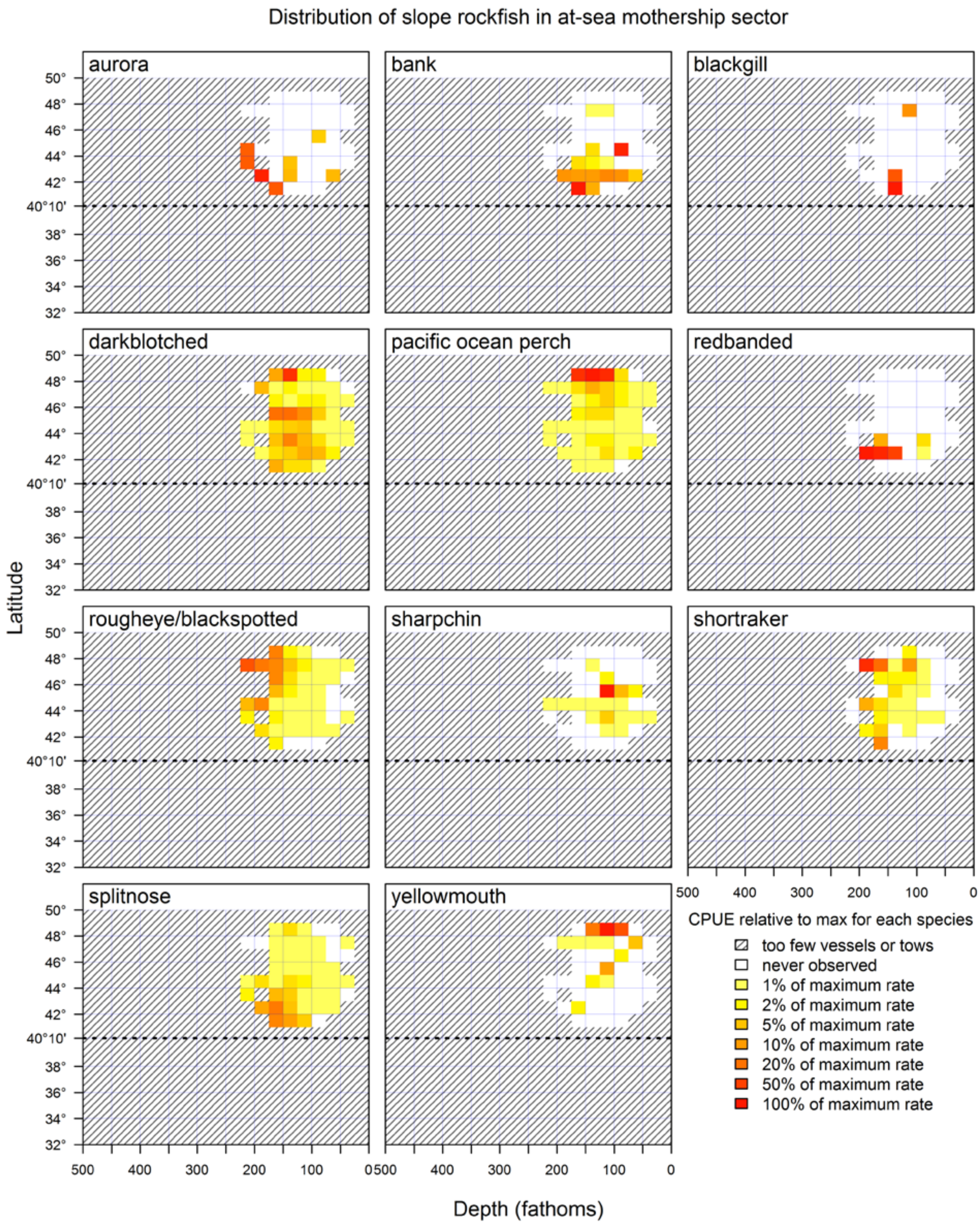

Figure 4. Distribution of observed catch of slope rockfish in the mothership sector, 2002-2011.

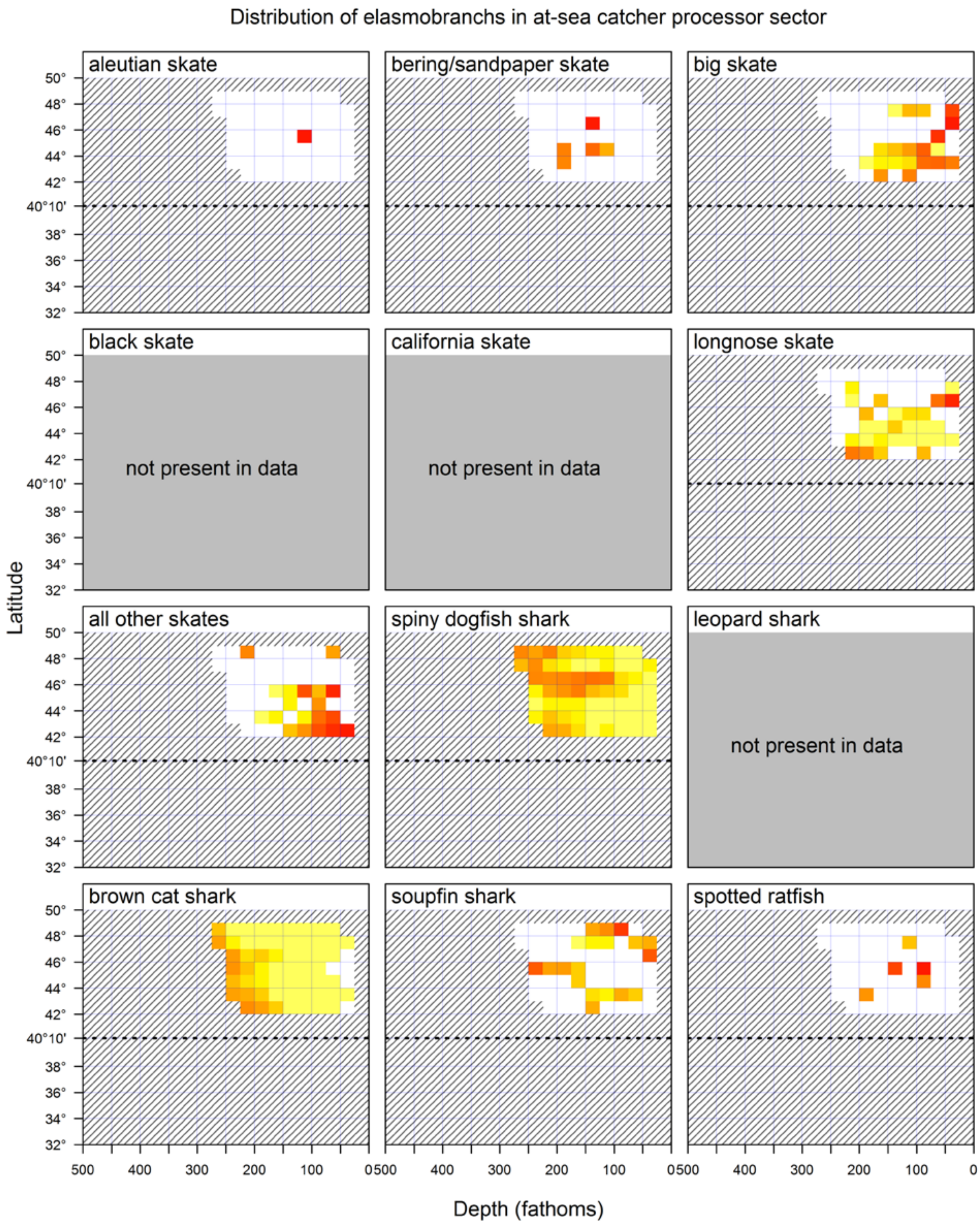

Figure 5. Distribution of observed catch of cartilaginous fishes in the catch-processor sector, 2002-2011.

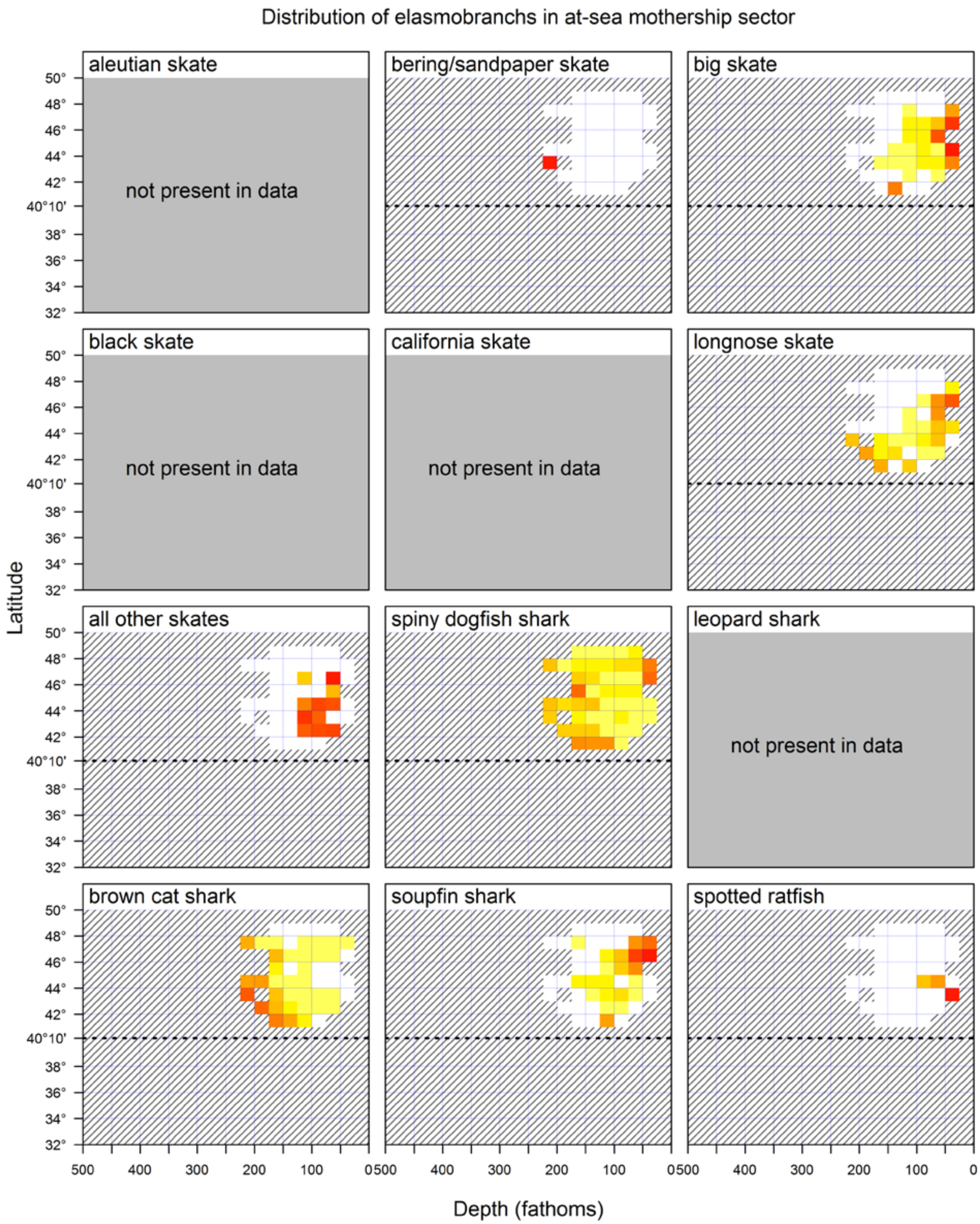

Figure 6. Distribution of observed catch of cartilaginous fishes in the mothership sector, 2002-2011.

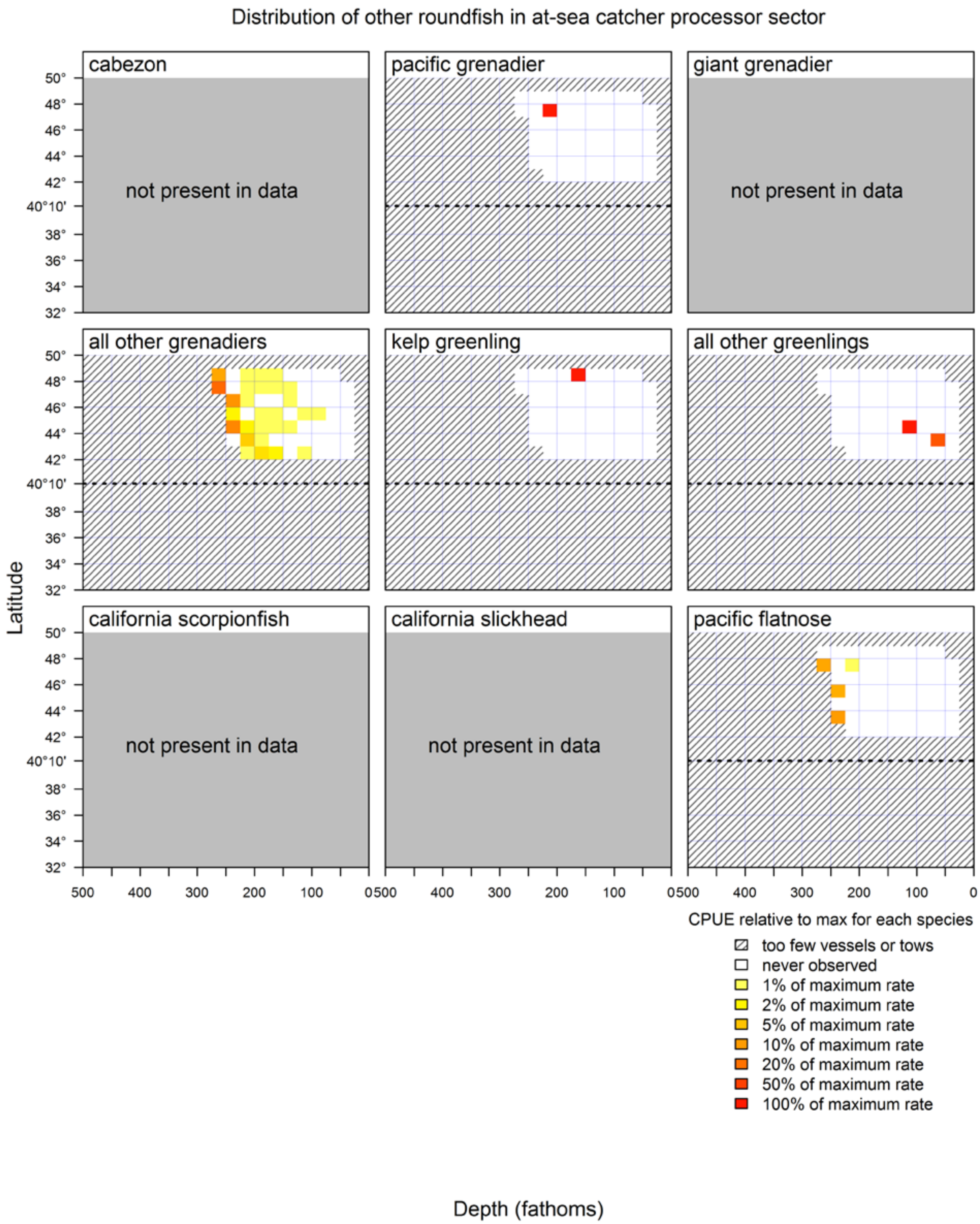

Figure 7. Distribution of observed catch of other roundfishes in the catcher-processor sector, 2002-2011.

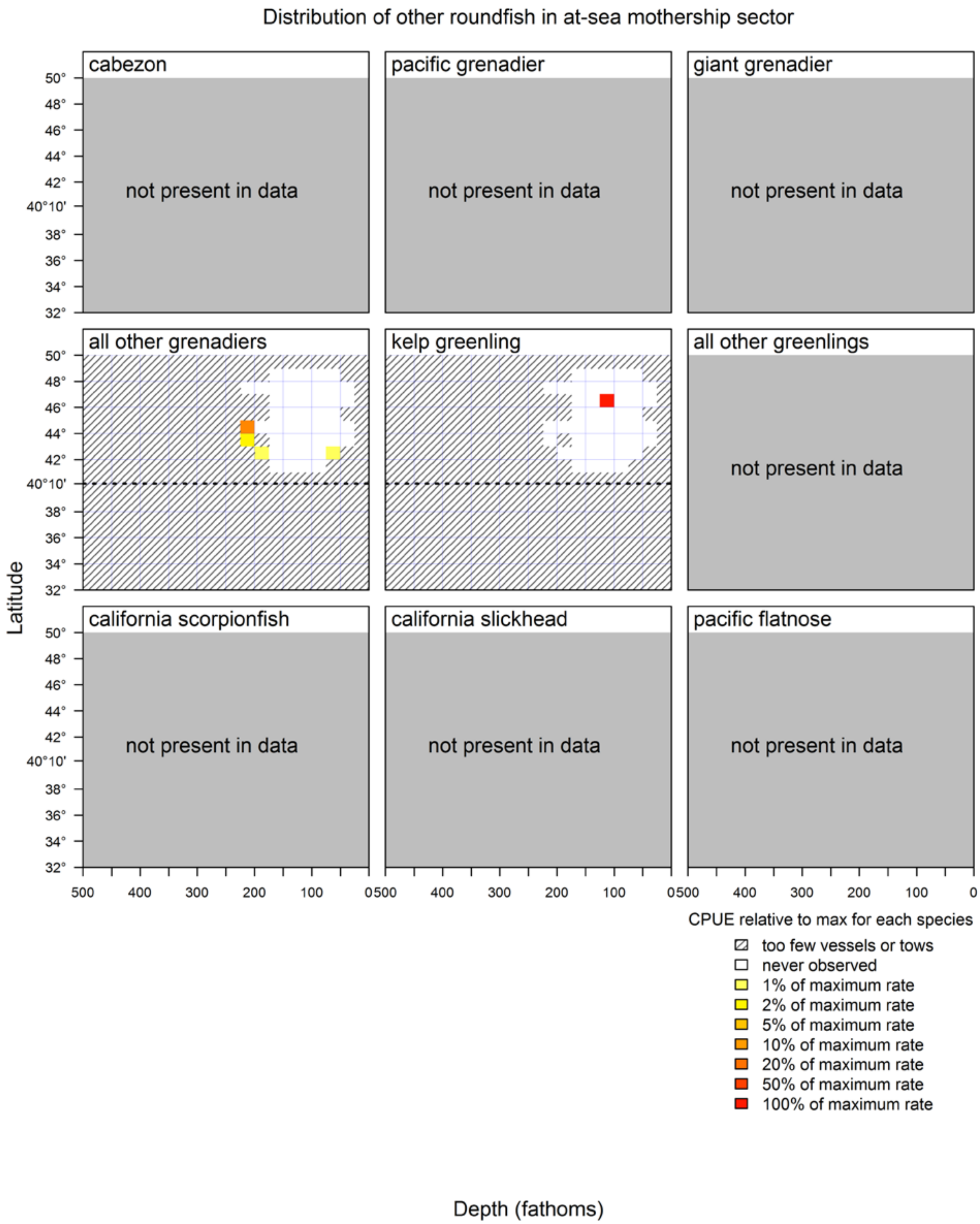

Figure 8. Distribution of observed catch of other roundfishes in the mothership sector, 2002-2011.

Table 1. Recreational catch of slope rockfish, 2004-2011.

Species and Sector	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Bank Rockfish									
California Recreational	0.45	0.91	0.04	0.08	0.07	0.03	0.07	0.23	3.01

Table 2. Recreational catch of cartilaginous fishes, 2004-2011.

Species and Sector	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Big Skate									
Oregon Recreational	0.80	0.01				0.08	0.03	0.03	0.96
Leopard Shark									0.00
California Recreational	55.09	38.79	84.97	21.88	31.79	34.93	34.67	24.65	418.32
Longnose Skate									
Oregon Recreational	0.12			0.03			0.04		0.19
Soupfin Shark									
Oregon Recreational								0.01	0.00
Spiny Dogfish Shark									
Oregon Recreational	0.07	0.09	0.01	0.04	0.02	0.07	0.08	0.05	0.42
California Recreational	2.37	4.15	4.10	5.22	2.92	4.51	1.47	9.73	66.37
Unidentified (sharks)									
Washington Recreational	1.59	0.52	0.83		0.93	0.74	1.10	0.23	5.94
Oregon Recreational	0.02				0.01	0.00			0.03

Table 3. Recreational catch of roundfishes, 2004-2011.

Species and Sector	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Cabezon									
Washington Recreational	5.94	7.94	5.74	4.33	2.67	5.24	5.34	8.66	45.86
Oregon Recreational	17.37	17.61	16.12	16.33	16.60	16.23	16.55	17.51	134.32
California Recreational	39.79	49.31	27.71	21.47	19.72	31.81	28.44	40.24	394.07
California Scorpionfish									0.00
California Recreational	43.89	90.30	44.79	68.13	60.79	66.11	63.10	99.66	728.40
Kelp Greenling									
Washington Recreational	2.00	1.95	1.31	1.18	0.96	1.34	2.73	2.13	13.59
Oregon Recreational	4.37	4.12	3.14	3.51	3.62	4.21	6.83	7.41	37.21
California Recreational	12.28	7.80	7.96	9.47	9.54	14.63	15.84	22.62	132.94
Rock Greenling									
Oregon Recreational	0.06	0.03	0.01	0.02	0.03	0.04	0.06	0.08	0.32
California Recreational	1.51	1.35	0.17	1.04	0.98	0.62	1.55	0.71	21.17

GROUNDFISH MANAGEMENT TEAM REPORT ON METHODS AND RESULTS THAT MAY BE USED TO EVALUATE ALTERNATIVES FOR STOCK COMPLEX REORGANIZATION

Overview

The Groundfish Management Team (GMT) provided comment on the initial proposal for restructuring groundfish stock complexes (Agenda Item D3a, Attachment 1, April 2013) at the April Council meeting (see Agenda Item D3b, Supplemental GMT Report, April 2013). In that GMT statement, it was noted that the current range of alternatives likely includes complexes that are close to favorable. However, the GMT suggested that this range of alternatives may not yet include all options of interest, and stated that additional tools (i.e., methods) may be needed to further evaluate alternatives. This statement describes additional analyses and results that may be added to the toolbox for evaluating current and new alternatives at the June Council meeting. These additional analyses are intended to supplement, not replace, methods and analyses shown in Agenda Item D3a, Attachment 1, April 2013.

Recommended alternatives for restructuring stock complexes are not presented in this document. The GMT will continue analyses and discussions at the June meeting and will provide a supplemental report that will include recommended alternatives supported by existing analyses (i.e., those shown in Agenda Item D3a, Attachment 1, April 2013) and new analyses that are described herein.

The intent of this report is to provide the Council with descriptions of new methods and examples of recent results that the GMT will use to evaluate current and additional alternatives. As such, figures and tables provided herein were included only as examples to help with proper interpretation of results. The full suite of tables and figures generated by these analyses can be found on the Council ftp site by using the following link: ftp://ftp.pcouncil.org/pub/Stock Complex Materials/.

A GMT webinar, which was open to the public, took place on May 22, 2013 to discuss analyses to date. A brief recap of that webinar is provided near the end of this statement.

The GMT thanks the Northwest Fisheries Science Center (NWFSC) and the West Coast Groundfish Observer Program (WCGOP) for providing data analyzed herein and for their help interpreting the dataset variables.

Types of New Analyses Included in this Report

Analyses described in this document will be used to evaluate species co-occurrence, species identification (or difficulty thereof), and potential costs to State sampling programs. Previous analyses described co-occurrence over broad or generally-reported depth ranges and across large areas (e.g., north of 40º10’ N lat.). In the analyses described here, co-occurrence among species was evaluated at a much higher resolution than before (e.g., at the haul level). This level of resolution is needed for identifying stock complexes that are most similar in terms of geographic distribution and vulnerability to fisheries. The degree to which species co-occur in the catch determines how easily they can be managed together. Species that occur together often are more likely to have similar responses to management measures.

Costs to State sampling programs and difficulty discerning among species were only inferred in previous Council documents, with no data or analysis provided for supporting conclusions (e.g., Appendix C of the 2013-2014 FEIS). In this report, we describe a survey developed by the GMT that was intended to ascertain information from state port biologists and managers about species that are often misidentified as well as potential costs of additional sorting requirements. The GMT anticipates that state reports will also be submitted to the briefing book or at the Council meeting that will provide additional information regarding potential costs of stock complex reorganization in terms of expenses for the states and potential impacts to data quality.

This report focuses only on reorganization of slope rockfish and "other fish" complexes, which were designated as a high priority by the Council in April. Similar analyses can be conducted for the remaining stock complexes being considered for reorganization (i.e., nearshore and shelf rockfish) for future meetings, if needed. The analyses and discussion for these other complexes were not included due to time constraints and because they were listed as a lower priority by the GMT and Council in April 2013.

Methods and Data

Five new analyses are being considered by the GMT for evaluating stock complex alternatives at the June meeting. Those analyses are:

(1) Spatial Analysis (haul/set level, or 25 fathom x 1^{o} lat. blocks, depending on data source)
(2) Species Co-occurrence Tables (haul/set level)
(3) C-scores Derived from the Co-occurrence Tables (haul/set level)
(4) Cluster analysis (haul/set level)
(5) Survey of Port Biologists and State Fishery Managers

Data Sets Analyzed

Alaska Fishery Science Center (AFSC) Survey Data: Data from AFSC surveys (shelf and slope) were obtained for the years 1977-2004. These data are not confidential and therefore can be used to demonstrate spatial analyses at the haul or set level. Survey data are advantageous to fishery data in some cases; for example, survey research sets can be made within rockfish conservation areas (RCAs), as bottom type allows. Therefore, habitats and depths accessible to surveys may provide information that is not possible using recent fishery data (i.e., post-RCAs). In addition, nearly all fish species are identified and enumerated for all survey hauls; therefore, data accuracy and precision are likely higher for survey data than for fishery datasets. On the other hand, minimum and maximum depths for the AFSC survey data are restricted relative to commercial fishery data, which limits our ability to fully evaluate vulnerability of certain species to commercial fisheries. Finally, gear design, towing speeds, towing duration, and seasonality of surveys (e.g., only spring and summer months) result in some disadvantages relative to commercial data when evaluating species co-occurrence and vulnerability to commercial fisheries.

WCGOP Trawl Data: WCGOP trawl data (2002-2011) were used for spatial analysis (25 fm x 1^{o} latitude blocks) and for co-occurrence analyses (analyses 2-4 listed above) at the haul level. Observer data must be properly filtered when making inference at the haul level; otherwise, false-positive haul locations or false-positive species co-occurrence designations could be prevalent. Use of these data requires clear guidance from the WCGOP program to ensure these haul-level false positive errors are minimized, as we did. Further detail can be provided by the WCGOP or by the GMT if needed.

WCGOP Non-Nearshore Fixed Gear Data: WCGOP non-nearshore fixed gear data (2002-2011) were used for spatial analysis (25 fm x 1^{o} latitude blocks) and for haul-level co-occurrence analyses (analyses 2-4 listed above). All hook (e.g., longline) and fish pot data were included in most analyses. Note that although most sets in the non-nearshore data base are seaward of the non-trawl RCA, some sets included in that database are shoreward of the RCA and therefore considered shallow. This is due to the definition of "non-nearshore" versus "nearshore", which is based on species and gear type rather than depth. Shallow "non-nearshore" sets are rare in this database. The discussion in the previous WCGOP Trawl Data section regarding the potential of including false-positive locations or species co-occurrence also applies to this database. More detail can be provided by the WCGOP or by the GMT if needed.

Species included in the Analyses: The species included in the analyses provided in this report were based on those shown in slope rockfish and "other fish" alternatives in Agenda Item D.3.a, Attachment 1, April 2013. Species analyzed for slope rockfish alternatives include:

- Aurora rockfish, bank rockfish, blackgill rockfish, darkblotched rockfish, Pacific ocean perch, redbanded rockfish, rougheye/blackspotted rockfish, sharpchin rockfish, shortraker rockfish, splitnose rockfish, and yellowmouth rockfish.

Species or species groups analyzed for the "other fish" complex were:

- Cartilaginous species – Aleutian skate, Bering/sandpaper skate, big skate, black skate, California skate, longnose skate, all other skates, spiny dogfish shark, leopard shark, brown cat shark, soupfin shark, and spotted ratfish;

- Roundfish – Giant grenadier, Pacific grenadier, all other grenadiers, California slickhead, Pacific flatnose (=finescale codling), California scorpionfish, cabezon, kelp greenling, and all other greenlings.

Methods and Examples of Results

Spatial Analysis

Spatial distribution by depth and latitude for roundfish are shown in Figure 1 and for slope rockfish in Figure 2. The WCGOP data for observed bottom trawl trips were used to create these figures. Similar plots for all other species (i.e., within the "other fish" and slope rockfish complex alternatives) and gear types (i.e., WCGOP non-nearshore fixed gear data; WCGOP trawl data; AFSC trawl survey) can be found at the ftp site (ftp://ftp.pcouncil.org/pub/Stock Complex Materials).

In Figure 1 and Figure 2, catch per unit effort (CPUE) is shown by blocks measuring 25 fm x 1^{o} latitude. CPUE was calculated as the sum of all catch per block divided by the sum of all effort (as towing hours; as number of hooks or pots), across all years. This quantity was then divided by the maximum value across blocks within each species and shaded so that the darkest cells correspond with the highest CPUE (see legends in Figure 1 and Figure 2). The CPUE shown in these figures should only be used to look at the distribution of each species and not as a measure of the relative density across species because the scaling eliminates all information about relative abundance. Empty cells represent areas where 3 or more vessels fishing with a given gear carried observers, but no fish of the species in question were caught. Diagonally-hatched cells represent areas where two or fewer vessels were observed while operating with a given gear (i.e. less than 3 vessels carried observers in these areas). The CPUEs for these areas did not satisfy data confidentiality requirements.

Figure 1 and Figure 2 clearly illustrate the spatial distribution by latitude and depth; both are important considerations for managing groundfish. In one sense, many of the inferences that can be drawn from these figures are self-evident (e.g., species that are typically caught shallow or deep; species that are typically found in the north or south). These figures do, however, provide a visual scale from which one can infer the degree of overlap either among species, or overlap across management lines. The amount of overlap among species (more overlap = more likely to co-occur) is one important attribute for grouping "like" species within complexes. For example, Pacific flatnose, California slickhead, and all grenadiers show a great deal of overlap by depth (deep) and area (north and south of 40º10' N lat.; Figure 1). The amount of overlap across regulatory lines (i.e., equally distributed versus unequally distributed north and south of regulatory lines) may also be considered when restructuring complexes. For example, shortraker rockfish (Figure 2) is caught mostly north of 40º10' N lat., whereas a relatively small amount is caught south of 40º10' N lat.

Species Co-occurrence Tables

Co-occurrence of species is shown in Table 1 (roundfish) and Table 2 (slope rockfish) for observed bottom trawl trips (WCGOP trawl data). Only hauls where these species were present are included. Values in these tables represent occasions where two species were present during the same haul. Shading ranges from no shading (= no to low co-occurrence in like hauls) to dark (= frequent co-occurrence in like hauls). Percentages are based on the following premise: given species A is present in a subset of hauls (= columns), what is the percent co-occurrence with species B (= rows) within the same hauls. To illustrate this relationship, refer to Table 1 and the column header "Giant Grenadier". The number of hauls encountering giant grenadier in the WCGOP database is 7,032 hauls. Thirty seven percent (or 2,629) of these hauls also encountered Pacific flatnose. On the other hand, of 4,120 hauls encountering Pacific flatnose, 64% those hauls (the same 2,629 hauls) also encountered giant grenadier.

Another way to interpret these co-occurrence tables is illustrated in Figure 3. This figure demonstrates that giant grenadier were caught in 7,032 trawl hauls in the WCGOP database, whereas Pacific flatnose were caught in 4,120 hauls. These species were caught together in the same haul 2,629 times, which represented 37% of the "giant grenadier" hauls and 64% of the "Pacific flatnose" hauls.

It is important to note that these examples are shown across all areas (coastwide). Results may be different if shown by area, such as north and south of 40º10' N lat. This analysis is forthcoming and will be uploaded to the Council ftp site.

C-scores

As another metric of pairwise species co-occurrence, we are also exploring the C-score metric (Table 3 and Table 4). This measure of species overlap is normalized so that a value of 1 indicates perfect segregation between the two species and 0 complete overlap (Stone and Roberts 1990, Gotelli and Ulrich 2010). The GMT is exploring the C-score as a possible, first-level filter to identify which species might be highly segregated. As examples, we provide the C-scores (Table 3 and Table 4) calculated from the WCGOP bottom trawl data for roundfish and slope rockfish. The information used to calculate the C-score is the same as that used to calculate the species co-occurrence tables above. One advantage of the C-score metric is that it allows a species pair to be compared with a single score instead of the two-way look provided in the species occurrences tables described above. It also allows a relative comparison to other species pairs.

The C-score metric derives from the "checkerboardness" concept in biogeography (i.e., a presence-absence dataset of two species that were perfectly segregated would form a checkerboard of 1s and 0s). The C-score is calculated from presence-absence data, where a "1" is used to mark the presence of a species in a sampling unit and a "0" to mark absence. With the WCGOP and trawl survey data, the sampling unit is an individual haul or set. For the examples here we have not stratified the dataset so that the C-scores are calculated over all years, areas, and depths. Because it is based only on presence-absence data, the C-score does not take into account the magnitude of catch.

The equation for the C-score is:

$C_{ij} = \frac{(K_i - S_{ij}) * (K_j - S_{ij})}{K_i * K_j}$	K_i = # of occurrences of species i K_i = # of occurrences species j S_{ij} = # of co-occurrences of species i and j C_{ij} = C-score for species i and j

The denominator represents the maximum value that the C-score can take for two species. The maximum occurs when the species are perfectly segregated in the dataset. For example, a species that occurs 6 times in a dataset and species that occurs 7 times could have a maximum value of 42. The numerator then factors in the number of common occurrences between the species and the resulting C-score is normalized as a ratio of the maximum value. If two species that occurred 6 and 7 times each had 3 common occurrences, the numerator takes a value of 12 and the normalized C-score is 12/42 = 0.29. If they had no common occurrences, their normalized C-score would be 1.

In interpreting the C-scores, it is important to note that the metric is multiplicative and thus non-linear. A C-score of 0.5 does not indicate that the species pair co-occurs in 50 percent of the tows/hauls in the data. To illustrate, two species that occurred 100 times each and had 50 common occurrences would receive a C-score of 0.25. The C-score will also differ between species pairs that have similar and disparate number of occurrences in the data. The score becomes more linear in nature where the discrepancy in total presence of the two species being compared becomes large.

To date, the GMT has considering C-scores above 0.70 as strong indication that two species are segregated and scores less than 0.30 as a having a relatively high degree of aggregation worth further exploration. It is important to note that these examples (Table 3 and Table 4) are shown across all areas (coastwide). Species pairs with intermediate C-scores could be explored to see how their scores may change in subsets of the data, such as north and south of 40º10' N lat.

Cluster analysis

Two clustering approaches were used to evaluate the co-occurrence of species within a proposed complex, based on fishery data collected by WCGOP: 1) partitioning analysis (k-medoids; Figure 4) and 2) agglomerative hierarchical clustering analysis (Figure 5). Each follows the methods outlined in Cope and Haltuch (2012) and differ in their approach. Partitioning analysis uses cluster validity diagnostics (in this specific case, silhouettes and Hubert's gamma) to indicate how many groups are most supported by the data. Cope and Punt (2009) demonstrated how different cluster validity diagnostics have a propensity for indicating less (silhouette; Figure 4a) and more (Hubert's gamma; Figure 4b) groups, hence the reason for using multiple diagnostic measures. Significant clustering are then interpreted using silhouette plots, wherein the silhouette value >0.75 indicates a very strong group, >0.5 indicates a strong group, and >0.25 indicates a weak, but notable association. Values <0.25 are not considered significantly part of a group. Agglomerative clustering (Figure 5) does not specify how many groups, and thus puts together a variable number of groups that minimizes the average distance of the inter- and intra-group dissimilarities. This approach necessitates a way to evaluate the significance of the resultant groupings. Following Cope and Haltuch (2012), we randomly assigned the presence-absence of 3 "fake" species to each haul (i.e., each species has a 50-50 chance of being in any haul). The clustering of these fake species gives a reference point at which species groupings more similar than the "fake" species are interpreted to occur significantly different than random. Three resultant groupings, two partitioning analyses based on the number of groups identified by either silhouette or Hubert's gamma validity diagnostics and one based on hierarchical clustering using “fake” species for relative significance, are provided for each complex considered (see the Council ftp site).

The results of the cluster analyses are given in Figure 4 and Figure 5. Both cluster validity diagnostics in the partitioning analysis (Figure 4a and Figure 4b) identified a similar notable grouping of species: yellowmouth, bank, shortraker, sharpchin, blackgill, and rougheye rockfishes. The remaining species did not significantly cluster with each other or any other species. The hierarchical analysis (Figure 5), while identifying the same grouping, considered the whole slope complex as being more associated than random.

Port Biologist and State Fishery Manager Surveys

A subgroup of the GMT is designing two surveys to be implemented prior to the June Council meeting. The intent of both surveys are to collect information about which groundfish species in existing stock complexes are difficult to identify, and to gain a better understanding of potential costs to state port sampling programs if additional sorting requirements are applied. The intended recipients of the surveys are port biologists and other port samplers, and state sampling program managers. As of the June 2013 briefing book deadline, both surveys were being finalized by the subgroup. Once finalized, the GMT’s state commercial representatives intend to implement the survey prior to the June meeting, with enough time to provide results from these surveys at that meeting. The surveys were focused only on groundfish composition sampling; biological sampling protocols (i.e., age, sex, and length data) were excluded.

The primary information of interest to be collected from the Port Biologist Survey includes the following: which pairs of species are difficult to distinguish within the slope rockfish and other fish complexes, how often are these species encountered, and how difficult are these species to distinguish (i.e., are visual or tactile cues used). Other information such as waiting time prior to a port biologist commencing their composition sampling protocols, will also be collected. Gaining a more specific understanding from state agency personnel about which pairs of species are difficult to discern (or are often misidentified by those who sort landed catch), may help to inform the composition of currently proposed stock complexes. That is, if two species are often misidentified, separating them into two different stock complexes may decrease the accuracy of data collected from either species. This understanding would argue the necessity of maintaining these two species within one complex.

The “Program Manager” Survey is intended to collect information that fleshes out and identifies the full range of potential costs to state sampling programs if new stock complex configurations require additional sorting requirements. There is current understanding that costs in either data quality, State sampling goals, port coverage levels, and/or resources (e.g., personnel and time) will be incurred. However, it is not currently clear to many on the GMT whether these costs will be incurred to the same degree, or if some balancing between these costs will be made out of necessity. For example, if resources currently available to State sampling programs remain static, will state sampling goals be adjusted downward to ensure that a certain level of data quality is maintained. The GMT also recognizes that specific costs may only be clear once the Council identifies their preliminary preferred alternatives (PPAs) at the June meeting and state programs have time to respond to these alternatives. Despite this, the survey was intended as a first pass at engaging State program managers and gaining a greater understanding of the full range of costs that may be incurred, even if these costs are initially listed in general and qualitative terms. More information about specific costs to State programs could be collected at a later date once PPAs are decided.

GMT Webinar

A GMT webinar, which was open to the public, took place on May 22, 2013 to discuss analyses to date. The following points were discussed:

- Whether to provide all figures and tables in this briefing book document, on an ftp site, or as an appendix to this document. It was decided to include only examples of results in this document but provide a link to the ftp site to enable others to download and evaluate results from all analyses.

- Additional analyses by the GMT using methods described here are expected after the briefing book deadline passes. For example, we expect to provide separate analyses north and south of 40º10’ N lat. In some cases, certain species will be excluded from these analyses to demonstrate the impact on co-occurrence results for the remaining species. One example is to perform cluster analyses for slope rockfish south of 40º10’ N lat. (a) with all slope rockfish species included, and (b) with redbanded, rougheye, shortraker, and yellowmouth rockfish removed. We anticipate other variations of data combinations for analyses to be discussed and/or presented at the June Council meeting. All relevant analyses will be uploaded to the ftp site accompanied by readme files that will include information needed to understand the output.

- One discussion not resolved during the webinar regarded those cases where a complex-component species crossed management lines, and specifically one where the OFL/ABC/ACL contribution of that component species is much lower in one area than the other (e.g., < 5% of the coastwide OFL/ABC/ACL for rougheye rockfish, Figure 2). The following questions arose: if there is no biological reason for splitting a stock-complex species into separate stocks, then is it necessary and prudent to provide OFLs for each area? If not, would some other solution both protect the stock from overfishing and provide less burden to fishermen and communities in the area where the component OFL is low relative to the coastwide value? The GMT concluded that this situation needs to be fully discussed before potential solutions could be offered.

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Gotelli, N. J. and W. Ulrich. 2010. The empirical Bayes approach as a tool to identify non-random species associations. *Oecologia*, 162: 463-477.

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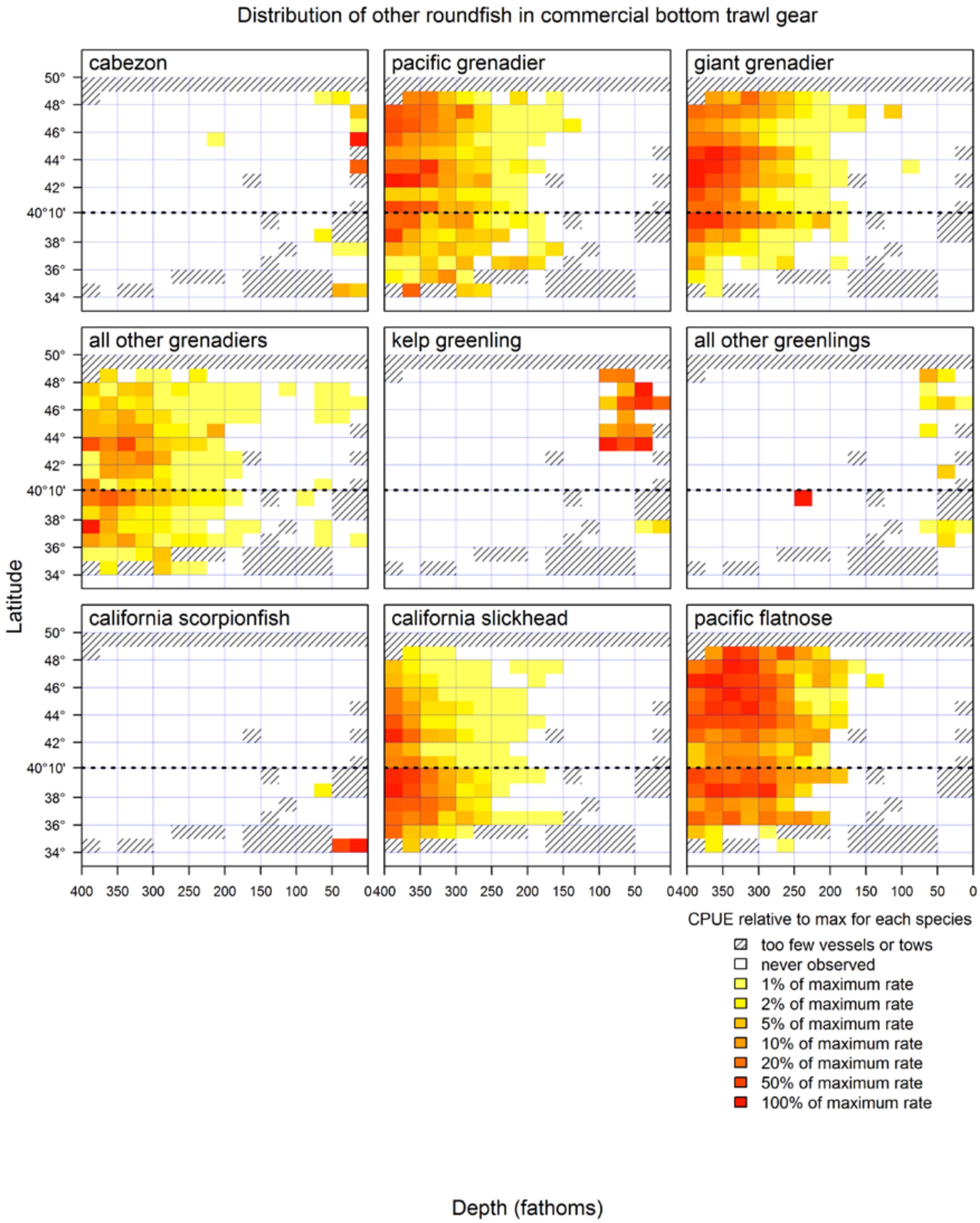


Figure 1. Spatial distribution of roundfish in WCGOP trawl data (2002 – 2011) for alternatives shown in Agenda Item D3a, Attachment 1, April 2013. Colors represent CPUE relative to the maximum within each species (see the legend below). Darkest red = highest CPUE; lightest yellow = lowest CPUE. Data for hatched boxes could not be displayed because of confidentiality (only 1 or 2 vessels carrying observers fished in the area) or because no vessels carrying observers fished in the area. White areas are places where 3 or more vessels fished and carried observers, but the species in question was not caught.

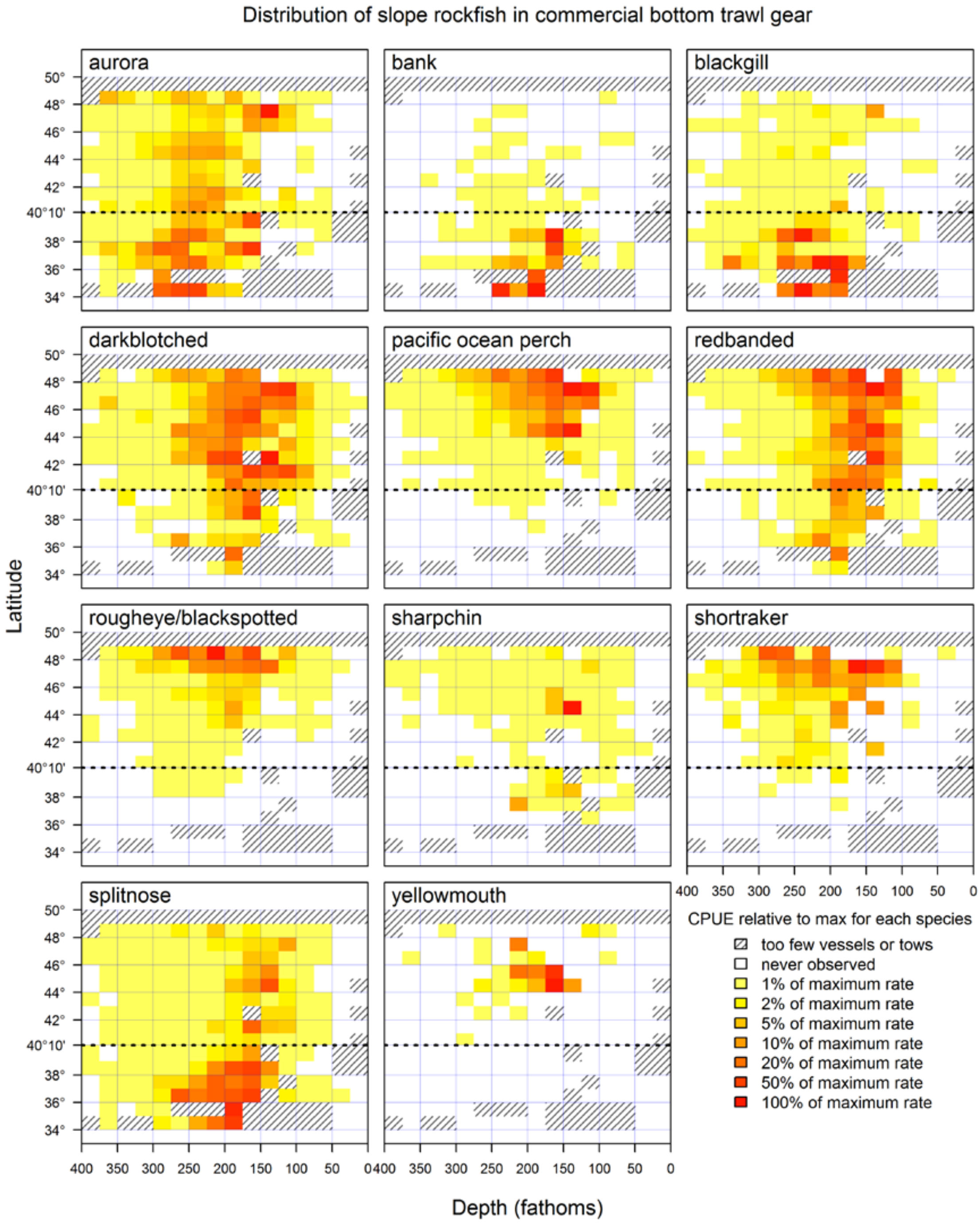


Figure 2. Spatial distribution of slope rockfish in WCGOP trawl data (2002 – 2011) for alternatives shown in Agenda Item D3a, Attachment 1, April 2013. Colors represent CPUE relative to the maximum within each species (see the legend below). Darkest red = highest CPUE; lightest yellow = lowest CPUE. Data for hatched boxes could not be displayed because of confidentiality (only 1 or 2 vessels carrying observers fished in the area) or because no vessels carrying observers fished in the area. White areas are places where 3 or more vessels fished and carried observers, but the species in question was not caught.

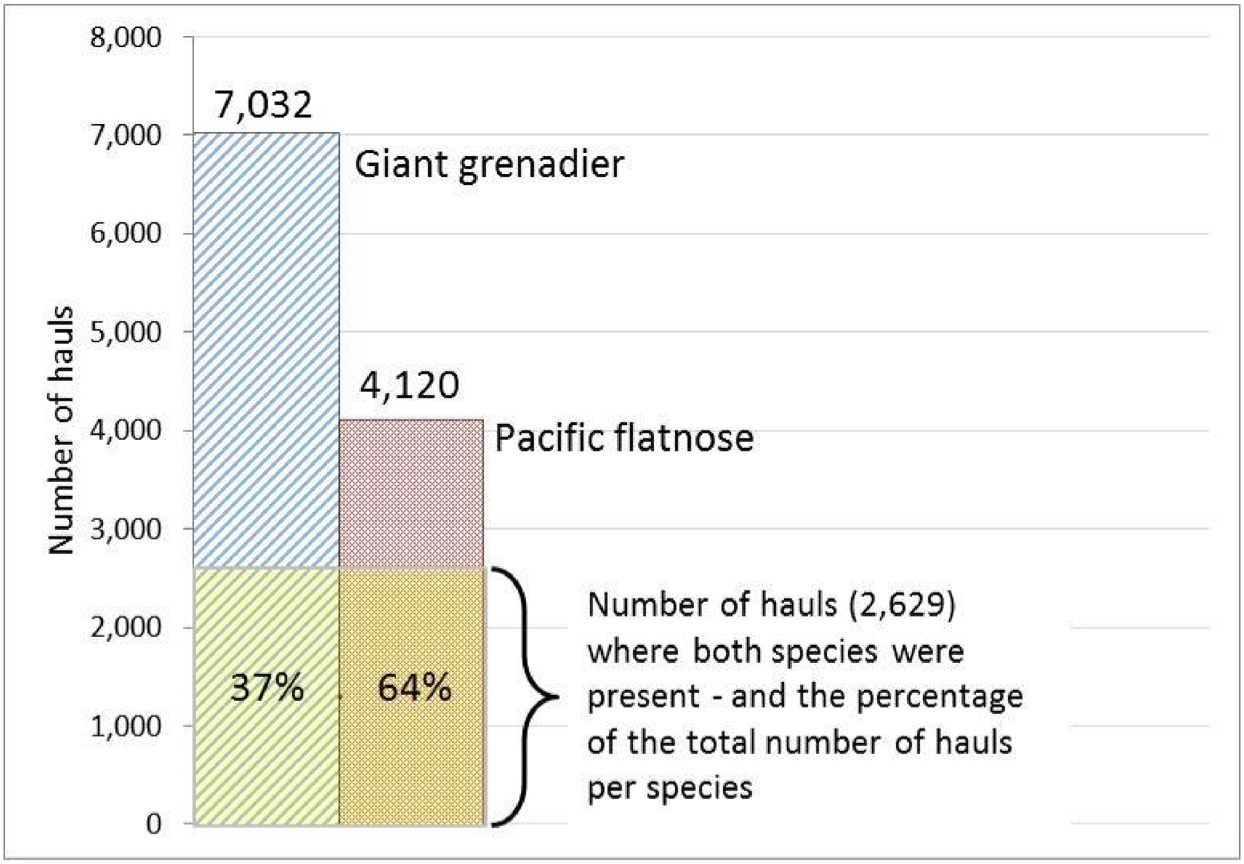
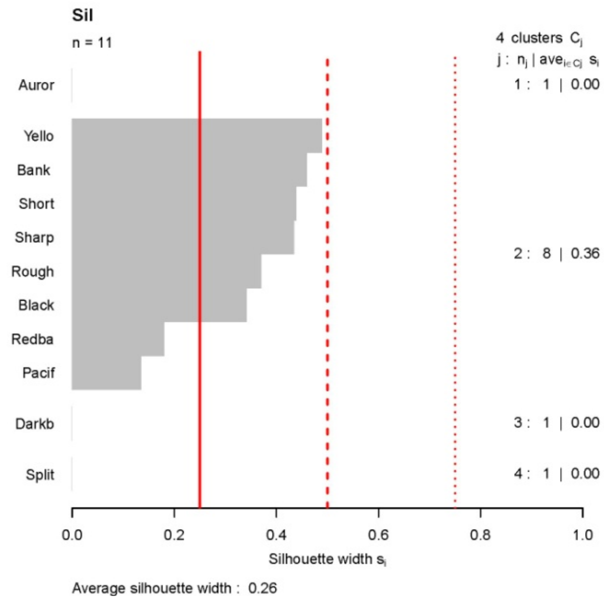


Figure 3. Number of bottom-trawl hauls (WCGOP data, 2002-2011) that caught giant grenadier and Pacific flatnose. Both species were caught during the same haul 2,629 times.

A. Silhouettes



B. Hubert's Gamma

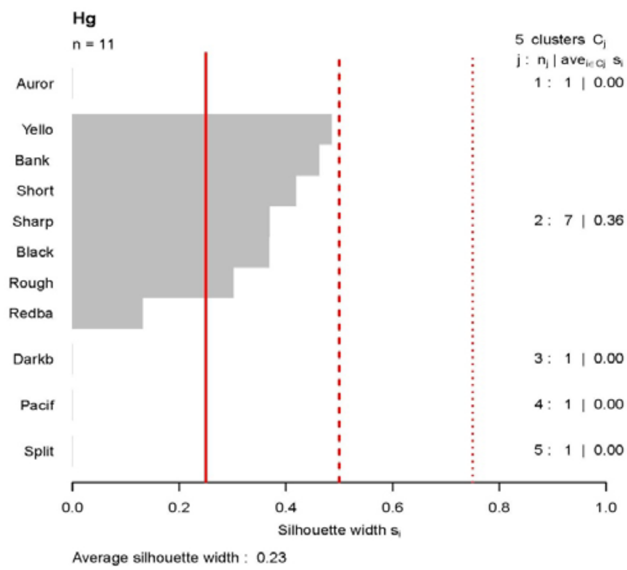


Figure 4. Partitioning analysis (k-medoids) for slope rockfish caught by trawl (WCGOP data, 2002-2011). Two types of validity diagnostics are shown: (A) Silhouettes and (B) Hubert's gamma.

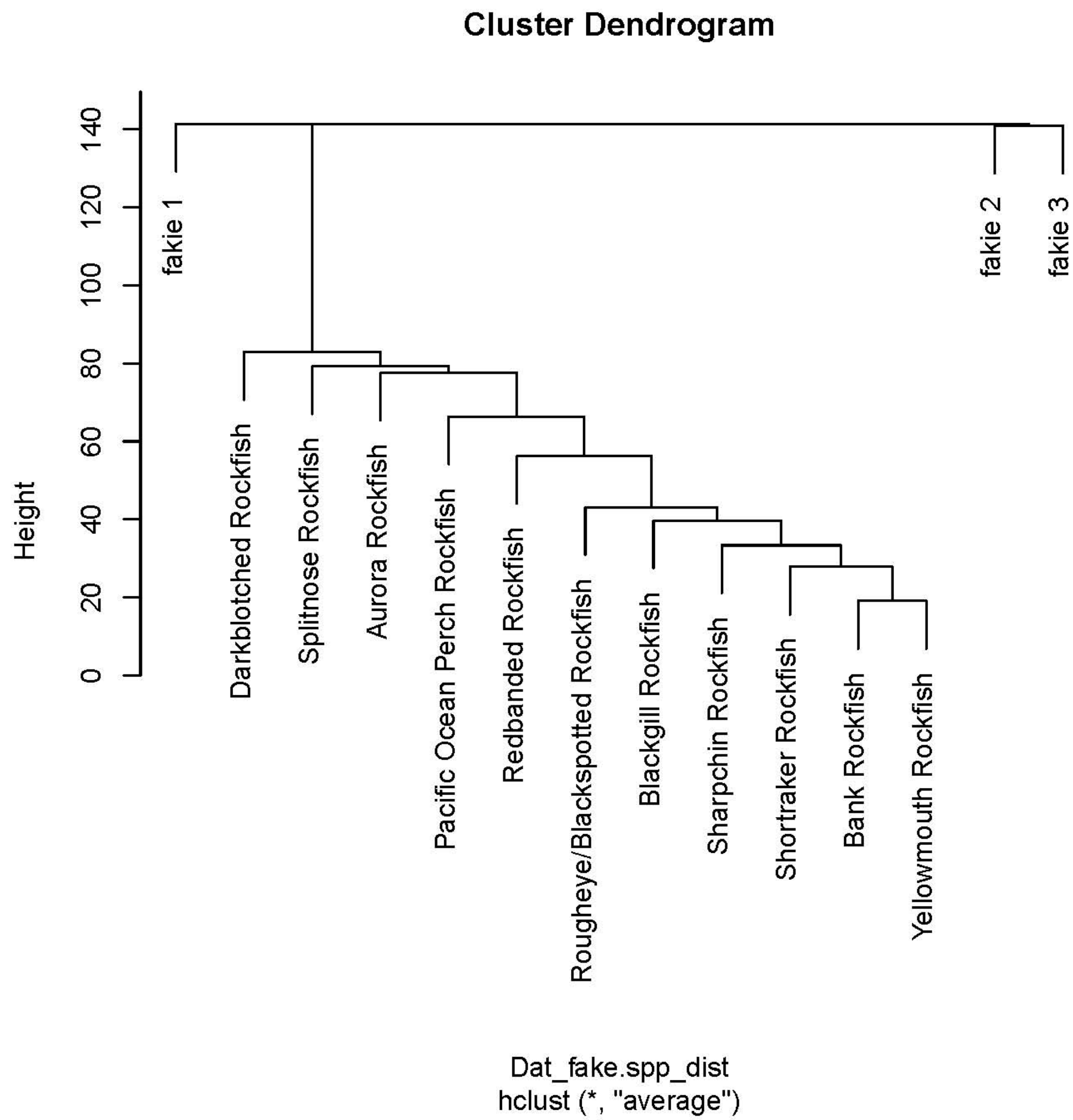


Figure 5. Agglomerative hierarchical clustering analysis for slope rockfish caught by trawl (WCGOP data, 2002-2011).

Table 1. Species co-occurrence in WCGOP trawl data (2002 – 2011) at the haul level for other roundfish alternatives shown in Agenda Item D.3., Attachment 1, April, 2013. This table represents the percentage of all hauls containing the species on a particular column that also have the species on the particular row. Darkest shading = highest co-occurrence.

	Giant Grenadier (7,032)	Pacific Grenadier (6,433)	California Slickhead (4,465)	Pacific Flatnose (4,120)	All Other Grenadiers (3,867)	California Scorpionfish (148)	Kelp Greenling (108)	Cabezon (29)	All Other Greenlings (28)
Giant Grenadier	XXXX	66%	73%	64%	36%	0%	1%	0%	0%
Pacific Grenadier	60%	XXXX	66%	58%	28%	0%	1%	0%	0%
California Slickhead	46%	46%	XXXX	47%	41%	0%	1%	0%	0%
Pacific Flatnose	37%	37%	43%	XXXX	39%	0%	1%	0%	0%
All Other Grenadiers	20%	17%	35%	37%	XXXX	0%	2%	0%	0%
California Scorpionfish	0%	0%	0%	0%	0%	XXXX	0%	3%	0%
Kelp Greenling	0%	0%	0%	0%	0%	0%	XXXX	0%	0%
Cabezon	0%	0%	0%	0%	0%	1%	0%	XXXX	0%
All Other Greenlings	0%	0%	0%	0%	0%	0%	0%	0%	XXXX

Table 2. Species co-occurrence in WCGOP trawl data (2002 – 2011) at the haul level for slope rockfish alternatives shown in Agenda Item D.3., Attachment 1, April, 2013. This table represents the percentage of all hauls containing the species on a particular column that also have the species on the particular row. Darkest shading = highest co-occurrence.

	Darkblotched Rockfish (6,933)	Splitnose Rockfish (6,534)	Aurora Rockfish (5,650)	Pacific Ocean Perch Rockfish (4,358)	Redbanded Rockfish (3,018)	Rougheye/ Blackspotted Rockfish (1,521)	Blackgill Rockfish (1,249)	Sharpchin Rockfish (855)	Shortraker Rockfish (604)	Bank Rockfish (337)	Yellowmouth Rockfish (39)
Darkblotched Rockfish	XXXX	47%	32%	62%	66%	65%	50%	64%	55%	48%	72%
Splitnose Rockfish	45%	XXXX	39%	55%	77%	58%	64%	78%	51%	82%	77%
Aurora Rockfish	26%	34%	XXXX	30%	37%	44%	61%	21%	50%	29%	36%
Pacific Ocean Perch Rockfish	39%	37%	23%	XXXX	53%	55%	25%	63%	52%	8%	67%
Redbanded Rockfish	29%	36%	20%	37%	XXXX	45%	28%	55%	38%	28%	49%
Rougheye/Blackspotted Rockfish	14%	14%	12%	19%	23%	XXXX	15%	21%	45%	5%	44%
Blackgill Rockfish	9%	12%	14%	7%	12%	12%	XXXX	8%	14%	26%	21%
Sharpchin Rockfish	8%	10%	3%	12%	16%	12%	5%	XXXX	8%	8%	41%
Shortraker Rockfish	5%	5%	5%	7%	8%	18%	7%	6%	XXXX	2%	10%
Bank Rockfish	2%	4%	2%	1%	3%	1%	7%	3%	1%	XXXX	15%
Yellowmouth Rockfish	0%	1%	0%	1%	1%	1%	1%	2%	1%	2%	XXXX

Table 3. Normalized C-scores (a), and input data (b) and (c), used to calculate them for Other Fish roundfish presence-absence in the WCGOP bottom trawl observations, 2002-2011. The shading in (a) is darkest for values less than 0.30 and lighter for values between 0.30 and 0.70. Values greater than 0.70 are un-shaded.

(a) Matrix of normalized C-scores

	GREN	CLSK	PFNS	GRDR	SCOR	KLPG	CBZN	UGLG
GGRD	0.14	0.14	0.23	0.51	1.00	0.99	1.00	1.00
GREN		0.19	0.27	0.60	1.00	0.99	1.00	1.00
CLSK			0.30	0.39	1.00	0.99	1.00	1.00
PFNS				0.38	1.00	0.99	1.00	1.00
GRDR					1.00	0.98	1.00	1.00
SCOR						0.96	1.00	1.00
KLPG							1.00	1.00
CBZN								1.00

GGRD = Giant grenadier
GREN = Pacific grenadier
CLSK = California slickhead
PFNS = Pacific flatnose
GRDR = Other grenadiers
SCOR = California scorpionfish
KLPG = Kelp greenling
CBZN = Cabezon
UGLG = Other greenlings

(b) Total occurrences for each species

GGRD	GREN	CLSK	PFNS	GRDR	SCOR	KLPG	CBZN	UGLG
7,032	6,433	4,465	4,120	3,867	148	108	29	28

(c) Matrix of common occurrences

	GREN	CLSK	PFNS	GRDR	SCOR	KLPG	CBZN	UGLG
GGRD	4,239	3,264	2,629	1,400	0	1	0	0
GREN		2,942	2,373	1,079	0	1	0	0
CLSK			1,928	1,566	0	1	0	0
PFNS				1,516	0	1	0	0
GRDR					0	2	0	0
SCOR						0	1	0
KLPG							0	0
CBZN								0

Table 4. Normalized C-scores (a), and input data (b) and (c), used to calculate them for slope rockfish presence-absence in the WCGOP bottom trawl observations, 2002-2011. The shading in (a) is darkest for values less than 0.30 and lighter for values between 0.30 and 0.70. Values greater than 0.70 are un-shaded.

(a) Matrix of normalized C-scores

	SNOS	POP	RDBD	SHRP	ARRA	REYE/BSPT	BLGL	BANK	YMTH	SRKR
DBRK	0.29	0.23	0.24	0.33	0.50	0.30	0.45	0.51	0.28	0.43
SNOS		0.28	0.15	0.20	0.41	0.36	0.31	0.17	0.23	0.47
POP			0.30	0.33	0.54	0.36	0.69	0.91	0.33	0.44
RDBD				0.38	0.50	0.42	0.63	0.70	0.51	0.57
SHRP					0.76	0.69	0.87	0.89	0.58	0.87
ARRA						0.49	0.33	0.70	0.64	0.48
REYE/BSPT							0.75	0.94	0.56	0.45
BLGL								0.69	0.79	0.80
BANK									0.83	0.97
YMTH										0.89

DBRK = darkblotched
SNOS = splitnose
POP = Pacific Ocean Perch
RDBD = redbanded
REYE/BSPT = rougheye/blackspotted
BLGL = blackgill
BANK = bank
YMTH = yellowmouth
SRKR = shortraker

(b) Total occurrences for each species

DBRK	SNOS	POP	RDBD	SHRP	ARRA	REYE/BSPT	BLGL	BANK	YMTH	SRKR
6,933	6,534	4,358	3,018	855	5,650	1,521	1,249	337	39	604

(c) Matrix of common occurrences

	SNOS	POP	RDBD	SHRP	ARRA	REYE/BSPT	BLGL	BANK	YMTH	SRKR
DBRK	3,091	2,706	2,001	551	1,808	983	625	161	28	331
SNOS		2,397	2,321	667	2,187	885	803	276	30	306
POP			1,590	536	1,311	840	317	28	26	316
RDBD				467	1,124	687	353	94	19	231
SHRP					181	181	67	26	16	48
ARRA						669	766	98	14	299
REYE/BSPT							185	17	17	273
BLGL								87	8	87
BANK									6	6
YMTH										4

OREGON DEPARTMENT OF FISH AND WILDLIFE REPORT ON THE OREGON COMMERCIAL SAMPLING PROGRAM AND POTENTIAL CHANGES TO SPECIES COMPLEXES

The Pacific Fisheries Management Council (Council) is considering a range of alternatives to restructure one or more major species groups to more closely align with Magnuson-Stevens Act and National Standard 1 guidelines. These major species groups include several rockfish complexes, other flatfish, and other fish, which would consist of various roundfishes and elasmobranchs. The proposed Council action restructures these complexes to comprise species groups more closely related in terms of: ecological and biological considerations; vulnerability to fishing; and association within fisheries. Restructuring of species complexes within the federal Groundfish Fishery Management Plan will force states to restructure current market categories, as recorded on the official landing receipt ("fish ticket"), to comply with these new federal regulations. Market categories consist of either single species (e.g. black rockfish) or multiple species complexes (e.g. shelf rockfish). Since 2008, there are 159 different market categories in use in Oregon, although many of these categories are rarely landed. These market categories form the basis of commercial port sampling efforts conducted by the Oregon Department of Fish and Wildlife (ODFW), to provide accurate estimates of commercial catch.

Currently, ODFW employees sample commercial landings in Oregon ports to obtain information on species composition of market categories, in addition to the collection of biological samples. Market categories are sampled to assess the species present in the landing and the proportion of those species present (species composition). The purity of a market category (the amount of contamination of species not in the market category) can be assessed for both single-species market categories and multi-species categories. Market categories evolve over time due to a number of factors, including market forces, data quality concerns, the ability to discern similar species, and regulatory requirements.

For Oregon's commercial groundfish fisheries, the number of rockfish market categories has dramatically increased over the last 30 years (Figure 1). Compared with the early 1980s, when there were only two multi-species market categories, ODFW now separates rockfish species into 24 single-species market categories and two multi-species categories. The number of single-species market categories constitutes a high percentage of the number of rockfish species known to occur off the Oregon coast (approximately 32 species), though many are relatively minor components of commercial groundfish landings.

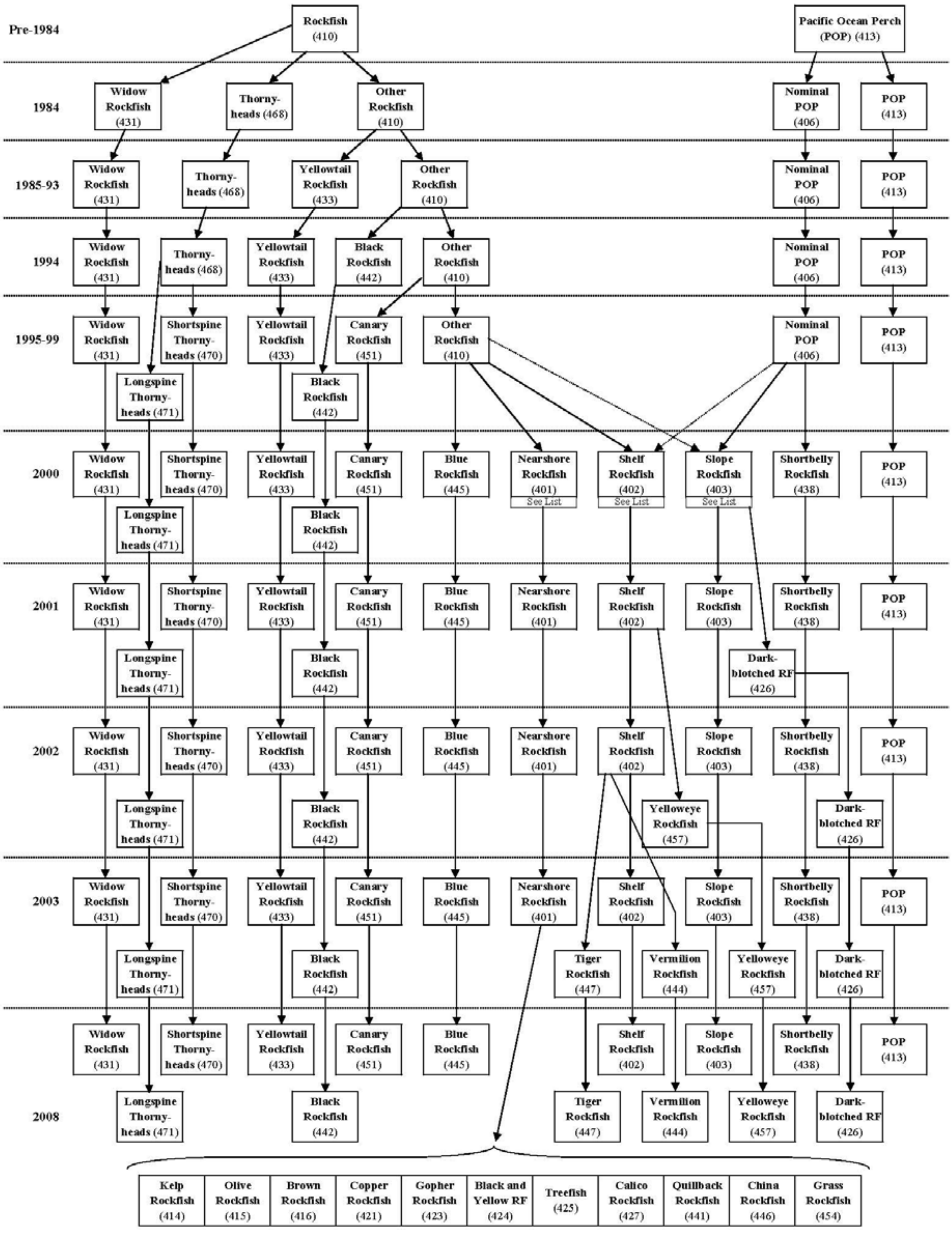


Figure 1. Oregon's rockfish "family tree" demonstrates how rockfish market categories have increased over the last 30 years. Note the two multi-species categories in 2008: shelf rockfish (402) and slope rockfish (403).

Status Quo: Current port sampling efforts and potential impacts of changes in species complexes

Commercial port samplers are unable to sample all landings or all market categories within a landing for a number of reasons that are explained in further detail in the following section. Instead, port samplers attempt to obtain at least one species composition sample per combination of market category, gear type, port, and area fished in each quarter of the year. Samplers aim to take a certain number of lengths, age structures (otoliths, fin rays or vertebrate) and species compositions for each market category. Samplers also take clusters (replicates) of species compositions when possible. Samplers must balance a large number of factors in order to fulfill their species composition sampling goals, including the time of day of the landing, seasonal variation in fishery execution, and prioritization of certain market categories over others.

Port samplers meet the vessel soon after offloading begins and may sample catches for species compositions as the catch is offloaded from large crates or from the conveyor belt within the processing facility. Each vessel and processing facility presents unique situations that the port sampler must be able to quickly adapt to in order to effectively sample the catch.

Uncertainty in rockfish species composition samples generated from the Oregon commercial groundfish monitoring program was assessed in the mid-90s (Crone 1995). Data for evaluating variability in species compositions included the last quarter of 1991 and the first quarter of 1992. At this time, there were only six market categories for rockfish (widow, yellowtail, Pacific Ocean perch, thornyhead, small rockfish complex, and large rockfish complex). This analysis suggested that the majority of the variability of species compositions in the landing estimates resulted from among-trip variation. The magnitude of this variance depended on the strata sampled (combination of port and quarter) but approximately two-thirds of the total rockfish landed had small coefficients of variation (<10 percent). Additionally, single-species market categories were also shown to have extremely precise landing estimates due to their high level of purity (>99 percent). As the number of single-species market categories has increased since this study, it can be reasonably assumed that our current level of sampling produces very precise estimates of rockfish landings for species in those single-species categories.

Over the last 20 years, the purity of the rockfish market categories increased as the number of market categories increased within the last 20 years. Each of the four time periods in Figures 2 and 3 are characterized by increases in the number of rockfish market categories. In 1990-1992 (Figure 1), there were six rockfish market categories. During 1997-1999 (Figure 1), there were nine categories, and in 2000-2002 (Figure 1), there were 12 to 14 categories. Finally, in 2009-2012 (Figure 1), though partially confounded by the advent of the IFQ trawl catch share program, there were 26 rockfish market categories. All of these periods are marked by increases in the purity of the market categories over time. The proportion of contaminated species composition samples (i.e. species present in sample that were not in the market category) at all ports has dropped from over 50 percent to approximately 15 percent over the last 20 years.

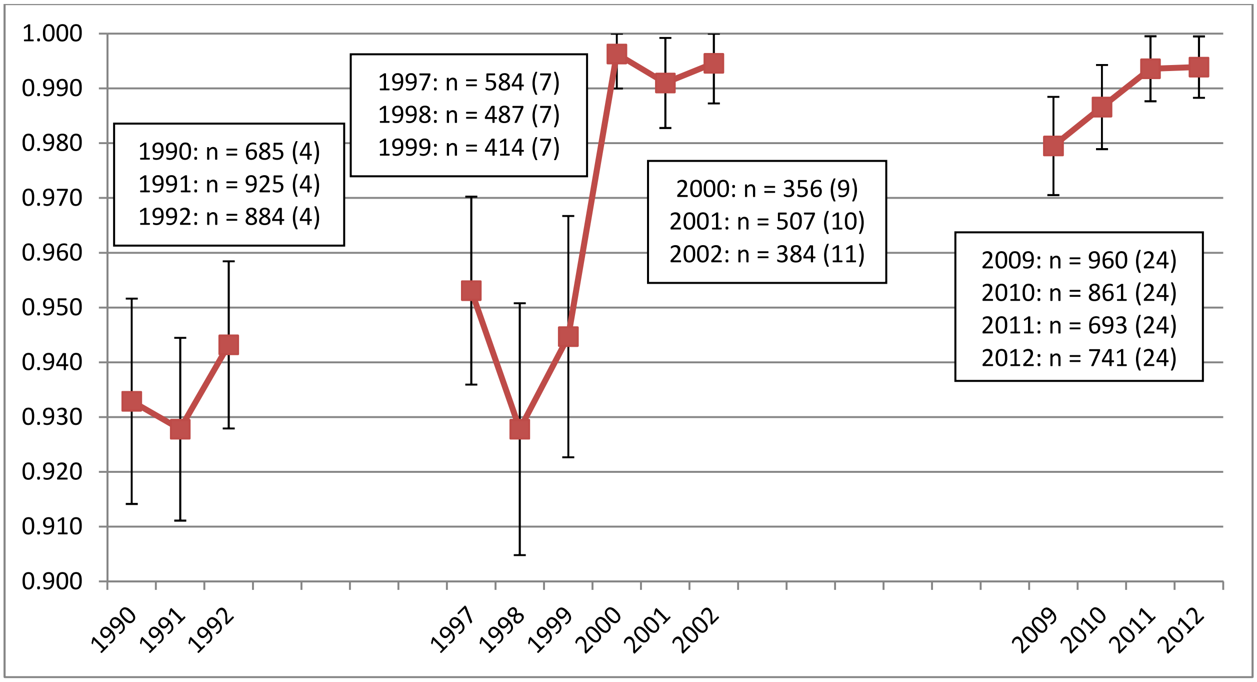


Figure 2. Average proportion of rockfish species compositions comprised of the species identified by the market category during four key time periods (1990-1992, 1997-1999, 2000-2002, and 2009-2012) for trawl landings in all Oregon ports. Sample sizes are provided for each year with the number of single-species market categories in parentheses. The confidence interval approximations are based on a normal distribution due to large sample sizes.

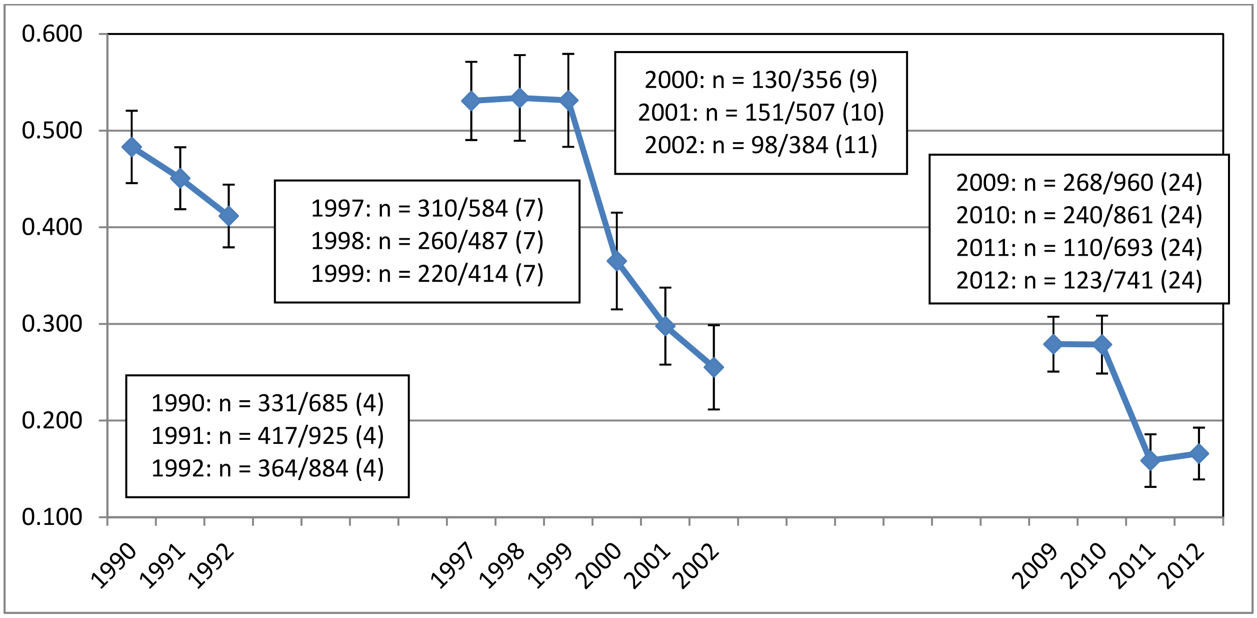


Figure 3. Proportion of rockfish species compositions with contamination of species not in market category for four key time periods (1990-1992, 1997-1999, 2000-2002, and 2009-2012) for trawl landings in all Oregon ports. Sample sizes are provided for each year with the number of single-species market categories in parentheses. The confidence interval approximations are based on a normal distribution due to large sample sizes.

Status Quo: "Borrowing" Species Compositions from Missing Strata

Samplers are unable to conduct sampling at all times, and landings occurring at night, on weekends or on holidays are much less frequently sampled than landings made during daytime hours on weekdays. Staff are not always available to sample multiple boats that are making landings at the same time or to sample each of the market categories from a single landing. Finally, it is not cost effective for ODFW to maintain sampling personnel at certain ports where fishing effort varies dramatically by season. Most often, port samplers are present during summer months at smaller ports and year-round at the larger ports. Processing operations may be moving catch so quickly that samplers are unable to sample. In addition, certain species may be landed relatively rarely, resulting in an increased chance of the sampler missing the species. These challenges result in a number of strata (combination of year, port, quarter, gear, PFMC area, and market category) where there is limited or no information on species compositions for some market categories. In these instances, ODFW "borrows" species compositions from other locations or times to fill in the gaps in the estimated landings. The original set of borrowing rules relied on both temporal and spatial factors in order to estimate species composition for unsampled strata. Documentation on the original protocol ("borrowing rules") is no longer available, but the rules were based on borrowing species composition data from neighboring ports during the same quarter or year.

Currently, there are some market categories for which borrowing is more common than others. Table 1 shows the number of species compositions taken for various strata from 2008 to 2012 for all rockfish market categories. The column labeled "0" indicates the number of strata for which species composition data were borrowed. Note that for some market categories, such as black-and-yellow rockfish or china rockfish, no borrowing was needed in 2008-2012. For other species, such as the longspine thornyhead market category where species composition samples are relatively abundant, borrowing occurred in roughly 30 percent of strata (67 / 226) and roughly 25 percent of strata (57 / 226) had only a single species composition sample to support estimates of landings.

Table 1. Number of species compositions per strata (combination of year, port, quarter, gear, PFMC area, and condition [live/dead]) taken for each rockfish market category from 2008 to 2012.

	Number of samples per strata											Proportion of Strata with Borrowing
Market Category	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9+**	**Total**	
Black rockfish	60	64	25	15	14	20	3	7	15	54	**277**	**0.22**
Blue rockfish	29	44	18	11	5	3	3	1	1	6	**121**	**0.24**
Black and Yellow rockfish	0	3	0	0	0	0	0	0	0	0	**3**	**0**
China rockfish	0	24	13	9	8	5	4	2	5	8	**78**	**0**
Canary rockfish	23	52	21	6	6	3	0	0	2	8	**121**	**0.19**
Copper rockfish	0	32	8	8	3	0	0	1	0	1	**53**	**0**
Darkblotched rockfish	77	133	54	27	26	12	8	6	10	13	**366**	**0.21**
Gopher rockfish	0	13	3	1	0	0	0	0	0	0	**17**	**0**
Grass rockfish	0	9	5	0	0	0	0	0	0	0	**14**	**0**
Longspine thornyhead	67	57	25	20	21	10	11	9	3	3	**226**	**0.30**
Shelf rockfish	49	89	33	22	8	2	2	2	1	0	**208**	**0.24**
Slope rockfish	108	121	55	43	26	21	15	14	12	35	**450**	**0.24**
Olive rockfish	0	2	0	0	0	0	0	0	0	0	**2**	**0**
Pacific ocean perch	79	85	58	23	19	7	9	2	3	12	**297**	**0.27**
Quillback rockfish	0	41	15	8	3	2	3	1	1	3	**77**	**0**
Shortbelly rockfish	2	2	0	0	0	0	0	0	0	0	**4**	**0.50**
Shortspine thornyhead	109	95	45	27	23	7	7	8	2	16	**339**	**0.32**
Tiger rockfish	0	17	6	0	0	0	0	0	0	0	**23**	**0**
Vermillion rockfish	13	31	7	7	4	2	2		3	5	**74**	**0.18**
Widow rockfish	45	62	22	10	6	5	1	3	3	2	**159**	**0.28**
Yelloweye rockfish	1	20	3	0	0	0	0	0	0	0	**24**	**0.04**
Yellowtail rockfish	39	80	27	23	7	1	4	4	1	5	**191**	**0.20**

Another way to gauge the impact of borrowing is to evaluate the percentage of the landings that are based on borrowed species compositions. For example, Table 2 and Table 3 below show the total pounds landed for the slope and shelf rockfish market categories, respectively, and the percentage of landings where borrowed species compositions were applied. In most cases, this is a relatively small percentage of overall landings, except some years of shelf rockfish, where there were a large number of small landings (<1000 lbs.).

Table 2. Total landings and total landings without species compositions available for the slope rockfish market category (2008-2012).

Year	Total Landings (lbs)	Total Landings without Species Compositions (lbs)	Percent landings without Species Compositions
2008	206,759	9,436	4.56%
2009	268,979	18,697	6.95%
2010	363,461	32,175	8.85%
2011	261,228	7,124	2.73%
2012	385,623	19,725	5.12%
Total	**1,486,050**	**87,157**	**5.87%**

Table 3. Total landings and total landings without species compositions available for the shelf rockfish market category (2008-2012).

Year	Total Landings (lbs)	Total Landings without Species Compositions (lbs)	Percent landings without Species Compositions
2008	9,214	2,706	29.37%
2009	15,433	2,652	17.18%
2010	10,826	2,306	21.30%
2011	29,582	7,351	24.85%
2012	68,330	2,737	4.01%
Total	**133,385**	**17,752**	**13.31%**

While there is uncertainty associated with borrowing, this system potentially allows for more accurate estimates of landings information for market categories that rarely occur or those that are not sampled at a high or consistent level. However, in some instances, bias may be introduced and expanded upon, possibly leading to severely inaccurate landings data that may have dramatic impacts on estimated landings of species that are typically minor components of a large fishery. This is of particular concern given the lack of assessment information on some of these species, where continued management relies heavily on landings information.

In 2012, using feedback from both port samplers and local stock assessment authors, the current framework of borrowing rules was revised to exclude borrowing from neighboring ports. Feedback from port biologists and samplers suggested that there are dramatic differences between neighboring ports, especially given the seasonality of many of the species complexes for which borrowing is more common. Staff also evaluated several different options for within-port borrowing. These options included: (1) borrowing from the same quarter in previous years; (2) borrowing from other quarters in the same year; and (3) a combination of both scenario one and two. Using simulations with hypothetically missing data, these scenarios were not found to be dramatically different from each other and all were found to provide reasonable estimates of species compositions after borrowing rules had been applied. Given this information, staff felt that scenario one would be the best option for the new expansion model unless a minimum sample size could not be obtained in the recent past. In that case, borrowing would be allowed across different quarters and between years. These improved borrowing rules are currently being implemented and are expected to improve estimates of species landings in the future.

Costs of Increasing the Number and/or Configuration of Species Complexes

As discussed above, if the number of market categories increases, samplers might not be able to continue to sample at the current rates and compensation measures would need to be taken, such as downward adjustments to sampling goals. This results in less clustering which reduces our ability to accurately gauge variability within samples. There will also likely be more borrowing, as borrowing has increased over time as the number of market categories has expanded. Both of these result in the possibility of increased uncertainty in species composition estimates and estimates of landings of species complexes.

There is the possibility of changes in species proportions within market categories if there are changes in the complexes or market categories. Fishermen could also revise their targeting strategies if species complexes or market categories are modified. At this time, we are unable to predict the behavior of the fishermen in response to this management action. This management action could also result in a reconfiguration of our sampling goals and protocols. Impacts are likely to be similar to those seen in conjunction with increases in the number of market categories in previous years; however, estimating the magnitude of the changes that would be necessary to maintain appropriate sampling rates is extremely uncertain.

Qualitative costs to the state commercial sampling program

The commercial sampling program currently needs to balance the need for high quality data with personnel and budget constraints. If the number of market categories increases, an increase in effort would be required to maintain status quo sampling rates. Over time, ODFW has gradually added more positions dedicated to sampling as market categories have increased (Figure 4). However, this progressed relatively slowly, over the last 20 years. Potentially, even if the number of market categories remains constant but are reconfigured, this will also force a reordering of positions and staff priorities to modify sampling protocols and goals. Borrowing already occurs because it is not effective to have port biologists or samplers at every port throughout the year. Sampling every trip or every complex within each trip is often not possible or cost effective. Without additional resources, increased complexity in market categories and status quo staffing levels in ODFW's commercial sampling program would result in lower sampling rates per category, and higher uncertainty in landing estimates for some species.

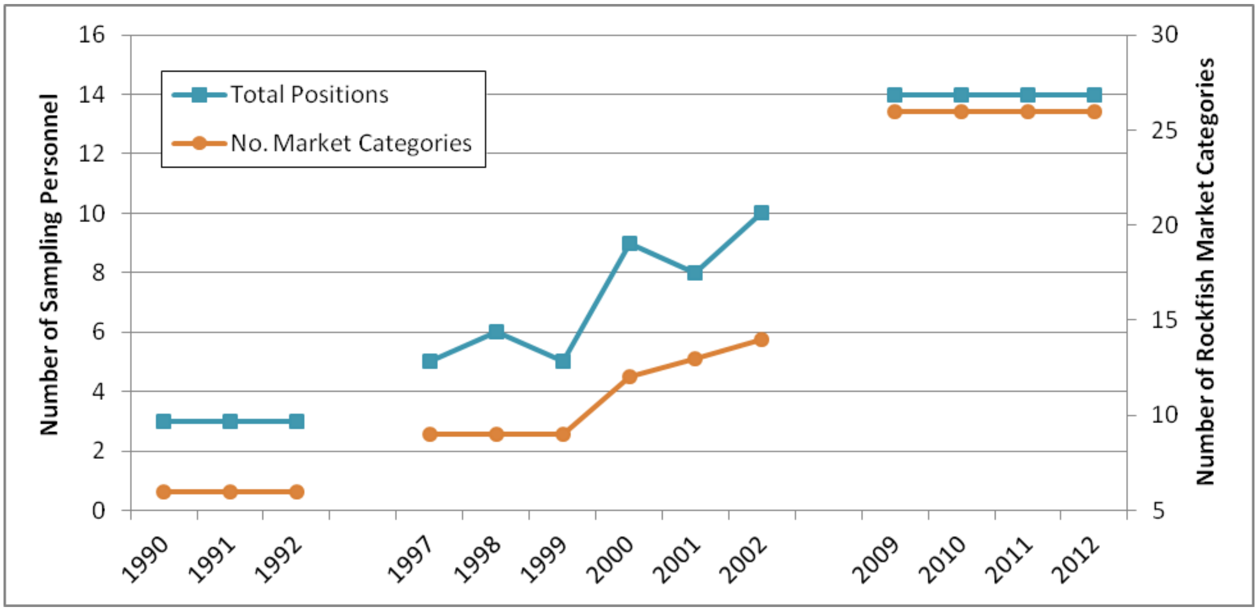


Figure 4. Changes in the number of dedicated sampling personnel with the MRP and the number of rockfish market categories (see Figure 1) for 1990-1992, 1997-2002 and 2009-2012. These are all full-time positions but do include seasonal personnel. Information on the number of positions is missing for some ports prior to 1999.

In Oregon, the Oregon State Police's Fish and Wildlife Division enforces fisheries regulations, including sorting requirements. Changes in species complexes may impact the effectiveness of enforcement and additional enforcement staffing is not expected to be available. Enforcement of sorting requirements is often collaboration between ODFW samplers and OSP troopers. With more market categories, a lower proportion is expected to be sampled by ODFW personnel, who will therefore have less opportunity to observe violations and notify enforcement personnel.

Concluding Points

The impact of changes in the configuration, or number, of species complexes is species- and complex-specific. Some species may be relatively easy to differentiate and some may be more difficult. Those species that are easy to differentiate are likely already in a single-species market category, thus we have high confidence in our landing estimates for these species. Each alternative would need to be evaluated with this in mind. Adding market categories through restructuring stock complexes may lead to lower sampling rates, resulting in higher uncertainty in species composition estimates and ultimately, estimates of catch per species. It is difficult to gauge the impact of one or more of the alternatives presented in this management action because of uncertainties regarding personnel, budgetary constraints, inability to predict changes to fisherman behavior or targeting, and the wide range of alternatives presented in this proposed Council action.

Reference List

Crone, P. R. 1995. Sampling design and statistical considerations for the commercial groundfish fishery of Oregon. Canadian Journal of Fishery and Aquatic Sciences 52: 716-732.

Agenda Item F.8.b
Supplemental GAP Report
June 2013

GROUNDFISH ADVISORY SUBPANEL REPORT ON ADOPT PRELIMINARY STOCK COMPLEX AGGREGATIONS

The Groundfish Advisory Subpanel (GAP) was briefed by Mr. John DeVore on the preliminary adoption of stock complex aggregations and offers the following comments and recommendations.

In general, the GAP cautions against a proliferation of multiple stock complexes that will create unnecessary management constraints. Many more stock complexes and management units will disrupt the fishery and further reduce the ability to achieve the Magnuson-Stevens Act (MSA) objective of attaining optimum yields. The GAP acknowledges that there should be consideration for restructuring some of our current stock complex aggregations but urges that an overall philosophy of “keep it simple” be a foundation in such considerations.

The GAP reiterates the general concern that this initiative will receive a higher priority than other initiatives that the GAP believes are of more immediate importance, such as recommended trawl trailing actions and non-trawl initiatives that have been consistently falling below the Council/NMFS priority line (e.g., sablefish permit ownership and control). Given the backlog of actions already decided by the Council yet not implemented in regulations, the GAP continues to be concerned about pursuing overly complex actions that may further delay implementation of higher priority items for little benefit to the fishery or fishery-dependent communities.

The GAP also reiterates the need for doing an adequate analysis of the socioeconomic effects of restructuring complexes, including an evaluation of the management implications of restructuring complexes, and an analysis of the conservation effects of proposed changes. While the GAP understands such analyses will be conducted, the GAP stresses these analyses will be critical for informing a good decision on restructuring stock complexes.

In the spirit of prioritizing workload, the GAP recommends that the action for restructuring stock complexes be limited to considerations for alternative slope rockfish complexes and alternatives for restructuring the Other Fish complex. The GAP notes that any issues regarding stocks managed in the nearshore rockfish complexes can be resolved with management measures in the 2015-16 specifications process. For example, if there are concerns, trip limits and no retention regulations implemented inseason in the next management cycle can effectively limit fishing-related mortality of that stock. The GAP reiterates that any restructuring of the shelf rockfish complexes need not be done at this time since Rockfish Conservation Area management effectively minimizes catch of these stocks and trawl catch can be further controlled with individual fishing quota (IFQ) management. The GAP also reiterates that there is no pressing need to restructure the Other Flatfish complex since that is a very well structured assemblage of stocks with similar vulnerabilities and meets the National Standard 1 guidelines for managing stock complexes.

Additional to these recommendations, the GAP offers the following recommendations and comments specific to restructuring the slope rockfish and Other Fish complexes.

Slope Rockfish

The GAP recommends the No Action alternative for managing the slope rockfish complexes. To clarify why the GAP did not summarily dismiss considerations for restructuring the slope rockfish complexes, the GAP acknowledges that the concerns regarding management of slope rockfish stocks that have apparent dissimilar vulnerabilities should be more thoroughly vetted in the contemplated analysis supporting any decision on restructuring stock complexes.

The GAP does not prefer Alternatives 1 and 2 for slope rockfish (see Tables 6 and 7 in Agenda Item F.8.a, Attachment 1). These alternatives contemplate additional vulnerable slope rockfish complexes which increase the number of management units where allocation and IFQ decisions will need to be made. Such actions could be difficult to reconcile since it could require a reconsideration of Amendment 21 allocations and entails the difficulty of determining new quota shares for a new set of stock complexes. Further, the GAP emphasizes that the proliferation of slope rockfish complexes will add unnecessary constraints to the fishery and creates smaller boxes that reduce fishery stability and increase the cost of managing the fishery. For example, creating more stock complexes requires sorting of more stocks that will hamper fishing operations on the water, increase the workload for first receivers, and complicate the port sampling of landed catch. None of these costs are trivial and will either require more resources (not likely to occur in today's budget-limited environment) or a reduction in other tasks that are currently done to sample and process groundfish catch.

The GAP also does not prefer Alternative 3 which contemplates removing rougheye and aurora rockfish from the slope rockfish complexes and managing these stocks with stock-specific harvest specifications. Both of these stocks will be newly assessed this year. It is premature to conclude these stocks are as vulnerable as the GMT's Productivity and Susceptibility Assessment indicate. The GAP notes that the catches of aurora rockfish have not exceeded the component over fishing limits of this stock reducing concerns regarding potential overfishing. If rougheye rockfish are managed coastwide with stock-specific harvest specifications, there will be the difficulty of reallocating the stock to sectors; a process that is exacerbated by the fact that the current Amendment 21 allocations differ north and south of 40º10' N lat. Furthermore, the rougheye catch histories associated with individual trawl permits are uncertain making it a difficult task to develop an equitable sharing of any trawl allocation of the stock.

Finally, the GAP's support of No Action for slope rockfish is bolstered by the fact that management measures can be implemented to address individual stock concerns. For example, the Council established a harvest guideline (HG) for blackgill rockfish south of 40º10' N lat. for this management cycle. This action effectively limits mortality of this stock designed to rebuild the blackgill rockfish to its target level. Similar actions can be contemplated for any other slope rockfish stock of concern if the need arises. Such actions are preferred by the GAP to avoid the other consequences associated with restructuring stock complexes described above.

Other Fish

The GAP agrees with the Council priority to consider restructuring the Other Fish complex. This complex is an assemblage of species with disparate life histories, distributions, co-occurrence in the fishery, and vulnerabilities to overfishing which should not be managed together. The GAP also agrees with the recommendation to first consider splitting the cartilaginous stocks from the roundfish stocks contemplated in Attachment 1.

Cartilaginous Stocks:
The GAP prefers Alternative 1 for cartilaginous species (see Table 13 in Attachment 1). This alternative contemplates managing skates separately from the other cartilaginous species (spiny dogfish and ratfish) which is sensible given their disparate life histories, distributions, and vulnerabilities. The GAP does not recommend Alternative 2, which further subdivides skates into shallow and deep complexes. This alternative unnecessarily creates an additional complex that is not fully supported by the analyses provided in Attachment 1. Figures 17 and 18 depict the observed area distributions of the catch of skate species in trawl and commercial hook-and-line fisheries, respectively from the West Coast Groundfish Observer Program. These figures indicate that the skate species caught in west coast groundfish fisheries have a wide depth range with a great deal of overlap of the stocks proposed for the shallow and deep skate complexes considered under Alternative 2.

The GAP does not recommend Alternative 3 for cartilaginous species (see Table 15 in Attachment 1) since it contemplates managing all these species (i.e., sharks, skates, and ratfish) with disparate life histories, distributions, and vulnerabilities in one complex. This alternative also contemplates adding brown catshark to the FMP and complex. Brown catsharks are not caught in great amounts in any groundfish fishery with a depth distribution far deeper than the trawl fishery can be prosecuted (i.e., deeper than 700 fm), which is the only fishery with any kind of historical bycatch of this species.

The GAP also does not recommend Alternative 4 for cartilaginous species (see Table 16 in Attachment 1) since it manages the species in Alternative 3 together with the added subdivision of cartilaginous species into shallow and deep assemblages. The reasons for this recommendation are the same as those posed for rejecting Alternative 3, coupled with the added complexity of a depth stratification of this mixed assemblage.

Roundfish:
The GAP recommends a revised Alternative 1 for roundfish species (see Table 18 in Attachment 1) that would create a nearshore roundfish complex[1] but eliminates the creation of a grenadier complex. The GAP recommends removing Pacific grenadier and not adding the other grenadier species to the FMP, as well as removing finescale codling (aka Pacific flatnose) from the FMP since the distribution of grenadiers and finescale codling extends far deeper than the 700 fm trawl limit and no fisheries target these species on the west coast.

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[1] The GAP was told by Mr. DeVore that the inclusion of the Oregon substock of cabezon in the nearshore roundfish complex under Roundfish Alternative 1 was a typographic error. This stock would continue to be managed with stock-specific harvest specifications under this alternative.

The GAP does not recommend Roundfish Alternative 2 (see Table 19 in Attachment 1). The creation of a deep roundfish complex under Alternative 2 does not comport with the GAP recommendation to remove Pacific grenadier and finescale codling. Alternative 2 also contemplates adding California slickhead, a deepwater smelt species, which is distributed deeper than 700 fm and is also not targeted on the west coast. The GAP does not recommend adding California scorpionfish to the nearshore roundfish complex, as contemplated under Alternative 2, since the stock does not co-occur with the other nearshore roundfish species (see Figures 21-23 in Attachment 1). The GAP also does not recommend adding the California and Oregon substocks into a new nearshore roundfish complex as contemplated under Roundfish Alternative 2. The GAP is satisfied that both stocks are well managed with stock-specific harvest specifications and management measures. Further, it is not clear to the GAP how management of stock complexes in general using indicator stocks is done or how it improves our current management system.

PFMC
06/22/13

GROUNDFISH MANAGEMENT TEAM REPORT ON CONSIDERATIONS FOR RESTRUCTURING WEST COAST GROUNDFISH STOCK COMPLEXES

The Groundfish Management Team (GMT) reviewed the Preliminary Alternatives and Analyses: Considerations for Restructuring West Coast Groundfish Stock Complexes (Agenda Item F.8.a, Attachment 1, June 2013). The GMT used analytical tools provided in that document, as well as additional tools described in Agenda Item F.8.b, GMT Report, June 2013, to support the following discussions and recommendations regarding the potential for restructuring of stock complexes. A full suite of tables and figures used for our analysis can be found on the Pacific Fishery Management Council's ftp site at ftp://ftp.pcouncil.org/pub/Stock_Complex_Materials/. A subset of those analyses can be found in Appendix A.

Overview

The purpose of forming stock complexes is described in detail in the Pacific Coast Groundfish Fishery Management Plan (FMP), as well as in Agenda Item D.3.b, Supplemental GMT Report and Preliminary Alternatives (Agenda Item F.8.a, Attachment 1). Some of the principal reasons for forming stock complexes include:

- stocks in a multispecies fishery that cannot be targeted independent from one another and maximum sustainable yield (MSY) cannot easily be achieved on a stock-by-stock basis;
- there is insufficient data to measure their status relative to stock determination criteria (SDC); or
- it may be difficult for fishermen and processors to distinguish individual stocks among their catch.

The GMT addressed these reasons and others while evaluating the stock complex alternatives shown under Agenda Item F.8.a, Attachment 1. The GMT operated under the premise that these purposes were designed to provide a means of minimizing the risk of overfishing for each component species within a stock complex, while tracking the catch of the complex as a whole. As such, one of the primary questions asked by the GMT when evaluating each complex was whether any species within the complex was at high risk of being overfished. If the answer was no, then additional consideration for restructuring was, in most cases, deemed not necessary at this time. More detail on our process is provided below.

Ecosystem Component (EC) Species

The definition and application of Ecosystem Component (EC) species is well described in Preliminary Alternatives (Agenda Item F.8.a, Attachment 1). The GMT did not have time to fully evaluate whether the species shown in the stock complex alternatives below should or should not be considered EC species, with the exception of small amounts of stock that may cross a management line (see below). The GMT will provide more consideration on the question of EC species comprehensively during the analysis that will be associated with the Final Preferred Alternative.

Inflator Stocks

The GMT generally agreed with discussion presented with the Preliminary Alternatives (Agenda Item F.8.a, Attachment 1) regarding potential impacts of inflator stocks to other species within a complex. In other words, the presence of inflator stocks in a complex can increase the risk of overfishing other stocks in the complex since it inflates the complex overfishing level (OFL). This is especially true for those stocks in a complex with high vulnerability to overfishing. More detail can be found in Preliminary Alternatives (Agenda Item F.8.a, Attachment 1).

Indicator Stocks

The GMT does not provide recommendations regarding indicator stocks within this statement. If the Council chooses to include indicator stocks (which must have an associated SDC and should have similar dynamics and vulnerability to the complex species) for monitoring stock complexes, we would like to emphasize the point made by the Scientific and Statistical Committee (Agenda Item F.8.b, Supplemental SSC Report) that it may not be required for indicator stocks to be members of the complexes for which their SDC are to be applied.

Complexes Evaluated for Reorganization

The GMT discussed prioritizing the complexes to be considered for reorganizing during the April Council meeting (Agenda Item D.3.b, Supplemental GMT Report, April 2013). At that time the GMT recommended, and the Council adopted, the shelf rockfish, nearshore rockfish, and flatfish complexes as lower priority for reorganizing than the slope rockfish and "other fish" complexes. Given the reasoning provided in Agenda Item D.3.b, Supplemental GMT Report, April 2013, **the GMT recommends that only the slope rockfish and "other fish" complexes be considered for reorganization; the alternatives for shelf rockfish, nearshore rockfish, and flatfish complexes should not be considered for reorganization at this time.** As such, the GMT only provides alternatives for the slope rockfish complex and the "other fish" complex herein.

"Cost" of Reorganization

As mentioned in the GMT's report for this meeting's briefing book (Agenda Item F.8.b, GMT Report), a subgroup of the team designed two surveys intended to collect information related to the potential impacts of an increase in market categories (or sorting requirements) that could result from changes to existing stock complexes. These surveys were designed for State port biologists/samplers and State program managers and supervisors. An update on the status of these surveys is shown in Appendix B.

Approach

The GMT adopted a four-step approach to evaluate stock complexes. The adopted approach is different than shown in the Preliminary Alternatives (Agenda Item F.8.a, Attachment 1) and used criteria the GMT found helpful for evaluating one alternative against another, using the information and analyses the Council, GMT, and SSC recommended that we consider (mainly species co-occurrence).

The first step relates to the "in the fishery" question. For each component species, we looked at 2002-2011 estimates of mortality, and productivity and susceptibility analysis (PSA) vulnerability scores to determine the extent of their catch and vulnerability to overfishing by West Coast groundfish fisheries. If catch, retention and vulnerability of a particular component species were low, then it could potentially be removed from the complex and considered as an Ecosystem Component species or it could be removed from the fishery management plan (FMP) all together.

The second step took into consideration area management and co-occurrence and how to inform the risk of overfishing in a biologically meaningful way and in consideration of area-specific management policies north and south. The primary focus of this area management question was on the 40° 10’ N. latitude management line but considerations for general north/south and depth distributions were also discussed at length.

The third step considered average catch of component species compared to their component OFLs to assess the risk of overfishing.

Lastly, we recommend a focus on the need to control catch of component species. This is not different from the Preliminary Alternatives, yet it switches the matter of priority away from the need to reorganize stock complexes wholesale and towards the need of addressing the risk of overfishing for the stocks where that risk is highest.

Additional Considerations and Rationale

The GMT does not think species with low presence on one side of the 40° 10’ N. lat. management line met the criteria for EC species listed in National Standard 1 guidelines[1], specifically because many of these species are targeted as part of the minor slope complex. The GMT generally agrees with the SSC (Agenda Item F.8.b, Supplemental SSC Report) that if a species crosses a management line, the full OFL (i.e., not component contributions north or south of 40° 10’) should be considered when analyzing the risk of overfishing. In other words, total catch from all areas should be measured against the OFL coming out of a stock assessment prior to its apportionment north and south of 40° 10’.

The GMT further notes that, as with all stocks in complexes, overfishing would not be legally declared for the component species on an annual basis (e.g., as it is with individually managed stocks where the OFL is exceeded). Instead, average catches over time relative to estimates of OFL/acceptable biological catch (ABC) contribution to the complex may give an indication that the species is experiencing an unsustainable harvest level that warrants further investigation to ensure that overfishing is not occurring. For example such species might be prioritized for a full assessment in the next cycle.

An additional alternative may be considered for those stocks that are currently apportioned on two sides of a management line for no clear biological reason, and are rarely encountered on one side or the other. For these cases, we suggest that these stocks be grouped by co-occurrence but

[1] To be considered for possible classification as an EC species, the species should: (A) be a non-target species or non-target stock; (B) not be determined to be subject to overfishing, approaching overfished, or overfished; (C) not be likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and (D) not generally be retained for sale or personal use.

managed using coastwide OFL and ABC contributions for those complexes. These alternatives eliminate the management line altogether, since it is unnecessary from a biologically standpoint, and create complexes based on co-occurring northern or southern "aggregations."

GMT Alternatives and Recommendation

Recommendation Regarding Complex Alternatives to Move Forward:
The GMT did not evaluate specific alternatives within the Preliminary Alternatives, but rather developed alternatives that we would like the Council to consider including for future analysis. The GMT does, however, **recommend that only the slope rockfish and "Other Fish" complexes be considered for reorganization; the alternatives for shelf rockfish, nearshore rockfish, and flatfish complexes should not be considered for reorganization at this time.** Reasoning was provided on page 2 above.

Slope Rockfish Alternatives

For slope rockfish the GMT presents two alternatives. The first alternative would result in a northern-distributed slope rockfish (redbanded, sharpchin, and yellowmouth rockfishes), denoted here as Slope Rockfish Complex A, and southern-distributed slope rockfish complex (bank and blackgill rockfishes) called Slope Rockfish Complex B. Although these stocks are caught primarily either in the north or in the south, the complex would be managed using coastwide ABCs under this alternative.

We also note that in this alternative several species are pulled out of complexes and managed separately. Rougheye, shortraker, and aurora are managed individually on the presumption that species vulnerable to overfishing might be easier to manage under individual specification. Splitnose rockfish is also managed individually (i.e., as it currently is south of 40^{o} 10' N. lat.) as it would have a very large relative OFL/ABC contribution and could act as an inflator species in the complex. In addition, Pacific Ocean perch (POP) could be removed from the southern complex all together and managed separately using a coastwide OFL/ABC/annual catch limit (ACL).

Slope Alternative #1

Individual management
Rougheye coastwide
Shortraker coastwide
Aurora coastwide
Splitnose coastwide
POP coastwide

Slope Rockfish Complex A
Yellowmouth
Redbanded
Sharpchin

Slope Rockfish Complex B

Bank
Blackgill

For the second slope alternative, we recommend managing splitnose and POP coastwide rather than in any complex (as in Alternative 1), as well as bank rockfish, under the similar rationale that it may serve as an inflator species.

This alternative maintains the status quo management line with separate north and south complexes, but with the caveat that those species with low occurrence on one side of the management line are highlighted to indicate that evaluation of overfishing should be done on the entire coastwide OFL rather than small contributions on one side of the line.

Slope Alternative #2

Individual management
Splitnose coastwide
Bank coastwide
POP coastwide

Slope Rockfish North of 40°10' Complex
Yellowmouth
Sharpchin
Shortraker
Rougheye
Redbanded
Aurora
Blackgill*

Slope Rockfish South of 40°10' Complex
Yellowmouth*
Sharpchin*
Shortraker*
Rougheye*
Redbanded
Aurora
Blackgill

*These species have low OFL/ABC contribution to this complex for this area. The determination of whether the policy to prevent overfishing is being violated should be evaluated at the total coastwide OFL.

Other Fish - Cartilaginous Species Alternatives

Two species were proposed for individual management: longnose skate and spiny dogfish. Both species have large OFL contributions relative to the other cartilaginous species; these species might inflate the OFL of a complex that included them. Longnose skate and spiny dogfish have OFLs based on Category 1 stock assessments. In this alternative, the remaining species under consideration would be grouped into a Shark and Ratfish Complex and a Skate Complex. These two complexes would be easily separated from each other but in neither case is there adequate differences in distribution or patterns of co-occurrence to require further separation. In general, cartilaginous species have life histories that are more similar to each other than to bony fishes, making their susceptibility somewhat similar. The GMT notes that further research is required on the concept of indicator species for status determination but the SSC supports the possibility that longnose skate could be used as an indicator species for the skate complex.

Individual management
Longnose skate
Spiny dogfish[2]

Shark and Ratfish Complex
Soupfin shark
Brown cat shark
Leopard shark[#]
Spotted ratfish

Skate complex
Aleutian skate
Big skate
Roughtail/black skate
California skate
All other skates
Bering/sandpaper skate

[#] Could be considered for State-management by California.

Other Fish – Roundfish Alternatives

Review of the depth distribution of components of the other roundfish complex identified what could be defined as deeper water and shallower roundfish complexes, as well as species that are managed or targeted individually. This is shown below in the proposed GMT alternative for further analysis. At present, California scorpionfish as well as cabezon in Oregon and California are managed outside of the other fish complex. The GMT recommends that they continue to be managed individually since they are targeted stocks where catch is currently tracked individually.

The shallow roundfish complex (kelp greenling, other greenlings, and cabezon (WA)) is clearly separate from the deeper roundfish complex. We note that species in this shallow roundfish complex are also managed under state fishery regulations.

Individual Management
California scorpionfish
Cabezon (Oregon and California, as in status quo)

[2] Evaluating dogfish catch to the OFL was done and overfishing has not occurred. However the MSY proxy for dogfish is scheduled for reconsideration by the SSC and Council.

Deepwater Roundfish Complex
Pacific rattail/grenadier
Giant rattail/grenadier
All other rattails/grenadiers
Finescale codling/Pacific flatnose (Consider making this an EC species)
California slickhead (Consider making this an EC species)

Shallow Roundfish Complex (consider individual management)
Kelp Greenling
All other greenlings
Cabezon (Washington only)

Next Steps

The GMT recommends that the alternatives described herein be included for further analysis and consideration. We also point out that as always, the Council has the flexibility to adopt parts of any alternative and mix and match those aspects.

GMT Recommendations

The GMT recommends:

1. **the slope rockfish and "Other Fish" complexes be considered for reorganization and the alternatives for shelf rockfish, nearshore rockfish, and flatfish complexes should not be considered for reorganization at this time (as discussed in** Agenda Item D.3.b, Supplemental GMT Report, April 2013**);**

2. **that the risk of overfishing be evaluated against the total coastwide OFL (i.e., the biological unit) for component species in complexes over time; and**

3. **the alternatives described herein be included for further analysis and consideration. We also point out that as always, the Council has the flexibility to adopt parts of any alternative and mix and match those aspects**

Appendix A. Tables and figures related to slope and other fish complex alternatives.

Table 1. Slope rockfish occurrences (a), co-occurrences (c), and normalized C-scores (e) in the West Coast Groundfish Observer Program (WCGOP) bottom trawl data (2002-2011) North of 40°10’ N lat. The shading in (c) is darkest for values less than 0.20 indicating the highest level of co-occurrence, and lighter for values between 0.20 and 0.70, indicating moderate levels of co-occurrence. Values greater than 0.70 are un-shaded indicating the lowest level of co-occurrence. Further explanation of these co-occurrence tables is provided in Agenda Item F.8.b, June 2013.

(a) Total occurrences of Slope Rockfish North of 40°10’ N lat.

Darkblotched	Splitnose	Aurora	Pacific Ocean Perch	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
6487	5033	4795	4334	2744	1508	788	778	597	69	39

(b) Matrix of common occurrences of Slope Rockfish North of 40°10’ N lat.

	Splitnose	Aurora	POP	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
Darkblotched	2743	1679	2700	1867	978	512	528	328	48	28
	Splitnose	1784	2383	2068	877	466	611	301	38	30
		Aurora	1297	1031	661	533	174	295	31	14
			POP	1584	837	310	536	315	24	26
				Redbanded	685	275	449	228	30	19
					Rougheye/ Blackspotted	177	180	273	13	17
						Blackgill	65	83	16	8
							Sharpchin	48	8	16
								Shortraker	5	4
									Bank	6

(c) Matrix of normalized C-scores for Slope Rockfish North of 40°10’ N lat.

	Splitnose R	Aurora	POP	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
Darkblotched	0.263	0.482	0.22	0.228	0.298	0.323	0.295	0.428	0.302	0.281
Splitnose		0.405	0.237	0.145	0.346	0.371	0.189	0.466	0.446	0.229
Aurora			0.511	0.49	0.484	0.288	0.748	0.475	0.547	0.639
POP				0.268	0.359	0.563	0.273	0.438	0.649	0.331
Redbanded					0.41	0.586	0.354	0.567	0.559	0.509
Rougheye/ Blackspotted						0.684	0.677	0.444	0.805	0.558
Blackgill							0.841	0.77	0.753	0.787
Sharpchin								0.863	0.875	0.578
Shortraker									0.92	0.891
Bank										0.773

Table 2. Slope rockfish occurrences (a), co-occurrences (c), and normalized C-scores (e) in the WCGOP bottom trawl data (2002-2011) South of 40°10’ N lat. The shading in (c) is darkest for values less than 0.20 indicating the highest level of co-occurrence, and lighter for values between 0.20 and 0.70, indicating moderate levels of co-occurrence. Values greater than 0.70 are un-shaded indicating the lowest level of co-occurrence. Further explanation of these co-occurrence tables is provided in Agenda Item F.8.b, June 2013.

(a) Total occurrences of Slope Rockfish South of 40°10’ N lat.

Darkblotched	Splitnose	Aurora	Pacific Ocean Perch	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
446	1501	855	24	274	13	461	77	7	268	0

(b) Matrix of common occurrences of Slope Rockfish South of 40°10’ N lat.

	Splitnose	Aurora	POP	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
Darkblotched	347	129	8	134	4	112	23	3	113	0
	Splitnose	404	14	252	8	337	56	5	238	0
		Aurora	13	91	9	233	5	4	67	0
			POP	6	2	7	0	1	4	0
				Redbanded	3	78	18	3	64	0
					Rougheye/ Blackspotted	8	1	0	4	0
						Blackgill	2	4	71	0
							Sharpchin	0	18	0
								Shortraker	1	0
									Bank	0

(c) Matrix of normalized C-scores for Slope Rockfish South of 40°10’ N lat.

	Splitnose	Aurora	POP	Redbanded	Rougheye/ Blackspotted	Blackgill	Sharpchin	Shortraker	Bank	Yellowmouth
Darkblotched	0.171	0.604	0.655	0.357	0.686	0.567	0.665	0.568	0.432	NA
	Splitnose	0.386	0.413	0.067	0.383	0.209	0.263	0.285	0.094	NA
		Aurora	0.451	0.597	0.304	0.36	0.93	0.427	0.691	NA
			POP	0.734	0.776	0.698	1	0.821	0.821	NA
				Redbanded	0.761	0.594	0.716	0.565	0.583	NA
					Rougheye/ Blackspotted	0.378	0.911	1	0.682	NA
						Blackgill	0.97	0.425	0.622	NA
							Sharpchin	1	0.715	NA
								Shortraker	0.854	NA
									Bank	NA

Table 3. Cartilaginous Species occurrences (a), co-occurrences (b), and normalized C-scores (c) in the WCGOP bottom trawl data (2002-2011) coastwide. The shading in (c) is darkest for values less than 0.20 indicating the highest level of co-occurrence, and lighter for values between 0.20 and 0.70, indicating moderate levels of co-occurrence. Values greater than 0.70 are un-shaded indicating the lowest level of co-occurrence. Further explanation of these co-occurrence tables is provided in Agenda Item F.8.b, June 2013.

(a) Total occurrences of Cartilaginous Species coastwide

Longnose Skate	All Other Skates	Spiny Dogfish Shark	Spotted Ratfish	Brown Cat Shark	Bering/ Sandpaper Skate	Big Skate	Black Skate	California Skate	Aleutian Skate	Leopard Shark	Soupfin Shark
19318	18043	16993	16959	15076	15040	6029	5279	2720	539	358	113

(b) Matrix of common occurrences of Cartilaginous Species coastwide

	All Other Skates	Spiny Dogfish Shark	Spotted Ratfish	Brown Cat Shark	Bering/Sandpaper Skate	Big Skate	Black Skate	California Skate	Aleutian Skate	Leopard Shark	Soupfin Shark
Longnose Skate	7581	10163	10561	8501	11531	2460	2152	974	408	22	29
	All Other Skates	9115	9604	5313	6927	2764	918	875	304	133	52
		Spiny Dogfish Shark	10426	4804	8391	2976	836	1190	294	186	57
			Spotted Ratfish	4059	8420	3113	543	744	288	41	42
				Brown Cat Shark	7448	159	4165	73	360	1	3
					Bering/ Sandpaper Skate	1596	1478	135	312	1	9
						Big Skate	24	1245	13	289	69
							Black Skate	19	115	1	0

	California Skate	Aleutian Skate	Leopard Shark	Soupfin Shark
California Skate		1	223	64
Aleutian Skate			0	0
Leopard Shark				25

(c) Matrix of normalized C-scores for Cartilaginous Species coastwide

	All Other Skates	Spiny Dogfish Shark	Spotted Ratfish	Brown Cat Shark	Bering/ Sandpaper Skate	Big Skate	Black Skate	California Skate	Aleutian Skate	Leopard Shark	Soupfin Shark
Longnose Skate	0.352	0.19	0.171	0.244	0.094	0.517	0.526	0.61	0.238	0.937	0.742
All Other Skates		0.229	0.203	0.457	0.332	0.459	0.784	0.645	0.429	0.624	0.538
Spiny Dogfish Shark			0.149	0.489	0.224	0.418	0.8	0.523	0.447	0.475	0.494
Spotted Ratfish				0.556	0.222	0.395	0.868	0.695	0.458	0.883	0.627
Brown Cat Shark					0.255	0.963	0.153	0.968	0.324	0.997	0.973
Bering/ Sandpaper Skate						0.657	0.649	0.942	0.412	0.997	0.92
Big Skate							0.991	0.43	0.974	0.183	0.385
Black Skate								0.989	0.77	0.997	1
California Skate									0.998	0.346	0.423
Aleutian Skate										1	1
Leopard Shark											0.724

Table 4. Other Roundfish occurrences (a), co-occurrences (b), and normalized C-scores (c) in the WCGOP bottom trawl data (2002-2011) coastwide. The shading in (c) is darkest for values less than 0.20 indicating the highest level of co-occurrence, and lighter for values between 0.20 and 0.70, indicating moderate levels of co-occurrence. Values greater than 0.70 are un-shaded indicating the lowest level of co-occurrence. Further explanation of these co-occurrence tables is provided in Agenda Item F.8.b, June 2013.

(a) Total occurrences of Other Roundfish coastwide

Giant Grenadier	Pacific Grenadier	California Slickhead	Pacific Flatnose	All Other Grenadiers	California Scorpionfish	Kelp Greenling	Cabezon	All Other Greenlings
7032	6433	4465	4120	3867	148	108	29	28

(b) Matrix of common occurrences of Other Roundfish coastwide

	Pacific Grenadier	California Slickhead	Pacific Flatnose	All Other Grenadiers	California Scorpionfish	Kelp Greenling	Cabezon	All Other Greenlings
Giant Grenadier	4241	3262	2628	1399	0	1	0	0
	Pacific Grenadier	2944	2375	1077	0	1	0	0
		California Slickhead	1929	1566	0	1	0	0
			Pacific Flatnose	1516	0	1	0	0
				All Other Grenadiers	0	2	0	0
					California Scorpionfish	0	1	0
						Kelp Greenling	0	0
							Cabezon	0

(c) Matrix of normalized C-scores for Other Roundfish coastwide

	Pacific Grenadier	California Slickhead	Pacific Flatnose	All Other Grenadiers	California Scorpionfish	Kelp Greenling	Cabezon	All Other Greenlings
Giant Grenadier	0.135	0.144	0.227	0.511	1	0.991	1	1
	Pacific Grenadier	0.185	0.267	0.601	1	0.991	1	1
		California Slickhead	0.302	0.386	1	0.991	1	1
			Pacific Flatnose	0.384	1	0.991	1	1
				All Other Grenadiers	1	0.981	1	1
					California Scorpionfish	1	0.959	1
						Kelp Greenling	1	1
							Cabezon	1

Table 4. Variables pertinent to consideration of slope rockfish stock complex composition including OFL contributions north and south of 40°10' N. lat, vulnerability to overfishing, percent attainment of complex OFL contributions since 2003 and post ITQ in 2011 and the percent of the complex composed of a given component stock.

Slope Rockfish Complex Component Species	2013 OFL North of of 40°10' N. lat (mt)	2013 OFL South of 40°10' N. lat (mt)	Primarily Found North or South of 40°10' N. lat or Coastwide	Vulnerability to Overfishing PSA Score	Average Percent Mortality 2003-2011 vs. 2013 OFL North	Percent Mortality 2011 vs. 2013 OFL North	Average Percent Mortality 2003-2011 vs. 2013 OFL South	Percent Mortality 2011 vs. 2013 OFL South	Component OFL as % of total 2013 OFL (N & S of 40°10' N. lat)
Rougheye/ Blackspotted	71.1	0.4	North	2.27	232%	283%	245%	75%	4.0% N; 0.06% S
Shortraker	18.7	0.1	North	2.25	129%	151%	630%	0%	1.2% N; 0.01% S
Aurora	15.4	26.1	Coastwide	2.1	179%	134%	109%	25%	1.0% N; 3.8% S
Blackgill	4.7	134	South	2.08	134%	98%	89%	109%	0.3% N; 19.1% S
Sharpchin	214.5	9.8	North	2.05	4%	3%	31%	0%	14% N; 1.4% S
Bank	17.2	503.2	South	2.02	8%	4%	12%	6%	1.1% N; 74% S
Redbanded	45.3	10.4	Coastwide	2.02	66%	67%	22%	3%	3.0% N; 1.5% S
Yellowmouth	192.4	0.8	North	1.96	6%	0%	38%	0%	12.7% N; 0.1% S
POP	180	<0.1	North	1.69	82%	34%	560%	26%	NA
Splitnose	974.1	1670	Coastwide	1.82	9%	3%	13%	<1%	61.9% N

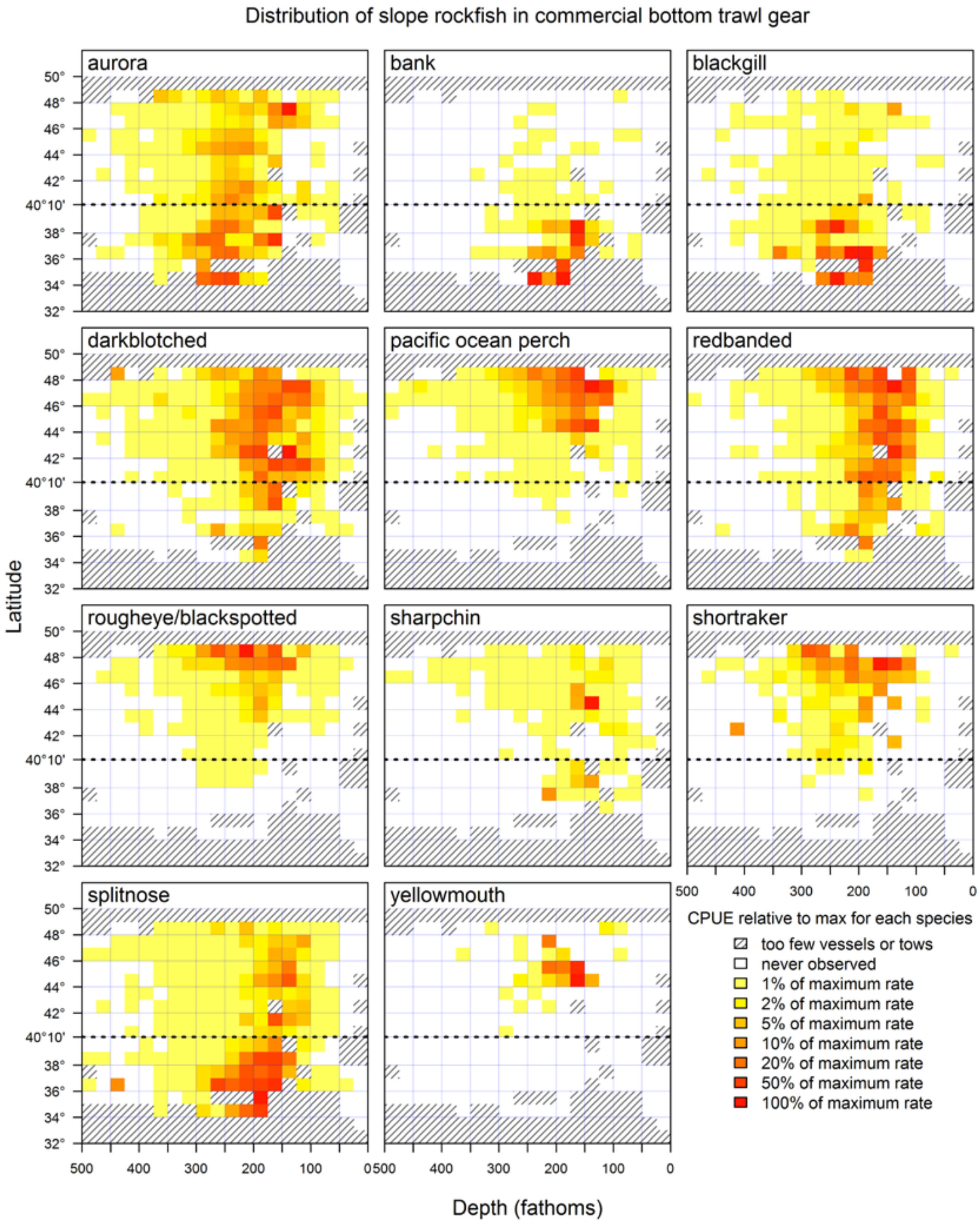

Figure 1. Spatial distribution of Slope Rockfish in WCGOP trawl data (2002 – 2011) for alternatives above. Colors represent CPUE relative to the maximum within each species (see the legend). Darkest red = highest CPUE; lightest yellow = lowest CPUE. Data for hatched boxes could not be displayed because of confidentiality (only 1 or 2 vessels carrying observers fished in the area) or because no vessels carrying observers fished in the area. White areas are places where 3 or more vessels fished and carried observers, but the species in question was not caught.

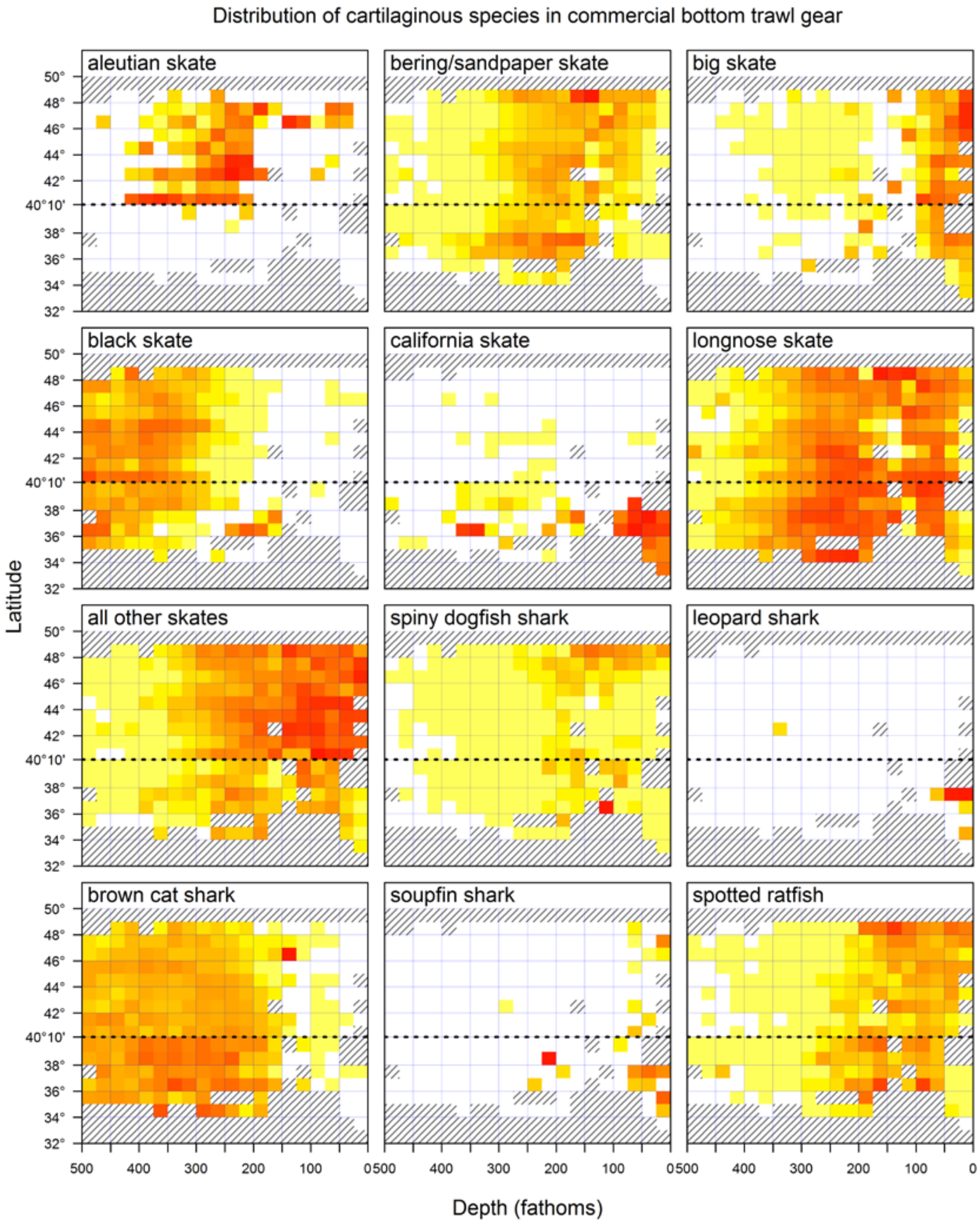

Figure 2. Spatial distribution of Cartilaginous Species in WCGOP trawl data (2002 – 2011) for alternatives above. Colors and hashed areas are described in Figure 1 caption.

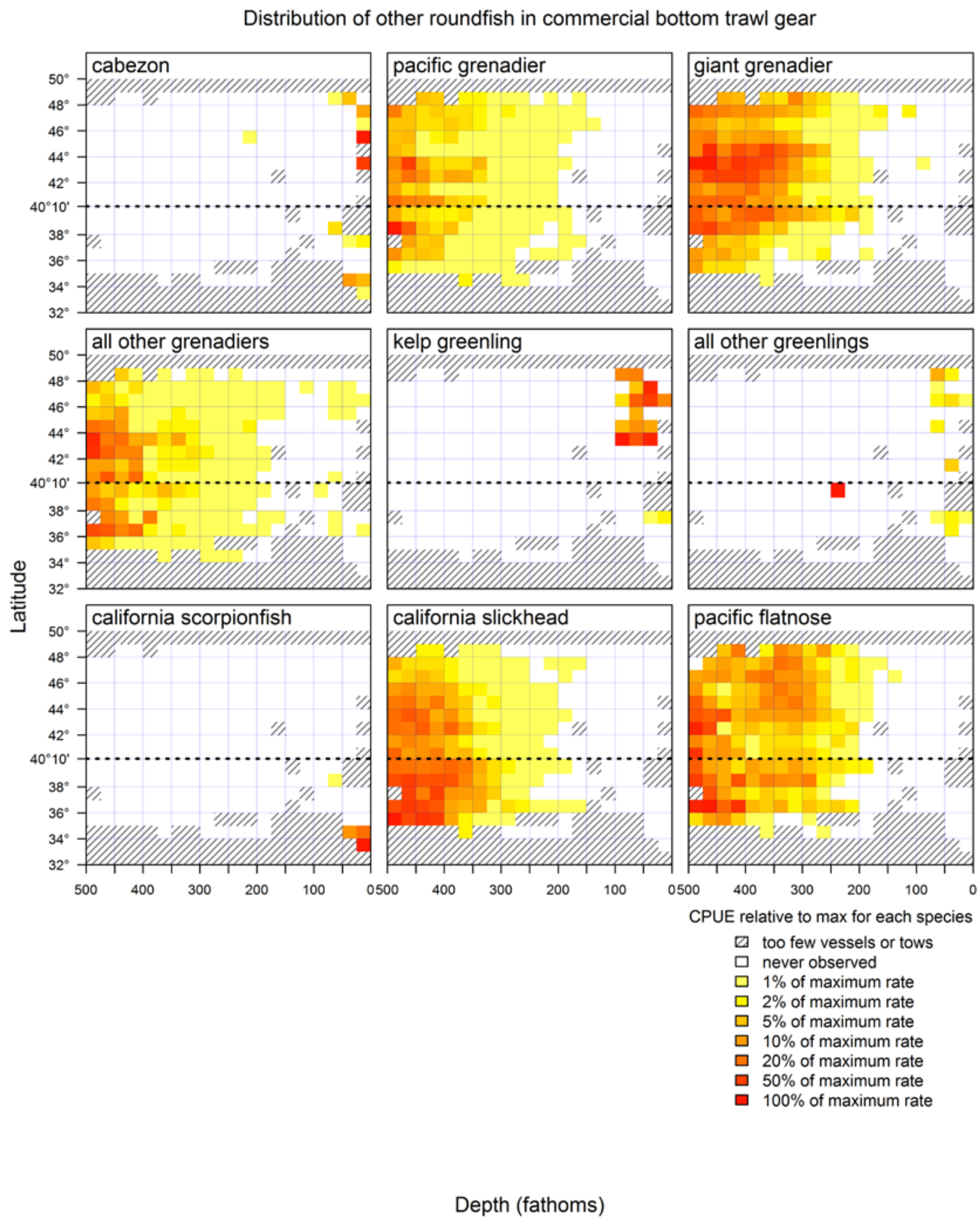

Figure 3. Spatial distribution of Other Roundfish in WCGOP trawl data (2002 – 2011) for alternatives above. Colors and hashed areas are described in Figure 1 caption.

Appendix B. Update on the GMT's port sampling surveys

As mentioned in the GMT's report for this meeting's briefing book (Agenda Item F.8.b, GMT Report), a subgroup of the team designed two surveys intended to collect information related to the potential impacts of an increase in market categories (or sorting requirements) that could result from changes to existing stock complexes. One survey was designed for state port sampling program managers and supervisors, and the second was designed for port biologists, samplers, and other state sampling personnel. Respondents had the opportunity to participate through the end of the day on June 17, allowing for at least one week for individuals to provide feedback. In this Briefing Book, the team ambitiously suggested that a full report of the surveys' results would be presented at this meeting. Due to the tight timeframe for developing and implementing the surveys, a complete discussion and analysis of all results was not possible. A complete report of survey results will be made available for the September 2013 Briefing Book.

A few preliminary results from both surveys are offered here for informational purposes. A total of 26 state agency personnel were given an opportunity to participate, representing a census of state sampling personnel. Surveys were completed by all five state program managers/supervisors and 17 of 21 port biologists, assistants, and seasonal samplers. Key information collected from program managers included anticipated impacts to state sampling programs and to fishing operations and/or processing plants, relative to increases in market categories. Information was also collected about groundfish port locations where the fewest number of groundfish species composition samples are currently collected. Potential impacts to state sampling programs that were mentioned by all five program managers/supervisors surveyed included:

- Existing fish ticket or landing receipt books and/or data management software and programs will have to be updated.
- Additional training of state agency staff, fishing operations personnel, and/or fish processing employees will be necessary.

A more thorough description of similar challenges – as well as other challenges – are mentioned in greater detail in the Oregon Department of Fish and Wildlife's (ODFW) report under this agenda item in the Briefing Book (Agenda Item F.8.b, ODFW Report).

Also mentioned by all five program managers/supervisors were two potential impacts to fishing operations and/or processing plants relative to increased numbers of market categories:

- Fishing operations and/or processing plants may be needed to train new or existing employees to accurately sort these market categories.
- Fishermen, plant workers, etc. will spend more time sorting groundfish landings if the number of market categories increases.

Key information collected from the state's port biologists, assistants, and seasonal samplers included how often they encountered each of the species currently in the slope, other fish, nearshore, and shelf stock complexes, which tools they used to identify these species, and other species they might mistake that species for. These information were available for the GMT's discussion of potential stock complex alternatives at this meeting. For example, the majority of port biologists and other sampling personnel mentioned that aurora and splitnose rockfishes were frequently encountered and individually identified with a quick visual look. However, these respondents noted that these species were ones they themselves might mistake for the other. At first glance, these information collectively seem disconnected; the team will take a closer look at these and other results prior to September.

Lastly, some on the GMT think that developing and implementing similar surveys for fishing operations and processing plants, and/or observers and catch monitors, may be useful for gaining greater insight into potential impacts to the fishing industry and agencies, from the perspective of these individuals. After this meeting, the team plans to discuss the utility and feasibility of collecting these data from these industry and agency partners.

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
ADOPT PRELIMINARY STOCK COMPLEX AGGREGATIONS

Mr. John DeVore gave an overview of the preliminary alternative stock complexes and the basis for those alternatives to the Scientific and Statistical Committee (SSC), and Mr. Dan Erickson summarized the Groundfish Management Team (GMT) Report on this matter. The document has been modified since the April 2013 meeting by adding alternatives, adding figures highlighting species for which catches exceed their contribution to the overfishing limit (OFL), and by adding figures to summarize how species overlap in fishery catches.

In general, the alternatives are sufficiently well developed for public review. However, the SSC recommends removing the version of alternative 2 for the proposed Roundfish complex in which California scorpionfish is treated as an indicator stock because this species does not overlap greatly with the remaining members of the proposed complex.

The GMT is making progress towards developing effective metrics to quantify overlap among species. These metrics should help to select among the alternatives. The SSC recommends that plots and tables be developed based on catch or catch per unit of effort (CPUE) in addition to probability of occurrence. The SSC provided the GMT with an alternative approach for constructing tables quantifying overlap, which compares the results to a random distribution. A cluster analysis approach (Figures 4 and 5 of the GMT Report) is also presented as a way to quantify overlap. However, this approach can lead to clustering by rarity regardless of co-occurrence. Consequently, the SSC recommends against this approach. The SSC recommends that the GMT conduct its analyses using catch-based (e.g., observer) data because these data provide the best appraisal of co-occurrence in the fishery and likely fishery impacts and because the trawl surveys are limited temporally. The SSC recommends that separate tables and figures be produced summarizing overlap north and south of 40°10’ N. lat.

The SSC reiterates its recommendation from the April meeting that the metrics used to evaluate current stock complexes be refined to focus on the ratio of total cumulative catch to total cumulative component OFL and the mean difference between total catch and total component OFL.

There are some species which are found primarily north of 40°10’ N. lat., but are caught in very small quantities south of 40°10’ N. lat. and vice versa. The SSC recommends that such components should not be designated as ecosystem component (EC) species because they do not satisfy the requirements for EC species as the catches are landed. If a catch has exceeded its associated component OFL, the fraction of the coastwide species OFL assigned as component OFL in the complex should be taken into account before triggering a management response.

There needs to be a way to determine the status of stocks within complexes, or complexes as a whole, relative to being in an overfished state. The SSC identified three approaches: (a) using stock assessments for indicator stocks which are members of the complexes, (b) using the results of data-moderate assessments, and (c) using stock assessments for indicator stocks which are not members of the complexes but have similar vulnerability and co-occur with the species in the complex. Adding a stock to a complex simply to have an indicator stock could lead to the indicator stock becoming an inflator stock.

PFMC
06/22/13

CONSIDERATION OF INSEASON ADJUSTMENTS

Management measures for groundfish are set by the Council with the general understanding these measures will likely need to be adjusted within the biennium to attain, but not exceed, the annual catch limits (ACL). This agenda item will consider inseason adjustments to ongoing 2013 fisheries. Potential inseason adjustments include adjustments to Rockfish Conservation Area (RCA) boundaries and adjustments to commercial and recreational fishery catch limits. Adjustments are, in part, based on recent landings and the latest information from the West Coast Groundfish Observer Program.

In May the National Marine Fisheries Service (NMFS) prepared a Public Notice and letter to the Council regarding the issuance of 2012 surplus carryover quota pounds (QP) to the 2013 shorebased individual fishing quota (IFQ) program (see http://tinyurl.com/bmf95 and Agenda Item F.9.b, NMFS Letter 1). Carryover was issued for all IFQ species except Pacific whiting, petrale sole, and lingcod (north and south of 40°10' N. latitude). NMFS did not issue carryover for Pacific whiting, consistent with Council action in November 2012 (see http://tinyurl.com/plrzx7u). Surplus carryover for petrale sole was not issued because NMFS determined there was a high risk of exceeding the 2013 ACL for petrale sole. Further, NMFS did not issue surplus carryover for lingcod because the QP management unit was coastwide in 2012 and is now divided north and south of 40°10' N. latitude. Current regulations at § 660.140 (c)(3)(vii), address reallocation with changes in management areas and subdivision of species groups for quota share in quota share accounts. However, these regulations do not specifically address reallocations with changes in management areas and subdivision of species groups for QP in vessel accounts with carryover. NMFS requests the Council consider how the reallocations by geographic area affect lingcod surplus carryover and provide an option for issuing lingcod carryover in 2013 (Agenda Item F.9.b, NMFS Report). Long-term solutions for all species are expected to be considered in September 2013 under future trawl trailing actions.

At their March 2013 meeting, the Council considered the performance of the shorebased IFQ fishery in 2011 and 2012, progress to date in 2013, as well as additional pre-IFQ bycatch rate data, and recommended the shoreward boundary of the trawl RCA be moved from 75 to 100 fathoms from the area 40°10' to 48°10' N. latitude in Period 2. The RCA modification was intended provide greater access to target species while allowing the individual accountability afforded by the rationalized fishery to minimize bycatch of overfished species. At the April 2013 Council meeting and in a subsequent letter, NMFS announced that the RCA modifications could not be implemented under the inseason procedures and that such adjustments should allow for public input through a notice and comment rulemaking (Agenda Item F.9.b, NMFS Letter 2). The Council adopted the following adjustments for implementation through a notice and comment rulemaking 1) the shoreward boundary of the trawl RCA be moved from 75 to 100 fathoms from the area 40°10' to 48°10' N. latitude for Period 6 in 2013 and 2) the 2014 RCA configuration in the area 40°10' to 48°10' N. latitude be 100 fm shoreward and 150 fm seaward for Periods 1-6. At this meeting, NMFS is anticipated to provide an update on the process to implement the Council's recommendation.

Council Action:

1. **Consider information on the status of 2013 fisheries and adopt inseason adjustments, as necessary.**
2. **Consider recent action regarding surplus carryover and recommend a method for issuing lingcod carryover, given changes to the management area that occurred in 2013.**
3. **Discuss the process for implementing the trawl RCA adjustments, as necessary.**

Reference Materials:

1. Agenda Item F.9.b, NMFS Letter 1: Surplus Carryover Decision.
2. Agenda Item F.9.b, NMFS Report: Lingcod Surplus Carryover Option.
3. Agenda Item F.9.b, NMFS Letter 2: RCA Recommendations for April 15-April 30.

Agenda Order:

a. Agenda Item Overview — Kelly Ames
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Adopt Recommendations for Adjustments to 2013 Groundfish Fisheries, Including Carryover

PFMC
05/30/13

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Sustainable Fisheries Division F/NWR2
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115-0070

MAY 06 2013

Dr. Donald O. McIsaac
Executive Director
Pacific Fishery Management Council
7700 Ambassador Place, Suite 101
Portland, OR 97220-1384

Dear Dr. McIsaac:

This is in response to the Pacific Fishery Management Council's (PFMC) transmittal letter dated April 19, 2013, regarding recommendations for inseason adjustments to 2013 groundfish fisheries from the April, 2013 meeting, including the issuance of surplus carryover in the Pacific Coast Individual Fishing Quota (IFQ) Program from 2012 to 2013.

The National Marine Fisheries Service (NMFS) decided to issue surplus carryover from 2012 to 2013 for the vast majority of IFQ species/area categories. The exceptions are Pacific whiting, lingcod and petrale sole. Consistent with the PFMC recommendation, NMFS will not issue surplus carryover for Pacific whiting due to the need for adherence to the international whiting agreement, where a method for addressing carryover of unused Pacific whiting already exists. Surplus carryover will not be issued for lingcod at this time because the PFMC needs to first recommend a method to transition surplus carryover methods from the 2012 coastwide IFQ species category to the area-specific ones that currently exist for 2013. Surplus carryover pounds of petrale sole will not be issued due to risk of exceeding the 2013 ACL for this stock, which is currently in overfished status.

Petrale sole

Petrale sole is currently listed in 2013 as an overfished species under a rebuilding plan, and as such it is imperative to keep harvests within the ACL. Attainment of the petrale sole allocation in the 2012 season of the IFQ program, as shown on the IFQ Program public website (https://www.webapps.nwfsc.noaa.gov/ifq/) was 100.3 percent. Consistent with the policy set on May 11, 2012, NMFS will not issue carryover of this species, in accordance with the associated risk of exceeding the 2013 ACL. That policy is, for IFQ species with overall attainment at or above 100 percent (of the IFQ Program allocation) in a given year, NMFS will not issue surplus carryover for the subsequent year.

NMFS estimates that if surplus carryover pounds were issued for petrale sole, this would lead to a projected 97.5 percent attainment of the 2013 ACL (2,526 mt/2,592 mt). Without surplus carryover, the projected attainment of the petrale sole ACL is 96.7 percent (2,507 mt/2,592 mt). Since the petrale sole ACL increases from 2012 to 2013 (from 1,160 mt in 2012, to 2,592 mt in 2013), the amount of potential surplus carryover (20 mt) from 2012, relative to the 2013 ACL is small (0.7 percent). The fact that the ACL more than doubles (an increase of 223 percent) means that the fishery sees a huge increase in targeting opportunity for this species in 2013.

It should be noted that changes to RCA boundaries are unlikely to be effective at curtailing petrale sole catch in the IFQ fishery as an inseason accountability measure. Petrale sole's highest density is reported to be between 160 and 250 fathoms (fm), and adults migrate seasonally between deep winter spawning areas to shallower spring feeding grounds (Status of the Pacific Coast Groundfish Fishery, Vol. 1, 2008, PFMC, http://www.pcouncil.org/wp-content/uploads/SAFE_2008_March.pdf). Modified RCA boundaries exist that can be used specifically to allow or deny access to those shallow spring feeding grounds. However, by the time managers could become aware that a conservation concern due to high catch has developed, the opportunity to use RCA boundaries will have already passed, and petrale sole will have left their spring feeding grounds, and returned to deeper waters. On average, half of the annual petrale sole catch each year has occurred during four winter months in the IFQ program (November through February), and 28 percent of the annual catch happens in November and December alone (2011-2012). Moving the seaward RCA to outside the area of highest density (deeper than 250 fm), although potentially somewhat effective, would be a severe accountability measure, which would make fishing very difficult for many target species, and should only be undertaken as a last resort. Taken together, this means that RCAs are not an effective tool to mitigate annual catch of petrale sole, given the likely timing of the need for implementation of an accountability measure, to stay within the ACL.

The sum of these factors, together with the policy established by NMFS in May of 2012, leads us to conclude there is a potentially high risk of exceeding the petrale sole ACL in 2013, and NMFS will not further increase this risk by issuing surplus carryover for this species.

<u>Lingcod</u>
The coastwide IFQ species/area category for lingcod was divided north and south of 40°10' N. lat., effective 2013. Methods for converting the surplus coastwide pounds from 2012 into area-specific pounds for 2013, and potentially related issues surrounding the method for proportional reduction of the surplus carryover pounds, according to the reduction in the ACLs for lingcod, should be recommended by the PFMC and approved by the NMFS before surplus carryover can be issued for lingcod from 2012 to 2013. Recommending a general method that could be applied to any IFQ species/area category would prevent similar complications in the future, when management lines for other species are changed. NMFS has explored this topic, and recommends, as stated in the 2013-2014 harvest specifications and management measures final rule (78 FR 580, 1/3/2013), that the PFMC and NMFS need to consider how reallocations affect surplus carryover, QS control limits (including aggregate non-whiting groundfish species), and potentially, a different solution to deficit carryover. (p.584) The PFMC and NMFS have not yet addressed how to issue surplus carryover when an IFQ species management area is subdivided between years, like lingcod.

Such a method should be consistent with how the lingcod ACL change was approached in the 2013-2014 harvest specifications (see proposed rule 77 FR 67974, 11/14/2012, p.67979) where a shift was made from 42° to 40°10'. A method recommended by the Council at the June 2013 meeting could be applied in order to distribute surplus carryover pounds of lingcod to vessel accounts at the next practical opportunity during 2013.

If you have any questions or comments regarding this letter, please contact me directly.

Sincerely,

Stephen P. Freese
(for)

Frank Lockhart
Assistant Regional Administrator
Sustainable Fisheries Division
Northwest Region
National Marine Fisheries Service

cc: Chairman Dan Wolford
Dr. Sean E. Matson
Kevin C. Duffy
Dr. Stephen Freese
Mariam McCall

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Sustainable Fisheries Division F/NWR2
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MAY 03 2013

Dr. D.O. McIsaac,
Executive Director
Pacific Fisheries Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: RCA recommendation for April 15-April 30

Dear Dr. McIssac,

This letter is in response to the Council's inseason transmittal letter dated on April 19, 2013 recommending the shoreward boundary of the trawl rockfish conservation area (RCA) be moved from 75 to 100 fathoms from the area 40° 10 to 48° 10 N. latitude in Period 2 (March 1 to April 30). As I announced at the April 2013 Council meeting, the National Marine Fisheries Service (NMFS) considered this request and determined that the benefits to industry would not outweigh the public interest in having the opportunity to provide comment on this recommended action.

Under the typical inseason process, NMFS usually asserts it has good cause to waive the APA requirements for notice and comment rulemaking because allowing for the time necessary for notice and comment would be impracticable and contrary to the public interest. However, in this circumstance, it did not appear that the benefits of a two-week action outweighed the public's interest in having the opportunity to provide comment. Further, NMFS believes that it is in the broader public interest to allow for notice and comment rulemaking during the consideration of increased industry access to adjust RCA modifications over the long term.

Should your staff have any questions regarding NMFS decision regarding this decision, please contact me at the Northwest Region Sustainable Fisheries Division office in Seattle, Washington.

Sincerely,

Frank Lockhart
Assistant Regional Administrator

Cc: Mr. Dan Wolford
Ms. Dorothy Lowman
Mr. Alan Risenhoover
Mr. Sam Rauch
Mr. Rod McInnis
Mr. Frank Lockhart
Mr. Colby Brady
Mr. Jon McVeigh
Ms. Mariam McCall
Mr. Ryan Couch

Lingcod Surplus Carryover Option

In a public notice dated May 7, 2013 (NMFS-SEA-13-08), NMFS announced that it did not issue surplus carryover for lingcod because the Council and NMFS need to consider how reallocations by geographic area affect surplus carryover. In this case lingcod changed from a coastwide IFQ species to being divided north and south of 40°10’ N. lat. The final rule for the 2013/2014 harvest specifications and management measures (78 FR 580, 1/3/2013) highlighted this issue on p.584, stating “the PFMC [Council] and NMFS need to consider how reallocations affect surplus carryover, QS control limits (including aggregate non-whiting groundfish species), and potentially, a different solution to deficit carryover.”

Effective 2013, the line dividing the lingcod ACLs into northern and southern areas was changed from 42° N. lat. to 40°10’ N. lat. However, the lingcod species/area category within the IFQ fishery remained coastwide during 2012, and then changed directly from a coastwide category, to being divided north and south of 40°10’ N. lat. in 2013. For lingcod, methods for converting the surplus coastwide pounds from 2012 into area-specific pounds for 2013 should be recommended by the Council and approved by the NMFS before surplus carryover can be issued for lingcod from 2012 to 2013. NMFS recommends the following method to calculate surplus carryover of lingcod north of 40°10’ N. lat. and south of 40°10’ N. lat. for individual vessel accounts:

1. First, NMFS would calculate the eligible surplus carryover for lingcod (coastwide) from 2012 for an individual vessel account.

2. Next, NMFS would apply the lingcod biomass ratio to split lingcod from coastwide to north and south of 40°10’ N. lat.

   Biomass Ratio:

   - *Lingcod North of 40°10’ N.: 3,036 / 4,147= 0.73210*
   - *Lingcod South of 40°10’ N.: 1,111 / 4,147 = 0.26790*

   Note: The database may carry the ratio value out to more digits.

   To calculate the biomass ratio, NMFS would divide the ACL for each area (north and south of 40°10’ N. lat.) by the sum of the two ACLs. The resulting biomass ratio would then be multiplied by the coastwide eligible surplus carryover quota pounds (QP) (from step 1).

   EXAMPLE: If a vessel account were eligible for 100 pounds of 2012 lingcod surplus carryover, it would be credited to their vessel account as 73 pounds of lingcod north of 40°10' N. and 27 pounds of lingcod south of 40°10' N.

3. Finally, NMFS would apply the lingcod ACL reduction for each area north and south of 40°10’ N. lat. to the eligible surplus carryover QP for each area north and south of 40°10’ N. lat. As specified in regulation at §660.140(e)(5), “If there is a decline in the ACL between the base year and the following year in which the QP or IBQ pounds would be carried over, the carryover amount will be reduced in proportion to the reduction in the ACL.” Because of the change in management line split for the lingcod ACL between years from 42° N. lat. to 40°10’ N. lat., NMFS needs to back calculate what the 2012 lingcod ACL would have been if it was split at 40°10’ N. lat. instead of 42° N. lat. The same methodology used to move the lingcod ACL split from 42° N. lat. to 40°10’ N. lat. during the 2013/2014 harvest specifications and management measures can be applied here (see 77 FR 67974, 11/14/2012, p.67979).

   “Lingcod are distributed coastwide with harvest specifications based on two area stock assessments that were conducted in 2009 for the areas north and south of the California-Oregon border at 42° N. latitude. The stock assessments indicate west coast lingcod stocks are healthy with the stock depletion estimated for lingcod off Washington and Oregon to be at 62 percent of its unfished biomass, and lingcod off California estimated to be at 74 percent of its unfished biomass at the start of 2009. The lingcod ACLs for 2013–14 are being proposed for the areas north and south of the current 40°10' N. lat. management line rather than north and south of the California-Oregon border (42° N. lat.), which is where the stock assessment splits the stocks. Current regulations at § 660.112(b)(1)(vii) prohibit vessels participating in the shorebased IFQ program from fishing in more than one IFQ management area on the same trip. Therefore, if lingcod were to have a geographic split at 42° N. lat. it would create a new IFQ management area that could unnecessarily restrict IFQ program participants. Dividing the lingcod specifications at 40°10' N. lat. has no biological implications yet is consistent with the management of most other species with north-south specifications. The adjusted specifications for lingcod were based on the NMFS Northwest Fisheries Science Center trawl survey. The swept area biomass estimates calculated annually (2003–2010) in the NMFS Northwest Fisheries Science Center trawl survey indicated that 48 percent of the lingcod biomass for the stock south of 42° N. lat. occurred between 40°10' N. lat. and 42° N. lat, and the specifications were adjusted accordingly.”

   Applying this methodology results in the following ACL reduction ratios:

   Lingcod ACLs:

   - *2012 – Lingcod North of 42° N.: 2,151 mt*
     Lingcod South of 42° N.: 2,164 mt
     Sum = 4,315 mt

     Converted to a split at 40°10' N. using 48% (1,039 mt) of the lingcod biomass that occurs between 42° N. and 40°10' N. –
     Lingcod North of 40°10' N.: 3,190 mt
     Lingcod South of 40°10' N.: 1,125 mt

Sum = 4,315 mt

- *2013 – Lingcod North of 40°10' N.: 3,036 mt*
  Lingcod South of 40°10' N.: 1,111 mt
  Sum = 4,147 mt

Lingcod ACL reduction ratio (2012 to 2013):

- *North of 40°10' N.: 3,036 /3,190 = 0.95172*
- *South of 40°10' N.: 1,111 /1,125 = 0.98756*

Note: The database may carry the ratio value out to more digits.

To calculate the ACL reduction ratio, NMFS would divide the 2013 ACL for north of 40°10' N. lat. by the 2012 back-calculated ACL for north of 40°10' N. lat. The same calculation would be done for south of 40°10' N. lat. The resulting ACL reduction ratio would then be multiplied by the eligible surplus carryover QP for each area (from step 2).

EXAMPLE: Using the example from above, the 73 pounds of lingcod north of 40°10' N. would be multiplied by the ACL reduction ratio for north of 40°10' N. (0.95172) resulting in up to 69 pounds of carryover being issued to an individual vessel account. NMFS would not issue surplus carryover QP in excess of daily or annual vessel limits.

This methodology is within the biological impacts analyzed for the 2013/2014 harvest specifications and management measures for lingcod. Dividing eligible surplus carryover lingcod QP from coastwide to north and south of 40°10' N. lat. would not result in any impacts different than those analyzed for the lingcod ACL north and south of 40°10' N. lat.

This method or another recommended by the Council could be applied in order to distribute surplus carryover pounds of lingcod to vessel accounts at the next practical opportunity during 2013.

While this is a short-term recommendation to address the lingcod split for surplus carryover during 2013, the Council could discuss a long-term solution (i.e., regulatory amendment) at the September 2013 Council meeting under the agenda item on scoping for future trawl trailing actions. At its September 2013 meeting, the Council could discuss future surplus carryover regulations for IFQ species management area subdivisions, how other reallocations affect surplus carryover (area recombination, area line movement, subdivision of a species group), QS control limits (including aggregate non-whiting groundfish species), and potentially, a different solution to deficit carryover.

GROUNDFISH ADVISORY SUBPANEL REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) met with the Groundfish Management Team (GMT) to discuss progress of this year's fishery and possible inseason adjustments. The GMT discussion was led by Mr. Bob Leos. The GAP offers the following recommendations and comments on proposed inseason adjustments to ongoing groundfish fisheries.

First, the GAP has a couple requests regarding sablefish. As many of you are aware, the sablefish market has been trending down since the end of 2011 due to many market factors.

For instance, sablefish competes with other seafood proteins such as Chilean farmed salmon in Japan, which also is the primary market for West Coast blackcod. In the marketplace, Chilean salmon is much less expensive than sablefish, which also has led to lower Japanese consumption of blackcod, with severe ramifications for West Coast fishermen and processors. Other issues, such as the Japanese economy, also have prompted lower sablefish prices.

Based on discussions with fixed-gear fishermen and a current average price of around $1.85 a pound, the GAP feels requesting an increase for both the daily-trip-limit (DTL) and open access fisheries north of 36° N. Latitude is warranted. The low price has forced fishermen into other fisheries and has discouraged fishing to the point where it is cost-prohibitive to even leave the dock for such low monthly limits. In order to offset expenses or make it worthwhile to fish, an increase in volume is necessary.

The table on the next page extracts landings from the PFMC Sablefish by Area Report: Historical Catch for all Hook and Line gear (except Troll). It clearly shows the downward trend of sablefish landings through the same time each year, May, for this year and the previous five years. The low landings so far in 2013 (305.2 mt) demonstrate how dramatically hook-and-line landings have fallen when compared to past years.

Data caveats:

- The data below is for north of 40° 10' only.
- This table does not separate the open access from limited entry hook-and-line landings.
- It does not include pot and trap landings, as some of the links to those reports were broken.
- January, February and March are closed to the tier fishery.

Table 1. Sablefish hook-and-line historical catch through May of each year (all numbers in metric tons).

								Area totals
	Year	Area	Jan	Feb	Mar	April	May	
	2013	Vancouver	3.1	1.5	34.1	79.2	54.4	172.3
		Columbia	0.7	1.5	8.9	27.2	28.3	66.6
		OR coast	0.0	0.0	0.0	8.3	1.0	9.3
		Eureka	3.1	3.3	12.6	18.7	19.3	57.0
North of 40° 10'	*Totals*	6.9	6.3	55.6	133.4	103.0	**305.2**	
	2012	Vancouver	2.9	2.9	41.0	119.6	86.8	253.2
		Columbia	3.4	13.3	28.7	75.2	69.0	189.6
		OR coast	0.1	-	-	5.7	0.6	6.4
		Eureka	8.1	9.7	15.7	53.0	38.1	124.6
North of 40° 10'	*Totals*	14.5	25.9	85.4	253.5	194.5	**573.8**	
	2011	Vancouver	3.5	3.7	32.6	97.1	121.1	258.0
		Columbia	5.7	10.9	17.4	95.7	118.4	248.1

		OR coast	0.0	0.0	13.4	39.5	5.1	58.0
		Eureka	9.9	4.6	6.0	16.4	48.3	85.2
North of 40° 10'	*Totals*	19.1	19.2	69.4	248.7	292.9	**649.3**	
	2010	Vancouver	0.5	2.9	44.0	112.9	99.0	259.3
		Columbia	0.5	3.3	19.0	81.1	164.6	268.5
		OR coast	0.0	0.0	1.5	44.0	4.6	50.1
		Eureka	2.3	9.2	17.1	32.5	49.7	110.8
North of 40° 10'	*Totals*	3.3	15.4	83.1	314.5	322.5	**738.8**	
	2009	Vancouver	2.0	3.3	12.5	131.2	47.3	196.3
		Columbia	3.2	6.0	8.9	191.2	206.7	416.0
		OR coast	0.0	0.0	0.0	79.1	3.0	82.1
		Eureka	9.4	14.8	19.9	44.1	64.9	153.1
North of 40° 10'	*Totals*	14.6	24.1	41.3	445.6	321.9	**847.5**	
	2008	Vancouver	1.1	0.8	68.1	120.4	47.0	237.4
		Columbia	0.0	2.8	13.9	73.8	82.2	172.7

		OR coast	0.0	0.0	0.0	0.1	33.1	33.2
		Eureka	0.4	7.7	14.4	37.9	54.7	115.1
North of 40° 10'	*Totals*	1.5	11.3	96.4	232.2	217.0	**558.4**	

Limited Entry Fixed Gear Sablefish Fishery North of 36° N. Latitude, DTL fishery

Daily-trip-limit fishermen have requested an increase in trip limits for sablefish for the balance of the year. The GMT analyzed 3 options, which included status quo. The GAP supports **GMT Alternative 2, (1 landing per week of up to 1,050 lb., not to exceed 3,150 lb. per 2 months)** This alternative leaves a sufficient buffer (est. 91% take) but still allows for a small opportunity to make a few extra dollars in what has been a very difficult market this year. The DTL in the limited entry fixed gear fishery north of 36° may be adjusted at the September or November Council meeting if it appears the fishery is approaching the harvest guideline.

Open Access Fixed Gear Sablefish Fishery North of 36° N. Latitude, DTL fishery

Open access representatives on the GAP have requested exploring the possibility of an increase in trip limits for sablefish for the remainder of the year. Open access fishermen are currently working with a very narrow profit margin due to high fuel prices, poor sablefish prices and low trip limits. The GMT analyzed 3 options, which included status quo. The GAP supports **GMT Alternative 1, (300 lb. per day, or 1 landing per week of up to 800 lb., not to exceed 1,600 lb. per 2 months)** Though this alternative has a higher attainment estimate (94%) the GAP believes sablefish effort will actually be lower due to the salmon fishery reopening from mid-July through September. The salmon market is strong while the sablefish market is weak; thus the GAP believes fishermen who would normally target blackcod will fish for the more lucrative salmon. The GAP believes the 6% buffer is adequate. Although a 200-pound increase may seem like a small increase, it will go a long way to help cover expenses for open access fishermen.

Based on the information in the table, showing the downward trend in landings, the GAP believes the Council can adopt GMT Alternative 1 without risk of exceeding the annual catch limit or open access harvest guideline.

Limited Entry Fixed Gear South of 34° 27' N. Latitude

Minor Shelf Rockfish South: The GAP recommends an increase in the Minor Shelf Rockfish South cumulative landing limit from 3,000 lbs/2 months to **4,000 lbs/2 months beginning as soon as possible (period 4?) through the end of the year.** The GAP notes that there are no conservation issues with shelf rockfish and this will reduce regulatory discards while providing some economic relief to the few fishermen in this sector who fish south of Pt. Conception. The GAP notes that this same proposal was approved by the Council in June 2012.

Bocaccio: The GAP recommends an increase in the bocaccio cumulative landing limit from 300 lbs/2 months to **500 lbs/2 months beginning as soon as possible (period 4?) through the end of the year.** The GAP notes that there is an adequate buffer in the scorecard and this will reduce regulatory discards. Again this same proposal was approved by the Council in June 2012.

Open Access Fixed Gear South of 34° 27’ N. Latitude

Bocaccio: The GAP recommends an increase in the bocaccio cumulative landing limit from 100 lbs/2 months to **200 lbs/2 months beginning as soon as possible (period 4?) through the end of the year.** Open access fixed gear fishermen have been encountering greater numbers of bocaccio in the last year in the nearshore fishery in the southern California bight. Again there is an adequate buffer in the scorecard and this increased limit will reduce regulatory discards.

Limited Entry Fixed Gear North of 34° 27’ N. Latitude

Shortspine Thornyhead North: Limited Entry fixed gear fishermen north of Point Conception have been hard hit financially due to the soft Sablefish market. Further exacerbating these financial impacts has been the virtual elimination of the directed Blackgill rockfish fishery south of Cape Mendocino. Slope rockfish trip limits of 40,000 lbs/2 months that could have been all Blackgill in 2012 have now dropped down to a limit of 1,375 lbs/2 months for Blackgill in 2013. In past years when the market was soft for thornyheads or Sablefish, fixed gear fishermen were able to target Blackgill to help buffer the financial hit but that option is no longer available.

LE fixed gear fishermen north of Point Conception are seeking regulatory relief in the form of an increased trip limit for shortspine thornyhead from the current trip limit of 2,000 lbs/2 months up to **2,500 lbs/2 months to begin on September 1, 2013 through the remainder of the year.**

Lastly, the GAP notes that we did review the supplemental public comment from the Port San Luis Commercial Fishermen’s Association request for an increase in nearshore limits. The GAP realizes that due to the late receipt of this request the GMT will be unable to analyze the potential impacts to overfished species at this meeting. This may be analyzed before the September Council meeting and we may act then. The GAP notes that this same proposal was rejected last year due to possible impacts to overfished species, namely Canary rockfish.

Lingcod Surplus Carry-Over in the Limited Entry Trawl Individual Fishing Quota (IFQ) Fishery

The GAP reviewed the NMFS report under Agenda Item F.9.b that laid out a short term solution to address the lingcod split for surplus carryover during 2013. The GAP agrees with this NMFS recommendation .

Summary of GAP recommendations

1. Limited Entry Fixed Gear Sablefish Fishery North of 36° N. Latitude, DTL

GMT Alternative 2, (1 landing per week of up to 1,050 lb., not to exceed 3,150 lb. per 2 months)

2. Open Access Fixed Gear Sablefish Fishery North of 36° N. Latitude, DTL

GMT Alternative 1, (300 lb. per day, or 1 landing per week of up to 800 lbs., not to exceed 1,600 lbs. per 2 months)

3. Limited Entry Fixed Gear South of 34° 27’ N. Latitude

Increase Minor Shelf Rockfish South cumulative landing limit from 3,000 lb/2 months to 4,000 lb./2 months beginning as soon as possible through the end of the year.

Increase Bocaccio South cumulative landing limit from 300 lb./2 months to 500 lb./2 months beginning as soon as possible through the end of the year.

4. Open Access Fixed Gear South of 34° 27 N. Latitude

Increase Bocaccio South cumulative landing limit from 100 lb./2 months to 200 lb./2 months beginning as soon as possible through the end of the year.

5. Limited Entry Fixed Gear North of 34° 27 N. Latitude

Increase shortspine thornyhead north cumulative landing limit from 2,000 lb./2 months to 2,500 lb./2 months to begin on September 1, 2013 through the remainder of the year.

PFMC
06/23/13

THE GROUNDFISH MANAGEMENT TEAM REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

Action items:

- Request to increase the limited entry fixed gear shortspine thornyhead bimonthly trip limits from 2,000 lbs/2months to 3,000 lbs/2 months, north of 34°27' N latitude
- Request to increase the limited entry fixed gear shelf rockfish complex bimonthly trip limits from 3,000 lb/2 months to 4,000 lb/2 months south of 34°27' N latitude
- Request to increase the limited entry fixed gear bocaccio bimonthly trip limits from 300 lbs to 500 lbs, south of 34°27' N latitude
- Request to increase the open access fixed gear bocaccio bimonthly trip limits from 100 pounds to 200 pounds, south of 34°27' N latitude
- Request to increase the shallow nearshore and deeper nearshore rockfish bimonthly trip limits to 1,000 pounds per vessel between 40°10' N latitude and 34°27' N latitude
- Consider the two alternatives brought forward by the GMT, both of which provide modest trip limit increases to the LE North and OA North sablefish non-trawl fixed-gear DTL fisheries north of 36° N lat. If adopted, regulations should go into effect as soon as possible, through the end of the year.

Informational items:

- Research
- IFQ snapshot
- Scorecard update

The Groundfish Management Team (GMT) considered the most recent information on the status of ongoing fisheries, research, and requests from industry and provides the following recommendations for 2013 inseason adjustments.

The GMT also received guidance from the National Marine Fisheries Service (NMFS) Northwest Region (NWR) regarding timing of implementation of inseason recommendations from this meeting. NMFS anticipates implementing routine inseason adjustments to fishery management measures by September 1, 2013.

1. ACTION ITEMS

1.1 Commercial Fisheries

1.1.1 Limited Entry Fixed-gear Shortspine Thornyhead Trip Limits North of 34°27' N Latitude

The GMT received a request from industry in March 2013 to increase the trip limits for the shortspine thornyhead in the limited entry fixed gear fishery north of 34°27' N lat. Industry requested that the current bimonthly cumulative trip limit of 2,000 lbs/2 months be increased to 3,000 lbs/2 months with implementation to be done as soon as possible, through the end of the year (Table 1).

Table 1. 2013 Limited entry fixed-gear shortspine thornyhead trip limits in pounds (current and proposed) for the area north of 34°27' N latitude.

	Jul/Aug	Sep/Oct	Nov/Dec
Current	2,000	2,000	2,000
Proposed	3,000	3,000	3,000

While shortspine thornyheads have not been underutilized during the past two years (Table 2), a depressed sablefish market during the past year, and what appears to be a continuation of this trend in the 2013 sablefish fishery, have forced participants to seek other fisheries to supplement their livelihood. The proposal's intent is to explore the possibility of supplementing those livelihoods with an increase in the landings of shortspine thornyheads.

Table 2. Recent landings (mt), by state, of shortspine thornyheads in the limited entry fixed-gear fishery. Data source: PacFIN

Year	Washington	Oregon	California	Total	Annual Harvest Guideline	% of Annual Harvest Guideline
2011	12.7	1.5	45.4	59.6	73.3	81.3%
2012	14.2	2.7	37.7	54.6	74	73.8%

Note: The data presented here reflect only the landing information from dealer receipts and do not have discard mortalities included.

Increasing the trip limits for periods 4 through 6, as proposed, would result in a projected annual harvest of approximately 78 mt, exceeding the 2013 non-trawl species-specific fishery harvest guideline of 74 mt by about 5.8 percent. This assumes that the fishery would utilize the increased trip limit for these three periods (Table 3). An alternate option developed by the GMT would be to have an increase in trip limits apply only for periods 5 and 6. Under this option, different two-month trip limit amounts and their projected annual harvest amounts are given for this two-period alternative, ranging from No Action (2,000 lb/2 months) up to the proposed amount of 3,000 lb /2 months (Table 4).

Table 3. Comparison of projected harvest amounts (mt) of cumulative two-month trip limits from 2,000 pounds up to the industry proposed amount of 3,000 pounds in 250 pound increments. These projected amounts would apply to periods 4, 5 and 6 of 2013 and are compared to the annual allocation of 74 mt for the shortspine thornyhead limited entry fixed-gear fishery north of 34°27' N latitude.

Trip limit (pounds)	Estimated Take (mt)[1]	% of Harvest Guideline
2,000 lb (No Action)	60.2	81.4%
2,250 lb	64.8	87.6%
2,500 lb	69.5	93.9%
2,750 lb	74.2	100.3%
3,000 lb (industry proposed)	78.3	105.8%

Table 4. Comparison of projected harvest amounts (mt) of cumulative two-month trip limits from 2,000 pounds up to the industry proposed amount of 3,000 pounds in 250 pound increments. These projected amounts would apply only to periods 5 and 6 of 2013 and are compared to the annual harvest guideline allocation of 74 mt for the shortspine thornyhead limited entry fixed-gear fishery north of 34°27' N latitude.

Trip limit (pounds)	Estimated Take (mt)[1]	% of Harvest Guideline
2,000 lb (No Action)	60.2	81.4%
2,250 lb	63.5	85.8%
2,500 lb	66.4	89.7%
2,750 lb	69.4	93.8%
3,000 lb (industry proposed)	72.5	98.0%

[1] Includes a discard estimate calculated from the 2011 WCGOP value published in the 2011 WCGOP Total Mortality Report.

Based on the model run for periods 4, 5 and 6, the GMT estimates that projected landings at the 2,750 and 3,000 pounds amounts have a very high chance of exceeding the annual harvest guideline allocation of 74 mt, given the likelihood of the continuing poor sablefish market for the remainder of 2013 (Table 3). Trip limits of 2,750 pounds and 3,000 pounds for the two-period model, while less than the three-period model, nevertheless have a moderate to high likelihood of the projected harvest exceeding the allocation amount. As such, the GMT feels that the 2,500 pound amount would be a better alternative. This level better compensates for uncertainty in the projected annual take and the potential dynamics of the fishery.

Lastly, the GMT examined the WCGOP data to determine the extent of bycatch of species that are caught when shortspine thornyheads are caught with the goal to identify the level of bycatch of overfished species and/or species that could exceed their harvest amounts as a result of the increased shortspine thornyhead trip limits. Upon examination of the observer data, the GMT concluded that there was no significant catch of overfished species or species that may exceed their harvest targets as a result of an increase in shortspine thornyhead trip limits (blackgill, canary, and yelloweye rockfish). Additionally, the GMT does not anticipate that a trip limit increase of 500 pounds would result in increased catches of overfished species.

- **Therefore, the GMT recommends increasing the limited entry shortspine thornyhead trip limit south of 34°27' N latitude from 2,000 lb/2 months to 2,500 lb/2 months for periods 5 and 6.**

1.1.2 Limited Entry Fixed-Gear Shelf Rockfish Trip Limits South of 34°27' N latitude

The GMT received an industry request to increase the limited entry fixed gear trip limits for the shelf rockfish complex south of 34°27' N lat. from 3,000 lb/2 months to 4,000 lb/2 months through the end of the year. This proposed trip limit increase is intended to reduce discarding of shelf rockfish.

The shelf rockfish complex (all sectors combined) south of 40°10' N lat. has been under-harvested in recent years (Table 5) with an annual average of 295 mt (41 percent of the annual ACL) during the 2006 through 2011 period. During that time period the take of the shelf rockfish complex by the limited entry fixed-gear fishery south of 34°27' N lat. ranged from 7.5 mt (2006) to 1.1 mt (2011), with an annual averaging about 3.3 mt (0.5 percent of the ACL).

Table 5. Estimates of mortality in the limited entry fixed gear fishery south of 40°10' N latitude. Data source: WCGOP.

Year	Mortality (mt)	OY/ACL (mt)	% of OY/ACL
2006	334	714	46.8%
2007	365	714	51.1%
2008	212	714	29.7%
2009	273	714	38.2%
2010	251	714	35.2%
2011	336	714	47.1%

Although there is no formal bycatch projection model for the non-nearshore fixed-gear fishery south of 34°27' N lat., WGCOP data indicate very few encounters with overfished species (see 2011-12 Final Environmental Impact Statement). Although the current trip limit for shelf rockfish is 3,000 lb/2 months, state fish ticket data indicate that no vessels actually attained the full trip limit during 2011 and/or 2012, with average fleet landings of approximately 450 lb/ 2 months. Also in 2012, an inseason adjustment was made to the trip limit for shelf rockfish south of 34°27' N lat. Even with this inseason adjustment harvest levels did not increase appreciably.

Based on these data, the GMT estimates landings would increase by approximately 0.5 mt, to a total of 2.1 mt compared to the 1.6 mt average for 2011 and 2012. The GMT does not anticipate any increased catches of overfished species as a result of the trip limit adjustment. Additionally, the GMT does not anticipate that this modest increase in trip limits will result in an overharvest of any species' contribution to the shelf rockfish complex as a result of this request.

- **Therefore, the GMT recommends increasing the limited entry shelf rockfish trip limit south of 34° 27' N. latitude from "3,000 lb/2 months" to 4,000 lb/2 months as soon as possible, through the end of the year.**

1.1.3 Limited Entry Fixed Gear Bocaccio Trip Limits South of 34°27' N Latitude

The GMT received a request to increase the limited entry fixed-gear trip limits for bocaccio south of 34°27' N lat. from 300 lb/2 months to 500 lb/2 months to reduce discarding as a result of increased encounters from what may be strong year-classes of bocaccio recruiting into the fishery. This is the same request industry made last year with a resultant inseason adjustment made in accordance with the proposal. The Council's rational was that these adjustments would not result in increased mortality of overfished species compared to the current scorecard estimates. The total take of bocaccio during the second half of 2012 for this sector totaled 0.3 mt. This amount included the harvest total for those few vessels using the increased trip limits.

Only a very small number of limited entry vessels take bocaccio south of 34°27' N lat. For 2011 and 2012, less than five vessels per period made bocaccio landings, averaging about 110 pounds per vessel per two month period. If the two month trip limit were increased from its current 300 lbs/2 months to the proposed amount of 500 lbs/2 months, the estimated 2013 take would increase by approximately 0.1 mt from the 2011-2012 annual average of 2.1 mt. This can be easily accommodated with the current non-trawl allocation south of 40°10' N lat.

- **Therefore, the GMT recommends increasing the limited entry fixed gear trip limits for bocaccio south of 34°27' N latitude from 300 lb/2 months to 500 lb/2 months as soon as possible, through the end of the year.**

1.1.4 Open Access Fixed Gear Bocaccio Trip Limits South of 34°27' N Latitude

The GMT received a request to increase the open access fixed-gear trip limits for bocaccio south of 34°27' N lat. from "100 lb/2 months" to either 150 or 200 lb/2 months intended to reduce discarding as a result of increased encounters from strong year-classes recruiting into the fishery.

Only a relatively small number of open access vessels harvest bocaccio south of 34°27' N lat. During 2011 and 2012, approximately 18 vessels per period made bocaccio landings in this sector, averaging about 40 lbs per vessel per two month period. The total harvest for this sector during the second half of 2012 was 1.0 mt. If the two month trip limit were increased from the current amount of 100 lbs/2 months to 200 lbs/2 months, the estimated 2013 take would increase by approximately 1.0 mt, compared to the 2011-2012 annual average of 1.5 mt. This too can be easily accommodated within the current non-trawl allocation south of 40°10' N lat. target of 72.3 mt.

- **Therefore, the GMT recommends increasing the open access fixed gear trip limits for bocaccio south of 34°27' N lat. from 100 lb/2 months to 200 lb/2 months as soon as possible, through the end of the year.**

1.1.5 Shallow and Deeper Nearshore Rockfish Trip Limit Between 40°10' N Latitude and 34°27' N lat.

A request was submitted to the Council requesting an increase for the shallow nearshore and deeper nearshore rockfishes from the current amounts to 1,000 lbs/2 months from 40°10' N lat. and 34°27' N lat. for the remainder of the year. The request was received just a few days before the beginning of the Council meeting and because of the lateness of the request, the GMT did not have time to analyze it and provide comment. It needs to be pointed out that a request for an increase for the nearshore fishery was also made in June 2012. The Council at that time did not support that request because of the concern that an increase in trip limits for this sector would increase the catch of canary rockfish estimated in the nearshore bycatch model. The GMT could analyze this request for the September meeting if tasked by the Council.

- **Consider the request to increase the shallow and deeper nearshore rockfish trip limits between 40°10' N lat. and 34°27' N lat., taking into account the potential impacts to overfished species.**

1.1.6 Fixed Gear Sablefish Daily-Trip-Limit (DTL) Fisheries

This section discusses 2013 inseason considerations for the four fixed gear daily trip limit (DTL) fisheries, including both limited entry (LE) and open access (OA), north and south of 36° N lat. for 2013. Hereafter, they will be referred to as follows: LE North, LE South, OA North, and OA South.

1.1.6.1 Current Status

Current projections under the No Action alternative for the sablefish DTL fisheries are shown in Table 6 and Figure 1. At this time, due to the uncertainty of the projected impacts for both the LE South and OA South sectors, the GMT is only supporting modest increases for the limited entry and open sectors north of 36° N. latitude. The GMT developed two alternatives to bring forward for Council consideration (Table 7). Alternative 1 has a projected take for both the limited entry and open access sectors of 94 percent of the sector targets (197 and 291 mt, respectively), whereas Alternative 2 (the slightly more conservative alternative) would result in an estimated take of around 90 percent of the respective targets (91 percent for limited entry and 88 percent for open access). The choice of whether to target 10 percent or 6 percent less than the sector allocation is a risk call and in the past, the Council has opted to maintain a 10 percent target for this and other sectors.

Table 6. Current projections of landings, corresponding attainment, targets and trip limits for the fixed gear, DTL fisheries under No Action, in 2013.

	LE North	**OA North**	**LE South**	**OA South**	**South sum**
Projection (mt)	165	239	463	243	706
Target (LT)	197	291	446	362	808
Difference	-32	-55	17	-119	-102
Projected attainment	84%	82%	104%	67%	87%
Bimonthly TL	2,850	1,400	-	2,920	
Weekly TL	950	700	1,800	1,460	
Daily TL	-	-	-	300	

Table 7. 2013 trip limit increase alternatives (in pounds) for the limited entry and open access sectors of the sablefish non-trawl fixed-gear fisheries north of 36° N lat.

	Limited entry - North	Open access - North
Alternative 1		
Bimonthly trip limit	3,300	1,600
Weekly trip limit	1,110	800
Daily trip limit	-	-
Projected attainment	94%	94%
Alternative 2		
Bimonthly trip limit	3,150	1,400
Weekly trip limit	1,050	700
Daily trip limit	-	-
Projected attainment	91%	88%

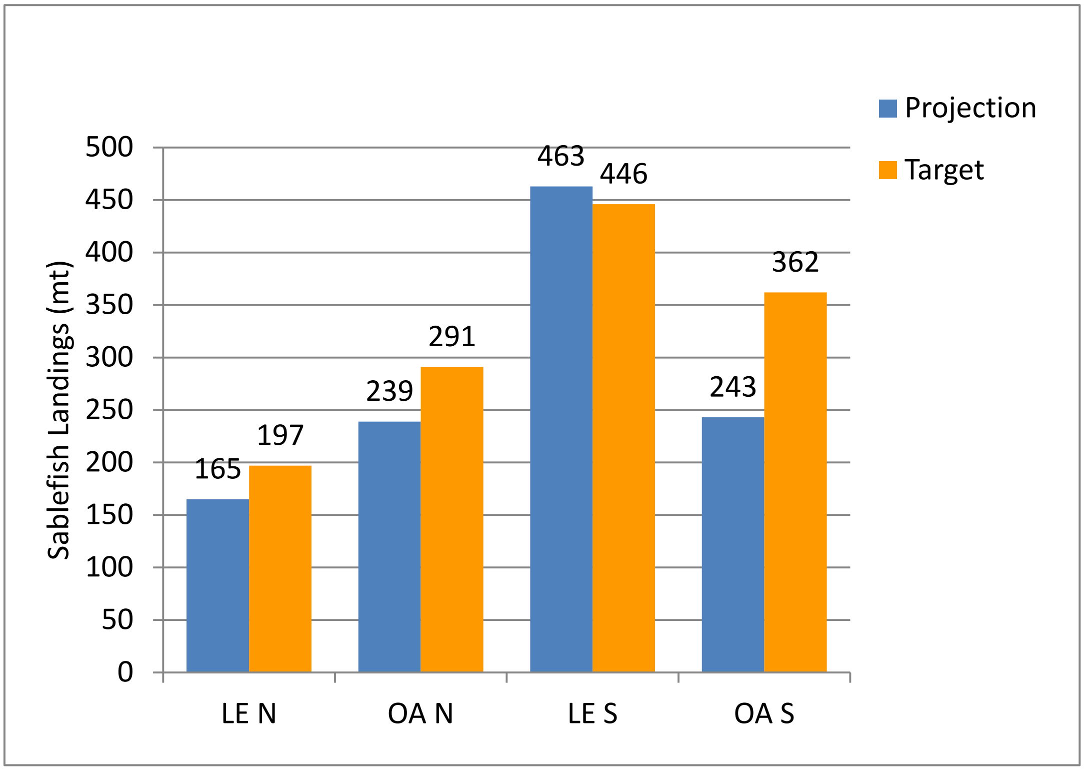

Figure 1. Current landings projections and landing targets for the fixed gear, DTL sablefish fisheries under No Action in 2013.

The current 2013 projection for the LE North fishery, assuming 2012 price structure, is 84 percent of the landing target (165 mt vs. 197 mt target, Table 5) with the landing target equal to the harvest guideline reduced for discard mortality. The current projection for the OA North is 82 percent of the landing target (239 mt vs. 291 mt target, Table 6), and the sum of the projections for the LE South and OA South is 87 percent of the sum of those two landing targets (706 mt sum of predictions vs. 808 mt sum of targets). The LE South fishery is projected to take 104 percent of its landing target (463 mt vs. 446 mt), while the OA South is currently predicted to take 67 percent of its landing target (243 mt vs. 362 mt). The Council has recently managed the two southern DTL fisheries under a sharing that was weighted to the LE sector, and the magnitude of predicted overage of the LE South is largely the result of a correction factor based on 2012 Quota Species Monitoring (QSM) catch estimates. The GMT believes there is time left this year to monitor catch and revisit it in September should an adjustment be necessary.

1.1.6.2 Background and Rationale

The GMT continues to work to keep the catch of the LE DTL North fishery to within its harvest guideline (which was estimated to have exceeded that amount by a wide margin in 2010 and 2011). This is now accomplished since a correction of the PacFIN DTL landings estimation software in June 2011 now provides accurate landings data for this fishery for the first time since 2004.

- **Consider the two alternatives brought forward by the GMT, both of which provide modest trip limit increases to the LE North and OA North sablefish non-trawl fixed-gear DTL fisheries north of 36° N lat. Alternative 1 projects an annual harvest attainment of 94 percent of the target for both sectors. Alternative 2 projects an annual harvest attainment of 91 percent for the LE North sector and 88 percent for the OA North sector. If adopted, regulations should go into effect as soon as possible, through the end of the year.**

The GMT recommends:

1. **increase the limited entry shortspine thornyhead trip limit south of 34°27' N latitude from 2,000 lb/2 months to 2,500 lb/2 months for periods 5 and 6.**
2. **increase the limited entry shelf rockfish trip limit south of 34° 27' N. latitude from "3,000 lb/2 months" to 4,000 lb/2 months as soon as possible, through the end of the year.**
3. **increase the limited entry fixed gear trip limits for bocaccio south of 34°27' N latitude from "300 lb/2 months" to 500 lb/2 months as soon as possible, through the end of the year.**
4. **increase the open access fixed gear trip limits for bocaccio south of 34°27' N lat. from "100 lb/2 months" to 200 lb/2 months as soon as possible, through the end of the year.**
5. **increase the shallow and deeper nearshore rockfish trip limits between 40°10' N lat. and 34°27' N lat., taking into account the potential impacts to overfished species.**
6. **consider the request to increase the shallow and deeper nearshore rockfish trip limits between 40°10' N lat. and 34°27' N lat., taking into account the potential impacts to overfished species.**
7. **consider the two alternatives brought forward by the GMT, both of which provide modest trip limit increases to the LE North and OA North sablefish non-trawl fixed-gear DTL fisheries north of 36° N lat. If adopted, regulations should go into effect as soon as possible, through the end of the year.**

2.0 INFORMATIONAL ITEMS

2.1 Research

The International Pacific Halibut Commission (IPHC) has started their annual set-line survey for Pacific halibut. They have completed two of an expected seven trips, including some additional WDFW rockfish stations. Catches of yelloweye rockfish are well within the set-aside. Therefore, there are no updates to the IPHC research set-aside at this time. The GMT anticipates updating this at the September meeting, at which time the IPHC survey should be completed. There are no other research updates for June. The Team anticipates receiving updates for the September or November Council meeting.

2.2 IFQ Fishery Catch Summary

The following is a "snapshot" of catch and effort in the shorebased IFQ fishery for the months of January through June 1, 2012 and June 4, 2013. IFQ catch data are available from http://www.webapp.nwfsc.noaa.gov/ifq/. Total catch by IFQ species category are shown in Table 8. Total catch is up for many species or species groups, compared to approximately the same time in 2012, most notably for arrowtooth flounder (up 20.3 percent), chilipepper south of 40°10' N lat., (+ 9.9 percent), longspine thornyheads north of 34°27' N lat. (+ 9.7 percent) and minor slope rockfishes south of 40°10' N lat. (+ 11.4 percent). Two species that are down by more than 5 percent are Pacific cod (- 7.1 percent) and petrale sole (- 5.3 percent).

Total coastwide effort, as vessel-days, is up by approximately 13 percent overall compared to the same time last year (Table 9), influenced by a 20 percent increase in California and a 12% increase in Oregon. Effort in Washington is down by about 4 percent.

2.5 Scorecard Update

The GMT scorecard for overfished species (Attachment 1) has been updated to reflect changes to the Tribal set-asides, based on the 2013 Pacific whiting TAC. There are no other updates to the scorecard at this time.

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Table 8. Total catch by IFQ species category through June 1 of 2012 and through June 3 of 2013.

IFQ Species	2012 Sector Quota Pounds	2012 Total Catch (through June 1)	2012 % of Quota Pounds	2013 Sector Quota Pounds	2013 Total Catch (through Jun 4)	2013 % of Quota Pounds	2013 % difference vs. 2012
Arrowtooth flounder	20,861,131	2,816,716	13.50%	8,479,264	2,867,029	33.81%	20.31%
Bocaccio rockfish south of 40°10' N. lat.	132,277	4,341	3.28%	165,126	10,610	6.43%	3.14%
Canary rockfish	57,761	1,245	2.16%	87,964	2,859	3.25%	1.09%
Chilipepper rockfish south of 40°10' N. lat.	2,934,904	131,373	4.48%	2,423,983	347,357	14.33%	9.85%
Cowcod south of 40°10' N. lat.	3,968	8	0.20%	2,205	128	5.80%	5.60%
Darkblotched rockfish	548,808	92,259	16.81%	587,976	118,565	20.16%	3.35%
Dover sole	49,018,682	7,953,207	16.22%	49,018,682	9,098,052	18.56%	2.34%
English sole	21,037,611	56,195	0.27%	14,032,486	107,609	0.77%	0.50%
Lingcod north of 40°10' N. lat. [a/]	3,991,800	220,450	5.52%	2,695,305	169,327	6.28%	0.76%
Lingcod south of 40°10' N. lat.				1,089,993	15,851	1.45%	1.45%
Longspine thornyheads north of 34°27' N. lat.	4,219,648	667,855	15.83%	4,100,267	1,046,264	25.52%	9.69%
Minor shelf rockfish north of 40°10' N. lat.	1,150,813	13,553	1.18%	1,119,948	12,339	1.10%	-0.08%
Minor shelf rockfish south of 40°10' N. lat.	189,598	1,578	0.83%	178,574	11,989	6.71%	5.88%
Minor slope rockfish north of 40°10' N. lat.	1,828,779	147,071	8.04%	1,712,835	222,272	12.98%	4.93%
Minor slope rockfish south of 40°10' N. lat.	831,958	42,770	5.14%	829,181	137,245	16.55%	11.41%
Other flatfish	9,253,683	335,305	3.62%	9,236,501	507,446	5.49%	1.87%
Pacific cod	2,502,247	251,898	10.07%	2,480,830	73,668	2.97%	-7.10%
Pacific halibut (IBQ) north of 40°10' N. lat.	232,856	33,902	14.56%	236,660	30,122	12.73%	-1.83%
Pacific ocean perch north of 40°10' N. lat.	263,441	47,250	17.94%	241,241	41,303	17.12%	-0.81%
Pacific whiting	151,373,798	155,648	0.10%	188,929,545	167,387	0.09%	-0.01%
Petrale sole	2,324,995	972,294	41.82%	5,110,315	1,865,903	36.51%	-5.31%
Sablefish north of 36° N. lat.	5,438,797	1,442,968	26.53%	4,030,050	1,321,060	32.78%	6.25%
Sablefish south of 36° N. lat.	1,133,352	33,225	2.93%	1,327,800	36,862	2.78%	-0.16%
Shortspine thornyheads north of 34°27' N. lat.	3,120,533	664,363	21.29%	3,054,183	834,545	27.32%	6.03%
Shortspine thornyheads south of 34°27' N. lat.	110,231	na	na	110,231	3,736	3.39%	na
Splitnose rockfish south of 40°10' N. lat.	3,206,513	25,932	0.81%	3,346,838	32,344	0.97%	0.16%
Starry flounder	1,480,404	6,460	0.44%	1,656,774	1,543	0.09%	-0.34%
Widow rockfish	755,352	14,896	1.97%	2,191,016	27,562	1.26%	-0.71%
Yelloweye rockfish	1,323	7	0.53%	2,205	37	1.68%	1.15%
Yellowtail rockfish north of 40°10' N. lat.	6,850,556	346,967	5.06%	5,809,905	246,949	4.25%	-0.81%
	294,855,819	16,479,736	5.59%	314,287,883	19,357,963	6.16%	0.57%

[a/] For 2012, there are no lingcod totals for north or south of 40°10'

Table 9. Shorebased IFQ groundfish effort as vessel days, as of June 1, 2012 and June 1, 2013.

	California	Oregon	Washington	Total
2012	158	262	47	467
2013	190	293	45	528
Difference	32	31	-2	61
Percent	20%	12%	4%	113%

Note: 2013 data are preliminary

Attachment 1. Scorecard for June 2013. Allocations[a] and projected mortality impacts (mt) of overfished groundfish species for 2013.

Fishery	Bocaccio b/		Canary		Cowcod b/		Dkbl		Petrale		POP		Yelloweye	
***Date*: 19 June 2013**	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts	Allocation a/	Projected Impacts
Off the Top Deductions	8.4	8.4	17.5	**18.1**	0.1	0.1	20.8	**21.1**	234.0	234.0	16.5	**20.6**	5.8	5.8
EFPc/	6.0	6.0	1.5	1.5	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Research d/	1.7	1.7	4.5	4.5	0.1	0.1	2.1	2.1	11.6	11.6	5.2	5.2	3.3	3.3
Incidental OA e/	0.7	0.7	2.0	2.0	--	--	18.4	18.4	2.4	2.4	0.4	0.6	0.2	0.2
Tribal f/			9.5	**10.1**			0.1	**0.4**	220.0	220.0	10.9	**14.8**	2.3	2.3
Trawl Allocations	74.9	74.9	52.5	52.5	1.0	1.0	281.4	281.4	2,323.0	2,323.0	126.8	126.8	1.0	1.0
---SB Trawl	74.9	74.9	26.2	26.2	1.0	1.0	266.7	266.7	2,318.0	2,318.0	109.4	109.4	0.6	0.6
---At-Sea Trawl			8.6	8.6			14.7	14.7	5.0	5.0	17.4	17.4		
a) At-sea whiting MS			3.6	3.4			6.1	6.1			7.2	7.2		
b) At-sea whiting CP			5.0	4.8			8.6	8.6			10.2	10.2		
Non-Trawl Allocation	236.7	125.5	46.0	27.2	1.9	0.8	14.8	3.5	35.0	2.2	6.7	0.2	11.2	10.4
Non-Nearshore	72.3		3.5										1.1	
LE FG				0.9				2.8				0.2		0.4
OA FG				0.1				0.5				0.0		0.1
Directed OA: Nearshore	0.9	0.5	6.2	7.2		0.0		0.2					1.2	1.1
Recreational Groundfish														
WA			3.1	0.9				--		--		--	2.9	2.9
OR			10.8	4.7				--		--		--	2.6	2.5
CA	163.5	125.0	22.4	13.4		0.8		--		--		--	3.4	3.4
TOTAL	320.0	208.8	116.0	**97.8**	3.0	1.9	317.0	**306.0**	2,592.0	2,559.2	150.0	**147.6**	18.0	17.2
2013 Harvest Specification	**320**	**320**	**116**	**116**	**3.0**	**3.0**	**317**	**317**	**2,592**	**2,592**	**150**	**150**	**18**	18
Difference	0.0	111.2	0.0	**18.2**	0.0	1.1	0.0	**11.0**	0.0	32.8	0.0	**2.4**	0.0	0.8
Percent of OY	100.0%	65.3%	100.0%	84.3%	100.0%	64.7%	100.0%	96.5%	100.0%	98.7%	100.0%	98.4%	100.1%	95.7%

Key:
- (hatched) = not applicable
- -- = trace, less than 0.1 mt
- (black) = Fixed Values
- (light blue) = off the top deductions

a/ Formal allocations are represented in the black shaded cells and are specified in regulation in Tables 1b and 1e. The other values in the allocation columns are 1) off the top deductions, 2) set asides from the trawl allocation (at-sea petrale only) 3) ad-hoc allocations recommended in the 2013-14 EIS process, 4) HG for the recreational fisheries for canary and YE.

b/ South of 40°10' N. lat.

c/ EFPs are amounts set aside to accommodate anticipated applications. Values in this table represent the estimates from the 13-14 biennial cycle, which are currently specified in regulation.

d/ Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs.

e/ The GMT's best estimate of impacts as analyzed in the 2013-2014 Environmental Impact Statement (Appendix B), which are currently specified in regulation.

f/ Tribal values in the allocation column represent the the values in regulation. Projected impacts are the tribes best estimate of catch.

Agenda Item F.9.c
Supplemental Public Comment
June 2013

From: **Bill James** <Halibutbill@live.com>
Date: Thu, Jun 13, 2013 at 4:40 AM
Subject: Agenda F.9 Inseason Adjustments
To: "pfmc." <pfmc.comments@noaa.gov>
Cc: Bill James <Halibutbill@live.com>

Mr. Dan Wolford
Chairman
Pacific Fishery Management Council

Dear Chairman Wolford, my name is Bill James. I am speaking on behalf of Port San Luis Commercial Fishermen's Association.

Specifically we are requesting a increase in the bi-monthly trip limits of Shallow Nearshore Species and Deeper Nearshore Species to 1000 lbs/ 2 months for the area of 40:10 to 34:27 for the remainder of 2013.

Last year Nearshore Commercial landing were about 50 percent of our ACL (OY). This year has started out being very windy and unfishable for weeks at a time. The Nearshore boats are small...mostly 25 feet in length or less. Weather (wind and wave height) this year has been keeping the Nearshore fishermen unable to fish the far away productive areas. Without a increase in the bi-monthly trip limits we will again fall to and possibly under 50 percent of the ACL for the commercial Nearshore Shallow and Deeper Nearshore Species for the area of 40:10 to 34:27. Late summer and fall are prime fishing months to catch our fish and sell to the markets we provide for. We cannot forecast which month will be less windy than another and that is why the request for a large trip limit increase for all remaining periods is being requested.

Port San Luis Commercial Fishermen's Association and myself Bill James wish to thank the Council for the opportunity to comment. If you have any questions about this request please contact me at 503-428-4028.

Thank you, Bill James