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 Pacific Fishery Management Council (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 G.1.a, Attachment 1: Federal Register notices published since the last Council meeting.

Agenda Order:

a. Regulatory Activities — Frank Lockhart
b. Science Center Activities — Elizabeth Clarke
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. Council Discussion

PFMC
08/17/07

FEDERAL REGISTER NOTICES

Groundfish and Halibut Notices
June 16, 2007 through August 21, 2007

Documents available at NMFS Sustainable Fisheries Groundfish Web Site
http://www.nwr.noaa.gov/1sustfsh/gdfsh01.htm

72 FR 36617. Pacific Coast Groundfish Fishery; Inseason Adjustments. This final rule announces inseason changes to management measures in the commercial Pacific Coast Groundfish Fishery - 7/5/07

72 FR 43193. Pacific Coast Groundfish Fishery; Inseason Adjustments; Correction. This final rule corrects publication errors in the final rule announcing inseason changes to management measures in the commercial Pacific Coast Groundfish fishery - 8/3/07

72 FR 43625. Fishing Capacity Reduction Program for the Pacific Coast Groundfish Fishery. NMFS issues this notice to increase the fee rate for the Oregon pink shrimp fee-share fishery to repay the sub-loan to finance the Pacific Coast Groundfish fishing capacity reduction program - 8/6/07

72 FR 44469. Pacific Coast Groundfish Fishery; Vessel Monitoring System; Open Access Fishery. NMFS issues this proposed rule to require all vessels fishing pursuant to the guidelines governing the open access groundfish fishery - 8/8/07

72 FR 46176. Pacific Coast Groundfish Fishery; End of the Pacific Whiting Primary Season for the Catcher-processor, Mothership and Shore-based Sectors – 8/17/07

CLARIFICATION ON METHODS USED TO ASSESS BYCATCH IN THE WEST COAST GROUNDFISH TRAWL FISHERY

Submitted by
John Stein, Elizabeth Clarke, and James Hastie
Northwest Fisheries Science Center
August 2007

Over the past few months, comments have been circulated regarding the methods that have been used by the Northwest Fisheries Science Center (NWFSC) to develop total mortality estimates for groundfish. In particular, the comments have focused on two issues: the absence of a recent review of the methods used to estimate trawl fleet bycatch, and the use of a retained catch measure, rather than tow hours, for expansion of observed bycatch up to the fleet level. We have prepared the following to address these comments and to correct inaccuracies or misconceptions upon which these comments appear to be based.

The methods that have been used to expand trawl observations up to fleet-wide estimates of total catch were reviewed for the first time in January 2003. At that time, the SSC conducted a 2-day review of the trawl bycatch model, which also included an outside reviewer provided by the Center for Independent Experts. The characterization of target fisheries used in the model was simplified during the following year, and the model, including those changes, was again reviewed and endorsed for Council use by the SSC during the spring of 2004. The methods used to estimate bycatch and total mortality have remained essentially the same as when last reviewed by the SSC. In general, unless substantial changes are made, the standard practice is to conduct a major review of methods used in a stock assessment or discard estimation once every 5 years.

The bycatch model is designed to project catch in an upcoming fishery, and uses observer, logbook, and fish ticket data from several prior years for that purpose. Total mortality estimates, on the other hand, are developed for a specific year that has already occurred. Therefore, only data from a specific year are included in the estimation of total mortality for that year. Discard estimation for the non-whiting trawl fishery, however, includes the same sources of information as the bycatch model, and employs a similar stratified approach that acknowledges area, depth, and seasonal differences in bycatch rates and trawl effort. The methods which have been used to develop the total mortality estimates are available and posted, with a description of total mortality estimation for 2005 available on the NWFSC web site (http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/totalmortality2005_final.pdf).

Comments have been made concerning the use of retained target catch as a measure of effort instead of trawl tow duration. Arguments can be made in support of either method. In actuality, the use of either method yields higher estimates for some species and lower estimates for others. Comments identified widow rockfish as a species for which discard was being underestimated using the current method. However, computing widow rockfish for 2005 using tow hours as the effort metric produces a slightly lower estimate of discard than the catch-based approach.

The fact that there are differences does not mean that the use of tow duration is necessarily superior. That depends on whether bycatch is better correlated with the catch of other species or with tow time, and also on whether one of these relationships is more consistent between the observed and unobserved fleet. Additionally, there is the question of which of these metrics is reported more consistently and reliably. Tow hours are self-reported by fishers in logbooks, and specific entries may, in some cases, not be recorded until days afterwards. Since logbooks are not submitted for all trips, and trawl hours are not reported on fish tickets, another metric, such as retained catch, must still be used to expand estimates for the "logbook" fleet up to the total fleet. Unlike logbooks, fish tickets must be signed, under penalty of law, as to the accuracy of the landed catches that are reported. There is some inherent inaccuracy in the adjustment of logbook hailed weights for individual tows, based on the entire trip's landings. However, there is no indication that the methods used by the states to adjust logbook hailed weights are biased, and given the aggregation of data used in estimating discard, it is unlikely that such tow-level anomalies affect discard estimates in any significant way. The bottom line is that a consistent effort metric (retained catch) is used throughout the analysis, and that estimates for the entire trawl fleet include all of the landed catch reported on fish tickets.

The following discussion addresses other inaccuracies contained in the comments. All validated observer data are included in developing discard estimates, as long as there is a corresponding fish ticket(s) with which to adjust the vessel's tow-level hailed weights that are recorded by the observers. Observations from a trip need not have an associated logbook record in order to be included in the analysis. The retained and discard weights of species from all of these observed tows are summed within strata, and then used to calculate discard ratios for each stratum. These rates are applied to logbook retained catch assigned to each stratum, and the resulting amounts of discard are adjusted using the ratio of retained catches in fish tickets and logbooks, to account for missing logbook data. "Adjusted-and-expanded" logbook catches from Washington are not used in expanding observed rates; instead, the basic "adjusted" Washington catch amounts are used. These are calculated by Washington Department of Fish and Wildlife using procedures that are comparable to those employed by the states of Oregon and California. Total catch for each stratum is not taken from the GMT Scorecard, since the final Scorecard amounts for the trawl fleet are, in fact, derived from this analysis, i.e. the total catch in the non-whiting trawl sector is derived from summing the model-estimated discards with landed catches reported through PacFIN. Estimated discard is not calculated through multiplying observed rates by total catch, because total catch is not known until the discard component has been estimated and added to reported landings.

It was also commented that access to groundfish observer data is very limited. As per the newly re-authorized Magnuson-Stevens Act, observer data is confidential. Release of observer data in a manner that directly or inferentially allows the association of catch records to specific vessels would not only create legal liabilities, it would also undermine trust between the industry and the observer program. This concern extends to release of these data to organizations that are not legally able to withhold release of the data as part of outside requests by members of the public through available legal channels. NWFSC staff have worked with the GMT, assessment scientists, and others, however, to provide summarized observer data to inform management and assessment activities in a timely manner.

There also appears to be a misconception that substantial under-estimation of discard amounts between 1988 and 2003 was the primary cause of the decline in stocks that are now under rebuilding plans. This view is inconsistent with the findings of recent stock assessments for many of the overfished species. For instance, according to the 2005 assessments, depletion levels for bocaccio, cowcod, and canary rockfish are estimated to have fallen below the current overfished threshold prior to 1986; with depletion levels for darkblotched rockfish, Pacific ocean perch, and lingcod falling below the threshold by 1990 or 1991. These assessments consistently indicate excessive landings and reductions in recruitment were the principal drivers in the decline of these stocks. All of these assessments are available for review on the Council's web site.

The NWFSC and the West Coast Groundfish Observer Program remain committed to collecting and analyzing observer and other fisheries data in a manner that is scientifically sound, unbiased, and as precise as our resources permit.

OFF-YEAR SCIENCE IMPROVEMENTS

This year is considered the "on-year" for intensive science activities as new groundfish stock assessments and rebuilding analyses are formally approved for management decision-making for 2009 and 2010 groundfish fisheries. While it is not entirely accurate to characterize the biennial management cycle in terms of an "on-year" and "off-year" for science, it is correct to distinguish the year in which stock assessments are conducted (the "on year") and the year other science activities are planned to prepare for the following assessment cycle and to resolve scientific issues that play a significant role in groundfish decision-making.

There are many activities that have been planned and/or should be considered for "off-year" science improvements. Some of these activities may be planned and sponsored by the NMFS Northwest Fisheries Science Center (NWFSC) (e.g., a pre-assessment data and modeling workshop to prepare for the next round of assessments); some activities may be planned and sponsored by the Council or the Council's Scientific and Statistical Committee (SSC) (e.g., a post-assessment workshop to review how well the assessment process worked this year and a second harvest policy evaluation workshop); and some activities may be recommended by other entities (e.g., Agenda Item G.2.a, Attachment 1).

Recently, the Council's Groundfish Management Team (GMT) has discussed the need for a formal reconciliation of historical groundfish catches for use by managers and assessment scientists. Assessment authors spend considerable time reconstructing historical catches for individual assessments, a process which is often repeated with each new assessment. Rather than repeating these efforts or doing catch reconstructions in an ad hoc species-by-species basis, the GMT is recommending a comprehensive effort to reconcile historical catches for all groundfish species and housing these catch estimates in a database such as PacFIN so they can be accessed by any interested party. The NMFS Southwest Fisheries Science Center is currently digitizing historical CDFG records that include monthly summaries of landings by CDFG block and individual fish ticket information back to 1931. Such efforts will be useful in a comprehensive catch history reconstruction.

The Council should consider the proposals and advice of the NWFSC, Council advisory bodies, other agencies, and the general public regarding off-year science improvements and plan and prioritize science activities for 2008.

Council Action:

Plan and Prioritize Science Activities for 2008.

Reference Materials:

1. Agenda Item G.2.a, Attachment 1: Suggestions for generic topics for "off-year" workshops (from Patrick Cordue, Center for Independent Experts).

Agenda Order:

a.	Agenda Item Overview	John DeVore
b.	Northwest Fisheries Science Center Report	Elizabeth Clarke
c.	Reports and Comments of Advisory Bodies	
d.	Public Comment	
e.	**Council Action:** Plan and Prioritize Science Activities for 2008	

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Agenda Item G.2.a
Attachment 1
September 2007

Suggestions for generic topics for "off-year" workshops

P.L. Cordue
5 August 2007

Given there is a scheduled meeting to discuss workshop topics for 2008, Steve Ralston asked if I would make some notes on issues which I thought could be considered for the workshops. There have certainly been a number of important generic issues which have arisen during the 2007 STAR Panel meetings – which do need to be addressed.

I am not convinced that previous workshops have been as effective as they might have been in addressing generic issues. I know that some good work was presented at the 2006 workshops, but I get the impression that there was less than a fully coordinated approach taken to solving identified problems.

I see two potential extremes in the process that could be used for the 2008 workshops.

One extreme goes like this: there is an announcement to potential participants that there will be a workshop on such and such a theme; a date and venue are specified and people let the organizer know if they want to present something; everyone then gets together for the day, there are presentations, a general discussion, and some conclusions and recommendations are made and written up in a report.

At the other end of the spectrum: specific topics are identified for a workshop (with an identified theme); projects are defined, in each case, with a detailed specification of the problem that needs to investigated/solved; researchers with the requisite skills are identified and contracted to work on the projects; the researchers present their results at the workshop; there is a general discussion, and some conclusions and recommendations are made and written up in a report.

I believe that the latter approach is preferable to the former. I suspect that the 2006 approach was perhaps closer to the former than the latter.

Below I list some issues, under general headings, which I think could be usefully addressed by some funded projects – the results of which could be discussed at workshops. Alternatively, perhaps a workshop is needed to discuss research priorities and make recommendations on projects to be funded. I am not familiar with your research planning procedures so it is difficult for me to judge. I am well aware, that several issues have been identified many times and the same recommendations have been made by STAR Panels, year after year.

Data accessibility and catch histories

It is somewhat inefficient for assessment authors to rely on the composition of STAR Panels to inform them of relevant data sources for their assessment. By the time the STAR Panel has convened it is often too late to obtain relevant data, let alone to include it in the assessment.

- Establish a *meta* database of all data relevant to groundfish stock assessment. The database should include enough detail about the nature and quality of the data that a stock assessment author can make a well informed decision on whether it could be useful for their stock assessment.
- Establish *accessible* online databases for all data relevant to groundfish stock assessment, so that assessment authors can obtain the *raw* data if required.
- Establish a database for historical groundfish catch histories, "best" guesses and estimates of uncertainty (and processes for updating and revising the database). There must be a coordinated and comprehensive approach to developing this database (it must *not* be a compilation of individually constructed catch histories.)

Abundance indices

With many fisheries under severe regulation it is difficult or impossible to monitor abundance using fishery data. Fishery independent abundance indices are needed. A number of trawl survey indices are developing but there are also a number of important species which are poorly surveyed by trawl. Other methods are needed for these species.

- Consider all species and stocks which need to be monitored.
- Identify which species are adequately monitored by current time series and which are not.
- Identify suitable methods for species which are not adequately monitored.
- Develop a prioritized schedule for conducting the required surveys (development of new time series or continuation of existing time series).

Triennial time series

The Triennial trawl survey has had a shift in timing. The surveys fall into two blocks: mid July-mid September timing for 1980-1992; and June-mid August timing for 1995-2004. Within the second block there is a trend towards earlier start dates and finish dates with the 2004 survey being the earliest. The 2004 survey is also notable for many species showing very large increases from 2001. Further, for some species the Triennial survey is unlikely to adequately sample the population. These species need to be identified. It is unacceptable to throw everything into the stock assessment model and hope that something sensible will emerge. Discernment is needed.

Conduct a comprehensive multi-species study of the Triennial trawl survey results:

- check for years with unusual "catchability" (i.e., do "too many species" show a marked increase or decrease in abundance in some years – look for indicator species which are less likely to have been affected by fishing)
- identify species for which the survey cannot be expected to provide abundance indices (those with higher densities on non-trawlable ground; those that are "too" semi-demersal; those which have highly variable catch rates)
- check for day-of-year effects for species for which abundance indices are defensible (e.g., perform a GLM on the Triennial survey data; GLM on NWFSC survey data; examine seasonal CPUE in fisheries data)
- if necessary incorporate day-of-year effects into the GLMM analysis used to produce abundance indices
- consider approaches to using the abundance indices from the Triennial survey in stock assessment (e.g., seasonally corrected or splitting the time series into two blocks).

Development of informed priors

Ideally, an informed prior should be developed for the proportionality constant (q or "catchability") associated with each abundance time series used in a stock assessment model. This is often done for fishery independent surveys but can, in theory, also be done for CPUE indices which retain some measure of units. Even if a prior is not used in the estimation model, it is a necessary to have it before the estimated value of q can be used as a legitimate diagnostic. Many times I have heard people say "that value of q is just not plausible". They clearly have in their mind an "informed prior", but it may be very uninformed in that they do not have a clear understanding of all of the factors that affect a particular q. The correct equations need to be used in the development of informed priors for survey qs. Ancillary data needs to be made available to help bound some components. Expert opinion will also be needed. Groups of related species are best done together (as they will share ancillary data sources and experts will have opinions on the relative values of their components).

I suggest that trawl surveys for groundfish be tackled first:

- identify defensible trawl survey abundance time series for a range of species (and stocks)
- identify the appropriate equations for trawl survey qs for each stock (e.g., proportion of non-trawlable ground will matter for some species and not others; as will their relative densities on trawlable and non-trawlable ground)
- identify, collate, and analyze relevant sources of ancillary data on the parameters within the equations
- identify *small* groups of experts to develop ranges and "best guesses" for each parameter (and hence to priors for each trawl survey q)

Recreational CPUE indices

For some important recreational species, there may be little choice but to use CPUE indices despite the imposition of regulations. However, it is crucial to have the full context within which to interpret and analyze CPUE indices. For many species, the same type of data are available and the same regulations have been implemented. Therefore, it would be efficient to do a comprehensive study over the whole recreational sector.

- Conduct and publish a full descriptive analysis of the recreational fisheries and fleets for CPUE interpretation (not limited to “groundfish trips” – interactions with other target species are important).
- Develop standard and validated methods for producing recreational CPUE indices which deal with the peculiarities of the recreational data and regulation changes. (The method of Stephens and MacCall for filtering recreational fishing trips is promising but remains largely unvalidated.)
- Specifically consider the use of random variables as explanatory variables. These have been used as proxies for habitat, but they introduce the “errors within variables” problem, and potentially may remove valid biomass signals from the response variables.
- Specifically consider the use of combined models (binomial model combined with a positive catch rate model) and whether they are robust to non-biomass factors that could drive the occurrence of zeroes.

Stock assessment modeling issues

Use of age and length data

The whole issue of how best to use age and length data in a stock assessment has not been resolved. The over-riding consideration for addressing these issues is whether the approach leads to a “better” stock assessment or not. Often, assessment authors appear to strive for greater reality through greater complexity and the inclusion of each and every data source that could conceivably be relevant. More data and more complexity does not necessarily mean a “better” assessment. There is much work that could be done looking at the following questions:

- What are the appropriate statistical distributions to use when modeling length and age data? (Properties of the data must be examined analytically and/or through bootstrapping.)
- If multinomial distributions are appropriate, how should effective sample sizes be determined (the existing equations of Stewart and Miller are not based on the observation error inherent in the data – rather on modeling choices and assumptions made in the 2005 stock assessments – again, analytical and/or bootstrap methods are needed).
- How should non-independent age and length data be jointly tuned? (E.g., when an age sub-sample of a length frequency is included as conditional age-at-length data, together with the length frequency.)

- Is it always best to estimate growth within the model? If so, how much conditional age-at-length data is desirable?
- How much violation of the assumption of constant proportions of age-at-length is allowable in conditional age-at-length data, before seasonal growth should be modeled? (E.g., when fish are growing during the sampling period.)

Estimation of R_0, recruitment deviations, sigmaR, natural mortality, and steepness
It is not clear how best to determine which year to start estimating recruitment deviations. Nor is it clear how best to estimate sigmaR (should sigmaR be tuned or not?). Estimation of steepness is also a thorny issue, as is the imposition of a stock recruitment relationship. Natural mortality is of course another problem.

There are least three general ways to configure a "forward projection statistical stock assessment model". An integrated model with a fully specified catch history and internally consistent relationship between R_0, recruitments, stock recruitment relationship, and B_0 can be configured with or without a penalty forcing recruitment deviations to follow the stock recruitment curve (in the latter case, recruitments are simply estimated to best fit the data and the stock-recruitment relationship is an output of the results). A third alternative is to start the model in a non-equilibrium state when data first become informative (and hence a full catch history is not needed).

It would be useful if some guidance was available on when different configurations were preferable – in terms of the conditions under which each method delivers the most "reliable" estimators. Some help will be available in the literature but there are no definitive studies. Retrospective analysis and bootstrapping methods are *not* adequate to investigate these questions. Nothing short of a full simulation study with a "complex" operating model and alternative (simpler) estimation models will do. A number of generic stock assessments will need to be simulated over a multi-dimensional operating model space (e.g., different true values of R_0, steepness, natural mortality, sigmaR, etc) to investigate the relative performance of the alternative estimators (in terms of accuracy – not just bias) and their robustness to violation of estimation model assumptions.

Agenda Item G.2.b
Supplemental NMFS Report
September 2007

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic Atmospheric Administration
National Marine Fisheries Service
Sustainable Fisheries Division
7600 Sand Point Way N. E., Building. 1, Bin C15700
Seattle, WA 98115-0070

DATE: September 7, 2007

TO: DISTRIBUTION

FROM: F/NWR2 -Becky Renko

SUBJECT: PRELIMINARY Report #6 -- 2007 Pacific Whiting Fishery

This report consolidates preliminary state, federal, and tribal data for the 2007 Pacific whiting fishery. Due to concerns about the incidental catch of overfished species, bycatch limits are in place for canary (4.7 mt), darkblotched rockfish (25 mt) and widow rockfish (220 mt) taken in the non-tribal sectors of the fishery. The non-tribal fisheries were closed on July 26 because the widow rockfish bycatch limit had been reached.

	Allocation		Whiting Catch* (mt)	Overfished Species and Chinook salmon catch	Thru [date]	Status	Percent of allocation taken
	Percentages	Metric Tons					
California (south of 42 N lat.)	(5% shore alloc'n; included in WOC shore allocation)	4,370	2,967			started 4/1	
Oregon	--	NA	41,347				
Washington	--	NA	23,583				
WOC shore-based	42% commercial OY	**87,398**	67,897	Canary – 2.01 mt Widow – 90.27 mt Darkblotched – 0.80 mt Chinook # 2,400	7/26	coastwide started 6/15, ended 7/26	77.7%
Mothership (n. of 42 N. lat.)	24% commercial OY	**49,942**	47,809	Canary – 1.62 mt Widow – 72.99 mt Darkblotched – 6.73 mt Chinook # 589	7/26	started 5/15, ended 7/26	95.7%
Catcher/ processor (n. of 42 N. lat.)	34% commercial OY	**70,751**	42,330	Canary – 0.35 mt Widow –71.74 mt Darkblotched – 5.25 mt Chinook # 434	7/26	started 5/15, ended 7/26	59.8%
Total nontribal	commercial OY	208,091	158,036	Canary – 3.98 mt Widow – 235.00 mt Darkblotched – 12.79 mt Chinook - # 3,423	--	--	76.0%
Tribal (Makah)		**32,500**	10,970	Canary - 0.55 mt Widow – 1.88 mt Darkblotched - 0.00 mt Chinook # 1,179	9/2		33.8%
Total directed fishing		240,591	169,006	Canary – 4.53 mt Widow – 236.88 mt Darkblotched –12.79 mt Chinook # 4,607	--		70.2%
Total	OY=optimum yield	242,591	169,006		--	--	--

* Catch includes: discards from at-sea processors; weigh-backs from shore-based vessels; catch landed under trip limits prior to the season, and estimated bycatch from non-EFP vessels. The values for at-sea processing sectors are based on NMFS observer data. Data for shore-based vessels were provided by the States. Data for the at-sea processing portion of the Makah fishery are based on preliminary NMFS observer data and shore-based catch was provided by tribal samplers. All weights are in metric ton (2,204.6 pounds).

GROUNDFISH ADVISORY SUBPANEL REPORT ON OFF-YEAR SCIENCE IMPROVEMENTS

The Groundfish Advisory Subpanel (GAP) heard from Mr. John DeVore about the proposed actions for off-year science improvements. The GAP has general comments on off-year science activities and specific recommendations for potential workshops.

General Comments

- All workshops should strive to accommodate layman participants. Technical discussions should be translated to the applied level to ensure understanding of important technical issues.
- The workshop title should clearly articulate the purpose of the workshop. For example the harvest policy workshop covered many issues much broader then harvest policy.
- The Council should continue to sponsor GAP representation at the workshops. At times this may include both commercial and recreational representatives if appropriate.
- Limit the scope of individual workshops; a series of workshops may be more appropriate.
- Consider increasing peer review from outside of the West Coast.
- Devise a process to consider the research and data needs identified by Stock Assessment Review Panels and track whether these recommendations and research needs are being accomplished, and if not, why not.

Recommended Activities

- B-zero workshop.
- Data modeling workshop – including the sablefish assessment recommendations from Dr. Jack Taggert.
- A workshop that examines what constitutes overfishing should be considered. The workshop would consider revisiting proxy harvest rates last examined in 2000.
- A workshop that examines the stock assessment review process.
- A workshop to construct a comprehensive catch history database for all species for stock assessment purposes.
- A workshop that examines stock assessments through the years – considers the decision points, what has worked and where management has obviously erred.
- Consider whether using SS2 to model all West Coast species is necessarily appropriate.

PFMC
09/11/07

GROUNDFISH MANAGEMENT TEAM REPORT ON OFF-YEAR SCIENCE IMPROVEMENTS

The Groundfish Management Team (GMT) discussed science activities necessary to prepare for the next stock assessment cycle and possible projects to resolve scientific issues that play a significant role in groundfish decision-making. The GMT identified the reconstruction of historical catch series for stock assessments and coordination of sampling goals for federally managed species.

Reconstruction of Historical Catch Series

Assessment authors are increasingly mining historical data, including landings and discard estimates, in order to provide the SS2 model with a better perspective on virgin biomass. This parameter, B_0, is extremely important in establishing a stock's current state of depletion, which can result in adjustments in harvest policy (40-10) or can trigger rebuilding requirements as mandated by the Magnuson-Stevens Act.

Also, to construct catch histories for species not identified to species level in historical catch data, assessment authors must arrive at some (often ad hoc) method of apportioning that catch to the species level. The need to resolve historical catch estimates is an issue across both recreational and commercial fisheries; and reconstruction of these historical catch data is no small task. This catch data mining exercise might be repeated from author to author, resulting in potentially redundant effort and disparate estimates of historical catch. This may not be the best use of our stock assessment resources, especially given the number of Council-managed groundfish species and the limited pool of stock assessment scientists.

Recommended Solution

Historical catch in itself does not change; only our estimate of it does. Undertaking a multistage process to resolve estimates of total catch for future use, across species and data sources, could potentially save stock assessors countless hours spent on catch data assembly that could instead be devoted to model exploration. This effort would face the same challenges of uncertainty in magnitude and species composition in many catch records that every assessment author faces. The difference would be that those uncertainties could be resolved in a deliberative process and made available for wider use, rather than individual assessors repeatedly struggling with the (same) issue. In order for this approach to be successful, there would have to be a buy-in to the concept and methodology at the front end, so that there would be a buy-off on the catch history produced as a result.

Potential Process

Given the amount of time that has been required to construct a catch stream for a single species, the magnitude of this exercise is likely larger than one might anticipate upon first consideration. One of the initial tasks would seem to be a "literature review" of completed stock assessments to compile all data sources that have been used for historical catch. This list should also be expanded to include any additional data sources that may be informative. This process could be expedited by an inter-agency meeting to identify potential sources of historical catch information. It would also be useful to consider a process by which this "official" historical catch database could be revised as new data sources or new perspectives became available. This should be structured in such a way that the changes are made comprehensively, not within individual assessments.

Depending on staffing and available resources, state or federal agencies could accomplish this task. A contractor with background and experience with West Coast data sources may be able to assist in the reconstruction process. Contractors would need to have detailed knowledge and access to institutional resources with respect to understanding the datasets available, the market categories and sampling methods used. If a contractor or academia conducted the work, a commitment to full involvement in the process by agencies housing historical catch data would be integral to success of the effort. Additionally, industry input into the nature of historical fisheries could prove valuable in providing perspective and ground-truthing assumptions on catch.

The uncertainty associated with historical catch is unavoidable, and is often one of the primary axes of uncertainty in stock assessments. Ideally, this uncertainty could be somehow quantified, or at least described, in developing a summary of historical catch data so that it could be profiled in assessment results, rather than having to construct different catch streams within the assessment. It's only by relieving assessment authors of that task will the full utility of this effort be realized.

Coastwide Coordination of Sampling Goals

The GMT also recommends that an effort to better coordinate groundfish biosampling and age reading priorities across agencies be undertaken as part of off-year science improvements. Differences in sampling regimes are often warranted and there is not likely to be a one-size-fits-all coastwide approach to standardizing sampling methods. However, some level of coastwide coordination of sampling methodologies, and perhaps more importantly coordination of priorities for species that are or will be assessed and managed as coastwide stocks, is necessary.

Given the increasingly limited resources we are able to direct toward biosampling and ageing, it seems prudent that we strategically direct those resources where they will be most effective in meeting the needs of groundfish stock assessments. Currently, state agencies develop tasks and priorities for their port sampling and age reading staff relatively independent of one another. Tracking success in achieving annual goals, or any inseason adjustment of priorities, is typically an isolated effort. Since most of our groundfish assessment needs are coastwide, coordination of sampling priorities should likewise be conducted on a coastwide basis.

Sampling methodologies have been discussed within the Pacific Fisheries Information Network (PacFIN) arena, usually at the annual Pacific Coast Fisheries Data Committee (PCFDC) meeting. However, the meeting priorities are typically centered on the data itself, coding issues, getting new data onto PacFIN, electronic tickets, etc. It would be worthwhile to have an additional meeting focused on coordinating groundfish biosampling and age reading priorities.

The GMT recommends that managers from the states and tribes, charged with establishing sampling priorities (both commercial and recreational), meet with representatives from the National Marine Fisheries Service (NMFS) Science Centers to develop a sampling plan that best meets the needs of planned groundfish stock assessment efforts. This process should be informed by the research and data needs compiled from past assessments and STAR Panel reports as well as by direct input from stock assessment scientists. The NMFS Northwest Fisheries Science Center might be most effective in coordinating this effort.

GMT Recommendations

1. Request that the Council ask the Northwest Fisheries Science Center, in cooperation with the Southwest Fisheries Science Center, to consider, as part of off-assessment year science improvements, a multi-stage process to develop a comprehensive, historical database for commercial and recreational catch across all species of Council-managed groundfish.

2. The GMT recommends that managers from the states and tribes, charged with establishing sampling priorities (both commercial and recreational), meet with representatives from the NMFS Science Centers to coordinate and prioritize sampling goals for federally managed species.

PFMC
09/12/07

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON OFF-YEAR SCIENCE IMPROVEMENTS

The Scientific and Statistical Committee (SSC) discussed off-year science improvement activity and concluded that several highly focused topics would be more productive that a large number of items. The SSC also deliberated about the organization and planning of these activities. Some research topics would be best addressed in a workshop setting while others may be most effectively accomplished within committees or working groups. Success of any research topic described herein will require substantial scientific input and support. The SSC offers the following topics, in prioritized order, with organizational and planning suggestions:

- Post-mortem workshop of the 2007-2008 assessment cycle to evaluate the stock assessment review process. The SSC recommends that this workshop take place in Portland on December 5, 2007.
- Data enhancement projects undertaken as follows:

  Reconciliation of historical commercial groundfish catches for use by managers and assessment scientists. Such an effort should include establishment of a database for historical groundfish catch histories that include a coordinated and comprehensive allocation structure (strata, time, etc) which is web accessible and maintained for updates and revisions. This task may be best handled using a committee (catch reconstruction working group) comprised of federal and state representatives, including industry input.

  Similar reconciliation of historical recreational catches and raw catch and effort data. Recreational databases should be accessible, transparent, and standardized across states to the extent possible and include ancillary information on regulations. A committee or working group including RecFIN representatives and stock assessment analysts may be the appropriate mechanism to accomplish this task.

  Both of these projects should include a review process that allows agencies and industry to provide needed checks on the validity of the data.

- A comprehensive analysis of survey timing and other factors affecting catch rates in both the triennial and Northwest Fisheries Science Center shelf/slope bottom trawl surveys. Factors affecting survey catchability may need to be incorporated into generalized linear models to account for such changes.
- A second harvest policy evaluation workshop to evaluate groundfish harvest policies. Such a workshop may need to consider the Council's groundfish harvest policies with regard to the new annual catch limits and accountability measures specified in the Reauthorized Magnuson-Stevens Act. Final scheduling is anticipated to be determined after annual catch limits are clarified. The SSC, in conjuction with National Marine Fisheries Service, State agencies and Academics, will assist in planning and organization of this workshop with Council Staff.
- Development and use of priors on survey catchability. The current whiting and sablefish stock assessments depend critically on priors for catchability that would benefit from

such a workshop. This research topic would require two steps. First, development of methodology and second, a workshop to apply the methodology.

- Evaluation of alternative methods to survey rockfish which do not commonly occur in the traditional bottom trawl surveys. This topic would be focus of a workshop to evaluate survey methodologies currently being developed for suitability in stock assessments.
- Development of data poor assessment approaches and their implementation into the management process. This topic may best be addressed by a working group. California Department of Fish and Game is currently in the process of sponsoring a symposium on this topic.

A steering committee should be established to establish the breath and scope of such workshops and designate time tables for completing of tasks.

Database to include uncertainty in historical catch reconstructions.

PFMC
09/12/07

CONSIDERATION OF INSEASON ADJUSTMENTS

Management measures for the 2007 groundfish season were set by the Council with the understanding these measures would likely need to be adjusted throughout the biennial period in order to attain, but not exceed, the optimum yields.

On July 26, the National Marine Fisheries Service closed the primary seasons for the catcher-processor, mothership, and the shore-based sectors of the Pacific whiting fishery because the widow rockfish bycatch limit specified for that fishery had been attained. Subsequent information revealed that the widow rockfish bycatch limit had been exceeded by several tons, and the amount of canary rockfish caught in the Pacific whiting fishery had approached the specified canary bycatch limit.

The Council received a joint letter (Attachment 1) from the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW) on August 1. This letter stated the importance of the whiting fishery to Oregon and Washington coastal communities, the negative repercussions of an early whiting fishery closure, the desire to re-open the fishery if biologically appropriate, and the intention to put forward a motion at the September meeting to reconsider the widow rockfish bycatch limit. In response, Council staff transmitted a letter to Dr. William Hogarth (Attachment 1) indicating the desire for the timely implementation of a potential Council action on adjustments to the whiting fishery. As part of this letter, Council staff included draft regulations and rationale for advance review and requested front loading of the review process. These draft regulations specify a hypothetical change in the widow rockfish bycatch limit and a hypothetical implementation of an existing rockfish conservation area mechanism for protecting canary rockfish.

The ODFW is also asking the Council to adopt conforming action for non-retention of cabezon in the Oregon recreational ocean boat fishery.

The Groundfish Management Team (GMT) and the Groundfish Advisory Subpanel will begin meeting on Monday, September 10, 2007 to discuss and recommend inseason adjustments to ongoing 2007 groundfish fisheries. Under this agenda item, the Council is to consider advisory body advice and public comment on the status of ongoing fisheries and recommend inseason adjustments. Agenda item G.6 is scheduled for Thursday, September 13, if it is necessary for further analysis of potential inseason adjustment or clarification prior to adopting final changes.

Council Action:

1. **Consider information on the status of ongoing fisheries.**
2. **Consider and adopt inseason adjustments as necessary.**

Reference Materials:

1. Agenda Item G.3.a, Attachment 1: Letter from Dr. Donald McIsaac to Dr. William Hogarth; Joint letter from ODFW and WDFW; Hypothetical regulations and rationale for implementing inseason adjustments to the Pacific whiting fishery.
2. Agenda Item G.3.c, ODFW Report.
3. Agenda Item G.3.e, Public Comment.

Agenda Order:

a. Agenda Item Overview — Merrick Burden
b. Report of the Groundfish Management Team — Kelly Ames
c. Agency and Tribal Comments
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. Council Action: Adopt Recommendations for Adjustments to 2007 Fisheries

PFMC
08/16/07

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101, Portland, OR 97220-1384
Phone 503-820-2280 | Toll free 866-806-7204 | Fax 503-820-2299 | www.pcouncil.org
Donald K. Hansen, Chairman Donald O. McIsaac, Executive Director

August 7, 2007

Dr. William Hogarth
National Marine Fisheries Service
1315 East-West Hwy, Room 14555
Silver Spring, MD 20910

RE: In-season Management for Pacific Whiting, Widow Rockfish, and Canary Rockfish

Dear ~~Dr. Hogarth~~ Bill:

We have received notice from the states of Washington and Oregon that they intend to bring forward consideration of in-season action regarding completing the Pacific Whiting fishery within the constraints of the catch limit in place for widow rockfish, at the upcoming September 9-14, 2007 Council meeting in Portland, Oregon (see attached letter from Philip Anderson and Curt Melcher dated August 1, 2007). At the same time, it has become apparent that intensified in-season management is necessary to optimize protective regulations for canary rockfish.

It is regionally important that any fishery reopening be done quickly, that is, on or before October 1, should the Pacific Council recommend such action and should the National Marine Fisheries Service agree. Towards that end, we forward here a draft proposed rule and justification rationale (Addendum 1 and 2, enclosed) with a request for advance review of a potential Council recommendation. Addendum 1 deals with the release of a portion of the widow rockfish reserve buffer to increase the current catch limit in the Pacific Whiting fishery. Addendum 2 institutes an existing shallow area boundary in the fishery to further minimize canary rockfish bycatch. The Pacific Council has not acted on these issues; the draft proposed rule represents a current expectation of Council action at the next meeting, with a hypothetical number for a revised catch limit on widow rockfish and the hypothetical adoption of a 150 fathom depth restriction. However, we ask for front loading of the review process to the extent possible under the presumption that final action by the Pacific Council will correspond closely to the enclosed material.

Should you or your staff have any questions on this matter, please do not hesitate to contact me or John DeVore at the Pacific Council office.

Sincerely,

D. O. McIsaac, Ph.D.
Executive Director

DOM:kam

Enclosures:
ODFW/WDFW Widow Rockfish Letter
Addendum 1: Widow Rockfish Buffer Release Proposed Regulation
Addendum 2: Canary Rockfish Depth Restriction Proposed Regulation

c: Council Members
Mr. Sam Rauch
Mr. Alan Reisenhoover
Mr. Robert Lohn
Mr. Frank Lockhart
Mr. Rod McInnis
Mr. Galen Tromble
Ms. Marian Macpherson
Ms. Eileen Cooney
Ms. Yvonne deReynier
Dr. John Coon
Mr. John DeVore
Mr. Merrick Burden
Ms. Kelly Ames
Mr. Tom Ghio

OREGON

Fish & Wildlife

Washington Department of FISH and WILDLIFE

August 1, 2007

RECEIVED

AUG - 1 2007

PFMC

Dr. Donald O. McIsaac, Executive Director
Pacific Fishery Management Council
7700 Northeast Ambassador Place, Suite 101
Portland, Oregon 97220-1384

Dear Dr. ~~McIsaac~~ Don:

The Oregon and Washington Departments of Fish and Wildlife hereby submit this request that the Pacific Fishery Management Council reconsider the amount of widow rockfish provided to the directed whiting fishery at the upcoming September Council meeting in Portland, Oregon.

As you know, the primary whiting fishery reached their widow rockfish bycatch cap of 220 mt last week. In response, the National Marine Fisheries Service, based on the direction provided by the Pacific Fishery Management Council, closed the primary whiting fishery, effective July 26, 2007. A large portion of the available whiting optimum yield amount remains uncaught at this time, and a large set-aside buffer of widow rockfish also remains available under the adopted optimum yield catch limit. The states of Oregon and Washington derive a significant amount of revenue from the whiting fishery and their respective coastal communities are heavily dependent upon the commercial whiting industry. The earlier than anticipated attainment of the widow bycatch cap will severely affect our coastal fishing communities. It is very important that the fishery re-open as quickly as possible if it is biologically appropriate to do so.

At this time, it is unclear how much widow rockfish will be taken in all fisheries coastwide by the end of the year and, thus, how much could remain available for access to the whiting resource. We are anxious to receive the Council's Groundfish Management Team's estimate of the projected total mortalities of overfished rockfish at the Council's September 2007 meeting. After reviewing those estimates, and hearing public comment on the issues at hand, we intend to put forward an appropriate motion regarding this request.

We look forward to discussing this further in September.

Sincerely,

Curt E. Melcher

Curt Melcher
Oregon Department of Fish and Wildlife

Sincerely,

Philip Anderson
Washington Department of Fish and Wildlife

Addendum 1. Hypothetical proposed rule for purposes of advance regulatory review, for a change in the bycatch limit of widow rockfish in the Pacific Whiting fishery, and expected justification rationale to be considered for adoption at the September 9–14 meeting of the Pacific Fishery Management Council.

Hypothetical Proposed Rule

PART 660--FISHERIES OFF WEST COAST STATES

1. The authority citation for part 660 continues to read as follows:

Authority: 16 U.S.C. 1801 et seq.

2. In § 660.373, paragraph (b)(4) is revised to read as follows:

§ 660.373 Pacific whiting (whiting) fishery management.

* * * * *

(b) * * *

(4) Bycatch limits in the whiting fishery. The bycatch limits for the whiting fishery may be used inseason to close a sector or sectors of the whiting fishery to achieve the rebuilding of an overfished or depleted stock, under routine management measure authority at §660.370 (c)(1)(ii). These limits are routine management measures under §660.370 (c) and, as such, may be adjusted inseason or may have new species added to the list of those with bycatch limits. The whiting fishery bycatch limits for the sectors identified in §660.323(a) are 4.7 mt of canary rockfish, ~~220~~ 270 mt of widow rockfish, and 25 mt of darkblotched rockfish. {added at 69 FR 77012, December 23, 2004; corrected at 70 FR 13118, March 18, 2005; revised at 70 FR 22808, May 3, 2005; revised at 70 FR 58066, October 5, 2005; revised at 71 FR 29257, May 22, 2006; revised at 71 FR 37839, July 3, 2006: revised at 71 FR 58289, October 3, 2006; revised at 71 FR 78638, December 29, 2006; revised at 71 FR 19390, April 18, 2007}

* * * * *

The only revision above, for the purpose of front loading regulatory review of a potential Pacific Council action, is the hypothetical increase in the widow rockfish catch limit of 50 mt, from 220 mt to 270 mt.

Expected Justification Rationale

Widow rockfish, an overfished groundfish species, co-occurs with Pacific whiting and is, therefore, commonly caught in Pacific whiting fisheries. Beginning in 2005, the Pacific Council recommended and NMFS implemented a bycatch limit for certain overfished species that co-occur with whiting in whiting-directed fisheries, particularly canary, darkblotched, and widow rockfish; these species are also constraining to the whiting fishery in 2007. Implementing bycatch limits allowed NMFS to set a higher OY for Pacific whiting in 2007 than would otherwise have been possible. Because catch in the Pacific whiting fishery can be tracked by NMFS with near real-time data, NMFS has the ability to manage the Pacific whiting fishery to stay within bycatch limits. Based on the most recent catch data for the shore-based sector and real-time observer data for the at-sea sector, the nontribal Pacific whiting sector has taken 234 mt of the 220 mt widow rockfish bycatch limit. In order to allow the non-tribal Pacific whiting sector to harvest their allocation of whiting and avoid the negative socioeconomic impacts of keeping the fishery closed for the remainder of the year, the Pacific Council will consider whether some of the widow rockfish set aside and not projected to be taken by other sectors by the Pacific Council's Groundfish Management Team (GMT)) could be moved into the whiting fishery's projected take for 2007. This implies a reconsideration of the bycatch limits as stated in regulation at 50CFR 660.373(b)(4). Of the 75 mt of widow rockfish estimated to be available in the set-aside buffer, the Pacific Council is expected to recommend 50 mt of the set-aside buffer into the widow rockfish bycatch limit for the Pacific whiting fishery. Without this action, the Pacific whiting fishery will remain closed, causing a multi-million dollar forfeiture of about 48,616 mt of Pacific whiting otherwise available for harvest. If approved, NMFS would implement an increase in the 2007 bycatch limit for Pacific whiting, as stated at 50 CFR 660.373(b)(4), from 220 mt of widow rockfish to 270 mt. This action would leave about 25 mt of widow rockfish in the set-aside buffer.

Addendum 2. Hypothetical proposed rule for purposes of advance regulatory review, for a depth restriction in the nontribal Pacific Whiting fishery to protect canary rockfish, and expected justification rationale to be considered for adoption at the September 9 – 14 meeting of the Pacific Fishery Management Council.

Hypothetical Proposed Rule

PART 660--FISHERIES OFF WEST COAST STATES

1. The authority citation for part 660 continues to read as follows:

Authority: 16 U.S.C. 1801 et seq.

2. In § 660.373, paragraph (c) is revised to read as follows:

§ 660.373 Pacific whiting (whiting) fishery management.

* * * * *

(b) * * *

(c) Closed areas. Pacific whiting may not be taken and retained in the following portions of the fishery management area: {revised at 71 FR 66122, November 13, 2006}

(1) Klamath River Salmon Conservation Zone. The ocean area surrounding the Klamath River mouth bounded on the north by 41°38.80' N. lat. (approximately 6 nm north of the Klamath River mouth), on the west by 124°23' W. long. (approximately 12 nm from shore), and on the south by 41°26.80' N. lat. (approximately 6 nm south of the Klamath River mouth). {revised at 71 FR 78638, December 29, 2006}

(2) Columbia River Salmon Conservation Zone. The ocean area surrounding the Columbia River mouth bounded by a line extending for 6 nm due west from North Head along 46°18' N. lat. to 124°13.30' W. long., then southerly along a line of 167 True to 46°11.10' N. lat. and 124°11' W. long. (Columbia River Buoy), then northeast along Red Buoy Line to the tip of the south jetty. {revised at 71 FR 78638, December 29, 2006}

(3) Ocean Salmon Conservation Zone. All waters shoreward of a boundary line approximating the 100 fm (183 m) depth contour. Latitude and longitude coordinates defining the boundary line approximating the 100 fm (183 m) depth contour are provided at §660.393(a). {added at 71 FR 78638, December 29, 2006}

(4) Canary Rockfish Conservation Zone. All waters shoreward of a boundary line approximating the 150 fm (274 m) depth contour after September 1, 2007 through December 31, 2007. Latitude and longitude coordinates defining the boundary line approximating the 150 fm (274 m) depth contour are provided at §660.393(h). {revised at 71 FR 78638, December 29, 2006}

* * * * *

The only revision above, for the purpose of front loading regulatory review of a potential Pacific Council action, is the hypothetical specification of a 150-fm depth restriction for the remainder of the 2007 nontribal Pacific whiting fishery (closed shoreward of 150 fm after September 1, 2007 through December 31, 2007) to protect canary rockfish.

Expected Justification Rationale

Canary rockfish, an overfished groundfish species, co-occurs with Pacific whiting and is, therefore, commonly caught in Pacific whiting fisheries. Beginning in 2005, the Pacific Council recommended and NMFS implemented a bycatch limit for certain overfished species that co-occur with whiting in whiting-directed fisheries, particularly canary, darkblotched, and widow rockfish; these species are also constraining to the whiting fishery in 2007. Implementing bycatch limits allowed NMFS to set a higher OY for Pacific whiting in 2007 than would otherwise have been possible. Because catch in the Pacific whiting fishery can be tracked by NMFS with near real-time data, NMFS has the ability to manage the Pacific whiting fishery to stay within bycatch limits. Based on the most recent catch data for the shore-based sector and real-time observer data for the at-sea sector, the nontribal Pacific whiting sector has taken 3.92 mt of the 4.7 mt canary rockfish bycatch limit. In order to allow the non-tribal Pacific whiting sector to harvest their allocation of whiting while minimizing impacts to the canary rockfish resource, the Pacific Council will consider specifying a depth restriction of 150 fm for the remainder of the 2007 nontribal Pacific whiting fishery (the best available science indicates canary rockfish rarely occur in depths greater than 150 fm). With only 0.78 mt of canary rockfish available under the 2007 canary rockfish bycatch limit of 4.7 mt, it is unlikely that the allocation of Pacific whiting to the nontribal sector of the Pacific whiting fishery could be attained without this depth restriction. If approved, NMFS would implement a depth restriction to the nontribal 2007 Pacific whiting fishery after September 1, 2007, which closes waters shoreward of a line approximating 150 fm (274 m) to maintain an acceptable level of canary rockfish bycatch in the fishery while allowing the nontribal sector to attain their allocation of canary rockfish. While increased impacts to the darkblotched rockfish resource are expected by closing these nearshore waters, the impacts should not exceed 25 mt and the specified 25 mt darkblotched bycatch limit allows NMFS to close the fishery before an unacceptable harvest of darkblotched rockfish can occur.

GROUNDFISH MANAGEMENT TEAM (GMT) REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

The GMT considered the most recent information on the status of ongoing fisheries and provides the following considerations and recommendations.

RESEARCH UPDATE

Canary Rockfish

The GMT June scorecard listed a value of 7.5 mt for total research take of canary rockfish, with a majority of this tonnage coming from the Northwest Fisheries Science Center (NWFSC) trawl survey. The NWFSC recently provided the GMT with updated projections of canary rockfish take in the 2007 survey based on catches through September 10, 2007. At that time, the NWFSC had completed the second leg in the second pass of the survey, meaning all surveying off of Washington’s coast has been completed and only two areas of potentially high canary catch remain to be surveyed (southern Oregon and Cape Mendocino). The current status of the survey, with no extremely high catches of canary thus far, has reduced the canary rockfish catch estimates. The updated value in the scorecard includes expected catches of ongoing research projects, including the NMFS trawl survey.

Yelloweye Rockfish

The total research take of yelloweye rockfish was reduced by 0.1 mt to 1.9 mt in response to new 2007 catch estimates that were updated with actual 2006 catch data recently submitted to NMFS NWR.

RECREATIONAL

California

California Department of Fish and Game (CDFG) staff reviewed California Recreational Fishery Survey (CRFS) estimates available through July 2007 and projected total mortalities through the end of the year. Current projections are higher than projections developed in 2006. Under the existing regulations, California’s 2007 recreational catches for canary, yelloweye, and minor nearshore rockfish south of 40’10 N lat. are projected to exceed harvest guidelines. Without inseason action the California recreational catch of yelloweye rockfish in combination with all other fishery impacts in the scorecard, would exceed the coastwide optimum yield (OY) (Agenda Item G.3.b Attachment 1).

A number of factors have contributed to the increased catch projections for the 2007 season:

- Several changes have been made to the CRFS catch and effort estimation methodologies and were applied to the 2005 and 2006 data used in the 2007 inseason catch projections. The 2004 and 2005 data were used to derive 2007 and 2008 management measures and 2004 data had relatively lower groundfish catch than the 2006 data. As a result, the inseason catch projections predict higher than anticipated catches for remaining months in 2007.
- Based on CRFS data, the combined preliminary catch estimates for yelloweye rockfish were greater than projected for May and June. High catches also occurred in July 2007 for yelloweye rockfish in the Northern Management Region and Shelter Cove in the North

Central Management Region (37°11’ N lat. to 42°00’ N lat.). This may have resulted from increased fishing activity on bottom fish due to poor salmon catches.

- Although progress has been made towards implementing a discard mortality estimation methodology similar to Oregon and Washington, there are still several outstanding issues that could not be resolved in time for the September Council meeting. Consequently, discard mortality was estimated in the same manner as that reviewed by the GMT at the November 2006 Council meeting (applying a 42% mortality rate to fish reported to be released alive (B2) fish).

CDFG analyzed various management options to determine the best possible strategy for minimizing impacts to overfished species while providing fishing opportunities. Because of the higher encounters with yelloweye rockfish in the management regions north of Pigeon Point (37°11’ N lat.), CDFG considered actions to limit fishing opportunities from Pigeon Point to the California-Oregon (CA-OR) border. Increased depth restrictions from 30 fm to 20 fm from Pt. Conception to the CA-OR border did not result in appreciable catch savings. Closure of the North and North-Central Groundfish Management Areas provides the fewest impacts to yelloweye rockfish. This option reduces fishing opportunities in the Northern Management Region by three months and the North-Central Management Region by two months and closes boat-based fishing for lingcod, rockfish, cabezon, greenlings, and other federal groundfish species subject to bag limits. State action would close fishing for other associated species not included in the FMP such as sheephead and ocean whitefish.

California will take action to close the above recreational fisheries in North and North Central Management Areas effective October 1 (Agenda Item G.3.c CDFG Supplemental Report). The GMT reviewed the projected impacts, taking into consideration the outcome of proposed management options relative to the projected catch for all sectors, and concurs with California’s recommendation.

Oregon
The Oregon Department of Fish and Wildlife (ODFW) requested that the **Council take action, concurrent with the state, to prohibit the retention of cabezon in Oregon’s recreational ocean boat fishery** (Agenda Item G.3.c ODFW report)**.** The GMT concurs with this inseason action.

COMMERCIAL

<u>Open Access</u>

Conception Area sablefish
At the June 2007 meeting, the GMT recommended increasing the open access sablefish trip limit for the area south of 36°N lat. (Conception area) to 350 lbs per day or one landing of 1,050 lbs per week because current catches were tracking well below the OY. The GMT revisited catches relative to the OY in September to consider whether a decrease in these limits would be necessary. **As current catches are tracking well below the OY, the GMT recommends maintaining the trip limits adopted by the Council in June 2007 (350 lbs per day or one landing of 1,050 lbs per week).**

Sablefish Daily Trip Limit (DTL) 36° - 40°10' deg. N Lat.
The GMT received a request to increase open access DTL limits between 36° and 40°10' N. lat. The GMT notes that while there are limited yelloweye interactions south of 40'10 and at the depths of the currently specified RCA (Rockfish Conservation Area) (150 fm), the scorecard that includes the California recreational action (Agenda G.3.b Supplemental GMT report Attachment 2) results in a remainder of only 0.1 mt of yelloweye rockfish. In addition, the sablefish catches in this fishery are close to what was expected for this time of year; therefore any increase in sablefish opportunity would be relatively minor. **The GMT, therefore, does not recommend increasing the sablefish limit at this time.**

<u>Limited Entry (LE) Fixed Gear</u>

Shortspine Thornyheads South of 34° 27' N Lat.
At the June 2007 meeting, the GMT was asked to analyze an increase in the LE fixed gear limits for shortspine thornyhead south of 34°27' N. lat. The trip limit in this area was 2,000 lbs per two months. Catches for the area south of 34°27 N. lat. were tracking lower than projected in June. The GMT was concerned that increasing the trip limit would increase effort, resulting in higher sablefish catch and higher catches of other species and a premature closure of other fishing opportunities. Therefore, in June 2007 the GMT recommended adopting a measured approach with limits of 3,000 lbs per two months in period 4, reverting to 2,000 lbs per two months for period 5.

Current data indicates shortspine catches south of 34°27' N. lat. are well within the allowable OY and the inseason increases made in June slightly increased the catch rate in that area. Additionally, data indicate that a significant effort shift did not occur. **Therefore, the GMT recommends that the LE fixed gear shortspine limit south of Point Conception be increased to 3,000 lbs per two months through the end of the year.**

<u>Limited Entry Trawl Non-Whiting</u>

Lingcod Shoreward of the RCA
The GAP requested that the GMT examine increasing retention of lingcod in the LE trawl fishery in areas shoreward of the RCA. This proposal was discussed at the June 2007 Council meeting and the GMT did not recommend increasing lingcod limits due to concerns of increased targeting which would result in increased yelloweye and canary impacts. Based on the updated scorecard, there is limited availability for increased yelloweye impacts. **Therefore, the GMT does not recommend increasing the lingcod limit during this time.**

Slope Rockfish South of 40°10' N Lat.
The GMT received a request to increase trip limits for slope rockfish south of 40°10' N lat. T**he GMT will analyze this request further and report back to the Council during the final inseason session.**

Dover Sole Coastwide
The GAP requested that the GMT examining increasing coastwide limits of Dover sole. T**he GMT will analyze this request further and report back to the Council during the final inseason session.**

Shoreward Adjustments of RCA boundaries – North of Cape Alava and Humbug Mountain to Cape Arago

The team reviewed the public comments that were received in June and in September regarding the impacts of these closures and acknowledges the adverse impacts these closures have on the affected communities. The GMT will analyze the possibility of re-opening the areas north of Cape Alava and Humbug Mountain to Cape Arago based on the Council decision relative inseason action taken under this agenda item and the associated balance of canary rockfish in the scorecard.

<u>Limited Entry Trawl -Whiting</u>

The GMT received a request to consider re-opening the whiting fishery based on available bycatch limits and protected species impacts. The GMT reviewed Agenda Item G.3.a Attachment 1, which includes a request to increase the widow bycatch cap to 50 mt and implement a 150 fm depth restriction.

Implementation of 150 fm Depth Restriction

The GMT explored the possibility of implementing the 150 fm seaward RCA boundary. Implementation of a RCA for the whiting fishery was not analyzed during the 2007-2008 spex EIS, therefore, it is not an available inseason RCA boundary for the whiting fishery. However, the GMT explored other methods to implement this depth restriction. For the shoreside sector, the 150 fm depth restriction could be implemented as a condition of the EFP. If the whiting fishery were to re-open then NMFS could re-issue EFPs with this restriction. Since 2004, the at-sea fleet has voluntarily operated in depths deeper than 150 fm during the fall season to reduce canary impacts. It may be reasonable to assume they could continue this practice if the whiting fishery were re-opened for the remainder of 2007.

Uncertainties in Bycatch

When the Council chose to manage the whiting fishery with bycatch limits, the intent was to close the fishery when the bycatch limit is reached. This methodology was chosen because projecting bycatch estimates can be difficult and could result in premature closure of the fishery. This year, the whiting fishery was closed when the widow bycatch limit of 220 mt was estimated to have been reached. Calculations post-season estimate the final widow catch as 241.6 mt. If the bycatch limit is increased by 50 mt to 270 mt, 28.4 mt of widow will be available to re-open the fishery. The current canary bycatch limit in the whiting fishery is 4.7 mt, therefore, 0.7 mt remains if the fishery is re-opened. For darkblotched rockfish, 12.8 mt out of the 25.0 mt bycatch cap has been taken. Therefore approximately 12.2 mt would be available to re-open the fishery. As evidenced in 2007, additional bycatch will occur subsequent to the bycatch limit being reached and the fishery closure. The GMT recommends that any Council action take into account the magnitude of bycatch limits in light the remaining bycatch limits and the current bycatch limit management structure.

One potential consequence of reopening the fishery could be the expectation of a short season as a result of the modest remaining bycatch limits, potentially replicating many of the conditions that followed the announcement that the fishery was closing in July of this year. In the last week of the 2007 fishery, canary bycatch rates were the highest compared to previous weeks. Widow bycatch rates followed a similar pattern and were the second highest compared to previous weeks. The GMT also had concerns with the relative lack of data to inform an autumn (i.e., October/November) whiting fishery. There is limited catch data available for at-sea sectors in fall months during years in which bycatch limits were in place, but what limited data are available show decreases in bycatch of overfished species during those months. Likewise the risk of large canary hauls (i.e., disaster tows) greatly decreases outside of 150 fm as shown in Table 1 and Figure 1. This information shows that inside 150 fm there are fewer occurrences of canary rockfish in at-sea whiting fishery activity, and the magnitude of relatively large tows is larger inside 150 fm compared to outside 150 fm. This suggests that the number of canary encounters and the risk of a large canary haul in the whiting fishery is less if the fishery is operating outside 150 fm.

The GMT also noted that recent stock assessments have shown many of the rebuilding stocks increasing in recent years, some substantially, while the whiting population continues to decline. Such conditions could increase the likelihood of large bycatch events in 2007 and beyond.

Discussion on Enforcement Briefing
The GMT received information from state and federal Enforcement Consultants (EC) on bycatch reporting issues associated with the 2007 shoreside whiting fishery. They specifically referenced two attempts to dispose of rockfish bycatch and bypass the mechanisms that have been put in place for full bycatch accounting: one by a vessel that disabled their camera and dumped catch at sea, and one by a processing plant attempting to grind rockfish without recording them on a fish ticket. While enforcement detected both of these violations and the associated rockfish bycatch has been accounted for in the scorecard, they also reported that other investigations are still underway, and expressed some concern relative to our overall bycatch monitoring capability in the whiting fishery.

The GMT struggled with whether we should consider the violations described by EC as isolated events, or whether these issues might affect the confidence in the bycatch amounts currently in the scorecard. The GMT also discussed how any uncertainty associated with whiting bycatch numbers might be quantified. For example, EC reported that they have recorded instances where cameras were inoperable during fishing events, one of which was the rockfish discard event referenced above. One avenue to set confidence bounds around discard estimates might be to assume that some, or all, of the other "camera-off" events had similar illegal discard to the event that was detected. However, due to the lack of information, as well as the assumptions inherent in this approach, the GMT did not pursue this further.

<u>GMT Recommendations</u>:

1. Close the California recreational fishery in North and North-Central management areas as specified in GMT statement.
2. Adopt concurrent actions to prohibit the retention of cabezon in Oregon's recreational ocean boat fishery.
3. Maintain trip limits adopted by the Council in June 2007 (350 lbs per day or one landing of 1,050 lbs per week) for the Conception area open access sablefish south of 36° N Lat.
4. Increase limited entry fixed gear shortspine thornyheads limit south of 34° 27' N Lat. to 3,000 lb per two months cumulative trip limit through the end of the year.
5. Consider re-opening the areas north of Cape Alava and from Humbug Mountain to Cape Arago to the limited entry non-whiting trawl fishery and provide guidance to the GMT.
6. Consider re-opening of the whiting fishery and provide guidance to the GMT.

Table 1. Occurrence of Relatively Large Overfished Species Tows in the At-Sea Whiting Fishery by Species and Depth from 2004-2007

	Tows Less than 150 fm	Tows Greater than 150 fm
Canary	1 out of 412	0 out of 69
Darkblotched	0 out of 728	1 out of 547
Widow	3 out of 1,747	5 out of 2,925

Note: A relatively large canary tow is assumed to be 0.5 mt
A relatively large darkblotched tow is assumed to be 0.5 mt
A relatively large widow tow assumed to be 5 mt

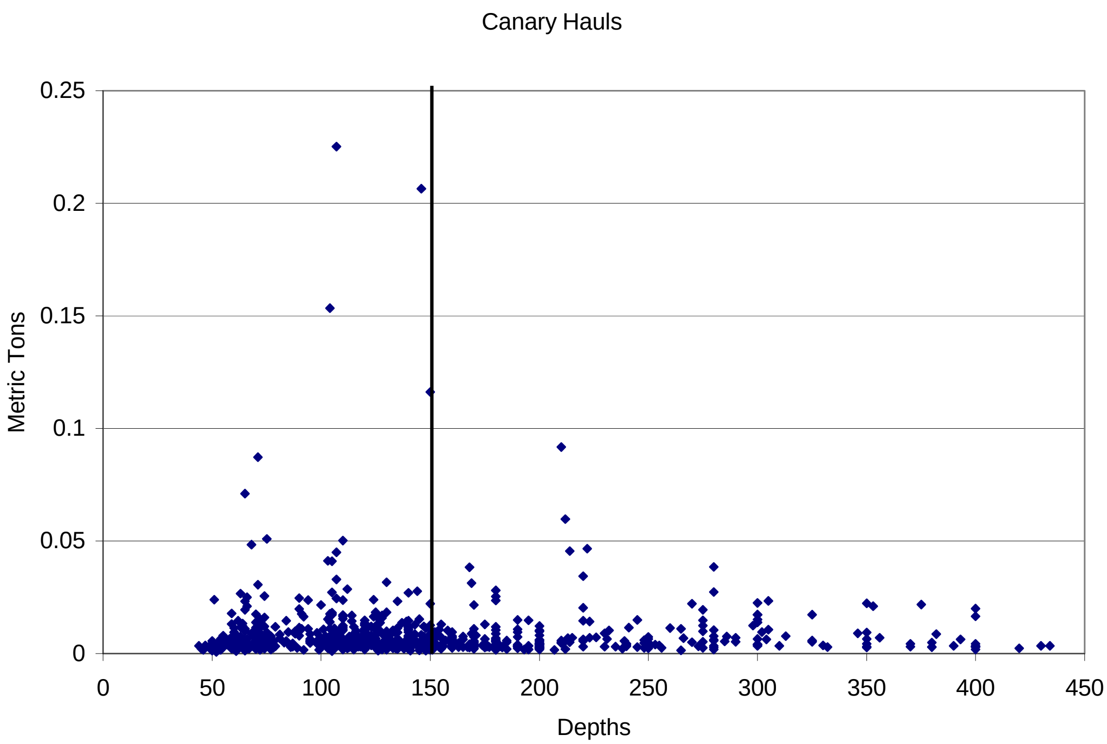

Figure 1. Occurrence of At-Sea Whiting Hauls with Canary Rockfish by Depth and Magnitude from 2004-2007 (one data point excluded)

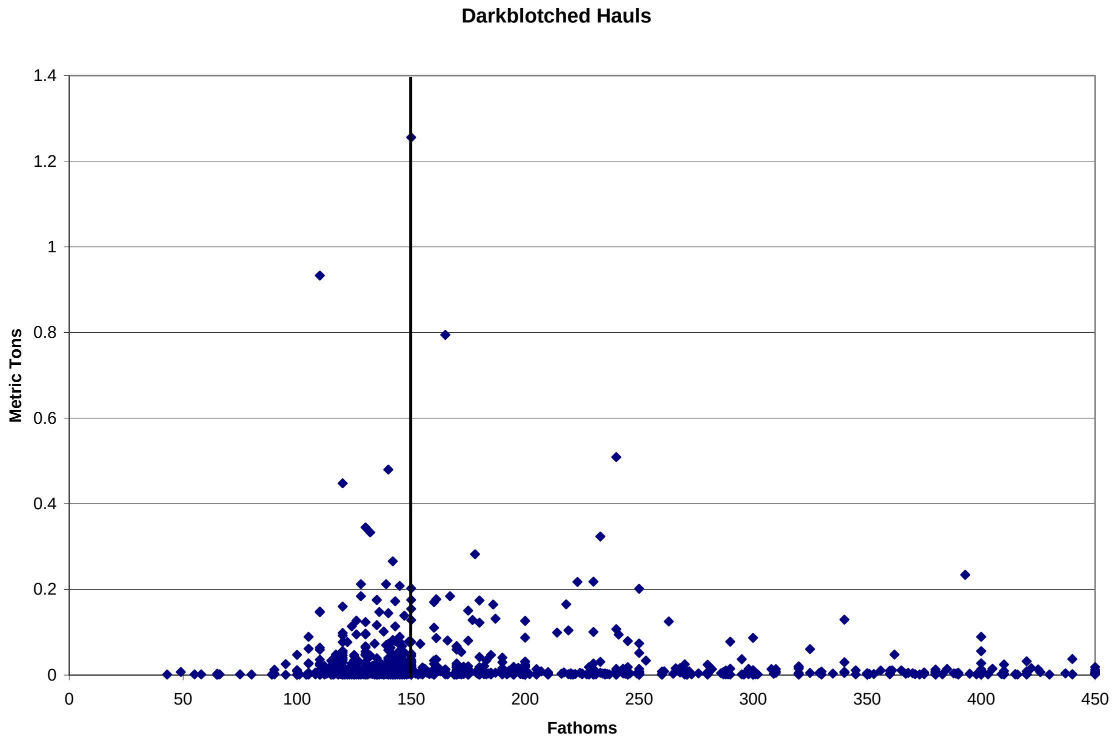

Figure 2. Occurrence of At-Sea Whiting Hauls with Darkblotched Rockfish by Depth and Magnitude from 2004-2007

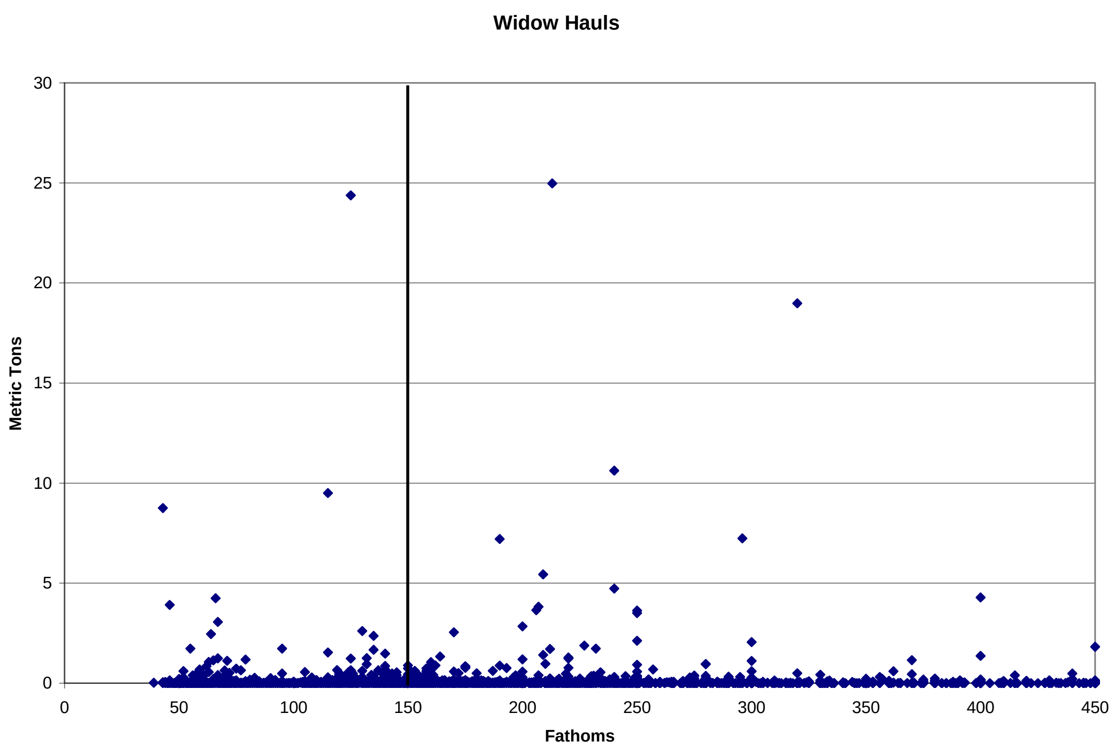

Figure 3. Occurrence of At-Sea Whiting Hauls with Widow Rockfish by Depth and Magnitude from 2004-2007

Agenda Item G.3.b
Supplemental GMT Report Attachment 1
September 12, 2007 9:30 AM

2007 Projected mortality impacts (mt) of overfished groundfish species prior to inseason adjustments

9/11/07

Fishery	Bocaccio b/	Canary	Cowcod	Dkbl	POP	Widow	Yelloweye
Limited Entry Trawl- Non-whiting	23.9	8.1	1.4	222.0	73.2	1.6	0.4
Limited Entry Trawl- Whiting							
At-sea whiting motherships a/					1.9		0.0
At-sea whiting cat-proc a/		**4.0**		**12.8**		**241.6**	0.0
Shoreside whiting a/					0.0		0.0
Tribal whiting		0.7		0.0	0.6	6.1	0.0
Tribal							
Midwater Trawl		1.8		0.0	0.0	40.0	0.0
Bottom Trawl		0.8		0.0	3.7	0.0	0.0
Troll		0.5		0.0	0.0		0.0
Fixed gear		0.3		0.0	0.0	0.0	2.3
Limited Entry Fixed Gear		1.1		1.3	0.4		**2.8**
Sablefish	13.4		0.0			0.0	
Non-Sablefish			0.1			0.5	
Open Access: Directed Groundfish		1.0					
Sablefish DTL	0.0			0.2	0.1	0.0	**0.3**
Nearshore (North of 40°10' N. lat.)	0.0	1.7	0.1	0.0	0.0	0.5	**1.5**
Nearshore (South of 40°10' N. lat.)	0.0			0.0	0.0		
Other	10.6			0.0	0.0	0.0	0.1
Open Access: Incidental Groundfish							
CA Halibut	0.1	0.0		0.0	0.0		
CA Gillnet c/	0.5			0.0	0.0	0.0	
CA Sheephead c/				0.0	0.0	0.0	0.0
CPS- wetfish c/	0.3						
CPS- squid d/							
Dungeness crab c/	0.0		0.0	0.0	0.0		
HMS b/		0.0	0.0	0.0			
Pacific Halibut c/	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pink shrimp	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Salmon troll	0.2	0.8	0.0	0.0	0.0	0.3	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spot Prawn (trap)							
Recreational Groundfish e/							
WA		5.7					**6.0**
OR						1.4	
CA	53.2	**12.3**	0.4			8.0	**8.4**
Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/							
	2.0	**3.7**	0.2	3.8	3.6	0.9	**1.9**
TOTAL	104.4	42.6	2.2	240.1	83.5	300.9	24.1
2007 OY	218	44.0	4.0	290	150	368	23
Difference	113.6	1.4	1.8	49.9	66.5	67.1	-1.1
Percent of OY	47.9%	96.8%	55.0%	82.8%	55.7%	81.8%	104.6%
Key		= either not applicable; trace amount (<0.01 mt); or not reported in available data					

a/ Non-tribal whiting numbers reflect actual catches through July 26 based on September 7, 2007 NMFS report

b/ South of 40°10' N. lat.

c/ Mortality estimates are not hard numbers; based on the GMT's best professional judgment.

d/ Bycatch amounts by species unavailable, but bocaccio occurred in 0.1% of all port samples and other rockfish in another 0.1% of all port samples (and squid fisheries usually land their whole catch).

e/ Values in scorecard represent projected impacts. However, harvest guidelines for 2007 are as follows: canary in WA and OR combined = 8.2 mt and in CA = 9.0 mt; yelloweye in WA and OR combined = 6.8 mt and in CA = 2.1 mt.

f/ Research projections updated August 2007. Canary and yelloweye updated Sept. 10, 2007. Estimate based on combination of actual 2006 catches and projected 2007 catch.

Agenda Item G.3.b
Supplemental GMT Report Attachment 2
September 12, 2007 9:30 am

2007 Projected mortality impacts (mt) of overfished groundfish species with proposed California inseason changes.

9/11/07

Fishery	Bocaccio b/	Canary	Cowcod	Dkbl	POP	Widow	Yelloweye
Limited Entry Trawl- Non-whiting	23.9	8.1	1.4	222.0	73.2	1.6	**0.4**
Limited Entry Trawl- Whiting							
At-sea whiting motherships a/					1.9		0.0
At-sea whiting cat-proc a/		**4.0**		**12.8**		**241.6**	0.0
Shoreside whiting a/					0.0		0.0
Tribal whiting		0.7		0.0	0.6	6.1	0.0
Tribal							
Midwater Trawl		1.8		0.0	0.0	40.0	0.0
Bottom Trawl		0.8		0.0	3.7	0.0	0.0
Troll		0.5		0.0	0.0		0.0
Fixed gear		0.3		0.0	0.0	0.0	2.3
Limited Entry Fixed Gear		1.1		1.3	0.4		**2.8**
Sablefish	13.4		0.0			0.0	
Non-Sablefish			0.1			0.5	
Open Access: Directed Groundfish		1.0					
Sablefish DTL	0.0		0.1	0.2	0.1	0.0	**0.3**
Nearshore (North of 40°10' N. lat.)	0.0	1.7		0.0	0.0	0.5	1.5
Nearshore (South of 40°10' N. lat.)	0.0			0.0	0.0		
Other	10.6			0.0	0.0	0.0	0.1
Open Access: Incidental Groundfish							
CA Halibut	0.1	0.0		0.0	0.0		
CA Gillnet c/	0.5			0.0	0.0	0.0	
CA Sheephead c/				0.0	0.0	0.0	0.0
CPS- wetfish c/	0.3						
CPS- squid d/							
Dungeness crab c/	0.0		0.0	0.0	0.0		
HMS b/		0.0	0.0	0.0			
Pacific Halibut c/	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pink shrimp	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Salmon troll	0.2	0.8	0.0	0.0	0.0	0.3	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spot Prawn (trap)							
Recreational Groundfish e/							
WA		5.7					**6.0**
OR						1.4	
CA	**53.2**	**10.1**	**0.1**			**9.0**	**7.2**
Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/							
	2.0	**3.7**	0.2	3.8	3.6	0.9	**1.9**
TOTAL	104.4	40.4	1.9	240.1	83.5	301.9	22.9
2007 OY	218	44.0	4.0	290	150	368	23
Difference	113.6	3.6	2.1	49.9	66.5	66.1	0.1
Percent of OY	47.9%	91.8%	47.5%	82.8%	55.7%	82.0%	99.4%
Key		= either not applicable; trace amount (<0.01 mt); or not reported in available data					

a/ Non-tribal whiting numbers reflect actual catches through July 26 based on September 7, 2007 NMFS report

b/ South of 40°10' N. lat.

c/ Mortality estimates are not hard numbers; based on the GMT's best professional judgment.

d/ Bycatch amounts by species unavailable, but bocaccio occurred in 0.1% of all port samples and other rockfish in another 0.1% of all port samples (and squid fisheries usually land their whole catch).

e/ Values in scorecard represent projected impacts. However, harvest guidelines for 2007 are as follows: canary in WA and OR combined = 8.2 mt and in CA = 9.0 mt; yelloweye in WA and OR combined = 6.8 mt and in CA = 2.1 mt.

f/ Research projections updated August 2007. Canary and yelloweye updated Sept. 10, 2007. Estimate based on combination of actual 2006 catches and projected 2007 catch.

Agenda Item G.3.c
Supplemental CDFG Report
September 2007

CDFG Proposed Inseason Action Regarding California Recreational Groundfish Regulations

Issue:
CDFG staff reviewed CRFS estimates available through June 2007 and projected total mortalities through the end of the year. Current projections are higher than past projections developed in 2006. Under the existing regulations, California's recreational catch for 2007 is projected to exceed harvest guidelines for both yelloweye and canary rockfish (Table 1). California has developed in season management options designed to reduce the catch projections which would affect the take of rockfish, cabezon, greenlings, lingcod and associated state-managed species and would only apply to boat-based anglers.

Reason for Increased Projections: Several factors have contributed to the higher projections observed. During the 2007-2008 specification process, California used the 2004 and 2005 CRFS data to calculate final projections for the current season structure. Since then, several modifications have been made to the CRFS catch and effort estimation methodologies to improve the accuracy of estimates, although so far they have only been applied to 2005 and 2006 data. The current 2007 inseason catch projections use the revised 2005 and 2006 data, and 2006 catch estimates are higher than the 2004 data originally used, resulting in higher projections. (The RecFIN technical committee has discussed these modifications to the estimation methodologies and they are documented in California's latest six-month report of recreational program changes.)

The preliminary CRFS catch estimates for yelloweye and canary rockfish were higher than projected. This may have resulted from increased fishing activity on bottom fish due to poor salmon catches. Greater catches occurred in July 2007 for yelloweye and canary rockfish in the Northern Management Region and Shelter Cove in the North Central Management Region. The CRFS catch estimates for July were higher than projected, which resulted in an increase catch projection for these regions. In agreement with the GMT, the CDFG applied an adjustment to the August and September catch projections. The adjustment is proportional to the July under-projection was applied to August and September catch projections for these regions in anticipation of continued under projection of catch. The proportional increase was made to the North-Central Management Region for August and September catch projections. The Northern Management Region catch projections were increased for August only due to an anticipated decrease in effort due to the September 4, 2007 salmon closure. Catch projections for all other management regions will not be effected. The adjustment increased the California statewide projected catch estimate for yelloweye rockfish from 4.9 mt to 7.2 mt.

Although progress has been made towards implementing a discard mortality estimate methodology that is the same as that used by Oregon and Washington, there are still several outstanding issues that could not be resolved in time for the September Council meeting. Consequently, discard mortality was estimated in the same manner as that reviewed by the GMT at the November 2006 Council meeting.

Possible Inseason Management Options:
CDFG analyzed various management options to determine the best possible strategy for achieving savings while providing the most fishing opportunity. Because of the reduced impacts to canary and yelloweye rockfish in the management regions south of Pigeon Point (San Mateo County), CDFG is considering any proposed actions to be limited to the area from Pigeon Point to the Oregon border. Decreasing available fishing depth from 30 fm to 20 fms from Pt. Conception to the CA-OR border did not result in appreciable catch savings (see Table 1). The option that achieves the greatest savings would close the North and North-Central Groundfish Management Areas (37 deg 11' north latitude to 42 deg. 00' north latitude) on October 1 for the remainder of the year. The proposed action projects catch of canary rockfish within the CA recreational HG (94% HG), and minimizes overages for the CA recreational HG of yelloweye rockfish (129% of HG; see table 1). This option would reduce fishing opportunities in the North Management Region by 3 months and the North Central Management Region by 2 months and have adverse effects in that area on the CPFV fleet and other recreational anglers planning to fish for bottomfish. Any proposed actions would also apply to lingcod, and associated state-managed species including California sheephead, ocean whitefish (although few are encountered in those areas), and greenlings (*Hexagrammous* spp.) not under federal management.

The GMT will review these projected impacts along with their review of the updated September scorecard and will consider the outcome of proposed management actions relative to the projected catch for all sectors. Following Council action in federal waters, California will then adopt conforming action for state waters. Groundfish staff will continue to track CRFS catch estimations and compare these against catch projections to evaluate whether the catch of these species is proceeding as projected. Any further concerns or more positive information regarding the status of the fishery will be conveyed when appropriate.

Table 1: Management Option Outcome Matrix

Action	Species	Projected Catch (mt)	2007 Harvest Guideline (mt)	Outcome: Tons Over CA HG (%HG)
Status Quo	Yelloweye rf	8.3	2.1	6.2 mt (395%)
	Canary rf	12.3	9	3.3 mt (137%)
Close North and North Central Management Regions Oct. 1	Yelloweye rf	7.2	2.1	5.1 mt (343%)
	Canary rf	10.3	9	1.3 mt (114%)

Agenda Item G.3.c
Supplemental EC Report
September 2007

ENFORCEMENT CONSULTANTS REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

The Enforcement Consultants (EC) understand the primary use of video monitoring of whiting boats was initially intended to be used as a scientific tool, not an enforcement tool. As such, the program was not designed to make video recorded data immediately available to enforcement when needed to investigate possible discard issue. In the absence of a compliance monitor onboard the vessel, the EC feels that these cameras can be an essential part of the enforcement effort. If the intent is to utilize camera data for enforcement purposes, the information becomes evidence. Rules of evidence then apply in order to successfully prosecute violations and must be considered. Enforcement needs the ability to access the information throughout the season without having to remove a hard drive from the camera thus leaving the camera disabled until the hard drive is replaced. It is important to design a system that allows enforcement the opportunity to conduct their own review and analysis in real time, conduct spot checks, and minimize down time for the vessel operator.

The EC recommendations are contained within the attached discussion points that were associated with the EC PowerPoint presentation.

EC Recommendations - Vessels

- ***Need for a strong regulation packet.***
- Install adequate number of cameras including a high resolution “ramp” camera.
- Secure camera against tampering (unplug, etc…).
- Only allow daytime fishing and haul back.
- No onboard camera monitors.
- Provide ability to download daily information for patrol officer review at time of boarding.
- Better define “operational discard.”
- Major penalties for monitoring violations.
- Require video monitoring and maximum retention - catcher vessels.
- Require mandatory logbook - catcher processors.

Recommendations Shoreside - Plants

- 100% third party compliance monitoring of all offloads.
- Direct Enforcement access to monitors and data.

PowerPoint Presentation Attached

PFMC
09/12/07

West Coast Enforcement

A WEST COAST OPERATION

SHORESIDE WHITING FISHERY ENFORCEMENT

One Fish, Two Fish Red Fish, Blue Fish

- Objectives:
  - Total catch accounting
  - Educate enforcers & commercial industry
  - Provide information to PFMC
- Involved all original receivers of Whiting in CA, OR & WA
- June 25 – June 29 / 24 hour monitoring

What have we learned by this?

By-catch Sorting Issues

- Some plant conveyers were not long enough to handle volume
  - To few employees to effectively sort
- Unmonitored sorting at secondary receiver
- Fish ticket variations – accuracy?
- Proper species identification

Case Investigation

- 3 tons Widow rockfish wash up on Long Beach, WA
- Investigation ties fish to illegal discard
- Camera disabled – hard drive seized
- 16,000 pounds estimated dumped
- Motive was to avoid approaching Widow Rockfish cap

Preliminary Camera Review

- 32 hard drives gathered for analysis
- To date, 22 % have been evaluated
- Of those 22%, 40% show camera outages
- Duration of outages up to 3 hours
- Outages occurred during haul backs

Monitoring System Failings

- Video Monitoring
  - Placement and number of cameras
  - Easily compromised
    - Unplugged
    - haul back low/no light
    - up to a week to fix
  - Crew able to monitor camera image
    - Aware of blind spots
  - In-season review challenging
    - Requires removal of hard drive and timely review
  - Post season challenges
    - Analysis reports not timely for LE efforts.
  - Fish difficult to identify

System Failings Con't:

- Exceptions to maximum retention
  - Operational discard (undefined in rule)
- Catcher vessel/mother ship sector
  - Catcher vessel currently not required to fish under maximum retention
    - No monitoring requirement
- Catcher Processor sector
  - Voluntary logbook instead of mandatory

Can Lead To…

- Overfishing as illegal discards not realized until after season
- Extreme challenges in enforcing maximum retention

EC Recommendations Vessels

- ***Need for a strong regulation packet***
- Only allow daytime fishing and haul back
- No onboard camera monitors
- Install adequate number of cameras including a high resolution “ramp” camera
- Secure camera against tampering (unplug)

Recommendations Vessels Con’t

- Provide ability to download daily information for patrol officer review at time of boarding
- Better define “operational discard”
- Major penalties for monitoring violations
- Require video monitoring and maximum retention - Catcher vessels
- Require mandatory logbook - Catcher processors

Recommendations Shoreside Plants

- 100% third party compliance monitoring of all offloads
- Direct Enforcement access to monitors and data

Thank You

PFMC
Enforcement Consultants

Last updated: 12 September 2007

OREGON DEPARTMENT OF FISH AND WILDLIFE REPORT ON INSEASON ACTION AND REQUEST FOR COUNCIL ACTION

The Oregon Department of Fish and Wildlife (ODFW) requests that the Council take action, concurrent with the state, to prohibit the retention of cabezon in Oregon's recreational ocean boat fishery.

Based on catch estimates through July 1 and projections through August 10, the state landing limit for cabezon, which was 15.8 mt, has been reached. State landing limits apply to landings by recreational ocean boats, and do not include shore catch and discards.

Beginning at 12:01 a.m. on Saturday, August 11, 2007, cabezon retention in the recreational ocean and estuary boat fisheries was prohibited. Shore fisheries, including shore-based diving, angling and spear fishing, are not affected by this closure.

PFMC
08/24/07

GROUNDFISH ADVISORY SUBPANEL REPORT ON INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) has the following comments and recommendations for the Council to consider for inseason adjustments to groundfish fisheries.

Commercial Fishery

1. The GAP supports extending the current catch limits for open access sablefish south of 36°.
2. The GAP recommends extending the 3,000/per 2 month cumulative limit for limited entry short spine south of 34° 27'.
3. The GAP supports increasing the open access DTL fishery north of 36 degrees and south of 40/10 which is operating in 300 fathoms
4. The majority of the GAP also supports reopening the whiting fishery beginning October 1st. In order to accomplish this, the GAP recommends increasing the hard cap of widow rockfish to 275 mt.

The full GAP and Groundfish Management Team (GMT) did not have time to discuss the uncertainty of discard estimates in the whiting fishery, and what this may mean for the size of buffer from widow and canary optimum yield and the potential need for additional measures in the shore based fleet. Therefore, a minority recommends the Council consider these uncertainties in their discussion of increasing the bycatch caps for the whiting fishery, and the potential need for 100% observer coverage and real time monitoring.

Recreational Fishery

In light of the information presented the GAP supports closing the central and northern recreational fishery on October 1st, 2007. GAP members question the validity of the data especially concerning the geographic area impacted. If the data is accurate, the GAP is disappointed in the overages and associated impacts of depleted species by the California recreational fishery. The GAP believes that the state of California should be managing to their prescribed harvest guidelines as Oregon and Washington must. An overage of such a substantial amount on species of high concern such as yelloweye is extremely troublesome. Some members of the GAP would like to remind California that in 2008 they should be managing to the harvest guideline that was established for 2007 and 2008, not to the current catches that have occurred.

Lastly, the GAP is disappointed over the delay in the catch accounting for the California recreational fishery (and other sectors as well) and the subsequent delay in providing an up-to-date scorecard at the beginning of the week. The GAP understands that the GMT was waiting for data from the California recreational fishery, the tribal fishery, and the research catch – all of which was being provided by outside sources. The GAP believes that the process is failing: the states have harvest guidelines that they must manage to and all three states can and should take action to close fisheries which are projected to exceed catch limits. Recreational data is supposed to be reported monthly. The data to inform the scorecard is supposed to be provided the week prior to the Council meeting. When the systems fail, the deliberation process of the advisors (GAP and GMT) is delayed.

Other inseason adjustments being considered by the GMT will be addressed in the second inseason agenda item. PFMC – 09/12/07

Agenda Item G.3.d
Supplemental SAS Report
September 2007

SALMON ADVISORY SUBPANEL REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

The Salmon Advisory Subpanel (SAS) opposes reopening the whiting fishery this late in the season when immature salmon move offshore. There are potential impacts on:

1. Next year's salmon fisheries;
2. Canary rockfish optimum yield that could limit open access fisheries, and;
3. Other Council area fisheries as effort is redistributed when one sector is closed.

Agenda Item G.3.e
Public Comment
September 2007

OCEANA | Protecting The World's Oceans

4189 SE Division Street, North Suite +1 503.235.0278
Portland, OR 97202 USA www.oceana.org

August 16, 2007

Mr. Donald K. Hansen, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220

Mr. D. Robert Lohn, Administrator
National Marine Fisheries Service, Northwest Region
7600 Sand Point Way NE
Seattle, WA 98115-0070

RE: Whiting Fishery Management

Dear Mr. Hansen and Mr. Lohn:

We are greatly concerned by the illegal dumping and disposal of widow rockfish and salmon by whiting fishermen and a Washington processor. This dishonest activity underscores the need for elevated bycatch monitoring, caps and controls of the whiting fishery. Our goal must continue to be a healthy ocean ecosystem for future generations and this requires the protection of overfished and recovering rockfish and other marine life impacted by managed fisheries. In the recent whiting fishery incidents, the few bad actors ought to be punished for their illegal activities; and any management solutions to continue the fishery must fully consider the conservation of all affected rockfish species, salmon, and other marine life; and include hard caps, 100% observer coverage, real-time monitoring, and enforcement that controls bycatch.

The Pacific whiting fishery is already managed on the edge of sustainability. The 2007 optimum yield for Pacific whiting was set at a level that risks bringing the stock to within one percent of overfished by 2009.[1] Widow rockfish remain under a continued rebuilding plan. Estimates of the widow rockfish population indicate the stock remains in the "precautionary zone." Management of the whiting fishery, however, must not be in the vacuum of single-species assessments and widow bycatch caps. Consideration must be given to the take of all affected marine life including the ecological impact of the proposed removal of 242,500 metric tons of whiting (the U.S. OY) from the California Current Large Marine Ecosystem.

We trust that the Council will closely engage in this issue, paying full consideration to the status of the whiting stock, rockfishes, salmon and other marine life affected by this fishery. This catastrophe should not be used to weaken regulations. We look forward to working with you at the upcoming September meeting in finding an appropriate and responsible solution.

Sincerely,

Ben Enticknap
Pacific Project Manager

[1] 72 Federal Register, 19390 (April 18, 2007).

August 21, 2007

Dr. Donald McIsaac
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

Dear Dr. McIsaac and members of the Council,

First, we would like to apologize for the length of this public comment. But it holds some very important issues that need to be addressed. We hope that you take the time to read it in its entirety and that you will gain some insight because of it. This may very well be our last public comment letter to the Council.

Taken from the Minutes of the 187th PFMC Meeting in March 2007

E.5 Consideration of Inseason Adjustments

E.5.b Report of the GMT

> " Mr. Moore noted the GMT's concern with midwater trawls fishing for whiting in the RCA while sorting their catch during the primary season without full monitoring".
>
> Mr. Anderson noted that the GMT was recommending closing shoreward of the trawl RCA north of Cape Alava, which will probably move the small Neah Bay fleet south of Cape Alava.
>
> Mr. Anderson asked, "Did the GMT consider the effect of this effort shift? Mr. Burden answered yes, the GMT was trying to shift larger vessels seaward of the RCA. The GMT is uncertain about the effort shift of small vessels".

And obviously, the GMT didn't care enough to acknowledge and consider the impact of an 'effort shift' for the small vessels of Neah Bay. And obviously, the Council didn't care either because the Council thought that closing the area shoreward of the RCA was a good enough idea to implement it immediately.

From the Federal Register: April 18, 2007 (Volume 72, Number 74)] [Rules and Regulations] [Page 19390-19410]:

> "The Council also considered various alternatives that would leave the area shoreward of the RCA and north of Cape Alava open during winter months to reduce the disproportionate impact this closure would have on vessels based in northern Washington."

We are asking the GMT and the Council… WHY isn't the impact to our small fleet important enough for you to do something about? WHY was the impact to the large vessels the only consideration important enough for you to act upon? WHY is one fleet more important to you than another? The Council acknowledges the fact that this impact is disproportionate against the vessels based in northern Washington. Yet no consideration is made for that unfair impact. The gesture for leaving the area north of Cape Alava, shoreward of the RCA open during the winter months is a alternative. But it would have absolutely no beneficial relief for the Neah Bay non-tribal trawl fleet, as the weather is too severe for us to fish during the winter months and we off the water already anyway.

We would like to tell you, Mr. Burden, and the others that thought this was a good idea, just exactly what kind of an impact this 'effort shift' has made on the non-tribal trawl fleet out of Neah Bay. It has proven to be the final blow for us. You have finally killed the non-tribal nearshore trawl fishery of Neah Bay. And we honestly have to say that it virtually feels like that was the agenda. There are indeed many that would like us off the water for several various reasons.

Mr. Burden makes the assumption that our fleet can just relocate to below Cape Alava and continue fishing and everything will be okay for us. That observation and assumption shows that he does not have a true understanding of what our fishery is really all about. If he does indeed understand, then he just doesn't care if our fleet survives or not.

It's not like we can just sell our home, relocate, and get a new job someplace else. This is a lot different then that. We have two very important issues, first and foremost is safety… we have to be able to survive in the fishing areas we are allowed to fish in and come back home. The second is economical viability… we have to be able to make enough to cover our expenses AND bring some money home. The latter has been harder and harder to do with each area closure that we have had to endure in Washington.

Telling the larger vessels and/or the Whiting boats that they can not fish in the nearshore waters anymore and they can only fish seaward of the RCA is not a great hardship for them. That is a viable option for them… they can easily keep fishing. There may be some financial loss for them because they are losing an area to fish in, but it is an actual viable option for them and they can keep fishing and survive fishing seaward of the RCA. The large vessels are capable of physically surviving the hard weather… safety is not a daily issue for them. For us there is a huge safety issue. To tell us that we can only fish south of Cape Alava and we are forced to brave the storms is placing our fleet in peril. Our boats are extremely limited in their capabilities on the Pacific Ocean. By pushing us south of Cape Alava that safety issue is magnified many times over. Shifting our effort seaward of the RCA is not an economically viable option for us and neither is running south to below Cape Alava. We have told the Council over and over that our vessels are simple not large enough to be able to do that.

We always had faith that our fisheries were being governed by people that were fair and just, that care about the environment, and care about the fish and the people that harvest them, and managed the fisheries with careful consideration to all aspects and impacts of all users. But the Council's actions of the last few years towards our small fleet out of Neah Bay has caused us to have great reservations about the Council's actions and that integrity. How could the impact of such a drastic closure on our fleet not be important enough for the Council to consider a more equal alternative? Why doesn't our fleet deserve the same respect and importance from the Council? Does the GMT and the Council view the Whiting fishery and the seaward Petrale fishery more important than the Neah Bay non-tribal trawl fishery? We know that we are only a small fleet and we do not have the same status as the larger vessels, but non-the-less we are fishermen with equal rights, that by law are suppose to have the same equal opportunity to fish and survive. The MSA states that the regulation of one fishery shall not adversely effect another, and that it is the Council's responsibility to conduct itself in such a manor that is unbiased and non-discriminatory, and guards against those adverse effects.

Taken from the Minutes of the 187th PFMC Meeting in March 2007

Mr. Moore asked, *"Why can't an adjustment to this fishing strategy be made as a routine inseason adjustment?"*

Mr. DeVore stated, "*A routine adjustment cannot be made because this strategy, its associated impacts, and possible actions to mitigate these impacts were not analyzed in the 2007-08 Groundfish Harvest Specifications and Management Measures EIS*".

We fail to see how the Council can not move the Whiting boats out of the RCA as an adjustment to the fishing strategy, yet the Council can close half of a state coastline as a fishing strategy, without it being analyzed in the 2007-08 GHS and MM EIS, and with no regard or consideration of the impact to the historic non-tribal trawl fleet of that area. How can this action by the Council appear to be anything but inappropriate and discriminatory? It certainly was not an emergency action Inseason Adjustment closure, as we were not near the OY for any bycatch in the nearshore area. As a result of our nearshore closure, Canary rockfish that would have been part of the nearshore bycatch OY was taken away and given to the Whiting sector. They said that it was our fault and we caught too many Canary rockfish and they needed to close our area. Then the Council increases the Canary bycatch OY from 4mt to 4.3mt for the Whiting boats. This isn't fishery management… this is biased fishery allocation! Is our problem simply that we are not doing anything about those '*possible actions to mitigate the impacts'*? Perhaps we should be.

NMFS Comments

Mr. Lockhart said that the GMT has done a great job of laying out the Canary rockfish bycatch problem and exploring the various options the Council needs to consider to address this concern.

We do not agree with you. Maybe if you are a Whiting boat, then the GMT has done a great job for you. If you are among the Neah Bay non-tribal trawl fleet you are done fishing. How can the GMT have done a great job exploring various options when it wasn't even important enough for them to discuss the impact of an area wide closure for the Neah Bay non-tribal trawl fleet? The only bycatch problem that was laid out was to give the Whiting boats .3mt more Canary rockfish to harvest.

The GMT has concerns with the Whiting trawlers fishing in the RCA while they were sorting their catch during the primary season without full monitoring. Why can the Whiting boats be in the RCA at all? The other tralwers can not be in the RCA. When the RCA was implemented by the Council, we brought up the issue that the RCA was in part of the area that we have historically used for drifting at night when the weather allowed us to and we asked if it would be all right for us to continue that practice. And if it would be legal for us to drift over the RCA line if we were picking up our gear and got pushed in by the current. The Council's answer to us was "No". We could not night drift in the RCA and we could not be in the RCA for any reason other than transiting through it. To do so would be at risk of citation. We tried to explain to the Council about the currents in the northern nearshore area and that it would be much more dangerous for us to night drift in a different area, but the answer was still "No, we could not be in the RCA". So, our question is… Why are the Whiting boats allowed to sort their fish in it? If they were not allowed in it at all, like all the other trawlers, then there would not be the problem of them possibly fishing in it.

From the Federal Register: April 18, 2007 (Volume 72, Number 74)] [Rules and Regulations] [Page 19390-19410]:

Overfished Species Bycatch Limits in the Pacific Whiting Fishery

> "In recent years, the most constraining overfished species for the whiting fishery have been darkblotched, canary and widow rockfish."

These are the very same fish species that our Neah Bay fleet fishery was shut down for. How can it possibly be that our three small boats have the greatest bycatch?

Trying to shift the larger vessels seaward of the RCA is a good strategy… but at what expense? Killing off another fleet? That is NOT acceptable Fishery Management… that is discrimination. We have made several suggestions to the Council on how to lessen the impact of large vessels in the area nearshore of the RCA, but they have always fallen on deaf ears. Now we are shut down and the large vessels seaward of the RCA are still fishing. The northern nearshore non-tribal trawl fleet are not the offenders of this bycatch issue… yet we suffer the heaviest burden. That's simply not right. Our punishment for supposedly catching too many Canary rockfish north of 40'10 is a complete closure of the last area we can viably fish in. The Whiting trawlers punishment for catching too many Canary rockfish north of 40'10 is an increase of .3mt more Canary rockfish to harvest, and 20mt more of Widow rockfish to harvest.

Limited Entry Trip Limits - [Page 19397]

> "Industry representatives indicated that petrale sole limits less than 20,000 lbs (9,072 kg) per two months were not economically sustainable, given the cost of fuel needed to access that catch. The Council also considered the effects of petrale sole cumulative limit reductions on the bycatch of canary rockfish.
>
> Based on these analyses and information, the Council recommended and NMFS is implementing a decrease in the limited entry trawl fishery cumulative limits for petrale sole north of 40[deg]10.00[min] N. lat.: Beginning May 1 through October 31, 2007, from ``25,000 lb per two months" to ``20,000 lb per two months"; and beginning November 1 through December 31, 2007, from ``50,000 lb per two months" to ``30,000 lb per two months". South of 40[deg]10.00[min] N. lat., beginning May 1 through October 31, 2007, the Council recommended and NMFS is implementing reductions in cumulative limits for petrale sole from ``30,000 lb per two months" to ``25,000 lb per two months". "

Our Neah Bay non-tribal trawl fleet needs to be given the same consideration for the high cost of fuel and the economic viability of forcing us to travel to south of Cape Alava to fish. There is a point at which it is just not financially profitable to continue fishing. This recent closure north of Cape Alava has put our fleet at that breaking point. Notice that the Council obliged the request and did not recommend any limit less than the 20,000lb per two month period. Why is it that our fleets requests continually go unheard?

The Council has stated that additional data was given by the SSC from the WCGOP and the data showed that there was too much bycatch caught in the area shoreward of the RCA north of Cape Alava. We are requesting a copy of that data. This data was generated with taxpayer dollars and as such should be public information. Consider this our formal request for **ALL** catch and bycatch data from the SSC and WCGOP (with the exception of individual personal information privacy) for the area shoreward and seaward of the RCA in Washington state. We want to see the data responsible for the demise of our Neah Bay non-tribal trawl fleet.

Contrary to what your data says, because we are a small fleet, our bycatch impacts are less. Our fleet has worked very hard for years to try and guarantee that our impact is very minimal. We use to have a very clean fishery for Pacific Cod and for Petrale also. The advances that were made with the selective trawl were very successful. A fleet of only three small family owned and operated boats just does not make a huge impact. Our fleet doesn't even fish all year… at best we may get to fish for six to eight months of the year. Weather and sea conditions are our main controller.

Tuesday, August 07, 2007
The Oregonian Newspaper - Illegal Action Stops Fishing of Whiting

> Bycatch - A fishing boat and plant were dumping widow rockfish, which has caps…
>
> http://www.oregonlive.com/business/oregonian/index.ssf?/base/business/118645712345330.xml&coll=7

This kind of greed harms all of the commercial fishermen. But it is an especially bitter pill for us to swallow when the Neah Bay non-tribal fleet was shut down this year partially because of this species.

After the closure we tried moving south of Cape Alava, we even moved our entire business operation out of Neah Bay and relocated to Westport, WA. That didn't work. We don't have a clue where the fish are down there. The hardship of the extra fuel cost to search for new fishing grounds was cost prohibitive. The only area left that we were familiar with is up close to the Cape Alava line. That is a very long run for us either from Neah Bay or from Westport… it is right in the middle. We tried night drifting below Cape Alava in order to conserve fuel and we almost lost our boat because of it. We tried anchoring at night behind some of the small islands and sea-stacks dotted in a few places along the coast. These places are very few and far between and only offer very limited protection, if any at all. During storms there is virtually no protection. As we stated in several comment letters previously, the boats in our fleet are small and we can not operate like the larger vessels. Our fleet does not have the option of fishing seaward of the RCA and our fishing effort is extremely limited by the weather alone. Because fishing below Cape Alava is not a financially viable option for our fleet either, this last Council decision has devastated our fleet and we are basically done.

The only thing that would save our fleet at this point would be if there were an immediate opening of the area shoreward of the RCA north of Cape Alava to the Canadian Border. That would allow our fleet to still exist. The financial hardship our fleet has been forced to suffer because of this Council decision will take us atleast a year to recuperate from… and that would only be if we were allowed to go fishing immediately. Any delay would mean our ultimate demise. Our fleet tried doing what the Council and GMT recommended… it didn't work. With one stroke of the pen by the Council and GMT the Neah Bay non-tribal nearshore trawl fleet will cease to exist and be gone forever. And we would like to remind the Council that there has been a historic non-tribal Neah Bay nearshore trawl fleet for over 75 years. We have slowly been reduced to only three because of old age and regulations. Previously, we have told the Council how all three of us are in our mid sixties and asked the Council to allow us to fish in our usual area for just a few more years so that we may be able to finish out our careers. There are no younger trawl fishermen coming up behind us to replace us. So when we retire the Neah Bay non-tribal trawl fishery will be finished anyway. That request fell on deaf ears also.

It's not fair to make our fleet the main ones to suffer the burden of area closures. It's not fair to allocate our bycatch to a different sector. The survival of our small fleet is in the Council's hands. We sincerely hope that you make an honorable decision… manage the fishery fairly… and open the area nearshore of the RCA north of Cape Alava immediately.

We would like to thank Mr. Anderson from the WDFW, and Mr. Moore from West Coast Seafood Producers for their comments to the GMT and the Council in trying to bring to your attention the need to consider the true impact on our fleet. They both bring up very valid and relative issues. The GMT and Council would do well to listen to Mr. Anderson and Mr. Moore more carefully in the future. The impacts on ALL fleets need to be addressed completely. Not just be assumed. These are life-changing decisions the Council makes, with big impacts on other people's lives. These decisions deserve deep consideration and not frivolous assumptions. Our fleet deserves the respect from the Council of your equal consideration too.

Sincerely,
Alan and Lee Ann Hightower
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Danniel Sarunich
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Agenda Item G.4
Situation Summary
September 2007

STOCK ASSESSMENTS FOR 2009-2010 GROUNDFISH FISHERIES

The 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.

A new updated assessment of bocaccio and new full assessments for black rockfish (northern portion of the stock), chilipepper rockfish, darkblotched rockfish, cowcod, canary rockfish, and arrowtooth flounder were recently prepared and reviewed by the STAR Panels. The executive summaries of these assessments and the associated STAR Panel reports are provided as Agenda Item G.4.a, Attachments 1-15. A**ll the assessments in their entirety and STAR Panel reports under Council consideration at this meeting are included in the CD copy of meeting materials.**

The Council should consider the new updated and full assessments and STAR Panel reports, as well as the advice of the SSC, other advisory bodies, and the public before adopting the new stock assessments for use in 2009-2010 groundfish management.

Council Action:

Approve stock assessments recommended by the SSC.

Reference Materials:

1. Agenda Item G.4.a, Attachment 1: Executive Summary of "Status of the Black Rockfish Resource off the Washington Coast in 2006".
2. Agenda Item G.4.a, Attachment 2: Black Rockfish (Northern) STAR Panel Report.
3. Agenda Item G.4.a, Attachment 3: Executive Summary of "Status of Bocaccio off California in 2007".
4. Agenda Item G.4.a, Attachment 4: Bocaccio Rockfish STAR Panel Report.
5. Agenda Item G.4.a, Attachment 5: Executive Summary of "Status of the Chilipepper rockfish, *Sebastes goodei*, in 2007".
6. Agenda Item G.4.a, Attachment 6: Chilipepper Rockfish STAR Panel Report.
7. Agenda Item G.4.a, Attachment 7: Executive Summary of "Status and Future Prospects for the Darkblotched Rockfish Resource in Waters off Washington, Oregon, and California as Assessed in 2007".
8. Agenda Item G.4.a, Attachment 8: Darkblotched Rockfish STAR Panel Meeting Report.
9. Agenda Item G.4.a, Attachment 9: Executive Summary of "Status of Cowcod, *Sebastes levis*, in the Southern California Bight".

10. Agenda Item G.4.a, Attachment 10: Cowcod STAR Panel Meeting Report.
11. Agenda Item G.4.a, Attachment 11: Executive Summary of "Status of the U.S. Canary Rockfish Resource in 2007".
12. Agenda Item G.4.a, Attachment 12: Canary Rockfish STAR Panel Report.
13. Agenda Item G.4.a, Attachment 13: Executive Summary of "Stock Assessment of the Arrowtooth Flounder (*Atheresthes stomias*) Population off the West Coast of the United States in 2007".
14. Agenda Item G.4.a, Attachment 14: Executive Summary of "Status of the Widow Rockfish Resource in 2007: an Update".
15. Agenda Item G.4.b, WDFW Report: Washington Department of Fish and Wildlife Report on Northern Black Rockfish Stock Assessment.
16. Agenda Item G.4.a, Supplemental Attachment 15: Arrowtooth Flounder STAR Panel Report.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. Agency and Tribal Comments
c. Scientific and Statistical Committee Report — Bob Conrad
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Approve Stock Assessments

PFMC
08/23/07

Agenda Item G.4.a
Attachment 1
September 2007

STATUS OF THE BLACK ROCKFISH RESOURCE NORTH OF CAPE FALCON, OREGON TO THE U.S.-CANADIAN BORDER IN 2006

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August 2007

Executive Summary

In this document, we included model results from the STAR base model and results based on the "STAT best fit" model, where natural mortality for "old" females is assumed to be 0.24 compared to the assumption of 0.2 in the STAR base model. All other parameter settings remain the same in both models. The "STAT best fit" model is based largely on new and expanded analyses following the conclusion of the STAR Panel. We ran a grid search of natural mortality between 0.1 and 0.3 for "old" females and found that model with natural mortality of 0.24 for "old" females resulted in a better fit to the data with the largest negative change in log likelihood. The mortality of 0.24 agreed with a direct estimate of female natural mortality at 0.27 (SE = 0.26) from historical catch, effort, and length frequency data. We felt compelled to integrate these results because the "Low Natural Mortality" model selected by the STAR panel to bracket model uncertainty does not appear plausible. Further, we believe that management should be based on the "STAT best fit" model because it represents the best fit to data, and the STAR base and "High Natural Mortality" models be used to bracket the uncertainty.

Stock

This assessment applies to the Northern portion of the black rockfish (*Sebastes melanops*) stock found between Cape Falcon, Oregon and the U.S. border with Canada. This assessment treats these fish as a separate unit stock. The stock found South of Cape Falcon, Oregon is treated as another unit stock in a different assessment document. Black rockfish are not subjected to a targeted fishery in Canadian coastal waters and are not assessed.

Catches

Little information exists on the historical landings of black rockfish prior to the early 1960's. Landings of "rockfish" peaked at nearly 25,000 mt in 1945 in support of the war effort; however, there is no known species composition estimates for these catches. Due to the nearshore habitat of this species it is likely that very little of this catch was black rockfish. Predominate harvesters of black rockfish between 1963 and 1983 were commercial line and trawl fishers. Black rockfish trawl landings typically came from directed tows on nearshore rocky reefs and shipwrecks with few landings incidental to other targeted fisheries. Peak landings in the trawl fishery reached 350 mt in 1976 and declined to less than 10 mt in recent years. Black rockfish comprised less than 1% of total rockfish landings by the trawl fishery during this period.

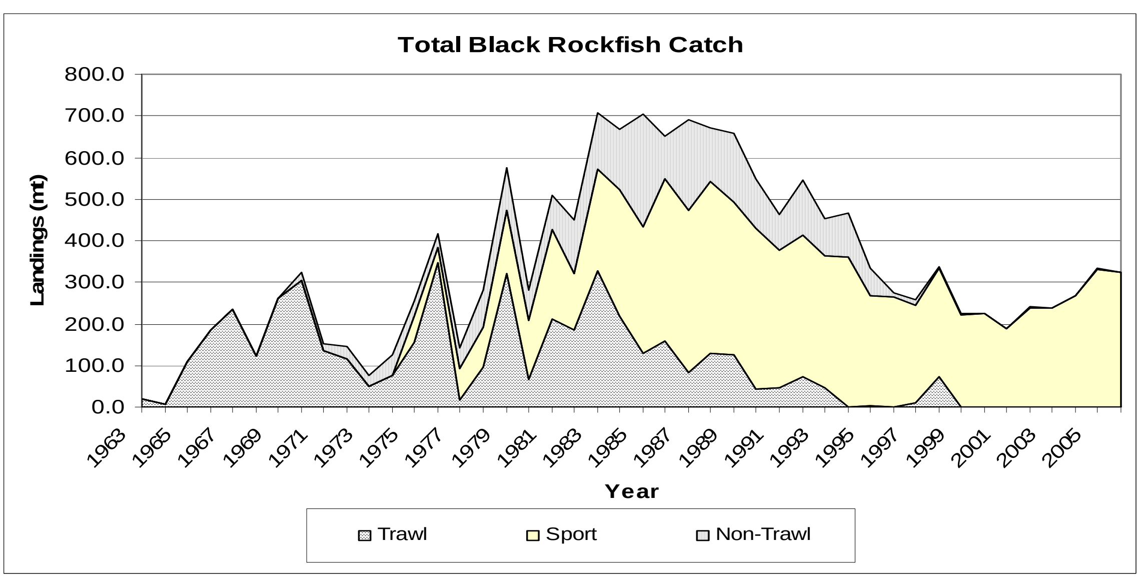
The "non-trawl" fishery is composed of three distinct line fisheries, and each differs in target species. Oregon and Washington fish receiving tickets show nominal rockfish catches as early as 1970 in the salmon troll fishery, during 1973 in the jig fishery, and during 1979 in the bottomfish troll fishery. Black rockfish are generally caught as bycatch in the commercial salmon troll fishery; landings peaked in the late 70's (151 mt) and steadily decreased coincident with losses in fishing opportunities for coastal salmon. The bottomfish troll fishery generally targeted lingcod; rockfish landings were small and estimated black rockfish catch never exceeded 2 mt. The jig fishery is primarily composed of small vessels less than 26 feet in length that generally fish near their port of access. Black rockfish were targeted in nearshore areas and were a significant fraction of the nominal rockfish landings in the jig fishery. Black rockfish catch in the jig fishery was inconsequential prior to 1980, and peaked in 1982 at 272 mt. Since 1996, nominal rockfish landings have contained no black rockfish due to area restrictions that have forced jig fishers to target other rockfish species found farther offshore.

Black rockfish are the primary target of the coastal groundfish sport fishery, with small catches first reported in the late 1970's that steadily increased to over 300 ton per year by the mid 1990's. Due to the implementation of a 10 fish bag limit in 1995 (Figure 7), and longer salmon seasons, annual catches of black rock declined to 188 mt in 2001. In recent years, sport catches increased to more than 300 mt. The coastal recreational rockfish fishery generally competed with sport salmon, halibut and tuna fisheries, and this is reflected in year-to-year variability in black rockfish catch.

Discard of black rockfish in Washington waters in either the commercial or recreational fisheries is likely very small. "Sebastes complex" trip limits in the line fishery were non-restrictive prior to 1999 since few landings ever achieved the trip limit, and there was no incentive to discard catch. Furthermore, Washington State waters (inside 3 miles) have been closed to directed non-trawl commercial fishing since 1996 and directed trawl fishing since 1999. Black rockfish represented only a small fraction of the nominal rockfish catch in the trawl fishery and it is unlikely they were discarded. Discard in the sport fishery is also insignificant since the vast majority of recreational fishers do not high-grade their rockfish catch. This is supported by recent sport fishery information that indicates discard is less than 16 mt on an annual basis.

Recent Black Rockfish Landings From Waters North of Cape Falcon, Oregon to the US-Canadian Border by Gear and Area

	Trawl Gear				Non-Trawl Gear			Recreational		
	3A	3B	3CS	Total	3A	3B	Total	3A	3B	Total
1995	2.9	0.1	0.3	3.3	2.7	63.1	65.8	209.3	55.5	264.8
1996	0.0	0.0	0.0	0.0	4.8	3.8	8.6	199.7	64.6	264.2
1997	0.7	8.2	0.1	9.0	14.5	0.5	15.0	179.7	54.4	234.1
1998	72.5	0.3	0.3	73.1	0.4	4.5	4.8	195.2	64.2	259.4
1999	0.0	0.0	0.0	0.0	3.4	0.9	4.3	166.0	55.6	221.6
2000	0.0	0.0	0.0	0.0	0.5	0.7	1.2	157.6	67.2	224.8
2001	0.0	0.0	0.0	0.0	0.6	0.5	1.1	133.7	55.0	188.7
2002	0.1	0.1	0.0	0.2	0.4	1.0	1.5	173.0	66.0	238.9
2003	0.1	0.0	0.0	0.1	0.0	0.2	0.2	166.7	70.4	237.1
2004	0.6	0.0	0.0	0.6	0.4	0.3	0.7	173.4	94.6	268.0
2005	0.0	0.0	0.0	0.0	0.3	0.6	0.9	217.5	114.2	331.7
2006	1.2	0.2	0.0	1.4	0.8	0.4	1.2	246.7	74.9	321.5
Total	78	9	1	88	29	77	105	2,218	837	3,055



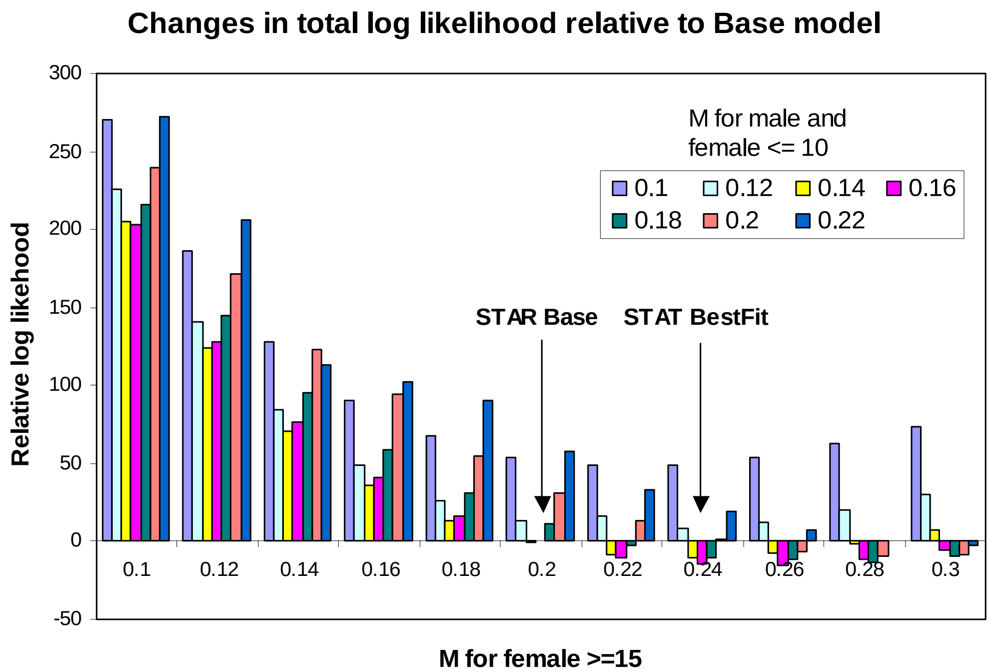
Data and Assessment

This portion of the U.S. black rockfish stock was last assessed in 1999 (Wallace et al. 1999) with a population dynamics model constructed with AD model builder software (Fournier1997).

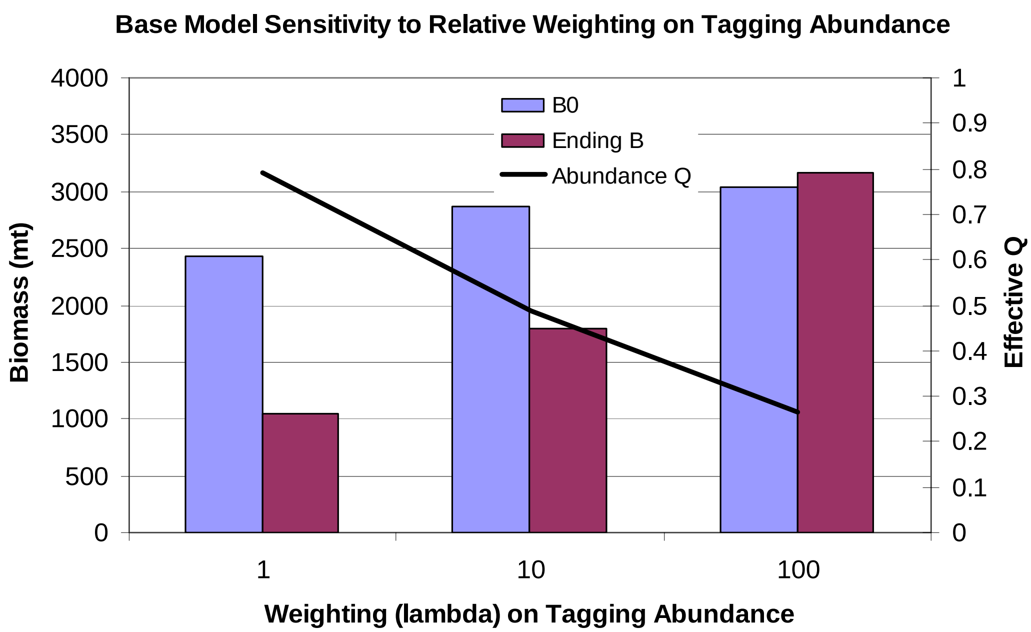
The current assessment employed Stock synthesis 2 (SS2V2.00c, compiled 3/27/2006) to model the dynamics of the black rockfish population found between Cape Falcon, Oregon and North to the U.S./Canadian border in Coastal Waters. The model was specified to begin in 1915 to ensure population equilibrium at the start of the modeling time period. Catch data were decayed from the last reliable catch estimates (1965) to 0 by 1940. Fisheries catch, size and age compositions were pooled into three fishery types including trawl, sport and non-trawl. The first size-age compositions were collected in the mid 1970's from the trawl fishery, but samples were not collected on a systematic basis until 1985. Growth (Lmin, Lmax and k) was estimated within the model to account for fishery selection of the larger individual fish at age. The population model was tuned to two fisheries-independent indices that include a tagging CPUE (1986-2007) and a tag abundance biomass index (2000-2007), both derived from WDFW black rockfish tagging information. Both STAT and STAR Panel members agreed that the available fishery dependent indices should not be incorporated due to potential bias resulting from bag limit changes and undocumented measures of fishing effort resulting from changes in search time across the time series.

Unresolved Problems and Major Uncertainties

Natural mortality is confounded with fishing mortality and is therefore one of the most challenging biological parameters to estimate. It is also one of the most important parameters due to its affects on population dynamics, including stock rebuild time and the estimation of virgin fishery biomass. In this assessment, we explored direct methods to estimate natural mortality and compared it to estimates derived from indirect methods (from other biological parameters, e.g., the growth constant and fecundity) in previous assessments. The estimated $\hat{M}$ derived from direct methods was 0.223 (SE= 0.0071) and 0.272 (SE= 0.061) for males and females, respectively. Given the uncertainties, these estimates compared well with other existing indirect methods. The current base model assumes a female natural mortality rate to be age-specific for females using age at first and full maturity for inflections (10 and 15). A constant natural mortality rate of 0.16 was assumed for males and young females (< 10 years of age), and a rate of 0.2 was assumed for old females (>=15 years of age). This is higher than that used in the 2003 black rockfish assessment off Oregon and California (Ralston and Dick 2003) which used a natural mortality of 0.1 and 0.2 for males and old females, respectively. It is apparent from our analysis using both direct and indirect methods that our current assumptions on natural mortality in the base model are within our limits to estimate this parameter and that the low natural mortality rate model is likely too low. Model sensitivity analysis showed that model configurations using higher natural mortality for older females provided better overall fits to the data than the STAR base model.



Tagging is not incorporated in the model as a tagging experiment, which is not possible within the current SS2 modeling framework. The index for tagging abundance is not fit well, and the model estimated effective *q* for the tagging index was 0.83. This is likely double what it should be based on STAT knowledge of available habitat off the Washington coast. Further, the north central Washington coast, where most of the nearshore rocky habitat exists, is inaccessible to most recreational fishers and is not part of the current tagging program. However, the estimation of *q* is complicated by the fact that the SS2 value of *q* is a function of selectivity that is strongly dome shaped for the fishery. Increasing the weighting on survey abundance shows that a better fit to the survey abundance index significantly improves our view of the current population status.



Without an objective evaluation of an informed prior on *q*, it is difficult to compare a prior conception of *q* based on tagging and the one estimated by SS2. Other issues include the non-independence of the length/age compositions and non-independence of the tagging abundance and CPUE series.

Reference Points

The Pacific Fisheries Management Council recommends that a default target fishing mortality rate of FSPR=0.5 be used for Council managed rockfish species. The current assessment uses this default for harvest projections for black rockfish and based on the Councils control rule for groundfish would not be considered overfished. The "STAR base" represents results from the STAR base model and the "best fit" model represents results from the best fit model incorporated by the STAT in the decision matrix post-STAR.

STAR Base Model Reference Points

Unfished Stock	Value
Age 3+ Biomass (B_0) (mt)	10,813
Spawning Biomass SB($_0$) (mt)	2,429
SPBio/Recruit (kg/fish)	0.780
Age1 Recruitment (R_0) (1,000's)	3,113
Steepness_R0_S0	0.6

	Reference points based on		
Exploited Stock	**Estimated MSY**	**SB $_{40\%}$**	**SPR (SB $_{0.5}$)**
SPR (Spawning Biomass/Recruit)	0.413	0.400	0.400
F (Fishing Mortality Rate)	0.132	0.101	0.101
Exploitation Rate (Yield/Bsmry)	0.076	0.060	0.060
MSY (mt) or MSY proxy (mt)	377	361	361
Yield (mt)	718	972	972
SPBIO/SB(0)	29.6%	40.0%	40.0%
Age 3+ Biomass	4,947	6,012	6,012

STAT Best Fit Model Reference Points

Unfished Stock	Value
Age 3+ Biomass (B_0) (mt)	11,390
Spawning Biomass SB($_0$) (mt)	2,321
SPBio/Recruit (kg/fish)	0.687
Age1 Recruitment (R_0) (1,000's)	3,377
Steepness_R0_S0	0.6

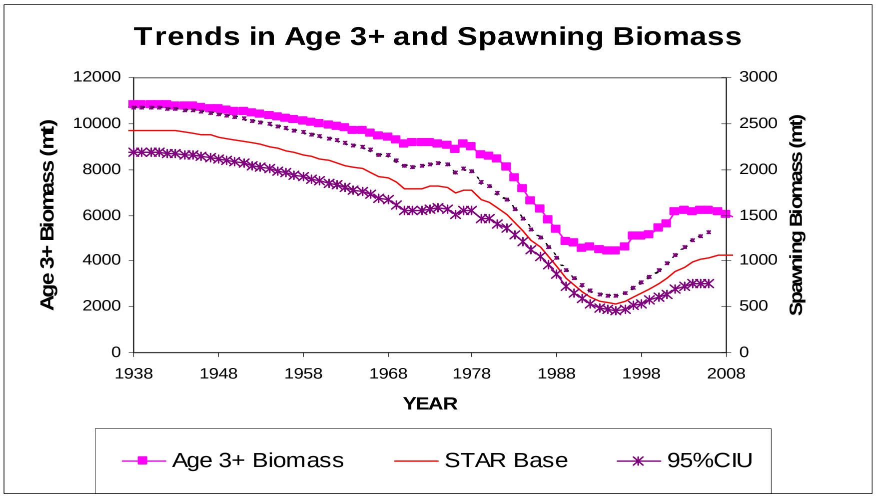
	Reference points based on		
Exploited Stock	**Estimated MSY**	**SB $_{40\%}$**	**SPR (SB $_{0.5}$)**
SPR (Spawning Biomass/Recruit)	0.418	0.400	0.40
F (Fishing Mortality Rate)	0.141	0.110	0.110
Exploitation Rate (Yield/Bsmry)	0.081	0.065	0.065
MSY (mt) or MSY proxy (mt)	423	408	408
Yield (mt)	700	928	928
SPBIO/SB(0)	30.1%	40.0%	40.0%
Age 3+ Biomass	5,218	6,264	6,264

Stock Biomass

The estimated current spawning biomass resulting from the STAR base model was 1,034 mt and unexploited spawning biomass is 2,429 mt, resulting in a current stock level that is 42.6% of the unfished. The STAT best fit model estimates current spawning biomass as being 1,239 mt and unexploited spawning biomass at 2,321 mt, resulting in a current stock level that is 53.4% of the unfished. In both models spawning biomass and age 3+ biomass reached the lowest levels in 1995, following poor recruitment and intense fishing in the late 1980's.

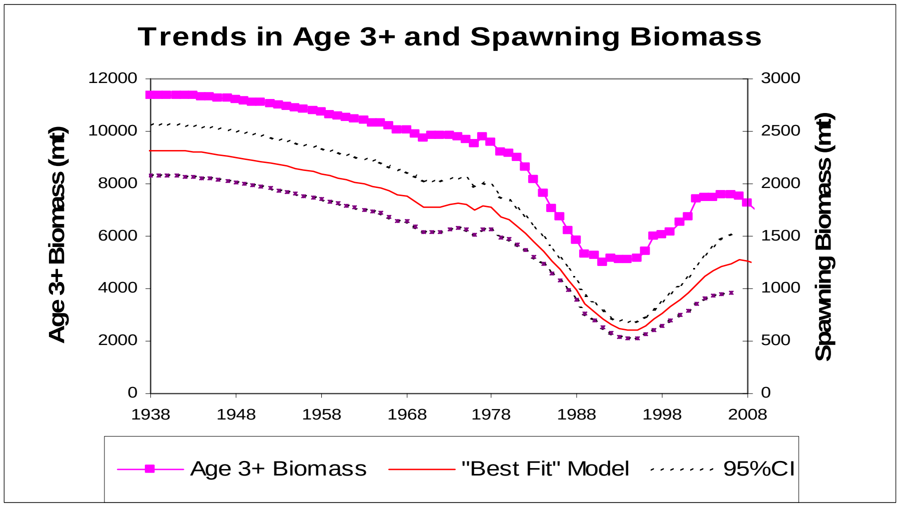
STAR Base Model Results

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Spawning Biomass	612	652	701	754	809	880	938	985	1016	1034
% of Virgin	0.252	0.268	0.289	0.310	0.333	0.362	0.386	0.405	0.418	0.426
Age 3+ Biomass	5069	5107	5146	5433	5594	6133	6178	6143	6204	6180



STAT "Best Fit" Model Results

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Spawning Biomass	707	762	826	891	959	1043	1114	1171	1211	1239
% of Virgin	0.304	0.328	0.356	0.384	0.413	0.449	0.480	0.505	0.522	0.534
Age 3+ Biomass	5977	6066	6147	6516	6739	7405	7485	7470	7564	7558

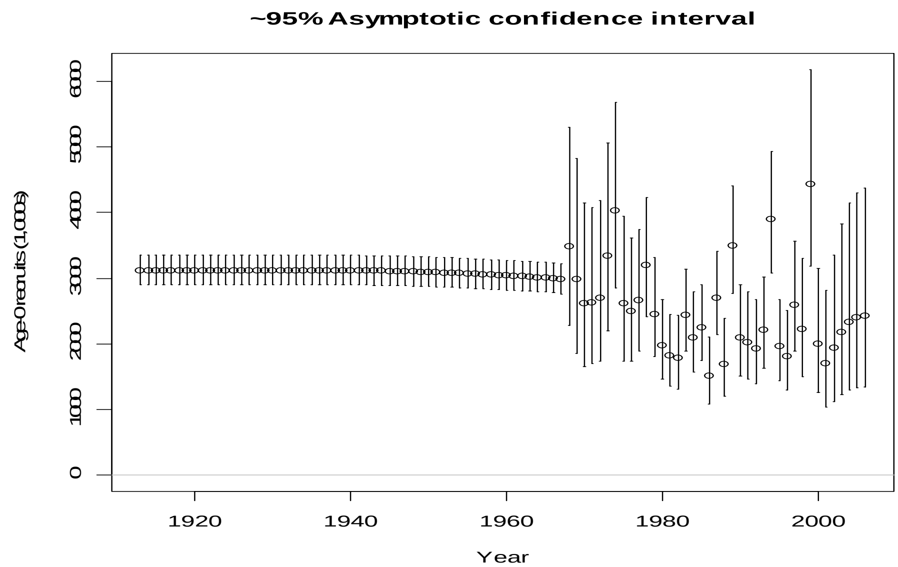


Recruitment

Recent increases in biomass are the result of two prominent year classes in 1994 and in 1999. The 1999-year class is estimated to be the largest year class since the beginning of the estimation phase.

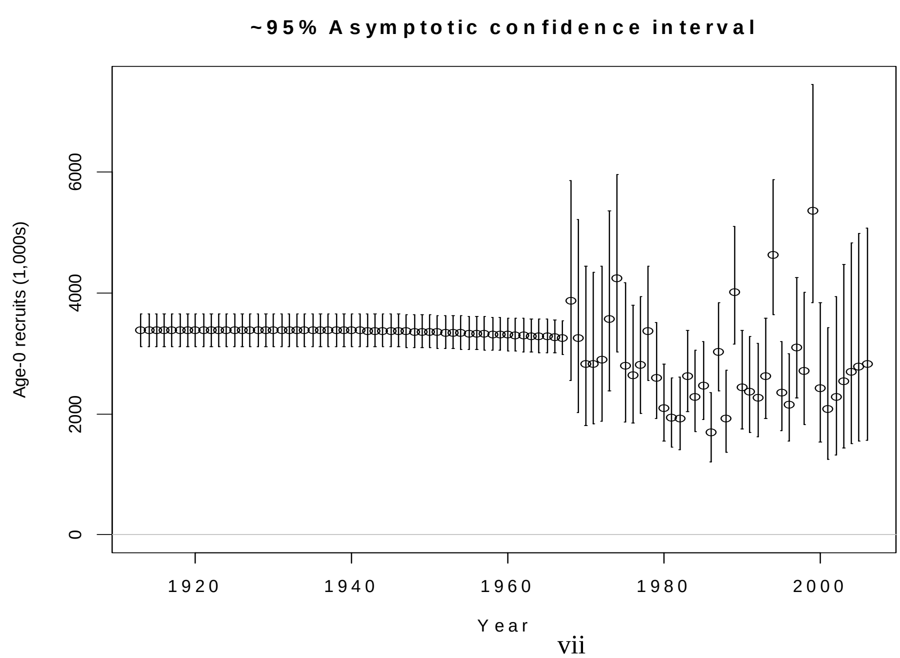
STAR Base Model Results

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Age 1 Recruits (1,000's)	2,614	2,239	4,478	1,997	1,696	2,414	2,468	2,509	2,535	2,550



STAT "Best Fit" Model Results

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Age 1 Recruits (1,000's)	3,129	2,732	5,410	2,444	2,075	2,826	2,882	2,924	2,951	2,970



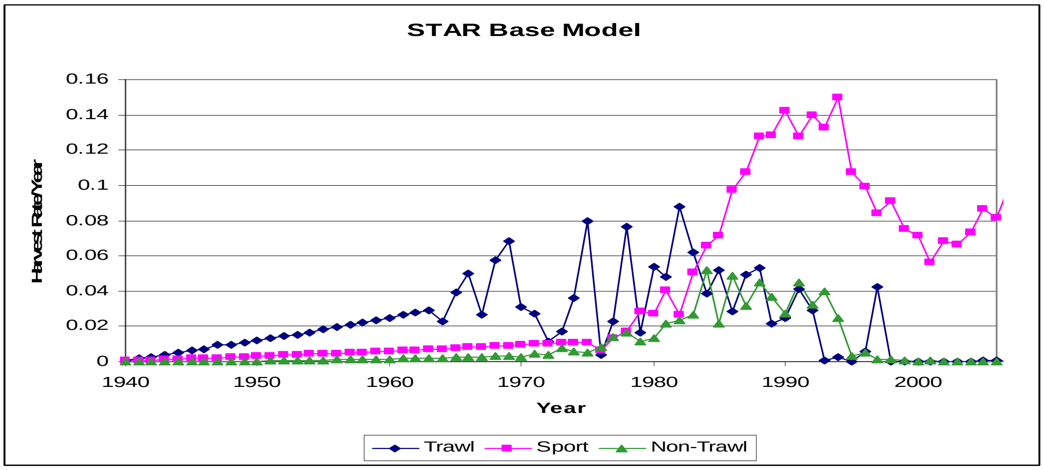
Exploitation Status

Exploitation of black rockfish reached a peak in 1988 of 13% of the Age 3+ biomass and remained near that level for 7 years, dropping precipitously between 1995 and 2000. In recent years exploitation has been relatively low (4-6%).

STAR Base Model Results

Recent trends in black rockfish exploitation

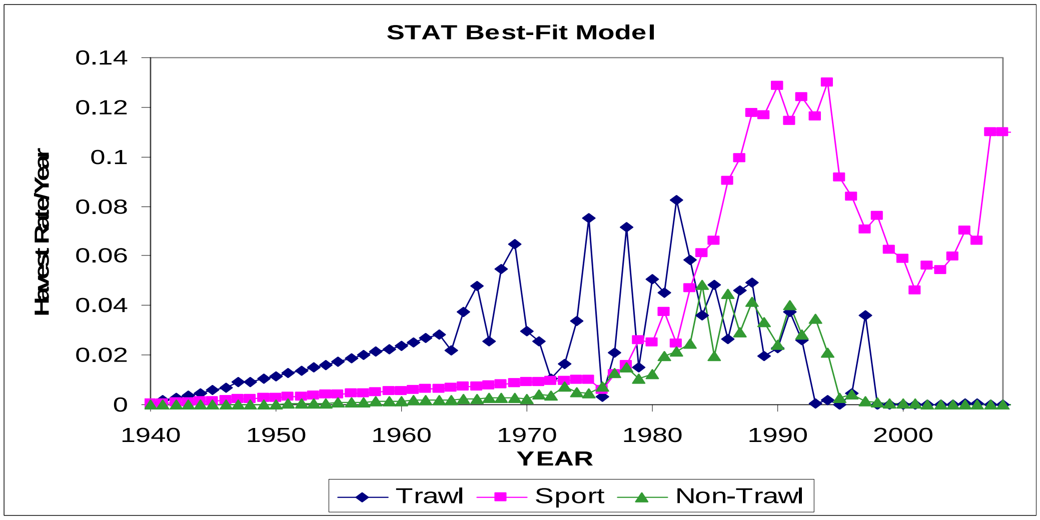
Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Exploitation Rate	0.0501	0.0418	0.0326	0.0323	0.027	0.0334	0.033	0.0368	0.0448	0.0432



STAT "Best Fit" Model Results

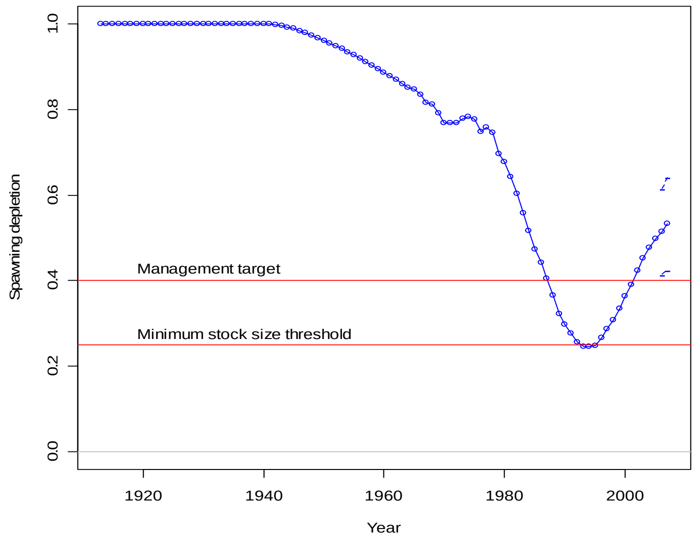
Recent Trends in black rockfish exploitaion

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Exploitation Rate	0.042	0.035	0.027	0.027	0.022	0.028	0.027	0.030	0.037	0.036

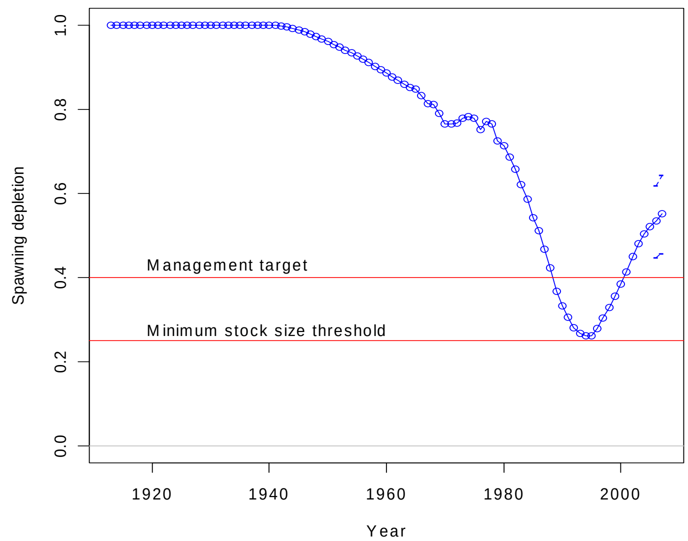


Black rockfish stock abundance has been below the Councils' management target and results from the STAR base model indicates that it has dipped below the Councils' minimum stock size threshold in the last decade. The stock is currently above the management target of B40% in both the STAR base and STAT best fit models.

STAR Base Model

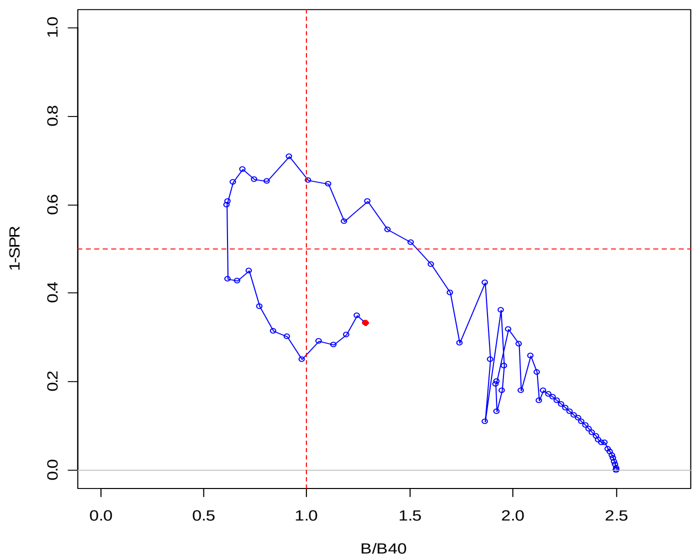


STAT "Best Fit" Model

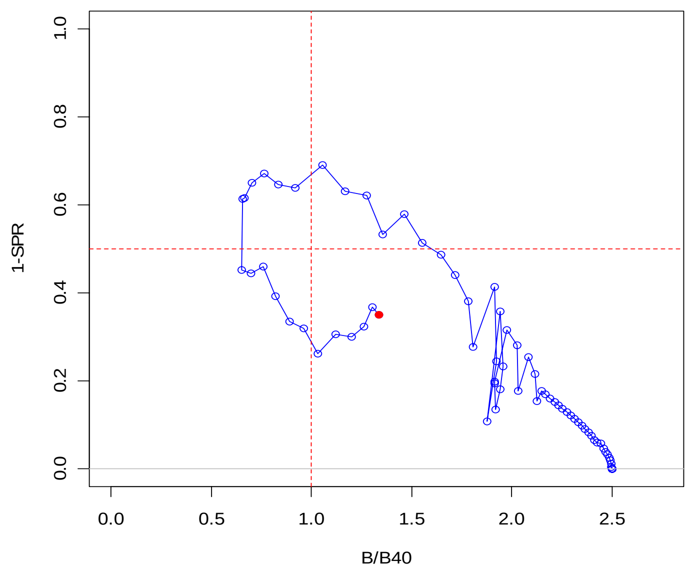


Exploitation rate relative to spawning biomass indicate that harvest rates exceeded management targets between the mid 1980's through the mid 1990's. The STAT best fit model indicates a slightly improved exploitation time series.

STAR Base Model



STAT "Best Fit" Model



Management Performance

Harvest has remained well below the harvest guideline of 517 mt (1997-1999) and the 577 mt (+- 2CV's 523-632 mt's) equilibrium catch following the 1994 (Wallace et al., 1994) and the 1999 assessment (Wallace et al., 1999), respectively. The 1999 assessment estimated the 2001 spawning biomass of 646 mt (+- 2CV's 601-687 mt's) with an equilibrium spawning biomass of 451 mt (+- 2CV's 401-501 mt's) equating to a 2001 SB_{2001}/SB_{Equil} of 143%. The catch time series includes discard when existing, ABC is constant and changes in spawning biomass across the time series is not available.

There were no explicit ABC's for the northern area until 2004. Prior this time (for the period 2000 –2003), yield from the northern assessment was added to catches from the southern, unassessed area to produce a coastwide ABC of 1,115 mt (615 mt from the N. assessment plus 500 mt of catch from the south). In 2004, a management line was implemented at the Columbia River, separating Washington and Oregon. Since the assessment extended to Cape Falcon, the GMT transferred a portion of the yield from the northern assessed area to the south to account for the portion of the stock (yield) from the Columbia River to Cape Falcon, 88% to the north, 12% to the south. This resulted in an ABC for Washington (Columbia River to the Canadian Border) of 540 mt. This has been (will be) constant from 2004 through 2008. With regard to management performance, catches have remained below both the northern portion of the coastwide ABC assumed from the assessment as well as the explicit northern ABC beginning in 2004

Total black rockfish catch by all fisheries

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total Catch (mt)	258.1	337.3	225.9	226	189.8	240.6	237.4	269.3	332.6	324.1

Forecasts

Projections of future catches were based on a $F_{SPR\ 50\%}$ rate of fishing mortality. We also assumed that the sport fishery would account for 100% of the catch and that selectivity would remain unchanged from that estimated within the model in the final year. For the STAR Base model only, beginning in 2013, there is a slight downward adjustment in ABC of ~ 1% to account for 40:10 harvest Control rule adjustments.

STAR Base Model

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ABC (mt)	394	377	361	350	345	344	346	350	354	357
Spawning Biomass (mt)	1064	1071	1060	1036	1005	977	956	944	940	943
% of Virgin	0.438	0.441	0.436	0.426	0.414	0.402	0.394	0.389	0.387	0.388

STAT "Best Fit" Model

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ABC (mt)	535	503	474	453	440	433	431	432	434	436
Spawning Biomass (mt)	1281	1267	1233	1182	1126	1074	1033	1005	989	984
% of Virgin	0.552	0.546	0.531	0.509	0.485	0.463	0.445	0.433	0.426	0.424

Decision Table

The decision table matrix was developed through STAR Panel and STAT discussions. Three states of nature were defined in terms of natural mortality: 1) M equals to 0.12 for all males and females <=10 years of age, and M linearly increases from 0.12 to 0.16 for females age 11 to 15 then remains constant at 0.12 after age 15; 2) M equals to 0.16 for males and females <=10 years of age, and M linearly increases from 0.16 to 0.20 for females age 11 to15 then remains constant at 0.20 after age 15; and 3) M=0.19 for males and females <=10 years of age, and M linearly increases from 0.19 to 0.23 for females age 11 to age 15, then remains constant at 0.23 after age 15. To assess the affect of alternative management actions, harvest was forecast with alternative catch levels derived from each state of nature.

In addition to the above three states of nature, we included model results in the decision matrix that are based on the "best fit" model where M=0.16 for males and females <=10 years of age, and M for females linearly increasing from age 11 to age 15 to 0.24, and then constant. The STAT feels compelled to integrate these results into the decision matrix (post STAR) because the "Low Natural Mortality" model does not appear plausible. Further, we consider the STAR base model as a very conservative representation of the current population. The STAT recommends that the "Best Fit" model be used for management recommendations and the "STAR Base Model" and the "High Natural Mortality Model" be used to bracket the uncertainty. Our evaluation is based on sensitivity analysis, comparison of model results to the tagging study, and general observations we have made in the fishery that include:

1) the assumed rate of natural mortality in the "Low Natural Mortality" state of nature is lower than any previous assessment for the "Northern" population, and is lower than any external estimation by direct and indirect methods,
2) biomass results from the "Low Natural Mortality" indicate that the population declined to less than 13% of the unfished population in the mid-1990's yet we have no indication from the fishery or from our tagging study that there was localized depletion during this time period,
3) sensitivity analyses indicate "Low Natural Mortality" model fit to the data is very poor relative to other model results that assume a higher rates of natural mortality,
4) the estimated q for the survey is likely double what it should be based on STAT knowledge of available habitat off the Washington coast,
5) tagging data are not fit well and tagging estimates external to the model indicate that the population is larger and fishing mortality is lower compared to STAR base model run results,
6) other model runs with higher steepness and Sigma R fit the data better and improved our view of the current population status above both the STAR base and "Best Fit" model runs and finally,
7) compared to the STAT best fit model, a model with high natural mortality for females (where M=0.16 for males and females <=10 years of age and M for females linearly increasing from age 11 to age 15 to 0.26) fit the data equally well. This model resulted in an improved view of current population status above both the STAR base and "Best Fit" model runs. However, results from this model

were not incorporated in the decision table because the higher natural mortality on females (0.26) fell outside the range considered at the STAR Panel.

STAR and STAT decision matrix based on a range of natural mortality rates where rows represent results from the assumed natural mortality model given catch rates that resulted from alternative states of nature (columns).

Decision Table - 2007 Northern Black Rockfish Assessment

			M=0.12 Males M= 0.16 Females		*M= 0.16 Males M= 0.20 Females*		*M= 0.16 Males M= 0.24 Females*		*M= 0.19 Males M= 0.23 Females*	
State of			Low Natural Mortality		STAR Base Model		Best Fit		High Natural Mortality	
Nature	Year	ABC	SpawnBio	Depletion	SpawnBio	Depletion	SpawnBio	Depletion	SpawnBio	Depletion
Low Natural Mortality	2007	108	320	14.1%	320	14.1%	320	14.1%	320	14.1%
	2008	96	287	12.6%	287	12.6%	287	12.6%	287	12.6%
	2009	86	246	10.8%	246	10.8%	246	10.8%	246	10.8%
	2010	100	279	12.3%	194	8.5%	163	7.1%	99	4.4%
	2011	115	316	13.9%	152	6.7%	96	4.2%	26	1.1%
	2012	129	359	15.8%	120	5.3%	48	2.1%	13	0.6%
	2013	140	403	17.7%	96	4.2%	18	0.8%	10	0.4%
	2014	148	447	19.6%	77	3.4%	11	0.5%	9	0.4%
	2015	153	486	21.4%	58	2.6%	9	0.4%	9	0.4%
	2016	156	518	22.8%	39	1.7%	8	0.4%	8	0.4%
STAR Base Model	2007	394	1064	43.8%	1064	43.8%	1064	43.8%	1064	43.8%
	2008	382	1088	44.8%	1088	44.8%	1088	44.8%	1088	44.8%
	2009	370	1092	44.9%	1092	44.9%	1092	44.9%	1092	44.9%
	2010	358	1139	46.9%	1065	43.8%	1030	42.4%	959	39.5%
	2011	351	1175	48.4%	1032	42.5%	965	39.7%	833	34.3%
	2012	349	1204	49.6%	1000	41.2%	906	37.3%	724	29.8%
	2013	350	1232	50.7%	976	40.2%	860	35.4%	637	26.2%
	2014	352	1260	51.8%	959	39.5%	825	34.0%	571	23.5%
	2015	356	1289	53.1%	952	39.2%	803	33.0%	524	21.6%
	2016	360	1321	54.4%	952	39.2%	790	32.5%	490	20.2%
Best Fit	2007	535	1281	55.2%	1281	55.2%	1281	55.2%	1281	55.2%
	2008	521	1317	56.7%	1317	56.7%	1317	56.7%	1317	56.7%
	2009	505	1328	57.2%	1328	57.2%	1328	57.2%	1328	57.2%
	2010	478	1376	59.3%	1304	56.2%	1270	54.7%	1202	51.8%
	2011	459	1406	60.6%	1268	54.6%	1204	51.9%	1076	46.4%
	2012	448	1425	61.4%	1230	53.0%	1140	49.1%	964	41.5%
	2013	443	1440	62.0%	1198	51.6%	1087	46.8%	873	37.6%
	2014	441	1456	62.7%	1174	50.6%	1048	45.2%	805	34.7%
	2015	442	1474	63.5%	1162	50.1%	1023	44.1%	756	32.6%
	2016	443	1498	64.6%	1159	49.9%	1010	43.5%	725	31.2%
High Natural Mortality	2007	827	2075	71.8%	2075	71.8%	2075	71.8%	2075	71.8%
	2008	804	2137	73.9%	2137	73.9%	2137	73.9%	2137	73.9%
	2009	775	2161	74.8%	2161	74.8%	2161	74.8%	2161	74.8%
	2010	714	2206	76.3%	2132	73.8%	2096	72.5%	2025	70.1%
	2011	671	2221	76.8%	2079	71.9%	2012	69.6%	1880	65.1%
	2012	642	2219	76.8%	2019	69.9%	1926	66.7%	1744	60.4%
	2013	624	2210	76.5%	1963	67.9%	1850	64.0%	1629	56.4%
	2014	615	2204	76.3%	1919	66.4%	1790	61.9%	1539	53.3%
	2015	610	2204	76.3%	1889	65.4%	1747	60.5%	1474	51.0%
	2016	607	2212	76.5%	1872	64.8%	1721	59.6%	1431	49.5%

Note:

1. The natural mortality rate of "young" females <= 10 years of age and males are equal. The natural mortality rate for "old" females between the ages of 11 and 15 is linearly increasing and then remains at the constant rate listed above. Assumed catch of 325 mt in 2007 and 2008.

2. ABC for 2007 and 2008 in the current annual management specifications is 540 mt for the area north of the Columbia River. Since the assessment extends south to Cape Falcon, Oregon, the ABC in regulation is a result of apportioning the 615 mt ABC from the previous assessment north and south of the Columbia River.

Research and Data Needs
In order to objectively evaluate a prior on q for the tagging, information on habitat distribution within the stock boundary is necessary. A nearshore assessment should be completed using side-scan, backscatter and multi beam methods. This has already been completed for some portions of the coast and new information can be integrated.

Rebuilding Projections
None required.

Regional Management Concerns
Black rockfish is highly resident to specific reefs and are therefore susceptible to localized depletion especially during times of population decline. Because of this, relatively higher levels of abundance may be needed to meet recreational fishery objectives. For example, the recreational fishery industries need to maintain a sufficient success rate to be economically feasible.

1.0 INTRODUCTION

The status of stocks for the "Northern" black rockfish stock found between Cape Falcon, Oregon and the U.S. Canadian border was last determined in 1999 (Wallace et al, 1999). The population was assessed using an AD model configuration where tag recovery was modeled explicitly. The population was regarded as healthy, stock abundance was estimated to be slightly increasing after passing through a low in the late 1980's and early 1990's. The recommended allowable annual yield was 577 mt based on an F45% exploitation strategy and a tag recovery rate of 50%. The estimated stock biomass ranged between 9,500-10,100 mt, depending on assumptions on tag reporting rates. The current analysis reprises estimates based on the 1999 model that uses an improved stock synthesis program (SS2) (Methot, 2006) and presents a completely new model specification. This assessment is distinguished from other more southerly black rockfish population assessment(s) by identifying it as the "northern" stock. However, we have no indication that there is any stock divide at the U.S.-Canadian border just that this assessment includes information only as far north as the U.S.-Canadian border.

Throughout the document we include model results that are based on both the "STAT best fit" model and the STAR base model. STAT best fit model natural mortality for "old" females is assumed to be 0.24 versus 0.20 in the STAR base model and all other parameter settings remain the same. Results in the STAT best fit model are based largely on new and expanded analyses following conclusion of the STAR Panel. We felt compelled to integrate these results because the "Low Natural Mortality" model used to bracket model uncertainty does not appear plausible and the STAT best fit model provided a better fit to the tagging and age composition data.

1.1 Species Distribution, Stock Structure, and Management Units

Black rockfish (*Sebastes melanops*) are widely distributed along the Pacific coast from central California to the Gulf of Alaska inhabiting nearshore areas at bottom depths of less than 50 fathoms (Miller and Lea, 1972). Adults are schooling and associated with irregular, rocky bottom or underwater structures, though at times may be found actively feeding on the surface.

Washington tagging data suggest that Cape Flattery and Cape Falcon may represent area bounds for a coastal Washington-northern Oregon black rockfish stock. From over 54,000 tag releases in this area, no fish were recovered north of the Strait of Juan de Fuca and only 6 were recovered south of Cape Falcon in the 15-year study (Figure 1). To corroborate these results, a genetic stock identification study of coastal black rockfish populations was conducted from 1995-1997 {}(WDFW report in progress). Horizontal starch-gel electrophoresis was used to examine 10 black rockfish collections from northern California, Oregon, Washington and southern British Columbia. Significant heterogeneity occurred among Oregon collections, while less heterogeneity was found among Washington collections. Dendrogram and multidimensional scaling (MDS) analysis of genetic distances (Nei, 1978) revealed three major geographical groupings (Figure 2). The groups include samples from: 1) north of Cape Falcon, 2) south of Cape

Falcon off the Oregon coast, and 3) a single collection from northern California (Port Albion). The study concluded that there is an apparent large-scale geographical clustering of coastal black rockfish populations and there does not appear to be any geographical pattern to clustering of populations within each group. For this assessment, we assume that black rockfish distributed between Cape Falcon, Oregon and Cape Flattery, Washington represent a unit stock. All biological parameters, data analysis and yield projections presented in this assessment are intended to describe this portion of black rockfish coast-wide distribution.

It is interesting to note that although no black rockfish tags were recovered from southern British Columbia during the 15 year tagging study, fish collected just 20 km north of Cape Flattery in Barkley Sound, B.C. were genetically similar to the coastal Washington collections. The lack of recoveries from across the Strait of Juan de Fuca is likely due to a lack of any target fisheries in coastal B.C. waters or may indicate that the Strait provides an effective physical boundary, which few if any adult black rockfish will cross. Nearshore and oceanic drift likely influence gene flow during the three to four month planktonic stages. Survival during the early life stages is strongly influenced by oceanic processes and recruitment may be dependent upon the health of black rockfish populations both north and south of the Strait of Juan de Fuca.

1.2 Life History Overview

Like many rockfish species, black rockfish are slow growing, long lived and mature late in life. Black rockfish are recruited into the commercial and sport fishery at 4 years of age; age composition of the catch can span three decades. Early recruitment, delayed maturity and schooling behavior make black rockfish susceptible to over-exploitation. Furthermore, WDFW found evidence that, in at least one year, a number (approximately 10%) of mature females examined during parturition did not spawn during year of collection. Ovarian characteristics derived from histological preparations on these specimens indicated that although they had spawned in prior seasons, they had not advanced beyond the early yolk accumulation stage and were re-absorbing their oocytes. Thus, some fraction of the mature population may not spawn annually. If this behavior were common from year to year production would be accordingly reduced.

Another important aspect of black rockfish life history is differences in growth and apparent natural mortality rates between sexes. Composition sampling data show that the sex ratio before age 10 is nearly equal and then the percent female declines sharply thereafter (Figure 3). For the purposes of this assessment we interpret the loss of females due to increased natural mortality at age, which coincides with female transition into sexual maturity.

1.3 Review of Fishery

Recreational and commercial fishers have harvested black rockfish in nearshore areas off the Washington coast since the early 1960's. Commercial fisheries include salmon and bottomfish troll, jig and groundfish trawl. The recreational fishery is divided between charter and private boat operations. Due to restrictive regulations black rockfish landings have steadily declined for commercial fisheries since the mid 1980's. Recreational landings peaked in the late 1980's and declined slightly in the 1990's and have increased slightly in the most recent years (Table 1 and Figure 4).

1.3.1 Catch

Little information exists on the historical landings of black rockfish prior to the early 1960's. The first black rockfish catch of 151.5 mt was recorded in 1952 for trawl gear. Landings of rockfish peaked at nearly 25,000 mt in 1945 in support of the war effort, however, there is no known species composition estimates for these catches (Table 2). Due to the nearshore habitat of this species it is likely that very little of this catch was black rockfish. Catches prior to known estimates were decayed to zero back to 1940 within the model and these catches are presented in Table 3.

Predominate harvesters of black rockfish between 1963 and 1983 were commercial line and trawl fishers. Black rockfish trawl landings typically came from directed tows on nearshore rocky reefs and shipwrecks with few landings incidental to other targeted fisheries. Catch information has been updated since the 1999 assessment to reflect changes in species composition estimates derived from port sampling. These changes resulted in a slightly lower catch during the early part of the time series (Figure 5). Peak landings in the trawl fishery reached 350 mt in 1976 and declined to less than 10 mt in recent years due to area and catch restrictions (Figures 6-8).

The "non-trawl" fishery is composed of three distinct line fisheries and each differs in target species. Oregon and Washington fish receiving tickets show nominal rockfish catch as early as 1970 in the salmon troll fishery, during 1973 in the jig fishery and during 1979 in the bottomfish troll fishery. Black rockfish are generally caught as bycatch in the commercial salmon troll fishery; landings peaked in the late 70's (151 mt) and steadily decreased coincident with losses in fishing opportunities for coastal salmon. The bottomfish troll fishery generally targeted lingcod; rockfish landings are small and estimated black rockfish catch never exceeded 2 mt. The jig fishery is primarily composed of small vessels less than 26 feet in length that generally fish near their port of access. Black rockfish were targeted in nearshore areas and are a significant fraction of the nominal rockfish landings in the jig fishery. Black rockfish catch in the jig fishery was inconsequential prior to 1980 and peaked in 1982 at 272 mt. Since 1996 nominal rockfish landings contain no black rockfish due to area restrictions that have forced jig fishers to target other rockfish species found farther offshore.

Black rockfish have become the primary target of the coastal groundfish sport fishery since the mid 1980's (Table 1 and Figure 4). Small black rockfish catches were reported in the late 1970's and steadily increased to over 300 ton per year in the mid 1990's. Due to the implementation of a 10 fish bag limit in 1995 (Figure 7) and longer salmon seasons, annual catch of black rock declined to 188 mt in 2001. In recent years, sport catches increased to more than 300 mt. The coastal recreational rockfish fishery generally competed with sport salmon, halibut and tuna fisheries, and this is reflected in year-to-year variability in black rockfish catch.

1.3.2 Discard

Discard of black rockfish in Washington waters in either the commercial or recreational fisheries is likely very small. "Sebastes complex" trip limits in the line fishery were non-restrictive prior to 1999 since few landings ever achieved the trip limit, and there was no incentive to discard catch. Furthermore, Washington State waters (inside 3 miles) have been closed to directed commercial fishing since 1995. Black rockfish represented only a small fraction of the nominal rockfish catch in the trawl fishery and it is unlikely they were discarded. Discard in the sport fishery is also insignificant since the vast majority of recreational fishers do not high-grade their rockfish catch. This is supported by recent sport fishery information that indicates discard is less than 16 mt on an annual basis (Table 4).

1.3.3 Effort

Coastal Washington recreational effort has steadily increased since the early 1980's with some declines in the late 1990's (Table 5). Increase in the popularity of bottomfish fishing has been coincident with loss of salmon fishing opportunities and a genuine increase in public interest in recreational groundfish fishing. Though a multiple target strategy may be used by sport fishermen, the bottomfish-only trips consisted about 15%-20% of the total activities in the Washington recreational fisheries.

1.4 Fishery Management

1.4.1 ABC/HG and Management Performance

The black rockfish resource was first assessed in 1994 (Wallace and Tagart, 1994). Estimated biomass declined to 60% and female egg production decreased to 43% of the unfished level. The 1995 forecasted yield ($F_{45\%}$) and harvest guideline (HG) for combined fisheries was 517 mt. Black rockfish harvest has remained below the HG at 298, 244, 242 and 309 mt for 1995, 1996 1997 and 1998, respectively. Harvest has also remained well below the harvest guideline of 577 mt that was established by the Council following the 1999 assessment (Wallace et al., 1999).

1.4.2 Review of Regulatory Changes

In recognition of the recreational fishery dependence on black rockfish and to address concerns over localized declines in availability, state and federal regulations have significantly restricted commercial and recreational harvest over the last decade (Figures 5-7). In 1992, the recreational bag limit was reduced from 15 to 12 rockfish off most of Washington, and commercial line fisheries were limited to 100 lbs of black rockfish or 30% of total catch on board except when fishing in the area between Destruction Island and Cape Alava or south of Leadbetter Point. The area restrictions were intended to reduce commercial harvest of black rockfish in areas heavily utilized by recreational fishers. WDFW imposed further restrictions in 1995 that prohibit commercial line harvest (except for bycatch in the salmon troll fishery) inside state waters, imposed trawl gear restrictions and reduced the recreational bag limit to 10 fish. These regulations are still in effect today.

1.5 Sampling Regime

Oregon and Washington routinely collect commercial and sport groundfish biological samples at various ports of landing (Tables 6 and 7). ODFW sampling is stratified by port complex, gear, market category, and quarter and generally follow methodology describe by Sen (1984). Oregon samples of interest for this assessment include only those samples collected from the sport fishery fishing north of Cape Falcon and landing into Garibaldi. WDFW black rockfish age composition sampling is stratified by time (year) and area (3B and 3A). Washington samples are collected from the trawl fishery throughout the year, and between March and October for the sport and commercial line fisheries concurring with the spring to fall fishing season.

Both Oregon and Washington regularly collect species composition samples for mixed rockfish market categories in the trawl fishery. Samples are used to derive catch estimates for various species including black rockfish and are available from PacFIN. WDFW periodically collected species composition samples from nominal rockfish landings in the commercial line fishery and these were used to estimate black rockfish catch in mixed rockfish categories.

2.0 Data

2.1 Catch

Black rockfish catch data are compiled from a variety of sources including PacFIN, agency reports, fish ticket information and communication with agency personnel. Rockfish landings from the domestic trawl fishery are routinely sampled for species composition by coastal port samplers. Revised estimates of catch for Washington and Oregon were obtained from PacFIN, fish tickets, and species composition sampling in coastal ports in Oregon and Washington (Tables 1-2). Revised catch estimates were slightly smaller in most years prior to 1983 (Figure 8).

Estimates of Washington coastal sport catch and effort is produced from creel and exit count data collected by WDFW's Ocean Sampling Program (OSP). WDFW instituted the OSP in the 70's to estimate catch. The program was later refined to provide necessary information to meet the goals of the Magnuson Fishery Conservation and Management Act of 1976. Estimation procedures for sport groundfish landings are not well documented in earlier years, but species-specific catches were reported in a series of WDFW technical publications since the 1970's. Lai, et al. (1991) describes estimation methodologies beginning in the late 1980's. Variance estimates for catch are available since 1990. Black rockfish discard data in sport fisheries are available since 2002 (Table 3). Proportion-at-size and proportion-at-age by sex and fisheries where derived from biological samples collected from coastal Washington and Oregon landings north of Cape Falcon (Figures 9 and 10).

2.2 Biology

2.2.1 Sampling

Biological sampling of fisheries for black rockfish age and length compositions goes back as far as 1976 in the trawl fishery. Coverage of the commercial fisheries in the last 10 years is nil due to restrictive management. The sport fishery has been relatively well sampled over the last two decades (Tables 6 and 7).

2.2.2 Length weight relationship

Random samples were collected in 1984 (1,157 fish) and from1988-2001 (1,397 fish), with fork length (cm) and weight (kg) measurements. We modeled the length weight relationship as $W = aL^b + \varepsilon$, where W and L were the weight and fork length, $\varepsilon \sim \mathrm{N}(0,\sigma^2)$ and the parameters a and b were to be determined. For male black rockfish, $\hat{a}$ and $\hat{b}$ were $3.796x10^{-5}$ kg cm$^{-2.782}$ ($3.303x10^{-6}$ kg cm$^{-2.782}$) and 2.782 (SE=0.02309), respectively (Figure 11). For female black rockfish, $\hat{a}$ and $\hat{b}$ were $4.030x10^{-5}$ kg cm$^{-2.768}$ ($3.334x10^{-6}$) and 2.768 (SE=0.02188), respectively (Figure 9). There was no statistical difference (P>0.05) between the male and female length weight relationships.

2.2.2 Growth

Random samples of black rockfish (14,919 male, 12,304 female, and 213 of unknown sex) were collected in 1984 and from 1988-2006 with age and fork length measurements. Most of the fish with unknown sex were juveniles with the smallest age equal to one. , The Schnute (1981) three-parameter von Bertalanffy growth model was used to model growth, with the assumption of no variation in growth among years. The growth equation is

$$l_t = L_\infty + (L_1 - L_\infty)(1 - e^{-K(t-1)}) + \varepsilon,$$

where l_t is the fork length at age t, L_1, L_∞ and K are unknown to be determined, $\varepsilon \sim \mathrm{N}(0,\sigma^2)$. L_1 is the length at age one; L_∞ and K are von Bertalanffy growth parameters, limited size and growth constant.

Due to the restriction of L_1,which was assumed to be the same in male and female fish, we proposed the use of a dummy variable in the Schnute three parameters growth model. The use of dummy variable was to test the growth difference between male and female fish. The proposed model was

$$l_t = L_\infty + D_L z + (L_1 - L_\infty - D_L z)(1 - e^{-(K + D_k z)(t-1)}) + \varepsilon,$$

where z was a dummy variable (male =0, female =1), D_L and D_k were two additional unknown variables to be determined. In this model, males and females have the same growth curves before age 1.

The parameters $\hat{L}_\infty$, $\hat{K}$, $\hat{L}_1$, $\hat{D}_L$ and $\hat{D}_K$ were 46.370 cm (SE.=0.215 cm), 0.194/yr (SE=0.00628/yr), 20.123 cm (SE=0.583 cm), 3.903 cm (SE=0.347 cm) and –0.0299/yr (SE=0.00472/yr), respectively. In Figure 12, there are plots of the expected age fork length relationships of male and female black rockfish. Both $\hat{D}_L$ and $\hat{D}_K$ were highly significant (P<0.001).; this implied the expected $\hat{L}_\infty$ and $\hat{K}$ were different between the sexes. The expected limited size of male rockfish and the growth constant were 46.370 cm and 0.194/yr. The expected limited size of female rockfish and the growth constant were 50.273 cm and 0.164/year. The estimated expected limited sizes of male and female black rockfish were similar to the expected limited sizes of male (46.611 cm) and female (51.225 cm) estimated by the capture-recapture data with time at large and size measurements but not the growth constants. The difference in the growth constants estimation might be due to the assumption of age at zero and the aging of fish with an integer scale.

2.2.3 Aging error

Since 1992, 3,147 black rockfish were sequentially selected and aged with two age readers independently. We modeled the aging error with a simple regression with no intercept. The estimated slope was 0.9977 (s.e.=0.001858). The CV of the aging error was small (0.18%). Figure 13, shows a scatter plot of the age data from the two readers. Figure 14 shows the between reader age specific variation that was used for data input in the SS2 stock assessment.

2.2.4 Age weight conversion errors

There were aging errors, age to length conversion errors, and length weight conversion errors in age to weight conversion:

$$W = a[(L_\infty + D_L z + (L_1 - L_\infty - D_L z)(1 - e^{-(K+D_k z)(t+1)})]^b .$$

We assumed all these errors were independently normally distributed. The Delta method was employed to estimate the overall standard errors. The estimated male and female black rockfish age to weight and standard errors are presented in Table 8.

2.2.5 Age-length relationship and maturity

A random sample of 352 female black rockfish captured in 1998 was selected for the estimation of black rockfish maturity (Table 9). A generalized linear model with a binomial (logit link) was used to model the age of 50% maturity. Bootstrapping was used to estimate the 95% confidence intervals of the age of 50% maturity. The estimated age of 50% maturity was 10.31 year and the 95% confidence intervals by bootstrapping was (9.72 year, 11.24 year). The estimated probability of maturity with age was

$$\hat{\pi} = \frac{e^{-7.13+0.69t}}{1+e^{-7.13+0.69t}} .$$

The estimated probability of sex maturity curve with age for females is plotted in Figure. 15. Females with fork length (l) 25-49 cm captured in 1998 (391 fish) were randomly selected for the estimation of maturity of rockfish (Table 10). The estimated length of 50% was 42.15 cm and the 95% confidence intervals by bootstrapping was (41.49 cm, 42.87 cm). The estimated probability of maturity with fork length was

$$\hat{\pi} = \frac{e^{-17.05+0.40l}}{1+e^{-17.05+0.40l}} .$$

The estimated probability of sex maturity curve with fork length is plotted in Figure. 16.

Fecundity estimates are based on 47 mature black rockfish ovaries collected during parturition between 1989 and 1991 off the central Washington coast. Estimated fecundity ranged from 117,550 eggs for a 37 mm fish to 1.2 million eggs for a 490 mm fish. Fecundity at a mean size of 41 cm is 544,528. There is a significant relationship between fecundity and length (M , E+6larvae/cm) = 0.0634L-2.0586 and fecundity and weight (M , E+6larvae/kg) = 0.7674W-0.3657 (Figure 17). Fecundity at weight parameters are provided as data input to synthesis and since larval output are in 1.0E+6 units, spawning biomass from the model should be multiplied by 106 to obtain the absolute spawning output. An increasing larval output by older, larger fish has a significant impact on the population dynamics such that a lightly exploited population with and age structure shifted towards older fish, would have greater spawning potential than a population shifted towards younger fish even if the biomass of spawning females were the same. This effect is significantly amplified in the black rockfish populations because it appears that larvae from larger, older black rockfish appear to be more viable than those from younger fish (Berkeley, 2004). This further implies that maintaining a black rockfish population that preserves the older segment of the population may be very important for reproductive success of this species.

2.2.6 Total mortality

The mortality model we used assumes direct density dependence. If the population at time t is $N(t)$, then

$$\frac{dN(t)}{dt} = -ZN(t),$$

where M is the termed the instantaneous coefficient of total mortality. This model is popular for fish stock assessment because it is simple, because data are usually not available to support more complex representations, and because it often makes reasonable assumptions for the exploited age classes. The population size at time t is

$$N(t) = N(0)e^{-Zt}.$$

We assume that fishing mortality (F) and natural mortality (M) sum to total mortality (Z) , where Z=$F + M$.

Taking the log of both sides of the equation, we get

$$\log(N(t)) = \log(N(0)) - Zt.$$

For the rockfish length frequency composition data, we need to convert the fork length into age. The inverse von Bertalanffy growth equation is

$t(L) = t_0 - \frac{\log(1 - \frac{L}{L_\infty})}{K}$ .We set $t_0 = 0$ for simplicity. Now,

$$\log\left(\frac{N(t)}{t(L+\Delta L) - t(L-\Delta L)}\right) = \log\left(\frac{N(0)}{2(t(L+\Delta L) - t(L))}\right) - Zt(L).$$

The length interval for the frequency data is 3 cm. Assuming errors in the data, we can fit a regression line with

$$y = \log\left(\frac{N(t)}{t(L+\Delta L) - t(L-\Delta L)}\right) \text{ and } x = t(L) \text{ with } \Delta L = 1.5 \text{cm.}$$

The above method is equivalent to the method of Pauly (1983).. who derived it by using the Baranov catch equation,

$$C(t_1, t_2) = N(t_1)\frac{F}{Z}\{1 - \exp[-Z(t_2 - t_1)]\},$$

where $C(t_1, t_2)$ is the total between age class t_1 and t_2. He approximated part of the catch equation

$$\log C(t_1, t_2) = d - Zt_1 + \log\{1 - \exp[-Z(t_2 - t_1)]\}$$

with $\log(1 - \exp(-\Delta t)) \approx \log(\Delta t) - \frac{\Delta t}{2}$. Both results are similar.

Black rockfish length frequency data have been collected from port sampling and recreational surveys since 1984. Both male and female black rockfish length frequency data show peaks near 36 cm, presumably due to fishery selectivity. Thus, for the purposes of this analysis, black rockfish with size greater than 36 cm were used to estimate the total mortality. We estimated the total mortalities of black rockfish by sex. The estimated male and female total mortality coefficients from 1984 to 2006 and number of samples are listed in Table 11. Plot of expected male and female estimated total mortality coefficients against total fishing effort are shown in Figure 18. The estimated intercept (~0.2 for males and ~0.26 for females) in each sub graph is the estimated natural mortality (where effort=0) using the mortality model described above and assuming direct density dependence. The estimated female total mortality coefficients were greater than the estimated male total mortality coefficients from 1984 to 2006 and beginning in 2000 there was a decreasing trend observed in both male and female black rockfish total mortality (Figure 19).

2.2.7 Natural mortality

Fish natural mortality is confounded with fishing mortality, so it is one of the most challenging fish biological parameters to be estimated. It significantly affects the stock rebuild time and the estimation of virgin fishery biomass. There are both direct and indirect methods to estimate the natural mortality of fish species. Indirect methods are derived from other biological parameters, e.g., the growth constant and fecundity (Wallace et al., 1994 and Wallace et al., 1999). It is difficult to estimate the uncertainties from indirect methods.

In this assessment, we attempted to estimate the natural mortality of black rockfish with a direct method. We assumed $F = qE$, where q was catchability coefficient and E was fishing effort. Natural mortality could be estimated with the relationship

$$Z = F + M .$$

After 1995, the bag limit for recreational catch dropped to 10; thus, we only included the recreational rockfish trip effort (fish/angler) and the total catch in this analysis. We assumed constant M with annual variation and the total fishing effort at year t would result in the total mortality in year $t+1$. The proposed model was

$$Z_{t+1} = qE_t + M + \varepsilon_t ,$$

where $\varepsilon_t \sim \text{NID}(0, \sigma^2)$, q and M were the unknown to be determined.

Plot of expected male and female estimated total mortality coefficients against total fishing effort where the intercept was the estimated natural mortality is shown in Figure 18. The estimated linear relationship between male and female black rockfish is shown in Figure 19 and a time series plot of the estimated male and female black rockfish total mortalities is shown in Figure 20. The estimated $\hat{M}$ of male and female black rockfish were 0.223 (SE= 0.0071) and 0.272 (SE= 0.061). The relationship of $\hat{M} \approx \hat{K}$ was observed in male black rockfish, while $M = 1.6\hat{K}$ was observed in female black rockfish. All these values agreed with other existing indirect methods.

2.3 Abundance Indices

2.3.1 Bottom trawl surveys

The NMFS has conducted the West Coast triennial bottom trawl survey of groundfish resources since 1977. Survey depth range in most years has been from 30-200 fm (Wilkins et al., 1995). This is outside the normal depth range of black rockfish and only 233 fish in 27 tows have been captured to date. Therefore, we incorporated no triennial trawl survey data into this assessment.

2.3.2 Recreational CPUE

Abundance indices are assumed to be proportional to population abundance. The catchability coefficient (Q) is the factor that relates the units of the index to the abundance of the population. Random variability in the coefficient may occur, but if there is a trend over time or if the coefficient varies with population abundance, then the assessment may be biased. Sport fishery catch rates will be influenced by undocumented search time at sea, and the observed decline in CPUE indices would be underestimated. There is no information to evaluate annual differences in effort for specific individual target species such as black rockfish. April-September estimates of catch and effort (by trip type) for the sport fishery from coastal Washington ports are available from the WDFW Ocean Sampling Program since 1990. Black rockfish abundance trends were explored using methods described below, but not used in the current assessment due to 1) changes in bag limits, 2) a switch to bait in the early –mid 1990's, and 3) a bag limit that may have capped the trend since the mid-late 1990's that may have biased the population trend.

Delta lognormal model

A delta lognormal model (Lo et al. 1992) has been commonly used for modeling the abundance of marine species from trawling data. It uses generalized linear models GLMs in both stages, where P_{ij} is the probability of abundance of observation j in year i and C_{ij} is the catch per unit effort (CPUE). CPUE can be catch per angler hr, catch per trip, or catch per angler. The distribution of $C_{ij} > 0$ usually follows a lognormal distribution. The distribution of P_i follows a binomial distribution. The modeling of P_{ij} and C_{ij} through a two stage process with other predictor variables is commonly called delta lognormal model (Lo et al., 1992). This approach affords the opportunity to investigate the probability of abundance on a spatial scale with other predictor variables, which include both geographical information and environmental variables. Problems associated with zero values in catch data can be avoided by using the delta lognormal model, which only fits the positive catch data. There is, however, a possible bias induced by using a two stage model process. Lo et. al. (1992) and Syrjala (2000) attempted to estimate the bias of the estimated variance in this model using both simulation and approximation techniques. Both P_{ij} and C_{ij} do not assume normally distributed (binomial, lognormal) in the two stages model process and there is possible correlation between them. Also, the use of the delta lognormal method to estimate the variance of the final estimate is questionable. This can be overcome by non-parametric bootstrapping.

First stage model

The response variable P_{ij} is a Bernoulli component (presence-absence) of CPUE *j* in year *i*. The choice of the logit link function is standard (McCullagh and Nelder, 1989; Cheng and Gallinat, 2004). The link function is

$$g(P_{ij}) = \log(\frac{P_{ij}}{1 - P_{ij}}) = x_i ,$$

where x_i is a factor variable (annual effect).

Second stage model

We model $C_{ij} > 0$ in terms of the covariates x_{ij}. It is a truncated Poisson distribution.

Bootstrapping method and non-parametric coefficient of variation

The nonparametric bootstrap method (Efron 1982; Hall 1992; Jackson and Cheng 2001) was used to estimate the 95% confidence intervals for the mean CPUE estimates obtained from average CPUE and from the delta lognormal model. Due to the computational intensity required when applying GLMs and a large data set, K = 200 to 1000 samples have been used. We have rerun the bootstrapping three times and compared the precision of the estimates of the 2.5%, 15.87%, 84.13%, and 97.5% quantiles. The estimates of the quantiles are correct to the first 3 significant places due to the very large dataset. The coefficient of variation of a data X,

$$CV_X = \frac{\sigma_X}{\mu_X} \approx \frac{\hat{\sigma}_X}{\bar{X}},$$

is commonly used to describe the variation (one standard deviation) of the data compared with the mean of the data. The parameters σ_X and $\hat{\sigma}_X$ are population X standard deviation and estimate population X standard deviation. Letting $q_{X,0.025}$ be the 2.5% quantile of data X, we define the ad hoc CV for the non-normal distribution as

$$CV_X = \frac{q_{X,0.8413} - q_{X,0.1587}}{2\mu_X} \approx \frac{\hat{q}_{X,0.8413} - \hat{q}_{X,0.1587}}{2\bar{X}} .$$

For the sample mean, we use

$$CV_{\bar{X}} = \frac{q_{X,0.8413} - q_{X,0.1587}}{2\sqrt{n}\mu_X} \approx \frac{\hat{q}_{X,0.8413} - \hat{q}_{X,0.1587}}{2\sqrt{n}\bar{X}},$$

where n is the sample mean.

The sample mean of the CPUE in each year was compared with delta lognormal model results. Black rockfish length frequency data have been collected since 1990 in both recreational and commercial fisheries. Plots of the estimated recreational fishery CPUEs from mean estimators and the delta lognormal model for all areas combined is shown in Figure 21 and Figure 22 shows results from Area 2 only, A summary of the number of recreational data recorded in all areas (Areas 1,2 3, 74 and 84) and the proportion of these from 1990 to 2006 is given in Table 12. Area 2 was the major fishing area and the fishing effort was roughly proportional to the catch. Area 2 was the major rockfish area. Tables 13 and 14 provide summaries of the estimated CPUEs from the mean estimator and the delta lognormal model for all areas combined and area 2, respectively. Undoubtedly, Area 2 had a higher CPUEs compared with the other areas. Although the bag limit changed from 15, to 12 to 10 during 1990 to 1995, the estimated CPUEs reflected the changes from 1990 to 1993. From 1995 onwards, there was an increasing trend in CPUEs with a constant bag limit (Figures 19-20).

2.3.3 Tagging CPUE

Since the start of the coastal Washington black rockfish tagging program in 1981 information on catch and rod hours have been recorded. These data represent the total number of fish caught and angler hours at each specific fishing location during a trip. The number of fish tagged (and released) was typically less because of mortality from hooking or barotraumas. The tag CPUE in the current assessment represents the mean annual CPUE across all trips (by year) for the Central Washington Coast between Grays Harbor and Sea Lion Rock since 1985 (Table 15 and Figure 24).

2.3.4 Mark-recapture tagging study

From 1981 to 1990 and resuming again in 1998, black rockfish has been the subject of multiple tagging experiments along the coast of Northern Oregon and Washington Since

1998, internally implanted coded wire tags (CWT) were employed to ensure that tag recovery was not dependent upon tag reporting by fishers. Information from the first two years of recovery was suspect and was dropped from the tag abundance index.

2.3.5 CWT tag loss rate

Double CWT tagging experiments were conducted between 1998 and 2006 to estimate the tag loss rates. The estimated tag loss rates were used to adjust the number of tag returns. In 1998, 2262 black rockfish were released with double CWT tags on both the left and right sides of the fish in order to estimate the instant CWT tag loss rate per year. In total, there were 2209 fish returned with double CWT tags, 58 fish returned with left CWT tag loss and 66 fish returned with right CWT tag loss (Table 16 and Figure 23). The estimate the instant rate of tag loss per year was – 0.0017 (st. err=0.0003, P=0.0035).

2.3.6 Population estimate

Petersen's method (Chapman, 1951) was used to estimate the population size from capture and recapture data. The method requires only two survey periods; the first survey involves the initial marking of n_1 fish, of which m tagged fish are recovered from n_2 fish sampled in the second survey. The estimated population size is

$$\hat{N} = \frac{(n_1 +)(n_2 + 1)}{m + 1} - 1$$

and

$$\mathrm{Var}(\hat{N}) = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m)(n_2 - m)}{(m+1)^2 (m+2)} .$$

The assumptions are

i) The tags are not lost and always identified on recapture.
ii) The population is closed.
iii) Every individual has the same probability of recapture.

When the tag loss rate is known, the new estimate is $\hat{\hat{m}} = \frac{m}{1 + \hat{\beta}}$.

The estimated population sizes for years 2000 to 2006 are given in Table 17.

3.0 Modeling History

In the 1994 stock synthesis model configuration, two auxiliary data sets were used as black rockfish abundance indicators: tagging CPUE, and coastal recreational bottomfish directed effort (Wallace and Tagart, 1994).

In 1999 we constructed an assessment model by using the AD model builder software (Fournier1997) to assess black rockfish abundance (Wallace et al 1999). The three key features of the 1999 model were (1) the parameterization of the expected catches at age, (2) the definitions of the sampling unit for the different types of data input, and (3) the integration of tagging data explicitly. The parameterization chosen mostly affected parameter bias whereas the sampling unit designation mostly affected estimator variance.

Both bias and variance were components of overall parameter uncertainty. The parameterization and the sampling unit definitions were both designed to conform to the actual sampling protocol used, thereby propagating sampling uncertainty through to the final biomass estimates.

4.0 Current Model Description

The current assessment employed Stock synthesis 2 (SS2V2.00c, compiled 3/27/2006) to model the dynamics of black rockfish population found between Cape Falcon, Oregon and North to the U.S./Canadian border in Coastal Waters. This model is a forward projecting, separable, age-structured model developed by Methot (2006). The convergence criterion for maximum gradient was set to 1.0e-5. The model was specified to begin in 1915 to ensure population equilibrium at the start of the modeling time period. Catch data were decayed from the last reliable catch estimates (1965) to 0 by 1940. Fisheries catch, size and age compositions were pooled into three fishery types including trawl, sport and non-trawl. The first size-age compositions were collected in the mid 1970's from the trawl fishery, but samples were not collected on a systematic basis until 1985. Growth (Lmin, Lmax and k) was estimated within the model to account for fishery selection of the larger individual fish at age. The population model was tuned to two fisheries-independent indices that include a tagging CPUE (1986-2007) and a tag abundance biomass index (2000-2007) both derived from WDFW black rockfish tagging information. Both STAT and STAR Panel members agreed that the available fishery dependent indices should not be incorporated due to potential bias resulting from bag limit changes and undocumented measures of fishing effort resulting from changes in search time across the time series. The black rockfish STAR base and STAT best fit models down-weights size composition for all fisheries (emphasis=0.1) to improve model fit to the age composition and indices rather than length. Given that length compositions are from all samples including aged samples, down weighting mitigates effects that may be contributed to the model by "double-counting" composition sampling.

There are 10 likelihood components for data including: 1) tag abundance, 2) tag CPUE, 3) trawl size compositions, 4) sport size compositions, 5) non-trawl size compositions, 6) tag survey size compositions, 7) trawl age compositions, 8) sport age compositions, 9) non-trawl age compositions and 10) mean size at age (Table 18).

There are a total of 76 parameters estimated within the base model and assumptions on priors are listed in Table 19. We modeled the black rockfish spawner-recruit relationship using the Beverton-Holt curve. The key steepness parameter (h), which determines overall productivity of a stock, is fixed at 0.6 and the prior on h is set to 0.35 in the STAR base model and in the STAT best fit model. Based on Dorn's (personal communication) Bayesian meta-analysis of productivity for west coast rockfish stocks, steepness parameter (h) for black rockfish should be in the 0.6-0.7 range and variation about the stock-recruit curve (Sigma R) would be near 0.57. The natural mortality for females is assumed to be constant (0.16) for ages <=10 and then increasing to 0.2 by age 15, and males were assumed to have a constant natural mortality of 0.16 for all ages in the STAR base model. The natural mortality for females is assumed to be constant (0.16) for ages

<=10 and then increasing to 0.24 by age 15, and males were assumed to have a constant natural mortality of 0.16 for all ages in the STAT best fit model.

Sample size and effective sample size
Initial sample size inputs were based upon methods presented at the NMFS 2006 Stock Assessment Data and Modeling workshop that incorporates objective weighting for length- and age-frequency data for West coast groundfish fisheries where:

Fishery data:

Effective N = ((0.138*FPS)+1)*NS   where: FPS < 44
Effective N = 7.06*NS   where: FPS > 44

Survey data:

Effective N = ((0.070*FPS)+1)*NS   where: FPS < 55
Effective N = 4.89*NS   where: FPS > 55

NS = Number of samples
FPS = Average number of fish per sample

Comparison of input sample size and the effective sample sizes estimated by the STAR base model are provided in Tables 20 and 21.

5.0 Model Selection and Evaluation

A large number of model structures were initially explored prior to establishing a base black rockfish model. Our primary goal in model selection was to ensure fit to the tag abundance index and age composition data while minimizing the overall likelihood. This is because we have confidence in the study design and methodology of our current tagging program and the resulting abundance estimates. In addition, we have collected numerous age samples from the fisheries during the last two decades that likely represents the underlying age structure of the population.

Natural mortality for mature females (>10 years of age) was assumed to be 0.20 (STAR base) and 0.24 (STAT best fit) and constant 0.16 for males and females < age 11. These rates are within the range of natural mortality rates estimated external to synthesis. Both male and female natural mortality rates are lower than that estimated in the 1999 assessment (Figure 25) and somewhat lower than the 1982 catch curve estimate of 0.265 (Wallace et al., 1994). The natural mortality in the current assessment is higher than that used in the 2003 assessment for black rockfish populations off Oregon and California (Ralston and E.J. Dick, 2003), which used a natural mortality of 0.1 and 0.2 for males and females, respectively.

Results of the model sensitivity analysis on natural mortality (Table 24) indicate that the STAT best fit model provided a better overall fit to the data compared to the STAR base model and estimates of fishing mortality is closer to tagging study results (Figure 26). We conclude that the STAR base model should be used to base management decisions and set allowable harvest. A list of supporting information include: 1) the assumed rate of natural mortality in the "Low Natural Mortality" state of nature is lower than any previous assessment for the "Northern" population, is lower that any external estimation by direct and indirect methods, 2) biomass results from the "Low Natural Mortality" indicate that the population declined to less than 13% of the unfished population in the mid-1990's yet we have no indication from the fishery or from our tagging study that there was localized depletion during this time period, 3) sensitivity analyses indicate "Low Natural Mortality" model fit to the data is very poor relative to other model results that assume a higher rates of natural mortality, 4) the estimated q for the survey is likely double what it should be based on STAT knowledge of available habitat off the Washington coast, 5) tagging data are not fit well and tagging estimates external to the model indicate that the population is larger and fishing mortality is lower compared to STAR base model run results, 6) other model runs with higher steepness and Sigma R fit the data better and improved our view of the current population status above both the STAR base and "Best Fit" model runs and finally, 7) compared to the STAT best fit model a model with high natural mortality for females (where M=0.16 for males and females <=10 years of age and M for females linearly increasing from age 11 to age 15 to 0.26) fit the data equally well. This model resulted in an improved view of current population status above both the STAR base and STAT best-fit model runs. However, results from this model were not incorporated in the decision table because the higher natural mortality on females (0.26) fell outside the range considered at the STAR Panel.

Convergence properties using a parameter jitter of 0.001 was also explored in the base model and results indicate no other local minima (Figure 27). Growth was assumed linear to age 5 where variation in fork-length at age was stabilized across ages (Figure 28). Growth was fully (Lmin, Lmax and k) estimated within the model to account for fishery selection that favors the largest individuals at age. Model estimates of growth compared reasonably to external estimates and there were no apparent differences in estimates of growth between STAR and STAT models (Figure 29).

Both the STAR and STAT models underestimated the increasing trend in tag abundance and tag CPUE indices in most recent years (Figure 30). We believe this is due to several factors including that tagging is not incorporated in the model as a tagging experiment, which is not possible within the current SS2 modeling framework. Further, the model estimated effective q for the tagging index was 0.83 and this is likely double what it should be based on STAT knowledge of available habitat off the Washington coast. The north central Washington coast, where most of the nearshore rocky habitat exists, is inaccessible to most recreational fishers and is not part of the current tagging program. However, the estimation of q is complicated by the fact that the SS2 value of q is a function of selectivity that is strongly dome shaped for the fishery. Increasing the weighting on survey abundance demonstrates that a better fit to the survey abundance index significantly improves our view of the current population status (Figure 31). Additionally, a retrospective analysis of the STAR base and STAT best-fit models shows that the indices strongly influence population trends and that the population trajectory in most recent years was highly influenced by the large (estimated) 1999 year-class (Figure 32).

Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of q based on tagging and the one estimated by SS2. Other issues include the non-independence of the length/age compositions and non-independence of the tagging abundance and CPUE series. However, both STAR and STAT conclude the current model configuration(s) represented the "best available" scientific information and should be used for management.

There appears to be some pattern in the size composition residuals such that model estimates for small fish were much higher than that observed in the trawl fishery fit. However, forcing the model to fit the size compositions degraded the fit to the age composition. Fit to size compositions in the sport, non-trawl and survey showed little trend. Overall, fit (or lack of) to the size composition data did not draw significant debate at the STAR panel and model fit to size compositions is likely within the uncertainty (Figures 33-36). Model fit to the age composition data showed relatively inconsistent patterns and was considered to be within model uncertainty (Figures 37-39). There was an obvious trade off where forcing the model to fit the age data degraded the fit to the size composition data. This was not fully resolved and is discussed below in the uncertainty section.

6.0 Base-run Results

Comparison of STAR base model recruitment estimates to the previous assessments and the STAT best fit model indicates similar estimated recruitment patterns (Figure 40). It is apparent that the large estimated recruitment in 1994 and 1999 is highly influential in determining current stock status. Due to lack of good recruitments and intense fishing by multiple fisheries, highest fishing mortality rates occurred in the late 1980's (Figure 41). Selectivity was domed-shaped (STAR and STAT models) in both the tagging survey and sport fishery and asymptotic in the trawl and non-trawl commercial fisheries (Figure 42). Comparison of STAR base model spawning biomass estimates to the previous assessments indicate a similar declining trend through the mid 1990's and then sharply increasing to 43% of the unfished biomass by 2006, though the trend is lower in the current model (Figure 43). The STAT best fit model resulted in a slightly smaller unfished biomass and a larger ending biomass compared to the STAR base model, biomass estimates show little difference in population trend (Figure 44).

Black rockfish stock abundance was below the Councils' management target a number of years and also dipped below the Councils' minimum stock size threshold in the STAR base model. The STAT best fit model population trajectory remained just above minimum stock size threshold. Both models indicate that the stock is currently well above the management target of B40% (Figure 45). The corresponding exploitation rate relative to spawning biomass shows similar trend and harvest rates have exceeded management targets between the mid 1980's through the mid 1990's (Figure 46).

7.0 Uncertainty and Sensitivity

Natural mortality is confounded with fishing mortality making it one of the most difficult biological parameters to estimate. In this assessment we explored direct methods to estimate natural mortality and compared to estimates derived from indirect methods (from other biological parameters, e.g., the growth constant and fecundity) in previous assessments. It is apparent from our analysis using both direct and indirect methods that our current assumptions on natural mortality in the STAR base model are within our limits to estimate this parameter and that the “low natural mortality rate” model used to bracket uncertainty is likely too low. Model sensitivity analysis show that other model configurations using higher natural mortality assumptions such as the STAT best fit model provides a better overall fit to the data (Figure 47).

Tagging is not incorporated in the model as a tagging experiment, which is not possible within the current SS2 modeling framework. The index for tagging abundance is not fit well and the model estimated effective *q* for the tagging index was 0.83. This is likely double what it should be based on STAT knowledge of available habitat off the Washington coast. Further, the north central Washington coast, where most of the nearshore rocky habitat exists, is inaccessible to most recreational fishers and is not part of the current tagging program. However, the estimation of q is complicated by the fact that the SS2 value of *q* is a function of selectivity that is strongly dome shaped for the fishery. Increasing the weighting on survey abundance shows that a better fit to the survey abundance index significantly improves our view of the current population status (Figure 31). Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of *q* based on tagging and the one estimated by SS2. Other issues include the non-independence of the length/age compositions and non-independence of the tagging abundance and CPUE series.

Likelihood profile of the STAR base assessment model for different fixed values of the Beverton-Holt steepness parameter (h) and Sigma R show that higher values (STAR base and STAT best-fit model had the steepness fixed at 0.6 and Sigma R tuned to 0.35) of both parameters improved the overall fit to the data (Figure 48). Our assumption on h is well within the uncertainties based on the Dorn meta-analysis, but assumptions on Sigma R may be too low (Dorn personal communication).

Changes in likelihood profile for various components of the base assessment model following changes in the emphasis (weight) of the recruitment Dev and Dev time series indicate very modest changes in fit for weighting between 0.1 to 100 with fit improving to age compositions and declining fit to size compositions with increasing emphasis (Figure 49).

Likelihood profile for various components of the base assessment model following changes in the emphasis (weight) on the abundance and tag CPUE indices indicate a slight improvement in fit by increasing emphasis to 10 on most components with the exception to the fit to sport size and age that declined (Figure 50). Increasing emphasis on the age composition for all fisheries above 1 improves fit to the abundance indices but increased likelihood for the fishery size components (Figure 51). The model was very sensitive to increasing emphasis on the size compositions and declined fit to all age and index components substantially (Figure 52).

8.0 Reference Points and Forecast

The Pacific Fisheries Management Council recommends that a default target fishing mortality rate of FSPR=0.5 be used for Council managed rockfish species. The current assessment uses this default for harvest projections and based on the Councils control rule for groundfish would not be considered overfished. Reference points and benchmark fishing mortality rates are shown in Table 23. Forecast ABC's, Spawning biomass and depletion is shown for both the "STAR base" and STAR base model and the STAT best fit model in Table 24.

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Tables

Table 1. Black rockfish catch North of Cape Falcon, Oregon by gear and year 1963-2006 (blanks indicate no data).

Coastal black rockfish catch North of Cape Falcon, Oregon

	Catch by Gear			*Catch by PMFC Area*			
Year	**Trawl**	**Sport**	**Non-Trawl**	**3A**	**3B**	**3C-S**	**TOTAL**
1963	19.0			19.0	0.0	0.0	19.0
1964	8.0			8.0	0.0	0.0	8.0
1965	108.0			108.0	0.0	0.0	108.0
1966	186.0			186.0	0.0	0.0	186.0
1967	234.0			234.0	0.0	0.0	234.0
1968	122.0			122.0	0.0	0.0	122.0
1969	261.0			261.0	0.0	0.0	261.0
1970	303.0		20.5	320.4	3.1	0.0	323.5
1971	134.1		17.5	147.6	4.0	0.0	151.6
1972	116.0		29.3	137.7	7.5	0.0	145.3
1973	48.0		26.8	63.7	11.1	0.0	74.8
1974	75.0		51.2	106.8	19.4	0.0	126.2
1975	156.0	62.3	36.9	216.7	38.5	0.0	255.2
1976	347.2	36.8	32.7	384.5	32.3	0.0	416.7
1977	15.0	76.0	52.2	96.1	47.2	0.0	143.2
1978	96.0	94.2	89.8	185.2	94.8	0.0	280.1
1979	321.3	150.7	104.0	500.5	75.5	0.0	576.0
1980	64.6	144.8	70.5	228.9	51.0	0.0	279.9
1981	213.0	213.8	81.8	436.6	72.0	0.0	508.6
1982	185.1	135.7	128.9	364.8	84.9	0.0	449.7
1983	327.5	244.3	134.1	458.2	247.7	0.0	705.9
1984	218.9	302.2	145.8	513.2	153.8	0.0	666.9
1985	127.3	305.3	272.0	407.8	296.8	0.0	704.6
1986	158.6	391.1	103.0	534.0	118.8	0.0	652.8
1987	82.0	389.3	220.1	494.3	197.0	0.0	691.3
1988	129.0	414.2	129.3	521.1	151.5	0.0	672.5
1989	124.4	369.6	165.3	469.3	188.0	2.0	659.3
1990	43.3	387.2	119.4	386.9	163.0	0.0	549.9
1991	46.2	332.3	83.4	320.3	139.6	1.9	461.9
1992	71.4	342.9	132.3	327.2	219.3	0.0	546.5
1993	46.8	316.9	88.4	298.3	152.9	1.0	452.2
1994	1.0	358.6	106.3	323.9	141.6	0.4	465.9
1995	3.3	264.8	65.8	214.9	118.7	0.3	333.9
1996	0.0	264.2	8.6	204.4	68.4	0.0	272.8
1997	9.0	234.1	15.0	194.8	63.2	0.1	258.1
1998	73.1	259.4	4.8	268.1	69.0	0.3	337.4
1999	0.0	221.6	4.3	169.4	56.5	0.0	225.9
2000	0.0	224.8	1.2	158.2	67.9	0.0	226.1
2001	0.0	188.7	1.1	134.3	55.5	0.0	189.8
2002	0.2	238.9	1.5	173.5	67.1	0.0	240.6
2003	0.1	237.1	0.2	166.8	70.6	0.0	237.4
2004	0.6	268.0	0.7	174.4	94.9	0.0	269.3
2005	0.0	331.7	0.9	217.8	114.7	0.0	332.5
2006	1.4	321.5	1.2	248.7	75.4	0.0	324.1
Mean	101.7	253.8	68.8	261.5	82.6	0.1	344.2
Last 10 y	8.4	252.6	3.1	190.6	73.5	0.0	264.1
Last 5 y	0.5	279.4	0.9	196.2	84.5	0.0	280.8

Table 2. Historical catch of rockfish by known rockfish catch categories between 1936 and 1969.

Historical catch of rockfish by rockfish catch categories for coastal Washington Waters

Year	Black Rockfish	Rockfish
1936	-	0.1
1937	-	219.0
1938	-	273.7
1939	-	290.8
1940	-	330.2
1941	-	554.7
1942	-	1,925.0
1943	-	5,811.7
1944	-	9,084.7
1945	-	25,969.7
1946	-	11,322.2
1947	-	2,970.8
1948	-	5,192.1
1949	-	5,943.5
1950	-	151.1
1951	-	6,777.8
1952	151.5	-
1953	8.0	153.1
1954	16.1	2.8
1955	5.0	76.5
1956	7.8	-
1957	19.1	76.5
1958	71.8	33.1
1959	26.6	36.2
1960	96.2	32.7
1961	40.7	40.5
1962	12.5	22.5
1963	-	279.9
1964	3.4	38.7
1965	-	347.8
1966	1.0	36.6
1967	-	167.7
1968	-	130.9
1969	-	151.4

Note: Data from WDFW annual catch reports.

Table 3. Assumed catch and data input of black rockfish between 1940 and 1975. Bold italics represents catch assumptions and normal italics indicate the actual catch estimate based on fish ticket and species composition data.

	Catch by Gear		
Year	**Trawl**	**Sport**	**Non-Trawl**
Initial	***2.0***	***2.0***	***1.0***
1940	***3.2***	***2.8***	***0.0***
1941	***9.2***	***4.6***	***0.0***
1942	***15.2***	***6.3***	***0.0***
1943	***21.2***	***8.1***	***0.0***
1944	***27.2***	***9.8***	***0.0***
1945	***33.2***	***11.6***	***0.0***
1946	***39.2***	***13.3***	***0.0***
1947	***52.0***	***15.1***	***0.0***
1948	***51.2***	***16.8***	***0.0***
1949	***57.2***	***18.6***	***0.0***
1950	***63.2***	***20.3***	***1.5***
1951	***69.2***	***22.1***	***2.5***
1952	***75.2***	***23.8***	***3.5***
1953	***81.2***	***25.6***	***4.5***
1954	***87.2***	***27.3***	***5.5***
1955	***93.2***	***29.1***	***6.5***
1956	***99.2***	***30.8***	***7.5***
1957	***105.2***	***32.6***	***8.5***
1958	***111.2***	***34.3***	***9.5***
1959	***117.2***	***36.1***	***10.5***
1960	***123.2***	***37.8***	***11.5***
1961	***129.2***	***39.6***	***12.5***
1962	***135.2***	***41.3***	***13.5***
1963	***141.2***	***43.1***	***14.5***
1964	108.0	***44.8***	***15.5***
1965	186.0	***46.6***	***16.5***
1966	234.0	***48.3***	***17.5***
1967	122.0	***50.1***	***18.5***
1968	261.0	***51.8***	***19.5***
1969	303.0	***53.6***	20.5
1970	134.1	***55.3***	17.5
1971	116.0	***57.1***	29.3
1972	48.0	***58.8***	26.8
1973	75.0	***60.6***	51.2
1974	156.0	62.3	36.9
1975	347.2	62.3	32.7

Presumed Catch SS2 input in bold italics.

Table 4. Estimated black rockfish discard in the Washington recreational sport fishery.

Black Rockfish Discard in the Washington Sport Fishery

Year	# of Fish	Mean Weight (kg)	Assumed Mortality	Catch Weight (mt)
2002	5,719	1.17	90%	6.0
2003	4,554	1.21	90%	5.0
2004	9,764	1.18	90%	10.4
2005	15,085	1.19	90%	16.2
2006	8,733	1.22	90%	9.6

Note: Discard not availible prior to 2002

Table 5. Total effort (expanded) in Washington sport fisheries.

	All Trip Types		**Bottom-Fish-Only Trips**	
	ANGLERS	BOAT TRIPS	ANGLERS	BOAT TRIPS
1985	177,305	36,486	31,200	5,984
1986	213,459	47,941	36,223	6,536
1987	245,293	60,622	45,115	9,268
1988	254,412	67,793	47,793	9,299
1989	301,922	80,913	32,506	6,217
1990	198,095	50,245	36,572	7,109
1991	216,554	60,133	37,416	7,437
1992	174,219	48,476	40,248	8,960
1993	230,890	68,690	42,022	9,446
1994	55,288	12,039	40,005	8,009
1995	115,954	28,775	36,120	8,425
1996	144,324	39,575	32,950	6,822
1997	111,714	32,792	29,937	6,593
1998	81,429	22,740	29,818	6,012
1999	81,182	21,764	24,269	4,737
2000	113,869	31,976	22,563	4,169
2001	208,076	59,325	20,385	4,068
2002	153,200	40,120	20,394	3,817
2003	180,360	48,437	18,453	3,548
2004	184,615	51,119	22,188	4,733
2005	150,017	39,433	28,645	6,451
2006	122,067	31,743	30,138	6,321

Table 6. Summary of size composition data collected from commercial and recreational fisheries during 1976 – 2006.

Year	Number of field samples			Number of length measurements			Mean size (cm)		
	Sport	Trawl	Non-Trawl	Sport	Trawl	Non-Trawl	Sport	Trawl	Non-Trawl
1976		4			782			47.5	
1977									
1978									
1979	7			508			46.4		
1980	8	2	2	703	206	96	45.4	46.1	45.9
1981	23	4		1468	400		43.3	46.8	
1982	9	4	1	263	400	29	40.7	44.5	40.1
1983	1	8	2	10	800	124	36.9	45.3	41.2
1984	21	3	1	835	300	100	40.4	44.7	40.9
1985	2			160			43.1		
1986	21	13	27	512	322	527	41.8	45.5	44.4
1987	23	16	25	645	401	722	43.3	47.3	43.2
1988	18	4	17	451	100	424	41.9	47.3	43.8
1989	16	9	12	397	225	299	42.2	49.1	44.7
1990	11	10	4	290	249	125	41.6	47.1	36.7
1991	22	12	19	720	302	500	40.8	47.1	40.2
1992	34	8	11	890	200	275	41.3	46.3	40.0
1993	35	5	13	866	125	325	40.6	46.9	40.4
1994	35	2	9	868	49	250	40.9	46.2	38.1
1995	32	2	9	814	50	225	40.5	45.7	39.6
1996	33			834			39.5		
1997	36	2		900	31		40.5	46.6	
1998	37	2		1327	85		39.8	43.6	
1999	34			1673			39.5		
2000	33	1		1650	3		40.0	47.3	
2001	36	1		1777	1		40.2	53.0	
2002	56	1		2629	50		40.9	47.8	
2003	58	1		2323	3		41.4	45.7	
2004	44	2		2002	15		41.0	51.7	
2005	61		1	2228		1	41.2		43.0
2006	152		2	2854		20	41.1		48.1

Table 7. Summary of age composition data collected from commercial and recreational fisheries during 1976 – 2006.

Year	Number of field samples			Number of age			Mean age		
	Sport	Trawl	Non-Trawl	Sport	Trawl	Non-Trawl	Sport	Trawl	Non-Trawl
1976		2			238			11.3	
1977									
1978									
1979									
1980	4	2		364	195		14.3	13.0	
1981	2	4		71	394		10.6	11.8	
1982		3			295			10.2	
1983		8	1		794	100		10.2	11.8
1984	20	3	1	828	298	99	9.7	12.6	11.3
1985	2			160			10.8		
1986	21	13	27	506	321	525	9.3	10.1	11.9
1987	23	16	25	642	401	720	11.5	11.3	10.9
1988	18	4	17	448	99	416	10.0	12.1	10.8
1989	16	9	12	395	224	297	9.3	10.5	10.8
1990	11	10	4	289	249	125	9.4	11.2	7.3
1991	22	12	19	717	301	500	9.2	12.2	8.7
1992	34	8	11	889	200	275	9.7	10.1	9.0
1993	35	5	13	863	125	324	9.0	10.9	8.5
1994	35	2	9	866	48	250	9.6	13.4	7.7
1995	32	2	9	813	49	225	8.6	12.0	7.7
1996	33			829			8.5		
1997	36			893			9.6		
1998	37			1323			9.4		
1999	34			1655			9.1		
2000	33			1644			9.6		
2001	36			1773			9.7		
2002	38			1894			9.8		
2003	37			1841			9.6		
2004	33			1645			9.4		
2005	33			1603			9.6		
2006	30		1	1484		19	9.5		14.3

Table 8. Summary of male and female black rockfish age to weight data with estimated errors in each conversion.

Age	Male		Female	
$\hat{t}$ (st. err.)	$\hat{L}$ (st.err.)	$\hat{W}$ (st.err.)	$\hat{L}$ (st.err.)	$\hat{W}$ (st.err.)
1(0.002)	20.123(0.583)	0.161(0.019)	20.123(0.583)	0.163(0.019)
2(0.004)	24.754(0.406)	0.286(0.029)	24.689(0.396)	0.288(0.028)
3(0.006)	28.568(0.281)	0.426(0.040)	28.564(0.262)	0.431(0.039)
4(0.007)	31.709(0.195)	0.569(0.052)	31.851(0.170)	0.583(0.051)
5(0.009)	34.296(0.138)	0.708(0.064)	34.641(0.113)	0.735(0.063)
6(0.011)	36.427(0.105)	0.838(0.076)	37.008(0.083)	0.883(0.076)
7(0.013)	38.181(0.092)	0.955(0.086)	39.017(0.070)	1.022(0.088)
8(0.015)	39.626(0.094)	1.059(0.096)	40.722(0.064)	1.150(0.099)
9(0.017)	40.816(0.106)	1.149(0.104)	42.168(0.062)	1.267(0.109)
10(0.019)	41.796(0.122)	1.228(0.111)	43.396(0.063)	1.371(0.118)
11(0.020)	42.603(0.140)	1.295(0.117)	44.437(0.068)	1.465(0.126)
12(0.022)	43.268(0.159)	1.352(0.123)	45.321(0.077)	1.547(0.133)
13(0.024)	43.815(0.177)	1.400(0.127)	46.071(0.090)	1.618(0.139)
14(0.026)	44.266(0.195)	1.441(0.131)	46.707(0.106)	1.681(0.144)
15(0.028)	44.637(0.211)	1.474(0.134)	47.247(0.123)	1.735(0.149)
16(0.030)	44.943(0.227)	1.503(0.137)	47.706(0.141)	1.782(0.153)
17(0.032)	45.195(0.241)	1.526(0.139)	48.095(0.158)	1.823(0.157)
18(0.033)	45.402(0.253)	1.546(0.141)	48.425(0.175)	1.858(0.160)
19(0.035)	45.573(0.265)	1.562(0.143)	48.705(0.192)	1.888(0.163)
20(0.037)	45.714(0.275)	1.576(0.144)	48.942(0.207)	1.913(0.165)
21(0.039)	45.829(0.284)	1.587(0.146)	49.144(0.221)	1.935(0.167)
22(0.041)	45.925(0.292)	1.596(0.147)	49.315(0.234)	1.954(0.169)
23(0.043)	46.003(0.299)	1.603(0.147)	49.460(0.246)	1.970(0.171)
24(0.045)	46.068(0.306)	1.610(0.148)	49.583(0.257)	1.983(0.172)
25(0.046)	46.121(0.311)	1.615(0.149)	49.688(0.267)	1.995(0.173)
26(0.048)	46.165(0.316)	1.619(0.149)	49.776(0.275)	2.005(0.174)
27(0.050)	46.201(0.320)	1.623(0.150)	49.852(0.283)	2.013(0.175)
28(0.052)	46.231(0.323)	1.626(0.150)	49.916(0.291)	2.020(0.176)
29(0.054)	46.256(0.326)	1.628(0.150)	49.970(0.297)	2.026(0.177)
30(0.056)	46.276(0.329)	1.630(0.150)	50.016(0.303)	2.032(0.177)
31(0.058)	46.293(0.331)	1.632(0.151)	50.055(0.308)	2.036(0.178)
32(0.059)	46.306(0.333)	1.633(0.151)	50.088(0.312)	2.040(0.178)
33(0.061)	46.318(0.335)	1.634(0.151)	50.116(0.316)	2.043(0.179)
34(0.063)	46.327(0.336)	1.635(0.151)	50.140(0.320)	2.046(0.179)
35(0.065)	46.334(0.338)	1.636(0.151)	50.160(0.323)	2.048(0.179)
36(0.067)	46.341(0.339)	1.636(0.151)	50.177(0.325)	2.050(0.179)
37(0.069)	46.346(0.339)	1.637(0.151)	50.192(0.328)	2.051(0.180)
38(0.071)	46.350(0.340)	1.637(0.151)	50.204(0.330)	2.053(0.180)
39(0.072)	46.354(0.341)	1.638(0.151)	50.215(0.332)	2.054(0.180)
40(0.074)	46.357(0.341)	1.638(0.151)	50.224(0.333)	2.055(0.180)
41(0.076)	46.359(0.342)	1.638(0.151)	50.231(0.335)	2.056(0.180)
42(0.078)	46.361(0.342)	1.638(0.152)	50.238(0.336)	2.057(0.180)
43(0.080)	46.363(0.343)	1.639(0.152)	50.243(0.337)	2.057(0.180)
44(0.082)	46.364(0.343)	1.639(0.152)	50.248(0.338)	2.058(0.180)
45(0.084)	46.365(0.343)	1.639(0.152)	50.252(0.339)	2.058(0.180)
46(0.085)	46.366(0.343)	1.639(0.152)	50.255(0.340)	2.059(0.180)
47(0.087)	46.367(0.343)	1.639(0.152)	50.258(0.340)	2.059(0.181)

48(0.089)	46.367(0.344)	1.639(0.152)	50.260(0.341)	2.059(0.181)
49(0.091)	46.368(0.344)	1.639(0.152)	50.262(0.341)	2.059(0.181)
50(0.093)	46.368(0.344)	1.639(0.152)	50.264(0.342)	2.060(0.181)
51(0.095)	46.369(0.344)	1.639(0.152)	50.265(0.342)	2.060(0.181)
52(0.097)	46.369(0.344)	1.639(0.152)	50.267(0.342)	2.060(0.181)
53(0.098)	46.369(0.344)	1.639(0.152)	50.268(0.343)	2.060(0.181)
54(0.100)	46.369(0.344)	1.639(0.152)	50.269(0.343)	2.060(0.181)
55(0.102)	46.369(0.344)	1.639(0.152)	50.269(0.343)	2.060(0.181)
56(0.104)	46.370(0.344)	1.639(0.152)	50.270(0.343)	2.060(0.181)
57(0.106)	46.370(0.344)	1.639(0.152)	50.270(0.343)	2.060(0.181)
58(0.108)	46.370(0.344)	1.639(0.152)	50.271(0.343)	2.060(0.181)
59(0.110)	46.370(0.344)	1.639(0.152)	50.271(0.344)	2.060(0.181)
60(0.112)	46.370(0.344)	1.639(0.152)	50.272(0.344)	2.061(0.181)

Table 9. Summary of the number of black rockfish fish sampled with age in maturity study and the expected probability of maturity with age.

Age	**No. of immature fish**	**No. of mature fish**	**Expected probability of maturity**
4	1	0	0.01
5	12	0	0.02
6	50	1	0.05
7	73	7	0.09
8	65	13	0.17
9	38	22	0.29
10	22	12	0.45
11	6	15	0.62
12	2	5	0.76
13	2	2	0.87
14	0	2	0.93
15	0	0	0.96
16	0	0	0.98
17	0	0	0.99
18	0	0	1.00
19	0	0	1.00
20	0	2	1.00

Table 10. Summary of the number of black rockfish fish sampled with fork length in maturity study and the expected probability of maturity with fork length.

Fork length (cm)	No. of immature fish	No. of mature fish	Expected probability of maturity
25	1	0	0
26	1	0	0
27	1	0	0
28	2	0	0
29	3	0	0
30	7	0	0.01
31	3	1	0.01
32	5	0	0.02
33	13	0	0.02
34	18	0	0.03
35	30	0	0.05
36	32	3	0.07
37	37	4	0.11
38	30	8	0.15
39	35	10	0.22
40	27	12	0.29
41	20	13	0.38
42	14	9	0.48
43	8	10	0.59
44	4	11	0.68
45	2	2	0.76
46	0	7	0.83
47	1	3	0.88
48	0	2	0.92
49	0	2	0.94

Table 11. Summary of the estimated total mortality coefficients of male and female black rockfish from 1984 to 2006.

Year	Male		Female	
	N	$\hat{Z}$ (st. err.)	n	$\hat{Z}$ (st. err.)
1984	267	0.162(0.068)	429	0.267(0.005)
1988	128	0.169(0.098)	148	0.341(0.207)
1989	180	0.256(0.112)	217	0.205(0.071)
1990	132	0.200(0.044)	158	0.407(0.129)
1991	326	0.213(0.050)	394	0.259(0.031)
1992	424	0.187(0.080)	457	0.325(0.011)
1993	364	0.270(0.048)	495	0.277(0.028)
1994	399	0.244(0.013)	465	0.348(0.016)
1995	372	0.304(0.009)	440	0.370(0.039)
1996	399	0.394(0.080)	432	0.387(0.014)
1997	437	0.298(0.079)	438	0.361(0.031)
1998	947	0.315(0.043)	874	0.400(0.013)
1999	851	0.320(0.034)	822	0.353(0.013)
2000	741	0.316(0.071)	909	0.406(0.056)
2001	800	0.353(0.026)	974	0.427(0.053)
2002	783	0.324(0.064)	1066	0.298(0.057)
2003	793	0.290(0.055)	1009	0.327(0.069)
2004	731	0.254(0.066)	922	0.297(0.032)
2005	681	0.238(0.092)	982	0.339(0.069)
2006	806	0.220(0.074)	802	0.323(0.035)

Table 12. Summary of the proportion by area and the number of recreational observations taken from 1990 to 2006.

Year	Area				
	1	2	3	74	84
1990	5102(2.87%)	159462(89.83%)	2202(1.24%)	5601(3.16%)	5144(2.90%)
1991	2156(1.43%)	138150(91.69%)	2602(1.73%)	3122(2.07%)	4643(3.08%)
1992	3422(2.82%)	97598(80.29%)	4159(3.42%)	10128(8.33%)	6252(5.14%)
1993	5636(5.13%)	88923(81.01%)	3153(2.87%)	6115(5.57%)	5942(5.41%)
1994	7754(4.37%)	148419(83.69%)	7552(4.26%)	7275(4.10%)	6340(3.58%)
1995	3442(2.42%)	112959(79.57%)	5118(3.61%)	10172(7.17%)	10271(7.24%)
1996	5018(3.02%)	133094(80.22%)	4179(2.52%)	8263(4.98%)	15349(9.25%)
1997	5771(4.67%)	100816(81.61%)	1729(1.40%)	5814(4.71%)	9400(7.61%)
1998	8048(5.79%)	110960(79.78%)	2711(1.95%)	4645(3.34%)	12720(9.15%)
1999	1951(1.77%)	93642(84.92%)	2801(2.54%)	4412(4.00%)	7470(6.77%)
2000	3524(3.09%)	93927(82.31%)	3125(2.74%)	6625(5.81%)	6918(6.06%)
2001	3814(4.01%)	77415(81.37%)	2232(2.35%)	5322(5.59%)	6355(6.68%)
2002	4610(4.54%)	79168(77.89%)	2823(2.78%)	8967(8.82%)	6079(5.98%)
2003	6589(7.25%)	68067(74.87%)	2735(3.01%)	6757(7.43%)	6766(7.44%)
2004	4599(4.66%)	74905(75.93%)	3706(3.76%)	6047(6.13%)	9399(9.53%)
2005	4136(3.43%)	84719(70.28%)	7052(5.85%)	9351(7.76%)	15280(12.68%)
2006	5769(4.31%)	106803(79.75%)	4558(3.40%)	6307(4.71%)	10492(7.83%)

Table 13. Summary of the recreational fishery CPUEs estimated from mean estimator and delta lognormal model for all areas.

Year	Total catch/total anglers				Delta lognormal model			
	Estimates	$q_{\bar{X},2.5\%}$	$q_{\bar{X},97.5\%}$	$CV_{\bar{X}}$	Estimates	$q_{\bar{X},2.5\%}$	$q_{\bar{X},97.5\%}$	$CV_{\bar{X}}$
1990	8.58	8.33	8.85	0.02	5.73	5.52	5.92	0.02
1991	7.37	7.18	7.60	0.02	5.43	5.24	5.61	0.02
1992	6.14	5.92	6.37	0.02	4.77	4.63	4.92	0.02
1993	5.83	5.61	6.11	0.02	4.24	4.13	4.42	0.02
1994	6.87	6.70	7.04	0.01	4.43	4.29	4.56	0.01
1995	5.94	5.75	6.10	0.01	4.07	3.94	4.18	0.02
1996	6.37	6.22	6.53	0.01	4.57	4.45	4.69	0.01
1997	5.78	5.64	5.94	0.02	3.93	3.81	4.05	0.02
1998	6.35	6.17	6.50	0.01	4.80	4.66	4.91	0.01
1999	6.93	6.73	7.07	0.01	4.86	4.70	4.99	0.02
2000	6.83	6.63	6.98	0.01	5.03	4.87	5.18	0.02
2001	6.46	6.25	6.66	0.01	4.29	4.13	4.44	0.02
2002	7.03	6.86	7.20	0.01	5.01	4.86	5.17	0.02
2003	6.93	6.75	7.12	0.01	4.95	4.75	5.14	0.02
2004	7.14	6.94	7.33	0.01	5.57	5.41	5.73	0.02
2005	6.98	6.80	7.13	0.01	5.36	5.21	5.48	0.01
2006	7.29	7.15	7.42	0.01	5.20	5.06	5.33	0.01

Table 14. Summary of the recreational sport CPUEs estimated from mean estimator and delta lognormal model for Area 2.

Year	Total catch/total anglers				Delta lognormal model			
	Estimates	$q_{\bar{X},2.5\%}$	$q_{\bar{X},97.5\%}$	$CV_{\bar{X}}$	Estimates	$q_{\bar{X},2.5\%}$	$q_{\bar{X},97.5\%}$	$CV_{\bar{X}}$
1990	10.98	10.66	11.29	0.02	10.84	10.51	11.18	0.01
1991	8.75	8.54	8.96	0.01	8.35	8.11	8.56	0.01
1992	7.35	7.01	7.63	0.02	6.85	6.53	7.11	0.02
1993	7.52	7.24	7.85	0.02	7.16	6.92	7.48	0.02
1994	9.64	9.43	9.86	0.01	9.33	9.13	9.55	0.01
1995	8.31	8.16	8.46	0.01	7.81	7.64	8.01	0.01
1996	8.03	7.83	8.23	0.01	7.63	7.45	7.81	0.01
1997	7.23	7.01	7.44	0.01	6.37	6.12	6.59	0.02
1998	7.44	7.20	7.63	0.01	6.76	6.57	6.95	0.01
1999	8.54	8.35	8.72	0.01	7.70	7.46	7.91	0.02
2000	8.36	8.18	8.58	0.01	7.80	7.60	7.99	0.01
2001	8.25	8.03	8.47	0.01	7.08	6.81	7.35	0.02
2002	8.85	8.63	9.05	0.01	7.95	7.68	8.24	0.02
2003	8.46	8.24	8.68	0.01	6.83	6.51	7.11	0.02
2004	8.10	7.86	8.31	0.01	6.86	6.58	7.12	0.02
2005	8.77	8.60	8.93	0.01	7.80	7.60	8.03	0.02
2006	8.92	8.78	9.05	0.01	8.16	7.96	8.33	0.01

Table 15. Central Washington coastal tagging mean catch per trip (catch/hours fished).

Central Washington Coast Tagging CPUE

Year	Mean Catch Per Hour Across All Trips	ln(1+cv)
1981	4.8	0.666
1986	2.3	0.5993
1987	1.2	0.6344
1988	0.8	0.5539
1989	1.2	0.9771
1990	1.0	0.8439
1998	2.5	0.813
1999	3.1	0.7407
2000	2.2	0.5684
2001	4.7	0.6076
2002	5.5	0.5034
2003	6.2	0.5913
2004	9.4	0.5149
2005	10.2	0.7579
2006	10.5	0.4205

Table 16. Summary of the return of tagged fish from the CWT double tags experiment.

Year	i	No. of one tag return (r_{si})		No. of two tags return (r_{di})
		left	right	
1998	0	8	17	691
1999	1	14	11	542
2000	2	14	18	433
2001	3	14	8	276
2002	4	6	8	160
2003	5	2	2	73
2004	6	0	2	34

Table 17. Summary of the year, the no. of fish tagged, no. of fish sampled, the numbers of fish return with tags, tag on the right, tag on the left, double tag, the estimated population size and variance, the adjusted no. of tag return with tag loss, the estimated population size with tag loss adjustment and variance.

Year	n_1	n_2	m	m_r	m_l	m_d	$\hat{N}$	$\text{Var}(\hat{N})$	$\hat{\hat{m}}$	$\hat{N}$	$\text{Var}(\hat{\hat{N}})$
1998	2456	46951	14	1	1	12	7.69E+06	3.67E+12	14.08	7.65E+06	4.53E+12
1999	3479	66253	43	1	0	42	5.24E+06	6.02E+11	43.01	5.24E+06	6.46E+11
2000	2789	65276	130	3	5	122	1.39E+06	1.39E+10	130.13	1.39E+06	1.53E+10
2001	3210	64440	68	2	1	65	3.00E+06	1.26E+11	68.03	3.00E+06	1.35E+11
2002	4089	68475	143	1	1	141	1.94E+06	2.51E+10	143.01	1.94E+06	2.66E+10
2003	6747	77622	246	1	8	237	2.12E+06	1.74E+10	246.09	2.12E+06	1.86E+10
2004	4209	53385	74	1	1	72	3.00E+06	1.16E+11	74.01	3.00E+06	1.23E+11
2005	3913	70482	54	0	0	54	5.02E+06	4.43E+11	54.00	5.02E+06	4.66E+11

Table 18. Likelihood components from the STAR base (top) and STAT best-fit (bottom) northern black rockfish models.

STAR Base Model

Likelihood Components	**Emphasis**	**Likelihood**
indices		
Tag Abundance	1.0	43.4
Tag CPUE	1.0	11.7
discard	0.0	0.0
length_comps		
Trawl	0.1	67.6
Sport	0.1	32.3
Non-Trawl	0.1	38.1
Tag	0.1	18.3
age_comps		
Trawl	1.0	187.2
Sport	1.0	395.3
Non-Trawl	1.0	187.0
size-at-age	0.0	105.9
mean_body_wt	0.0	0.0
Equil_catch	1.0	0.0
Recruitment	0.1	14.5
Parm_priors	1.0	0.0
Parm_devs	0.1	0.0
penalties	0.0	0.0
Forecast_Recruitment	0.0	0.2
		1101.6

STAT Best Fit Model

Likelihood Components	**Emphasis**	**Likelihood**
indices		
Tag Abundance	1.0	41.5
Tag CPUE	1.0	10.4
discard	0.0	0.0
length_comps		
Trawl	0.1	69.2
Sport	0.1	32.5
Non-Trawl	0.1	39.4
Tag	0.1	19.0
age_comps		
Trawl	1.0	180.6
Sport	1.0	386.8
Non-Trawl	1.0	185.7
size-at-age	0.0	106.5
mean_body_wt	0.0	0.0
Equil_catch	1.0	0.0
Recruitment	0.1	15.4
Parm_priors	1.0	.
Parm_devs	0.1	0.0
penalties	0.0	0.0
Forecast_Recruitment	0.0	0.2
		1087.15

Table 19. Assumptions and Priors used in the Northern black rockfish STAR base model. The only change in the STAT Best Fit model is an increase in the “old” female natural mortality rate from 0.20 to 0.24.

#_growth_parms							
#_LO	HI	INIT	PRIOR	PR_type	SD_Prior	PHASE	
#Females							
0.1	0.2	0.16	0.3	-1	0.9	-2	#_Gpattern:_1_Gender:_Female_M1_natM_young
-3	3	0.2	0.3	-1	0.9	-2	#M1_natM_old_4_intermediateages_do_a_linear_interpolation_of_NM_on_age
10	40	34.4	13.5	-1	10	2	#M1_Lmin_Body_length_at_Amin_(units_in_cm)
30	70	50.37	49.3	-1	10	2	#M1_Lmax_Body_length_at_Amax_(units_in_cm)
0.01	0.4	0.181	0.1745	-1	0.9	3	#M1_VBK
-3	3	0.08	0.0622	-1	0.9	-2	#M1_CV-young_Variability_for_size-at-age_at-age<=AFIX_(units_are_fraction)Units_CV_or
-3	3	0.08	0.0721	-1	0.9	-3	#M1_CV-old_Variability_for_size-at-age_at-age>=AFIX2_do_a_linear_interpolation_of_CV_
#Males							
0.1	0.2	0.16	0.1	-1	0.9	-2	#_Gpattern:_1_Gender:_Male__M1_natM_young
0.1	0.2	0.16	0.1	-1	0.9	-2	#M1_natM_old_4_intermediateages_do_a_linear_interpolation_of_NM_on_age
10	40	34.2	15	-1	0.9	2	#M1_Lmin
30	70	47.3	46.6	-1	0.9	2	#M1_Lmax
0.1	0.3	0.191	0.1982	-1	0.9	3	#M1_VBK
0.05	0.25	0.07	0.06	-1	0.9	-3	#M1_CV-young
-3	3	0.07	0.0567	-1	0.9	-3	#M1_CV-old
#Females_wtln_Maturity_fec							
-3	3	4.03E-05	4.03E-05	-1	99	-3	#Female wt-len-1_coefficient_to_convert_L_in_cm_to_Wt_in_kg
-3	3	2.768	2.768	-1	0.9	-3	#Female_wt-len-2_Exponent_in_female_L-W_conversion
-3	3	42.6	42.6	-1	0.9	-3	#Female_Maturity_logistic_inflection
-3	3	-0.4	-0.4	-1	0.9	-3	#Female_Logistic_slope
-3	3	-0.3657	-0.3657	-1	0.9	-3	#-0.3657Female_eggs/gm_intercept
-3	3	0.7674	0.7674	-1	0.9	-3	#0.7674Female_eggs/gm_slope
#Male_wtln							
-3	3	3.80E-05	3.80E-05	-1	99	-3	#Male wt-len-1_coefficient_to_convert_L_in_cm_to_Wt_in_kg
-3	3	2.782	2.782	-1	0.9	-3	#Male_wt-len-2_Exponent_in_female_L-W_conversion
-4	4	0	1	-1	0.9	-3	#_recrdistribution_by_growth_pattern
-4	4	0	1	-1	0.9	-3	#_recrdistribution_by_area_1
-4	4	0	1	-1	0.9	-3	#_recrdistribution_by_season_1
-1	1	1	1	-1	0.9	-3	#_cohort_growth_deviation
0	#_custom_MG-env_setup						
0	#_custom_MG-block_setup						
#_Spawner-Recruitment							
3	#_SR_function						
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	
1	15	12	6.7	0	10	1	#log(R0)
0.2	1	0.6	0.566	2	0.181	-5	#steepness
0	2	0.3	0.65	0	0.4	-4	#sigma-r
-5	5	0	0	0	1	-3	#env-linkrecruitment-environmental_linkage_coefficient
-5	5	0	0	0	1	-1	#log(R1)offsetfor_initial_equil_recruitment_relative_to_virgin_recruitment_(usually0)
0	0	0	0	-1	0	-99	#autocorrelation_parameter_for_S-R
0	#_SR_env_link						
1	#_SR_env_target_1=devs;_2=R0;_3=steepness						
1	#do_recr_c 0=none; 1=devvector;_2=simple_deviations						
1968	#Begin RecDevs						
2001	#End_recr_Dev						
-15	#Min_Value4Rec_Dev						
15	#Max_Value4RecDev						
3	#Phaseto begin_Estimation						
1492	#_first_yr_fullbias_adj_in_MPD						
#_initial_F_parms							
#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE	
0	0.6	0	0.0001	-1	99	-1	
0	0.6	0	0.0001	-1	99	-1	
0	0.6	0	0.0001	-1	99	-1	
#_Q_setup							
#	A=do	power,	B=env-var, C=extra	SD,		D=devtype	0/1=none, 2=cons, 3=rand, 4=randwalk E=0=num/1 F=err_type
#_A	B	C	D	E	F		
0	0	0	0	1	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		
#_Q_parms(if_any)							

Table 19. Continued.

#_selex_parms

#_LO	HI	INIT	PRIOR	PR_type	SD	PHASE
#_size_sel: Trawl						
30	60	46	51.2	-1	0.05	2
-6	4	1.6	-2.6	-1	0.05	3
-1	9	4	5.2	-1	0.05	-3
-1	9	2.2	6	-1	0.05	-3
-8	9	-4	-3.7	-1	0.05	2
-5	9	-1	0.1	-1	0.05	2
#_size_sel: Sport						
20	60	41.5	41.2	-1	0.05	2
-6	4	-4	-2.6	-1	0.05	3
-1	9	3.5	5.2	-1	0.05	-3
-1	9	3	6	-1	0.05	-3
-8	9	-3.7	-3.7	-1	0.05	2
-5	9	-1	0.1	-1	0.05	2
#_size_sel: Non-trawl						
30	60	46	41.2	-1	0.05	2
-6	4	-0.747	-2.6	-1	0.05	3
-1	9	4.83454	5.2	-1	0.05	3
-1	9	4	6	-1	0.05	3
-8	9	-4	-3.7	-1	0.05	2
-5	9	2	0.1	-1	0.05	2
#_size_sel: OSP CPUE mirror sport						
1	19	1	5	-1	0.05	-2
1	19	19	5	-1	0.05	-3
#_size_sel: Tagging abundance mirrow tagging CPUE						
1	19	1	5	-1	0.05	-2
1	19	19	5	-1	0.05	-3
#_size_sel: Tagging CPUE						
20	60	39.513	41.2	-1	0.05	2
-6	4	-3.41	-2.6	-1	0.05	3
-1	9	3.7	5.2	-1	0.05	3
-1	9	3.5	6	-1	0.05	3
-8	9	-4.69	-3.7	-1	0.05	2
-5	9	-3.95	0.1	-1	0.05	2

#_lambdas_(columns_for_phases)

1	#_Fishery:_1
1	#_Fishery:_2
1	#_Fishery:_3
0	#_OSP_CPUE:_4
1	#_TagAbundance:_5
1	#_TagCPUE:_6
0	#_discard:_1
0	#_discard:_2
0	#_discard:_3
0	#_discard:_4
0	#_discard:_5
0	#_discard:_6
0	#_meanbodyweight
0.1	#_lencomp:_1
0.1	#_lencomp:_2
0.1	#_lencomp:_3
0	#_lencomp:_4
0	#_lencomp:_5
0.1	#_lencomp:_6
1	#_agecomp:_1
1	#_agecomp:_2
1	#_agecomp:_3
0	#_agecomp:_4
0	#_agecomp:_5
0	#_agecomp:_6
1	#_size-age:_1
1	#_size-age:_2
0	#_size-age:_3
0	#_size-age:_4
0	#_size-age:_5
0	#_size-age:_6
1	#_init_equ_catch
1	#_recruitm Deveations
1	#_parameter-priors
1	#_parameter-dev-vectors
1000	#_crashPenLambda
0.99	#_maximum_allowed_harvest_rate

Table 20. Average Pearson residual by fishery (Trawl=1, Sport=2, Non-Trawl=3) by likelihood component.

Used	1
year	(All)

				Data						For Age & Len:
kind	fleet	season	mkt	Average of	Average of effN	Average (	Min of Pe	Max of Pe	StdDev of Pearson	effN/inputN
AGE	1	1	0	66	103	-0.026	-2.39	4.86	0.823880087	1.57
	2	1	0	312	343	0.027	-2.67	3.84	0.885559936	1.10
	3	1	0	116	157	0.004	-2.44	8.05	0.988462445	1.35
LEN	1	1	0	110	44	0.785	-3.78	14.38	2.878351254	0.40
	2	1	0	135	340	0.161	-3.08	7.96	1.137126017	2.52
	3	1	0	199	139	0.430	-3.72	9.64	2.065073952	0.70
	6	1	0	217	204	0.001	-2.71	4.79	1.166505276	0.94
L@A	2	1	0	42	1.2326	-0.454	-4.37	3.95	1.501360074	0.03

Table 21. Average Pearson residual by fishery (Trawl=Top 2 rows, Sport=Middle 2 rows, Non-Trawl Bottom 2 rows) , age and sex.

Mean Pearson residule by Age and Fleet (Trawl=1, Sport =2 and Non-Trawl=3)

Average of Pearson		bin																							
fleet	gender	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30	Grand Total
1	1	0.33	-0.35	-0.22	-0.38	-0.06	-0.02	0.29	-0.10	0.11	0.20	0.08	-0.30	-0.35	-0.40	-0.24	-0.45	-0.56	-0.44	-0.49	-0.62	-0.31	-0.29	-0.63	-0.16	-0.20
	2	1.95	-0.19	0.00	0.21	0.64	1.01	0.82	0.43	-0.20	0.24	0.24	-0.13	-0.04	-0.08	-0.20	-0.26	-0.27	-0.19	0.23	0.00	-0.13	-0.03	-0.04	0.03	0.12
2	1	-0.22	0.00	0.17	0.05	0.16	0.59	0.46	0.56	0.53	0.46	0.32	0.10	0.26	-0.01	-0.08	-0.05	-0.18	-0.27	-0.25	-0.43	-0.29	-0.42	-0.33	0.60	0.10
	2	-0.63	-0.25	0.04	-0.02	-0.09	-0.09	-0.68	-0.90	-0.64	-0.81	-0.43	-0.28	0.02	-0.05	0.26	0.23	0.25	0.58	0.45	0.25	0.36	0.40	0.47	0.47	-0.04
3	1	-0.15	0.73	0.80	0.24	0.25	0.09	0.22	-0.36	-0.09	0.21	0.48	0.03	0.30	0.28	-0.10	0.00	-0.29	-0.32	-0.56	0.09	-0.57	-0.40	-0.47	1.25	0.10
	2	0.00	-0.24	0.58	-0.05	-0.31	-0.29	-0.58	-0.25	-0.68	-0.24	-0.05	-0.10	-0.10	-0.30	0.05	-0.16	-0.02	0.19	0.11	0.02	0.15	-0.01	0.05	0.82	-0.07
Grand Total		-0.20	-0.02	0.24	0.00	0.09	0.25	0.08	-0.10	-0.13	-0.02	0.07	-0.12	0.02	-0.09	-0.03	-0.08	-0.12	0.01	0.02	-0.08	-0.02	0.00	0.06	0.47	0.01

Table 22. Model sensitivity by likelihood component to rates of natural mortality relative to that assumed in the STAR base model. Values represent the change in likelihood relative to the base models such that negative values indicate a better fit. Female natural mortality rates for ages less than 11 are assumed to be equal to that assumed for males.

Total Likelihood — **Female Natural Mortality Rate**

Male Natural Mortality Rate	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**
0.1	270.0	186.0	128.4	90.6	67.2	54.2	48.8	49.2	54.1	62.4	73.6
0.12	226.1	140.6	84.5	48.5	26.2	13.6	16.4	8.1	12.4	20.0	30.5
0.14	205.1	124.0	70.6	35.7	13.0	-0.9	-8.1	-10.0	-7.5	-1.6	7.1
0.16	203.4	127.5	76.5	41.1	16.5	0.0	-10.0	**-14.7**	-15.0	-11.6	-5.1
0.18	216.3	144.4	95.1	58.6	31.3	11.4	-2.2	-10.3	-12	-13.5	-9.9
0.2	240.0	171.6	122.8	89	54.6	30.9	13.4	1.3	-6.0	-9.2	-8.7
0.22	272.4	206.4	112.8	102.7	90.0	57.4	33	19.2	7.8	0.7	-2.4

Fit to Tag Abundance

Male Natural Mortality Rate	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**
0.1	127.1	95.1	71.4	54.9	43.7	35.9	30.5	26.6	23.7	21.5	19.8
0.12	97.1	62.1	40.2	26.9	18.9	13.8	7.4	8.3	6.8	5.7	4.9
0.14	72.1	39.9	21.8	12.2	7.0	3.9	2.1	0.9	0.1	-0.3	-0.7
0.16	54.1	26.3	11.9	5.2	1.8	0.0	-1.0	-1.5	-1.8	**-1.9**	-2.0
0.18	41.7	18.1	6.8	2.0	0.0	-0.9	-1.3	-1.4	-1	-1.2	-1.1
0.2	33.1	13.5	4.3	2.1	-0.1	-0.3	-0.1	0.2	0.5	0.8	1.1
0.22	27.5	10.9	2.5	2.8	3.2	1.5	2	2.7	3.3	3.8	4.2

Fit to Tag CPUE

Male Natural Mortality Rate	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**
0.1	26.4	22.6	19.3	16.7	14.6	13.0	11.8	10.8	10.0	9.4	9.0
0.12	22.9	17.9	13.8	10.8	8.6	7.0	5.8	4.9	4.3	3.8	3.4
0.14	19.4	13.7	9.3	6.2	4.2	2.7	1.7	1.0	0.5	0.1	-0.1
0.16	16.3	10.5	6.0	3.0	1.2	0.0	-0.8	-1.3	-1.7	-2.0	-2.2
0.18	13.6	7.9	3.6	1.0	-0.7	-1.6	-2.3	-2.7	-3	-3.2	-3.3
0.2	11.5	5.9	2.2	0	-1.8	-2.5	-3.0	-3.3	-3.5	-3.6	**-3.7**
0.22	9.8	4.6	-3.7	-3.6	-3.5	-2.9	-3	-3.4	-3.5	-3.6	-3.6

Fit to all Indices

Male Natural Mortality Rate	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**
0.1	153.4	117.7	90.7	71.6	58.3	48.9	42.2	37.4	33.7	30.9	28.8
0.12	120.0	80.0	54.0	37.7	27.5	20.8	13.1	13.3	11.1	9.5	8.3
0.14	91.6	53.7	31.0	18.5	11.1	6.6	3.8	1.9	0.7	-0.2	-0.8
0.16	70.4	36.8	17.9	8.2	3.0	0.0	-1.8	-2.8	-3.5	-3.9	-4.2
0.18	55.4	26.0	10.5	3.0	-0.7	-2.6	-3.6	-4.1	-4	-4.4	-4.4
0.2	44.6	19.5	6.5	2.3	-1.8	-2.8	-3.1	-3.1	-3.0	-2.8	-2.6
0.22	37.3	15.5	-1.2	-0.8	-0.3	-1.5	-1	-0.7	-0.2	0.2	0.6

Note: Square indcates the Base Model and bold font indicates best fit.

Table 22. Continued.

Fit to Length Composition — **Female Natural Mortality Rate**

Male Natural Mortality Rate	0.1	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.26	0.28	0.3
0.1	2.0	-1.6	-3.1	-3.2	-2.4	-1.1	0.5	2.4	4.3	6.3	8.3
0.12	5.6	0.8	-1.5	-2.3	-2.0	-0.9	17.1	2.3	4.2	6.2	8.1
0.14	8.0	4.6	1.0	-0.7	-1.1	-0.5	0.7	2.2	4.0	5.9	7.9
0.16	8.2	9.4	4.1	1.2	0.0	0.0	0.8	2.0	3.6	5.4	7.3
0.18	9.1	10.7	7.5	3.3	1.1	0.4	0.7	1.7	-8.4	4.7	6.6
0.2	10.7	11.5	11.6	5.5	2.2	0.7	0.5	1.1	2.2	3.7	5.5
0.22	12.7	13.0	10.3	8.3	4.8	0.8	**-18.4**	0.2	1.1	2.4	4.1

Fit to Age Composition

Male Natural Mortality Rate	0.1	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.26	0.28	0.3
0.1	89.8	58.9	35.4	19.4	9.6	5.0	4.7	8.0	14.3	23.1	34.1
0.12	91.0	57.5	32.4	14.4	2.2	-5.0	-18.6	-7.0	-2.9	3.9	13.1
0.14	102.8	66.8	40.8	20.2	4.7	-6.0	-12.2	-14.4	-13.1	-8.9	-2.0
0.16	126.3	83.4	57.1	33.7	14.5	0.0	-10.0	-15.8	-17.8	-16.5	-12.3
0.18	155.7	111.2	79.6	53.8	30.9	12.4	-1.7	-11.3	46.3	**-19.1**	-17.9
0.2	190.0	145.1	106.8	57.4	53.7	31.0	12.7	-1.2	-10.9	-16.7	-19.0
0.22	228.5	183.0	59.1	55.7	54.0	55.8	114.8	14.6	0.7	-9.2	-15.3

Depletion Level

Male Natural Mortality Rate	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.3
0.1	0.05	0.06	0.08	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.300
0.12	0.05	0.08	0.12	0.15	0.19	0.23	0.25	0.29	0.32	0.34	0.24
0.14	0.07	0.11	0.16	0.22	0.27	0.32	0.37	0.41	0.45	0.48	0.37
0.16	0.08	0.13	0.21	0.29	0.36	0.43	0.49	0.54	0.58	0.62	0.51
0.18	0.10	0.17	0.26	0.35	0.45	0.53	0.60	0.67	0.72	0.76	0.65
0.2	0.12	0.20	0.29	0.46	0.53	0.63	0.72	0.79	0.85	0.90	0.80
0.22	0.14	0.23	0.84	0.86	0.87	0.73	1.27	0.90	0.97	1.02	0.94

Note: Square indcates the Base Model and bold font indicates best fit.

B0

Male Natural Mortality Rate	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.3
0.1	2620	2458	2301	2159	2034	1923	1825	1738	1661	1592	1531
0.12	2700	2548	2404	2281	2171	2071	1986	1901	1827	1761	1701
0.14	2741	2579	2486	2396	2315	2238	2164	2096	2031	1971	1915
0.16	2780	2577	2540	2513	2474	2433	2389	2344	2298	2253	2207
0.18	2809	2615	2583	2620	2656	2674	2683	2685	2676	2670	2652
0.2	2836	2652	2574	2725	2875	2992	3102	3205	3297	3378	3443
0.22	2856	2684	13213	10728	8357	3460	3792	4124	4496	4887	5283

Note: Square indcates the Base Model and bold font indicates best fit.

Table 23. Comparison of Councils' default target fishing mortality rates and reference points between the STAR base model and STAT best fit model. The default target fishing mortality rate of FSPR=0.5 is used in this assessment for both models and that used for other Council managed rockfish species.

STAR Base Model Results

Unfished Stock	Value
Age 3+ Biomass (B_0) (mt)	10,813
Spawning Biomass $SB_{(0)}$ (mt)	2,429
SPBio/Recruit (kg/fish)	0.780
Age1 Recruitment (R_0) (1,000's)	3,113
Steepness_R0_S0	0.6

	Reference points based on		
Exploited Stock	**Estimated MSY**	**SB $_{40\%}$**	**SPR (SB $_{0.5}$)**
SPR (Spawning Biomass/Recruit)	0.413	0.400	0.400
F (Fishing Mortality Rate)	0.132	0.101	0.101
Exploitation Rate (Yield/Bsmry)	0.076	0.060	0.060
MSY (mt) or MSY proxy (mt)	377	361	361
Yield (mt)	718	972	972
SPBIO/SB(0)	29.6%	40.0%	40.0%
Age 3+ Biomass	4,947	6,012	6,012

STAT Best Fit Model Results

Unfished Stock	Value
Age 3+ Biomass (B_0) (mt)	11,390
Spawning Biomass $SB_{(0)}$ (mt)	2,321
SPBio/Recruit (kg/fish)	0.687
Age1 Recruitment (R_0) (1,000's)	3,377
Steepness_R0_S0	0.6

	Reference points based on		
Exploited Stock	**Estimated MSY**	**SB $_{40\%}$**	**SPR (SB $_{0.5}$)**
SPR (Spawning Biomass/Recruit)	0.418	0.400	0.40
F (Fishing Mortality Rate)	0.141	0.110	0.110
Exploitation Rate (Yield/Bsmry)	0.081	0.065	0.065
MSY (mt) or MSY proxy (mt)	423	408	408
Yield (mt)	700	928	928
SPBIO/SB(0)	30.1%	40.0%	40.0%
Age 3+ Biomass	5,218	6,264	6,264

Table 24. Comparison of ABC's, Spawning biomass and depletion between the STAR base (top) and STAT best fit model (bottom).

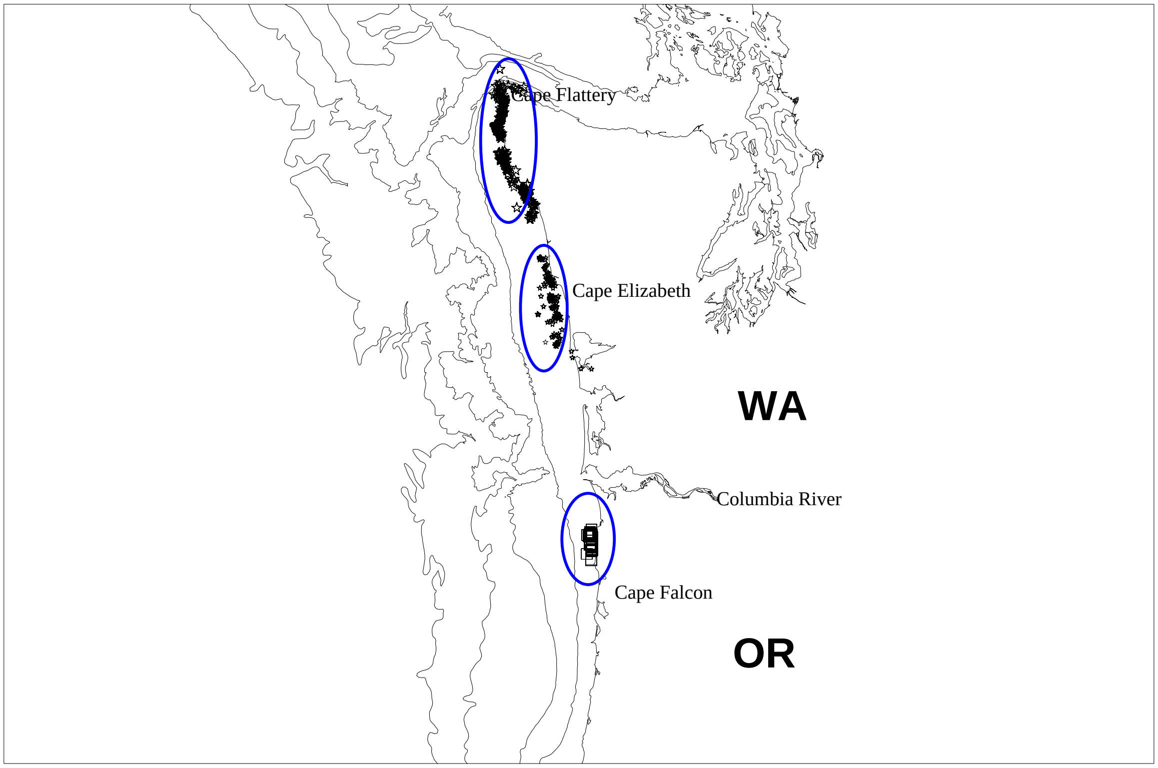
STAR Base Model

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ABC (mt)	394	377	361	350	345	344	346	350	354	357
Spawning Biomass (mt)	1064	1071	1060	1036	1005	977	956	944	940	943
% of Virgin	0.438	0.441	0.436	0.426	0.414	0.402	0.394	0.389	0.387	0.388

STAT "Best Fit" Model

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ABC (mt)	535	503	474	453	440	433	431	432	434	436
Spawning Biomass (mt)	1281	1267	1233	1182	1126	1074	1033	1005	989	984
% of Virgin	0.552	0.546	0.531	0.509	0.485	0.463	0.445	0.433	0.426	0.424

Figures



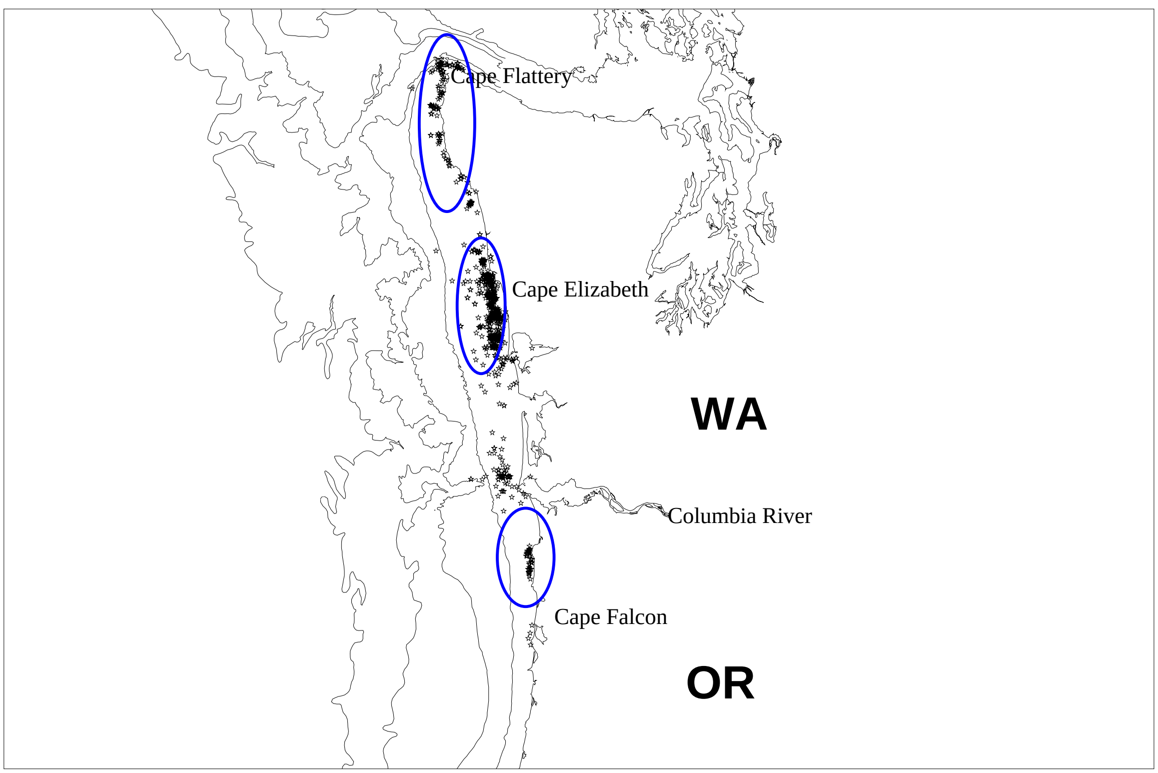


Figure 1. Location of black rockfish tag release area (top) and tag recovery locations (bottom).

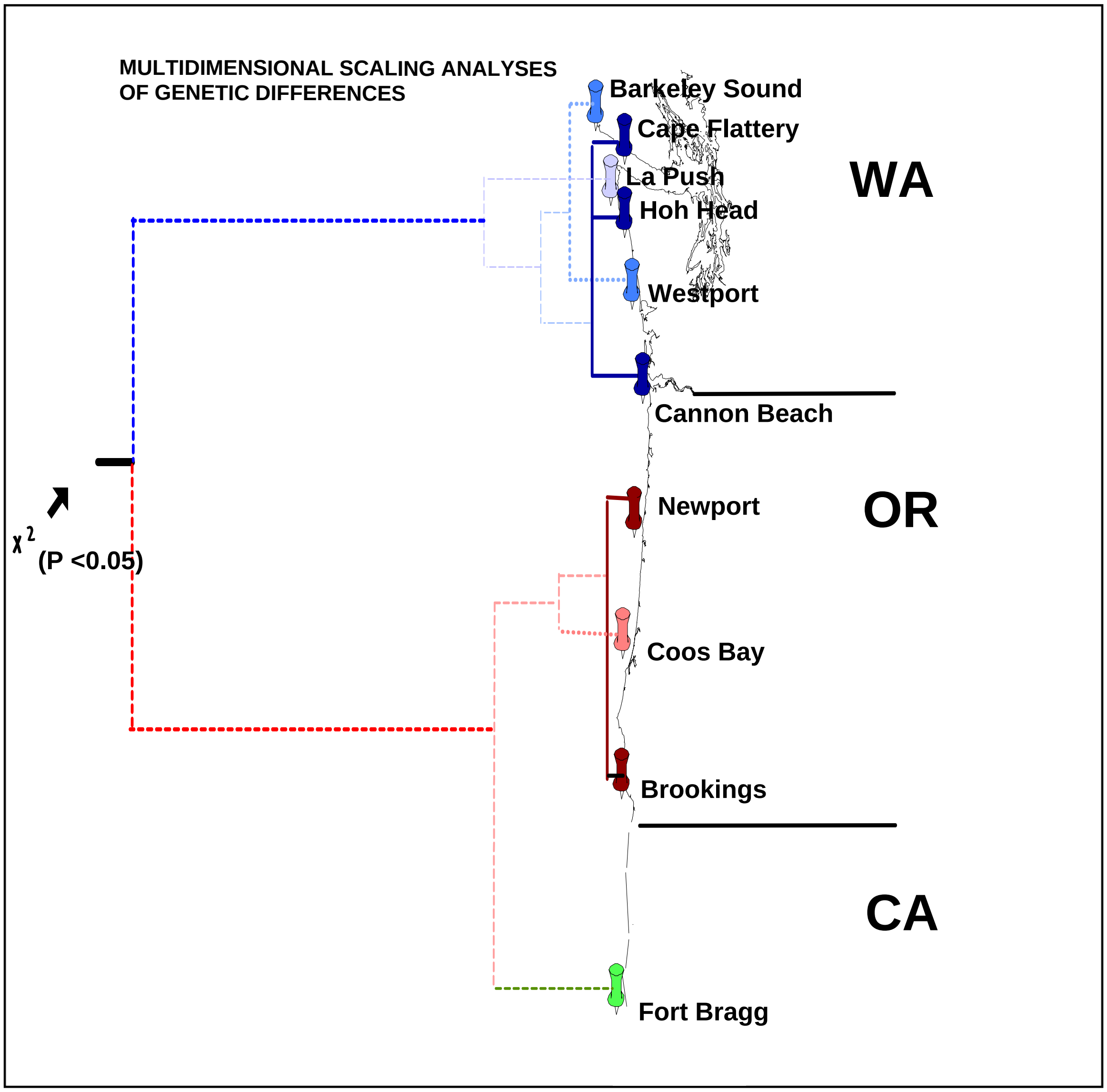


Figure 2. Dendogram showing results of cluster analysis of ten black rockfish collections using Nei's (1978) unbiased genetic distance at 20 polymorphic loci.

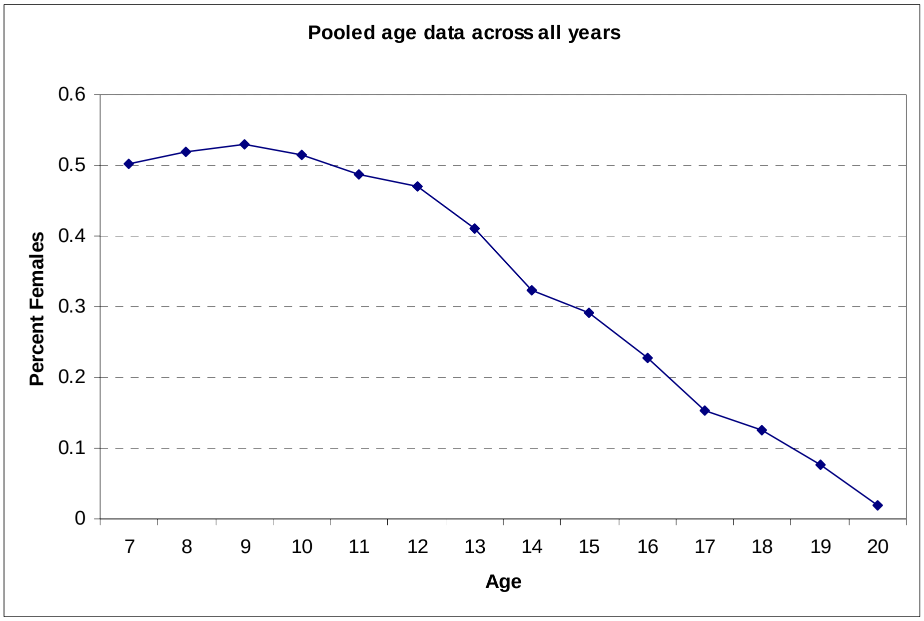


Figure 3. Relative abundance of females with age in pooled age data for Washington fisheries.

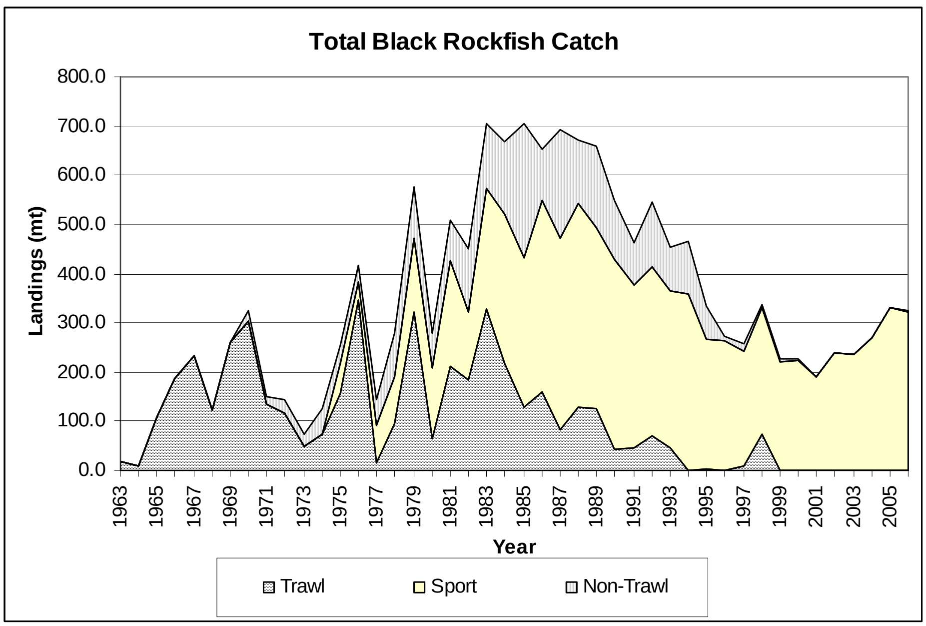


Figure 4. Total black rockfish catch by gear and year for areas North of Cape Falcon to the U.S. Canadian border.

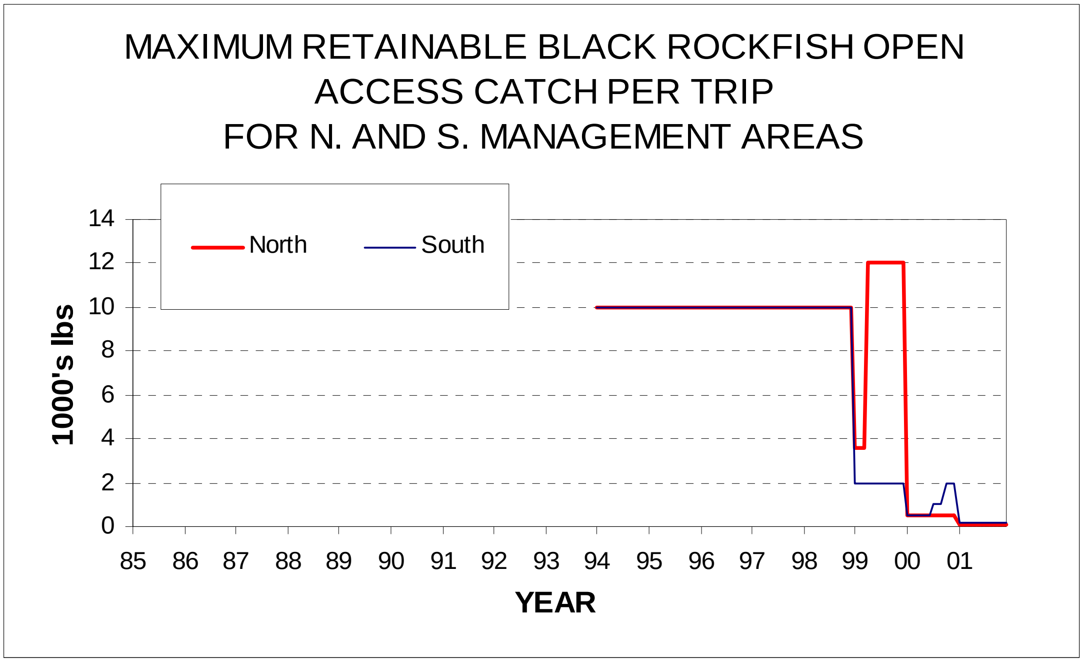


Figure 5. Regulation changes in commercial fisheries

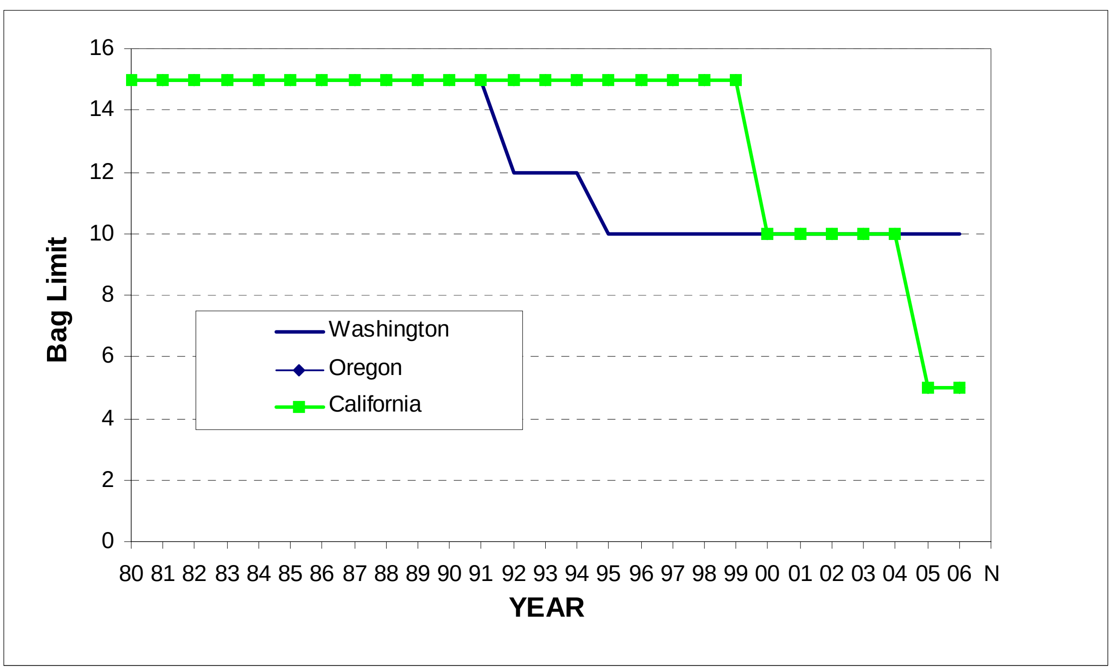


Figure 6. Maximum retainable rockfish catch per trip for the sport fisheries.

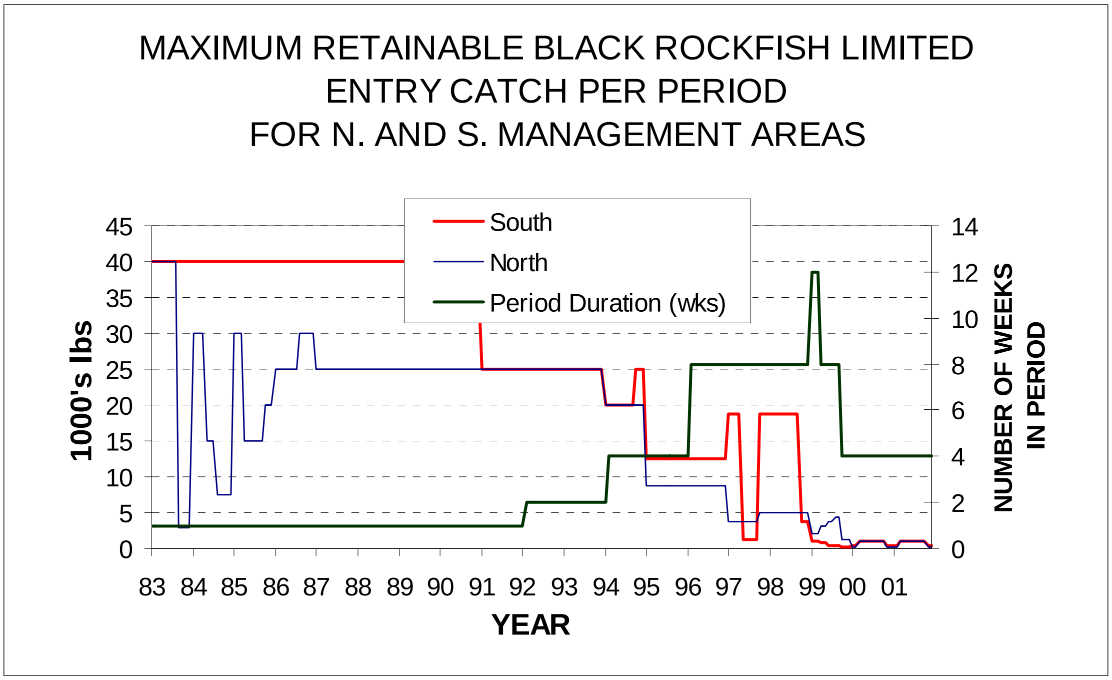


Figure 7. Maximum retainable black for the limited entry commercial fisheries.

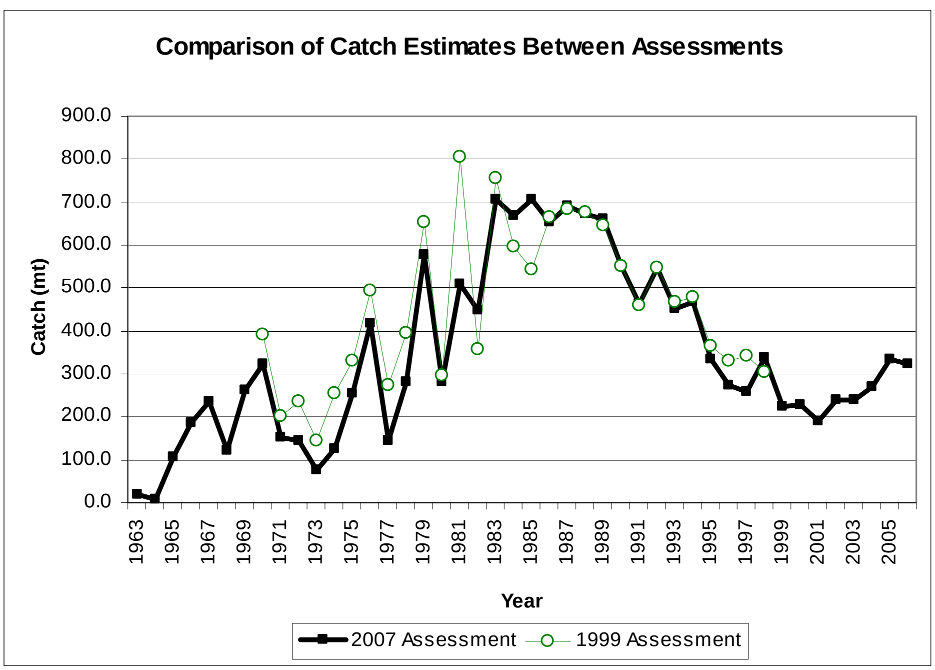


Figure 8. Comparison of catch estimates between the 1999 and the current assessment.

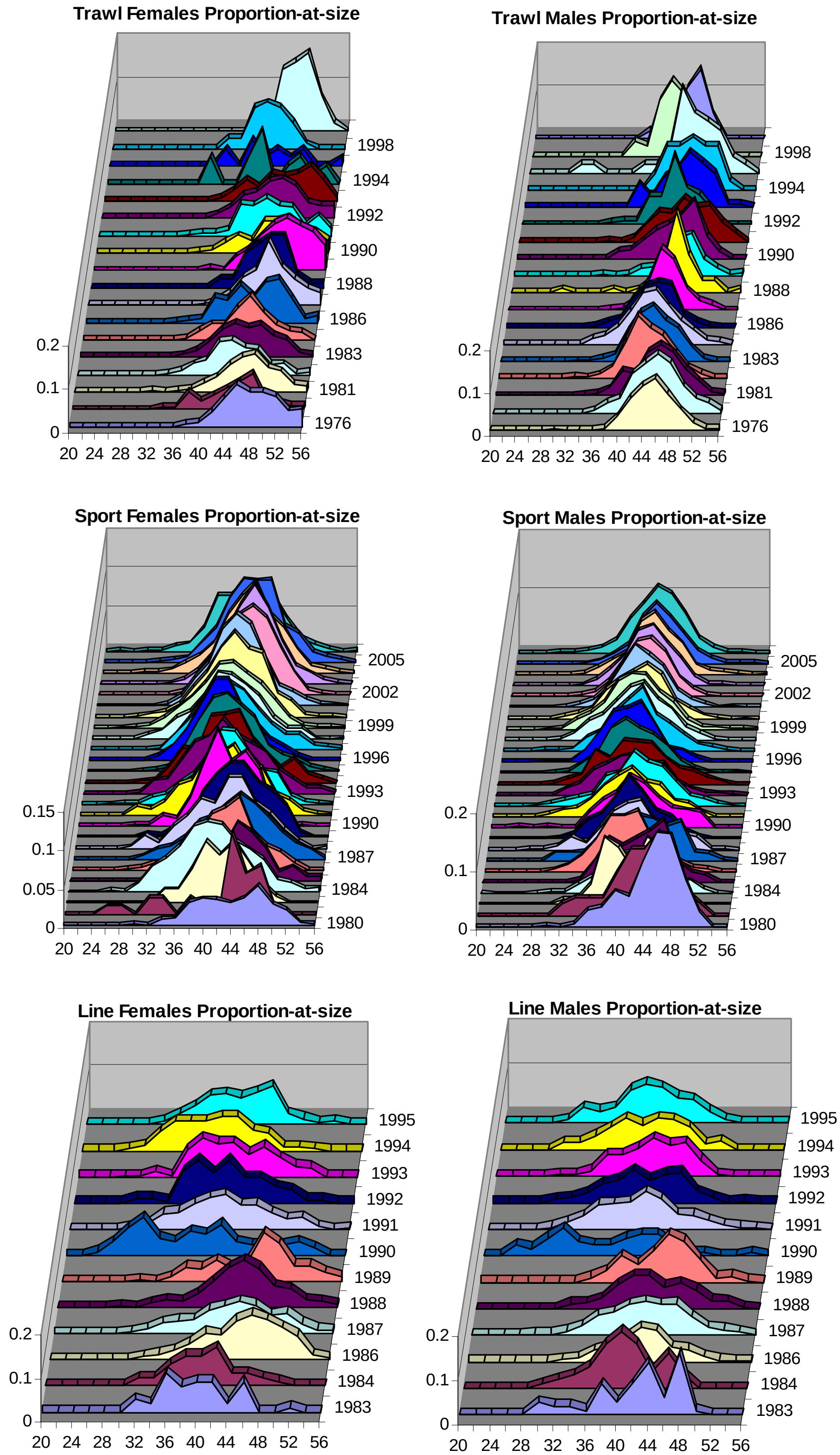


Figure 9. Proportion at size by sex and fisheries from 1984 to 2006.

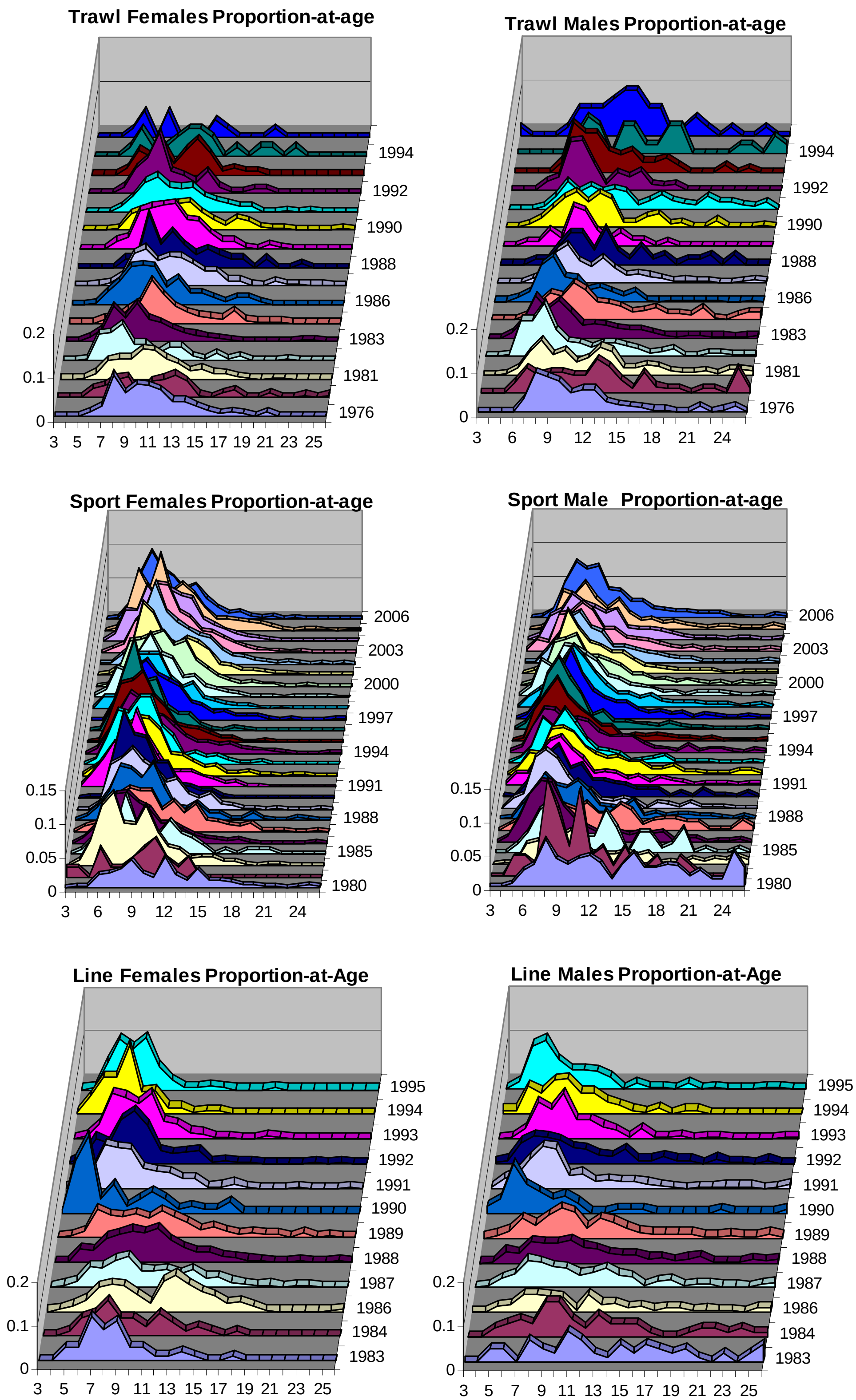


Figure 10. Proportion at age by sex and fisheries from 1984 to 2006.

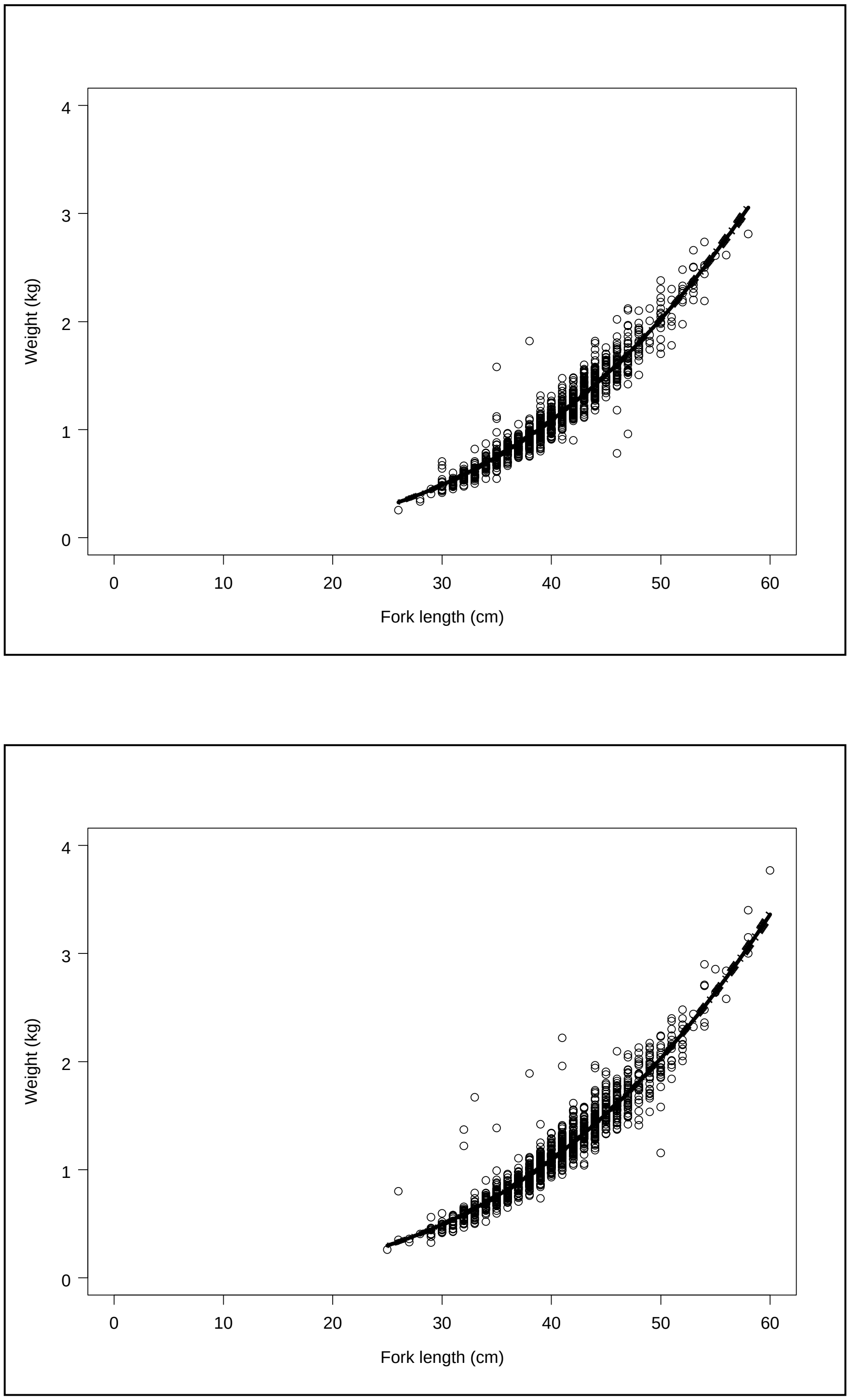


Figure 11. Scatter plot of fork length and weight of male (top panel) and female (bottom panel) black rockfish and the expected length weight relationship.

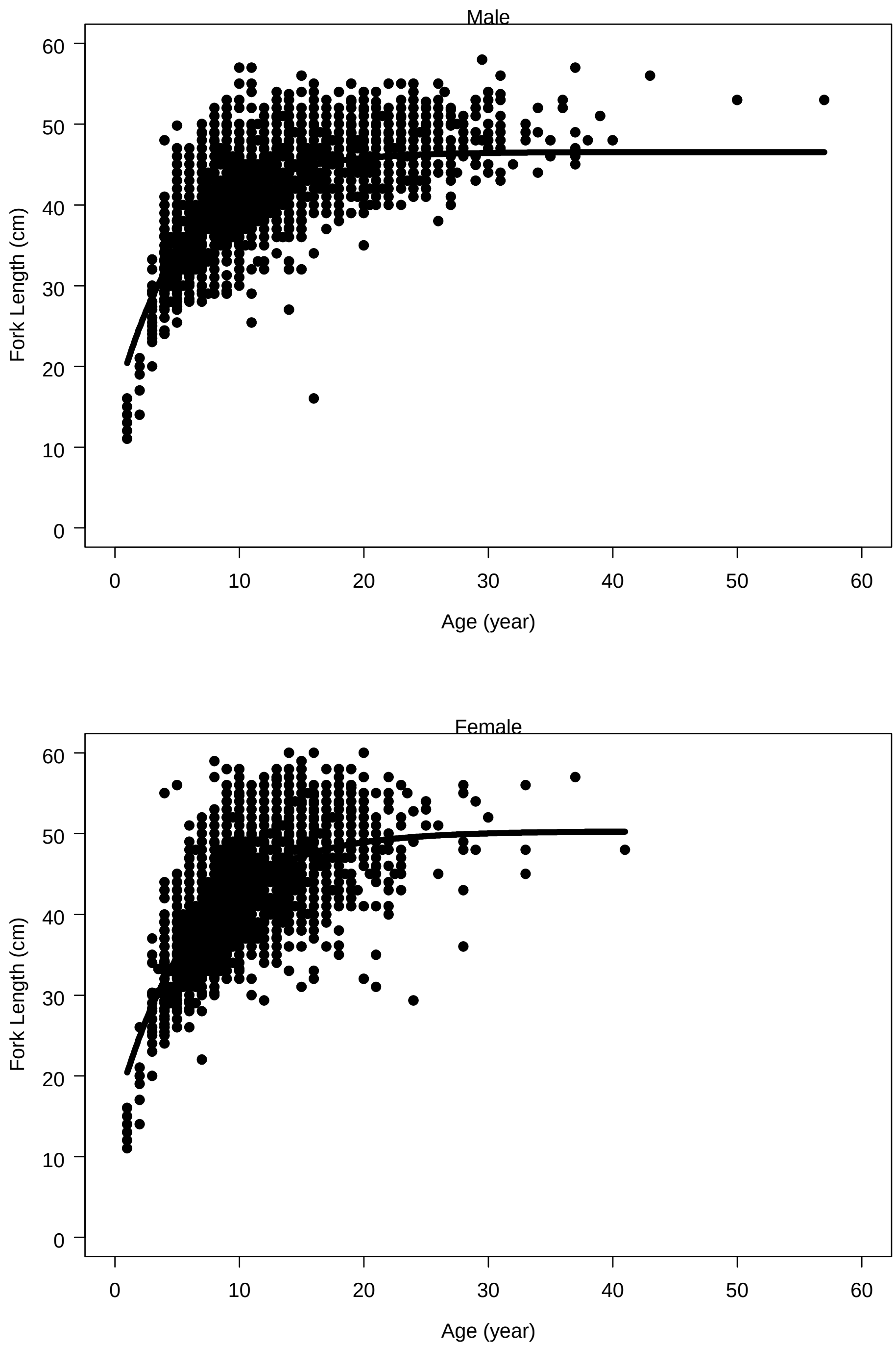


Figure 12. Scatter plots of male (top panel) and female (bottom panel) age and fork length data and the estimated growth curves.

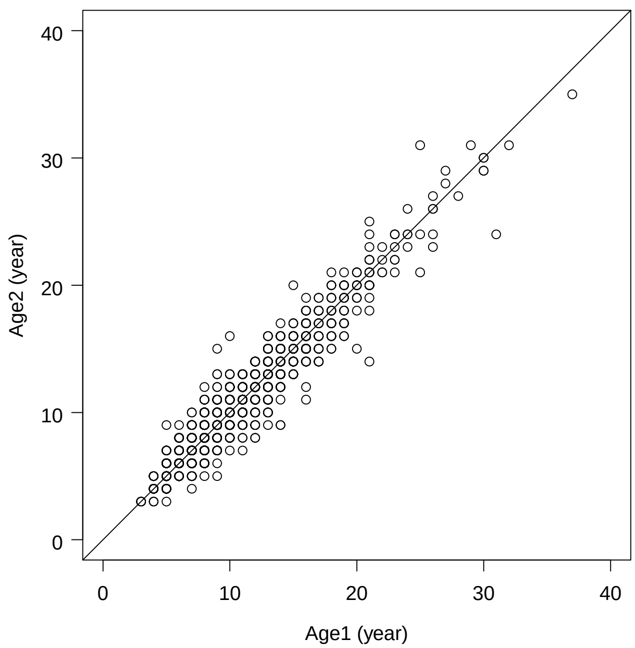


Figure 13. Scatter plot of age reading from two independent age readers and the expected relationship of age reading between the two age readers.

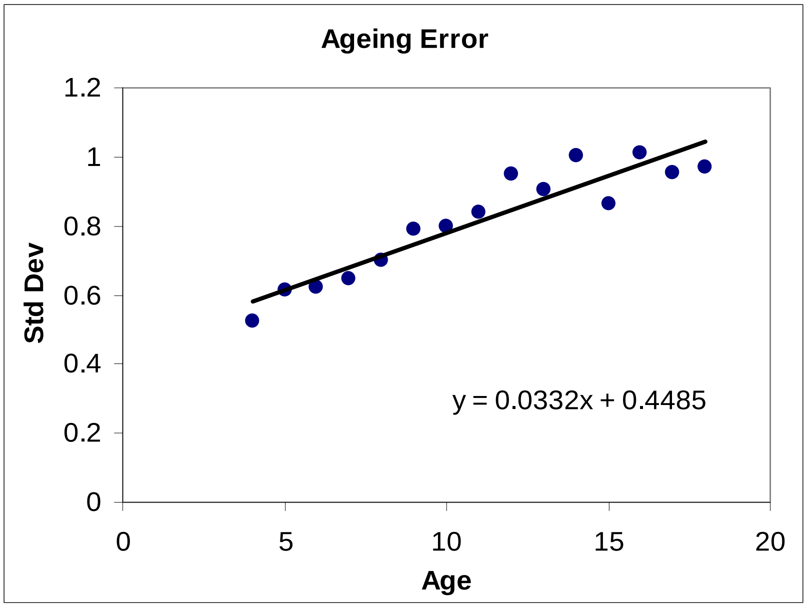


Figure 14. Standard deviation of ageing error.

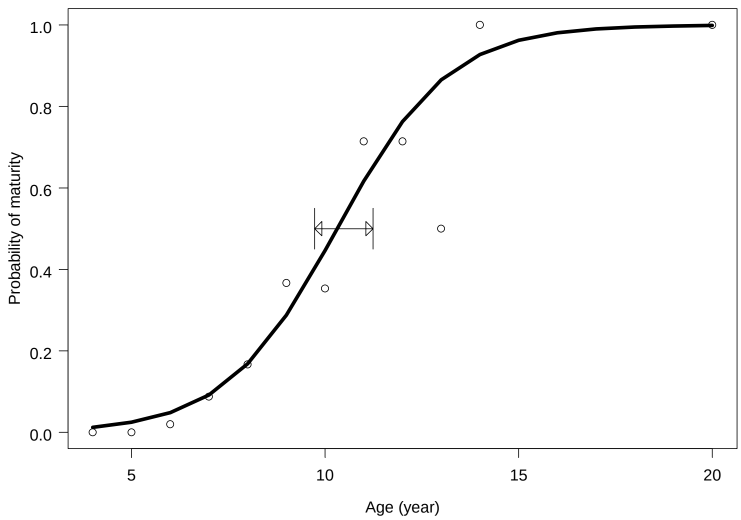


Figure 15. Plot of the estimated probability of maturity against the estimated age of female black rockfish. The intervals are the 95% confidence intervals estimated by bootstrapping.

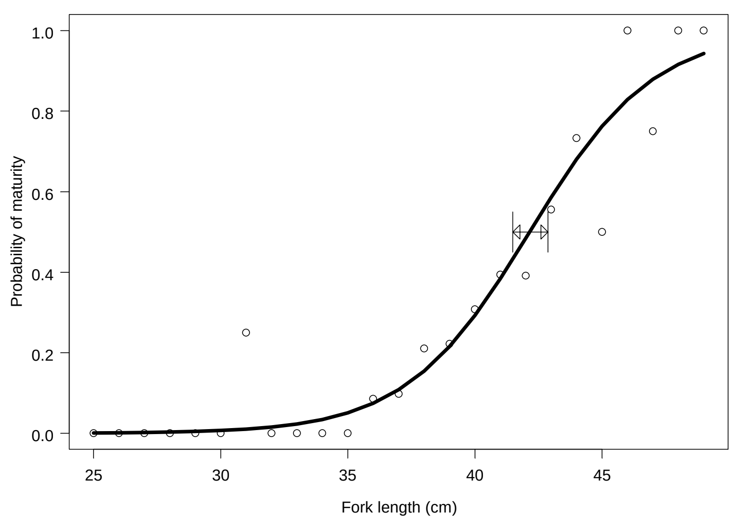
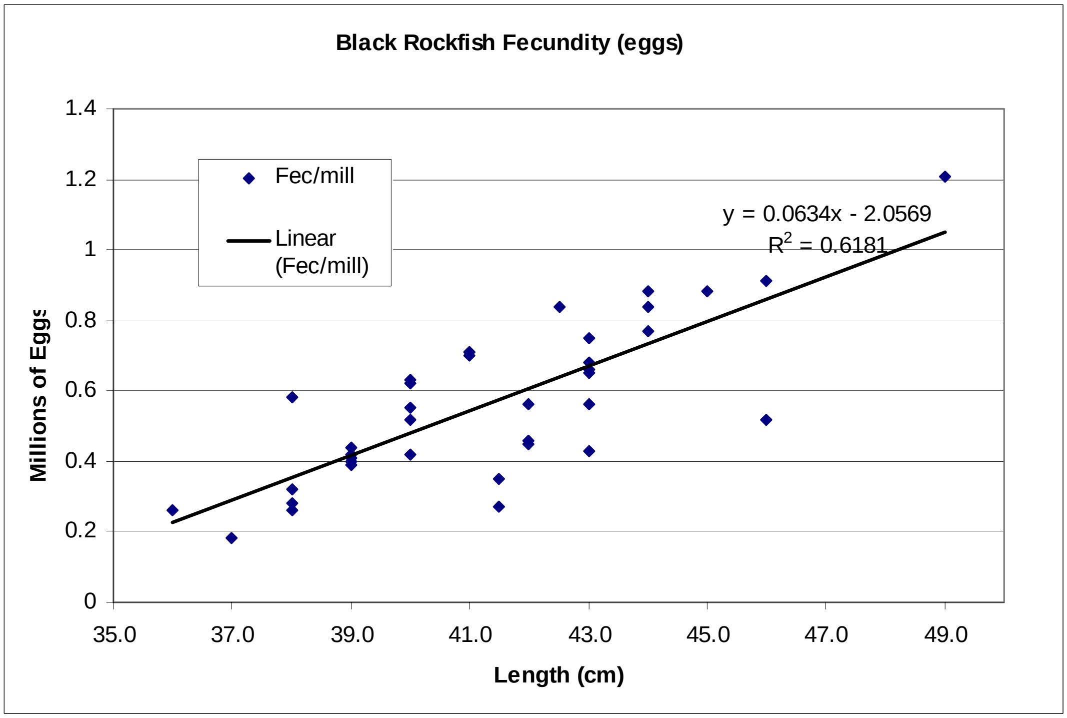


Figure 16. Plot of the estimated probability of maturity against the fork length of female black rockfish. The intervals are the 95% confidence intervals estimated by bootstrapping.



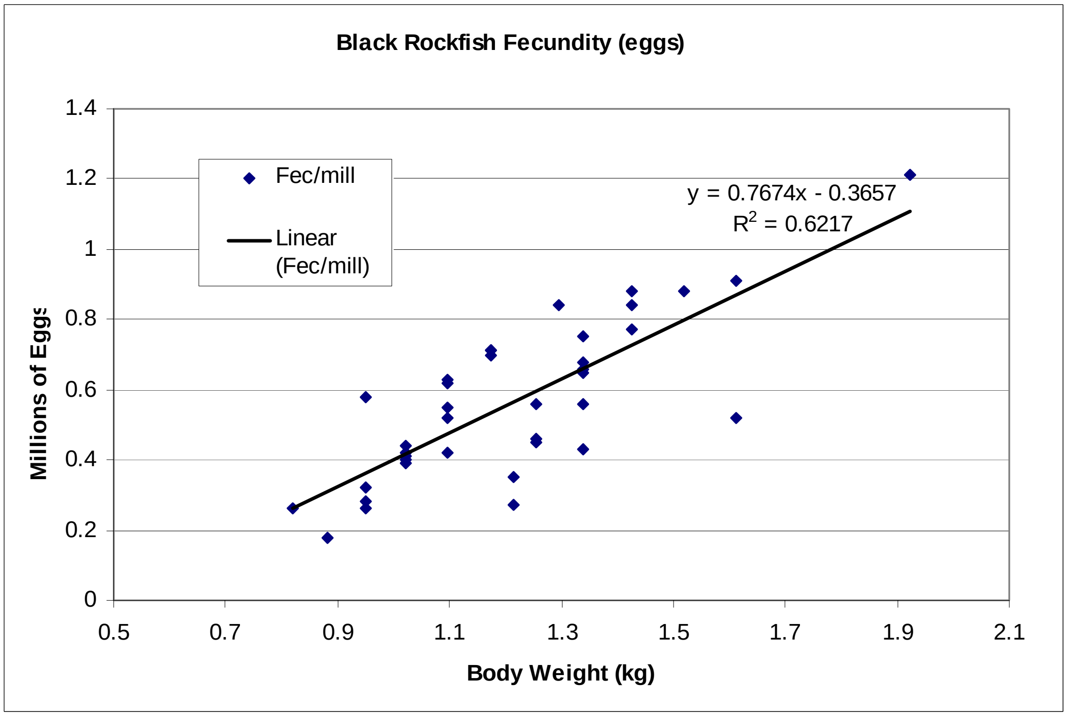


Figure 17. Relationship between fecundity and size (top panel) and fecundity and body weight (bottom panel).

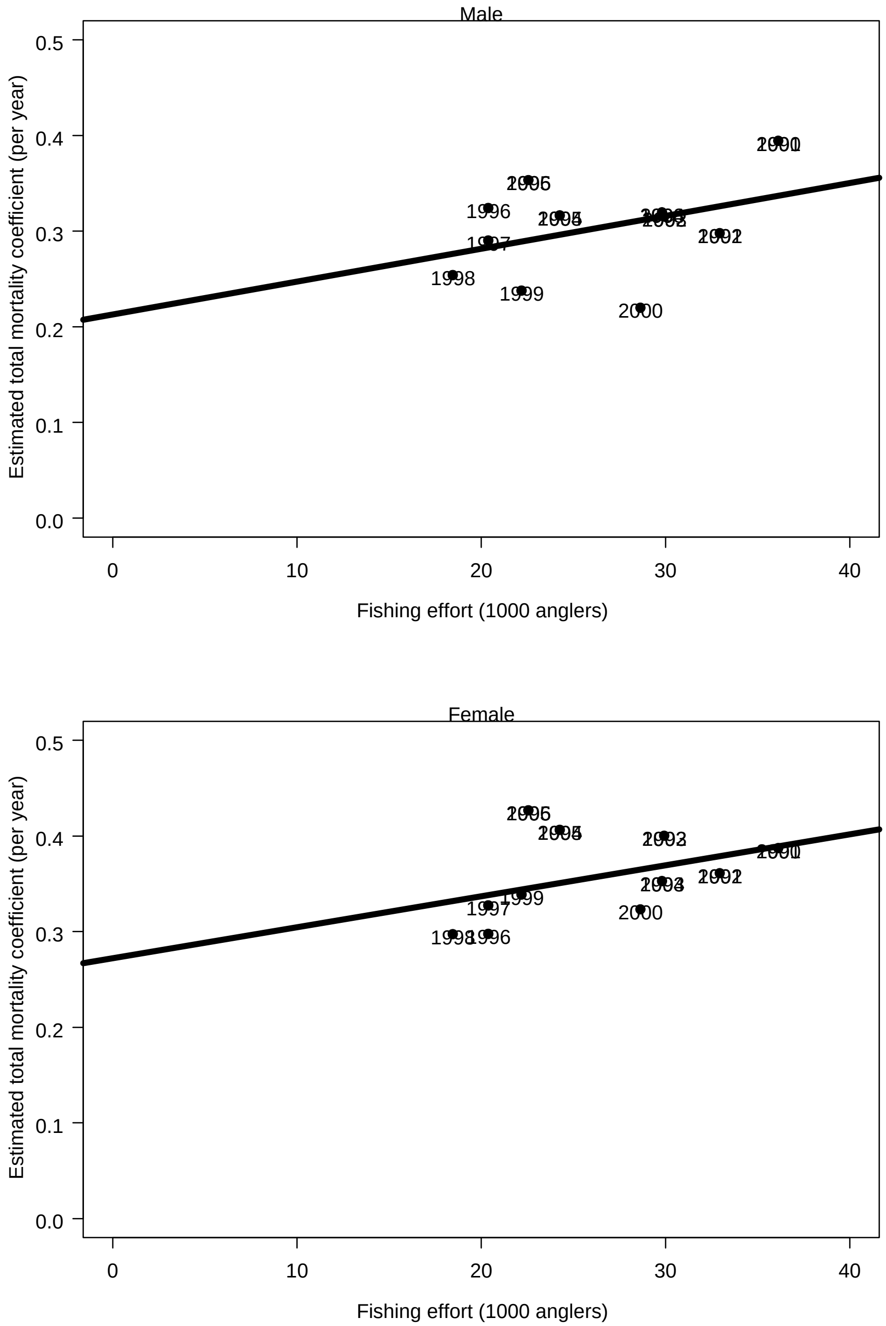


Figure 18. Plot of expected male (top panel) and female (bottom panel) estimated total mortality coefficients against total fishing effort. The estimated intercept in each sub graph was the estimated natural mortality.

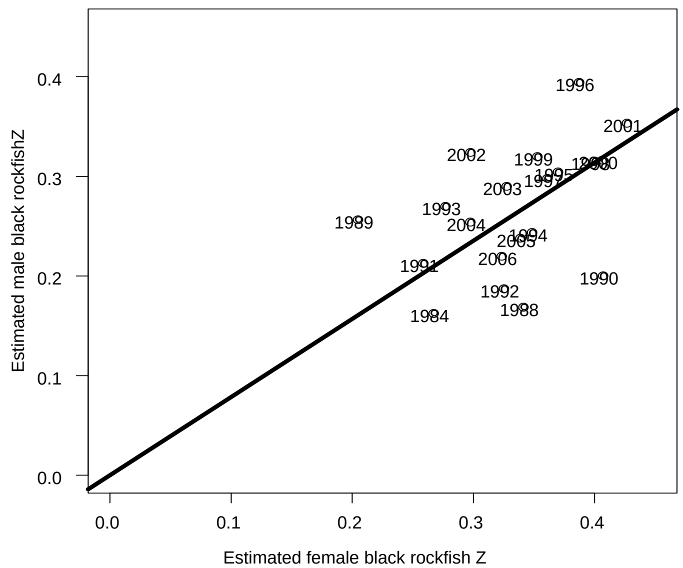


Figure 19. Scatter plot of estimated female black rockfish mortality coefficients versus estimated male black rockfish mortality coefficients, and the estimated linear relationship.

Figure 20. Time series plot of the estimated male and female black rockfish total mortalities.

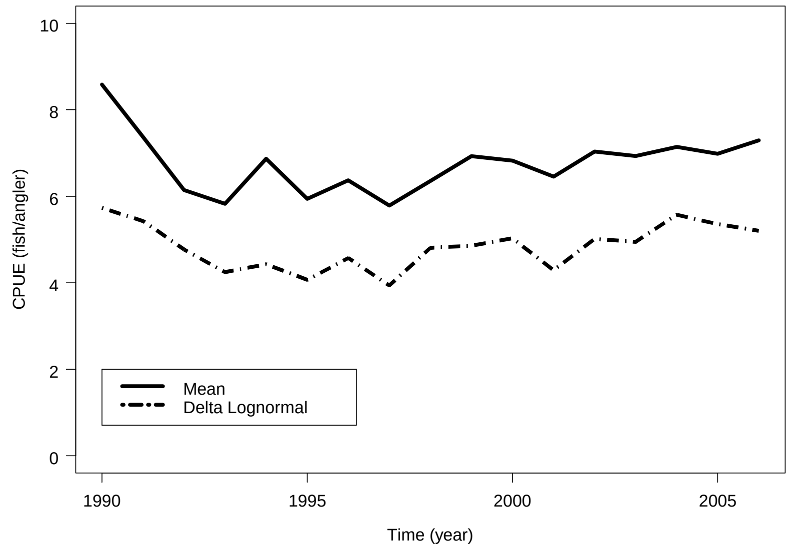


Figure 21. Time series plot of the estimated CPUEs of recreational survey data in all areas from 1990 to 2006. The estimated CPUEs were done by mean estimator and delta lognormal model.

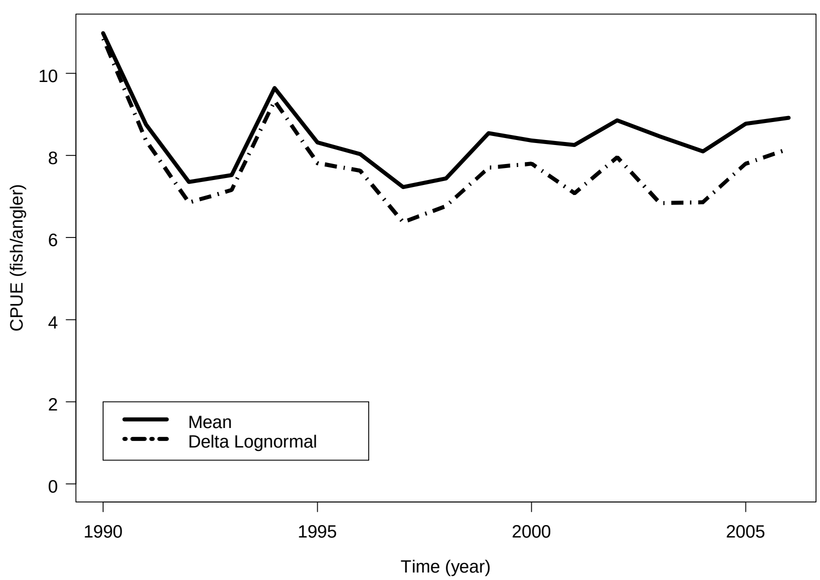


Figure 22. Time series plot of the estimated CPUEs of recreational survey data in Area 2 from 1990 to 2006. The estimated CPUEs were done by mean estimator and delta lognormal model.

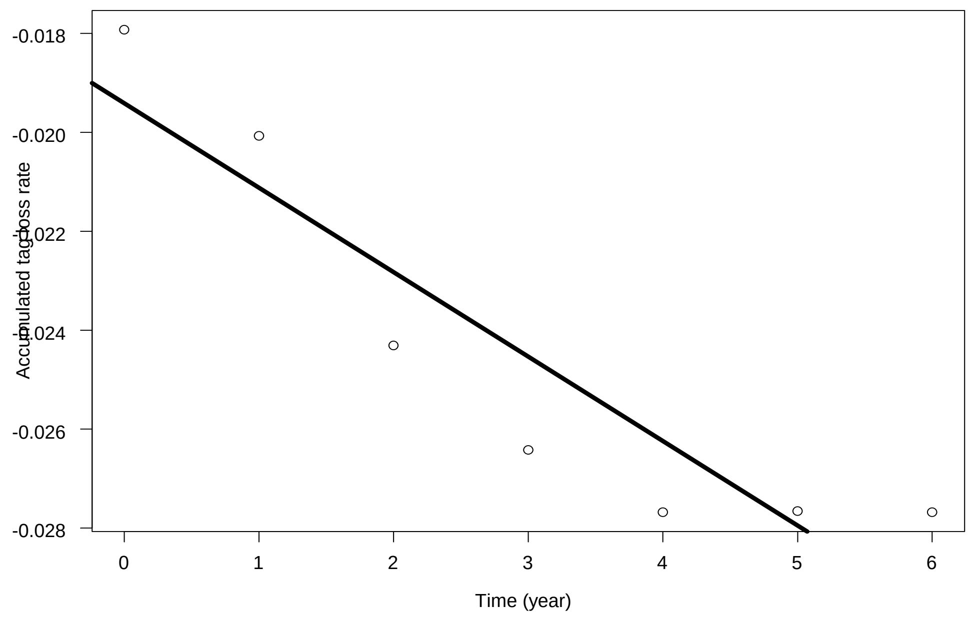


Figure 23. Plot of accumulated CWT tag lost rate with time.

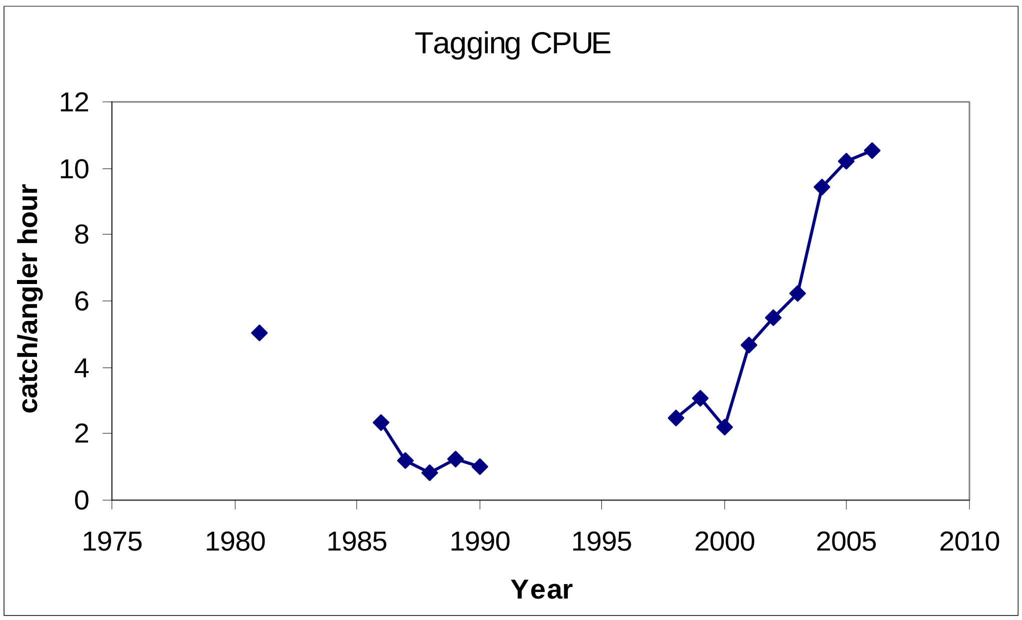


Figure 24. Time series of the tagging CPUE of the central Washington coast.

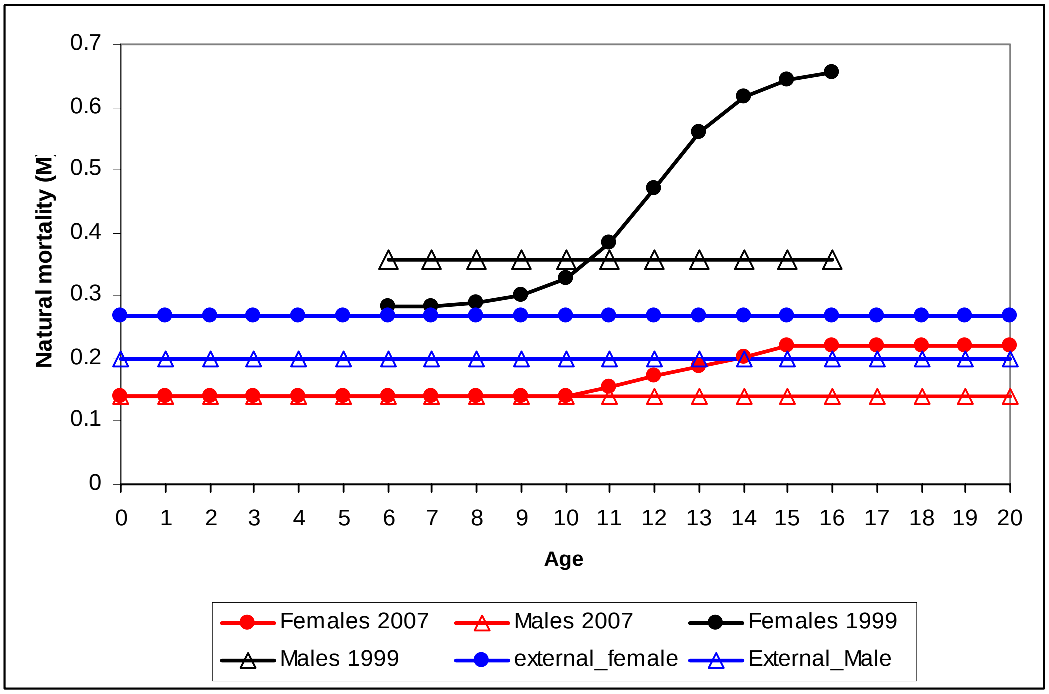


Figure 25. Comparison of natural mortality rates between males and females as defined in the STAT Best Fit Model. In the STAR base model Female natural mortality asymptotes at 0.20 at age 15 instead of 0.24 in the STAT Best Fit model.

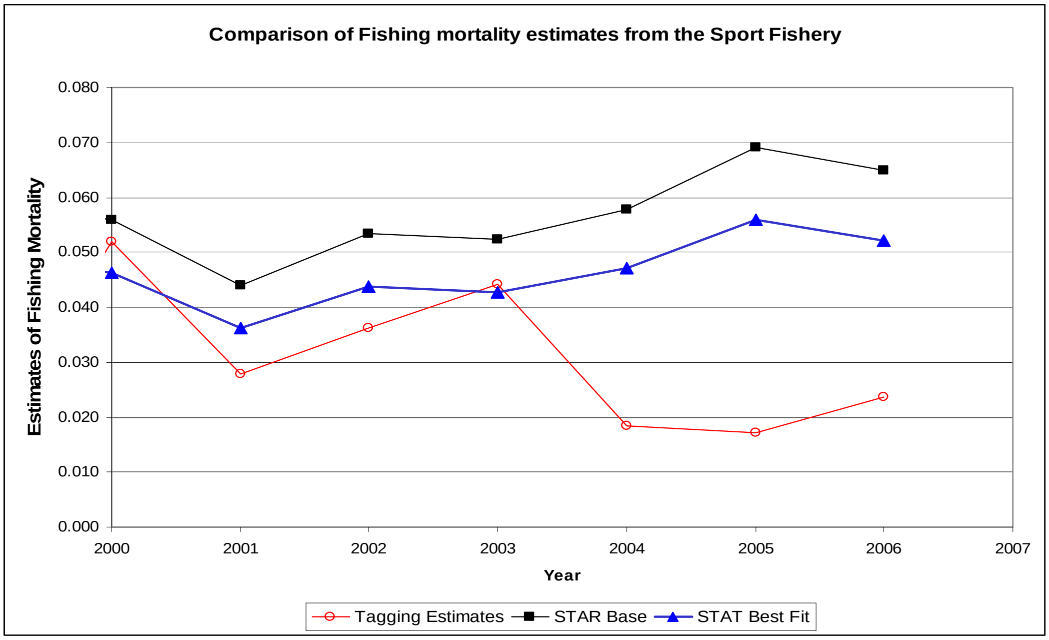
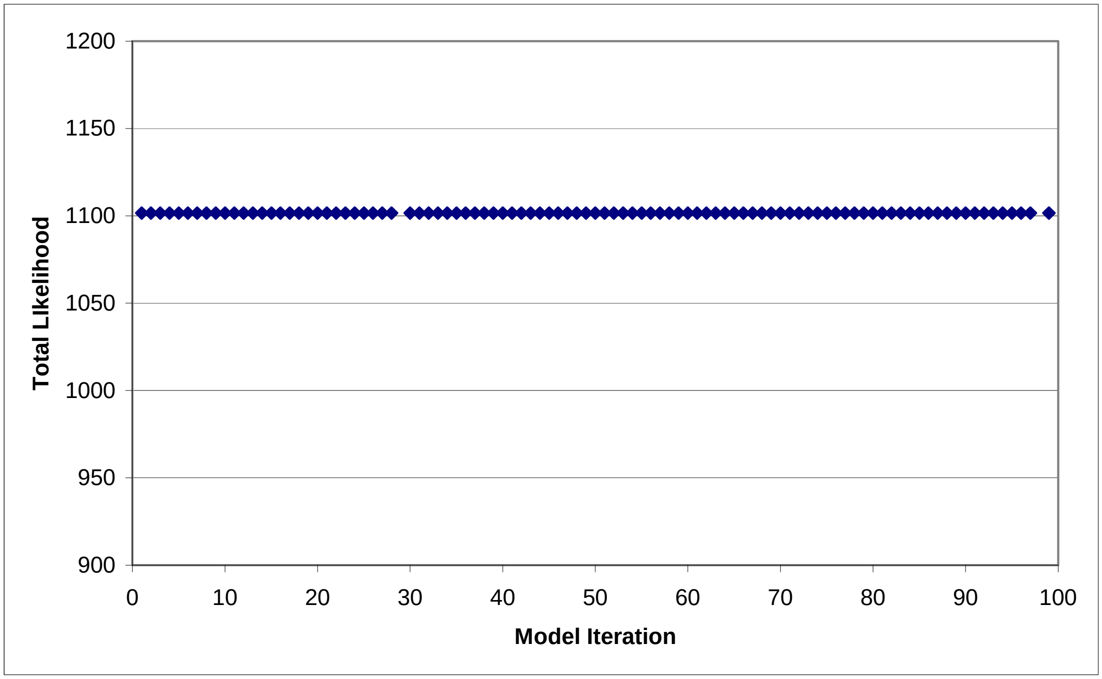


Figure 26. Comparison of fishing mortality rates estimated from STAR Base, STAT Best Fit model and the tagging model (assuming M=0.2 for both sexes).



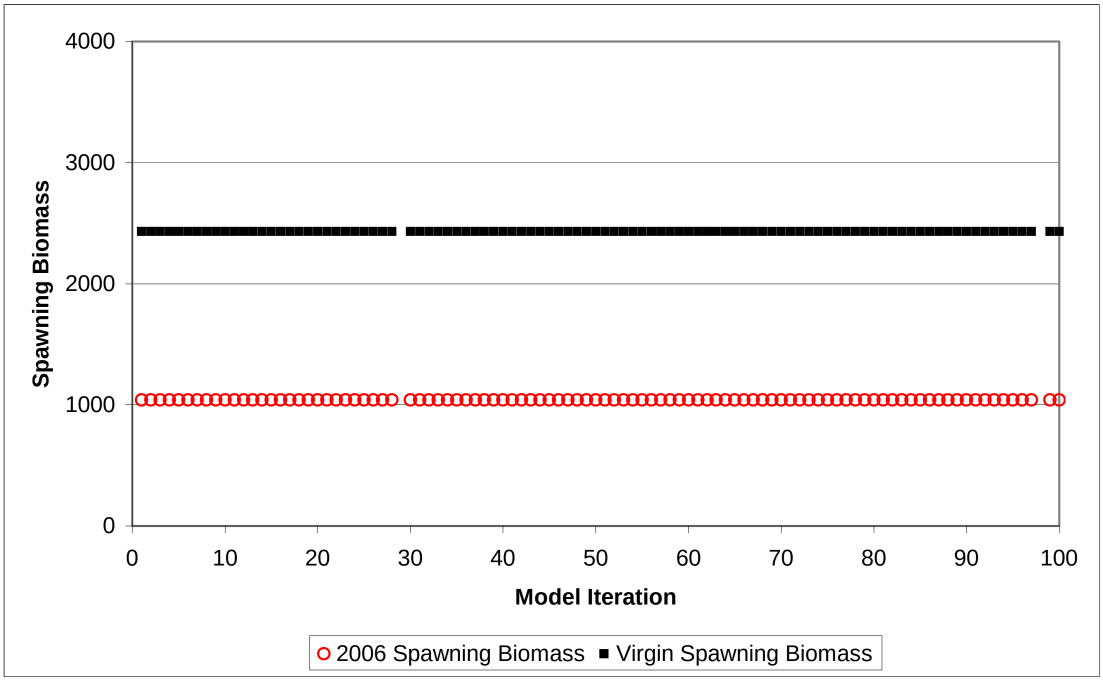


Figure 27. Convergence properties of the STAR base model.

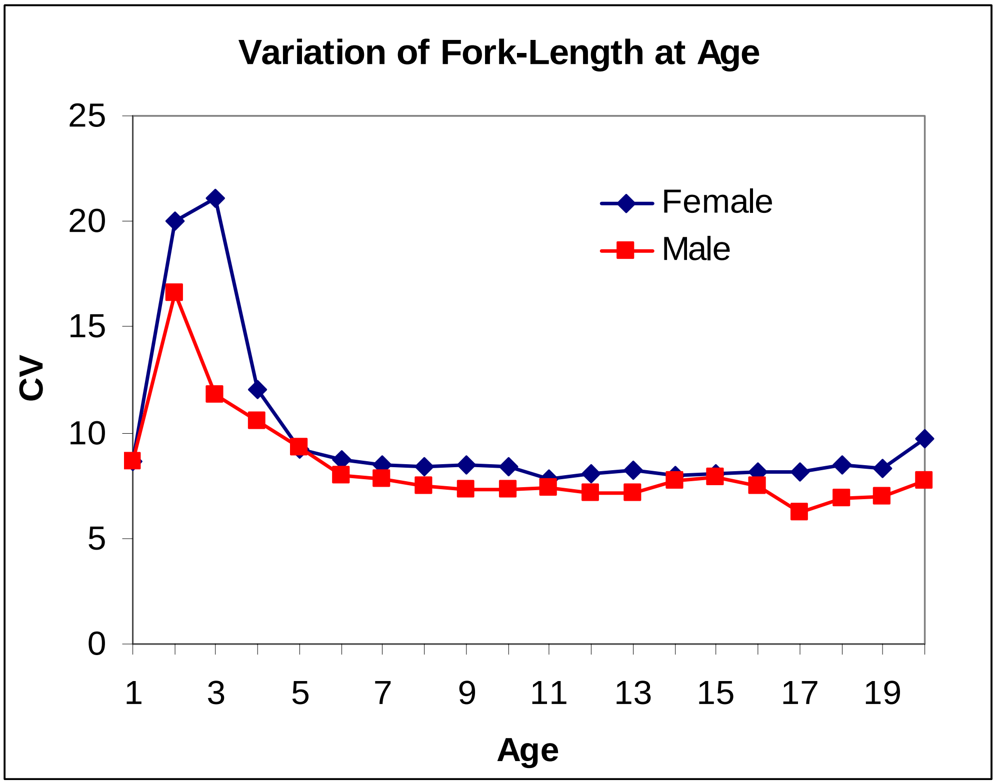
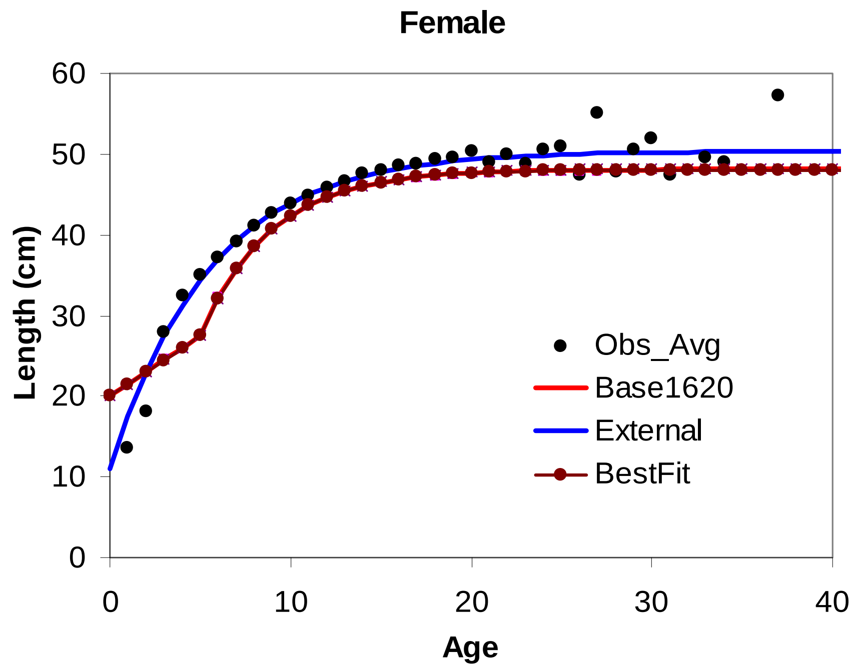


Figure 28. Variation in fork-length at age by sex.



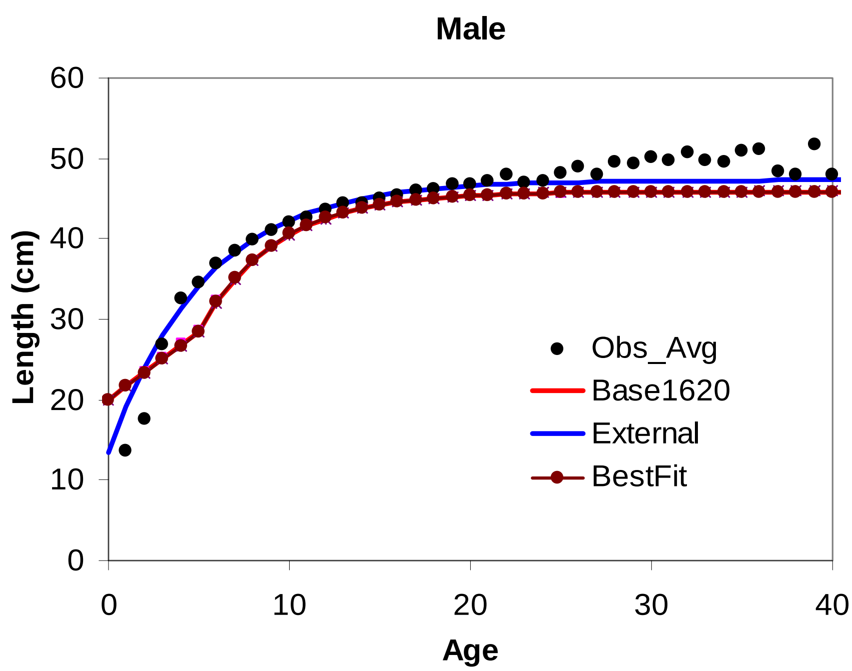


Figure 29. Comparison of growth curves estimated from STAR base, STAT best-fit model and external estimates to the mean size at observed age.

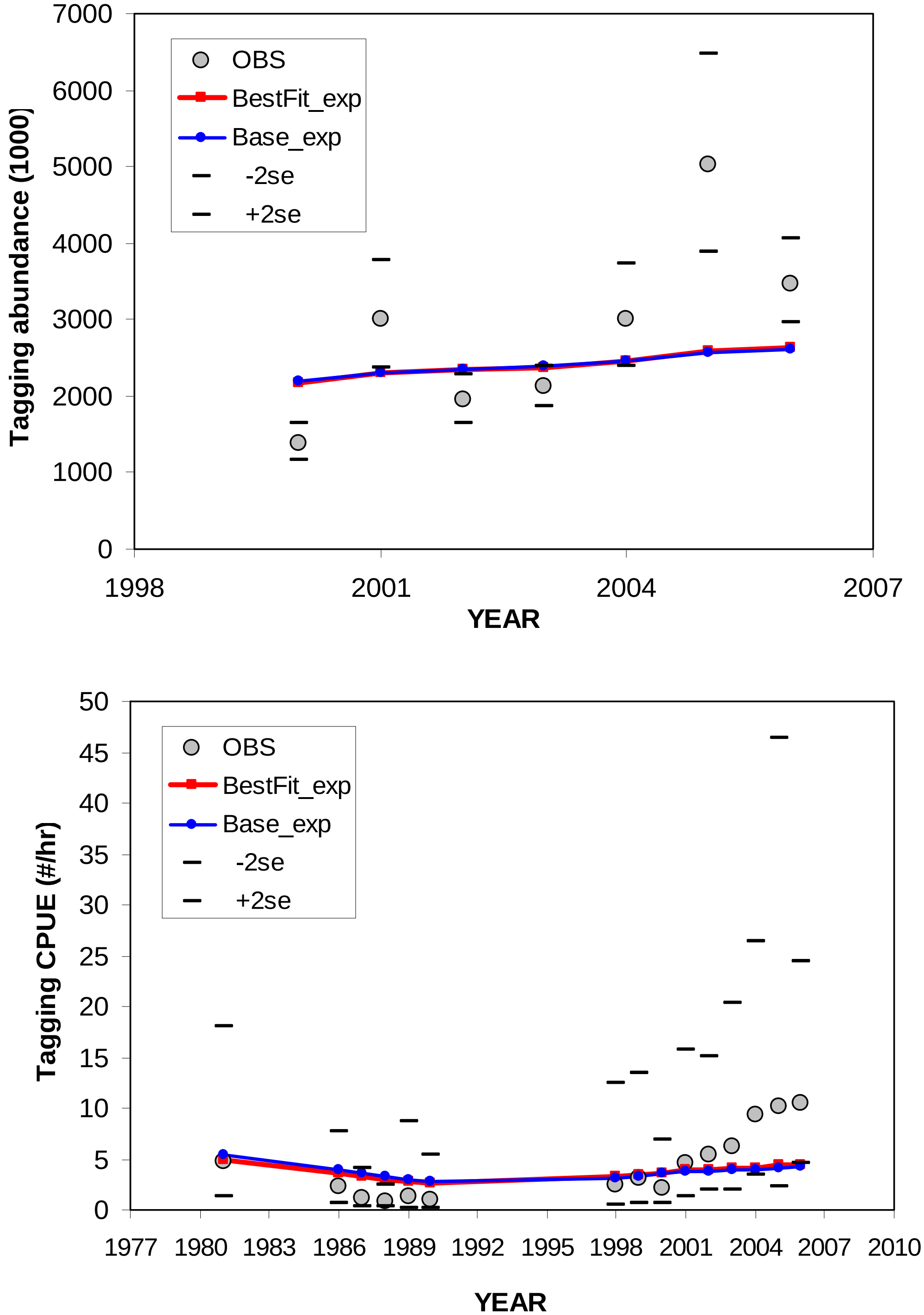


Figure 30. STAR base and STAT "best fit" model fit to tagging abundance (top panel) and tagging CPUE (bottom panel) data by fishery.

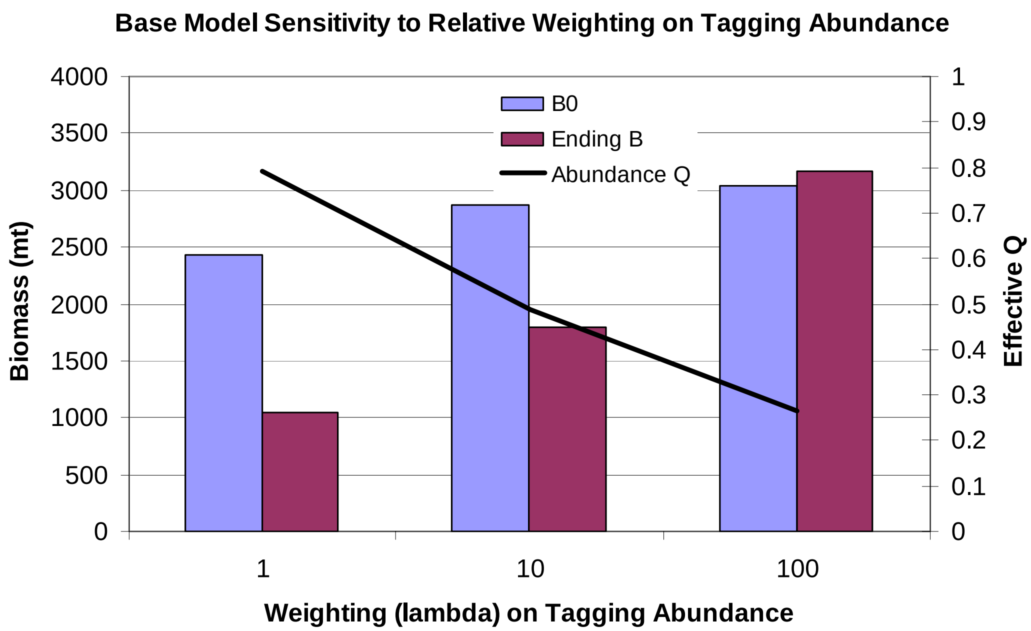
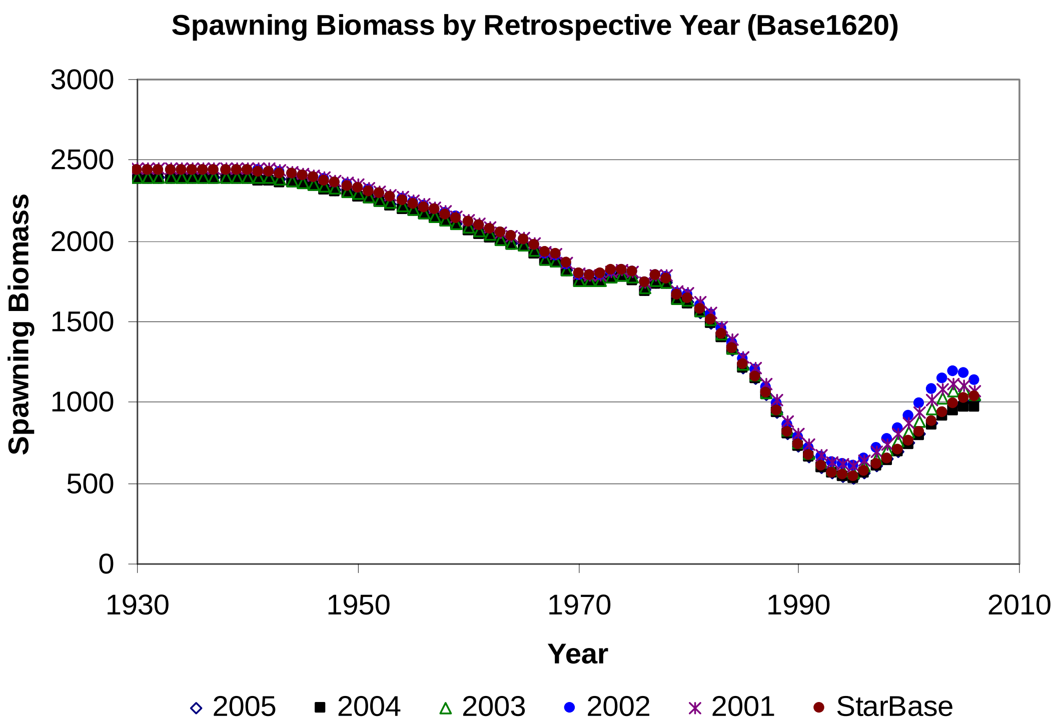


Figure 31. STAR base model sensitivity to increased weight on the tagging CPUE and tagging population estimates of abundance.



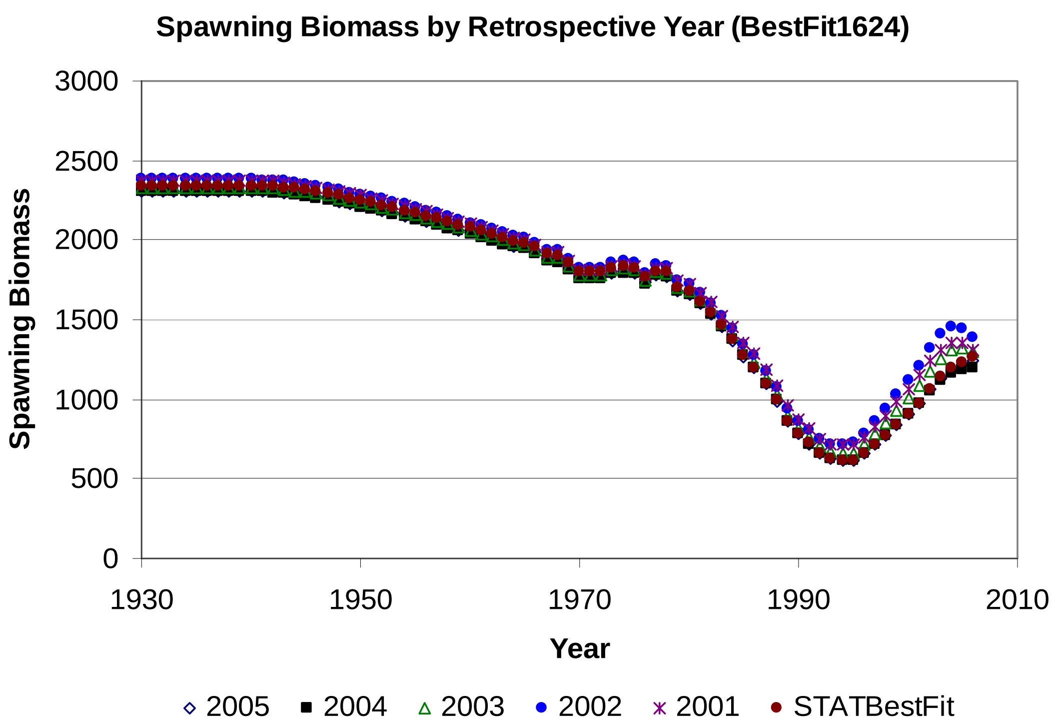


Figure 32. Retrospective analysis of the northern black rockfish STAR base (top panel) and STAT best-fit (bottom panel) models. Observation data are ignored and there is no recruitment deviations estimated beyond retrospective year

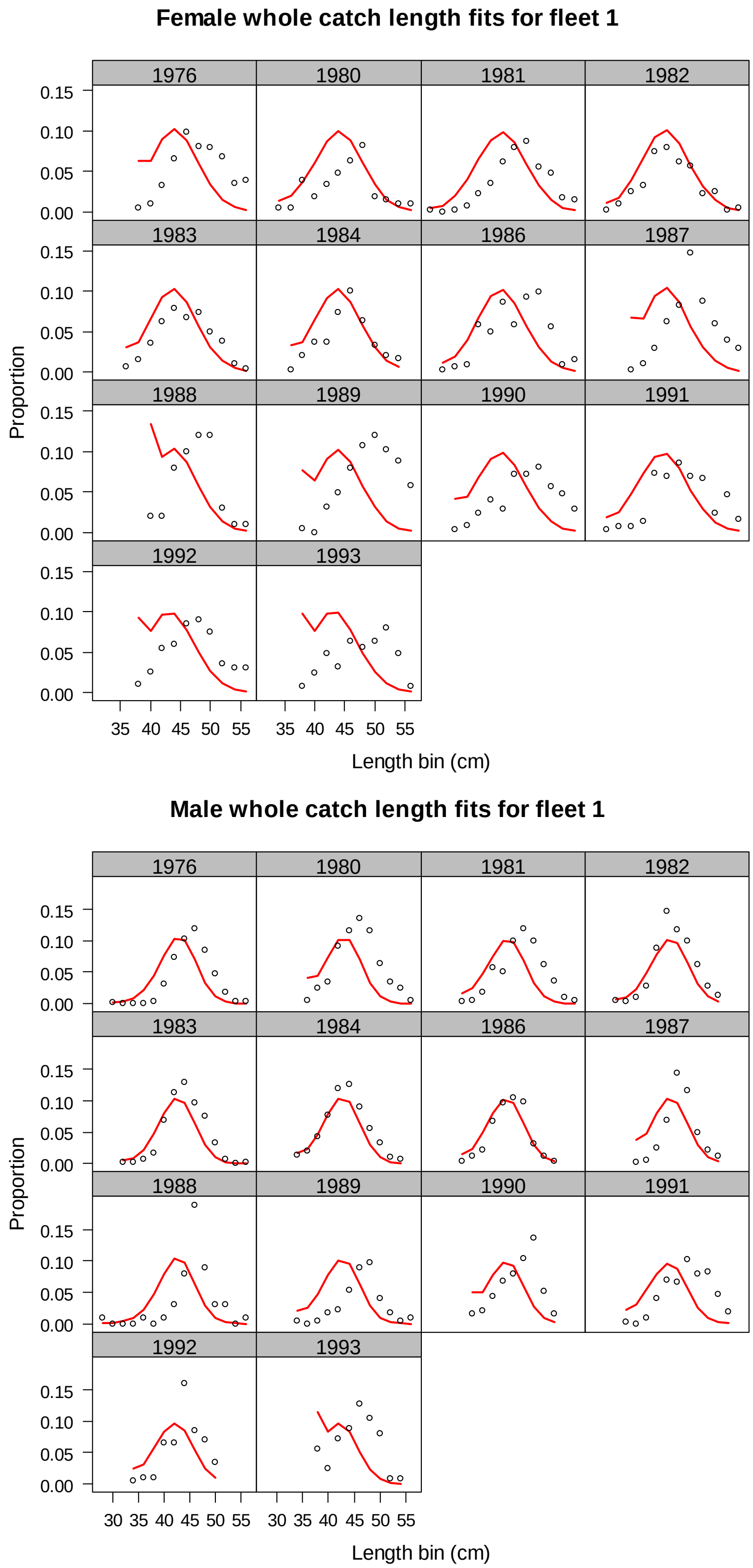
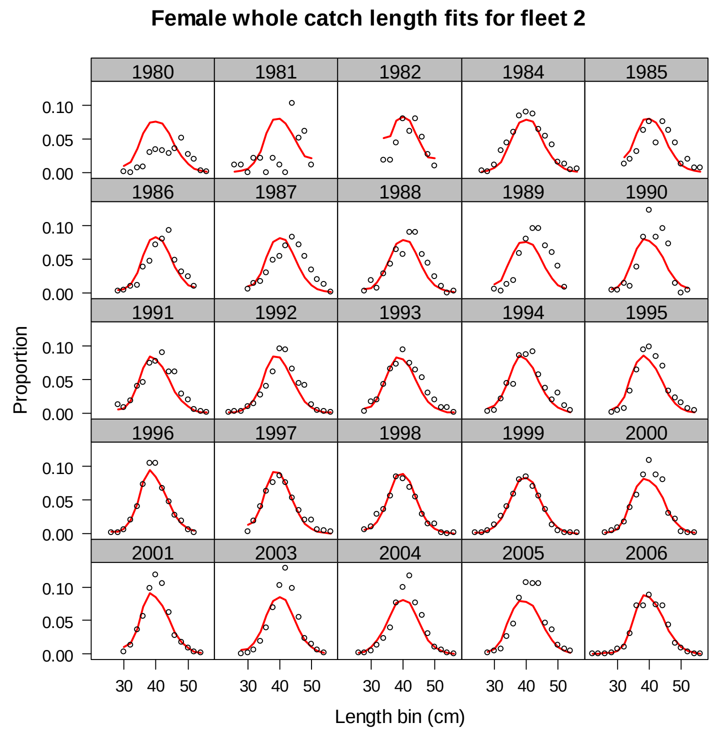


Figure 33. STAR base model fit to female (top) and male (bottom) length composition samples collected from the trawl fishery.



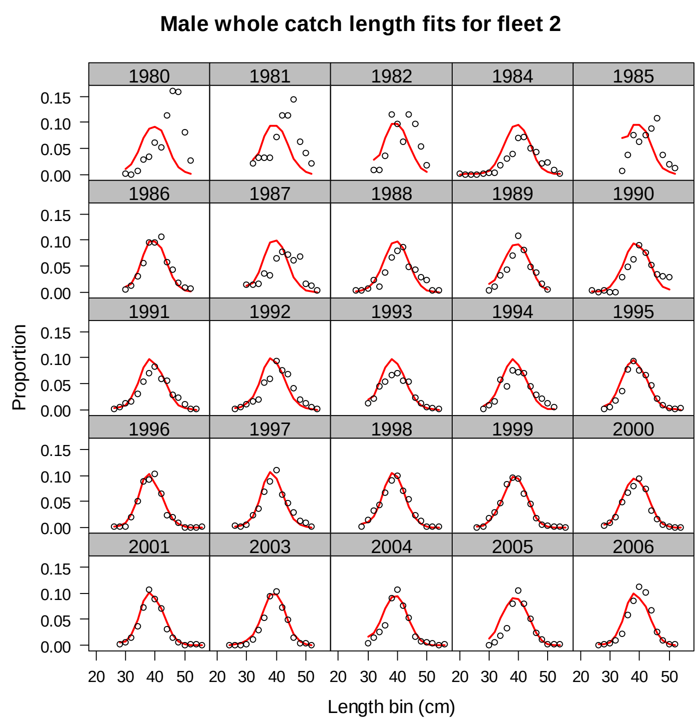


Figure 34. STAR base model fit to female (top) and male (bottom) length composition samples collected from the sport fishery.

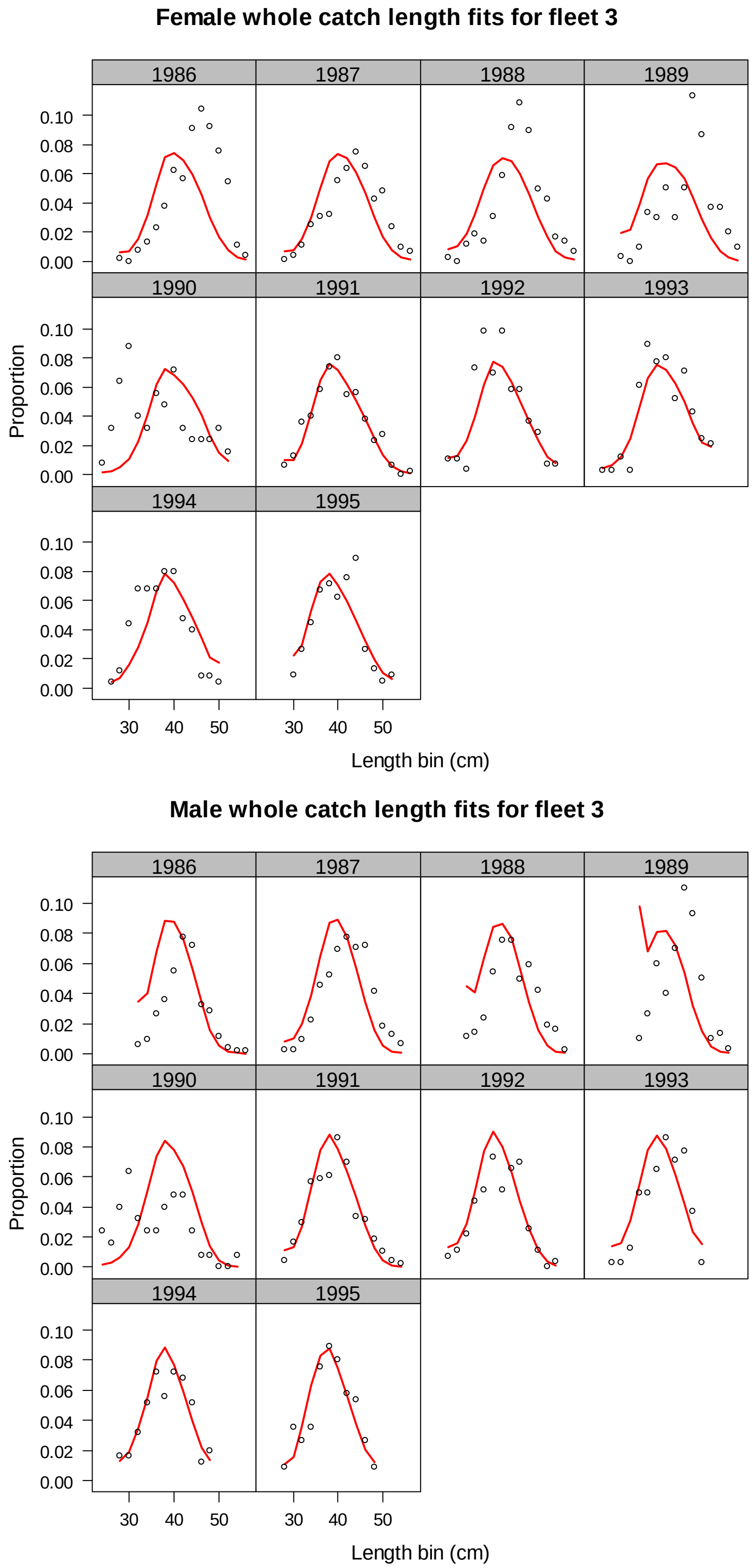


Figure 35. STAR base model fit to female (top panel) and male (bottom panel) length composition samples collected from the non-trawl fishery.

Combined sex whole catch length fits for fleet 6

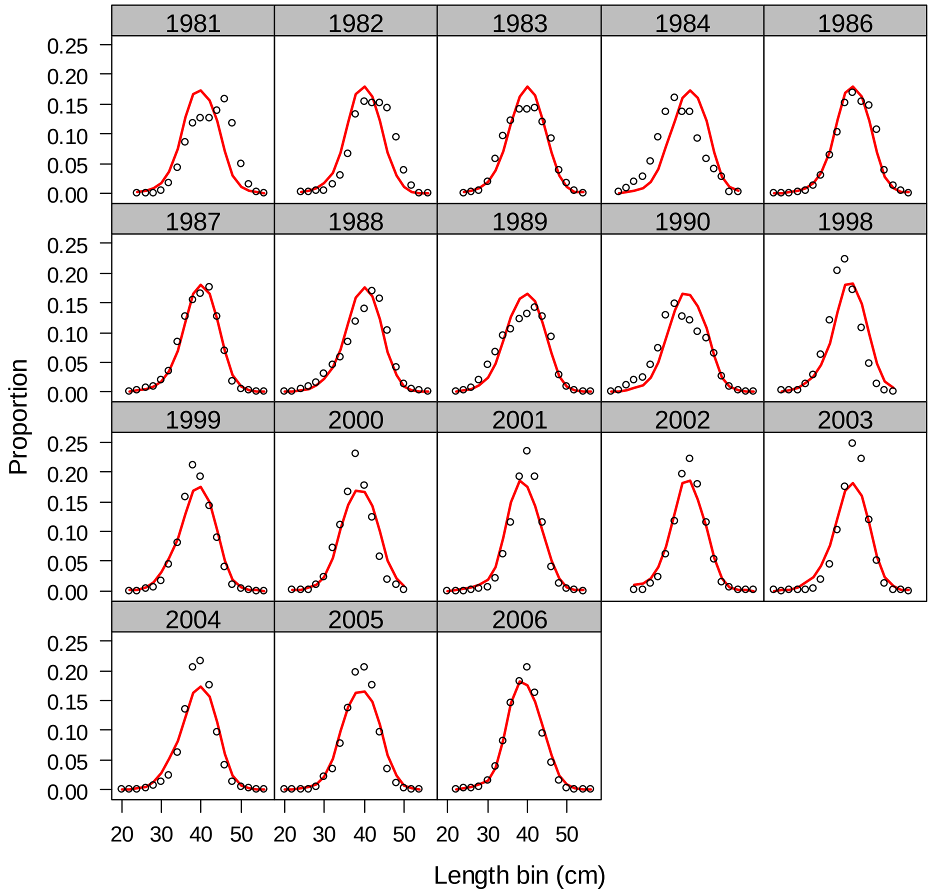


Figure 36. STAR base model fit to male length composition samples (combined sex) collected from the trawl fishery.

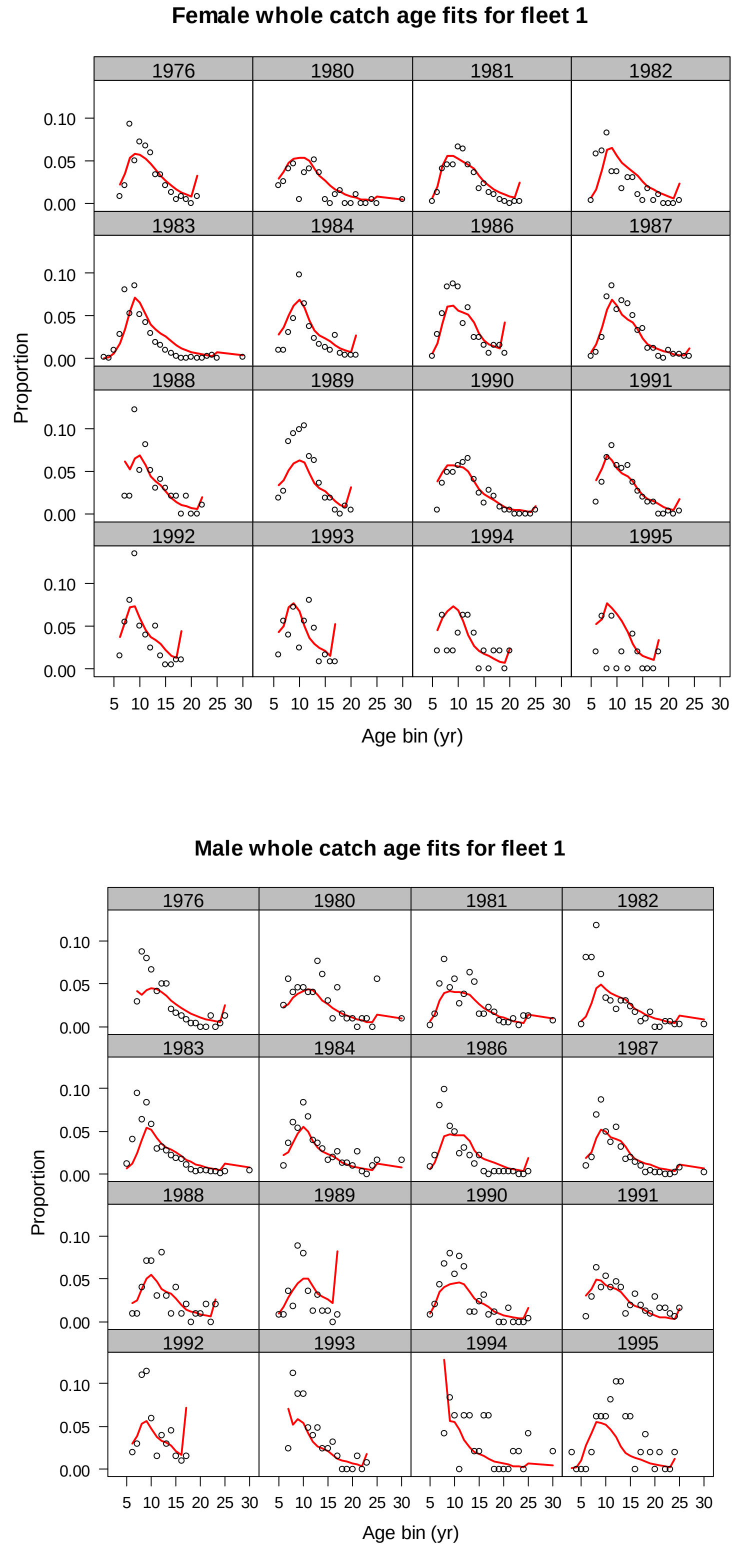
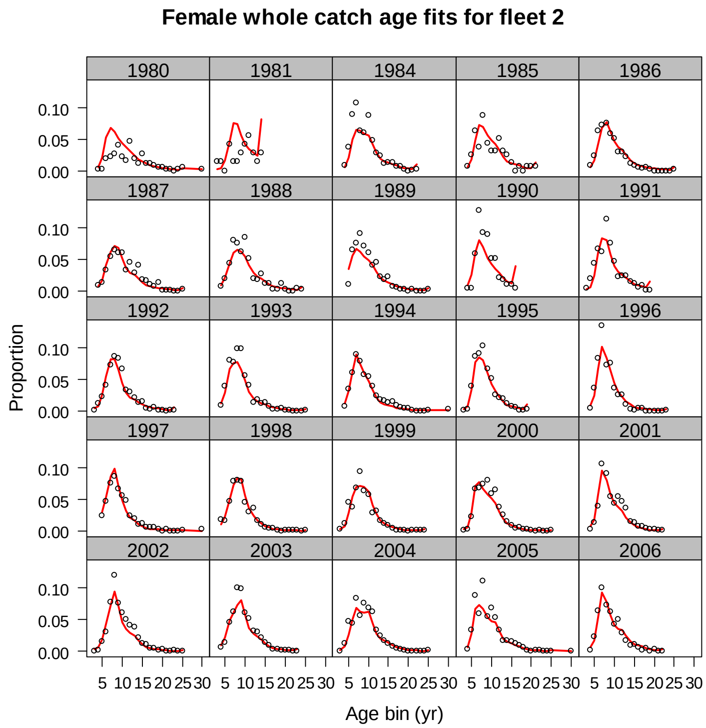


Figure 37. STAR base model fit to female (top panel) and male (bottom panel) age composition samples collected from the trawl fishery.



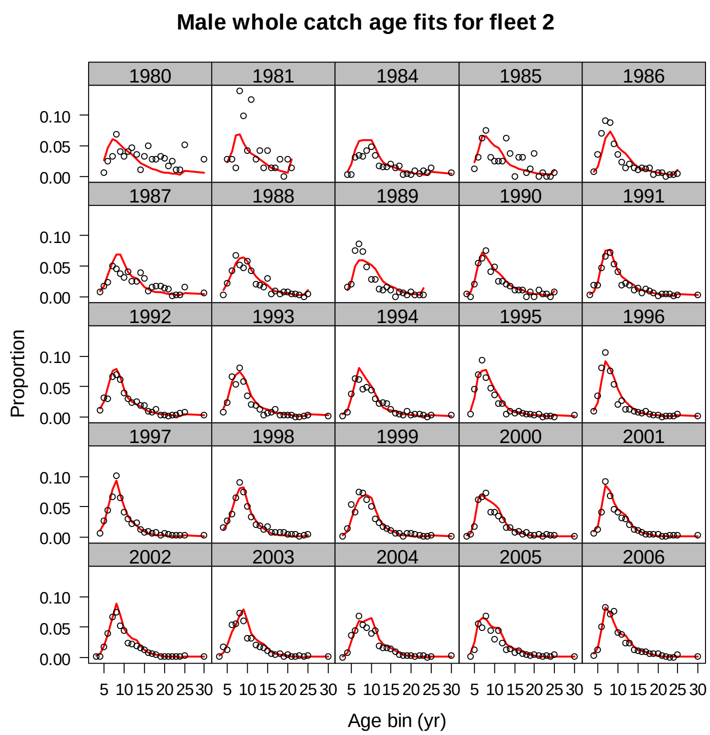
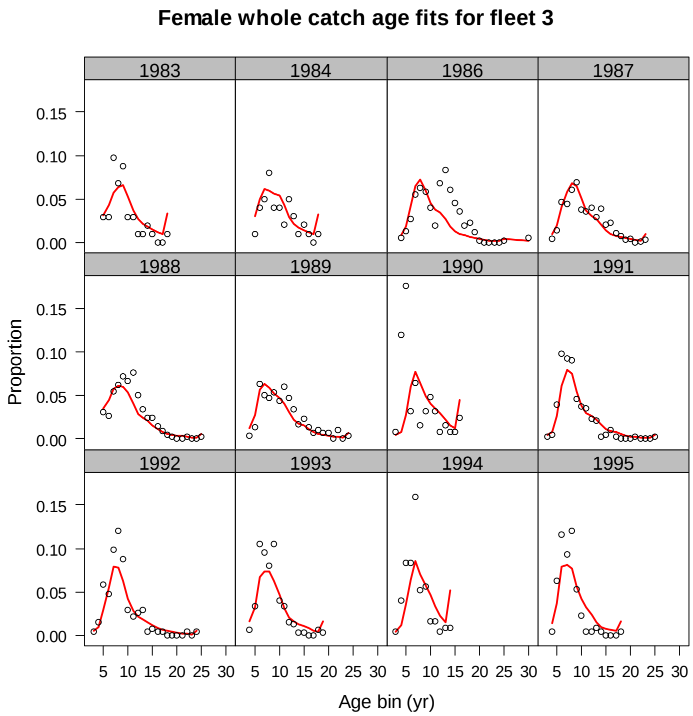


Figure 38. STAR base model fit to female (top panel) and male (bottom panel) age composition samples collected from the sport fishery.



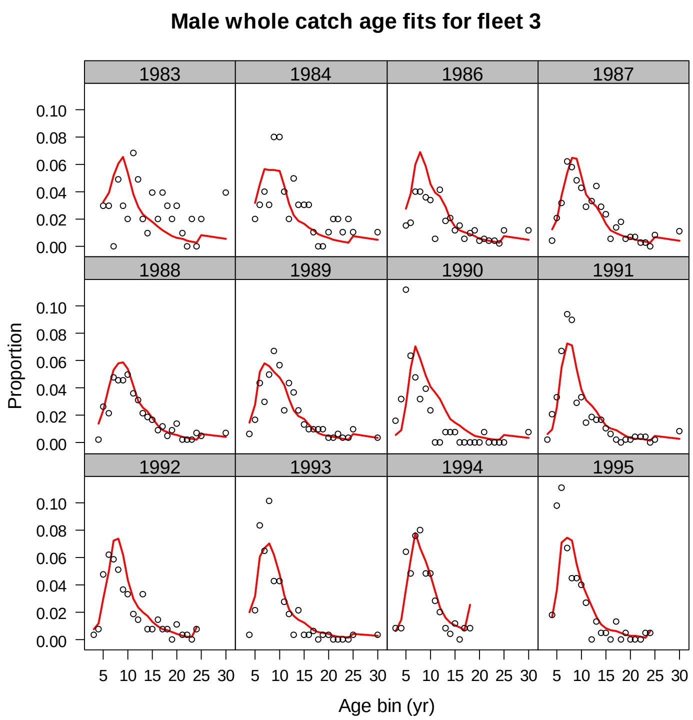


Figure 39. STAR base model fit to female (top panel) and male (bottom panel) age composition samples collected from the non-trawl fishery.

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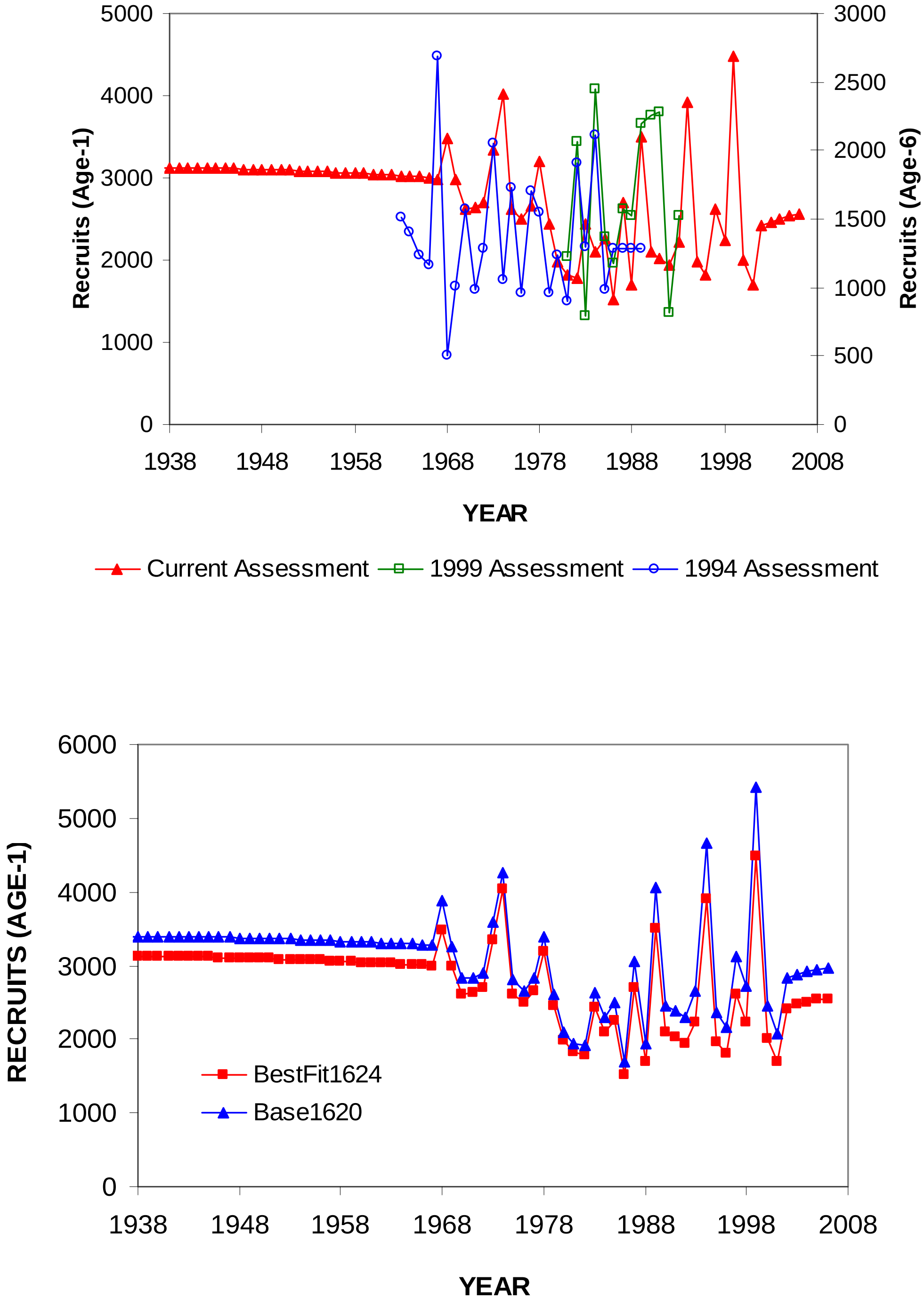

Figure 40. Comparison of STAR base model recruitment estimates to the previous northern black rockfish assessments (top panel) and to the STAT best-fit model recruitment estimates (bottom panel).

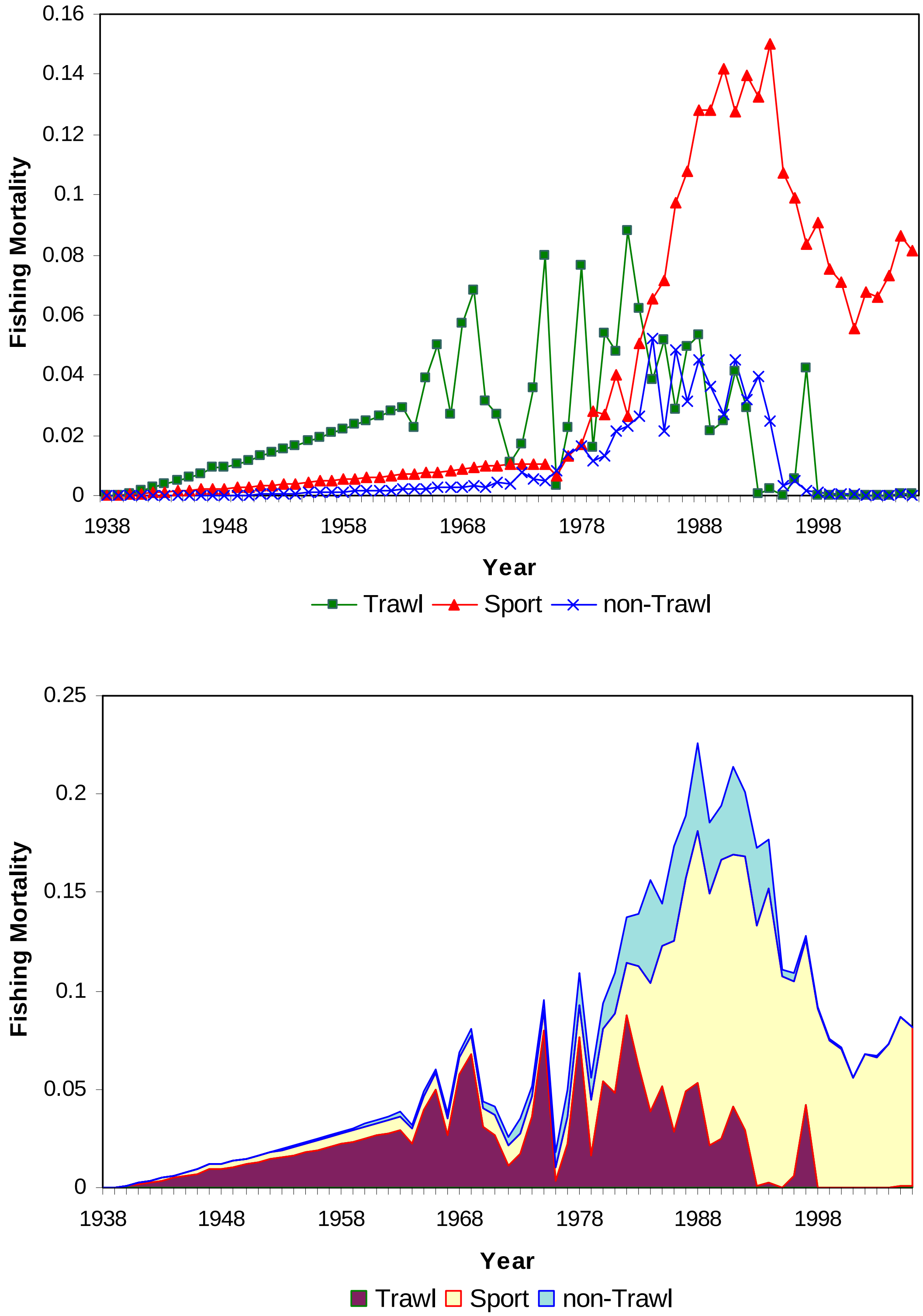

Figure 41. Northern black rockfish STAR base model estimated fishing mortality rates by year and fishery (top panel) and cumulative fishing mortality by year and fishery (bottom panel).

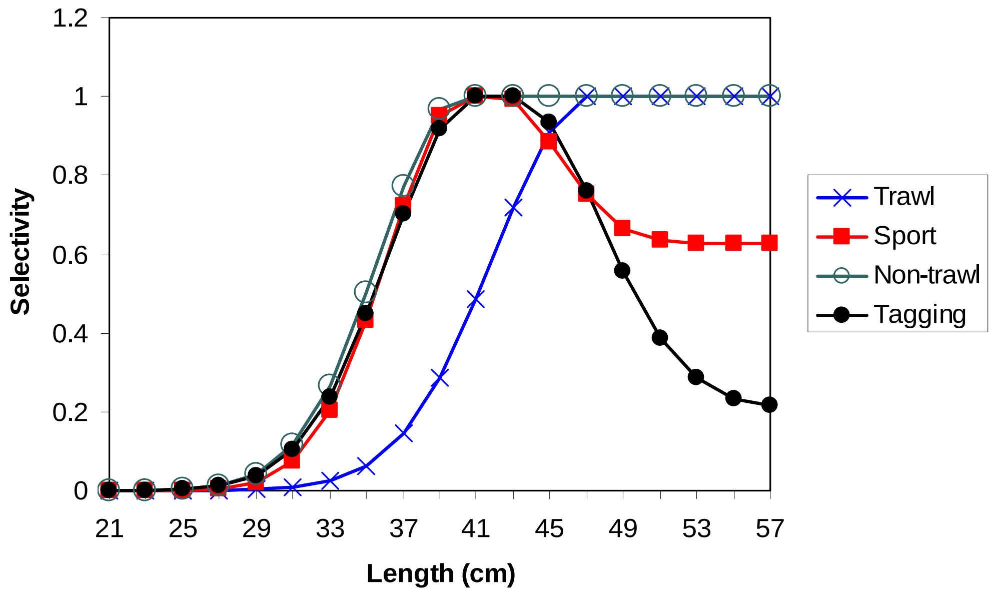

Figure 42. Trawl, sport, non-trawl, and tagging survey selectivity estimated by the STAR base model.

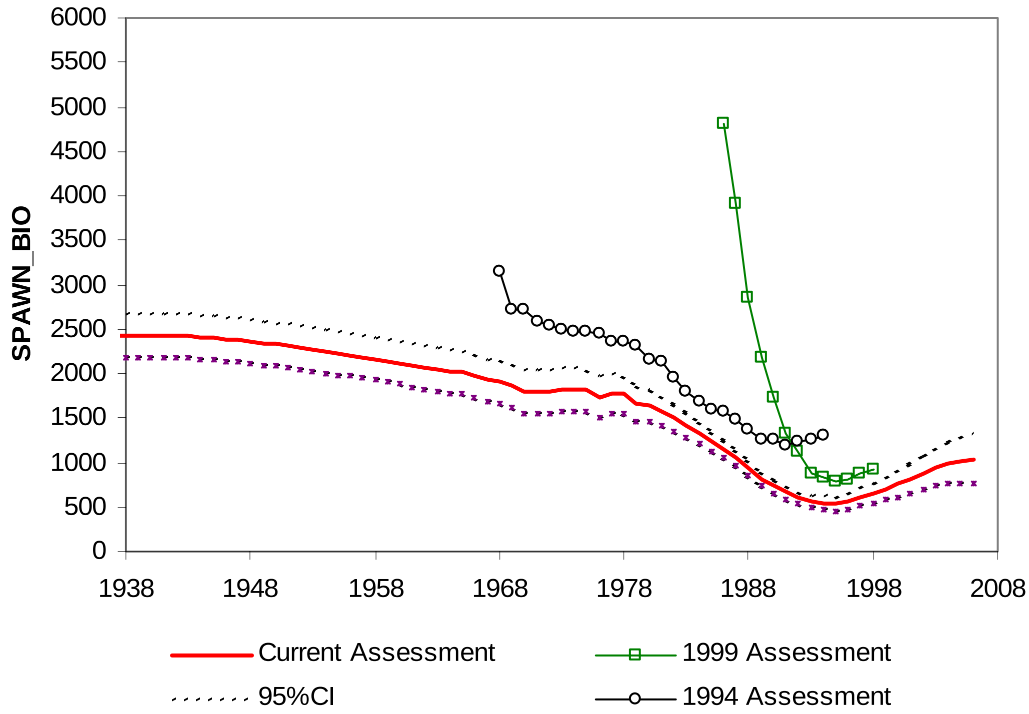

Figure 43. Comparison of STAR base model spawning biomass estimates to the previous two assessments for the northern black rockfish assessment.

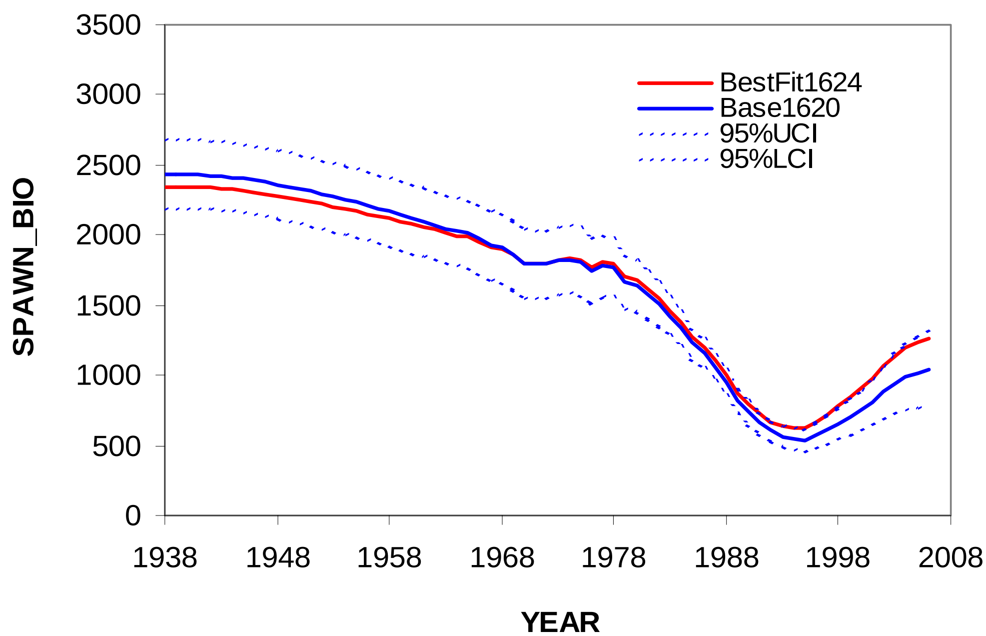

Figure 44. Comparison of STAR base model spawning biomass estimates to the STAT best-fit spawning biomass estimates for the Northern black rockfish assessment.

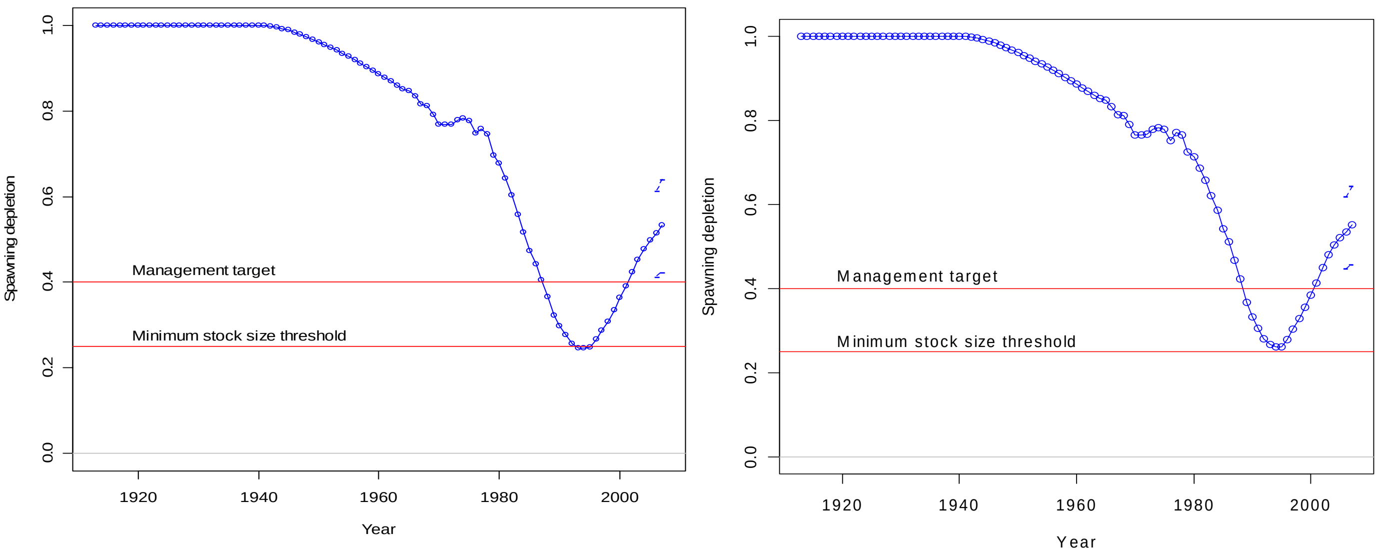

Figure 45. Comparison of stock abundance resulting from the STAT base model (left panel) and the STAT best fit model (right panel) to the Councils' minimum stock size threshold and management target.

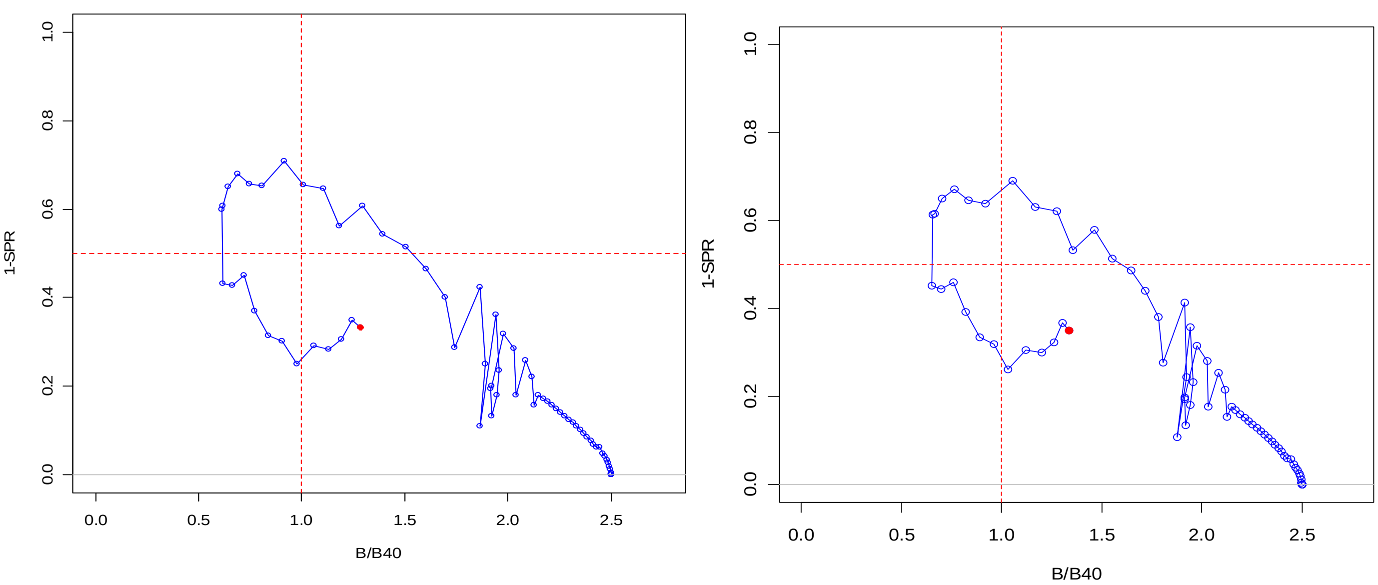

Figure 46. Plot of population status in relation to fishery management benchmarks for the STAR base (left panels) and STAT best fit models (right panels). Fspr versus (Bunfished/B40) in top panel and spawning depletion in relation to management target of B40% and B 25% in bottom panel.

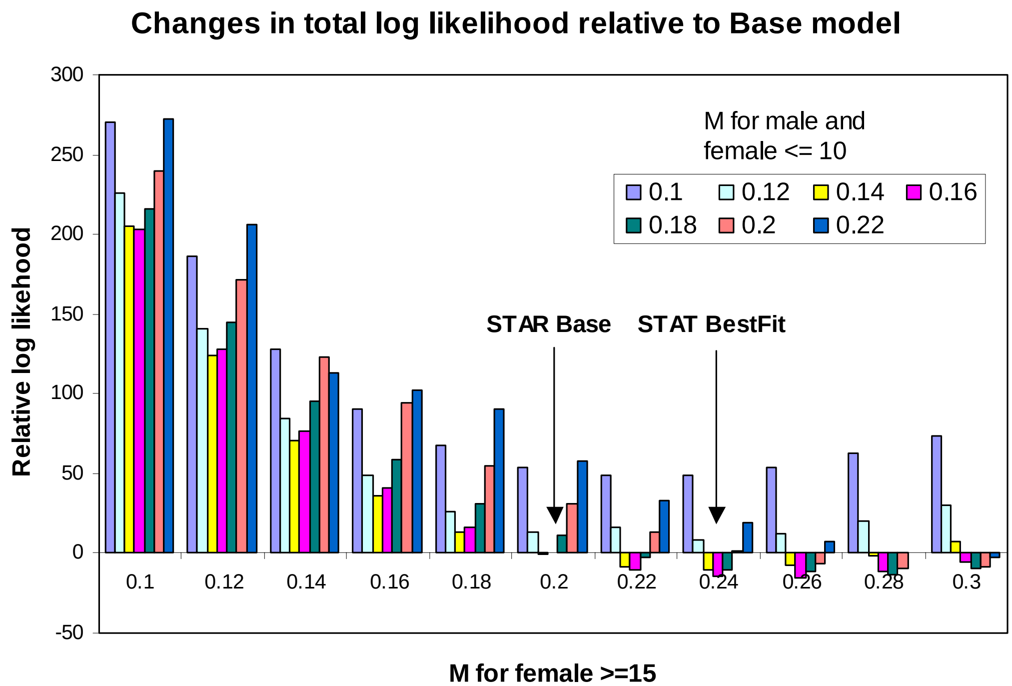

Figure 47. Change in total likelihood relative to the STAR base model. Negative values indicate a better fit.

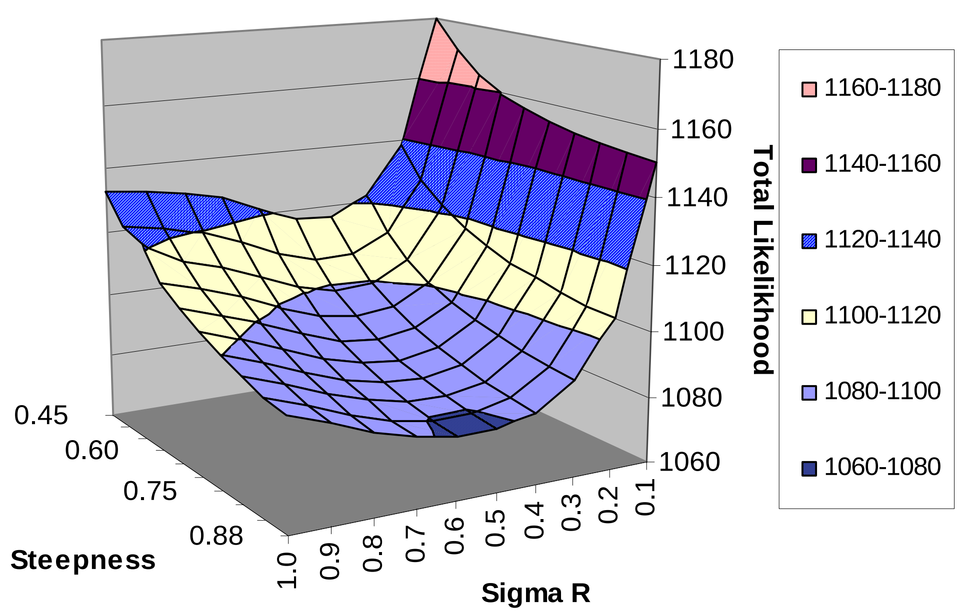

Figure 48. Likelihood profile of the STAR base assessment model for different fixed values of the Beverton-Holt steepness parameter (h) and Sigma R. The STAR base and STAT best-fit model had the steepness fixed at 0.6 and Sigma R tuned to 0.35.

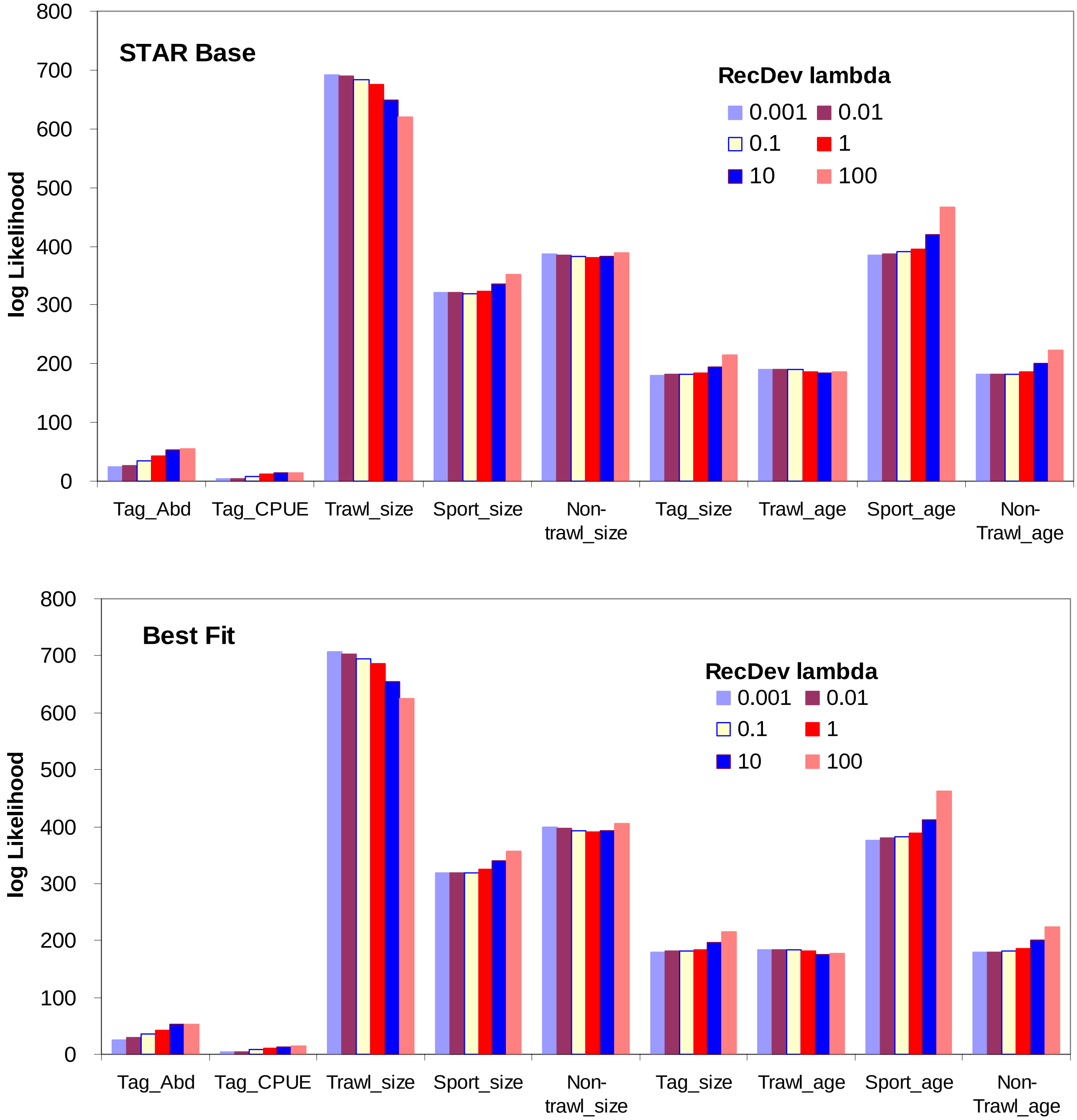

Figure 49. Likelihood profile for various components following simultaneous changes in the emphasis (weight) of the Recruitment Dev and Recruitment Dev time series for the STAR base (top panel) and STAT best-fit models (bottom panel).

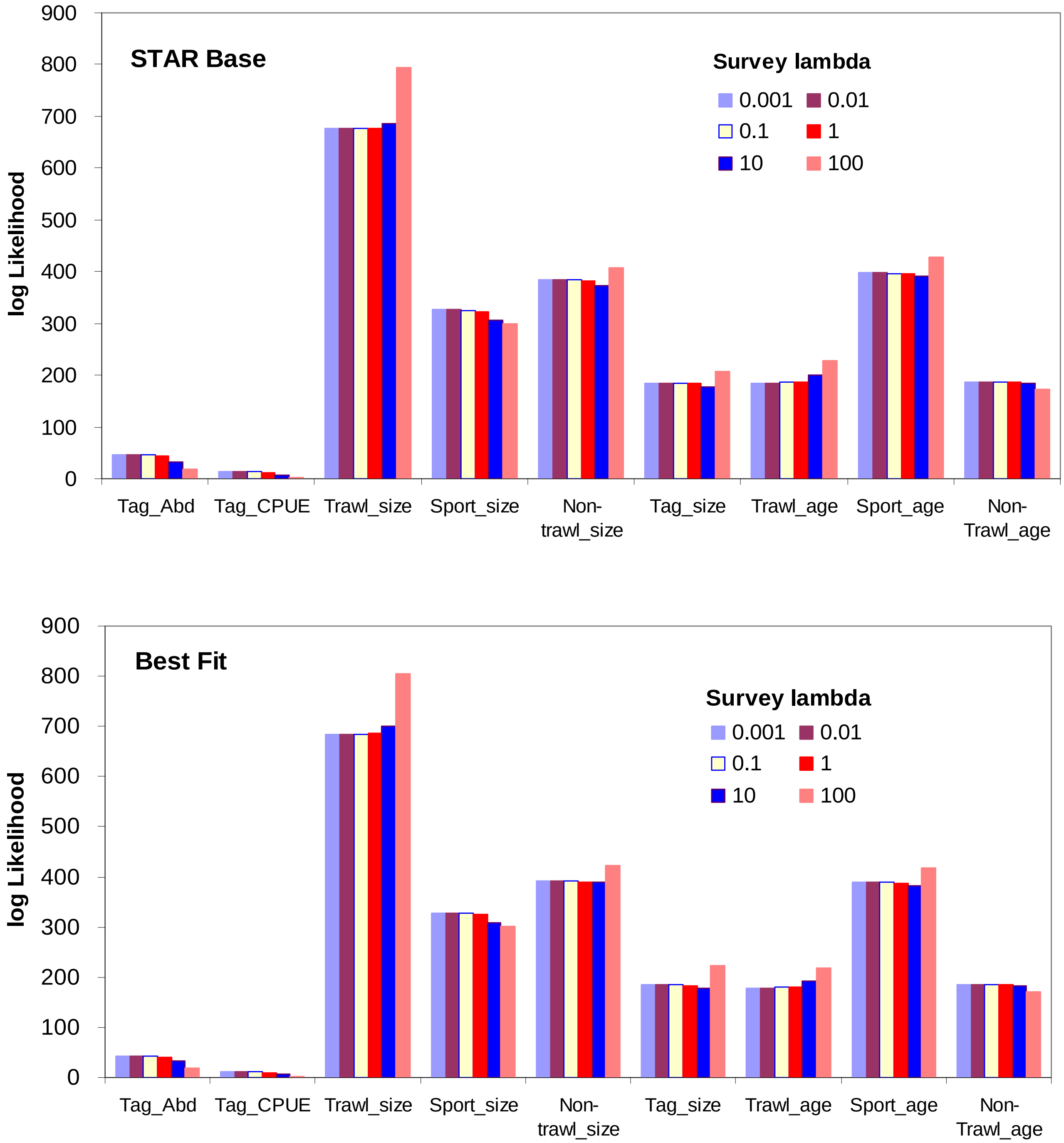

Figure 50. Likelihood profile for various components of the STAR base model (top panel) and STAT best-fit model (bottom panel) following changes in the emphasis (weight) on the tagging abundance and tagging CPUE indices.

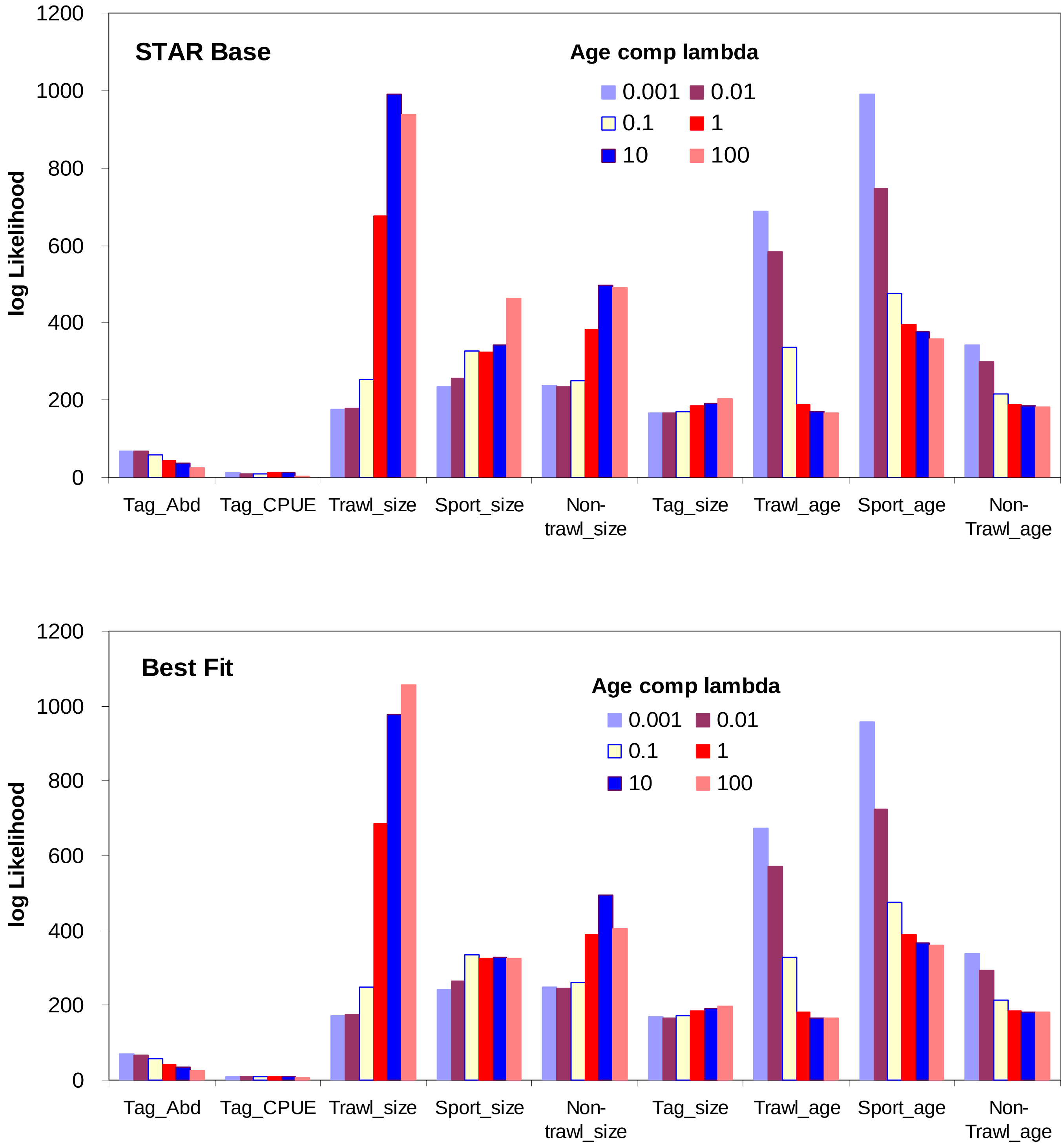

Figure 51. Likelihood profile for various components of the STAR base model and the STAT best-fit model following changes in the emphasis (weight) on the age composition for all fisheries.

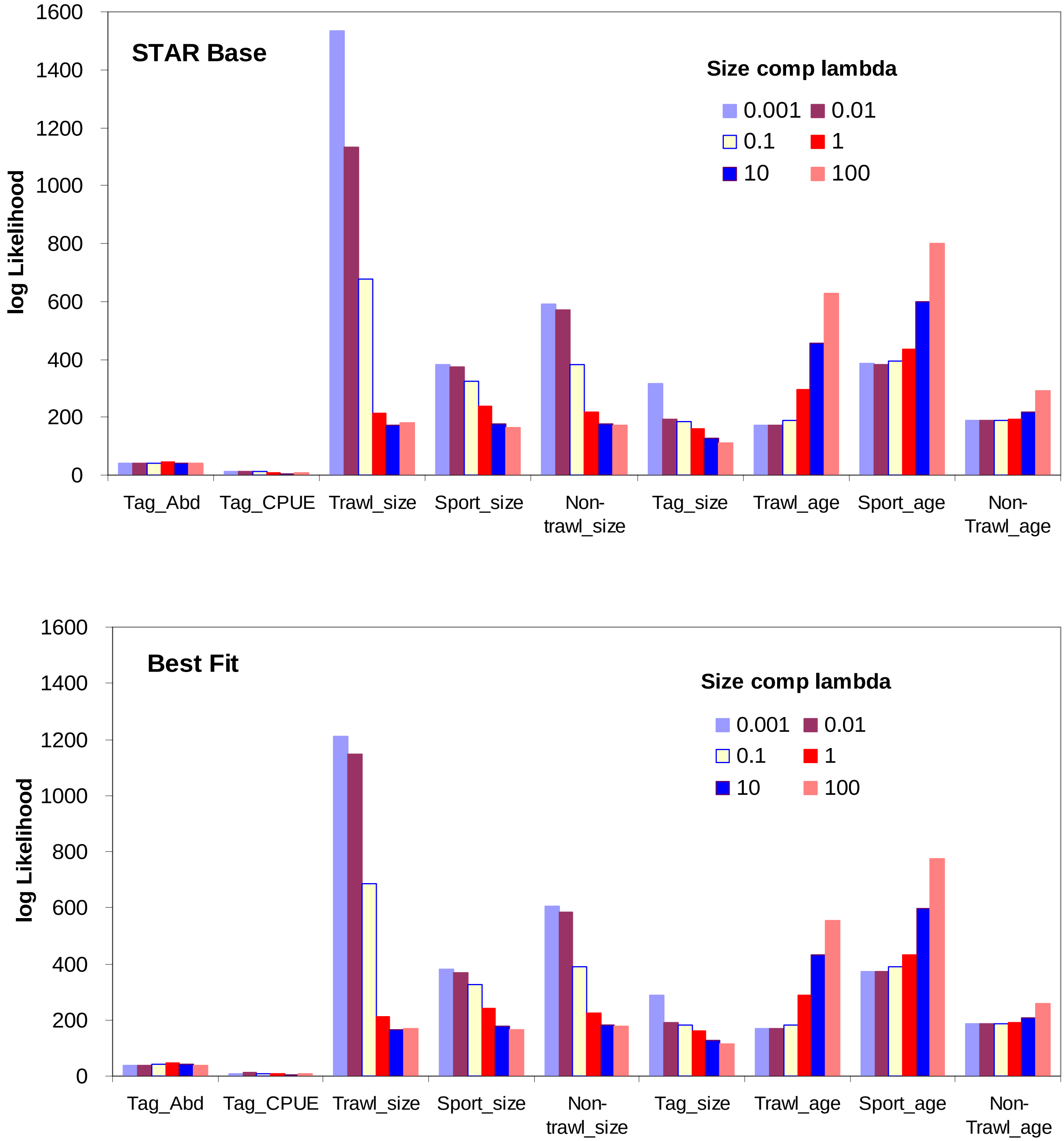

Figure 52. Likelihood profile for various components of the STAR base model and STAT best-fit model following changes in the emphasis (weight) on the length composition for all fisheries.

Appendix A: SS2 2.00c Control and Data Files

```
#_data_and_control_files:     ageonly.DAT    //     ageonly.CTL

1       #_N_Growth_Patterns

1       #_N_submorphs

1       #_N_areas

1       1       1       1       1       1
        #_area_assignments_for_each_fishery_and_survey

#_recruit_design_(G_Pattern_x_birthseas_x_area)_X_(0/1_flag)


1       #4_single       "season,area,and"       growth  "pattern,then=1"""

0       #Allow_recr_distr_interaction

0       #Allow_migration

0       0       0       #       movement        from    area    1       to      area    1
        in      season  1       (0=no;  start   age=1;  End     age     =1)
2       #_Nblock_Designs

1       1       #_N_Blocks_per_Pattern
1996 2006 #_begin_and_end_year_for_each_Block_in_Pattern_1
1989 2006 #
0.5     #_fracfemale

1       #_submorph_between/within

-1      #vector_submorphdist_(-1_first_val_for_normal_approx)


#       Natural Mortality       &       Maturity

10      #_natM_amin

15      #_natM_amax

5       #_Growth_Age-at-L1

20      #_Growth_Age-at-L2

0       #_SD_add_to_LAA

0       #_CV_Growth_Pattern

1       #_maturity_option

4       #_First_Mature_Age

1       #_parameter_offset_approach

1       #MG_Adjustment_method

-4      #_MGparm_Dev_Phase

#_growth_parms

#_LO    HI      INIT    PRIOR   PR_type SD_Prior        PHASE   env-var use_dev dev_minyr
        dev_maxyr       STD_4elements_in_Dev_Vector     Block   Block_Fxn
#Females

0.1     0.2     0.16    0.3     -1      0.9     -2      0       0       0       0       0.5
        0       0       #_Gpattern:_1_Gender:_Female_M1_natM_young
```

```
-3      3       0.2     0.3     -1      0.9     -2      0       0       0       0       0.5
        0       0
        #M1_natM_old_4_intermediateages_do_a_linear_interpolation_of_NM_on_age
10      40      34.4    13.5    -1      10      2       0       0       0       0       0.5
        0       0       #M1_Lmin_Body_length_at_Amin_(units_in_cm)
30      70      50.37   49.3    -1      10      2       0       0       0       0       0.5
        0       0       #M1_Lmax_Body_length_at_Amax_(units_in_cm)
0.01    0.4     0.181   0.1745  -1      0.9     3       0       0       0       0       0.5
        0       0       #M1_VBK
-3      3       0.08    0.0622  -1      0.9     -2      0       0       0       0       0.5
        0       0       #M1_CV-young_Variability_for_size-at-age_at-
age<=AFIX_(units_are_fraction)Units_CV_or_stddev_depending_on_assigned_value_of_CV_patter
n
-3      3       0.08    0.0721  -1      0.9     -3      0       0       0       0       0.5
        0       0       #M1_CV-old_Variability_for_size-at-age_at-
age>=AFIX2_do_a_linear_interpolation_of_CV_on_mean_size-at-age
#Males

0.1     0.2     0.16    0.1     -1      0.9     -2      0       0       0       0       0.5
        0       0       #_Gpattern:_1_Gender:_Male__M1_natM_young
0.1     0.2     0.16    0.1     -1      0.9     -2      0       0       0       0       0.5
        0       0
        #M1_natM_old_4_intermediateages_do_a_linear_interpolation_of_NM_on_age
10      40      34.2    15.0    -1      0.9     2       0       0       0       0       0.5
        0       0       #M1_Lmin
30      70      47.3    46.6    -1      0.9     2       0       0       0       0       0.5
        0       0       #M1_Lmax
0.1     0.3     0.191   0.1982  -1      0.9     3       0       0       0       0       0.5
        0       0       #M1_VBK
0.05    0.25    0.07    0.06    -1      0.9     -3      0       0       0       0       0.5
        0       0       #M1_CV-young
-3      3       0.07    0.0567  -1      0.9     -3      0       0       0       0       0.5
        0       0       #M1_CV-old
#Females_wtln_Maturity_fec

-3      3       4.03E-05        4.03E-05        -1      99      -3      0       0       0
        0       0.5     0       0       #Female wt-len-
1_coefficient_to_convert_L_in_cm_to_Wt_in_kg
-3      3       2.768   2.768   -1      0.9     -3      0       0       0       0       0.5
        0       0       #Female_wt-len-2_Exponent_in_female_L-W_conversion
-3      3       42.6    42.6    -1      0.9     -3      0       0       0       0       0.5
        0       0       #Female_Maturity_logistic_inflection
-3      3       -0.4    -0.4    -1      0.9     -3      0       0       0       0       0.5
        0       0       #Female_Logistic_slope
-3      3       -0.3657 -0.3657 -1      0.9     -3      0       0       0       0       0.5
        0       0       #-0.3657Female_eggs/gm_intercept
-3      3       0.7674  0.7674  -1      0.9     -3      0       0       0       0       0.5
        0       0       #0.7674Female_eggs/gm_slope
#Male_wtln

-3      3       3.80E-05        3.80E-05        -1      99      -3      0       0       0
        0       0.5     0       0       #Male   wt-len-
1_coefficient_to_convert_L_in_cm_to_Wt_in_kg
-3      3       2.782   2.782   -1      0.9     -3      0       0       0       0       0.5
        0       0       #Male_wt-len-2_Exponent_in_female_L-W_conversion
-4      4       0       1       -1      0.9     -3      0       0       0       0       0.5
        0       0       #_recrdistribution_by_growth_pattern
-4      4       0       1       -1      0.9     -3      0       0       0       0       0.5
        0       0       #_recrdistribution_by_area_1
-4      4       0       1       -1      0.9     -3      0       0       0       0       0.5
        0       0       #_recrdistribution_by_season_1
-1      1       1       1       -1      0.9     -3      0       0       0       0       0.5
        0       0       #_cohort_growth_deviation
0       #_custom_MG-env_setup

0       #_custom_MG-block_setup

#_Spawner-Recruitment

3       #_SR_function
```

```
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE

1       15      12      6.7     0       10      1       #log(R0)

0.2     1       0.6     0.566   2       0.181   -5      #steepness
0       2       0.3     0.65    0       0.4     -4      #sigma-r
-5      5       0       0       0       1       -3      #env-linkrecruitment-
environmental_linkage_coefficient
-5      5       0       0       0       1       -1
        #log(R1)offsetfor_initial_equil_recruitment_relative_to_virgin_recruitment_(usuall
y0)
0       0       0       0       -1      0       -99     #autocorrelation_parameter_for_S-R
0       #_SR_env_link
1       #_SR_env_target_1=devs;_2=R0;_3=steepness
1       #do_recr_dev:  0=none; 1=devvector;_2=simple_deviations
1968    #Begin  RecDevs
2001    #End_recr_Dev
-15     #Min_Value4Rec_Dev
15      #Max_Value4RecDev
3       #Phaseto        begin_Estimation
1492    #_first_yr_fullbias_adj_in_MPD
#_initial_F_parms
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE
0       0.6     0.000   0.0001  -1      99      -1
0       0.6     0.000   0.0001  -1      99      -1
0       0.6     0.000   0.0001  -1      99      -1
#_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       E       F
0       0       0       0       1       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
#_Q_parms(if_any)

#_size_selex_types

#_Pattern_DiscardMale_Special

24      0       0       0       #       1
24      0       0       0       #       2

24      0       0       0       #       3

5       0       0       2       #       4

5       0       0       6       #       5

24      0       0       0

#_age_selex_types

#_Pattern       Discard Male    Special

10      0       0       0       #       1

10      0       0       0       #       2

10      0       0       0       #       3

10      0       0       0       #       4

10      0       0       0       #       5

10      0       0       0       #       6
```

```
#_selex_parms

#_LO    HI      INIT    PRIOR   PR_type SD      PHASE   env-var use_dev dev_minyr
        dev_maxyr       dev_stddev      Block   Block_Fxn
#_size_sel:1

#19     70      45.57   50      1       0.05    2       0       0       0       0       0.5
        0       0       #infl_for_logistic
#0.01   60      6.6     15      1       0.05    2       0       0       0       0       0.5
        0       0       #95%width_for_logistic
30      60      46      51.2    -1      0.05    2       0       0       0       0       0.5
        0       0
-6      4       1.6     -2.6    -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       4       5.2     -1      0.05    -3      0       0       0       0       0.5
        0       0
-1      9       2.2     6       -1      0.05    -3      0       0       0       0       0.5
        0       0
-8      9       -4      -3.7    -1      0.05    2       0       0       0       0       0.5
        0       0
-5      9       -1      0.1     -1      0.05    2       0       0       0       0       0.5
        0       0
#_size_sel:2

#19     70      45      50      1       0.05    2       0       0       0       0       0.5
        0       0       #infl_for_logistic
#0.01   60      20      15      1       0.05    2       0       0       0       0       0.5
        0       0       #95%width_for_logistic
#

20      60      41.5    41.2    -1      0.05    2       0       0       0       0       0.5
        0       0
-6      4       -4      -2.6    -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       3.5     5.2     -1      0.05    -3      0       0       0       0       0.5
        0       0
-1      9       3       6       -1      0.05    -3      0       0       0       0       0.5
        0       0
-8      9       -3.7    -3.7    -1      0.05    2       0       0       0       0       0.5
        0       0
-5      9       -1      0.1     -1      0.05    2       0       0       0       0       0.5
        0       0
#_size_sel:3

#19     70      41.6    50      1       0.05    -2      0       0       0       0       0.5
        0       0       #infl_for_logistic
#0.01   60      9.3     15      1       0.05    -2      0       0       0       0       0.5
        0       0       #95%width_for_logistic
30      60      46      41.2    -1      0.05    2       0       0       0       0       0.5
        0       0
-6      4       -0.747  -2.6    -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       4.83454 5.2     -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       4       6       -1      0.05    3       0       0       0       0       0.5
        0       0
-8      9       -4      -3.7    -1      0.05    2       0       0       0       0       0.5
        0       0
-5      9       2       0.1     -1      0.05    2       0       0       0       0       0.5
        0       0
#_size_sel:4

1       19      1       5       -1      0.05    -2      0       0       0       0       0.5
        0       0       #MirrorTag
1       19      19      5       -1      0.05    -3      0       0       0       0       0.5
        0       0       #MirrorTag
#_size_sel:5

1       19      1       5       -1      0.05    -2      0       0       0       0       0.5
        0       0       #MirrorTagCPUE
```

```
1       19      19      5       -1      0.05    -3      0       0       0       0       0.5
        0       0       #MirrorTagCPUE
#_size_sel:6

#1      19      30      5       -1      0.05    2       0       0       0       0       0.5
        0       0       #
#1      19      19      5       -1      0.05    3       0       0       0       0       0.5
        0       0       #
20      60      39.513  41.2    -1      0.05    2       0       0       0       0       0.5
        0       0
-6      4       -3.41   -2.6    -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       3.7     5.2     -1      0.05    3       0       0       0       0       0.5
        0       0
-1      9       3.5     6       -1      0.05    3       0       0       0       0       0.5
        0       0
-8      9       -4.69   -3.7    -1      0.05    2       0       0       0       0       0.5
        0       0
-5      9       -3.95   0.1     -1      0.05    2       0       0       0       0       0.5
        0       0
#_age_sel:1

#0      40      1       5       0       99      2       0       0       0       0       0.5
        0       0       #       3
#0.01   10      2       2       0       99      3       0       0       0       0       0.5
        0       0       #       4
#1      20      7       5       0       99      2       0       0       0       0       0.5
        0       0       #       5
#1      25      17      2       0       99      3       0       0       0       0       0.5
        0       0       #       6
#_age_sel:2

#1      20      7       5       0       99      2       0       0       0       0       0.5
        0       0       #       5
#1      25      17      2       0       99      3       0       0       0       0       0.5
        0       0       #       6
#_age_sel:3

#0      40      1       5       0       99      2       0       0       0       0       0.5
        0       0       #       7
#0.01   10      2       2       0       99      3       0       0       0       0       0.5
        0       0       #       8
#1      20      7       5       0       99      2       0       0       0       0       0.5
        0       0       #       5
#1      25      17      2       0       99      3       0       0       0       0       0.5
        0       0       #       6
#_age_sel:4

#0      40      1       5       0       99      2       0       0       0       0       0.5
        0       0       #       9
#0.01   10      2       2       0       99      3       0       0       0       0       0.5
        0       0       #       10
1       #_Selparm_Adjust_Method

0       #_custom_sel-env_setup

0       #_custom_sel-block_setup
#-6     60      44      -2.6    1       0.05    4

#-10    10      .0      .1      1       0.05    4
#-10    10      .0      .1      1       0.05    4
-1      #_selparmdev-phase

#_Variance_adjustments_to_input_values

#_1     2

0       0       0       0       0       0       #_add_to_survey_CV
0       0       0       0       0       0       #_add_to_discard_CV
0       0       0       0       0       0       #_add_to_bodywt_CV
3       4       3       1       1       3       #_mult_by_lencomp_N
```

```
2       2       2       1       1       1       #_mult_by_agecomp_N
1       1       1       1       1       1       #_mult_by_size-at-age_N
30      #_DF_for_discard_like
30      #_DF_for_meanbodywt_like
1       #_maxlambdaphase
0       #_sd_offset
#_lambdas_(columns_for_phases)
1       #_Fishery:_1
1       #_Fishery:_2
1       #_Fishery:_3
0       #_OSP_CPUE:_4
1       #_TagAbundance:_5
1       #_TagCPUE:_6
0       #_discard:_1
0       #_discard:_2
0       #_discard:_3
0       #_discard:_4
0       #_discard:_5
0       #_discard:_6
0       #_meanbodyweight
.1      #_lencomp:_1
.1      #_lencomp:_2
.1      #_lencomp:_3
0       #_lencomp:_4
0       #_lencomp:_5
.1      #_lencomp:_6
1       #_agecomp:_1
1       #_agecomp:_2
1       #_agecomp:_3
0       #_agecomp:_4
0       #_agecomp:_5
0       #_agecomp:_6
1       #_size-age:_1
1       #_size-age:_2
0       #_size-age:_3
0       #_size-age:_4
0       #_size-age:_5
0       #_size-age:_6
1       #_init_equ_catch
1       #_recruitment  Deveations
1       #_parameter-priors
1       #_parameter-dev-vectors
1000    #_crashPenLambda
0.99    #_maximum_allowed_harvest_rate
999
```

```
#
#       SS2     Data    File
#
1915    #       start   year
2006    #       end     year
1       #       number  seasons
12      #       months  per     season
1       #       spawning        season
3       #       number  of      fleets
3       #       number  of      surveys
Trawl_1%Sport_2%Line_3%SPTCPUE_4%TagAbun_5%TagCPUE_6 #       Fleets  &       Surveys

0.5     0.5     0.5     0.5     0.5     0.5     #       Timing  of      Catch   and     Survey
2       #       number  of      genders
40      #       Maximum Age     in      Plus    Group
#
#       Landings
#
0       0       0       #       Initial Landings        MT      Opposite        Time    Series
        Estimated       Time    Series
```

0	0	0	#	1915						
0	0	0	#	1916						
0	0	0	#	1917						
0	0	0	#	1918						
0	0	0	#	1919						
0	0	0	#	1920						
0	0	0	#	1921						
0	0	0	#	1922						
0	0	0	#	1923						
0	0	0	#	1924						
0	0	0	#	1925						
0	0	0	#	1926						
0	0	0	#	1927						
0	0	0	#	1928						
0	0	0	#	1929						
0	0	0	#	1930						
0	0	0	#	1931						
0	0	0	#	1932						
0	0	0	#	1933						
0	0	0	#	1934						
0	0	0	#	1935						
0	0	0	#	1936						
0	0	0	#	1937						
0	0	0	#	1938						
0	1	0	#	1939						
0	2.8	0	#	1940	Landings	MT	1.4	312	0.4	2
	2	1								
3.2	4.6	0	#	1941	Landings	MT	1.4	312	1.2	3.2
	2.8	0								
9.2	6.3	0	#	1942	Landings	MT	0	315.5	0.9	9.2
	4.6	0								
15.2	8.1	0	#	1943	Landings	MT	0.6	257.6	0.7	15.2
	6.3	0								
21.2	9.8	0	#	1944	Landings	MT	0.1	232.2	0.2	21.2
	8.1	0								
27.2	11.6	0	#	1945	Landings	MT	0.2	232.9	1.5	27.2
	9.8	0								
33.2	13.3	0	#	1946	Landings	MT	0	188.7	1.1	33.2
	11.6	0								
39.2	15.1	0	#	1947	Landings	MT	0	224.8	1.2	39.2
	13.3	0								
52	16.8	0	#	1948	Landings	MT	0	221.6	4.3	5.2
	15.1	0								
51.2	18.6	0	#	1949	Landings	MT	73.1	259.4	4.8	51.2
	16.8	0								
57.2	20.3	0	#	1950	Landings	MT	9	234.1	15	57.2
	18.6	0								
63.2	22.1	1.5	#	1951	Landings	MT	0	264.2	8.6	63.2
	20.3	1.5								
69.2	23.8	2.5	#	1952	Landings	MT	3.3	264.8	65.8	69.2
	22.1	2.5								
75.2	25.6	3.5	#	1953	Landings	MT	1	358.6	106.3	75.2
	23.8	3.5								
81.2	27.3	4.5	#	1954	Landings	MT	46.8	316.9	88.4	81.2
	25.6	4.5								
87.2	29.1	5.5	#	1955	Landings	MT	71.4	342.9	132.3	87.2
	27.3	5.5								
93.2	30.8	6.5	#	1956	Landings	MT	46.2	332.3	83.4	93.2
	29.1	6.5								
99.2	32.6	7.5	#	1957	Landings	MT	43.3	387.2	119.4	99.2
	30.8	7.5								
105.2	34.3	8.5	#	1958	Landings	MT	124.4	369.6	165.3	105.2
	32.6	8.5								
111.2	36.1	9.5	#	1959	Landings	MT	129	414.2	129.3	111.2
	34.3	9.5								
117.2	37.8	10.5	#	1960	Landings	MT	82	389.3	220.1	117.2
	36.1	10.5								
123.2	39.6	11.5	#	1961	Landings	MT	158.6	391.1	103	123.2
	37.8	11.5								
129.2	41.3	12.5	#	1962	Landings	MT	127.3	305.3	272	129.2
	39.6	12.5								

135.2	43.1	13.5	#	1963	Landings	MT	218.9	302.2	145.8	135.2
	41.3	13.5								
141.2	44.8	14.5	#	1964	Landings	MT	327.5	244.3	134.1	141.2
	43.1	14.5								
108	46.6	15.5	#	1965	Landings	MT	185.1	135.7	128.9	108
	44.8	15.5								
186	48.3	16.5	#	1966	Landings	MT	213	213.8	81.8	186
	46.6	16.5								
234	50.1	17.5	#	1967	Landings	MT	64.6	144.8	70.5	234
	48.3	17.5								
122	51.8	18.5	#	1968	Landings	MT	321.3	150.7	104	122
	50.1	18.5								
261	53.6	19.5	#	1969	Landings	MT	96	94.2	89.8	261
	51.8	19.5								
303	55.3	20.5	#	1970	Landings	MT	15	76	52.2	303
	53.6	20.5								
134.1	57.1	17.5	#	1971	Landings	MT	347.2	36.8	32.7	134.1
	55.3	17.5								
116	58.8	29.3	#	1972	Landings	MT	156	62.3	36.9	116
	57.1	29.3								
48	60.6	26.8	#	1973	Landings	MT	75	60.6	51.2	48
	58.8	26.8								
75	62.3	51.2	#	1974	Landings	MT	48	58.8	26.8	75
	60.6	51.2								
156	62.3	36.9	#	1975	Landings	MT	116	57.1	29.3	156
	62.3	36.9								
347.2	36.8	32.7	#	1976	Landings	MT	134.1	55.3	17.5	347.2
	36.8	32.7								
15	76	52.2	#	1977	Landings	MT	303	53.6	20.5	15
	76	52.2								
96	94.2	89.8	#	1978	Landings	MT	261	51.8	19.5	96
	94.2	89.8								
321.3	150.7	104	#	1979	Landings	MT	122	50.1	18.5	321.3
	150.7	104								
64.6	144.8	70.5	#	1980	Landings	MT	234	48.3	17.5	64.6
	144.8	70.5								
213	213.8	81.8	#	1981	Landings	MT	186	46.6	16.5	213
	213.8	81.8								
185.1	135.7	128.9	#	1982	Landings	MT	108	44.8	15.5	185.1
	135.7	128.9								
327.5	244.3	134.1	#	1983	Landings	MT	141.2	43.1	14.5	327.5
	244.3	134.1								
218.9	302.2	145.8	#	1984	Landings	MT	135.2	41.3	13.5	218.9
	302.2	145.8								
127.3	305.3	272	#	1985	Landings	MT	129.2	39.6	12.5	127.3
	305.3	272								
158.6	391.1	103	#	1986	Landings	MT	123.2	37.8	11.5	158.6
	391.1	103								
82	389.3	220.1	#	1987	Landings	MT	117.2	36.1	10.5	82
	389.3	220.1								
129	414.2	129.3	#	1988	Landings	MT	111.2	34.3	9.5	129
	414.2	129.3								
124.4	369.6	165.3	#	1989	Landings	MT	105.2	32.6	8.5	124.4
	369.6	165.3								
43.3	387.2	119.4	#	1990	Landings	MT	99.2	30.8	7.5	43.3
	387.2	119.4								
46.2	332.3	83.4	#	1991	Landings	MT	93.2	29.1	6.5	46.2
	332.3	83.4								
71.4	342.9	132.3	#	1992	Landings	MT	87.2	27.3	5.5	71.4
	342.9	132.3								
46.8	316.9	88.4	#	1993	Landings	MT	81.2	25.6	4.5	46.8
	316.9	88.4								
1	358.6	106.3	#	1994	Landings	MT	75.2	23.8	3.5	1
	358.6	106.3								
3.3	264.8	65.8	#	1995	Landings	MT	69.2	22.1	2.5	3.3
	264.8	65.8								
0	264.2	8.6	#	1996	Landings	MT	63.2	20.3	1.5	0
	264.2	8.6								
9	234.1	15	#	1997	Landings	MT	57.2	18.6	0	9
	234.1	15								

```
73.1    259.4   4.8     #       1998    Landings        MT      51.2    16.8    0       73.1
        259.4   4.8
0       221.6   4.3     #       1999    Landings        MT      5.2     15.1    0       0
        221.6   4.3
0       224.8   1.2     #       2000    Landings        MT      39.2    13.3    0       0
        224.8   1.2
0       188.7   1.1     #       2001    Landings        MT      33.2    11.6    0       0
        188.7   1.1
0.2     238.9   1.5     #       2002    Landings        MT      27.2    9.8     0       0.2
        232.9   1.5
0.1     237.1   0.2     #       2003    Landings        MT      21.2    8.1     0       0.1
        232.2   0.2
0.6     268     0.7     #       2004    Landings        MT      15.2    6.3     0       0.6
        257.6   0.7
0       331.7   0.9     #       2005    Landings        MT      9.2     4.6     0       0
        315.5   0.9
1.4     321.5   1.2     #       2006    Landings        MT      3.2     2.8     0       1.4
        312     1.2
#       1.4     312     0.4
#       Surveys
#CPUE_from_Area_2_Raw_Means

#Year   Season  Type    Value   ln(1+cv)

28
1990    1       4       5.73    0.728959186

1991    1       4       5.426   0.703659282

1992    1       4       4.768   0.695933036

1993    1       4       4.242   0.759157379

1994    1       4       4.426   0.740246527

1995    1       4       4.069   0.705679139

#1996   1       4       4.569   0.646320543
#1997   1       4       3.932   0.699568754
#1998   1       4       4.805   0.622019705
#1999   1       4       4.856   0.620031093
#2000   1       4       5.028   0.604528452
#2001   1       4       4.288   0.673016624
#2002   1       4       5.01    0.607570313
#2003   1       4       4.946   0.607124035
#2004   1       4       5.571   0.553122333
#2005   1       4       5.355   0.562373981
#2006   1       4       5.201   0.586151481
#Tag_Abundance_from_Area_2_Raw_Means
#Year   Season  Type    Value   ln(1+cv)
2000    1       5       1389    0.0854
2001    1       5       2997    0.1157
2002    1       5       1944    0.0806
2003    1       5       2119    0.0624
2004    1       5       2996    0.1107
2005    1       5       5015    0.1276
2006    1       5       3464    0.08
#TagCPUE_from_Area_2_Raw_Means
#Year   Season  Type    Value   ln(1+cv)
1981    1       6       4.75    0.666
1986    1       6       2.337   0.5993
1987    1       6       1.172   0.6344
1988    1       6       0.826   0.5539
1989    1       6       1.236   0.9771
1990    1       6       0.991   0.8439
1998    1       6       2.46    0.813
1999    1       6       3.061   0.7407
2000    1       6       2.203   0.5684
2001    1       6       4.657   0.6076
2002    1       6       5.486   0.5034
2003    1       6       6.245   0.5913
```

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2004    1       6       9.414   0.5149
2005    1       6       10.192  0.7579
2006    1       6       10.543  0.4205
#       Discards
#
2
-1
#
#       Mean    Body    Weight
#
0
#
#       Composition     Conditioners
#
0.0001
0.0001
#
#       Length  Composition
#
#Yr     Seas    Flt/Svy Gender  Part    Nsamp   datavector(female-male)
19
20      22      24      26      28      30      32      34      36      38      40      42
        44      46      48      50      52      54      56
#
67
1976    1       1       3       0       28      0       0       0       0       0       0
        0       0       0       0.0051  0.0102  0.0332  0.0652  0.0985  0.0806  0.0793  0.0678
        0.0358  0.0396  0       0       0       0       0       0.0013  0       0       0
        0.0026  0.0307  0.0729  0.1036  0.1189  0.0844  0.0473  0.0179  0.0026  0.0026
1980    1       1       3       0       14      0       0       0       0       0       0
        0       0.0049  0.0049  0.0388  0.0194  0.034   0.0485  0.0631  0.0825  0.0194  0.0146
        0.0097  0.0097  0       0       0       0       0       0       0       0       0.0049
        0.0243  0.034   0.0922  0.1165  0.1359  0.1165  0.0631  0.034   0.0243  0.0049
1981    1       1       3       0       28      0       0       0       0       0       0
        0.0025  0       0.0025  0.0075  0.0225  0.035   0.0625  0.08    0.0875  0.055   0.0475
        0.0175  0.015   0       0       0       0       0       0       0       0.0025  0.005
        0.0175  0.0575  0.05    0.1     0.12    0.1     0.0625  0.035   0.01    0.005
1982    1       1       3       0       28      0       0       0       0       0       0
        0       0.0025  0.01    0.025   0.0325  0.075   0.08    0.0625  0.0575  0.0225  0.025
        0.0025  0.005   0       0       0       0       0       0       0.005   0.0025  0.01
        0.0275  0.0875  0.1475  0.1175  0.1     0.0625  0.0275  0.0125  0       0
1983    1       1       3       0       56      0       0       0       0       0       0
        0       0       0.0063  0.015   0.0363  0.0625  0.0788  0.0675  0.0738  0.05    0.0388
        0.01    0.0038  0       0       0       0       0       0       0.0025  0.0025  0.0075
        0.0163  0.07    0.1138  0.13    0.0963  0.0763  0.0338  0.0075  0       0.0013
1984    1       1       3       0       21      0       0       0       0       0       0
        0       0       0.0033  0.02    0.0367  0.0367  0.0733  0.1     0.0633  0.0333  0.02
        0.0167  0       0       0       0       0       0       0       0       0.0133  0.02
        0.0433  0.0767  0.12    0.1267  0.09    0.0567  0.0333  0.01    0.0067  0
1986    1       1       3       0       57      0       0       0       0       0       0
        0       0.0031  0.0062  0.0093  0.059   0.0497  0.087   0.059   0.0932  0.0994  0.0559
        0.0093  0.0155  0       0       0       0       0       0       0       0.0031  0.0124
        0.0217  0.0683  0.0963  0.1056  0.0994  0.0311  0.0124  0.0031  0       0
1987    1       1       3       0       71      0       0       0       0       0       0
        0       0       0       0.0025  0.01    0.0299  0.0623  0.0823  0.1471  0.0873  0.0599
        0.0399  0.0299  0       0       0       0       0       0       0       0       0.0025
        0.005   0.0249  0.0698  0.1446  0.1172  0.0499  0.0224  0.0125  0       0
1988    1       1       3       0       18      0       0       0       0       0       0
        0       0       0       0       0.02    0.02    0.08    0.1     0.12    0.12    0.03
        0.01    0.01    0       0       0       0       0.01    0       0       0       0.01
        0       0.01    0.03    0.08    0.19    0.09    0.03    0.03    0       0.01
1989    1       1       3       0       40      0       0       0       0       0       0
        0       0       0       0.0044  0       0.0311  0.0489  0.08    0.1067  0.12    0.1022
        0.0889  0.0578  0       0       0       0       0       0       0       0.0044  0
        0.0044  0.0178  0.0222  0.0533  0.0889  0.0978  0.04    0.0178  0.0044  0.0089
1990    1       1       3       0       44      0       0       0       0       0       0
        0       0       0.004   0.008   0.0241  0.0402  0.0281  0.0723  0.0723  0.0803  0.0562
        0.0482  0.0281  0       0       0       0       0       0       0       0       0.0161
        0.0201  0.0442  0.0683  0.0803  0.1044  0.1365  0.0522  0.0161  0       0
1991    1       1       3       0       54      0       0       0       0       0       0
        0       0.0033  0.0066  0.0066  0.0132  0.0728  0.0695  0.0861  0.0695  0.0662  0.0232
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	0.0464	0.0166	0	0	0	0	0	0	0	0.0033	0
	0.0099	0.0397	0.0695	0.0662	0.1026	0.0795	0.0828	0.0464	0.0199	0	
1992	1	1	3	0	36	0	0	0	0	0	0
	0	0	0	0.01	0.025	0.055	0.06	0.085	0.09	0.075	0.035
	0.03	0.03	0	0	0	0	0	0	0	0.005	0.01
	0.01	0.065	0.065	0.16	0.085	0.07	0.035	0	0	0	
1993	1	1	3	0	22	0	0	0	0	0	0
	0	0	0	0.008	0.024	0.048	0.032	0.064	0.056	0.064	0.08
	0.048	0.008	0	0	0	0	0	0	0	0	0
	0.056	0.024	0.072	0.088	0.128	0.104	0.08	0.008	0.008	0	
#1994	1	1	3	0	9	0	0	0	0	0	0
	0	0	0.0612	0	0	0.0612	0.1224	0	0.0408	0.0612	0.0204
	0.0408	0	0	0	0	0	0	0	0	0	0
	0	0.0408	0.102	0.102	0.1224	0.102	0.102	0.0204	0	0	
#1995	1	1	3	0	9	0	0	0	0	0	0
	0	0	0	0.04	0	0.06	0.02	0.04	0.02	0.04	0
	0	0.02	0	0	0	0	0.02	0.02	0	0	0
	0.02	0.02	0.06	0.2	0.14	0.12	0.1	0.04	0.02	0	
#1998	1	1	3	0	14	0	0	0	0	0	0
	0	0	0	0.0235	0.0235	0.0941	0.1059	0.0941	0.0588	0.0118	0
	0	0	0	0	0	0	0	0	0	0	0.0353
	0.0235	0.1294	0.1765	0.1412	0.0588	0.0235	0	0	0	0	
#2002	1	1	3	0	8	0	0	0	0	0	0
	0	0	0	0	0	0	0.02	0.14	0.16	0.18	0.08
	0.02	0	0	0	0	0	0	0	0	0	0
	0.02	0	0.04	0.12	0.16	0.06	0	0	0	0	
#1980	1	2	0	0	9	0	0	0	0	0	0
	0.002	0.0039	0.0236	0.0394	0.0571	0.0886	0.1575	0.1594	0.25	0.1496	0.0413
	0.0276	0	0	0	0	0	0	0	0.002	0.0039	0.0236
	0.0394	0.0571	0.0886	0.1575	0.1594	0.25	0.1496	0.0413	0.0276	0	
1980	1	2	3	0	10	0	0	0	0	0	0.0014
	0	0.0071	0.0085	0.0299	0.0341	0.0327	0.0284	0.0356	0.0512	0.027	0.0199
	0.0028	0.0014	0	0	0	0	0	0.0014	0	0.0057	0.0284
	0.0341	0.0612	0.0512	0.1124	0.1607	0.1579	0.0811	0.0256	0	0	
1981	1	2	3	0	30	0	0	0	0.0103	0.0103	0
	0.0206	0.0206	0	0.0206	0.0103	0	0.1031	0.0515	0.0619	0.0103	0
	0	0	0	0	0	0	0	0	0.0206	0.0309	0.0309
	0.0309	0.0722	0.1134	0.1134	0.1443	0.0619	0.0412	0.0206	0	0	
#1982	1	2	0	0	22	0.0088	0.0109	0.0044	0.0022	0.0073	0.008
	0.0146	0.0248	0.0518	0.0904	0.1196	0.1276	0.1488	0.1145	0.1371	0.0795	0.0343
	0.0131	0.0022	0.0088	0.0109	0.0044	0.0022	0.0073	0.008	0.0146	0.0248	0.0518
	0.0904	0.1196	0.1276	0.1488	0.1145	0.1371	0.0795	0.0343	0.0131	0.0022	
1982	1	2	3	0	12	0	0	0	0	0	0
	0	0.0177	0.0177	0.0442	0.0796	0.0619	0.0796	0.0531	0.0265	0.0088	0
	0	0	0	0	0	0	0	0	0.0088	0.0088	0.0354
	0.115	0.0973	0.0619	0.115	0.0973	0.0531	0.0177	0	0	0	
#1983	1	2	0	0	1	0	0	0	0	0	0.04
	0.0733	0.12	0.1133	0.1733	0.1733	0.12	0.08	0.0467	0.0133	0.0267	0.02
	0	0	0	0	0	0	0	0.04	0.0733	0.12	0.1133
	0.1733	0.1733	0.12	0.08	0.0467	0.0133	0.0267	0.02	0	0	
#1984	1	2	0	0	2	0	0	0	0.1	0	0
	0.2	0.1	0.2	0	0	0.4	0	0	0	0	0
	0	0	0	0	0	0.1	0	0	0.2	0.1	0.2
	0	0	0.4	0	0	0	0	0	0	0	
1984	1	2	3	0	25	0	0	0	0.0029	0.0014	0.0115
	0.033	0.0445	0.0603	0.0848	0.0905	0.0876	0.0647	0.0546	0.0417	0.0158	0.0129
	0.0043	0.0057	0.0014	0	0	0	0.0014	0.0029	0.0029	0.0172	0.0302
	0.0388	0.0704	0.0718	0.0503	0.0431	0.0201	0.023	0.0086	0.0014	0	
#1985	1	2	0	0	1	0.1884	0.0072	0	0.0072	0.0217	0.0435
	0.1594	0.1377	0.2391	0.1014	0.058	0.0145	0.0072	0	0.0072	0	0
	0	0.0072	0.1884	0.0072	0	0.0072	0.0217	0.0435	0.1594	0.1377	0.2391
	0.1014	0.058	0.0145	0.0072	0	0.0072	0	0	0	0.0072	
1985	1	2	3	0	3	0	0	0	0	0	0
	0.0127	0.019	0.0316	0.0633	0.0759	0.0443	0.0759	0.0633	0.0443	0.0127	0.019
	0.0063	0.0063	0	0	0	0	0	0	0	0.0063	0.038
	0.0759	0.0633	0.0759	0.0886	0.1076	0.038	0.019	0.0127	0	0	
1986	1	2	3	0	17	0	0	0	0	0.002	0.0039
	0.0098	0.0117	0.0391	0.0469	0.0723	0.0801	0.0938	0.0488	0.0313	0.0234	0.0098
	0	0	0	0	0	0	0	0.0039	0.0117	0.0293	0.0547
	0.0957	0.0957	0.1055	0.0566	0.043	0.0176	0.0078	0.0059	0	0	

1987	1	2	3	0	21	0	0	0	0	0	0.0047
	0.014	0.0171	0.0295	0.0481	0.0543	0.0698	0.0837	0.0713	0.0543	0.0341	0.0202
	0.0124	0.0016	0	0	0	0	0	0.014	0.014	0.0155	0.0357
	0.0326	0.0651	0.0775	0.0713	0.0605	0.0682	0.0155	0.0124	0.0031	0	
1988	1	2	3	0	15	0	0	0	0	0.0022	0.0177
	0.0067	0.0288	0.0421	0.0643	0.0576	0.0909	0.0909	0.0576	0.0443	0.0244	0.0089
	0	0.0022	0	0	0	0.0022	0.0022	0.0067	0.0222	0.0111	0.0377
	0.0665	0.0798	0.0865	0.0488	0.0421	0.0288	0.0222	0.0022	0.0022	0	
1989	1	2	3	0	13	0	0	0	0	0	0.005
	0.0025	0.0126	0.0176	0.0579	0.0806	0.0957	0.0957	0.0705	0.0605	0.0403	0.0076
	0	0	0	0	0	0	0	0.0025	0.0101	0.0327	0.0428
	0.0705	0.1083	0.0806	0.0479	0.0378	0.0151	0.005	0	0	0	
1990	1	2	3	0	9	0	0	0	0	0.0034	0.0034
	0.0138	0.0103	0.0379	0.0828	0.1241	0.0828	0.0966	0.0724	0.0138	0	0.0034
	0	0	0	0	0.0034	0	0.0034	0	0	0.0276	0.0483
	0.0621	0.0897	0.0759	0.0517	0.0345	0.031	0.0276	0	0	0	
1991	1	2	3	0	22	0	0	0	0	0.0125	0.0083
	0.0181	0.0403	0.0458	0.075	0.0778	0.0903	0.0611	0.0611	0.0278	0.0194	0.0056
	0.0028	0.0014	0	0	0	0.0014	0.0056	0.0125	0.0153	0.0306	0.0542
	0.0708	0.0833	0.0597	0.0556	0.0278	0.0236	0.0097	0.0014	0.0014	0	
1992	1	2	3	0	29	0	0	0.0011	0.0023	0.0023	0.0091
	0.0136	0.0272	0.0397	0.0613	0.0965	0.0942	0.0658	0.0443	0.0409	0.0125	0.0045
	0.0023	0.0011	0	0	0	0.0011	0.0045	0.0102	0.0159	0.0204	0.0522
	0.059	0.0942	0.0749	0.0681	0.042	0.0193	0.0125	0.0057	0.0011	0	
1993	1	2	3	0	28	0	0	0	0	0.0023	0.0163
	0.0198	0.0431	0.0664	0.0733	0.0955	0.0745	0.064	0.0536	0.0303	0.0198	0.0081
	0.0081	0.0012	0	0	0	0	0	0.0116	0.021	0.0442	0.0547
	0.0664	0.071	0.0559	0.0547	0.0233	0.0116	0.0047	0.0035	0.0012	0	
1994	1	2	3	0	28	0	0	0	0	0.0023	0.0035
	0.0208	0.044	0.0428	0.0856	0.088	0.0914	0.0567	0.037	0.0197	0.0301	0.0116
	0.0046	0	0	0	0	0	0.0012	0.0093	0.0162	0.0579	0.0451
	0.0752	0.0729	0.0706	0.0451	0.0289	0.022	0.0116	0.0058	0	0	
1995	1	2	3	0	26	0	0	0	0	0.0012	0.0037
	0.0074	0.0333	0.0653	0.0948	0.0998	0.085	0.0702	0.0333	0.0222	0.016	0.0062
	0.0037	0	0	0	0	0	0.0012	0.0049	0.0185	0.0357	0.0776
	0.0936	0.0764	0.0665	0.0468	0.0222	0.0086	0.0025	0.0012	0.0025	0	
1996	1	2	3	0	27	0	0	0	0.0012	0.0012	0.006
	0.0193	0.0398	0.0736	0.1049	0.1049	0.0676	0.047	0.0277	0.0181	0.006	0.0012
	0	0	0	0	0	0.0024	0.0024	0.0024	0.0205	0.0507	0.0881
	0.0929	0.1025	0.0651	0.0241	0.0205	0.0084	0	0	0	0.0012	
1997	1	2	3	0	29	0	0	0	0	0	0.0022
	0.0189	0.04	0.0633	0.0756	0.0867	0.0756	0.0533	0.0344	0.02	0.02	0.0056
	0.0044	0.0022	0	0	0	0.0033	0.0022	0.0044	0.0233	0.0356	0.0678
	0.0889	0.11	0.0633	0.0467	0.0289	0.0122	0.0089	0.0022	0	0	
1998	1	2	3	0	40	0	0	0	0	0.0053	0.0106
	0.028	0.0355	0.0559	0.0854	0.0824	0.0695	0.0544	0.028	0.0144	0.0136	0.0008
	0	0.0008	0	0	0	0	0.0023	0.0136	0.0333	0.0438	0.0673
	0.0907	0.0998	0.0703	0.0537	0.0242	0.0128	0.0023	0.0008	0.0008	0	
1999	1	2	3	0	44	0	0	0.0006	0.0012	0.0042	0.0126
	0.0263	0.04	0.0592	0.0813	0.0843	0.0699	0.0562	0.0359	0.0132	0.0036	0.0012
	0.0012	0.0006	0	0	0	0.0006	0.0012	0.0185	0.0281	0.0466	0.0831
	0.095	0.0932	0.0652	0.046	0.0185	0.0048	0.0036	0.0024	0.0012	0.0006	
2000	1	2	3	0	43	0	0	0	0.0012	0.0042	0.0079
	0.0176	0.0382	0.0576	0.0885	0.1091	0.0873	0.0812	0.0303	0.0212	0.003	0.0018
	0.0018	0	0	0	0	0	0.0036	0.0091	0.0188	0.0479	0.0661
	0.08	0.0939	0.0739	0.0315	0.0164	0.0055	0.0018	0	0.0006	0	
2001	1	2	3	0	47	0	0	0	0	0	0.0028
	0.013	0.0355	0.0558	0.0986	0.1189	0.1048	0.0614	0.0271	0.018	0.009	0.0023
	0.0017	0	0	0	0	0	0.0011	0.0056	0.0152	0.0355	0.0716
	0.1071	0.0891	0.0705	0.031	0.0147	0.0056	0	0.0023	0.0011	0.0006	
#2002	1	2	3	0	72	0	0	0.0005	0.0005	0.0005	0
	0.0049	0.0168	0.0481	0.0898	0.1028	0.1141	0.0984	0.0606	0.0292	0.0059	0.0027
	0.0011	0.0005	0	0	0	0.0011	0.0016	0.0027	0.0087	0.0276	0.0573
	0.0957	0.1001	0.0757	0.0335	0.013	0.0043	0.0016	0.0005	0	0	
#2003	1	2	0	0	9	0	0	0	0.0013	0.0077	0.0103
	0.0333	0.0833	0.1308	0.1487	0.2064	0.1603	0.1038	0.0641	0.0282	0.0128	0.0051
	0.0038	0	0	0	0	0.0013	0.0077	0.0103	0.0333	0.0833	0.1308
	0.1487	0.2064	0.1603	0.1038	0.0641	0.0282	0.0128	0.0051	0.0038	0	
2003	1	2	3	0	70	0	0	0	0	0.0005	0.0011
	0.0059	0.0184	0.0394	0.0691	0.1021	0.128	0.0977	0.0551	0.0232	0.0151	0.0059

	0.0016	0	0	0	0.0005	0	0.0005	0.0016	0.0108	0.0286	0.0524
	0.0945	0.1037	0.0729	0.0481	0.0151	0.0038	0.0038	0.0005	0	0	
#2004	1	2	0	0	9	0	0	0	0.0021	0.0042	0.0127
	0.0276	0.0467	0.1083	0.1826	0.1868	0.1571	0.1253	0.0425	0.034	0.0127	0.0212
	0.0127	0.0234	0	0	0	0.0021	0.0042	0.0127	0.0276	0.0467	0.1083
	0.1826	0.1868	0.1571	0.1253	0.0425	0.034	0.0127	0.0212	0.0127	0.0234	
2004	1	2	3	0	57	0	0	0	0.0012	0.0018	0.0048
	0.0133	0.023	0.0387	0.0762	0.0992	0.1168	0.0768	0.0581	0.0302	0.0097	0.0054
	0.0018	0.0006	0	0	0	0	0	0.003	0.0139	0.0254	0.0387
	0.0907	0.1071	0.0762	0.0532	0.0169	0.0073	0.0048	0.003	0.0006	0.0012	
#2005	1	2	0	0	9	0.0029	0	0	0.0029	0.0058	0.0259
	0.049	0.1037	0.1153	0.1441	0.2046	0.1383	0.0951	0.0548	0.0231	0.0115	0.0115
	0.0029	0.0086	0.0029	0	0	0.0029	0.0058	0.0259	0.049	0.1037	0.1153
	0.1441	0.2046	0.1383	0.0951	0.0548	0.0231	0.0115	0.0115	0.0029	0.0086	
2005	1	2	3	0	67	0	0	0	0	0.0018	0.0042
	0.0066	0.0253	0.0451	0.083	0.1064	0.1046	0.1052	0.0463	0.0367	0.0132	0.0078
	0.0042	0	0	0	0	0	0	0.0006	0.006	0.0174	0.0325
	0.08	0.1046	0.08	0.0511	0.0235	0.0102	0.0012	0.0012	0.0012	0	
#2006	1	2	0	0	9	0	0.0018	0	0	0.0018	0.0159
	0.0584	0.1204	0.1434	0.1752	0.1416	0.131	0.0903	0.0726	0.0248	0.0142	0.0053
	0.0018	0.0018	0	0.0018	0	0	0.0018	0.0159	0.0584	0.1204	0.1434
	0.1752	0.1416	0.131	0.0903	0.0726	0.0248	0.0142	0.0053	0.0018	0.0018	
2006	1	2	3	0	100	0	0.0006	0	0.0006	0.0012	0.0075
	0.01	0.0305	0.0715	0.0721	0.0883	0.0734	0.0715	0.0429	0.0162	0.0087	0.0031
	0	0.0006	0	0	0	0.0006	0.0019	0.0044	0.0087	0.0224	0.0585
	0.0858	0.1132	0.1007	0.0678	0.0261	0.0087	0.0012	0.0012	0	0	
#1980	1	3	0	0	14	0	0	0	0	0	0
	0	0.0104	0.0208	0.0313	0.0938	0.1146	0.1979	0.1563	0.1771	0.1354	0.0521
	0	0.0104	0	0	0	0	0	0	0	0.0104	0.0208
	0.0313	0.0938	0.1146	0.1979	0.1563	0.1771	0.1354	0.0521	0	0.0104	
#1982	1	3	0	0	5	0	0	0	0	0	0.0345
	0.0345	0.069	0.2414	0.1034	0.1034	0.1034	0.1379	0.1379	0.0345	0	0
	0	0	0	0	0	0	0	0.0345	0.0345	0.069	0.2414
	0.1034	0.1034	0.1034	0.1379	0.1379	0.0345	0	0	0	0	
#1983	1	3	0	0	19	0	0	0	0	0	0.0833
	0.0417	0.0833	0.2083	0.2083	0.2083	0.0833	0.0417	0	0.0417	0	0
	0	0	0	0	0	0	0	0.0833	0.0417	0.0833	0.2083
	0.2083	0.2083	0.0833	0.0417	0	0.0417	0	0	0	0	
#1983	1	3	3	0	5	0	0	0	0	0	0
	0.03	0.02	0.09	0.06	0.07	0.07	0.02	0.07	0	0	0.01
	0	0	0	0	0	0	0	0.03	0.02	0.02	0.01
	0.07	0.03	0.07	0.12	0.04	0.14	0.01	0	0	0	
#1984	1	3	3	0	7	0	0	0	0	0	0
	0.02	0.02	0.05	0.07	0.07	0.09	0.03	0.03	0.02	0.01	0
	0	0	0	0	0	0	0	0.01	0.02	0.03	0.05
	0.1	0.13	0.1	0.04	0.08	0.03	0	0	0	0	
1986	1	3	3	0	100	0	0	0	0	0.0019	0
	0.0076	0.0133	0.0228	0.038	0.0626	0.0569	0.0911	0.1044	0.093	0.0759	0.055
	0.0114	0.0038	0	0	0	0	0	0	0.0057	0.0095	0.0266
	0.0361	0.055	0.0778	0.0721	0.0323	0.0285	0.0114	0.0038	0.0019	0.0019	
1987	1	3	3	0	125	0	0	0	0	0.0014	0.0042
	0.0111	0.025	0.0305	0.0319	0.0555	0.0638	0.0749	0.0652	0.043	0.0485	0.0236
	0.0097	0.0069	0	0	0	0	0.0028	0.0028	0.0097	0.0222	0.0458
	0.0527	0.0693	0.0777	0.0707	0.0721	0.0416	0.018	0.0125	0.0069	0	
1988	1	3	3	0	76	0	0	0	0	0.0024	0
	0.0118	0.0189	0.0142	0.0307	0.059	0.092	0.1085	0.0896	0.0495	0.0425	0.0165
	0.0142	0.0071	0	0	0	0	0	0	0.0118	0.0142	0.0236
	0.0542	0.0755	0.0755	0.0495	0.059	0.0425	0.0189	0.0165	0.0024	0	
1989	1	3	3	0	53	0	0	0	0	0	0.0033
	0	0.01	0.0334	0.0301	0.0502	0.0301	0.0502	0.1137	0.087	0.0368	0.0368
	0.0201	0.01	0	0	0	0	0	0	0	0.01	0.0268
	0.0602	0.0401	0.0702	0.1104	0.0936	0.0502	0.01	0.0134	0.0033	0	
1990	1	3	3	0	21	0	0	0.008	0.032	0.064	0.088
	0.04	0.032	0.056	0.048	0.072	0.032	0.024	0.024	0.024	0.032	0.016
	0	0	0	0	0.024	0.016	0.04	0.064	0.032	0.024	0.024
	0.04	0.048	0.048	0.024	0.008	0.008	0	0	0.008	0	
1991	1	3	3	0	88	0	0	0	0	0.0063	0.0126
	0.0358	0.04	0.0589	0.0737	0.08	0.0547	0.0568	0.0379	0.0232	0.0274	0.0063
	0	0.0021	0	0	0	0	0.0042	0.0168	0.0295	0.0568	0.0589
	0.0611	0.0863	0.0695	0.0337	0.0316	0.0189	0.0105	0.0042	0.0021	0	

1992	1	3	3	0	49	0	0	0	0	0.011	0.011
	0.0037	0.0733	0.0989	0.0696	0.0989	0.0586	0.0586	0.0366	0.0293	0.0073	0.0073
	0	0	0	0	0	0	0.0073	0.011	0.022	0.044	0.0513
	0.0733	0.0513	0.0659	0.0696	0.0256	0.011	0	0.0037	0	0	
1993	1	3	3	0	58	0	0	0	0.0031	0.0031	0.0123
	0.0031	0.0617	0.0895	0.0772	0.0802	0.0525	0.071	0.0432	0.0247	0.0216	0
	0	0	0	0	0	0	0.0031	0.0031	0.0123	0.0494	0.0494
	0.0648	0.0864	0.071	0.0772	0.037	0.0031	0	0	0	0	
1994	1	3	3	0	44	0	0	0	0.004	0.012	0.044
	0.068	0.068	0.068	0.08	0.08	0.048	0.04	0.008	0.008	0.004	0
	0	0	0	0	0	0	0.016	0.016	0.032	0.052	0.072
	0.056	0.072	0.068	0.052	0.012	0.02	0	0	0	0	
1995	1	3	3	0	40	0	0	0	0	0	0.0089
	0.0268	0.0446	0.067	0.0714	0.0625	0.0759	0.0893	0.0268	0.0134	0.0045	0.0089
	0	0	0	0	0	0	0.0089	0.0357	0.0268	0.0357	0.0759
	0.0893	0.0804	0.058	0.0536	0.0268	0.0089	0	0	0	0	
1981	1	6	0	0	29	0	0	0.0004	0.0006	0.0006	0.0045
	0.0159	0.0416	0.0855	0.1166	0.1255	0.1247	0.137	0.1569	0.117	0.0492	0.0142
	0.0023	0.0004	0	0	0.0004	0.0006	0.0006	0.0045	0.0159	0.0416	0.0855
	0.1166	0.1255	0.1247	0.137	0.1569	0.117	0.0492	0.0142	0.0023	0.0004	
1982	1	6	0	0	24	0	0	0.0024	0.0024	0.0044	0.0047
	0.0142	0.0305	0.0665	0.1322	0.1535	0.1516	0.1504	0.1417	0.0926	0.0372	0.0115
	0.0008	0.0004	0	0	0.0024	0.0024	0.0044	0.0047	0.0142	0.0305	0.0665
	0.1322	0.1535	0.1516	0.1504	0.1417	0.0926	0.0372	0.0115	0.0008	0.0004	
1983	1	6	0	0	29	0	0	0.0005	0.0015	0.0045	0.0198
	0.06	0.1011	0.1269	0.1477	0.1472	0.1487	0.1259	0.0962	0.0407	0.0183	0.004
	0.0005	0	0	0	0.0005	0.0015	0.0045	0.0198	0.06	0.1011	0.1269
	0.1477	0.1472	0.1487	0.1259	0.0962	0.0407	0.0183	0.004	0.0005	0	
1984	1	6	0	0	24	0	0.0015	0.0089	0.0193	0.0297	0.0565
	0.0996	0.1441	0.1694	0.1441	0.1441	0.0966	0.0609	0.0416	0.0282	0.003	0.003
	0	0	0	0.0015	0.0089	0.0193	0.0297	0.0565	0.0996	0.1441	0.1694
	0.1441	0.1441	0.0966	0.0609	0.0416	0.0282	0.003	0.003	0	0	
#1985	1	6	0	0	64	0.0002	0.0002	0.0031	0.0025	0.006	0.0151
	0.0501	0.1035	0.166	0.1766	0.1708	0.1387	0.0987	0.0735	0.036	0.0141	0.0029
	0.0004	0	0.0002	0.0002	0.0031	0.0025	0.006	0.0151	0.0501	0.1035	0.166
	0.1766	0.1708	0.1387	0.0987	0.0735	0.036	0.0141	0.0029	0.0004	0	
1986	1	6	0	0	103	0.0002	0.0002	0.0007	0.0017	0.005	0.0133
	0.0302	0.067	0.1064	0.1577	0.1761	0.1616	0.1546	0.1116	0.0395	0.0135	0.0041
	0.0007	0	0.0002	0.0002	0.0007	0.0017	0.005	0.0133	0.0302	0.067	0.1064
	0.1577	0.1761	0.1616	0.1546	0.1116	0.0395	0.0135	0.0041	0.0007	0	
1987	1	6	0	0	122	0	0.0009	0.0025	0.007	0.0101	0.0216
	0.0363	0.0877	0.1338	0.1631	0.1739	0.1853	0.134	0.0723	0.018	0.0059	0.0021
	0.0008	0.0002	0	0.0009	0.0025	0.007	0.0101	0.0216	0.0363	0.0877	0.1338
	0.1631	0.1739	0.1853	0.134	0.0723	0.018	0.0059	0.0021	0.0008	0.0002	
1988	1	6	0	0	103	0.0003	0.0004	0.0051	0.0105	0.016	0.0326
	0.0465	0.0603	0.0869	0.1227	0.1433	0.1745	0.1622	0.1071	0.0416	0.0131	0.0045
	0.0023	0.0006	0.0003	0.0004	0.0051	0.0105	0.016	0.0326	0.0465	0.0603	0.0869
	0.1227	0.1433	0.1745	0.1622	0.1071	0.0416	0.0131	0.0045	0.0023	0.0006	
1989	1	6	0	0	103	0	0.0006	0.0033	0.0081	0.0215	0.047
	0.0695	0.0993	0.1085	0.1265	0.1362	0.1476	0.1311	0.095	0.0288	0.0105	0.0018
	0.0007	0.0006	0	0.0006	0.0033	0.0081	0.0215	0.047	0.0695	0.0993	0.1085
	0.1265	0.1362	0.1476	0.1311	0.095	0.0288	0.0105	0.0018	0.0007	0.0006	
1990	1	6	0	0	108	0.0004	0.0026	0.0116	0.0211	0.026	0.0464
	0.0766	0.1349	0.1533	0.1321	0.126	0.1061	0.093	0.0684	0.0268	0.0099	0.0026
	0.0012	0.0007	0.0004	0.0026	0.0116	0.0211	0.026	0.0464	0.0766	0.1349	0.1533
	0.1321	0.126	0.1061	0.093	0.0684	0.0268	0.0099	0.0026	0.0012	0.0007	
1998	1	6	0	0	83	0	0.0019	0.0023	0.0034	0.0129	0.0278
	0.0636	0.12	0.2034	0.2224	0.171	0.107	0.0468	0.0129	0.0038	0.0008	0
	0	0	0	0.0019	0.0023	0.0034	0.0129	0.0278	0.0636	0.12	0.2034
	0.2224	0.171	0.107	0.0468	0.0129	0.0038	0.0008	0	0	0	
1999	1	6	0	0	93	0	0.0003	0.0003	0.0029	0.0063	0.0173
	0.0434	0.0811	0.157	0.2105	0.1915	0.1432	0.0894	0.0408	0.0109	0.004	0.0009
	0	0.0003	0	0.0003	0.0003	0.0029	0.0063	0.0173	0.0434	0.0811	0.157
	0.2105	0.1915	0.1432	0.0894	0.0408	0.0109	0.004	0.0009	0	0.0003	
2000	1	6	0	0	78	0	0.0007	0.0011	0.0011	0.0093	0.0237
	0.0714	0.1104	0.166	0.2302	0.1775	0.1233	0.0567	0.0183	0.0093	0.0011	0
	0	0	0	0.0007	0.0011	0.0011	0.0093	0.0237	0.0714	0.1104	0.166
	0.2302	0.1775	0.1233	0.0567	0.0183	0.0093	0.0011	0	0	0	
2001	1	6	0	0	78	0.0003	0	0.0003	0.0016	0.0041	0.0062
	0.0212	0.0614	0.1156	0.1911	0.2347	0.1911	0.1141	0.0396	0.0128	0.0041	0.0016

```
        0.0003  0       0.0003  0       0.0003  0.0016  0.0041  0.0062  0.0212  0.0614  0.1156
        0.1911  0.2347  0.1911  0.1141  0.0396  0.0128  0.0041  0.0016  0.0003  0
2002    1       6       0       0       49      0       0       0       0.0012  0.0017  0.0113
        0.0237  0.0614  0.1177  0.1955  0.2214  0.1781  0.115   0.0521  0.0135  0.0049  0.0015
        0.0007  0.0005  0       0       0       0.0012  0.0017  0.0113  0.0237  0.0614  0.1177
        0.1955  0.2214  0.1781  0.115   0.0521  0.0135  0.0049  0.0015  0.0007  0.0005
2003    1       6       0       0       78      0.0007  0       0.0006  0.001   0.0013  0.0043
        0.0196  0.0444  0.1013  0.1739  0.2486  0.221   0.1182  0.0505  0.0123  0.0015  0.0004
        0.0003  0       0.0007  0       0.0006  0.001   0.0013  0.0043  0.0196  0.0444  0.1013
        0.1739  0.2486  0.221   0.1182  0.0505  0.0123  0.0015  0.0004  0.0003  0
2004    1       6       0       0       68      0.0005  0       0.0005  0.0028  0.0065  0.0138
        0.0242  0.0615  0.136   0.2066  0.2167  0.1753  0.0969  0.0399  0.0137  0.0036  0.0013
        0.0002  0.0002  0.0005  0       0.0005  0.0028  0.0065  0.0138  0.0242  0.0615  0.136
        0.2066  0.2167  0.1753  0.0969  0.0399  0.0137  0.0036  0.0013  0.0002  0.0002
2005    1       6       0       0       49      0.0005  0.0005  0.0003  0.001   0.0043  0.0205
        0.0352  0.0777  0.1372  0.197   0.2051  0.1752  0.0972  0.0337  0.0104  0.003   0.0005
        0.0005  0       0.0005  0.0005  0.0003  0.001   0.0043  0.0205  0.0352  0.0777  0.1372
        0.197   0.2051  0.1752  0.0972  0.0337  0.0104  0.003   0.0005  0.0005  0

2006    1       6       0       0       64      0       0.0005  0.0017  0.0025  0.0035  0.0153
        0.038   0.0824  0.1454  0.1829  0.2063  0.1624  0.0953  0.0445  0.0146  0.003   0.001
        0.0003  0.0002  0       0.0005  0.0017  0.0025  0.0035  0.0153  0.038   0.0824  0.1454
        0.1829  0.2063  0.1624  0.0953  0.0445  0.0146  0.003   0.001   0.0003  0.0002
#       Age     Composition
#
#Yr     Seas    Flt/Svy Gender  Part    Ageerr  Lbin_lo Lbin_hi Nsamp   datavector(female-
male)
24
3       4       5       6       7       8       9       10      11      12      13      14
        15      16      17      18      19      20      21      22      23      24      25
        30
#       number  of      unique  ageing  error   matrices        to      generate
1
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

0.4817  0.5149  0.5481  0.5813  0.6145  0.6477  0.6809  0.7141  0.7473  0.7805  0.8137  0.8469
        0.8801  0.9133  0.9465  0.9797  1.0129  1.0461  1.0793  1.1125  1.1457  1.1789  1.2121
        1.2453  1.2785  1.3117  1.3449  1.3781  1.4113  1.4445  1.4777  1.5109  1.5441  1.5773
        1.6105  1.6437  1.6769  1.7101  1.7433  1.7765  1.7765
#Sampson Below
#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
#0.062  0.186   0.310   0.435   0.559   0.683   0.807   0.931   1.056   1.180   1.304   1.428
        1.552   1.676   1.801   1.925   2.049   2.173   2.297   2.422   2.546   2.670   2.794
        2.918   3.043   3.167   3.291   3.415   3.539   3.663   3.788   3.912   4.036   4.160
        4.284   4.409   4.533   4.657   4.781   4.905   5.029
#
#
53
1976    1       1       3       0       1       -1      -1      14      0       0       0
        0.0084  0.021   0.0924  0.0504  0.0714  0.0672  0.0588  0.0336  0.0336  0.021   0.0126
        0.0042  0.0084  0.0042  0       0.0084  0       0       0       0       0       0
        0       0       0       0.0294  0.0882  0.0798  0.0672  0.042   0.0504  0.0504  0.021
        0.0168  0.0126  0.0084  0.0042  0.0042  0       0       0.0126  0       0.0042  0.0126
        0
1980    1       1       3       0       1       -1      -1      14      0       0       0
        0.0205  0.0256  0.041   0.0462  0.0051  0.0359  0.041   0.0513  0.0359  0.0051  0
        0.0103  0.0154  0       0       0.0103  0       0       0.0051  0       0.0051  0
        0       0       0.0256  0.0564  0.041   0.0462  0.0462  0.041   0.041   0.0769  0.0615
        0.0308  0.0103  0.0462  0.0154  0.0103  0.0103  0       0.0103  0.0103  0       0.0564
        0.0103
1981    1       1       3       0       1       -1      -1      28      0       0       0.0025
        0.0127  0.0406  0.0457  0.0457  0.066   0.0635  0.0457  0.0355  0.0178  0.0228  0.0127
        0.0102  0.0051  0.0025  0       0.0025  0.0025  0       0       0       0       0
        0       0.0025  0.0152  0.0508  0.0787  0.0457  0.0558  0.0279  0.0381  0.0635  0.0533
```

	0.0152	0.0152	0.0228	0.0178	0.0076	0.0051	0.0051	0.0102	0.0025	0.0127	0.0127
	0.0076										
1982	1	1	3	0	1	-1	-1	21	0	0	0.0034
	0.0576	0.061	0.0814	0.0373	0.0373	0.0169	0.0305	0.0305	0.0102	0.0034	0.0169
	0.0034	0.0102	0	0	0	0.0034	0	0	0	0	0
	0	0.0034	0.0814	0.0814	0.1186	0.061	0.0339	0.0305	0.0203	0.0305	0.0305
	0.0237	0.0169	0.0068	0.0102	0.0169	0	0	0.0068	0.0068	0.0034	0.0034
	0.0034										
1983	1	1	3	0	1	-1	-1	56	0.0013	0	0.0101
	0.0277	0.0806	0.0529	0.0856	0.0516	0.0428	0.029	0.0189	0.0151	0.0101	0.0063
	0.0025	0	0	0.0013	0	0	0.0025	0.0038	0	0.0013	0
	0	0.0126	0.0416	0.0957	0.0642	0.0844	0.0592	0.0302	0.0327	0.0277	0.0227
	0.0189	0.0176	0.0113	0.0063	0.0038	0.005	0.005	0.0038	0.0038	0.0013	0.0038
	0.005										
1984	1	1	3	0	1	-1	-1	21	0	0	0
	0.0101	0.0101	0.0303	0.0471	0.0976	0.064	0.037	0.0236	0.0168	0.0135	0.0101
	0.0269	0.0067	0.0034	0.0034	0.0034	0	0	0	0	0	0
	0	0	0.0101	0.037	0.0606	0.0539	0.0842	0.0673	0.0404	0.037	0.0303
	0.0168	0.0202	0.0269	0.0135	0.0135	0.0101	0.0269	0.0034	0	0.0101	0.0168
	0.0168										
1986	1	1	3	0	1	-1	-1	57	0	0	0.0031
	0.028	0.053	0.0841	0.0872	0.0841	0.0405	0.0592	0.0249	0.0249	0.0156	0.0062
	0.0156	0.0156	0.0062	0	0	0	0	0	0	0	0
	0	0.0093	0.0218	0.081	0.0997	0.0561	0.0498	0.0249	0.0312	0.0218	0.0125
	0.0218	0.0031	0	0.0031	0.0031	0.0031	0.0031	0.0031	0	0	0.0031
	0										
1987	1	1	3	0	1	-1	-1	71	0	0	0.0025
	0.0075	0.0249	0.0723	0.0848	0.0574	0.0673	0.0648	0.0499	0.0324	0.0349	0.0125
	0.0125	0.0025	0	0.01	0.005	0.005	0.0025	0.0025	0	0	0
	0	0	0.01	0.02	0.0698	0.0873	0.0499	0.0374	0.0549	0.0324	0.0175
	0.02	0.015	0.01	0.0025	0.005	0.0025	0.0025	0	0	0.0025	0.0075
	0.0025										
1988	1	1	3	0	1	-1	-1	18	0	0	0
	0	0.0202	0.0202	0.1212	0.0505	0.0808	0.0505	0.0303	0.0404	0.0303	0.0202
	0.0202	0	0.0202	0	0	0.0101	0	0	0	0	0
	0	0	0.0101	0.0101	0.0404	0.0707	0.0707	0.0303	0.0808	0.0303	0.0101
	0.0404	0.0101	0.0202	0	0.0101	0.0101	0.0202	0	0.0202	0	0
	0										
1989	1	1	3	0	1	-1	-1	40	0	0	0
	0.0179	0.0268	0.0848	0.0938	0.0982	0.1027	0.067	0.0625	0.0357	0.0179	0.0179
	0.0045	0	0.0089	0.0045	0	0	0	0	0	0	0
	0	0.0089	0.0089	0.0357	0.0179	0.0893	0.0804	0.0357	0.0134	0.0313	0.0134
	0.0134	0	0.0089	0	0	0	0	0	0	0	0
	0										
1990	1	1	3	0	1	-1	-1	44	0	0	0
	0.004	0.0361	0.0482	0.0482	0.0562	0.0602	0.0643	0.0402	0.0241	0.012	0.0281
	0.0201	0.008	0.004	0.004	0	0	0	0	0.004	0	0
	0	0.008	0.0201	0.0442	0.0683	0.0803	0.0562	0.0763	0.0643	0.012	0.012
	0.0241	0.0321	0.008	0.012	0	0	0.0161	0	0	0	0.004
	0										
1991	1	1	3	0	1	-1	-1	54	0	0	0
	0.0133	0.0365	0.0664	0.0797	0.0565	0.0532	0.0565	0.0365	0.0266	0.0199	0.0133
	0.0133	0	0	0.0033	0	0.0033	0	0	0	0	0
	0	0	0.0066	0.0299	0.0631	0.0399	0.0532	0.0399	0.0465	0.0399	0.01
	0.0199	0.0332	0.0199	0.0133	0.01	0.0299	0.0166	0.0166	0.01	0.0066	0.0166
	0										
1992	1	1	3	0	1	-1	-1	36	0	0	0
	0.015	0.055	0.08	0.135	0.05	0.04	0.025	0.05	0.015	0.005	0.005
	0.01	0.01	0	0	0	0	0	0	0	0	0
	0	0	0.02	0.03	0.11	0.115	0.06	0.015	0.04	0.03	0.045
	0.015	0.01	0.015	0	0	0	0	0	0	0	0
	0										
1993	1	1	3	0	1	-1	-1	22	0	0	0
	0.016	0.056	0.04	0.072	0.024	0.056	0.08	0.048	0.008	0.016	0.008
	0.008	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.024	0.112	0.088	0.088	0.048	0.04	0.048	0.024
	0.024	0.032	0.016	0	0	0	0.016	0	0.008	0	0
	0										
1994	1	1	3	0	1	-1	-1	9	0	0	0
	0.0208	0.0625	0.0208	0.0208	0.0417	0.0625	0.0625	0.0417	0	0.0208	0
	0.0208	0.0208	0	0.0208	0	0	0	0	0	0	0

	0	0	0	0	0.0417	0.0833	0.0625	0	0.0625	0.0625	0.0208
	0.0208	0.0625	0.0625	0	0	0	0	0.0208	0.0208	0	0.0417
	0.0208										
1995	1	1	3	0	1	-1	-1	9	0	0	0
	0.0204	0.0612	0	0.0612	0	0.0204	0	0.0408	0.0204	0	0
	0	0.0204	0	0	0	0	0	0	0	0	0.0204
	0	0	0	0.0204	0.0612	0.0612	0.0612	0.0816	0.102	0.102	0.0612
	0.0612	0	0.0204	0.0408	0.0204	0	0.0204	0	0	0.0204	0
	0										
1980	1	2	3	0	1	-1	-1	28	0	0.0027	0.0027
	0.0192	0.022	0.0275	0.0412	0.022	0.0165	0.0467	0.0192	0.011	0.0275	0.011
	0.011	0.0082	0.0055	0.0055	0.0027	0.0027	0	0.0027	0.0055	0.0027	0
	0	0.0055	0.0247	0.033	0.0687	0.0412	0.033	0.0412	0.0467	0.0357	0.011
	0.033	0.0495	0.0275	0.0275	0.033	0.0302	0.0165	0.0247	0.011	0.011	0.0522
	0.0275										
1981	1	2	3	0	1	-1	-1	12	0.0141	0.0141	0
	0.0423	0.0141	0.0141	0.0282	0.0423	0.0563	0.0282	0.0141	0.0282	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.0282	0.0282	0.0141	0.1408	0.0986	0.0423	0.1268	0.0282	0.0423	0.0141
	0.0423	0.0141	0.0141	0.0282	0	0.0282	0.0141	0	0	0	0
	0										
1984	1	2	3	0	1	-1	-1	134	0	0.0086	0.0375
	0.0893	0.1081	0.0634	0.0605	0.0879	0.049	0.0288	0.0245	0.0115	0.013	0.013
	0.0072	0.0072	0.0029	0	0.0014	0.0029	0	0	0	0	0
	0.0029	0.0029	0.0303	0.0346	0.0331	0.0418	0.049	0.0346	0.0173	0.0159	0.0144
	0.0202	0.013	0.0173	0.0029	0.0043	0.0029	0.0086	0.0043	0.0086	0.0058	0.013
	0.0058										
1985	1	2	3	0	1	-1	-1	14	0	0.0063	0.0253
	0.0633	0.038	0.0886	0.0443	0.0316	0.0316	0.0506	0.0316	0.0253	0.0127	0
	0.0063	0	0.0063	0.0063	0.0063	0	0	0	0	0	0
	0	0.0127	0.0316	0.0633	0.0759	0.0316	0.0253	0.0253	0.0253	0.0633	0.038
	0	0.0316	0.0316	0.0063	0.0127	0.038	0	0.0063	0	0	0.0063
	0										
1986	1	2	3	0	1	-1	-1	91	0	0.0079	0.0237
	0.0632	0.0731	0.0751	0.0593	0.0514	0.0296	0.0296	0.0217	0.0119	0.0079	0.0059
	0.004	0.0059	0.002	0	0	0	0	0	0.002	0	0
	0.0079	0.0356	0.0711	0.0909	0.0889	0.0534	0.0356	0.0237	0.0138	0.0198	0.0138
	0.0099	0.0138	0.0119	0.0138	0.002	0.0059	0.0059	0	0.002	0.002	0.004
	0										
1987	1	2	3	0	1	-1	-1	112	0	0.0093	0.0125
	0.0327	0.0545	0.0654	0.0607	0.0607	0.0327	0.0452	0.028	0.0405	0.0171	0.0156
	0.0109	0.0078	0.0125	0.0016	0.0016	0.0016	0	0	0.0031	0	0
	0.0078	0.0171	0.0234	0.0498	0.0452	0.0374	0.0312	0.0405	0.0249	0.0249	0.0389
	0.0296	0.0093	0.0156	0.0171	0.0171	0.014	0.0125	0.0016	0.0031	0.0031	0.0156
	0.0062										
1988	1	2	3	0	1	-1	-1	80	0	0.0067	0.0201
	0.0446	0.0804	0.0759	0.0625	0.0848	0.0513	0.0201	0.0179	0.0268	0.0112	0.0112
	0.0022	0.0022	0.0112	0.0022	0	0	0.0045	0.0022	0	0	0
	0.0022	0.0223	0.0424	0.067	0.0513	0.0469	0.058	0.0424	0.0201	0.0179	0.0156
	0.029	0.0045	0.0089	0.0045	0.0067	0.0067	0.0045	0.0045	0.0022	0	0.0045
	0										
1989	1	2	3	0	1	-1	-1	71	0	0	0.0101
	0.0658	0.0759	0.0911	0.0709	0.0608	0.0405	0.0456	0.0228	0.0177	0.0228	0.0076
	0.0051	0.0025	0.0025	0	0.0025	0	0	0	0.0025	0	0
	0.0152	0.0203	0.0759	0.0861	0.0734	0.0481	0.0278	0.0278	0.0127	0.0101	0.0152
	0.0101	0	0.0076	0.0051	0.0025	0.0076	0.0025	0.0025	0.0025	0	0
	0										
1990	1	2	3	0	1	-1	-1	51	0	0.0035	0.0035
	0.0588	0.128	0.0934	0.09	0.0519	0.0519	0.0208	0.0173	0.0104	0.0104	0.0035
	0	0	0	0	0	0	0	0	0	0	0.0035
	0	0.0208	0.0554	0.0623	0.0761	0.0415	0.0484	0.0242	0.0242	0.0208	0.0173
	0.0104	0.0104	0.0104	0	0.0069	0	0.0104	0.0035	0.0035	0	0.0069
	0										
1991	1	2	3	0	1	-1	-1	121	0.0042	0.0195	0.0432
	0.0669	0.0628	0.1144	0.0753	0.0474	0.0223	0.0237	0.0237	0.0153	0.0112	0.0056
	0.0084	0.0014	0.0014	0	0	0	0	0	0	0	0.0028
	0.0181	0.0181	0.0474	0.0669	0.0725	0.053	0.0404	0.0181	0.0209	0.0181	0.0098
	0.0139	0.0056	0.0126	0.0084	0.0056	0.0014	0.0042	0.0042	0.0042	0.0014	0.0028
	0.0028										
1992	1	2	3	0	1	-1	-1	157	0.0011	0.0125	0.0227
	0.0409	0.0727	0.0864	0.0841	0.067	0.033	0.0307	0.0216	0.0136	0.0148	0.0045

	0.0034	0.0057	0.0011	0.0011	0	0.0011	0.0011	0	0	0	0
	0.0114	0.0318	0.0295	0.067	0.0693	0.0614	0.0398	0.0295	0.0227	0.025	0.0182
	0.0182	0.0091	0.008	0.0125	0.0034	0.0034	0.0011	0.0023	0.0023	0.0057	0.0068
	0.0023										
1993	1	2	3	0	1	-1	-1	154	0	0.0082	0.0397
	0.0806	0.0771	0.0993	0.0993	0.0561	0.0409	0.0129	0.0175	0.0117	0.014	0.007
	0.0023	0.0023	0.0047	0.0012	0.0012	0	0	0	0.0012	0	0
	0.0082	0.0234	0.0666	0.0537	0.0806	0.0584	0.035	0.0199	0.0187	0.0129	0.0023
	0.0058	0.007	0.0117	0.0023	0.0035	0.0035	0.0035	0	0	0.0012	0.0035
	0.0012										
1994	1	2	3	0	1	-1	-1	155	0	0.007	0.0348
	0.0615	0.0893	0.08	0.058	0.0545	0.0394	0.0244	0.0174	0.0162	0.0128	0.0151
	0.0081	0.0058	0.0046	0.0035	0.0012	0	0	0	0.0012	0.0023	0.0012
	0.007	0.0383	0.0638	0.0615	0.0464	0.0487	0.0441	0.0302	0.022	0.0232	0.022
	0.0128	0.0058	0.0046	0.0023	0.0093	0.0023	0.0046	0.0046	0.0023	0	0.0035
	0.0023										
1995	1	2	3	0	1	-1	-1	144	0.0012	0.0025	0.0395
	0.0875	0.0912	0.1036	0.0666	0.0518	0.0259	0.021	0.0197	0.0123	0.0074	0.0062
	0.0012	0.0012	0.0025	0	0	0	0	0	0	0	0
	0.0049	0.0456	0.0691	0.0937	0.0654	0.0469	0.0358	0.0222	0.0222	0.0037	0.0086
	0.0062	0.0086	0.0062	0.0049	0.0037	0.0025	0.0037	0	0.0012	0.0012	0
	0.0025										
1996	1	2	3	0	1	-1	-1	147	0	0.0036	0.0364
	0.0836	0.1358	0.0727	0.0764	0.0364	0.0255	0.0255	0.0097	0.0024	0.0012	0.0048
	0.0036	0	0	0	0	0	0.0012	0	0	0	0
	0.0097	0.0339	0.08	0.1067	0.0764	0.0533	0.0206	0.0267	0.0121	0.0121	0.0085
	0.0073	0.0061	0.0097	0.0048	0.0024	0.0024	0	0.0012	0.0012	0.0012	0.0036
	0.0012										
1997	1	2	3	0	1	-1	-1	159	0	0	0.0246
	0.047	0.0761	0.0873	0.0672	0.0571	0.0493	0.0246	0.0202	0.0112	0.0123	0.0056
	0.0056	0.0056	0.0022	0	0.0022	0	0	0	0.0011	0.0022	0
	0.0067	0.0269	0.0437	0.0672	0.1019	0.0649	0.0414	0.0302	0.0224	0.0235	0.0123
	0.0078	0.0101	0.0067	0.0078	0.0022	0.0056	0.0045	0.0022	0.0022	0.0034	0.0022
	0.0022										
1998	1	2	3	0	1	-1	-1	220	0	0.0182	0.0174
	0.0477	0.0795	0.0811	0.0795	0.0462	0.0311	0.0364	0.0159	0.0106	0.0061	0.0038
	0.0038	0.0015	0	0.0015	0.0008	0.0008	0.0008	0	0.0008	0	0
	0.0159	0.0265	0.0386	0.0644	0.0909	0.0742	0.0508	0.0326	0.0197	0.0189	0.0129
	0.0167	0.0083	0.0076	0.0076	0.0076	0.0053	0.0045	0.0053	0.0015	0.0023	0.0045
	0										
1999	1	2	3	0	1	-1	-1	240	0.0024	0.0127	0.0453
	0.0375	0.0689	0.0943	0.0647	0.058	0.029	0.0314	0.0169	0.0115	0.0085	0.0048
	0.0006	0.0018	0.0012	0	0.0012	0.0006	0.0006	0.0006	0	0	0.0006
	0.0133	0.0538	0.0417	0.0749	0.0725	0.0616	0.0508	0.0302	0.0242	0.0169	0.0139
	0.0109	0.006	0.0066	0.0018	0.006	0.006	0.0048	0.0036	0.0006	0.0018	0.0036
	0.0012										
2000	1	2	3	0	1	-1	-1	233	0.0006	0.003	0.0231
	0.0669	0.0681	0.0748	0.0809	0.0596	0.0663	0.0383	0.0255	0.0152	0.0085	0.0043
	0.0061	0.003	0.003	0.0006	0	0.0018	0	0	0.0006	0	0.0006
	0.0043	0.017	0.062	0.0669	0.0724	0.0408	0.0408	0.0347	0.028	0.0152	0.0158
	0.0073	0.0091	0.0049	0.0073	0.0036	0.0024	0.0043	0.0006	0.0043	0.0024	0.0036
	0.0012										
2001	1	2	3	0	1	-1	-1	254	0	0.0034	0.0141
	0.0401	0.1073	0.0915	0.0554	0.0446	0.0542	0.0475	0.0362	0.0158	0.0136	0.0073
	0.0068	0.0045	0.0023	0.0023	0.0017	0.0006	0	0	0	0	0
	0.0056	0.0119	0.0418	0.0927	0.0678	0.0463	0.0407	0.0316	0.0305	0.0203	0.0119
	0.0102	0.0079	0.0045	0.004	0.0051	0.0045	0.0017	0.0011	0.0023	0.0023	0.0034
	0.0028										
2002	1	2	3	0	1	-1	-1	268	0.0005	0.0022	0.0146
	0.0304	0.0781	0.1204	0.0765	0.0613	0.051	0.0418	0.0385	0.0211	0.0125	0.0108
	0.0049	0.0043	0.0016	0.0033	0.0005	0	0.0011	0	0.0005	0	0.0011
	0.0016	0.0179	0.0396	0.0667	0.0743	0.0521	0.0445	0.0233	0.0222	0.0184	0.0152
	0.0119	0.0081	0.0065	0.0054	0.0016	0.0022	0.0016	0.0016	0.0011	0.0016	0.0033
	0.0022										
2003	1	2	3	0	1	-1	-1	261	0	0.006	0.0136
	0.0462	0.062	0.1011	0.0989	0.0609	0.0527	0.0326	0.0304	0.0207	0.0141	0.0092
	0.0038	0.0033	0.0022	0.0011	0.0022	0	0.0005	0	0	0	0.0016
	0.0168	0.0125	0.0543	0.0554	0.0723	0.0609	0.0321	0.0321	0.0201	0.0168	0.0158
	0.0109	0.0071	0.0043	0.0065	0.0016	0.0043	0.0016	0.0016	0.0027	0.0016	0.0038
	0.0016										

2004	1	2	3	0	1	-1	-1	233	0.0006	0.0116	0.0469
	0.0451	0.084	0.0572	0.0767	0.0682	0.0627	0.0329	0.0238	0.0171	0.0122	0.0073
	0.0043	0.0024	0.0018	0.0006	0	0	0.0006	0	0.0012	0	0.0006
	0.0079	0.0359	0.0438	0.0688	0.0542	0.0487	0.039	0.0451	0.0183	0.0164	0.0152
	0.014	0.0091	0.0049	0.0037	0.0024	0.0024	0.0018	0.0024	0.003	0.0006	0.0018
	0.0024										
2005	1	2	3	0	1	-1	-1	233	0	0.0037	0.0331
	0.0893	0.06	0.1118	0.055	0.0687	0.0537	0.0331	0.0175	0.0162	0.0156	0.0119
	0.0094	0.0056	0.0019	0	0.0012	0.0012	0.0006	0	0.0006	0.0006	0
	0.0012	0.0131	0.0562	0.05	0.0687	0.045	0.0294	0.0437	0.0231	0.0131	0.0144
	0.0081	0.0112	0.0056	0.0044	0.0025	0.0044	0.0031	0.0012	0.0025	0.0012	0.005
	0.0019										
2006	1	2	3	0	1	-1	-1	212	0	0.002	0.0229
	0.0647	0.1005	0.0742	0.062	0.0432	0.0512	0.0297	0.0169	0.0088	0.0108	0.0054
	0.002	0.0047	0	0.0034	0	0.0007	0	0	0	0	0
	0.0027	0.0121	0.0512	0.0829	0.0722	0.0762	0.0418	0.0384	0.0236	0.0236	0.0128
	0.0108	0.0088	0.0088	0.0061	0.0067	0.0061	0.0027	0.0013	0.0007	0.0007	0.0047
	0.002										
1983	1	3	3	0	1	-1	-1	7	0	0	0.03
	0.03	0.1	0.07	0.09	0.03	0.03	0.01	0.01	0.02	0.01	0
	0	0.01	0	0	0	0	0	0	0	0	0
	0	0.03	0.03	0	0.05	0.03	0.02	0.07	0.05	0.02	0.01
	0.04	0.02	0.04	0.03	0.02	0.03	0.01	0	0.02	0	0.02
	0.04										
1984	1	3	3	0	1	-1	-1	7	0	0	0.0101
	0.0404	0.0505	0.0808	0.0404	0.0404	0.0202	0.0505	0.0303	0.0101	0.0202	0.0101
	0	0.0101	0	0	0	0	0	0	0	0	0
	0	0.0202	0.0303	0.0404	0.0303	0.0808	0.0808	0.0404	0.0202	0.0505	0.0303
	0.0303	0.0303	0.0101	0	0	0.0101	0.0202	0.0202	0.0101	0.0202	0.0101
	0.0101										
1986	1	3	3	0	1	-1	-1	99	0	0.0057	0.0133
	0.0267	0.0552	0.0629	0.059	0.04	0.019	0.0686	0.0838	0.061	0.0457	0.0362
	0.019	0.0229	0.0114	0.0019	0	0	0	0	0.0019	0.0057	0
	0	0.0152	0.0171	0.04	0.04	0.0362	0.0343	0.0057	0.0419	0.019	0.021
	0.0114	0.0152	0.0057	0.0095	0.0114	0.0038	0.0057	0.0038	0.0038	0.0019	0.0114
	0.0114										
1987	1	3	3	0	1	-1	-1	124	0	0.0042	0.0139
	0.0473	0.0445	0.0612	0.0695	0.0376	0.0362	0.0403	0.0292	0.0389	0.0209	0.0223
	0.0111	0.007	0.0028	0.0042	0	0.0014	0.0028	0	0	0	0
	0.0042	0.0209	0.032	0.0626	0.0584	0.0487	0.0431	0.0292	0.0334	0.0445	0.0292
	0.0236	0.0056	0.0139	0.0181	0.0056	0.007	0.007	0.0028	0.0028	0	0.0083
	0.0111										
1988	1	3	3	0	1	-1	-1	74	0	0	0.0313
	0.0264	0.0553	0.0625	0.0721	0.0673	0.0769	0.0505	0.0337	0.024	0.024	0.0144
	0.0096	0.0048	0.0024	0	0	0.0024	0	0	0.0024	0	0
	0.0024	0.0264	0.0216	0.0481	0.0457	0.0457	0.0505	0.0361	0.0313	0.0216	0.0192
	0.0168	0.0096	0.012	0.0048	0.0096	0.0144	0.0024	0.0024	0.0024	0.0072	0.0048
	0.0072										
1989	1	3	3	0	1	-1	-1	53	0	0.0034	0.0135
	0.064	0.0505	0.0471	0.0539	0.0438	0.0606	0.0471	0.0337	0.0168	0.0236	0.0135
	0.0067	0.0101	0.0067	0.0067	0	0.0101	0	0.0034	0	0	0
	0.0067	0.0168	0.0438	0.0303	0.0505	0.0673	0.0572	0.0236	0.0438	0.037	0.0236
	0.0135	0.0101	0.0101	0.0101	0.0101	0.0034	0.0034	0.0067	0.0034	0.0034	0.0101
	0.0034										
1990	1	3	3	0	1	-1	-1	21	0.008	0.12	0.176
	0.032	0.064	0.016	0.032	0.048	0.032	0.008	0.016	0.008	0.008	0.024
	0	0	0	0	0	0	0	0	0	0	0.016
	0.032	0.112	0.064	0.048	0.032	0.04	0.024	0	0	0.008	0.008
	0.008	0	0	0	0	0	0.008	0	0	0	0
	0.008										
1991	1	3	3	0	1	-1	-1	88	0.0021	0.0042	0.04
	0.0989	0.0926	0.0905	0.0463	0.0379	0.0358	0.0232	0.0211	0.0021	0.0042	0.0105
	0.0021	0	0	0	0.0021	0	0	0	0.0021	0	0.0021
	0.0211	0.0337	0.0674	0.0947	0.0905	0.0295	0.0337	0.0147	0.0189	0.0168	0.0168
	0.0105	0.0063	0.0021	0	0.0021	0.0021	0.0042	0.0042	0.0042	0	0.0021
	0.0084										
1992	1	3	3	0	1	-1	-1	49	0.0037	0.0147	0.0586
	0.0476	0.0989	0.1209	0.0879	0.0293	0.022	0.0256	0.0293	0.0037	0.0073	0.0037
	0.0037	0	0	0	0	0.0037	0	0.0037	0	0	0.0037
	0.0073	0.0476	0.0623	0.0586	0.0513	0.0366	0.033	0.0183	0.0147	0.033	0.0073

	0.0073	0.0147	0.0073	0.0073	0	0.011	0.0037	0.0037	0	0.0073	0
	0										
1993	1	3	3	0	1	-1	-1	58	0	0.0062	0.0341
	0.1053	0.096	0.0805	0.1053	0.0402	0.0341	0.0155	0.0124	0.0031	0.0031	0
	0	0.0062	0.0031	0	0	0	0	0	0	0	0
	0.0031	0.0217	0.0836	0.065	0.1022	0.0433	0.0433	0.0279	0.0186	0.0031	0.0217
	0.0031	0.0031	0.0062	0	0.0031	0.0031	0	0	0	0	0.0031
	0.0031										
1994	1	3	3	0	1	-1	-1	44	0.004	0.04	0.084
	0.084	0.16	0.052	0.056	0.016	0.016	0.004	0.008	0.008	0	0
	0	0	0	0	0	0	0	0	0	0	0.008
	0.008	0.064	0.048	0.076	0.08	0.048	0.048	0.028	0.02	0.008	0.004
	0.012	0	0.008	0.008	0	0	0	0	0	0	0
	0										
1995	1	3	3	0	1	-1	-1	40	0	0.0045	0.0625
	0.1161	0.0938	0.1205	0.0536	0.0223	0.0045	0.0045	0.0089	0.0045	0	0
	0	0.0045	0	0	0	0	0	0	0	0	0
	0.0179	0.0982	0.1116	0.067	0.0446	0.0446	0.0402	0.0268	0	0.0134	0.0045
	0.0045	0	0.0134	0	0.0045	0	0	0	0.0045	0.0045	0
	0										
#											
#	Mean	Size	at	Age							
2											
#_Year	Season	Type	Gender	Partition		Age-Err	Nsamp	3	4	5	6
	7	8	9	10	11	12	13	14	15	16	17
	18	19	20	21	22	23	24	25	30	3	4
	5	6	7	8	9	10	11	12	13	14	15
	16	17	18	19	20	21	22	23	24	25	30
#1986	1	2	3	0	1	1	27.50096098		31.28389375		
	34.44123171		37.07643134		39.2758402		41.11152629		42.64363953		
	43.92238267		44.98965626		45.88043165		46.62389688		47.24441306		
	47.76231264		48.19456563		48.55533566		48.85644408		49.10775731		
	49.31751013		49.4925755		49.63868979		49.76064073		49.86242428		
	49.94737558		50.01827824		28.1226401		31.45069993		34.20130247		
	36.47464329		38.3535329		39.90641319		41.18985059		42.25059659		
	43.12729075		43.85186823		44.45072304		44.94566953		45.35473703		
	45.69282652		45.97225354		46.2031967		46.39406852		46.55182185		
	46.68220313		46.78996174		46.87902296		46.95263103		47.01346723		
	47.06374764										
#	0	0	1	9	17	27	28	27	13	19	8
	8	5	2	5	5	2	0	0	0	0	0
	0	0	0	0	3	7	26	32	18	16	8
	10	7	4	7	1	0	1	1	1	1	1
	0	0	1	0							
#1986	1	1	3	0	1	1	28	31.5	37	41.2	42.1
	44.6	46.9	49	49.6	48.4	48.9	48.1	50.6	52	52.2	50
	49	51	51	51	51	51	51	51	28	31.5	42
	40.9	41.4	42.2	43.6	45.1	45.1	47.1	46.6	47	46.7	46
	47.3	46	49	52	46	50	47.3	47.3	49	47.3	
#	0	0	1	9	17	27	28	27	13	19	8
	8	5	2	5	5	2	0	0	0	0	0
	0	0	0	0	3	7	26	32	18	16	8
	10	7	4	7	1	0	1	1	1	1	1
	0	0	1	0							
#1987	1	1	3	0	1	1	28	31.5	44	41.3	47.1
	46.5	47	48	47.8	50.4	50.4	50.4	51.2	51.6	53.8	56
	51	56	54.5	53	58	60	50	50	28	31.5	36
	41.3	43.4	43.5	44.3	45.4	44.2	45.8	46.1	46.9	47.1	49
	48.8	48	47	51	51	47.3	47.3	53	52	53	
#	0	0	1	3	10	29	34	23	27	26	20
	13	14	5	5	1	0	4	2	2	1	1
	0	0	0	0	0	4	8	28	35	20	15
	22	13	7	8	6	4	1	2	1	1	0
	0	1	3	1							
#1984	1	2	3	0	1	1	28	32.3	34.4	36.5	38.9
	40.6	42.8	43.2	45.9	46	48.4	48.7	49.9	48.5	52.4	51.3
	55.9	50	41	47.1	50	50	50	50	28	30.3	36.1
	37.1	39.1	40.2	40.7	42.4	42.6	43.4	44.4	45.8	47.3	46.7
	46.5	45.2	47.7	44.9	51.6	51.1	45.3	49	49.5	50.3	

#	0	6	26	62	75	44	42	61	34	20	17
	8	9	9	5	5	2	0	1	2	0	0
	0	0	0	2	2	21	24	23	29	34	24
	12	11	10	14	9	12	2	3	2	6	3
	6	4	5	4							
#1993	1	2	3	0	1	1	28	32.6	33.9	36.5	39
	40.6	41.7	44.3	44.5	47	49.7	49.8	47.2	46.8	50	47
	51.8	55	52	50	50	50	54	50	28	35.4	33.1
	36.4	38	38.6	40.8	41.5	43.6	44.1	45.3	44.5	46.2	45.2
	45.9	50.5	45.3	48.3	46.7	47.3	47.3	48	48	54	
#	0	7	34	69	66	85	85	48	35	11	15
	10	12	6	2	2	4	1	1	0	0	0
	1	0	0	7	20	57	46	69	50	30	17
	16	11	2	5	6	10	2	3	3	3	0
	0	1	3	1							
2001	1	2	3	0	1	1	28	34.2	35.8	36.8	38.2
	39.7	40.2	41.1	42.6	43.8	43.8	45.3	45.6	47.1	44.1	48.4
	46	42.5	43.3	44	50	50	50	50	28	32.3	33.5
	36.4	37.5	38.5	39.3	40.3	41.3	42.4	42.3	42.1	41.8	42.9
	43.9	44	44.7	45.5	42.3	44	47.3	46.8	44.5	51	
	0	6	25	71	190	162	98	79	96	84	64
	28	24	13	12	8	4	4	3	1	0	0
	0	0	0	10	21	74	164	120	82	72	56
	54	36	21	18	14	8	7	9	8	3	2
	4	4	6	5							
2002	1	2	3	0	1	1	25	31	35.5	37.6	39.1
	40.8	41.6	42.6	43.8	44.6	45.1	45.4	46.8	46.3	44.4	46.9
	49.3	49.3	47	50	45	50	48	50	27	30	34.3
	36.4	38.2	39.4	39.5	41.1	41.1	41.6	42.5	42.3	43.4	43.1
	44.4	44.7	44	45.8	44	43.7	41	45.7	46.3	48.5	
	1	4	27	56	144	222	141	113	94	77	71
	39	23	20	9	8	3	6	1	0	2	0
	1	0	2	3	33	73	123	137	96	82	43
	41	34	28	22	15	12	10	3	4	3	3
	2	3	6	4							
#1987	1	3	3	0	1	1	28	35.7	35.3	36.6	38.8
	41.2	43.2	44.4	45	46.6	47.7	48.6	48.9	51.6	50.5	50.8
	50.5	52	50	57	51	50	50	50	28	30.7	34.4
	37.9	38.6	40.3	41.5	41.6	44	45	45.5	45.9	44.6	48.3
	46.9	49.4	50.3	47	47.6	49	52.5	47.3	49.43	51	
#	0	3	10	34	32	44	50	27	26	29	21
	28	15	16	8	5	2	3	0	1	2	0
	0	0	0	3	15	23	45	42	35	31	21
	24	32	21	17	4	10	13	4	5	5	2
	2	0	6	3							
#1991	1	3	3	0	1	1	29	32	34.1	36.1	39
	41.4	42.7	44.9	46.8	47.5	50.5	52	50.8	49.3	54	50
	50	50	47	50	50	50	51	50	34	30.8	33.8
	35.7	38.4	40.9	41.8	44.5	45.6	46.5	45.6	45.8	45.2	49.6
	47.5	48	51	49.2	48.3	49.3	49.5	50	50.7	47.3	
#	1	2	19	49	49	48	27	21	24	19	13
	7	5	7	3	0	0	0	1	0	0	0
	1	0	1	10	16	33	50	51	19	27	12
	17	14	9	6	7	2	2	1	5	4	6
	4	1	3	3							
#	Environmental	Data									
0											
0											
#											
999											

Agenda Item G.4.a
Attachment 2
September 2007

Black Rockfish (Northern)

STAR Panel Report

Pacific States Marine Fisheries Commission
Portland, Oregon
May 21-25, 2007

Reviewers:
Owen Hamel (Chair), Northwest Fisheries Science Center and SSC representative
Thomas Helser, Northwest Fisheries Science Center
Patrick Cordue, Center for Independent Experts
Neil Klaer (Rapporteur), Center for Independent Experts

Advisors:
Kelly Ames, GMT representative
Kenyon Hensel, GAP representative

STAT Team Members Present:
Farron Wallace, Washington Department of Fish and Wildlife
Yuk Wing Cheng, Washington Department of Fish and Wildlife
Tien-Shui Tsou, Washington Department of Fish and Wildlife

Overview

A draft assessment of black rockfish (*Sebastes melanops*) off the Washington coast was reviewed by the STAR Panel. This assessment used a recent version of the SS2 model. A Petersen tag and recapture study that was explicitly modeled within the previous assessment was included this time as providing a relative abundance index. During the review a number of alternative model configurations were explored that incorporated changes including using the correct CV_growth_pattern in the control file to allow correct interpretation of CV on length at age, alternative catch histories, freeing growth parameters, using a steepness value of 0.6, adding adjustments to the CV on tag abundance, removal of early tagging length composition data, freeing up peak parameter for selectivity for all fisheries, using a base value M male 0.16 and ramp to 0.2 for old females, setting λ values to 1 (except length compositions), adding 1983/84 trawl mean size at age data and re-weighting σ_r, length and age compositions.

Biological features unusual to this stock were discussed, including the lack of old females in population samples compared to numbers of males. It may be that females provide sustenance to the young and therefore have a “harder” life than males, and are therefore killed off more quickly than males. Alternatively, there may be a sex-specific selectivity difference with old females becoming less available to the fishery. In short, modeling methods to deal with these alternatives methods for dealing with older females may be termed “kill them or hide them” methods.

Modeling selectivity separately by sex is managed in SS2 using offset values, so the previous method using a change to a higher *M* for older females (kill them) is the only option that has been explored at present. Sex-specific selectivity (hide them) should be pursued as an option in future. The STAT also pointed out that black rockfish may have unusual breeding habits where about 10% of the older females don’t appear to spawn in any year.

Input data are available from three main fisheries – commercial trawl, commercial non-trawl and recreational sport fishery. Known catches commence in 1963 for trawl, 1970 for non-trawl and 1975 for the sport fishery. It is known that the species was caught back to at least the 1940s, so historical catches were reconstructed by assuming a linear increase from 1940 to the 1964-65 average for trawl and to1974 for the sport fishery. The non-trawl fishery was assumed to commence with a linear increase from 1950 to 1969. Particularly in early years, black rockfish were not identified at the species level in catches, and were recorded as part of a combined catch of all rockfish. Ratios from periods where the black rockfish fraction of the catch was known have been applied to unknown periods for each fishery. Some of this procedure was presented by the STAT, but a complete detailing of all of the assumptions made to generate the historical catch series is required.

Size and age composition samples commencing in 1976 are available for each of the fisheries. The Panel noted that the size samples often include the same fish as in the age samples, so there is not complete independence of these series. Results from SS2 model presented by the STAT show a large 1999 year class that is now 8 years old, forming a central portion of the fishery. By the mid-1990s length compositions and age compositions from the sports fishery show a definite truncation of older age classes indicating an impact of fishing.

Abundance indices are available from a tagging program that commenced in 1981 as Petersen tag and recapture estimates and a CPUE series from the tagging effort is also available.

Statistical methodologies for deriving the Petersen estimates from tag-recapture, sex-specific length-weight and age-length relationships, aging error, age-weight conversion errors, age-length-maturity relationships, total mortality and natural mortality were presented. The Panel noted that there was a residual pattern in the fitted relationship used to estimate tag loss for spaghetti tags, suggesting a non-linear relationship. Also, in fitting fecundity, the model has a positive intercept, so is not strictly proportional to weight. The Panel suggested that effort used in the M estimation should be from all sources of mortality, and not just the sport fishery, and that there is also an element of double use of the data if these estimates are used in the assessment. However, total and natural mortality estimates from these procedures were not used in the assessment, and were provided for information and comparison with estimates from other sources.

The tagging program is carried out off Westport by volunteers, and the effort measure is the number of rod hours. Tagging is mostly done before the commencement of the sports fishery each year. Recaptures are from the wider sports fishery. Although several boats were probably used early in the program, most of the tagging is done from a single vessel. The region tagged is the same each year, but not the exact positions. From 1998 onwards the effort was distribute according to known black rockfish habitat, but before that was across all areas. The Panel noted that Petersen population estimates are from the same tagging effort that produces the tagging CPUE, so there is possibly a problem with independence of these two series.

The STAT thought that the q value for the tag Petersen index should be about 0.3 or less, as the survey covers about that portion of the available habitat along the central Washington coast, but in models presented, q was estimated and the index is used as relative index. The CV for the tag index used in the model was 0.6, and the index values were in numbers of fish. Calculated values for the survey CV range from about 0.1 to 0.25. The distribution of the recapture fleet changes through time due to economic factors. The Panel noted that it is questionable whether the assumption of mixing between tag and release holds depending on how far the tagged fish move, and the extent of overlap between tagging and release fishing effort. It is not possible to determine from returns where the fish were caught. The STAT pointed out that 80% of fish move less than about 10 miles. The Panel noted that it would be worthwhile to carry out a study to determine whether there has been any trend in the recapture fleet that may cause a bias in this index.

Selectivity for tag release is different to the sport fishery because fishing is shallower in the water column to avoid barotrauma. The release selectivity is showing as more dome shaped in the stock assessment than the sport fishery. It may be that the sex ratio is affected by this as well.

A CPUE index is also available from the sport fishery. The STAT presented results of standardization of the sport fishery CPUE using a delta lognormal GLM, but did not use this index in the assessment as they regarded it as not reflecting abundance due to the effects of changes in bag limits and a switch to bait fishing in the early to mid-1990's.

The coast wide recruitment survey has not been used as there are only 6 years of data available from this source, which the STAT considers too limited to use at this stage.

At the end of a series of requests and responses a base case model was produced that was acceptable, but with a number of deficiencies. The index for tagging abundance was noisy and the trend almost missed all confidence intervals of the observations. Effective q for the tagging index was 0.83 and the STAT thought that this was perhaps twice what it should be. The Panel pointed out that the SS2 value of q is a function of selectivity which is strongly dome shaped for the associated fishery. Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of q based on tagging and the one estimated by SS2. The Panel and STAT agreed that this was the best assessment available at the moment, but there are reservations about the q for the survey and that this dimension was not explored. The STAT was content to proceed with this base case. They also agreed to use a set of low and high M values and alternative catch history for sensitivity testing.

Requests and responses

There was Washington catch landed in Astoria in the 1940s that may have contained large catches of black rockfish based on anecdotal information from Cleaver. The Panel was concerned that the current reconstruction of historical catch does not capture any of this uncertainty and suggested that as a first step, an alternative catch history be developed that accounts for such a potentially large historical catch, and that historical catches may have commenced in about 1915.

For both the trawl and sport fishery to some extent, there is a general underestimation of fish at older ages. The peak parameter for selectivity has been fixed, so these results suggest that it needs to be estimated.

Expected length frequencies show marked spikes, indicating the CV on length at age needs to be increased (The CV_growth_pattern had been set to 3 instead of 0).

The model has difficulty fitting length compositions from the tagging fleet prior to about 1990, and the Panel suggested that they might need to be down-weighted or disregarded.

Models presented had recruitment λ set to 0.1 and σ_r set to 0.55 which was the RMSE for one of the model runs after using an initial value of 0.6. The Panel suggested setting all λ values back to 1 and re-weighting σ_r based on the RMSE value from the same model.

Best likelihood values for *M* were high at 0.2 for males and 0.26 for females. Best fits to Petersen tag abundance only were for lower values of *M*, but the STAT thought that those values for *M* seemed unrealistic. The Panel suggested that *M* was a primary source of model uncertainty, and that it might be possible to select a range of *M* values that could be used for sensitivity testing that could be the same for the northern and southern black rockfish assessments. The Panel also noted that *M* values used for southern black rockfish were generally lower than those used for northern.

The Panel suggested value of 0.6 instead of 0.7 for steepness for consistency with the southern black rockfish assessment.

Requests (1):

The STAR Panel requested a new base case and some sensitivity runs as follows:

Base Case:

a) Increase CV on length at age (change CV_growth_pattern in the control file to 0)
b) Investigate freeing $l_{\min}$, $l_{\max}$ and K for growth
c) Set steepness to 0.6
d) Add 0.2 as an adjustment to the calculated CVs on tag abundance
e) Free up peak parameter for selectivity (and perhaps fix other appropriate ones) for all fisheries
f) M ramp from 10 to 15 for females (no change). M male 0.14 and ramp to 0.2 for females
g) All λ values set to 1
h) Include 1986 and 1987 trawl mean size at age
i) Re-weight σ_r, length and age compositions. Calculate sd of the Pearson residuals for age and length frequencies.

Sensitivities:

a) Remove length compositions and CPUE for the tagging fleet to 1990
b) Low M of 0.1 ramping to 0.16 and high M of 0.18 ramping to 0.24.
c) An alternative catch history is to be developed that accounts for higher trawl catch in the 1940s.

Response to Request (1)

A modified base case was presented that did not include base case options (b) or (i). For base option (e), the peak was freed on trawl, survey and sport with a fixed width. Non-trawl was not freed. It still showed a lack of fit to older age classes. Expected length frequencies now look normal.

Option (a) and (b) in the sensitivities were not yet explored.

An alternative catch history (c) was constructed. It included 90% of the Astoria landings from 1936 to 1950 plus 10% of the rockfish catch from the trawl fishery off Washington in the 1936 to 1950. Catches from 1915 to 1936 were set to 0. Initial fishing mortality was set to 0. Using this catch series in SS2 does not alter the initial biomass or current depletion substantially as there was sufficient time since the large trawl catches for the population to recover.

Requests (2)

Base:

a) Free l_{min}, l_{max} and *K* for growth
b) Down-weight length compositions to better fit the tag abundance index, if it won't fit, reduce the index CV.

Sensitivities:

a) Remove early length compositions and associated CPUE
b) Low *M* of 0.1 ramping to 0.16 and high *M* of 0.18 ramping to 0.24.

Response to requests (2)

Trawl size composition for 2002 was removed, and also 1987 mean size at age for trawl because these sizes were much larger than those seen even in 1986 and were difficult to fit.

No convergence problems were experienced for the base case and the jitters also worked.

Fits to low natural mortality were not as good as other scenarios (and the hessian didn't invert for low). Also did *M* 0.16 and 0.22 as an alternative base case. The STAT thinks that higher *M* values are more plausible as they better match the fishing mortality rates off Newport indicated by tagging. The STAT is essentially using the *q* for the tagging index as a diagnostic reality check, which the Panel suggests would be better implemented as an informed prior.

Removal of early tagging length composition data improves the tagging abundance and CPUE index fits. Estimation of *K* improves the fit to age compositions but not length. The overall likelihood was improved substantially through estimation of *K*.

The base case is still not fitting relatively narrow peaks in observed female age compositions, but fits to older females generally improved.

The sport fishery lengths do not fit the mode prior to about 1995 when there was a regulation change, so time blocks for selectivity might improve the fit.

The STAT doesn't believe that there is any good reason to leave out the early tagging data.

Requests (3)

Base case:

a) Male *M* 0.16, old female *M* 0.22
b) Free l_{min}, l_{max} and *K*
c) No removal of early tagging data
d) Trawl mean size at age data included.

Sensitivities:

a) Low *M* of 0.12 ramping to 0.18 and high *M* of 0.19 ramping to 0.25.
b) Free up parameters for trawl selectivity
c) Increase weight on tag abundance index
d) Larger historical catch.

Response to requests (3)

Earlier *K* was mis-specified. Model fits age and size at age are now better than earlier base, but worse fits for abundance indices and length comps. The overall fit is however improved.

There is a tradeoff in fit between the 1986 and 87 mean size at age and the length frequencies for the trawl fishery.

Trawl selectivity is tending towards a gradual increase from small to large which seems implausible.

There is conflict between fitted growth for recent and earlier periods.

A high weight (λ=350) was applied to tag abundance resulted in no significant improvement to the fit to tag abundance.

Request (4)

Base case:

a) Don't include trawl mean size at age
b) Fix trawl selectivity width.

Response (4)

The overall fit was improved, although with worse fit to trawl length frequencies.

Request (5)

Base case:

a) *M* 0.16 ramping to 0.22
b) All tag data included
c) Don't include trawl mean size at age data.

Response (5)

With an input σ_r of 0.5, the RMSE is 0.35. This model produces *q* values of 0.737 for the tag abundance. The STAT team believes that this value is too high and should be in the order of 0.2 to 0.4.

Request (6)

New base case as above with σ_r 0.30.

Sensitivities:

a) *M* low 0.12 to 0.18, high 0.19 to 0.25
b) Larger historical catch.

Response (6)

Overall likelihood across *M* has tightened. Other runs were presented by the STAT that reduced the ramp to 0.04, and with a range of male *M* values of 0.14, 0.18, and 0.21. The natural mortality analysis presented by the STAT earlier indicated that the spread should be about 0.04. A value of 0.18 was the indicated *Z* for 1980. The Panel was more comfortable with lower *M* values due to the longevity of the species. The current *q* value for the tagging abundance is coming out at about 0.7 and the STAT believes that value should be 0.3 based on the fraction of the area where the survey is carried out. The Panel would be happy to include an informed prior on *q* based on an analysis, but such an analysis to develop an informed prior has not been done. The STAT feels that the stock is not overfished, and the Panel preferred lower value of *M* produces an overfished stock which is implausible. The Panel suggests that this is not necessarily a problem, and that a range of *M* values should capture the range of uncertainty. There was a discussion about the role of the Panel and what level of guidance in development of base cases can be imposed, and how much the assessment becomes a product of the Panel. The STAT also felt that higher *M* values better match those used in previous assessments and also those produced from catch curve analyses from 1980. The Panel pointed out that these were *Z* values, and therefore the *M* value should be lower as the stock was not unexploited at the time. The STAT agreed to use the suggested range of lower *M* values for sensitivity but to modify the difference value to 0.04 based on STAT analyses.

Request (7)

Base case:
M 0.16 (males and young females) ramping to 0.20 (old females)

Sensitivities:

a) Low *M* of 0.12 ramping to 0.16 and high *M* of 0.19 ramping to 0.23.
b) Alternate catch series with base *M*s.

Response (7)

The index for tagging abundance is noisy and the trend almost misses all confidence intervals. Effective q for the tagging index is 0.83 and the STAT thinks that this is perhaps twice what it should be. The Panel pointed out that the SS2 value of q is a function of selectivity which is strongly dome shaped for the associated fishery. Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of q based on tagging and the one estimated by SS2. The Panel and STAT agree that this is the best assessment available at the moment, but there are reservations about the q for the survey and that this dimension has not been explored. The STAT is happy to proceed with this base case and range of *M* values.

Description of base model and alternative models used to bracket uncertainty

The following was the final base case and sensitivity tests agreed by the Panel and STAT.

Base Case (with reference to original draft base case):

- Increased CV on length at age
- Free l_{min}, l_{max} and K for growth
- Steepness 0.6
- Include sport fishery mean size at age data from 2001 and 2002
- Free up peak parameter for selectivity, fix width for trawl
- *M* ramp from age 10 to 15 for females. *M* male 0.16 and ramp to 0.20 for females
- All λ values set to 1.0 except for 0.1 for length compositions
- Re-weight σ_r, length and age compositions.

Sensitivities:

- An alternative catch history that accounts for higher trawl catch in the 1940s and catches back to 1915
- Low *M* of 0.12 ramping to 0.16, and high *M* of 0.19 ramping to 0.23.

Comments on the assessment

The presented assessment was structurally quite different to the previous one for the same stock presented in 2003. The STAT is commended in their efforts to move the assessment into the SS2 framework, and the means used to retain tagging abundance and CPUE data within the assessment.

Merits:

- SS2 was used which brings the advantage of standards and a well tested package
- Tagging data has been brought into the model

Deficiencies:

- Tagging is not dealt with in the model as a tagging experiment (this is not possible with current SS2, but is being considered)
- Uncertainty in *q* was not explored. Uncertainty could have been expressed as a profile. The assessment would be improved if there was an informed prior on *q*.
- Non-independence of the length/age compositions
- Non-independence of the tagging abundance and CPUE series
- Sex-specific selectivity has not been explored as an alternative to elevated *M* for females as a means to produce less older females in the population
- The full uncertainty in the catch history has not been explored

Explanation of areas of disagreement regarding STAR Panel recommendations

A. Among STAR Panel members (including GAP and GMT representatives)

There were no areas of disagreement.

B. Between the STAR Panel and STAT Team

There were no areas of disagreement between the STAR panel and the STAT team at the end of the STAR panel meeting. However, after the STAR panel meeting, the STAT produced an alternative proposed base case which is included in the assessment document. This alternative base sets M at 0.16 for males and young females, as in the base case agreed upon at the STAR panel, but ramps up to an M of 0.24 for old females (instead of 0.20). The rational given for this alternative model is that the overall statistical fit is better and that the resulting q for the tagging study is closer to 0.3. The STAR panel did not have a chance to review this alternative model. It should be noted, moreover, that it was based upon the STAT recommendation that the difference between the male (and young female) and old female M should only be about 0.04 that the base model old female *M* was reduced from 0.22 to 0.20 towards the end of the STAR panel meeting.

Management, data, or fishery issues raised by the GMT or GAP representatives during the STAR Panel.

No issues were raised.

Unresolved problems and major uncertainties

- The major uncertainties are *q*, *M*, historical catch and sex-specific selectivity.

Recommendations for future research and data collection

The Panel reiterates research and data collection required to improve the assessments for all rockfish, and also makes specific recommendations for northern black rockfish.

Generic (all rockfish) recommendations

- Development of fishery independent time series using fixed sites and volunteer fishers properly supervised using standard protocols
- Establish a database for historical rockfish catch histories, "best" guesses and estimates of uncertainty (and processes for updating and revising the database).
- A full descriptive analysis of the recreational fisheries and fleets for CPUE interpretation (not limited to "rockfish trips" – interactions with other target species are important)
- Develop standard and validated methods for producing recreational CPUE indices which deal with the peculiarities of the recreational data and regulation changes.
- Mapping of rockfish habitat – quantitative estimates of area (which will inform CPUE *q*s and tagging *q*s).

Northern black rockfish recommendations

- Development of informed priors for tagging and recreational CPUE *q*s (see Appendix 1).
- Age validation study
- Reader to reader comparisons are needed between States (Oregon and Washington).

Appendix 1: Development of an informed prior for a CPUE proportionality constant

The development of an informed prior for an abundance-survey proportionality constant (q) is relatively common in New Zealand (e.g., see hoki and orange roughy stock assessments in Sullivan et al. 2006). A prior is often useful to help stabilize stock assessment results and, in a full Bayesian assessment, provides a natural method for incorporating ancillary information into an assessment. Also, comparison of the estimated q with the prior provides a useful diagnostic for point-estimate assessments or full Bayesian assessments (posterior compared with prior). Informed priors for CPUE qs have never been developed in New Zealand, but there is no theoretical reason why they should not be.

For assessments that depend largely on CPUE indices for abundance information an informed prior on a CPUE q could be very useful for ground-truthing assessment results. The equations of a simple model which could be used to develop CPUE q priors are given below. Not all details are covered – this is the presentation of a concept rather than a definitive method.

Let X be a CPUE abundance index in a given year for a given species and area. Assume that it is part of a time series (GLM standardized or not) and that the units of the catch rate have been retained (e.g., numbers per angler hour).

By definition,

$$\mathrm{E}(X) = qN$$

where N is the total number of fish in the vulnerable population (i.e., the fish selected by the associated fishery). Further, assume that the CPUE index is proportional to density:

$$\mathrm{E}(X) = \alpha d$$

where d is the average density across "fishing spots" (i.e., the specific areas which are fished) and α is a proportionality constant. Note the distinction between q and α; they are both unknown proportionality constants, but one relates density to catch rate and the other relates catch rate to population numbers. We need to express q in terms of its components – which we know something about – in order to develop a prior for q, and α is one of those components. The other main component is the area occupied by vulnerable fish.

Let,

A = total area of fishing spots
D = total background area (areas not fished, but which contain vulnerable fish)
b = average background density where $b = \beta d$.

Then,

$$N = dA + bD = d(A + \beta D)$$

and

$$E(X) = \alpha d = \frac{\alpha N}{A + \beta D}$$

Hence,

$$q = \frac{\alpha}{A + \beta D}$$

The denominator in this equation appears tractable. Certainly something is known about the area of the "total habitat" ($A + D$) and the area fished (A). Also, it is not too difficult to obtain suitable experimental data on the relative densities found in the "fishing spots" and the "background" (using the specified fishing method).

The numerator appears to be more difficult. How does catch rate (in a fishing spot) relate to the underlying density? Clearly α is a function of several variables and could be highly species specific. Certainly, the relationship between density and catch rate will vary, even for a given species, by time of day and season and many other factors. However, α relates an average density (over all fishing spots) to an expected catch rate for an associated CPUE index (so daily and seasonal variation are not a particular concern).

One way to explore potential ranges for α is through a simulation study. It might be possible analytically but it would be much easier to simply simulate fishing under a number of different conditions – e.g., density, clusters of lines and hooks, biting probabilities, "effective hook volumes" - and examine the relationship between catch rates and fish densities. Depending on the sub-model used, it may be that information/opinions on values of the sub-model parameters could be available.

There are at least two alternatives which could be supplementary to or used instead of such a simulation study. First, it may be possible to use a depletion experiment design (which need not be destructive - perhaps some/most fish could be retained alive in tanks and later returned to the fishing spot). Second, there may be some comparable species which have reliable assessments which include CPUE indices – and the estimates of their CPUE qs could be "borrowed" (this could be possible for q if the areas are comparable, otherwise it could be done for α if there is information on the habitat area for the comparable species).

References

Sullivan, K.J. et al. 2006. Report from the fishery assessment plenary May 2006: stock assessments and yield estimates. (Draft document available from the N.Z. Ministry of Fisheries.)

STATUS OF BOCACCIO OFF CALIFORNIA IN 2007

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Table of Contents

Executive Summary – Bocaccio

Approach: This assessment was conducted primarily as an "update" which follows the methodology and assumptions of the 2003 bocaccio assessment as closely as possible. The main differences from the previous assessment are addition or revision of recent data, and revision of the historical commercial catches. One additional model is added, based on a prior distribution of stock-recruitment steepness. The assessment used the original Stock Synthesis model (SS1), and does not develop an equivalent new Stock Synthesis 2 (SS2) version of the assessment. Accordingly, some features of SS2 output, such as precision estimates, do not appear in this assessment.

Stock: Bocaccio rockfish (*Sebastes paucispinis*) occurring in waters off the state of California. For management purposes, the stock may be considered to reside in U.S. waters south of Cape Mendocino. This stock assessment treats the resource in Southern and Central California as a combined unit.

Catches: Catches have declined steeply from the 1970s, reflecting both a long-term decline in abundance and progressive restrictions on harvest of bocaccio (Table ES1, Figure ES1). Values of catches since 2000 are imprecise because of management-induced discarding. Recent discards in the trawl fishery have been monitored; for lack of better information, discard rates in other commercial fisheries are assumed to be similar those for the trawl fishery. Discards in the recreational fishery were obtained from RecFIN. Details are given in Table ES2.

Data and assessment: This assessment follows the methodology and assumptions of the 2003 bocaccio assessment as closely as possible. This assessment uses the original Stock Synthesis model (SS1, synl32r.exe, compiled 4/2/2003), and does not develop an equivalent new Stock Synthesis 2 (SS2) version of the assessment.

Input data extend back to 1951. Data include catches from five fisheries segments reflecting three statewide commercial gears (trawl, setnet, hook&line), and separate southern California and central/northern California recreational fisheries, length compositions from six sources (all five fisheries segments, and the Triennial Survey), and six indexes of abundance (trawl logbook CPUE, three recreational CPUEs, Triennial Survey abundance, and CalCOFI larval index of spawning output). The assumed natural mortality rate (M) was 0.15/yr in accordance with the 2003 assessment.

Unresolved problems and major uncertainties: Within the scope of this assessment, there were no unresolved problems or uncertainties. The STATc model developed in the 2003 assessment is the focus of the update, with more limited consideration of the STARb1 and STARb2 models. Differences among the three models are described in Table ES3. One additional model developed in this document is based on the maximum posterior density estimate of bocaccio stock-recruitment steepness (h = 0.44) from a meta-analysis of rockfish stock

Table ES1. Summary of historical bocaccio catches (mtons, including discards)

	Trawl	Hook&Line	Setnet	RecSOUTH	RecNORTH	Total
1950	1287	200	0	39	86	1612
1960	2163	351	0	63	125	2702
1970	1660	298	0	289	204	2451
1980	3641	335	216	1755	178	6037
1990	1144	497	793	233	91	2451
1995	377	69	281	44	3	777
1996	288	93	92	67	26	573
1997	230	58	35	49	107	480
1998	73	42	39	29	23	209
1999	45	21	7	71	53	197
2000	54	21	2	52	60	189
2001	59	35	4	60	49	207
2002	41	7	0	76	8	132
2003	1	2	0	11	0	14
2004	11	9	0.3	59	2	82
2005	23	26	0.1	32	6	87
2006	5	20	0.2	31	11	67

Table ES2. Estimated recent fishery removals (mtons) of bocaccio. Parentheses indicate value used in 2003 assessment.

	TRAWL				H&L		SETNET		RecSouth	RecCen	Total
	Retained	Disc Rate*	Discard**	Est	Retained	Est	Retained	Est	A + B1	A + B1	Est
2000	20.1		34.0	54(54)	7.0	21(21)	0.7	2(2)	52	60	189(187)
2001	13.7		45.7	59(37)	7.8	35(23)	0.9	4(2)	60	49	207(187)
2002	18.2	56%		41(99)	3.0	7(17)	0.2	0(1)	76	8	132(201)
2003	0.2	79%		1	0.5	2	0.0	0	11	0	14
2004	6.2	42%		11	5.5	9	0.3	0.3	60	2	83
2005	3.9	83%		23	4.4	26	0.1	0.1	32	6	87
2006	0.9	83%		5	3.4	20	0.2	0.2	31	11	68

* Discard rate from J. Hastie (email 2007); **Discards from J. Hastie (email 2005); 2006 discard rate assumed same as 2005

Table ES3. Summary of 2003 bocaccio models. Bold type indicates updated aspects of the models.

M = 0.15
Years: background, 1950 to **2002**
Recruitments (age 1):
STAR B1: expval 1951-59, individual 1960-**2001, expectval 2002, 2003**; SRR lambda=0
STAR B2: expval 1951-69, individual 1970-**2001, expectval 2002, 2003**; SRR lambda=0
STAT C: expval 1951-59, individual 1960-**2001, expectval 2002, 2003**: SRR lambda=0.1
Age bins: 1 to 21+
Length bins: 24, 26, …… 66, 68, 72,76, 80+
Growth: Von Bertalanffy fitted in model, separate male and female curves
Length CVs: 0.107 at age 1.5, 0.033 at age 99

Modeled Segments:	Selectivity form	First LF	Last LF	Nyears	Sexes	Used?
Trawl	Dbl. Logistic	1978	**2002**	**25**	yes	all
Hook and Line	Dbl. Logistic	1980	**2002**	**22**	yes	all
Set Net	Dbl. Logistic	1978	**2002**	**18**	yes	all
Recreational South	Dbl. Logistic	1975	**2002**	**24**	no	all
Recreational North	Dbl. Logistic	1980	**2002**	**23**	no	all
Triennial Trawl Survey	Dbl. Logistic	1986	**2001**	**6**	yes	not in STAR B1

Abundance Indexes	Selectivity source	First	Last	Nyears	CV	Used?
RecFIN CPUE North	Rec North	1980	2002	20	0.67	not in STAR B2
CDFG CPUE North	Rec North	1987	1998	12	0.37	all
RecFIN CPUE South	Rec South	1980	2002	20	0.71	not in STAR B2
Trawl CPUE (north)	Trawl	1982	1996	15	0.32	all
Triennial Trawl	Triennial	1977	**2001**	**9**	0.81	not in STAR B1
CalCOFI Larval	Spawn Ogive	1951	**2003**	**47**	0.68	all

Recruitment Indexes	Selectivity source	First	Last	Nyears	CV	Used?
Power Plant Ent'nment	age 1	1972	2000	29	2.10	no
Cen Cal Juvenile Trawl	age 1	1983	2002	20	2.05	no
Rec Pier CPUE	age 1	1980	2002	20	3.29	no

assessments (Dorn, pers. comm. 2007), with full emphasis (lambda = 1) on the Beverton-Holt model fit to the recruitment estimates, with all other aspects of the model similar to the STATc model.

Reference points: Values in this discussion are from the STATc model; values for all four models are given in Table ES4. Population reproductive potential is measured as spawning output (units of billion eggs). Unfished abundance cannot be estimated reliably from historical stock and recruitment due to lack of curvature in the relationship. An imprecise estimate of unfished spawning output was obtained by multiplying the average age-1 recruitment (1951 to 1986) by unfished SPR, giving 13572 billion eggs.

The 50%SPR exploitation rate (Catch/Biomass age 1+) is 0.0630, which is used as a proxy Fmsy rate by the PFMC. Proxy Bmsy (40% of Bunfished) corresponds to an approximate equilibrium total biomass of 31341mtons, and if this is fished at proxy Fmsy, the MSY is estimated to be 1974mtons. Although calculations related to MSY are imprecise, estimates vary relatively little among alternative models and methods of calculation. The overfishing threshold is Fmsy, in this case the proxy value of F(SPR50%), and corresponding catch levels are the ABC values given in the rebuilding projections.

Stock biomass: The estimated history of the biomass (age 1+) and spawning output (billion eggs) estimated by the four alternative models are shown in Figures ES2 and ES3 and values are given in Table ES5. Notably the three models (STARb1, STATc and STATcMPDh) that are allowed to estimate early biomass indicate that biomass was near the minimum stock size threshold at the beginning of the assessment period, ca. 1950. This is not surprising, given that the assumed pre-1950 “background” catch was 2000mtons, which slightly exceeds estimated MSY. CalCOFI larval abundances indicate a relatively low biomass in the 1950s, and a substantial increase in spawning abundance during the 1960s.

Recruitment: The estimated history of recruitment (omitting earlier years with little data to inform estimates) is shown in Figure ES4 and values are given in Table ES6. The strong 1999 year class was followed by a moderately strong 2003 year class. Strength of the 2004 and 2005 year classes is not estimated from data, but rather is taken from the stock-recruitment relationship. The recruitment values for these years are not substantiated by other sources of information, and these values may be overly optimistic.

Exploitation status: The history of exploitation rates is shown in Figure ES5 and ES6, and values are given in Table ES6. From the STATc model, the estimated spawning output in 2006 is 1727 billion eggs, or 12.7% of the estimated unfished level. The estimated 2006 total biomass (age 1+) is 10752mtons. The 2006 exploitation rate of 0.0062 was far below the reference exploitation rate of 0.0630 that is the maximum fishing mortality threshold under the SPR50% proxy (see Figure ES1). At the Fmsy proxy, the STATc model gives a 2006 catch (ABC) of 677mtons (this is also the overfishing threshold) and a “40-10" policy OY of 193mtons.

Management performance: The 2006 OY was set at 218mtons, the retained catch was about 42 mtons, and the estimated total catch including discards was 68mtons (Tables ES2 and ES7). Including mortality of estimated discards, estimated total kill in 2006 67mtons. Thus, recent management has been achieving total removals well below target levels, and far below maximum levels. A ten-year history of management performance is given in Table ES7.

Table ES4. Management reference points for bocaccio.

	units	Model STARb1	STARb2	STATc	STATcMPDh
Steepness(h)		ca. 0.2	ca. 0.2	ca. 0.2	0.44
Unfished Reference Points					
Reference source		Ravg51-86	Ravg51-86	Ravg51-86	SRR
Spawning Output	billion eggs	13563	13132	13572	12591
Summary (1+) Biomass	mtons	71104	68894	71195	66036
Mean Recruitment at age 1	thousands	5451	5270	5449	5039
SPR(F=0)		2.488	2.492	2.491	2.502
Current status (2006)					
Spawning Output	billion eggs	2075	1430	1727	2049
Spawning Output at SB40%	billion eggs	5425	5253	5429	5036
Relative depletion		15.3%	10.9%	12.7%	16.3%
Summary (1+) Biomass	mtons	14559	9582	10752	13661
2006 Catch (including discards)	mtons	67	67	67	67
Exploitation rate		0.0046	0.0070	0.0062	0.0049
Overfishing threshold (ExpRate at SPR50%)		0.0633	0.0631	0.0630	0.0633
ABC	mtons	922	605	677	865
OY (40-1010)	mtons	426	66	193	401
Reference Points based on SPR50% proxy at SB40%					
Spawning Output at SB40	billion eggs	5425	5253	5429	5036
SPRmsy proxy		50%	50%	50%	50%
Exploitation rate at SPR50%		0.0633	0.0631	0.0630	0.0633
Approx Bsummary at SB40% given Exploitation rate at SPR50%	mtons	30928	30313	31341	29146
Yield with SPR50% at SB40%	mtons	1958	1913	1974	1845
Reference Points based on estimated MSY values from SRR					
Smsr, Spawning Output at MSY	billion eggs	undefined	undefined	undefined	4549
Smsr/Sunfished					36%
R at Smsr	thousands				4138
SPRmsy					1.0992
rel SPRmsy					44%
Exploitation rate at SPRmsy					0.0768
Bsummary at Smsy	mtons				29671
MSY	mtons	undefined	undefined	undefined	2279

Forecasts: The first year of projection was 2006, so that the recruitment of age 1 fish in 2007 and later was obtained by random resampling of R/S value from the spawning years of 1969 through 2003 (Figure ES7, Table ES8). Catches were fixed at the observed 67 mtons in 2006, and at a projected 151 mtons in both 2007 and 2008. Beginning in 2009, the projections use a constant fishing rate corresponding to an SPR of 77.7% (2009 rebuilding OY would be 288 mtons), without reversion to the 40-10 harvest policy upon reaching the rebuilding target of B40. Based on 2000 simulations, approximately half of the projections reach the rebuilding target by 2023, and 67% of the simulations were rebuilt by the current statutory rebuilding target date of 2026. If the probability of attaining the rebuilding target by 2026 is reduced to 50%, the SPR could be decreased to 66.4%, allowing larger catches (in which case, 2009 rebuilding OY would be 468 mtons).

Decision tables: No decision table was developed.

Table ES5. History of bocaccio biomass and spawning output.

	Total biomass (age 1+)				Spawning output (billion eggs)							
	STARb1	STARb2	STATc	STATcMPDh	STARb1		STARb2		STATc		STATcMPDh	
	mtons	mtons	mtons	mtons	sp out	rel depl	sp out	rel depl	sp out	rel depl	sp out	rel depl
avg unexpl	71104	68894	71195	70069	13563	100%	13132	100%	13572	100%	13368	100%
1950	23644	39688	22625	23029	3764	28%	6871	52%	3580	26%	3650	27%
1960	16575	33291	16405	16320	2546	19%	5666	43%	2359	17%	2429	18%
1970	44285	32447	43288	42458	8306	61%	5099	39%	7910	58%	7450	56%
1975	30504	28662	30969	30069	4980	37%	4115	31%	5034	37%	4829	36%
1980	29064	29148	29561	28792	3467	26%	3406	26%	3600	27%	3426	26%
1985	13229	13434	13504	13091	2160	16%	2239	17%	2256	17%	2136	16%
1990	8994	8876	9039	8880	1140	8%	1170	9%	1179	9%	1117	8%
1995	5510	4842	5348	5474	820	6%	757	6%	820	6%	812	6%
1996	5257	4466	5037	5223	819	6%	730	6%	808	6%	812	6%
1997	5222	4297	4944	5198	826	6%	712	5%	804	6%	820	6%
1998	5136	4091	4796	5117	835	6%	697	5%	802	6%	830	6%
1999	5276	4126	4888	5274	881	6%	718	5%	836	6%	877	7%
2000	6562	4918	5882	6511	928	7%	739	6%	871	6%	925	7%
2001	7412	5416	6522	7374	970	7%	757	6%	901	7%	970	7%
2002	8611	6137	7422	8559	1050	8%	797	6%	958	7%	1050	8%
2003	9712	6788	8213	9634	1277	9%	938	7%	1134	8%	1274	10%
2004	11341	7720	9283	11047	1599	12%	1145	9%	1386	10%	1592	12%
2005	12805	8563	10024	12275	1863	14%	1309	10%	1585	12%	1852	14%
2006	14559	9582	10752	13661	2075	15%	1430	11%	1727	13%	2049	15%

Table ES6. Recent trends in recruitment (thousands) and exploitation rate.

	Recruitment at age 1				Exploitation rate (C/B1+)			
Year	STARb1	STARb2	STATc	STATcMPDh	STARb1	STARb2	STATc	STATcMPDh
1995	879	690	796	867	14.0%	16.0%	14.5%	14.1%
1996	509	369	435	497	10.8%	12.7%	11.2%	10.8%
1997	1061	843	1006	1109	9.2%	11.1%	9.7%	9.2%
1998	334	205	245	317	4.0%	5.0%	4.3%	4.0%
1999	384	297	368	432	3.7%	4.8%	4.0%	3.7%
2000	7385	4977	5944	7043	2.9%	3.8%	3.2%	2.9%
2001	56	50	50	249	2.8%	3.8%	3.2%	2.8%
2002	625	442	481	607	1.5%	2.2%	1.8%	1.5%
2003	861	469	489	710	0.1%	0.2%	0.2%	0.1%
2004	4602	2433	2732	3480	0.7%	1.1%	0.9%	0.7%
2005	2651	1907	917	2279	0.7%	1.0%	0.9%	0.7%
2006	3080	2176	1049	2524	0.5%	0.7%	0.6%	0.5%

* Recruitment values for 2005 and 2006 are expected values from SRR, not estimated.

Table ES7. Recent history of management performance.

	Commercial			Recreational			Total			ABC	OY
Year	Catch	Discard	Total	Catch	Discard	Total	Catch	Discard	Total		
1997	323	*	323	145	11	156	468	11	479	265	265
1998	154	*	154	52	0	52	206	0	206	230	230
1999	73	*	73	120	4	124	193	4	197	230	230
2000	28	49	77	103	9	112	128	58	189	164	100
2001	22	76	98	103	6	109	125	82	207	122	100
2002	21	27	48	82	2	84	103	32	132	122	100
2003	1	2	3	9	2	11	10	12	14	244	<20
2004	12	8	20	55	8	62	66	18	82	400	199
2005	8	41	49	34	4	38	42	45	87	566	307
2006	5	20	25	37	5	42	42	25	67	549	306
2007			53**			98**			151**	602	218
2008										618	218

* Discarded commercial catch was not estimated and is assumed to be negligible.
** Projected as of August, 2007 (John. DeVore, pers. comm.)

Research and data needs: The recommendations presented here are from the STAT Team; STAR Panel reports also contain recommendations on this subject. Future bocaccio assessments should utilize the Stock Synthesis 2 model, and time-varying growth rates should be explored. Although a two-area model (north and south of Pt. Conception) is worth exploring to distinguish the state of the resource in those two areas, migration patterns and rates are not known well enough to project rebuilding trajectories separately for the two areas. The southern California segment may prove to be less depleted, but may be a vitally important source of migrants to central California waters. Continuation of the CalCOFI larval survey, including central California stations, is critical to future bocaccio assessments. Tracking intra-annual patterns of gonadal states could improve its interpretation and eventually lead to calibrated estimates of true abundance. The STAT recommends against pursuing trawl-based abundance estimates, due to poor ability to sample rocky habitats preferred by bocaccio. An acoustic-optical survey system being developed at the SWFSC in La Jolla may be suitable for estimating bocaccio abundance.

Table ES8. Median projected abundances of bocaccio, at F(SPR=77.7%) beginning in 2009, without reversion to 40-10 policy. Estimates are based on model STATc and future projections do not include imprecision in estimated 2006 status. Bold values indicate rebuilt status. Catch is observed value in 2006, and is assumed in 2007-08.

Year	SPR	Catch	ABC	Depletion			Spawning Output		
	projected	median	median	5%	median	95%	5%	median	95%
2006	0.939	67	677	12.7%	12.7%	12.7%	1727	1727	1727
2007	0.871	151	693	13.8%	13.8%	13.8%	1872	1872	1873
2008	0.823	218	704	14.9%	14.9%	14.9%	2015	2016	2024
2009	0.777	288	718	15.6%	15.7%	16.4%	2117	2128	2221
2010	0.777	302	753	15.9%	16.3%	18.9%	2156	2209	2564
2011	0.777	323	806	15.9%	17.0%	22.1%	2154	2298	2994
2012	0.777	354	882	15.8%	17.8%	25.7%	2137	2419	3480
2013	0.777	387	964	15.6%	18.9%	28.8%	2115	2561	3900
2014	0.777	426	1062	15.6%	20.2%	32.5%	2109	2744	4404
2015	0.777	467	1165	15.6%	21.8%	35.8%	2113	2960	4856
2016	0.777	507	1263	15.7%	23.7%	**40.2%**	2130	3212	**5452**
2017	0.777	546	1361	16.1%	25.9%	**44.5%**	2183	3505	**6036**
2018	0.777	586	1460	16.4%	27.9%	**49.2%**	2226	3782	**6665**
2019	0.777	622	1550	16.9%	30.1%	**54.0%**	2291	4079	**7320**
2020	0.777	661	1649	17.4%	32.4%	**59.7%**	2365	4396	**8092**
2021	0.777	723	1804	18.1%	34.5%	**66.6%**	2454	4680	**9033**
2022	0.777	772	1926	18.7%	37.1%	**74.4%**	2532	5025	**10084**
2023	0.777	826	2060	19.3%	39.9%	**83.3%**	2622	5408	**11295**
2024	0.777	890	2220	20.2%	**43.0%**	**91.2%**	2743	**5829**	**12367**
2025	0.777	936	2334	20.9%	**46.4%**	**101.2%**	2839	**6285**	**13721**
2026	0.777	1018	2538	21.9%	**49.4%**	**110.4%**	2962	**6699**	**14961**

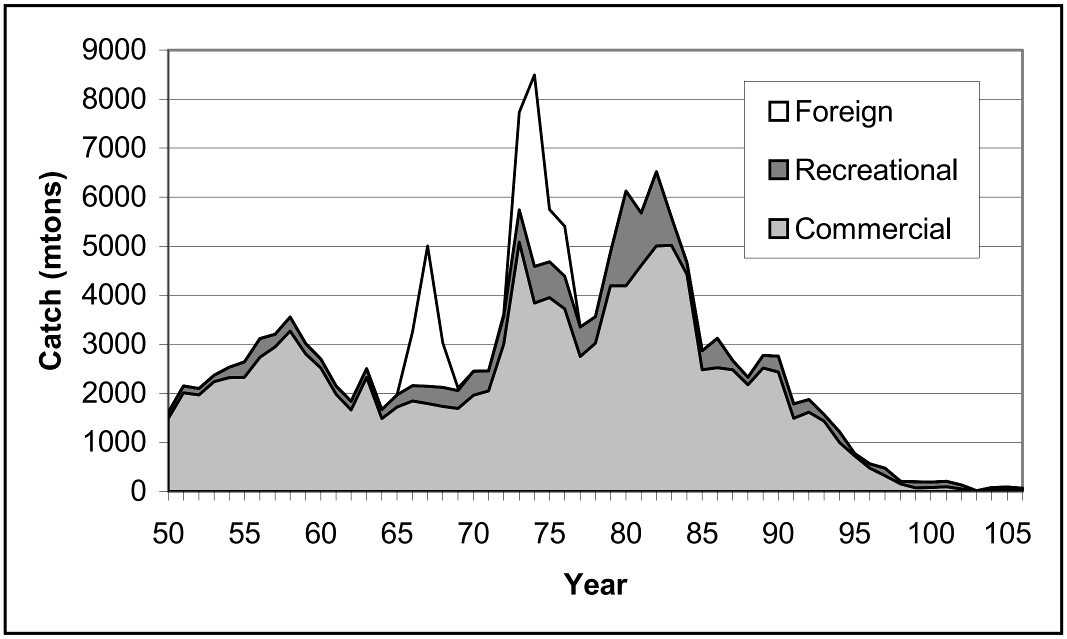

Figure ES1. History of bocaccio catches, showing foreign, recreational and commercial components. A catch of 2000 mtons is assumed prior to 1950.

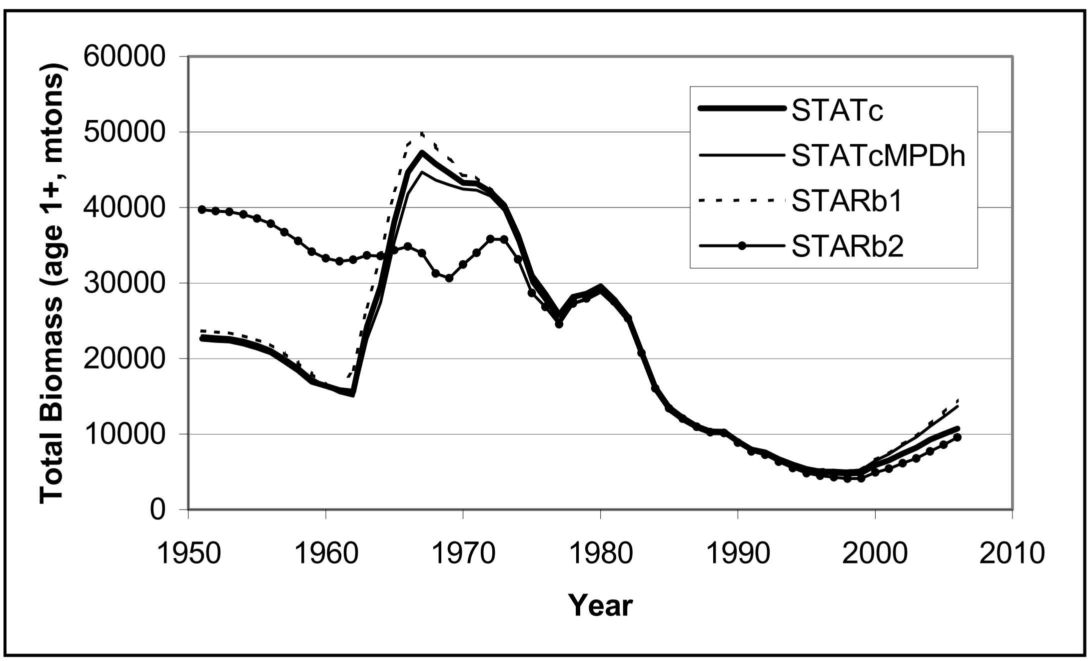

Figure ES2. History of total biomass (age 1+) of bocaccio estimated by four alternative models.

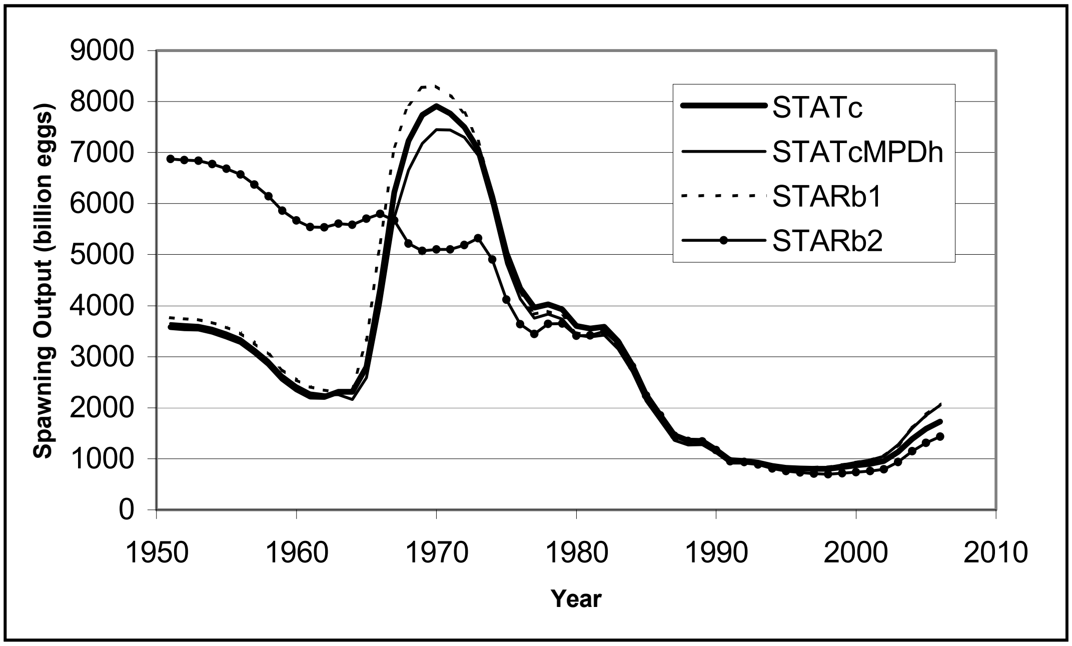

Figure ES3. History of spawning output of bocaccio estimated by four alternative models.

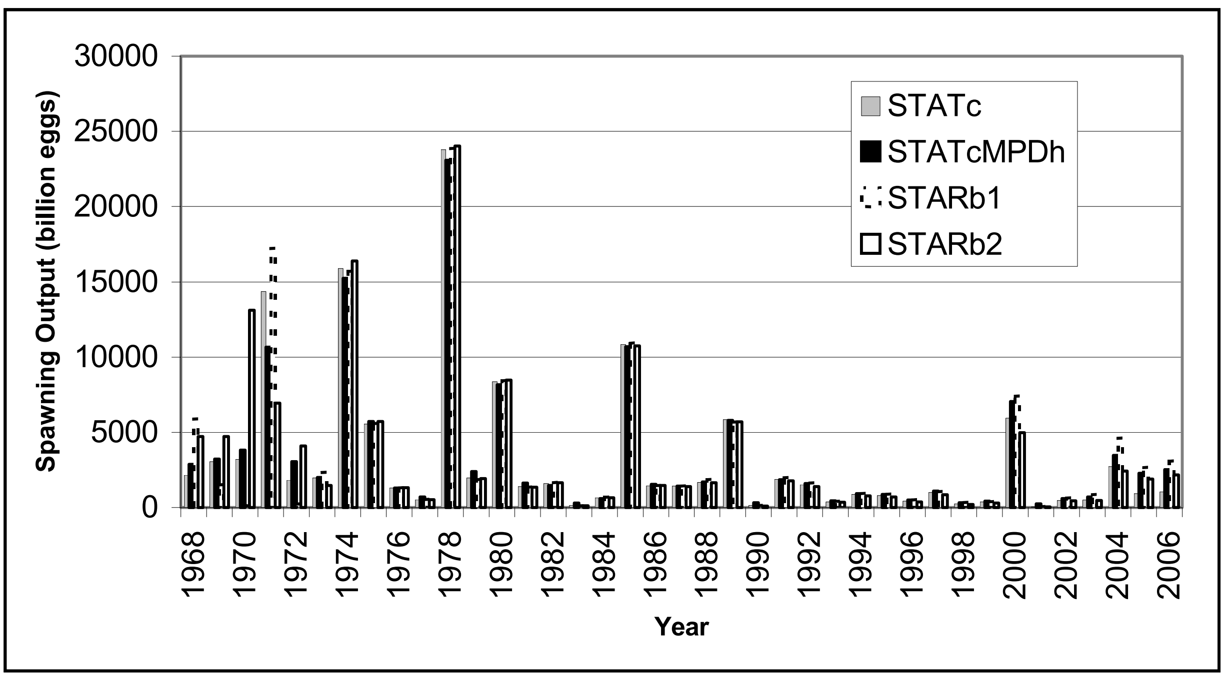

Figure ES4. Trends in bocaccio recruitment (thousand fish at age 1) estimated by four alternative models. Indicated year is age 1, spawning occurred in previous year.

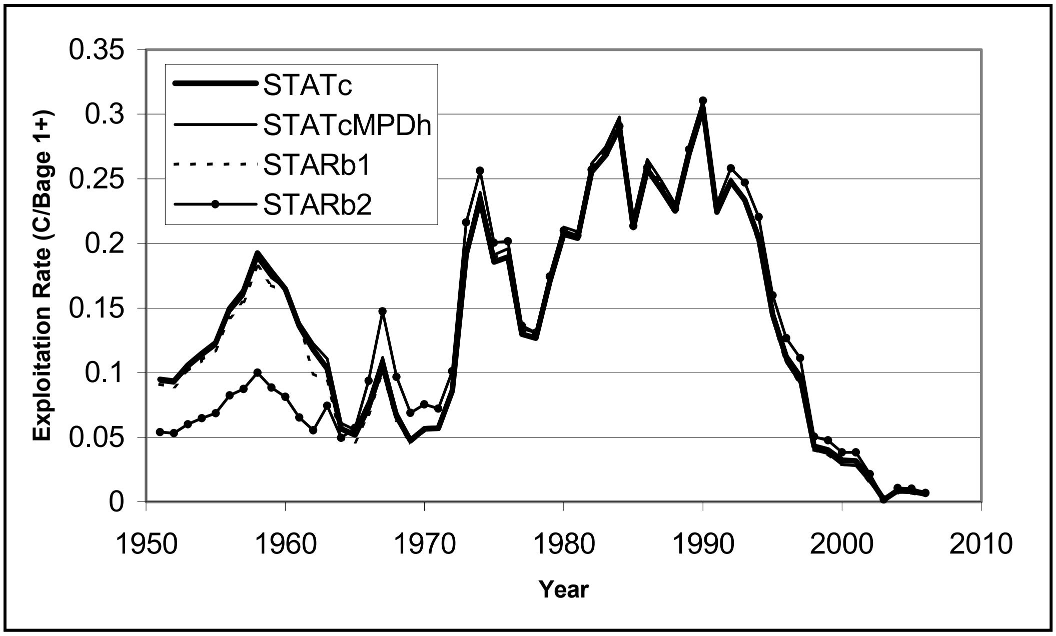

Figure ES5. Trends in bocaccio exploitation rate indicated by four alternative models.

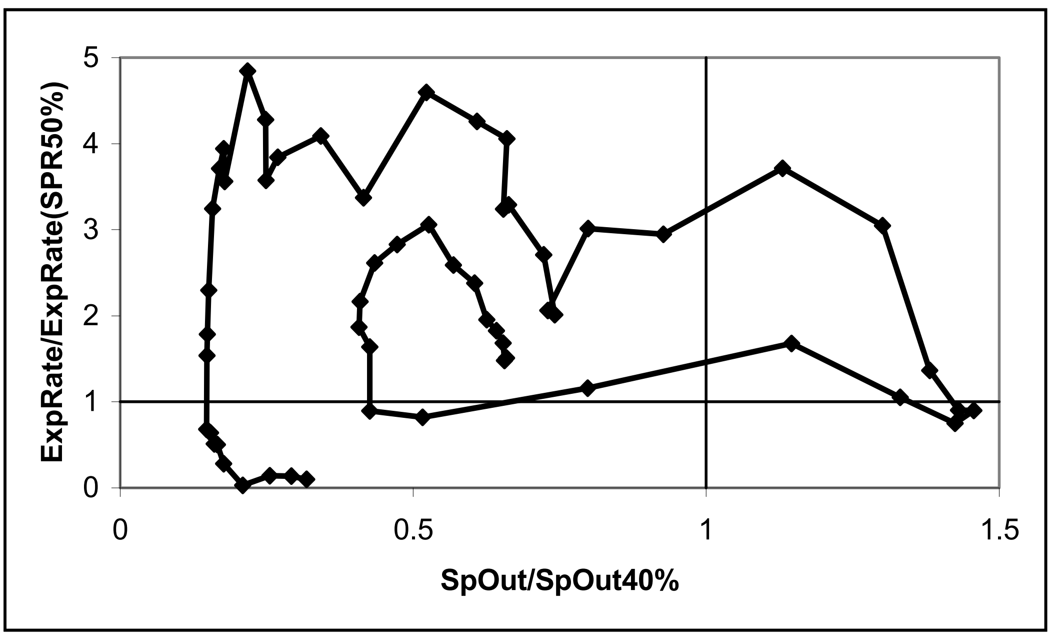

Figure ES6. Historical exploitation rates and spawning outputs relative to target values. Plot begins in 1951 (near center) and ends in 2006 (lower left). Model is STATc.

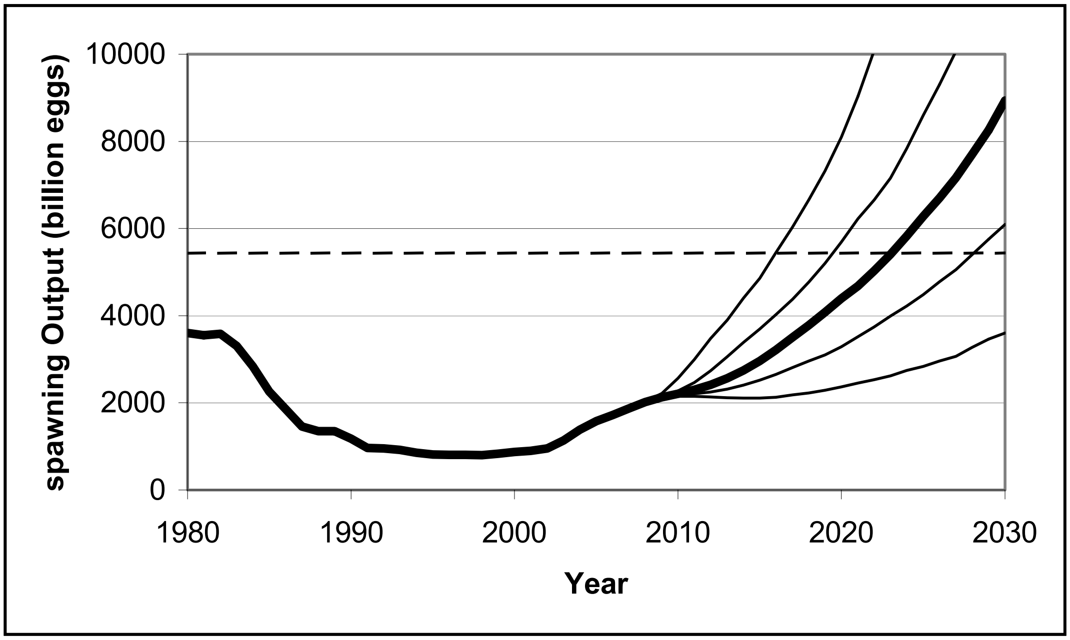

Figure ES7. Projected spawning output under a constant SPR=77.7% rebuilding policy. Trajectories are 5, 25, 50 (median, bold line), 75 and 95 percentiles; broken line is B40 rebuilding target.

Status of bocaccio off California in 2007

Introduction

A full stock assessment of bocaccio off California was last conducted in 2003 (MacCall 2003a), and an update assessment was conducted in 2005 (MacCall 2005a). Although initial plans were to convert the model to SS2 and do an extensive bocaccio assessment in 2007, a variety of uncertainties resulted in a revision of the work plan. Rather than cancelling the assessment altogether, an assessment equivalent to an update in scope was proposed for 2007 (email MacCall to Clarke, 10/18/06). However, the STAR Panel review schedule was not modified.

This assessment is equivalent to an "update" assessment, but the STAR Panel review allows additional leeway to consider alternative models. According to the TOR for stock assessment updates, an update stock assessment must carry forward its fundamental structure from a model that was previously reviewed and endorsed by a STAR Panel. Accordingly, this assessment adheres to the model frameworks established in 2003, and is similar to the update developed in 2005 (MacCall 2005a). With regard to the specific requirements for an update assessment, there must be similarity in:

- a) the particular sources of data used,
- b) the analytical methods used to summarize data prior to input to the model,
- c) the software used in programming the assessment,
- d) the assumptions and structure of the population dynamics model underlying the stock assessment,
- e) the statistical framework for fitting the model to the data and determining goodness of fit,
- f) the procedure for weighting the various data components, and
- g) the analytical treatment of model outoputs in determining management reference points, including Fmsy, Bmsy, and B0.

The present assessment satisfies all of these requirements.

For clarity of presentation, this document treats current results relative to the original 2003 assessment, without attempting to reconcile very minor changes from the 2005 update, most of which were due to use of incomplete data from 2004 and 2005 in the latter assessment. Specifications of the three models developed in the 2003 assessment are summarized in Table 1. The STARb1 and STARb2 models omit portions of the data. The STATc model includes all of the data sources and is the accepted basis of management decisions. One additional model described later in this document is a variant of the STATc model where the stock-recruitment curve has increased influence on the model.

Fishery data

Catches

Revision of commercial catches: The time series of commercial catches was revised, due to recovery of misplaced data from landings sampling during the late-1970's to early 1990's. The new (2007) catch values are compared with the previous (2003) catch values in Figure 1. Annual values of catches by individual fishery segments are given in the Stock Synthesis data file (Appendix B).

Historical catches by major fishery segments are shown in Figure 2, and detail of landings and discard in recent years are given in Table 2. Five distinct fishery segments are recognized in this assessment: commercial trawl, hook and line and set net gears, and recreational fisheries north and south of Pt. Conception. Recent estimates of recreational catch and discards (Table 2) were obtained from the RecFIN database. Commercial catches were obtained from the CALCOM database (Don Pearson, SWFSC, pers. comm.), and estimated rates of bycatch/discard from the trawl fishery were provided by Jim Hastie (NWFSC, pers. comm.). Because gears other than trawl were not observed sufficiently, the trawl discard rate was applied to all commercial gears. The estimated three-year 2000-2002 cumulative catch and discard (528 mtons) is slightly lower than in the 2003 assessment (575 mtons). Annual catch rates declined in the subsequent 2003-2006 period due to severe restrictions imposed by management.

Length Compositions

Recreational fisheries: Length compositions of retained bocaccio are available from the southern California recreational fishery in 2003-2006 (Figure 3), and in the central California recreational fishery in 2004-2006 (Figure 4). Sample sizes are given in Table 3. In central California, the strong 1999 year class remains dominant through 2006. In southern California, the 1999 year class declines in importance after2004, and the 2003 year class dominates the size composition in 2005-2006.

Commercial fisheries: The severe decline in commercial landings of bocaccio has resulted in few length composition samples of commercially-caught bocaccio (Figure 5, Table 3). Useful data exist only from the trawl fishery in 2004 and the hook and line fishery in 2006. Samples exist for the set net fishery in 2004 and hook and line fishery in 2005 but too small to be used.

Fishery-Dependent Abundance Indexes

No attempt was made to update the recreational fishery CPUE abundance indexes because of difficulty interpreting catch rates under the strong restrictions that were placed on landing bocaccio.

Fishery-Independent Data: Surveys and Indexes

Triennial Survey

The information from the Triennial Survey is unchanged from the 2005 update, but is included here for completeness. A Triennial Trawl Survey was conducted in 2004 (data provided by Mark Wilkins, AFSC, and Beth Horness, NWFSC, pers. comm.). The length composition of bocaccio taken in that survey is show in Figure 5. As was done previously, I used a simple log-transformed GLM to produce year-specific indexes of abundance. This approach allows a consistent interpretation of the survey results even though the Conception area was not sampled in 1980, 1983 and 1986. The GLM predicts stratum means with fixed area, depth and year effects (Figure 6), and a minor error for year 1980 was corrected as in the 2005 update. The new index values are consistent with those used in the 2003 assessment.

CalCOFI Survey

The 2003 assessment included the January 2003 CalCOFI ichthyoplankton survey, but did not include the April 2003 survey. This assessment includes both CalCOFI surveys through April 2006 (Richard Charter, SWFSC, pers. comm.). Annual sample sizes for the southern and central California portions of the survey are given in Table 2. As before, a delta-lognormal GLM with fixed year, month and station effects was use to produce annual index values (Figure 7). Consistency between values in the 2003 assessment and this assessment is shown in Figure 8. The index value for 2003 decreased slightly when the April survey data for that year were included.

Recruitment Indexes

In its review of the 2003 assessment, the STAR Panel recommended excluding use of recruitment indexes. Those indexes are not used in this assessment, and updated values were not calculated.

Assessment Model

The assessment was conducted using the "Stock Synthesis 1" length-based maximum likelihood model (synl32r.exe, compiled 4/2/2003), and is directly comparable to the 2003 assessment. As in the 2003 assessment, natural mortality rate is set at M=0.15. All three of the models developed in the 2003 assessment (STARB1, STARB2 and STATC; see Table 1 for model details) are updated here.

This assessment includes consideration of one additional model, based on an assumed value of Mace-Doonan steepness (h) in a Beverton-Holt stock-recruitment relationship (SRR). Martin Dorn (ms in prep) recently conducted a Bayesian meta-analysis of Beverton-Holt SRRs for a number of west coast rockfish stocks. The bocaccio information in that analysis was based on the STATc model used for the 2005 update. Dorn provided a maximum posterior density (mpd) estimated of h = 0.44 for bocaccio (Dorn email 6/4/07). That value of steepness is used here in model STATcMPDh. The only differences from the STATc model are the assumed value of h = 0.44 and an increase in emphasis (lambda) on the stock-recruitment residuals to 1.

Model Results

Model results, including a retrospective view of results for 2003 from the new model, are compared in Table 4, and more details are given in Tables 5 and 6. Abundance trajectories, recruitments and exploitation rates are shown in Figures 9-13. Fits to abundance time series are shown in Figure 14 and fits to recent length compositions are shown in Figure 15. All four models are in general agreement for the most recent 30 years (models STARb1 and STARb2 differ in specification of early recruitments).

Reference points: Values in this discussion are from the STATc model; values for all four models are given in Tables 4 and 5. Population reproductive potential is measured as spawning output (units of billion eggs). Except for model STATcMPDh with its explicit stock-recruitment relationship (SRR), unfished abundance cannot be estimated reliably from historical stock and recruitment due to lack of curvature in the estimated relationship. An imprecise estimate of unfished spawning output was obtained by multiplying the average age-1 recruitment (1951 to 1986) by unfished SPR, giving 13572 billion eggs. The SRR from model STATcMPDh is used to estimate the values of reference points for that model (Table 5). Estimated values of reference points vary little among alternative models.

The 50%SPR exploitation rate (Catch/Biomass age 1+) is 0.0630, which is used as a proxy Fmsy rate by the PFMC. Proxy Bmsy (40% of Bunfished) corresponds to an approximate equilibrium total biomass of 31341mtons, and if this is fished at proxy Fmsy, the MSY is estimated to be 1974mtons. Although calculations related to MSY are imprecise, estimates vary relatively little among alternative models and methods of calculation. The overfishing threshold is Fmsy, in this case the proxy value of F(SPR50%), and corresponding catch levels are the ABC values given in the rebuilding projections.

Stock biomass: The estimated history of the biomass (age 1+) and spawning output (billion eggs) estimated by the four alternative models are shown in Figures 9 and 10 and recent values are given in Table 6. Notably the three models (STARb1, STATc and STATcMPDh) that are allowed to estimate early biomass indicate that biomass was near the minimum stock size threshold at the beginning of the assessment period, ca. 1950. This is not surprising, given that the assumed pre-1950 “background” catch was 2000mtons, which slightly exceeds estimated MSY. CalCOFI larval abundances indicate a relatively low biomass in the 1950s, and a substantial increase in spawning abundance during the 1960s. Abundance has approximately doubled since rebuilding began in year 2000.

Recruitment: The estimated history of recruitment (omitting earlier years with little data to inform estimates) is shown in Figure 11 and values are given in Table 6. The strong 1999 year class was followed by a moderately strong 2003 year class. Strength of the 2004 and 2005 year classes is not estimated from data, but rather is taken from the stock-recruitment relationship. The recruitment values for these years are not substantiated by other sources of information, and these values may be overly optimistic.

Exploitation status: The history of exploitation rates is shown in Figure 12 and 13, and values are given in Table 6. From the STATc model, the estimated spawning output in 2006 is 1727 billion eggs, or 12.7% of the estimated unfished level. The estimated 2006 total biomass (age 1+) is 10752mtons. The 2006 exploitation rate of 0.0062 was far below the reference exploitation rate of 0.0630 that is the maximum fishing mortality threshold under the SPR50% proxy (see Figure 13). At the Fmsy proxy, the STATc model gives a 2006 catch (ABC) of 677mtons (this is also the overfishing threshold) and a "40-10" policy OY of 193mtons.

Retrospective patterns: Retrospective patterns given in Table 4 indicate that 2003 estimates from model STARb2 are nearly unchanged in the 2007 assessment (estimated 2003 spawning output increases by 2%). The 2007 STATc model results for 2003 provide upward revisions of 2003 abundance estimates, with an 11% increase in estimated 2003 spawning output. The 2007 STARb1 model indicates substantial upward revision of its 2003 estimates, with a 44% upward revision of estimated 2003 spawning output. For a more detailed year-by-year analysis of retrospective patterns, the reader is referred to the 2005 assessment document.

Rebuilding Projections

Projections used the SSC Default Rebuilding Analysis (Version 2.10b) programmed by Andre Punt (program available at http://www.fish.washington.edu/people/punt/software.html). The first year of projection was 2006, so that the recruitment of age 1 fish in 2007 and later was obtained by random resampling of R/S value from the spawning years of 1969 through 2003 (Figure 16, Table 7). Catches were fixed at the observed 67 mtons in 2006, and at a projected 151 mtons in both 2007 and 2008. Beginning in 2009, the projections use a constant fishing rate corresponding to an SPR of 77.7% (2009 rebuilding OY would be 288 mtons), without reversion to the 40-10 harvest policy upon reaching the rebuilding target of B40. Based on 2000 simulations, approximately half of the projections reach the rebuilding target by 2023, and 67% of the simulations were rebuilt by the current statutory rebuilding target date of 2026. If the probability of attaining the rebuilding target by 2026 is reduced to 50%, the SPR could be decreased to 66.4%, allowing larger catches (in which case, 2009 rebuilding OY would be 468 mtons).

Research and Data Needs

The recommendations presented here are from the STAT Team; STAR Panel reports also contain recommendations on this subject. Future bocaccio assessments should utilize the Stock Synthesis 2 model, and time-varying growth rates should be explored. Although a two-area model (north and south of Pt. Conception) is worth exploring to distinguish the state of the resource in those two areas, migration patterns and rates are not known well enough to project rebuilding trajectories separately for the two areas. The southern California segment may prove to be less depleted, but may be a vitally important source of migrants to central California waters. Continuation of the CalCOFI larval survey, including central California stations, is critical to future bocaccio assessments. Tracking intra-annual patterns of gonadal states could improve its interpretation and eventually lead to calibrated estimates of true abundance. The STAT recommends against pursuing trawl-based abundance estimates, due to poor ability to sample rocky habitats preferred by bocaccio. An acoustic-optical survey system being developed at the SWFSC in La Jolla may be suitable for estimating bocaccio abundance

Acknowledgements

I would like to thank people who provided updated data sets used in this assessment: Don Pearson, Richard Charter, Beth Horness, Mark Wilkins, and Jim Hastie. My thanks also extend to the much larger number of people who did the field work and data processing that underlie the summary information I received.

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Table 1. Summary of 2003 bocaccio models. Bold type indicates updated aspects of the models.

M = 0.15
Years: background, 1950 to **2002**
Recruitments (age 1):
STAR B1: expval 1951-59, individual 1960-**2001, expectval 2002, 2003**; SRR lambda=0
STAR B2: expval 1951-69, individual 1970-**2001, expectval 2002, 2003**; SRR lambda=0
STAT C: expval 1951-59, individual 1960-**2001, expectval 2002, 2003**: SRR lambda=0.1
Age bins: 1 to 21+
Length bins: 24, 26, …… 66, 68, 72,76, 80+
Growth: Von Bertalanffy fitted in model, separate male and female curves
Length CVs: 0.107 at age 1.5, 0.033 at age 99, interpolated on mean length at age

Modeled Segments:	Selectivity form	First LF	Last LF	Nyears	Sexes	Used?
Trawl	Dbl. Logistic	1978	**2002**	**25**	yes	all
Hook and Line	Dbl. Logistic	1980	**2002**	**22**	yes	all
Set Net	Dbl. Logistic	1978	**2002**	**18**	yes	all
Recreational South	Dbl. Logistic	1975	**2002**	**24**	no	all
Recreational North	Dbl. Logistic	1980	**2002**	**23**	no	all
Triennial Trawl Survey	Dbl. Logistic	1986	**2001**	**6**	yes	not in STAR B1

Abundance Indexes	Selectivity source	First	Last	Nyears	CV*	Used?
RecFIN CPUE North	Rec North	1980	2002	20	**0.67**	not in STAR B2
CDFG CPUE North	Rec North	1987	1998	12	**0.37**	all
RecFIN CPUE South	Rec South	1980	2002	20	**0.71**	not in STAR B2
Trawl CPUE (north)	Trawl	1982	1996	15	**0.32**	all
Triennial Trawl	Triennial	1977	**2001**	**9**	**0.81**	not in STAR B1
CalCOFI Larval	Spawn Ogive	1951	**2003**	**47**	**0.68**	all

Recruitment Indexes	Selectivity source	First	Last	Nyears	CV	Used?
Power Plant Ent'nment	age 1	1972	2000	29	2.10	no
Cen Cal Juvenile Trawl	age 1	1983	2002	20	2.05	no
Rec Pier CPUE	age 1	1980	2002	20	3.29	no

* Re-tuning of CVs is automatic based on RMSE of fit (log scale).

Table 2. Estimated recent fishery removals (mtons) of bocaccio. Parentheses indicate value used in 2003 assessment.

	TRAWL				H&L		SETNET		RecSouth	RecCen	Total
	Retained	Disc Rate*	Discard**	Est	Retained	Est	Retained	Est	A + B1	A + B1	Est
2000	20.1		34.0	54(54)	7.0	21(21)	0.7	2(2)	52	60	189(187)
2001	13.7		45.7	59(37)	7.8	35(23)	0.9	4(2)	60	49	207(187)
2002	18.2	56%		41(99)	3.0	7(17)	0.2	0(1)	76	8	132(201)
2003	0.2	79%		1	0.5	2	0.0	0	11	0	14
2004	6.2	42%		11	5.5	9	0.3	0.3	60	2	83
2005	3.9	83%		23	4.4	26	0.1	0.1	32	6	87
2006	0.9	83%		5	3.4	20	0.2	0.2	31	11	68

* Discard rate from J. Hastie (email 2007); **Discards from J. Hastie (email 2005); 2006 discard rate assumed same as 2005

Table 3. Sample size and model tuning information for updated information sources. Starred samples were small and not used.

Length Compositions	Year	Nobs	Neff	Units	Nsamples
Trawl	2004	110	78	Fish	9
Set Net	2004	17*	n.a.	Fish	2
Hook&Line	2005	11*	n.a.	Fish	2
	2006	78	13	Fish	10
So Calif Recreational	2003	122	84	Fish	
	2004	889	86	Fish	
	2005	571	85	Fish	
	2006	1330	88	Fish	
Cen Calif Recreational	2004	80	14	Fish	
	2005	73	13	Fish	
	2006	49	9	Fish	
Triennial Survey	2004	33	23	Hauls	
Abundance Index	**Year**	**Cen Calif**	**So Calif**	**Units**	
CalCOFI	2003	52	92	Stations	
	2004	49	88	Stations	
	2005	86	191	Stations	
	2006	40	148	Stations	

Table 4. Comparison of model results.

Model	Total Biomass mt, age 1+	Spawning Output	Spawn Output Unfished	Spawn Output rel to Unfished
STAR B1	(exclude Triennial Survey index)			
2003 original	8913	1136	13412	8.5%
2003 new	9712	1277		9.4%
2007 new	14559	2075	13563	15.3%
STAR B2	(exclude Recreational CPUE)			
2003 original	5455	733	13064	5.6%
2003 new	6783	938		7.1%
2007 new	9582	1430	13132	10.9%
STAT C	(use all abundance indexes)			
2003 original	7133	984	13387	7.4%
2003 new	8213	1134		8.4%
2007 new	10752	1727	13572	12.7%
STAT C MPDh	(use all abundance indexes)			
2003 original				
2003 new	9634	1274		9.5%
2007 new	13661	2049	13368	15.3%

Table 5. Management reference points for bocaccio.

	units	STARb1	STARb2	STATc	STATcMPDh
			Model		
Steepness(h)		ca. 0.2	ca. 0.2	ca. 0.2	0.44
Unfished Reference Points					
Reference source		Ravg51-86	Ravg51-86	Ravg51-86	SRR
Spawning Output	billion eggs	13563	13132	13572	12591
Summary (1+) Biomass	mtons	71104	68894	71195	66036
Mean Recruitment at age 1	thousands	5451	5270	5449	5039
SPR(F=0)		2.488	2.492	2.491	2.502
Current status (2006)					
Spawning Output	billion eggs	2075	1430	1727	2049
Spawning Output at SB40%	billion eggs	5425	5253	5429	5036
Relative depletion		15.3%	10.9%	12.7%	16.3%
Summary (1+) Biomass	mtons	14559	9582	10752	13661
2006 Catch (including discards)	mtons	67	67	67	67
Exploitation rate		0.0046	0.0070	0.0062	0.0049
Overfishing threshold (ExpRate at SPR50%)		0.0633	0.0631	0.0630	0.0633
ABC	mtons	922	605	677	865
OY (40-1010)	mtons	426	66	193	401
Reference Points based on SB40%					
Spawning Output at SB40%	billion eggs	5425	5253	5429	5036
Recruitment at SB40	thousands				4322
SPR resulting in SB40%					47%
Exploitation rate at SB40%					0.0707
Bsummary at R(SB40%)	mtons				29565
Yield with SPR(SB40%) at SB40%		undefined	undefined	undefined	2090
Reference Points based on SPR50%					
Spawning Output at SPR50%	billion eggs				5668
Recruitment at SB(SPR50%)	thousands				4531
SPRmsy proxy		50%	50%	50%	50%
Exploitation rate at SPR50%		0.0633	0.0631	0.0630	0.0633
Bsummary at R(SB(SPR50%))	mtons				32803
Yield with SPR50% at SB(SPR50%)		undefined	undefined	undefined	2076
Reference Points based on SPR50% proxy at SB40%					
Spawning Output at SB40	billion eggs	5425	5253	5429	5036
SPRmsy proxy		50%	50%	50%	50%
Exploitation rate at SPR50%		0.0633	0.0631	0.0630	0.0633
Approx Bsummary at SB40% given Exploitation rate at SPR50%	mtons	30928	30313	31341	29146
Yield with SPR50% at SB40%	mtons	1958	1913	1974	1845
Reference Points based on estimated MSY values from SRR					
Smsr, Spawning Output at MSY	billion eggs	undefined	undefined	undefined	4549
Smsr/Sunfished					36%
R at Smsr	thousands				4138
SPRmsy					1.0992
rel SPRmsy					44%
Exploitation rate at SPRmsy					0.0768
Bsummary at Smsy	mtons				29671
MSY	mtons	undefined	undefined	undefined	2279

Table 6. Results of model STATc for recent years. Approximate values at MSY assume F(SPR=0.5) at B=0.4Bunfished where Bunfished is estimated from the unfished biomass resulting from average recruitment from 1951 to 1986.

Year	Spawning Output	Relative Abundance	Total age1+ Biomass	Recruits at age 1	Catch	Exploitation Rate
avg value unfished	13572	100%	71230	5456	0	0
approx value at MSY	5429	40%	31340	2182	1974	6.30%
1995	820	6.0%	5348	796	774	14.5%
1996	808	6.0%	5037	435	566	11.2%
1997	804	5.9%	4944	1006	479	9.7%
1998	802	5.9%	4796	245	206	4.3%
1999	836	6.2%	4888	368	197	4.0%
2000	871	6.4%	5882	5944	189	3.2%
2001	901	6.6%	6522	50	207	3.2%
2002	958	7.1%	7422	481	132	1.8%
2003	1134	8.4%	8213	489	14	0.2%
2004	1386	10.2%	9283	2732	82	0.9%
2005	1585	11.7%	10024	917	87	0.9%
2006	1727	12.7%	10752	1049	67	0.6%

Table 7. Median projected abundances of bocaccio, at SPR of 77.7% beginning in 2009, without reversion to 40-10 policy upon attainment of rebuilding target. Estimates are based on model STATc and future projections do not include imprecision in estimated 2006 status. Bold values indicate rebuilt status. Catch is observed value in 2006, and is assumed in 2007-08.

Year	SPR	Catch	ABC	Depletion			Spawning Output		
	projected	median	median	5%	median	95%	5%	median	95%
2006	0.939	67	677	12.7%	12.7%	12.7%	1727	1727	1727
2007	0.871	151	693	13.8%	13.8%	13.8%	1872	1872	1873
2008	0.823	218	704	14.9%	14.9%	14.9%	2015	2016	2024
2009	0.777	288	718	15.6%	15.7%	16.4%	2117	2128	2221
2010	0.777	302	753	15.9%	16.3%	18.9%	2156	2209	2564
2011	0.777	323	806	15.9%	17.0%	22.1%	2154	2298	2994
2012	0.777	354	882	15.8%	17.8%	25.7%	2137	2419	3480
2013	0.777	387	964	15.6%	18.9%	28.8%	2115	2561	3900
2014	0.777	426	1062	15.6%	20.2%	32.5%	2109	2744	4404
2015	0.777	467	1165	15.6%	21.8%	35.8%	2113	2960	4856
2016	0.777	507	1263	15.7%	23.7%	**40.2%**	2130	3212	**5452**
2017	0.777	546	1361	16.1%	25.9%	**44.5%**	2183	3505	**6036**
2018	0.777	586	1460	16.4%	27.9%	**49.2%**	2226	3782	**6665**
2019	0.777	622	1550	16.9%	30.1%	**54.0%**	2291	4079	**7320**
2020	0.777	661	1649	17.4%	32.4%	**59.7%**	2365	4396	**8092**
2021	0.777	723	1804	18.1%	34.5%	**66.6%**	2454	4680	**9033**
2022	0.777	772	1926	18.7%	37.1%	**74.4%**	2532	5025	**10084**
2023	0.777	826	2060	19.3%	39.9%	**83.3%**	2622	5408	**11295**
2024	0.777	890	2220	20.2%	**43.0%**	**91.2%**	2743	**5829**	**12367**
2025	0.777	936	2334	20.9%	**46.4%**	**101.2%**	2839	**6285**	**13721**
2026	0.777	1018	2538	21.9%	**49.4%**	**110.4%**	2962	**6699**	**14961**

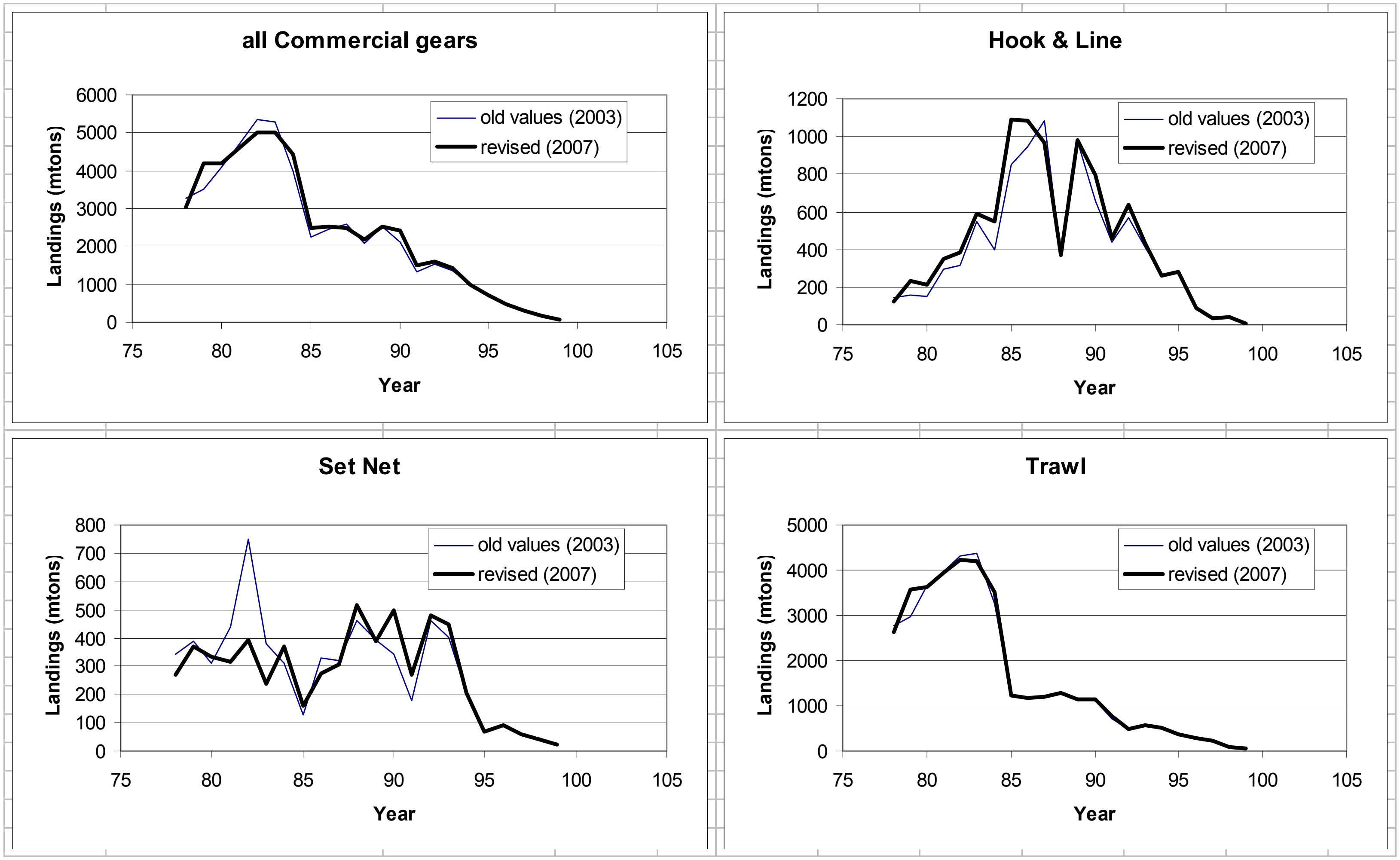


Figure 1. Comparison of revised commercial landings of bocaccio with values used in the 2003 assessment.

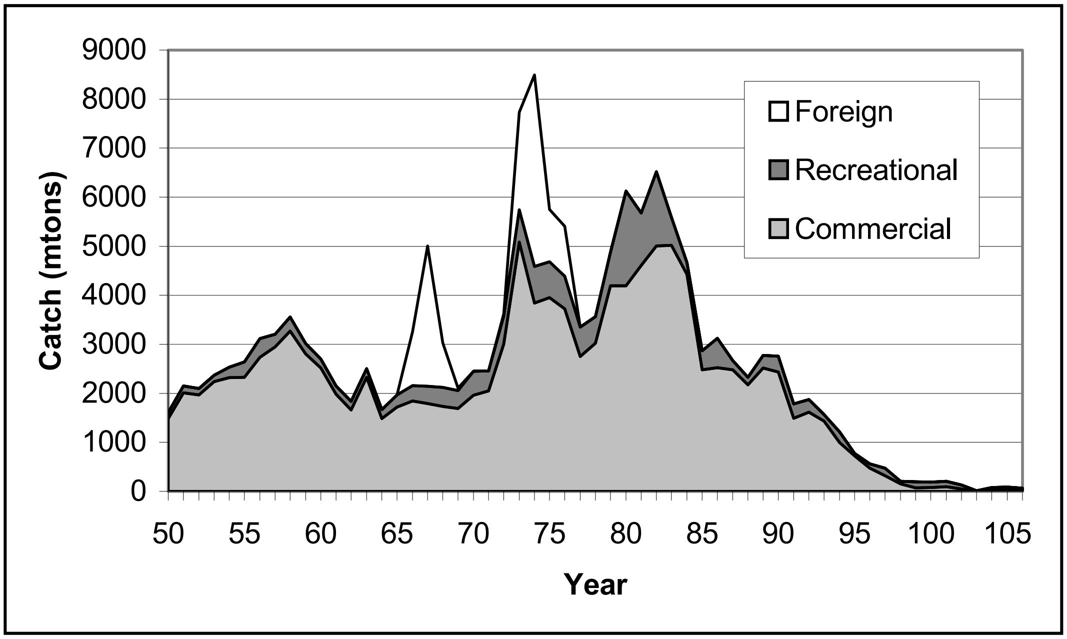


Figure 2. History of bocaccio catches, showing foreign, recreational and commercial components. A catch of 2000 mtons is assumed prior to 1950.

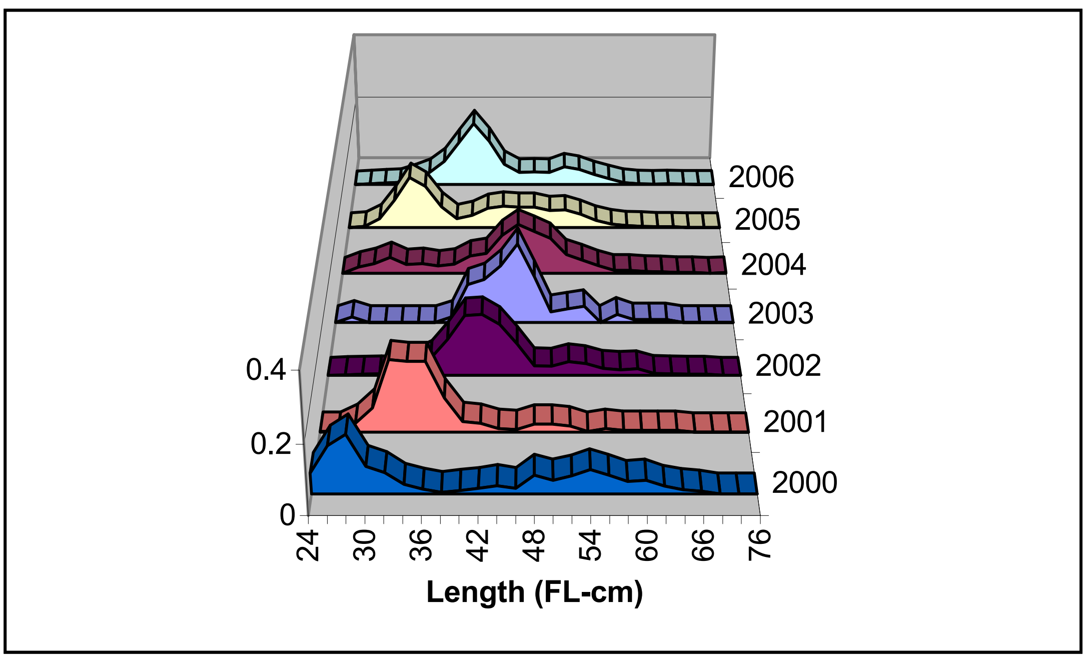


Figure 3. Length composition of bocaccio landed by the southern California recreational fishery.

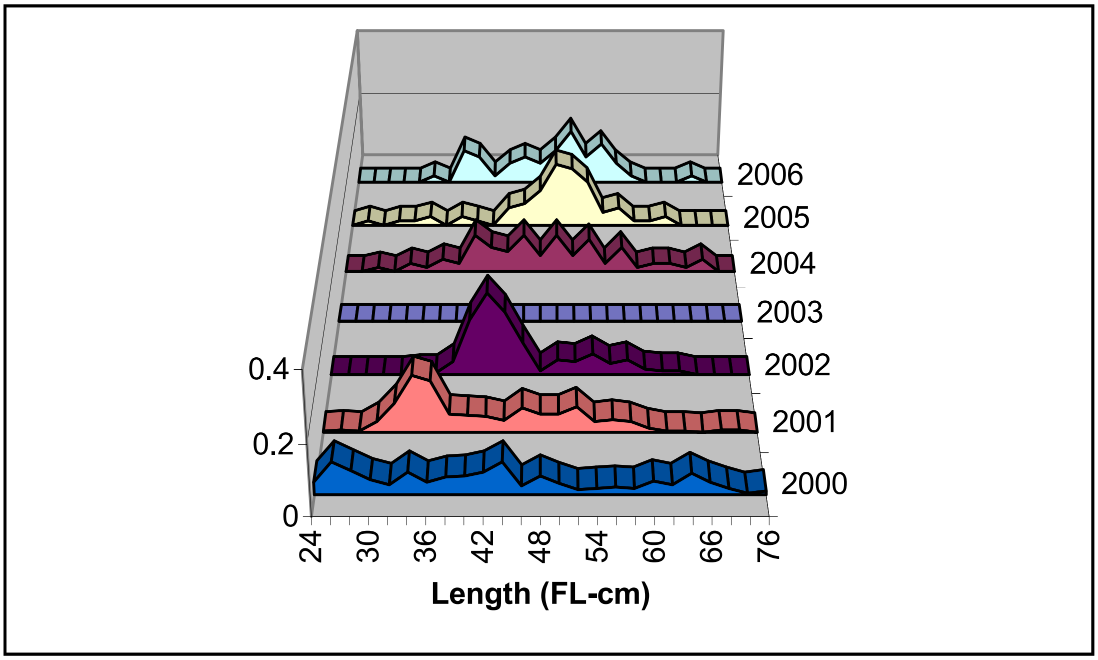


Figure 4. Length composition of bocaccio landed by the central California recreational fishery.

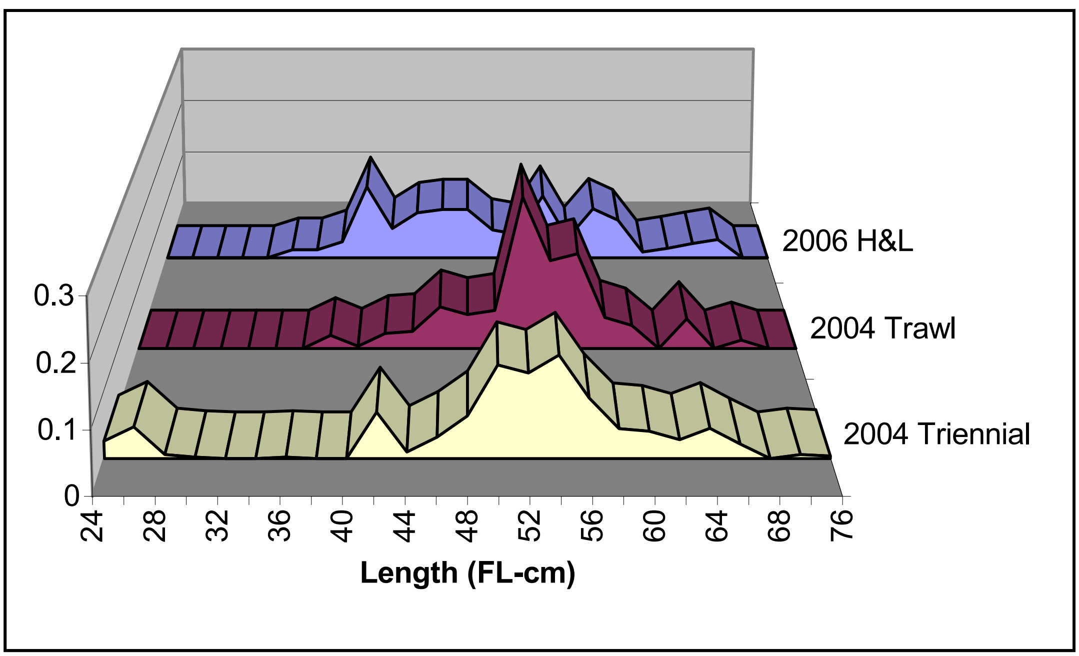


Figure 5. Other length compositions used in the 2007 bocaccio update.

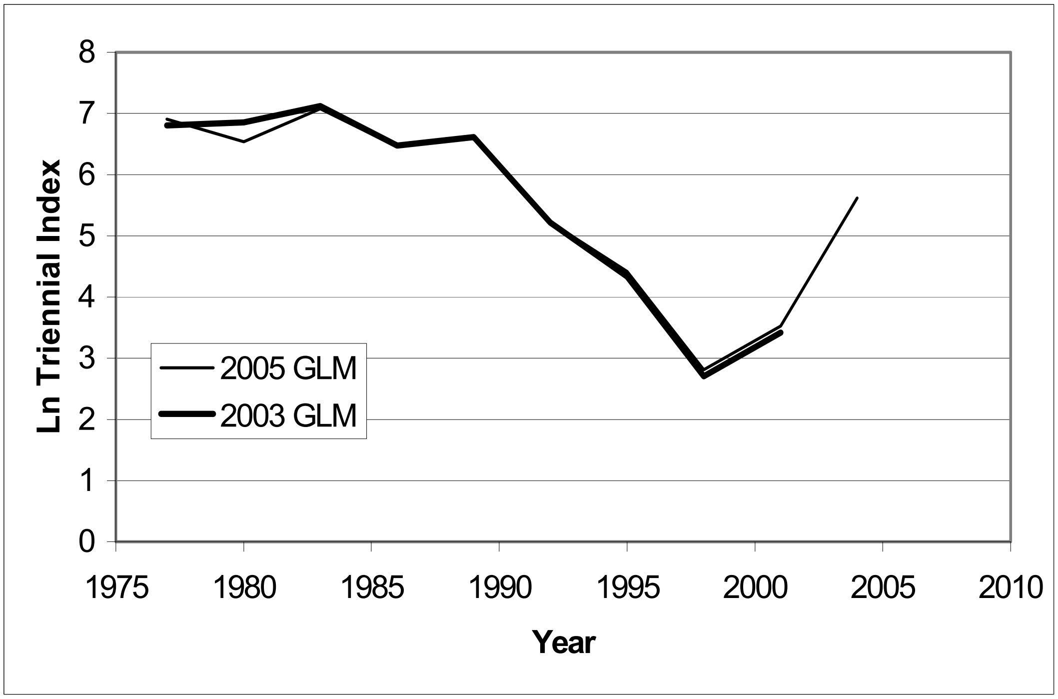


Figure 6. Triennial Trawl Survey index of bocaccio abundance (note log scale).

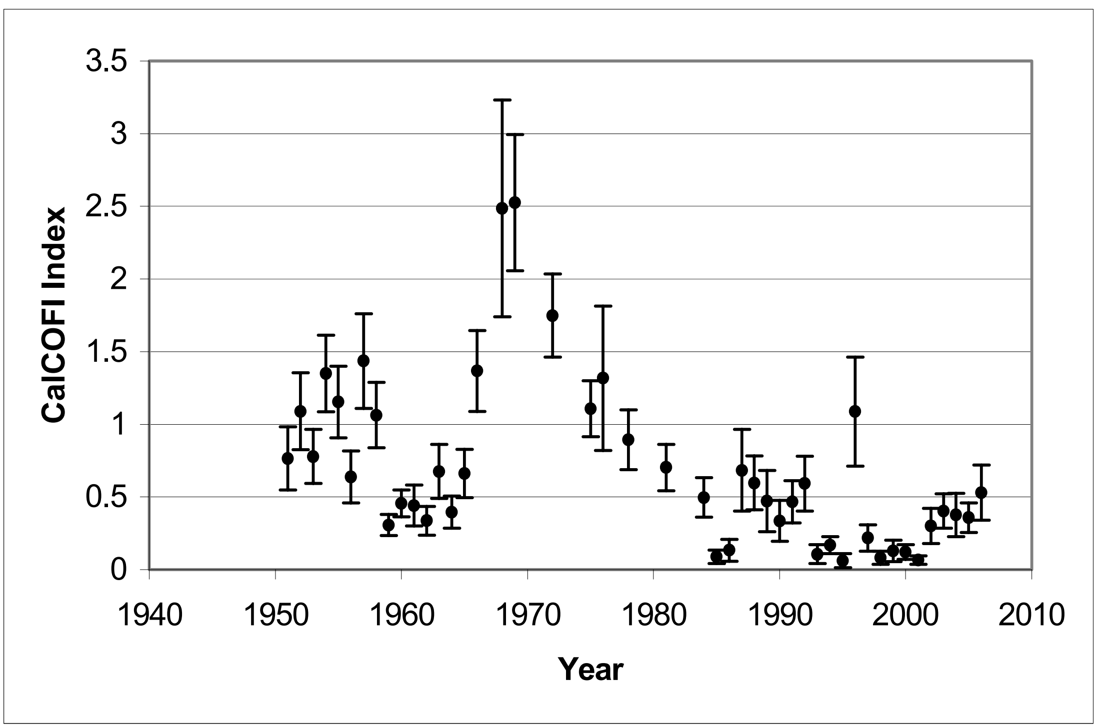


Figure 7. CalCOFI Survey index of bocaccio spawning output. Error bars are ± 1SE.

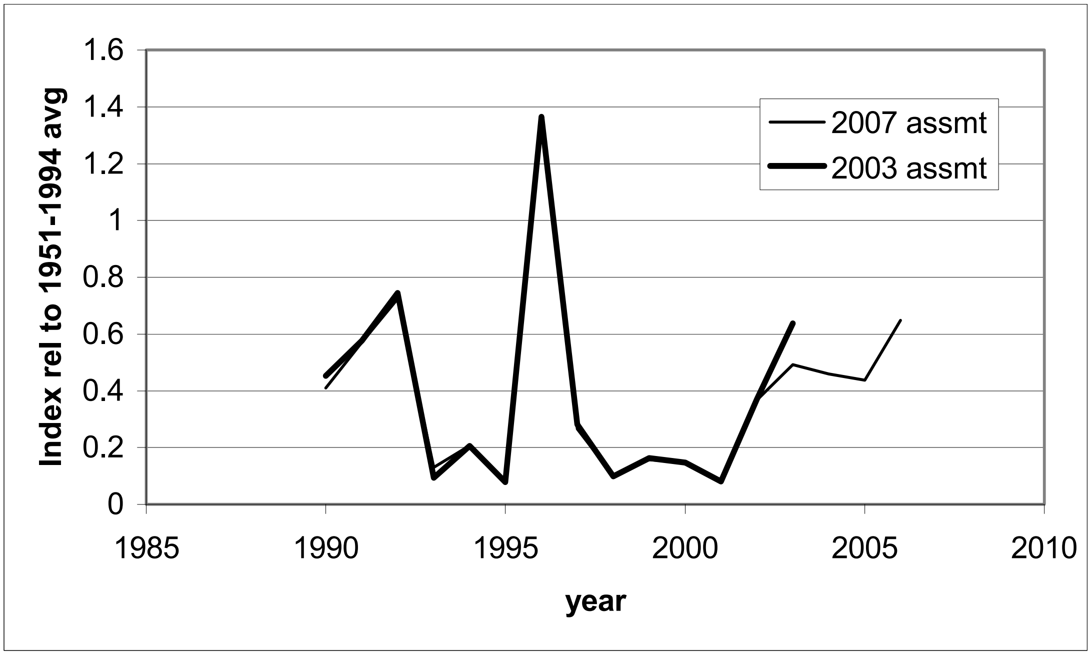


Figure 8. Comparison of updated recent CalCOFI Index values with values used in the 2003 bocaccio assessment (standardized for comparison). The 2003 point was based on incomplete data available in the 2003 assessment.

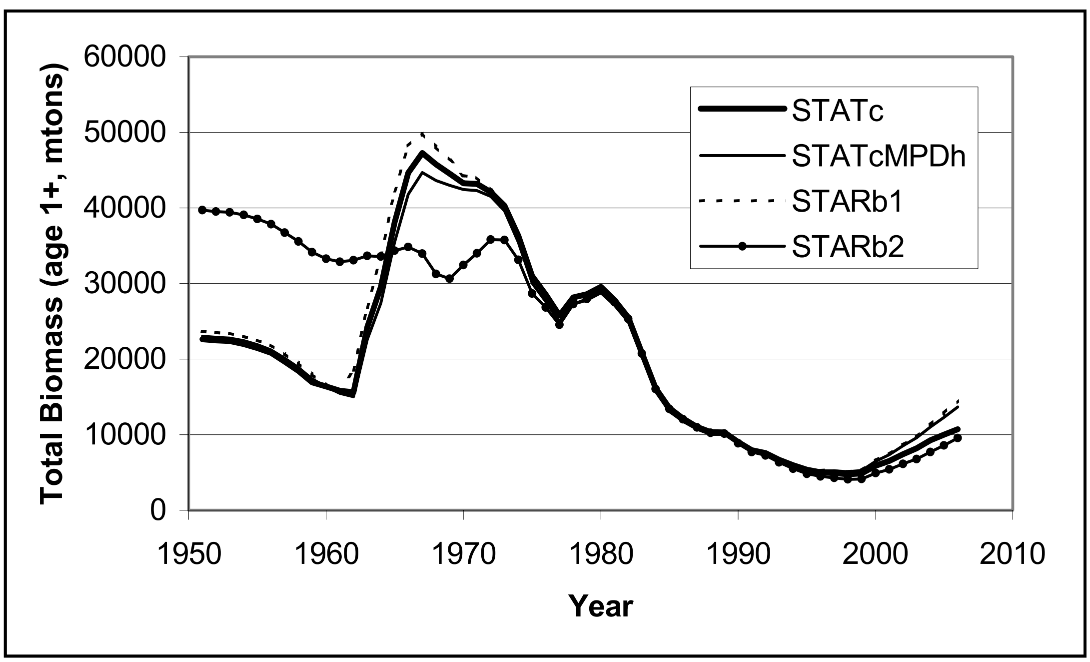


Figure 9. History of total biomass (age 1+) of bocaccio estimated by four alternative models.

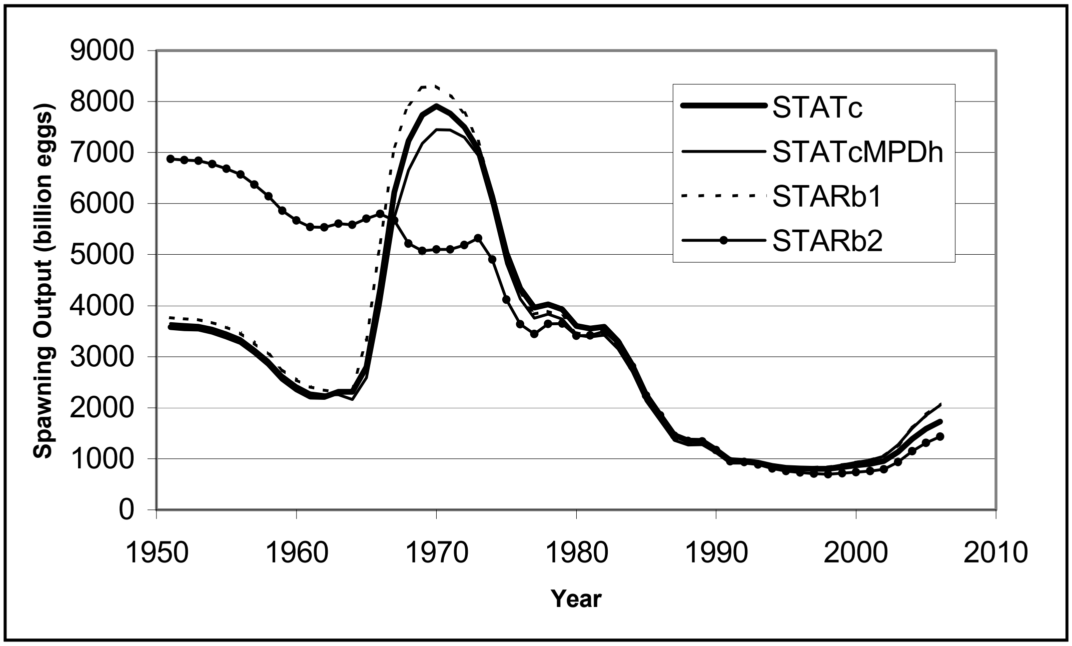


Figure 10. History of spawning output of bocaccio estimated by four alternative models.

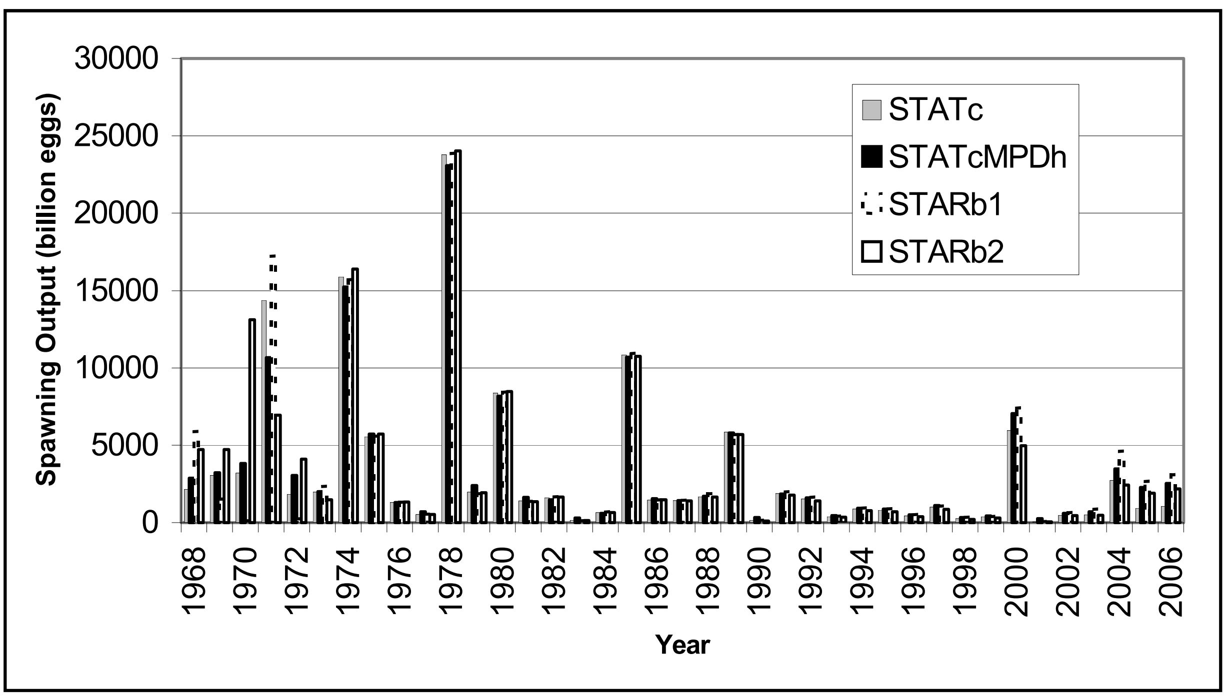


Figure 11. Trends in bocaccio recruitment (thousand fish at age 1) estimated by four alternative models. Indicated year is age 1, spawning occurred in previous year.

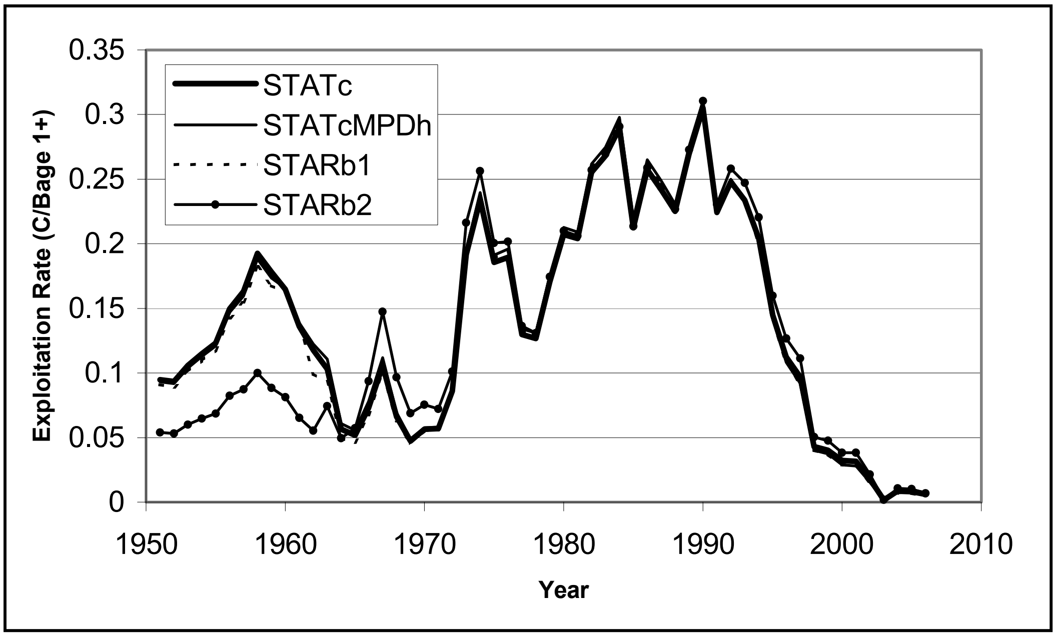


Figure 12. Trends in bocaccio exploitation rate indicated by four alternative models.

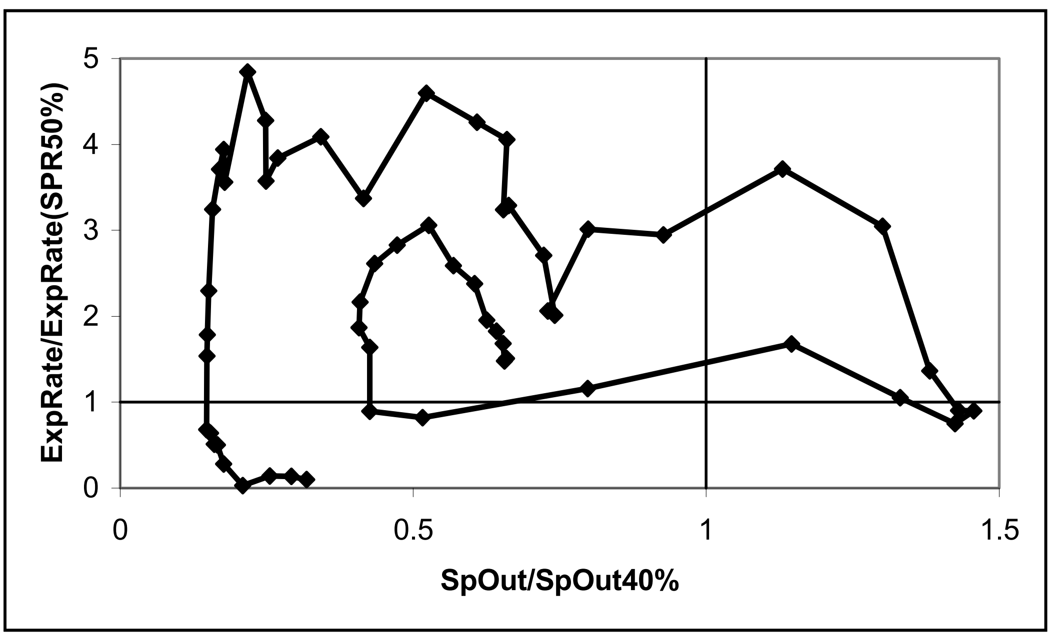


Figure 13. Historical exploitation rates and spawning outputs relative to target values. Plot begins in 1951 (near center) and ends in 2006 (lower left). Model is STATc.

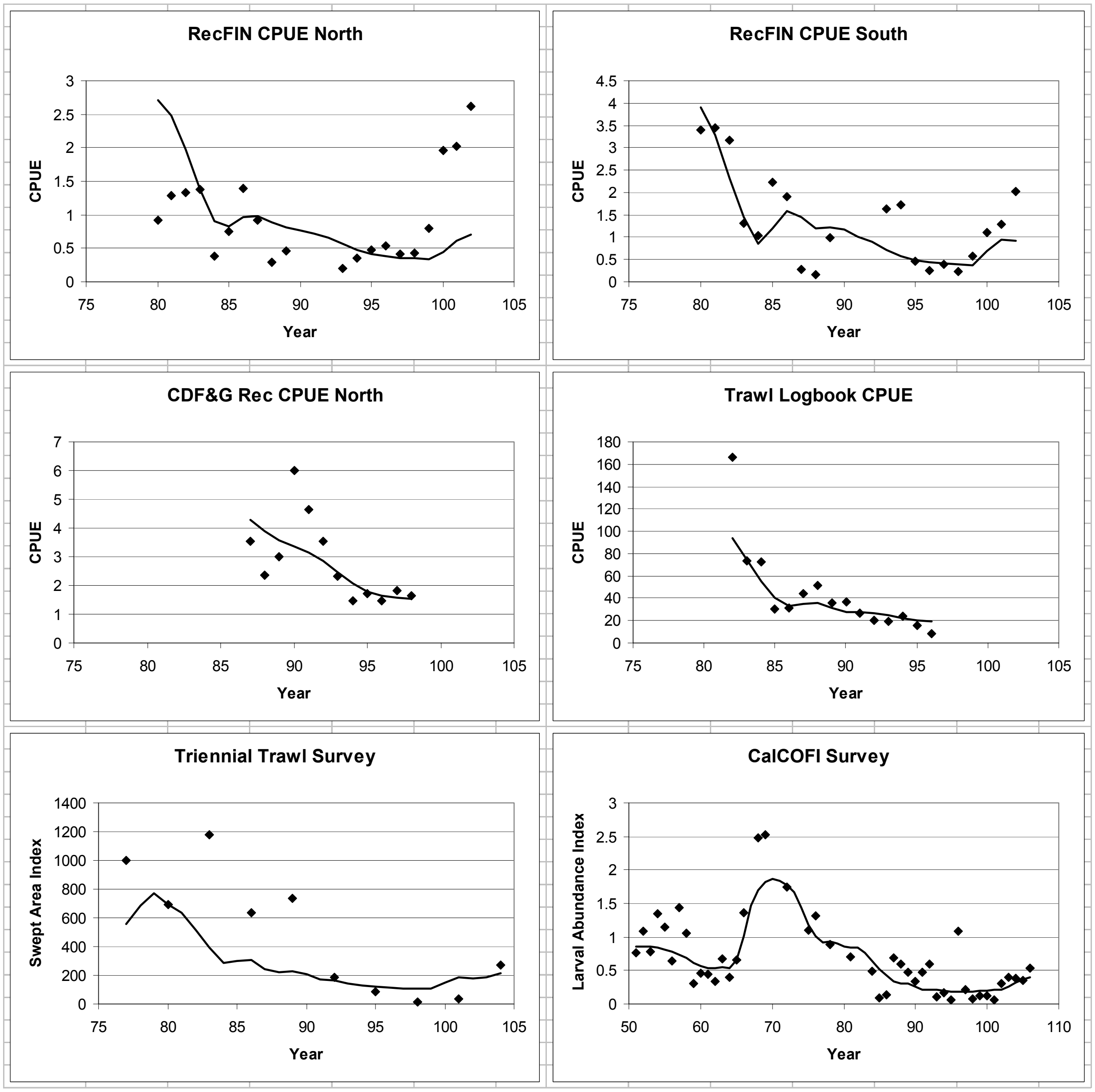


Figure 13. Model STATc2007 fits to abundance indexes and surveys. Triennial trawl survey in 2004 and CalCOFI indexes for 2003-2006 are the only new data since 2003.

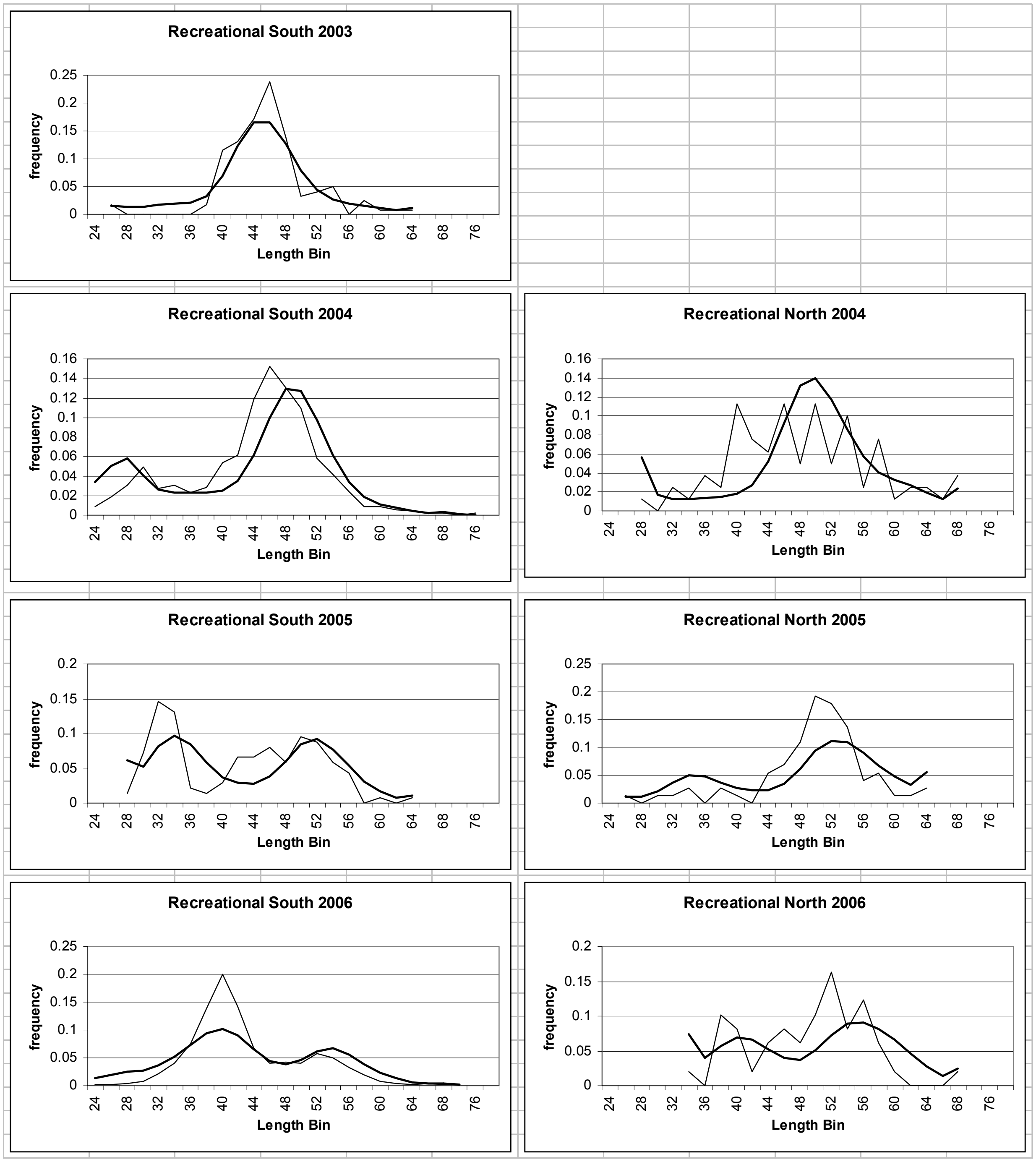


Figure 14. STATc model fits to recreational fishery length compositions collected since 2003.

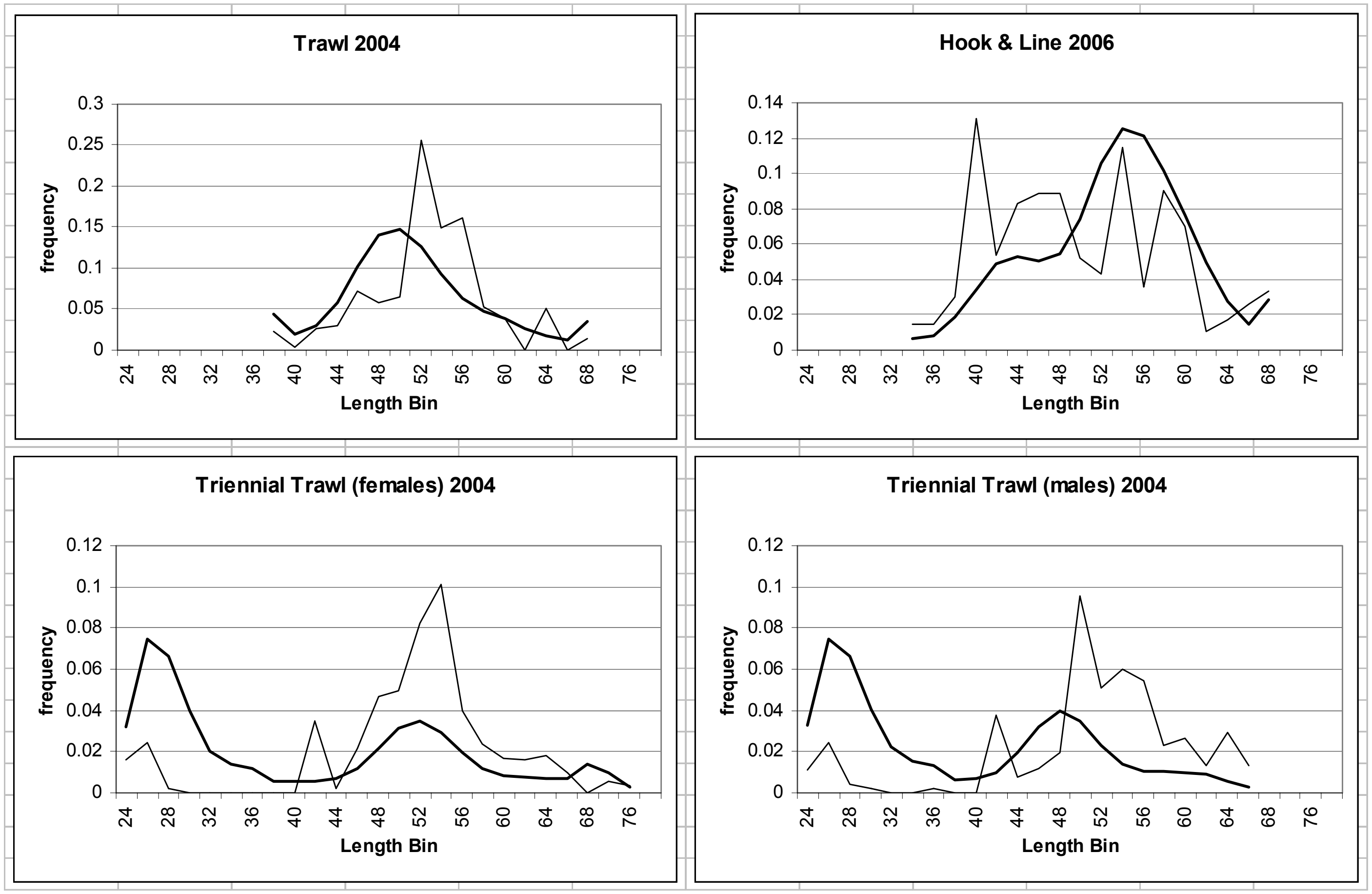


Figure 15. STATc model fits to commercial fishery and Triennial Trawl Survey length compositions.

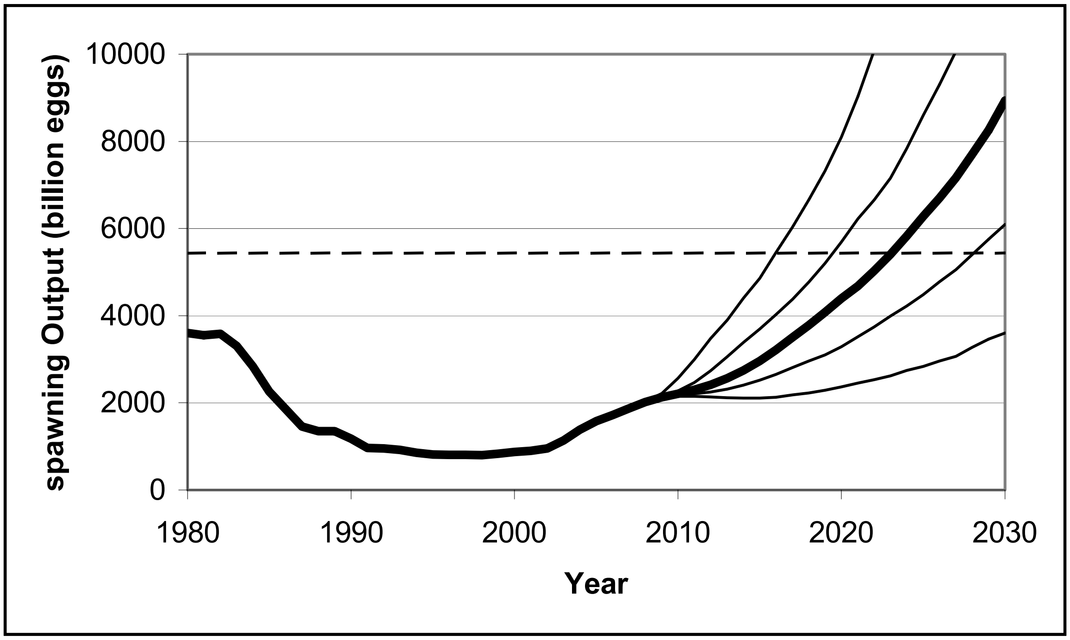


Figure 16. Projected spawning output under a constant SPR=77.7% rebuilding policy. Trajectories are 5, 25, 50 (median, bold line), 75 and 95 percentiles; broken line is B40 rebuilding target.

Remainder of document:

Appendix A. STAT 2007 responses to comments and recommendations in 2003 and 2005 STAR reports.
Appendix B. Data file for model STATc
Appendix C. Parameter file for model STATc

Appendix A. STAT 2007 responses to comments and recommendations in 2003 and 2005 STAR reports.

1.0 Items from Bocaccio 2003 STAR Panel Report

1.1 STAR: Triennial survey selectivity is implausible. The selectivity curve of the triennial survey appeared nearly uniform over all sizes, which appeared very unlikely for a research bottom trawl survey.

STAT response: The STAT considers the Triennial Survey to be inappropriate for bocaccio, because it samples the wrong habitat. The selectivity curve for ages 2+ is flat, but the value for age 1 (the most pelagic period in the life history) is higher. This is not implausible.

The swept-area abundance estimates can be compared with the 2005 model re-run using only data north of Pt. Conception, and approximate values of q are shown in the table below. This provides an equivalent geographic area for comparison; the sum of the two area-specific models is approximately equal to the single stock model (this comparison is the best we can do for now). The opinion of the STAT is that the Triennial Survey (and similarly, the NWFSC combo survey) should be excluded from the assessment model.

year	Triennial tons	Synthesis CenCal only	est q
1977	13778	18530	0.74
1989	19132	4098	4.67
1992	2584	3225	0.80
1995	1646	2606	0.63
1998	424	2276	0.19
2001	485	3372	0.14
2004	6934	4279	1.62

1.2 STAR: A rebuilding analysis was not brought forward, and was not reviewed. The Panel provided in this report what it feels are appropriate recommendations for the parameters and historic recruitments to be used. Specifically, the Panel recommends B1-base and B2 models with constant recruitment to 1969 as alternative model scenarios (equal probability) with recruitment resampled only back to 1970. The Panel re-emphasizes its recommendation against using the Stock Synthesis estimates of steepness or recruitment strength prior to 1970 in rebuilding analyses.

Biomass and recruitment prior to 1970 are highly uncertain since the only available time series is the CalCOFI index, which may not be reliable, and in any case would be unable to resolve the relative strength of individual year-classes.

STAT response: Rebuilding analyses have complied with this recommendation. Values of R/S were resampled for recruiting years (age 1) since 1970, and have included both B1 and B2 models. Resampling R/S is consistent with the model estimate of steepness ca. 0.2.

1.3 STAR: The RecFIN CPUE indices and the triennial survey trends are contradictory. Fishery-dependent CPUE indices can mask real declines in abundance if fishers are able to redirect effort to areas of high density. Similarly, the triennial trawl survey may be less efficient at low stock abundance because bocaccio preferentially occupy untrawlable habitat (varying q with stock abundance). Generally, the Panel felt that data sources with conflicting information should not be used together in the assessment.

STAT response: Various STAR Panels have differed on how to treat this kind of conflicting information. The Council requires a single biomass as the basis of its action. If the assessment presents two different "equally plausible" numbers, the Council is left with little alternative but to take a simple average. The STAT considers a model that included both sources of information (model STATc) to be a better approach than to average the B1 and B2 results. The SSC concurred with this approach.

1.4 STAR: In general, Stock Synthesis predicted modes within the size composition data for bocaccio reasonably well, but had a tendency to consistently under-fit the magnitude of the modal size and overestimate the dispersion about the mode. The residual pattern from the fit to the length frequency data is unusual and indicates systematic lack of fit. Its effect on the assessment results is unknown.

STAT response: One promising area of future work would be to develop a time-varying growth model (similar to that for chilipepper in 2007). This requires migration to the SS2 modeling framework.

1.5 STAR: Due to the extensive fishery closures and regulations prohibiting retention of catch in excess of the legal limits, fishery CPUE indices in the future will be biased indices of abundance. The Council and NMFS need to consider to how to monitor bocaccio status in the future. The CPFV data set consisting of reef-specific indices of abundance from partyboats is extremely valuable for evaluating of local fishing effects and as an index of overall abundance. Reef-specific CPUE is not as subject to the typical limitations of fishery CPUE data. A program of exempted fishing permits for partyboats with observers to monitor stock status should be considered.

STAT response: CPUE indexes cease being used in the model after 2003, due to these sorts of uncertainties. Development of a monitoring program of site-specific CPUE is desirable, but is not within the scope of the STAT's capability.

1.6 STAR: More attention needs to be given to how growth is modeled in the assessment. A model with time varying growth or cohort-specific growth may improve the fit to the length frequency data. Alternative ways to model variation in length with age should also be considered. Also, the Panel recommends that ageing of bocaccio be re-visited. A modest ageing sample could be used to evaluate whether the linear trend in the coefficient of variation (CV) of length with age in Stock Synthesis is a reasonable assumption, as well as confirming the model estimates of growth.

STAT response: The STAT agrees with the recommendation to develop a variable growth rate model, which requires use of SS2. Ageing could be revisited if resources were provided to do the work. Unfortunately, the formal program budget has been insufficient since 2004.

1.7 STAR: The Stock Synthesis model apparently does not perform well with the diverse data sets used to assess bocaccio. Consideration should be given to moving the bocaccio assessment to a new modeling environment, ideally one with optimization routines using automatic differentiation rather than numerical differentiation as in Stock Synthesis.

STAT response: The STAT agrees, though the SS2 model is unlikely in itself to resolve the problems associated with diverse and in some cases contradictory data sets.

1.8 STAR: Early catch history of bocaccio is a significant source of assessment uncertainty. Focused research on historical catch is needed. A comprehensive approach should be taken where historical catches of all West Coast groundfish species are investigated at the same time. Assessing historical effort in West Coast groundfish fisheries may be more successful as a collaborative undertaking between an expert in historical research and a stock assessment scientist.

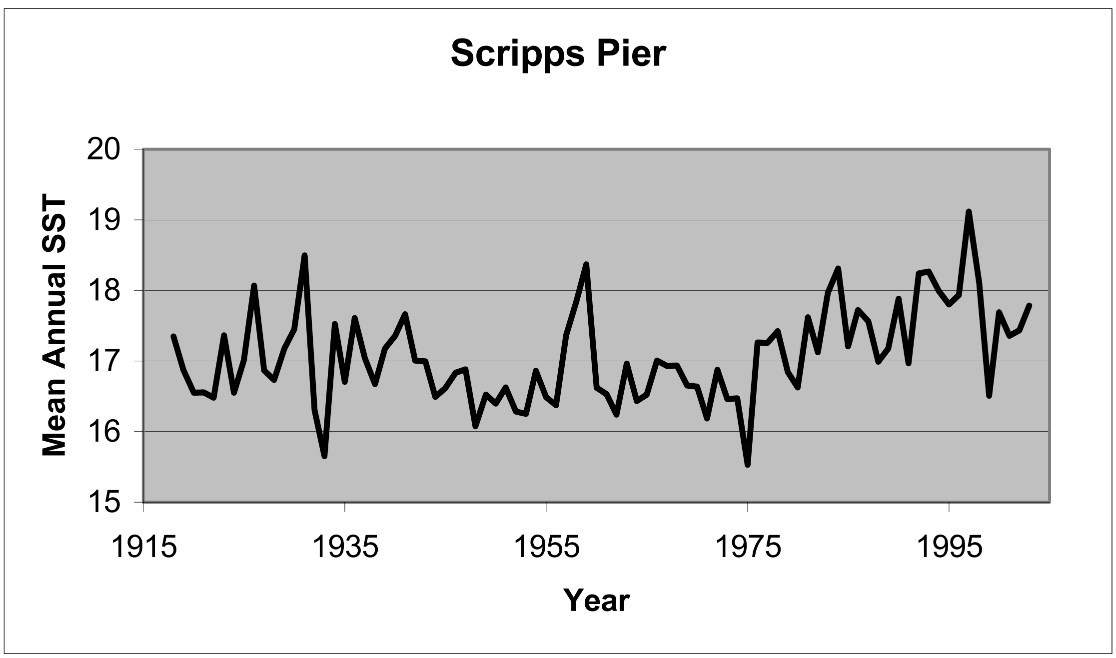
STAT response: We are making significant progress on this issue, but there is still a long ways to go The CDFG has now released landings receipt information back to 1969. We have obtained significant outside funding from the NESDID CDMP program to capture earlier historical landing data, and have captured summary data by market category (not strictly equivalent to species), month and geographic block of origin back to 1931. Unfortunately these summaries do not include gear information. We have microfiche of individual vessel landings data back to 1950, and work will begin this year to process portions of that massive data set.

1.9 STAR: Work needs to be done to figure how to the start the model with appropriate initial conditions and with sensible initial depletion which is consistent with the data.

STAT response: The initial conditions in the model are completely plausible, and there is nothing wrong with them. The assumed background level of annual catch (2000 mtons) is very close to the estimated MSY values in Table ES4, suggesting that the stock could easily have been at or below (especially given bocaccio’s tendency toward rare large recruitments) Bmsy at the beginning of the modeled period, ca. 1950.

1.10 STAR: The relationship between the CalCOFI index and climate should be evaluated. Two analyses are suggested. The first is to compare the residual patterns in model fits to an environmental index such as the Scripps Pier water temperatures. Adding an environmental covariate to the CalCOFI index catchability coefficient may improve the model fit to the index if annual egg production is influenced by environment conditions. A second analysis would be to compare biomass trends to indices associated with regime-scale environmental variability to see if significant correlations exist that would help explain long-term abundance trends.

STAT response: Both of these studies are desirable, but are not yet possible due to lack of information on colder ocean conditions. There was a major warming of California coastal waters between 1976 and 1998, and there is little sign that temperatures have returned to pre-1976 levels even yet. Given that the bocaccio model does not produce “reliable” independent estimates before the early 1970s (when the CalCOFI index itself is the only source of information), we lack the necessary contrast in ocean conditions to provide the needed information.



2.0 Items from Bocaccio 2005 STAR Panel Report

2.1 STAR: The triennial survey will likely be discontinued in 2006 so it is desirable to calibrate the triennial survey indices with those from the NWFSC Combined Survey.

STAT response: The NWFSC has taken the lead on calibration of the trawl surveys, and may want to consider doing this.

2.2 STAR: Exempted fishing permits are unlikely to provide the quality of catch and effort data hoped for. If exempted fishing permits are to be used to provide indices of abundance, it is necessary to check the power of the monitoring program first.

STAT response: This appears to be a response to a recommendation in the 2003 STAR report.

2.3 STAR: An exploratory delta-GLM analysis of the triennial survey was provided to the STAR Panel. The STAR Panel considered the analysis to be promising and suggested that it be applied to the NWFSC Combined Survey.

STAT response: The NWFSC is welcome to do this. Generically, they haven't been willing to release the data.

2.4 STAR: This species exhibits multiple annual spawning (as a function of age, size, or environment?). This possibility needs to be investigated based on fish collected from the fisheries or the survey if an index of spawning output based on larval counts is to be developed for comparison with the CALCOFI index or juvenile surveys.

STAT response: The STAT concurs. Due to management restrictions, sampling is no longer encountering enough fish to do this. Funding has been insufficient since 2004.

2.5 STAR: The indices of abundance are assumed to be linearly related to abundance. There is a possibility of non-linear relationships between the triennial indices and abundance due to density dependence and habitat (trawlable and untrawlable) considerations. Investigation of historical data and in situ observations may shed light on some possible relationships.

STAT response: The STAT concurs, though it still may not produce a useful index of abundance.

2.6 STAR: Models with time-varying growth should be included in the assessment if data can support them. The length data exhibit strong modes which could form the basis for such estimates.

STAT response: The STAT concurs. This requires SS2.

2.7 STAR: Although ageing of bocaccio is difficult, there are large numbers of otoliths that have been collected, but not been read. There is potential for using the age information to resolve broad-scale questions regarding changes over time in growth. Multiple reader studies, or other methods of validation, are desirable to assess reader bias and imprecision.

STAT response: Also see 1.6 above. Funding has been insufficient since 2004.

2.8 STAR: Models could be fitted to data on check marks if there is uncertainty about the interpretation of check marks as annuli. Check mark data could be treated in the same way as age data, i.e. subject to ageing bias and ageing imprecision, with the extent of ageing error treated as estimable within the model.

STAT response: The STAT concurs, but funding has been insufficient since 2004.

2.9 STAR: Future assessments should be based on Stock Synthesis 2. This should allow more formal quantification of parameter uncertainty. The next assessment should include a formal comparison of the results of SS1 and SS2 based on the current assessment.

STAT response: The STAT concurs.

2.10 STAR: Consideration should be given to the development of a more spatially disaggregated model for bocaccio. Although this approach was rejected by the 2002 STAR Panel, improved CalCOFI coverage north of Pt Conception since 2003 may support more spatial structure within the assessment.

STAT response: The STAT concurs, with reservations. This requires SS2, which has a limited capacity to model migration of adults between geographic areas. However, we lack knowledge of age-specific migration rates, so any model results would be very tentative.

2.11 STAR: According to the STATC model, the spawning output was close to the overfished threshold in the first year of the model (1951), which differs from the common assumption that the biomass is close to B0 at the beginning of the analysis. This species has highly variable recruitment and its biomass would vary substantially over time and a single B0 may not be appropriate. The STAR Panel stresses the need for guidelines for defining B0 (and hence proxies for BMSY) for stocks with episodic recruitment. The related problem of what subset of annual recruitments to average to obtain Recruits/Spawning output values for forecasts should also be addressed.

STAT response: Also see 1.9 above. The initial conditions are plausible, given the magnitude of the near-MSY level of assumed background catch. The SS2 model will allow a much earlier start date, and should be able to portray the dynamics leading to the relatively low 1950 abundance.

2.12 STAR: There should be further consideration of the implications of using the prior on steepness derived by He et al. (in review), including its implications for species with other life history characteristics.

STAT response: The old Stock Synthesis cannot do this. However, in 2007 the STAT has included a model (model STATcMPDh) with a stock-recruitment relationship based on the Maximum Posterior Distribution (MPD) value of steepness (h) from Dorn's unpublished analysis, which accomplishes much the same thing.

2.13 STAR: The approach used to estimate B0 for widow rockfish had been modified from the 2003 assessment to be consistent with that on which rebuilding analyses are based (multiplying average recruitment in the early years of the fishery by unfished spawning biomass per recruit). This led to a change to the current depletion of 10%. There is a need for more explicit guidance regarding determination of B0 in assessments and in rebuilding analyses.

STAT response: It is unclear what this means for bocaccio.

2.14 STAR: There is a need for a series of cut-off dates for data to be included in assessments, with cut-offs dependent on the type of data. The lack of such dates means that assessment authors may be forced to revise decisions on base-case models very close to the date the assessment needs to be submitted to the STAR Panel, and even revise the draft assessment after this. Given that documents are supplied to reviewers two weeks in advance of meetings, major changes in assessments thereafter could compromise the integrity of the review.

STAT response: Late receipt of critical data was a problem in 2005, but not in 2007.

2.15 STAR: Several of the 2005 assessments have conducted historical catch reconstructions. An effort needs to be made to develop a consistent approach to reconstructing catch histories. The ideal outcome would be a single document outlining the best reconstructed catch histories for each species (c.f. Rogers (2003) that lists foreign catches). The California landing receipts on microfilm back to 1950 should be incorporated into the landings database.

STAT response: We are currently working on this, with support from the NESDIS/CDMP. It is not a small job, and may take years.

2.16 STAR: There is still some inconsistency in how assessment authors decide whether to include or exclude recreational indices in assessments. Attempts to provide guidelines for the development and use of indices of abundance based on recreational catch and effort data would be worthwhile.

STAT response: The methodology use in this assessment was presented at a recreational CPUE workshop, and was endorsed for use.

2.17 STAR: Stock Synthesis 2 should be extended to: a) allow assessment authors to include weight-frequency data in assessments; b) estimate the parameters of the ageing error matrix; and c) estimate the extent of overdispersion of the indices.

STAT response: When the model migrates to SS2, these features would be useful.

2.18 STAR: The raw data on which recreational length-frequency and catch-effort information are based should be made available to assessment authors in a convenient format. This will allow more detailed examination of the spatial patterns, and allow more sophisticated analyses of the catch-effort information; at present it is impossible to distinguish between lack of data and zero catch records.

STAT response: Retrieval of recreational data has been an ongoing problem. Some aspects are "friendly" but others, especially involving disaggregated data can be difficult.

Appendix B. Data file for model STATc

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96,1,1,11,1.088,-9,CalCOFIindex
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-1,1,1,1,1,1,END,OF,,,,,,,,,,,,,,,,,,
-1,-1,<==,No,aging,error(not,used),,,,,,,,,,,,,,,,,,
-1,-1,,,,,,,,,,,,,,,,,,,,,,,,
-1,-1,,,,,,,,,,,,,,,,,,,,,,,,
25,25,"<==25lengthbins24..68at2cm,72,76 bins",,,,,,,,,,,,,,,,,,,,,,
24,26,28,30,32,34,36,38,40,42,44,46,48,50,52,54,56,58,60,62,64,66,68,72,76,80
47.6,-0.2876,length@50%matureslopeEcheverria1987,,,,,,,,,,,,,,,,,,,,,,
6.17E-06,3.1712,Length-weightparsfemale1995TriennialTrawl(Ralston),,,,,,,,,,,,,,,,,,,,,,
0.22475,0.03657,eggs/kginterceptandslopeReinterpretedfromPhillipsbyRalston1996,,,,,,,,,,,,,,,,,,,,,,
6.17E-06,3.1712,Length-weightparsmale1995TriennialTrawl(Ralston),,,,,,,,,,,,,,,,,,,,,,
YEAR,PER,TYPE,KIND,MAXSEX,TOTAGED,MIN1,MIN2,MAX1,MAX2,MARKET,,,,,,,,,,,,,,,
75,1,4,4,0,157,1,1,25,25,0,nfish=,21486,,,,,,,,,,,,,
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77,1,10,4,3,0,1,1,25,25,0,nfish=,,nsamps=,30,,,,,,,,,,
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97,1,3,4,3,21,1,1,25,25,0,nfish=,104,nsamps=,4,,,,,,,,,,
0,0,0,0,0,0,0,0,41,0,67,67,391,108,695,497,323,189,175,74,0,0,0,0,0
0,0,0,0,0,0,0,0,41,67,108,190,985,486,263,67,115,74,0,0,0,0,0,0,0
97,1,4,4,0,54,1,1,25,25,0,nfish=,54,,,,,,,,,,,,
0,1,0,1,5,2,2,3,7,11,6,1,4,4,2,2,0,0,2,0,1,0,0,0,0
97,1,5,4,0,314,1,1,25,25,0,nfish=,1759,,,,,,,,,,,,
14,2,5,19,30,42,68,66,91,88,109,114,128,145,137,126,132,145,78,85,47,20,51,15,2
98,1,1,4,3,84,1,1,25,25,0,nfish=,430,nsamps=,24,,,,,,,,,,
0,0,0,0,246,380,213,211,201,164,628,988,1219,1977,1339,699,524,280,1153,702,1265,1170,917,189,27
0,0,0,0,47,344,477,170,549,611,1158,1340,1989,2673,1004,1533,1434,1871,1057,362,299,146,0,0,0
98,1,2,4,3,21,1,1,25,25,0,nfish=,347,nsamps=,16,,,,,,,,,,
0,0,0,0,0,0,15,15,17,91,32,316,229,323,334,416,262,197,49,0,0,40,0,17,0
0,0,0,0,0,0,0,0,51,81,185,257,212,189,183,62,59,0,25,0,0,0,0,0,0
98,1,3,4,3,26,1,1,25,25,0,nfish=,212,nsamps=,10,,,,,,,,,,
0,0,0,0,0,0,0,0,0,0,16,819,811,2487,984,154,2387,51,46,35,0,21,0,0,0
0,0,0,0,0,0,0,0,16,42,70,1544,178,216,870,60,0,0,0,8,0,0,0,0,0
98,1,4,4,0,84,1,1,25,25,0,nfish=,106,,,,,,,,,,,,
0,1,0,1,7,9,8,8,11,6,10,13,9,5,4,5,5,2,2,0,0,0,0,0,0
98,1,5,4,0,167,1,1,25,25,0,nfish=,937,,,,,,,,,,,,
10,4,6,31,38,36,13,36,49,72,77,79,79,52,81,59,60,43,37,27,16,14,5,12,1
98,1,10,4,3,25,1,1,25,25,0,nfish=,,nsamps=,37,,,,,,,,,,
2284,0,0,7550,21844,21579,10836,6785,0,0,0,3677,0,0,1734,0,0,3612,0,2098,2788,0,3113,0,0
0,0,4407,2997,12517,5118,2627,0,0,0,0,1366,2178,13373,3612,0,2178,5118,0,3128,0,0,0,0,0
99,1,1,4,3,84,1,1,25,25,0,nfish=,424,nsamps=,17,,,,,,,,,,
0,0,0,0,0,0,398,1242,1755,1006,240,111,272,465,432,212,232,221,484,943,150,70,460,714,0
0,0,0,21,19,324,570,1168,1074,426,287,277,473,767,907,662,967,599,450,399,0,0,0,0,0
99,1,2,4,3,8,1,1,25,25,0,nfish=,114,nsamps=,6,,,,,,,,,,
0,0,0,0,0,0,0,0,0,0,0,148,0,218,256,228,832,660,328,140,298,164,0,0,0,0
0,0,0,0,0,0,0,74,0,0,74,74,186,636,446,238,490,350,612,112,112,0,112,0,0
99,1,4,4,0,85,1,1,25,25,0,nfish=,421,,,,,,,,,,,,
0,3,4,1,3,4,11,7,13,15,28,34,46,63,40,45,41,21,22,11,2,2,3,2,0
99,1,5,4,0,114,1,1,25,25,0,nfish=,637,,,,,,,,,,,,
2,0,1,3,10,13,11,38,44,47,34,41,57,71,47,40,50,30,35,21,22,8,6,6,0
100,1,1,4,3,80,1,1,25,25,0,nfish=,191,nsamps=,10,,,,,,,,,,
0,0,0,26,158,39,39,79,0,159,276,458,249,432,273,0,101,148,77,53,112,150,56,37,48
0,0,0,105,39,92,105,79,106,88,271,572,267,232,53,19,114,55,20,48,27,21,0,0,0
100,1,2,4,3,12,1,1,25,25,0,nfish=,69,nsamps=,9,,,,,,,,,,

0,0,0,28,0,0,0,0,0,0,66,28,0,160,94,132,56,132,28,0,0,0,28,0,0
0,0,0,0,0,0,0,0,0,66,160,226,122,132,160,28,28,56,56,56,56,28,0,0,0
100,1,4,4,0,85,1,1,25,25,0,nfish=,505,,,,,,,,,,,,
30,69,85,40,31,14,7,2,5,8,12,8,27,20,26,35,27,18,20,11,6,4,0,0,0
100,1,5,4,0,50,1,1,25,25,0,nfish=,282,,,,,,,,,,,,
10,26,19,12,8,18,10,14,15,18,26,7,15,9,4,5,6,5,11,8,17,10,5,1,3
101,1,1,4,3,88,1,1,25,25,0,nfish=,617,nsamps=,25,,,,,,,,,,
0,0,3,60,228,235,144,229,211,82,29,50,91,121,147,44,75,6,123,17,22,17,167,0,77
0,0,12,75,247,255,103,235,49,31,54,91,250,131,42,25,6,92,474,0,158,0,77,0,0
101,1,2,4,3,24,1,1,25,25,0,nfish=,233,nsamps=,18,,,,,,,,,,
0,0,0,0,0,18,90,56,9,20,20,42,49,31,76,114,90,147,51,62,81,34,25,0,0
0,0,0,3,9,18,45,57,20,0,33,69,51,88,91,84,82,43,80,46,0,0,0,0,0
101,1,4,4,0,85,1,1,25,25,0,nfish=,380,,,,,,,,,,,,
1,1,10,27,80,78,78,38,12,10,4,3,9,9,7,1,4,2,2,2,2,0,0,0,0
101,1,5,4,0,58,1,1,25,25,0,nfish=,324,,,,,,,,,,,,
1,2,1,10,27,53,48,17,16,15,11,23,17,17,24,10,12,10,4,1,1,0,2,2,0
101,1,10,4,3,21,1,1,25,25,0,nfish=,114,nsamps=,31,,,,,,,,,,
0,0,0,2367,28385,11560,25465,3103,5351,2289,2289,0,0,0,2516,0,0,2516,0,0,0,0,2744,0,0
0,0,0,2539,21189,22364,34500,2984,5031,0,0,0,0,8417,3103,4878,5804,0,2047,2047,0,0,0,0,0
102,1,1,4,3,82,1,1,25,25,0,nfish=,320,nsamps=,15,,,,,,,,,,
0,0,0,0,0,0,0,218,510,552,341,337,123,54,236,393,114,173,163,153,340,131,120,0,70
0,0,0,0,57,78,93,259,661,307,281,199,178,336,61,73,0,0,90,30,3,0,0,0,0
102,1,2,4,3,1,1,1,25,25,0,nfish=,14,nsamps=,1,,,,,,,,,,
0,0,0,0,0,0,0,0,0,2,2,0,2,4,8,2,2,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,0,6,0,0,0,0,0,0,0,0,0,0
102,1,3,4,3,17,1,1,25,25,0,nfish=,25,nsamps=,1,,,,,,,,,,
0,0,0,0,0,0,0,0,0,0,0,0,0,2,0,0,0,0,0,0,0,0,0,2,0
0,0,0,0,0,0,0,0,0,0,0,2,2,10,20,14,0,0,0,0,0,0,0,0,0
102,1,4,4,0,86,1,1,25,25,0,nfish=,771,,,,,,,,,,,,
0,1,2,3,2,20,39,83,137,139,117,72,22,21,31,27,16,13,15,4,3,2,2,0,0
102,1,5,4,0,32,1,1,25,25,0,nfish=,180,,,,,,,,,,,,
0,0,0,0,0,1,1,7,29,43,33,17,2,8,7,11,6,8,3,2,2,0,0,0,0
103,1,4,4,0,84,1,1,25,25,0,nfish=,122,,,,,,,,,,,,
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
104,1,1,4,0,78,1,1,25,25,0,nfish=,110,nsamps=,9,,,,,,,,,,
0,0,0,0,0,0,0,25,4,29,33,80,65,73,288,168,181,60,44,0,57,0,16,0,0
104,1,4,4,0,86,1,1,25,25,0,nfish=,889,,,,,,,,,,,,
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
104,1,5,4,0,14,1,1,25,25,0,nfish=,80,,,,,,,,,,,,
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
104,1,10,4,3,23,1,1,25,25,0,nfish=,216,nsamps=,33,,,,,,,,,,
19065,29801,2189,0,0,0,0,0,0,42045,2356,26204,56703,59820,99071,121898,48127,28657,19776,19405,21625,11473,3,7044,4580
13679,29672,4912,2456,0,0,2456,0,0,45264,9674,14121,23379,115715,61595,72185,65801,27955,31884,16194,35618,15942,0,0,0
105,1,4,4,0,84,1,1,25,25,0,nfish=,571,,,,,,,,,,,,
0,0,2,10,20,18,3,2,4,9,9,11,8,13,12,8,6,0,1,0,1,0,0,0,0
105,1,5,4,0,13,1,1,25,25,0,nfish=,73,,,,,,,,,,,,
0,1,0,1,1,2,0,2,1,0,4,5,8,14,13,10,3,4,1,1,2,0,0,0,0
106,1,2,4,0,13,1,1,25,25,0,nfish=,78,nsamps=,10,,,,,,,,,,
0,0,0,0,0,20,20,40,175,72,111,119,119,69,58,153,48,121,93,14,23,35,45,0,0
106,1,4,4,0,88,1,1,25,25,0,nfish=,1330,,,,,,,,,,,,
2,3,6,10,29,54,101,183,265,189,89,54,55,54,78,66,43,26,9,4,2,4,2,1,1
106,1,5,4,0,9,1,1,25,25,0,nfish=,49,,,,,,,,,,,,
0,0,0,0,0,1,0,5,4,1,3,4,3,5,8,4,6,3,1,0,0,0,1,0,0

Appendix C. Parameter file for model STATc

```
boc2007revC.csv  **** UNKNOWN CONVERGENCE STATUS
statc07revC.r01
statc07revC.par
2007 starting from statc2005 assessment postSTAR include all & 0.1srr, revised c
     10.000000       .000100     BEGIN AND END DELTA F PER LOOP1
   3   .95              FIRST LOOP1 FOR LAMBDA & VALUE
   1.100                MAX VALUE FOR CROSS DERIVATIVE
   1 READ HESSIAN
STARB2.hes
   1 WRITE HESSIAN
STARB2.hes
    .001                MIN SAMPLE FRAC. PER AGE
   1  21   1  21        MINAGE, MAXAGE,  SUMMARY AGE RANGE
    51   106            BEGIN YEAR, END YEAR
  1      12  0  0  0    NPER, MON/PER
  1.00                  SPAWNMONTH
  5  9 NFISHERY, NSURVEY
  2 N SEXES
   50000.  REF RECR LEVEL
  0 MORTOPT
    .150000    .010000     .250000 'M              '  0    1  0    .000000   .0000 !   1 NO PICK    .000       0.      .0000000
 -999.000000    .010000    1.000000 'M SAME FOR M+F  '  0    1  0    .000000   .0000 !   2 NO PICK    .000       0.      .0000000
   TRAWL    TYPE:  1
  7 SELECTIVITY PATTERN
   0   0   0   2   0   0   0  AGE TYPES USED
     1.00000       .10 ' TWL CATCH BIOMASS  '  ! # =  1 VALUE:         .00000
     1.00000       .30 ' TWL  SIZE COMPS    '  ! # =  2 VALUE:     -537.43774
  1  1  0  0  0  0  SEL. COMPONENTS
   51.916183   20.000000   70.000000 'Trawl:transition'   2    1  0    .000000   .0000 !   3 OK       -.005     -27.  1672.6971612
    .000001     .000001    1.000000 'Trawl:InitSelect'   0    1  0    .000000   .0000 !   4 NO PICK    .000       0.      .0000000
    .488685     .001000    1.000000 'Trawl:SmlInflect'   2    1  0    .500000  1.0000 !   5 OK         .000  -45676.      .5484042
    .336529     .001000    3.000000 'Trawl:SmlSlope  '   2    1  0    .900000  1.0000 !   6 OK         .000   -3199.      .0015743
    .595213     .001000    1.000000 'Trawl:femfinal  '   2    1  0   1.000000  1.0000 !   7 OK         .000   -4823.      .0066239
    .348224     .001000    1.000000 'Trawl:feminflct '   2    1  0    .500000  1.0000 !   8 OK         .000   -2896.     1.5064589
   1.347485     .001000    5.000000 'Trawl:femSlope  '   0    1  0    .900000  1.0000 !   9 NO PICK    .000       0.      .0000000
   H&L      TYPE:  2
  7 SELECTIVITY PATTERN
   0   0   0   4   0   0   0  AGE TYPES USED
     1.00000       .10 ' H&Lso CATCH BIOMASS'  ! # =  3 VALUE:         .00000
     1.00000       .30 ' H&Lso SIZE COMPS   '  ! # =  4 VALUE:     -204.38755
  1  1  0  0  0  0  SEL. COMPONENTS
   48.382066   20.000000   70.000000 'H&L:transition  '   2    1  0    .000000   .0000 !  10 OK         .000      -7.     5.2163052
    .003059     .000001    1.000000 'H&L:InitSelect  '   2    1  0    .000000   .0000 !  11 OK         .000  -56790.      .0001048
    .840932     .001000    1.000000 'H&L:SmlInflect  '   2    1  0    .500000  1.0000 !  12 OK         .000   -1877.      .0306416
    .333099     .001000    3.000000 'H&L:SmlSlope    '   2    1  0    .900000  1.0000 !  13 OK         .000   -2281.      .0114772
    .275881     .001000    1.000000 'H&L:femfinal    '   2    1  0   1.000000  1.0000 !  14 OK         .000    -363.      .0798732
    .380517     .001000    1.000000 'H&L:feminflct   '   2    1  0    .500000  1.0000 !  15 OK         .000    -305.      .0222269
    .268922     .001000    5.000000 'H&L:femSlope    '   2    1  0    .900000  1.0000 !  16 OK         .000     -89.      .1777621
  SETNET    TYPE:  3
  7 SELECTIVITY PATTERN
   0   0   0   6   0   0   0  AGE TYPES USED
     1.00000       .10 'SetNetCATCHBIOM    '  ! # =  5 VALUE:         .00000
     1.00000       .30 'SetNetSizeComps    '  ! # =  6 VALUE:     -258.61169
  1  1  0  0  0  0  SEL. COMPONENTS
   49.540604   20.000000   60.000000 'StNso:transition'   2    1  0    .000000   .0000 !  17 OK         .004     -19.    23.4146939
    .004154     .000001    1.000000 'StNso:InitSelect'   2    1  0    .000000   .0000 !  18 OK         .000 -313878.      .0000070
    .785004     .001000     .990000 'StNso:YngInflect'   2    1  0    .500000  1.0000 !  19 OK         .000  -11461.      .0296508
    .653476     .001000    3.000000 'StNso:YngSlope  '   2    1  0    .900000  1.0000 !  20 OK         .000    -458.      .0135755
    .147646     .001000    1.000000 'StNso:femfinal  '   2    1  0    .000000   .0000 !  21 OK         .000   -1213.      .0059668
    .131565     .001000    1.000000 'StNso:feminflct '   2    1  0    .500000  1.0000 !  22 OK        -.001    -344.      .3510564
    .247784     .001000    5.000000 'StNso:femSlope  '   2    1  0    .900000  1.0000 !  23 OK         .000   -1044.      .0459814
  RECLso    TYPE:  4
  7 SELECTIVITY PATTERN
```

```
 0   0   0   8   0   0   0  AGE TYPES USED
   1.00000      .10 'RECLsoCATCHBIOM     '  ! # =  7 VALUE:          .00000
   1.00000      .30 'RECLsoSIZECOMPS     '  ! # =  8 VALUE:     -310.73584
1  1  0  0  0  0  SEL. COMPONENTS
 41.756833   15.000000   60.000000 'RCLso:transition'   2     1  0     .000000   .0000 !  24 OK        -.003      -3.    53.1311282
   .140186     .000001    1.000000 'RCLso:InitSelect'   2     1  0     .000000   .0000 !  25 OK         .000   -2921.      .0004495
   .001000     .001000    1.000000 'RCLso:SmlInflect'   0     1  0     .500000  1.0000 !  26 NO PICK    .000       0.      .0000000
   .194675     .001000    5.000000 'RCLso:SmlSlope  '   2     1  0     .900000  1.0000 !  27 OK         .000   -1909.      .0027112
   .067805     .001000    1.000000 'RCLso:femfinal  '   2     1  0     .000000   .0000 !  28 OK         .000   -4034.      .0012391
   .386057     .001000    1.000000 'RCLso:feminflct '   2     1  0     .500000  1.0000 !  29 OK         .000   -5940.      .0252360
   .298196     .001000    5.000000 'RCLso:femSlope  '   2     1  0     .900000  1.0000 !  30 OK         .000    -941.      .0045968
RECLnor   TYPE:  5
7 SELECTIVITY PATTERN
 0   0   0  10   0   0   0  AGE TYPES USED
   1.00000      .10 'RECLnorCATCHBIOM    '  ! # =  9 VALUE:          .00000
   1.00000      .30 'RECLnorSIZECOMPS    '  ! # = 10 VALUE:     -267.58865
1  1  0  0  0  0  SEL. COMPONENTS
 48.733482   15.000000   60.000000 'RCLno:transition'   2     1  0     .000000   .0000 !  31 OK        -.001      -2.   164.7240616
   .065319     .000001    1.000000 'RCLno:InitSelect'   2     1  0     .000000   .0000 !  32 OK         .000  -12248.      .0014999
   .496223     .001000    1.000000 'RCLno:SmlInflect'   2     1  0     .500000  1.0000 !  33 OK         .000    -606.      .6273304
   .129680     .001000    5.000000 'RCLno:SmlSlope  '   2     1  0     .900000  1.0000 !  34 OK         .000   -1046.      .2221516
   .279615     .001000    1.000000 'RCLno:femfinal  '   2     1  0     .000000   .0000 !  35 OK         .000    -398.      .0133749
   .584202     .001000    1.000000 'RCLno:feminflct '   2     1  0     .500000  1.0000 !  36 OK         .000    -686.      .0526584
   .268031     .001000    5.000000 'RCLno:femSlope  '   2     1  0     .900000  1.0000 !  37 OK         .000    -114.      .0271967
 NoRec   TYPE:  6
2 SELECTIVITY PATTERN
 0   0   0   0   0   0   0  AGE TYPES USED
   .000168  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .67 'RecFINnoCPUE        '  ! # = 11 VALUE:       -4.91890
  5.000000    -.200000    1.000000 'NoCalCPU:Seltype'   0   -80  0     .000000   .0000 !  38 NO PICK    .000       0.      .0000000
 24.000000     .010000   24.000000 'NoCalCPUl:minsiz'   0   -80  0     .000000   .0000 !  39 NO PICK    .000       0.      .0000000
 76.000000     .001000   76.000000 'NoCalCPUl:maxsiz'   0   -80  0     .000000   .0000 !  40 NO PICK    .000       0.      .0000000
DFGcpuN   TYPE:  7
2 SELECTIVITY PATTERN
 0   0   0   0   0   0   0  AGE TYPES USED
   .000733  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .37 ' NoCalDFG           '  ! # = 12 VALUE:        8.19614
  5.000000    -.200000    1.000000 'NoCalDFG:Seltyp '   0   -87  0     .000000   .0000 !  41 NO PICK    .000       0.      .0000000
 24.000000     .010000   24.000000 'NoCalDFG:minsi  '   0   -87  0     .000000   .0000 !  42 NO PICK    .000       0.      .0000000
 76.000000     .001000   76.000000 'NOCalDFG:maxsi  '   0   -87  0     .000000   .0000 !  43 NO PICK    .000       0.      .0000000
SoRecFI   TYPE:  8
2 SELECTIVITY PATTERN
 0   0   0   0   0   0   0  AGE TYPES USED
   .000196  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .71 'RecFINsoCPUE        '  ! # = 13 VALUE:       -4.06754
  4.000000    -.200000    1.000000 'SoCalCPU:Seltype'   0   -80  0     .000000   .0000 !  44 NO PICK    .000       0.      .0000000
 24.000000     .010000   24.000000 'SoCalCPUl:minsiz'   0   -80  0     .000000   .0000 !  45 NO PICK    .000       0.      .0000000
 76.000000     .001000   76.000000 'SoCalCPUl:maxsiz'   0   -80  0     .000000   .0000 !  46 NO PICK    .000       0.      .0000000
TwlCPUE   TYPE:  9
2 SELECTIVITY PATTERN
 0   0   0   0   0   0   0  AGE TYPES USED
   .004940  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .32 'TrawlCPUE           '  ! # = 14 VALUE:        9.45784
  1.000000    -.200000    1.000000 'TrawlSeltype    '   0   -82  0     .000000   .0000 !  47 NO PICK    .000       0.      .0000000
 20.000000     .010000   20.000000 'TrawlCPUE:minsiz'   0   -82  0     .000000   .0000 !  48 NO PICK    .000       0.      .0000000
 84.000000     .001000   84.000000 'TrawlCPUE:maxsiz'   0   -82  0     .000000   .0000 !  49 NO PICK    .000       0.      .0000000
TRITRAW   TYPE: 10
7 SELECTIVITY PATTERN
 0   0   0  16   0   0   0  AGE TYPES USED
   .044151  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .81 'TRI SURVEY BIO      '  ! # = 15 VALUE:       -5.56087
   1.00000      .30 'TRI SIZE COMPS      '  ! # = 16 VALUE:      -82.35644
1  1  0  0  0  0  SEL. COMPONENTS
 34.311827   26.000000   76.000000 'TriSv:transition'   0    89  0     .000000   .0000 !  50 NO PICK    .000       0.      .0000000
   .363817     .001000    1.000000 'TriSv:InitSelect'   2    89  0     .000000   .0000 !  51 OK         .000     -55.      .0195570
   .001000     .001000    1.000000 'TriSv:YngInflect'   0    89  0     .500000  1.0000 !  52 NO PICK    .000       0.      .0000000
```

```
  3.000000     .001000    3.000000 'TriSv:YngSlope  '   0    89  0     .900000  1.0000 !  53 NO PICK     .000       0.      .0000000
   .484561     .001000    1.000000 'TriSv:femfinal  '   2    89  0     .000000   .0000 !  54 OK          .000    -169.      .0127043
   .001000     .001000    1.000000 'TriSv:feminflct '   0    89  0     .500000  1.0000 !  55 NO PICK     .000       0.      .0000000
  5.000000     .001000    5.000000 'TriSv:femSlope  '   0    89  0     .900000  1.0000 !  56 NO PICK     .000       0.      .0000000
 CALCOFI   TYPE: 11
 4 SELECTIVITY PATTERN
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   .000233  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
   1.00000      .68 'CALCOFISPB          ' ! # = 17 VALUE:      -1.11389
 PowPlnt   TYPE: 12
 3 SELECTIVITY PATTERN
  0   0   0   0   0   0   0  AGE TYPES USED
   .011220  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .00000     2.10 'PowPltRectIndex     ' ! # = 18 VALUE:     -35.54367
  1.000000     .000000    1.000000 'PowplntAge1Nos  '   0   -73  0     .000000   .0000 !  57 NO PICK     .000       0.      .0000000
  1.000000     .000000    1.000000 'PowplntAge1Nos  '   0   -73  0     .000000   .0000 !  58 NO PICK     .000       0.      .0000000
JuvSurv    TYPE: 13
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   .000078  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .00000     2.05 'CenCalJuvIndex      ' ! # = 19 VALUE:     -25.19993
  1.000000     .000000    1.000000 'JuvSurvAge1Nos  '   0   -84  0     .000000   .0000 !  59 NO PICK     .000       0.      .0000000
  1.000000     .000000    1.000000 'JuvSurvAge1Nos  '   0   -84  0     .000000   .0000 !  60 NO PICK     .000       0.      .0000000
PierCPU    TYPE: 14
 3 SELECTIVITY PATTERN
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   .000275  0  1  2 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    .00000     3.29 'PierRectIndex       ' ! # = 20 VALUE:     -32.84073
  1.000000     .000000    1.000000 'PierIndex1Nos   '   0   -81  0     .000000   .0000 !  61 NO PICK     .000       0.      .0000000
  1.000000     .000000    1.000000 'PierIndex1Nos   '   0   -81  0     .000000   .0000 !  62 NO PICK     .000       0.      .0000000
 1 AGEERR: 1: MULTINOMIAL,  0: S(LOG(P))=CONSTANT,  -1: S=P*Q/N
500.000 : MAX N FOR MULTINOMIAL
 3 1=%CORRECT, 2=C.V., 3=%AGREE, 4=READ %AGREE @AGE
   .800000     .300000     .950000 'p AGREE. @1     '   0    80  0     .000000   .0000 !  63 NO PICK     .000       0.      .0000000
   .050000     .000000     .900000 'p agree @21     '   0    80  0     .000000   .0000 !  64 NO PICK     .000       0.      .0000000
  1.000000     .001000    2.000000 'POWER           '   0    80  0     .000000   .0000 !  65 NO PICK     .000       0.      .0000000
   .150000     .010000     .300000 'OLD DISCOUNT    '   0    80  0     .000000   .0000 !  66 NO PICK     .000       0.      .0000000
   .000001     .001000     .100000 '%MIS-SEXED      '   0    80  0     .000000   .0000 !  67 NO PICK     .000       0.      .0000000
 0 END OF EFFORT
 0 FIX n FMORTs
 0  MATURITY
 1  GROWTH: 1=CONSTANT, 2=MORT. INFLUENCE
 1.5000 99.0000  AGE AT WHICH L1 AND L2 OCCUR
 1 1=NORMAL, 2=LOGNORMAL
  27.000000   20.000000   60.000000 'FEMALE L1       '   0     1  0     .000000   .0000 !  68 NO PICK     .000       0.      .0000000
  75.892728   60.000000   90.000000 'FEMALE LINF     '   0     1  0     .000000   .0000 !  69 NO PICK     .000       0.      .0000000
   .183673     .050000     .400000 'FEMALE K        '   2     1  0     .000000   .0000 !  70 OK          .000-2186705.      .0000036
   .107000     .010000     .990000 'FEMALE CV1      '   0     1  0     .000000   .0000 !  71 NO PICK     .000       0.      .0000000
   .033000     .010000     .990000 'FEMALE CV21     '   0     1  0     .000000   .0000 !  72 NO PICK     .000       0.      .0000000
-999.000000   20.000000   40.000000 'MALE L1         '   0     1  0     .000000   .0000 !  73 NO PICK     .000       0.      .0000000
  65.555310   50.000000   80.000000 'MALE LINF       '   0     1  0     .000000   .0000 !  74 NO PICK     .000       0.      .0000000
   .210373     .100000     .400000 'MALE K          '   2     1  0     .000000   .0000 !  75 OK          .000-1146616.      .0001222
-999.000000     .010000     .990000 'MALE CV1        '   0     1  0     .000000   .0000 !  76 NO PICK     .000       0.      .0000000
-999.000000     .010000     .990000 'MALE CV21       '   0     1  0     .000000   .0000 !  77 NO PICK     .000       0.      .0000000
        0  DEFINE MARKET CATEGORIES
 0 ENVIRONMENTAL FXN:   [-INDEX]  [FXN TYPE(1-4)]  [ENVVAR USED]
 0 ESTIMATE N ENVIRON VALUES
21 PENALTIES
    .00000      .30 ' Parm Penalty       ' ! # = 21 VALUE:     -40.61406
-1  1.0  1.0
 0 ENVIRONMENT EFFECT ON EXP(RECR)
22  STOCK-RECR
 3 1=B-H, 2=RICKER, 3=new B-H, 4=HOCKEY
 0 disabled option
    .10000    -1.00 'SPAWN RECR.         ' ! # = 22 VALUE:     -44.15689
    .00001     -.30 'S-R means           ' ! # = 23 VALUE:    -527.37648
```

```
 10.000000    .001000   10.000000 'VIR. RECR. MULT.'  0    1  0    .000000   .0000 !  78 NO PICK    .000      0.     .0000000
   .200000    .200000     .990000 'B-H S/R PAR.   '  0    1  0    .000000   .0000 !  79 NO PICK    .000      0.     .0000000
   .070451    .001000   10.000000 'BACK RECR.     '  0    1  0    .000000   .0000 !  80 NO PICK    .000      0.     .0000000
  1.000000    .010000    2.000000 'S/R STD.       '  0    1  0    .000000   .0000 !  81 NO PICK    .000      0.     .0000000
   .000000   -.100000     .100000 'RECR. TREND    '  0    1  0    .000000   .0000 !  82 NO PICK    .000      0.     .0000000
  1.000000    .000000    2.000000 'RECR. MULT.    '  0    1  0    .000000   .0000 !  83 NO PICK    .000      0.     .0000000
-2 INIT AGE COMP
-999.000000   .001000   30.000000 'Recruit 51     ' -2   51  0    .000000   .0000 !  84 NO PICK    .000      0.     .0000000
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-999.000000   .001000   30.000000 'Recruit 59     ' -2   59  0    .000000   .0000 !  92 NO PICK    .000      0.     .0000000
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   .026661    .001000   30.000000 'Recruit 61     '  2   61  0    .000000   .0000 !  94 OK         .000   -7798.     .0332638
   .023849    .001000   30.000000 'Recruit 62     '  2   62  0    .000000   .0000 !  95 OK         .000   -9434.     .0281218
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   .017206    .001000   30.000000 'Recruit 64     '  2   64  0    .000000   .0000 !  97 OK         .000  -13153.     .0115736
   .015136    .001000   30.000000 'Recruit 65     '  2   65  0    .000000   .0000 !  98 OK         .000  -15536.     .0040839
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   .043123    .001000   30.000000 'Recruit 68     '  2   68  0    .000000   .0000 ! 101 OK         .000  -23888.     .1460500
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   .287270    .001000   30.000000 'Recruit 71     '  2   71  0    .000000   .0000 ! 104 OK         .000  -29243.     .0873928
   .036365    .001000   30.000000 'Recruit 72     '  2   72  0    .000000   .0000 ! 105 OK         .000  -32986.     .0280150
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   .317521    .001000   30.000000 'Recruit 74     '  2   74  0    .000000   .0000 ! 107 OK         .000  -44829.     .0009801
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   .031985    .001000   30.000000 'RECRUIT 82     '  2   82  0    .000000   .0000 ! 115 OK         .000 -122236.     .0000850
   .003014    .001000   30.000000 'RECRUIT 83     '  2   83  0    .000000   .0000 ! 116 OK         .000 -297957.     .0000076
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   .033653    .001000   30.000000 'RECRUIT 88     '  2   88  0    .000000   .0000 ! 121 OK         .000 -133208.     .0000195
   .117140    .001000   30.000000 'RECRUIT 89     '  2   89  0    .000000   .0000 ! 122 OK         .000  -92186.     .0000478
   .002850    .001000   30.000000 'RECRUIT 90     '  2   90  0    .000000   .0000 ! 123 OK         .000 -191316.     .0000158
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   .007710    .001000   30.000000 'RECRUIT 93     '  2   93  0    .000000   .0000 ! 126 OK         .000 -337838.     .0000195
   .017371    .001000   30.000000 'RECRUIT 94     '  2   94  0    .000000   .0000 ! 127 OK         .000 -347802.     .0000125
   .015919    .001000   30.000000 'RECRUIT 95     '  2   95  0    .000000   .0000 ! 128 OK         .000 -392818.     .0000073
   .008697    .001000   30.000000 'RECRUIT 96     '  2   96  0    .000000   .0000 ! 129 OK         .000 -460757.     .0000042
   .020112    .001000   30.000000 'RECRUIT 97     '  2   97  0    .000000   .0000 ! 130 OK         .000 -311071.     .0000131
   .004891    .001000   30.000000 'RECRUIT 98     '  2   98  0    .000000   .0000 ! 131 OK         .000 -482180.     .0000058
   .007352    .001000   30.000000 'RECRUIT 99     '  2   99  0    .000000   .0000 ! 132 OK         .000 -205674.     .0000094
   .118887    .001000   30.000000 'RECRUIT 100    '  2  100  0    .000000   .0000 ! 133 OK         .000  -13098.     .0004233
   .001000    .001000   30.000000 'RECRUIT 101    '  0  101  0    .000000   .0000 ! 134 NO PICK    .000      0.     .0000000
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   .009787    .001000   30.000000 'RECRUIT 103    '  2  103  0    .000000   .0000 ! 136 OK         .000  -82446.     .0000204
   .054638    .001000   30.000000 'RECRUIT 104    '  2  104  0    .000000   .0000 ! 137 OK         .000  -16128.     .0001699
  -.018345    .001000   30.000000 'RECRUIT 105    ' -2  105  0    .000000   .0000 ! 138 NO PICK    .000      0.     .0000000
  -.020981    .001000   30.000000 'RECRUIT 106    ' -2  106  0    .000000   .0000 ! 139 NO PICK    .000      0.     .0000000
```

Agenda Item G.4.a
Attachment 4
September 2007

Bocaccio Rockfish STAR Panel Report

National Marine Fisheries Service
SWFSC Santa Cruz

June 25-29, 2007

Reviewers:

David Sampson, Scientific and Statistical Committee Representative, Panel Chair
Patrick Cordue, Center for Independent Experts
Norman Hall, Center for Independent Experts
Kevin Piner, NOAA Fisheries Service, Southwest Fisheries Science Center

Advisors:

Gerry Richter, Groundfish Advisory Subpanel Representative
John DeVore, Groundfish Management Team Representative

STAT Team:

Alec D. MacCall, NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division.

Overview

A STAR Panel met June 25-29th in Santa Cruz, CA to review a full stock assessment for bocaccio rockfish. An update to the 2003 stock assessment was given to the Panel two weeks prior to the review, an earlier update having been produced in 2005. At the meeting the STAT provided the Panel two additional documents: a new draft assessment with additional diagnostics and a response to the 2003 and 2005 STAR Panel recommendations. The Panel and STAT discussed what objectives should be set for the meeting given that only an update, rather than a full assessment, was available. Two objectives were agreed: to examine the assessment under the Terms of Reference (TOR) for an update in order to provide advice to the SSC prior to their review of the update; and, to explore the assessment to provide guidance for the next full stock assessment. The Panel examined the TOR for an update assessment and advised the STAT that the document appeared to meet the requirements for an update. The Panel recommended that the catch history in the final update document be "refreshed" with recent CalCOM landings data.

The STAT and STAR Panel agreed to use the available time during the review to explore some aspects of the model beyond the constraints of an update assessment. The Panel worked with the STAT to develop a new reference run that differed in two respects from the accepted base model (from the 2003 assessment): the last three points in the two recreational CPUE abundance time series were dropped to eliminate tension in the model and a fixed steepness parameter was included in the spawner-recruit relationship (h=0.44). Runs with alternative but plausible values for the assumed historical equilibrium catch showed that the new reference model's estimates of depletion were sensitive to the assumed historical equilibrium catch but the estimated biomass trajectories were not. The species composition of catches suggested that the distribution of recreational fishing, and thus selectivity, had changed in recent years. However, several analyses, completed to explore the reliability of the model's estimates of a strong 2003 year-class, provided evidence to counter concerns that the apparent strength of the year-class might be due to recent changes in selection by the recreational fishery.

Prior to the next assessment, which should be a full assessment, there should be a thorough review and evaluation of all input data and assumptions. Also, the new assessment should be implemented using modern statistical stock assessment software.

Analyses requested by the STAR Panel

Round 1 requests

A. Re-examine the historical rockfish catch (back to 1916) using the ratio of bocaccio to total rockfish to estimate historical catches.

   Reason: This will determine if the assumed equilibrium catch of 2000t is reasonable.

B. Determine the co-occurrence of other species in RecFIN trips that caught bocaccio from 1993-2006. For trips that caught bocaccio, produce the proportion of those trips that also caught other species (only the top 20 or so).

   Reason: Attempt to distinguish near shore from offshore fishing using co-occurrence of species in the RecFIN source, to confirm no change in recreational fishery selection patterns in recent years.

C. Do a model run using steepness=0.44, lambda=1 on the S/R curve and remove the recent recreational CPUE values. Retune the CPUE and survey S.E.

   Reason: This is a working model to be used in the subsequent runs. Removing the recent cpue values removes the conflict with the triennial survey.

D. Do sensitivity runs to equilibrium catches of 1000 and 3000t using the working model (Request C). Output the biomass trajectory and depletion.

   Reason: Determine the effect of the magnitude of equilibrium catch on estimated abundance.

E. Do a new model run starting in 1916 with no equilibrium catch and ramping up catch to 2000t in 1930. This will be done using the working model (Request C). Output the biomass trajectories and depletion.

   Reason: To demonstrate the effect of assuming equilibrium conditions as opposed to assuming the population was not in equilibrium conditions with a similar magnitude of catch.

F. Do a new model assuming a logistic selectivity pattern (estimated) for the triennial survey and using the working model (Request C). Produce a table of likelihoods for all components, biomass trajectories and depletion. Show the fits to the triennial proportion at length data, CPUE series, and surveys.

Reason: To see the effect of the current selectivity pattern on the estimates of recruitment in the recent period.

G. Produce a model with separate blocks of selectivity for the southern recreational fleet pre and post 2003. Use the working model (Request C). You may have to extend the last block including earlier years to get convergence.

Reason: Determine the effect of a constant selectivity on the magnitude of recruitment given that the fishery may have changed due to management.

Round 1 responses

The STAT provided full responses for requests A, C, and D and a partial response for E.

A. Data exist to reconstruct rockfish landings back to the 1916 and indicate that the assumed value of 2000 mt for historical average catch may be about 25% high. There are important spatial and temporal gradients in the development of the rockfish fishery that will require careful consideration in a thorough catch reconstruction.

C. This run configuration resulted in higher initial biomass and initial recruitment. Removal of the last three RecFIN CPUE points had little effect on the biomass trajectory. This configuration was adopted as a reference run for exploratory purposes.

D. The different assumed values for historical equilibrium catches produced minor differences in the biomass trajectories from the mid-60s on but appreciable changes in unexploited spawning biomass and depletion. The higher equilibrium catch resulted in higher unfished biomass but lower 1950 biomass. The lower equilibrium catch had similar unfished biomass as the run with 2000 t but slightly higher 1950 biomass. The run confirmed the sensitivity of the model results to the assumed equilibrium catch.

E. Because of array limitations in the SS1 software the request to start the catches in 1916 could not be accommodated. The Panel crafted a revised request for Round 2.

Round 2 requests

H. Do request B given below.

Determine the co-occurrence of other species in RecFIN trips that caught bocaccio from 1993-2006. For trips that caught bocaccio, produce the proportion of those trips that also caught other species (only the top 20 or so).

Reason: Attempt to distinguish near shore from offshore fishing using co-occurrence of species in the RecFIN source, to confirm no change in recreational fishery selection patterns in recent years.

I. Do request F given below.

Do a new model assuming a logistic selectivity pattern (estimated) for the triennial survey and using the working model (Request C). Produce a table of likelihoods for all components, biomass trajectories and depletion. Show the fits to the triennial proportion at length data, CPUE series, and surveys.

Reason: To see the effect of the current selectivity pattern on the estimates of recruitment in the recent period.

J. (a modification of request E).

Do a new model run starting in 1930 (due to SS1 constraints) with no equilibrium catch and catches after 1930 until the start of the measured catches set at 2000t. This will be done using the working model (Request C). Output the biomass trajectories and depletion.

Reason: To demonstrate the effect of assuming equilibrium conditions as opposed to assuming the population was not in equilibrium conditions with a similar magnitude of catch.

K. Do request G given below.

Produce a model with separate blocks of selectivity for the southern recreational fleet pre and post 2003. Use the working model (Request C). You may have to extend the last block including earlier years to get convergence.

Reason: Determine the effect of a constant selectivity on the magnitude of recruitment given that the fishery may have changed due to management.

Round 2 responses

H. The STAT examined RecFIN species composition data from the northern CA region (north of Point Conception). Data from southern CA were not readily available. The analysis of species caught during trips that caught bocaccio rockfish showed higher proportions of shallow-water species in recent years, implying that the recreational fishery shifted nearer shore where one might expect to find more small bocaccio. Thus the strength of the 2003 recruitment could be an artefact of changes in selection by the recreational fishery. The STAT noted that small bocaccio generally show up first in the southern recreational fishery, presumably because they recruit in the south and then move north.

I. In the 2003 base model the triennial survey selection was domed with a limited size range of small fish being fully selected. In the requested model, with asymptotic selection for the triennial survey, all sizes were fully selected. There was very little change in the estimated biomass trajectories or the estimates of recruitment.

J. The requested model, which started catches of 2000t in 1930, had a very different early biomass trajectory than the reference model or the 2003 base model, both of which assumed that the stock prior to 1950 was in equilibrium with annual removals of 2000t. The differing results may have been due to the very limited number of years available for the transition from unfished to fished conditions (due to the SS1 limit on array sizes). Also, the STAT reported that the model had difficulty converging.

K. The STAT accomplished this request by setting up a separate southern recreational fishery rather than with time-blocks. The two fisheries had identical descending limbs for their selection curves but the ascending limbs were free to change. The selection curve for the recent fishery was right-shifted and resulted in a slightly larger estimate for the 2003 year-class and slight lower estimates for earlier recruitment.

Third Round Requests

L. Do request H given below.

Determine the co-occurrence of other species in southern RecFIN trips that caught bocaccio from 1993-2006. For trips that caught bocaccio, produce the proportion of those trips that also caught other species (only the top 20 or so).

Reason: Attempt to distinguish near shore from offshore fishing using co-occurrence of species in the RecFIN source, to confirm no change in recreational fishery selection patterns in recent years.

Round 3 responses

L. The response to the original request (H) did not include an analysis for southern CA. The STAT obtained the required RecFIN data and conducted an analysis of changes in species composition, similar to the one presented in response H. The analysis showed higher proportions of deep-water species in recent years, implying that the recreational fishery shifted offshore where one might expect to find fewer small bocaccio. This finding is consistent with the results shown by response K: a shift in selection to bigger fish and a larger estimate for the strong 2003 year-class.

Final base model description

The update assessment had the same base model configuration as the 2005 update and the original 2003 assessment, but included length-compositions and survey index data for recent years and used refreshed modern landings data (post-1977).

Comments on the technical merits and/or deficiencies of the assessment

The same technical merits and deficiencies remain as in the 2003 assessment (see the 2003 and 2005 STAR Panel reports).

Areas of disagreement regarding STAR Panel recommendations

There were no areas of disagreement with respect to the update or the objectives of what would be accomplished during the STAR Panel review, either among the STAR Panelists or between the STAR and the STAT.

Unresolved problems and major uncertainties

The same unresolved problems and major uncertainties remain as in the 2003 assessment (see the 2003 and 2005 STAR Panel reports).

Concerns raised by GMT and GAP representatives during the meeting

No issues were raised.

Recommendations for future research and data collection

The 2003 and 2005 STAR Panel reports provide numerous recommendations, many of which are still relevant but have not been acted upon. The STAR Panel makes the following additional recommendations.

For the next bocaccio rockfish stock assessment

- The issues raised by previous STAR Panels should be thoroughly reviewed.
- The next assessment of bocaccio rockfish should be a full assessment and should use SS2 or some comparable modeling platform.
- All the bocaccio rockfish data need a critical review and potential revision before being included in the next assessment. Of particular concern are adjustments for bag-limit and other management-induced changes, the derivation of length-composition data, and the basis and selection of data sources to include in the assessment. The next assessment document should provide thorough and comprehensive documentation of the data sources and statistical models used in processing the data.
- Assumptions about stock structure and boundaries should be reviewed in light of information on catches of bocaccio rockfish taken off Mexico, Oregon, and Washington.
- The bocaccio rockfish catch history should be reconstructed using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. The STAR Panel notes that the SWFSC has made significant progress in retrieving detailed historical landings data, which will facilitate catch reconstructions. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical rockfish landings needs to be done comprehensively across all rockfish species to ensure efficiency and consistency.
- Length frequency data, which are collected seasonally, should be modeled accordingly. This could be accomplished within the stock assessment model or externally by converting length-compositions to age-compositions, as has been done in New Zealand (Hicks et al. 2002).
- The new assessment model and data should be configured to explore cohort- and/or year-specific growth. Again, this could be done within the stock assessment model or externally by converting length-compositions to age-compositions.

For the longer term

- Age-reading of bocaccio otoliths should be pursued.
- Develop a fishery independent time series using fixed sites and volunteer anglers who use standard protocols and are properly supervised.
- Establish a meta-database that provides a comprehensive overview of all relevant data sources and sufficient information to correctly interpret the data.
- Establish an accessible database for rockfish catch histories by species, including envelopes of high and low values for each species to set bounds for exploration of alternative catch histories.

- Relevant raw data, updated in a timely manner, should be readily accessible to assessment authors in on-line databases that are user-friendly.
- Develop comprehensive descriptive analyses of recreational fisheries and fleets to assist in interpretation of recreational CPUE and length-composition data.
- Develop standard and validated methods for producing recreational CPUE indices that adequately deal with the influence of regulation changes and the peculiarities of the recreational data collection systems. The method of Stephens and MacCall for filtering recreational fishing trips is promising but remains largely unvalidated.
- Develop a concise set of documents that provide details of common data sources and methods used for analyzing the data to derive assessment model inputs.

Acknowledgements

The staff at the SWFSC Santa Cruz laboratory provided excellent hospitality and support for the STAR meeting. The Panel especially thanks Steve Ralston for making certain we were well provisioned.

References

Hicks, A.C., Cordue, P.L., and Bull, B. 2002: Estimating proportions at age and sex in the commercial catch of hoki (Macruronus novaezelandiae) using length frequency data. New Zealand Fisheries Assessment Report 2002/43. 51 p.

SSC Review Draft

August 22, 2007

Status of the Chilipepper rockfish, *Sebastes goodei*, in 2007

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EXECUTIVE SUMMARY

Stock Structure: This assessment applies to the chilipepper rockfish (*Sebastes goodei*) in the waters off of California and Oregon, in the region bounded by the U.S./Mexico border in the south through the Columbia River in the north. Although the distribution is described in the literature as ranging from Queen Charlotte Sound (British Columbia) to Bahia Magdalena (Baja California Sur), the region of greatest abundance is found between Point Conception and Cape Mendocino, California.

Catch History: Chilipepper rockfish have been one of the most important commercial target species in California waters since the 1880s, as well as an important recreational target in Southern California waters historically, and an important recreational target in central and northern California more recently (following the movement of recreational fishing effort to deeper waters in the 1970s and 1980s). Catches were estimated to have begun in 1892, and are estimated to have ranged from several hundred to nearly 1000 tons throughout the first half of the 20th century. Gear types are grouped into four general categories; trawl, hook and line, setnet, and recreational; since World War II a majority has been taken with trawl gear, although hook and line, setnet, and recreational gear have accounted for between 20 and 40% of landings for most of the last three decades. As early rockfish landings were only reported at the genus level, a combination of historical data and publications, as well as anecdotal accounts of early line, trawl, and recreational fisheries, were used to reconstruct the fraction of catch by gear and sector assumed to be chilipepper. Estimated landings from foreign fisheries from the mid-1960s through the mid-1970s were included as part of the trawl fishery. Throughout most of the past three decades, domestic landings have ranged between approximately 2000 and 3000 tons, however since 2002 landings have averaged less than 100 tons per year (Table E1, Figure E1), primarily a consequence of area closures implemented to rebuilding depleted co-occurring species such as bocaccio (*S. paucispinis*) and canary (*S. pinniger*) rockfish. Discards are assumed to be negligible in the historical period, however regulatory discards have been substantial in recent years, more than doubling the total catch relative to landings since 2002.

Table E1: Recent commercial and recreational landings (mt, excludes discards)

Year	Trawl	Hook/line	Setnet	Recreation
1995	1595	325	94	7
1996	1528	254	58	30
1997	1614	339	83	73
1998	1138	209	78	5
1999	839	104	10	24
2000	403	51	6	39
2001	436	25	5	52
2002	162	3	0.2	12
2003	18	0.2	0.1	0
2004	61	3	1	6
2005	60	3	0.1	4
2006	37	6	0.2	1

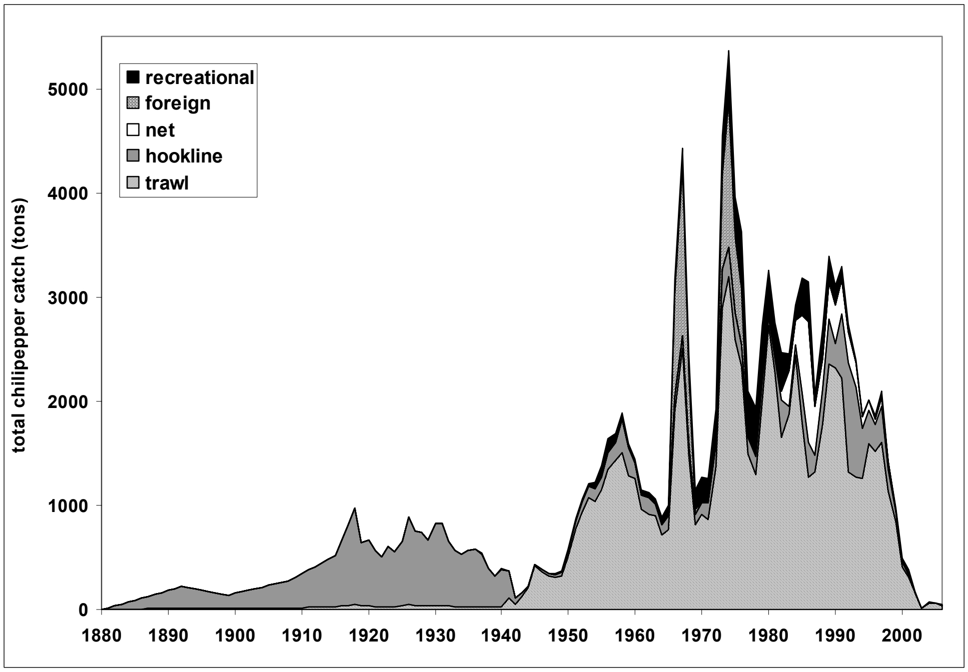

Figure E1: Estimated catches of chilipepper rockfish by major fishery

Data and Assessment: Chilipepper rockfish were last assessed in 1998 (Ralston et al. 1998), at which time they were considered to be above target levels of abundance. From 1978 through 2006, commercial catches and demographic (age and length composition) data for California were obtained from the CalCOM database, those from Oregon were obtained from the PacFIN database, and recreational catches and length composition data were obtained from the RecFIN database beginning in 1981 (with interpolation of landings in missing years). Indices of relative abundance used in the assessment model included a catch per unit effort index from commercial trawl logbooks (from 1980 to 1996, developed and used in the 1998 assessment), an index of relative abundance from a recreational observer program (1987-1998), an index of relative abundance based on the triennial trawl survey (1980-2004), an index of relative abundance based on the Northwest Fishery Science Center Combined Survey (2003-2006), and a coastwide index of pelagic age-0 juvenile abundance developed by combining data from both the SWFSC and NWFSC/PWCC juvenile survey data. Several other potential sources of information were evaluated in earlier models and are discussed in the assessment documentation, although they were not used in the final model. The population was modeled using an age and size structured statistical model, Stock Synthesis II (SS2), version 2.00c, the modeling framework used for most West Coast groundfish assessments.

Unresolved Problems and Major Uncertainties

The length composition data was down-weighted when associated age-composition data were available, however the approach was acknowledged to be ad-hoc. A more appropriate approach is to use conditional age-at-length compositions, which should be explored in more detail in future modeling efforts.

The results from the convergence tests with randomly jittered starting parameter values indicated that the likelihood surface is very irregular. In general, biomass trajectories and other critical results do not appear to be sensitive to these differences.

The application of a combined age- and length- based selectivity curve for the recreational CPFV data is somewhat non-traditional and would benefit by either more detailed investigation or an alternative selectivity configuration (an age-based, sex-specific selection curve showed considerable promise).

Future (post-1999) year class strength is highly uncertain; although this model includes highly informative projections through 2006 based on juvenile abundance indices, the failure of the historical (core area) juvenile index to capture much of the year class variability that has been observed is cause for some concern.

The current approach for implementing time-varying growth would benefit by additional data (particularly fishery-independent size at age data), the use of conditional age-at-length data, and more comprehensive efforts to link variability in growth to climate conditions.

Stock Status: This assessment estimates that the spawning biomass of chilipepper rockfish (*Sebastes goodei*) has increased substantially in recent years, due to a strong 1999 year class as well as greatly reduced harvest rates in commercial and recreational fisheries. The base model result suggests a spawning biomass of 23,889 tons in 2006, corresponding to approximately 70% of the unfished spawning biomass of 33,390 tons and representing a near tripling of spawning biomass from the estimated low of 8696 tons (26% of unfished) in 1999 (Figure ES-1). As both commercial and recreational fisheries for chilipepper rockfish have been greatly reduced in recent years due to management measures implemented to rebuild depleted rockfish, it is likely that the stock will continue to increase modestly in the longer term under assumptions of equilibrium recruitment.

Table E2: Recent trends in chilipepper rockfish spawning biomass and relative depletion

year		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	*2007*
Summary biomass		17008	16453	15865	14578	13635	13573	18556	23175	27023	30022	31509	32405	*32401*
Spawning biomass		9812	9589	9489	8968	8666	9029	9536	12671	17040	20229	22146	23224	*23827*
~95 confidence limits on spawning biomass														
	lower	8418	8033	7743	7046	6608	6734	7044	9281	12336	14616	15984	16773	
	upper	11259	11202	11296	10953	10785	11379	12080	16125	21830	25948	28424	29797	
depletion		0.29	0.29	0.28	0.27	0.26	0.27	0.29	0.38	0.51	0.61	0.66	0.70	*0.71*
~95 confidence limits on depletion														
	lower	0.25	0.24	0.23	0.21	0.2	0.2	0.21	0.28	0.37	0.44	0.48	0.5	
	upper	0.34	0.34	0.34	0.33	0.32	0.34	0.36	0.48	0.65	0.78	0.85	0.89	

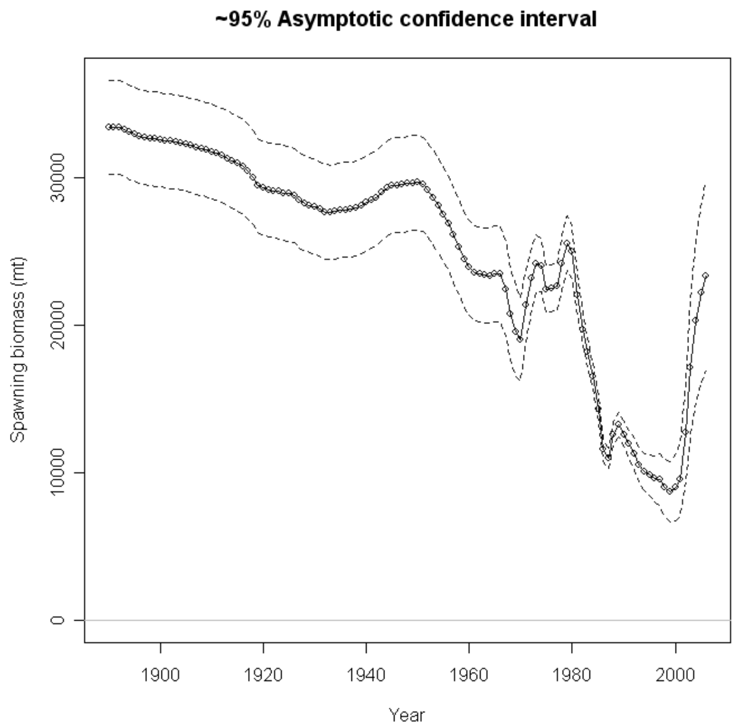

Figure E2: Estimated trajectory of spawning stock biomass over the modeled period.

Recruitment

An extremely strong 1999 year class represents the largest estimated historical recruitment, and is the primary cause for the current population trajectory. A year class of comparable strength was also observed in 1984, and the model suggests a series of strong year classes in the late 1960s and early 1970s as well. There are no obvious signs of strong year classes since 1999, and coastwide pelagic juvenile surveys suggest average to low recruitment in recent years, suggesting that the stock may dip slightly in the near term. The projected low recruitments in 2005 and 2006 are based exclusively on the coastwide pelagic juvenile rockfish survey index, which is of short duration and has yet to be validated.

Table E3: Estimated recruitment (1000s) for the recent (1995-2006) period

year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	*2007*
recruits	15080	6555	7584	12569	153415	3708	15148	23831	14082	25895	7647	6645	*32063*
~95 confidence limits on recruitment													
lower	8031	1399	2723	4260	104994	0	9036	14220	8380	15385	4546	3959	
upper	22095	11691	12465	20936	202966	8023	21322	33540	19842	36511	10779	9358	

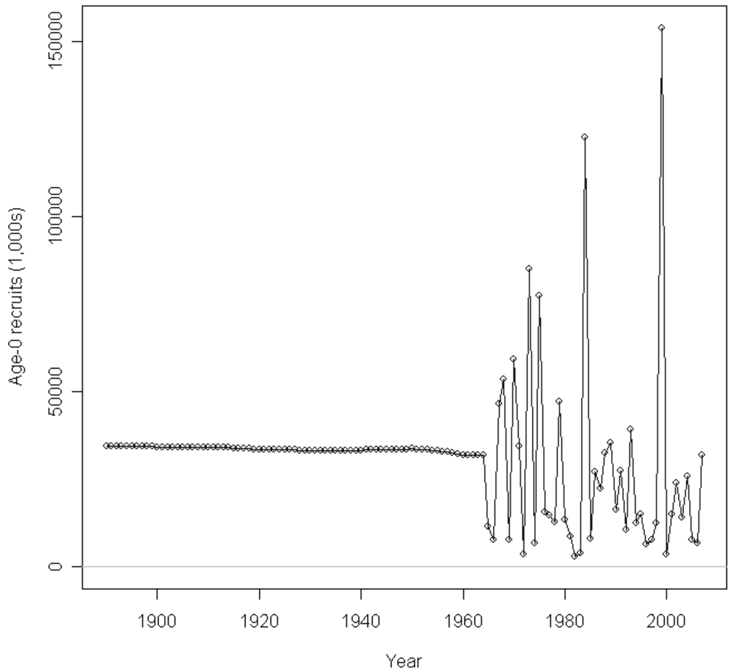

Figure E3: Estimated recruitment over the modeled time period

Exploitation Status: Although chilipepper rockfish have been a commercially important species in California waters since well before the second World War, the exploitation rate has rarely exceeded the current target exploitation rate (SPR 50%). The highest exploitation rates occurred from the late 1980s through the mid 1990s, when they were above target levels and the stock was approaching it's lowest estimated historical levels. From the late 1990s through the present, exploitation rates have been declining significantly, as a result of management measures implemented to rebuild other depleted rockfish species.

Table E4: Estimated exploitation rate (catch/sum bio) for the recent historical period

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Expl. Rate	0.119	0.113	0.133	0.098	0.071	0.037	0.028	0.014	0.001	0.008	0.006	0.004

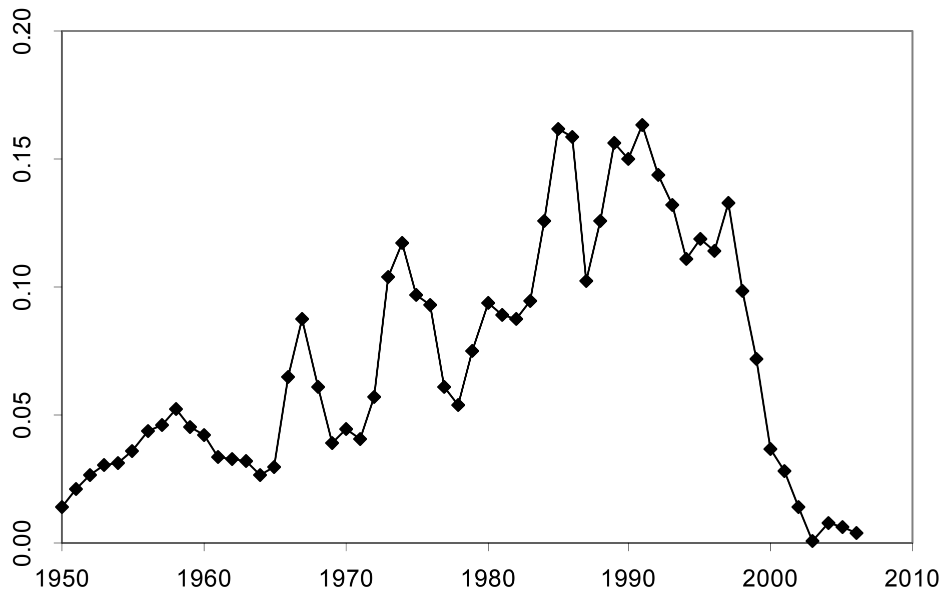

Figure E4: Estimated exploitation rate over the post-World War II period.

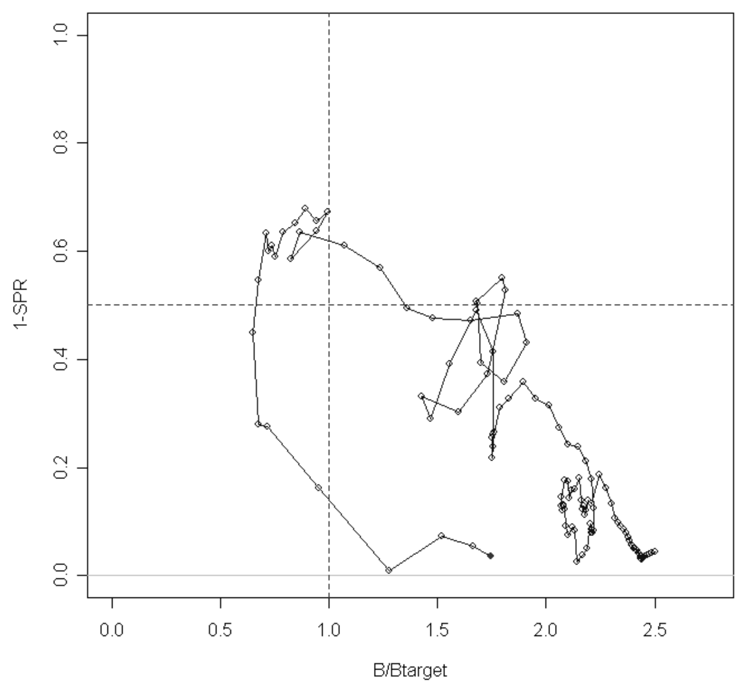

Figure E5: SPR relative to stock status through the modeled period

Reference Points

For rockfish of the genus *Sebastes*, the proxy for B_{MSY} is estimated to be 40% of the unfished spawning stock biomass (SSB_0), and the stock is considered to be overfished if the SSB drops below 25% of SSB_0. The proxy for MSY is estimated to be the harvest rate associated with a spawning potential ratio (%SPR) of 50%, which is a measure of the expected spawning biomass per recruit at the current population level relative to that at the stock's unfished condition (allowing for direct comparison of fishing mortality rates among fisheries with different selectivity patterns). The estimated MSY proxy (harvest associated with an SPR of 50%) for this assessment is 2099 tons, based on the relative proportion of total catches by fishery assumed in the last year for which data were available (2006), however this in no way intended to imply a de facto sector allocation. The estimated MSY value will change modestly depending upon allocation among fisheries with differing selectivity curves. With a greater proportion of catch allocated to fisheries that are selective at younger ages (trawl and recreational fisheries) the total yield would increase slightly, while if a greater fraction were allocated to hook and line or setnet fisheries, the total equilibrium yield would decrease slightly. Estimates of maximum sustainable yield based on a target equilibrium spawning biomass of 40% of the unfished spawning biomass, or on the model-estimated MSY, were very modestly greater than the $F_{50\%}$ SPR proxy for MSY.

Table E5: Summary of reference points for chilipepper rockfish

		~95% Confidence Limits	
Unfished Stock	Estimate	Lower	Upper
Summary (1+) Biomass	45057		
Spawning Biomass (SSB)	33390	30138	36642
Equilibrium recruitment	34490	31131	37849

	SPR proxy MSY	$SB_{40\%}$	Estimated MSY
SPR	0.50	0.45	0.43
Fmult (2006)	25.2	29.9	33.0
Exploitation rate	0.088	0.102	0.112
Yield	2099	2155	2164
SSB at Equilibrium	15482	21034	12126
SSB/SSB_0	0.46	0.40	0.36

Forecasts

Projections of future biomass were made for three possible catch stream scenarios; status quo (2006) catches and the catch associated with $F_{50\%}$ fishing mortality. Under all projections, selection curves were unchanged and the relative proportion of the catch by fishery was assumed to be at the 2006 value for ease of computation. In the $F_{50\%}$ projections, the 2007 and 2008 catches were assumed to be at status quo (2006 levels), as it is unlikely that catches could be significantly increased prior to the 2009-2010 management cycle, and as the spawning biomass was greater than 40% of the unfished level the OY was assumed to be equal to the ABC, and assumed to be fully achieved.

Table E6: Two alternative forecasts of Catch, Spawning Biomass and Depletion

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
status quo catch	127	127	127	127	127	127	127	127	127	127	127	127
SSB	23827	23285	22379	21574	21199	21226	21531	22011	22587	23211	23846	24473
Depletion	0.71	0.70	0.67	0.65	0.63	0.64	0.64	0.66	0.68	0.70	0.71	0.73
F50% catch	127	127	3037	2576	2229	2013	1901	1852	1831	1822	1814	1804
SSB	23827	23285	22379	19139	16940	15629	14911	14530	14312	14164	14041	13928
Depletion	0.71	0.70	0.67	0.57	0.51	0.47	0.45	0.44	0.43	0.42	0.42	0.42

Decision Table

The alternative states of nature used in the decision table were developed in conjunction with the STAR Panel, which considered a variety of potentially appropriate sources of uncertainty. As steepness was thought to be poorly specified for this model (perhaps more so than the natural mortality rate), the lower and upper 25% of the prior probability distribution for steepness based on the informative prior developed (but not used) in the assessment represented a reasonable means of bracketing uncertainty. As steepness was fixed at the point estimate for the prior (0.57) in the base model, the alternative states of nature were consequently 0.34 (low productivity) and 0.81 (high productivity). The three catch streams used in the decision table were developed in coordination with the Groundfish Management Team (GMT) and Groundfish Advisory Subpanel (GAP) representatives to the STAR Panel, and represented "status quo" catches (based on estimates of the 2006 catch, including estimates of discards), equilibrium MSY catches (based on the SPR 0.50 harvest strategy), and ABC catches (based on the 40:10 harvest control rule). In all cases, the 2006 total catch estimates were used to apportion theoretical future catches among gear types, importantly this was done to facilitate comparable evaluation of plausible stock trajectories under different states of nature, and in no way implies a recommended or de facto sector allocation.

Rebuilding Projections

The chilipepper rockfish stock is estimated to be well above the overfished level, such that no rebuilding is required.

Table E7: Decision Table

					Low Productivity h=0.34		**BASE MODEL h=0.57**		**High Productivity h=0.81**	
	"Status quo" (2006) catches				SSB0	40568	SSB0	33390	SSB0	30489
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18542	0.46	23827	0.71	26482	0.87
2008	105	18	0.5	4	17887	0.44	23285	0.70	25949	0.85
2009	105	18	0.5	4	16995	0.42	22379	0.67	24991	0.82
2010	105	18	0.5	4	16255	0.40	21574	0.65	24072	0.79
2011	105	18	0.5	4	15929	0.39	21199	0.63	23526	0.77
2012	105	18	0.5	4	15966	0.39	21226	0.64	23347	0.77
2013	105	18	0.5	4	16239	0.40	21531	0.64	23436	0.77
2014	105	18	0.5	4	16645	0.41	22011	0.66	23704	0.78
2015	105	18	0.5	4	17118	0.42	22587	0.68	24082	0.79
2016	105	18	0.5	4	17624	0.43	23211	0.70	24522	0.80
2017	105	18	0.5	4	18141	0.45	23846	0.71	24986	0.82
2018	105	18	0.5	4	18661	0.46	24473	0.73	25451	0.83
	"MSY" catches (base model)									
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18542	0.46	23827	0.71	26485	0.87
2008	105	18	0.5	4	18325	0.45	23917	0.72	26652	0.87
2009	1735	292	7	64	17684	0.44	23385	0.70	26111	0.86
2010	1735	292	7	64	15560	0.38	21270	0.64	23899	0.78
2011	1735	292	7	64	14111	0.35	19814	0.59	22259	0.73
2012	1735	292	7	64	13216	0.33	18934	0.57	21149	0.69
2013	1735	292	7	64	12644	0.31	18440	0.55	20424	0.67
2014	1735	292	7	64	12199	0.30	18171	0.54	19956	0.65
2015	1735	292	7	64	11776	0.29	18019	0.54	19650	0.64
2016	1735	292	7	64	11333	0.28	17921	0.54	19446	0.64
2017	1735	292	7	64	10863	0.27	17845	0.53	19302	0.63
2018	1735	292	7	64	10369	0.26	17779	0.53	19194	0.63
	40:10 Catches									
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18652	0.46	23827	0.71	26366	0.86
2008	105	18	0.5	4	17994	0.44	23285	0.70	25836	0.85
2009	2507	429	12	89	17099	0.42	22379	0.67	24882	0.82
2010	2127	364	11	75	13923	0.34	19139	0.57	21533	0.71
2011	1847	308	9	65	11785	0.29	16940	0.51	19164	0.63
2012	1679	266	8	60	10501	0.26	15629	0.47	17650	0.58
2013	1594	241	7	59	9739	0.24	14911	0.45	16734	0.55
2014	1558	228	6	60	9204	0.23	14530	0.44	16194	0.53
2015	1543	223	6	61	8719	0.21	14312	0.43	15874	0.52
2016	1535	220	5	62	8208	0.20	14164	0.42	15681	0.51
2017	1528	219	5	62	7654	0.19	14041	0.42	15561	0.51
2018	1520	218	5	62	7068	0.17	13928	0.42	15486	0.51

Table E8: Summary Table for chilipepper rockfish

year		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	*2007*
Summary biomass		17008	16453	15865	14578	13635	13573	18556	23175	27023	30022	31509	32405	*32401*
Spawning biomass		9812	9589	9489	8968	8666	9029	9536	12671	17040	20229	22146	23224	*23827*
~95 confidence limits on spawning biomass														
	lower	8418	8033	7743	7046	6608	6734	7044	9281	12336	14616	15984	16773	
	upper	11259	11202	11296	10953	10785	11379	12080	16125	21830	25948	28424	29797	
depletion		0.29	0.29	0.28	0.27	0.26	0.27	0.29	0.38	0.51	0.61	0.66	0.70	*0.71*
~95 confidence limits on depletion														
	lower	0.25	0.24	0.23	0.21	0.2	0.2	0.21	0.28	0.37	0.44	0.48	0.5	
	upper	0.34	0.34	0.34	0.33	0.32	0.34	0.36	0.48	0.65	0.78	0.85	0.89	
recruits		15080	6555	7584	12569	153415	3708	15148	23831	14082	25895	7647	6645	*32063*
~95 confidence limits on recruitment														
	lower	8031	1399	2723	4260	104994	0	9036	14220	8380	15385	4546	3959	
	upper	22095	11691	12465	20936	202966	8023	21322	33540	19842	36511	10779	9358	
ABC		4000	4000	4000	3400	3724	3681	2700	2700	2700	2700	2700	2700	*2700*
OY						3724	2000	2000	2000	2000	2000	2000	2000	*2000*
total catch		2021	1870	2110	1430	977	499	517	329	21	236	192	127	*n/a*
expl. rate		0.119	0.114	0.133	0.098	0.072	0.037	0.028	0.014	0.001	0.008	0.006	0.004	*n/a*
SPR		0.40	0.37	0.45	0.55	0.72	0.72	0.84	0.99	0.93	0.95	0.96	0.97	0.97

Research and Data Needs

Additional investigations into the catch history should be made, ideally as a part of a greater reconstruction of historical rockfish landings done comprehensively across all species.

Greater exploration of methods for modeling time-varying growth as influenced by environmental factors should be a key research area for future assessments, and would benefit greatly from data from historical (triennial trawl) and recent (NWC combined) surveys.

The effects of spatial management measures on patterns of vulnerability and selectivity over time have not been evaluated, and would benefit from generic simulation studies of the consequences of spatially explicit management measures to the basic assumptions of stock assessment models.

Regional Management Concerns

There are insufficient data to consider spatial structure in the model. Although the CalCOFI time series (which was not used in the final model) might suggest greater relative depletion south of Point Conception, this time series has some unusual characteristics that undermine its utility as an index of abundance. As there is only very limited fisheries dependent information in this region, and only a very short (four years) time series of fishery independent information (with low sampling density), there is insufficient information to assess regional concerns. However, as abundance appears to drop sharply towards the U.S./Mexico border, transboundary issues are minimal for this stock.

Status of the Chilipepper rockfish, *Sebastes goodei*, in 2007

Introduction and distribution

Chilipepper rockfish (*Sebastes goodei*) are described as an elongate fish with reduced head spines similar in appearance to both shortbelly rockfish (at smaller sizes, although shortbelly tend to be slimmer) and bocaccio rockfish (bocaccio tend to have larger mouths). The latin name honors that 19th century ichthyologist and fisheries biologist David Brown Goode (Love et al. 2002), while the common name was derived from the observation that long strings of these bright red fish resemble a string of drying chilis (Davis 1978). They have been one of the most important commercial target species in California waters since the 1880s, particularly in this core region, and were historically an important recreational target in Southern California waters. Their importance in recreational fisheries in northern waters followed the movement of recreational fishing effort to deeper waters in the 1970s and 1980s, prior to which catches were apparently minimal.

The distribution is described in the literature as ranging from Queen Charlotte Sound (British Columbia) to Bahia Magdalena (Baja California Sur)(Westrheim 1965; Eschmeyer 1983; Love et al. 2002), however they are uncommon north of Cape Blanco (Oregon) and south of Punta Colnett (Baja California Norte). The region of greatest abundance is found between Point Conception and Cape Mendocino, California. Alverson et al. (1964) reported only trace catches of chilipepper rockfish in resource surveys conducted in the 1960s off of Oregon and Washington, all of which was noted between 100 and 150 fathoms. Adult fish tend to be most abundant in large schools between 100 and 300 meters, often in midwater. Settled juveniles tend to be found in shallow water, and move to greater depths with size and age. Love et al. (2002) describe the habitat of adult schools as including boulder fields and other high relief substrata, and occasionally low-relief cobblestones.

Like all rockfish, chilipepper are primitively viviparous and bear live young at parturition. They copulate during September-October and extrude their larvae from December-February (Wyllie Echeverria 1987). Larvae and juveniles have an extended pelagic phase of about 150 days, consequently the spatial dispersal of larvae likely links recruitment among areas. Field and Ralston (2005) evaluated spatial patterns in recruitment variability based on regional catch at age data and concluded that recruitment is largely synchronous throughout most of the range of chilipepper in the California Current between Cape Blanco and Point Conception, although there were insufficient data to evaluate chilipepper south of Point Conception. Wishard et al. (1980) conducted the only known study of stock structure, from samples collected between 34 and 40 N, and they concluded that chilipepper was unusual in its very low levels of allozyme variability, with no suggestion of population substructure. In an extensive review of phylogenetic relationships among *Sebastes*, Hyde and Vetter (2007) found that chilipepper rockfish were most closely related to both shortbelly (*S. jordani*) and bocaccio (*S. paucispinis*) rockfish, with a lineage that dated back approximately 6 million years.

Although there are no quantitative food habits studies of this species, they are described as midwater foragers, with euphausiids, forage fishes (such as anchovies, Pacific hake, and mesopelagic fishes), and small squids among key prey items (Love et al. 2002). Pelagic juveniles are preyed upon by a wide range of predators, including seabirds, salmon, lingcod and marine mammals. Larger piscivorous fishes, marine mammals, and in recent years jumbo squid are among the predators of larger adults.

Growth and Maturity

The most recent assessment (Ralston et al. 1998) provides a summary of previous estimates of chilipepper growth parameters, dating back to Phillips (1964). Age and length data were available for over 16,000 males and 30,000 females, however most of these data were fisheries derived. The external fits are shown (Figures 1a and 1b), comparable parameter values estimated internally from an early draft of the model that included conditional catch-at-age information were used in the base model as fixed parameters. As the previous assessment reported significant variation in size at age, potentially confounded with changes in selectivity over time, time varying growth was explored in some detail for this assessment. Figures 2a and 2b shows the average size at age from the commercial trawl fishery over time, as both annual averages and a 3-year running mean for fish ages 3, 6 and 9. These data suggest a gradual decline in size at age from the late 1970s and early 1980s, with a slight bump in the late 1980s, followed by low values in the 1990s and increasing values since 1999. Consequently, changes in the size at age were explored in this model.

Weight at length was estimated separately for males and females, based on data from 233 females and 220 males for which this information was collected during triennial trawl surveys (Figures 3a and 3b). Although maturity could vary both as a function of length and age, for the purposes of this model, maturity was fit with a logistic regression model as a function of length (Figure 4).

Natural Mortality

In the last chilipepper stock assessment, Ralston et al. (1998) estimated sex-specific values of natural mortality internally; for females the model estimated a natural mortality rate of 0.223 and for males the model estimated M = 0.253. Prior to that assessment, Rogers and Bence (1993) assumed a natural mortality rate of 0.15 - 0.20, and Henry (1986) had used a value of 0.20. In earlier assessments, the maximum observed age of chilipepper was 35 years, which corresponds to an estimate of Z = 0.12 from Hoenig's (1983) equation. However, Ralston et al. (1998) also note that application of the Jensen (1997) equation to the estimated K values obtained for the two sexes yielded M values in the range of 0.28 - 0.34. In order to evaluate Beverton's (1992) approach relating the age at 50% maturity to the natural mortality rate, we compiled data on age at maturity and estimated natural mortality for all West Coast groundfish stocks as well as four Gulf of Alaska rockfish stocks (Figure 5). The resulting relationships were used to develop point estimates of natural mortality for chilipepper rockfish, based on an estimated age at 50% maturity of 2.5. These provided point estimates of M of 0.17 based on all West Coast and Gulf of Alaska *Sebastes* (n=15), and 0.24 based on all West Coast groundfish (n=22). Despite the fact that each relationship had an R^2 of ~0.75, no attempt was made to develop confidence intervals or informative priors based on any of these estimates, in keeping with the guidance developed in the Harvest Policy workshop. This report emphasized the significant limitations associated with deriving a relationship between M and life history characteristics, and stressed that in the absence of a genuine scientific advance in estimating natural mortality rates, continuity in assumptions regarding natural mortality has a greater priority than any preferences developed by assessment authors.

Despite this, the natural mortality rate used in the last assessment was considered to be too high by the STAT team and the STAR Panel during the review of this stock assessment. Part of the rationale for this likely includes the age data for 1978-1981 that were used or considered in this model, which suggested a greater proportion of older fish in the early years of the fishery. Based on model estimates and model profiles of alternative natural mortality rates conducted prior to and during the stock assessment review, M was fixed at 0.16 for females, and 0.202 for males.

Aging Precision

As surface ageing often underestimates ages of older individuals, the 1980 and 1981 age data (which were originally surface read) were not included in the 1998 model. These samples were re-aged using break and burn methods, and samples from 1978 and 1979 were also aged using break and burn methods, these data are now included in the model. The ages available for four years of the triennial trawl survey were all surface read and are no longer available (to re-read and evaluate for a potential bias correction), and consequently these too are not used in this model. The precision of the age determination process was measured by both comparing the independent readings of two age readers of samples collected in 2004 (n=95), as well as comparing independent readings by the same reader (n=97), as reported in the 1998 assessment). The standard deviation by age for each double read was estimated, and as there was no evidence of bias or of an increasing CV with age, a constant CV based on pooling the two samples was used to project the standard deviation by age in the aging error matrix. However, the precision could be overestimated as the high agreement at older ages could also be due to the small sample sizes, as most fish with two reads were less than ~7 years of age.

Regulatory History

Chilipepper have long been an important element of California fisheries, however with the exception of excluding foreign fishing effort from the U.S. EEZ in the late 1970s, management actions were modest (and usually general to all rockfish and other groundfish) prior to the implementation of the Groundfish Fishery Management Plan in 1982. When the Groundfish FMP was implemented, management for the groundfish trawl fishery was based on individual vessel trip limits, which were set at 40,000 lbs per trip on the Sebastes (all rockfish species) complex. These limits were maintained until 1991, when they were reduced to 25,000; in 1993 the trip limit system was revised from daily to biweekly trip limits, which were set at 50,000 lbs (south of Cape Mendocino). The trip limit regime continued to evolve in their absolute amounts and temporal duration (monthly, bimonthly) throughout the 1990s, with a general trend towards lower limits as conservation concerns arose for other rockfish species (particularly bocaccio rockfish in the region south of Mendocino). Consequently, landings for chilipepper rockfish declined significantly during this period, falling well below the ABCs and OYs implemented by the PFMC. Figure 6 summarizes the major management actions for chilipepper (and rockfish regulations more generally), Table 1 summarizes the ABC and OY values adopted by the Council and the subsequent estimates of total catches (including discards), while Appendix A provides an extensive summary of the management actions relevant to chilipepper rockfish since the implementation of the FMP.

For the current management cycle, the Pacific Fishery Management Council has specified status quo alternatives for chilipepper rockfish south of Cape Mendocino for 2007 and 2008 (ABC 2,700; OY 2,000). Chilipepper rockfish within the Eureka INPFC region are managed within the minor rockfish North category (an assumption that they account for approximately 32 tons of that OY has been made). Recent catches are well below these levels due to the constraints imposed by the rockfish conservation areas, and low trip limits in open areas implemented to ensure low bycatch rates of rebuilding species that co-occur with chilipepper (particularly bocaccio, but including canary, widow, cowcod and yelloweye). Although proposals have been repeatedly developed that would facilitate accessing the existing chilipepper OY, a paucity of bycatch data in southern areas for many gear types as well as coastwide bycatch constraints have repeatedly prevented liberalization of trip limits or approval of Experimental Fishing Permits (EFPs) in recent years.

Commercial Fisheries Landings

Chilipepper have historically been one of the most important rockfish species in California fisheries. Commercial landings from 1978 to the present were obtained directly from the California Cooperative Survey (CALCOM) database using expansion procedures from sampling commercial market categories (Pearson and Erwin 1997). Chilipepper have been landed primarily in chilipepper, bocaccio and mixed rockfish market categories. In a recent evaluation of market categories of the commercial fishery, chilipepper rockfish scored high on an index of reliability (D. Pearson, NMFS/SWFSC, pers. comm.), and landings from 1978 to the present are consequently considered to be accurate.

Landings of rockfish (all species combined) in California were recorded in CDFG Fisheries Bulletins from 1928 through 1978 by region (Del Norte/Eureka, San Francisco, Monterey, Santa Barbara, Los Angeles, and San Diego), shown as Figure 7a and 7b (digitized summaries of these catches can be queried online http://las.pfeg.noaa.gov:8080/las_fish1/servlets/dataset). We used these landings to derive catch estimates for the early time period. For the period prior to 1928, we used rockfish landings reported by Sette and Fiedler (1928), who report landings irregularly from 1892 through 1926. Landings are interpolated between unreported years, and assumed to be zero prior to 1892. Although paranzella trawling (and later otter-board trawling) have been an important source of marine fisheries landings in California since 1876, most of the trawl catch in early years was composed of flatfish (petrale and English sole) fished over soft bottom (Clark 1936). Wolford (1930) describes hook and line, set lines, long lines, and hand lines as being the primary gears used in rockfish fisheries prior to World War II, and Phillips (1949) estimates that only about 5% of the early rockfish landings were from trawl-caught fish. Thus, we assume 95% of all rockfish landings prior to 1943 to be hook and line caught, and 5% to be trawl caught.

Table 2 provides estimates based on Sette and Fiedler from 1880 to 1927. Table 3 provides the CDF&G Fisheries Bulletin summaries of total rockfish catch by region, and the assumed proportion of these catches by gear type, and the assumed proportion of each catch estimated to be chilipepper rockfish by region based on the following analysis.

There is little in the way of species composition information for these early fisheries, however Phillips (1939) reported on the species composition of rockfish from the Monterey wholesale fish markets between April 1937 and March 1938, in which 30.8% of the landings by weight were chilipepper rockfish (with 39.4% bocaccio and 7.9% yellowtail rockfish). Monterey Bay ports were the most productive along the coast (accounting for 51% of all landings between 1936 and 1940, with San Francisco accounting for another 20%). Consequently, as landings of rockfish in the Eureka area were minimal until the introduction of the trawl fishery in the 1940s, we assume that 30.8% of California rockfish landings from Santa Barbara north to the Del Norte/Eureka area were chilipepper rockfish until the introduction of the balloon trawl fishery in 1943. Based on the earliest estimate of species composition in the Del Norte/Eureka area (see below), we assume that 5.7% of rockfish landed in this region were chilipepper (note that landings in this region were minimal until 1943). The species composition of southern California rockfish fisheries is not quantified in historical accounts, however chilipepper are cited by Wolford (1930) as being the "second most important rockfish in southern California rockfish fisheries (vermillion are described as the "most important" and bocaccio as "important"). Similarly, Roedel (1948) described chilipepper as "one of three leading Southern California species" (along with vermillion and bocaccio). Even earlier, Jordan and Evermann (1898) had described chilipepper as being "taken in abundance about the Coronados Islands, Santa Catalina, and the Cortez Banks." The 1930s was a period in which landings in Los Angeles and San Diego regions dominated southern California landings, as the Santa Barbara region, including Morro Bay, accounts for only 12% of Southern California landings during this period. Consequently, chilipepper seem to have been historically a significant component of hook and line fisheries throughout Los Angeles and San Diego regions, and we assume that chilipepper accounted for 20% of all Los Angeles and San Diego region rockfish landings from 1928 through 1963.

In 1943 the balloon trawl was introduced to northern California waters from Oregon, in association with a strong market for frozen rockfish by the military to support the war effort. Trawl gear rapidly surpassed hook and line gear in accounting for the majority of California rockfish landings, particularly in the northern ports of Eureka and Fort Bragg (Scofield 1948; Phillips 1949). Thus, through 1940 we assume that 95% of chilipepper were hook and line caught, and we assume that by 1944 90% of the total rockfish (and subsequently, chilipepper) catch was trawl (based on the percentage trawl in later years, see below). Between 1940 and 1944 we assume that rockfish catches were 25, 50 and 75% trawl in 1941, 1942 and 1943 respectively. Trawl caught rockfish continued to comprise approximately 85 to 90% of all rockfish landings throughout the 1960s and early 1970s, and we used the ratio of trawl caught rockfish reported by Nitsos (1965), Orcutt (1969) and Gunderson et al. (1974) to total rockfish landings from CDFG bulletin to apportion the chilipepper catch by gear from 1953 through 1977 based on these observed fractions and interpolation between unobserved periods (Table 4).

To assess the fraction of trawl caught rockfish that were chilipepper, we relied on the very sparse species composition reports included in Nitsos (1965) and Gunderson et al. (1974). Nitsos reported the 1962-1963 species composition by port complex for most California ports (as trawling was then prohibited in nearshore waters south of Santa Barbara, no species composition was reported for that region), these are reported in bold font in Table 4, and these values were used for both trawl and hook-line fisheries from 1942 through 1963 (during the period in which trawl landings dominated). Gunderson et al. (1974) also reported trawl species composition for the year 1973, for all intervening years between 1963 and 1978, the fraction of the catch that was chilipepper rockfish was interpolated between these observed catch compositions and the CalCOM estimates for 1978-1979. Accounting for the catch composition in the Los Angeles and San Diego regions since 1963 is tricky, as most landings were hook and line in this region and no hook and line data for this period is available. However Gunderson et al. (1974) described chilipepper as accounting for 26.4% of the Conception area trawl catch in 1973, and chilipepper continued to be described as important to Santa Barbara hook and line fisheries during this period, although they were not as valuable as the more brightly colored vermillion and other species (Love 1991; Kronman 1999). Consequently we assume the Gunderson et al. (1974) catch proportion for all fisheries throughout Santa Barbara, Los Angeles and San Diego; and interpolate catch proportions from 20% in 1963 to 26.4% in 1973. From 1974 to 1977 we interpolate the 26.4% in Southern California fisheries reported by Gunderson to the CalCOM estimates of 2% of Santa Barbara, 8.1% of Los Angeles, and 2.2% of San Diego rockfish catches. There is clearly a great deal of uncertainty over whether this decline is an artifact of the means by which catches were reconstructed, or reflects changes in abundance or target fisheries, and we acknowledge that the relative importance of chilipepper in Southern California fisheries throughout this period is highly uncertain. For Oregon landings, PacFIN estimates were used for landings from 1981-present, and for 1963-1980 estimated are based on Douglas (1998), who report minimal (and sporadic) chilipepper landings on the Pacific Ocean perch and other rockfish market categories. We assume landings were negligible in Oregon waters prior to 1963. The resulting estimates of chilipepper catch are reported in Tables 5-6 and Figures 8a and 8b.

An alternative catch stream for the period between 1953-1977 was also developed, based on retroactively applying market category species compositions from the 1978-1984 period to CDFG landings data by market category extending back to 1953 (D. Pearson, pers. com.). Based on recently digitized CDFG landings information by block and market category, and applying the species composition for market categories from the 1978-1983 period, the catch of chilipepper rockfish was reconstructed from the period 1953-1968, and CalCOM reconstructions from 1969-1977 were used based on Pearson (in prep). The corresponding total catch estimate is compared to the earlier reconstruction in Figure 9. As these values differed only modestly, the first catch stream was used in the base model, to maintain consistency with the approach used to estimate landings prior to 1953.

Prior to the STAR Panel meeting, but following the distribution of the draft assessment, the STAR Panel Chair (Dr. David Sampson) pointed out that records of rockfish catches (at the genus, not species level) by gear and by region were also available for much of the historical period, as published in Bureau of Commercial Fisheries Reports. A subset of the relative proportion of catch by gear and by region was developed from these records, which reflect strong geographical differences in historical gear type use, with a shift to primarily trawl-caught rockfish in the north to almost exclusively hook and line caught rockfish in the south. Figures 10a-10e show the relative rockfish catch by gear type and district for select years in this period, however there was insufficient time to re-define the initial catch statistics in a timely fashion for consideration in the final. Modest changes between the proportion of catch by gear type are not anticipated to have a major influence on the model results. A number of STAR Panel reviews have lamented the lack of a comprehensive reconstruction of historical rockfish catches by species for California waters, similar to that of Rogers (2003) for foreign fishery catches, and this remains a key stock assessment need. Currently, California fish ticket information with associated market category and CDF&G block number is in the process of being digitized for the period 1928-1977, and a comprehensive rockfish historical catch reconstruction will benefit greatly from the results of this effort. Finally, comparison of the catch estimates used in this model to those used in Ralston et al (1998) are presented as Figures 11a through 11d, which show that although some catch estimates have varied modestly over time, the time series track each other very closely.

Commercial Discards

Heimann and Miller (1960) reported a bycatch rate of approximately 0.8% for chilipepper rockfish taken in 64 bottom trawls off of Morro Bay, California between August 1957 and July 1958. Similarly, Heimann (1963) reported extremely low discard rates for chilipepper rockfish, of approximately 0.4% for a series of 19 intermediate depth tows made between Pigeon Point and Point Sur, California in 1960. Aside from these observations, there is essentially no data available on potential discard rates for any but the most recent years for chilipepper rockfish. As chilipepper are a desirable market category, discards have been assumed to be negligible in past assessments (Ralston 1998), and with the exception of the recent years in which regulatory changes have resulted in high discard rates, we will continue with that assumption.
The estimated commercial discard rates for chilipepper and bocaccio in the Monterey and Conception INPFC areas, derived primarily from observations of the trawl fleet, were 46%, 11%, 70%, and 65% from 2002 through 2005 respectively (as a % of discard+landed). Catches for all gear types for these four years were adjusted proportionately, with the 65% discard rate from 2005 carried over into 2006 (based on Hastie and Bellman 2006, and comparable reports). As the total landings have been minor relative to historical landings in this period, adjustments to this rate for recent years would not be expected to have major consequences to the model results.

Recreational Fishery Landings

Recreational fishing effort in California for fishes other than big game fish such as tunas and salmon was relatively modest in California until about 1928, when Commercial Passenger Fishing Vessels (CPFVs) popularized recreational fishing (Scofield 1928; Croker 1940; Young 1969). Initially, most effort was in the waters of the Southern California Bight, however party boat fisheries soon became popular in Monterey, and although these fisheries were suspended during World War II, effort increased rapidly shortly after the war ended. CPFV captains have been required to submit logbooks detailing catches since 1936, in which species resolution is typically low (typically only “rockfish” is recorded, although some rockfish targets such as cowcod were usually identified to species). Reported CPFV catches in numbers of fish for most years between 1936 and 2000 were available from the CPFV database (Hill and Schneider 1999), with missing years and region-specific information filled in from Young (1969) and Best (1963). Although this database has no estimate of private vessel catches or other fishing modes (shore, pier, neither of which catch chilipepper), and compliance rates have typically been less than 100%, this is the only source of recreational catches prior to 1980, and catch estimates are based on this information as tuned to more recent estimates.

For 1980 through 2006, catches in both numbers of fish and weight of fish were obtained from the RecFIN database. RecFIN data are based on Marine Recreational Fisheries Statistics Survey (MRFSS) catch estimates, which are based on a combination of angler field surveys and randomized telephone surveys from 1980 through 2006 (with a hiatus from 1990 through 1992), with four primary fishing modes; CPFV, private vessel, pier, and shore (only the first two catch notable quantities of chilipepper). Spatial resolution of these catch estimates is limited to northern and southern California (north and south of Point Conception). Table 7 provides RecFIN catch information for chilipepper rockfish in northern and southern (south of Conception) recreational fisheries in numbers, total weight, and average weight from 1980-2006 (with the years 1990-1992 interpolated) by mode (CPFV and private/rental only). Figure 12 also shows the percentage of all rockfish that were estimated to be chilipepper rockfish by region and mode from RecFIN data as well as CDFG observer program data collected from 1975-1978 and 1986-1989 in the south, and 1987-1998 in the north. These percentages were critical to reconstructing historical estimates of chilipepper catches in recreational fisheries.

The reconstruction of recreational catches prior to 1980 is highly dependent on assumptions about the spatial development of this fishery to deeper water over time, particularly in the north, (reconstructions were made separately both north and south of Point Conception). North of Point Conception, it widely held that CPFV fisheries moved from nearshore habitat and target species to deeper and deeper waters over time. Miller and Gotshall (1965) report on the landings, weights, and species composition of northern California recreational fisheries from 1957 through 1961, in which blue, yellowtail, olive, and bocaccio rockfish were among the most important (together accounting for ~65% of the total catch by number). Chilipepper were reported in only trace amounts, accounting for 0.321% of the total observed CPFV rockfish catch (2165 out of 674,678 rockfish reported), and were even more scarce in the private/rental boat (skiff) fishery, where they accounted for 0.004% of observed rockfish (7 out of 157,257 rockfish reported). Similarly, Heimann and Miller (1960) described chilipepper as being a very minor species in Morro Bay party boat fisheries in the late 1950s; this fleet too was clearly targeting nearshore assemblages (blue, olive, yellowtail, and vermillion rockfish comprised over 80% of the catch). However, chilipepper appear to have been sporadically important, at least in the Monterey Bay area recreational fisheries, in the years between this report and the RecFIN time period; Mason (1995) describes wide fluctuations in the CPFV catches of deepwater rockfish, with chilipepper being a key recreational species in 1962, 1964 and 1977-1978. As no species composition data is available, nor is it clear whether this reflected local or coastwide shifts in fishing spots and methods, we interpolated the percentage of rockfish landings (in numbers of fish) thought to be chilipepper from the 1957-1961 point estimate (0.321%) to the 1980-1982 RecFIN average (3.84%). This in turn was scaled upwards by the ratio of RecFIN estimated CPFV catches over logbook CPFV catches from 1980-1982 to develop an expansion factor for the historic CPFV fishery (1.87), which provided an estimate of the historical CPFV (and other fishery modes) total rockfish catches in numbers (Table 8; Figure 13). Finally, as the average weight of chilipepper reported in Miller and Gotshall (1.2 kg) was significantly greater than the average weight of fish reported by RecFIN in the 1980-1982 period (0.72 kg), we interpolated the average weight between these periods to arrive at the tonnage of total catch. To account for the presumably modest CPFV chilipepper catches in the north prior to 1957, we assume that chilipepper catches were 0% of the total rockfish catch at the initiation of the fishery in 1928, and interpolate from 0 to 0.331% in 1957. As the private boat fishery represented a trivial source of mortality in both the 1957-61 period and the 1980-82 period, we do not account for possible private vessel landings in the north prior to 1980.

For southern recreational fisheries, we used RecFIN data from 1980 through 2006, an expansion factor for historical CPFV logbook data as was done in the north (estimated at 1.98), and supplemented with observations of the percentage of the CPFV catch listed as chilipepper from the 1975-1979 onboard observer program. As this program tended to record a higher (and less variable) percentage of chilipepper rockfish relative to the total rockfish catch, we used the average proportion of the total rockfish catch observed to be chilipepper from the 1975-1979 observer data and the 1980-1982 RecFIN data to interpolate the fraction of historical catches that were chilipepper, assuming a ramp up from 0% chilipepper in 1928 (when CPFV fishing began, presumably with a focus on shallow water targets) to 11.3% in 1974. As chilipepper have long been described as an important recreational fish in Southern California (Wolford 1930; Roedel 1948; Davis 1977, Love 1991), and tend to be more important over deeper reefs, this is a reasonable approximation of recreational fisheries development. As private vessel landings of chilipepper estimated by RecFIN were significant in the early 1980s (estimated at 38,000 fish per year between 1980-1982), we assumed that private vessels began catching chilipepper in the post-world war II era, and interpolated landings from 0 in 1947 to 38,000 fish per year in 1979. As the average weights of chilipepper in the early 1980s were comparable in the north and south in the RecFIN database, we used the same average weight estimated for central California fisheries (above) for southern California fisheries.

The total estimated catches in the recreational fishery are shown as Figure 14, the total catches by all fisheries are shown in Figure 15, and these catches by fishery are also shown relative to catches estimated in the 1998 assessment in Figure 10 (referred to earlier). The number of subsamples and length measurements in the RecFIN database are included as Table 9.

Trawl Logbook CPUE Data

A catch per unit effort index was developed in the last assessment by Ralston et al. (1998), and was included in this assessment in the same form, as management constraints have likely biased the assumptions that would be necessary to update this index. Ralston (1999) further developed the trawl CPUE time series using alternative weighting regimes; these two time series as well as the time series from the 1998 model are presented as Table 10 and Figure 16. The 1998 estimates were assumed to have a CV of 0.10 in the 1998 model, however this CV was largely arbitrary. As the indices developed in 1999 had CVs on the order of 0.25 to 0.35, and model runs consistently estimated an effective RSME of ~0.25-0.28 when the initial CV was set at 0.1, we used 0.25 as the assumed CV.

Commercial age and length composition data

Expanded length composition data for the three commercial fisheries was extracted from the CalCOM database (Pearson and Erwin 1997) for all years from 1978 through 2006. Length data were pooled into 2 cm groups with accumulator groups representing sizes less than 16 cm and greater than 52 cm. Age data were aggregated into 21 age groups, comprised of ages 1-20 and an accumulator age of 21 and older fish. Age composition data by commercial gear type are shown in Figures 17-19, and length composition data are shown as Figures 20-22. Although earlier years of the fishery had significant proportions of older fish, less than 1% of all (expanded) fish were older than age 20 (although this fraction was somewhat higher for earlier years in which catch at age data were available). Starting values for multinomial sample for both age and length composition data were based on the number of port samples taken that included chilipepper age structures or lengths, respectively. Table 11 provides the sample sizes and total number of fish by year and gear type used in the expansions.

A comparison of raw (unexpanded) catch-at-length data from port samples that included age information and those that did not suggested some potential discrepancies between the length composition of aged versus un-aged fish, which may have been a (minor) contributing factor to the complications encountered with the conditional catch-at-age data. A more likely complicating factor may have been means that were used to both generate the effective sample sizes as well as the approach used for tuning the effective sample sizes of the conditional age-at-length data. Recommendations for future efforts to incorporate conditional age-at-length information, as well as innovative approaches that could be used to link the likelihood components between length frequency and age-length data, are included in the STAR Panel report as well as the recommendations section of this document. As a result of potential biases in the age composition subsampling, the effective sample sizes were set to negative numbers (resulting in a zero emphasis for those combinations in the likelihood function) for the following gear/year combinations; trawl (1978-1979, 1998-2000), hook and line (1998-2002), and setnet (1983, 1992). These data should be revisited for potential bias (by evaluating the expanded, rather than raw, catch at length for both aged and un-aged fish) prior to the next assessment. Additionally, the length frequency data for the 1992 setnet fishery suggested catches of a large number of very large males, which were sufficiently suspect to warrant exclusion of these data from the model.

Recreational length composition data and CPUE time series

Recreational length data from the RecFIN database were based on a query of coastwide length composition data from March of 2007, and are presented as Figure 23 (northern and southern separate) and Figure 24 (combined). As these data were not associated with sex information, they were included in the model as combined sex length composition data associated with the recreational fishery. In evaluating the potential for developing a CPUE time series for chilipepper rockfish using RecFIN observer data, we found that chilipepper were only recorded in 52 of the thousands of observed trips. Attempting to identify appropriate trips using the approach of Stephens and MacCall (2004) resulted in a subset of nearly 250 trips that could be identified as those in which chilipepper catches were likely, however there were unusual species co-occurrences that lead to this approach being suspect. As chilipepper rockfish tend to only be encountered in deeper water recreational trips, and the depth distribution of recreational effort has changed markedly over time, RecFIN catch rate data were not evaluated further in this assessment.

The California Department of Fish and Game conducted on-board monitoring of partyboat catches in Northern California from 1987 to 1998, which includes catch, angler effort, size composition of catches, location information and, more importantly, depth information (Deb Wilson-Vandenberg, CDFG, pers. comm.). Between 1987 and 1998 some 2267 recreational fishing trips were observed from Morro Bay (649) to Eureka and Crescent City (12), however the majority of observed trips originated from Monterey (821), San Francisco (444), and Bodega Bay (269) area ports. CDFG block information, as well as fishing site (457 sites) and the maximum and minimum observed depth information (ranging from 2 to 150 fathoms), was also available for all trips. Locations represented 68 separate CDF&G blocks, but 90% of the trips took place in just 27 of these blocks. Between 1987 and 1998 most of the trips were in the 20 to 60 fathom range, however there was a slight increase in the percentage of trips in the 0 to 20 fathom range and a slight decrease in the percentage of trips in the 60 to 100 fathom range (overall, the latter represented less than 15% of all trips observed).

The total number of observed trips, binned by the average depth for the trip, for each year are given in Table 12. Chilipepper were ranked third in terms of the total number of fish caught in observed trips (27,690 out of 313,752), after blue and yellowtail rockfish, however they were ranked 21st in terms of the most frequently occurring species. This seems to be a consequence of fishing location, chilipepper were frequently encountered in trips that fished at greater depths, occurring in only 1% of trips that fished less than 40 fathoms, but in 68% of trips that fished in 60 to 80 fathoms and 92% of trips that fished greater than 80 fathoms. The number of chilipepper caught per year and depth bin are included as Table 13. Clearly, depth is an important variable in the GLM, although when site-specific location information was explored as a variable, the variance explained by depth decreased substantially (and not surprisingly, note that this reinforced the decision to exclude RecFIN data). Consequently, due to concerns discussed during the STAR Panel review regarding possible impacts of changing depth strategies over time, all trips at depths greater than 80 fathoms were excluded from the final model. We used the average depth per location, binned into 20 fathom depth intervals for the GLM. Ultimately, trips taken at less than 20 fathoms average depth were also excluded due to the very low frequency of positives for chilipepper. For location information, we considered site specific information, CDF&G block information, and port-group information as possible factors in exploratory models. All explained a moderate fraction of the variance, and all resulted in very similar results with respect to year effects, however using site as a variable resulted in the loss of a substantial number of records.

The logistic regression method of Stephens and MacCall (2004) was also evaluated to obtain a subset of the trip data that would be appropriate for calculating chilipepper CPUE from the observer data. This method uses the species composition from each trip to determine whether chilipepper rockfish were likely to have been encountered on that trip, however this method is more commonly used for datasets in which location information is unavailable or unreliable (such as sampling and interviews conducted at the end of a fishing trip, used for MRFSS dataseries). One reason for this was to evaluate whether this approach resulted in different inferences with respect to trend, and to evaluate whether the resulting species coefficients from this approach were consistent with those obtained from a similar effort using the MRFSS data. The top 50 species in frequency of occurrence were extracted, chilipepper were separated as being the target species, and species that co-occurred with chilipepper less than two times were excluded (four species). The remaining 45 species served as potential explanatory variables. Logistic regression of chilipepper presence/absence on categorical presence/absence of these explanatory species provided predicted probabilities that chilipepper would be taken on a trip, given the other species that were taken on that trip. The resulting species associations (coefficients from the logistic regressions) are shown in Figure 25. The threshold probability for inclusion in the selected set was set at 0.35 as this was the probability that resulted in the lowest average CV of the annual indexes. However, the results of using the filtered dataset relative to the entire dataset were nearly identical (discussed below), as the logic behind the filter was to provide proxy information for habitat (area, depth) in datasets without data on these factors. When location and depth information is included, the filter is essentially unnecessary.

Consequently, the final model used all of the available trip information, the year effects are the relative CPUE index (Figure 26), with precision estimated using a jackknife procedure. The other fixed effects were block information (11 blocks with sufficient data, Figure 27) and depth (three bins, 20 to 39, 40 to 59, and 60 to 79 fathoms, Figure 28). A large number of sensitivity runs suggested highly similar, if not virtually identical, results when either higher resolution (site-specific) or lower resolution (port group) location information was used, as well as month or season, or other changes in the resolution of these bins was altered. The AIC values for a suite of models are reported in Table 14, which demonstrates that year, depth, block and season information contributed to an improved model fit. Although the results varied only modestly, the AIC also suggested that a gamma error distribution fit the data better than a lognormal distribution for the base models. Furthermore, the resulting trend when the Stephens/MacCall filter was developed and used to filter trips was nearly identical to the trend without this filter when all trips positive for chilipepper or with a threshold of 0.35 or above were used. The coefficient of variation (CV) estimated in the jackknife routine was also very similar with all of these runs, and between the gamma and lognormal error distribution, although the CV was considerably greater when depth information was excluded.

Length frequency information from chilipepper measured in the observer program was converted from total length to fork length, using the conversions provided by D. Pearson (pers. com.), where

$Fl = 0.977*TL-0.977$

The resulting length compositions by year, for fish caught within the depth ranges used to develop the relative abundance index, are shown in Figure 29. The number of trips in which chilipepper were caught was used as the sample size in the length composition data. As sex information was not included, the resulting length frequencies were used in the model with the unknown gender code. These data suggest that the high value in the index during 1987-1988 represented the abundance of the 1984 year class, which is identifiable in other age and length time series. As this age class grew, it likely moved into deeper water, consistent with the shift to greater depths with size observed in the triennial length composition data and consistent with similar ontogenetic movement for many other rockfish and groundfish. Similarly, the increase in abundance in 1992 may have been a function of a relatively strong 1988 or 1989 year class. This also suggests that a dome-shaped selectivity curve is likely to be appropriate for these length data, given the changing spatial distribution of animals with size.

Triennial Trawl Survey

A primary source of fishery independent information for most managed and assessed groundfish species in the California Current is the West Coast triennial trawl survey conducted between 1977 and 2004 (Weinberg et al. 2002). As the general consensus from recent data workshops has been to exclude 1977 data, we obtained both stratum-specific area swept biomass estimates and haul-specific survey data from 1980 to 2004 (M. Wilkins, AFSC, pers. com; B. Horness, NWFSC, pers. com), both of which were generated after excluding bad performance tows and "waterhauls," in which few benthic organisms were noted (Zimmermann et al. 2001). Tow specific CPUEs from this survey by year are shown in Figure 30, which also illustrates the variation in the latitudinal range of this survey over time (These Figures include a "cap" on the relative size of the largest tows, to maintain a constant scale across all of the Figures). Area-swept biomass indices by INPFC area and depth strata are presented as Table 15. To develop a consistent area-swept biomass index that represented all years, we compiled biomass estimates for all stratum between 36˚ 48' N and 43˚ 00 N (55m-366 m depth)(Figure 31).

Another comparable index was developed by T. Helser (NWFSC, pers. com.) using the methods Generalized Linear Mixed Model (GLMM) approach described in Helser (2003) and Helser et al. (2005). This model uses depth strata and latitude (or INPFC latitude proxies) as fixed effects, and vessel as a random effect. This index more explicitly accounts for the area of the given strata, as well as integrates uncertainty across both the proportion positive and the positive catch rate indices (such that both the variance due to vessel and residual variances are estimated, with the assumption of a log-normal error variance assumption for the positive observations). Point estimates of biomass and the associated CVs are based on the median of the marginal posterior density from MCMC, however to develop these estimates the model needs a high density of positive tows per strata (at least 2, preferably 3 for each year, depth, latitude combination). The strata used for this index were from 34.5 N to 38 N, and from 38 to 41 N (the region N. of 41 was excluded due to the very infrequent nature of positive tows in that area, inclusion of this area could result in a bias by extrapolating the larger CPUEs observed south of this region). Depth strata were 50 to 155 m, and 156 to 366 m.

As seen in Table 16 and Figures 31 and 32, there is a relatively large difference between the design-based estimate and the GLMM estimates, due primarily to the fact that the mean from the standard approach is heavily influenced by a small number of tows with very large positive catches; the influence of these tows is reduced in the GLMM under the assumption of a log-normal error distribution. This is a common challenge in developing indices of abundance from trawl surveys for semi-pelagic rockfish species with very patchy distributions and often highly specific habitat associations (by contrast, modeling of absolute abundance using design-based versus GLMM approaches tends to produce very similar trends for most flatfish species). Consequently, survey biomass indices are often more appropriately treated as indices of relative, rather than absolute biomass, and both the triennial trawl survey index and the combined survey index are treated in this matter in this assessment

Length frequencies for the triennial survey were calculated based on standard estimation methods (Dark and Wilkins, 1994), and are presented as Figure 33. Additionally, these data are pooled over all years and shown aggregated into depth bins to demonstrate a clear movement to deeper water with size, as shown for many other *Sebastes* species (Figure 34). Otoliths collected in 1977, 1980, 1992 and 1995 were surfaced aged, and the samples have since been lost or destroyed; there is no available data with which to bias-correct these estimates and they were consequently not used in the model. The number of hauls was used for the initial effective multinomial sample size in the length compositional data.

Northwest Center Trawl Survey

Data were available for area-swept biomass estimates from 2003 to 2006, and associated length frequency compositions, were provided by Beth Horness NWFSC. A summary of methods used to derive these data is available from O. Hamel (Calculation of summary statistics for the Pacific West Coast upper continental slope trawl survey of groundfish resources off Washington, Oregon and California, in prep, available on request). Catch per unit effort estimates from this survey by latitude and depth are shown as Figure 35. The total area swept biomass estimates ranged from a high of 129,000 tons in 2003 to a low of 69,200 tons in 2006, with the vast majority of the biomass in the shallow stratum of the Monterey INPFC area (Table 17). However, there is no obvious overall trend in the results, particularly given the high uncertainty in the estimates, although there may be a possible suggestion of a decline in recent years. As with the triennial survey index, another comparable index was developed by T. Helser (NWFSC, pers. com.) using the GLMM methods described above for the triennial survey index. The stratification for this index differed, as there was greater spatial coverage in the southern area, and consequently this index estimated biomass for three latitudinal strata, from 32-36 N, 36-40 N, and 40-43 N, with depth strata 50-155, and 156-400. The resulting index is provided in Table 18, which also includes the comparable design-based estimates. As shown in Figure 36, the two indices both appear to be somewhat noisy, with substantial interannual variability from which no obvious trends can be detected; although the GLMM index does seem somewhat better behaved, and may be indicative of a modest population decline over the (short) duration of that time series. The length data for all years, and the age data for 2004, all suggest that the biomass vulnerable to this survey in this period was very strongly dominated by the 1999 year class (Figure 46). Approximately 700 to 1000 chilipepper otoliths have been collected in each year of this survey, however only 850 ages for 2004 were available for this model, these were expanded by the NWFSC and entered into the model as catch at age data.

Juvenile rockfish survey

The Fishery Ecology Division of the Southwest Fishery Science Center has conducted a standardized midwater trawl survey during May-June aboard the NOAA R/V David Starr Jordan every year since 1983. The primary purpose of the survey is to estimate the abundance of pelagic juvenile rockfishes (*Sebastes* spp.) and to develop indices of year-class strength for use in groundfish stock assessments on the U. S. west coast. This is possible because the survey samples young-of-the-year rockfish when they are ~100 days old, an ontogenetic stage that occurs after year-class strength is established, but well before cohorts recruit to commercial and recreational fisheries. Chilipepper rockfish are the second most frequently encountered species in the survey, accounting for ~4.3 of the total number of rockfish caught from 1983-2006 (shortbelly accounting for just over 85% of the rockfish identified to species since 1983, excluding shortbelly, chilipepper account for nearly 31% of the remaining rockfish). This survey has encountered tremendous interannual variability in the abundance of the ten species that are routinely indexed, as well as high apparent synchrony in abundance among the ten most frequently encountered species. Past assessments have used this survey as an index of year-class strength, including widow rockfish (He et al. 2005), Pacific hake (Helser et al. 2005), shortbelly rockfish (Field et al. 2007) and the most recent chilipepper rockfish (Ralston et al. 1998).

Historically, the survey was conducted between 36°30' to 38°20' N latitude (approximately Carmel to just north of Point Reyes, CA), but starting in 2004 the spatial coverage has expanded to effectively cover the entire range of shortbelly rockfish indexed in this model, from Cape Mendocino in the north to the U.S./Mexico border. Additionally, since 2001 juvenile rockfish data are available from a comparable survey conducted by the Pacific Whiting Conservation Cooperative and the Northwest Fisheries Science Center (spanning from just south of Monterey Bay to Westport, WA; see Sakuma et al. 2007). Comparison of the coastwide data have revealed two types of shifts in the distribution of most pelagic, in which species characterized by a more southerly geographic range (e.g., bocaccio, shortbelly, and squarespot rockfish) were caught in relatively large numbers south of Point Conception, while species with more northerly distributions (widow, canary, and yellowtail rockfish) were caught in moderate numbers north of Cape Mendocino. The near absence of fish in the core survey area then, was associated with a redistribution of fish, both to the north and the south, as well as overall lower abundances.

The survey index is calculated after the raw catch data are adjusted to a common age of 100 days to account for interannual differences in age structure. For this assessment cycle, a number of survey indices were developed by S. Ralston (FED/SWFSC) using both the historical (core) survey area and a combined index that uses both SWFSC and NWFSC/PWCC survey data. The indices prepared for chilipepper are presented in Table 19 and shown in Figure 37, and the methods are described in the 2007 stock assessment cycle background materials prepared by S. Ralston. One shortcoming of the core index has been noticed in past assessments has been the failure of the core area survey to capture the magnitude of the 1999 year class for most stocks, the strength of which has since been demonstrated for most recently assessed species. Based on the strong evidence for a very strong 1999 year class for chilipepper rockfish, and the recommendations from the juvenile rockfish survey workshop, the core juvenile index was not included in the final model. However, the coastwide juvenile index developed by integrating the results of both the SWFSC and NWFSC/PWCC surveys in an ANOVA model with year, latitude, vessel, period, and depth effects, was used to inform the relative year class strength for the years 2001-2006. Past assessments have used a power coefficient to transform the index (He et al. 2006), based on the assumption of a compensatory relationship between pelagic juvenile abundance and subsequent recruitment to the adult population following settlement settlement (Adams and Howard 1996). However, as there is a lack of age data for the most recent years, a power transformation was not estimated for the coastwide survey (2001-2006).

CalCOFI larval abundance data

Egg or larval abundance data from the California Cooperative Oceanic and Fisheries Investigations (CalCOFI) surveys have been used in stock assessments for a number of commercially important west coast species, including northern anchovy (Jacobson and Lo 1994), Pacific sardine (Conser et al. 2002), bocaccio rockfish (MacCall 2003), shortbelly rockfish (Field et al. 2007) and sheephead (Alonzo et al. 2004). Although a larval abundance index was developed in the first stock assessment for cowcod (*S. levis*, Butler et al. 1999), this index was not included in the most recent assessment (Piner et al. 2006) out of concerns for the rarity of cowcod in sampled tows. Only a small number of *Sebastes* larvae can readily be identified to species, including bocaccio, shortbelly, cowcod, splitnose, and chilipepper. Chilipepper rockfish larvae were not identified to the species level in initial plankton sorting efforts. However, morphological characteristics were developed in recent years that allowed for identification, and they were consequently identified in all samples in the CalCOFI core area, and are currently in the process of being enumerated in CalCOFI tows taken in northern stations (W. Watson, SWFSC, pers. comm.). The distribution of chilipepper larvae catches between 1951 and 1969 demonstrates higher catches in northern lines, with catches generally greatest within 75 miles of the mainland (Figures 38 and 39).

As with other indices, we used tow specific information and a delta-GLM approach to derive an index of spawning biomass. Fixed effects in the model included year (fixed to spawning season, such that a year is the October-April spawning period), latitude (30' bins), month (October-April), and distance from shore (25 mile bins). These estimates and the associated standard errors estimated from a jackknife routine were used in the model as an index of population fecundity (spawning biomass). Figures 40-42 show the resulting latitude, distance from shore, and month effects; Figure 43 shows the year effects (with standard error) for the resulting model. In general, high levels of abundance were observed throughout most of the 1950s and 1960s, sporadic catches were observed through the 1970s and 1980s (recall that the survey was triennial between 1971 and 1984), and very few larvae were observed in the 1990s. Larvae have been more frequently encountered between 2002-2006. Although the CalCOFI time series is not inconsistent with other data series, the fact that these data are taken from the southern periphery of the stock's range indicates that this may not be an appropriate index of abundance for a coastwide model. Additionally, the lack of estimates throughout most of the period between the early 70s and 2000 (associated with few or no catches of larvae) are troublesome. Consequently, these data were not used in the final model.

History of Modeling Approaches

Chilipepper rockfish were last assessed by Ralston et al. (1998) using the stock synthesis age-structured model (Methot 2000) for the combined Eureka, Monterey, and Conception areas. The 1998 model began in 1970, but assumed a starting biomass below the unfished equilibrium (based on using the estimated landings from 1960-69 to generate an initial equilibrium population in 1970). The 1998 model also made no assumptions regarding a stock-recruit relationship; recruitment strengths were estimated based on free parameters. Natural mortality rates were estimated internally at 0.22 for females and 0.25 for males. The structure of the data in this assessment is consistent with that assessment, as both assumed four distinct fisheries (trawl, hook-and-line, setnet and recreational). Landings, age, length, and length-at-age data from these four fisheries were included in the model based on similar expansion routines, age data were limited to 1982-1996 but length data were available from 1980-1996. Estimates of landings changed little between the 1998 and current assessments (Figures 11a-11d, discussed in the catch reconstruction). Similarly, the 1998 model included survey indices from a catch-per-unit-effort index derived from the California commercial trawl logbook data base (which remains unchanged in this assessment), and index of abundance from the triennial trawl survey (which has an extended time series and was been modeled using a different GLM approach than that used in this assessment), and a time series of pelagic juvenile, although the current time series is considerably shorter (2001-2006) than the core index used in the 1998 assessment (1983-1997). However, the 1998 assessment explicitly described significant changes in mean size at age, which were raised as an important research question, but ultimately applied an approach utilizing time-varying selectivity to fit the length composition data. New indices used in this assessment include the recreational CPUE time series based on CDF&G monitoring data, and the 2003-2006 NWFSC combined survey index (also modeled using a GLMM approach).

The results of the 1998 assessment suggested that chilipepper were at a moderate level of biomass and were not estimated to be overfished. The 1998 model estimated that spawning biomass had declined from ~48,000 tons during the 1970's to a low of 22,000 tons in 1987, before increasing as a result of the 1984 year class (which was apparent in both the 1998 and 2006 models). The unfished spawning biomass in the 1998 model was estimated at 58,500 mt. The 1998 model estimated that the total exploitation rate ranged from a low of 4.2% in 1970 to a peak of 19.8% in 1989, although the exploitation rate had been below the target fishing mortality rate since 1993. Primary sources of uncertainty in the 1998 assessment included the statistical uncertainty associated with the fit of the various data sources to the base model, the conflict between the two principle sources of information (logbook and triennial trawl survey indices), the difficulty in projecting future recruitment for a stock characterized by high recruitment variability, and the difficulty in distinguishing potential changes in selectivity from apparently substantial declines in the mean size at age for fish collected in the post-1993 period.

Prior to the 1998 assessment, Rogers and Bence (1993) conducted a similar length-based assessment (using the length-based version of stock synthesis, Methot 1990) for which the modeled time period began in 1980. Their model included a triennial trawl survey index and a recreational CPUE index, but did not include either a trawl logbook CPUE or a pelagic juvenile survey index. The 1993 assessment also included age and length data from commercial fisheries (modeled as the same four fisheries as in Ralston et al. 1998 and this assessment), including data from fish that had their otoliths surface aged (rather than break-and-burn), and used estimates of natural mortality rate that ranged from 0.15 to 0.20. Rather than present the results of a single base model, the authors presented the results of a suite of three models, in which the 1992 biomass ranged from 40,000 to 87,000 mt, and the equilibrium yield (based on the then proxy for FMSY of F35%) ranged from 3,941 to 6,729 mt. Their general conclusions were that the existing ABC of 3600 mt was sufficient to protect the fishery at the F35% level, and that raising the ABC above this level could be “somewhat optimistic.”

Prior to the 1993 assessment, a stock assessment had been developed by Henry (1986), who used the age composition data in a cohort analysis model to estimate upper and lower bounds on fishing mortality rates and population abundance (Deriso et al. 1985). The author then applied an age-structured deterministic population model (GENMOD; Hightower and Lenarz 1989) to estimate MSY and equilibrium yields with two alternative models. The data used in that model included total catch (modeled as a single fishery), catch at age (1978-1982, surface read ages), catch at length (1978-1985), and triennial survey abundance point estimates from 1977, 1980 and 1983. The results indicated that the stock was moderately exploited, with "good recent recruitment and the absence of apparent biological stress," and the author recommended an ABC level set at the midpoint of two alternative MSY estimates, which was 3563 mt (the ABC was ultimately set at 3,600 mt). A precursor to the 1986 assessment was performed in 1985 (Henry 1985) using a cohort analysis, however this assessment did not result in a clear picture of stock status and did not recommend changes in the ABC levels.

Previous STAR Panel Suggestions

The prioritized STAR Panel recommendations from the 1998 assessment included:

- Aging otoliths collected from research surveys (the triennial trawl survey)
- Investigating differences between the trawl logbook and the shelf trawl survey index
- Continuation of the midwater trawl survey for pelagic juveniles
- Continuing to monitor the age and length composition of the fishery catch
- Reporting of logbook catches of rockfish by species rather than unspecified rockfish.

For the first priority, only a very limited number of otoliths were aged in time to incorporate in this assessment, these from the 2004 NWFSC combined survey. Ageing of both historical and recent otoliths from resource surveys remains a key priority, unfortunately most of the historically collected otoliths from the triennial survey (4 survey years) were surface aged and their whereabouts are no longer known. As a result, these samples are not available to re-age using break-and-burn methods. For the second priority, the triennial survey index was developed using a somewhat different means in for this assessment, however the major data conflicts in this assessment were among the recreational CPUE survey (which tended to be in agreement with the trawl survey) and the trawl fishery catch at age data (and to a lesser extent the trawl CPUE index).

The third recommendation was to maintain the midwater trawl survey for pelagic juveniles; this survey has been maintained and in fact expanded spatially (including a second survey that is used to develop a combined coastwide index). Additional details, analysis and recommendations related to the application of juvenile indices were additionally the subject of a Council-sponsored workshop, and recommendations in the report to the PFMC should be consulted for additional details. One recommendation was to exclude the historical (core area) index unless a strong relationship between the index and subsequent year class strength could be demonstrated. Consequently, as the core area index failed to capture the magnitude of the 1999 year class, this index was not used in the final model.

With respect to the fourth recommendation, continued data collection of age and length data from fisheries has been well maintained, and otoliths aged in a timely fashion. With respect to the reporting of logbook catches by species, it is generally agreed that the substantial impact of management measures implemented to rebuild depleted rockfish in the post-1998 era have undermined the assumptions that would allow for continuation of a trawl logbook CPUE index. Finally, while not explicitly stated in the list of prioritized research recommendations, the recognition and consideration of time-varying growth was a key uncertainty in the 1998 assessment, and remains a key research priority in this most recent review.

Consultations with the Groundfish Advisory Subpanel (GAP) and with Fishers

Due to time and budget constraints, a pre-assessment data workshop was not held for the chilipepper and bocaccio stock assessments. Consultations with members of the GAP representatives did not suggest major concerns regarding the data available or considered for the chilipepper assessment, as there was a general sense that this stock would be shown to be above target levels. One issue raised was the question of historical discard rates, which were described as negligible by fishers prior to the implementation of highly restrictive management measures beginning in the late 1990s due to the desirability of chilipepper by processors. Consequently, discards were assumed to be zero prior to the collection of observer data in 2002.

Model

The population was modeled using an age and size structured statistical model, Stock Synthesis II (SS2), version 2.00b, the modeling framework used for most West Coast groundfish assessments. This modeling framework was developed with the intent of allowing the complexity of the model to be consistent with the quantity and quality of the data commonly available for West Coast groundfish. The model treats a cohort as a collection of fish whose size-at-age is characterized by a mean and a variance, such that the numbers at age are distributed across defined length bins- similar to a length-age transition matrix, although with the potential to account for the effects of size-specific survivorship. The model also allows for growth, mortality, selectivity and other functions to be time varying, and time varying growth is explored in this model. A full description of the population dynamics, selectivity and catch equations, and associated likelihood functions are given in Methot (2005), while a more practical guide to using this modeling framework is provided in Methot (2006).

The base model developed here is based on equal emphasis factors (lambdas=1.0) for most likelihood components, with the exception that lambda's are set at 0.1 for length composition data where age composition data are used (trawl, hook and line, and setnet fisheries, as well as the NWFSC Combined survey). This downweighting is acknowledged to be an ad-hoc approach, which determined to be a reasonable interim approach based on the STAR Panel recommendations. A more appropriate approach would be to use conditional age-at-length compositions, which would also facilitate the estimation of growth (including time-varying growth) internally, however early efforts to apply conditional age-at-length information were unsuccessful and were postponed for future work. The approach used for iteratively re-weighting standard errors (for indices) and sample sizes (for catch at age, catch at length information) was based on the recommendations of the stock assessment developer (Rick Methot, OST/NMFS). For standard errors, the model estimated root mean squared error (RSME) was compared to the input error, and where the model RSME was greater (lower), a scalar was added to the CVs in the data file. However, in tuning inconsistencies between the model fits to surveys that had very large input CVs (considerably larger than the model estimated RSMEs), the input CVs were reduced externally using multiplicative scalars, as the subtraction of a scalar to the input CV could result in a negative CV for some index/year combinations.

An additional problem noted during the assessment review is that the model tuning process that adjusted for inconsistencies between the "input" and "effective" sample sizes for length and age compositions treated the age- and length-compositions as independent even though length/age data for some fish were included in both length- and age-compositions.

Priors

Based on the recommendations from the Groundfish Harvest Policy Evaluation Workshop, a prior for steepness was developed by M. Dorn (AFSC, pers. comm.) for consideration in the stock assessment model. This resulted from an updated meta-analysis comparable to that developed in Dorn (2002), but excluding the contribution of chilipepper rockfish to avoid double use of stock information. The prior developed for chilipepper rockfish was 0.573 with a standard deviation of 0.183, very comparable to the prior for previously unassessed rockfish of 0.58 with a standard deviation of 0.181. Ultimately, steepness was fixed at this point estimate, and no other priors were used in the model, however the standard deviation of the prior was used to bracket uncertainty in the decision table.

Major changes since last assessment

Change in modeling platform to SS2v2.00c

Catch reconstruction revised, with catch history extended back to 1892 rather than starting at an initial equilibrium in 1970 (fleet structure is unchanged).

Length composition data extended back to 1978 (and forward to 2006), new age data include years 1978-1981 and 1998-2005 (some of these years were not used in final model).

Relative abundance indices developed using CPFV observer data (1987-1998) and CalCOFI larval abundance data (1951-2006), although the latter were not used in the final model.

Juvenile survey indices revised from index used in 1998 model; but excluded from the final model due to the failure of the index to capture the magnitude of the 1999 year class. A new coastwide index, based on the expanded SWFSC survey and a new NWFSC/PWCC survey, was used for the last six years of the model (2001-2006).

Steepness fixed at 0.57 (there was no explicit spawner-recruit relationship in the 1998 model), natural mortality fixed at 0.16 for females, 0.20 for males (values in 1998 were 0.22 and 0.25 for females and males respectively).

Selectivity curves are modeled using a double-normal selectivity curve for recreational fisheries and CPUE index.

Time varying growth estimated internally in the model (implemented with a time-varying growth coefficient, K, using five time period blocks that were informed by major shifts in the signal for the Pacific Decadal Oscillation.

Base Model Selection

The initial (draft) base model was developed under the assumption that a reasonable starting point would be to include all of the relevant sources of information and examine their influence on the model in the sensitivity analysis by sequentially removing time series. The model assumed a single stock, with two sexes, which had differential growth and natural mortality. Several of the time series, including the CalCOFI larval abundance index and the core juvenile rockfish survey index, were excluded from the final base model during this examination. Similarly, early exploration of alternative values for steepness, natural mortality and other parameters led to these parameters being estimated in the draft model, and fixed in the final model. Sigma-R was fixed at 1, a value consistent with the effective Sigma-R in the results, and recruitment deviations were estimated for 1965-2006. Age frequency data in this assessment were initially treated as conditional age-at-length data, an approach recommended by the developers of SS2 in order to improve the ability to fit growth curves internally and avoid problems associated with weighting of the length and age likelihood components. However, efforts to model conditional age-at-length data, and in particular efforts to tune the effective sample sizes for these data, led to a decision to use traditional catch-at-age data along with catch-at-length information.

As time-varying growth was described as a key uncertainty in the last (1998) assessment, there were numerous efforts to develop a reasonable approach to estimating time-varying growth (primarily by allowing the growth coefficients K to vary), including exploration of annual deviations, offsets staggered in three year time blocks, linking growth directly to climate indices, and allowing time-varying blocks of years that are informed by major shifts in climate indices. All improved the model fit by dozens to several hundred likelihood units, most of which was accounted for in length frequency information.

Due to both the tremendous discrepancy between design-based and GLMM-based estimates of biomass from the trawl surveys, the inconsistencies in the relative values for each survey using each estimation approach, and the observed patchiness of the data, the trawl survey indices were treated as relative abundance indices with no estimated catchability coefficients. There was general agreement that the index should provide a meaningful index of relative abundance, and consequently this index was evaluated carefully with respect to the raw data used to develop the index as well as the model fit to the index. Initial fits were quite poor, and reflected another unusual characteristic of the early versions of the model, the failure of the model to capture an increase in relative abundance in the late 1980s as a result of the strong 1984 year class, a phenomena that was puzzling given the widespread evidence for an increase in stock abundance in most of the data.

Logistic and dome-shaped selectivity were explored for all fleets and surveys. For most fleets there was little or no improvement in fit by using dome-shaped selectivity, however the fits to the recreational fishery and CPUE data both improved significantly with dome-shaped selectivity. In the draft model and the model evaluated early in the STAR process, the setnet fishery showed strong signs of dome-shaped selectivity, within a relatively narrow size band. However, changes made during the end of the STAR week led to a selectivity curve with a double-normal parameterization that seemed to be "truncated" prior to reaching the ascending asymptote.

Developing an appropriate means of modeling selectivity to the recreational CPUE time series was widely acknowledged to be key to incorporating the index into the model, and upon exploration of various combinations of sex- and age-specific selectivity curves, a combination of size and age-based selectivity (non sex-specific) was ultimately used for this index. The ability of the model to capture the increase and subsequent stock decline associated with the strong 1984 year class, including the bimodality present in the observed length data (indicative of the dimorphic growth rates by sex of that year class), contributed to the decision to use this somewhat nontraditional approach to modeling selectivity. The model predicted length-compositions using length-based selectivity alone, including sex-specific length-based selectivity, failed to replicate the length composition data. However, exploration of sex-specific age selectivity curves during the STAR Panel review suggested that such an approach held promise for replacing the age- and length-based, sex-specific selectivity curve; although successful implementation would have required additional (unavailable) time.

Base model results

For the final base model, the total number of parameters estimated in this model was 80, including R_0, time-varying growth (K offsets, 5), parameters for logistic selectivity curves for trawl and hook and line fisheries and the two trawl surveys (8), parameters for the double-normal selectivity curves for the setnet fishery, recreational fishery, and recreational CPUE index (18), parameters for double-normal age selectivity for the recreational CPUE index (6), and recruitment deviation values for the years 1965-2006 (42). Table 20 provides the estimates for all of these parameters, as well as the model estimated standard deviation values for most of these parameters. However, in order for the model to be able to invert the Hessian matrix, selectivity for the triennial trawl survey as well as the age selectivity for the recreational CPUE index were fixed at their estimated values and the model was re-run.

The final base model used five offsets for K that were based on intervals informed by major shifts in the Pacific Decadal Oscillation (PDO) index, with the years grouped according to a five-block pattern based on major changes in the PDO index (1970-1979, 1980-1988, 1989-1991, 1992-1998, and 1999-2006). The PDO has been widely described as the dominant low frequency signal in Northeast Pacific Ocean, and is essentially the leading principal component of North Pacific Ocean temperatures above 20° N latitude. This climate signal has been linked to zooplankton abundance and productivity, salmon smolt survival, halibut recruitment, and other indices of marine productivity (Mantua et al. 1997; Francis et al. 2001; Clark and Hare 2002; Peterson and Schwing 2003; Logerwell et al. 2003). Consequently this approach was considered to be preferable to arbitrary multi-year bins and provided a comparable improvement in the fit to the data (on the order of 90 likelihood units at the cost of five parameters, and noting that the length frequency data were downweighted for many data sources). Other growth parameters were estimated externally.

The base model estimates of total biomass, spawning biomass, depletion, recruitment, total catch, exploitation rate, spawning biomass per recruit (SPR) are provided in Tables 21a and 21b. The model estimated an unfished spawning biomass (SSB_0) of 33,390 metric tons, an unfished summary biomass of 45,057, and a 2007 spawning biomass of 23,827, which results in a relative spawning biomass estimate of 0.71. Figures 44-47 show the total biomass, spawning biomass, depletion (with reference 25% and 40% of unfished biomass references, and depletion with a ten year forecast (based on 2006 status quo catches). The depletion level at its lowest point (1999) was estimated to be 8,666 tons, or 26% of SSB_0. Thus, based on the base model result, the spawning biomass has nearly tripled in a relatively short (8 year) time period, due primarily to a very strong 1999 year class (the strongest year class estimated by the model) and greatly reduced harvest levels in recent years. Figures 48 and 49 show estimated annual recruitment values over the time period with 95% asymptotic confidence limits, and Figures 50-51 show the recruitment deviations and deviation variance checks. Figure 52 shows the estimated harvest rate by year and fishery, and Figure 53 shows the model estimated spawner recruit relationship.

The SPR was well above (current) target levels throughout most of the historical period, but was below (current) target levels between 1983 and 1997, with a low of 0.32 in 1990. The SPR has ranged between 0.72 and 0.99 since 1999, reflecting the lack of fishing mortality and fishing opportunities for chilipepper rockfish (Figures 54-55). The model estimated proxy MSY based on an $F_{50\%}$ SPR, the current (1999-2006) growth conditions, and an allocation regime consistent with the catch composition of the final year (2006) of the fishery, was estimated to be 2099 metric tons. This value as associated with an exploitation rate (catch over summary biomass) of 0.088, and an equilibrium spawning biomass of 15,482, which corresponds to 46% of the unfished biomass. Based on the fishing mortality rate that would cause the spawning biomass to maintain an equilibrium value of 40% of the unfished level ($B_{40\%}$), the MSY proxy would be slightly greater, at 2155 metric tons, corresponding to an exploitation rate of 0.102 and an SPR of 0.45. When the model estimated MSY internally the estimated value was very slightly greater, at 2164 metric tons (corresponding to an exploitation rate of 0.112 and an SPR of 0.43). Table 22 provides a more comprehensive summary of all of the relevant MSY proxy reference points.

The selectivity curves for the six fisheries are shown in Figures 56-63. Model estimated numbers at age over time, and the average age of fish in the population are shown separately for both females and males (Figures 64-67). Fits to each of the relative abundance indices (in both arithmetic and log scale) as well as scatterplots of observed versus predicted indices are shown as Figures 68-87. Figures 88 and 89 show time varying growth and Figure 90 shows model estimates of the von Bertalanffy growth coefficient (K) over time, with the mean annual winter PDO and a running three year mean of the winter PDO, which were used to inform the designation of the time blocks. Fits to catch at length data by fleet are shown as Figures 91 through 128, including Pearson residual plots and observed versus effective sample sizes. Fits to catch at age data by fleet are shown as Figures 129 through 150, including Pearson residual plots and observed versus effective sample sizes.

Time-varying growth was included in the base model as offsets from the base K parameter for five time blocks that were structured around major changes in the Pacific Decadal Oscillation (PDO). Inclusion of time varying growth in this manner improved the overall model fit by nearly 100 likelihood units, primarily in the trawl and recreational CPUE length composition data as well as the recreational CPUE index. There were modest degradation of fits to survey length composition data and fishery age composition data. Inclusion of time-varying growth also captured a significant amount of the observed variability in the size at age of fish from commercial fisheries (Figures 151-152). However, the approach used to model time-varying growth would benefit by additional data and analyses, as discussed in greater detail in the sections that follow.

Forecasts and decision table

The alternative states of nature used in the decision table (Table 23) were developed in conjunction with the STAR Panel, which considered a variety of potentially appropriate sources of uncertainty. As steepness was generally thought to be poorly specified for this model, the lower and upper 25% of the prior probability distribution for steepness based on the informative prior developed (but not used) for the assessment represented a reasonable means of bracketing uncertainty. As steepness was fixed at the point estimate for the prior (0.57) in the base model, the alternative states of nature were consequently 0.34 (low productivity) and 0.81 (high productivity). The three catch streams used in the decision table were developed in coordination with the Groundfish Management Team (GMT) and Groundfish Advisory Subpanel (GAP) representatives to the STAR Panel, and represented "status quo" catches (based on estimates of the 2006 catch), equilibrium MSY catches (based on the SPR 0.50 harvest strategy), and ABC catches (based on the 40:10 harvest control rule). In all cases, the 2006 total catch estimates were used to apportion theoretical future catches among gear types, importantly this was done to facilitate comparable evaluation of plausible stock trajectories under different states of nature, and in no way implies a recommended or de facto sector allocation.

The forecast scenarios included in the decision table provide a sense of the likely population trajectories under alternative fishing regimes. In all examples, it seems likely that the sharp increase in spawning biomass associated with the 1999 year class will taper off, with the stock taking a slight (under status quo fishing effort) or moderate (under equilibrium MSY or higher catches) dip in abundance in the near term. Under status quo catches, none of the states of nature suggest the possibility of the stock declining below target biomass levels (40% of unfished) within the next ten years. Only the low productivity scenario coupled with MSY catches or 40:10 catches (fishing down to MSY) show any risk of dipping below target levels, and even under this low productivity scenario only with the very high catch stream might cause the stock to fall below the overfished limit within the next ten years. In general, the stock is above target levels and expected to remain so within the foreseeable future.

Sensitivity Analysis

To evaluate model convergence during the model review, starting values were randomly adjusted ("jittered") between a range of starting values. During the assessment review, convergence problems were evident as indicated by irregular profile plots and other analyses. This seems to reflect an irregular likelihood surface related to conflicting signals from various data sources. Although a cause for some concern, the effects of this did not seem to be severe with respect to the model results. To evaluate the effect, twelve simulations were done with "jittered" initial values, and the resulting equilibrium recruitment estimates and likelihood estimates were plotted against each other (Figure 151). These results suggest two relatively localized minima in the likelihood surface, one very close to the minimum likelihood of the base model, the other associated with a slightly lower equilibrium recruitment value, but a considerably higher total likelihood value. The latter seemed to be associated with very poor fits to the recreational CPUE index and associated length composition data (Table 24), and may reflect the difficulty in achieving convergence with combined age and length-based selectivity for that index. However, the effects did not appear too severe for most other indices, and the model results varied only slightly even among the simulations with considerably higher likelihood values.

The sensitivity analyses reported here provided an opportunity to compare the results from the base model in terms of measures of the model fit (in likelihood units) when key parameters that were fixed at assumed values in the model were varied, as well as the changes in model results. Table 25 presents the likelihood values by data type for the two states of nature, the high steepness (h=0.81) and low steepness (h=0.34) scenarios, as well as very high (h=0.99) and very low (h=0.21) scenarios. Similarly, the Table includes likelihood estimates when female natural mortality is varied from 0.12 to 0.2 (in all examples, the male offset is 1.26*Female_M, as in the base model). Likelihood profiles for steepness (h) and natural mortality (M) are presented as Figures 154 and 155, and a likelihood surface is presented as Figure 156. For all of these values, each run was "jittered" no less than ten times, and the model run with the lowest likelihood of the ten was reported for the likelihood values and profiles. The results of the sensitivity and the profiling on steepness suggests that estimates of steepness lower than the base case (0.57) are increasingly unlikely, while higher values of steepness are increasingly (but very modestly) more likely.

Overall, these results suggest that steepness is likely to be greater than approximately 0.4, but that the model is relatively uninformative with respect to steepness. The improvement in likelihood with higher steepness values is found primarily in the trawl fishery length and age frequency data, as well as in the trawl CPUE index, by contrast the triennial survey index and the recreational CPUE index are more consistent with lower steepness values. This tension characterizes the strongest inconsistencies among the various sources of data used in this model. Consequently, the steepness value assumed for the base model is reasonable, as high steepness values for *Sebastes* are generally considered to be less consistent with their long-lived, slow growing life history characteristics (although chilipepper rockfish are among the faster growing species with relatively higher turnover rates), and lower levels are not consistent with the likelihood profile. Figures 157 and 158 show the resulting estimates of spawning biomass and recruitment over time with the high and low productivity scenarios, with the intuitive result that the historical biomass is scaled upwards in the low productivity scenario, with current abundance at a slightly lower level than in the base model, while historical abundance is slightly lower in the high productivity model, and current abundance is even closer to the unfished level.

As with the previous assessment, the choice (or estimation) of M has a strong impact on the model results, and as with the previous assessment, lower natural mortality rates are associated with less severe declines in biomass over time (with a smaller overall stock size), while higher natural mortality rates are associated with greater declines in spawning biomass and higher overall stock sizes. Consequently, natural mortality is a key uncertainty in the model. Figures 159 and 160 show the estimated spawning biomass and recruitment over time with the lower (0.12) and higher (0.20) assumed values for female natural mortality; although the historical estimates of abundance change little, recent estimates are (intuitively) far more dynamic for the higher natural mortality assumption relative to the lower natural mortality assumption. The likelihood profile for M suggests that the fixed (assumed) value is close to the local minima for M (Figure 153), suggesting that the assumed value is reasonable. Similarly, the likelihood surface (Figure 154) demonstrates that the gradient in likelihood is consistent across all assumed values of h, implying that the model is relatively more informative for natural mortality.

Another means of evaluating the sensitivity of the model is to sequentially remove datasets from the base model. Table 26 provides the likelihood values and point estimates of unfished spawning biomass and recruitment, while Figures 161-172 show the estimated trends in spawning biomass and recruitment for a suite of runs in which data are excluded or model structure otherwise altered. For most data, the consequence of removal was relatively modest, for example there were only very modest changes in estimates of B_0, biomass trend and end-year depletion with removal of the trawl CPUE time series, the NWC combined survey time series, the setnet fishery length and age composition data, and the assumption of asymptotic versus dome-shaped selectivity for the setnet fishery (which in retrospect would have been a more reasonable assumption given the shape of the final selectivity curve, however the effect on the model estimates is virtually nonexistent). With the exclusion of other sources of data, there were often more noteworthy effects on model estimates of the unfished spawning biomass and the depletion trend, although none of these had a major impact on the general population trend or depletion level. For example, exclusion of the recreational CPUE index resulted in a slight scaling upwards of the unfished spawning biomass level (from ~33,400 to ~35,300), a flattening of the population trend during the 1990s relative to the base model (Figure 162) which suggests continued population declines in this period, and a greater population increase during the early 2000s to end at a final (2006) depletion level of 84% of the unfished level (rather than 70% in the base model). By contrast, when the trawl fishery length and age frequency data are excluded (Figure 163), the recreational CPUE data are more influential in the 1990s, such that depletion is lower in both the late 1990s (16% rather than 26% of unfished biomass in 1998) and 2006 (53% rather than 70%). A similar, but less significant, result occurred when the hook and line length and age frequency data were excluded, although this result was also associated with a general scaling downward of the total spawning biomass throughout the duration of the time series.

In general, this reflects the greatest sources of tension in the model, both the trawl CPUE and length/age frequency data, as well as the hook and line length frequency and age frequency data, were generally in conflict with recreational CPUE data and (to a lesser extent) the triennial survey data. The latter two sources suggested relatively greater population declines during the 1990s, while the former sources were more consistent with a relatively level biomass trend throughout the 1990s. The major effect of not including time-varying growth was a general scaling upward of the historical biomass (Figure 167), consistent with the lower productivity that this would have assumed as the growth deviations were generally all in the positive direction during the period in which they were estimated. Reconciliation of the most appropriate approach for modeling time varying growth is a key research and modeling priority for future assessments.

For the coastwide juvenile survey time series, Figure 164 shows only the estimates of SSB and recruitment from 1990 but includes a ten year forecast (assuming status quo catches), as the primary effect of this survey is to invert the recruitment estimates for 2002-2004, which are very weakly informed by the NWC combined survey length composition data, and reduce the estimates of the 2005 and 2006 year classes, which have very little data which might inform the model otherwise. As this dataset is of short duration, has not necessarily been validated, and the previous (core area, longer time series) failed to capture the magnitude of the 1999 year class (the index is moderately well correlated with year class strength estimates for other years), the inferences resulting from inclusion of the coastwide survey index should be treated with some apprehension. However, the overall effect of including this dataset is negligible with respect to estimates of reference points and biomass trend through the present period, and is relatively modest with respect to the forecast of future biomass trends. Importantly however, all of the data sources seemed to be consistent with a population increase in the early 2000s, as in none of these sensitivity runs did the end year depletion fall below 50% of the unfished population level.

A final sensitivity test evaluated the consequences of either doubling or halving the estimates of historical (pre-1978) landings of chilipepper rockfish (Figures 171-172). As described in the section on catch reconstructions, the estimates proportion of historical catches that are likely to have been chilipepper are highly uncertain for most of the pre-1978 period, including the period of foreign fisheries through the mid-1960s to the early 1970s. Doubling or halving these estimates is an ad-hoc approach to evaluating the sensitivity of the model to the exploitation history, but provides a reasonable bounds on the plausible impacts. The results are consistent with the base model, with a general scaling upwards (for the doubling) and downwards (for the halving) of the historical trend, however the trend over the past 25 years and the ending depletion levels are virtually unchanged.

Summary of Responses to STAR Panel requests

The draft assessment distributed to the STAR Panel included conditional age-at-length compositions rather than age-compositions, however problems with tuning this model resulted in a model revision that was based on both length- and age-compositions without conditional age-at-length compositions. The STAT also proposed that the core area juvenile survey index be removed from the SS2 analysis, largely as a result of the failure of that index to capture the magnitude of the extremely strong 1999 year class. In discussing the significant limitations of the CalCOFI index, both the STAT and the STAR Panel agreed that this index too was not suitable for chilipepper rockfish, primarily as the survey misses much of the spatial range of the stock. The STAR Panel accepted these initial revisions to the base model, and proposed down-weighting those length-compositions for which there were also age-compositions. The STAR Panel also suggested fixing, rather than estimating, both steepness and natural mortality in the revised model. The point estimate of steepness based on the Dorn prior was used for steepness, while 0.16 was used for female natural mortality (based on profiles of M in the draft model).

Among the first requests made by the Panel was the review of the length composition data for both aged and unaged fish, which uncovered some potentially imbalanced age composition subsampling and resulted in removing select years of data from the model (although the overall influence of these data on the model was minimal). The STAR Panel and STAT also spend considerable time reviewing the data that contributed to the CPFV index, ultimately arriving at a new approach for estimating the index based on excluding the deeper depths (which had limited sampling) and considering a suite of alternative approaches for modeling selectivity, including age-based, sex-based and length-based dome-shaped selectivity curves. Considerable effort was also expanded on evaluating an appropriate means of modeling time-varying growth. For both of these issues, the current approaches should be considered placeholders until more appropriate means of modeling selectivity to the recreational index and time-varying growth can be developed. The STAR Panel also provided additional guidance for future modeling efforts with respect to tuning the effective sample sizes in a model in which sampled fish contribute to both length- and age-compositions (see the STAR Panel report). This summary highlights the key issues that were raised and considered during the model review, a more detailed accounting of the requests and responses is included as Appendix C.

Comparison with the last assessment

The major differences between the 1998 assessment and the current assessment were summarized earlier, and Figures 173 and 174 show the major differences in the results of the base models for each assessment. There is a substantial difference in the scale of the total biomass between the two models, with the 1998 model estimating a considerably larger (approximately double) spawning biomass than the current model in the early period (the 1998 model was initiated in 1970). However, the “low natural mortality rate” model run as a sensitivity test in the 1998 assessment (in which M was set to 0.16, which is the base model M for this assessment) predicted an early 1970s total biomass of approximately 35,000 mt, much closer to 30,000 mt total biomass estimated in the base model for this assessment (Ralston et al. 1998, Figure 38). The 1998 model also suggested a greater relative decline throughout the early 1980s, and a proportionately greater (but slightly lagged) response in the spawning biomass through the late 1980s into the 1990s. These results are also consistent with the sensitivity tests that assumed a higher natural mortality rate in this assessment (Figure 160). Estimates of recruitment in the two models were nearly identical throughout the overlapping time period

(Figure 174), demonstrating consistency in both the estimation of recruitment strengths and variability. Estimates of exploitation rates and harvest projections were also similar, although estimates of both were slightly higher in the 1998 assessment.

Retrospective analysis

A retrospective analysis was conducted by sequentially removing the most recent two years of data, such that models included data through 2004 only (Figure 175), through 2002 only (Figure 176), through 2000 only (Figure 177) and through 1998 only (Figure 178). As with other sensitivity runs, the runs were "jittered" at least 8-10 times, and the model with the lowest likelihood was presented in the comparison. The historical spawning biomass and recruitment trajectories changed very little with each analysis, which is not a terribly surprising result in a model for which steepness and natural mortality were fixed, and catches in the past 5-8 years have been minimal. Interestingly, the strength of the 1999 year class was very evident in the data by as early as 2002, and the 2000 retrospective may have mistakenly attributed an apparent abundance of small fish associated with the 1999 recruitment year (these fish were just beginning to appear in trawl catches) to a strong 1998 year class.

Technical Deficiencies

During the STAR Panel review, the length composition data was down-weighted when associated age-composition data were available, however the approach (a lambda of 0.1 for length data where age data also exist, and 1 for the associated age data) was acknowledged to be ad-hoc and lacking a solid theoretical basis. A more appropriate approach is to use conditional age-at-length compositions, which was attempted in early runs but led to a suite of problems in model tuning.

In evaluating possible causes of these problems, the raw length composition data by fishery for years with both aged and non-aged fish was evaluated on a year-by-year basis, and where the length compositions seemed inconsistent, the emphasis on the data was effectively set to zero. For some years, there seems to be evidence that there was some geographic bias in the sampling of aged versus un-aged fish that could have been internally inconsistent, and there was at least one example of samples that had large numbers of male chilipepper that were of unreasonably large size and must have represented identification errors of some sort. However, as this evaluation was based on unexpanded length compositions, it is possible that good length-composition data may have been excluded from the model. A re-evaluation of these length composition data, improved efforts to incorporate conditional age-at-length information, and approaches to model tuning that account for joint tuning of co-dependent age and length frequencies are all priorities for future assessments.

The model tuning process that adjusted for inconsistencies between the model fits to surveys (RMSE) and the input CVs took an ad hoc approach with surveys that had very large CVs for some index values. The input CVs were reduced proportionally, which was somewhat inconsistent with the normal process of adding a constant to account for process error.

The estimated growth curves had kinks that could probably be eliminated by reducing the lower bound of the smallest length bin. This would also improve estimation of the selectivity curves for the two fisheries independent trawl surveys, for which the smallest (<16 cm) fish appear to be fully, or near fully, selected. This in turn would negate the need to fix the parameters for the triennial survey selectivity, which was necessary to invert the Hessian matrix.

The results from the convergence tests with randomly jittered starting parameter values indicated that the likelihood surface is very irregular. The final runs, as well as sensitivity runs, were "jittered" 10 to 12 times in order to better ensure convergence, however the conflicting signals of some data sources is a source of some concern. In general, biomass trajectories and other critical results do not appear to be sensitive to these differences.

Although there is a clear progression from shallow to deeper water with age and size, the application of a combined age- and length- based selectivity curve for the recreational CPFV data is somewhat non-traditional and would benefit by either more detailed investigation or an alternative selectivity configuration (an age-based, sex-specific selection curve showed considerable promise).

Although the setnet fishery was modeled with dome-shaped (double logistic) selecitivity, which indicated declining selectivity at the very largest size classes for early model configurations, the ultimate shape of the selectivity curve suggested a more monotonic increase in selectivity with largest sizes. Consequently, a logistic selectivity curve may have been more appropriate for modeling the selectivity of this fishery, although sensitivity analysis suggest that the significance of such a change would be negligible.

Key Uncertainties

This stock has increased substantially in recent years due to the strength of the 1999 year class, which is strongly visible in age and length composition data from both fisheries and resource surveys. Future (post-1999) year class strength is highly uncertain; although this model includes highly informative projections through 2006 based on juvenile abundance indices, the failure of the historical (core area) juvenile index to capture much of the year class variability that has been observed is troublesome.

Early catch histories are fairly uncertain. Although it is common knowledge that chilipepper have been historically important, and reasonable estimates of the total rockfish catch estimates exist, estimates of the percentage of historical catches that were chilipepper, and how that percentage may have changed over time, are based primarily on anecdotal information.

Lack of fishery-independent age data is problematic; as the four years of triennial age data were surface read, they were not used in the model (the ages up to age 8 were used in estimating the external growth curves, based on the common assumption that surface ages tend to be consistent with break and burn ages up to approximately age 10). Such data would be particularly useful in estimating time-varying growth, which seems to be an important factor for chilipepper rockfish. As the 1970-1979 estimated K is quite high (approximately 0.32), alternative approaches for estimating growth prior to the period in which most data are available should be explored. Additionally, the estimates of yield and productivity will be based in part on future assumptions regarding growth. Similarly, while there is a paucity of smaller fish in the commercial fisheries, there are indications of smaller individuals in the surveys, and including a broader range of length bins (smaller than 16 cm) or exploring a younger minimum age (A_{min}) for the Schnute growth curve formulation could lead to improvements in how growth is estimated.

There are insufficient data to consider spatial structure in the model; although the CalCOFI time series might suggest greater relative depletion South of Point Conception, this time series has some unusual characteristics that undermine it's utility as an index of abundance. As there is only very limited fisheries dependent information in this region, and only a very short (four years) time series of fishery independent information (with low sampling density), spatial features have been ignored in this model.

Discards are assumed to be negligible until 2002, when catches were scaled upwards to account for the discard rates estimated by the West Coast groundfish observer program. This assumption may be incorrect, as regulatory impacts may have resulted in an increase in discarding as management measures evolved from the mid to late 1990s to 2002 to rebuild overfished and depleted stocks. In the earlier historical period, even negligible to modest estimates of discarding in some fisheries could potentially be developed based on observed discard rates in other fisheries for earlier time periods. Average size data from the observer program have not been developed or integrated into the model, and could be evaluated in the future.

There is considerable uncertainty associated with the coastwide juvenile index as this dataset is of short duration, has not necessarily been validated, and the previous (core area survey) failed to capture the magnitude of the 1999 year class. Although the current influence of the survey is modest, and there is currently little information in the model to counter the influence of this index, it is also likely that the CVs in the coastwide index may be constraining (currently the average CV is approximately 0.037) as the time series lengthens and begins to overlap temporally with length and age data from fisheries and surveys. Re-evaluation of the coastwide juvenile index should be an important element of both future research and future assessments.

Since 2003, the Rockfish Conservation Areas (RCAs) have been the primary management tool implemented protect rebuilding species that co-occur with chilipepper, such as bocaccio, widow, and canary rockfish. As a result of these management measures and reductions in trip limits, catches of chilipepper rockfish have declined significantly, limiting the amount of fishery-dependent information (age and length frequency information) available to the assessment model. However, such measures have also likely resulted in a bias in those age and length frequency information that do exist, as such data are derived from fish that were caught either shoreward or seaward of the RCAs, while the areas of greatest chilipepper abundance are within the RCAs. As a result, and further complicated by the clear ontogenetic shift to deeper water with size (and presumably age), these age and length frequency information are not likely to be reflective of the true age and length structure of the population (e.g., Punt and Methot 2004; Field et al. 2006). Such considerations could potentially be addressed by a more rigorous evaluation of the sources of the data, and possibly by including alternative selectivity curves for the post-RCA period, however such approaches were not evaluated in detail in this assessment and should be considered in future assessments.

Regional Management Concerns

There are insufficient data to consider spatial structure in the model, consequently the resource is modeled as a single stock. Although the stock extends north of Cape Blanco, Oregon, the abundance and catches are minimal and have no significance in the model. Catches and biomass between Cape Mendocino and Cape Blanco are modest, but noteable and historically accounted for in landings and surveys. By contrast, catches and biomass trends south of Point Conception are poorly quantified and highly uncertain, but anecdotal accounts suggest that chilipepper were historically a relatively important stock in this region. Although the CalCOFI time series (which was not used in the final model) is suggestive of greater relative depletion in this region, this time series has some unusual characteristics that undermine its utility as an index of abundance. As there is only very limited fisheries dependent information in this region, and only a very short (four years) time series of fishery independent information (with low sampling density), there is insufficient information to assess potential regional concerns in this area. Increased sampling of both fisheries data and by resource surveys are critical to any attempts to develop a greater understanding of potential spatial differences in stock status and trends in this region. However, as the Southern California Bight appears to be a region of sharply declining abundance, and abundance appears to drop even more sharply towards the U.S./Mexico border, transboundary issues are minimal for this stock.

Research and Data Needs

Additional investigations into the catch history should be made, including greater evaluation of detailed historical landings data from fish tickets (ongoing) which should inform catch history reconstructions. As has been recommended previously by both STAT teams and STAR panels, the reconstruction of historical rockfish landings should be done comprehensively across all rockfish species to ensure efficiency and consistency (priority medium, medium to long term).

Information on maturity and fecundity is available, but limited. Additional information should be compiled and carefully evaluated for accuracy, potential changes over time, and potential maternal effects (priority medium, long term).

There is a paucity of length at age information for smaller fish, particularly those collected in fishery independent surveys. Otoliths that are available from past years of the triennial survey, and those available from the combined survey, should be aged to provide better data on the early stages of growth and possible time-variations in growth. Additionally, aging error is poorly estimated, as only a modest number of otoliths were read by two readers, and most of these were relatively young fish. Additional double-reads of break and burn otoliths should be conducted to better estimate ageing error (priority high, short term).

Greater exploration of methods for modeling time-varying growth as influenced by environmental factors should be a key research area for future assessments. Such exploration will benefit substantially from both an increased availability of data from research catches (both historical and recent) as well as a renewed attempt to model age and length data using conditional length-at-age approaches (priority high, short to medium term).

The consequences of the Rockfish Conservation Areas to vulnerability, selectivity patterns and other stock attributes could be significant, and would benefit from greater analysis as well as more generic simulation studies that might inform assessment authors of the consequences of spatially explicit management measures to the basic assumptions of stock assessment models (priority medium, medium to long term).

Additional fisheries dependent and fisheries independent data for the region south of Point Conception (including additional evaluation of historical landings in this region) is essential in evaluating whether the relative stock status may be different in this region relative to the coastwide trend, as might be suggested by a superficial evaluation of the CalCOFI data. Further evaluation of the CalCOFI data, to determine the extent to which these data may or may not inform relative trends at a more spatially explicit level, should also be a research priority (priority medium, medium to long term).

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Table 1: Management performance in obtaining the ABC and OY for chilipepper rockfish (catch includes all catches in all areas, commercial and recreational, as well as estimated discards from 2002-2006; discards prior to 2002 are assumed to be negligible, although some regulatory discarding was likely).

Year	ABC	OY	Catch	%ABC	%OY
1982	-		2492		
1983	2300		2465	107	
1984	2300		2923	127	
1985	2300		3182	138	
1986	2300		3147	137	
1987	2300		2059	90	
1988	3600		2691	75	
1989	3600		3395	94	
1990	3600		3110	86	
1991	3600		3311	92	
1992	3600		2753	76	
1993	3600		2393	66	
1994	4000		1877	47	
1995	4000		2021	51	
1996	4000		1870	47	
1997	4000		2110	53	
1998	3400		1430	42	
1999	3724	3724	977	26	26
2000	3681	2000	499	14	25
2001	2700	2000	517	19	26
2002	2700	2000	329	12	16
2003	2700	2000	21	1	1
2004	2700	2000	236	9	12
2005	2700	2000	192	7	10
2006	2700	2000	127	5	6
2007	2700	2000	-		

Table 2: Estimated chilipepper rockfish landings by gear type for the early period (1892-1927), based on reported estimates of total rockfish landings by Sette and Fiedler (1928, bold under "all rockfish"), interpolated estimates for intervening years, the estimated ratio of chilipepper to all rockfish in 1928 based on the regional landings data, and the assumption that 95% of rockfish landings were hook and line until 1943.

	trawl	hookline	total
1892	11	206	**217**
1893	10	195	205
1894	10	183	193
1895	9	171	**180**
1896	9	162	170
1897	8	152	160
1898	8	143	150
1899	7	133	**140**
1900	8	147	155
1901	8	161	170
1902	9	176	185
1903	10	190	200
1904	11	204	**215**
1905	11	218	229
1906	12	232	244
1907	13	246	259
1908	14	260	**274**
1909	15	292	308
1910	17	325	342
1911	19	358	376
1912	21	390	411
1913	22	423	445
1914	24	455	479
1915	26	488	**513**
1916	33	633	**666**
1917	41	778	**819**
1918	49	924	**972**
1919	32	605	**637**
1920	33	631	**665**
1921	28	534	**562**
1922	25	483	**509**
1923	30	571	**601**
1924	28	532	**560**
1925	32	615	**648**
1926	44	845	**890**
1927	38	716	**754**

Table 3: Total California rockfish catches by region (based on CDF&G Fisheries Bulletin reports) and as estimated by gear type.

Year	Trawl	% trawl	% hook-line	**Eureka**	**San Francisco**	**Monterey**	**Santa Barbara**	**Los Angeles**	**San Diego**	**CA Total**
1928		0.050	0.950	49	453	1037	47	770	555	2911
1929		0.050	0.950	117	487	745	45	687	642	2723
1930		0.050	0.950	114	466	1282	21	906	478	3268
1931		0.050	0.950	48	473	1162	31	1183	400	3298
1932		0.050	0.950	40	451	930	35	798	299	2552
1933		0.050	0.950	14	516	734	47	588	253	2152
1934		0.050	0.950	58	414	762	128	511	130	2001
1935		0.050	0.950	73	402	976	178	374	78	2080
1936		0.050	0.950	85	391	1189	182	123	70	2039
1937		0.050	0.950	61	470	955	166	157	65	1875
1938		0.050	0.950	248	254	839	73	126	34	1573
1939		0.050	0.950	342	176	603	91	141	92	1445
1940		0.050	0.950	264	206	753	136	153	67	1579
1941		0.250	0.750	206	205	662	132	203	42	1451
1942		0.500	0.500	123	32	298	38	74	10	576
1943		0.750	0.250	624	92	311	39	89	5	1160
1944		0.900	0.100	2506	31	332	22	10	5	2907
1945		0.900	0.100	5315	84	534	45	27	5	6009
1946		0.900	0.100	4007	100	508	49	80	9	4752
1947		0.900	0.100	2497	96	690	27	132	9	3450
1948		0.900	0.100	1595	123	748	36	200	24	2726
1949		0.900	0.100	1275	236	611	62	259	37	2481
1950		0.900	0.100	1556	449	1107	86	294	34	3525
1951		0.900	0.100	2052	1000	1441	122	329	15	4958
1952		0.900	0.100	1090	1625	1677	108	219	9	4728
1953		0.900	0.100	1336	1892	1954	89	179	15	5466
1954	4899	**0.892**	0.108	1263	1354	2349	263	247	14	5491
1955	5035	**0.899**	0.101	1225	709	1887	1533	199	48	5601
1956	5897	**0.887**	0.113	1305	1335	2548	1169	258	35	6650
1957	6396	**0.886**	0.114	1676	1279	2482	1523	228	32	7220
1958	6486	**0.814**	0.186	1610	1903	2657	1426	229	141	7967
1959	5534	**0.818**	0.182	1366	2233	2132	671	265	95	6761
1960	5352	**0.889**	0.111	1300	1493	1617	1281	239	90	6019
1961	4037	**0.862**	0.138	885	1008	1465	1053	175	99	4684
1962	3538	**0.849**	0.151	808	903	1295	917	172	70	4166
1963	4445	**0.883**	0.117	1332	1070	1119	1181	221	112	5034
1964	3078	**0.864**	0.136	768	794	987	719	208	87	3562
1965	3481	**0.838**	0.162	1082	715	1188	786	249	133	4153
1966	3856	**0.861**	0.139	822	732	1536	1027	226	136	4480
1967		0.860	0.140	1075	389	1156	1313	251	167	4351
1968		0.860	0.140	1272	265	1087	1188	243	126	4180
1969	3434	**0.860**	0.140	1340	276	932	1133	227	86	3994
1970	4109	**0.866**	0.134	1694	350	1305	1115	172	108	4744
1971	4018	**0.809**	0.191	2098	565	1088	869	197	150	4968
1972	5969	**0.829**	0.171	2734	736	1669	1493	301	267	7200
1973	7958	**0.823**	0.177	2371	1391	3528	1759	277	344	9671
1974		0.832	0.168	3277	984	2723	1809	224	584	9602
1975		0.841	0.159	3679	1014	2732	2168	369	445	10407
1976		0.851	0.149	4410	1105	2193	2652	328	460	11147
1977		0.860	0.140	3183	826	2292	2514	214	407	9435

Table 4: Fraction of rockfish landings by region assumed to be chilipepper, based on analysis in text (where bold early years represent fractions supported by literature estimates, and 1978-1979 fractions are based on CalCOM estimates).

	Eureka	San Francisco	Monterey	Santa Barbara	Los Angeles	San Diego
1928	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1929	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1930	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1931	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1932	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1933	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1934	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1935	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1936	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1937	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1938	*0.057*	*0.308*	**0.308**	*0.308*	*0.200*	*0.200*
1939	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1940	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1941	*0.057*	*0.308*	*0.308*	*0.308*	*0.200*	*0.200*
1942	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1943	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1944	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1945	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1946	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1947	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1948	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1949	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1950	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1951	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1952	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1953	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1954	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1955	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1956	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1957	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1958	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1959	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1960	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1961	*0.057*	*0.331*	*0.213*	*0.341*	*0.200*	*0.200*
1962	**0.059**	**0.365**	**0.230**	**0.389**	*0.200*	*0.200*
1963	**0.054**	**0.297**	**0.196**	**0.293**	*0.200*	*0.200*
1964	*0.057*	*0.331*	*0.213*	*0.341*	*0.206*	*0.206*
1965	*0.066*	*0.327*	*0.224*	*0.332*	*0.213*	*0.213*
1966	*0.076*	*0.323*	*0.234*	*0.322*	*0.219*	*0.219*
1967	*0.086*	*0.319*	*0.245*	*0.312*	*0.225*	*0.225*
1968	*0.095*	*0.315*	*0.256*	*0.302*	*0.232*	*0.232*
1969	*0.105*	*0.311*	*0.266*	*0.293*	*0.238*	*0.238*
1970	*0.114*	*0.307*	*0.277*	*0.283*	*0.245*	*0.245*
1971	*0.124*	*0.303*	*0.288*	*0.273*	*0.251*	*0.251*
1972	*0.134*	*0.299*	*0.299*	*0.264*	*0.257*	*0.257*
1973	**0.134**	**0.299**	**0.299**	**0.264**	**0.264**	**0.264**
1974	*0.143*	*0.283*	*0.308*	*0.215*	*0.227*	*0.215*
1975	*0.152*	*0.268*	*0.317*	*0.166*	*0.190*	*0.167*
1976	*0.162*	*0.252*	*0.326*	*0.117*	*0.154*	*0.119*
1977	*0.171*	*0.237*	*0.335*	*0.069*	*0.117*	*0.071*
1978	**0.181**	**0.222**	**0.344**	**0.020**	**0.081**	**0.022**
1979	**0.209**	**0.194**	**0.337**	**0.019**	**0.080**	**0.021**

Table 5: Estimated landings of chilipepper rockfish by California region, 1928-1979, including Oregon and Foreign Fishery landings, and by gear type.

Year	Eureka	San Francisco	Monterey	Santa Barbara	Los Angeles	San Diego	Oregon	Foreign Fisheries	Trawl	Hook-line
1928	3	140	320	14	154	111			37	701
1929	7	150	229	14	137	128			33	626
1930	6	144	395	7	181	96			41	781
1931	3	146	358	10	237	80			42	788
1932	2	139	286	11	160	60			33	623
1933	1	159	226	14	118	51			28	539
1934	3	127	235	39	102	26			27	503
1935	4	124	301	55	75	16			29	541
1936	5	120	366	56	25	14			29	552
1937	3	145	294	51	31	13			27	508
1938	14	78	258	22	25	7			20	371
1939	19	54	186	28	28	18			17	299
1940	15	64	232	42	31	13			20	362
1941	12	63	204	41	41	8			92	268
1942	7	11	63	13	15	2			55	52
1943	35	30	66	13	18	1			123	32
1944	142	10	71	8	2	1			210	9
1945	301	28	114	15	5	1			418	16
1946	227	33	108	17	16	2			362	18
1947	141	32	147	9	26	2			322	22
1948	90	41	159	12	40	5			313	26
1949	72	78	130	21	52	7			325	29
1950	88	149	235	29	59	7			510	48
1951	116	331	307	42	66	3			778	75
1952	62	538	357	37	44	2			935	98
1953	76	627	416	30	36	3			1069	111
1954	72	448	500	90	49	3			1037	118
1955	69	235	402	523	40	10			1149	122
1956	74	442	542	399	52	7			1344	163
1957	95	423	528	520	46	6			1434	174
1958	91	630	565	487	46	28			1504	326
1959	77	740	454	229	53	19			1286	271
1960	74	494	344	437	48	18			1258	149
1961	50	334	312	359	35	20			956	146
1962	48	330	297	357	34	14			917	156
1963	72	318	219	346	44	22	14.9		917	111
1964	43	263	210	245	43	18	0.1		711	106
1965	72	234	266	261	53	28	0		765	136
1966	62	236	360	331	50	30	0	985	1905	140
1967	92	124	283	410	57	38	0.3	1634	2498	127
1968	121	83	278	359	56	29	0	671	1468	113
1969	140	86	248	332	54	20	0	53	810	104
1970	194	107	362	316	42	27	0	1	908	114
1971	260	171	313	238	50	38	0	2	867	155
1972	365	220	498	394	77	69	0	26	1372	215
1973	317	416	1054	464	73	91	0	907	2893	371
1974	469	279	838	389	51	126	0.2	1403	3193	282
1975	561	272	865	360	70	74	1.5	734	2588	260
1976	713	279	714	311	50	55	0	529	2335	210
1977	545	196	767	172	25	29	0		1491	167
1978	618	284	500	45	33	9	0		1293	169
1979	1005	417	694	51	56	12	0		2004	177

Table 6: Estimates of chilipepper landings by region and gear type in California area (based on CalCOM), including Oregon (based on PacFIN), 1978-2006. Excludes 2002-2006 discards.

year	Eureka	San Francisco	Monterey	Santa Barbara	Los Angeles	San Diego	Oregon	Trawl	Hook-line	Net
1978	618	284	500	45	33	9	0	1293	169	169
1979	1005	417	694	51	56	12	0	2004	177	177
1980	783	835	1157	31	52	5	0	2721	96	45
1981	713	874	772	32	68	23	23.4	2295	139	71
1982	369	508	1087	37	75	23	23.2	1681	356	85
1983	558	950	717	11	38	22	9.8	1879	80	345
1984	573	1141	908	43	81	29	2.1	2448	98	231
1985	421	872	1386	19	91	35	2.1	1807	279	739
1986	404	1353	940	29	28	6	1.1	1269	331	1161
1987	506	522	827	59	21	11	0.5	1314	173	461
1988	741	689	889	65	11	5	0.2	1778	333	289
1989	721	989	1210	193	30	3	4.5	2363	426	361
1990	926	1174	722	95	1	2	2.3	2317	232	373
1991	814	1411	774	155	10	1	14	2229	618	332
1992	377	1489	717	63	15	6	13.1	1330	1053	297
1993	595	963	761	41	3	7	6.1	1282	861	233
1994	498	608	723	13	1	3	13.9	1267	485	108
1995	606	564	819	8	3	4	9.5	1595	325	94
1996	451	606	748	19	2	4	9.3	1528	254	58
1997	486	840	681	17	4	2	7.3	1614	339	83
1998	319	644	449	2	3	1	5.8	1138	209	78
1999	411	358	175	2	1	3	3.3	839	104	10
2000	177	213	68	1	0	0	0.7	403	51	6
2001	116	144	72	0	1	0	132.7	436	25	5
2002	67	61	37	0	0	0	0.3	162	3	0
2003	10	2	5	0	0	0	0.7	18	0	0
2004	38	18	9	0	0	0	0.2	61	3	1
2005	43	11	8	0	0	0	0.7	60	3	0
2006	19	14	10	0	0	0	0.1	37	6	0

Table 7: RecFIN catch information for chilipepper rockfish, 1980-2006.

	Private/Rental 1000s		CPFV 1000s		Total metric tons		Mean weight (kg)	
	North	South	North	South	North	South	North	South
1980	0	50	50	385	30	362	0.60	0.83
1981	0	27	105	252	61	210	0.58	0.75
1982	0	36	181	246	178	192	0.98	0.68
1983	1	6	110	100	100	60	0.90	0.57
1984	0	3	201	28	127	19	0.63	0.60
1985	2	3	218	253	156	202	0.70	0.79
1986	21	6	342	183	276	110	0.76	0.58
1987	12	6	146	6	109	3	0.69	0.23
1988	14	25	679	51	264	26	0.38	0.35
1989	15	21	289	195	150	95	0.49	0.44
1990	*15*	*23*	*261*	*159*	*114*	*74*		
1991	*8*	*25*	*232*	*122*	*79*	*52*		
1992	*5*	*28*	*203*	*86*	*43*	*31*		
1993	15	30	174	50	7	10	0.50	0.32
1994	0	37	146	14	0	17	0.09	0.34
1995	3	26	117	2	2	5	0.62	0.21
1996	1	20	88	1	21	10	0.48	0.45
1997	0	1	1	1	73	1	0.82	0.40
1998	0	6	24	9	1	4	0.75	0.61
1999	0	12	49	9	18	6	0.75	0.28
2000	1	9	50	7	31	8	0.63	0.44
2001	1	6	28	11	51	1	1.01	0.16
2002	0	3	5	14	6	6	0.97	0.37
2003	0	0	0	0	0	0	0.37	
2004	0	0	0	15	0	6		0.38
2005	0	0	0	8	0	4	0.07	0.43
2006	0	0	0	4	0	1	0.07	0.34

Table 8: Reconstructed catches of all rockfish based on CPFV logs and estimated catches of chilipepper rockfish (1000s fish, tons), 1928-1979, based on interpolated species composition and average weight information.

	All rockfish Reported CPFV		All rockfish Expanded CPFV		Chilipepper Private (1000s)		Chilipepper CPFV (1000s)		Chilipepper Total Tons	
	North	South	North	South	North	South	North	South	North	South
1928	0	0	0	0	0	0	0	0	0	0
1929	*18*	*8*	34	15	0	0	0	0	0	0
1930	*36*	*15*	67	30	0	0	0	0	0	0
1931	*54*	*23*	101	45	0	0	0	0	0	0
1932	*72*	*30*	135	60	0	0	0	1	0	0
1933	*90*	*38*	168	75	0	0	0	1	0	1
1934	*108*	*46*	202	90	0	0	0	1	0	1
1935	*126*	*53*	236	105	0	0	0	2	0	1
1936	*144*	*61*	270	120	0	0	0	2	0	2
1937	*171*	*72*	320	143	0	0	0	3	0	2
1938	*168*	*71*	314	140	0	0	0	3	0	2
1939	*147*	*62*	275	123	0	0	0	3	0	2
1940	*211*	*90*	396	177	0	0	1	5	0	4
1941	0	0	0	0	0	0	0	0	0	0
1942	0	0	0	0	0	0	0	0	0	0
1943	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0
1947	148	46	277	91	0	0	1	4	0	3
1948	295	116	553	228	0	1	1	11	1	8
1949	383	188	716	372	0	2	2	18	1	14
1950	467	213	873	420	0	3	2	21	2	16
1951	533	189	997	374	0	4	3	20	2	15
1952	464	242	868	479	0	4	2	26	2	20
1953	395	301	739	595	0	5	2	34	1	26
1954	491	658	919	1301	0	6	3	78	2	59
1955	585	1153	1095	2278	0	7	3	142	2	107
1956	653	1384	1223	2734	0	7	4	176	3	133
1957	645	767	1207	1516	0	8	4	101	3	77
1958	1052	517	1968	1021	0	9	6	71	5	53
1959	879	300	1645	593	0	10	5	42	4	32
1960	679	307	1271	606	0	10	4	45	3	34
1961	514	348	961	689	0	11	5	52	3	40
1962	589	339	1102	670	0	12	7	52	5	40
1963	609	346	1141	684	0	13	10	55	7	42
1964	462	488	864	964	0	13	9	80	6	60
1965	718	631	1345	1246	0	14	16	106	12	80
1966	773	940	1447	1858	0	15	20	163	14	123
1967	760	1158	1423	2288	0	16	22	205	16	155
1968	800	1274	1497	2517	0	16	26	232	19	175
1969	843	1097	1578	2167	0	17	30	205	22	155
1970	1047	1532	1960	3027	0	18	41	293	29	221
1971	803	1399	1504	2764	0	19	34	274	24	207
1972	1098	1827	2054	3609	0	19	50	366	36	276
1973	1391	2137	2603	4223	0	20	68	438	49	331
1974	1466	2552	2745	5042	0	21	76	569	55	430
1975	1396	2516	2613	4971	0	22	77	428	56	323
1976	1580	1978	2957	3909	0	22	93	635	67	480
1977	1384	1792	2590	3541	0	23	86	492	62	372
1978	1199	1674	2245	3307	0	24	78	514	57	389
1979	1321	2319	2472	4583	0	38	91	562	65	425

Table 9: Number of subsamples (trips) and fish measured for RecFIN length composition data

	Number of subsamples			Number of fish measured		
	N.Cal	S.Cal	Coastwide	N.Cal	S.Cal	Coastwide
1980	18	32	50	88	303	391
1981	6	41	47	90	697	787
1982	10	49	59	204	414	618
1983	12	33	45	213	433	646
1984	41	49	90	675	111	786
1985	86	52	138	1475	537	2012
1986	78	37	115	1715	383	2098
1987	21	1	22	384	10	394
1988	67	5	72	875	53	928
1989	20	9	29	658	254	912
1994		5	5		31	31
1995	5		5	149		149
1996	18	2	20	550	6	556
1997	15		15	590		590
1998	6		6	263		263
1999	28	19	47	528	53	581
2000	9	22	31	194	82	276
2001	9	7	16	210	89	299
2002	11	7	18	140	85	225
2004		41	41		233	233
2005		16	16		53	53

Table 10: Trawl logbook CPUE time series developed by Ralston et al. (1998) and Ralston (1999)

year	Ralston et al. 1998	cv (assumed)	catch weighted	SE	CV	area weighted	SE
1980	249	0.1					
1981	150	0.1					
1982	121	0.1	132	49.8	0.38	95	32.6
1983	116	0.1	35	13.1	0.38	35	11.4
1984	91	0.1	90	27	0.30	57	16.4
1985	88	0.1	101	31.3	0.31	51	13.1
1986	76	0.1	57	17.7	0.31	35	10
1987	116	0.1	103	30.3	0.30	55	14.2
1988	158	0.1	175	59.2	0.34	77	18.6
1989	172	0.1	92	28.4	0.31	66	18
1990	149	0.1	103	31.8	0.31	74	20
1991	146	0.1	131	41.3	0.32	70	17
1992	109	0.1	120	45.8	0.38	45	11.5
1993	80	0.1	69	19	0.27	45	11
1994	112	0.1	103	32.6	0.32	51	13.6
1995	126	0.1	119	34.5	0.29	59	15.6
1996	96	0.1	95	28.1	0.29	45	11.7

Table 11: Number of subsamples for length comp data, and numbers of length and age observations by fishery

	Subsamples (length)			Length measurements			Age measurements		
	Trawl	Hk-line	Net	Trawl	Hk-line	Net	trawl	Hk-line	net
1978	147			1560	4		559		
1979	110			1860	307		330		
1980	191	1		1590	85		841	2	
1981	125			955	109		701		
1982	195	20		1856	227		1220		
1983	275	8	24	2701	79	211	2305	8	68
1984	305	9	68	5186	94	660	3574		42
1985	338	14	155	7153	356	1090	3269	100	266
1986	219	8	113	4076	213	824	2008	173	414
1987	211	9	92	4433	135	700	2529	36	367
1988	199		70	4669	122	551	2428	5	220
1989	183	16	82	4582	284	650	2524	9	311
1990	204	16	99	5026	80	953	1692	15	443
1991	208	41	35	7632	1801	483	1600	424	96
1992	132	84	68	4208	2570	946	2081	745	406
1993	126	87	35	4630	3584	966	2001	434	188
1994	117	86	47	3898	3615	931	742	251	253
1995	114	23	32	3747	841	742	1306	249	60
1996	116	41	21	3327	1138	342	803	189	37
1997	136	38	14	4537	1367	439	1718	209	63
1998	123	38	11	3109	886	269	2135	322	93
1999	84	11		3030	435		2091	165	
2000	50	9		1706	364		998	161	
2001	58	12		1996	401		767	128	
2002	54	3		1832	64		1029	38	1
2003	18			533	6		309	3	
2004	54			1743			949		
2005	20			452			349		
2006	31	3		650	70				

Table 12: Number of trips by year and average depth bin for the CPFV observer dataset.

YEAR	0-19	20-39	40-59	60-79	80-99	>100
1987	1	14	36	21	17	1
1988	23	75	62	25	21	4
1989	16	77	83	26	25	4
1990	3	25	33	8	4	1
1991	9	34	32	9		1
1992	28	64	110	22	6	
1993	33	93	81	35	5	1
1994	35	89	85	25	3	
1995	32	89	86	8	3	
1996	46	94	76	11	2	
1997	54	77	88	20	5	
1998	40	72	46	13		

Table 13: Total number of chilipepper caught (by mean depth bin)

	0-19	20-39	40-59	60-79	80-99	>100
1987		1	557	1770	3573	295
1988	3		493	3267	2973	556
1989			355	2351	3004	388
1990			150	193	442	218
1991		1	60	173	6	8
1992		0	454	852	56	
1993			181	1504	457	161
1994		3	186	1069	111	
1995	15	12	45	320	82	
1996		3	33	413	216	
1997			18	376	91	
1998		3	3	189		

Table 14: AIC scores for the different fixed effect models considered in the recreational observer database CPUE series

Model	Binomial	Gamma
Year	1038	442
Depth	704	470
Block	846	436
Year+depth	696	417
Year+block	834	395
Year+depth+block	656	373
Year+depth+block+depth:block	672	379
Null deviance	1059	561

Table 15: Triennial trawl survey area-swept biomass estimates by depth and INPFC area. Dashes denote area-strata combinations in which no chilipepper were encountered, zeros denote area-strata combinations in which the total biomass was estimated at less than 0.5 ton, and empty cells denote strata that did not have any survey effort.

		Columbia		Eureka		Monterey		Conception		Total	
Year	Depth (m)	Biomass	CV	Biomass	CV	Biomass	CV	Biomass	CV	Biomass	CV
1977	91-183	-	-	-	-	4755	0.38	94	0.76	4850	0.37
	184-366	-	-	-	-	4942	0.35	148	0.49	5090	0.34
	367-475	-	-	-	-	0	0.72	1	1.00	1	0.81
	91-475	-	-	-	-	9697	0.26	243	0.42	9940	0.25
1980	55-183	129	0.62	901	1.00	12740	0.63			13770	0.59
	184-366	0	-	0	-	904	0.43			904	0.43
	55-366	129	0.62	901	1.00	13644	0.59			14674	0.55
1983	55-183	0	-	9	1.00	7113	0.62			7123	0.61
	184-366	26	0.81	19	0.07	2379	0.39			2423	0.38
	55-366	26	0.81	28	0.34	9492	0.47			9546	0.47
1986	55-183	0	-	2857	0.33	6596	0.32			9453	0.33
	184-366	30	1.00	228	0.63	385	0.64			643	0.61
	55-366	30	1.00	3175	0.30	7135	0.30			10340	0.30
1989	55-183	0	1.00	221	0.98	14563	0.34	1862	0.36	16646	0.30
	184-366	219	0.97	67	1.00	2540	0.48	643	0.42	3470	0.37
	55-366	220	0.97	288	0.79	17102	0.30	2505	0.29	20116	0.26
1992	55-183	0	-	5	0.94	6661	0.51	1284	0.48	7949	0.44
	184-366	0	-	18	0.37	657	0.80	258	0.13	933	0.57
	55-366	0	-	22	0.35	7318	0.47	1542	0.40	8882	0.40
1995	55-183	0	-	69	0.98	9640	0.31	299	0.38	10009	0.30
	184-366	0	1.00	33	0.61	2321	0.38	1326	0.73	3681	0.37
	367-500	0	-	0	-	2	0.81	2	0.66	4	0.55
	55-500	0	1.00	102	0.69	11963	0.26	1627	0.60	13693	0.24
1998	55-183	0	1.00	3	0.83	10991	0.47	576	0.57	11570	0.45
	184-366	12	0.79	235	0.83	5177	0.73	126	0.32	5550	0.69
	367-500	0	-	1	1.00	0	-	0	-	1	1.00
	55-500	12	0.78	239	0.82	16168	0.40	702	0.47	17121	0.38
2001	55-183	0	-	15	0.72	9270	0.38	13550	0.93	22835	0.58
	184-366	1	0.62	60	0.99	4838	0.90	107	0.50	5006	0.87
	367-500	0	-	0	-	1	1.00	1	1.00	3	0.71
	55-500	1	0.62	76	0.80	14109	0.40	13658	0.93	27844	0.50
2004	55-183	0	-	67	0.52	31716	0.40	305	0.41	32088	0.39
	184-366	4	0.88	22	0.38	6916	0.44	1896	0.62	8838	0.37
	367-500	0	-	0	-	0	-	0	-	0	-
	55-500	4	0.88	88	0.40	38632	0.34	2202	0.54	40927	0.32

Table 16: Comparison of triennial trawl survey indices generated by and core-area swept biomass and GLMM, with associated coefficients of variation.

	Core area-swept		GLMM	
	Biomass	CV	Index	CV
1980	14674	0.55	4093	1.73
1983	9546	0.47	1884	2.11
1986	8704	0.32	1685	2.81
1989	17274	0.29	3313	0.86
1992	6774	0.5	27	1.73
1995	11307	0.27	2034	0.98
1998	16007	0.4	1004	0.92
2001	14103	0.4	964	0.79
2004	38444	0.34	3644	1.41

Table 17: NWFSC combined survey estimates of area-swept biomass and associated CVs by INPFC area and depth strata, 2003-2006.

		Conception		Monterey		Eureka		Columbia		Total Biomass	
Year	Depth (m)	Biomass	CV	Biomass	CV	Biomass	CV	Biomass	CV	Biomass	CV
2003	55-183	1577	0.93	106395	0.54	1741	0.68	0		109713	
	184-548	12751	0.92	6510	0.46	58	0.75	4	1.00	19323	
	55-548	14329	0.82	112905	0.51	1799	0.66	4	1.00	129037	0.46
2004	55-183	238	0.39	49594	0.49	4087	0.67	1747	1.00	55666	
	184-548	2915	0.50	24704	0.57	0		87	0.94	27705	
	55-548	3153	0.47	74298	0.38	4087	0.67	1834	0.95	83371	0.34
2005	55-183	1386	0.64	71694	0.73	3682	0.69	216	0.78	76978	
	184-548	4211	0.96	29388	0.40	2129	0.96	0		35728	
	55-548	5597	0.74	101082	0.53	5810	0.56	216	0.78	112706	0.48
2006	55-183	1282	0.89	54131	0.55	1543	0.74	13	1.00	56970	
	184-548	356	0.54	11133	0.45	56	0.92	693	0.71	12239	
	55-548	1638	0.70	65264	0.46	1600	0.71	706	0.69	69209	0.43

Table 18: Comparison of area-swept and GLMM biomass estimates for the Northwest Fisheries Science Center combined survey

	Area-Swept		GLMM	
	Bio	CV	Bio	CV
2003	129037	0.46	3932	1.06
2004	83371	0.34	24559	2.06
2005	112706	0.48	9540	0.77
2006	69209	0.44	7384	0.69

Table 19: Indices of pelagic juvenile (age 0) rockfish abundance

	core index	jack.cv	design Index	CV	deltaGLM index	CV	anova Index	CV
1983								
1984	7.33	0.37						
1985	8.12	0.46						
1986	0.72	0.33						
1987	13.22	0.35						
1988	16.38	0.39						
1989	0.39	0.48						
1990	0.31	0.41						
1991	0.98	0.34						
1992	0.17	0.52						
1993	10.33	0.30						
1994	0.02	0.81						
1995	0.25	0.61						
1996	0.09	0.52						
1997	0.13	0.74						
1998								
1999	0.21	0.43						
2000	0.09	0.52						
2001	0.85	0.34	1.51	0.21	0.24	0.39	1.72	0.04
2002	2.29	0.32	5.61	0.25	0.76	0.38	2.76	0.05
2003	1.01	0.41	2.06	0.32	0.35	0.40	1.57	0.04
2004	1.33	0.39	5.80	0.21	0.63	0.34	2.94	0.04
2005			0.21	0.44	0.03	0.60	0.87	0.03
2006			0.02	0.44	0.01	0.59	0.75	0.03

Table 20: Parameter point estimates and standard deviations for the base model (note that both the triennial length selectivity and the recreational CPUE age-selectivity curve parameters were fixed to enable estimation of the Hessian matrix).

Parameter	value	std	parameter	value	std
ln R0	10.45	0.05	1965 rec dev	-0.50	0.72
K (1970-1979)	0.32	0.06	1966 rec dev	-0.93	0.74
K (1980-1988)	0.25	0.02	1967 rec dev	0.89	0.47
K (1989-1991)	0.23	0.04	1968 rec dev	1.05	0.39
K (1992-1998)	0.20	0.04	1969 rec dev	-0.89	0.76
K (1999-2006)	0.26	0.04	1970 rec dev	1.17	0.22
Trawl sel inflection	32.65	0.35	1971 rec dev	0.60	0.26
Trawl sel width 95% inflection	8.46	0.36	1972 rec dev	-1.66	0.62
Hook sel inflection	37.27	0.67	1973 rec dev	1.47	0.08
Hook sel width 95% inflection	7.20	0.60	1974 rec dev	-1.04	0.48
Setnet sel peak	59.43	3.46	1975 rec dev	1.40	0.07
Setnet sel top	-2.19	37616	1976 rec dev	-0.20	0.18
Setnet sel asc-width	4.99	0.18	1977 rec dev	-0.27	0.13
Setnet sel desc-width	1.98	9359	1978 rec dev	-0.42	0.14
Setnet sel init	-44.77	51789	1979 rec dev	0.87	0.06
Setnet sel final	-13.05	150010	1980 rec dev	-0.38	0.12
Rec sel peak	41.25	0.85	1981 rec dev	-0.78	0.12
Rec sel top	-15.76	1149.3	1982 rec dev	-1.78	0.23
Rec sel asc-width	4.92	0.12	1983 rec dev	-1.54	0.24
Rec sel desc-width	2.59	1.01	1984 rec dev	1.95	0.04
Rec sel init	-8.25	3.05	1985 rec dev	-0.74	0.20
Rec sel final	-0.64	0.75	1986 rec dev	0.57	0.08
Triennial sel size inflect	15.70	*fixed*	1987 rec dev	0.39	0.10
width 95% inflect	0.00	*fixed*	1988 rec dev	0.71	0.09
Combo sel size inflect	13.34	12.74	1989 rec dev	0.78	0.09
Combo sel width 95% inflect	12.88	22.76	1990 rec dev	0.02	0.14
Rec CPUE sel peak	39.34	0.61	1991 rec dev	0.57	0.12
Rec CPUE sel top	-6.00	0.10	1992 rec dev	-0.37	0.21
Rec CPUE sel asc-width	3.76	0.09	1993 rec dev	0.97	0.12
Rec CPUE sel desc-width	3.45	1.50	1994 rec dev	-0.15	0.21
Rec CPUEsel init	-7.66	0.63	1995 rec dev	0.04	0.22
Rec CPUE sel final	-1.32	2.32	1996 rec dev	-0.78	0.38
Rec CPUE age sel peak	1.11	*fixed*	1997 rec dev	-0.63	0.31
Rec CPUE age sel top	-60.00	*fixed*	1998 rec dev	-0.09	0.32
Rec CPUE age sel asc-width	-24.80	*fixed*	1999 rec dev	2.42	0.12
Rec CPUE age sel desc-width	-0.12	*fixed*	2000 rec dev	-1.32	0.57
Rec CPUE age sel init	-33.55	*fixed*	2001 rec dev	0.06	0.18
Rec CPUE age sel final	-4.11	*fixed*	2002 rec dev	0.40	0.18
			2003 rec dev	-0.23	0.17
			2004 rec dev	0.33	0.17
			2005 rec dev	-0.91	0.17
			2006 rec dev	-1.07	0.17

Table 21a: Base model output 1892-1949.

year	bio-all	bio-smry	SSB	depletion	recruits	total catch	expl. rate
Unfished	47214	45057	33390	1.00	34490	0	0.000
1892	47214	45057	33391	1.00	34490	217	0.005
1893	47013	44857	33200	0.99	34453	205	0.005
1894	46841	44688	33038	0.99	34421	193	0.004
1895	46699	44547	32904	0.99	34394	180	0.004
1896	46582	44432	32795	0.98	34373	171	0.004
1897	46486	44337	32706	0.98	34355	160	0.004
1898	46409	44261	32636	0.98	34341	151	0.003
1899	46348	44201	32582	0.98	34330	140	0.003
1900	46303	44156	32543	0.97	34322	155	0.004
1901	46247	44101	32494	0.97	34312	169	0.004
1902	46184	44039	32437	0.97	34300	185	0.004
1903	46112	43967	32372	0.97	34287	200	0.005
1904	46032	43889	32300	0.97	34272	215	0.005
1905	45946	43803	32222	0.97	34256	229	0.005
1906	45855	43713	32139	0.96	34239	244	0.006
1907	45759	43618	32051	0.96	34221	259	0.006
1908	45658	43518	31959	0.96	34201	274	0.006
1909	45552	43414	31862	0.95	34181	307	0.007
1910	45426	43289	31747	0.95	34157	342	0.008
1911	45279	43144	31611	0.95	34128	377	0.009
1912	45113	42980	31459	0.94	34095	411	0.010
1913	44931	42800	31292	0.94	34059	445	0.010
1914	44735	42606	31111	0.93	34020	479	0.011
1915	44525	42399	30919	0.93	33978	514	0.012
1916	44303	42180	30715	0.92	33933	666	0.016
1917	43960	41840	30397	0.91	33861	819	0.020
1918	43506	41391	29977	0.90	33765	973	0.024
1919	42950	40843	29462	0.88	33644	637	0.016
1920	42758	40656	29292	0.88	33604	664	0.016
1921	42560	40460	29118	0.87	33562	562	0.014
1922	42474	40376	29051	0.87	33545	508	0.013
1923	42445	40347	29037	0.87	33542	601	0.015
1924	42330	40233	28942	0.87	33519	560	0.014
1925	42260	40165	28888	0.87	33505	647	0.016
1926	42115	40021	28762	0.86	33474	889	0.022
1927	41757	39666	28434	0.85	33393	754	0.019
1928	41555	39468	28254	0.85	33347	739	0.019
1929	41386	39302	28105	0.84	33309	659	0.017
1930	41306	39223	28040	0.84	33292	822	0.021
1931	41081	39001	27839	0.83	33240	830	0.021
1932	40867	38790	27648	0.83	33190	656	0.017
1933	40834	38758	27627	0.83	33185	568	0.015
1934	40885	38809	27685	0.83	33200	531	0.014
1935	40965	38888	27770	0.83	33222	571	0.015
1936	40999	38921	27810	0.83	33233	583	0.015
1937	41017	38939	27833	0.83	33239	537	0.014
1938	41076	38997	27893	0.84	33254	394	0.010
1939	41262	39181	28071	0.84	33300	318	0.008
1940	41502	39418	28300	0.85	33359	386	0.010
1941	41658	39570	28447	0.85	33396	360	0.009
1942	41822	39732	28604	0.86	33435	107	0.003
1943	42206	40112	28965	0.87	33524	155	0.004
1944	42511	40412	29254	0.88	33594	219	0.005
1945	42725	40623	29460	0.88	33644	434	0.011
1946	42715	40611	29464	0.88	33645	380	0.009
1947	42754	40650	29506	0.88	33655	347	0.009
1948	42822	40716	29569	0.89	33670	347	0.009
1949	42883	40777	29627	0.89	33683	368	0.009

Table 21b: Base model output 1950-2007.

Year	bio-all	bio-smry	SSB	depletion	rec	total catch	expl. rate
1950	42920	40813	29662	0.89	33691	576	0.014
1951	42758	40652	29519	0.88	33658	870	0.021
1952	42330	40228	29141	0.87	33567	1055	0.026
1953	41761	39666	28637	0.86	33443	1207	0.030
1954	41096	39010	28048	0.84	33294	1215	0.031
1955	40479	38401	27505	0.82	33152	1381	0.036
1956	39756	37688	26875	0.80	32982	1643	0.044
1957	38842	36787	26079	0.78	32758	1687	0.046
1958	37961	35920	25314	0.76	32533	1889	0.053
1959	36963	34937	24442	0.73	32263	1593	0.046
1960	36325	34313	23892	0.72	32085	1443	0.042
1961	35879	33876	23524	0.70	31962	1146	0.034
1962	35748	33750	23431	0.70	31931	1118	0.033
1963	35652	33656	23370	0.70	31910	1077	0.032
1964	35596	33601	23347	0.70	31902	884	0.026
1965	35086	33727	23478	0.70	11737	993	0.029
1966	34339	33735	23473	0.70	7623	2182	0.065
1967	33633	31923	22447	0.67	46692	2796	0.088
1968	32115	28980	20755	0.62	53478	1775	0.061
1969	29870	27973	19569	0.59	7602	1090	0.039
1970	30621	28520	19029	0.57	59113	1273	0.045
1971	33863	30943	21323	0.64	34502	1253	0.040
1972	34608	33423	23118	0.69	3682	1899	0.057
1973	37977	35174	24162	0.72	85193	3644	0.104
1974	36701	33844	24005	0.72	6905	3960	0.117
1975	35964	33305	22406	0.67	77489	3228	0.097
1976	36092	33196	22459	0.67	15714	3092	0.093
1977	35209	34259	22631	0.68	14693	2091	0.061
1978	36770	35912	24114	0.72	12750	1934	0.054
1979	38241	36360	25500	0.76	47094	2725	0.075
1980	36490	34605	24919	0.75	13496	3255	0.094
1981	31887	31194	22019	0.66	8719	2776	0.089
1982	28876	28508	19682	0.59	3130	2492	0.087
1983	26269	26051	18125	0.54	3862	2465	0.095
1984	27234	23240	16495	0.49	122750	2923	0.126
1985	23721	19667	14284	0.43	7999	3182	0.162
1986	20941	19835	11548	0.35	27210	3147	0.159
1987	21602	20057	10969	0.33	22256	2059	0.103
1988	23163	21448	12593	0.38	32477	2691	0.125
1989	23808	21682	13242	0.40	35464	3395	0.157
1990	22382	20771	12573	0.38	16270	3110	0.150
1991	21653	20279	11919	0.36	27574	3311	0.163
1992	20340	19153	11258	0.34	10565	2753	0.144
1993	19649	18087	10540	0.32	39139	2393	0.132
1994	18583	16975	10036	0.30	12526	1877	0.111
1995	17872	17008	9812	0.29	15080	2021	0.119
1996	17127	16453	9589	0.29	6555	1870	0.114
1997	16307	15865	9489	0.28	7584	2110	0.133
1998	15209	14578	8968	0.27	12569	1430	0.098
1999	18866	13635	8666	0.26	153415	977	0.072
2000	18442	13573	9029	0.27	3708	499	0.037
2001	19149	18556	9536	0.29	15148	517	0.028
2002	24397	23175	12671	0.38	23831	329	0.014
2003	28205	27023	17040	0.51	14082	21	0.001
2004	31275	30022	20229	0.61	25895	236	0.008
2005	32553	31509	22146	0.66	7647	192	0.006
2006	32852	32405	23224	0.70	6645	127	0.004
2007	*33619*	*32401*	*23827*	*0.71*	*32063*	n/a	n/a

Table 22: Reference Points

Unfished Stock	Estimate	~95% Confidence Limits Lower	Upper
Summary (1+) Biomass	45057		
Spawning Biomass (SSB)	33390	30138	36642
Equilibrium recruitment	34490	31131	37849

	SPR proxy MSY	$SB_{40\%}$	Estimated MSY
SPR	0.50	0.45	0.43
Fmult (2006)	25.2	29.9	33.0
Exploitation rate	0.088	0.102	0.112
Yield	2099	2155	2164
SSB at Equilibrium	15482	21034	12126
SSB/SSB_0	0.46	0.40	0.36

Table 23: Decision table with 10 year forecast

					Low Productivity		**BASE MODEL**		**High Productivity**	
					h=0.34		**h=0.57**		**h=0.81**	
	"Status quo" (2006) catches				SSB0	40568	SSB0	33390	SSB0	30489
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18542	0.46	23827	0.71	26482	0.87
2008	105	18	0.5	4	17887	0.44	23285	0.70	25949	0.85
2009	105	18	0.5	4	16995	0.42	22379	0.67	24991	0.82
2010	105	18	0.5	4	16255	0.40	21574	0.65	24072	0.79
2011	105	18	0.5	4	15929	0.39	21199	0.63	23526	0.77
2012	105	18	0.5	4	15966	0.39	21226	0.64	23347	0.77
2013	105	18	0.5	4	16239	0.40	21531	0.64	23436	0.77
2014	105	18	0.5	4	16645	0.41	22011	0.66	23704	0.78
2015	105	18	0.5	4	17118	0.42	22587	0.68	24082	0.79
2016	105	18	0.5	4	17624	0.43	23211	0.70	24522	0.80
2017	105	18	0.5	4	18141	0.45	23846	0.71	24986	0.82
2018	105	18	0.5	4	18661	0.46	24473	0.73	25451	0.83
	"MSY" catches (base model)									
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18542	0.46	23827	0.71	26485	0.87
2008	105	18	0.5	4	18325	0.45	23917	0.72	26652	0.87
2009	1735	292	7	64	17684	0.44	23385	0.70	26111	0.86
2010	1735	292	7	64	15560	0.38	21270	0.64	23899	0.78
2011	1735	292	7	64	14111	0.35	19814	0.59	22259	0.73
2012	1735	292	7	64	13216	0.33	18934	0.57	21149	0.69
2013	1735	292	7	64	12644	0.31	18440	0.55	20424	0.67
2014	1735	292	7	64	12199	0.30	18171	0.54	19956	0.65
2015	1735	292	7	64	11776	0.29	18019	0.54	19650	0.64
2016	1735	292	7	64	11333	0.28	17921	0.54	19446	0.64
2017	1735	292	7	64	10863	0.27	17845	0.53	19302	0.63
2018	1735	292	7	64	10369	0.26	17779	0.53	19194	0.63
	40:10 Catches									
year	Trawl	Hook/line	Net	Rec	SpawnBio	depletion	SpawnBio	depletion	SpawnBio	depletion
2007	105	18	0.5	4	18652	0.46	23827	0.71	26366	0.86
2008	105	18	0.5	4	17994	0.44	23285	0.70	25836	0.85
2009	2507	429	12	89	17099	0.42	22379	0.67	24882	0.82
2010	2127	364	11	75	13923	0.34	19139	0.57	21533	0.71
2011	1847	308	9	65	11785	0.29	16940	0.51	19164	0.63
2012	1679	266	8	60	10501	0.26	15629	0.47	17650	0.58
2013	1594	241	7	59	9739	0.24	14911	0.45	16734	0.55
2014	1558	228	6	60	9204	0.23	14530	0.44	16194	0.53
2015	1543	223	6	61	8719	0.21	14312	0.43	15874	0.52
2016	1535	220	5	62	8208	0.20	14164	0.42	15681	0.51
2017	1528	219	5	62	7654	0.19	14041	0.42	15561	0.51
2018	1520	218	5	62	7068	0.17	13928	0.42	15486	0.51

Table 24: Likelihood values and reference points for the base model and 13 “jittered” base models

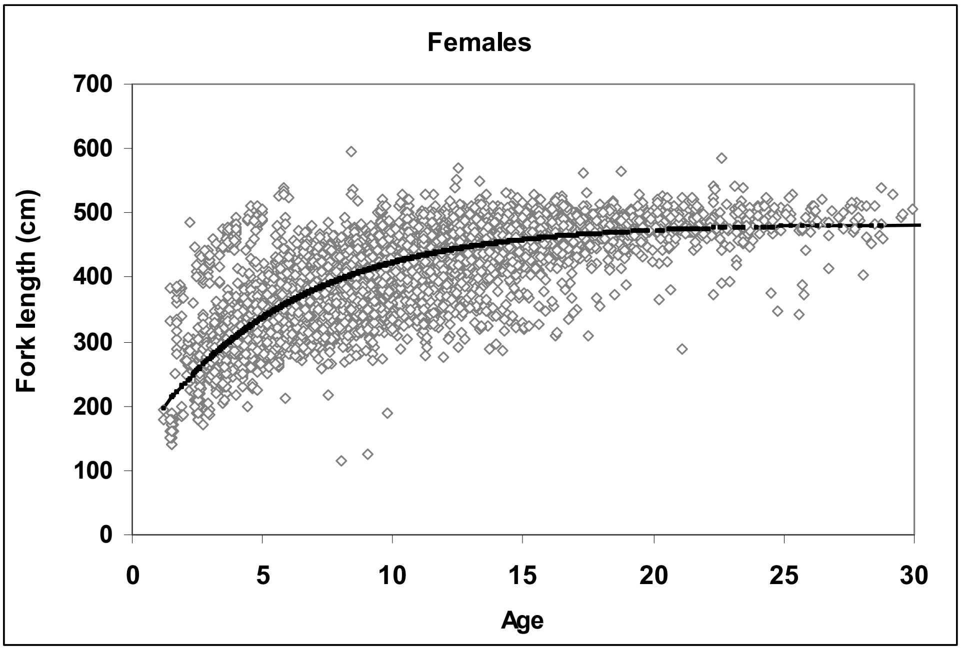
		BASE	Jittered models->											
SSB0		33390	33576	33756	31924	33483	32076	33390	33427	33776	32543	33845	32221	32268	33416
R0		34490	34682	34868	32975	34586	33133	34490	34528	34888	33615	34960	33282	33331	34516
Maximum gradient		0.00057	0.00072	0.00006	0.00072	0.00062	0.00055	0.00085	0.00098	0.00037	0.00052	0.00050	0.00084	0.00079	0.00090
Total Likelihood		1972.2	1973.8	1978.5	2010.5	1978.2	2006.6	1972.2	1974.7	1974.3	2014.8	1975.8	2008.0	2013.7	1972.4
Likelihood components															
indices		43.6	43.8	44.1	67.6	43.4	65.5	43.6	43.4	43.7	67.8	43.8	65.5	67.8	43.6
length_comps		430.1	431.0	436.2	453.6	435.5	450.6	430.1	432.3	428.2	457.1	433.0	451.8	457.8	430.2
age_comps		1479.0	1479.5	1478.8	1470.2	1479.7	1471.6	1479.0	1479.4	1482.7	1470.9	1479.6	1471.8	1468.9	1479.0
Recruitment		19.5	19.5	19.3	19.1	19.6	19.0	19.5	19.6	19.7	19.0	19.4	19.0	19.2	19.5
Indices															
Fleet	lambda		surv_like												
trawl	1	9.9	9.8	9.8	9.9	9.9	9.9	9.9	10.0	10.1	9.9	9.8	9.9	9.9	9.9
triennial	1	8.7	8.7	8.7	8.2	8.9	7.9	8.7	8.7	8.6	8.2	8.8	8.0	8.3	8.7
combined	1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
coast juvenile	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
recreational CPUE	1	23.8	24.0	24.4	48.2	23.4	46.3	23.8	23.5	23.7	48.4	24.0	46.4	48.3	23.8
Length composition	lambda		length_like												
trawl	0.1	468.9	469.4	471.7	470.7	468.9	472.4	468.9	468.3	473.7	472.4	471.4	472.7	471.1	468.9
hook	0.1	171.9	171.9	173.1	189.2	170.1	188.5	171.9	170.7	169.1	188.8	171.8	188.4	189.3	171.9
setnet	0.1	228.7	228.6	225.7	235.9	228.0	235.3	228.7	229.6	188.1	230.6	225.8	233.4	234.8	228.6
recreational	1	126.1	126.8	127.9	126.2	126.5	126.0	126.1	125.8	126.5	129.1	128.1	127.1	126.4	126.1
triennial	1	146.4	146.3	147.4	146.9	146.6	146.8	146.4	146.3	146.9	147.4	147.1	146.8	146.8	146.4
combined	0.1	33.6	33.6	33.6	35.6	35.0	33.7	33.6	33.6	33.9	33.7	33.6	33.7	33.6	33.6
recreational CPUE	1	67.4	67.5	70.5	87.3	72.2	84.8	67.4	70.0	68.3	88.1	67.6	85.1	91.6	67.4
Age composition	lambda		age_like												
trawl	1	672.7	673.3	672.9	664.6	673.4	666.3	672.7	672.9	671.6	665.7	673.6	666.7	663.9	672.7
hook	1	266.1	266.4	266.4	261.1	267.0	261.2	266.1	266.5	265.5	261.5	266.7	261.4	261.3	266.2
setnet	1	531.9	531.6	531.4	536.6	531.1	536.3	531.9	531.8	537.3	535.8	531.1	535.9	535.8	531.9
combined	1	8.2	8.2	8.2	7.9	8.2	7.9	8.2	8.2	8.3	7.9	8.2	7.9	7.9	8.2

Table 25: Select run results and likelihood components from profiles on alternative steepness and natural mortality values.

Parameter Value (h and M)			h=0.21	h=0.34	h=0.57	h=0.81	h=0.99	M=0.12	M=0.14	M=0.16	M=0.18	M=0.2
SSB0	SSB0		54233	40274	33390	30718	29667	34235	33933	33390	32606	32182
R0	R0		56019	41600	34490	31730	30645	20621	27096	34490	42718	52617
Total Likelihood			2009.5	1980.0	1972.2	1971.1	1970.9	2018.6	1983.8	1972.2	1977.8	1994.1
Likelihood components												
indices			40.4	41.3	43.6	44.9	45.4	44.1	44.0	43.6	43.1	42.7
length_comps			442.9	434.1	430.1	428.8	428.5	444.0	434.7	430.1	428.1	429.1
age_comps			1481.3	1478.9	1479.0	1479.1	1479.0	1500.9	1482.3	1479.0	1488.3	1503.9
Recruitment			44.9	25.6	19.5	18.4	18.1	29.7	22.9	19.5	18.3	18.4
Fleet	lambda	surv_like										
trawl	1		10.6	10.4	9.9	9.6	9.5	8.7	9.3	9.9	10.6	11.6
triennial	1		7.2	7.5	8.7	9.3	9.6	9.2	9.0	8.7	8.3	7.9
combined	1		1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
coast juvenile	1		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
recreational CPUE	1		21.3	22.1	23.8	24.7	25.1	24.9	24.5	23.8	23.0	21.9
Length composition	lambda	length_like										
trawl	0.1		474.5	470.7	468.9	468.0	467.7	476.7	469.2	468.9	474.6	489.4
hook	0.1		176.2	173.8	171.9	171.1	170.9	181.1	176.0	171.9	168.4	165.1
setnet	0.1		227.0	228.2	228.7	228.8	229.0	233.7	231.3	228.7	219.2	190.9
recreational	1		131.0	127.5	126.1	125.6	125.6	132.1	128.2	126.1	124.5	124.5
Triennial	1		152.5	148.0	146.4	146.0	145.8	151.9	148.3	146.4	146.2	147.3
combined	0.1		28.8	31.9	33.6	34.0	34.1	29.2	31.8	33.6	35.2	36.9
recreational CPUE	1		68.8	68.1	67.4	67.0	66.9	67.9	67.4	67.4	67.7	69.1
Age composition	lambda	age_like										
Trawl	1		669.1	670.7	672.7	673.3	673.6	695.4	677.8	672.7	676.8	686.4
Hook	1		265.8	266.2	266.1	265.9	265.8	273.5	269.2	266.1	263.7	262.3
Setnet	1		535.2	533.2	531.9	531.7	531.5	521.5	526.3	531.9	540.1	547.6
combined	1		11.1	8.7	8.2	8.2	8.2	10.5	9.0	8.2	7.8	7.6

Table 26: Model sensitivity runs, sequentially remove data or alter total catches.

		BASE	no trawl cpue	no triennial index, LFs	no combo index, LFs, AF	no juv survey	no rec cpue, LF's	no trawl cpue, LFs, Afs	no hook LFs, AFs	no net LFs, AFs	net sel. asymp.	K time-invariant	2x pre-1970 catches	0.5x pre-1970 catches
SSB0		33390	32958	32919	32273	33698	35285	33886	31160	35126	33510	39879	48079	25097
R0		34490	34044	34003	33336	34808	36447	35003	32186	36284	34614	41193	49662	25924
Maximum gradient		0.00057	0.00046	0.00073	0.00059	0.00054	0.00080	0.00074	0.00093	0.00071	0.00095	0.00060	0.00079	0.00081
Total Likelihood		1972.2	1964.4	1851.6	2001.6	1961.9	1863.9	1179.7	1718.4	1394.8	1989.2	2067.1	2023.6	1981.1
Likelihood components														
indices		43.6	31.7	58.3	66.3	43.1	21.4	17.3	61.1	45.5	45.9	54.2	75.5	41.2
length_comps		430.1	433.1	311.6	456.7	420.0	365.2	362.1	432.7	400.7	437.8	509.8	454.5	433.3
age_comps		1479.0	1480.2	1463.1	1459.8	1479.7	1456.8	782.0	1205.4	930.6	1486.2	1484.4	1475.8	1483.2
Recruitment		19.5	19.4	18.7	18.9	19.0	20.5	18.2	19.2	18.1	19.4	18.7	17.8	23.4
Indices														
Fleet	lambda	surv_like												
trawl	1	9.9	0.0	9.1	9.7	10.0	8.9	0.0	12.0	9.9	10.2	9.2	8.7	10.8
triennial	1	8.7	8.3	0.0	8.1	8.5	11.2	7.2	7.0	8.9	8.5	8.7	11.1	7.5
combined	1	1.0	1.0	1.1	0.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.1
coast juvenile	1	0.2	0.2	0.0	0.2	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2
recreational CPUE	1	23.8	22.1	48.1	48.3	23.5	0.0	8.9	41.0	25.5	25.9	35.1	54.5	21.7
Length composition	lambda	length_like												
trawl	0.1	468.9	467.7	482.6	470.9	468.8	485.3	0.0	473.4	453.4	470.3	679.5	467.1	472.9
hook	0.1	171.9	170.0	193.8	189.1	171.9	187.4	166.1	0.0	177.5	173.2	170.4	186.4	173.1
setnet	0.1	228.7	229.5	223.8	234.6	228.8	213.3	211.3	230.6	0.0	198.9	173.8	236.6	225.2
recreational	1	126.1	127.1	118.8	125.9	126.3	122.5	116.2	125.3	125.9	130.7	111.9	126.3	125.9
triennial	1	146.4	145.7	0.0	148.1	135.8	150.7	141.5	142.4	143.0	146.3	186.2	144.8	148.5
combined	0.1	33.6	33.5	42.9	0.0	35.5	33.9	32.1	34.0	33.9	33.6	59.2	35.6	32.7
recreational CPUE	1	67.4	70.2	98.4	93.2	67.4	0.0	63.4	91.2	65.2	73.1	103.4	90.9	68.6
Age composition	lambda	age_like												
trawl	1	672.7	673.9	660.1	662.4	672.3	656.0	0.0	663.6	658.9	670.9	677.0	676.7	669.9
hook	1	266.1	266.3	259.5	261.2	266.2	259.0	276.8	0.0	263.6	265.8	272.6	260.4	266.5
setnet	1	531.9	531.9	534.9	536.2	532.0	533.6	498.6	534.2	0.0	541.2	526.1	530.9	538.1
combined	1	8.2	8.2	8.6	0.0	9.2	8.2	6.7	7.5	8.1	8.2	8.7	7.8	8.6



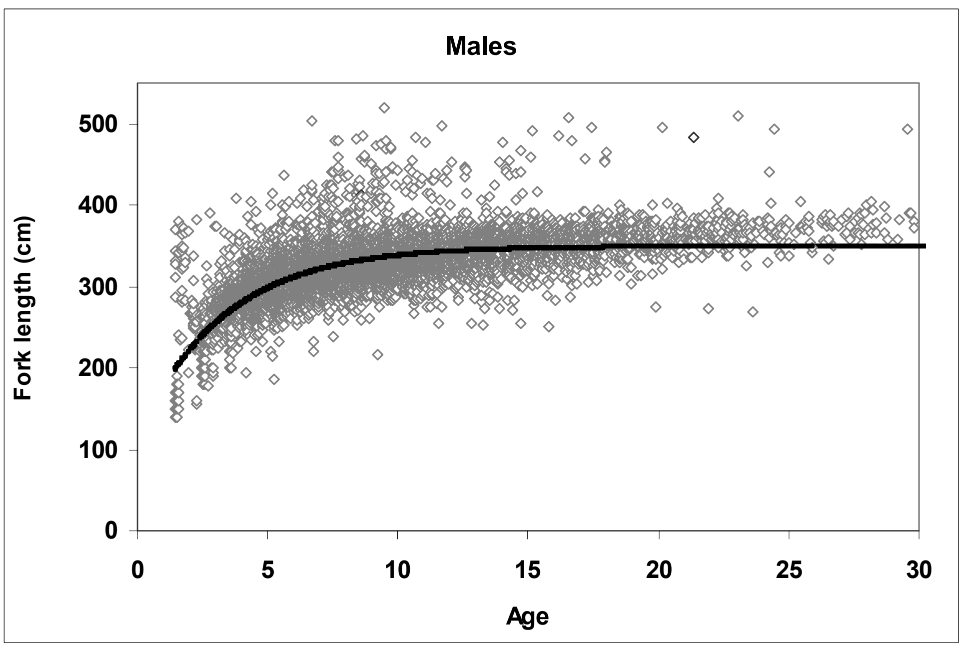


Figure 1a (top) and 1b (bottom): Externally fitted growth curves and size at age data for female and male chilipepper rockfish.

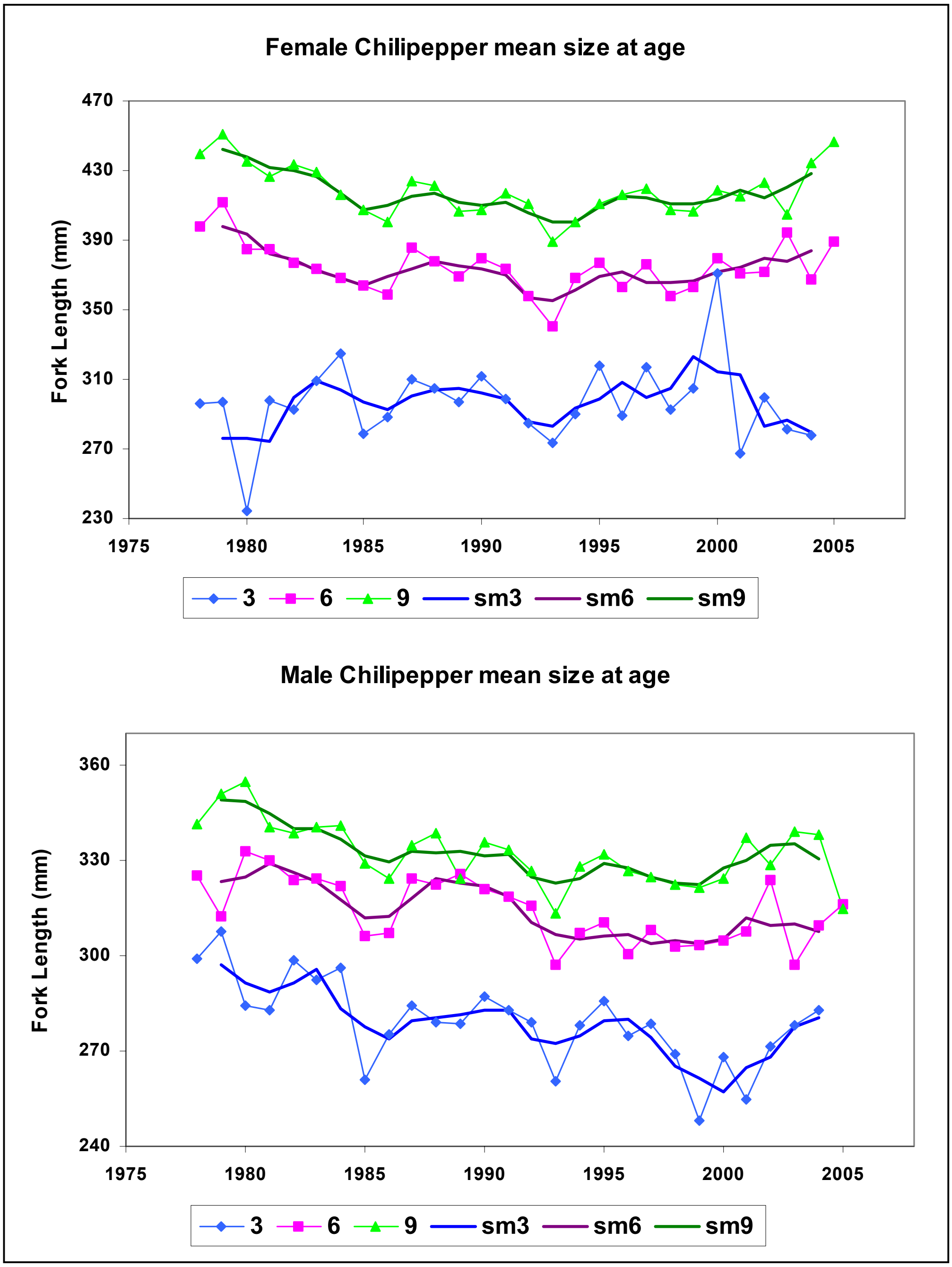
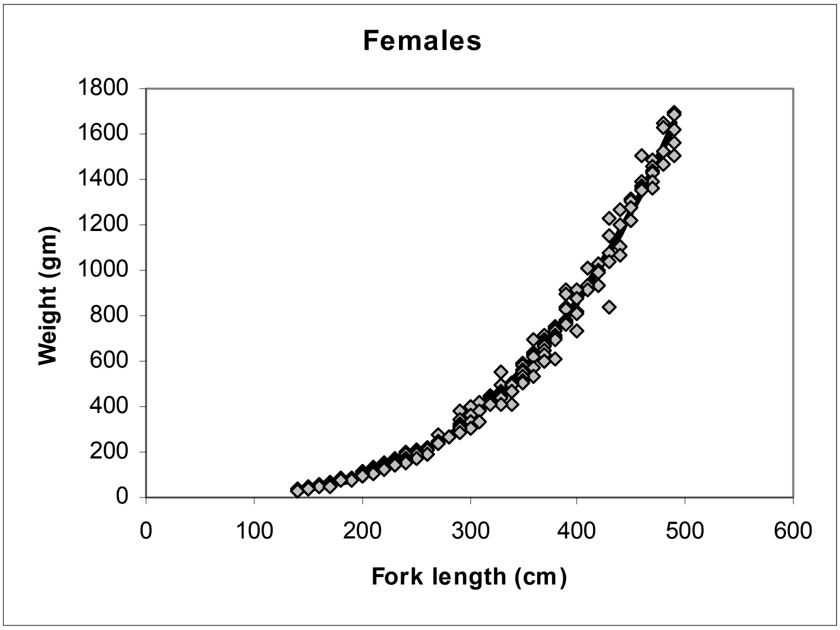


Figure 2a (top) and 2b (bottom): Average size at age over time for three representative ages of chilipepper rockfish (trawl fishery only).



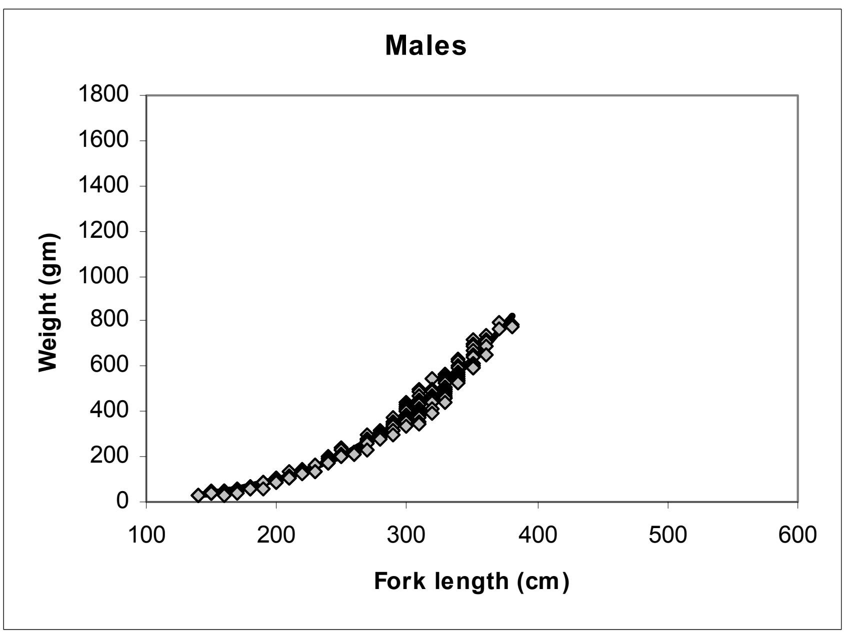


Figure 3a (top) and 3b (bottom): Female and male weight/length relationship.

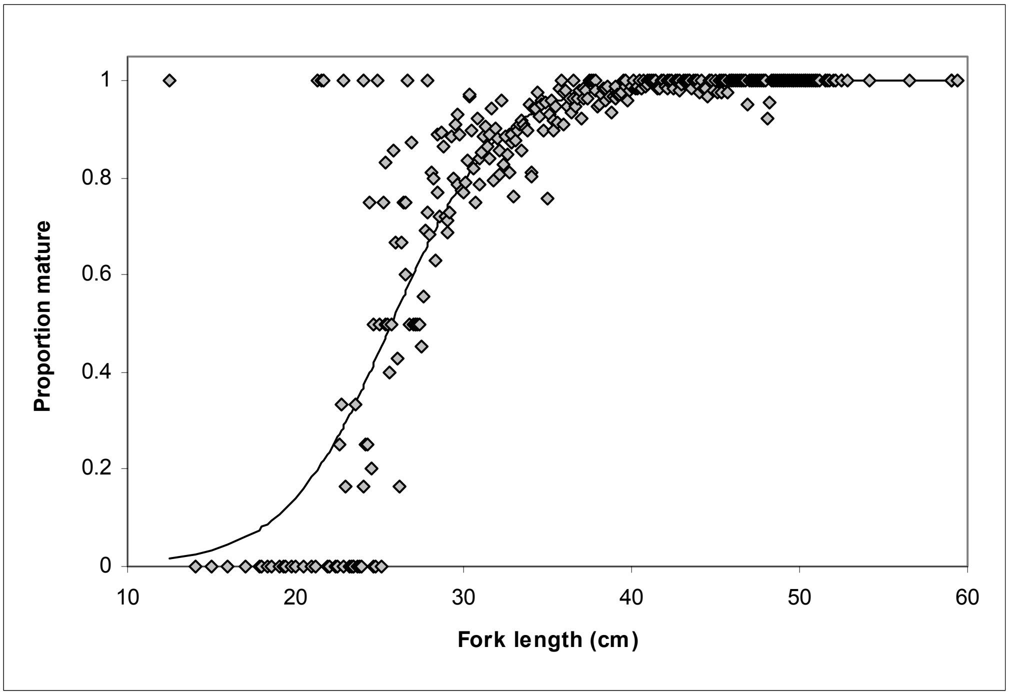


Figure 4: Maturity curve for chilipepper rockfish

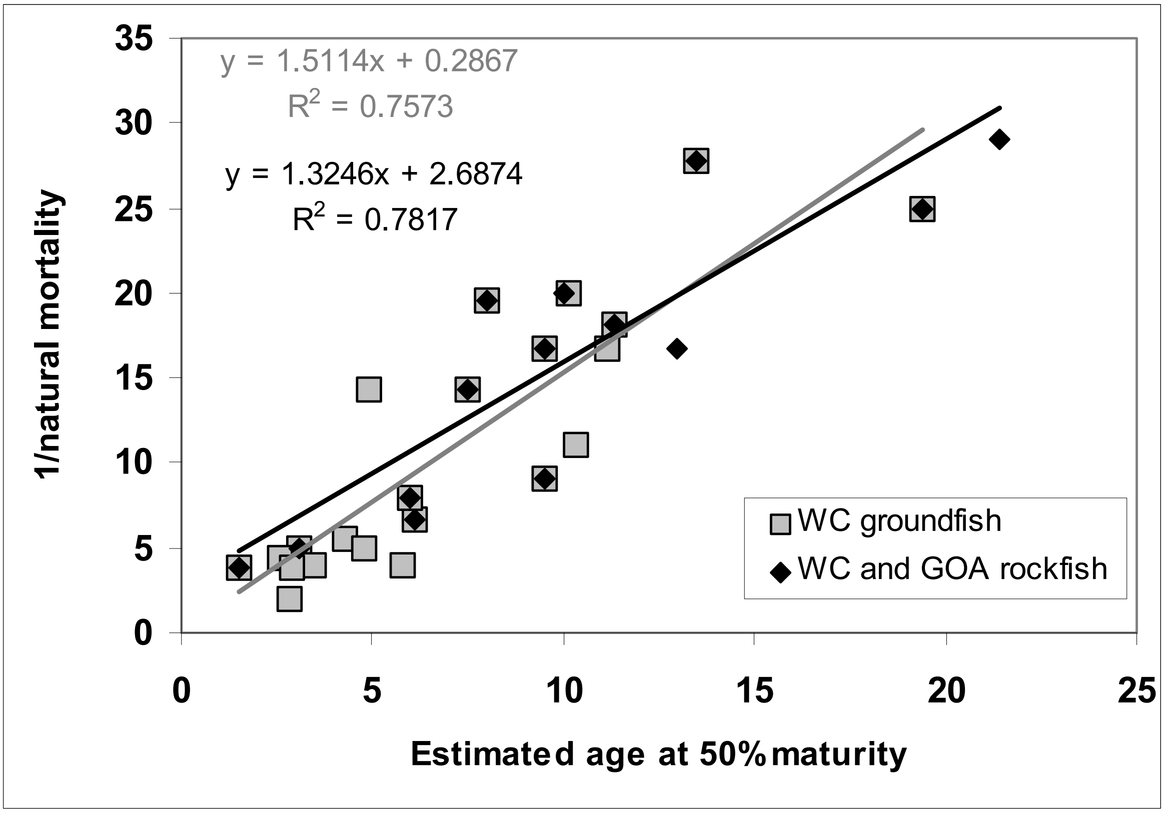


Figure 5: Observed and predicted natural mortality rates (1/M) based on age at 50% maturity for West Coast groundfish and Gulf of Alaska rockfish.

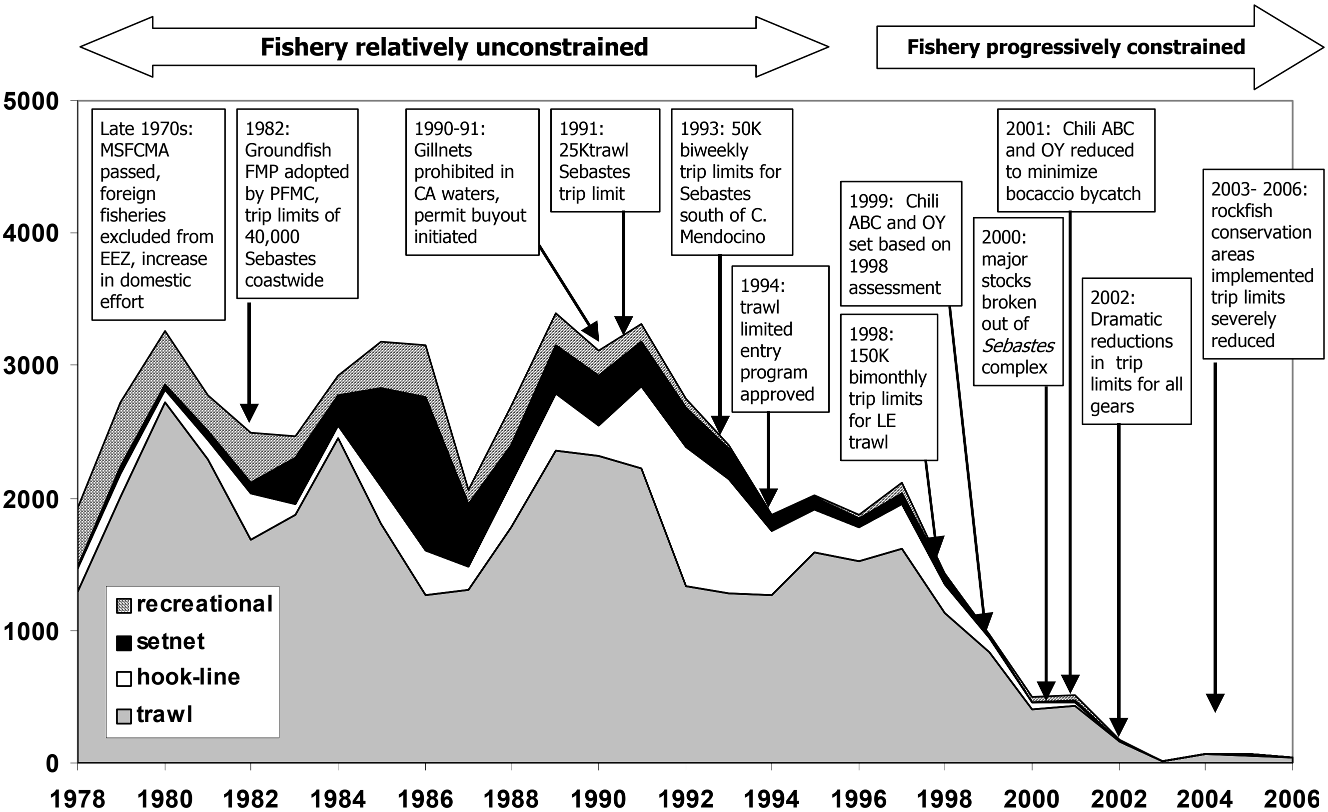
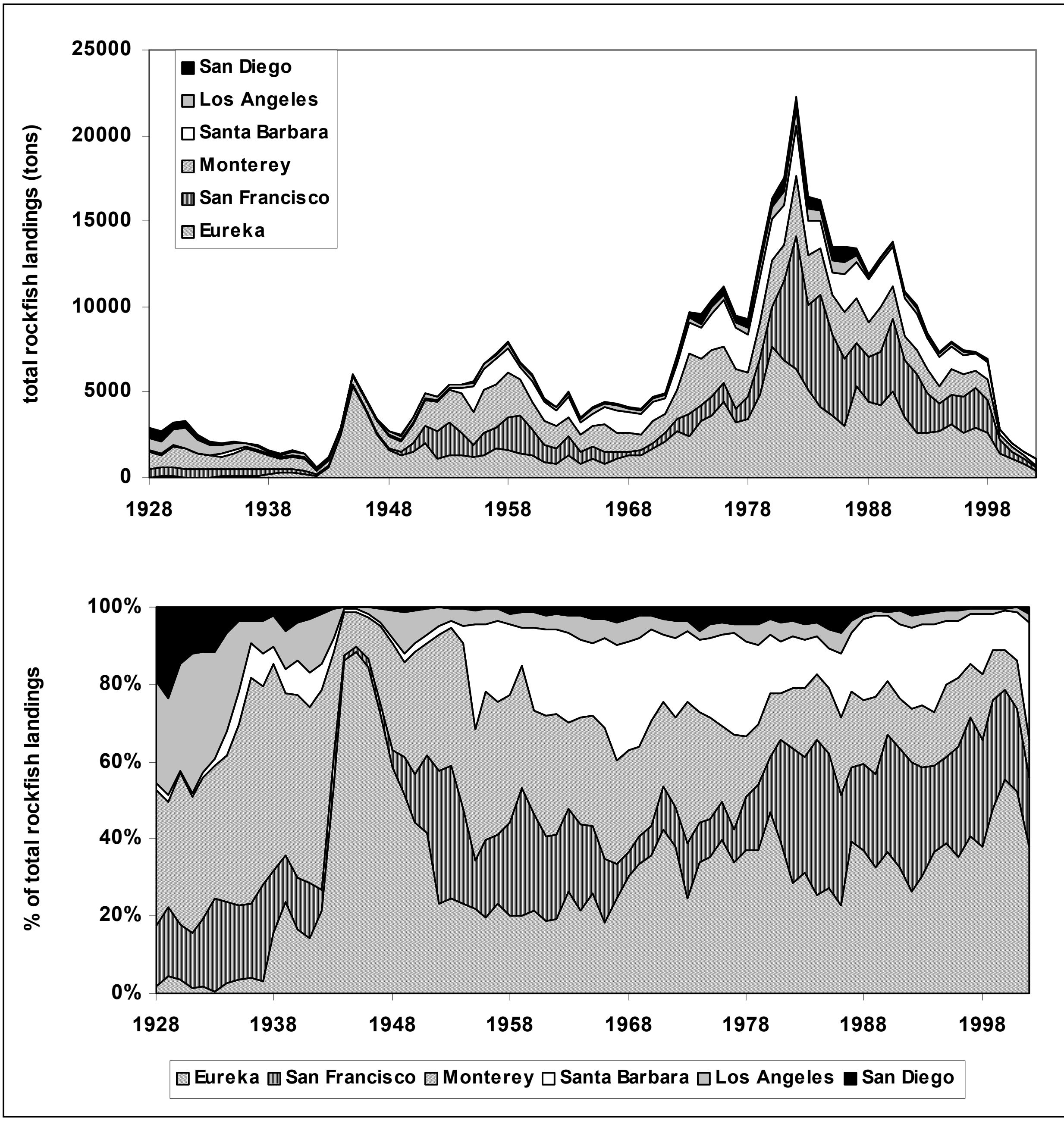


Figure 6: Observed and predicted natural mortality rates (1/M) based on age at 50% maturity for West Coast groundfish and Gulf of Alaska rockfish.



Figures 7a (top) and 7b (bottom): Total California rockfish landings by CDF&G region, 1928-2002.

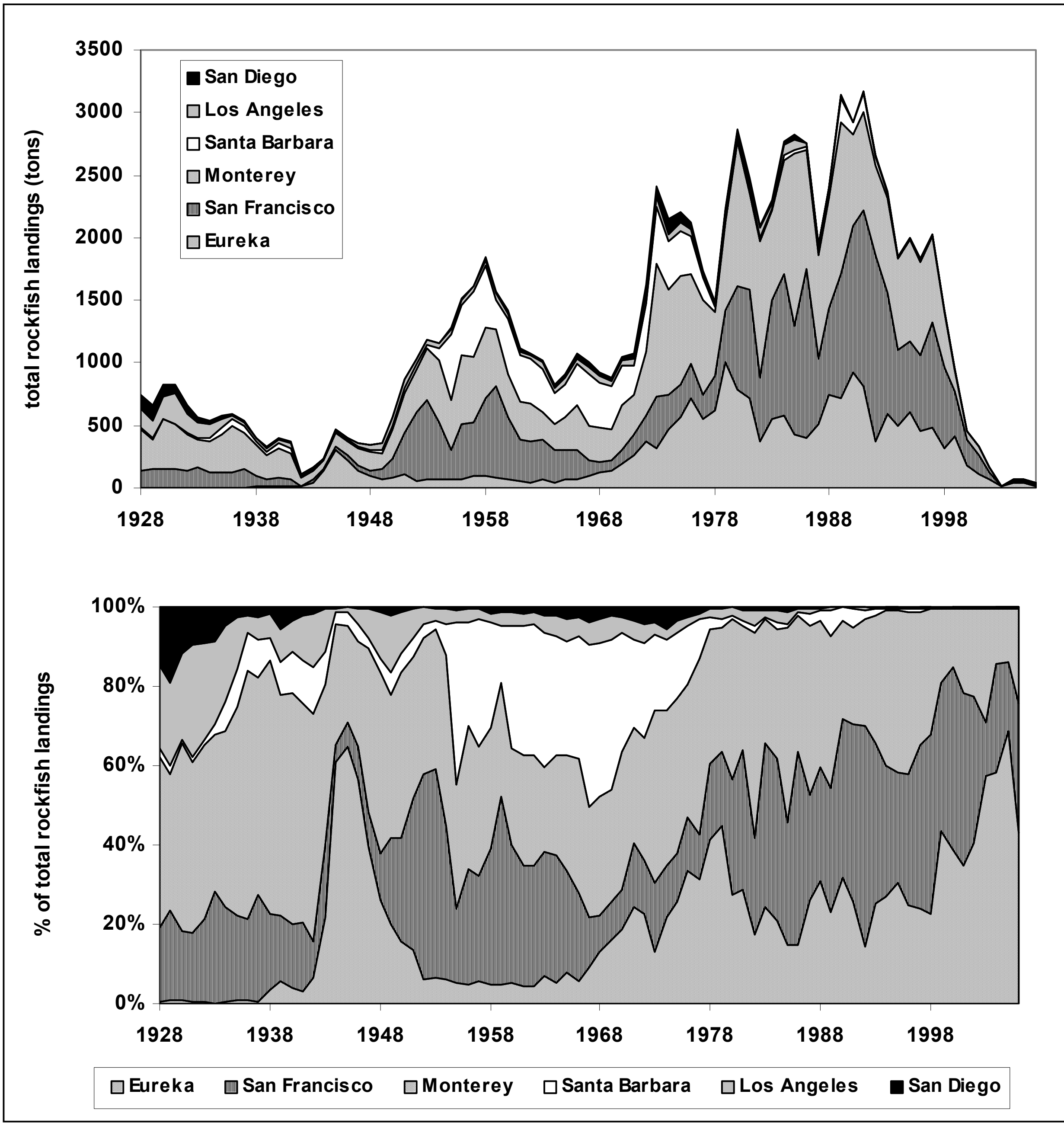


Figure 8a and 8b: Total estimated commercial chilipepper rockfish landings by CDF&G region, 1928-2002.

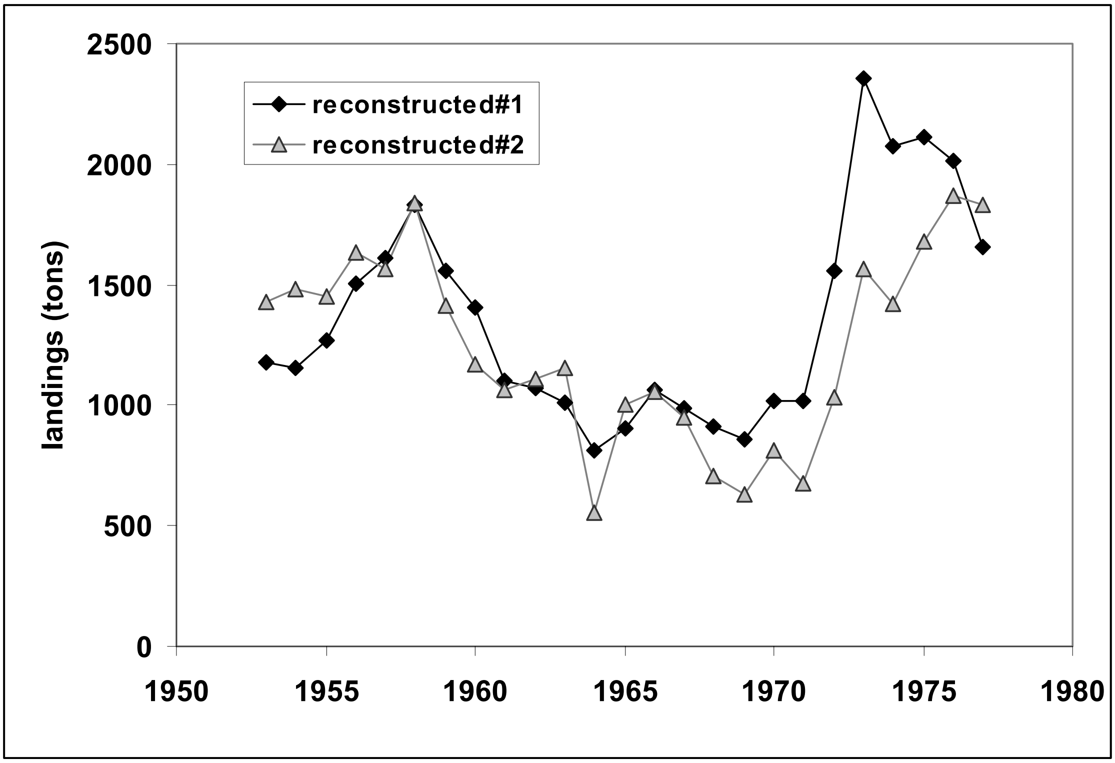
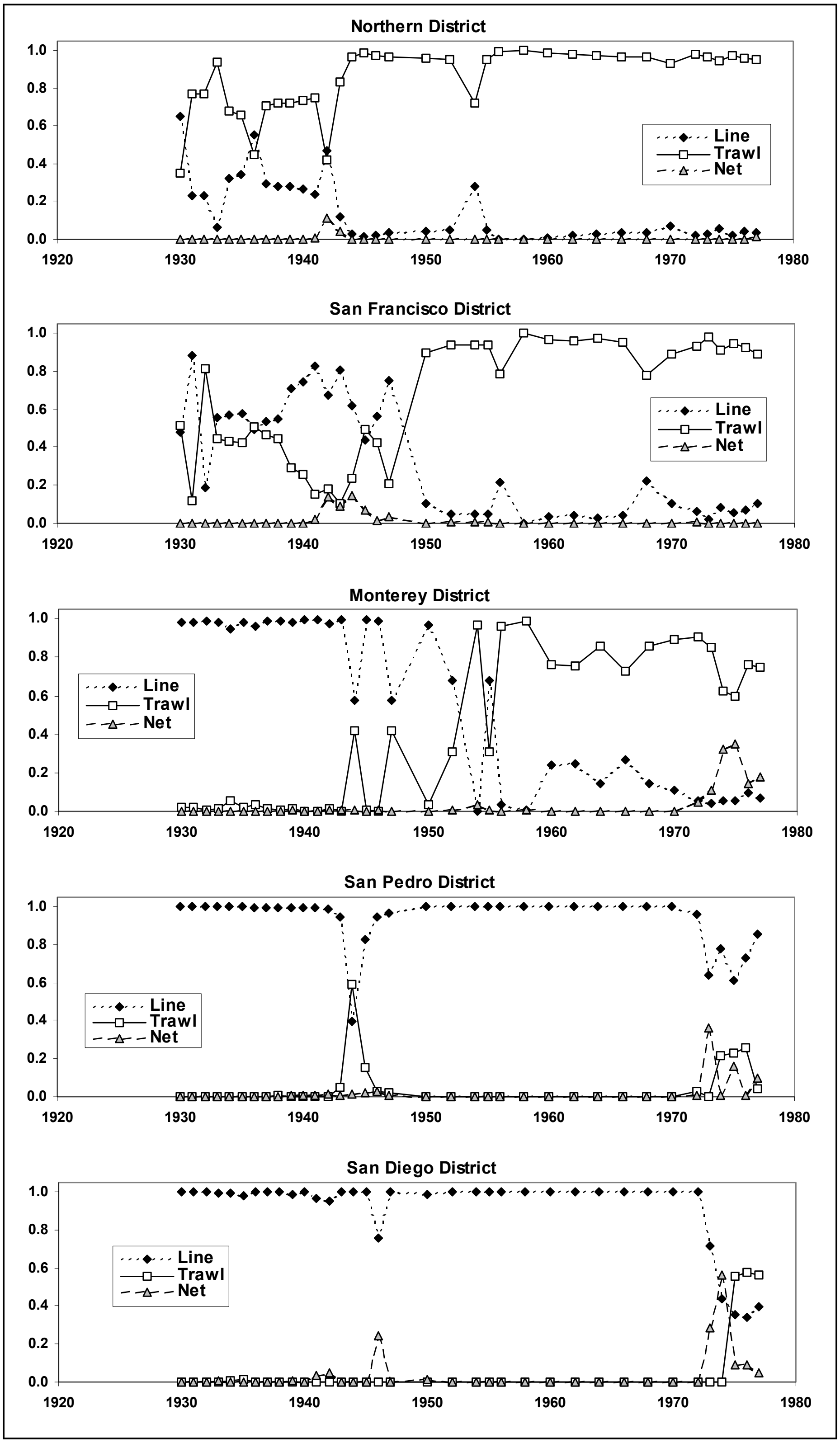


Figure 9: Comparison of base (reconstructed #1) versus an alternative (reconstructed #2) catch history for the period between 1953 and 1977.



Figures 10a-10e: Records of the fraction of landings by gear type from 1930-1978 reported by district.

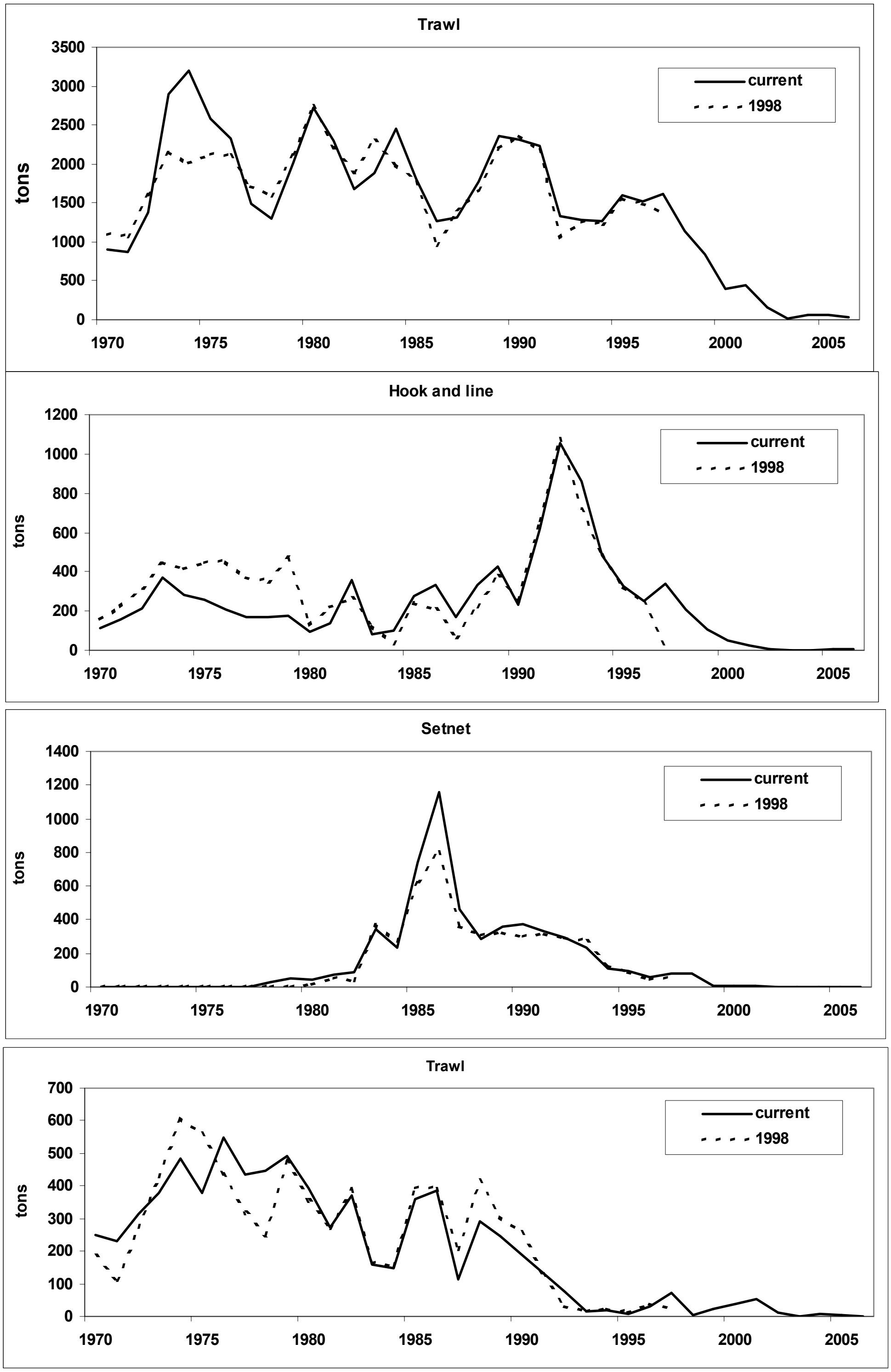


Figure 11a-11d: Comparison of catch estimates from Ralston 1998 with catch estimates used in this model.

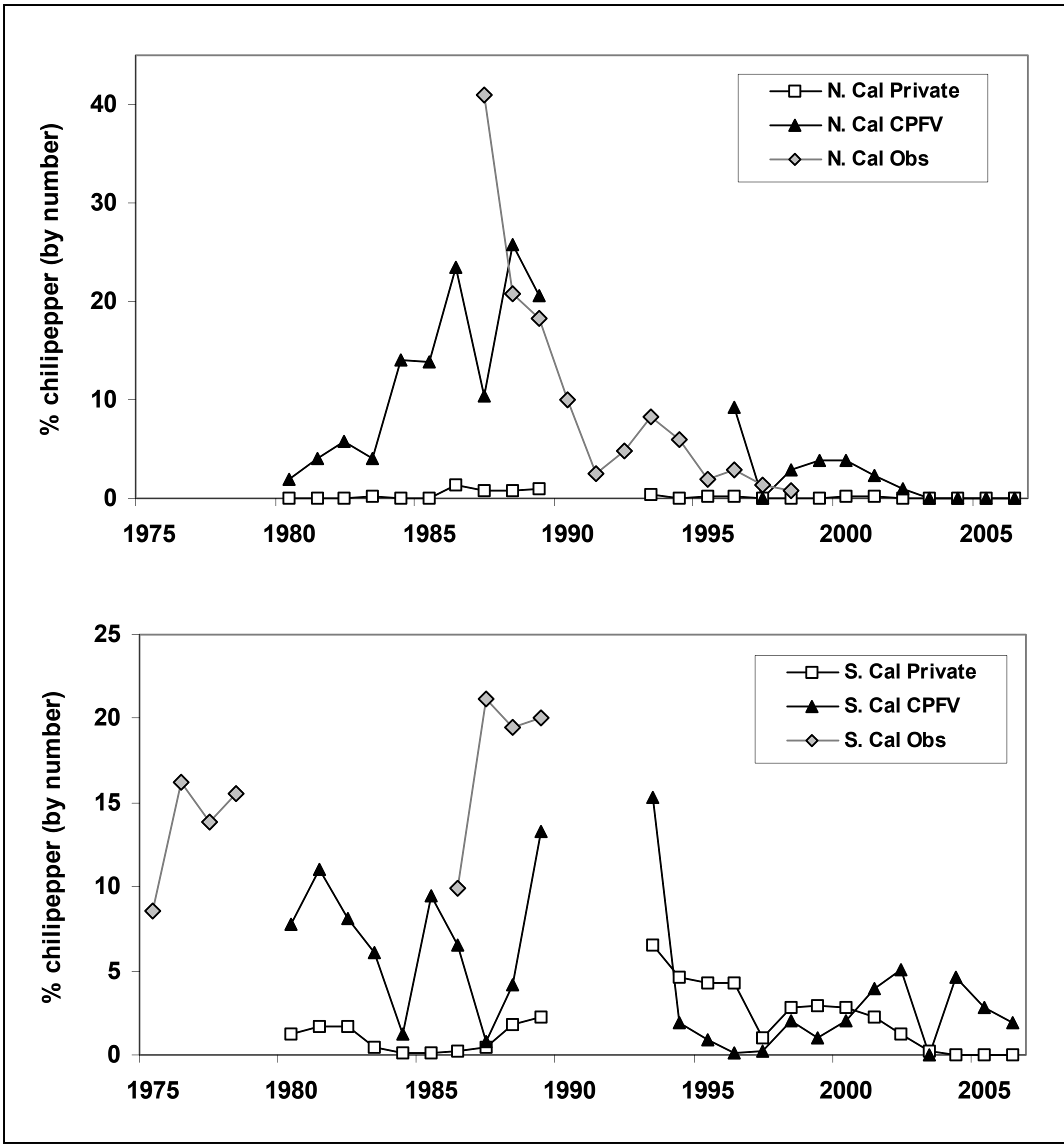


Figure 12: Percentage of total rockfish catch (in 1000s) estimated to be chilipepper by RecFIN (modes CPFV and private only) and from CPFV observer data.

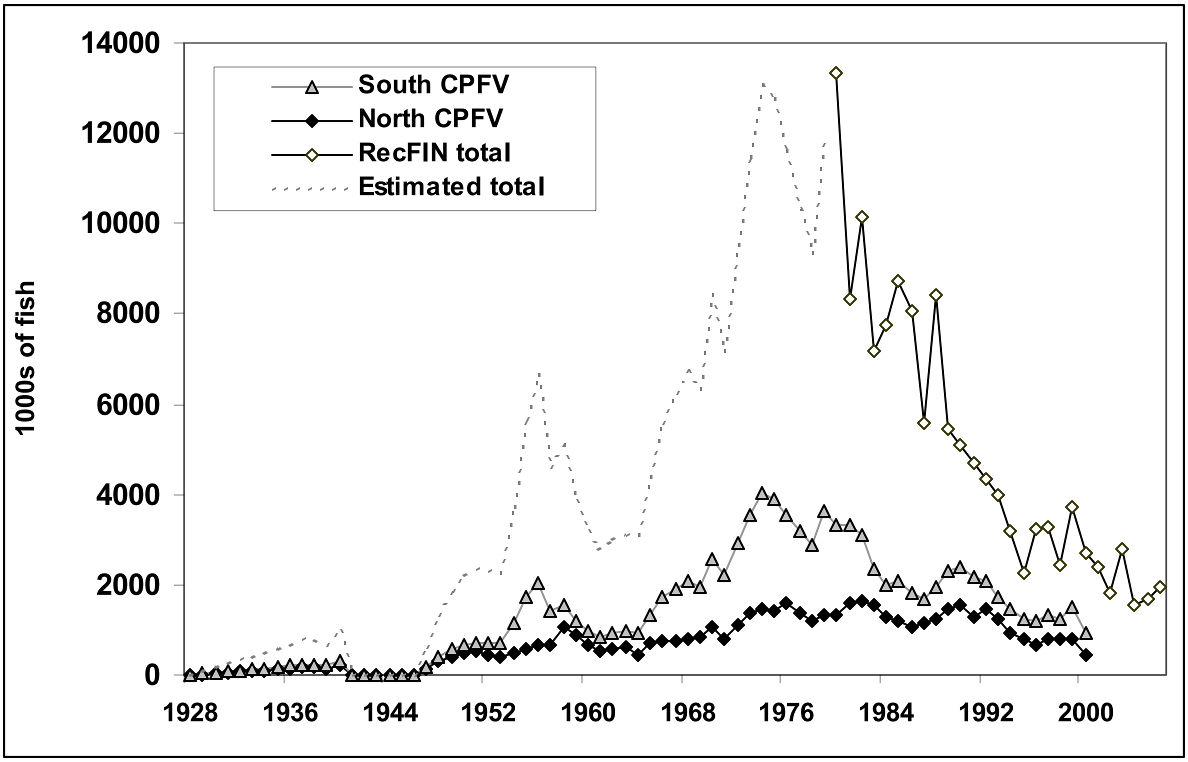


Figure 13: Total estimated recreational rockfish catches in northern and southern California as reported by RecFIN and CPFV logbook data, with reconstructed catches (in numbers) to 1928.

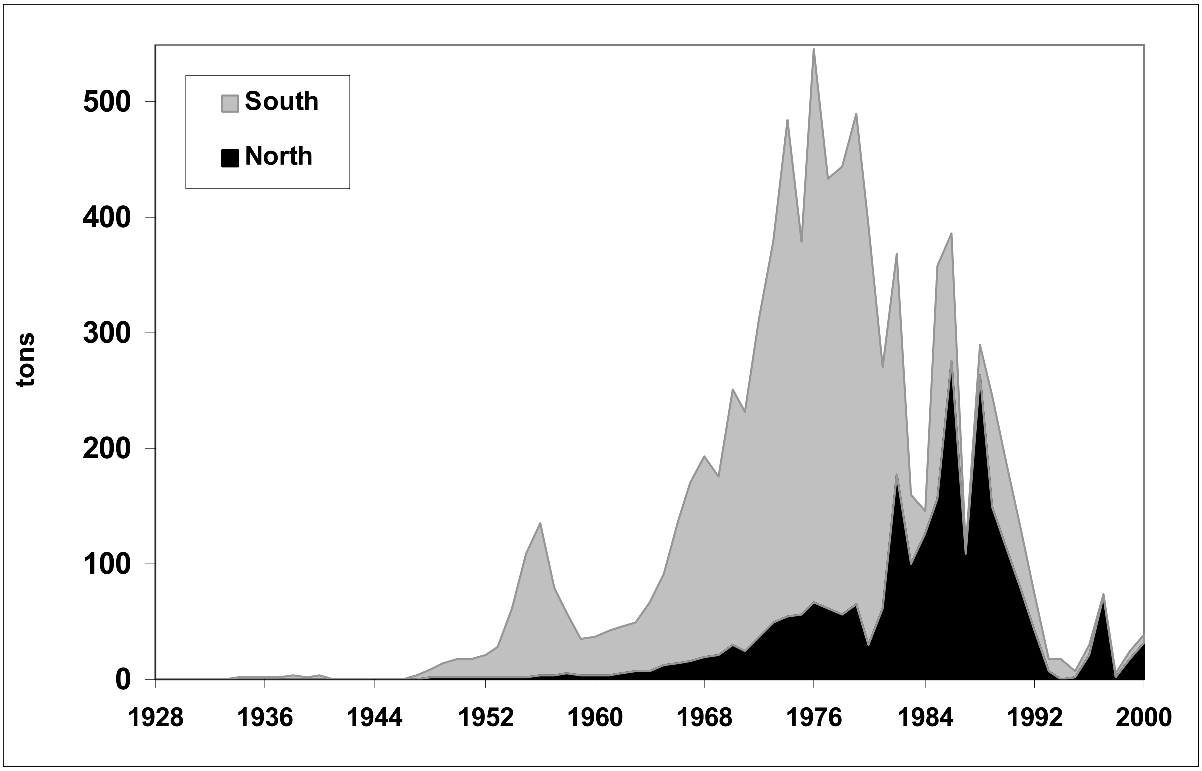


Figure 14: Estimated historical recreational catches of chilipepper rockfish in northern and southern California (tons) based on RecFIN data (1980-2006) and reconstructions based on historical sampling and CPFV logbook data (1928-1979).

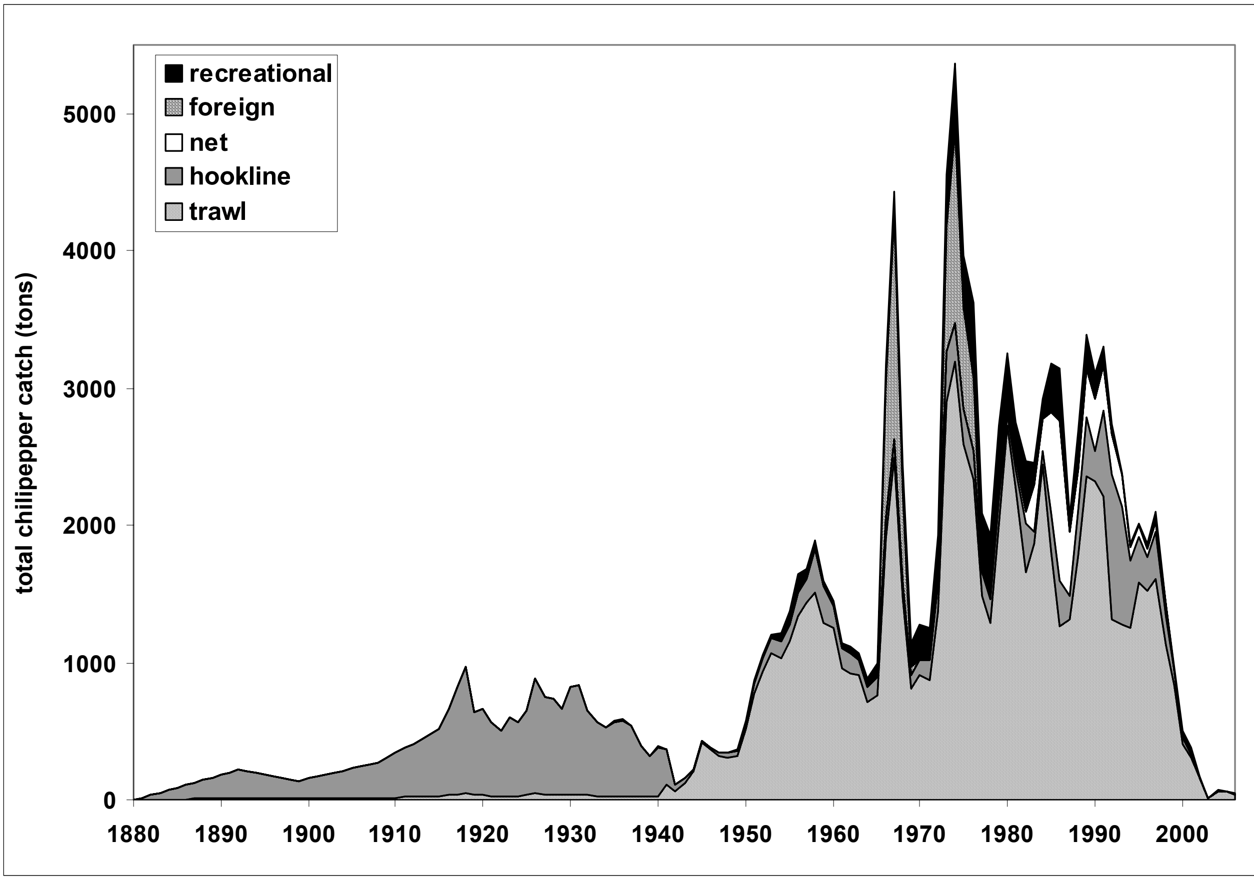


Figure 15: Total estimated chilipepper rockfish landings by fishery, 1880-2006.

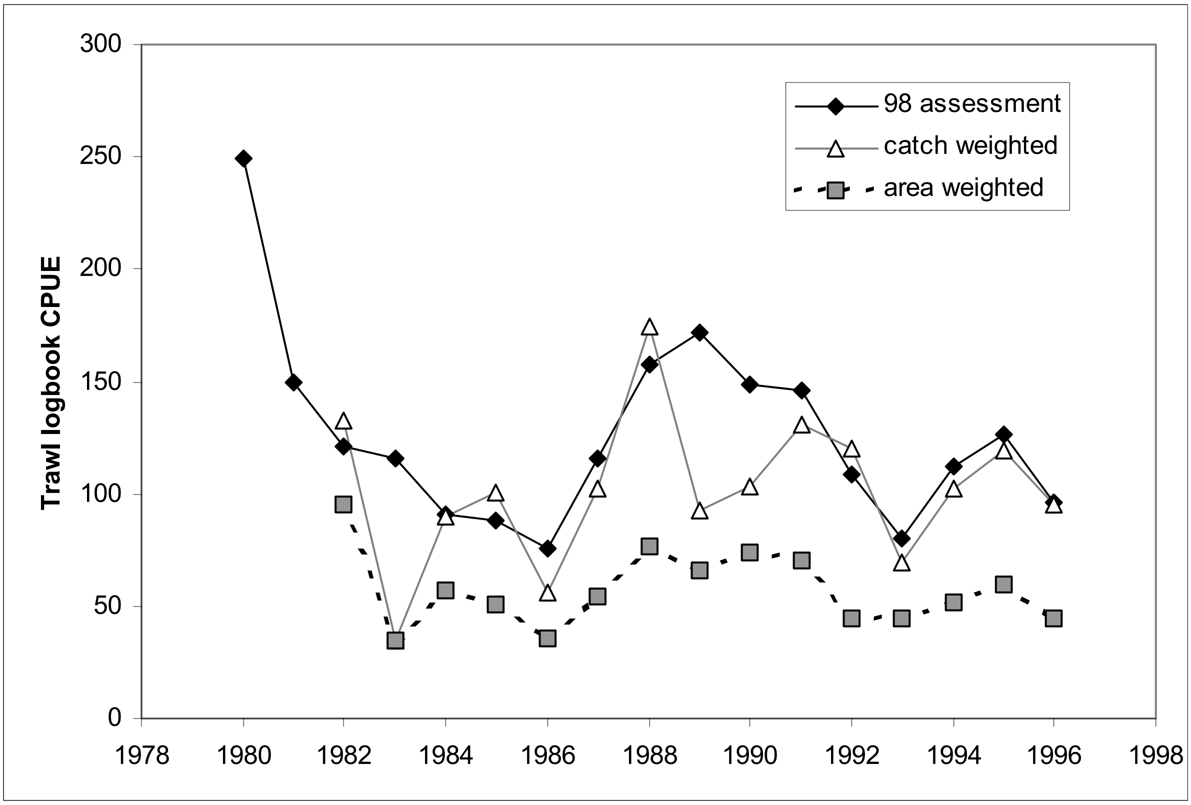


Figure 16: Trawl logbook CPUE time series developed in the last assessment by Ralston et al. (1998) and Ralston (1999).

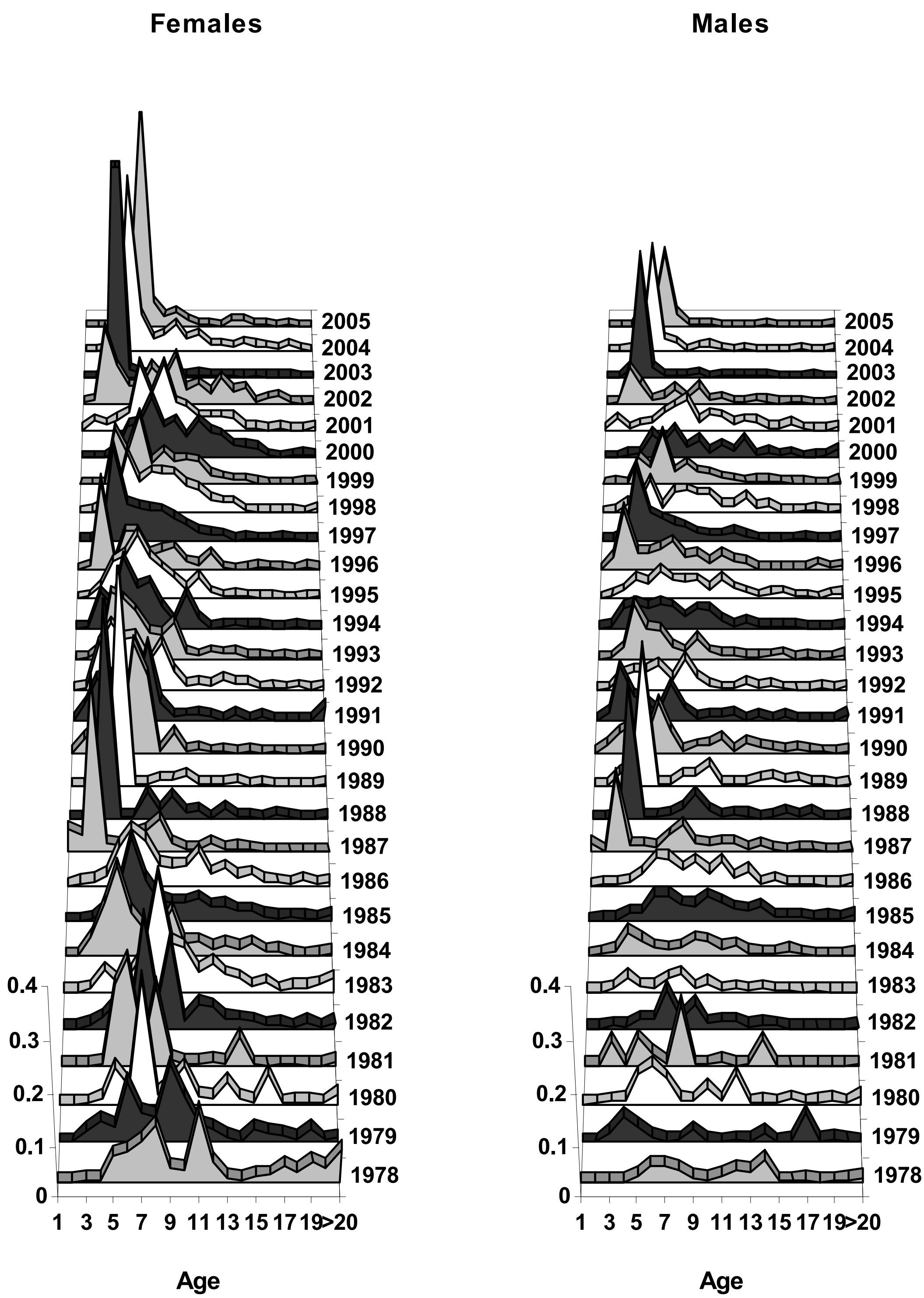


Figure 17: Age composition data from trawl fisheries, 1978-2005

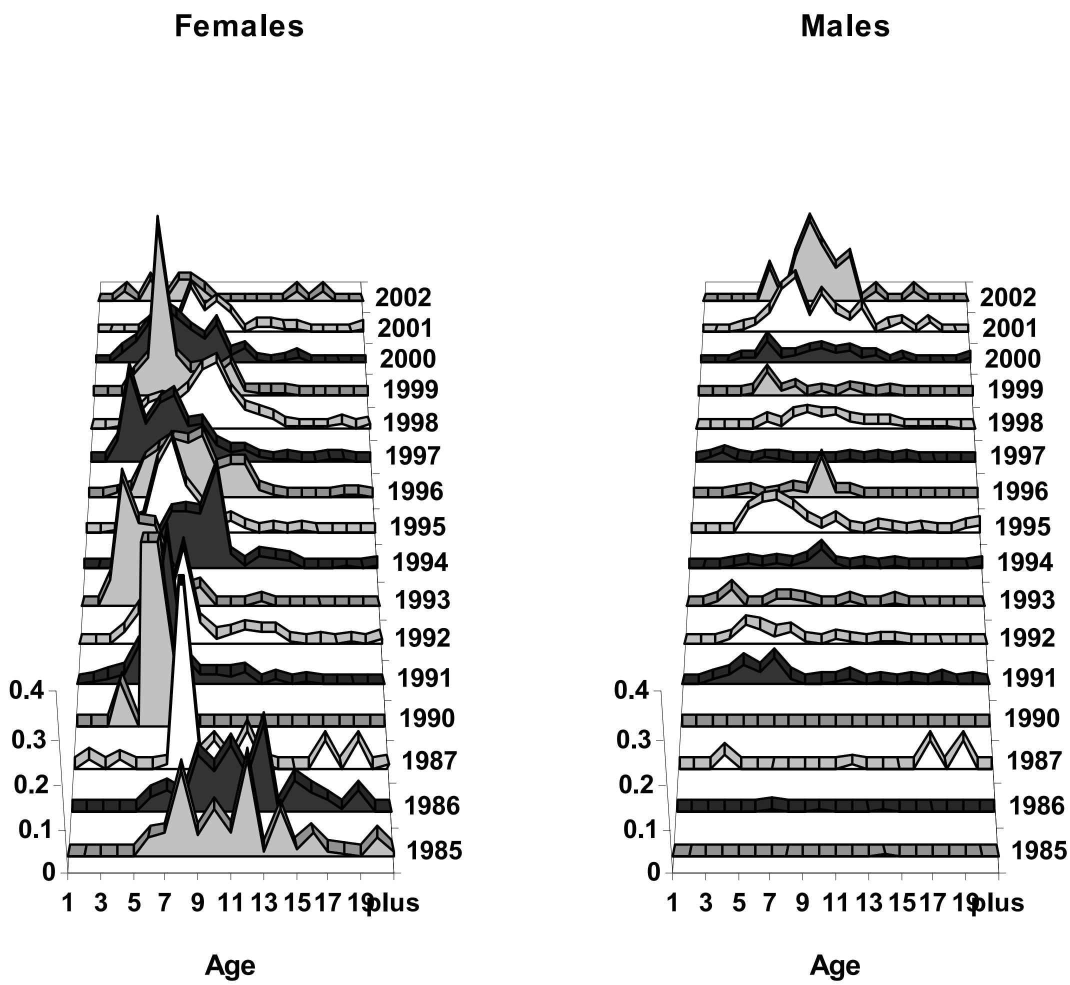


Figure 18: Age composition data from hook and line fisheries, 1985-2002 with no data for some years

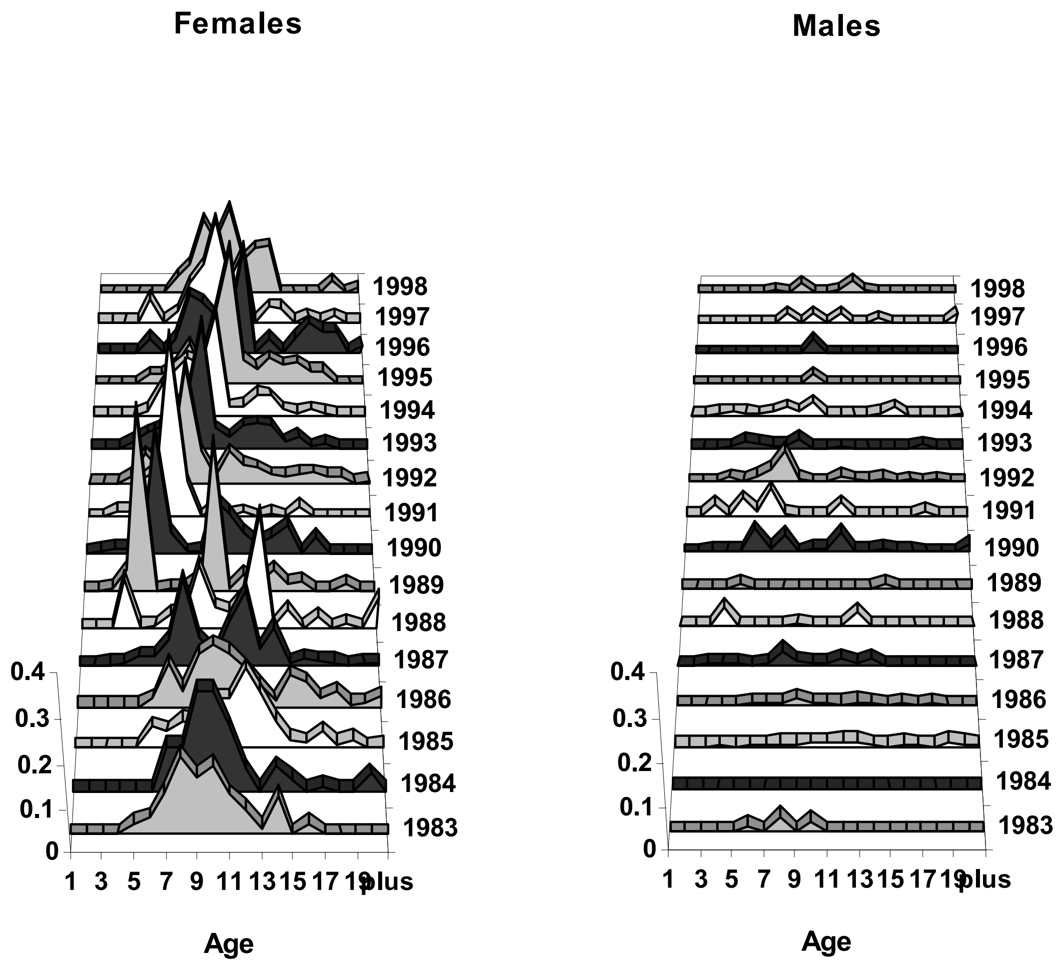


Figure 19: Age composition data from net fisheries, 1983-1998.

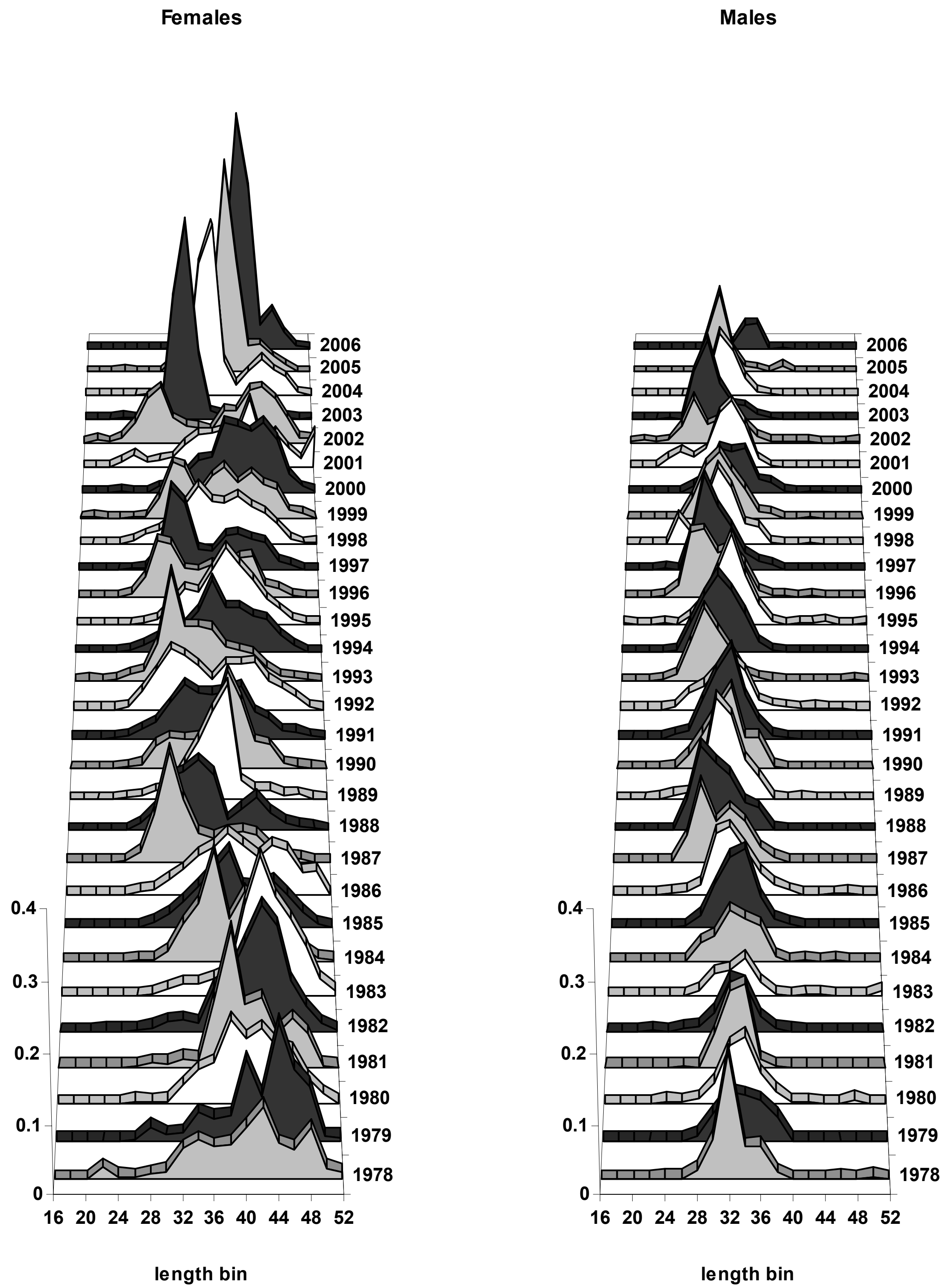


Figure 20: Length composition data from trawl fisheries, 1978-2006

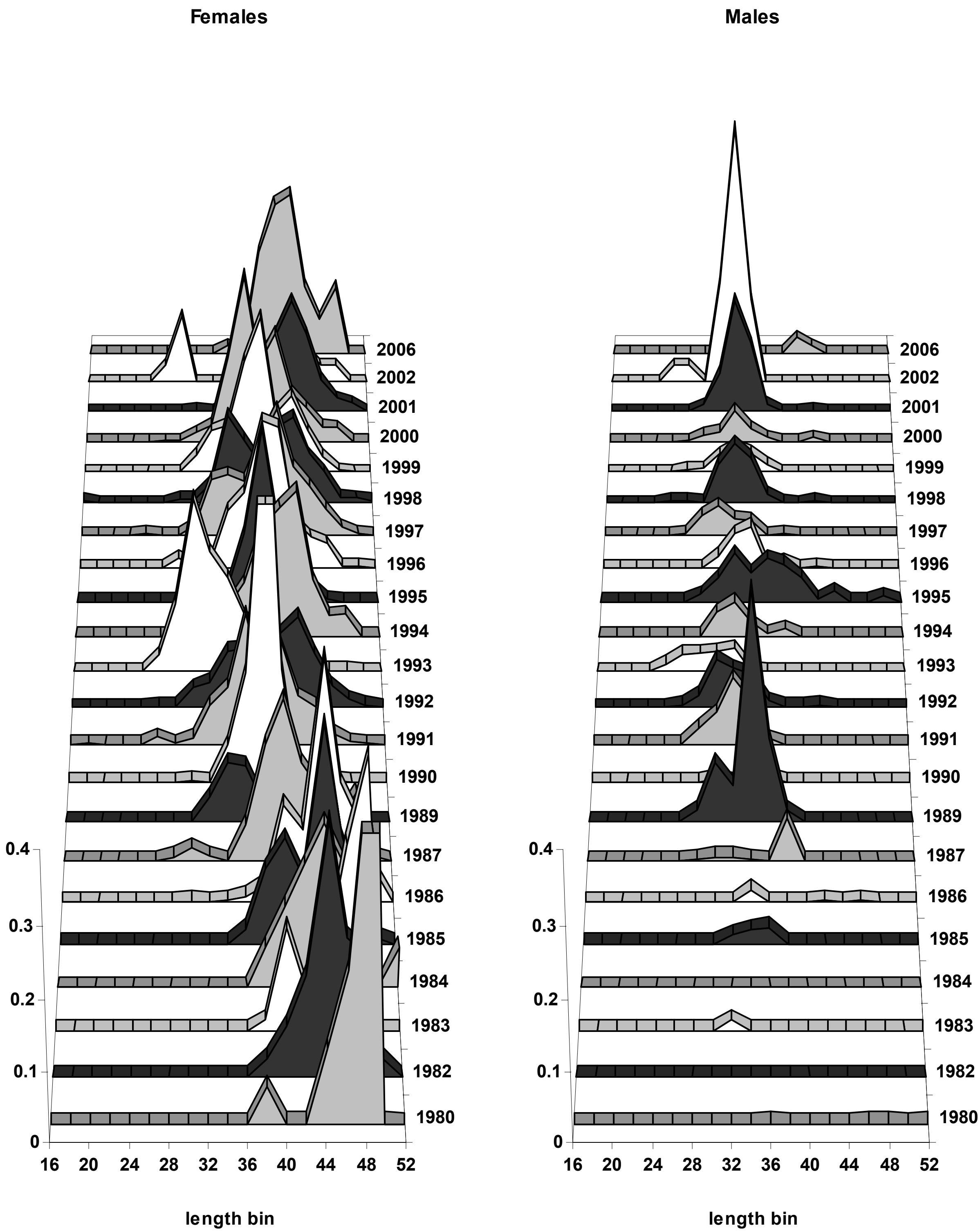


Figure 21: Length composition data from hook and line fisheries, 1980-2006 (with many years with no data)

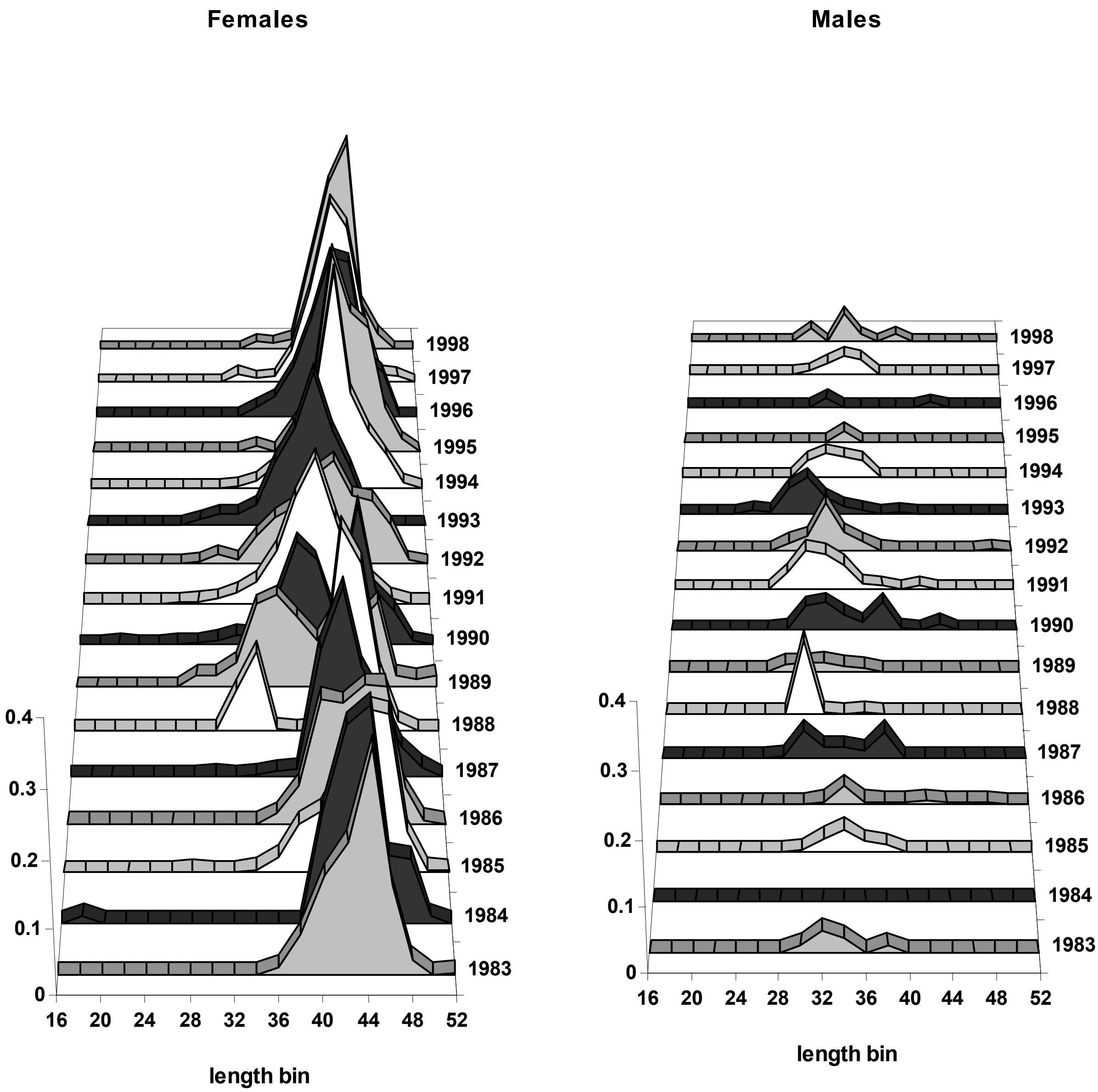


Figure 22: Length composition data from net fisheries, 1983-1998

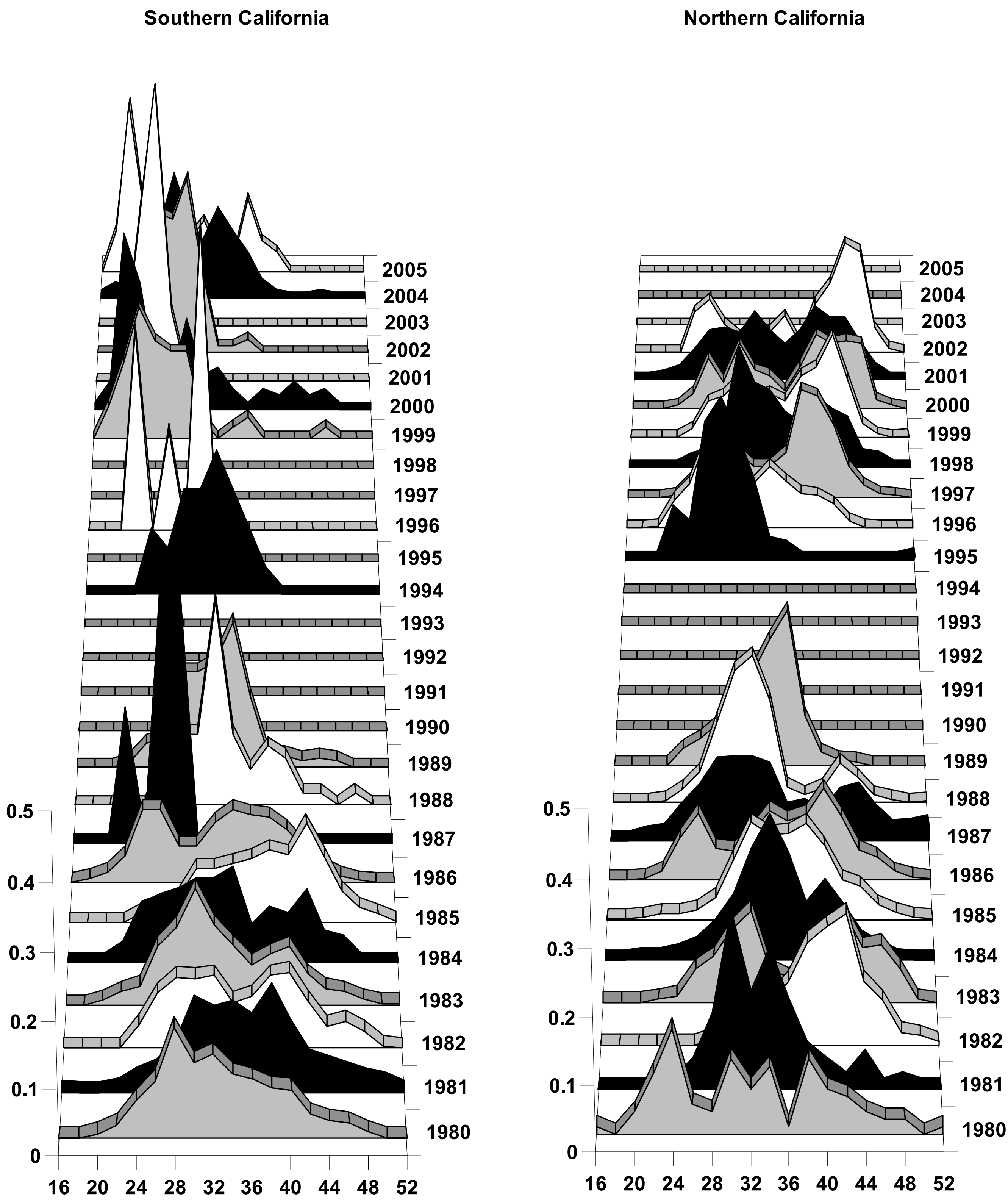


Figure 23: Length composition data for Southern and Northern California from RecFIN database

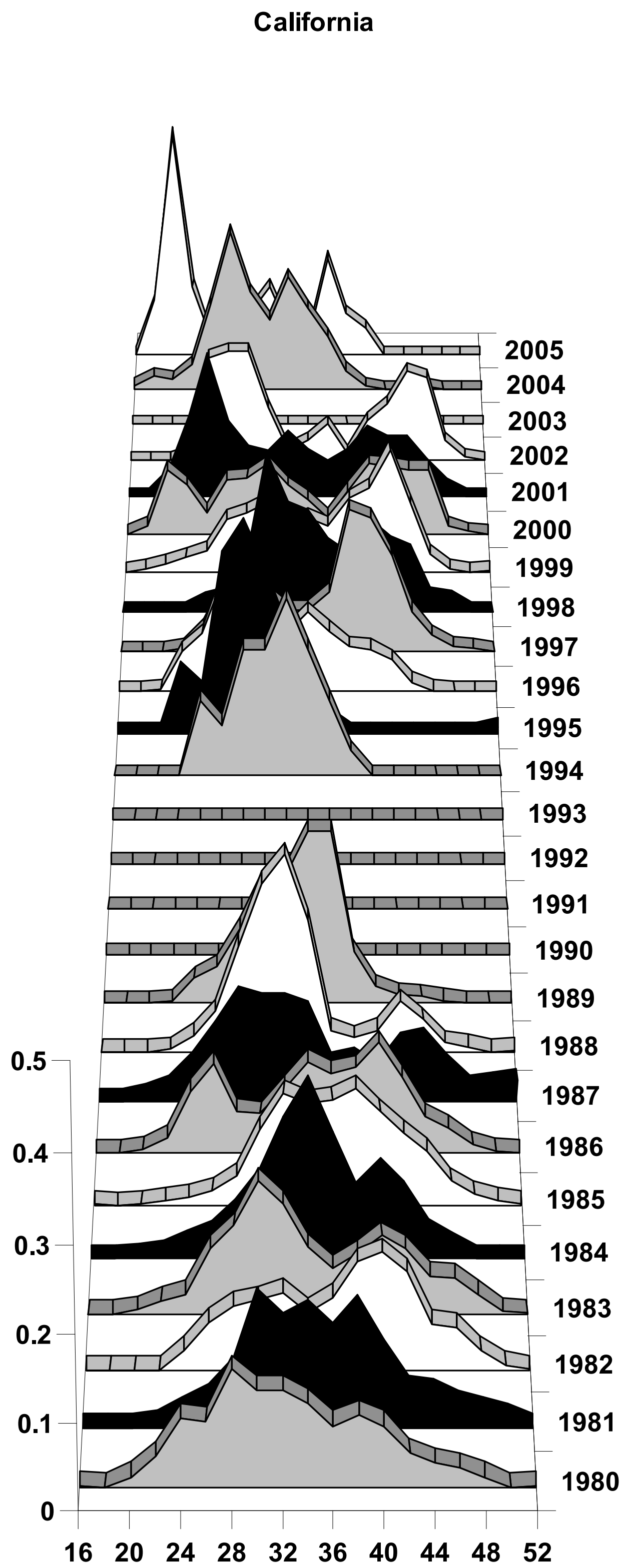


Figure 24: Coastwide length composition data from RecFIN database

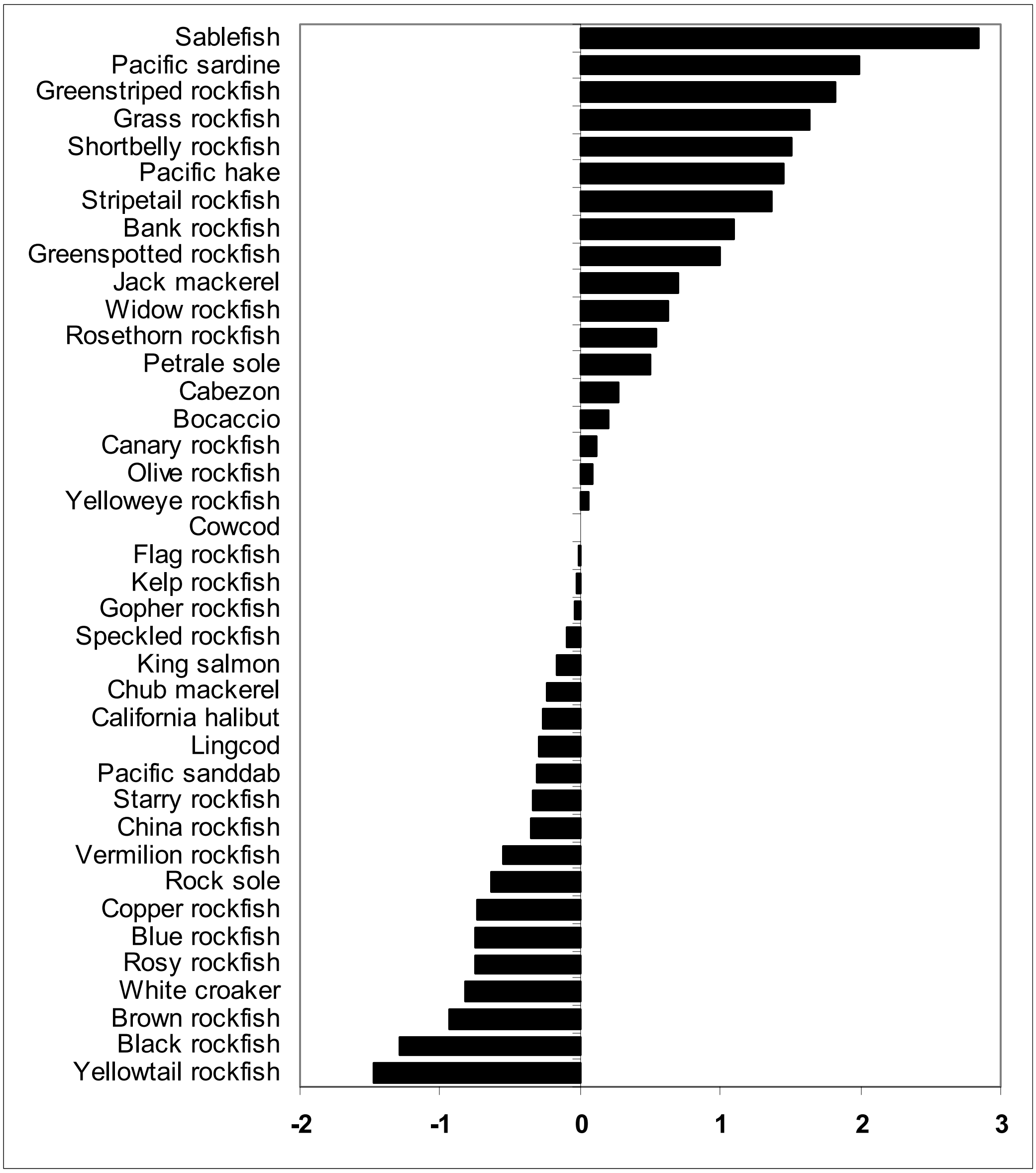
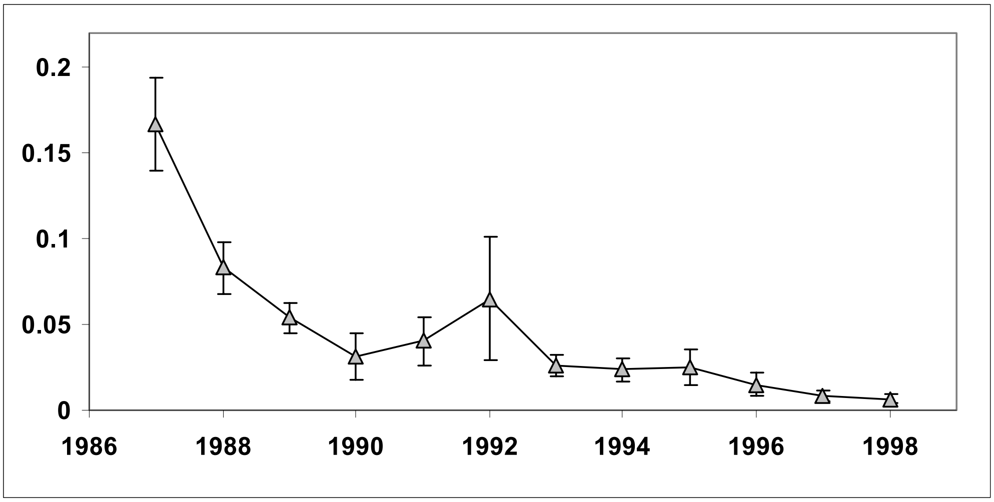
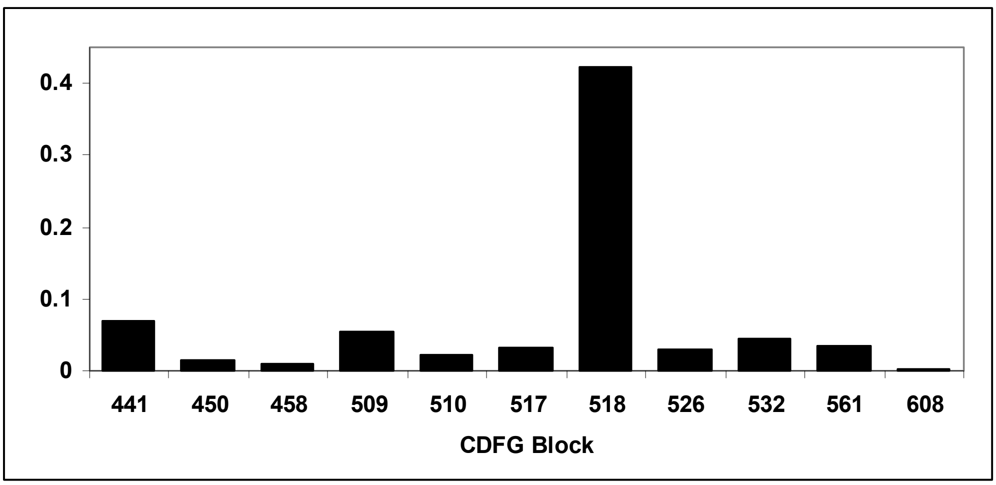


Figure 25: Species coefficients for CDFG observer data using the Stephens/MacCall method.





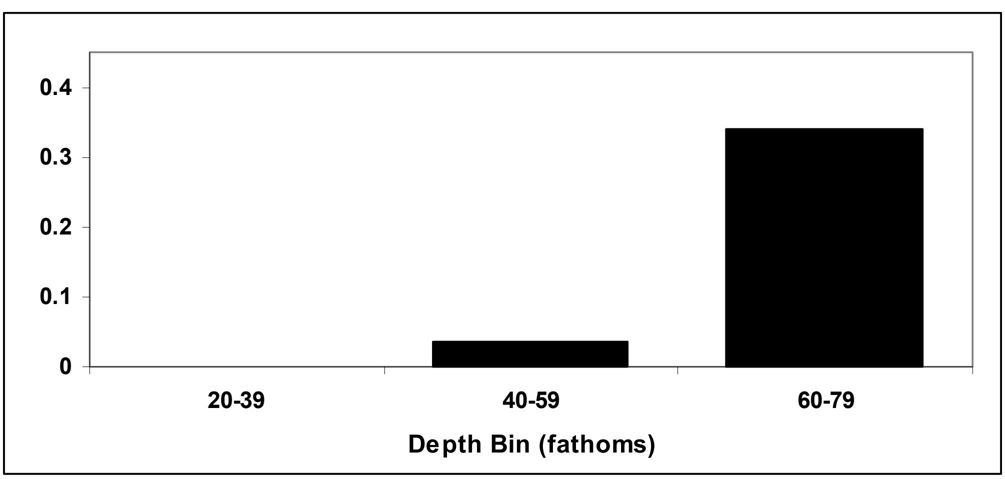


Figure 26 (top): CPUE time series from the CDF&G recreational observer data, with error estimated with a jackknife routine. Figure 27 (center) is block effects for the Rec CPUE model, Figure 28 (bottom) shows the depth bin effects.

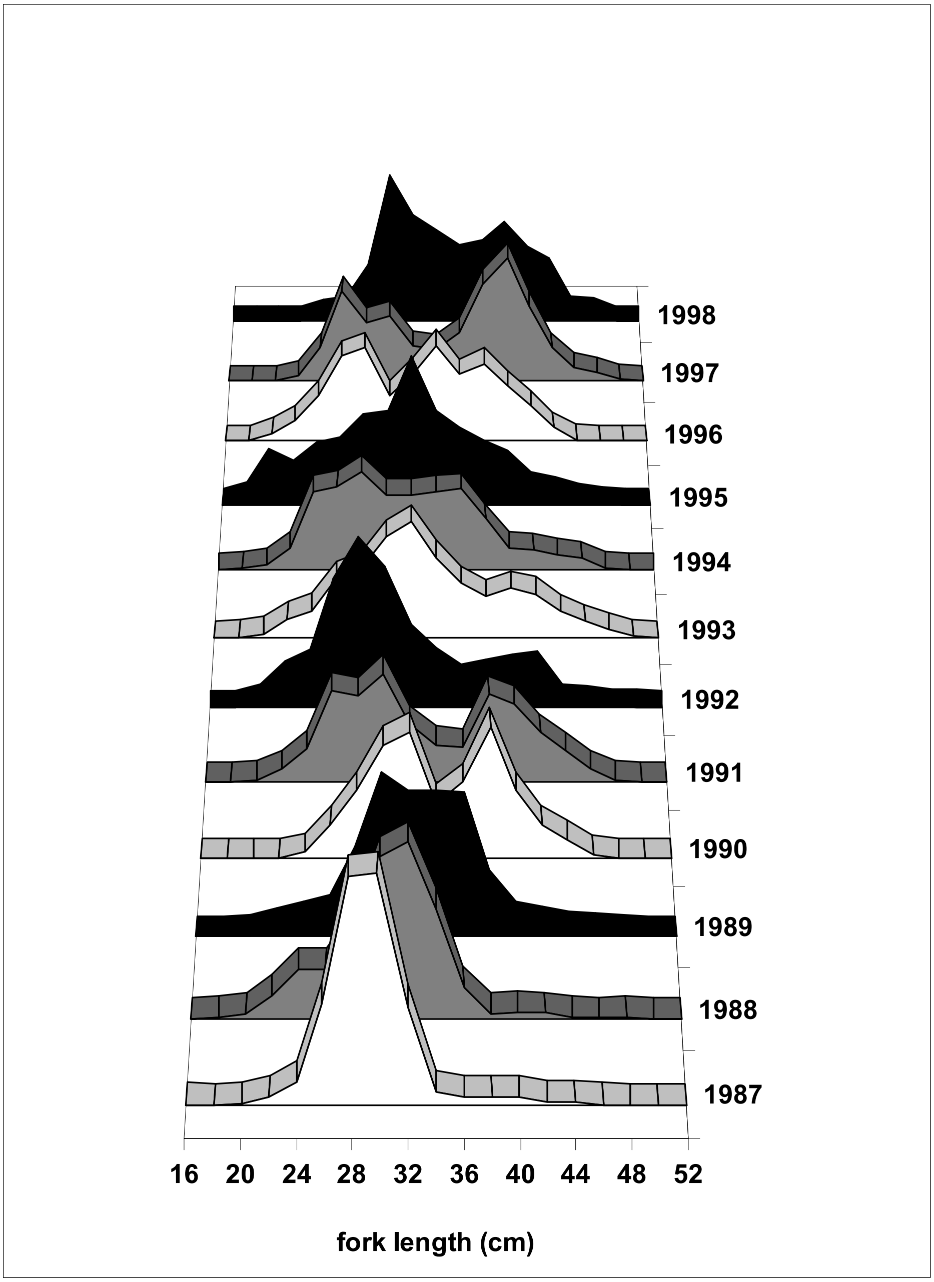


Figure 29: Length frequency information (sex unknown) for the CDF&G observer program recreational CPUE time series.

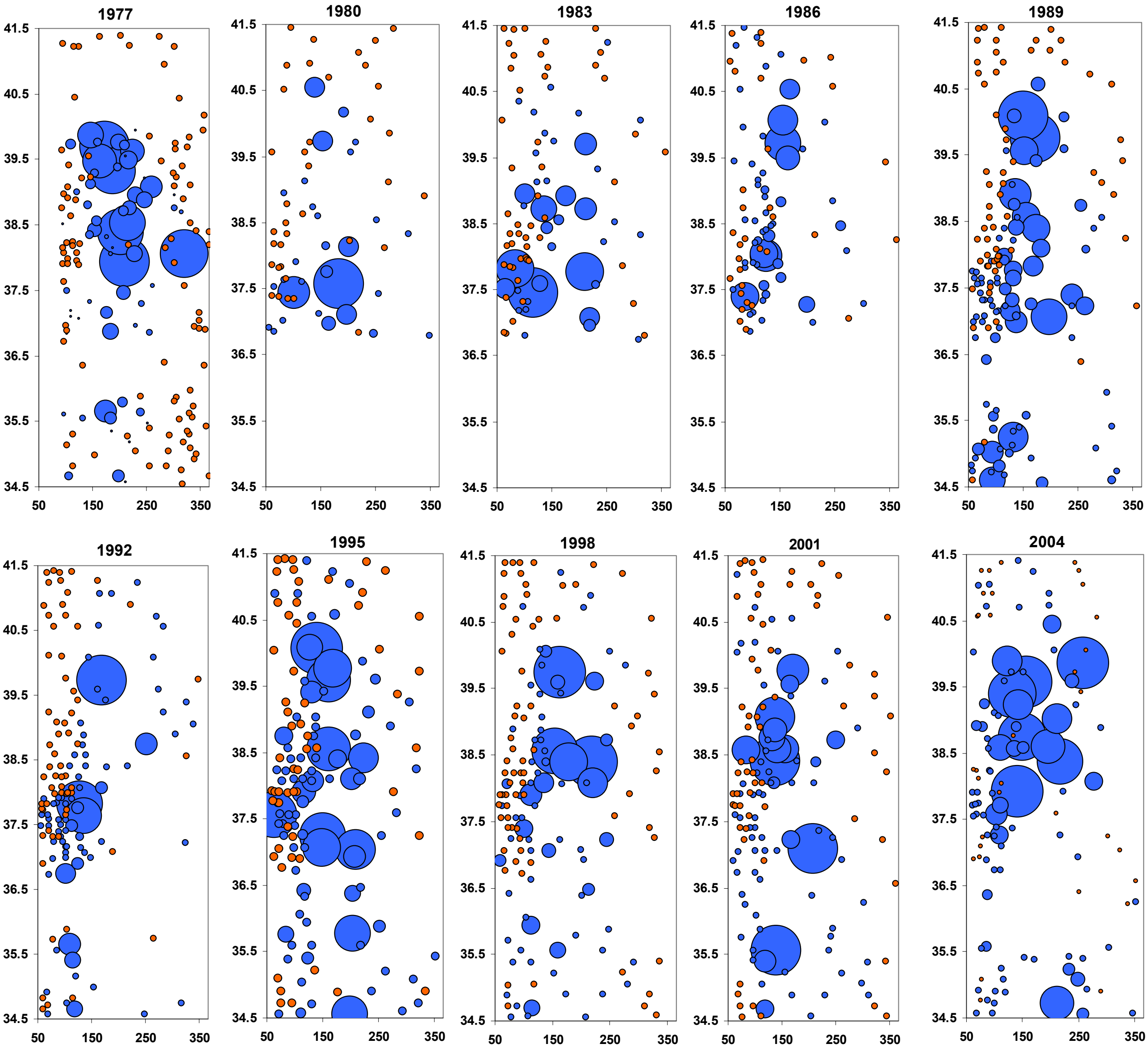
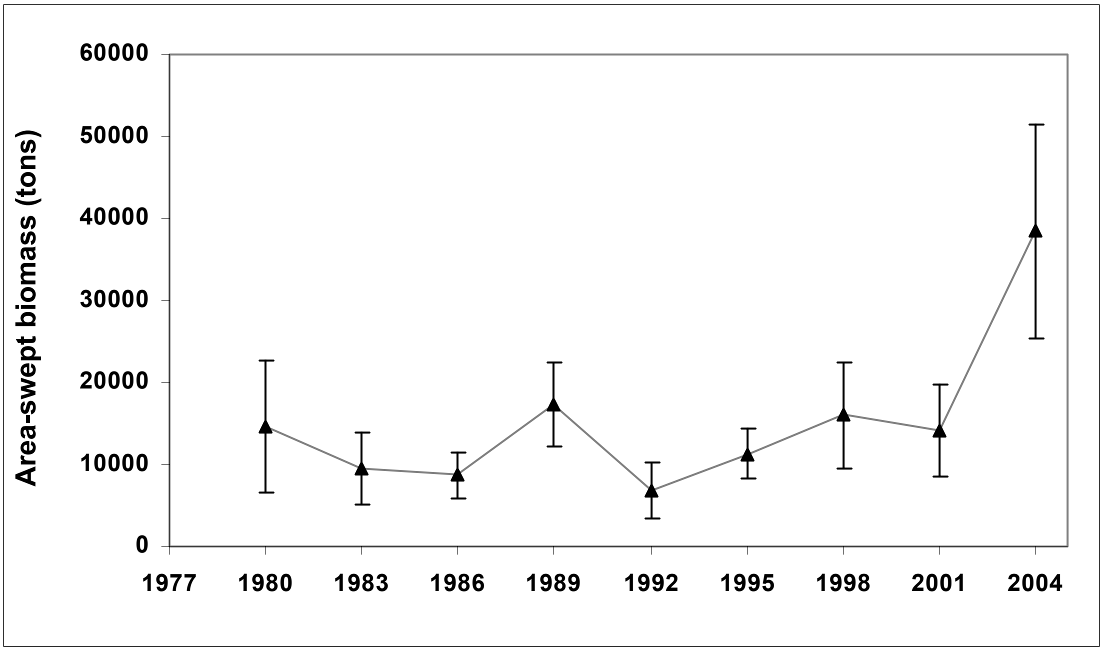


Figure 30: Chilipepper CPUE from triennial trawl survey across latitude and depth, 1977-2004; orange dots represent hauls in which no chilipepper were caught.



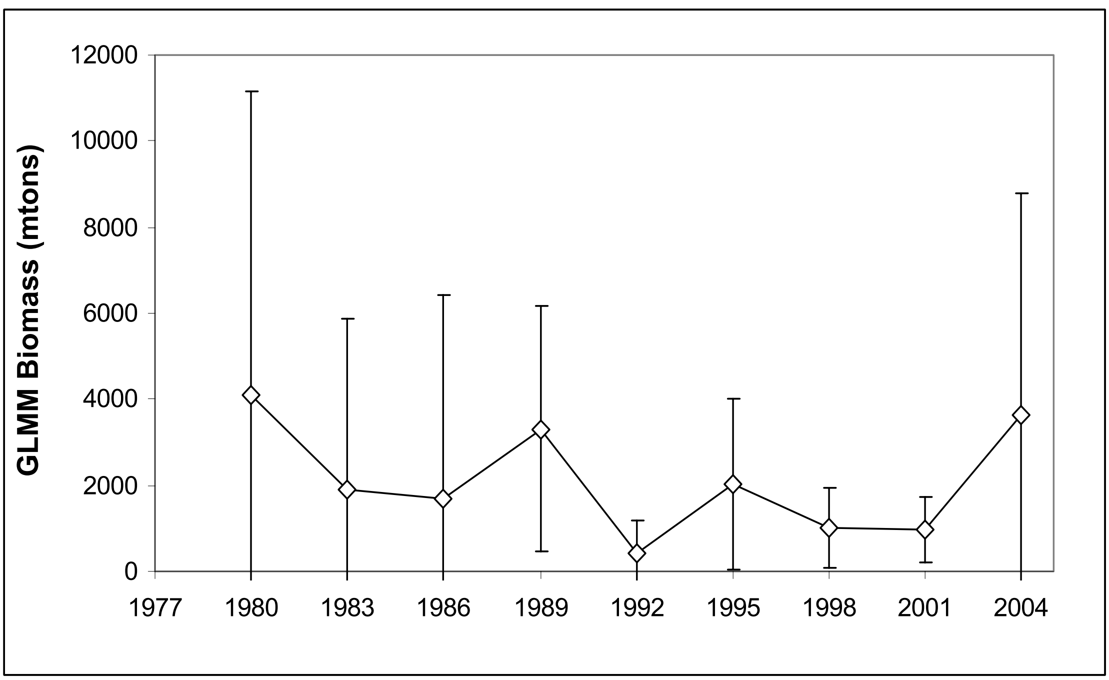


Figure 31 (top): Triennial survey core area-swept biomass index with estimated CV, and 32 (bottom) GLMM biomass point estimates with standard error.

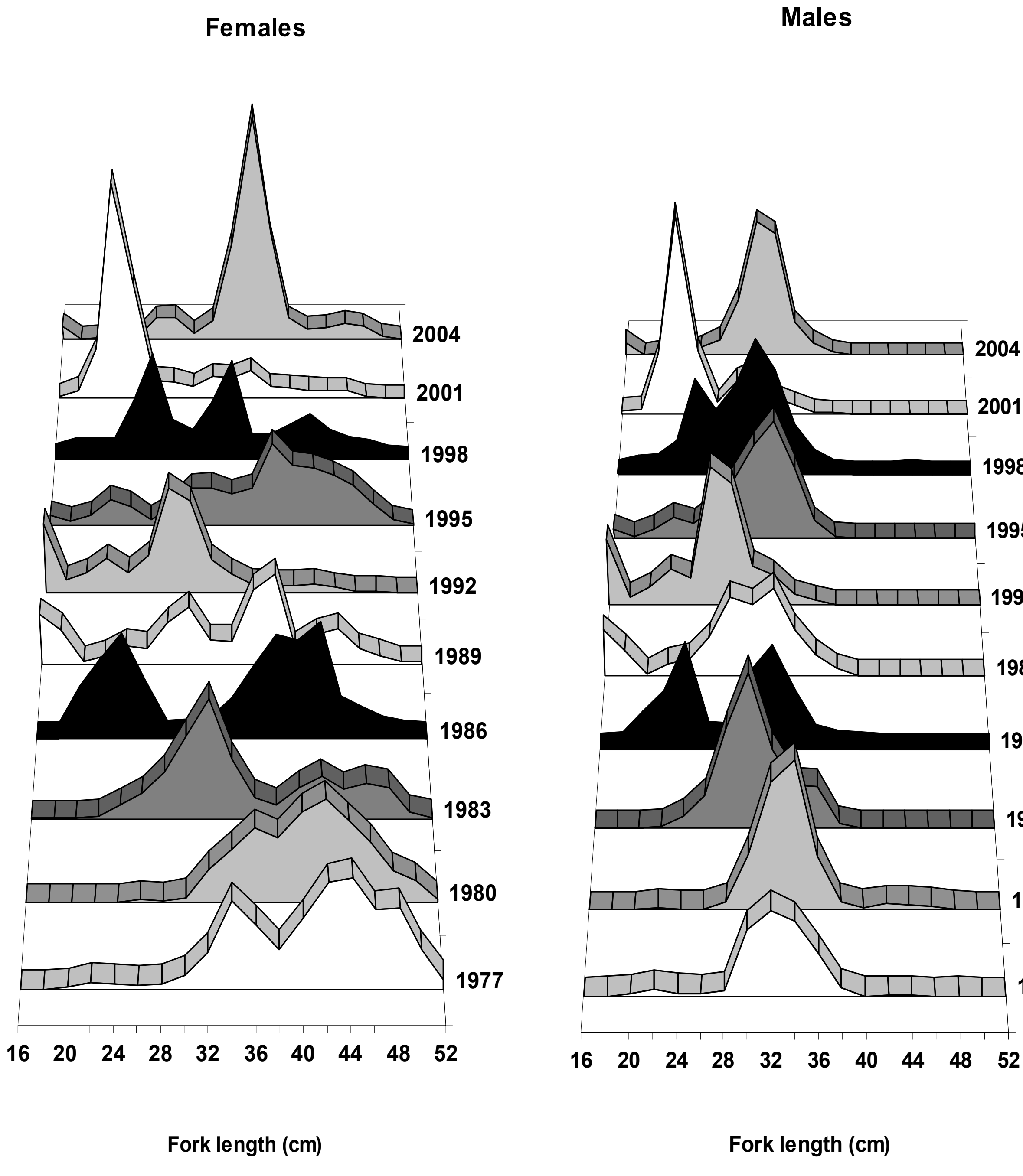


Figure 33: Size composition of chilipepper rockfish from the triennial trawl survey.

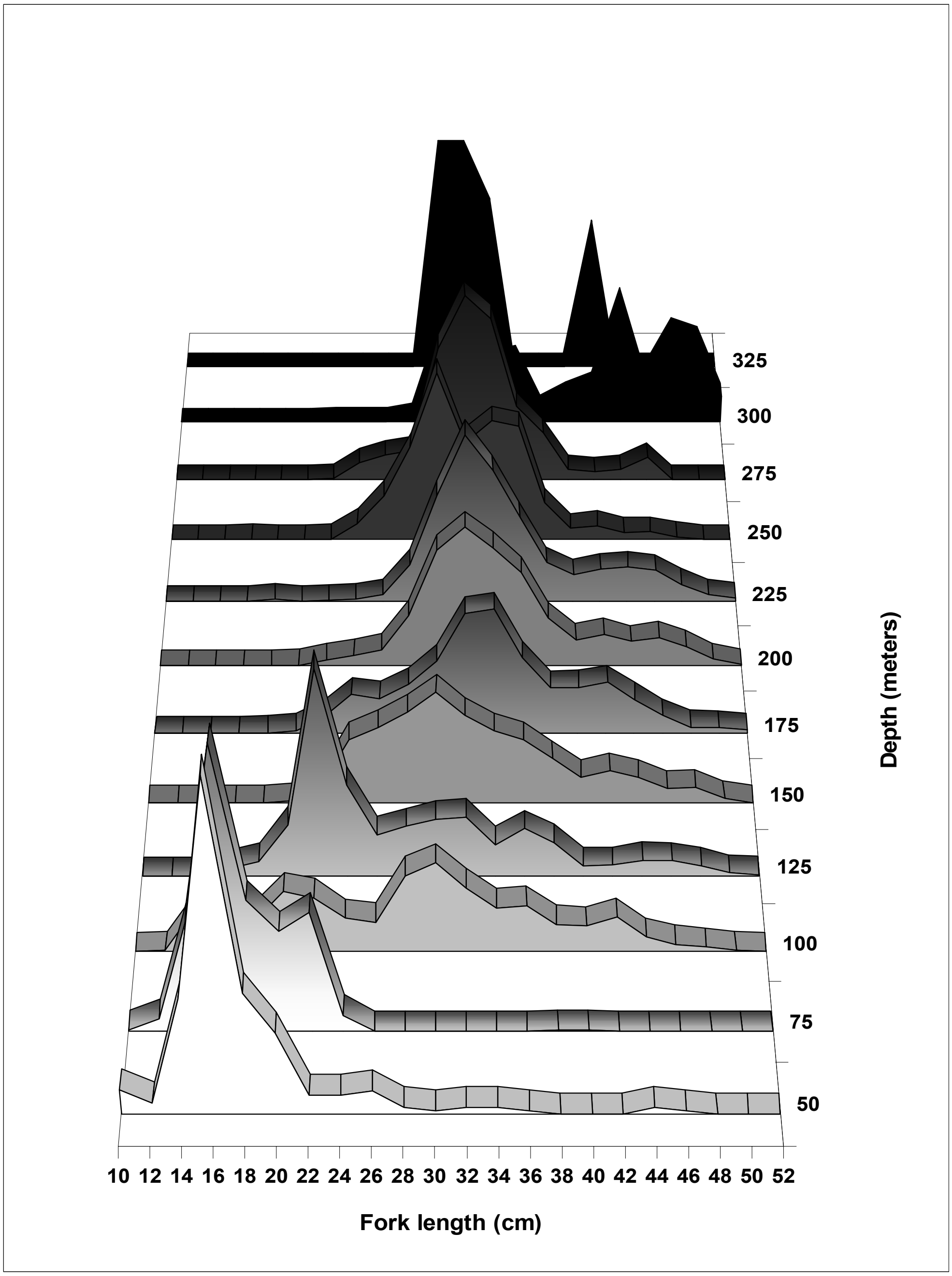


Figure 34: Shift in size composition of chilipepper rockfish by depth (from raw triennial trawl survey catches, all years).

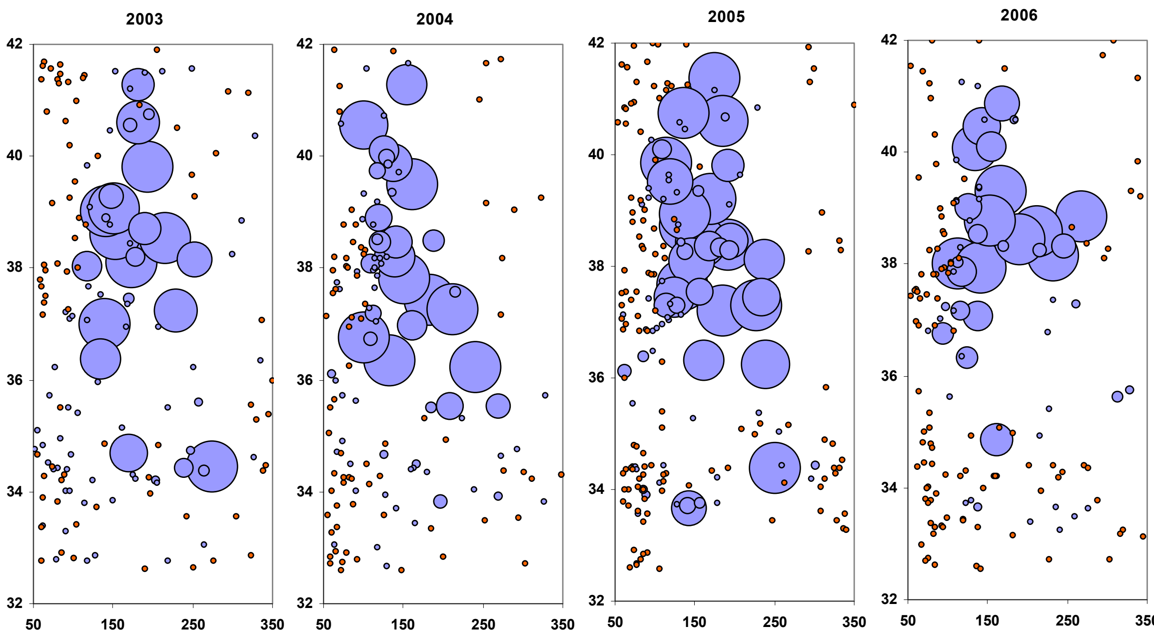


Figure 35: Chilipepper CPUE from NWFSC Combined survey, 2003-2006; orange dots reflect hauls in which no chilipepper were encoutnered.

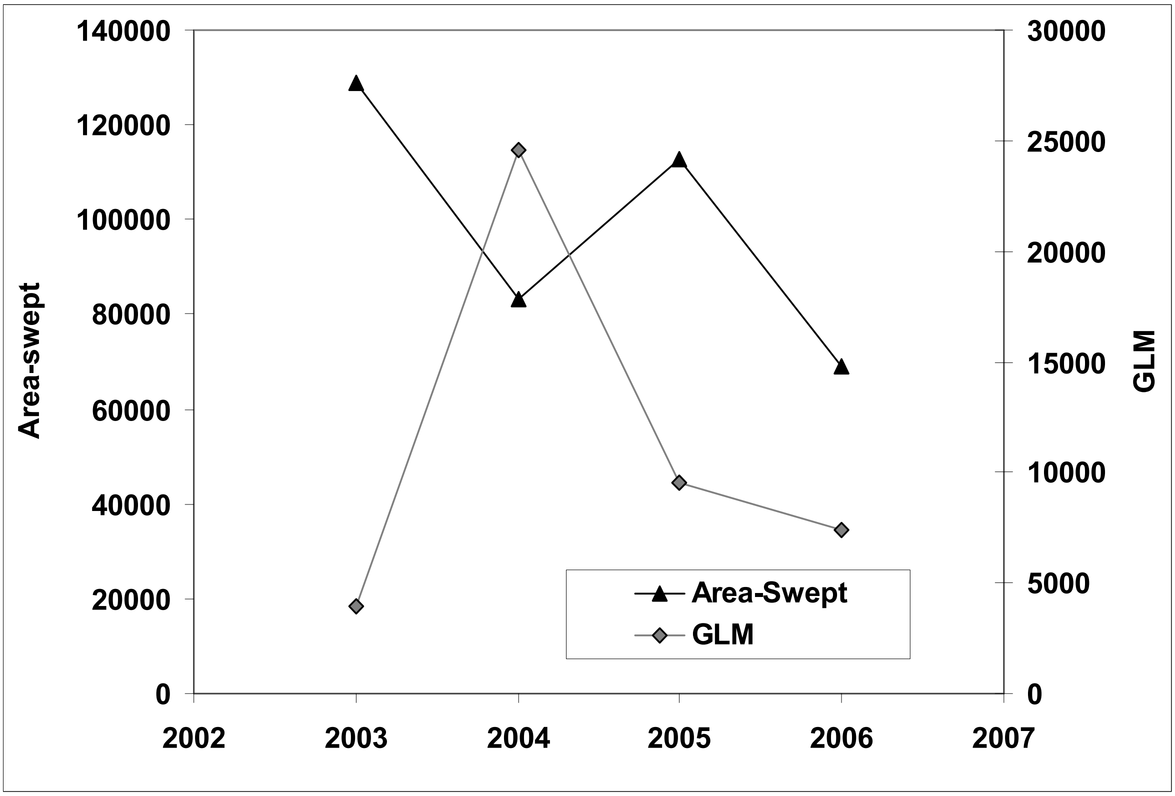
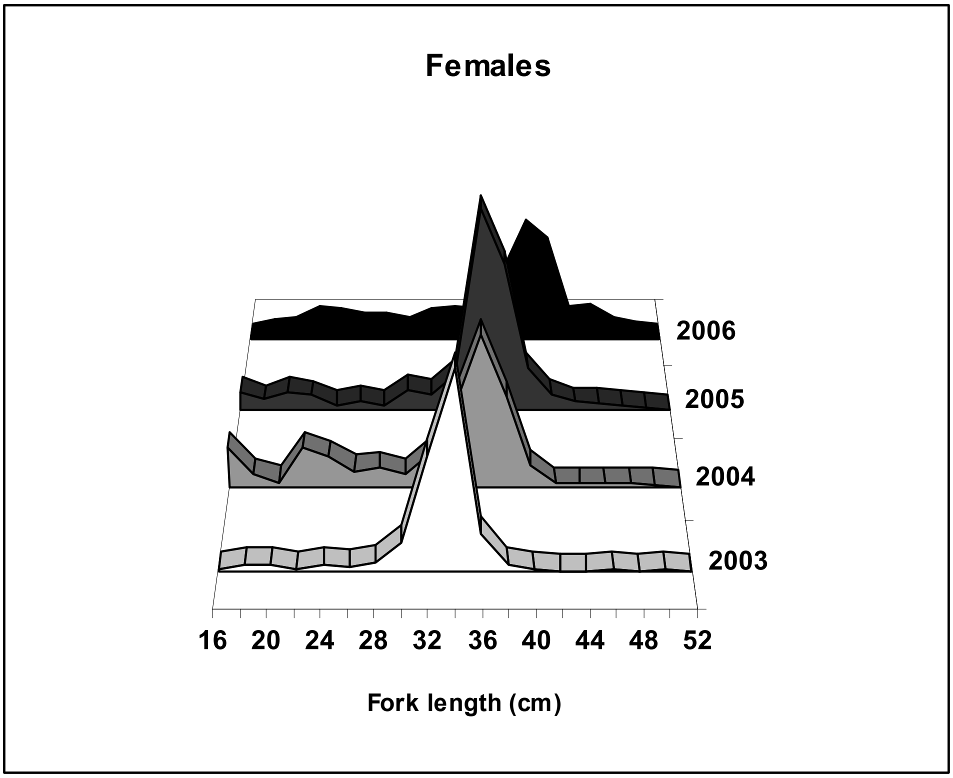


Figure 36: NWFSC Combined survey abundance indices for Chilipepper rockfish



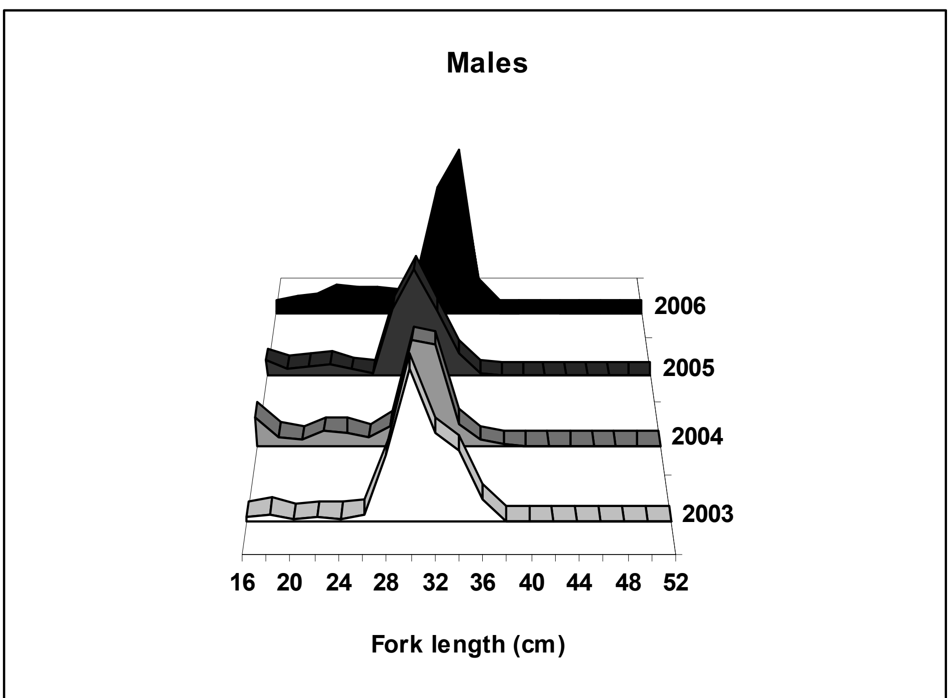


Figure 37: NWC Combined survey length compositions.

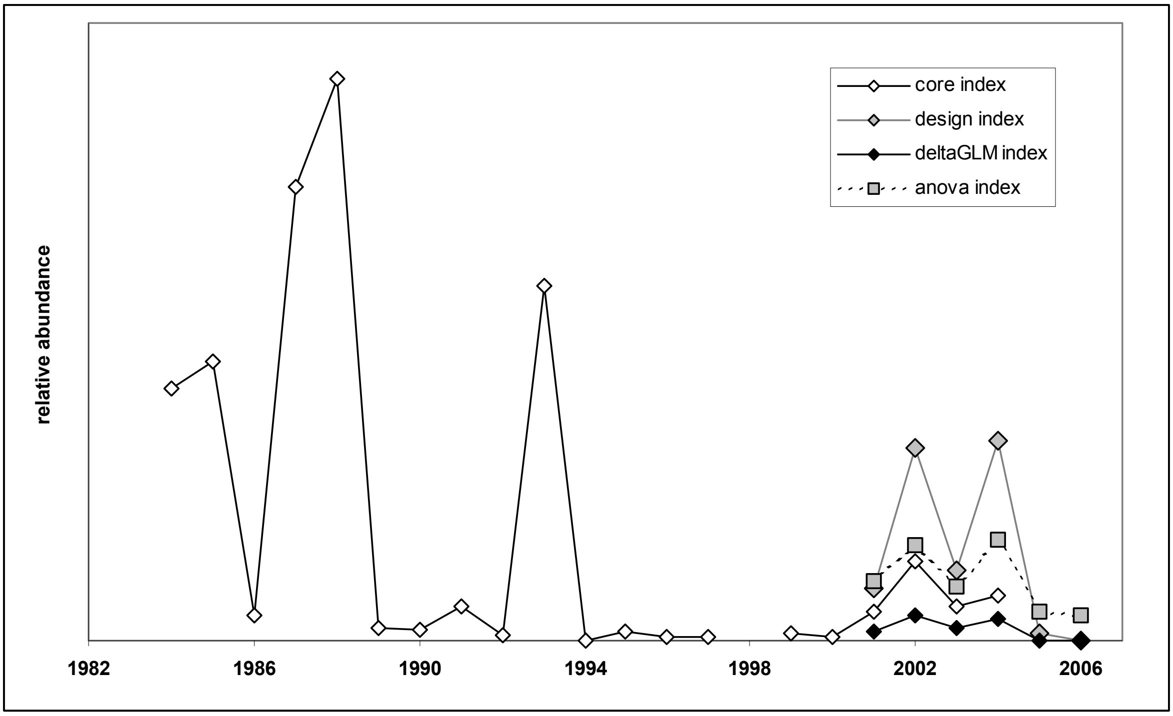
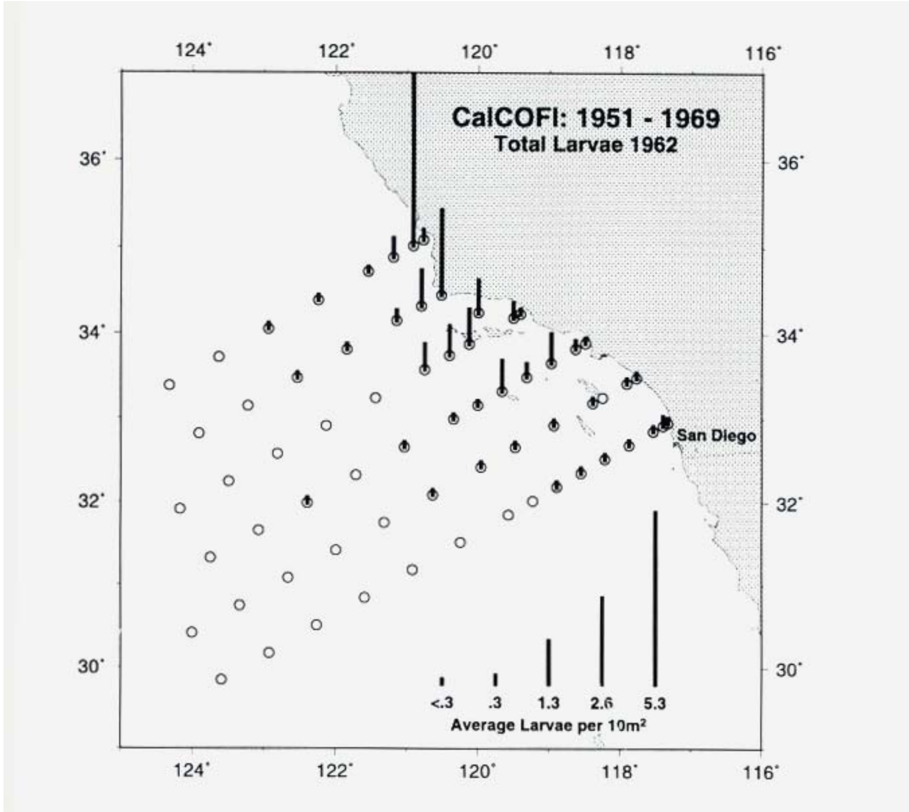


Figure 38: Juvenile (age 0) indices for core area (1984-2004) and coastwide (2001-2006) juvenile rockfish surveys



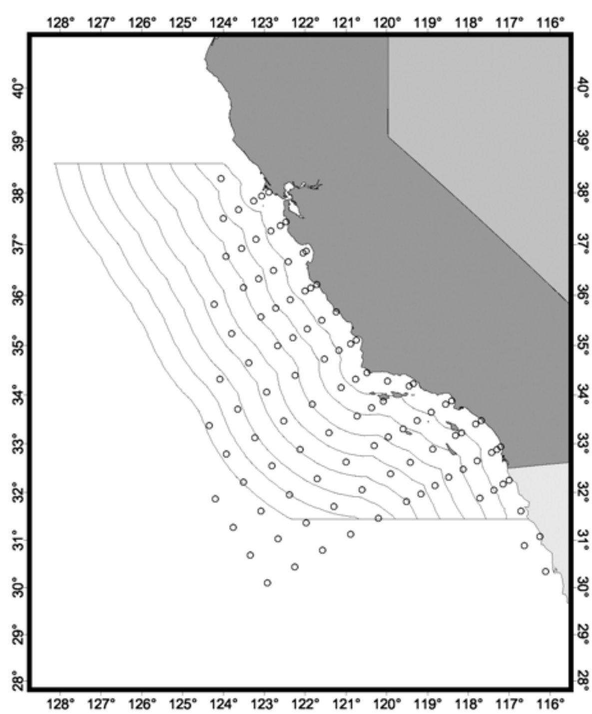
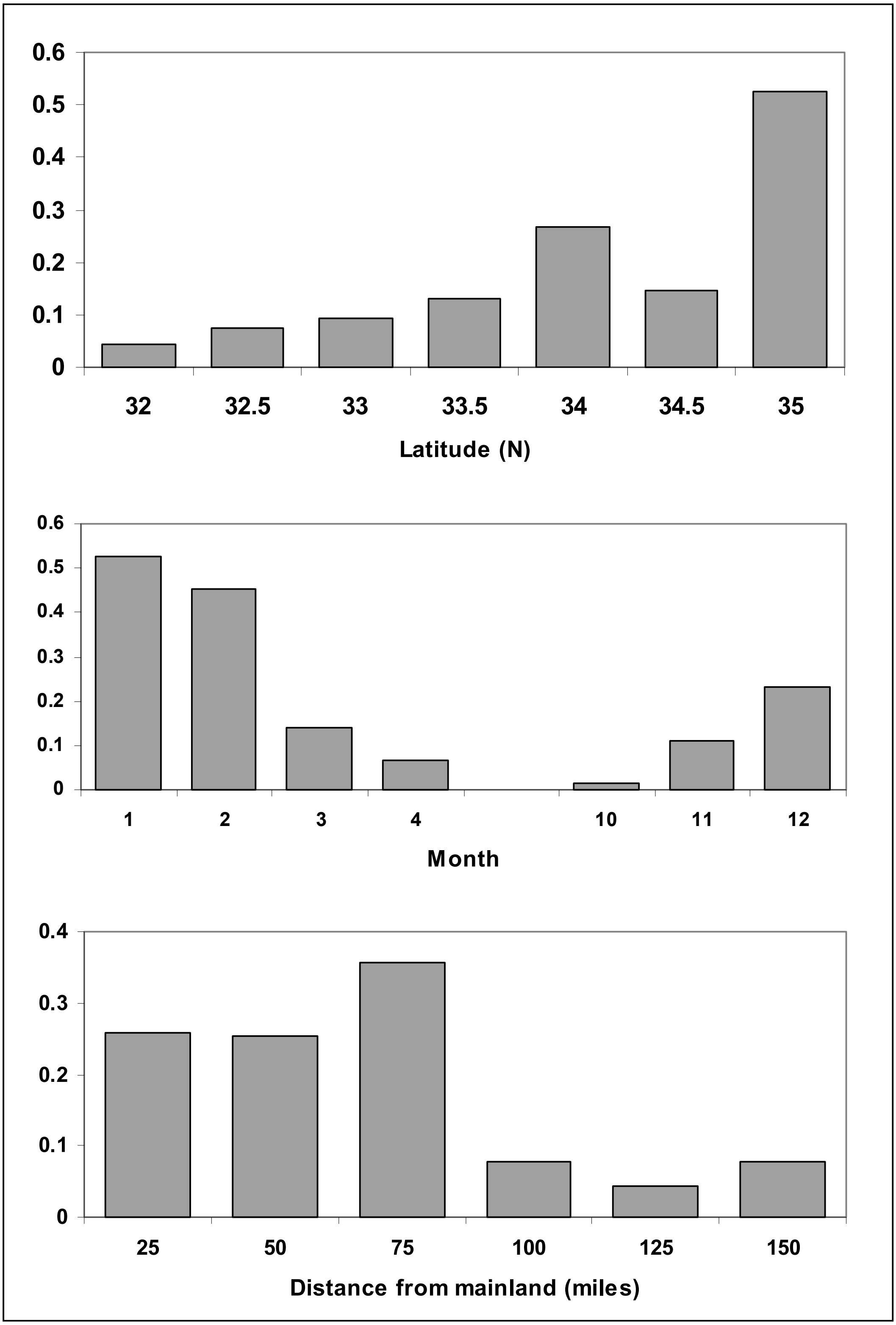


Figure 39 (top): Catches of chilipepper rockfish larvae from CalCOFI surveys, 1951-1969. Figure 40 (bottom), zones for estimating distance from shore in 25 km bins.



Figures 41a-c: Latitude (top), month (middle), and distance from shore (bottom) effects for the CalCOFI larval abundance index.

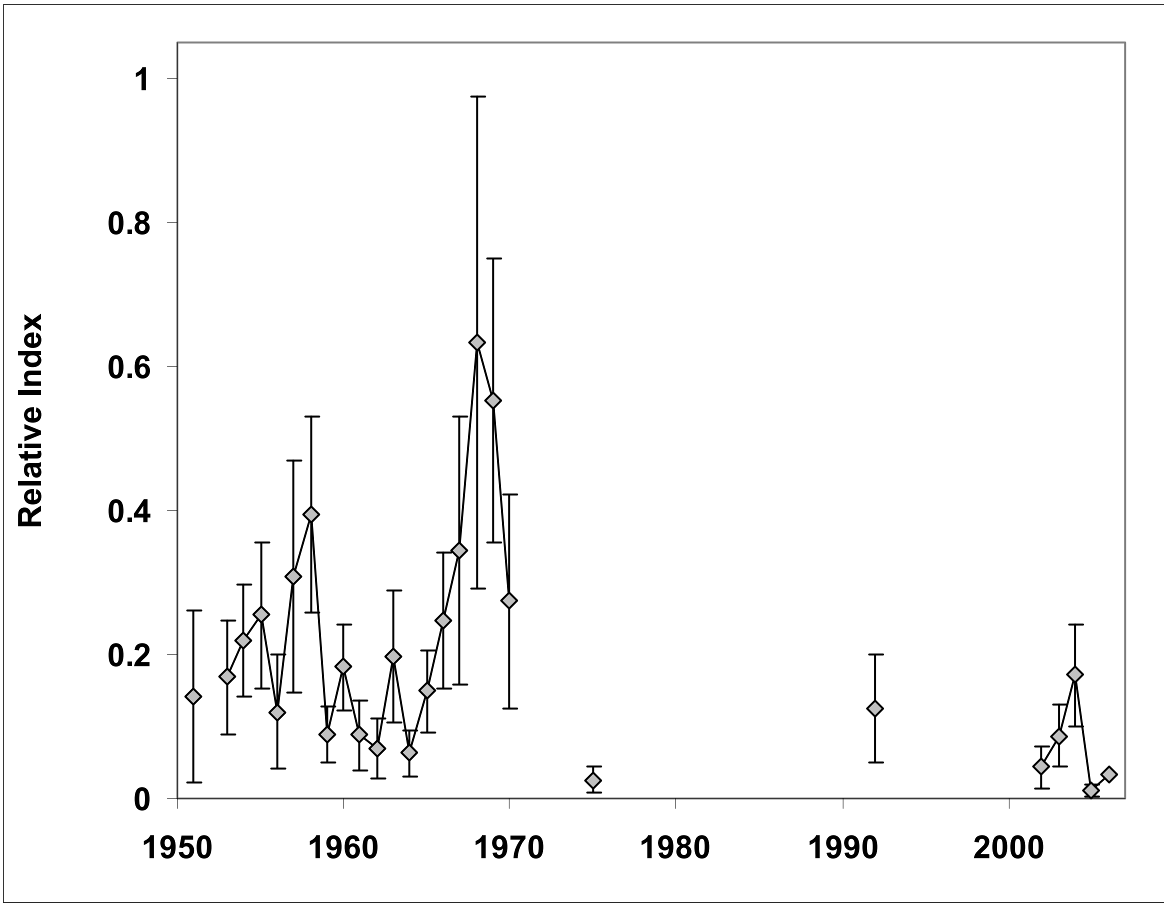
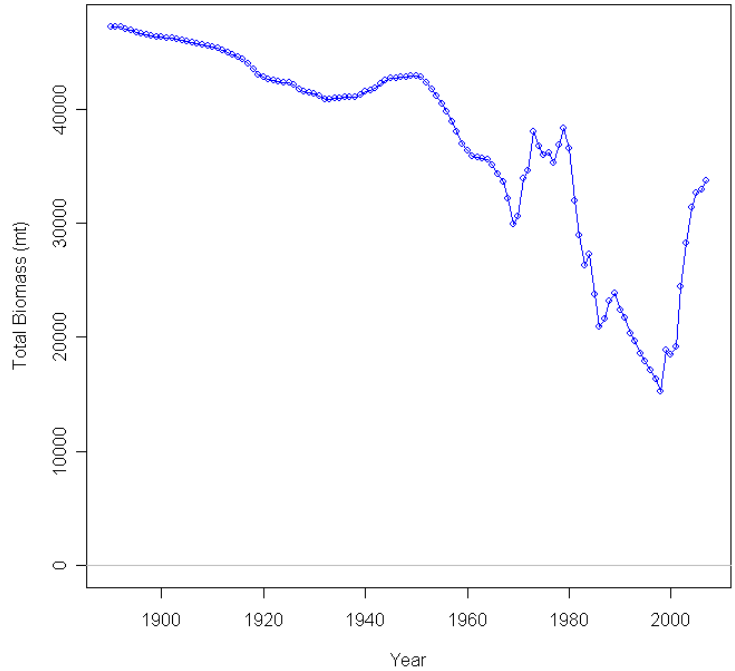


Figure 43: CalCOFI index point estimates, with error estimated from a jackknife. As two positive tows are necessary to run the jackknife, many years with a single positive tow (1984, 1985, 1991, 2000) are not included.



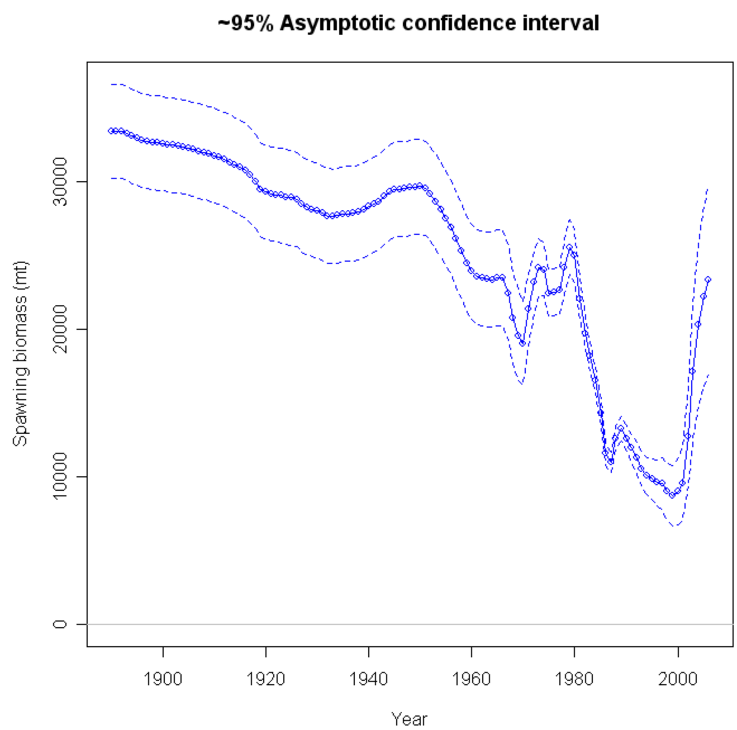
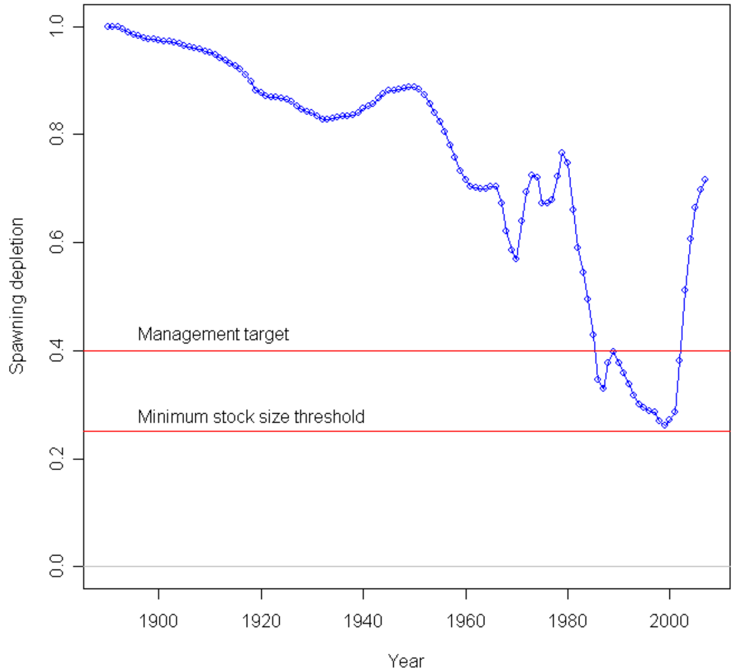


Figure 44-45: Base model output estimates of total biomass (top) and of spawning biomass with ~95% asymptotic confidence intervals (bottom).



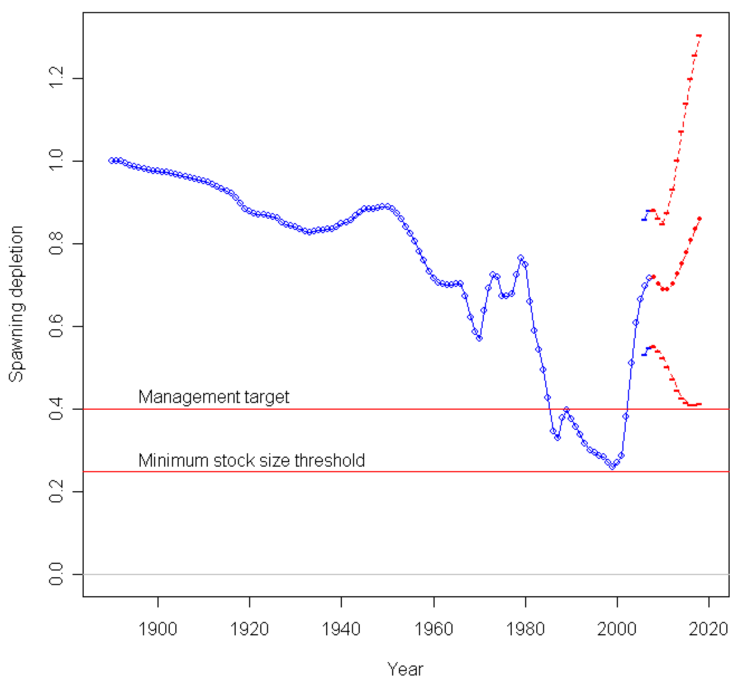
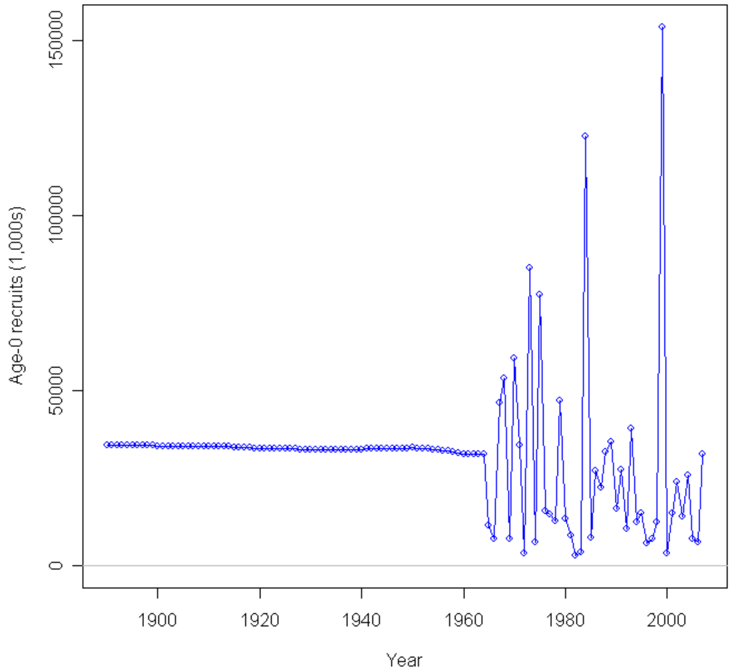


Figure 46-47: Base model output estimates of relative depletion (top) and projections of estimated depletion through 2018 with ~95% asymptotic confidence intervals (bottom).



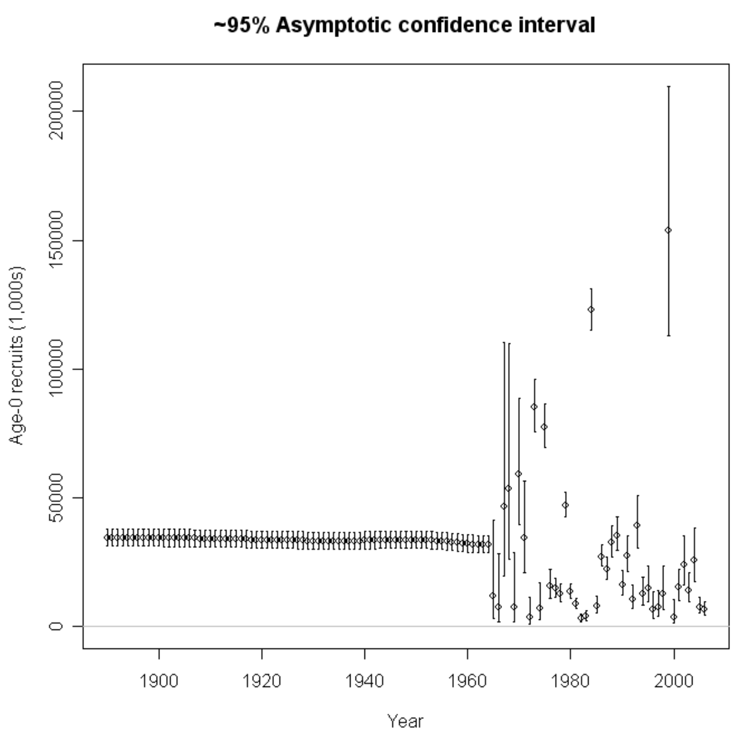
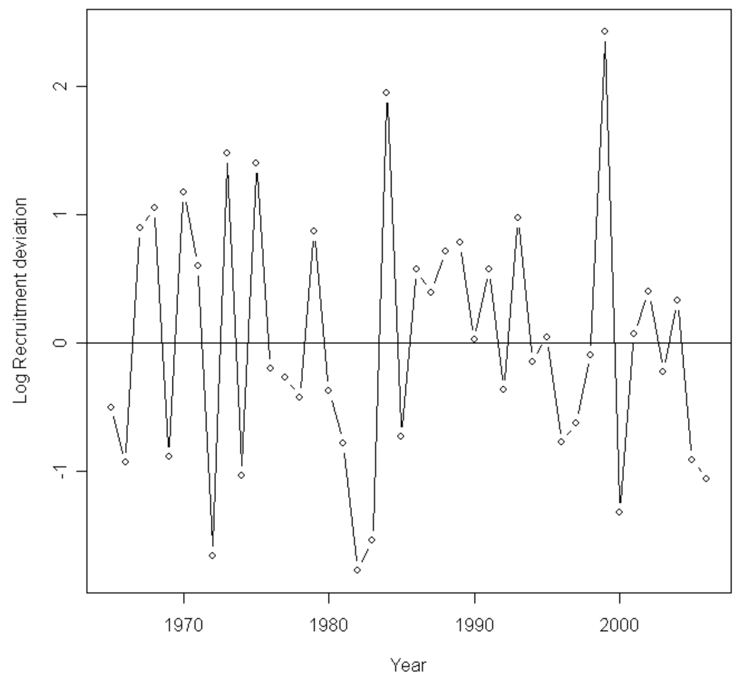


Figure 48-49: Model estimate recruitments (top) and observed recruitments with ~95% asymptotic confidence intervals (bottom).



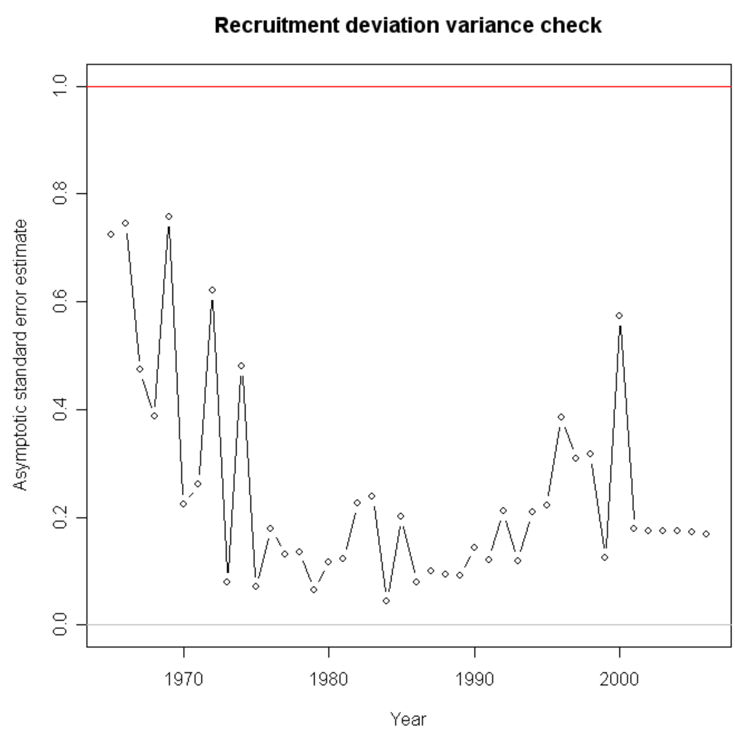
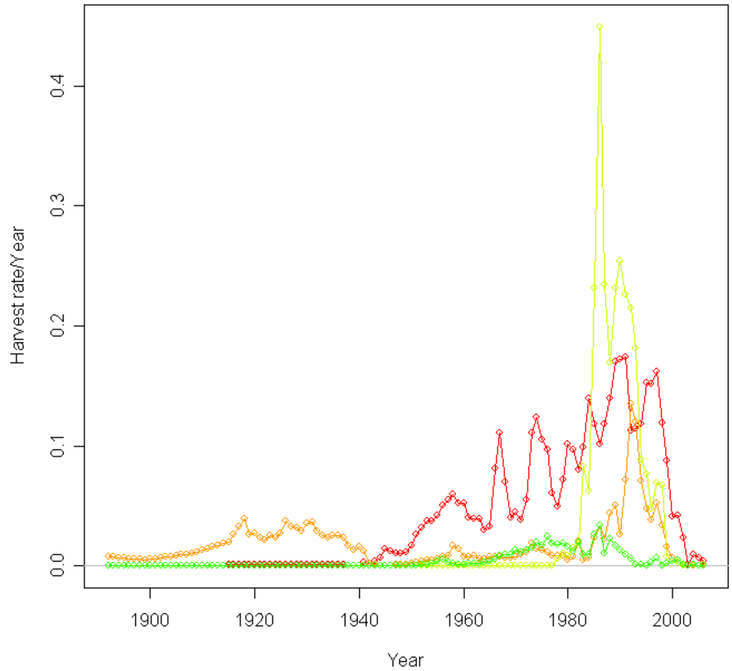


Figure 50-51: Model estimated recruitment deviation parameters (top) and recruitment deviance variance check (bottom).



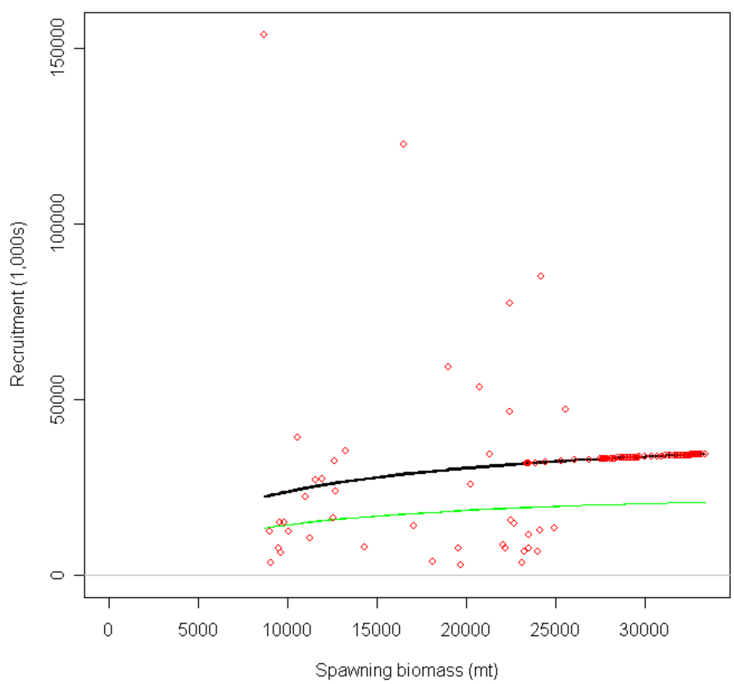
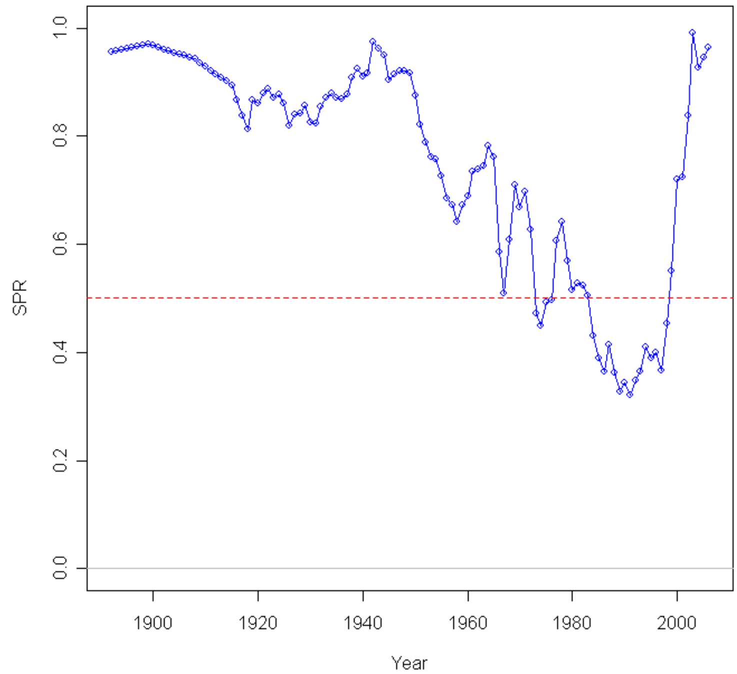


Figure 52-53: Harvest rates for each of the four fisheries (top) and model estimated spawner recruit relationship (bottom).



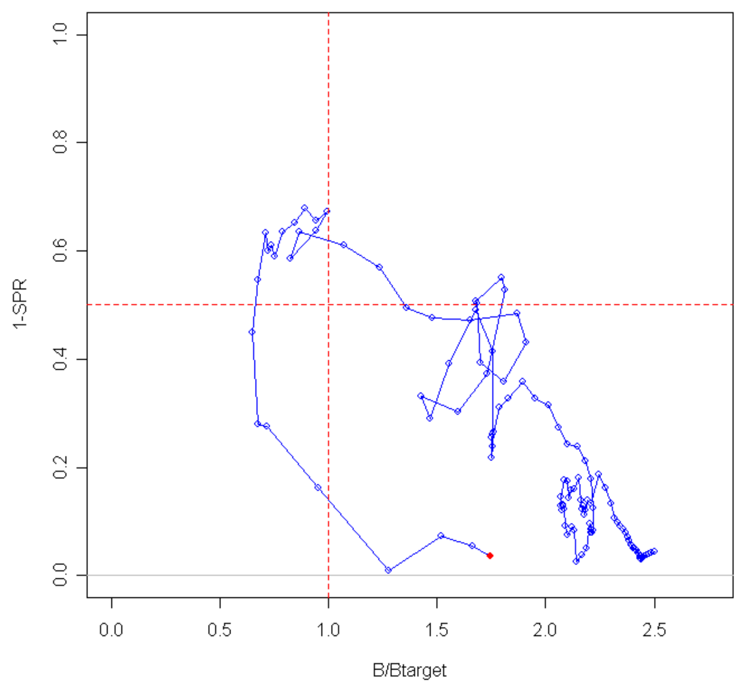
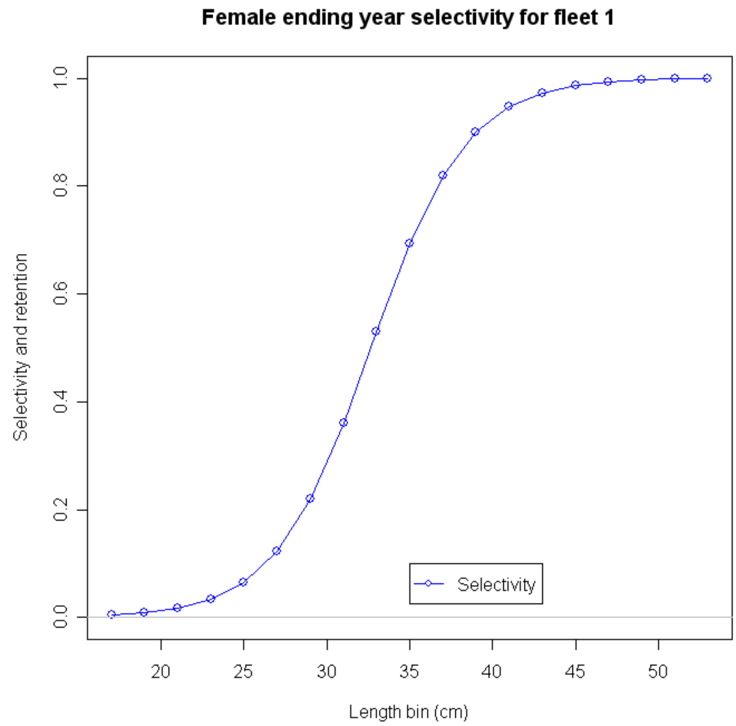


Figure 54-55: Base model output estimates of Spawning potential ratio (SPR) relative to the 50% level (top) and phase plot of the same information relative to SPR and SSB targets (bottom).



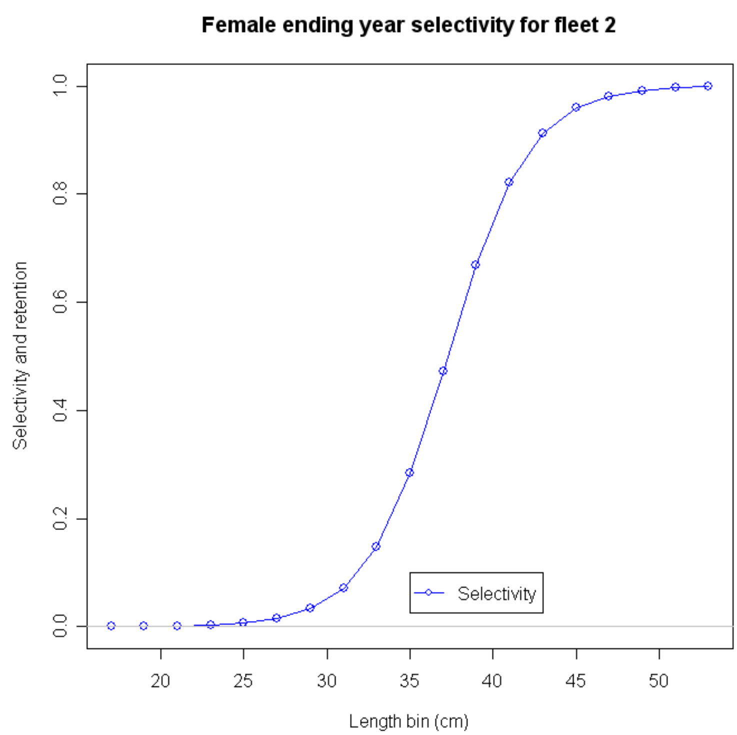
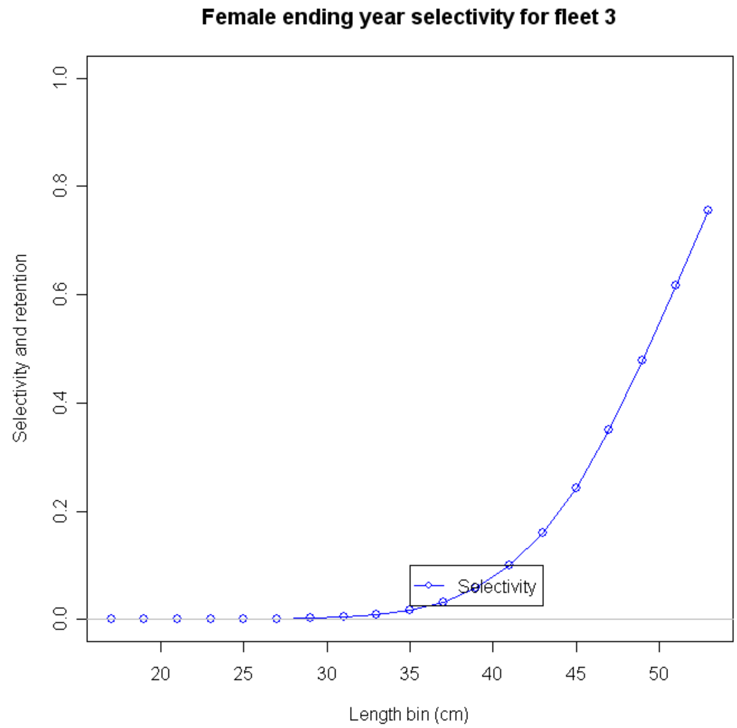


Figure 56-57: Selectivity curves (double-normal form) for trawl (top) and hook and line (bottom) fisheries.



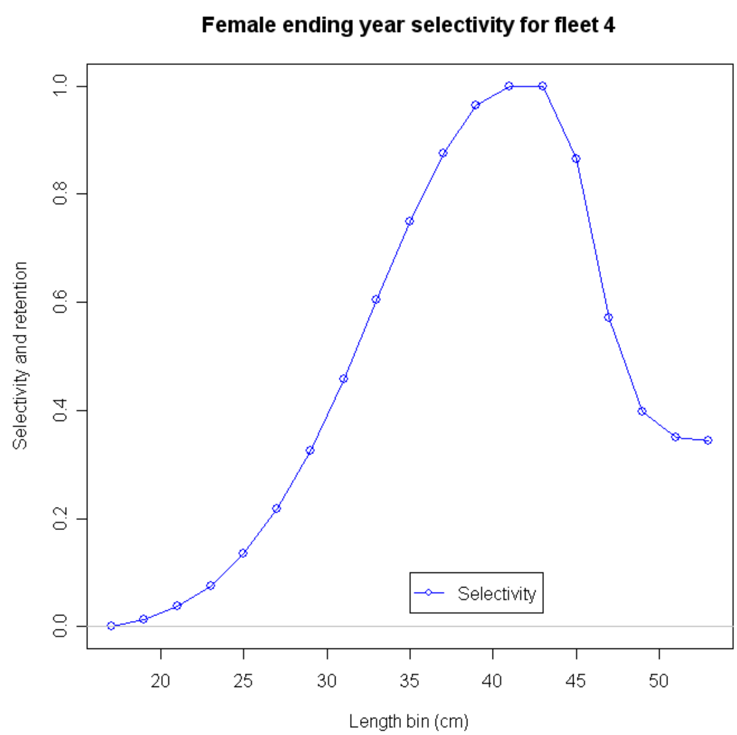
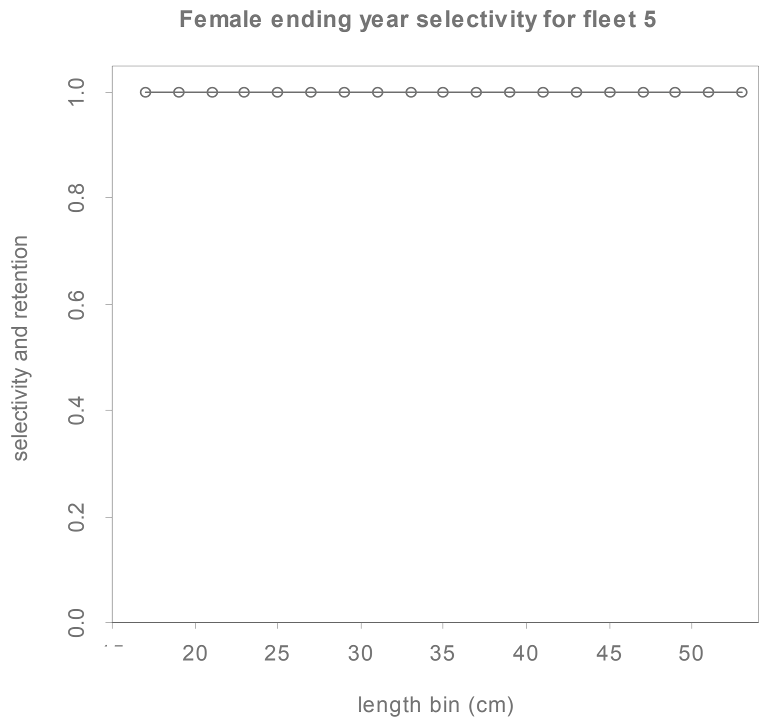


Figure 58-59: Selectivity curves (double-normal form) for setnet (top) and recreational (bottom) fisheries.



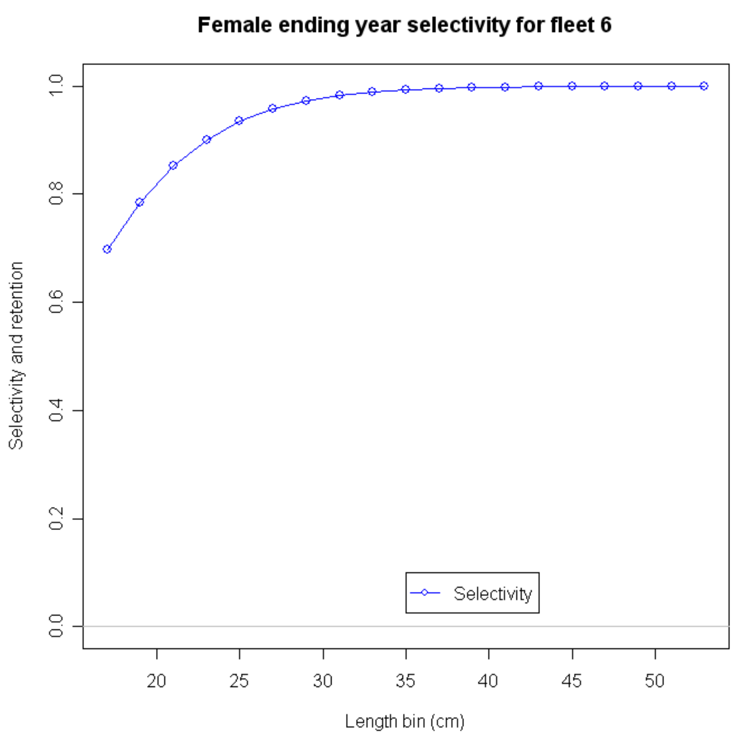
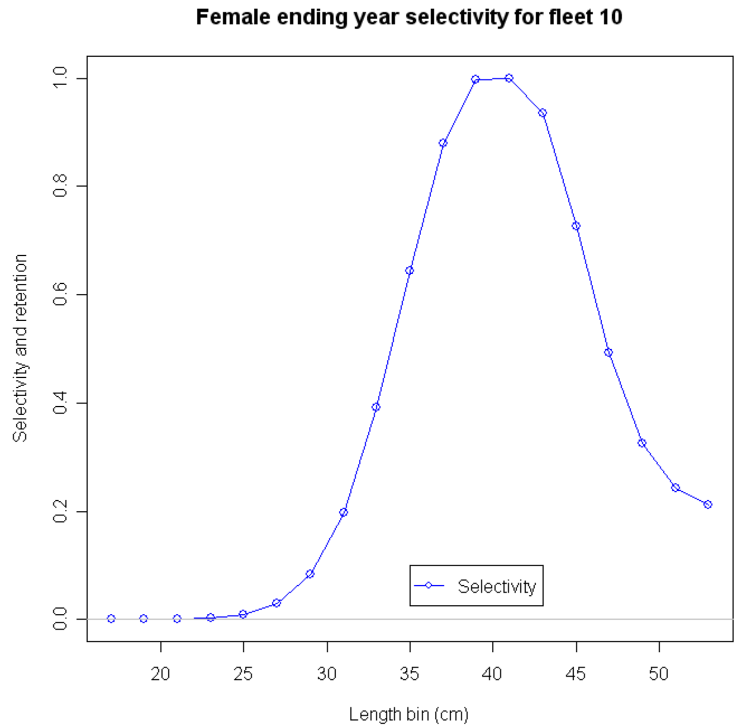


Figure 60-61: Selectivity curves (logistic form) for triennial bottom trawl survey (top) and NWC combined survey (bottom).



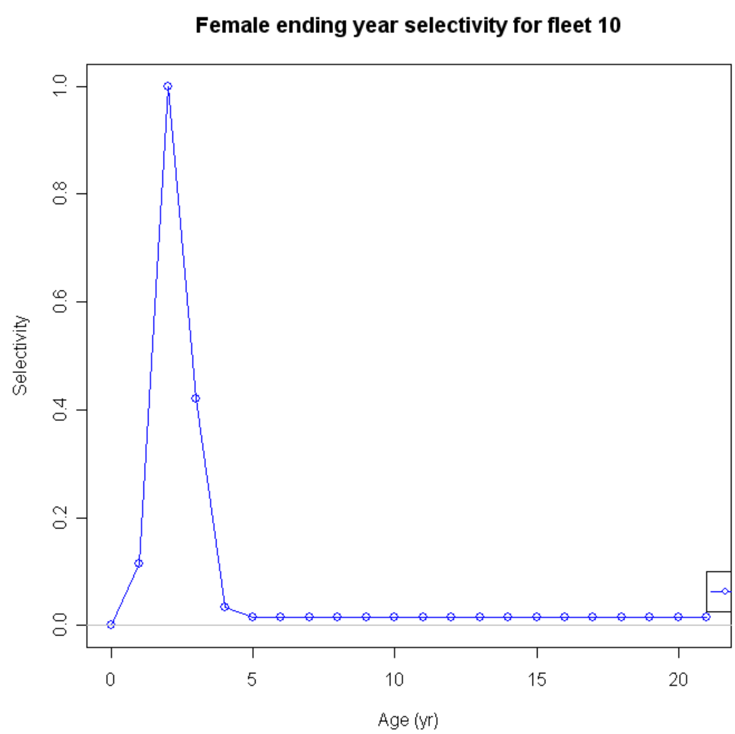
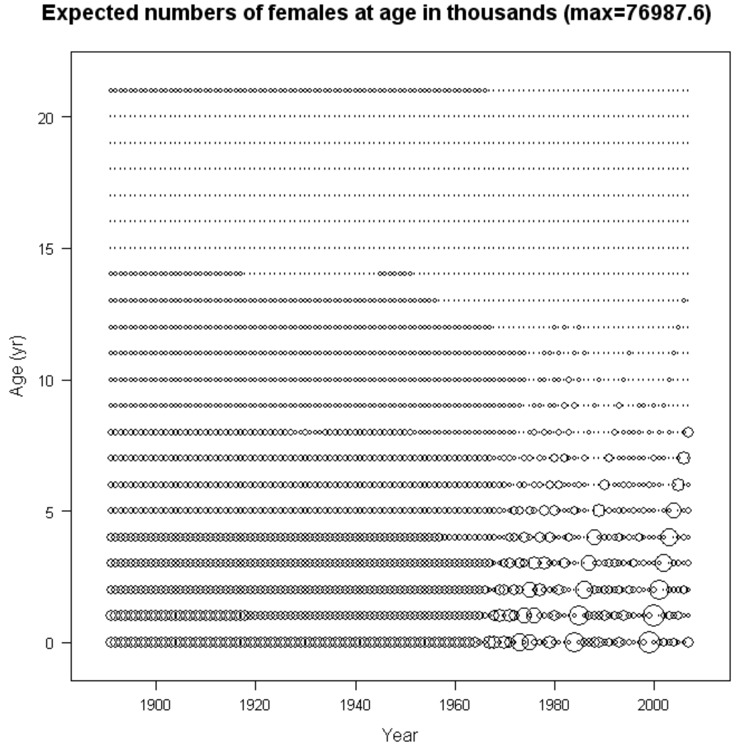


Figure 62-63: Selectivity curves (logistic form) for triennial bottom trawl survey (top) and NWC combined survey (bottom).



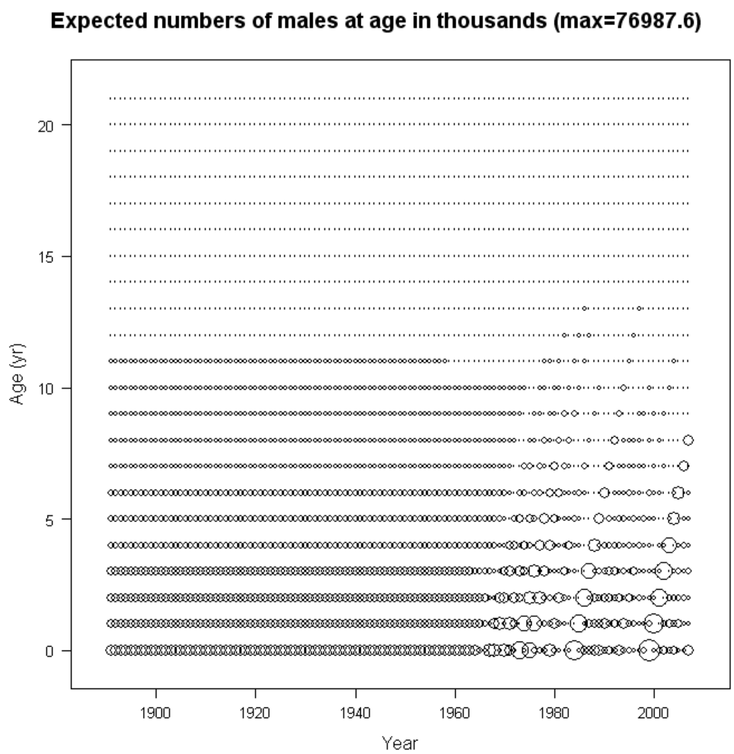
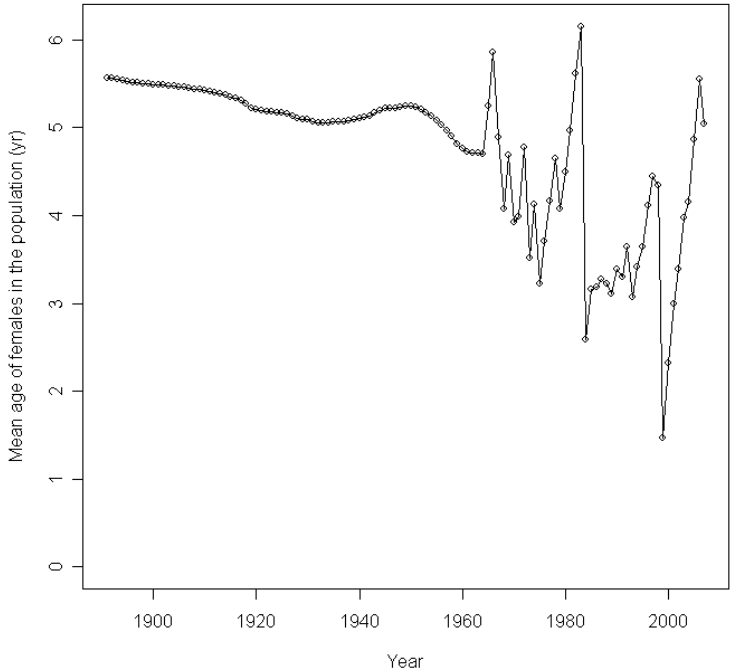


Figure 64-65: Model estimated numbers at age over time for females (top) and males (bottom).



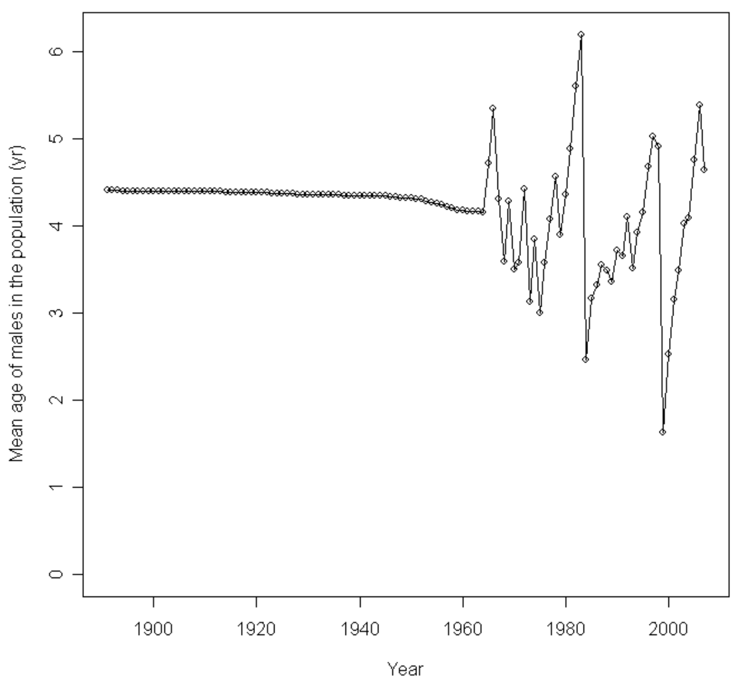
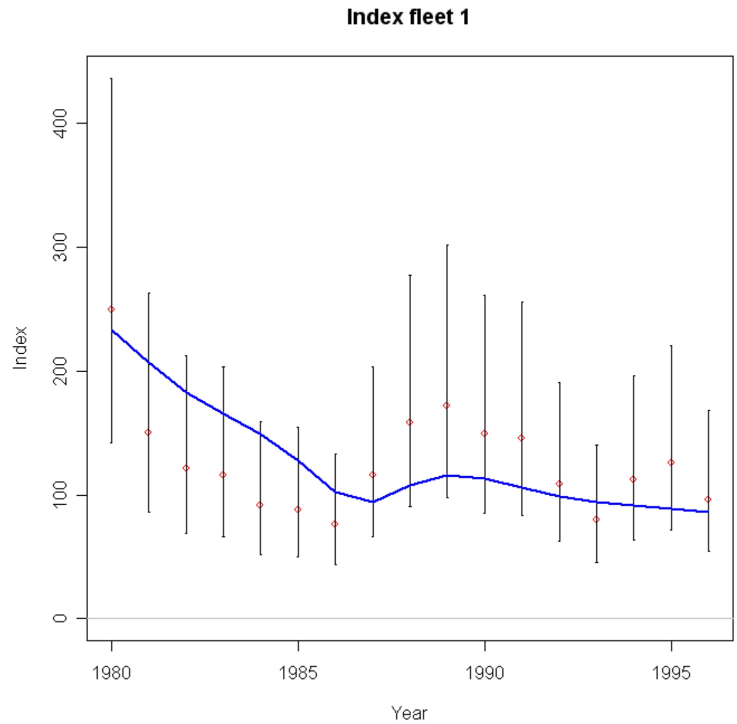


Figure 66-67: Mean age of females (top) and males (bottom) in the population over time.



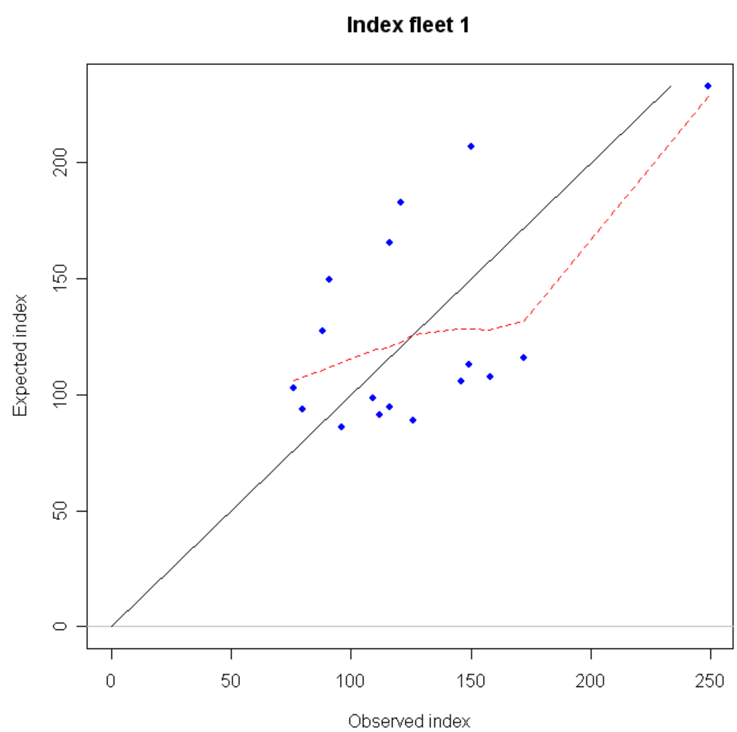
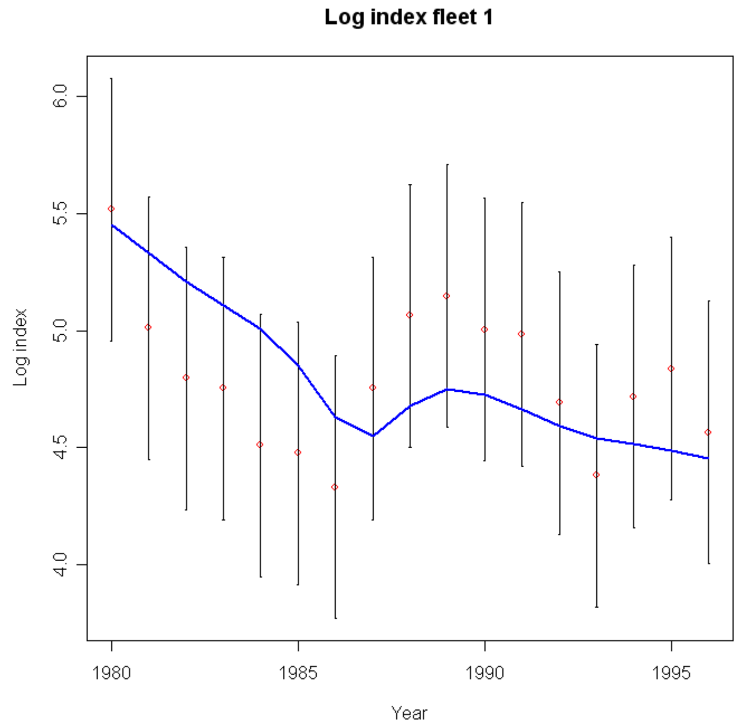


Figure 68-69: Fits to the trawl CPUE time series



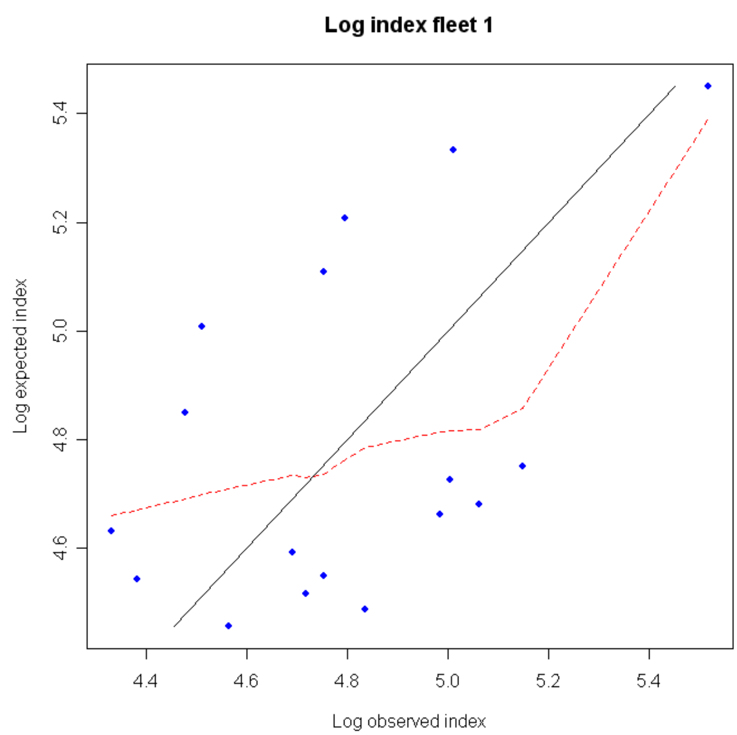
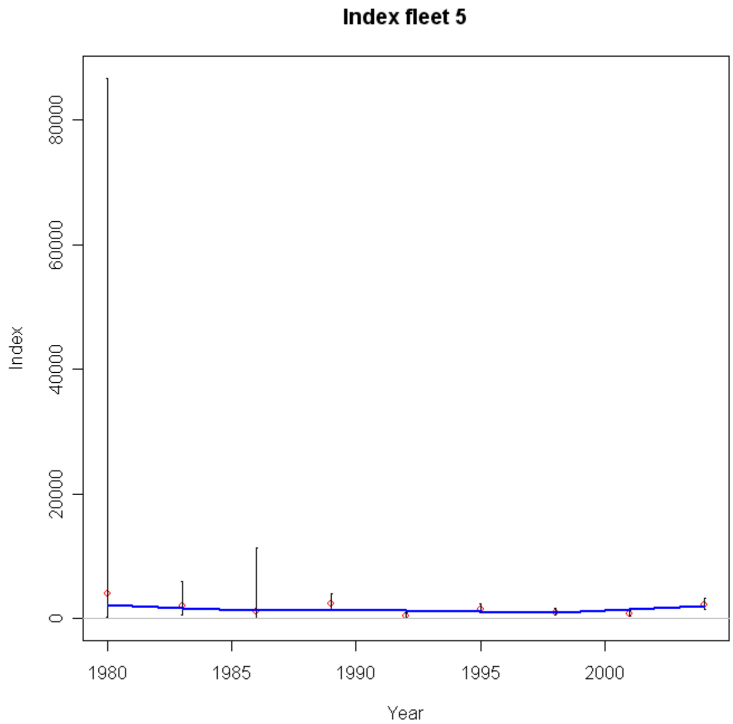


Figure 70-71: Fits to the trawl CPUE time series in log space



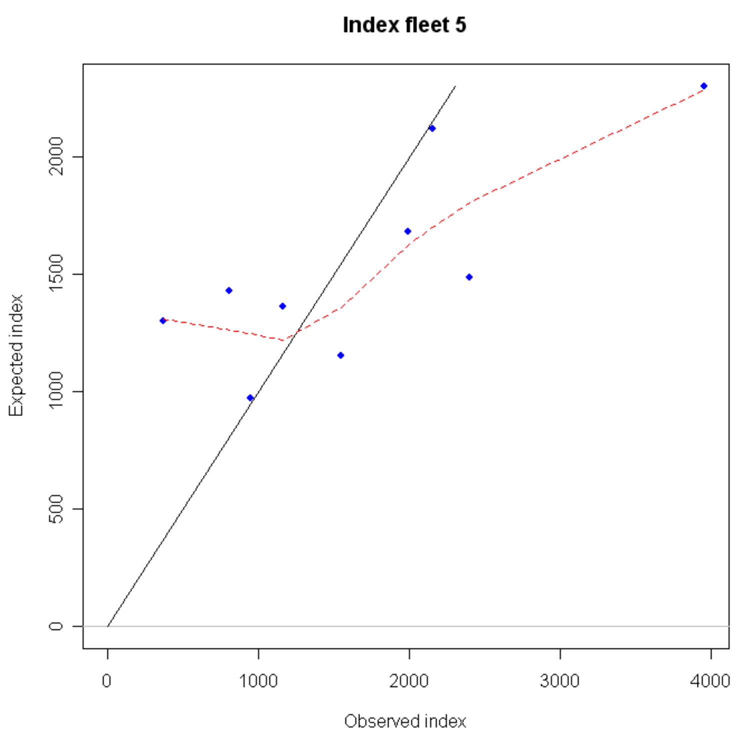
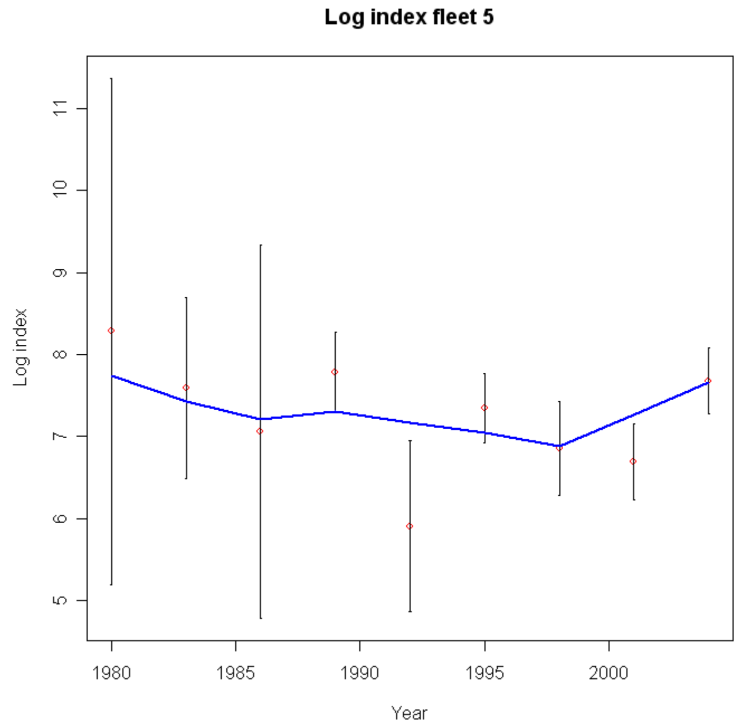


Figure 72-73: Fits to the triennial survey core area swept index.



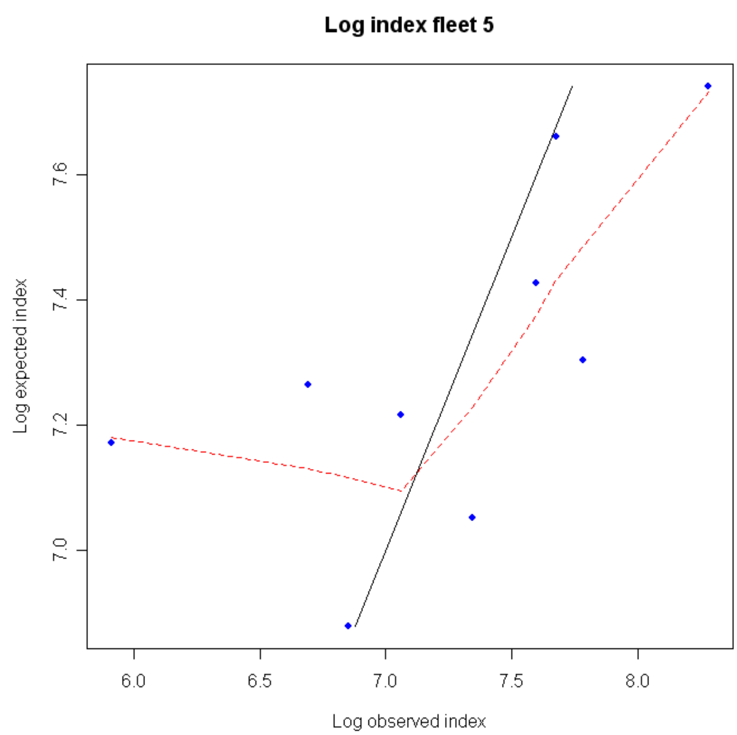
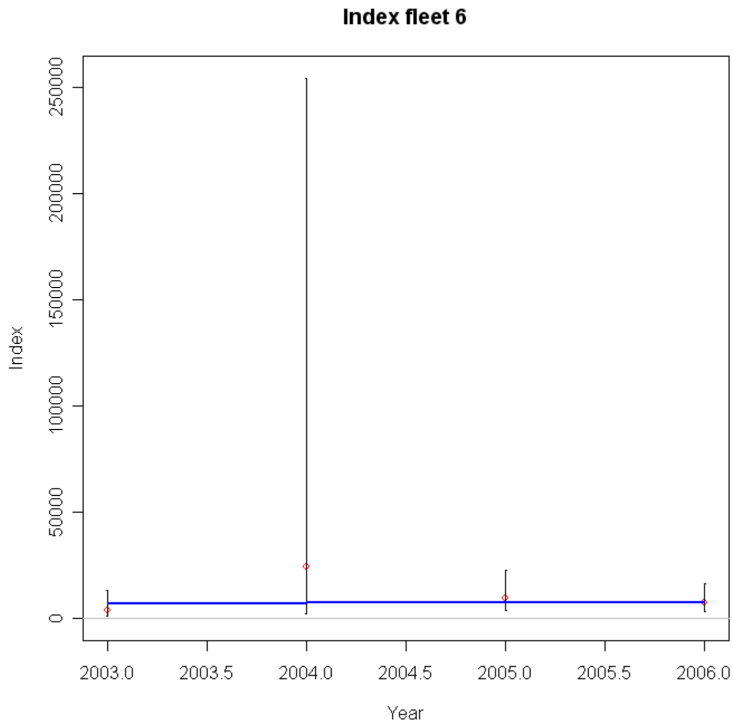


Figure 74-75: Fits to the triennial survey core area swept index in log space.



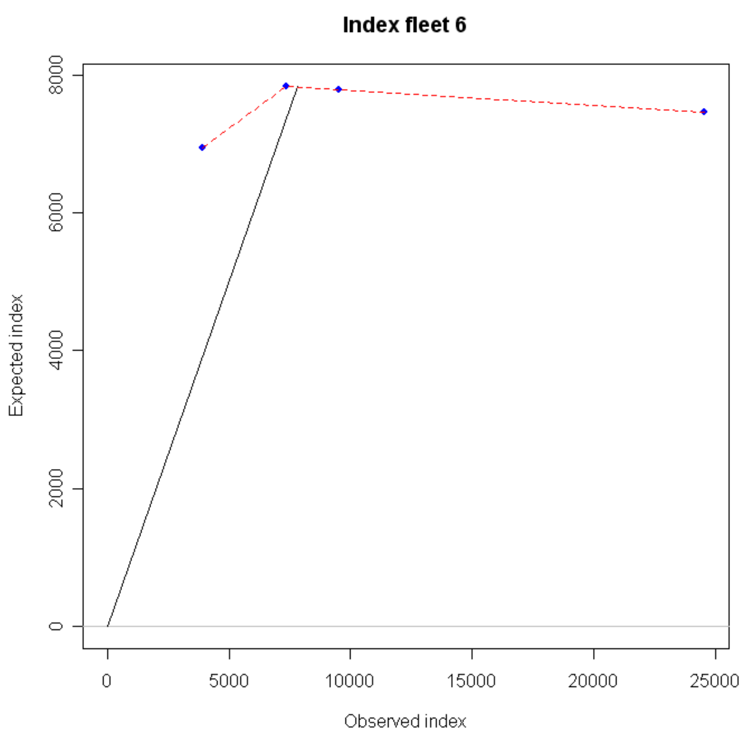
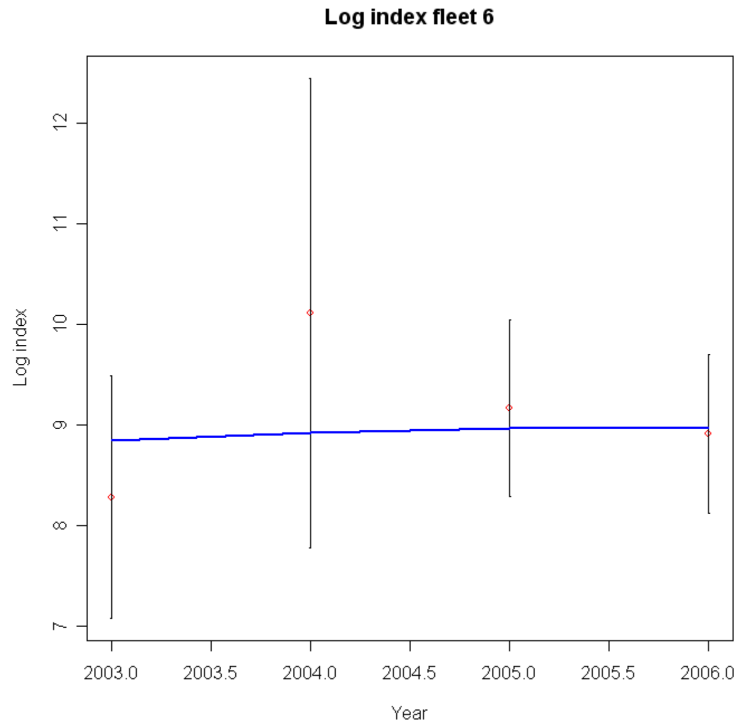


Figure 76-77: Fits to the NWC Combined survey.



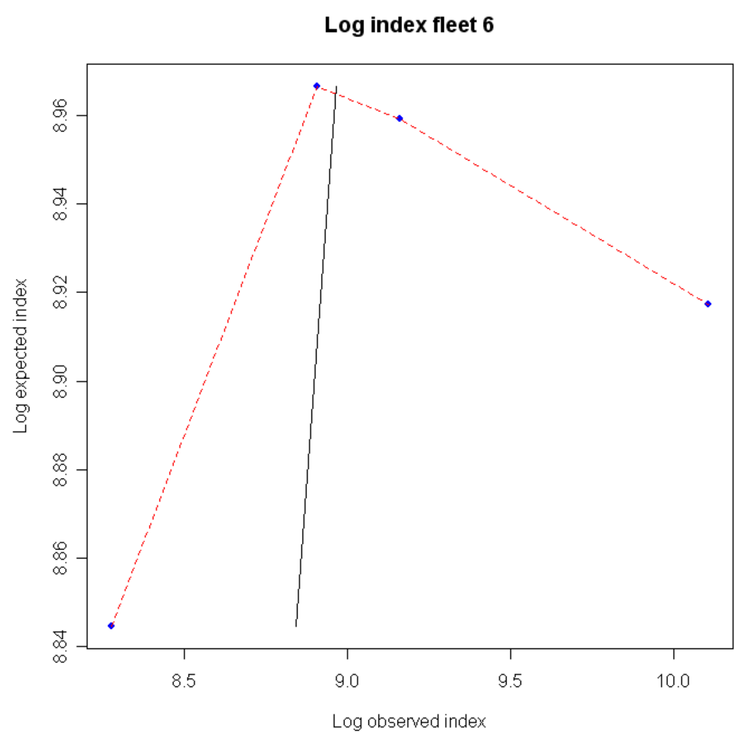
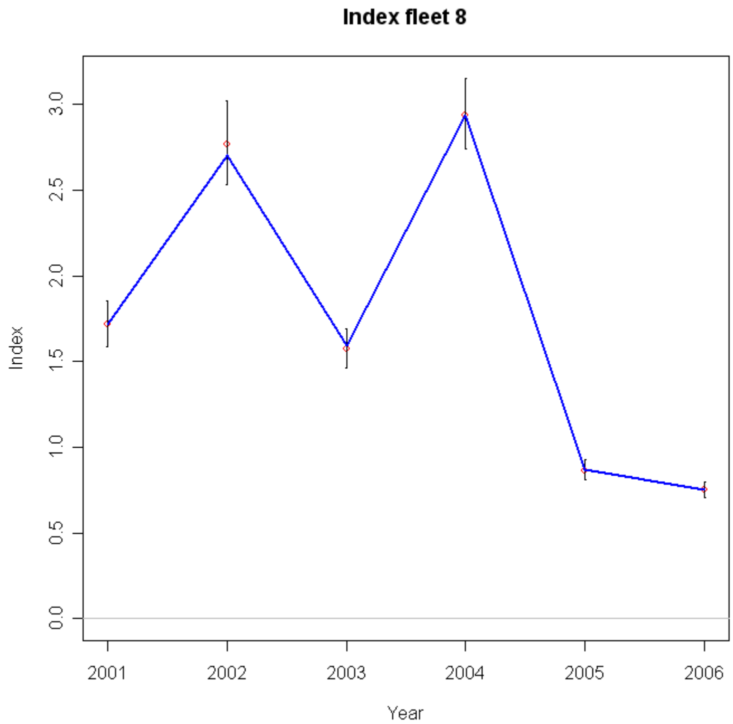


Figure 78-79: Fits to the NWC Combined survey in log space.



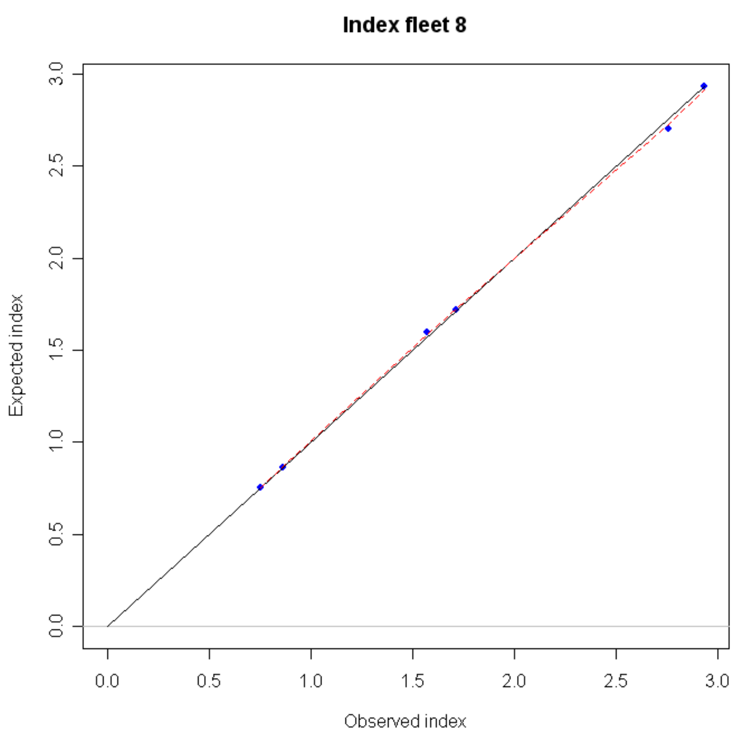
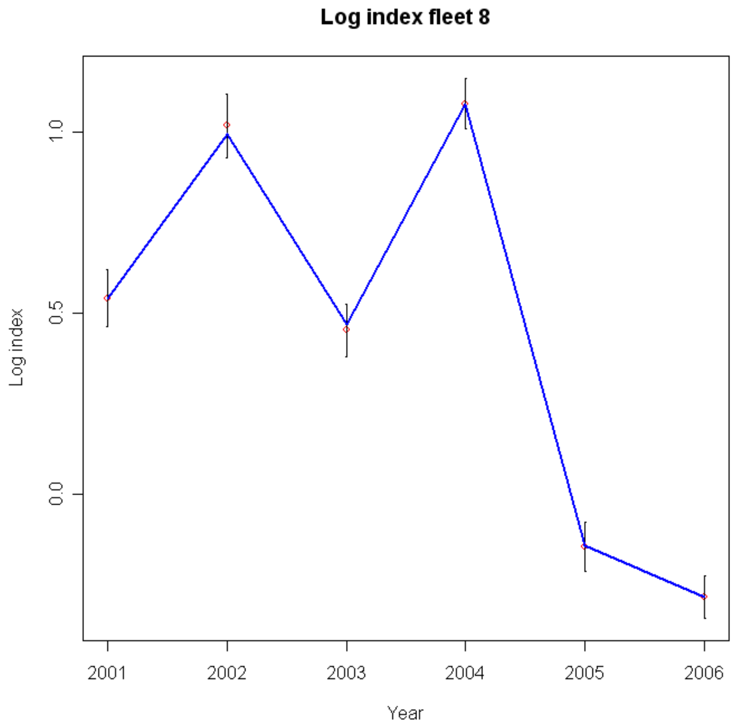


Figure 80-81: Fits to the Coastwide juvenile survey.



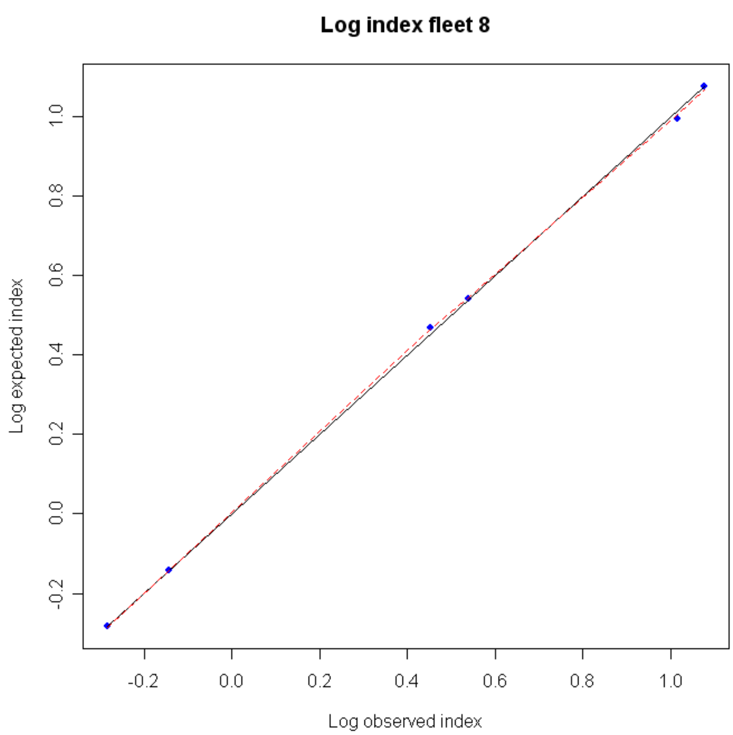
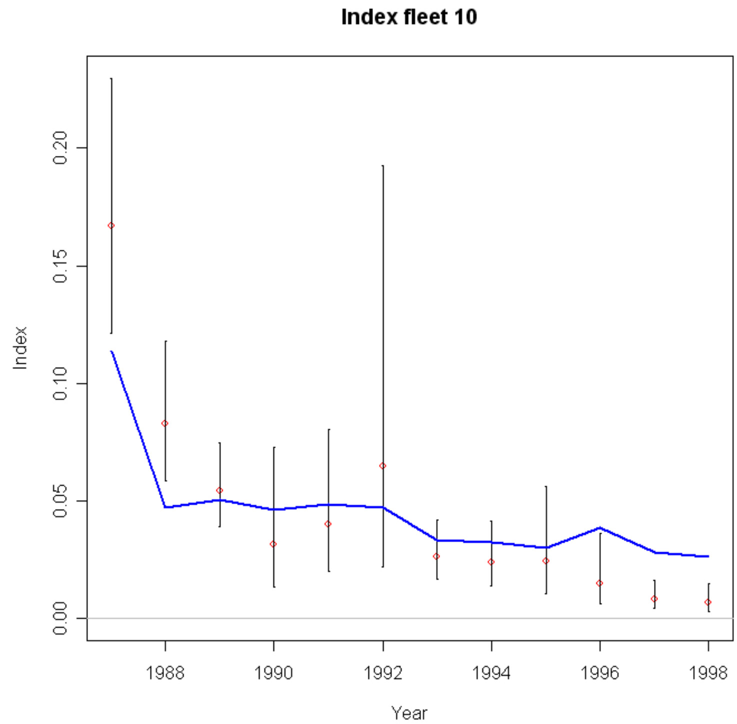


Figure 82-83: Fits to the Coastwide juvenile survey in log space.



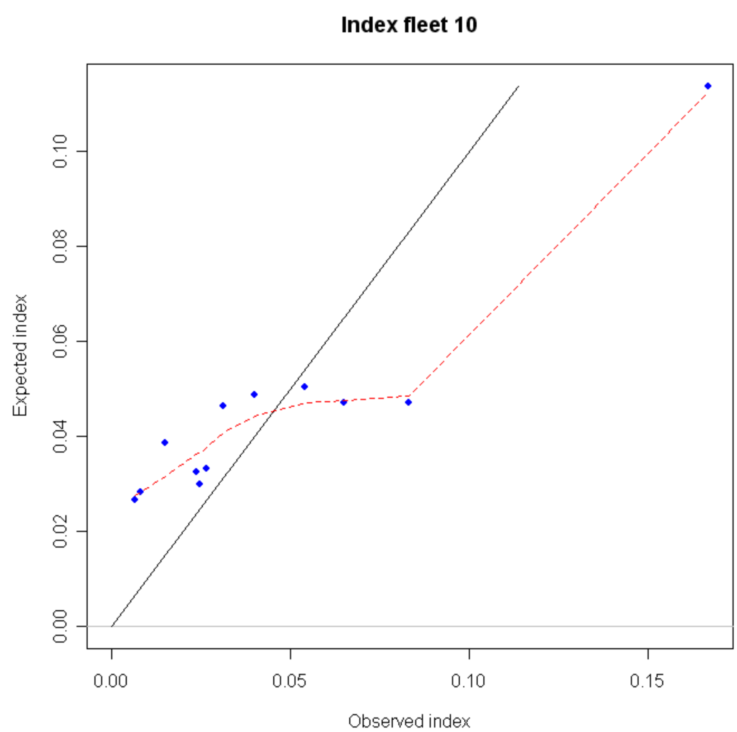
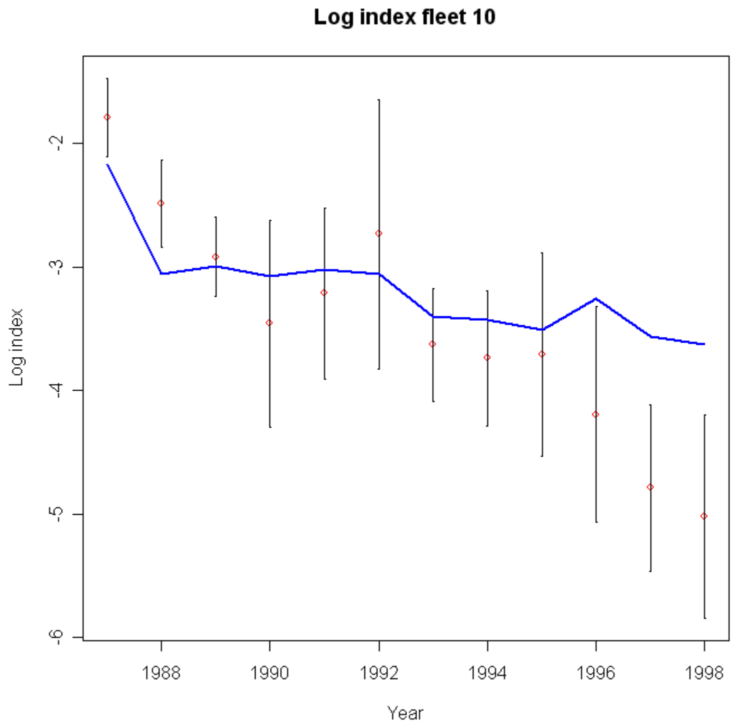


Figure 84-85: Fits to the Recreational CPUE index.



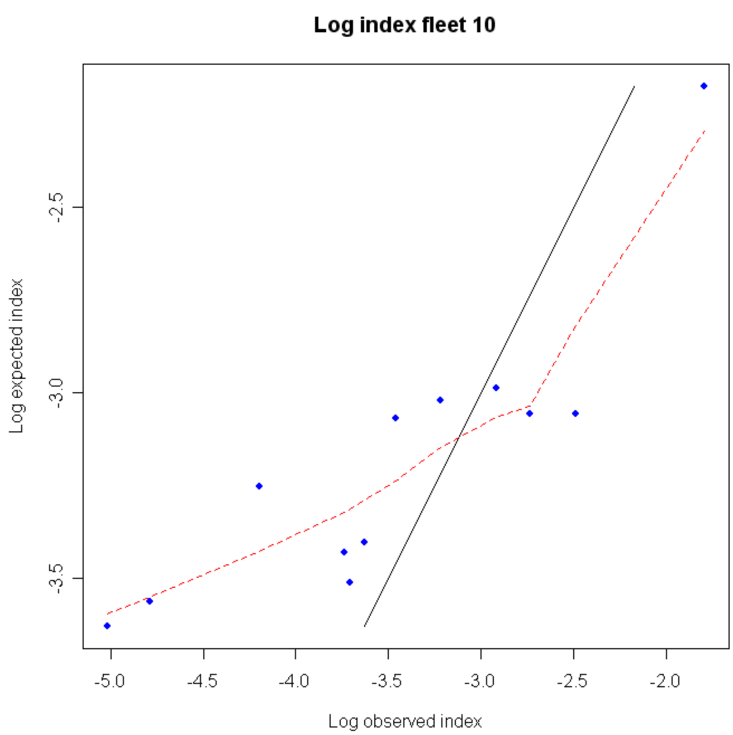
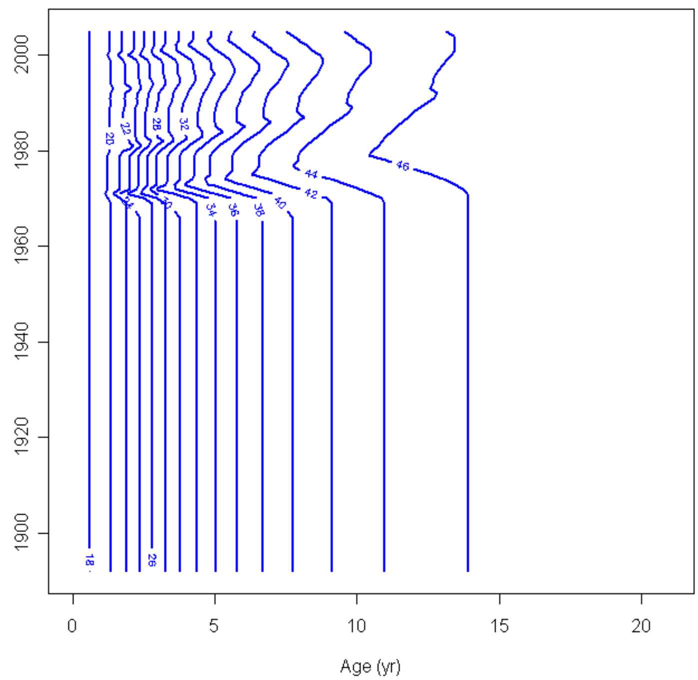
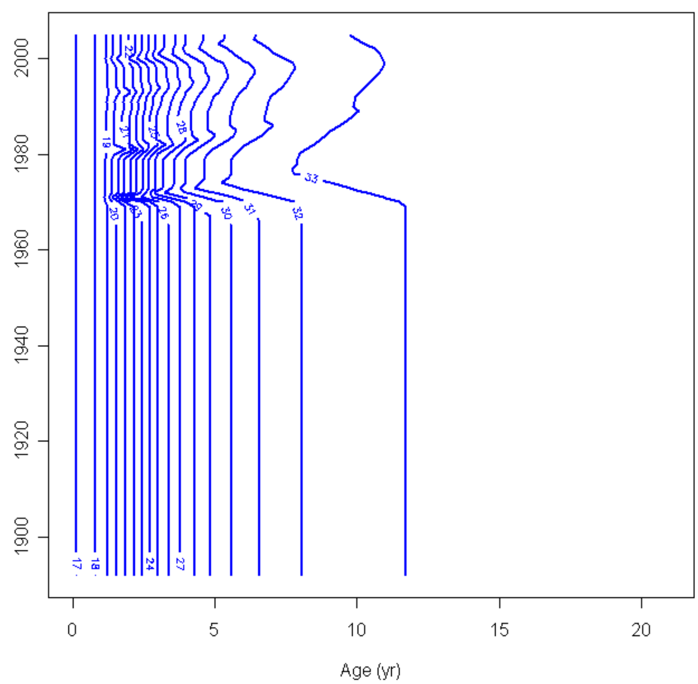


Figure 86-87: Fits to the recreational CPUE index in log space.

Female time-varying growth



Male time-varying growth



Figures 88-89: Size at age contours for female (top) and male (bottom) chilipepper rockfish over time under time-varying growth assumptions.

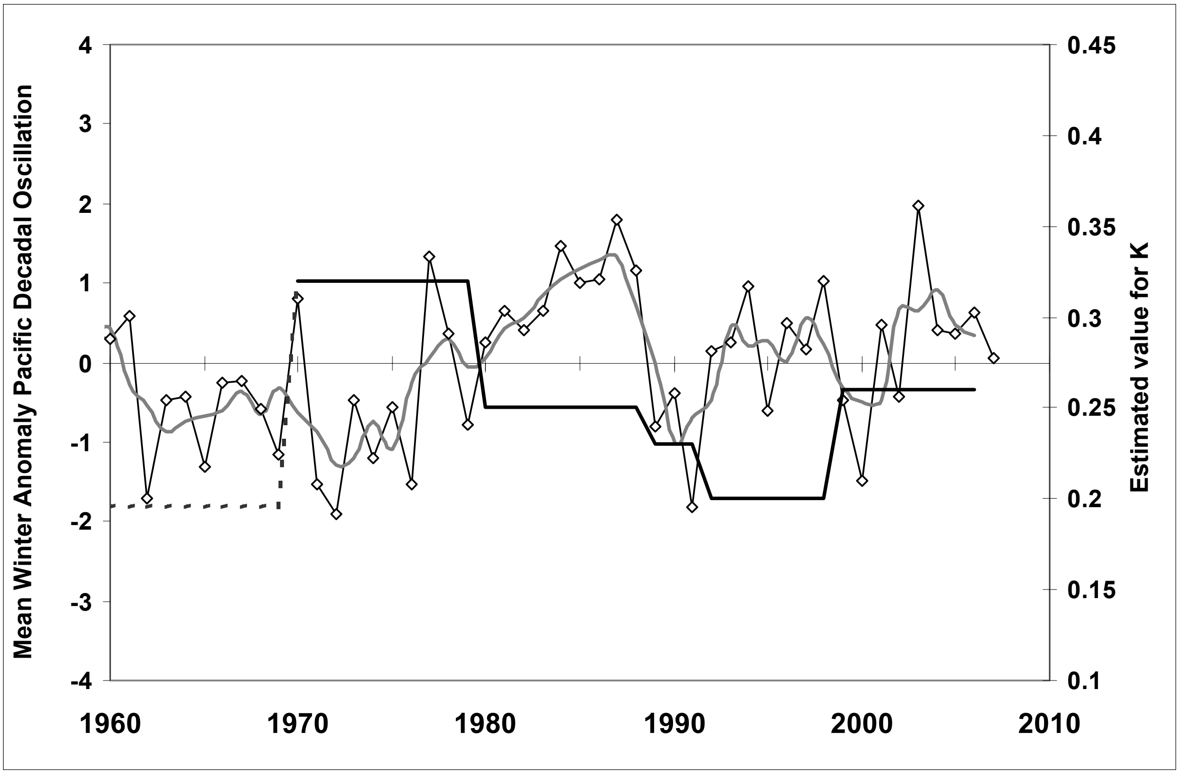


Figure 90: Estimates of time-varying growth coefficient (K), with mean annual winter PDO and a running three year mean of the winter PDO.

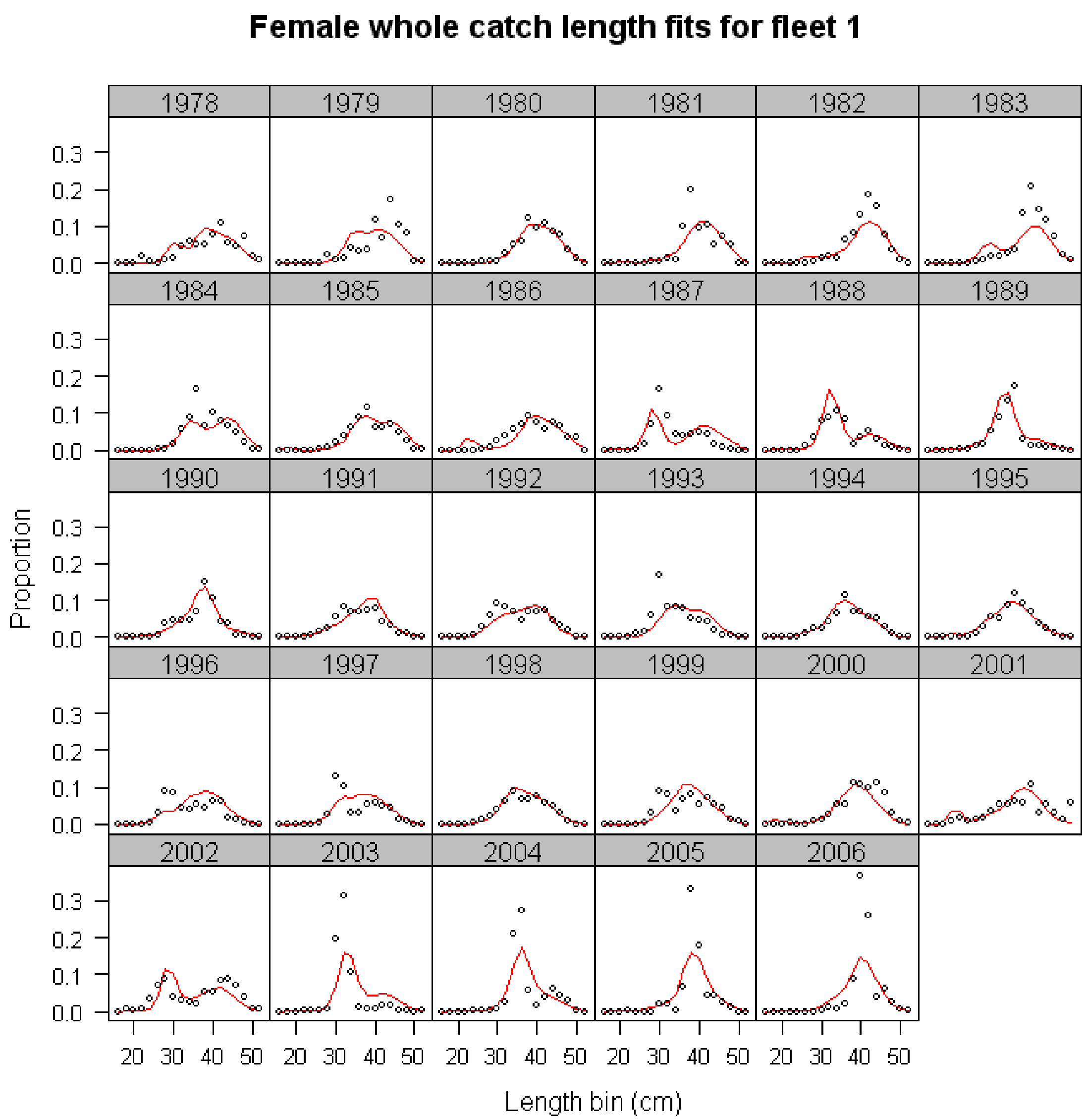


Figure 91: Observed and predicted catch at length for female chilipepper in the trawl fishery.

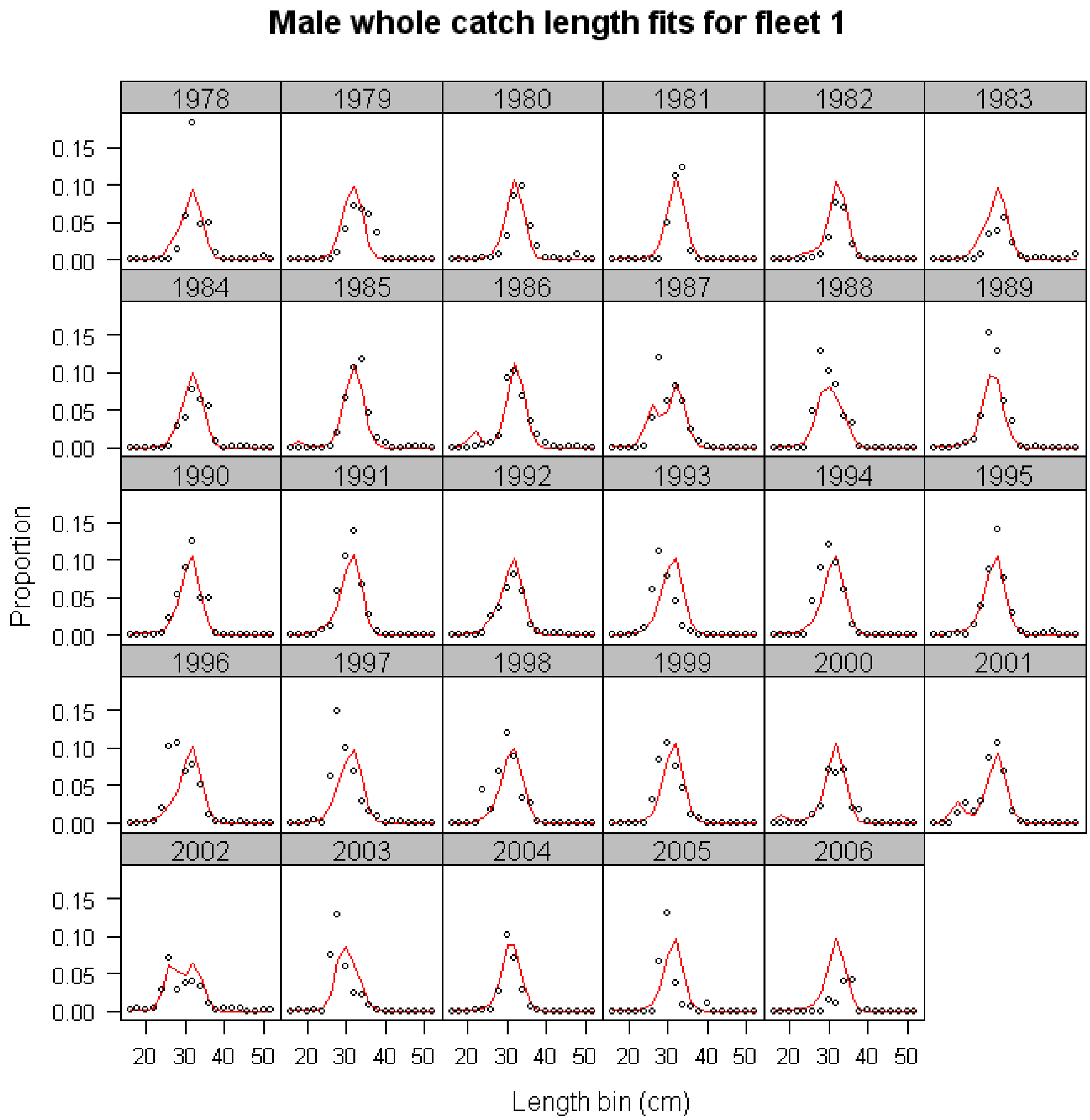


Figure 92: Observed and predicted catch at length for male chilipepper in the trawl fishery.

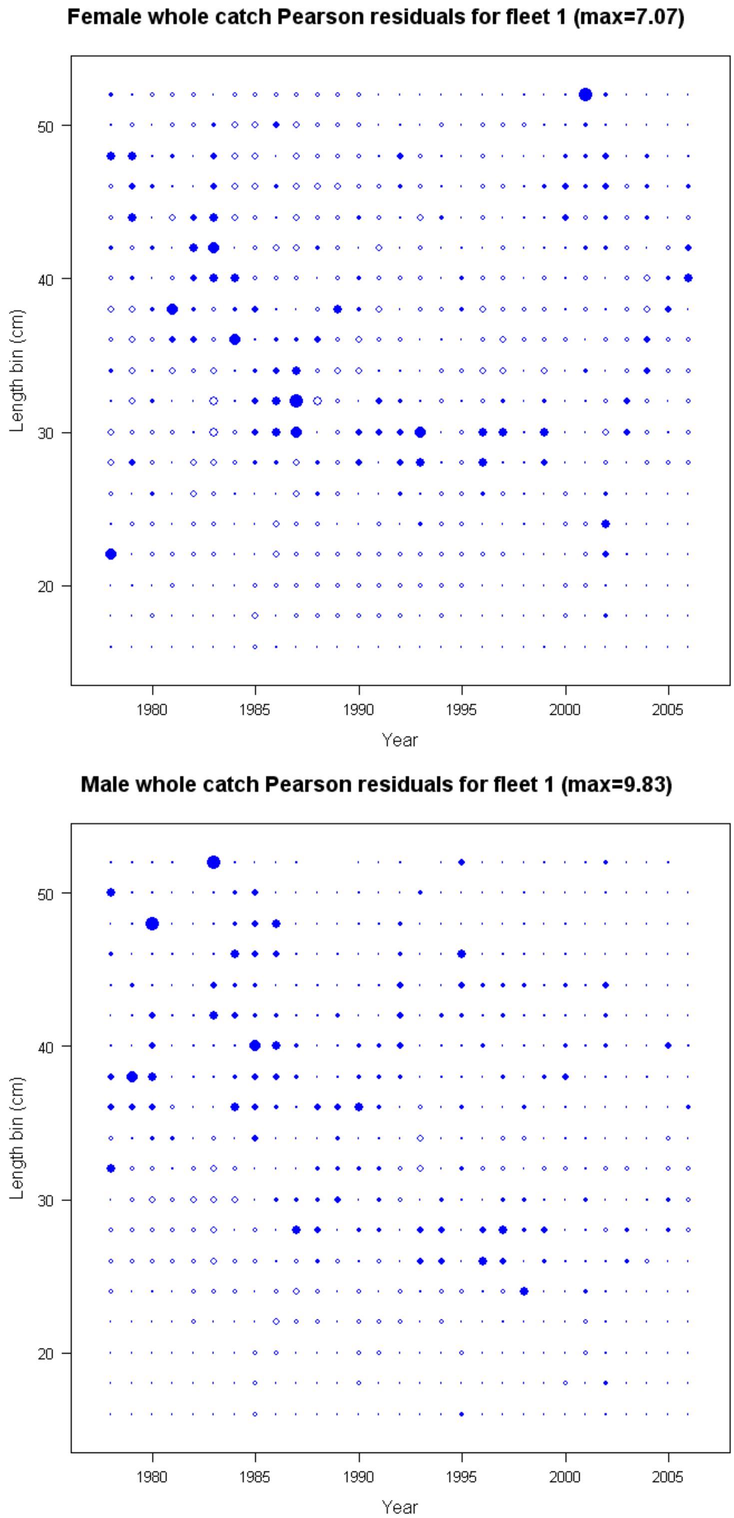
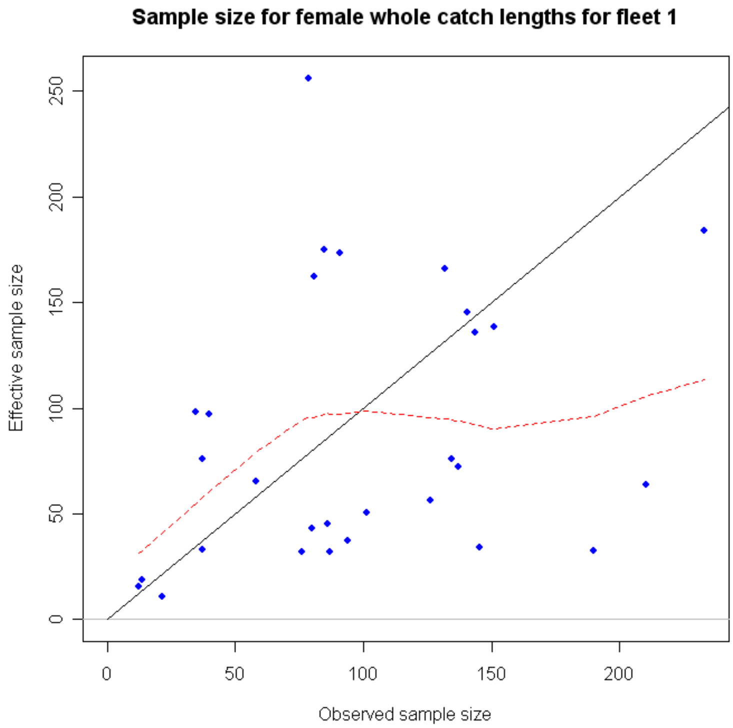


Figure 93-94: Residuals to the length composition data in the trawl fishery



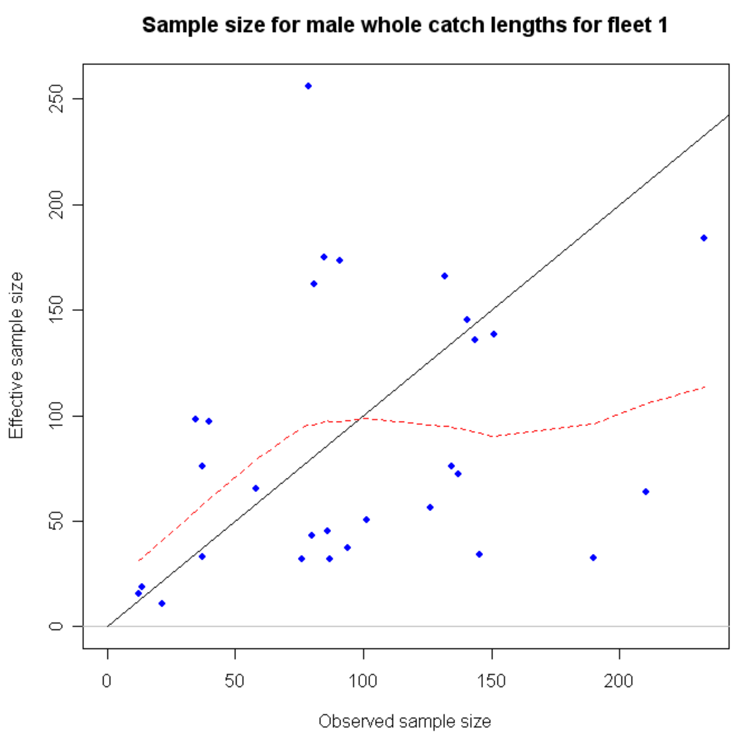


Figure 95-96: Observed and effective sample sizes for length composition data from the bottom trawl fishery.

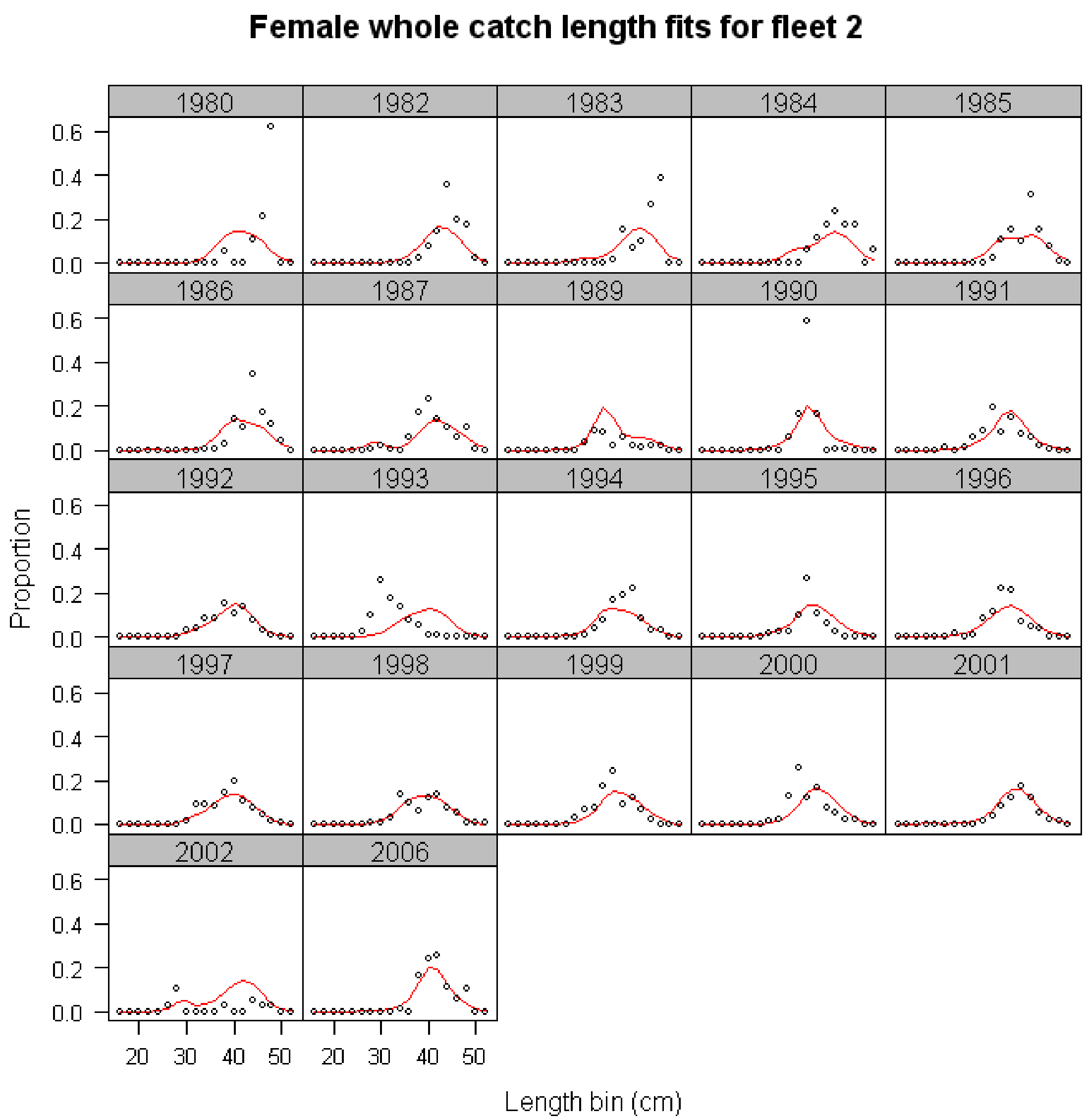


Figure 97-98: Observed and predicted length composition data for females in the hook and line fishery.

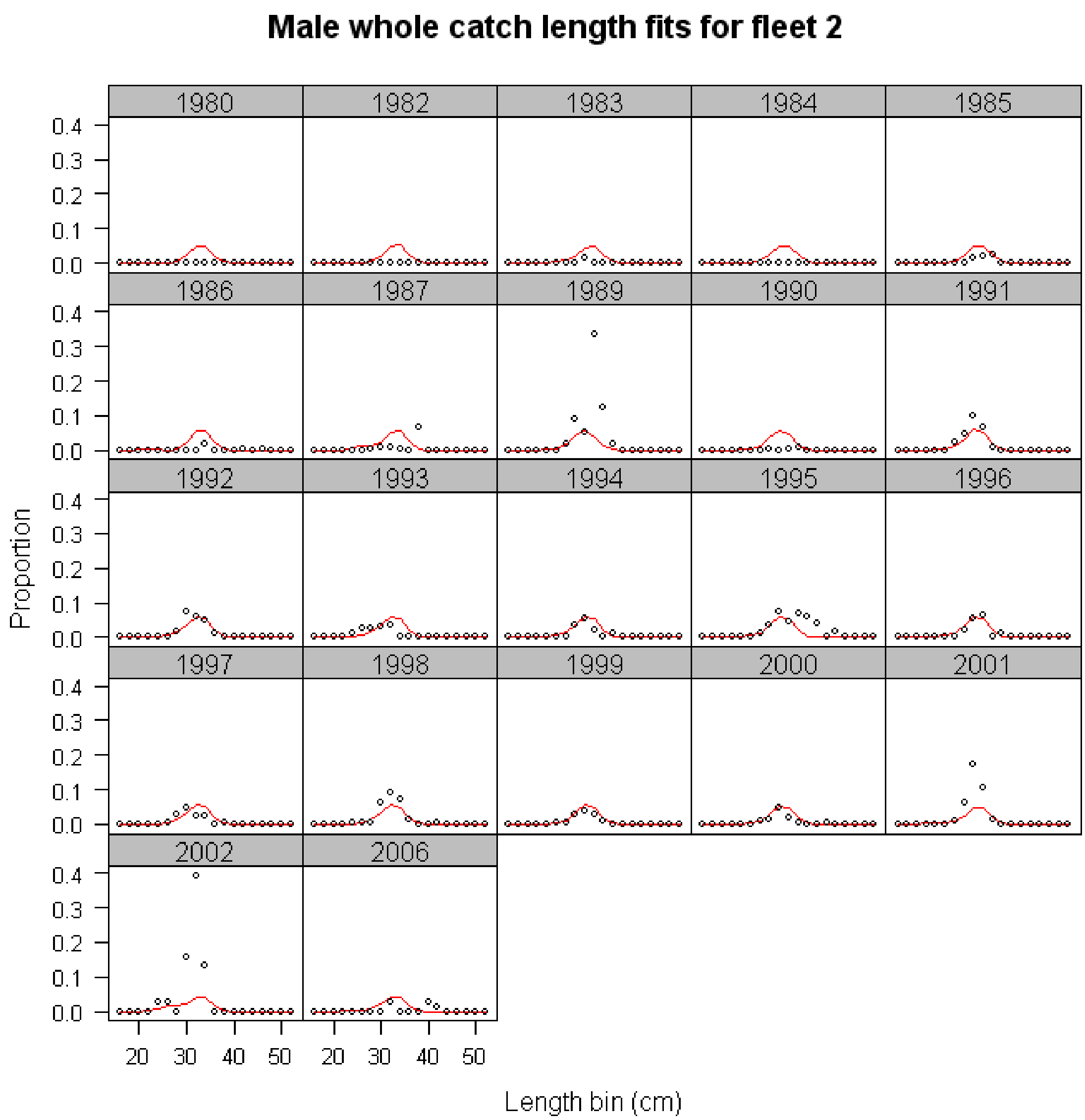
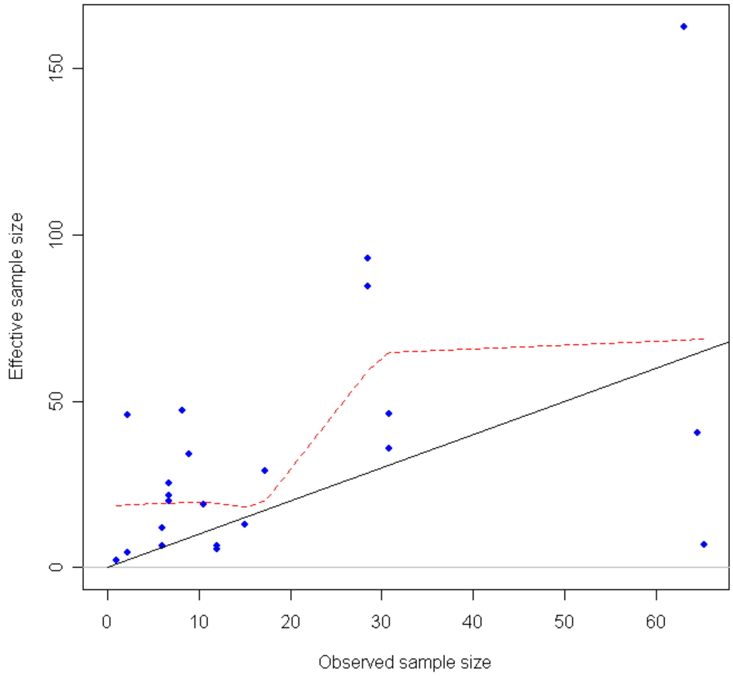


Figure 99: Observed and predicted length composition data for males in the hook and line fishery.

Sample size for female whole catch lengths for fleet 2



Sample size for male whole catch lengths for fleet 2

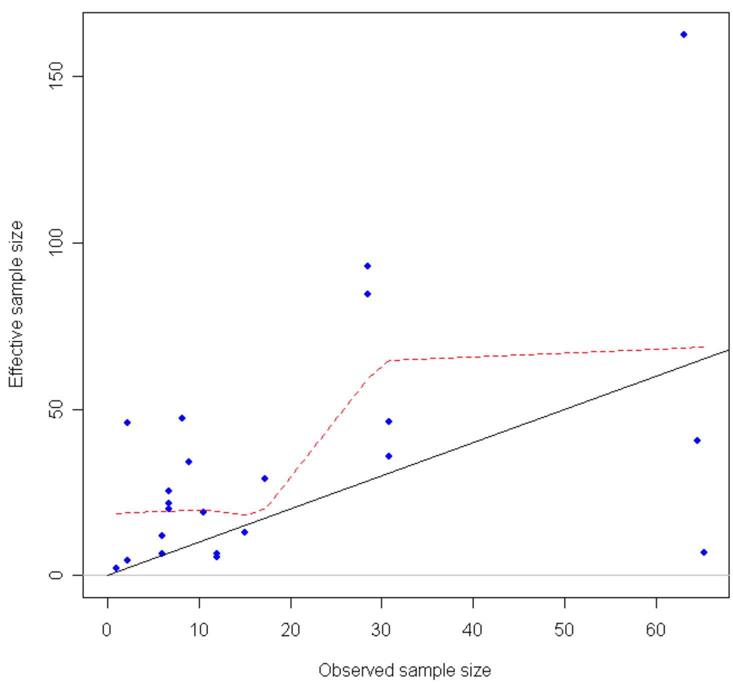
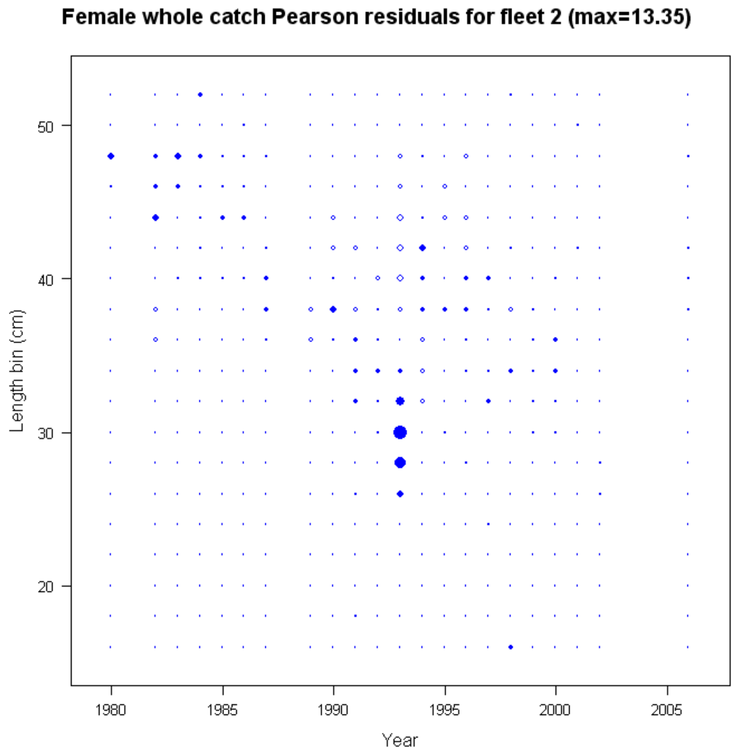


Figure 100-101: Observed and effective sample sizes for length composition data from the hook and line fishery.



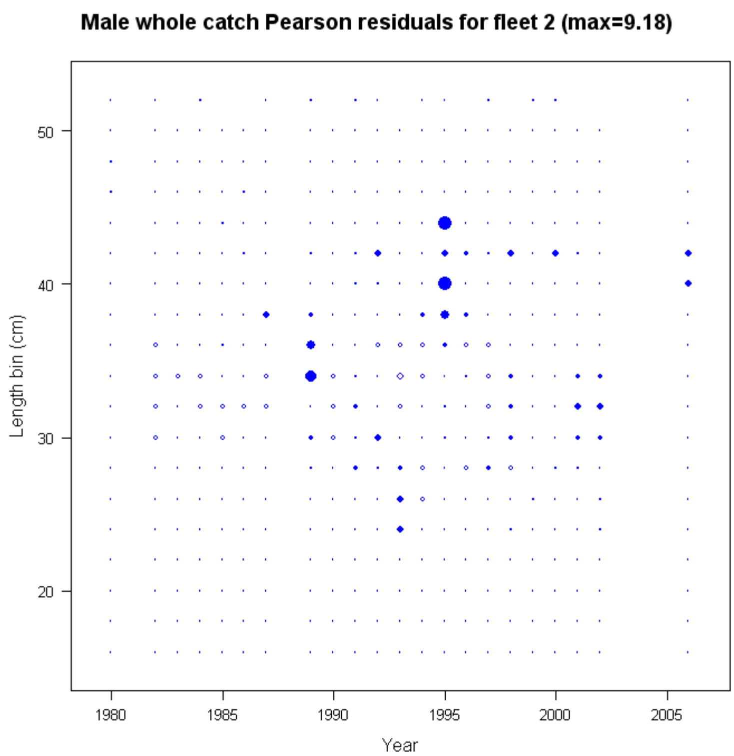
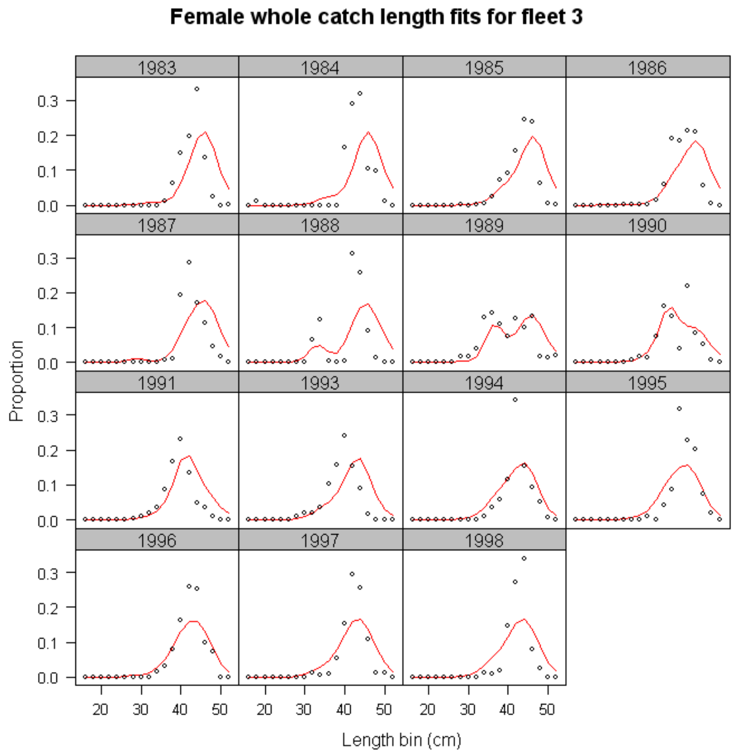


Figure 102-103: Residuals to the length composition data in the hook and line fishery



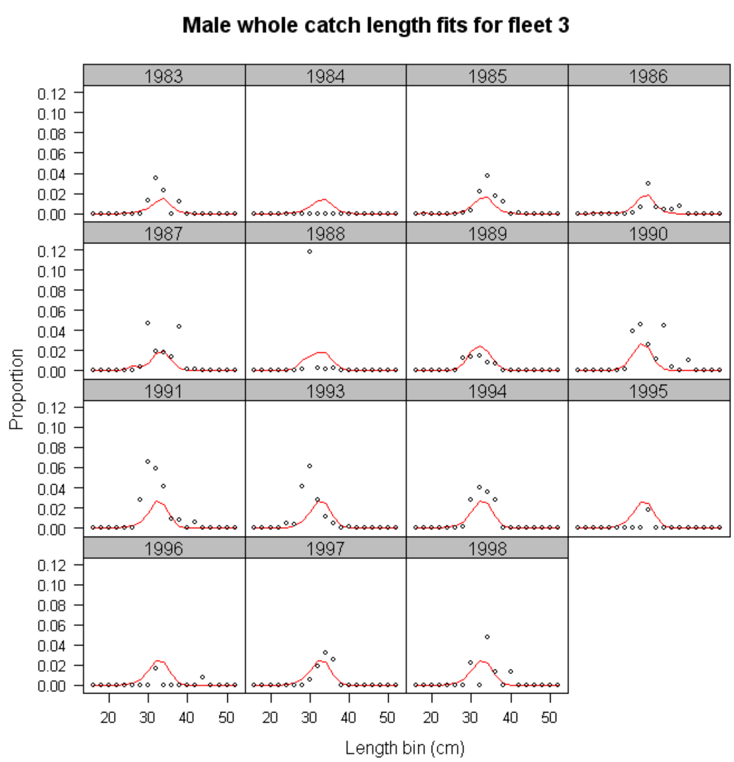
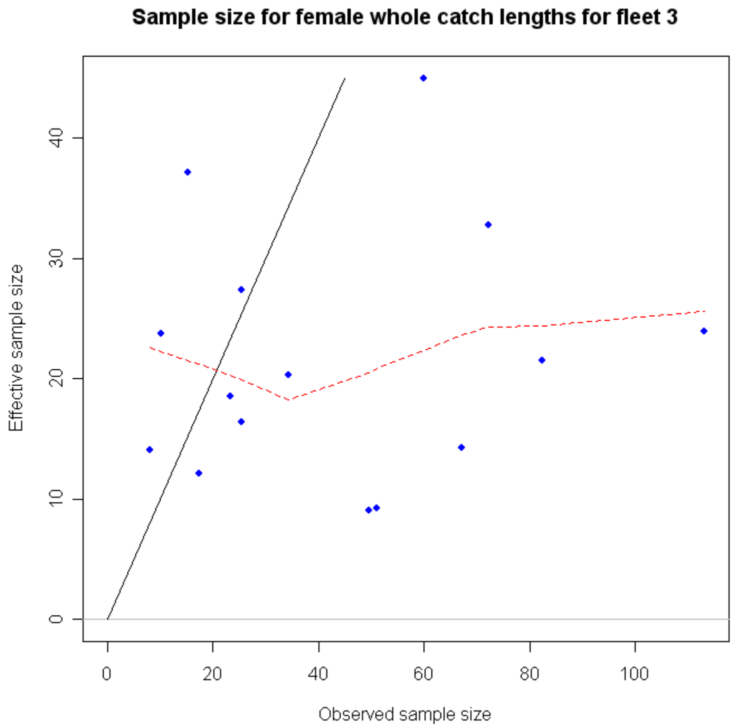


Figure 10-4-105: Observed and predicted length composition data for females (top) and males (bottom) in the setnet fishery.



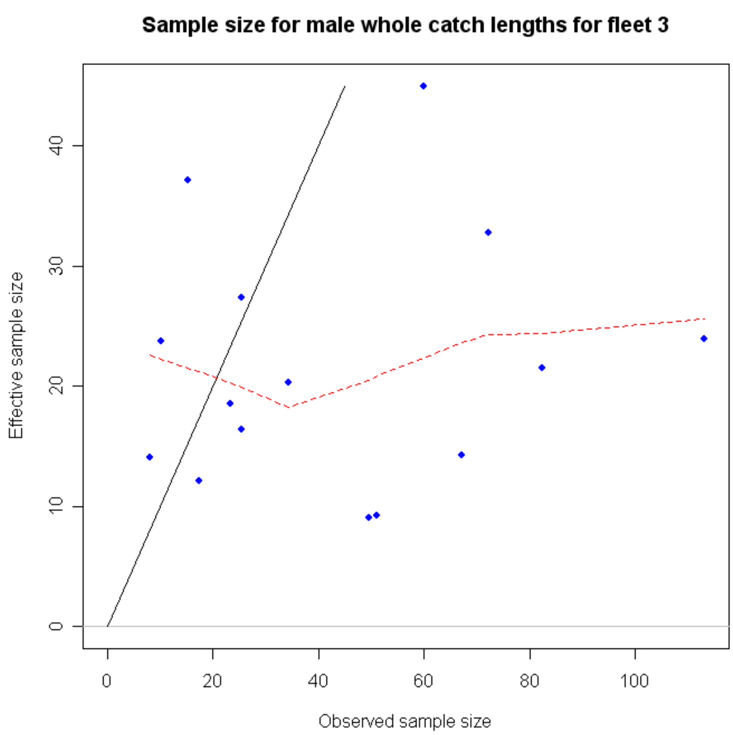
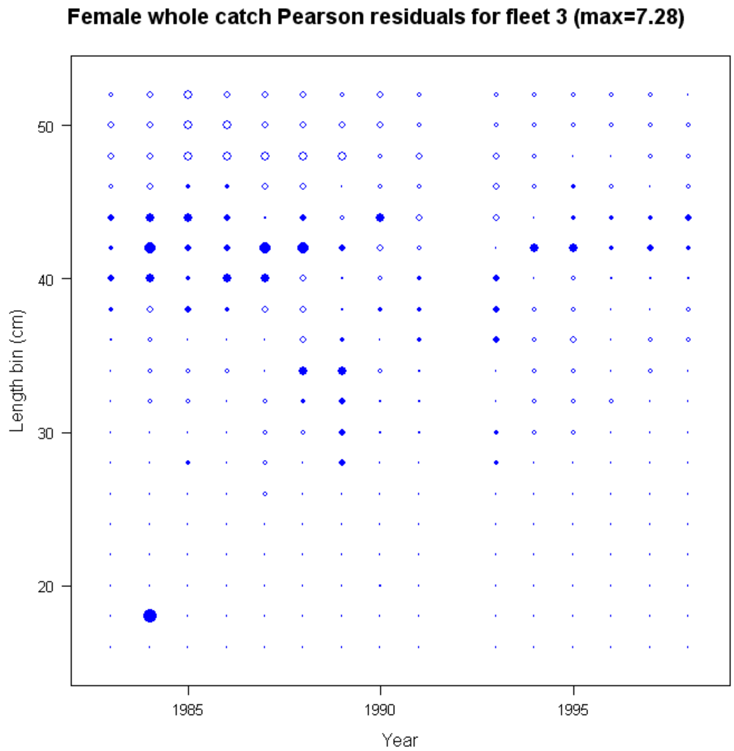


Figure 106-107: Observed and effective sample sizes for length composition data from the setnet fishery.



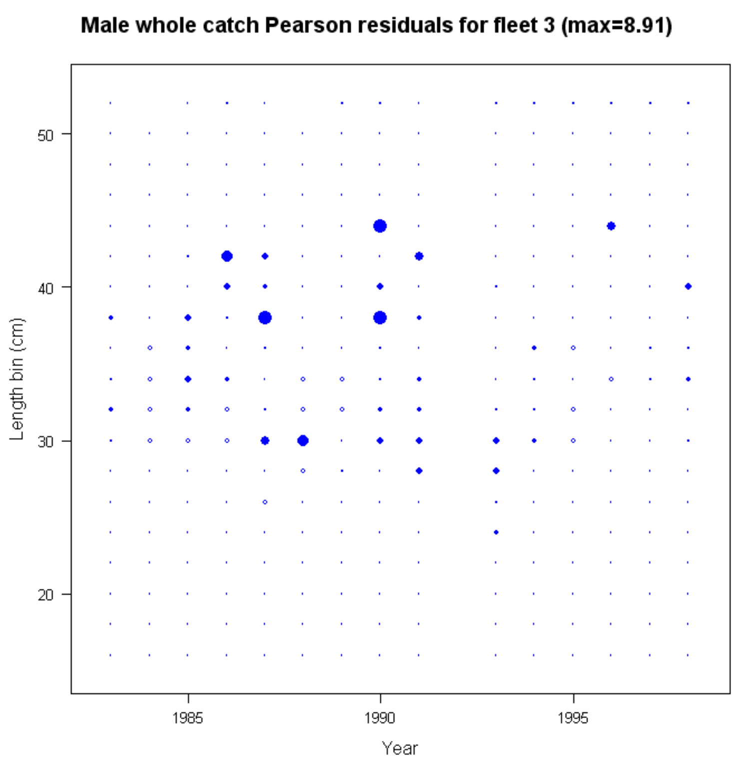


Figure 108-109: Residuals to the length composition data in the setnet fishery

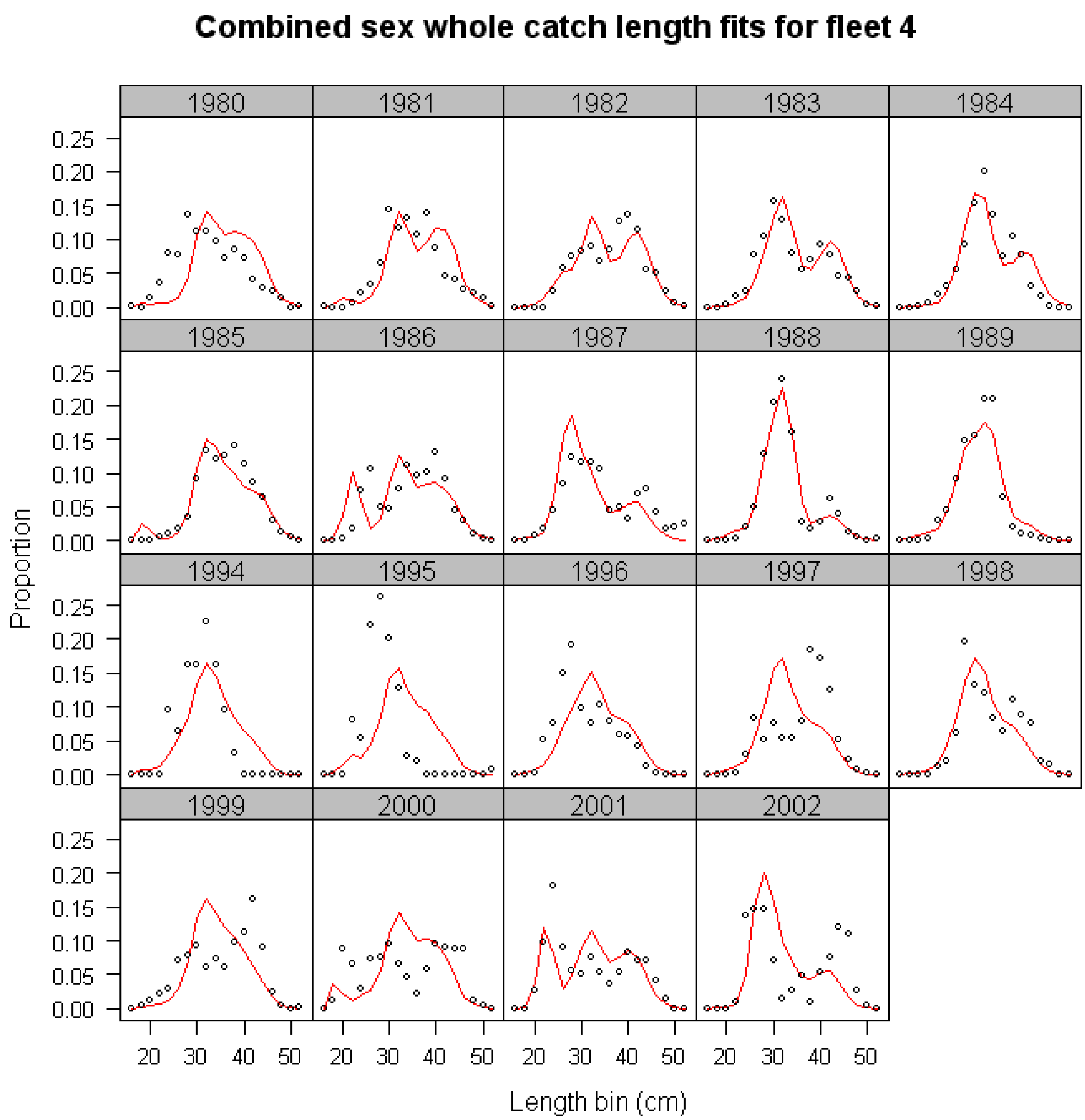


Figure 110-111: Observed and predicted length composition data for combined sexes in the recreational fishery.

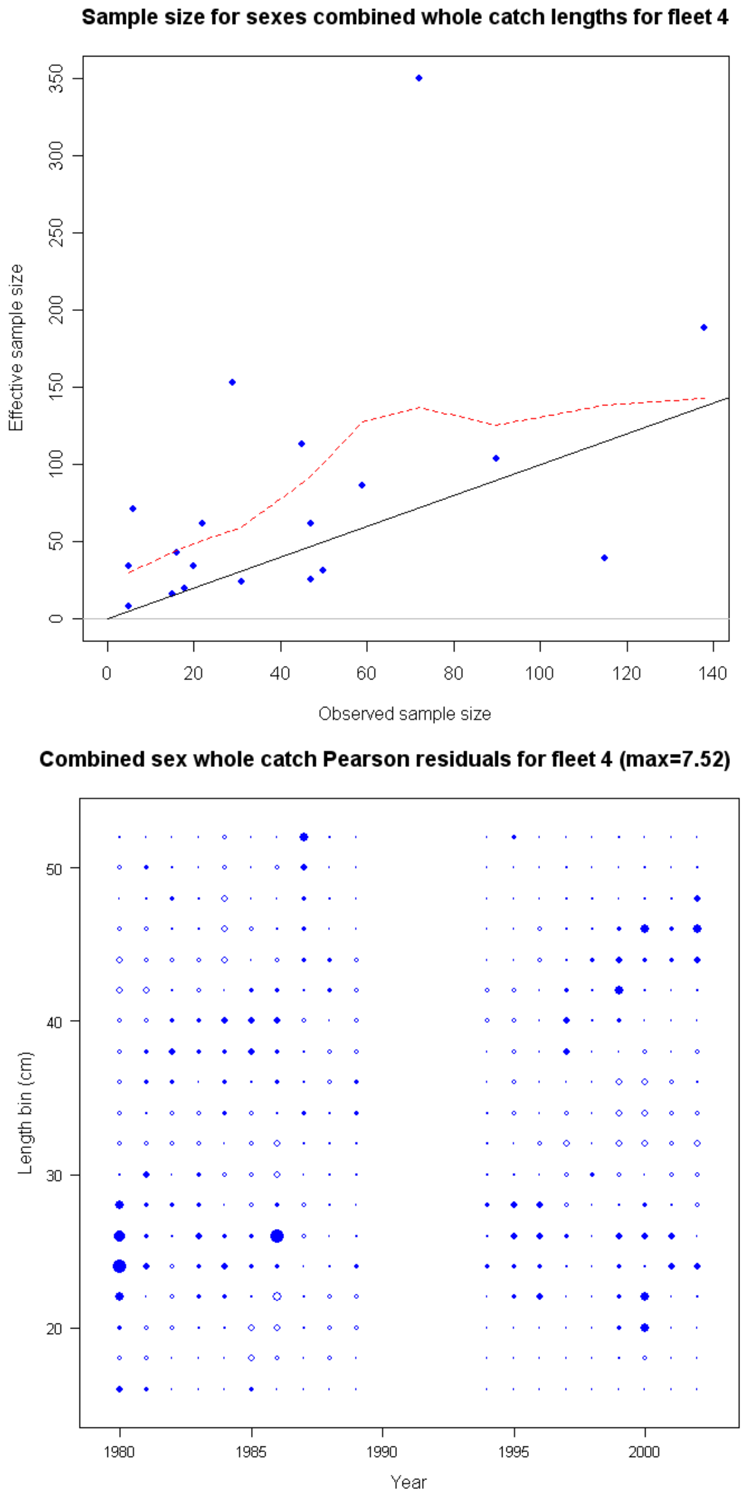
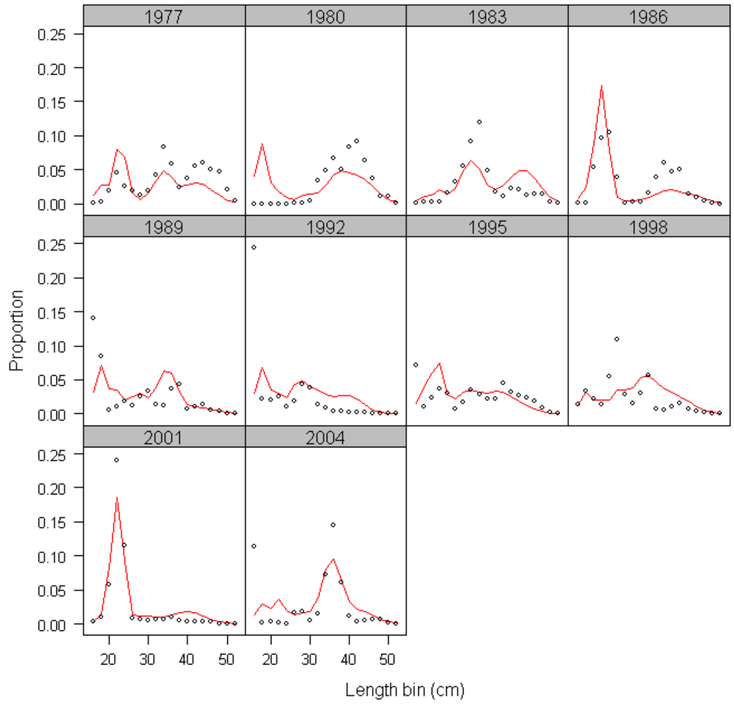


Figure 112-113: Residuals (top) to the length composition data in the recreational fishery and (bottom) observed and effective sample sizes.

Female whole catch length fits for fleet 5



Male whole catch length fits for fleet 5

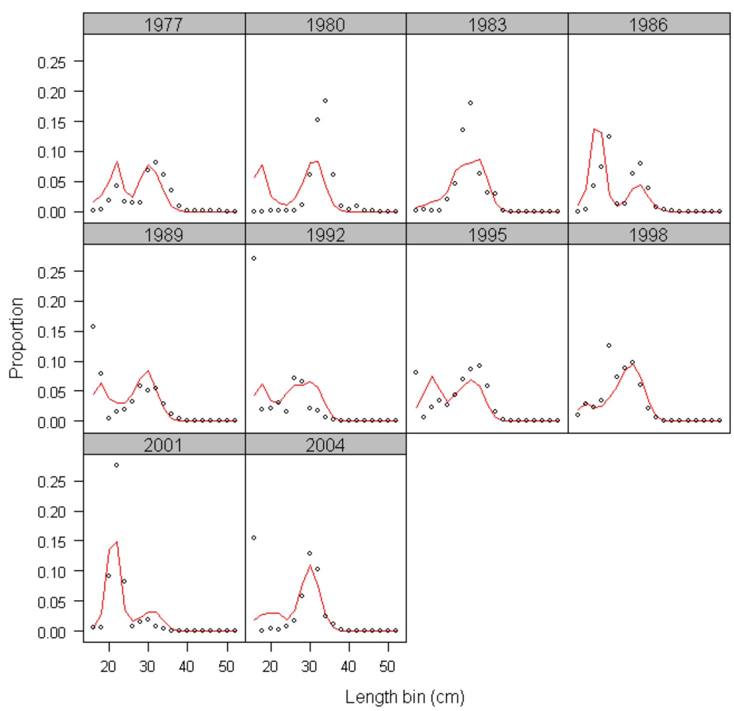
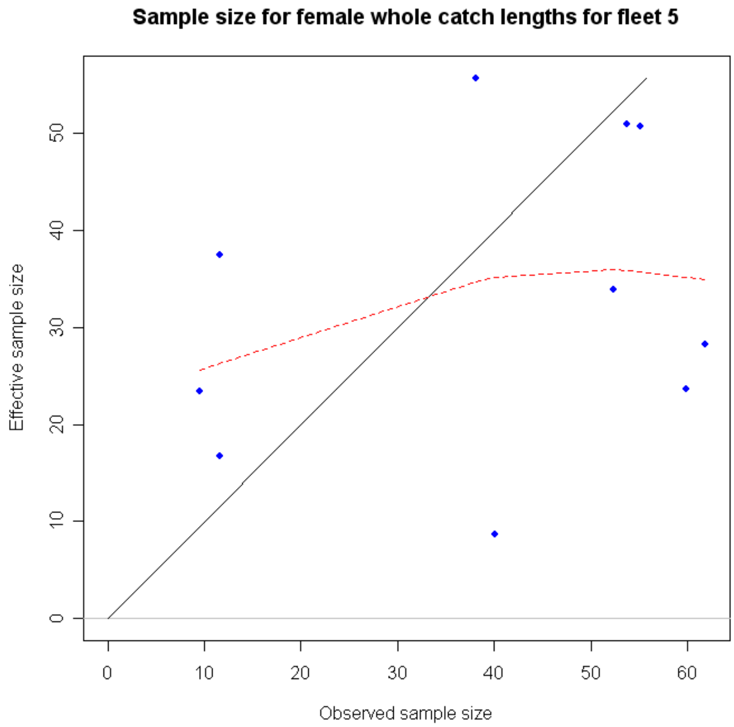


Figure 114-115: Observed and predicted length composition data for females (top) and males (bottom) in the triennial trawl survey.



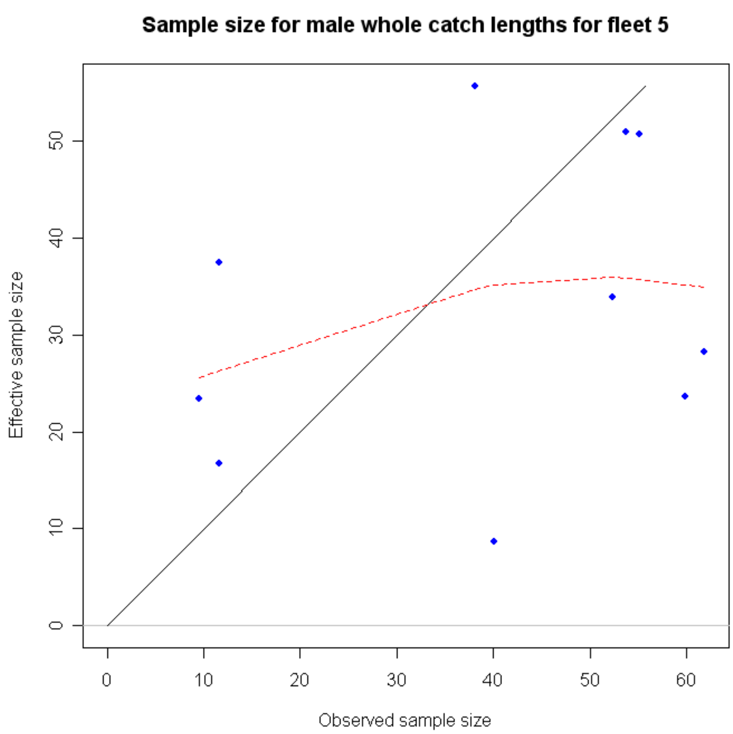
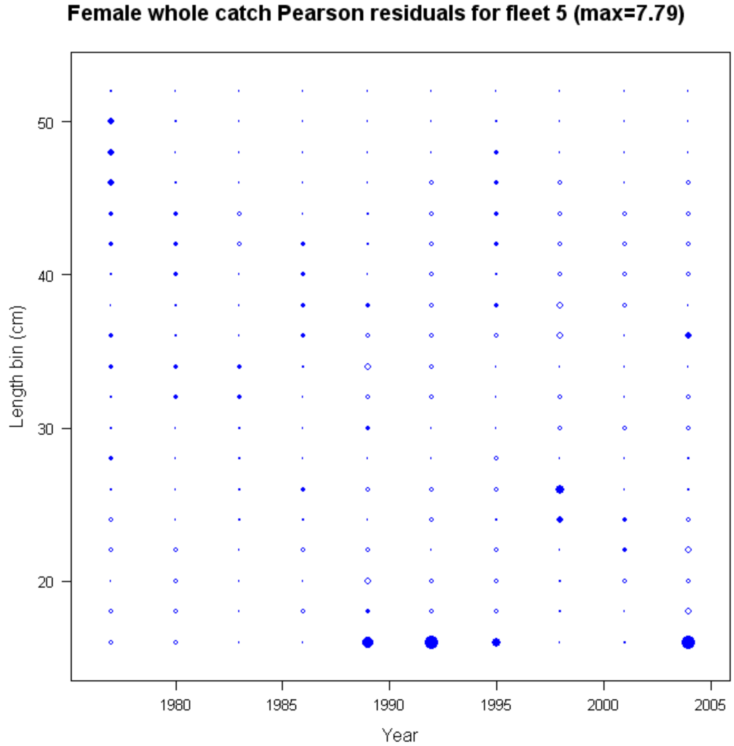


Figure 116-117: Observed and effective sample sizes for length composition data from the triennial trawl survey.



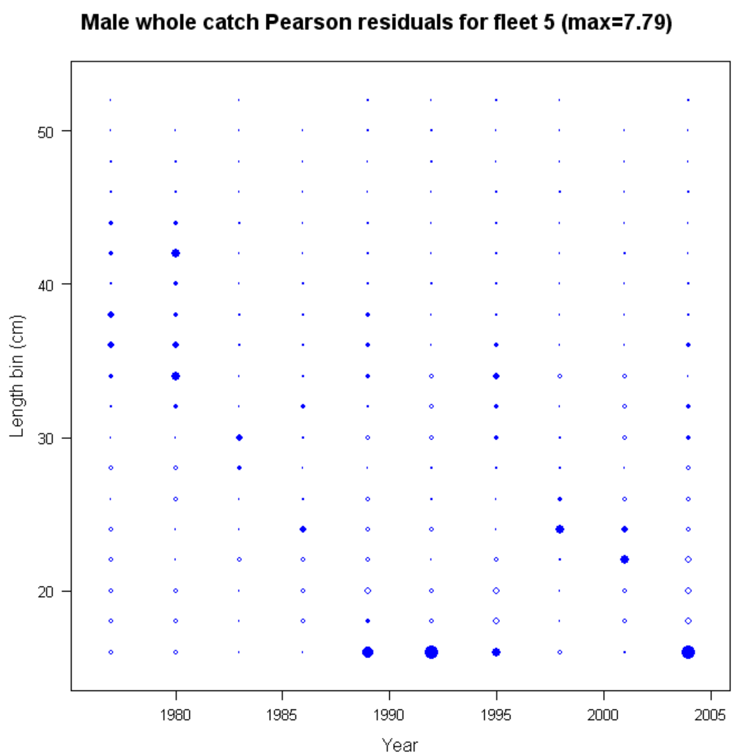
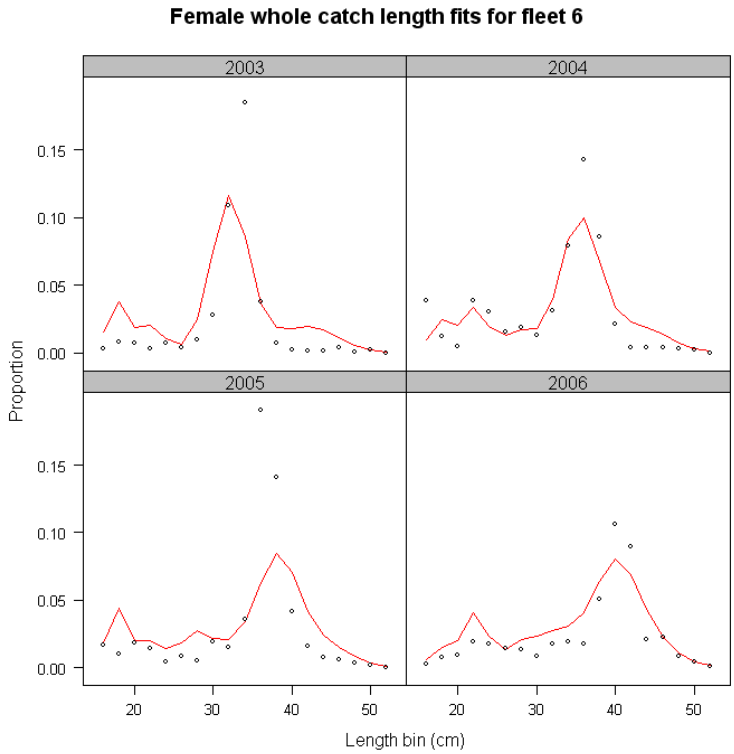


Figure 118-119: Residuals to the length composition data in the triennial trawl survey.



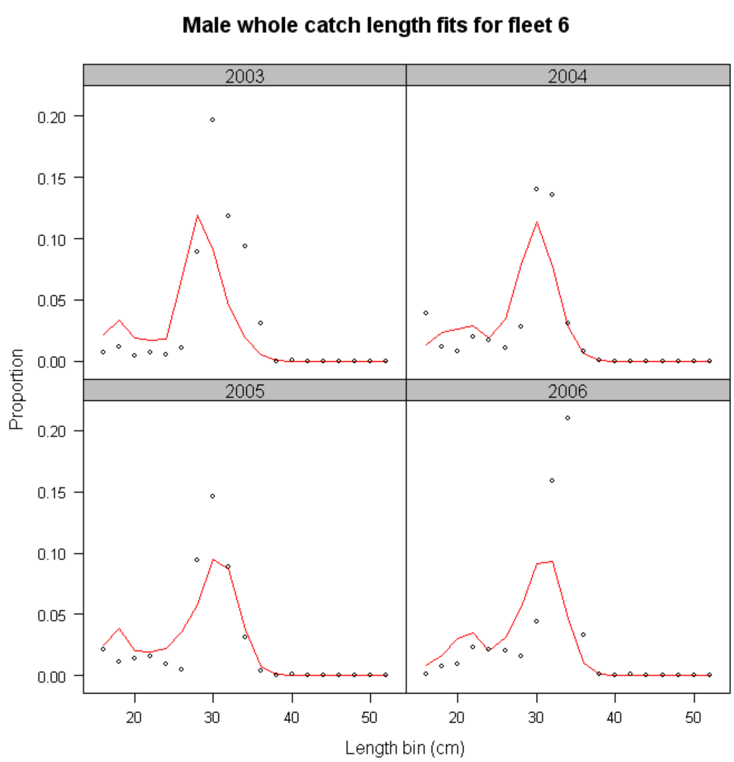
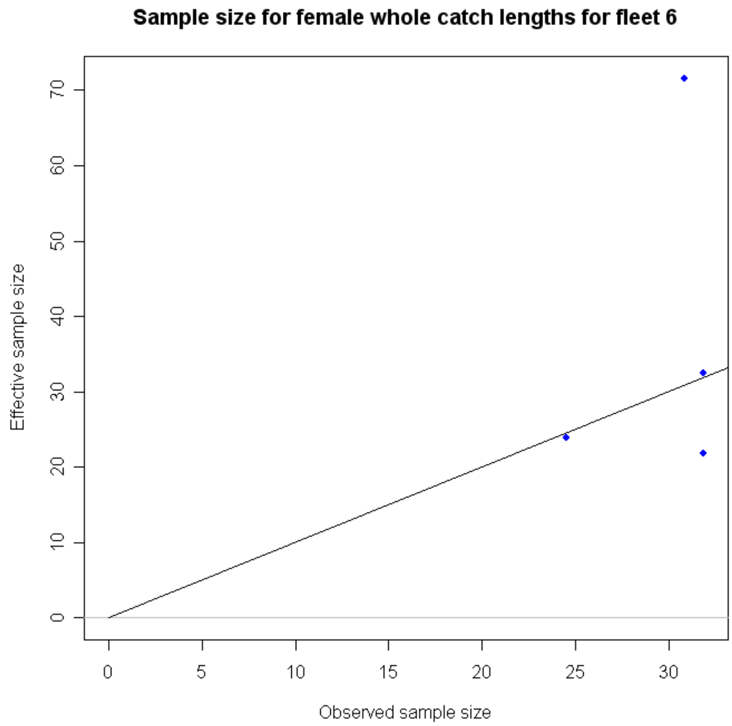


Figure 120-121: Observed and predicted length composition data for females (top) and males (bottom) in the NWC combined survey.



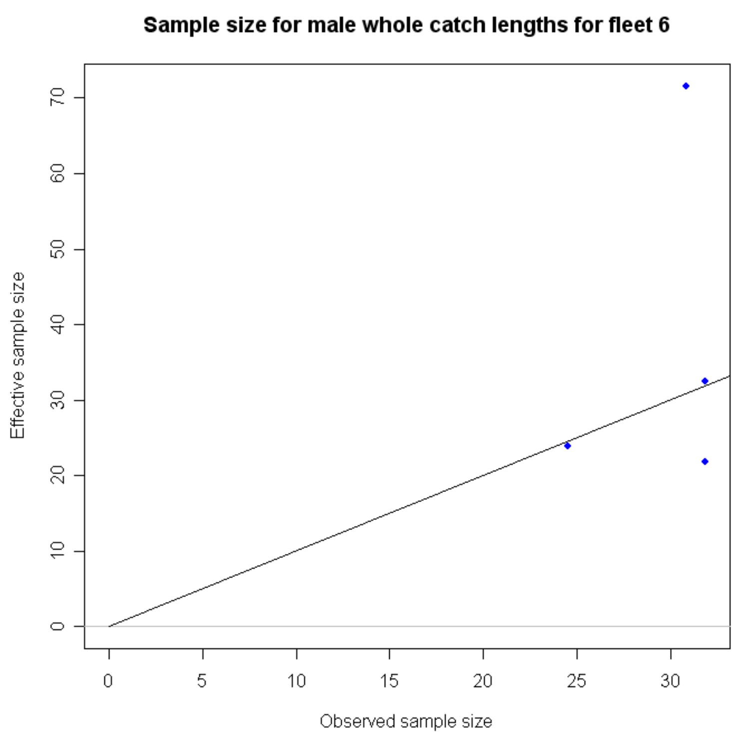
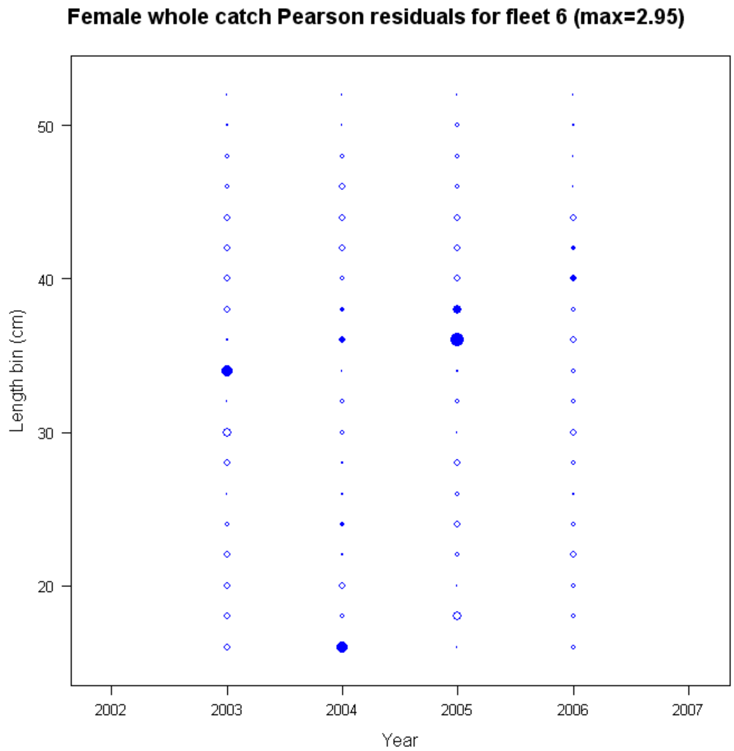


Figure 122-123: Observed and effective sample sizes for length composition data from the NWC combined survey.



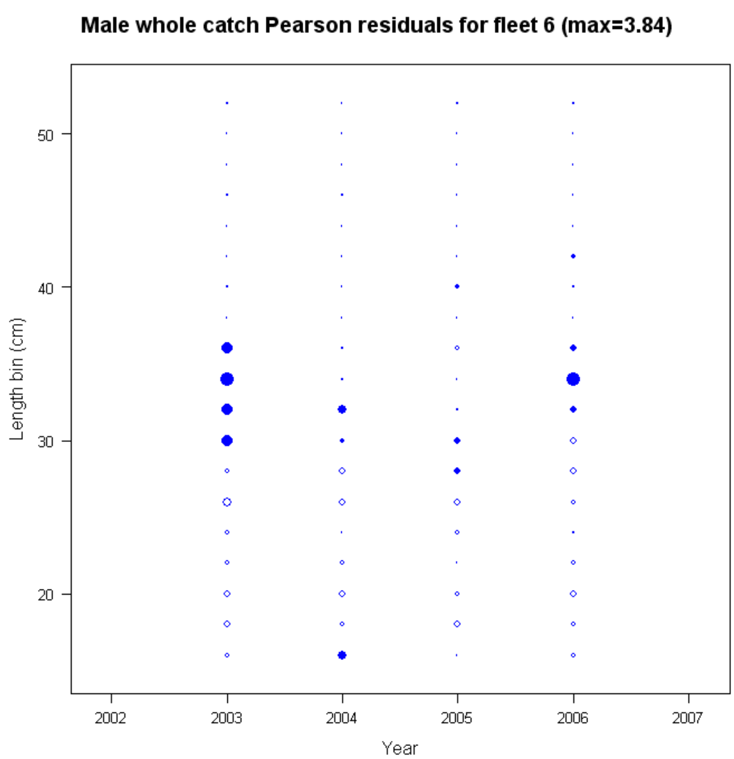


Figure 124-125: Residuals to the length composition data in the NWC combined survey

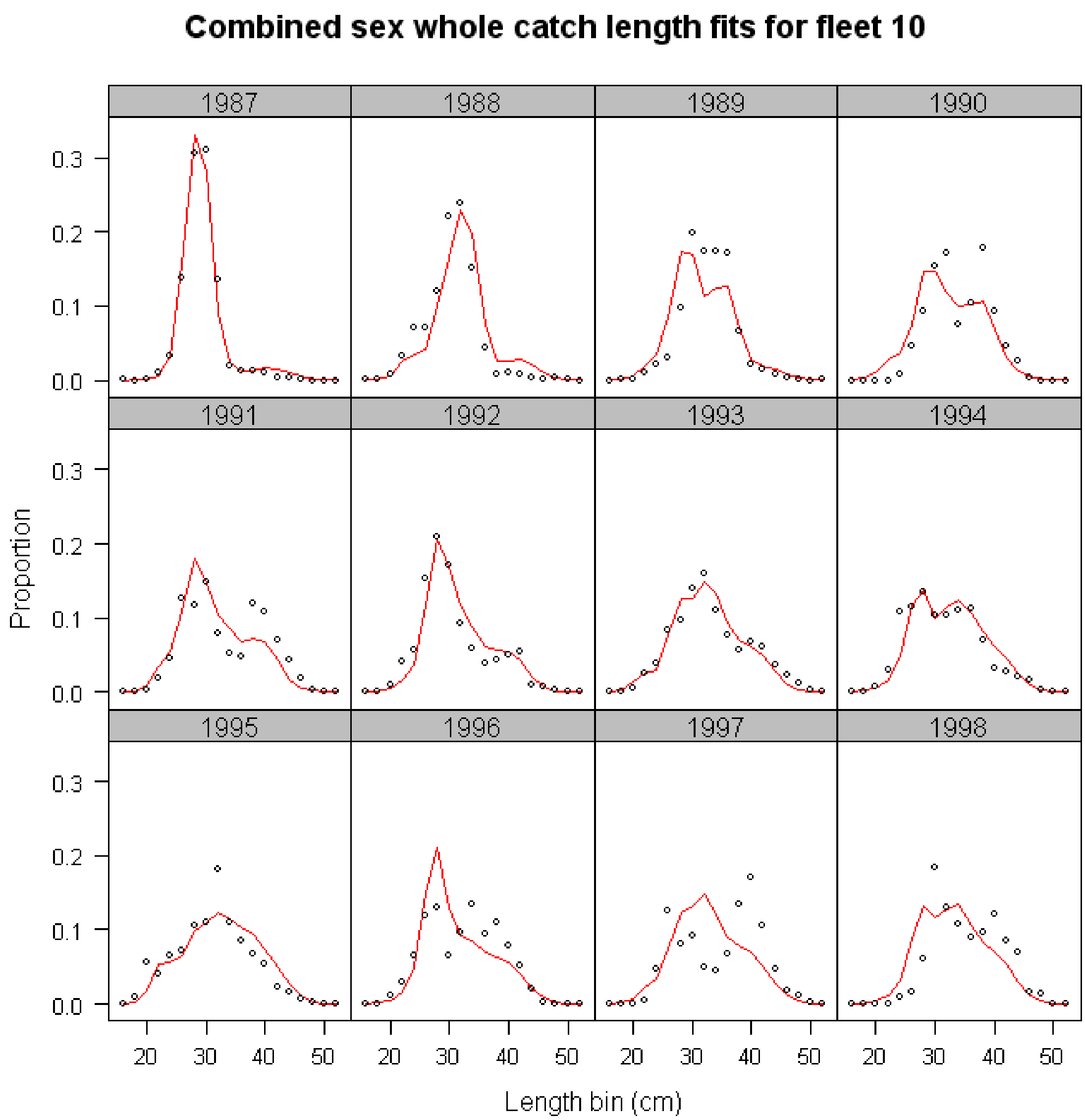
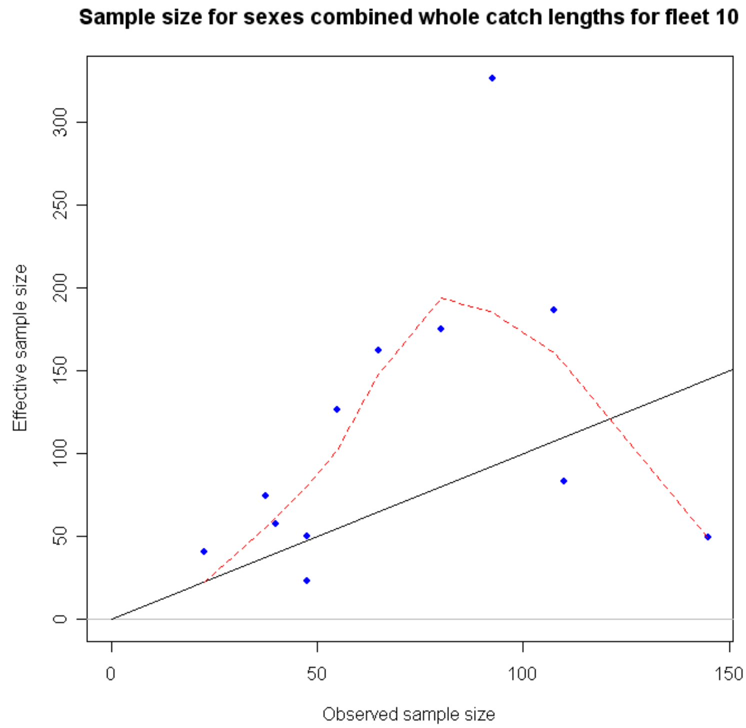


Figure 126: Observed and predicted length composition data for mixed sexes in the recreational observer data associated with the CPUE index.



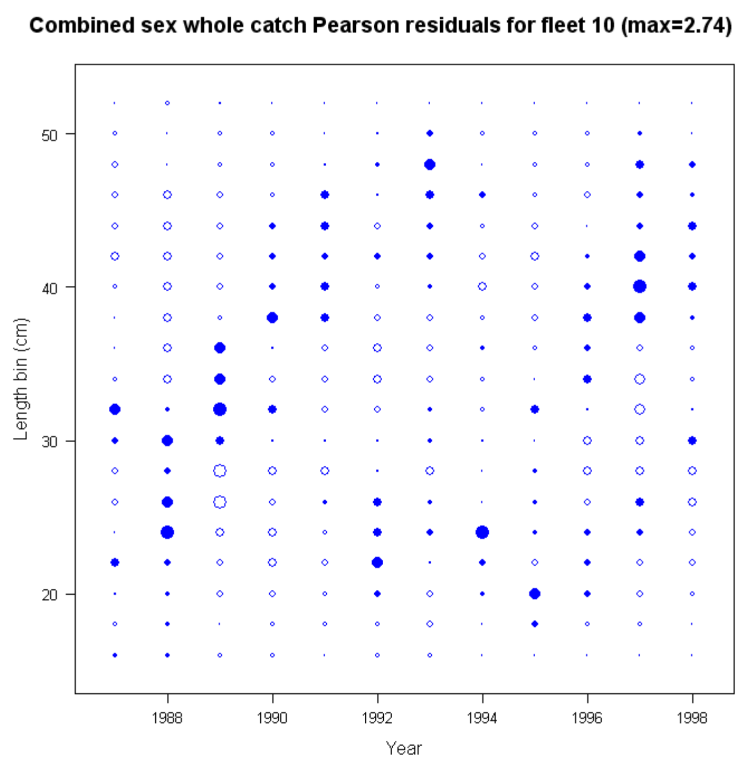


Figure 127 (top): Observed and effective sample sizes for length composition data from the recreational CPUE index, and Figure 128 (bottom): residuals to the length composition data in the recreational CPUE index.

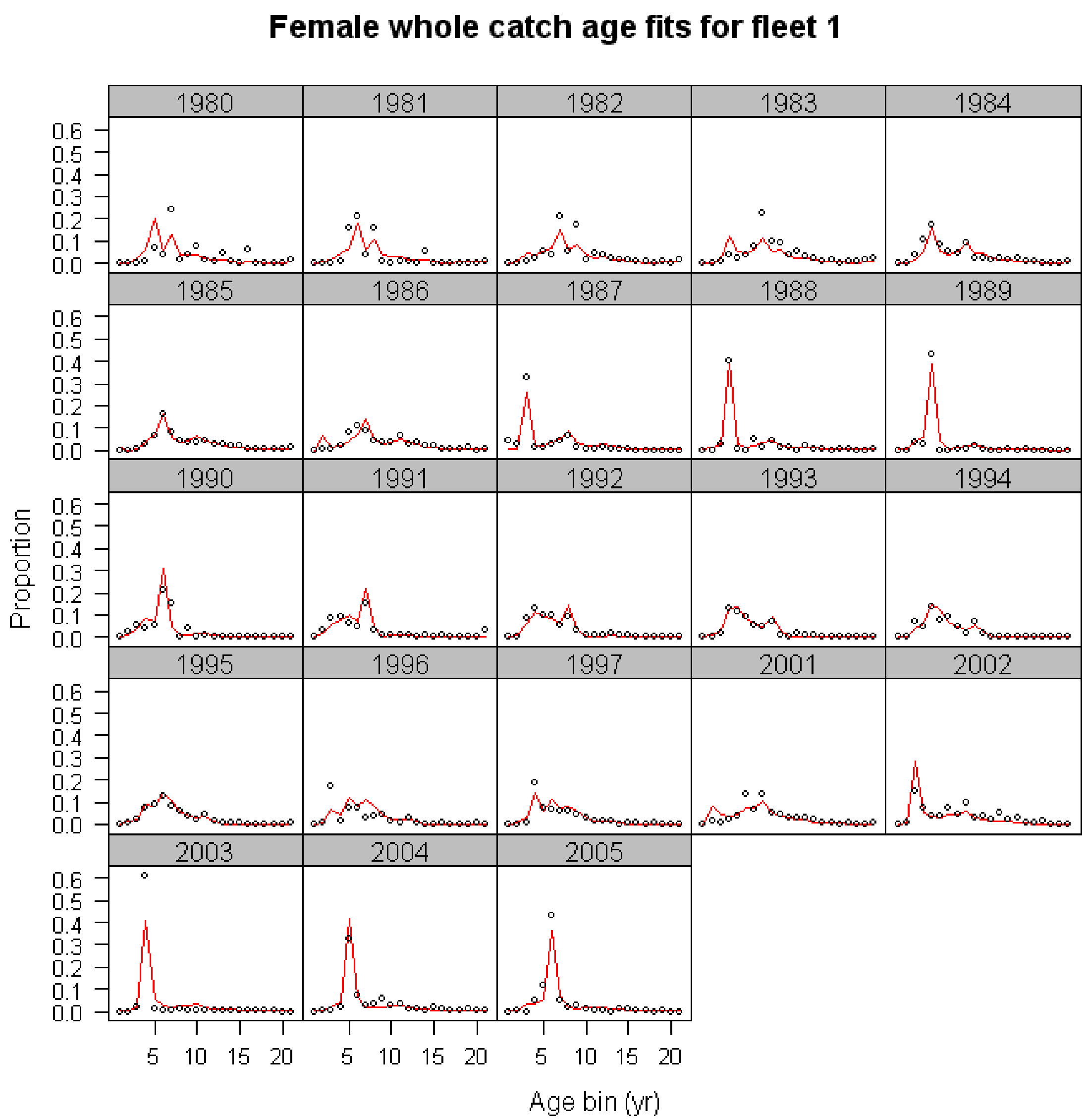


Figure 129: Observed and predicted catch at age data for females in the bottom trawl fishery.

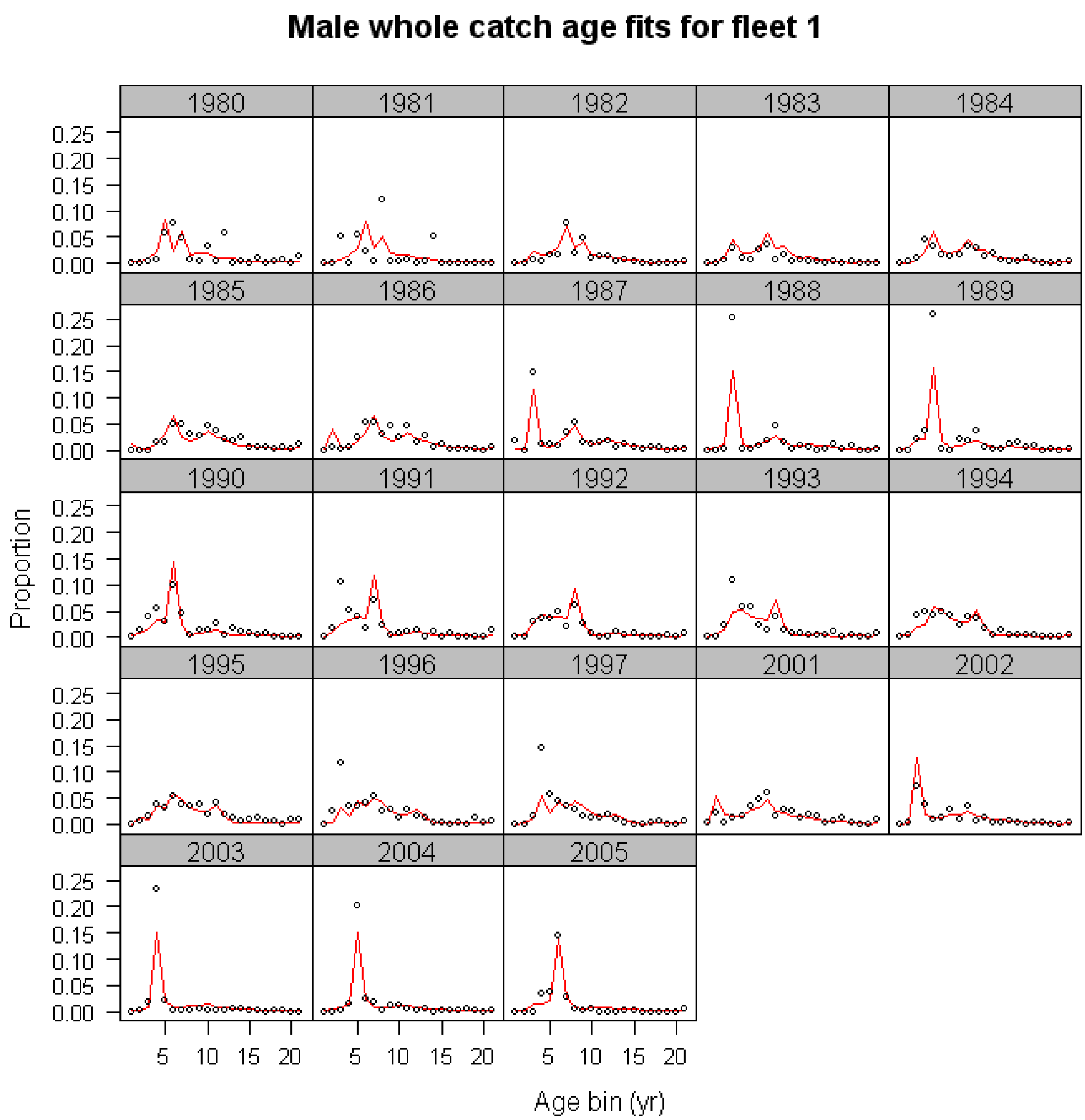
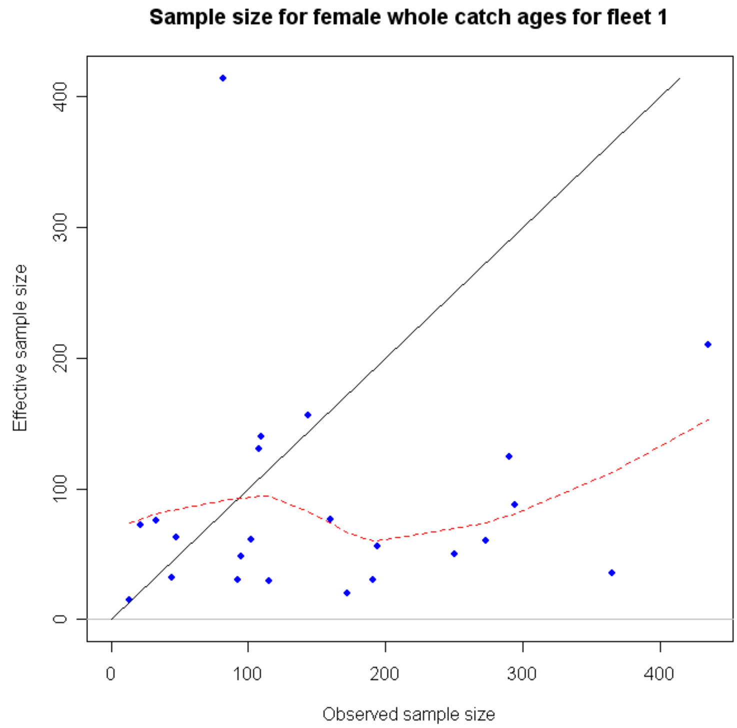


Figure 130: Observed and predicted catch at age data for males in the bottom trawl fishery.



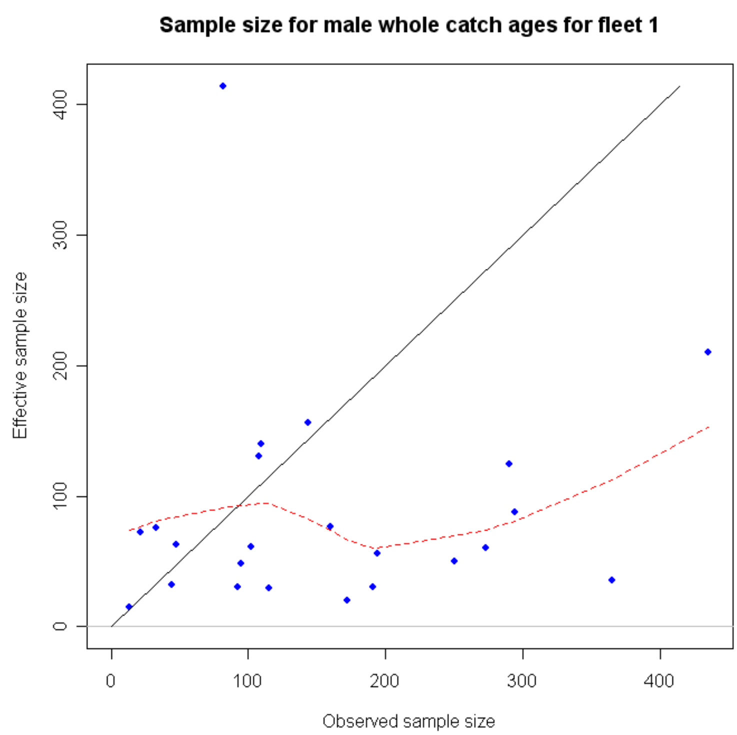
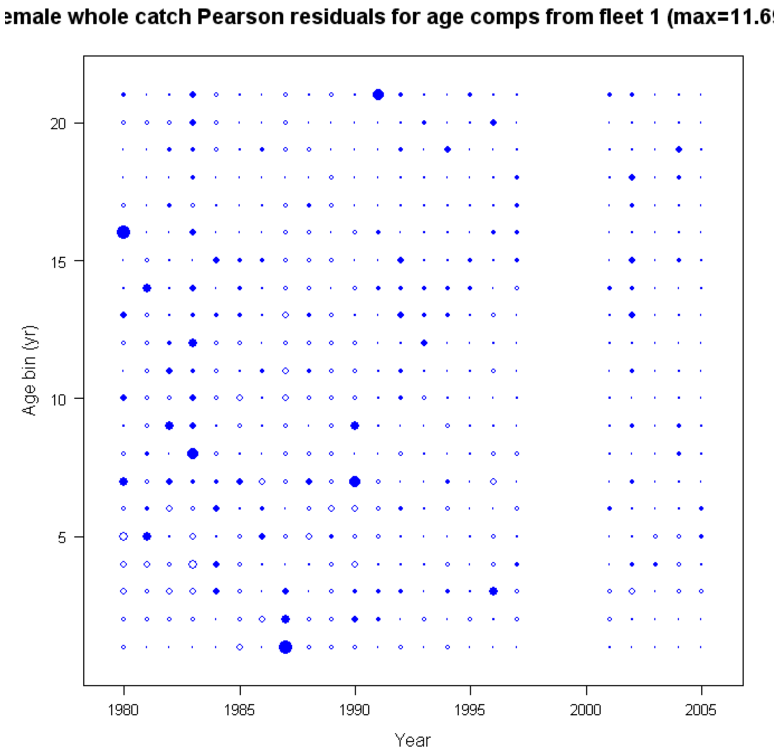


Figure 131-132: Observed and effective sample sizes for age composition data from the bottom trawl fishery.



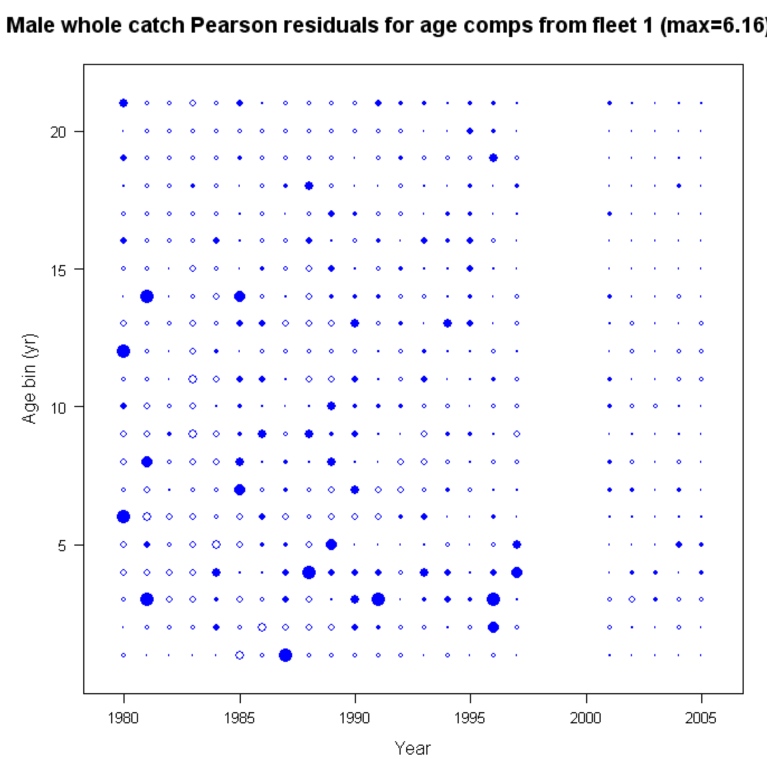
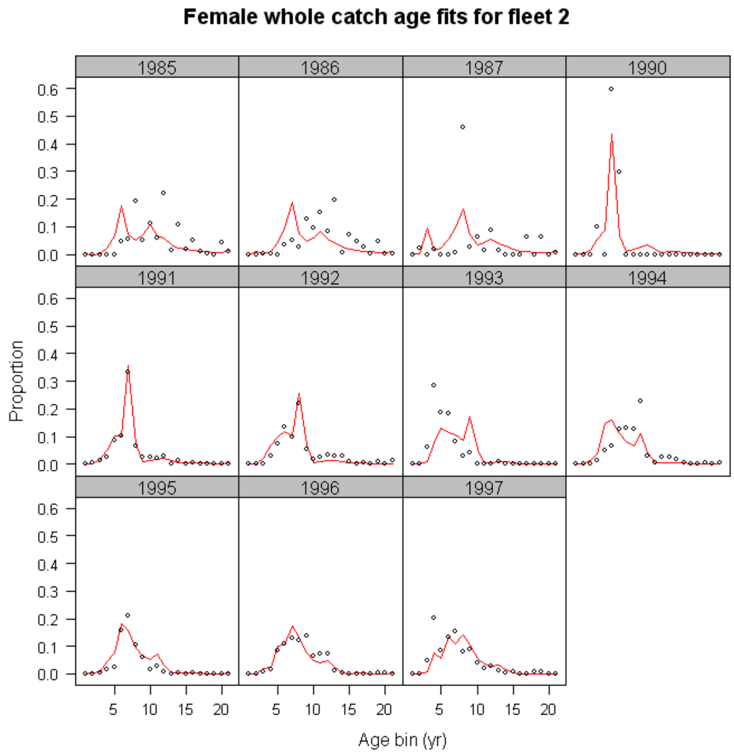


Figure 133-134: Residuals to the age composition data in the bottom trawl fishery



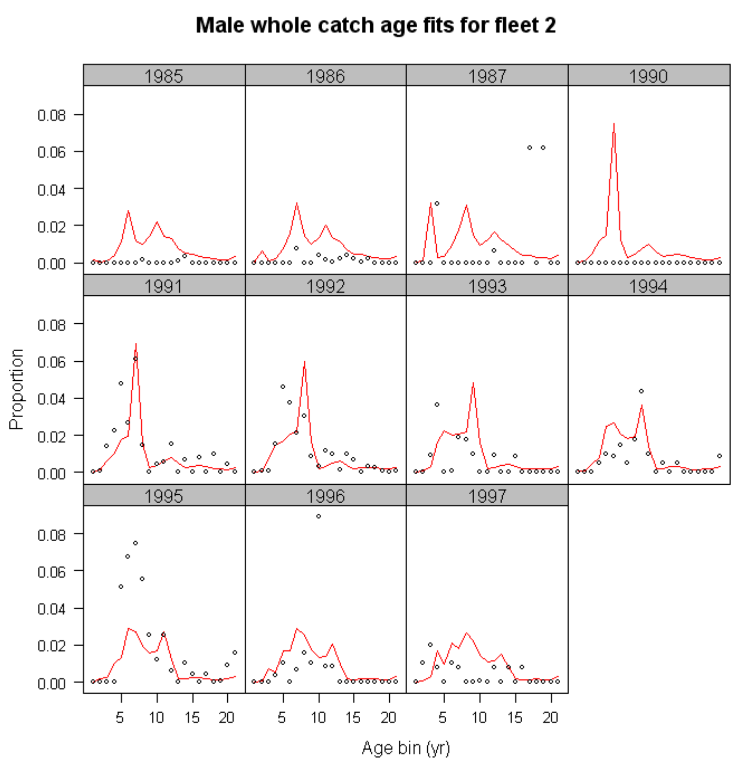
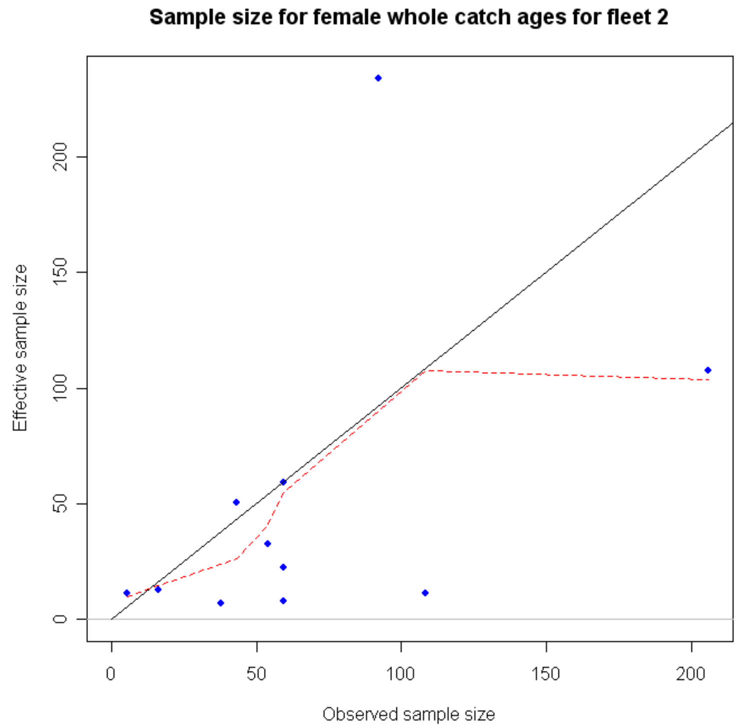


Figure 135-136: Observed and predicted catch at age data for females (top) and males (bottom) in the hook and line fishery.



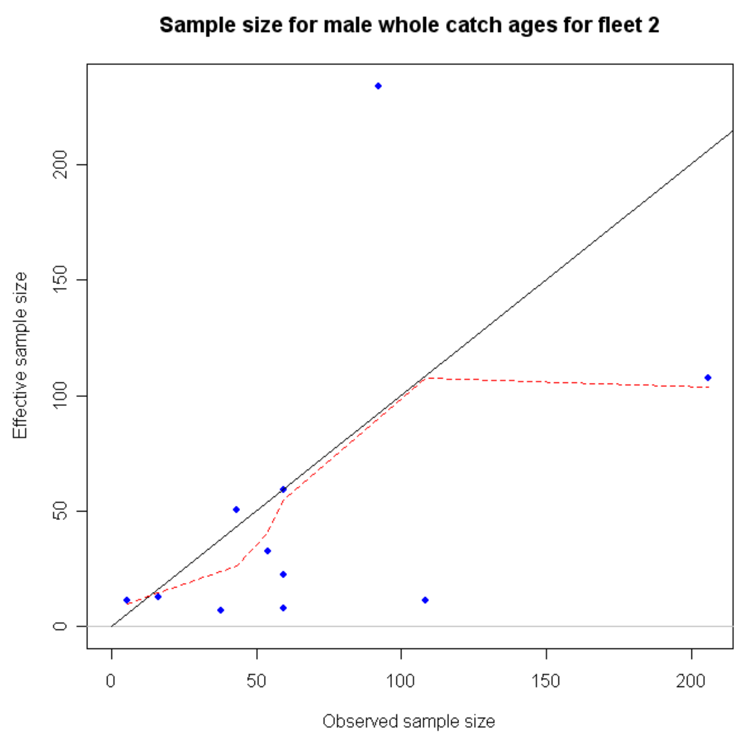
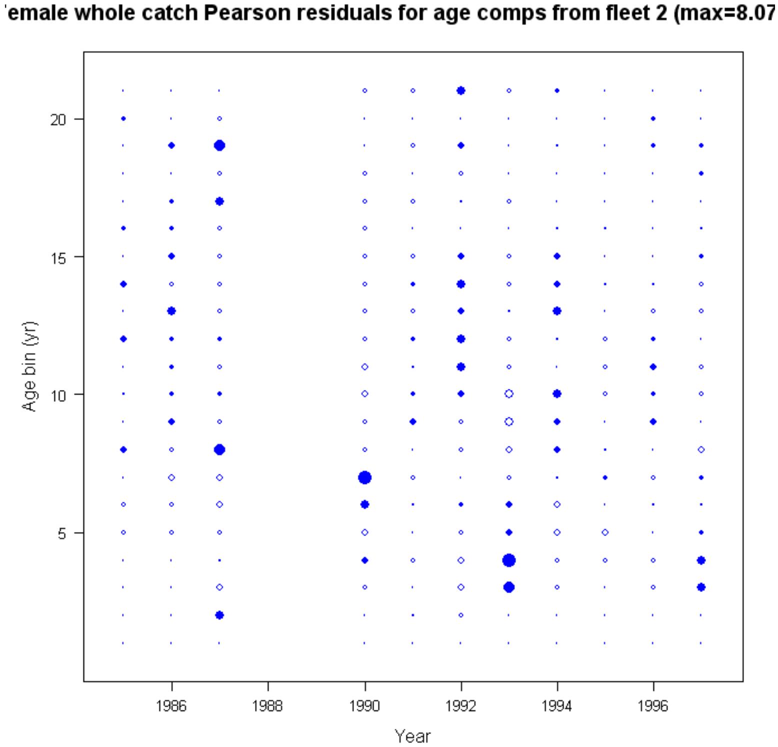


Figure 137-138: Observed and effective sample sizes for age composition data from the hook and line fishery.



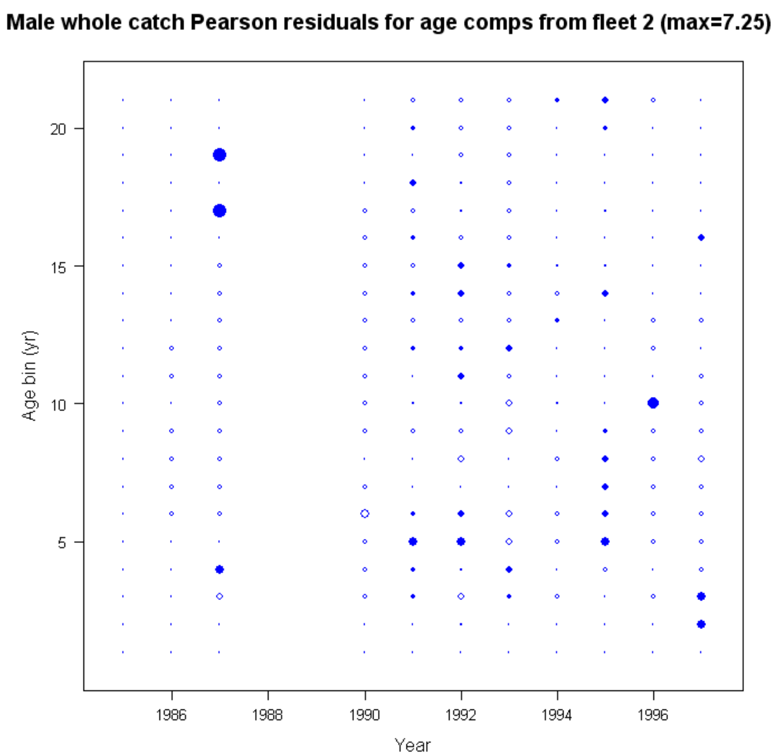
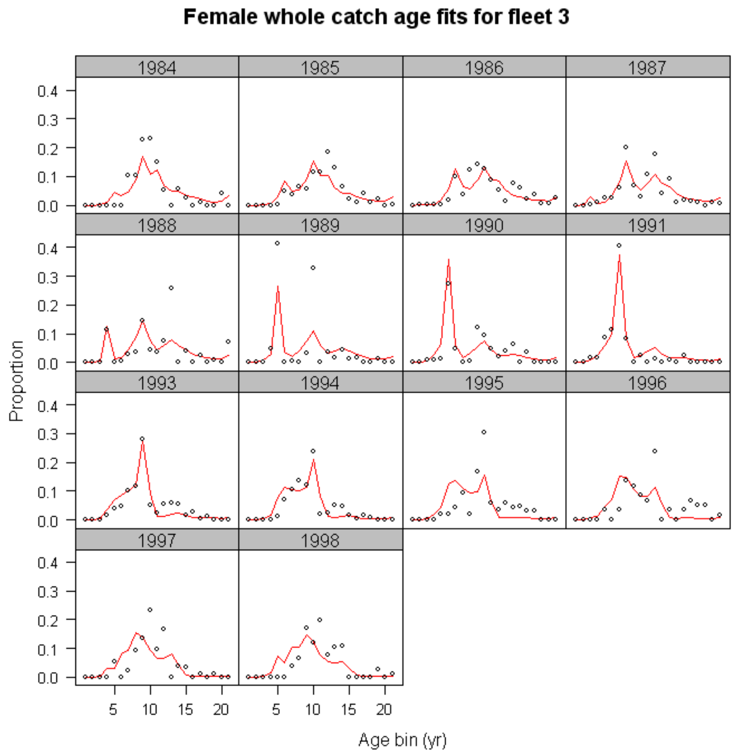


Figure 139-140: Residuals to the age composition data in the hook and line fishery



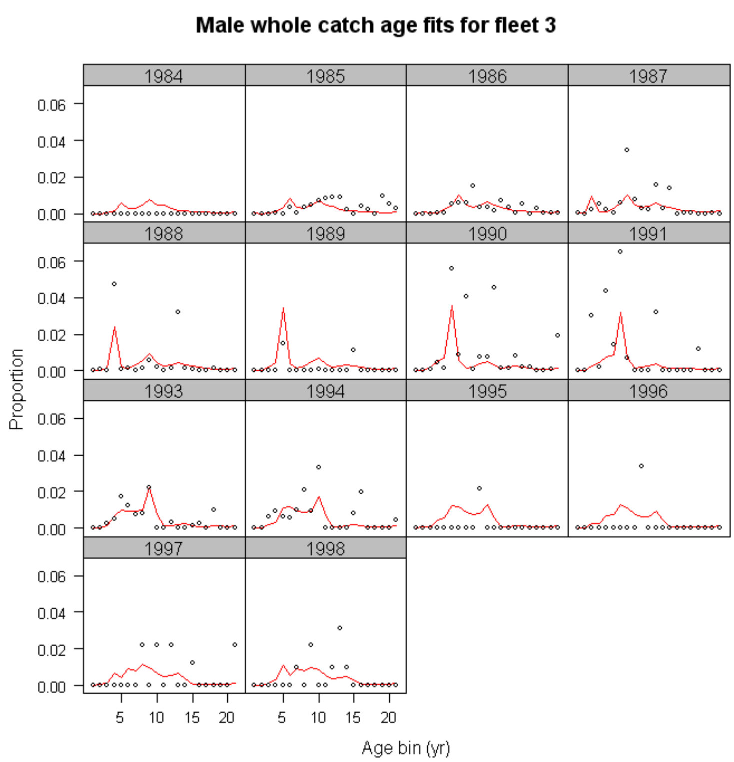
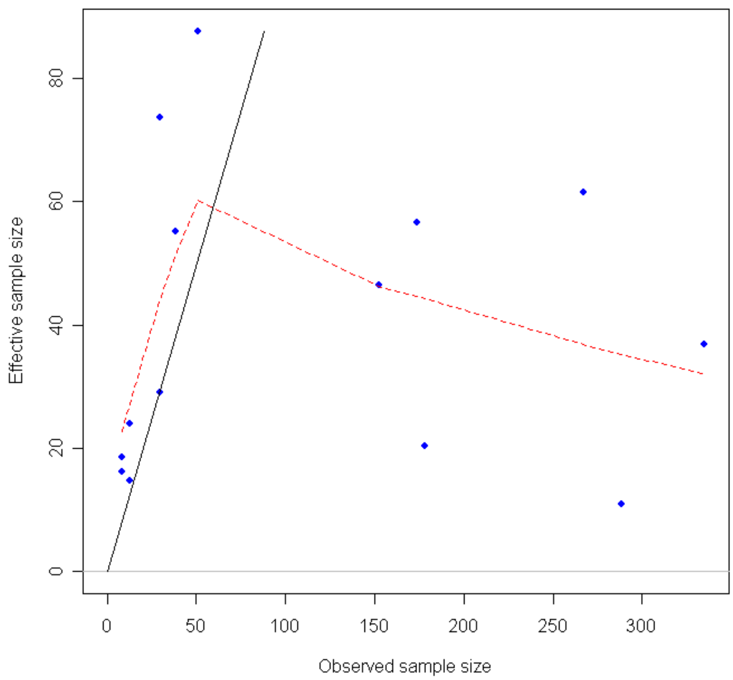


Figure 141-142: Observed and predicted catch at age data for females (top) and males (bottom) in the setnet fishery.

Sample size for female whole catch ages for fleet 3



Sample size for male whole catch ages for fleet 3

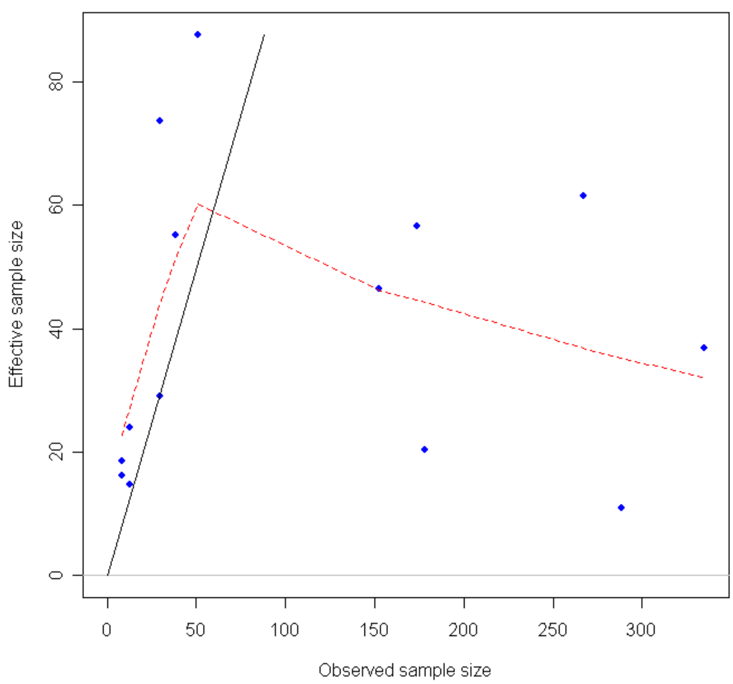
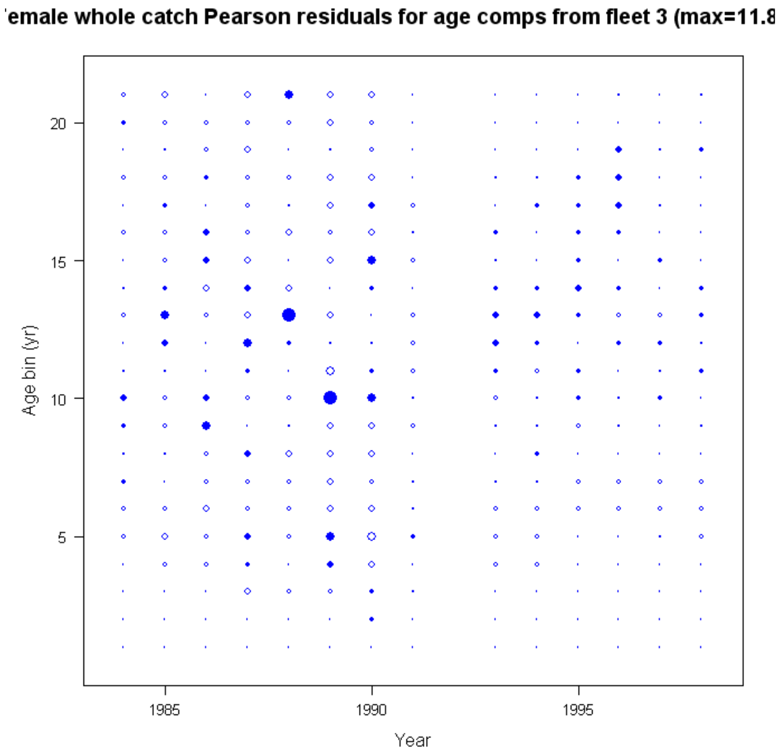


Figure 143-144: Observed and effective sample sizes for age composition data from the setnet fishery.



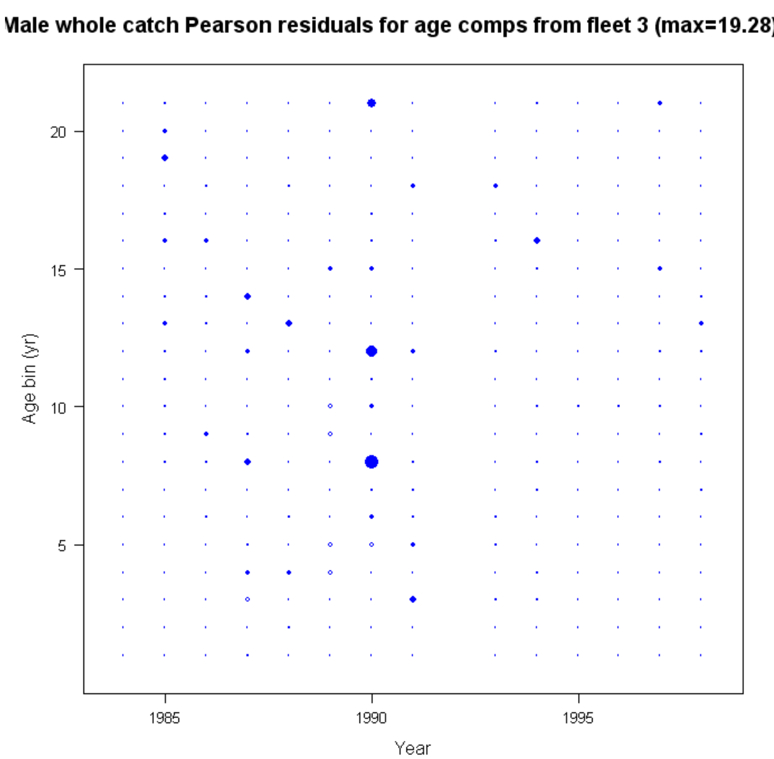
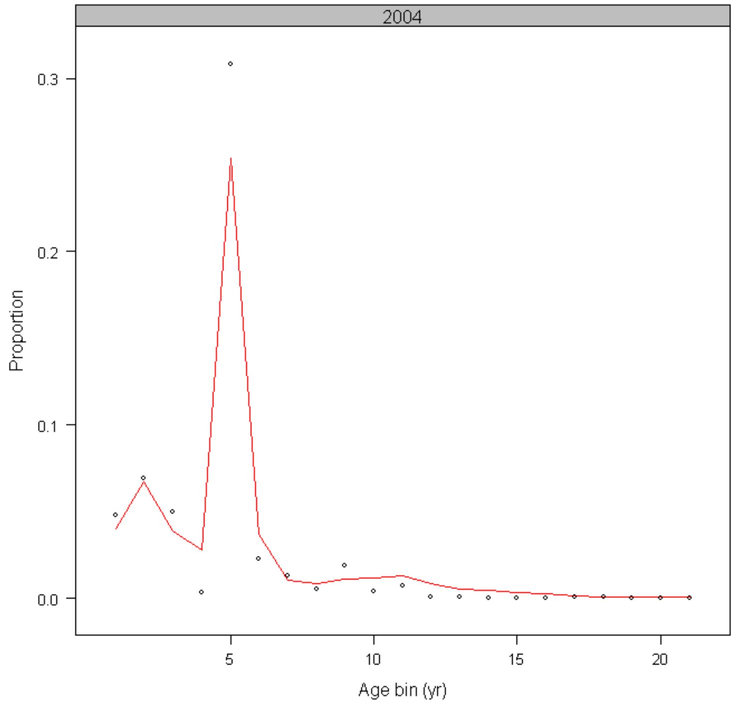


Figure 145-146: Residuals to the age composition data in the setnet fishery

Female whole catch age fits for fleet 6



Male whole catch age fits for fleet 6

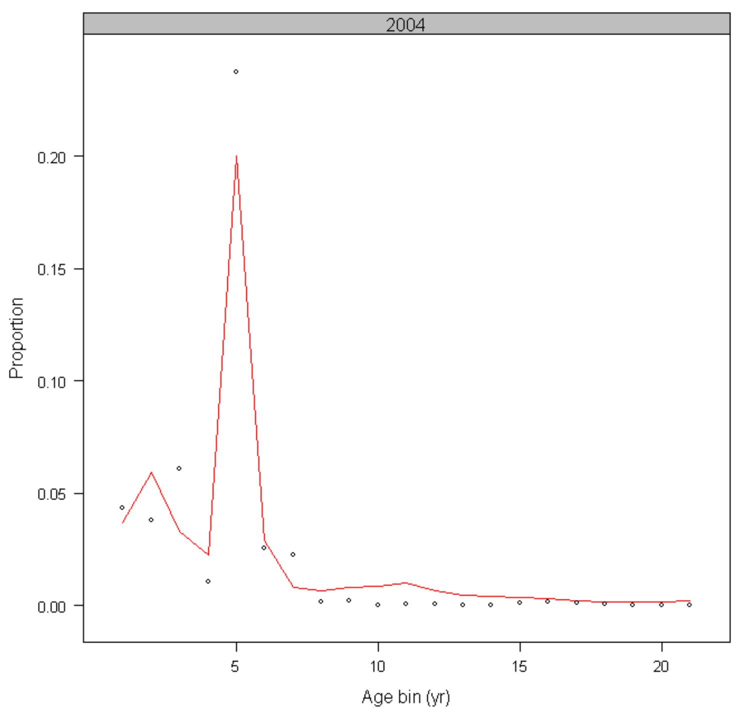
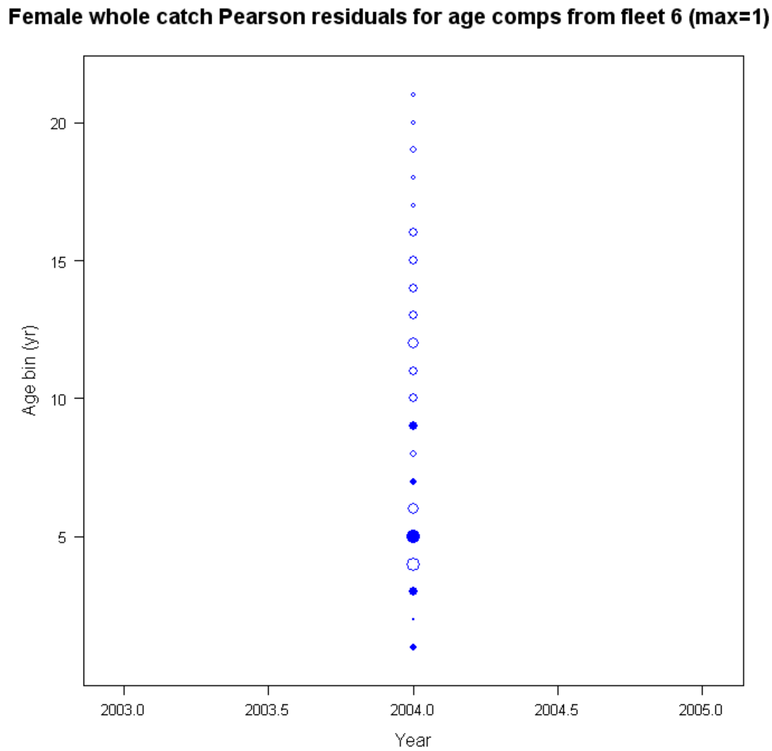


Figure 147-148: Observed and predicted catch at age data for females (top) and males (bottom) for the year 2004 in the NWC Combined survey.



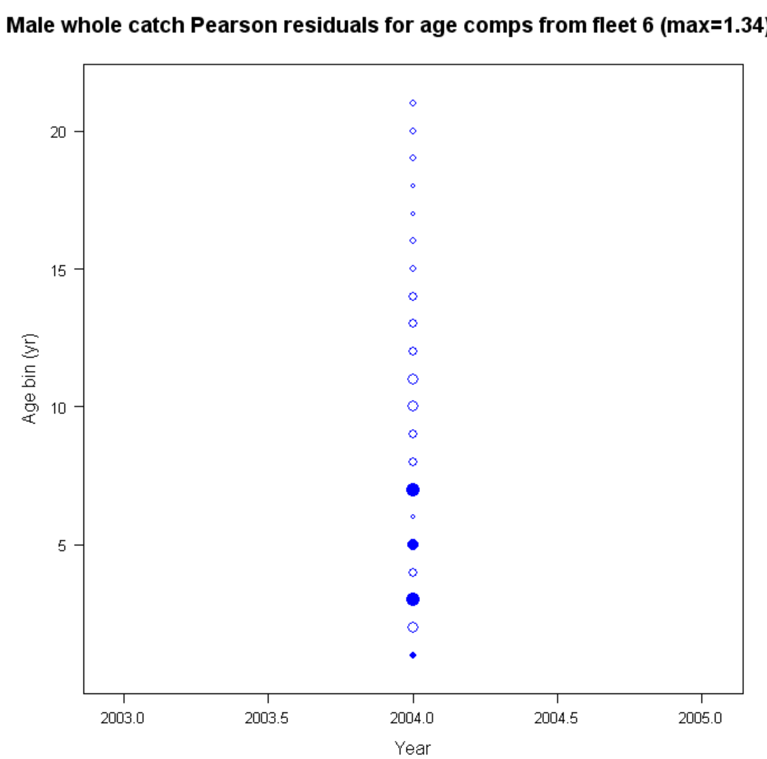
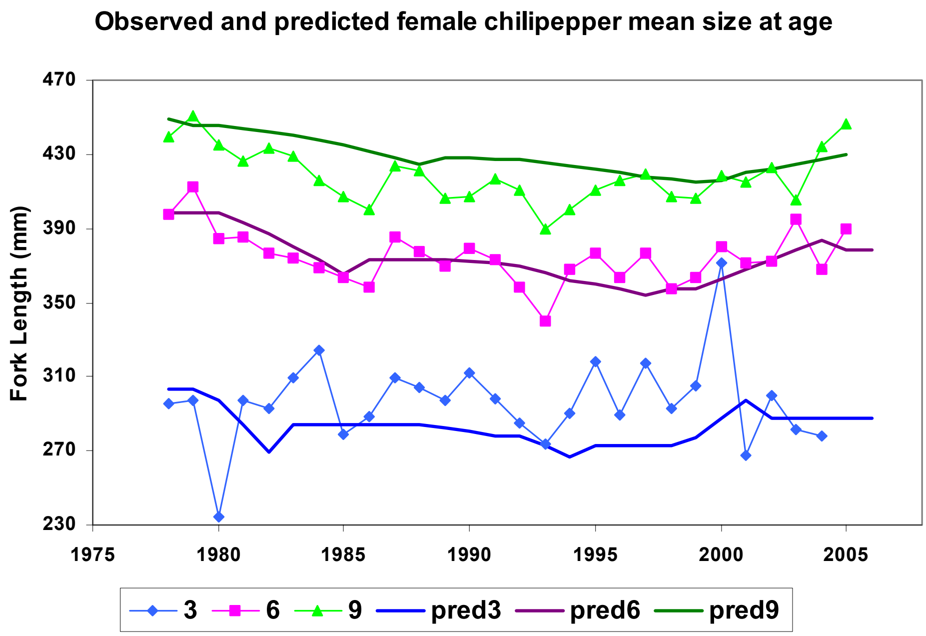


Figure 149-150: Residuals to the age composition data in the NWC combined survey



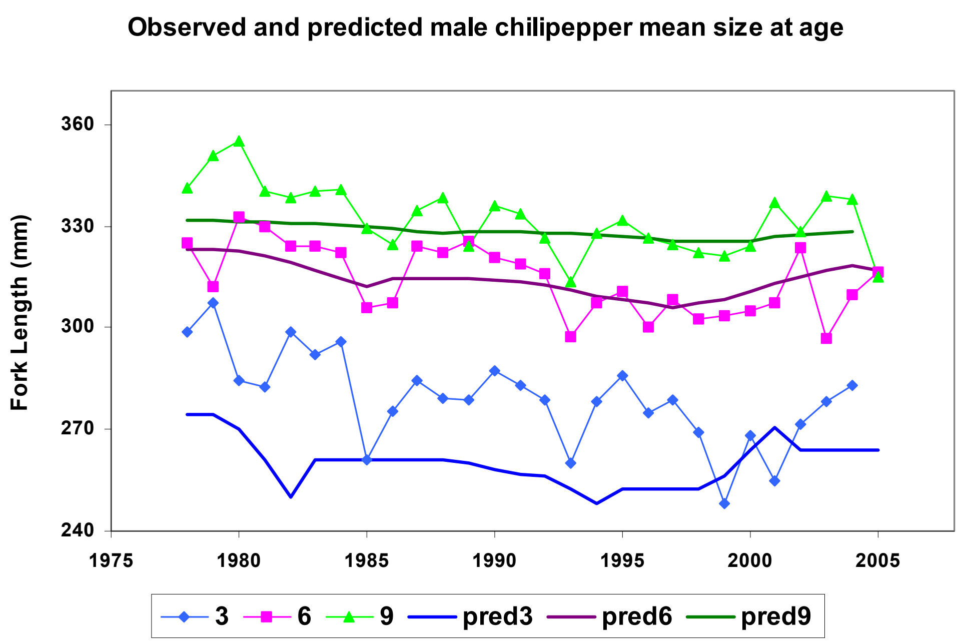


Figure 151-152: Observed (from commercial fisheries) and predicted (with time-varying k parameter) size at age for chilipepper rockfish females (top) and males (bottom).

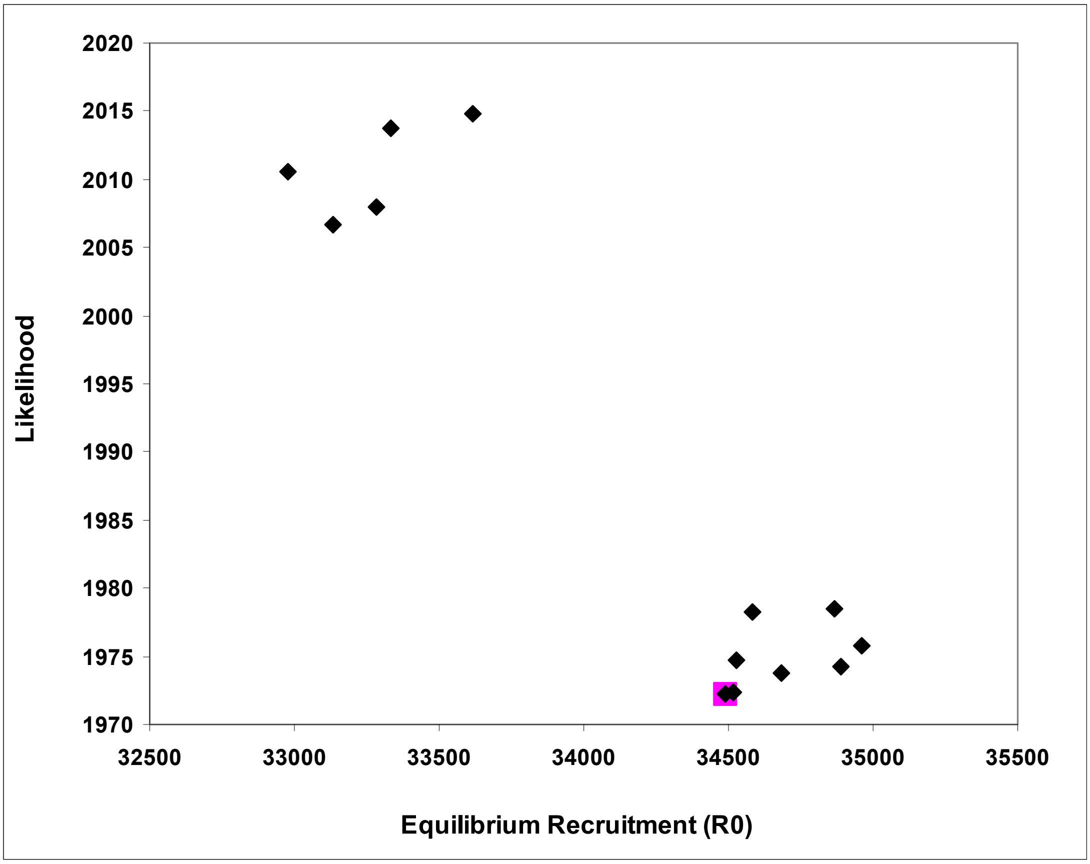


Figure 153: Estimates of equilibrium recruitment (R0) plotted against likelihood values for twelve "jittered" base model runs.

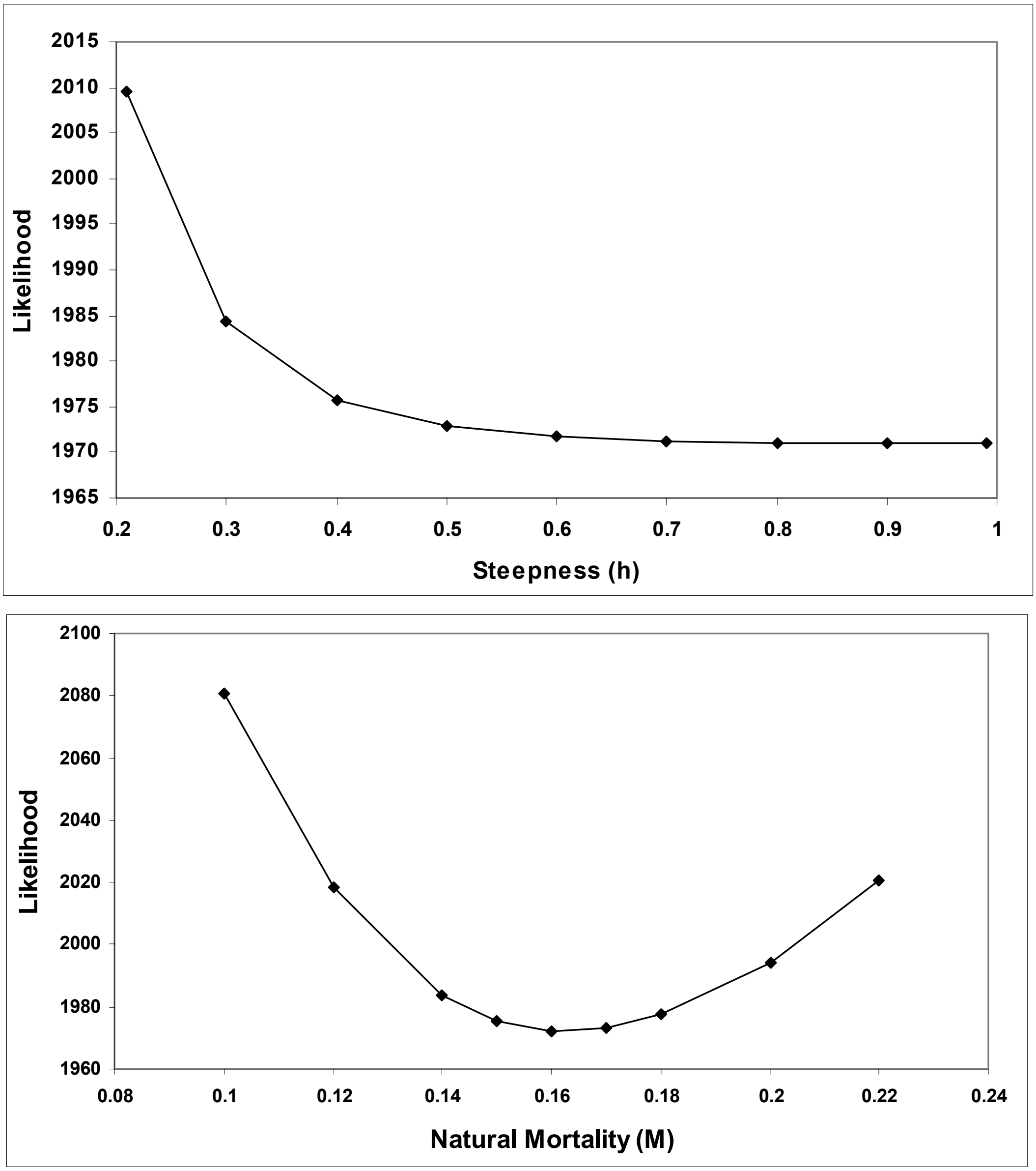


Figure 154-155: Likelihood profiles for steepness (top) and female natural mortality in which the male offset is constant (bottom).

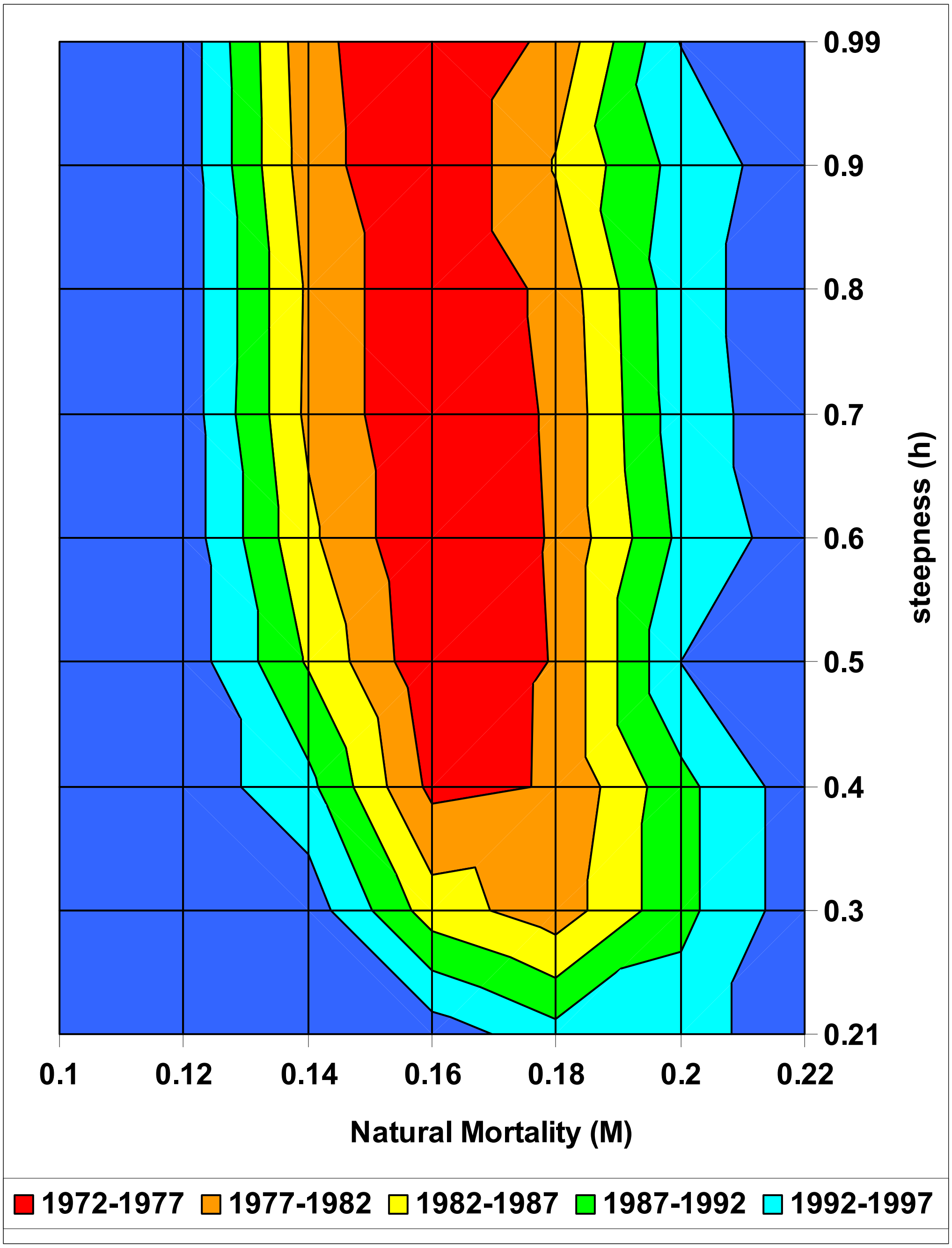
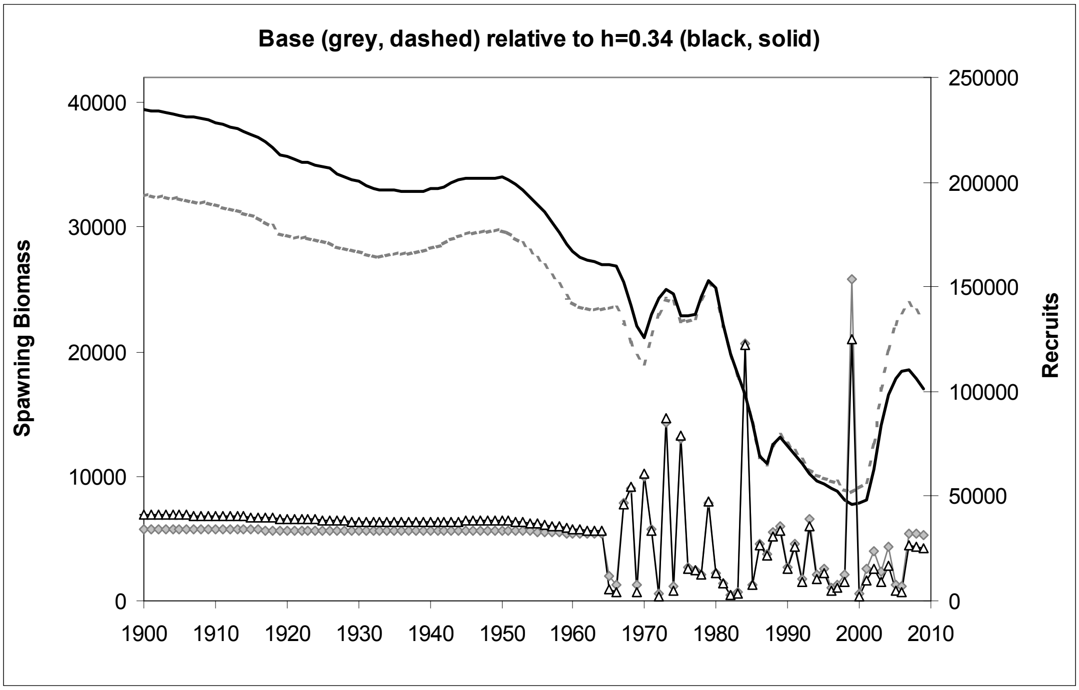


Figure 156: Likelihood surface plot for steepness against female natural mortality (in which the male offset is constant).



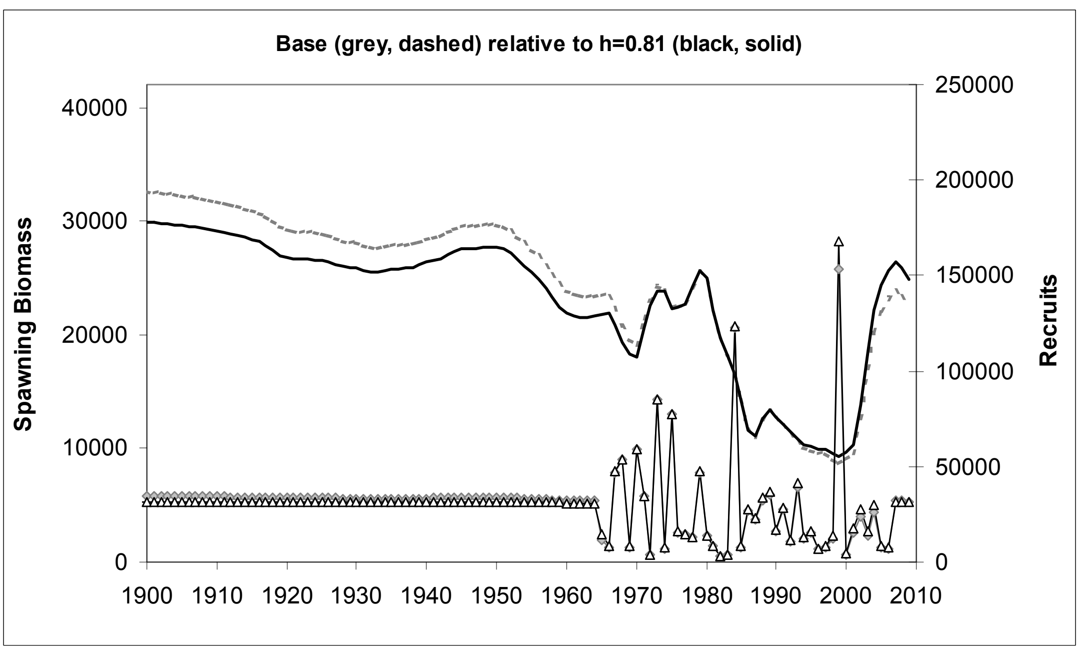
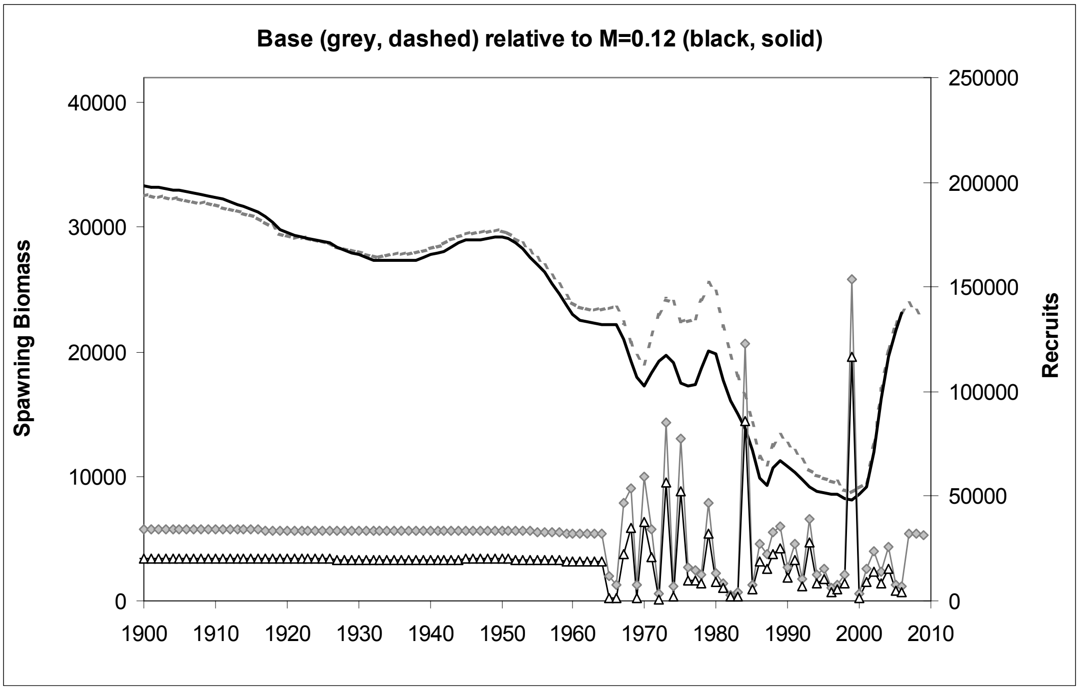


Figure 157-158: Estimated spawning biomass and recruitment trajectories when steepness is set to 0.34 (top, solid black lines) relative to the base model (grey, dashed lines) and when steepness is set to 0.81 (bottom).



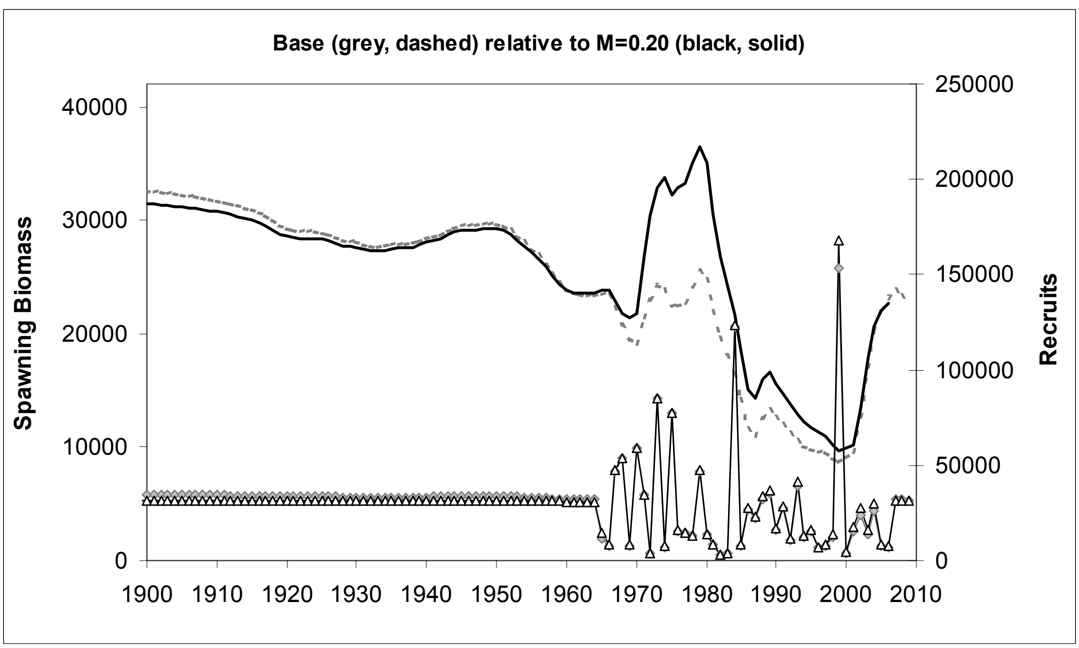
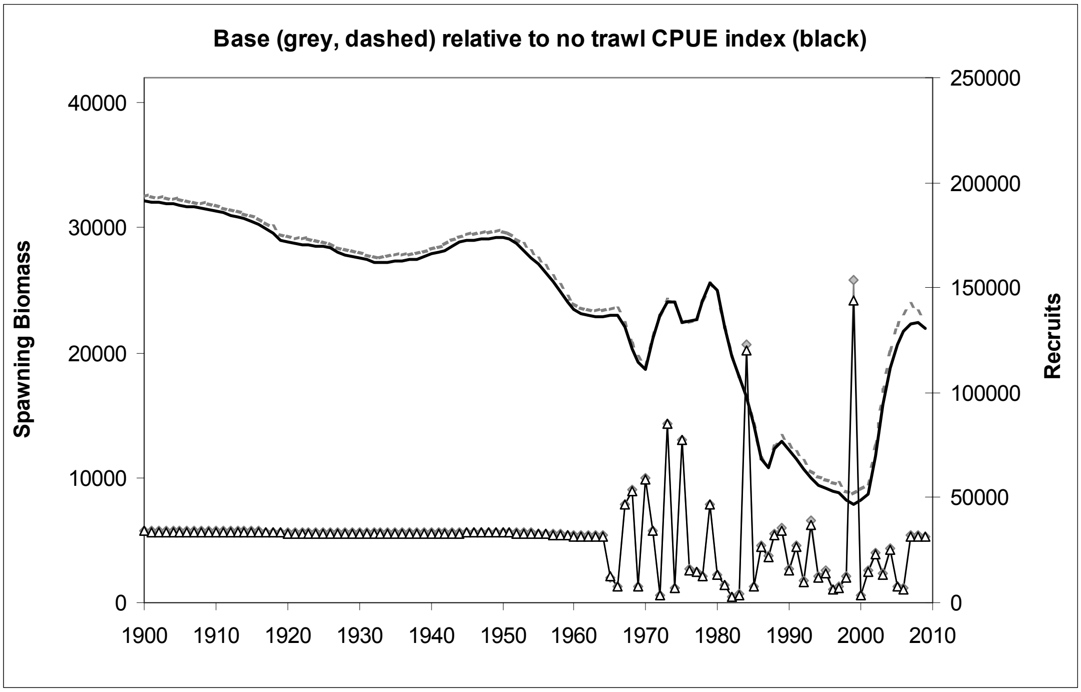


Figure 159-160: Estimated spawning biomass and recruitment trajectories when female natural mortality is set to 0.12 (top, solid black lines) relative to the base model (grey, dashed lines) and when steepness is set to 0.20 (bottom).



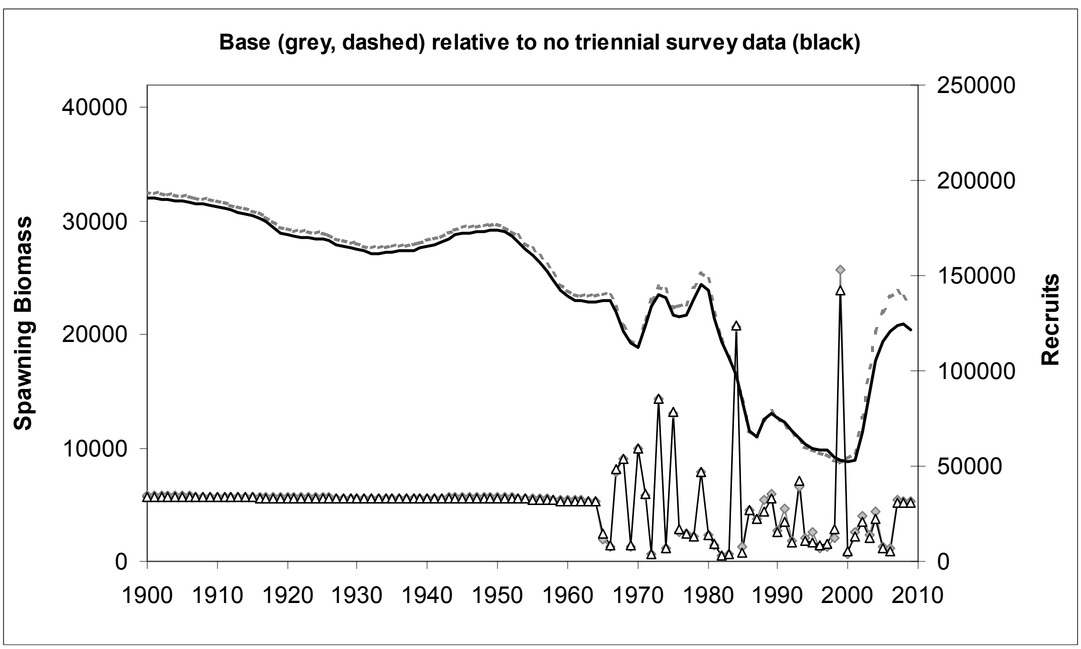
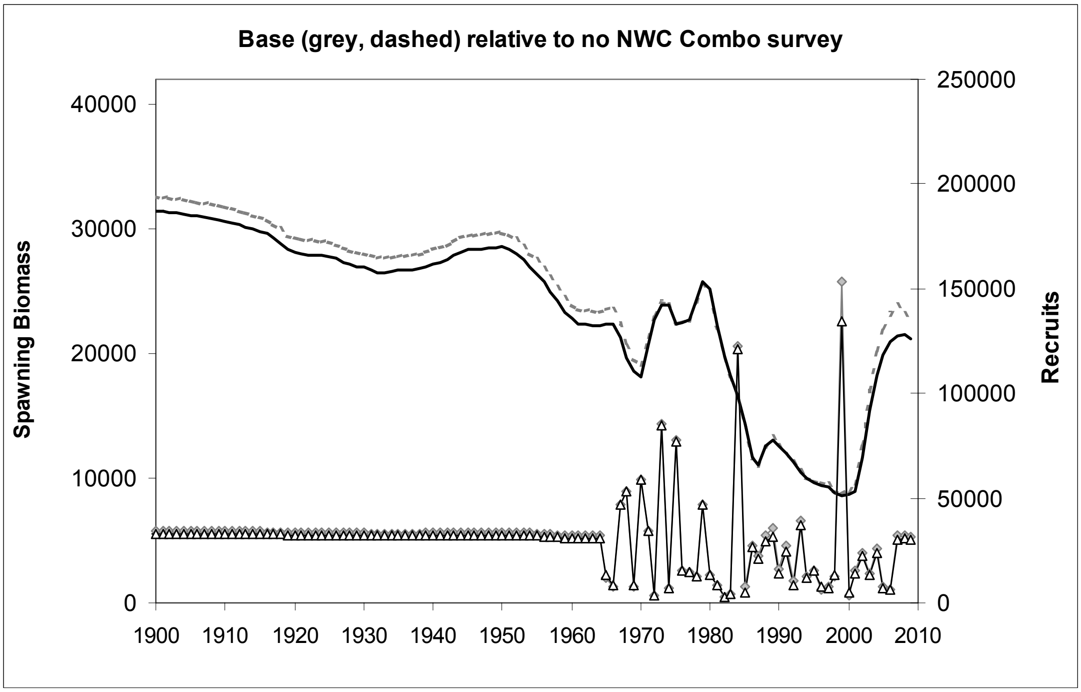


Figure 161-162: Estimated SSB and recruitment trajectories when the trawl fishery CPUE time series is excluded (top) relative to the base model and when the triennial survey index and length frequency data are excluded (bottom).



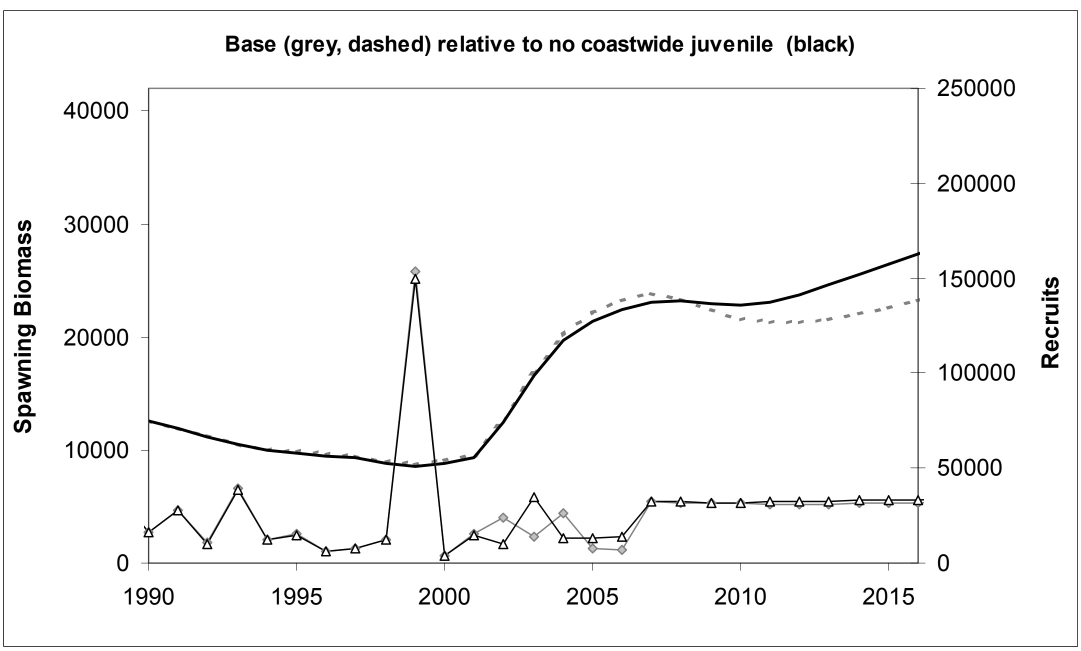
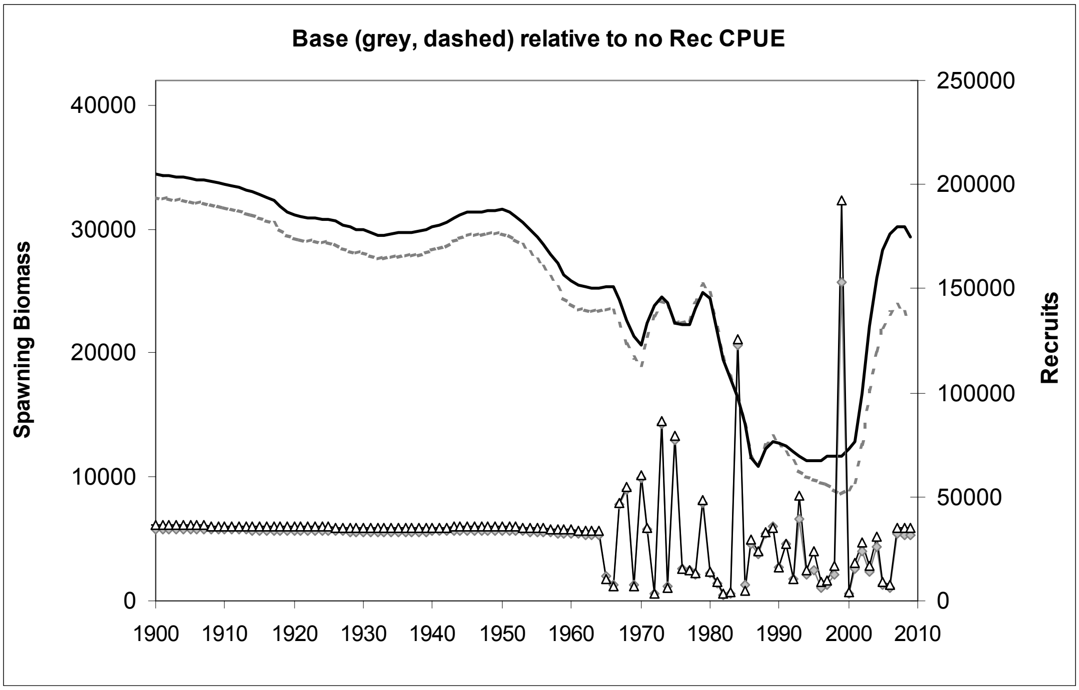


Figure 163-164: Estimated SSB and recruitment trajectories when the NWC combined survey data are excluded (top) and when the coastwide juvenile survey index is excluded (including forecast, bottom).



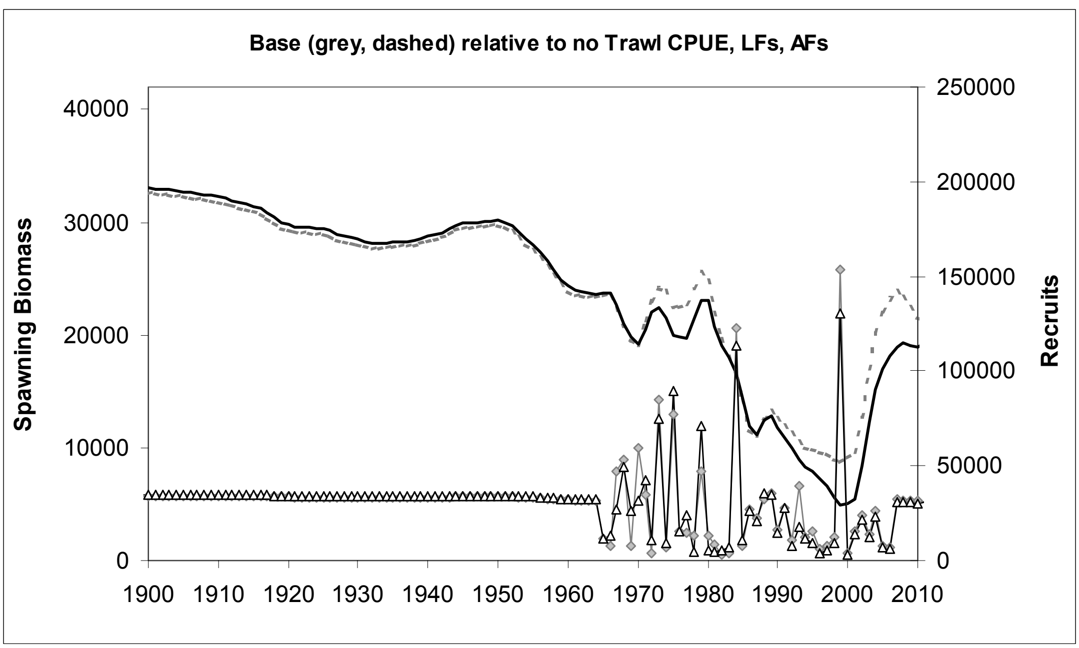
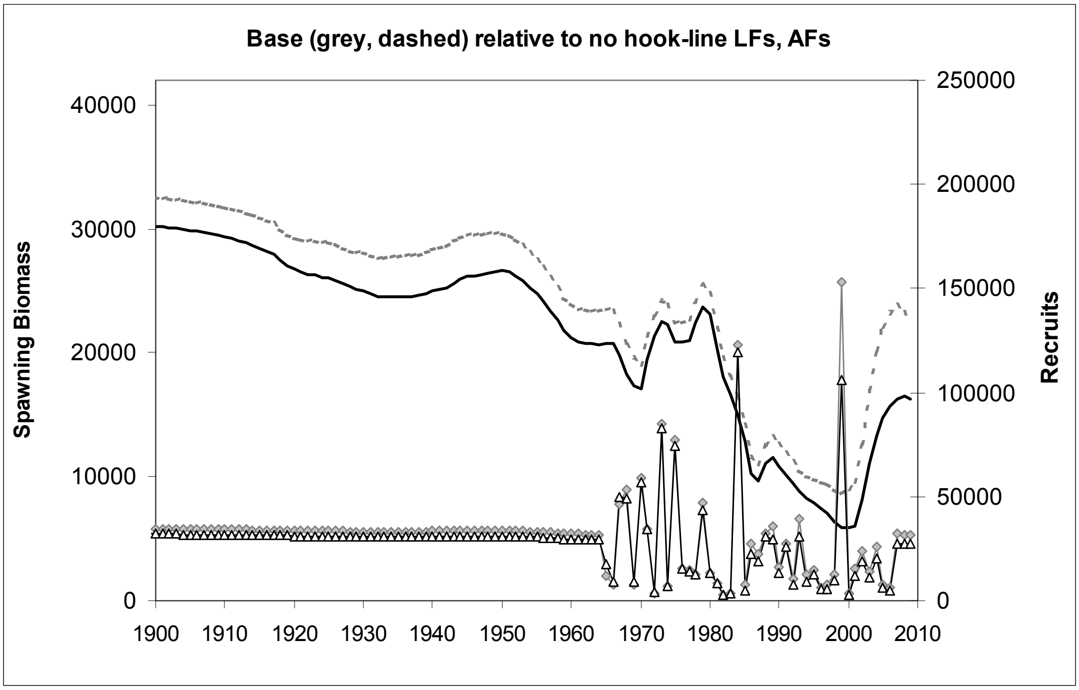


Figure 165-166: Estimated spawning biomass and recruitment trajectories when the recreational CPUE data are excluded (top), and when all trawl fishery data (CPUE, length composition, age composition) are excluded.



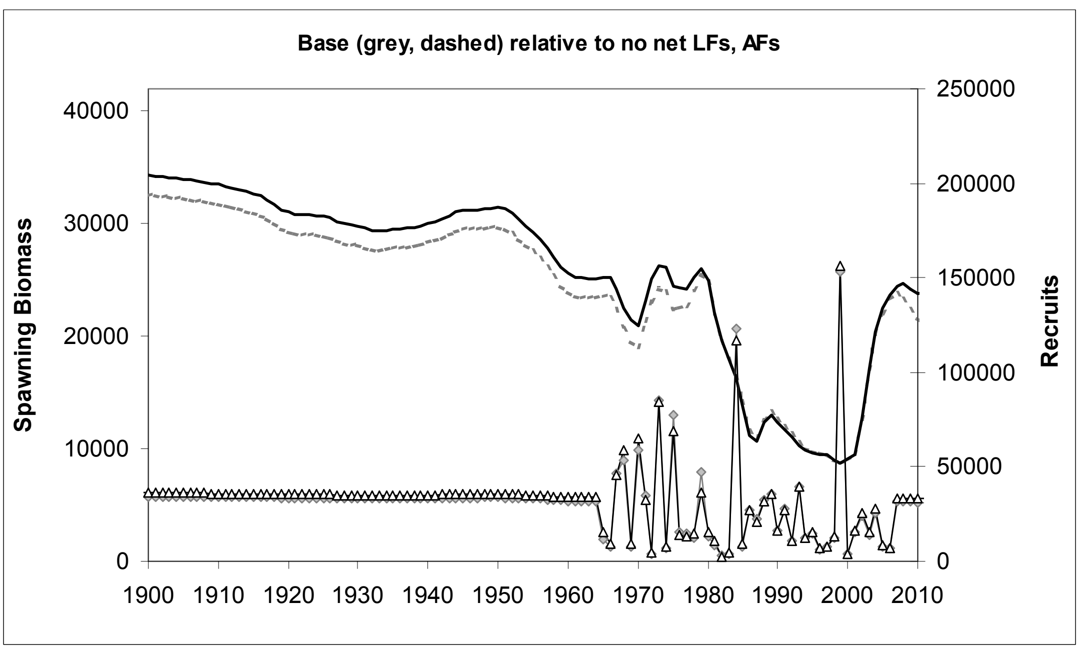


Figure 167-168: Estimated spawning biomass and recruitment trajectories when hook and line age and length data are excluded (top, solid black lines) and when the setnet fishery data are excluded (bottom).

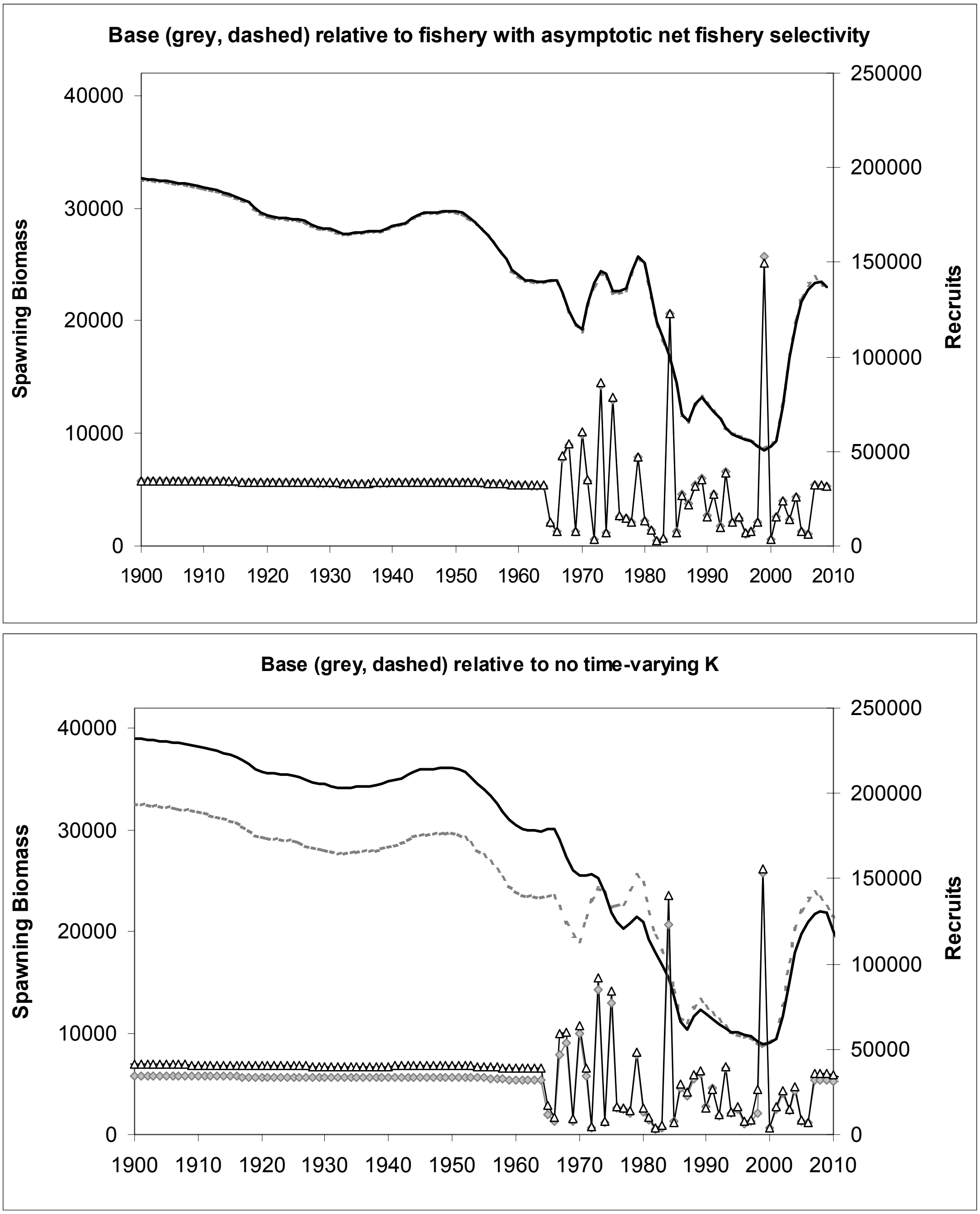
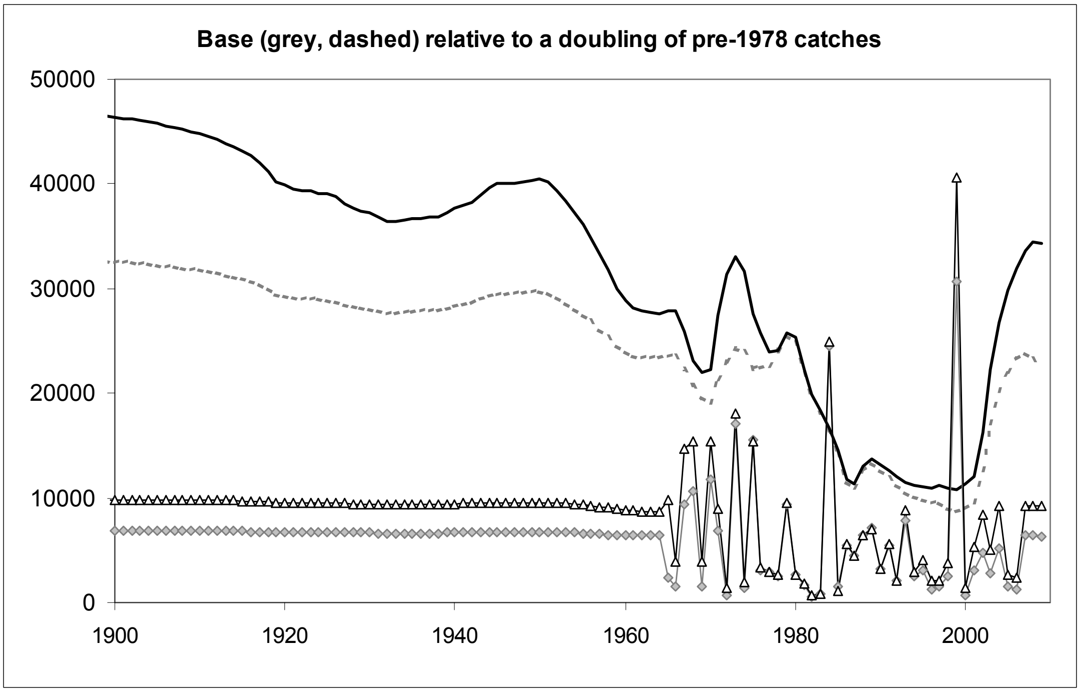


Figure 169-170: Estimated spawning biomass and recruitment trajectories with asymptotic selectivity estimated for the setnet fishery (top) and with time-invariant growth (bottom).



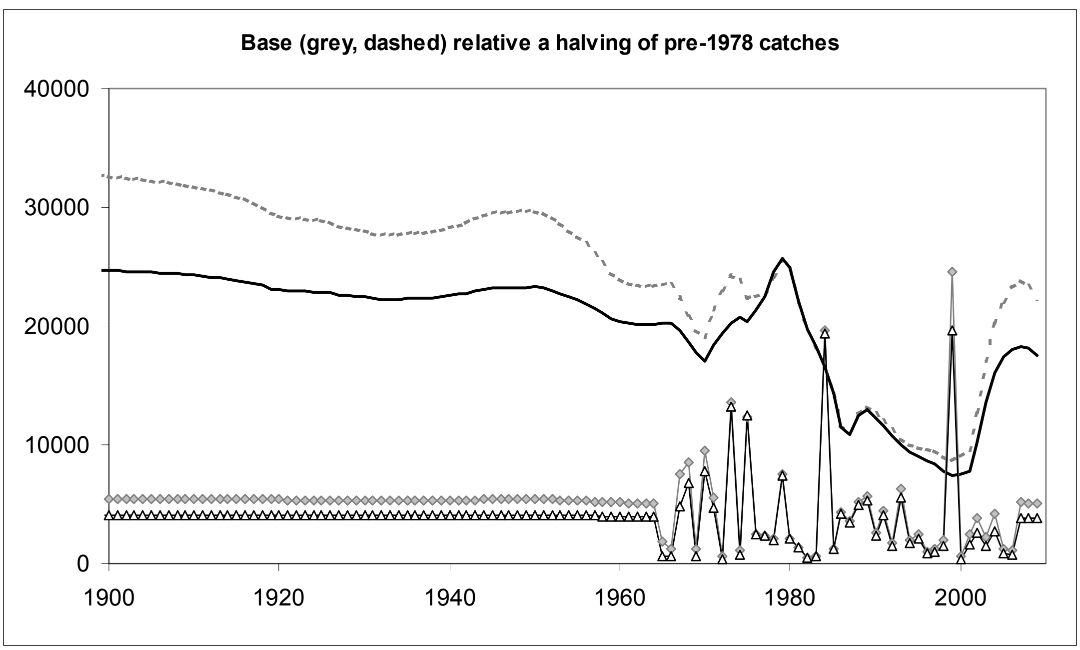
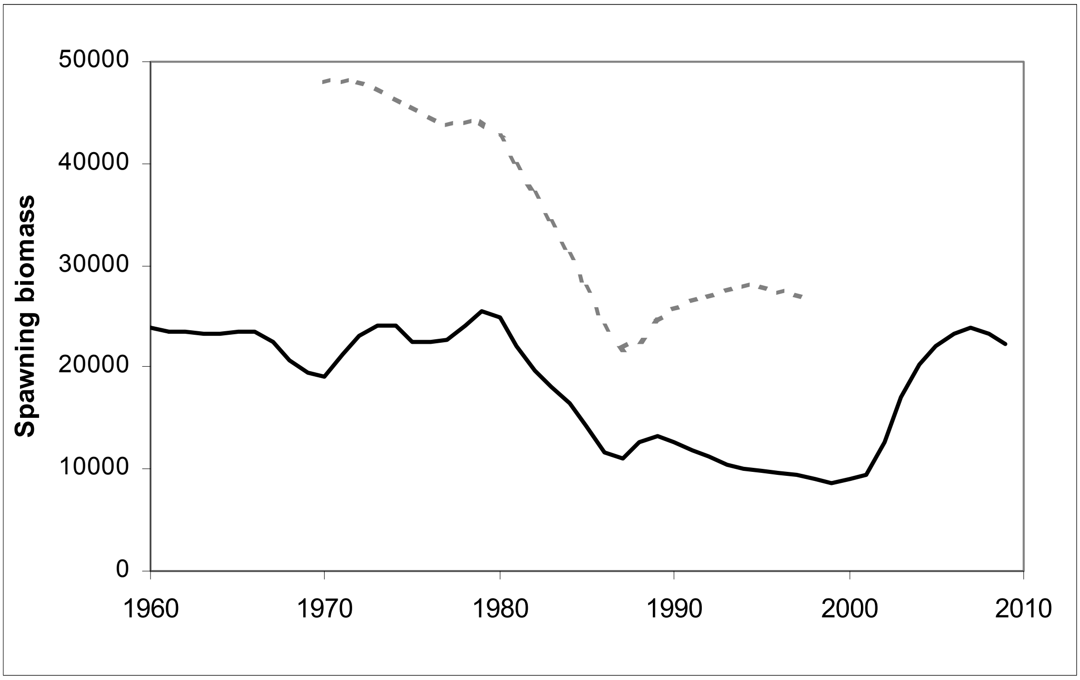


Figure 171-172: Estimated spawning biomass and recruitment trajectories when historical (pre-1970) catches are doubles (top) or halved (bottom)



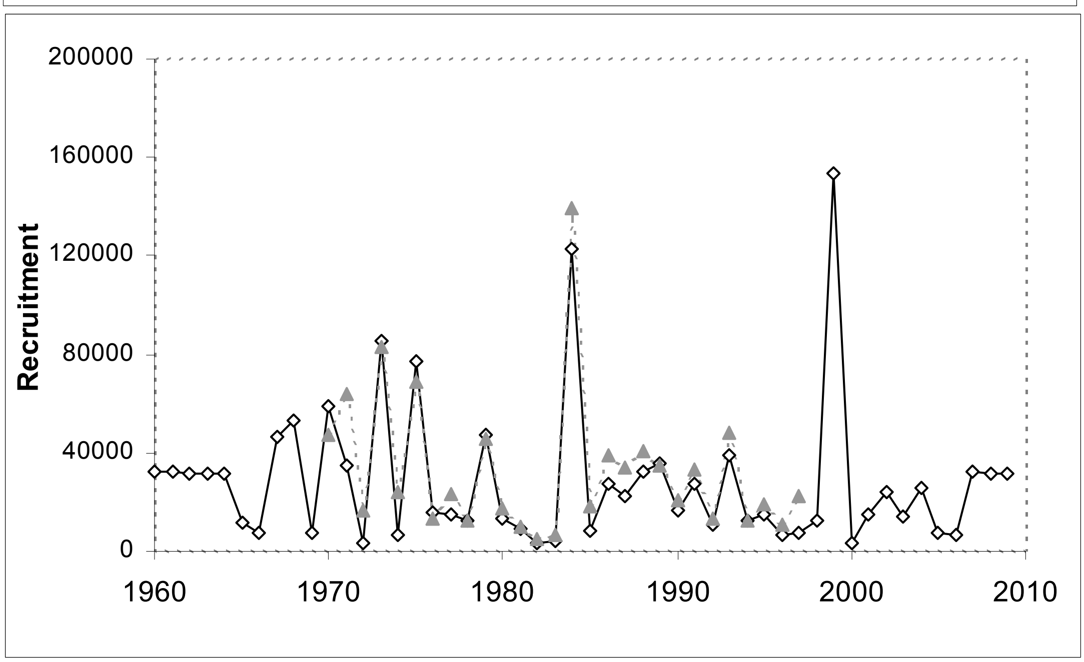
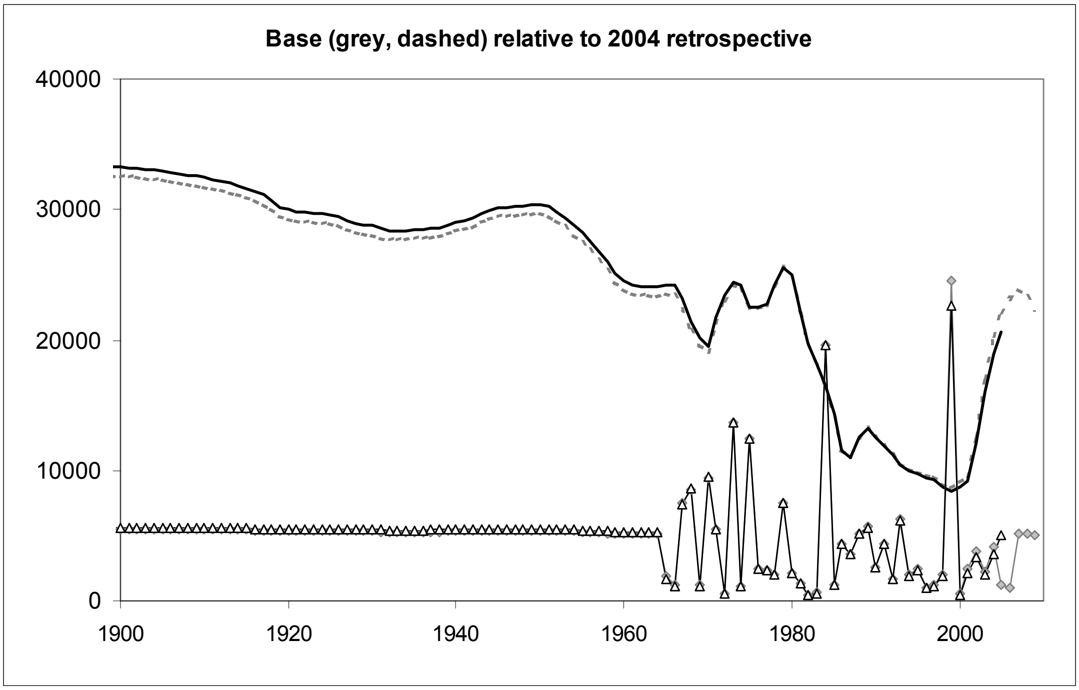


Figure 173-174: Comparison of the base model results with the results of the 1998 assessment for spawning biomass (top) and recruitment (bottom).



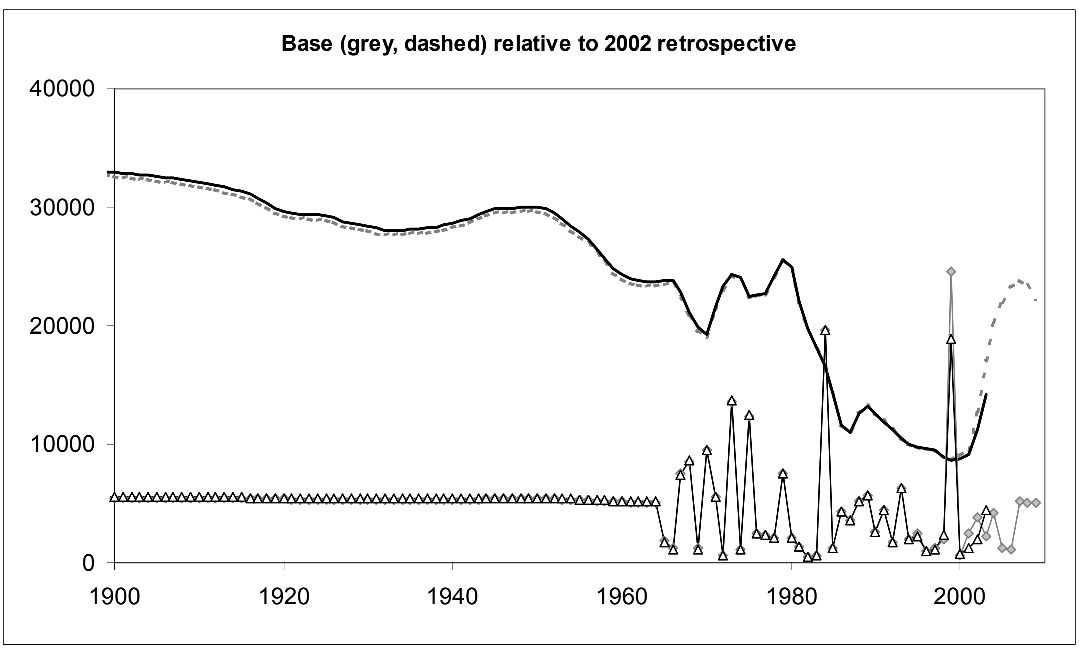
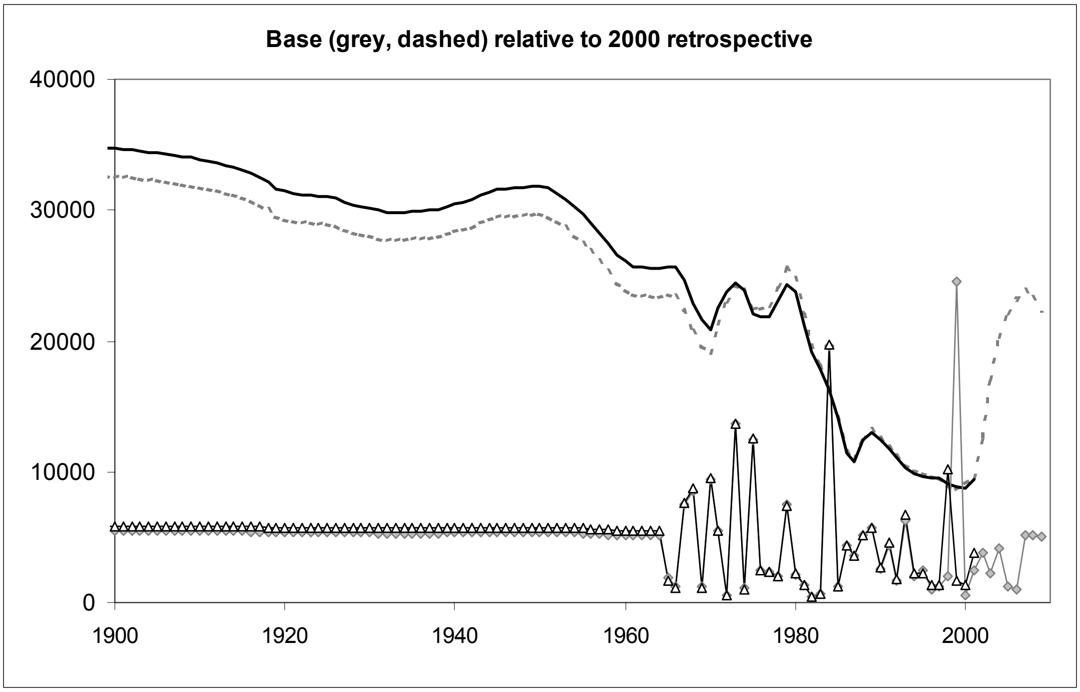


Figure 175-176: Comparison of the base model results with the results of the 2004 retrospective (top) and 2002 retrospective (bottom).



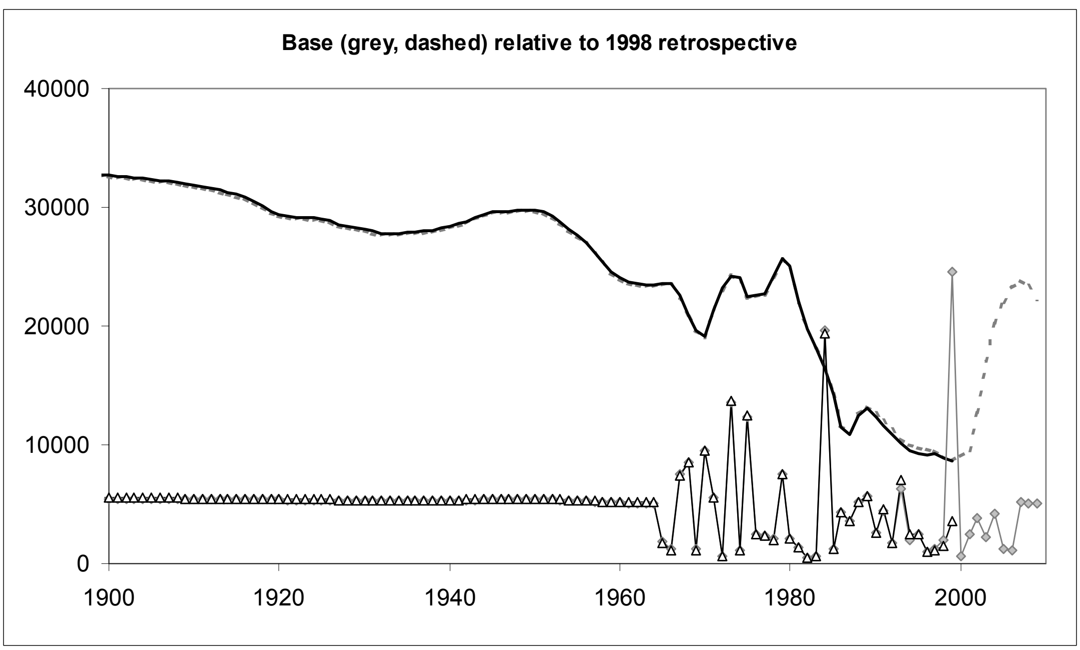


Figure 177-178: Comparison of the base model results with the results of the 1998 assessment for spawning biomass (top) and recruitment (bottom).

Appendix A: Detailed history of regulations affecting the harvest of chilipepper rockfish

Year	Period	Sector (s)	Cum. Limit	Area(s)	RCA Configuration
1983	Jan. 1 - June 27 June 28 - Sep. 9 Sep. 10 - Dec. 31	All comm.	40,000 lbs Sebastes/trip [1]	Coastwide	NA
1984	Jan. 1 - Dec. 31		40,000 lbs Sebastes/trip [2]	Eur., Mon., Concep.	
1985	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1986	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1987	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1988	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1989	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1990	Jan. 1 - Dec. 31	All comm.	40,000 lbs Sebastes/trip	Eur., Mon., Concep.	NA
1991	Jan. 1 - Dec. 31	All comm.	25,000 lbs Sebastes/trip of which no more than 5,000 lbs may be bocaccio	Eur., Mon., Concep.	NA
1992	Jan. 1 - Dec. 31	All comm.	50,000 lbs Sebastes/2 weeks of which no more than 8,000 lbs may be yellowtail (north of Cape Lookout, OR), no more than 10,000 lbs may be bocaccio (south of Cape Mendocino at 40°30' N lat.) [3]	Coastwide	NA
1993	Jan. 1 - Dec. 31	All comm.	50,000 lbs Sebastes/2 weeks of which no more than 8,000 lbs may be yellowtail (north of Coos Bay, OR), no more than 10,000 lbs may be bocaccio (south of Cape Mendocino at 40°30' N lat.) [4]	Coastwide	NA
1994	Jan. 1 - Dec. 31	All comm.[5]	80,000 lbs Sebastes/month of which no more than 14,000 lbs may be yellowtail (north of Cape Lookout, OR), no more than 30,000 lbs may be yellowtail (south of Cape Lookout, OR), no more than 30,000 lbs may be bocaccio (south of Cape Mendocino at 40°30' N lat.)	Coastwide	NA
	May 1 - Dec. 31	Setnet	40,000 lbs Sebastes/month	Off California	
	Sept. 1 - Dec. 31	LE	100,000 lbs Sebastes/month	South of Cape Mendocino at 40°30' N lat.	
1995			50,000 lbs Sebastes/month of which no more than 30,000 lbs may be yellowtail and no more than 6,000 lbs may be canary (coastwide)	Cape Lookout, OR - Cape Mendocino at 40°30' N lat.	NA
			100,000 lbs Sebastes/month of which no more than 30,000 lbs may be bocaccio and no more than 6,000 lbs may be canary (coastwide)	South of Cape Mendocino at 40°30' N lat.	
		OA	35,000 lbs Sebastes/month	North of Cape Lookout, OR	
			40,000 lbs Sebastes/month	South of Cape Lookout, OR	
		OA: hook-and-line and pot gears only	10,000 lbs Sebastes/trip	Coastwide	

1996	Jan. 1 - Oct. 31		100,000 lbs Sebastes/2 months of which no more than 70,000 lbs may be yellowtail and no more than 18,000 lbs may be canary (coastwide)	Cape Lookout, OR - Cape Mendocino at 40°30' N lat.	NA
	Jan. 1 - Dec. 31		200,000 lbs Sebastes/2 months of which no more than 60,000 lbs may be bocaccio and no more than 18,000 lbs may be canary (coastwide)	South of Cape Mendocino at 40°30' N lat.	
	Nov. 1 - Dec. 31		50,000 lbs Sebastes/month of which no more than 35,000 lbs may be yellowtail and no more than 9,000 lbs may be canary (coastwide)	Cape Lookout, OR - Cape Mendocino at 40°30' N lat.	
		OA	40,000 lbs Sebastes/month	South of Cape Lookout, OR	
		OA: hook-and-line and pot gears only	10,000 lbs Sebastes/trip	Coastwide	
1997	Jan. 1 - Apr. 30		150,000 lbs Sebastes/2 months of which no more than 12,000 lbs may be bocaccio and no more than 14,000 lbs may be canary (coastwide)	South of Cape Mendocino at 40°30' N lat.	NA
	May 1 - Sept. 30		150,000 lbs Sebastes/2 months of which no more than 10,000 lbs may be bocaccio and no more than 14,000 lbs may be canary (coastwide)		
	Oct. 1 - Dec. 31		75,000 lbs Sebastes/month of which no more than 5,000 lbs may be bocaccio and no more than 10,000 lbs may be canary (coastwide)		
	Jan. 1 - Dec. 31	OA [6]	40,000 lbs Sebastes/month	Coastwide	
		OA: hook-and-line and pot gears only [7]	10,000 lbs Sebastes/trip	Coastwide	
1998	Jan. 1 - June 30		150,000 lbs Sebastes/2 months of which no more than 2,000 lbs may be bocaccio and no more than 15,000 lbs may be canary (coastwide)	South of Cape Mendocino at 40°30' N lat.	NA
	July 1 - Aug. 31		40,000 lbs Sebastes/2 months of which no more than 10,000 lbs may be bocaccio and no more than 14,000 lbs may be canary (coastwide)		
	Sept. 1-30		40,000 lbs Sebastes/month of which no more than 10,000 lbs may be bocaccio and no more than 14,000 lbs may be canary (coastwide)		
	Oct. 1 - Dec. 31		15,000 lbs Sebastes/month of which no more than 10,000 lbs may be bocaccio and no more than 500 lbs may be canary (coastwide)		
	Jan. 1 - Dec. 31	OA [8]	40,000 lbs Sebastes/month	Coastwide	
	Oct. 1 - Dec. 31		Canary closed		
	Jan. 1 - Dec. 31	OA: hook-and-line and pot gears only [9]	10,000 lbs Sebastes/trip		

1999	Jan. 1 - March 31 (phase 1)	LE [10]	45,000 lbs chilipepper/3 months	South of Cape Mendocino at 40°30' N lat.	NA
	Apr. 1 - Sept. 30 (phase 2)		25,000 lbs chilipepper/2 months		
	Oct. 1 - Dec. 31 (phase 3)		5,000 lbs chilipepper/month		
	Jan. 1 - Dec. 31	OA	6,000 lbs chilipepper/month		
2000	Jan. 1 - Dec. 31	LE Trawl [11]	MW trawls: 25,000 lbs chilipepper/2 months; Sm. FR trawls: 7,500 lbs chilipepper/2 months	South of Cape Mendocino at 40°10' N lat.	NA
	Jan. 1 - Feb. 29	LE FG	2,000 lbs chilipepper/month	36° - 40°10' N lat.	
	Mar. 1 - Apr. 30		Closed		
	May 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29		Closed	South of 36° N lat.	
	Mar. 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29	OA	2,000 lbs chilipepper/month	36° - 40°10' N lat.	
	Mar. 1 - Apr. 30		Closed		
	May 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29		Closed	South of 36° N lat.	
	Mar. 1 - Dec. 31		2,000 lbs chilipepper/month		
2001	Jan. 1 - Oct. 31	LE Trawl [12]	MW trawls: 25,000 lbs chilipepper/2 months; Sm. FR trawls: 7,500 lbs chilipepper/2 months	South of Cape Mendocino at 40°10' N lat.	Cowcod Conservation Areas implemented.
	Nov. 1 - Dec. 31		MW trawls: 25,000 lbs chilipepper/2 months; Sm. FR trawls: 5,000 lbs chilipepper/2 months		
	Jan. 1 - Feb. 29	LE FG	2,000 lbs chilipepper/month	36° - 40°10' N lat.	
	Mar. 1 - Apr. 30		Closed		
	May 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29		Closed	South of 36° N lat.	
	Mar. 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29	OA	2,000 lbs chilipepper/month	36° - 40°10' N lat.	
	Mar. 1 - Apr. 30		Closed		
	May 1 - Dec. 31		2,000 lbs chilipepper/month		
	Jan. 1 - Feb. 29		Closed	South of 36° N lat.	
	Mar. 1 - Dec. 31		2,000 lbs chilipepper/month		
2002	Jan. 1- Apr. 30	LE Trawl	MW trawls: 25,000 lbs chilipepper/2 months; Sm. FR trawls: 7,500 lbs chilipepper/2 months; Lg. FR trawls: 500 lbs chilipepper/trip not to exceed the sm. FR cumulative limit	South of Cape Mendocino at 40°10' N lat.	NA
	May 1 - June 30		MW trawls: 25,000 lbs chilipepper/2 months; Sm. FR trawls: 4,000 lbs chilipepper/2 months; Lg. FR trawls: 500 lbs chilipepper/trip not to exceed the sm. FR cumulative limit		
	July 1 - Dec. 31		Closed		

	Jan. 1 - Feb. 28	LE FG	500 lbs chilipepper/month	34°27' - 40°10' N lat.	
	Mar. 1 - Dec. 31		Closed		
	Jan. 1 - Feb. 28		Closed	South of 34°27' N lat.	
	Mar. 1 - June 30		2,000 lbs chilipepper/month		
	July 1 - Dec. 31		Closed		
	Jan. 1 - Feb. 28	OA	500 lbs chilipepper/month	34°27' - 40°10' N lat.	
	Mar. 1 - Dec. 31		Closed		
	Jan. 1 - Feb. 28		Closed	South of 34°27' N lat.	
	Mar. 1 - June 30		2,000 lbs chilipepper/month		
	July 1 - Dec. 31		Closed		
2003	Jan. 1 - Feb. 28	LE Trawl	MW and sm. FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month	38° - 40°10' N lat.	50 - 250 fm w/ petrale areas
	Mar. 1 - Apr. 30				60 - 250 fm
	May 1 - Oct. 31				60 - 200 fm
	Nov. 1 - Dec. 31				shoreline - 200 fm w/ petrale areas
	Jan. 1 - Feb. 28			34°27' - 38° N lat.	50 - 150 fm
	Mar. 1 - Apr. 30				60 - 150 fm
	May 1 - Oct. 31				60 - 200 fm
	Nov. 1 - Dec. 31				shoreline - 200 fm w/ petrale areas
	Jan. 1 - Apr. 30			South of 34°27' N lat.	100 - 150 fm along mainland coast; shoreline - 150 fm around islands
	May 1 - Oct. 31				100 - 200 fm along mainland coast; shoreline - 200 fm around islands
	Nov. 1 - Dec. 31				shoreline - 200 fm along mainland coast and around islands w/ petrale areas
	Jan. 1 - Feb. 28	LE FG and OA	100 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months	34°27' - 40°10' N lat	20 - 150 fm
	Mar. 1 - Apr. 30		Closed		
	May 1 - June 30		200 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		
	July 1 - Aug. 31		250 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		
	Sept. 1 - Oct. 31		200 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		
	Nov. 1 - Dec. 31		100 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		shoreline - 150 fm
	Jan. 1 - Feb. 28		100 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months	South of 34°27' N lat.	20 - 150 fm along mainland coast and around islands
	Mar. 1 - Apr. 30		Closed		
	May 1 - June 30		200 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		

	July 1 - Aug. 31		250 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		
	Sept. 1 - Oct. 31		200 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		30 - 150 fm along mainland coast and around islands
	Nov. 1 - Dec. 31		100 lbs minor shelf rockfish, widow, chilipepper, and yellowtail/2 months		shoreline - 150 fm along mainland coast and around islands
2004	Jan. 1 - Apr. 30	LE Trawl	MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month	38° - 40°10' N lat.	75 - 150 fm; shoreline - 10 fm around Farallon Islands
	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month through June 30, then 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		100 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months through Dec. 31; sm FR trawls: 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		75 - 150 fm; shoreline - 10 fm around Farallon Islands
	Oct. 1 - Dec. 31		MW, lg. FR, and sm. FR trawls: 8,000 lbs of chilipepper/2 months		shoreline - 250 fm
	Jan. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month	36° - 38° N lat.	75 - 150 fm; shoreline - 10 fm around Farallon Islands
	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month through June 30, then 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		100 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months through Dec. 31; sm FR trawls: 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		75 - 150 fm; shoreline - 10 fm around Farallon Islands
	Oct. 1 - Dec. 31		MW, lg. FR, and sm. FR trawls: 8,000 lbs of chilipepper/2 months		shoreline - 200 fm
	Jan. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month	34°27' - 36° N lat.	75 - 150 fm
	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month through June 30, then 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		100 - 150 fm
	Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months through Dec. 31; sm FR trawls: 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		75 - 150 fm
	Oct. 1 - Dec. 31		MW, lg. FR, and sm. FR trawls: 8,000 lbs of chilipepper/2 months		shoreline - 150 fm
	Jan. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month	South of 34°27' N lat.	75 - 150 fm along mainland coast; shoreline - 150 fm around islands

	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, widow, and chilipepper/month through June 30, then 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		100 - 150 fm along mainland coast; shoreline - 150 fm around islands
	Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months through Dec. 31; sm FR trawls: 1,000 lbs of minor shelf rockfish, widow and chilipepper/month no more than 200 lbs of which may be minor shelf and widow rockfish through Sept. 30		75 - 150 fm along mainland coast; shoreline - 150 fm around islands
	Oct. 1 - Dec. 31		MW, lg. FR, and sm. FR trawls: 8,000 lbs of chilipepper/2 months		shoreline - 150 fm along mainland coast and around islands
	Jan. 1- Apr. 30	LE FG	2,000 lbs of chilipepper/2 months (opportunity only available seaward of the non-trawl RCA)	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands
	May 1 - Aug. 31				20 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - Dec. 31				30 - 150 fm; shoreline - 10 fm around Farallon Islands
	Jan. 1 - Dec. 31			South of 34°27' N lat.	60 - 150 fm along mainland coast and around islands
	Jan. 1 - Apr. 30	OA	300 lbs of minor shelf rockfish, widow, and chilipepper/2 months in period 1 (Jan. & Feb.); closed in period 2 (Mar. & Apr.)	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands
	May 1 - Aug. 31		200 lbs of minor shelf rockfish, widow, and chilipepper/2 months		20 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - Dec. 31		300 lbs of minor shelf rockfish, widow, and chilipepper/2 months		30 - 150 fm; shoreline - 10 fm around Farallon Islands
	Jan. 1 - Feb. 29		Closed	South of 34°27' N lat.	60 - 150 fm along mainland coast and around islands
	Mar. 1 - Dec. 31		500 lbs of minor shelf rockfish, widow, and chilipepper/2 months		
2005	Jan. 1 - Feb. 28	LE Trawl	MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month	38° - 40°10' N lat.	75 - 200 fm w/ petrale areas
	Mar. 1 - Apr. 30				100 - 200 fm
	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		100 - 150 fm
	Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		
	Oct. 1 - Dec. 31				shoreline - 250 fm
	Jan. 1 - Feb. 28		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month	36° - 38° N lat.	75 - 150 fm
	Mar. 1 - Apr. 30				100 - 150 fm
	May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		

Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		
Oct. 1 - Dec. 31				shoreline - 200 fm
Jan. 1 - Feb. 28		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month	34°27' - 36° N lat.	75 - 150 fm
Mar. 1 - Apr. 30				100 - 150 fm
May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		
Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		50 - 200 fm
Oct. 1 - Dec. 31				
Jan. 1 - Feb. 28		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month	South of 34°27' N lat.	75 - 150 fm along mainland coast; shoreline - 150 fm around islands
Mar. 1 - Apr. 30				100 - 150 fm along mainland coast; shoreline - 150 fm around islands
May 1 - Aug. 31		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		
Sept. 1 - 30		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of minor shelf rockfish, shortbelly, widow, yelloweye, and chilipepper/month		
Oct. 1 - Dec. 31				50 - 200 fm along mainland coast; shoreline - 200 fm around islands
Jan. 1- Apr. 30	LE FG	2,000 lbs of chilipepper/2 months (opportunity only available seaward of the non-trawl RCA)	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands
May 1 - Aug. 31				20 - 150 fm; shoreline - 10 fm around Farallon Islands
Sept. 1 - Dec. 31				30 - 150 fm; shoreline - 10 fm around Farallon Islands
Jan. 1 - Dec. 31			South of 34°27' N lat.	60 - 150 fm along mainland coast and around islands
Jan. 1 - Feb. 28	OA	300 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands
Mar. 1 - Apr. 30		Closed		
May 1 - Aug. 31		300 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		20 - 150 fm; shoreline - 10 fm around Farallon Islands
Sept. 1 - Dec. 31		300 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		30 - 150 fm; shoreline - 10 fm around Farallon Islands
Jan. 1 - Feb. 28		500 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months	South of 34°27' N lat.	60 - 150 fm along mainland coast and

	Mar. 1 - Apr. 30		Closed		around islands
	May 1 - June 30		500 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		
	July 1 - Dec. 31		750 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		
2006	Jan. 1 - Feb. 28	LE Trawl	MW and lg. FR trawls: 1,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month	38° - 40°10' N lat.	75 - 150 fm
	Mar. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month		100 - 150 fm
	May 1 - June 30		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		
	July 1 - Aug. 31				100 - 200 fm
	Sept. 1 - Oct. 31		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		100- 250 fm
	Nov. 1 - Dec. 31				75 - 250 fm w/ petrale areas
	Jan. 1 - Feb. 28		MW and lg. FR trawls: 1,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month	34°27' - 38° N lat.	75 - 150 fm
	Mar. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month		100 - 150 fm
	May 1 - June 30		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		
	July 1 - Aug. 31				
	Sept. 1 - Oct. 31		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		
	Nov. 1 - Dec. 31				75 - 150 fm
	Jan. 1 - Feb. 28		MW and lg. FR trawls: 1,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month	South of 34°27' N lat.	75 - 150 fm along mainland coast; shoreline - 150 fm around islands
	Mar. 1 - Apr. 30		MW and lg. FR trawls: 2,000 lbs of chilipepper/2 months; sm FR trawls: 300 lbs of chilipepper/month		100 - 150 fm along mainland coast; shoreline - 150 fm around islands
	May 1 - June 30		MW and lg. FR trawls: 12,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		
	July 1 - Aug. 31				
	Sept. 1 - Oct. 31		MW and lg. FR trawls: 8,000 lbs of chilipepper/2 months; sm FR trawls: 500 lbs of chilipepper/month		
	Nov. 1 - Dec. 31				75 - 150 fm along mainland coast; shoreline - 150 fm around islands
	Jan. 1- Apr. 30	LE FG	2,000 lbs of chilipepper/2 months (opportunity only available seaward of the non-trawl RCA)	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands
	May 1 - Aug. 31				20 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - Dec. 31				30 - 150 fm; shoreline - 10 fm around Farallon Islands
	Jan. 1 - Dec. 31			South of 34°27' N lat.	60 - 150 fm along mainland coast and around islands
	Jan. 1 - Feb. 28	OA	300 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months	34°27' - 40°10' N lat	30 - 150 fm; shoreline - 10 fm around Farallon Islands

	Mar. 1 - Apr. 30		Closed		
	May 1 - Aug. 31		200 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		20 - 150 fm; shoreline - 10 fm around Farallon Islands
	Sept. 1 - Dec. 31		300 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months		30 - 150 fm; shoreline - 10 fm around Farallon Islands
	Jan. 1 -Dec. 31		750 lbs of minor shelf rockfish, shortbelly, widow, and chilipepper/2 months	South of 34°27' N lat.	60 - 150 fm along mainland coast and around islands

(1) From Jan. 1 to June 27, Van. & Col. Sebastes HG = 14,000 mt, from June 28-Sept. 9, Van. & Col. Sebastes HG = 18,500 mt, 1 trip/week, from Sept. 10-Dec. 31, Van. & Col. 3,000 lbs/trip, no weekly trip limit.
(2) From 1984-1991, no weekly trip limits
(3) Sebastes harvest guideline north of Cape Lookout, OR = 8,000 mt; min. mesh size for trawl codends increased from 3 to 4.5 inches effective May 9, 1992.
(4) Sebastes harvest guideline north of Coos Bay, OR = 11,200 mt
(5) Groundfish fishery separated into limited entry and open access sectors w/ LE gear endorsements for trawl, longline, and pot/trap gears
(6) Setnets only legal south of 38° N lat.; setnets limited to 4,000 lbs bocaccio/month.
(7) Limits include 300 lbs bocaccio/trip, not to exceed 2,000 lbs/month south of Cape Mendocino (Jan. 1 - Apr. 30); 250 lbs bocaccio/trip not to exceed 2,000 lbs/month south of Cape Mendocino (May 1 - Dec. 31).
(8) Setnets only legal south of 38° N lat.; setnets limited to 2,000 lbs bocaccio/month.
(9) 250 lbs bocaccio/trip not to exceed 1,000 lbs/month south of Cape Mendocino (Jan. 1 - Dec. 31).
(10) First year of limits specifically for chilipepper rockfish. For limited entry fishery, a new three-phase cumulative limit period system is introduced: phase 1 is a single 3-month cum. limit period from Jan.1 - March 31, phase 2 has three separate 2-month cum. limit periods (Apr. 1 - May 31, June 1 - July 31, and Aug. 1 - Sept. 30, and phase 3 has three separate 1-month cum. limit periods (Oct. 1-31, Nov. 1-30 and Dec. 1-31); only POP and bocaccio have monthly limits within a cum. limit period.
(11) Cumulative landing limit periods redefined to encompass six 2-month periods through the year (Jan-Feb, Mar-Apr, May-June, July-Aug, Sept-Oct, and Nov-Dec). Chilipepper rockfish required to be sorted south of 40°10' N lat. Small footrope trawls required to land chilipepper rockfish in the LE trawl sector.
(12) Small footrope trawls required to land chilipepper rockfish in the LE trawl sector.

Appendix B: Data (.dat) and Control (.ctl) files for chilipepper rockfish model

```
# *************************************************************
#  Chilipepper rockfish .dat file
#  final model from June 2007 STAR Panel
#  SS2 Version 2.00c by_Richard_Methot_(NOAA);_using_Otter_Research_ADMB_7.0.1
# *************************************************************
#
1892	# start year- first year of CalCOFI data
2006	# end year
1	# n seasons
12	# months/season
1	# spawning season
4	# fishing fleets
6	# surveys
trawl%hookline%setnet%rec%triennial%combined%juvsurvey%calcofi%juv2%ghost
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.5	0.5	#timing
2	# number of genders
21	# accumulator age
# catch (mtons)
0	0	0	0	# init equil
#trawl	hookln	gillnet	rec
11	206	0	0	#	1892
10	195	0	0	#	1893
10	183	0	0	#	1894
9	171	0	0	#	1895
9	162	0	0	#	1896
8	152	0	0	#	1897
8	143	0	0	#	1898
7	133	0	0	#	1899
8	147	0	0	#	1900
8	161	0	0	#	1901
9	176	0	0	#	1902
10	190	0	0	#	1903
11	204	0	0	#	1904
11	218	0	0	#	1905
12	232	0	0	#	1906
13	246	0	0	#	1907
14	260	0	0	#	1908
15	292	0	0	#	1909
17	325	0	0	#	1910
19	358	0	0	#	1911
21	390	0	0	#	1912
22	423	0	0	#	1913
24	455	0	0	#	1914
26	488	0	0	#	1915
33	633	0	0	#	1916
41	778	0	0	#	1917
49	924	0	0	#	1918
32	605	0	0	#	1919
33	631	0	0	#	1920
28	534	0	0	#	1921
25	483	0	0	#	1922
30	571	0	0	#	1923
28	532	0	0	#	1924
```

32	615	0	0	#	1925
44	845	0	0	#	1926
38	716	0	0	#	1927
37.05	701.45	0	0	#	1928
33.28	626.11	0	0.02	#	1929
41.41	780.81	0	0.11	#	1930
41.63	788.44	0	0.26	#	1931
32.87	622.52	0	0.46	#	1932
28.42	539.33	0	0.72	#	1933
26.63	503.03	0	1.04	#	1934
28.68	541	0	1.41	#	1935
29.29	552.03	0	1.84	#	1936
26.9	508	0	2.46	#	1937
20.24	371.34	0	2.69	#	1938
16.69	298.89	0	2.59	#	1939
19.81	362.24	0	4.07	#	1940
92.13	267.63	0	0	#	1941
55.41	51.91	0	0	#	1942
122.97	32.15	0	0	#	1943
210.21	9.15	0	0	#	1944
417.86	16.31	0	0	#	1945
362.4	17.56	0	0	#	1946
321.63	21.59	0	3.42	#	1947
312.78	25.71	0	8.83	#	1948
324.8	28.86	0	14.79	#	1949
510.48	47.9	0	17.61	#	1950
777.91	74.8	0	16.79	#	1951
935.3	97.74	0	21.66	#	1952
1068.63	111.16	0	27.36	#	1953
1036.67	117.59	0	60.75	#	1954
1149.08	122.25	0	109.39	#	1955
1344.04	163.3	0	135.95	#	1956
1433.55	173.86	0	79.32	#	1957
1504.31	326.47	0	57.85	#	1958
1286.21	271.22	0	35.8	#	1959
1258.21	148.56	0	36.69	#	1960
956.33	146.41	0	42.99	#	1961
917.45	155.6	0	45.01	#	1962
917.46	111.18	0	48.64	#	1963
711	105.72	0	66.79	#	1964
765.36	136.09	0	91.87	#	1965
1904.92	140.17	0	137.25	#	1966
2497.6	127.21	0	171.21	#	1967
1468.36	112.75	0	193.89	#	1968
810.32	103.79	0	176.31	#	1969
907.76	114.21	0	250.66	#	1970
866.94	154.71	0	231.32	#	1971
1371.84	215.02	0	312.43	#	1972
2893.25	371.42	0	379.74	#	1973
3192.94	282.37	0	485.07	#	1974
2588.29	260.32	0	379.17	#	1975
2334.62	210.45	0	546.82	#	1976
1490.73	166.5	0	433.94	#	1977
1293.23	169.16	25.83	445.32	#	1978
2003.71	176.6	54.19	490.43	#	1979
2720.86	95.87	45.38	392.91	#	1980

```
2294.63 139.13  71.28   271.32  #       1981
1680.73 356.35  85.42   369.44  #       1982
1879.45 80.23   345.21  159.78  #       1983
2447.65 98.1    231.04  145.75  #       1984
1807.06 278.99  738.69  357.66  #       1985
1269.14 330.88  1161.46 385.97  #       1986
1313.85 172.61  461.11  111.75  #       1987
1777.91 333.47  289.36  290.01  #       1988
2363.3  425.58  361.37  245.15  #       1989
2317.2  232.12  372.77  188.11  #       1990
2229.02 618.32  332.08  131.08  #       1991
1329.79 1052.67 296.72  74.04   #       1992
1282.12 860.86  232.91  17      #       1993
1267.12 484.99  107.71  17.16   #       1994
1594.58 324.9   94.05   7.17    #       1995
1528.08 254.23  57.67   30.31   #       1996
1613.97 339.29  82.97   73.47   #       1997
1137.97 208.84  77.62   5.39    #       1998
838.61  104.18  9.67    24.29   #       1999
403.38  50.6    6.11    38.92   #       2000
435.57  25.18   4.9     51.74   #       2001
300.03  6.22    0.42    22.25   #       2002 data from 2002 onward include
20.33   0.25    0.05    0       #       2003 WCGOP estimates of discard
203.1   10.43   2.86    19.43   #       2004
171.97  9.77    0.14    10.17   #       2005
104.74  17.62   0.45    3.85    #       2006

# Abundance indices
94      # number of observations
#year   season  type    value   SD
1980    1       1       249     0.25
1981    1       1       150     0.25
1982    1       1       121     0.25
1983    1       1       116     0.25
1984    1       1       91      0.25
1985    1       1       88      0.25
1986    1       1       76      0.25
1987    1       1       116     0.25
1988    1       1       158     0.25
1989    1       1       172     0.25
1990    1       1       149     0.25
1991    1       1       146     0.25
1992    1       1       109     0.25
1993    1       1       80      0.25
1994    1       1       112     0.25
1995    1       1       126     0.25
1996    1       1       96      0.25
#
# triennial GLM tuned
1980    1       5       3954.37 1.625
1983    1       5       1994.42 0.613
1986    1       5       1166.33 1.213
1989    1       5       2400.58 0.300
1992    1       5       368.77  0.581
1995    1       5       1545.10 0.264
1998    1       5       945.46  0.341
```

```
2001	1	5	806.63	0.285
2004	1	5	2157.54	0.254

#NWC combo survey glm tuned
2003	1	6	3932	0.61654
2004	1	6	24559	1.19248
2005	1	6	9540	0.4466
2006	1	6	7384	0.40252
# juvenile survey- FED
#year	season	type	value	SD
1984	1	7	7.3254	0.37012
1985	1	7	8.1232	0.4589
1986	1	7	0.7227	0.3300
1987	1	7	13.2204	0.3468
1988	1	7	16.3753	0.3859
1989	1	7	0.3869	0.4811
1990	1	7	0.3093	0.4094
1991	1	7	0.9761	0.3383
1992	1	7	0.1687	0.5192
1993	1	7	10.3256	0.2972
1994	1	7	0.0235	0.8093
1995	1	7	0.2455	0.6069
1996	1	7	0.0909	0.5163
1997	1	7	0.1310	0.7428
1999	1	7	0.2059	0.4342
2000	1	7	0.0888	0.5242
2001	1	7	0.8528	0.3412
2002	1	7	2.2921	0.3228
2003	1	7	1.0052	0.4103
2004	1	7	1.3333	0.3902
#
2001	1	8	1.7161	0.0401
2002	1	8	2.7629	0.0451
2003	1	8	1.5719	0.0367
2004	1	8	2.9379	0.0360
2005	1	8	0.8658	0.0346
2006	1	8	0.7523	0.0301
#
#
# CalCOFI survey
#year	season	type	Index	CV
#year	season	type	Index	CV
1951	1	9	0.14183053	0.8414901
1953	1	9	0.16864622	0.4698166
1954	1	9	0.21885162	0.3547108
1955	1	9	0.2545118	0.4020231
1956	1	9	0.12075705	0.6590477
1957	1	9	0.30887709	0.522799
1958	1	9	0.39454343	0.3479359
1959	1	9	0.08842933	0.4466416
1960	1	9	0.18220879	0.3299083
1961	1	9	0.08775916	0.5532203
1962	1	9	0.068755	0.6127899
1963	1	9	0.19684699	0.4639924
1964	1	9	0.0631976	0.5157418
1965	1	9	0.14914866	0.3859004
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1966	1	9	0.24731002	0.3842774
1967	1	9	0.34379234	0.540158
1968	1	9	0.63368278	0.5381044
1969	1	9	0.55183877	0.3579827
1970	1	9	0.27392882	0.5389176
1975	1	9	0.02550871	0.6909198
1992	1	9	0.12549796	0.5956311
2002	1	9	0.04308614	0.6761029
2003	1	9	0.08688551	0.4902213
2004	1	9	0.1717815	0.4136779
2005	1	9	0.01187012	0.7130089
2006	1	9	0.03316714	0.7720739
# rec cpue
#year	season	type	index	jack.cv
1987	1	10	0.166856206	0.1631351
1988	1	10	0.083010716	0.1794928
1989	1	10	0.054122438	0.1633441
1990	1	10	0.031462634	0.4267126
1991	1	10	0.040173333	0.3545357
1992	1	10	0.064866103	0.5545214
1993	1	10	0.026517113	0.2333201
1994	1	10	0.023850668	0.2796596
1995	1	10	0.024610012	0.4197283
1996	1	10	0.015093027	0.4449115
1997	1	10	0.008328447	0.3430329
1998	1	10	0.006612019	0.421573


# Discard section- currently I have no discard data
2	# Discard biomass (1=biomass, 2=fraction)
0	# number of observations
# mean body weight (in kg)
0	# number of observations
# length composition
-1	# compress tails of composition (negative turns off)
0.0001	# constant added to observed and expected proportions at age
19	# number of length bins
16	18	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52
112	# number of length observations-
# length composition
#
# Trawl fishery		Females first, then males			females

		males

#year	season	type	gender	partition	# samples		16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52	16
	18	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52
1978	1	1	3	0	147	0.00022	0	0	0.01818	0.00388	0.00229	0.00744
	0.01194	0.04564	0.05786	0.04806	0.05182	0.07637	0.10655	0.05257	0.04429	0.07482	0.01717	0.01018	0
	0	0	0.00021	0.00069	0.00102	0.01447	0.05906	0.18275	0.04776	0.04849	0.01021	0.00039	0
	0.00018	0.00121	0	0.00429	0
1979	1	1	3	0	110	0	0	0.00049	0	0.00004	0.00132	0.02087	0.0092
	0.01246	0.04269	0.03287	0.03745	0.1193	0.066	0.17126	0.10614	0.08089	0.00735	0.00528	0	0
```

0 0 0.00041 0.00095 0.00821 0.04017 0.0724 0.06751 0.05974 0.03585 0.00011 0.00001 0.0008
0 0.00008 0.00017 0
1980 1 1 3 0 191 0 0 0.00039 0 0 0.00349 0.00287 0.0041
0.02768 0.05072 0.06043 0.1232 0.09582 0.10987 0.08439 0.07823 0.03707 0.0149 0.00063 0 0
0 0 0.00342 0.00256 0.00799 0.03147 0.08474 0.09921 0.04584 0.01837 0.00273 0.00223
0.00025 0.00042 0.0066 0.00008 0.0003
1981 1 1 3 0 125 0 0 0 0 0 0.00088 0.00667
0.00529 0.01266 0.01064 0.09861 0.2005 0.09316 0.10213 0.0487 0.07159 0.04917 0.00273 0.00009 0
0 0 0 0 0.00064 0.00026 0.04874 0.11222 0.12205 0.0119 0.00084 0.00005
0.00046 0 0.00002 0 0 0
1982 1 1 3 0 195 0 0 0 0.00035 0.00022 0.00067 0.00525
0.01354 0.01678 0.0125 0.06505 0.08043 0.13048 0.18373 0.15391 0.076 0.03757 0.01085 0.00174 0
0 0 0.00078 0.00005 0.00359 0.00727 0.02841 0.07633 0.06915 0.02099 0.00408 0.00023
0.00006 0 0 0 0 0
1983 1 1 3 0 275 0 0 0 0 0.0002 0.00113 0.00338
0.01176 0.01812 0.01728 0.02633 0.03683 0.13454 0.20614 0.14642 0.11552 0.07491 0.02504 0.00759 0
0 0 0.00004 0.0001 0.00066 0.00736 0.03449 0.03921 0.05539 0.02184 0.00391 0.00018
0.00244 0.00191 0.00005 0.00001 0.00007 0.00715
1984 1 1 3 0 305 0 0 0 0.00003 0.00006 0.00369 0.00333
0.01501 0.05746 0.08824 0.16352 0.06524 0.10441 0.07823 0.06725 0.04769 0.02093 0.00477 0.0017
0.00002 0 0 0 0.00009 0.00102 0.02879 0.03878 0.0771 0.06447 0.05422 0.00792
0.00032 0.00166 0.00061 0.00242 0.00049 0.00052 0.00002
1985 1 1 3 0 338 0 0 0 0.001 0.00035 0.00128 0.00832
0.02207 0.04019 0.06271 0.08883 0.11605 0.06376 0.05989 0.07079 0.04972 0.02535 0.00534 0.00193 0
0 0 0.00009 0.00011 0.00232 0.01902 0.06599 0.10678 0.1175 0.04632 0.01314 0.00603
0.00042 0.00045 0.00138 0.0015 0.00138 0
1986 1 1 3 0 219 0.00044 0.0001 0 0.00022 0.00009 0.00458 0.00832
0.02425 0.0379 0.0594 0.07245 0.09209 0.07529 0.05696 0.07571 0.06683 0.03424 0.03705 0.00078 0
0.00004 0 0.00093 0.0034 0.00564 0.01592 0.09321 0.10176 0.06953 0.03448 0.01659 0.00662
0.00095 0 0.0018 0.00244 0 0
1987 1 1 3 0 211 0.00016 0 0.00012 0.00003 0.00189 0.01545 0.07235
0.16683 0.09549 0.04457 0.03733 0.04516 0.04761 0.04209 0.0179 0.00896 0.00521 0.00057 0.00056 0
0 0 0 0.00112 0.04064 0.1188 0.06182 0.08213 0.06136 0.02295 0.00782 0.00086
0.00019 0.00001 0.00001 0 0 0
1988 1 1 3 0 199 0 0 0 0 0.00003 0.01118 0.03265
0.08052 0.0893 0.10642 0.08444 0.01661 0.03359 0.05067 0.02813 0.01291 0.00676 0.00425 0.0009 0
0 0 0.00003 0.00014 0.04746 0.12885 0.10265 0.08427 0.0428 0.03387 0.00139 0
0.00016 0.00001 0 0 0 0
1989 1 1 3 0 183 0.00007 0 0 0 0.00207 0.00491 0.0133
0.01524 0.05436 0.09059 0.13372 0.17294 0.02935 0.01437 0.01396 0.00704 0.00758 0.00131 0 0
0 0 0.00096 0.00612 0.00994 0.0414 0.15366 0.12776 0.06141 0.03496 0.00173 0.00017
0.00098 0 0.00009 0 0 0
1990 1 1 3 0 204 0.00001 0 0.00006 0 0.00355 0.00738 0.03629
0.04755 0.04567 0.04607 0.06876 0.14846 0.10491 0.043 0.03709 0.00822 0.00432 0.00119 0.00018 0
0 0 0 0.00195 0.02245 0.05403 0.08982 0.12547 0.04891 0.04953 0.004 0.00087 0
0.00021 0 0.00002 0.00005 0
1991 1 1 3 0 208 0.00017 0 0.0005 0.00091 0.00456 0.01515 0.02599
0.05384 0.08291 0.06996 0.06904 0.07213 0.07997 0.04056 0.03088 0.01192 0.0107 0.00363 0.00104 0
0 0.00015 0.00013 0.00662 0.01265 0.05956 0.10457 0.13979 0.06707 0.02766 0.00608 0.00157 0
0.00009 0 0.0002 0 0
1992 1 1 3 0 132 0 0 0 0.00005 0.00405 0.0288 0.05881
0.09328 0.08427 0.06824 0.04726 0.07089 0.06935 0.07266 0.04536 0.03254 0.02026 0.00379 0 0
0 0.00001 0.00008 0.00384 0.02468 0.03734 0.0624 0.08162 0.05922 0.01503 0.00609 0.00293
0.00213 0.00284 0.00075 0.00142 0 0
1993 1 1 3 0 126 0 0.00012 0.00001 0.00064 0.00864 0.01402 0.05882
0.16809 0.08456 0.08385 0.08023 0.05142 0.04641 0.04061 0.02042 0.00764 0.00506 0.00094 0 0

0 0 0.00203 0.00957 0.06125 0.11245 0.07924 0.04639 0.01194 0.00498 0.00006 0 0
0 0 0 0.0006 0
1994 1 1 3 0 117 0 0 0 0 0.00167 0.0112 0.02259
0.02581 0.04153 0.06489 0.1126 0.06874 0.07034 0.05595 0.05194 0.02649 0.01075 0.00073 0.0009 0
0 0 0 0.00184 0.04468 0.08946 0.12132 0.0972 0.06042 0.01519 0.0029 0.00021
0.00068 0 0 0 0 0
1995 1 1 3 0 114 0 0 0 0.00035 0.00078 0.00111 0.00893
0.03026 0.05741 0.05007 0.08525 0.12008 0.09374 0.06827 0.0388 0.02381 0.00884 0.00242 0.00119
0.00175 0 0 0.00205 0 0.01412 0.03783 0.08782 0.14094 0.0774 0.03078 0.00468
0.00073 0.00171 0.00223 0.0049 0 0 0.00175
1996 1 1 3 0 116 0 0 0 0.00033 0.00445 0.03196 0.08891
0.08369 0.0443 0.04167 0.05217 0.04535 0.06299 0.06357 0.01947 0.01333 0.00335 0.00023 0.00019 0
0 0 0.00168 0.01966 0.10183 0.10599 0.06959 0.07843 0.0509 0.01033 0.00186 0.00194 0.0005
0.00132 0 0 0 0
1997 1 1 3 0 136 0 0 0 0.00077 0.00202 0.00216 0.02881
0.12925 0.10512 0.03317 0.02917 0.05403 0.05664 0.04962 0.04472 0.01526 0.00855 0.0007 0.00001 0
0 0 0.0033 0.00045 0.06268 0.14975 0.09977 0.06919 0.02845 0.01467 0.00857 0.0001
0.00137 0.00127 0.00042 0 0 0
1998 1 1 3 0 123 0 0 0 0 0.00397 0.01444 0.0224
0.03925 0.06226 0.09141 0.0686 0.06555 0.07515 0.05957 0.04919 0.03089 0.00886 0.00108 0.0018 0
0 0 0 0.04411 0.01694 0.06933 0.12133 0.08988 0.03285 0.02736 0.00183 0.00042 0.0005
0.00085 0.00014 0.00003 0.00001 0
1999 1 1 3 0 84 0.00047 0.00112 0 0 0.00036 0.00233 0.03304
0.08849 0.0807 0.03665 0.06671 0.08052 0.05581 0.07201 0.05503 0.04537 0.01173 0.00715 0.00016 0
0 0 0 0.00011 0.03147 0.08443 0.10657 0.07571 0.04674 0.01023 0.00673 0
0.00002 0.00035 0 0 0 0
2000 1 1 3 0 50 0 0 0 0.00228 0.00019 0.00019 0.00928
0.01157 0.02875 0.05166 0.05578 0.11252 0.10642 0.09753 0.11272 0.08519 0.03014 0.00908 0.00308
0.00002 0 0 0.00031 0 0.01031 0.02243 0.0715 0.0666 0.07021 0.0207 0.01719 0.0016
0.00051 0.00101 0.00089 0.00033 0 0
2001 1 1 3 0 58 0 0 0 0.0083 0.01993 0.00771 0.01187
0.01642 0.03758 0.0536 0.05483 0.06074 0.05892 0.10988 0.03332 0.05608 0.0312 0.0132 0.05663 0
0 0 0.01426 0.02615 0.01599 0.02994 0.0876 0.10742 0.0699 0.01551 0.0022 0.00032 0
0.0004 0 0 0 0.00011
2002 1 1 3 0 54 0 0.00586 0.00114 0.00864 0.03363 0.07192 0.09017 0.0404
0.02739 0.0244 0.01947 0.05204 0.05112 0.08519 0.0902 0.07081 0.04005 0.00877 0.00706 0.00113
0.00452 0.00124 0.0041 0.02706 0.07152 0.02883 0.03737 0.03884 0.03246 0.01081 0.00224 0.00322
0.00246 0.00284 0 0 0.00083 0.0023
2003 1 1 3 0 18 0 0 0 0.00218 0.00084 0.00031 0.00632
0.19441 0.31227 0.10404 0.01206 0.00536 0.00727 0.01577 0.01604 0.00329 0.00214 0 0.00096 0
0.00023 0.00011 0.00084 0.00011 0.07587 0.12785 0.0586 0.02396 0.02086 0.00712 0.00119 0 0
0 0 0 0 0
2004 1 1 3 0 54 0 0 0 0.00012 0.00048 0.00063 0.00095
0.00524 0.02633 0.21118 0.27406 0.05632 0.01742 0.03838 0.05902 0.04136 0.02919 0.0043 0 0
0 0 0.00023 0.00058 0.00026 0.02585 0.10078 0.07134 0.02827 0.00561 0.00212 0 0
0 0 0 0 0
2005 1 1 3 0 20 0 0 0 0.00095 0 0 0
0.01986 0.0208 0.00037 0.06466 0.3323 0.18004 0.04388 0.04495 0.02574 0.01096 0 0 0
0 0 0 0 0 0.06488 0.12996 0.03707 0.00865 0.00543 0 0.00949 0
0 0 0 0 0
2006 1 1 3 0 31 0 0 0 0 0 0 0
0.00112 0.01377 0.00514 0.02027 0.08864 0.3692 0.25929 0.03989 0.06281 0.0263 0.00508 0.00053 0
0 0 0 0 0 0 0.01525 0.01022 0.04 0.04166 0 0.00083 0
0 0 0 0 0
#

Hook and line fishery females

males

#year	season	type	gender	partition	# samples		16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52	16
	18	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52								
1980	1	2	3	0	1	0	0	0	0	0	0	0	0
	0	0	0	0.05346	0.0004	0.0002	0.10731	0.21581	0.62144	0.0004	0	0	0
	0	0	0	0	0	0	0	0	0.0002	0	0	0	0
	0.0002	0.0004	0	0									
1982	1	2	3	0	20	0	0	0	0	0	0	0	0
	0	0	0	0.02656	0.07327	0.14654	0.35618	0.19872	0.17263	0.02609	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0									
1983	1	2	3	0	8	0	0	0	0	0	0	0	0
	0	0	0	0.01666	0.14961	0.06663	0.09964	0.26559	0.38521	0	0	0	0
	0	0	0	0	0	0	0.01666	0	0	0	0	0	0
	0	0	0	0									
1984	1	2	3	0	9	0	0	0	0	0	0	0	0
	0	0	0	0.05882	0.11765	0.17647	0.23529	0.17647	0.17647	0	0.05882	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0									
1985	1	2	3	0	14	0	0	0	0	0	0	0	0
	0	0.00023	0.0222	0.10922	0.15438	0.09717	0.3143	0.15556	0.0774	0.01025	0	0	0
	0	0	0	0	0	0	0.01315	0.02107	0.0246	0	0	0	
	0.00047	0	0	0	0								
1986	1	2	3	0	8	0	0	0	0	0	0	0	
	0.00138	0	0.00204	0.00836	0.02555	0.14258	0.10739	0.35049	0.17396	0.11928	0.04642	0.0002	0
	0	0	0	0	0	0.00003	0	0	0.01824	0.0004	0	0	
	0.00191	0	0.00178	0	0	0							
1987	1	2	3	0	9	0	0	0	0	0	0	0.00657	
	0.02064	0.0066	0	0.05516	0.17066	0.23488	0.1451	0.10775	0.05923	0.1022	0.00734	0.00004	0
	0	0	0	0	0	0.00319	0.00657	0.00657	0.00319	0	0.06432	0	0
	0	0	0	0	0								
1989	1	2	3	0	16	0	0	0	0	0	0	0	0
	0.03538	0.08849	0.08298	0.02435	0.0592	0.01779	0.01218	0.01826	0.02435	0	0	0	0
	0	0	0	0	0.01769	0.08846	0.05308	0.33615	0.12388	0.01769	0	0.00007	0
	0	0	0	0									
1990	1	2	3	0	16	0	0	0	0	0	0	0	
	0.00205	0	0.05716	0.16326	0.58683	0.16725	0	0.0032	0.00326	0	0	0	0
	0	0	0	0	0	0	0.00483	0	0.00526	0.00689	0	0	0
	0	0	0	0	0								
1991	1	2	3	0	41	0	0.00143	0	0	0.00003	0.01129	0.00118	
	0.01025	0.06023	0.08648	0.19366	0.08308	0.15067	0.07261	0.05628	0.01759	0.00397	0.00164	0	0
	0	0	0	0.00003	0.00045	0.02487	0.04852	0.09975	0.06582	0.00883	0.00088	0.00025	
	0.00019	0	0	0	0	0							
1992	1	2	3	0	84	0	0	0	0	0	0.00081	0.00155	
	0.03048	0.03815	0.08563	0.08881	0.1549	0.11131	0.13644	0.08134	0.03369	0.01247	0.00425	0	0
	0	0	0	0	0.00315	0.01819	0.07305	0.05973	0.05016	0.01027	0.00158	0.00079	
	0.00311	0	0	0	0	0							
1993	1	2	3	0	87	0	0	0.00036	0	0	0.0251	0.10349	
	0.25814	0.18048	0.14098	0.08223	0.05605	0.00957	0.0072	0.0021	0.001	0.00086	0	0	0

0 0 0.00036 0.01122 0.02667 0.02754 0.02959 0.03582 0.00116 0.00007 0 0 0
0 0 0 0 0
1994 1 2 3 0 86 0 0 0 0 0 0 0
0.00284 0.01322 0.04427 0.08209 0.16641 0.19531 0.21998 0.08578 0.03136 0.03328 0.00023 0 0
0 0 0 0 0 0 0.03582 0.05304 0.02098 0.00407 0.0113 0 0
0 0 0 0 0
1995 1 2 3 0 23 0 0 0 0 0 0 0
0.02018 0.02427 0.02279 0.10374 0.2622 0.10859 0.0662 0.02693 0.0042 0.00013 0 0 0
0 0 0 0 0 0.01229 0.03623 0.0747 0.04455 0.06782 0.05856 0.03752
0.00387 0.01682 0 0 0 0
1996 1 2 3 0 41 0 0 0 0 0 0 0.01667 0.0016
0.01394 0.08846 0.1179 0.22555 0.21468 0.07447 0.04815 0.03936 0.00221 0.00204 0 0 0
0 0 0 0 0 0.01948 0.05499 0.06521 0.00247 0.01121 0 0.0016 0
0 0 0 0
1997 1 2 3 0 38 0 0 0 0 0.00215 0.00078 0
0.01598 0.08748 0.09409 0.08517 0.14414 0.19467 0.10841 0.07685 0.04188 0.01266 0.00378 0 0
0 0 0 0 0.00303 0.03014 0.04673 0.02531 0.02327 0.00078 0.00239 0.00003
0.00027 0 0 0 0 0
1998 1 2 3 0 38 0.00326 0 0 0 0 0 0.00563 0.0064
0.03196 0.13658 0.09991 0.06159 0.11968 0.13457 0.07747 0.04899 0.00844 0.00774 0.00391 0 0
0 0 0.00461 0.00326 0.00226 0.06047 0.09318 0.07127 0.01461 0.00047 0 0.00372 0
0 0 0 0
1999 1 2 3 0 11 0 0 0 0 0 0 0
0.02659 0.06492 0.07368 0.17232 0.24041 0.09193 0.11931 0.06458 0.02409 0.00238 0 0 0
0 0 0 0 0.00467 0.00517 0.02843 0.04026 0.02993 0.01134 0 0 0
0 0 0 0 0
2000 1 2 3 0 9 0 0 0 0 0 0.00031 0.00031
0.01411 0.02543 0.13084 0.25728 0.12122 0.16961 0.077 0.05276 0.0226 0.02131 0 0 0
0 0 0 0 0.00031 0.01034 0.01534 0.04837 0.02074 0.00626 0 0
0.00587 0 0 0 0 0
2001 1 2 3 0 12 0 0 0 0 0 0 0
0.00132 0 0.01175 0.03414 0.0829 0.11837 0.1749 0.12195 0.05119 0.02052 0.01335 0 0
0 0 0 0 0 0.01026 0.06216 0.17562 0.10756 0.01241 0 0 0.0016
0 0 0 0 0
2002 1 2 3 0 3 0 0 0 0 0 0.02632 0.10526 0
0 0 0 0.02632 0 0 0.05263 0.02632 0.02632 0 0 0 0
0 0 0.02632 0.02632 0 0.15789 0.39474 0.13158 0 0 0 0 0
0 0 0 0
2006 1 2 3 0 3 0 0 0 0 0 0 0 0
0 0.01272 0 0.16185 0.23815 0.25318 0.10867 0.05549 0.10636 0 0 0 0
0 0 0 0 0 0 0.02543 0 0 0 0.02543 0.01272 0
0 0 0 0
#

#Net fishery females

#year season type gender partition # samples 16 18 20 22 24 26 28
30 32 34 36 38 40 42 44 46 48 50 52 16
18 20 22 24 26 28 30 32 34 36 38 40 42
44 46 48 50 52
1983 1 3 3 0 24 0 0 0 0 0 0 0 0
0 0 0.01248 0.06211 0.14868 0.19754 0.332 0.13685 0.02443 0 0.00307 0 0

	0	0	0	0	0	0.01248	0.03545	0.02297	0	0.01195	0	0	0
	0	0	0	0									
1984	1	3	3	0	68	0	0.01047	0	0	0	0	0	0
	0	0	0	0	0.16667	0.29147	0.32045	0.10306	0.09742	0.01047	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0									
1985	1	3	3	0	155	0	0	0	0	0	0	0.00122	0
	0.00021	0.00467	0.02343	0.07395	0.09334	0.15591	0.24592	0.23791	0.06391	0.00509	0.00302	0	0
	0	0	0	0	0.00015	0.00273	0.02204	0.03686	0.01733	0.01211	0	0.0002	0
	0	0	0	0									
1986	1	3	3	0	113	0	0	0	0	0	0	0.00023	0.0004
	0.00057	0.00026	0.01582	0.06056	0.18991	0.18421	0.21071	0.20903	0.05679	0.00621	0	0	0
	0	0	0	0	0	0.00011	0.00566	0.02964	0.00568	0.00403	0.00343	0.00667	0
	0	0	0	0									
1987	1	3	3	0	92	0	0	0	0	0	0	0.00079	
	0.00162	0.00036	0.00232	0.00897	0.01165	0.19355	0.2855	0.17057	0.1123	0.0467	0.01564	0.00089	0
	0	0	0	0	0	0.00347	0.04653	0.01944	0.01772	0.01386	0.04378	0.00194	
	0.00186	0	0	0	0	0							
1988	1	3	3	0	70	0	0	0	0	0	0.00041	0.00044	
	0.00117	0.0638	0.12296	0.00271	0.00163	0.00385	0.31123	0.257	0.09212	0.01448	0.00127	0	0
	0	0	0	0.00006	0.00015	0.00097	0.11848	0.00267	0.00138	0.00279	0.00013	0.00005	0
	0	0	0	0	0								
1989	1	3	3	0	82	0	0	0	0	0	0	0.01848	
	0.01832	0.03839	0.12987	0.14382	0.11016	0.07334	0.12715	0.10056	0.13359	0.01859	0.01313	0.01893	0
	0	0	0	0	0	0.0123	0.01375	0.01428	0.00822	0.00655	0.00043	0.00014	0
	0	0	0	0	0								
1990	1	3	3	0	99	0	0	0.00078	0	0	0.00057	0.0025	
	0.00785	0.01569	0.01327	0.0751	0.1624	0.13408	0.04108	0.2186	0.08537	0.05356	0.00613	0.00021	0
	0	0	0	0	0	0.00171	0.0388	0.04572	0.02568	0.01163	0.04536	0.00371	0
	0.0102	0	0	0	0								
1991	1	3	3	0	35	0	0	0	0	0	0.00144	0.00352	
	0.00863	0.0187	0.03612	0.08646	0.16717	0.23046	0.13553	0.04859	0.03628	0.00927	0	0	0
	0	0	0	0	0.00016	0.02781	0.06585	0.05945	0.04155	0.00943	0.00767	0	
	0.00591	0	0	0	0	0							

1992 length comps had several large males from Morro Bay area - probably mis-ID'd sex or species- thus sample size turned to negative 1

1992	1	3	3	0	-1	0	0	0	0	0	0	0.00216	
	0.01539	0.00683	0.04506	0.07463	0.09314	0.14088	0.16453	0.10951	0.10248	0.06281	0.00667	0	0
	0	0	0	0	0.00139	0.01445	0.02481	0.08037	0.03203	0.01596	0.00178	0.00095	
	0.00059	0.00027	0	0	0	0							
1993	1	3	3	0	35	0	0	0	0	0	0.00102	0.00848	
	0.01798	0.0186	0.03445	0.10195	0.15712	0.24255	0.15447	0.09174	0.01546	0	0	0	0
	0	0	0	0.00473	0.00358	0.04126	0.06158	0.02809	0.01171	0.00428	0	0.00097	0
	0	0	0	0	0								
1994	1	3	3	0	47	0	0	0	0	0	0	0	0
	0.00085	0.01046	0.03534	0.05834	0.11516	0.34256	0.15397	0.0921	0.05238	0.00712	0	0	0
	0	0	0	0	0.00085	0.02841	0.03954	0.0351	0.0278	0	0	0	0
	0	0	0	0									
1995	1	3	3	0	32	0	0	0	0	0	0	0	0
	0	0.00906	0	0.0436	0.08736	0.31989	0.22707	0.20206	0.07282	0.02	0	0	0
	0	0	0	0	0	0	0	0.01813	0	0	0	0	0
	0	0	0	0									
1996	1	3	3	0	21	0	0	0	0	0	0	0	0
	0	0.01626	0.03252	0.0813	0.1626	0.26016	0.25203	0.09756	0.07317	0	0	0	0
	0	0	0	0	0	0	0.01626	0	0	0	0	0	
	0.00813	0	0	0	0								

1997	1	3	3	0	14	0	0	0	0	0	0	0	0
	0.01361	0.00537	0.00956	0.05249	0.15283	0.29519	0.25541	0.11019	0.01381	0.01074	0	0	0
	0	0	0	0	0	0.00517	0.01829	0.03229	0.02504	0	0	0	0
	0	0	0	0									
1998	1	3	3	0	11	0	0	0	0	0	0	0	0
	0	0.01304	0.0087	0.01739	0.14783	0.27391	0.33913	0.07826	0.02609	0	0	0	0
	0	0	0	0	0	0.02174	0	0.04783	0.01304	0	0.01304	0	0
	0	0	0	0									

#

Recfin length comps Coastwide (N and S)

#year	season	type	gender	part	Nsamp	16	18	20	22	24	26	28	30
	32	34	36	38	40	42	44	46	48	50	52	16	18
	20	22	24	26	28	30	32	34	36	38	40	42	44
	46	48	50	52									
1980	1	4	0	0	50	0.00255	0	0.01278	0.0358	0.07928	0.07672	0.13554	
	0.11253	0.11253	0.09718	0.07161	0.08439	0.07161	0.04092	0.02813	0.02301	0.01278	0	0.00255	
	0.00255	0	0.01278	0.0358	0.07928	0.07672	0.13554	0.11253	0.11253	0.09718	0.07161	0.08439	
	0.07161	0.04092	0.02813	0.02301	0.01278	0	0.00255						
1981	1	4	0	0	47	0.00127	0	0	0.00508	0.02033	0.0343	0.06607	
	0.14485	0.11689	0.13214	0.10673	0.1385	0.08767	0.04447	0.04066	0.02668	0.02033	0.0127	0.00127	
	0.00127	0	0	0.00508	0.02033	0.0343	0.06607	0.14485	0.11689	0.13214	0.10673	0.1385	
	0.08767	0.04447	0.04066	0.02668	0.02033	0.0127	0.00127						
1982	1	4	0	0	59	0	0	0	0	0.02427	0.05663	0.07605	
	0.08252	0.09061	0.06796	0.08576	0.12621	0.13754	0.11488	0.05501	0.05016	0.02427	0.00647	0.00161	0
	0	0	0	0.02427	0.05663	0.07605	0.08252	0.09061	0.06796	0.08576	0.12621	0.13754	
	0.11488	0.05501	0.05016	0.02427	0.00647	0.00161							
1983	1	4	0	0	45	0	0	0.00464	0.01547	0.02321	0.07739	0.10371	
	0.15634	0.12848	0.07894	0.05417	0.0712	0.09287	0.07739	0.04489	0.04334	0.02321	0.00309	0.00154	0
	0	0.00464	0.01547	0.02321	0.07739	0.10371	0.15634	0.12848	0.07894	0.05417	0.0712	0.09287	
	0.07739	0.04489	0.04334	0.02321	0.00309	0.00154							
1984	1	4	0	0	90	0	0	0.00254	0.00636	0.01908	0.03053	0.0547	0.0916
	0.15267	0.20101	0.13613	0.07506	0.10432	0.07633	0.0318	0.01653	0.00127	0	0	0	0
	0.00254	0.00636	0.01908	0.03053	0.0547	0.0916	0.15267	0.20101	0.13613	0.07506	0.10432	0.07633	0.0318
	0.01653	0.00127	0	0									
1985	1	4	0	0	138	0.00099	0.00049	0.00198	0.00596	0.00994	0.01838	0.03628	
	0.09045	0.1332	0.12176	0.12524	0.14015	0.11282	0.08697	0.0656	0.02932	0.01391	0.00546	0.00099	
	0.00099	0.00049	0.00198	0.00596	0.00994	0.01838	0.03628	0.09045	0.1332	0.12176	0.12524	0.14015	
	0.11282	0.08697	0.0656	0.02932	0.01391	0.00546	0.00099						
1986	1	4	0	0	115	0	0.00095	0.00381	0.01858	0.07435	0.10724	0.05052	
	0.04718	0.07769	0.1101	0.0958	0.10247	0.13203	0.09103	0.04385	0.0305	0.01096	0.00238	0.00047	0
	0.00095	0.00381	0.01858	0.07435	0.10724	0.05052	0.04718	0.07769	0.1101	0.0958	0.10247	0.13203	
	0.09103	0.04385	0.0305	0.01096	0.00238	0.00047							
1987	1	4	0	0	22	0	0	0.00761	0.01776	0.04568	0.08375	0.12436	
	0.11675	0.11675	0.10659	0.04568	0.05076	0.03299	0.06852	0.07614	0.04314	0.01776	0.0203	0.02538	0
	0	0.00761	0.01776	0.04568	0.08375	0.12436	0.11675	0.11675	0.10659	0.04568	0.05076	0.03299	
	0.06852	0.07614	0.04314	0.01776	0.0203	0.02538							
1988	1	4	0	0	72	0	0	0	0.00323	0.02047	0.04956	0.12931	
	0.20474	0.23922	0.16056	0.02693	0.01724	0.02693	0.06142	0.03987	0.01185	0.00646	0	0.00215	0
	0	0	0.00323	0.02047	0.04956	0.12931	0.20474	0.23922	0.16056	0.02693	0.01724	0.02693	
	0.06142	0.03987	0.01185	0.00646	0	0.00215							
1989	1	4	0	0	29	0	0	0	0.00219	0.0307	0.04495	0.0921	
	0.14692	0.1546	0.21052	0.21052	0.06469	0.02083	0.00986	0.00877	0.00328	0	0	0	0

```
       0       0       0.00219 0.0307  0.04495 0.0921  0.14692 0.1546  0.21052 0.21052 0.06469 0.02083
       0.00986 0.00877 0.00328 0       0       0
1994   1       4       0       0       5       0       0       0       0       0.09677 0.06451 0.16129
       0.16129 0.2258  0.16129 0.09677 0.03225 0       0       0       0       0       0       0       0
       0       0       0       0.09677 0.06451 0.16129 0.16129 0.2258  0.16129 0.09677 0.03225 0       0
       0       0       0       0       0
1995   1       4       0       0       5       0       0       0       0.08053 0.05369 0.22147 0.26174
       0.20134 0.12751 0.02684 0.02013 0       0       0       0       0       0       0       0.00671 0
       0       0       0.08053 0.05369 0.22147 0.26174 0.20134 0.12751 0.02684 0.02013 0       0       0
       0       0       0       0       0.00671
1996   1       4       0       0       20      0       0       0.00359 0.05215 0.07553 0.14928 0.19064
       0.09892 0.07553 0.10431 0.07913 0.05935 0.05575 0.04136 0.01258 0.00179 0       0       0       0
       0       0.00359 0.05215 0.07553 0.14928 0.19064 0.09892 0.07553 0.10431 0.07913 0.05935 0.05575
       0.04136 0.01258 0.00179 0       0       0
1997   1       4       0       0       15      0       0       0       0.00338 0.0305  0.08305 0.05254
       0.07627 0.05423 0.05423 0.07796 0.18474 0.17288 0.12542 0.05254 0.02203 0.00677 0.00338 0       0
       0       0       0.00338 0.0305  0.08305 0.05254 0.07627 0.05423 0.05423 0.07796 0.18474 0.17288
       0.12542 0.05254 0.02203 0.00677 0.00338 0
1998   1       4       0       0       6       0       0       0       0       0.0114  0.01901 0.06083
       0.19771 0.13307 0.12167 0.08365 0.06463 0.11026 0.08745 0.07604 0.01901 0.0152  0       0       0
       0       0       0       0.0114  0.01901 0.06083 0.19771 0.13307 0.12167 0.08365 0.06463 0.11026
       0.08745 0.07604 0.01901 0.0152  0       0
1999   1       4       0       0       47      0       0.00516 0.01204 0.02065 0.02925 0.07056 0.07917
       0.09294 0.06196 0.07228 0.06196 0.0981  0.11187 0.16179 0.09122 0.02409 0.00516 0       0.00172 0
       0.00516 0.01204 0.02065 0.02925 0.07056 0.07917 0.09294 0.06196 0.07228 0.06196 0.0981  0.11187
       0.16179 0.09122 0.02409 0.00516 0       0.00172
2000   1       4       0       0       31      0       0.01086 0.08695 0.06521 0.02898 0.07246 0.07608 0.0942
       0.06521 0.0471  0.02173 0.05797 0.0942  0.09057 0.08695 0.08695 0.01086 0.00362 0       0
       0.01086 0.08695 0.06521 0.02898 0.07246 0.07608 0.0942  0.06521 0.0471  0.02173 0.05797 0.0942
       0.09057 0.08695 0.08695 0.01086 0.00362 0
2001   1       4       0       0       16      0       0       0.02675 0.09698 0.1806  0.0903  0.05685
       0.05016 0.07692 0.05351 0.03678 0.05351 0.08361 0.07023 0.07023 0.04013 0.01337 0       0       0
       0       0.02675 0.09698 0.1806  0.0903  0.05685 0.05016 0.07692 0.05351 0.03678 0.05351 0.08361
       0.07023 0.07023 0.04013 0.01337 0       0
2002   1       4       0       0       18      0       0       0       0.00888 0.13777 0.14666 0.14666
       0.07111 0.01333 0.02666 0.04888 0.00888 0.05333 0.07555 0.12    0.11111 0.02666 0.00444 0       0
       0       0       0.00888 0.13777 0.14666 0.14666 0.07111 0.01333 0.02666 0.04888 0.00888 0.05333
       0.07555 0.12    0.11111 0.02666 0.00444 0
#2004  1       4       0       0       41      0.00429 0.01716 0.01287 0.03433 0.11587 0.21459 0.13304
       0.09442 0.1545  0.11158 0.07296 0.02575 0.00429 0       0       0.00429 0       0       0
       0.00429 0.01716 0.01287 0.03433 0.11587 0.21459 0.13304 0.09442 0.1545  0.11158 0.07296 0.02575
       0.00429 0       0       0.00429 0       0       0
#2005  1       4       0       0       16      0       0.07547 0.30188 0.09433 0.01886 0.07547 0.0566
       0.09433 0.03773 0.01886 0.13207 0.0566  0.03773 0       0       0       0       0       0       0
       0.07547 0.30188 0.09433 0.01886 0.07547 0.0566  0.09433 0.03773 0.01886 0.13207 0.0566  0.03773 0
       0       0       0       0       0
#
# Triennial survey length data-
1977   1       5       3       0       56      0.00132 0.0028  0.01864 0.04554 0.02555 0.01866 0.01316
       0.01863 0.04304 0.08371 0.05878 0.02463 0.03757 0.05619 0.05998 0.05109 0.04681 0.02098 0.00456
       0.00157 0.0026  0.01833 0.04147 0.01525 0.01458 0.01431 0.06889 0.08181 0.06158 0.03506 0.00853
       0.00065 0.00107 0.00148 0.00043 0.00057 0       0
1980   1       5       3       0       17      0       0       0       0       0       0.00102 0.00022
       0.00442 0.03417 0.0489  0.06656 0.04987 0.08431 0.09185 0.06391 0.0378  0.0108  0.01103 0.00138 0
       0       0.00092 0.00123 0.00056 0.00021 0.01013 0.06132 0.15277 0.18459 0.06082 0.00831 0.00208
       0.00842 0.00156 0.00056 0.00014 0       0
```

```
1983	1	5	3	0	17	0.00147	0.00236	0.00222	0.00237	0.01546	0.03155	0.05519
	0.09165	0.11927	0.04888	0.01741	0.01022	0.02294	0.02131	0.01335	0.01473	0.01341	0.00281	0.00054
	0.00129	0.00236	0.00082	0.00187	0.01964	0.04507	0.13632	0.1805	0.0633	0.03084	0.02869	0.00197	0
	0	0.00003	0	0	0	0
1986	1	5	3	0	14	0.00021	0.00021	0.054	0.09675	0.10531	0.03826	0.00166
	0.00191	0.00319	0.01658	0.03826	0.06103	0.04773	0.04995	0.01422	0.00968	0.00458	0.00138	0	0
	0.00214	0.042	0.0741	0.12401	0.01268	0.01143	0.06192	0.07889	0.03768	0.0074	0.00226	0.00044	0
	0	0	0	0	0
1989	1	5	3	0	91	0.14115	0.08542	0.00522	0.01077	0.0188	0.01236	0.02578
	0.03328	0.01295	0.01263	0.03708	0.04408	0.00765	0.01092	0.01361	0.00611	0.00323	0.00099	0.00065
	0.15814	0.07824	0.00423	0.01606	0.01862	0.03192	0.05855	0.05072	0.05481	0.02932	0.01254	0.00347
	0.00022	0.00004	0.00005	0	0	0.00009	0.00009
1992	1	5	3	0	59	0.24397	0.02135	0.01956	0.025	0.00991	0.0186	0.04261
	0.03886	0.01397	0.00795	0.00448	0.00373	0.00244	0.00253	0.00212	0.00026	0.00065	0.00006	0	0.2715
	0.01878	0.02134	0.02997	0.01546	0.0718	0.06547	0.0214	0.01717	0.00594	0.00245	0.00024	0.00006	0
	0	0	0.00012	0.00006	0
1995	1	5	3	0	79	0.07182	0.0105	0.02365	0.03701	0.03052	0.00774	0.01664
	0.03555	0.02933	0.02137	0.02177	0.04439	0.03114	0.02686	0.02366	0.01874	0.00794	0.00212	0.00033
	0.08029	0.0065	0.02289	0.03343	0.02708	0.04323	0.06932	0.08634	0.09242	0.05937	0.01576	0.00175
	0.00006	0.00016	0.00008	0.00008	0	0	0
1998	1	5	3	0	81	0.01317	0.03329	0.02219	0.01371	0.05545	0.10907	0.02906
	0.01489	0.0305	0.05614	0.00735	0.00612	0.01038	0.01613	0.00776	0.00386	0.00265	0.00042	0
	0.00908	0.02868	0.02244	0.03439	0.12487	0.07326	0.08847	0.09834	0.06031	0.02068	0.00673	0.00042	0
	0	0	0.00003	0	0	0
2001	1	5	3	0	77	0.00367	0.01002	0.05792	0.2417	0.11619	0.00883	0.00665
	0.00424	0.00695	0.00655	0.00921	0.00452	0.00343	0.00301	0.00261	0.00244	0.00065	0.00001	0
	0.00531	0.00575	0.09168	0.27631	0.08195	0.00664	0.01412	0.018	0.00695	0.00373	0.00063	0.00013	0
	0.00001	0	0	0	0	0
2004	1	5	3	0	88	0.11449	0.00173	0.00278	0.00155	0.00074	0.0159	0.01839
	0.00552	0.01475	0.07254	0.14576	0.06047	0.01188	0.00359	0.00538	0.00669	0.00589	0.00154	0.00022	0.1552
	0.00081	0.0029	0.0018	0.00745	0.01609	0.05755	0.12913	0.1032	0.02382	0.01048	0.00153	0.00004	0
	0	0.00004	0	0	0
#
# NWC combo survey
#year	season	type	gender	part	#_samp	16	18	20	22	24	26	28	30
	32	34	36	38	40	42	44	46	48	50	52	16	18
	20	22	24	26	28	30	32	34	36	38	40	42	44
	46	48	50	52
2003	1	6	3	0	91	0.00298	0.00807	0.00688	0.00342	0.00746	0.00424	0.00967
	0.02817	0.1095	0.18554	0.03815	0.00738	0.00217	0.00154	0.00099	0.00393	0.00067	0.00251	0
	0.00677	0.01157	0.0043	0.00725	0.00539	0.01074	0.08931	0.19781	0.11868	0.09394	0.03074	0.00002
	0.00019	0	0	0.00002	0	0	0
2004	1	6	3	0	88	0.03914	0.01214	0.00471	0.03843	0.0303	0.01527	0.01859
	0.01287	0.03111	0.07962	0.14332	0.08634	0.02108	0.0039	0.00402	0.00361	0.00326	0.0023	0.00012
	0.03949	0.01135	0.00811	0.02011	0.01754	0.0103	0.02772	0.14081	0.13563	0.03042	0.00772	0.00057	0
	0	0	0.00008	0	0	0
2005	1	6	3	0	91	0.01717	0.00979	0.01818	0.01461	0.00422	0.00865	0.00481	0.0195
	0.01542	0.03592	0.19109	0.14109	0.04185	0.01576	0.00738	0.00624	0.00384	0.00164	0.0004	0.02127
	0.01078	0.01367	0.01604	0.00897	0.00515	0.09415	0.14629	0.08918	0.03161	0.00381	0.00036	0.0011	0
	0	0	0	0	0
2006	1	6	3	0	70	0.00242	0.00734	0.00929	0.01924	0.01731	0.01448	0.01335
	0.00833	0.01775	0.01951	0.01799	0.05114	0.10618	0.08986	0.02131	0.02241	0.00883	0.00433	0.00089
	0.00113	0.00712	0.00966	0.02279	0.02103	0.02015	0.01599	0.04448	0.15975	0.21062	0.03326	0.00071
	0.00021	0.00113	0	0	0	0	0
#
#Recreational Length data - June 15 fix to TL-> FL conversion!!
```

```
#year	season	type	gender	part	numsamp		16	18	20	22	24	26	28
	30	32	34	36	38	40	42	44	46	48	50	52	16
	18	20	22	24	26	28	30	32	34	36	38	40	42
	44	46	48	50	52
1987	1	10	0	0	43	0.0007	0	0.00141	0.01131	0.03182	0.13932	0.30622
	0.31046	0.13649	0.01909	0.01202	0.01202	0.01131	0.00353	0.00353	0.0007	0	0	0	0.0007
	0	0.00141	0.01131	0.03182	0.13932	0.30622	0.31046	0.13649	0.01909	0.01202	0.01202	0.01131
	0.00353	0.00353	0.0007	0	0	0
1988	1	10	0	0	44	0.0011	0.00221	0.00832	0.03329	0.07103	0.07047	0.12042
	0.22031	0.24028	0.15149	0.04495	0.00832	0.00998	0.00887	0.00277	0.00166	0.00332	0.0011	0	0.0011
	0.00221	0.00832	0.03329	0.07103	0.07047	0.12042	0.22031	0.24028	0.15149	0.04495	0.00832	0.00998
	0.00887	0.00277	0.00166	0.00332	0.0011	0
1989	1	10	0	0	58	0	0.00122	0.00183	0.01102	0.02205	0.03063	0.09803
	0.19852	0.17401	0.1734	0.17095	0.06617	0.02205	0.0147	0.00857	0.00428	0.00183	0	0.00061	0
	0.00122	0.00183	0.01102	0.02205	0.03063	0.09803	0.19852	0.17401	0.1734	0.17095	0.06617	0.02205	0.0147
	0.00857	0.00428	0.00183	0	0.00061
1990	1	10	0	0	16	0	0	0	0	0.00716	0.04659	0.09318
	0.15412	0.17204	0.07526	0.10394	0.17921	0.09318	0.04659	0.02508	0.00358	0	0	0	0
	0	0	0	0.00716	0.04659	0.09318	0.15412	0.17204	0.07526	0.10394	0.17921	0.09318
	0.04659	0.02508	0.00358	0	0	0
1991	1	10	0	0	15	0	0	0.00256	0.01794	0.04615	0.12564	0.11794
	0.14871	0.07948	0.05128	0.04871	0.12051	0.10769	0.06923	0.04358	0.01794	0.00256	0	0	0
	0	0.00256	0.01794	0.04615	0.12564	0.11794	0.14871	0.07948	0.05128	0.04871	0.12051	0.10769
	0.06923	0.04358	0.01794	0.00256	0	0
1992	1	10	0	0	32	0	0	0.00941	0.04143	0.05775	0.15379	0.20966
	0.17137	0.09165	0.05963	0.03766	0.04331	0.04959	0.05524	0.00941	0.0069	0.00251	0.00062	0	0
	0	0.00941	0.04143	0.05775	0.15379	0.20966	0.17137	0.09165	0.05963	0.03766	0.04331	0.04959
	0.05524	0.00941	0.0069	0.00251	0.00062	0
1993	1	10	0	0	37	0	0.00061	0.00553	0.02642	0.0381	0.08358	0.09649
	0.13952	0.16041	0.11124	0.07682	0.05777	0.06883	0.06084	0.03749	0.02274	0.01167	0.00184	0	0
	0.00061	0.00553	0.02642	0.0381	0.08358	0.09649	0.13952	0.16041	0.11124	0.07682	0.05777	0.06883
	0.06084	0.03749	0.02274	0.01167	0.00184	0
1994	1	10	0	0	26	0.0008	0.00161	0.00726	0.03069	0.10904	0.1155	0.1357	0.1042
	0.10339	0.10985	0.11227	0.07108	0.0315	0.02827	0.02019	0.01615	0.00242	0	0	0.0008
	0.00161	0.00726	0.03069	0.10904	0.1155	0.1357	0.1042	0.10339	0.10985	0.11227	0.07108	0.0315
	0.02827	0.02019	0.01615	0.00242	0	0
1995	1	10	0	0	22	0	0.00892	0.05535	0.03928	0.06428	0.07142	0.10535
	0.10892	0.18214	0.10892	0.08571	0.06785	0.05357	0.02321	0.01607	0.00714	0.00178	0	0	0
	0.00892	0.05535	0.03928	0.06428	0.07142	0.10535	0.10892	0.18214	0.10892	0.08571	0.06785	0.05357
	0.02321	0.01607	0.00714	0.00178	0	0
1996	1	10	0	0	19	0	0	0.01167	0.02918	0.0642	0.11867	0.13035	0.0642
	0.09533	0.13424	0.09338	0.10894	0.07782	0.05058	0.01945	0.00194	0	0	0	0	0
	0.01167	0.02918	0.0642	0.11867	0.13035	0.0642	0.09533	0.13424	0.09338	0.10894	0.07782	0.05058
	0.01945	0.00194	0	0	0
1997	1	10	0	0	19	0	0	0	0.00523	0.04712	0.12565	0.08115
	0.09162	0.04973	0.0445	0.06806	0.1335	0.17015	0.10471	0.04712	0.01832	0.01047	0.00261	0	0
	0	0	0.00523	0.04712	0.12565	0.08115	0.09162	0.04973	0.0445	0.06806	0.1335	0.17015
	0.10471	0.04712	0.01832	0.01047	0.00261	0
1998	1	10	0	0	9	0	0	0	0	0.00955	0.01592	0.0605
	0.18471	0.13057	0.10828	0.08917	0.09554	0.12101	0.08598	0.07006	0.01592	0.01273	0	0	0
	0	0	0	0.00955	0.01592	0.0605	0.18471	0.13057	0.10828	0.08917	0.09554	0.12101
	0.08598	0.07006	0.01592	0.01273	0	0
#
# Age composition data
21	# number of age bins
```

```
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
1	# number of unique ageing error matrices to generate
# ageing error matrix- no bias, has imprecision (st dev)
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
0.03	0.091	0.153	0.214	0.275	0.336	0.398	0.459	0.52	0.581	0.643	0.704	0.765	0.826
	0.888	0.949	1.01	1.072	1.133	1.194	1.255	1.317
61	# number of age observations-
# this run goes back to traditional age comps-
#year	season	type	gender	part	errmat	Lbinlo	LbinHi	# samp	1	2	3	4	5
	6	7	8	9	10	11	12	13	14	15	16	17	18
	19	20	plus	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20	plus
1978	1	1	3	0	1	1	52	-1	0	0	0.00378	0.00192
	0.05193	0.06229	0.08103	0.11205	0.0285	0.02318	0.1395	0.04135	0.00805	0.00451	0.01162	0.01389
	0.03325	0.01976	0.03987	0.0299	0.0635	0	0	0.00086	0.00094	0.01108	0.03327	0.03173
	0.02462	0.00872	0.00288	0.01137	0.02357	0.02161	0.04333	0.00117	0.00127	0.00263	0.00019	0.00142	0.0035
	0.00597
1979	1	1	3	0	1	1	52	-1	0	0	0.02289	0.04417
	0.03256	0.12065	0.06067	0.05047	0.1531	0.09065	0.03673	0.0262	0.01061	0.00285	0.02734	0.01818
	0.01339	0.00627	0.02685	0.00403	0.00893	0	0	0.01917	0.05047	0.03043	0.00964	0.00342	0.0042
	0.02474	0.00362	0	0.00462	0.00335	0.01917	0.00044	0.00141	0.05746	0.00223	0.00531	0.00335
	0.00044
1980	1	1	3	0	1	1	52	120	0	0	0.00079	0.01116
	0.07118	0.03558	0.24243	0.01848	0.04077	0.07396	0.01513	0.0116	0.04232	0.01038	0.00231	0.05865
	0.00011	0.00244	0.0029	0.00044	0.01973	0	0.00102	0.00435	0.007	0.05788	0.07713	0.04955
	0.00622	0.00431	0.03101	0.00437	0.05813	0.00071	0.00266	0.00096	0.00918	0.00028	0.00333	0.00621
	0.00103	0.01431
1981	1	1	3	0	1	1	52	80	0	0	0.00121	0.00551
	0.15777	0.20849	0.03943	0.15607	0.01213	0.00378	0.00498	0.00835	0.0039	0.05709	0.00182	0.00056
	0.00245	0.00194	0.00101	0.00021	0.00806	0	0	0.04975	0.00037	0.05482	0.02426	0.00489
	0.12049	0.00215	0.00208	0.00777	0.00153	0.00261	0.05139	0.0007	0.00008	0.00007	0.00024	0
	0.00015	0.00187
1982	1	1	3	0	1	1	52	135	0	0.00006	0.00795	0.02247
	0.05293	0.03563	0.21462	0.053	0.17273	0.01588	0.04724	0.04183	0.0206	0.01731	0.01459	0.00567
	0.00705	0.002	0.01187	0.00069	0.01252	0	0	0.00646	0.00462	0.01703	0.01767	0.07607
	0.01949	0.04761	0.00885	0.01292	0.01438	0.00282	0.00729	0.00479	0.00001	0.00012	0	0
	0.00026	0.00296
1983	1	1	3	0	1	1	52	254	0	0	0.00712	0.04191
	0.02014	0.03882	0.07728	0.22797	0.09597	0.08751	0.04105	0.05616	0.0338	0.02631	0.00968	0.01863
	0.00111	0.00751	0.00826	0.01526	0.02535	0	0.00006	0.00528	0.02822	0.01055	0.00792	0.02584
	0.03455	0.00701	0.01561	0.00306	0.00564	0.00299	0.00495	0.00147	0.00218	0.00057	0.00277	0
	0.00071	0.00073
1984	1	1	3	0	1	1	52	202	0	0.00002	0.03783	0.10336
	0.17369	0.086	0.05089	0.04349	0.09149	0.02664	0.02702	0.01316	0.02271	0.01373	0.02425	0.00804
	0.00912	0.00185	0.00051	0.00106	0.00579	0	0.00335	0.01033	0.04641	0.03068	0.01707	0.013
	0.01551	0.03336	0.02777	0.01319	0.01903	0.00578	0.00412	0.00282	0.01028	0.00259	0.00077	0.00085
	0.00012	0.00234
1985	1	1	3	0	1	1	52	303	0	0.00002	0.00279	0.02507
	0.06476	0.16204	0.08104	0.0408	0.03527	0.0363	0.04287	0.02739	0.02872	0.0188	0.01871	0.00889
	0.00452	0.00542	0.00493	0.00236	0.00932	0	0.00006	0.00011	0.01536	0.01544	0.04936	0.04948
	0.03218	0.02924	0.04719	0.03604	0.0216	0.01902	0.02613	0.00676	0.00622	0.00532	0.00345	0.00422
	0.00134	0.01145
1986	1	1	3	0	1	1	52	111	0	0.00466	0.0088	0.02095
	0.07726	0.1109	0.08903	0.04127	0.03736	0.03883	0.06767	0.02447	0.03381	0.01699	0.02167	0.009
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0.00728 0.00213 0.0115 0.00149 0.00566 0 0.00432 0.00224 0.00663 0.02418 0.05423 0.05353
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0.00062 0.00677
1987 1 1 3 0 1 1 52 205 0.04462 0.03154 0.32482 0.01466
0.01095 0.03123 0.04142 0.06563 0.01636 0.00299 0.00499 0.01538 0.00375 0.00637 0.0031 0.0003
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0.00111 0.00318
1988 1 1 3 0 1 1 52 190 0 0.00014 0.02819 0.4067
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0.00099
1989 1 1 3 0 1 1 52 174 0 0.00011 0.03457 0.03029
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0.00005 0.00022 0.00004 0.00045 0 0.00009 0.0226 0.03778 0.26056 0.00339 0.0004 0.02036
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0.00193
1990 1 1 3 0 1 1 52 133 0 0.02742 0.05254 0.03834
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0.00036 0.00199
1991 1 1 3 0 1 1 52 66 0 0.03237 0.08143 0.08939
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0.00004 0.00615
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1994 1 1 3 0 1 1 52 76 0 0.00248 0.07104 0.0454
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0.00187 0.0018 0.0023 0.00021 0.00795 0.00031 0.00093 0.01815 0.01496 0.06433 0.01016 0.04198
0.04395 0.03572 0.03541 0.01461 0.01351 0.03056 0.00985 0.01385 0.00231 0.00231 0.00326 0.00503
0.00238 0.00265
1999 1 1 3 0 1 1 52 -1 0 0.00006 0.00173 0.10925
0.06315 0.13796 0.04408 0.0662 0.04837 0.05063 0.04667 0.01942 0.01212 0.00903 0.0089 0.00263
0.00008 0.00094 0.00205 0.0029 0.00533 0 0.00332 0.00007 0.05304 0.03379 0.10262 0.02641
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2000 1 1 3 0 1 1 52 -1 0 0.00002 0.00014 0.01344
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0.00784
2002 1 1 3 0 1 1 52 31 0.00126 0.00519 0.14825 0.07593
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0.01071 0.03351 0.00561 0.01174 0.00248 0.00351 0.00683 0.00442 0.00052 0.00317 0.00247 0
0.00006 0.00257
2003 1 1 3 0 1 1 52 9 0 0.00016 0.01887 0.61473
0.01414 0.00693 0.00484 0.00961 0.00441 0.0041 0.00512 0.00221 0.00276 0.00221 0.00102 0.00307
0.00102 0.00118 0.00102 0 0 0 0.00063 0.01768 0.23438 0.0206 0.00197 0.00228
0.00221 0.00607 0.00087 0.0026 0.00173 0.00347 0.00347 0.00189 0.00087 0 0.00087 0.00102 0
0
2004 1 1 3 0 1 1 52 33 0 0.00099 0.00483 0.02117
0.32677 0.07346 0.02548 0.03422 0.05385 0.02661 0.03364 0.01354 0.01335 0.00763 0.01656 0.01126
0.00744 0.00654 0.0117 0.00401 0.00143 0 0 0.00313 0.01417 0.20207 0.02458 0.0176
0.00118 0.00983 0.01118 0.00368 0.00148 0.00346 0 0.00203 0.00074 0.00074 0.00434 0.00203 0
0.00327
2005 1 1 3 0 1 1 52 15 0 0.00082 0 0.05207
0.11353 0.4349 0.04918 0.01954 0.02939 0.01235 0.00348 0.00256 0.0001 0.00985 0.0098 0.00251
0.00256 0.00005 0.00251 0 0 0 0 0 0.03266 0.0368 0.14335 0.02588
0.00343 0.00251 0.00343 0 0 0 0.00082 0.00251 0 0 0 0 0
0.00343
#

#

Hook-line - females

Hook-line males

#Hook and Line									# samples		1	2	3
	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	plus	1	2	3	4	5	6	7	8
	9	10	11	12	13	14	15	16	17	18	19	20	plus
1985	1	2	3	0	1	1	52	1	0	0	0	0	0
	0.04536	0.05328	0.19343	0.05236	0.11135	0.05757	0.2199	0.01276	0.10755	0.01731	0.05256	0.01011	
	0.00383	0	0.0445	0.01204	0	0	0	0	0	0	0	0.00179	0
	0	0	0	0.00086	0.00343	0	0	0	0	0	0	0	
1986	1	2	3	0	1	1	52	3	0	0	0.00204	0.00148	0
	0.03329	0.04987	0.02766	0.1301	0.09393	0.15182	0.082	0.19844	0.00591	0.07306	0.04547	0.0265	0.0038
	0.04702	0.00225	0.00148	0.00004	0	0	0	0	0	0.00732	0	0	
	0.00394	0.00183	0.00028	0.00232	0.00408	0.0019	0.00014	0.00204	0	0	0	0	
1987	1	2	3	0	1	1	52	7	0	0.02078	0	0.01888	0
	0	0.00618	0.46082	0.0254	0.0622	0.0127	0.0876	0.0127	0	0	0	0.0622	0
	0.0622	0	0.00618	0	0	0	0.03158	0	0	0	0	0	0
	0	0.00618	0	0	0	0	0.0622	0	0.0622	0	0		
1990	1	2	3	0	1	1	52	11	0	0	0	0.1	0
	0.6	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	0	0	0	0	0		
1991	1	2	3	0	1	1	52	17	0	0.00476	0.01476	0.02609	
	0.08713	0.10463	0.33351	0.06743	0.02424	0.02449	0.02101	0.02871	0	0.01271	0.00142	0.00539	0
	0.00273	0	0	0	0	0.00057	0.01381	0.02257	0.04766	0.02672	0.06108	0.0148	0
	0.0044	0.00532	0.01512	0	0.00692	0	0.00791	0	0.0099	0	0.00419	0	
1992	1	2	3	0	1	1	52	38	0	0	0.0014	0.03133	
	0.07605	0.13621	0.0988	0.22181	0.05191	0.01575	0.02486	0.03549	0.02768	0.02943	0.00976	0.00214	
	0.00497	0.00063	0.008	0.0009	0.01247	0	0.00099	0.00055	0.01498	0.04606	0.03756	0.02124	
	0.03045	0.00864	0.00296	0.01137	0.01003	0.00167	0.00978	0.00704	0.00023	0.00298	0.00272	0.00049	0
	0.00066												
1993	1	2	3	0	1	1	52	20	0	0	0.06322	0.28475	
	0.18681	0.18307	0.08329	0.03099	0.04344	0.00095	0.00031	0.00033	0.00986	0.00056	0.00009	0.00034	
	0.00006	0.00036	0.00041	0.00009	0.00029	0	0	0.00892	0.03631	0.00024	0.00054	0.01886	
	0.01789	0.00957	0.00017	0.00014	0.00892	0.00008	0.00002	0.00879	0.00005	0	0.00002	0.0003	0
	0												
1994	1	2	3	0	1	1	52	11	0	0	0.00204	0.01527	
	0.05033	0.06699	0.12842	0.13083	0.12713	0.22705	0.03146	0.00527	0.02674	0.02452	0.01832	0.00342	0
	0	0.00379	0	0.00629	0	0	0	0.0049	0.00981	0.00833	0.01471	0.0049	
	0.01739	0.04386	0.00972	0	0.0049	0	0.0049	0	0	0	0	0	0.0087
1995	1	2	3	0	1	1	52	8	0	0	0.00187	0.01532	
	0.02451	0.15618	0.20948	0.10585	0.06084	0.01692	0.0284	0.00986	0	0.00475	0	0.00403	0
	0	0.00029	0.00073	0	0	0	0	0	0.05106	0.06784	0.07469	0.05575	
	0.02552	0.01207	0.02556	0.00579	0	0.01021	0.00402	0	0.00402	0	0.00029	0.00873	
	0.01542												
1996	1	2	3	0	1	1	52	11	0	0	0.00672	0.0158	
	0.08338	0.10917	0.13115	0.12225	0.13751	0.06567	0.0743	0.0743	0.0139	0.00463	0	0	0
	0	0.00427	0.00463	0	0	0	0	0.00336	0.01008	0	0.00672	0.01553	
	0.01035	0.08919	0.00854	0.00854	0	0	0	0	0	0	0	0	0
1997	1	2	3	0	1	1	52	10	0	0	0.04794	0.20447	
	0.08564	0.13285	0.15286	0.08235	0.08854	0.03996	0.0217	0.02629	0.01015	0.00295	0.00769	0.00139	0
	0.00729	0.00711	0	0.00121	0	0.01006	0.02013	0.00768	0	0.01006	0.00768	0	0
	0.00057	0	0.00768	0	0.00768	0	0.00809	0	0	0	0	0	
1998	1	2	3	0	1	1	52	-1	0	0	0.00213	0.02347	
	0.05733	0.06901	0.06024	0.08737	0.13578	0.15112	0.08453	0.04459	0.03388	0.02155	0.005	0.00189	
	0.00189	0.00402	0.00991	0	0.00927	0	0	0	0	0	0.01595	0.00601	
	0.02622	0.035	0.02812	0.02959	0.01547	0.00991	0.01179	0.01004	0.00189	0.00301	0.00213	0.00189	0
	0												

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1999	1	2	3	0	1	1	52	-1	0	0	0	0.04742
	0.08607	0.37575	0.09088	0.0561	0.0608	0.0513	0.07462	0.0102	0.00748	0.00669	0.00669	0
	0.00079	0	0	0	0	0	0	0	0	0.00739	0.05183	0.00942
	0.01883	0.00079	0.00942	0	0.01338	0.00669	0.00079	0.00669	0	0	0	0	0
	0
2000	1	2	3	0	1	1	52	-1	0	0.00132	0.02549	0.0523
	0.09041	0.13052	0.10797	0.0791	0.05472	0.09137	0.01976	0.03555	0.00624	0.00059	0.00566	0.0152	0
	0	0.00059	0	0	0	0	0	0.01373	0.01241	0.05369	0.01579	0.01711
	0.02931	0.03335	0.02255	0.0282	0.01579	0.01645	0	0.01241	0	0	0	0
	0.01241
2001	1	2	3	0	1	1	52	-1	0	0	0	0.00172
	0.01954	0.01552	0.01753	0.10458	0.04813	0.07298	0.04295	0.00172	0.01451	0.01451	0.00891	0.00891	0
	0	0	0	0.00891	0	0	0	0.00891	0.01781	0.04683	0.09869	0.12771
	0.03793	0.08648	0.04683	0.02902	0.05804	0	0.01451	0.02342	0	0.02342	0	0	0
2002	1	2	3	0	1	1	52	-1	0	0	0.02632	0
	0.05263	0	0.05263	0.05263	0.02632	0	0	0	0	0	0	0.02632	0
	0.02632	0	0	0	0	0	0	0	0	0.07895	0	0.10526
	0.18421	0.13158	0.07895	0.10526	0	0.02632	0	0	0.02632	0	0	0	0
#

#

#										Net - females

						net - males

#Net								# samples		1	2	3	4
	5	6	7	8	9	10	11	12	13	14	15	16	17
	18	19	20	plus	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18	19	20	plus
1983	1	3	3	0	1	1	52	-1	0	0	0	0
	0.02676	0.04003	0.09744	0.18161	0.13584	0.15997	0.09485	0.05798	0.01296	0.08973	0	0.0265	0
	0	0	0	0	0	0	0	0	0	0.01353	0	0.03788	0
	0.02491	0	0	0	0	0	0	0	0	0	0	0
1984	1	3	3	0	1	1	52	7	0	0	0	0	0
	0	0.10225	0.10225	0.23027	0.23108	0.14895	0.05153	0	0.05636	0.02576	0	0.01047	0
	0	0.04106	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
1985	1	3	3	0	1	1	52	36	0	0	0	0	0.0004
	0.04985	0.03887	0.06337	0.05768	0.11556	0.11659	0.18543	0.13259	0.06512	0.02013	0.01098	0.04088	0.0085
	0.02041	0.00005	0.00264	0	0	0	0.00033	0	0.00323	0.00046	0.00367	0.00463
	0.00705	0.00807	0.00897	0.0089	0.00199	0	0.0041	0.00195	0	0.00965	0.00523	0.00269
1986	1	3	3	0	1	1	52	41	0	0.00039	0.0003	0.00022
	0.00023	0.01824	0.10149	0.0392	0.1235	0.14438	0.12603	0.08913	0.05311	0.01379	0.07571	0.0592
	0.02077	0.03545	0.00555	0.00722	0.02524	0	0	0	0.00006	0.00006	0.00502	0.00612
	0.00573	0.01498	0.00355	0.00317	0.0015	0.00735	0.00351	0.00049	0.00555	0	0.00269	0.00026
	0.00057	0.00026
1987	1	3	3	0	1	1	52	63	0	0	0.00408	0.0086
	0.02549	0.02475	0.06117	0.20162	0.06769	0.03134	0.10648	0.17654	0.04042	0.0921	0.00948	0.01664
	0.01234	0.00956	0	0.00945	0.00641	0.00019	0	0.00204	0.00496	0.00241	0.00048	0.00582
	0.03464	0.00774	0.00259	0.00245	0.01552	0.00274	0.01393	0	0.00007	0.00019	0	0
	0.00007	0
```

```
1988 1 3 3 0 1 1 52 42 0 0 0.00067 0.1144
0.00112 0.00482 0.02916 0.03724 0.14749 0.04565 0.03701 0.07402 0.26009 0.00213 0.04172 0
0.02535 0 0.01009 0 0.07133 0 0.00101 0 0.04744 0.00101 0.00168 0
0.00168 0.00594 0.00202 0 0.00112 0.0323 0.00112 0.00101 0 0 0.00135 0 0
0
1989 1 3 3 0 1 1 52 68 0 0 0.00031 0.04789
0.41627 0 0.00348 0.00234 0.03069 0.33092 0.00052 0.03721 0.01504 0.04579 0.01175 0.01738
0.00009 0 0.01224 0 0 0 0 0 0.00006 0.01467 0.00003 0
0.00003 0.00031 0.00065 0 0.00003 0.00043 0 0.01153 0 0.00012 0.00022 0 0
0
1990 1 3 3 0 1 1 52 79 0 0.00227 0.00965 0.01093 0.0132
0.27502 0.04884 0.00185 0.00554 0.12338 0.09399 0.04657 0.01903 0.0389 0.06318 0.00014 0.03748
0.00043 0 0 0.00014 0 0 0.00099 0.00426 0.00114 0.05594 0.00852 0.04089
0.00057 0.00781 0.00753 0.04572 0.00142 0.0017 0.00838 0.00199 0.00227 0.00014 0.00014 0.00057
0.01945
1991 1 3 3 0 1 1 52 7 0 0 0.01502 0.01502
0.08834 0.11352 0.40592 0.08216 0 0.02606 0.00221 0.01193 0 0.00928 0 0.02385 0
0 0 0 0 0 0 0.03004 0.00221 0.04373 0.01413 0.06537 0.00707 0
0 0 0.03224 0 0 0 0 0 0.01193 0 0 0
1992 1 3 3 0 1 1 52 -1 0 0 0 0.01552
0.06707 0.03244 0.08285 0.26658 0.07167 0.01541 0.07176 0.04182 0.03368 0.0175 0.01385 0.01981
0.02353 0.01624 0.01472 0 0.00251 0 0 0.00048 0.01162 0.00295 0.01433 0.02943
0.07371 0.00964 0.00145 0 0.016 0.00531 0.00491 0.01054 0 0.00645 0.00075 0.00546 0
0
1993 1 3 3 0 1 1 52 12 0 0 0 0.01679
0.03743 0.04886 0.10278 0.11866 0.28306 0.04927 0.02559 0.05382 0.05969 0.05412 0.01487 0.02802
0.00344 0.01325 0 0 0 0 0 0.00233 0.00465 0.017 0.01254 0.00718
0.00799 0.02226 0 0 0.00303 0 0 0.00132 0.00223 0 0.00981 0 0
0
1994 1 3 3 0 1 1 52 9 0 0 0 0
0.01278 0.07036 0.10557 0.13574 0.12117 0.23743 0.02058 0.02415 0.05076 0.04652 0.01438 0.00504 0.0153
0.00719 0 0 0 0 0 0.00633 0.00922 0.00596 0.00547 0.01008 0.02065
0.00922 0.03343 0 0 0 0 0.00811 0.01997 0 0 0 0
0.00461
1995 1 3 3 0 1 1 52 3 0 0 0 0 0.0212
0.0212 0.0424 0.09385 0.0212 0.16669 0.30604 0.05738 0.03618 0.05955 0.04381 0.04787 0.03072
0.03072 0 0 0 0 0 0 0 0 0 0 0 0
0.0212 0 0 0 0 0 0 0 0 0 0 0
1996 1 3 3 0 1 1 52 2 0 0 0 0
0.03388 0 0.03388 0.13553 0.11862 0.08474 0.06776 0.23737 0 0.03388 0 0.03388
0.06783 0.05092 0.05086 0 0.01697 0 0 0 0 0 0 0 0
0 0.03388 0 0 0 0 0 0 0 0 0 0 0
1997 1 3 3 0 1 1 52 2 0 0 0 0
0.05571 0 0.02455 0.09254 0.13598 0.23513 0.09537 0.16619 0 0.03683 0.03399 0
0.01228 0 0.01228 0 0 0 0 0 0 0 0 0
0.02172 0 0.02172 0 0.02172 0 0 0.01228 0 0 0 0 0
0.02172
1998 1 3 3 0 1 1 52 3 0 0 0 0 0
0 0.0377 0.06604 0.16985 0.11951 0.19811 0.0786 0.10374 0.11006 0 0 0 0
0.02513 0 0.00945 0 0 0 0 0 0 0.00945 0 0.02201 0
0 0.00945 0.03146 0.00945 0 0 0 0 0 0 0
#
2004 1 6 3 0 1 1 52 87 0.0481 0.06947 0.0497 0.0034
0.30939 0.02263 0.01291 0.00537 0.01858 0.00393 0.00693 0.00032 0.00074 0 0.00016 0 0.0009
0.00037 0 0.00004 0.0001 0.04323 0.03786 0.06075 0.01039 0.23843 0.02529 0.02268 0.00128
0.00208 0 0.0006 0.0006 0 0 0.00077 0.00135 0.00081 0.0006 0 0.00008 0
```

```
#
# Mean size at age data
0	# number of size at age observations
# environmental data-
0	# num env. Variables
0	# num env. Observations
999	# end of file
```

```
# *************************************************************
#  Chilipepper rockfish .ctl file
#  final model from June 2007 STAR Panel
#  SS2 Version 2.00c by_Richard_Methot_(NOAA);_using_Otter_Research_ADMB_7.0.1
# *************************************************************
#
#
1  #_N_Growth_Patterns
1 #_N_submorphs

1 #_N_areas
 1 1 1 1 1 1 1 1 1 1#_area_assignments_for_each_fishery_and_survey

 #_recruit_design_(G_Pattern_x_birthseas_x_area)_X_(0/1_flag)
 1
0 #_recr_distr_interaction
0 #_Do_migration
 #_movement_pattern_(for_each_season_x_source_x_destination)_input_(0/1_flag)_minage_maxage
 0 0 0
2 #_Nblock_Designs
5 10 # blocks per design
1970 1979
1980 1988
1989 1991
1992 1998
1999 2006
# block design 2
1972 1977
1978 1980
1981 1983
1984 1986
1987 1989
1990 1992
1993 1995
1996 1998
1999 2001
2002 2006

0.5 #_fracfemale
1000 #_submorph_between/within
1 #vector_submorphdist_(-1_first_val_for_normal_approx)
4 #_natM_amin
5 #_natM_amax
2 #_Growth_Age-at-L1
18 #_Growth_Age-at-L2
0.1 #_SD_add_to_LAA
0 #_CV_Growth_Pattern
1 #_maturity_option
1 #_First_Mature_Age
3 #_parameter_offset_approach
1 #_env/block/dev_adjust_method(1/2)
-5 #_MGparm_Dev_Phase

#_growth_parms
#_LO     HI          INIT       PRIOR   PR_type SD         PHASE  env-var use_dev dev_minyr dev_maxyr dev_stddev Block
Block_Fxn
```

```
0.05	0.3	0.16	0.22	0	0.8	-4	0	0	0	0	0.5	0	0
#_Gpattern:_1_Gender:_1
-3	3	0	0	0	0.8	-4	0	0	0	0	0.5	0	0
5	50	19.659	19	0	20	-2	0	0	0	0	0.5	0	0
25	70	47.3	45	0	20	-2	0	0	0	0	0.5	0	0
0.05	0.3	0.1945	0.1772	0	0.8	-2	0	0	0	0	0.5	1	0
0.02	0.5	0.06	0.065	0	0.8	-2	0	0	0	0	0.5	0	0
-3	3	0.06	0.065	0	0.8	-2	0	0	0	0	0.5	0	0
-6	3	0.232	0.1279	0	0.8	-4	0	0	0	0	0.5	0	0
#_Gpattern:_1_Gender:_2
-6	3	0	0	0	0.8	-4	0	0	0	0	0.5	0	0
-3	3	-0.03	-0.1	0	0.8	-2	0	0	0	0	0.5	0	0
-3	3	-0.35 -0.3	0	0.8	-2	0	0	0	0	0.5	0	0
-3	3	0.605 0.05	0	0.8	-2	0	0	0	0	0.5	0	0
-3	3	0	0	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	0	0	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	4.05e-006 4.1e-006	0	0	-3	0	0	0	0	0.5	0
	0 #_wt-len&maturity
-3	10	3.2	3.25	0	0.5	-3	0	0	0	0	0.5	0	0
1	50	25.713	25	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	-0.316 -0.3	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	1	1	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	0	0	0	0.8	-3	0	0	0	0	0.5	0	0
-3	3	2.24e-006 2.2e-006	0	0	-3	0	0	0	0	0.5	0
	0
-3	10	3.32	3.32	0	0.05	-3	0	0	0	0	0.5	0	0
-4	4	0	0	-1	99	-3	0	0	0	0	0.5	0	0
#_recrdistribution_by_growth_pattern
-4	4	0	0	-1	99	-3	0	0	0	0	0.5	0	0
#_recrdistribution_by_area 1
-4	4	4	0	-1	99	-3	0	0	0	0	0.5	0	0
#_recrdistribution_by_season 1
1	1	1	1	-1	99	-3	0	0	0	0	0.5	0	0
#_cohort_growth_deviation

0 #_custom_MG-env_setup
0 #_custom_MG-block_setup
#K block param setup (one setup for all devs)
#_LO	HI	INIT	PRIOR	PR_type SD	PHASE
-10	10	0	0	0	.5	5

#_Spawner-Recruitment
1 #_SR_function
#_LO	HI	INIT	PRIOR	PR_type SD	PHASE
9	13	14	10	0	5	1
0.2	1	0.57	0.573	0	0.183	-4
0	2	1	1	0	1	-3
-5	5	0	0	0	1	-3
-5	5	0	0	0	1	-2
0.0	0.5	0.0	0.0	-1.	99	-2  #_reserve for future autocorrelation
0 #_SR_env_link
1 #_SR_env_target_1=devs;_2=R0;_3=steepness
1 #do_recr_dev:  0=none; 1=devvector; 2=simple deviations
1965 2006 -3 3 2 #_recr_devs
1492 #_first_yr_fullbias_adj_in_MPD
```

```
#_initial_F_parms
#_LO	HI	INIT	PRIOR	PR_type SD	PHASE
0	0.1	0	0.01	0	0.2	-1
0	0.1	0	0.05	0	0.2	-1
0	1	0	0	0	0.2	-1
0	1	0	0	0	0.2	-1

#_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	E	F
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	1	0
0	0	0	0	0	0
#
#_Q_parms(if_any)
# LO HI INIT PRIOR PR_type SD PHASE
#-10	20	0	0	0	10	-3 # juv survey1 power
#-10	20	0	0	0	10	-3 # juv survey2 power
#-10	20	0	0	0	10	1  # triennial q
#-10	20	0	0	0	10	1  # NWC combo q

#_size_selex_types
#_Pattern Discard Male Special
1	0	1	0	# 1
1	0	1	0	# 2
24	0	1	0	# 3
24	0	0	0	# 4
1	0	0	0	# 5
1	0	0	0	# 6
0	0	0	0	# 7
0	0	0	0	# 8
30	0	0	0	# 9
24	0	0	0	# 10
#
#_age_selex_types
#_Pattern Discard Male Special
 10 0 0 0 # 1
 10 0 0 0 # 2
 10 0 0 0 # 3
 10 0 0 0 # 4
 10 0 0 0 # 5
 10 0 0 0 # 6
 11 0 0 0 # 7
 11 0 0 0 # 8
 10 0 0 0 # 9
 20 0 1 0 # 10

#_selex_parms
```

```
#_size_sel: 1
#size sel 1 logistic
5	50	40.28	30	0	100	2	0	0	0	0	0	0	0 #
0.0001	35	14.31	5	0	10	3	0	0	0	0	0	0	0 #
# 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	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at minL
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at dogleg
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel) at maxL
#
#_size_sel: 2
5	45	45	40	0	10	2	0	0	0	0	0	0	0 #
0.0001	35	14.31	5	0	10	2	0	0	0	0	0	0	0 #
# size_se1: 2- male offsets- 4 lines
1	60	16	20	0	10	-5	0	0	0	0	0.5	0	0
	#	size@dogleg
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at minL
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at dogleg
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel) at maxL
# size sel 3
#5	45	40	45	0	100	2	0	0	0	0	0	0	0 #
#0.001	35	14.31	5	0	10	2	0	0	0	0	0	0	0 #
#_size_sel: 3
1	60	45.17	50	0	100	2	0	0	0	0	0.5	2	0
	#	PEAK	value
-6	50	-2.19	-0.75	0	10	4	0	0	0	0	0.5	0	0
	#	TOP	logistic
-1	9	3.87	3.5	0	10	2	0	0	0	0	0.5	0	0
	#	WIDTH exp
-1	9	1.98	5	0	10	4	0	0	0	0	0.5	0	0
	#	WIDTH exp
-50	9	-4.76	-4.5	0	10	2	0	0	0	0	0.5	0	0
	#	INIT	logistic
-50	9	-0.54	2.9	0	10	2	0	0	0	0	0.5	0	0
	#	FINAL	logistic
# size_se1: 3- male offsets- 4 lines
1	60	16	20	0	10	-5	0	0	0	0	0.5	0	0
	#	size@dogleg
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at minL
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at dogleg
-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel) at maxL
#_size_sel: 4
1	60	33.85	32	0	10	2	0	0	0	0	0.5	0	0
	#	PEAK	value
-20	4	-1.27	-0.75	0	10	2	0	0	0	0	0.5	0	0
	#	TOP	logistic
```

```
-10	9	3.4	3.5	0	10	2	0	0	0	0	0.5	0	0
	#	WIDTH exp
-10	9	3.68	5	0	10	2	0	0	0	0	0.5	0	0
	#	WIDTH exp
-10	9	-3.37	-4.5	0	10	2	0	0	0	0	0.5	0	0
	#	INIT	logistic
-10	9	0.79	2.9	0	10	2	0	0	0	0	0.5	0	0
	#	FINAL	logistic
#_size_sel: 5
5	35	15.7	25.7	0	10	-2	0	0	0	0	0	0	0 #
0.000001	35	0.0002	5	0	10	-2	0	0	0	0	0	0
	0 #
# size sel 6
5	35	20	15	0	100	2	0	0	0	0	0	0	0 #
0.000001	35	14	5	0	10	2	0	0	0	0	0	0
	0 #
#_size_sel: 7,8 - none- pre recruit survey
#_size_sel: 9 set to maturity-
#_size_sel: 10 Rec CPUE
1	60	33.85	32	0	100	2	0	0	0	0	0.5	0	0
	#	PEAK	value
-6	4	-1.27	-0.75	0	10	2	0	0	0	0	0.5	0	0
	#	TOP	logistic
-1	9	3.4	3.5	0	10	2	0	0	0	0	0.5	0	0
	#	WIDTH exp
-1	9	3.68	5	0	10	2	0	0	0	0	0.5	0	0
	#	WIDTH exp
-10	9	-3.37	-4.5	0	10	2	0	0	0	0	0.5	0	0
	#	INIT	logistic
-10	9	0.79	2.9	0	10	2	0	0	0	0	0.5	0	0
	#	FINAL	logistic
# size_se1: 10- male offsets- 4 lines
#1	60	16	20	0	10	-5	0	0	0	0	0.5	0	0
	#	size@dogleg
#-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at minL
#-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel)at dogleg
#-10	10	0	0	0	10	-5	0	0	0	0	0.5	0	0
	#	log(relmalesel) at maxL
#
#
#_age_sel: 1
#_age_sel: 2
#_age_sel: 3
#_age_sel: 5
#_age_sel: 6
#_age_sel: 7 - juv survey 1
 0 0 0 0 0 10 -3 0 0 0 0 0 0 0 # 39
 0 0 0 0 0 10 -3 0 0 0 0 0 0 0 # 40
#_age_sel: 8 - juv survey 2
 0 0 0 0 0 10 -3 0 0 0 0 0 0 0 # 39
 0 0 0 0 0 10 -3 0 0 0 0 0 0 0 # 40
#_age_sel: 10
1	10	1	1	0	1	2	0	0	0	0	0.5	0	0
	#	PEAK	value
```

-60 60 -13 -23 0 1 2 0 0 0 0 0.5 0 0
TOP logistic
-40 20 -2 -20 0 1 2 0 0 0 0 0.5 0 0
WIDTH exp
-40 10 0 0 0 1 3 0 0 0 0 0.5 0 0
WIDTH exp
-40 10 -17 -17 0 1 2 0 0 0 0 0.5 0 0
INIT logistic
-40 20 -4.5 -4.5 0 1 2 0 0 0 0 0.5 0 0
FINAL logistic

agesel 10- male offsets- 4 lines
1 60 2 2 0 1 -5 0 0 0 0 0.5 0 0
size@dogleg
-10 10 0 0 0 1 -5 0 0 0 0 0.5 0 0
log(relmalesel)at minL
-10 10 0 0 0 1 -5 0 0 0 0 0.5 0 0
log(relmalesel)at dogleg
-10 10 0 0 0 1 -5 0 0 0 0 0.5 0 0
log(relmalesel) at maxL

1 #_env/block/dev_adjust_method(1/2)

0 #_custom_sel-env_setup

0 #_custom_sel-block_setup
currently for trawl fishery only, 3 params, 4 blocks
#_LO HI INIT PRIOR PR_type SD PHASE
-10 10 0 0 0 99 -6

-4 #_selparmdev-phase

#_Variance_adjustments_to_input_values
#_1 2 3 4 5 6 7 8

#0 0 0 0 0 0 0 0 0 0#_add_to_survey_CV
0.036251
0
0
0.19632
-0.049828
0
0
0
0.00
0
0 0 0 0 0 0 0 0 0 0#_add_to_discard_CV
0 0 0 0 0 0 0 0 0 0#_add_to_bodywt_CV
tune length
0.69
0.75
0.73
1

0.68
0.35
1
1
1
2.5
#1 1 1 1 1 1 1 1 1 1#_mult_by_lencomp_N
1.43714
5.41864
4.24022
1
1
0.75
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#_mult_by_size-at-age_N
30 #_DF_for_discard_like
30 #_DF_for_meanbodywt_like

1 #_maxlambdaphase
0 #_sd_offset
#_lambdas_(columns_for_phases)
1 #_CPUE/survey:_1
0 #_CPUE/survey:_2
0 #_CPUE/survey:_3
0 #_CPUE/survey:_4
1 #_CPUE/survey:_5
1 #_CPUE/survey:_6
0 #_CPUE/survey:_7
1 #_CPUE/survey:_8
0 #_CPUE/survey:_9
1 #_CPUE/survey:_10
0 #_discard:_1
0 #_discard:_2
0 #_discard:_3
0 #_discard:_4
0 #_discard:_5
0 #_discard:_6
0 #_discard:_7
0 #_discard:_8
0 #_discard:_9
0 #_discard:_10
0 #_meanbodyweight
0.1 #_lencomp:_1
0.1 #_lencomp:_2
0.1 #_lencomp:_3
1 #_lencomp:_4
1 #_lencomp:_5
0.1 #_lencomp:_6
0 #_lencomp:_7
0 #_lencomp:_8
0 #_lencomp:_9
1 #_lencomp:_10

1	#_agecomp:_1
1	#_agecomp:_2
1	#_agecomp:_3
0	#_agecomp:_4
0	#_agecomp:_5
1	#_agecomp:_6
0	#_agecomp:_7
0	#_agecomp:_8
0	#_agecomp:_9
0	#_agecomp:_10
0	#_size-age:_1
0	#_size-age:_2
0	#_size-age:_3
0	#_size-age:_4
0	#_size-age:_5
0	#_size-age:_6
0	#_size-age:_7
0	#_size-age:_8
0	#_size-age:_9
0	#_size-age:_10
0	#_init_equ_catch
1	#_recruitments
0	#_parameter-priors
1	#_parameter-dev-vectors
100	#_crashPenLambda
0.9	#_maximum allowed harvest rate
999	

Appendix C: Detailed list of STAR Panel requests and STAT responses.

Round 1 requests

A. Compare the length-composition of the aged fish with non-aged fish for each fishery and each year.

B. Fix the code for the recreational CPUE to be number-based rather than biomass-based.

C. Reset the lambdas on LFs to 0.1 if age data exist, and to 1 if there are no associated age data for the same samples. Run with:

- No CalCOFI or core juvenile;
- No time varying K – fix at the values of all growth parameters of the earlier conditional runs;
- Trawl CPUE indices;
- Rec CPUE;
- Triennial Survey;
- Combined survey;
- Coast-wide juvenile index;
- Fix h at something reasonable;
- Fix M for females and estimate offset for males;
- Fix CV of length at age at 0.06 [based on external analysis done by the STAT];
- Profile over M including likelihood components;
- Estimate selectivity parameters;
- Estimate SSB0;
- Estimate depletion.

D. Save the results from the un-tuned model

E. Tune the trial reference model – see fit for everything. Plots and tables of diagnostics and results.

F. Profile over M for the tuned model looking at individual likelihood components – identify inconsistencies among data sources.

G. Plot or tabulate spatial distribution of samples in recreational data from observers over time.

Round 1 responses

A. The length-compositions of the aged and non-aged chilipepper rockfish were for approximately 50% of the samples from each fishing gear. The results suggested that the size compositions of aged versus unaged fish (plotted as individuals, rather than expanded length compositions) may be biased for some years.

B. The SS2 control switch for the CPFV survey (the recreational fishery CPUE index) was corrected to indicate that the data represented numbers of fish rather than biomass.

C. The SS2 model specified for this request was set up and run with steepness fixed at 0.57 and female natural mortality fixed at 0.16, consistent with the point estimate of steepness associated with the informative prior and the results of profiling over natural mortality. The length-composition data were down-weighted as requested, which was recognized by both the STAR Panel and the STAT as an ad hoc correction for non-independence of the data.

D. Results of the un-tuned model were saved as requested.

E. The revised model was tuned and the results evaluated. As with the earlier model, the relative abundance indices failed to reflect the increase in biomass associated with the large 1984 cohort apparent in observed data. Similarly, the predicted values for the CPFV survey (which began in 1988) showed no decline despite a clear downward trend in the observed values for this index.

F. The profile plot over M revealed tension between the data sets, particularly between the trawl fishery (particularly the length composition data, but including the trawl CPUE time series) and the recreational CPFV survey (with the triennial survey tending to be in agreement with the recreational CPFV survey). Higher estimates of spawning stock biomass were associated with higher values of M.

G. Plots of the number of observed CPFV trips and the number of chilipepper rockfish caught by depth categories and year demonstrated that a relatively small number of samples from deeper depths, each of which encountered large number of fish, were recorded in the years prior to 1994. To ensure consistency in depth ranges covered by the survey through time, trips taken in depths greater than 80 fathoms were excluded from the GLM analysis. The location of the blocks that were included in the CPUE index was also displayed graphically to the STAR Panel, and although a majority of these blocks occurred in the Cordell Bank and Monterey Bay regions, the locations ranged from just south of Point Arena to the Morro Bay region. This spatial coverage was considered adequate (albeit not optimal) for reflecting relative trends throughout the core area of the stock biomass.

H. In the spirit of the discussions with the STAR Panel, the CPUE index was also reproduced using the Stephens/MacCall filter, which was very similar to that produced by the GLM using depth and block data. This indicated that the filter was working properly to identify trips likely to catch chilipepper, although both the STAT and the STAR agreed to continue with the GLM based on location and depth data. The CVs of the results from the filter were less than those from the GLM. Based on discussions with the STAR Panel regarding the triennial survey indices developed with GLMM approaches and area-swept estimates of biomass, a more detailed description of the GLMM analysis provided by T. Helser (pers. Com) was also presented to the STAR Panel. Both the STAT and the STAR agreed that the GLMM provided good predictions of the data.

Round 2 requests

Based on the reference run that was established on Monday evening (Round 1):

H. Test for block-year interaction in GLM for recreational observer CPFV data. If a strong interaction is detected, report back to this issue and complete points I to M, but do not undertake the additional runs at points N to P.

I. Plot length-compositions of aged versus non-aged fish in remaining samples to determine those samples which are relatively unbiased. Weed out obviously biased samples from the SS2 input including those samples that had infeasible numbers of large males.

J. Investigate samples that had extraordinarily large proportions of males.

K. Link RecFIN length-compositions to the recreational fishery and CPFV observer length-composition to the CPFV CPUE survey to assist in elucidating the respective selectivity curves.

L. Remove whole of deep trips >80.

M. Use Helser's GLMM rather than area swept index.

N. Estimate an appropriate selectivity pattern for triennial survey.

O. Systematically set lambda for recreational observer CPFV index to 1, 5, 10, … till a reasonable fit to this index is attained and investigate changes in likelihood for all other components.

P. Profile over R0 as was done for M, plotting against B0.

Round 2 responses

H. Due to the large number of interaction parameters necessary to adequately test for interactions between year and block effects, it was not possible to detect block-year interactions in a satisfactory manner, however the indication was that there were no significant interactions.

I. The length-compositions of aged and non-aged samples were plotted for samples not examined in the initial request, and several potentially problematic years of age-composition data were excluded from further analysis (see the section on commercial age and length composition data for specific years that were effectively removed from the objective function).

J. After filtering to remove outliers, the length-composition for one sample still contained a number of unfeasibly large males. This length-composition year was also "turned off" in all subsequent analyses as well as the base model.

K. In the preliminary model the CPFV index was biomass-based and was linked with the recreational fishery along with the CPFV length-composition data. In discussions with the STAR Panel it was agreed to treat the CPFV index and length compositions as a separate survey, and use RecFIN length-composition data to represent the full range of recreational fishing modes. These changes did not have a major effect on the model results.

L. Removing the data for trips >80 fathoms, including associated length data, had little effect on the biomass trajectory.

M. The use of the GLMM results rather than the swept area indices for the triennial and NWFSC combination survey resulted in slightly greater depletion than in the previous run. As the GLMM analysis was agreed to more appropriately account for the highly variable nature of tow-specific catch rates, this was agreed by both the STAT and the STAR Panel to be a more appropriate index for the final model and was used in all further analyses.

N. The selectivity curve for the triennial survey was essentially a horizontal line, with the result that the parameters were poorly specified and the Hessian for this run could not be inverted. To invert the Hessian required fixing the selectivity parameters at their estimated values.

O. Elevated lambdas on the CPFV index resulted in lower biomass trajectories and apparently greater depletion, with a better fit to the CPFV and triennial indices but poorer fit to the trawl CPUE index. However, even with lambda = 25 the predicted CPFV index failed to reflect the increase in biomass that resulted from the 1984 year class, which was evident in other data sources. A more effective approach for capturing the signal of the 1984 year class was to set the CPFV index lambda at 5, and incorporate both length and age selectivity (similar to the sablefish model), and including time-varying growth (with a 3-year blocking pattern). The resulting predicted length-compositions for the CPFV survey reflected the bimodality present in the observed length data, which was not as well reflected when using length-based selectivity alone.

P. The STAT had insufficient time to satisfy this request.

Round 3 requests

Q. Modify the SS2 input specification to turn off the age-composition data where samples were biased (as determined from comparison of aged and non-aged LF data) and turn length-composition data back on. For the sample with an infeasible number of large males, turn off both age and length-compositions.

R. Using lambda for CPFV survey data set to 1, run SS2 to provide a reference for subsequent runs

S. Investigate alternative parameterisation for sex-specific selection curves for the CPFV survey using either age OR length selection (but not both) and hence determine a suitable selection pattern to use. Save runs.

T. Using the final selection curve from Request S, produce a simple profile analysis based on R0 to explore the tension among different indices and data sets.

Round 3 responses

Q. The changes were completed to remove the effect of biased sampling for age but retain the associated length data.

R. The run was completed as requested. Turning off the biased age-composition data did not have a major impact on the predictions of biomass, nor did it help the fit to the CPFV survey data.

S. The rationale for this request was to find a selection curve for the CPFV survey that would fit the CPFV index and length-composition data without the complexity of the composite age- and length-based curve that the STAT had used in response O. The STAT replaced the CPFV length-based selection curve with an age-based curve, which went asymptotic when fitted. The resulting fit appeared slightly better than that obtained with length-based selectivity. However, the request that the selectivity curve be sex-specific was not implemented. Consequently the response to request T was not informative, and that request was repeated in the next round.

Round 4 requests

U. Complete Request S. That is, search for alternative parameterisation for sex-specific selection curves for the CPFV survey using either age OR length selection (but not both) and hence determine a suitable selection pattern to use. Save runs.

V. Using the final selection curve from Request U, produce a simple profile analysis based on R_0 to explore the tension among different indices and data sets.

W. Explore alternative blocking for time-varying growth based on external environmental variables.

Round 4 responses

U. The STAT attempted to find an alternative parameterization for sex-specific selectivity curves, but was unable to fit an age-based or length-based, sex-specific selection curve that provided as good a model fit as that obtained by the combined age- and length-based selection curve (which were not sex-specific).

V. The relative impact on the overall likelihood of the different model components at different values of R_0 could not be compared easily using the profile plots because the plots did not account for the effect of lambda, which was reduced to 0.1 for some components. Using sex-specific selection for the CPFV survey did not appear to warrant further investigation.

W. An alternative block formulation was developed based on the major shifts in the sign of the Pacific Decadal Oscillation (PDO) index, which has been shown to be related to physical ocean conditions, zooplankton production, salmon smolt survival and other indices of marine productivity. The Panel agreed with the STAT that the PDO provided an adequate basis for blocking offsets for the growth parameter K into six time-blocks. The results included a large improvement in the log-likelihood, but the value of K for the final time-block was far lower than the values for previous time-blocks.

Round 5 requests

X. Investigate feasibility of driving K with PDO (spend no more than half hour on this task).

Y. Adopt time-varying growth based on the better of using either PDO blocks (with slightly-informative prior on K to avoid infeasible reduction in K for last period) or using environmentally-driven growth (Request X), and using both age and size-selectivity on the CPFV CPUE recreational survey, create tuned base. Demonstrate adequate convergence of tuned run.

Z. Produce profile plots on R0 accounting for lambda.

AA. Using base run, produce standard diagnostics for STAR Panel review.

Round 5 responses

X. The direct forcing of the growth parameter K with a three-year running mean of the PDO index showed promise, and resulted in an improved fit (approximately 25 likelihood units) relative to the time-invariant K model. However, the improvement in fit was notably less than using blocked time intervals, and consequently it was agreed that the base model should use the time-blocking approach.

Y. A value of 0.5 was used as the standard deviation for a slightly informative prior on K for the configuration with six PDO-based time-blocks for changes in K. The convergence-test runs that used "jittered" starting parameter values revealed convergence problems, suggesting that the likelihood surface is quite irregular. Requests Z and AA were not completed due to these convergence problems.

Round 6 requests

AB. Explore convergence and results of time-varying K with (a) last two blocks combined into a single large block and (b) changing the standard deviation for the prior on the deviations on K from 0.5 to 0.35.

AC. Use 0.5 on the K-dev prior. Run with five-block rather than 6-block model. Examine results.

AD. Turn off all priors. Run with five-block rather than 6-block model. Examine results

AE. Use run from Request AD. Clean up initial values. Make qs analytical. Clean up phasing. Do jitters and alternative phasing to confirm model convergence. If not converged, report back ASAP. If converged, produce a full set of diagnostic results and profile plots on R_0 accounting for lambda. If these are satisfactory, this will be the base model.

Round 6 responses

AB. The two requested runs explored alternative methods for constraining the growth coefficient K in the final time block. The Panel was concerned that the unconstrained estimate for the final K value was extremely small and would have a strong influence on forecasts. The run with the standard deviation for the prior probability reduced to 0.35 still produced a low value for the final K. The run that merged the last two blocks in combination with a standard deviation of 0.35 for the prior probability resulted in an intermediate value of K.

AC. The Panel sought confirmation that having the longer final block in the five-block model would provide sufficient constraint for the final K value and that the prior probability on the K-offsets could be eliminated. The use of a standard deviation value of 0.5 for the prior probability on the K-offsets had little effect on the results.

AD. As several parameters had very modest likelihood values associated with weakly informative priors other than the offsets to K, all prior probabilities were removed and the lambda on priors was set to zero in order to simplify the model configuration.

AE. Convergence test runs with jittered initial parameter values indicated there still were convergence problems associated with roughness in profile plots, although the effects did not appear too severe. The panel provided guidance to jitter the final profile plots in the revised assessment to ensure convergence to the best model fit, and this was done for all sensitivity runs.

Round 7 requests

AF. Set process error added to CPFV survey indices to 0. Re-run. Confirm that this is appropriate to use as a base model through jitters and alternative phasing to confirm model convergence.

AG. With settings resulting from Request AF, increase emphasis to 20 on both CPFV survey indices and length frequencies to estimate age-based, sex-specific selectivity. Assess whether this gives sensible selection patterns. If so, using the resulting parameter space and selectivity pattern (possibly fixing selectivity parameters to the resulting values), de-emphasise, re-fit, and re-tune to produce plausible alternative results (removing process error if necessary after tuning). Note – no more than ~45 minutes to be spent on this task. Produce a plot of the biomass trajectory of this compared with the result from Request AF as a sensitivity analysis. Compare the depletion estimates.

AH. With settings resulting from Request AF, explore the following dimensions of uncertainty using low and high values for (a) historical catch prior to 1978 (half and double), (b) M, and (c) h. Retain SS2 results from each run. Produce comparative plots of the biomass trajectories of these compared with the result from Request AF. Produce a table showing comparison of likelihood contributions from different components. Produce a table of comparative depletion estimates.

Round 7 responses

AF. Removing the variance adjustment on the CPFV survey index had the desired effect of producing a better fit to the CPFV survey. After reviewing diagnostic plots the Panel recommended acceptance of this model configuration as the base model.

AG. These sensitivity runs re-explored using an alternative configuration for the CPFV survey selection curve. Previous explorations had increased the lambda on the CPFV survey index but not on the CPFV length-composition data. The new runs produced a very good fit to the CPFV index even when lambda was decreased from 20 to 10, but the CPFV selectivity curve had been configured as age- and length-based and sex-specific. Convergence tests with jittered initial parameter values still produced fits that appeared not fully converged.

During discussions the STAT indicated that the CVs for the triennial and combination surveys had been reduced externally rather than with a variance adjustment factor in the SS2 control file. Because the model provided good fits to several survey data points that had very large input CVs, the standard variance adjustment approach would have produced negative CVs for other data points with small input CVs. The Panel notes that further consideration is needed to develop an appropriate approach for handling survey variance adjustments that could potentially become negative.

AH. The runs were completed as requested. The resulting profile plots were somewhat jagged, suggesting that the model had failed to converge fully at many values of the reference variable. Following examination of the profile plots the Panel concluded that, of the variables considered, h was likely to provide the most useful axis of uncertainty. The Panel recommended assuming a normal distribution for h with a mean value of 0.573 and standard deviation of 0.183 to determine the bracketing values.

Round 8 requests

AI. Complete Request AG to estimate age-based, sex-specific selectivity. Run and produce comparison of results.

AJ. For developing a decision table, run the base model with h = 0.34 and 0.81 [mean values of the lower and upper 25% of the prior probability distribution for h] to obtain results likely to be representative of the lower 25% and upper 25% of values, respectively. Use the alternative phasing supplied by the STAR Panel. Jitter and ensure convergence for each value of h.

Round 8 responses

AI. The response to AG had used a sex-specific, age- and length-based selection curve for the CPFV survey. Results demonstrated that, although needing further refinement, an age-based, sex-specific selectivity curve could be developed to replace the age- and length-based, sex-specific selectivity curve.

AJ. While there were still convergence issues that required jittering of input parameter values for each analysis, the jittered runs for each level of steepness produced reasonably similar results. Depletion for the base case was 0.7, while those from the lower and higher values of h were 0.46 and 0.78, respectively. The Panel accepted that use of these values of h produced the required lower and upper runs to bracket uncertainty around the base-run results.

Chilipepper Rockfish STAR Panel Report

National Marine Fisheries Service
SWFSC Santa Cruz

June 25-29, 2007

Reviewers:

David Sampson, Scientific and Statistical Committee Representative, Panel Chair
Patrick Cordue, Center for Independent Experts
Norman Hall, Center for Independent Experts
Kevin Piner, NOAA Fisheries Service, Southwest Fisheries Science Center

Advisors:

Gerry Richter, Groundfish Advisory Subpanel Representative
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STAT Team:

John C. Field, NOAA Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division.

Overview

The STAR Panel met June 25-29th in Santa Cruz, CA and reviewed the draft stock assessment for chilipepper rockfish off California, which was conducted using the SS2 software and based on the following data sources: annual landings from 1892 for four fisheries (trawl, hook and line, set net, and recreational); five biomass/abundance indices (the triennial bottom trawl survey, the NWFSC shelf/slope combination bottom trawl survey, catch rates from trawl logbooks, catch rates from the northern California CPFV observer database, and the coast-wide SWFSC juvenile rockfish abundance survey); age-composition data from three fisheries (trawl, hook and line, and set net) and the NWFSC combination survey; and length-composition data from four fisheries (trawl, hook and line, set net, and recreational) and two surveys (the triennial bottom trawl survey and the NWFSC combination survey). This stock had not been assessed since 1998.

The draft assessment document distributed prior to the STAR Panel meeting described a preliminary assessment model that included conditional age-at-length compositions rather than age-compositions. Problems with tuning this model resulted in the STAT bringing to the Panel a revised assessment model that had length-compositions and age-compositions and no conditional age-at-length compositions. The STAR Panel accepted that the conditional age-at-length approach should not be pursued during the meeting. To compensate for using some sampled fish in both age- and length-compositions, it was agreed that revised models should down-weight those length-compositions for which there were also age-compositions. A review of the age-composition data uncovered some apparently biased age-composition sampling, as evidenced by large discrepancies between the length-compositions of aged versus un-aged fish. This resulted in additional data filtering to identify and remove suspect age-composition data.

Because chilipepper rockfish are known to be semi-pelagic, there were concerns that the two available bottom trawl surveys would not provide reliable biomass indices. Of all the available indices, the CPFV index, based on observed angler catch rates at defined fishing sites, seemed the most likely to provide a reliable abundance index. Hence the STAR asked the STAT to investigate the consequences of focusing on the CPFV index (based on observer data on recreational CPUE) as the primary tuning index. The model, however, generally predicted flat trends for the CPFV index, which seemed inconsistent with evidence in other data sources that indicated an exceptionally strong 1984 year-class. This inconsistency led to exploration of alternative selectivity configurations that would allow a closer fit to the CPFV index. The accepted base model provides a reasonable fit to the trends apparent in the survey by means of a composite age- and length-based selection curve for the CPFV survey, but there is no direct evidence of a mechanism for such selection.

The preliminary base model (distributed prior to the STAR Panel) was configured to allow time-variation in the growth coefficient K, with changes in K occurring at three-year intervals. It was agreed that time-variation in growth was a sensible feature to explore given the inter-annual variation in mean size-at-age apparent in this stock. However, rather than imposing an arbitrary three-year blocking pattern, time-varying growth in the final base model was incorporated using blocking derived from low-frequency changes in the Pacific Decadal Oscillation (PDO) index.

After exploring the accepted base model along several dimensions of uncertainty, including the rate of natural mortality and the level of historical catch, it was agreed that the major axis of uncertainty should be the steepness parameter (h), which provided reasonable contrast in the level of stock depletion. Low and high values of h for a decision table were derived from a normal prior probability distribution based on a meta-analysis of rockfish steepness parameters. The final decision table was developed after the STAR Panel meeting, based on consultation with the GMT and GAP advisors regarding appropriate harvest levels to include in the projections.

The STAR Panel commends Dr John Field, the STAT, for his hard work and cheerful willingness to address issues arising during the course of the STAR review. Despite encountering technical difficulties before and during the STAR review, Dr Field persisted and was able to find suitable solutions and develop an acceptable base model and alternative runs that adequately captured the uncertainty of the model. The next full assessment of the chilipepper rockfish stock should re-investigate using conditional age-at-length data, rather than non-independent length- and age-composition data, and should further explore environmentally driven changes in growth. There should also be fuller investigation of the effects of uncertainty in the catch history.

Analyses requested by the STAR Panel

The initial presentation by the STAT and accompanying supplemental material distributed on the first day of the STAR indicated that the preliminary model was very sensitive to "tuning" adjustments to the variance weightings of the likelihood components, there being large differences between the results of tuned versus un-tuned models. The STAR Panel considered this sensitivity to tuning to be an indication of tension between inconsistent data sets and proposed that the STAT explore the problem using a simplified model, with additional complexity being introduced later in a stepwise manner. The STAR Panel endorsed the view of the STAT that the juvenile core survey index should be removed from the SS2 analysis as the data are extremely noisy and the information content appears inadequate given the limited spatial coverage of the core survey. The STAR Panel also agreed with the STAT's view that the CalCOFI index was not suitable for chilipepper rockfish because the survey misses much of the spatial range of the stock.

Round 1 requests

A. Compare the length-composition of the aged fish with non-aged fish for each fishery and each year.

B. Fix the code for the recreational CPUE to be number-based rather than biomass-based.

C. Reset the lambdas on LFs to 0.1 if age data exist, and to 1 if there are no associated age data for the same samples. Run with:

- No CalCOFI or core juvenile;
- No time varying K – fix at the values of all growth parameters of the earlier conditional runs;
- Trawl CPUE indices;
- Rec CPUE;
- Triennial Survey;
- Combined survey;
- Coast-wide juvenile index;
- Fix h at something reasonable;
- Fix M for females and estimate offset for males;
- Fix CV of length at age at 0.06 [based on external analysis done by the STAT];
- Profile over M including likelihood components;
- Estimate selectivity parameters;
- Estimate SSB0;
- Estimate depletion.

D. Save the results from the un-tuned model

E. Tune the trial reference model – see fit for everything. Plots and tables of diagnostics and results.

F. Profile over M for the tuned model looking at individual likelihood components – identify inconsistencies among data sources.

G. Plot or tabulate spatial distribution of samples in recreational data from observers over time.

Round 1 responses

A. The length-compositions of the aged and non-aged chilipepper rockfish were plotted by the STAT for approximately 50% of the samples from each fishing gear. These plots indicated that, for a number of years, fish selected for ageing appeared to be larger than the non-aged fish from the same year, which not only affected the length-compositions but also affected the sex ratio because of sexual dimorphism in growth. While the proportions-at-age of fish of a given length are unlikely to be affected, the mean value of length-at-age is likely to be positively biased if the biased data are included in the SS2 analysis.

B. The SS2 control switch for the CPFV survey (the recreational fishery CPUE index) was corrected to indicate that the data represented numbers of fish rather than biomass.

C. The SS2 model specified for this request was set up and run with h fixed at 0.57 (based on a meta-analysis by Martin Dorn, personal communication) and M for females was fixed at 0.16. These values were consistent with the maximum likelihood estimate based on profiling over M and h. The length-composition data were down-weighted as requested as an ad hoc correction for non-independence of the data. A more appropriate method to address the problem is discussed in Appendix 1.

D. Results of the un-tuned model were saved as requested.

E. Predictions of the abundance/biomass indices from the tuned model failed to reflect the large 1984 cohort apparent in the model-estimated recruitment and catch at age data. The predicted values for the CPFV survey in particular showed no decline despite a clear downward trend in the observed values for this index.

F. The profile plot over M revealed the tension between the data sets, especially between the trawl fishery and the recreational CPFV survey. Higher estimates of spawning stock biomass were associated with higher values of M.

G. To address concern that possible unbalanced sampling in the CPFV observer data could invalidate the GLM time series as an index of abundance, the STAT generated tables and plots of both the number of trips in which samples were taken and the number of chilipepper rockfish caught by depth categories and year. A small number of samples, each with a large number of fish, collected from depths greater than 80 fathom were recorded in the years prior to 1994. To ensure consistency in depth ranges covered by the survey through time it was agreed that fish from depths greater than 80 fathom would be excluded from the GLM analysis.

Other analyses presented by the STAT in response to issues raised by the Panel.

- The time series of estimates of the CPFV recreational CPUE index produced using the Stephens/MacCall filter was very similar to that produced by the GLM using depth and block data, which suggests that the filter was working properly to identify trips likely to catch chilipepper. The CVs of the results from the filter were less than those from the GLM. Results produced by the GLM using only year effects were highly correlated with those produced by the original GLM but lay below them. A very similar result was produced when the deepest depth bins were dropped from the analysis.

- To explore inconsistency between GLMM and area-swept estimates of survey biomass, which had been highlighted during the initial presentation and review of data sources, the STAT contacted Dr Tom Helser (NWFSC), who had provided the STAT with the survey biomass indices. Dr Helser sent a more detailed description of the GLMM analysis, accompanied by results and diagnostic plots. The discrepancy between the scales of the results of the GLMM analysis and the swept-area approach appears to reside in the presence of occasional large catches of chilipepper rockfish (i.e., the patchiness of the distribution) and the use in the GLMM of a log-normal distribution. Diagnostic plots from the GLMM indicated that the model provides good predictions of the data.

Round 2 requests

Based on the reference run that was established on Monday evening (Round 1):

H. Test for block-year interaction in GLM for recreational observer CPFV data. If a strong interaction is detected, report back to this issue and complete points I to M, but do not undertake the additional runs at points N to P.

I. Plot length-compositions of aged versus non-aged fish in remaining samples to determine those samples which are relatively unbiased. Weed out obviously biased samples from the SS2 input including those samples that had infeasible numbers of large males.

J. Investigate samples that had extraordinarily large proportions of males.

K. Link RecFIN length-compositions to the recreational fishery and CPFV observer length-composition to the CPFV CPUE survey to assist in elucidating the respective selectivity curves.

L. Remove whole of deep trips >80.

M. Use Helser's GLMM rather than area swept index.

N. Estimate an appropriate selectivity pattern for triennial survey.

O. Systematically set lambda for recreational observer CPFV index to 1, 5, 10, … till a reasonable fit to this index is attained and investigate changes in likelihood for all other components.

P. Profile over R0 as was done for M, plotting against B0.

Round 2 responses

H. There was concern that presence of a strong block-year interaction would require a different analysis to derive a suitable blending of non-parallel abundance trends. It was not possible, however, to detect block-year interactions in the GLM for the recreational observer CPFV data because the data were too sparse. The value of AIC produced did not indicate an improved fit that justified the block-year interactions.

I. The length-compositions of aged and non-aged samples were plotted for samples not previously examined to subjectively identify samples for which there may have been biased selection of fish for ageing. The STAT advised that the data were raw and unexpanded. (Later in the week the Panel concluded that it would have been more appropriate to do the data screening based on length-compositions expanded to account for differing sampling rates.)

In subsequent SS2 runs for this round the STAT had "turned off" the length-compositions of the biased samples. However, as it was the age sample selection that was biased, it would have been more appropriate to retain the length-compositions and "turn off" the age-compositions. The Panel suggested that the likelihoods calculated in SS2 for the length samples and associated age samples may be inappropriate as the two samples were not independent. Patrick Cordue advised that he would derive the likelihood function and that he would include the necessary equations in an appendix.

J. After filtering to remove outliers, the length-composition for one sample still contained a number of unfeasibly large males. This length-composition should also be "turned off" in the SS2 analysis.

K. In the preliminary model the CPFV index was biomass-based and was linked with the recreational fishery, and the CPFV length-composition data were used to represent the recreational fishery. There were no RecFIN length-composition data to represent the full range of recreational fishing modes. Linking RecFIN length-compositions to the recreational fishery and CPFV length-composition to the CPFV survey produced little change in the biomass trajectory. (This request was done after completing changes specified in request M). The STAT advised that the RecFIN length-compositions were expanded length-compositions as produced by RecFIN.

L. The STAT reported that removing the data for trips >80 fathoms, including associated length data, had little effect on the biomass trajectory.

M. The use of the GLMM results rather than the swept area indices for the triennial and NWFSC combination survey resulted in slightly greater depletion than in the previous run. (This request was done before completing the changes specified in request K).

N. The STAT encountered difficulties fitting the selectivity curve for the triennial survey. The resulting logistic curve was essentially a horizontal line, apparently so the model could accommodate small fish. Also, the Hessian for this run could not be inverted.

O. The Panel wanted to understand why the model was not providing a reasonable fit to the CPFV recreational observer index, which should have been a more reliable index than other available indices. Elevated lambdas on the CPFV index resulted in lower biomass trajectories and apparently greater depletion, with a better fit to the CPFV and triennial indices but poorer fit to the trawl CPUE index. However, even with lambda = 25 the predicted CPFV index failed to reflect the strong 1984 year class, which was evident in other data sources and seemed to be reflected in the observed CPFV index value for 1992. Further exploration by the STAT found a configuration that produced a slight signal of the strong year class in the predicted CPFV index: lambda = 5 for the CPFV survey, selectivity for the CPFV survey was dome-shaped for both length and age, and growth was time-varying (with a 3-year blocking pattern). The resulting predicted length-compositions for the CPFV survey reflected the bimodality present in the observed length data. The predicted length-compositions using length-based selectivity alone did not appear to fit as well and failed to produce similar bimodality.

P. The STAT had insufficient time to satisfy this request.

Round 3 requests

Q. Modify the SS2 input specification to turn off the age-composition data where samples were biased (as determined from comparison of aged and non-aged LF data) and turn length-composition data back on. For the sample with an infeasible number of large males, turn off both age and length-compositions.

R. Using lambda for CPFV survey data set to 1, run SS2 to provide a reference for subsequent runs

S. Investigate alternative parameterisation for sex-specific selection curves for the CPFV survey using either age OR length selection (but not both) and hence determine a suitable selection pattern to use. Save runs.

T. Using the final selection curve from Request S, produce a simple profile analysis based on R0 to explore the tension among different indices and data sets.

Round 3 responses

Q. The changes were completed to remove the effect of biased sampling for age but retain the associated length data.

R. The run was completed as requested. Turning off the biased age-composition data did not have a major impact on the predictions of biomass, nor did it help the fit to the CPFV survey data.

S. The rationale for this request was to find a selection curve for the CPFV survey that would fit the CPFV index and length-composition data without the complexity of the composite age- and length-based curve that the STAT had used in response O. The STAT replaced the CPFV length-based selection curve with an age-based curve, which went asymptotic when fitted. The resulting fit appeared slightly better than that obtained with length-based selectivity. Unfortunately, the STAT had not noted the request that the selectivity curve should be sex-specific, and this had not been implemented.

T. Although the STAT produced profiles on R0 as requested, the runs were for CPFV selectivity that was age-based but not sex-specific. The profiles did not provide the information that the Panel had sought.

Round 4 requests

U. Complete Request S. That is, search for alternative parameterisation for sex-specific selection curves for the CPFV survey using either age OR length selection (but not both) and hence determine a suitable selection pattern to use. Save runs.

V. Using the final selection curve from Request U, produce a simple profile analysis based on R0 to explore the tension among different indices and data sets.

W. Explore alternative blocking for time-varying growth based on external environmental variables.

Round 4 responses

U. In its exploration, the STAT had been unable to fit an age-based or length-based, sex-specific selection curve that provided as good a model fit as that obtained by the age- and length-based selection curve (not sex-specific). The Panel noted that in tuning a model where sampled fish contribute to both length- and age-compositions the effective sample size for aged sub-samples should be linked to that of the associated length samples. The Panel also advised that when age data are derived from a sub-sample of the length data the likelihood function describing the length- and age-at-length composition data has additional components that are "constant" (i.e., independent of estimated parameters) but could influence model fits if the sub-samples were biased and the bias was estimated (Appendix 1).

V. The profile over R0 was completed as requested. The relative impact on the overall likelihood of the different model components at different values of R0 could not be compared easily using the profile plots because the plots did not account for the effect of lambda, which was reduced to 0.1 for some components. Using sex-specific selection for the CPFV survey did not appear to warrant further investigation.

W. The Panel was concerned that there was no basis for arbitrarily blocking changes in growth at three-year intervals, especially given the STAT's view, expressed during its initial presentation, that changes in growth were driven by changing oceanographic conditions. The STAT presented information on the Pacific Decadal Oscillation (PDO) index, which others have shown to be related to zooplankton production. The Panel agreed with the STAT that the PDO provided an adequate basis for blocking the modelled time period into six blocks. This model, with six time-blocks for growth parameter K, resulted in a large improvement in the log-likelihood, but the value of K for the final time-block was much lower than the values for previous time-blocks. The Panel suggested using an informed prior to ensure that the offset of K for the last block did not fall to an unrealistic level as it had in the runs produced for this request.

Round 5 requests

X. Investigate feasibility of driving K with PDO (spend no more than half hour on this task).

Y. Adopt time-varying growth based on the better of using either PDO blocks (with slightly-informative prior on K to avoid infeasible reduction in K for last period) or using environmentally-driven growth (Request X), and using both age and size-selectivity on the CPFV CPUE recreational survey, create tuned base. Demonstrate adequate convergence of tuned run.

Z. Produce profile plots on R0 accounting for lambda.

AA. Using base run, produce standard diagnostics for STAR Panel review.

Round 5 responses

X. The Panel and STAT agreed that effects similar to those obtained from time-blocking might be obtained by directly relating K with the PDO index, on which the blocking pattern was based. Use of the PDO index to drive K showed promise but this simpler model structure failed to improve the fit obtained using K-offsets in the six blocking periods. It was agreed that the base model should use the time-blocking approach.

Y. A value of 0.5 was used as the standard deviation for a slightly informative prior on K for the configuration with six PDO-based time-blocks for changes in K. The convergence-test runs that used "jittered" starting parameter values revealed convergence problems, with many runs clearly not converging. Four runs apparently converged but produced different solutions at different values of R0: two with high overall likelihood values and two with low. The different solutions appeared to be associated with changes in the values of the K-offset for the last two time-blocks. Evidently the likelihood surface is quite irregular.

Z. This request was not completed because of the convergence problems uncovered in response Y.

AA. This request was not completed because of the convergence problems uncovered in response Y.

Round 6 requests

AB. Explore convergence and results of time-varying K with (a) last two blocks combined into a single large block and (b) changing the standard deviation for the prior on the deviations on K from 0.5 to 0.35.

AC. Use 0.5 on the K-dev prior. Run with five-block rather than 6-block model. Examine results.

AD. Turn off all priors. Run with five-block rather than 6-block model. Examine results

AE. Use run from Request AD. Clean up initial values. Make qs analytical. Clean up phasing. Do jitters and alternative phasing to confirm model convergence. If not converged, report back ASAP. If converged, produce a full set of diagnostic results and profile plots on R0 accounting for lambda. If these are satisfactory, this will be the base model.

Round 6 responses

AB. The two requested runs explored alternative methods for constraining the growth coefficient K in the final time block. The Panel was concerned that the unconstrained estimate for the final K value was extremely small and would have a strong influence on forecasts. The run with the standard deviation for the prior probability reduced to 0.35 still produced a low value for the final K. The run that merged the last two blocks in combination with a standard deviation of 0.35 for the prior probability resulted in an intermediate value of K.

AC. The Panel sought confirmation that having the longer final block in the five-block model would provide sufficient constraint for the final K value and that the prior probability on the K-offsets could be eliminated. The use of a standard deviation value of 0.5 for the prior probability on the K-offsets did not have much effect on the results.

AD. Likelihood summaries examined in connection with earlier responses indicated that some parameters other than the offsets to K were also being constrained by prior probabilities. Because there were no appreciable differences between runs with prior probabilities and runs in which they had been eliminated, the Panel concluded that it would be appropriate to remove all prior probabilities and thus simplify the model configuration.

AE. The Panel requested a general clean-up and simplification of the SS2 control file in hope that this would improve convergence of the model. However, convergence test runs with jittered initial parameter values indicated there still were convergence problems. Roughness that was evident in the profile plots was probably a reflection of lack of full convergence but the effects did not appear too severe.

Round 7 requests

AF. Set process error added to CPFV survey indices to 0. Re-run. Confirm that this is appropriate to use as a base model through jitters and alternative phasing to confirm model convergence.

AG. With settings resulting from Request AF, increase emphasis to 20 on both CPFV survey indices and length frequencies to estimate age-based, sex-specific selectivity. Assess whether this gives sensible selection patterns. If so, using the resulting parameter space and selectivity pattern (possibly fixing selectivity parameters to the resulting values), de-emphasise, re-fit, and re-tune to produce plausible alternative results (removing process error if necessary after tuning). Note – no more than ~45 minutes to be spent on this task. Produce a plot of the biomass trajectory of this compared with the result from Request AF as a sensitivity analysis. Compare the depletion estimates.

AH. With settings resulting from Request AF, explore the following dimensions of uncertainty using low and high values for (a) historical catch prior to 1978 (half and double), (b) M, and (c) h. Retain SS2 results from each run. Produce comparative plots of the biomass trajectories of these compared with the result from Request AF. Produce a table showing comparison of likelihood contributions from different components. Produce a table of comparative depletion estimates.

Round 7 responses

AF. Removing the variance adjustment on the CPFV survey index had the desired effect of producing a better fit to the CPFV survey. After reviewing diagnostic plots the Panel recommended acceptance of this model configuration as the base model.

AG. These sensitivity runs re-explored using an alternative configuration for the CPFV survey selection curve. Previous explorations had increased the lambda on the CPFV survey index but not on the CPFV length-composition data. The new runs produced a very good fit to the CPFV index even when lambda was decreased from 20 to 10, but the CPFV selectivity curve had been configured as age- and length-based and sex-specific. Convergence tests with jittered initial parameter values still produced fits that appeared not fully converged.

During discussions the STAT indicated that the CVs for the triennial and combination surveys had been reduced externally rather than with a variance adjustment factor in the SS2 control file. Because the model provided good fits to several survey data points that had very large input CVs, the standard variance adjustment approach would have produced negative CVs for other data points with small input CVs. The Panel notes that further consideration is needed to develop an appropriate approach for handling survey variance adjustments that could potentially become negative.

AH. The runs were completed as requested. The resulting profile plots were somewhat jagged, suggesting that the model had failed to converge fully at many values of the reference variable. Following examination of the profile plots the Panel concluded that, of the variables considered, h was likely to provide the most useful axis of uncertainty. The Panel recommended assuming a normal distribution for h with a mean value of 0.573 and standard deviation of 0.183 to determine the bracketing values.

Round 8 requests

AI. Complete Request AG to estimate age-based, sex-specific selectivity. Run and produce comparison of results.

AJ. For developing a decision table, run the base model with h = 0.34 and 0.81 [mean values of the lower and upper 25% of the prior probability distribution for h] to obtain results likely to be representative of the lower 25% and upper 25% of values, respectively. Use the alternative phasing supplied by the STAR Panel. Jitter and ensure convergence for each value of h.

Round 8 responses

AI. The response to AG had used a sex-specific, age- and length-based selection curve for the CPFV survey. Results demonstrated that, although needing further refinement, an age-based, sex-specific selectivity curve could be developed to replace the age- and length-based, sex-specific selectivity curve.

AJ. While there were still convergence issues that required jittering of input parameter values for each analysis, the jittered runs for each level of steepness produced reasonably similar results. Depletion for the base case was 0.7, while those from the lower and higher values of h were 0.46 and 0.78, respectively. The Panel accepted that use of these values of h produced the required lower and upper runs to bracket uncertainty around the base-run results.

Final base model description

The agreed base model configuration for chilipepper rockfish had the following characteristics:

- Single-area model with two sexes.
- Stock initially at equilibrium with zero harvest. First harvests in 1892.
- Age- and length-compositions included but with down-weighting of length-compositions that had associated age data.
- No conditional age-at-length composition data.
- Fixed natural mortality coefficients (0.16 for females and 0.202 for males).
- Steepness parameter (h) fixed at 0.57.

- Assumed value of 1.0 for sigma-R.
- Recruitment deviations estimated for 1965-2006.
- Length-based selection with no sex-offset for all fisheries and surveys, except for the CPFV abundance index, for which selection is length- and age-based, with no sex-offset.
- Sex-specific growth coefficients (K) allowed to vary during 1970-2006 according to a five-block pattern based on changes in the PDO index.
- Other growth parameters estimated outside the model.
- No prior probabilities on any parameters.

Comments on the technical merits and/or deficiencies of the assessment

Technical Merits

- The STAT excluded some data sets from the assessment model based on pre-evaluations of potential input data sets. This is a more sensible approach than mixing good data with bad.
- The STAT made proficient use of SS2 and accompanying software, which greatly facilitated the Panel's review.
- Use of time-varying growth coupled with changes in the PDO was a useful innovation and the Panel encourages further work on the approach.

Technical Deficiencies

- Good length-composition data may have been excluded from the model because the data filtering to detect biased age samples was based on unexpanded length-compositions. (The Panel wrongly instructed the STAT to examine unexpanded length-compositions.)
- The approach applied in this assessment of down-weighting length-composition data when associated age-composition data are included is ad-hoc and has no good theoretical basis. The age data from fish that contribute both age and length data should be handled instead as conditional age-at-length compositions. See Appendix 1.
- The model tuning process that adjusted for inconsistencies between the "input" and "effective" sample sizes for length and age compositions treated the age- and length-compositions as independent even though length/age data for some fish were included in both length- and age-compositions. If dependent age and length frequencies are used (which is not recommended) then a method needs to be developed for their joint tuning.
- The model tuning process that adjusted for inconsistencies between the model fits to surveys (RMSE) and the input CVs took an ad hoc approach with surveys that had very large CVs for some index values. The input CVs were reduced proportionally. This is inconsistent with the normal basis for the tuning process, which involves adding a constant to account for process error.
- The estimated growth curves at the L1 value had kinks that could probably be eliminated by reducing the lower bound of the smallest length bin.

- Results from the convergence tests with randomly jittered starting parameter values indicated that the likelihood surface is very irregular, which implies that the final model runs may not have fully converged. However, the biomass trajectories and other critical results do not appear to be sensitive to any lack of convergence.
- All final runs used a composite length-age selection curve for the main tuning index (the CPFV survey), but currently there is no obvious rationale for such complex selection. Using an age-based, sex-specific selection curve showed promise as an alternative configuration. It was able to provide a good fit to the CPFV length-composition data and the decline in the CPFV index when given high lambda values on these likelihood components. The estimated depletion from this alternative was not inconsistent with the range used in the decision table analysis.

Areas of disagreement regarding STAR Panel recommendations

There were no areas of disagreement among the Panellists or between the STAR and the STAT.

Unresolved problems and major uncertainties

This section focuses on major uncertainties. Unresolved problem are discussed above under Technical Deficiencies.

- The base model configuration developed during the STAR meeting was based on the assumption that the survey index from the CPFV observer data is a reliable index of abundance.
- The full range of plausible catch histories has not been explored and the final model does not fully capture the influence of catch history on uncertainty in the biomass trajectory.
- The plausible parameter space for the assessment was not fully explored, but it was implausible to do so given the timeframe of the review and current technology.
- Spatial structure has been ignored in the model (e.g., north-south split at Point Conception).

Concerns raised by GMT and GAP representatives during the meeting

The GAP and GMT representatives expressed concern that the STAT had difficulty gaining access to some of the raw survey data and thus could not fully explore those data.

Recommendations for future research and data collection

For the next chilipepper rockfish stock assessment

- Reconstruct the chilipepper rockfish catch history using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. The Panel notes that the SWFSC has made significant progress in retrieving detailed historical landings data, which will facilitate catch reconstructions. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical rockfish landings needs to be done comprehensively across all rockfish species to ensure efficiency and consistency.

- Read chilipepper rockfish otoliths from the triennial and combination bottom trawl surveys to provide better data on the early stages of growth and possible time-variations in growth.
- Explore use of conditional age-at-length data rather than coupled age- and length-composition data.
- Explore time-varying growth as influenced by environmental changes.
- Explore possible spatial structuring of the data and model.
- The next STAT should have full access to raw data from the NWFSC trawl survey.

For the longer term

- Age-validation of chilipepper rockfish should be pursued.
- Develop a fishery-independent time series using fixed sites and volunteer anglers who use standard protocols and are properly supervised.
- Establish a meta-database that provides a comprehensive overview of all relevant data sources and sufficient information to correctly interpret the data.
- Establish an accessible database for rockfish catch histories by species, including envelopes of high and low values for each species to set bounds for exploration of alternative catch histories.
- Relevant raw data, updated in a timely manner, should be readily accessible to assessment authors in on-line databases that are user-friendly.
- Develop comprehensive descriptive analyses of recreational fisheries and fleets to assist in interpretation of recreational CPUE and length-composition data.
- Develop a concise set of documents that provide details of common data sources and methods used for analyzing the data to derive assessment model inputs.

Acknowledgements

The staff at the SWFSC Santa Cruz laboratory provided excellent hospitality and support for the STAR meeting. The Panel especially thanks Steve Ralston for making certain we were well provisioned.

Appendix 1: Modeling of age and length data

By Patrick Cordue

The appropriate use of age and length samples in stock assessments is important in obtaining robust stock assessment results. In a likelihood setting, the key is the application of appropriate likelihoods given the nature of the data – which is dependent upon how it was collected.

Age frequencies and length frequencies for a given fishery or abundance survey may be obtained independently or in combination. The usual likelihood used for both is a multinomial with an "effective sample size" which is smaller than the actual number of fish measured or aged (for length frequencies, the effective sample size is often similar in magnitude to the number of samples taken rather than the number of fish measured).

When a length frequency is sub-sampled for age, it is not immediately clear how the dependence between the length frequency and the age data should be represented. Two approaches have been taken in rockfish assessments. The most common method is to use both the length and age frequency in the assessment but to down-weight the joint contribution of the data to the total likelihood by adjusting emphasis factors on the individual components (e.g., lambda = 0.1 for length samples where a sub-sampled age frequency is also present; or lambda = 0.5 for both the age and length frequency). An alternative, which is theoretically better, when both age and length are used, is to use the age data as conditional age-at-length.

The latter method requires the input of the proportions at age for given length (class). The same approach is used when there are independent age and length samples, but the age sample was obtained from non-random length samples (e.g., to obtain a growth curve). The age frequency is biased, but the conditional age-at-length data are not.

The distinction between the two situations is the issue of independence between the length frequency and the age-length data. When there is sub-sampling of a length frequency for age, the length data and the age sub-sample are clearly not independent. It follows, in comparison to independent samples, that there must be an additional likelihood component which "links" the two data sets. It is very instructive to derive the likelihood and see why this component is important but also why it does not contribute to the total likelihood when fish are selected at random for the age sub-sampling.

Suppose that n_l fish are sampled at random for length from a population (in a statistical sense). Further, suppose that n_a fish are then sub-sampled at random for age.

Assume that there are m length classes and let L_i denote the number of fish in the ith length class for the length sample. Let X_{ij} denote the number of fish in the ith length class and jth age class in the sub-sample for age. Adopting the notation of lowercase letters for observations of the random variables and bold notation to represent vectors or matrices, it follows from conditional probability theory that,

$$P(\boldsymbol{L} = \boldsymbol{l}, \boldsymbol{X} = \boldsymbol{x}) = P(\boldsymbol{L} = \boldsymbol{l})\, P(\boldsymbol{X} = \boldsymbol{x} \mid \boldsymbol{L} = \boldsymbol{l})$$

The likelihood for $\boldsymbol{L}$ is a multinomial:

$$P(\boldsymbol{L} = \boldsymbol{l}) = \text{Mult}(\boldsymbol{l} \mid n_l, \boldsymbol{p})$$

where $\boldsymbol{p}$ is the vector of proportions at length in the population.

The conditional likelihood is derived by applying a further conditional construction:

$$P(\boldsymbol{X} = \boldsymbol{x} \mid \boldsymbol{L} = \boldsymbol{l}) = P(\boldsymbol{U} = \boldsymbol{u} \mid \boldsymbol{L} = \boldsymbol{l})\, P(\boldsymbol{X} = \boldsymbol{x} \mid \boldsymbol{U} = \boldsymbol{u}, \boldsymbol{L} = \boldsymbol{l})$$

where U_i is the number of fish in the ith length class in the age sub-sample.

The conditional likelihood for $\boldsymbol{U}$ is another multinomial:

$$P(\boldsymbol{U} = \boldsymbol{u} \mid \boldsymbol{L} = \boldsymbol{l}) = \text{Mult}(\boldsymbol{u} \mid n_a, \boldsymbol{s})$$

where $s_i = l_i / n_l$ is the proportion of fish in the ith length bin in the length sample.

The final component in the joint likelihood is the conditional age-at-length likelihood:

$$P(\mathbf{X} = \mathbf{x} \mid \mathbf{U} = \mathbf{u}, \mathbf{L} = \mathbf{l}) = \prod_{i=1}^{m} \text{Mult}(\mathbf{x_i} \mid u_i, \mathbf{p_i})$$

where $\boldsymbol{p_i}$ is the vector of proportions at age in the population for the ith length class.

Hence, the joint likelihood of the length sample sub-sampled for age is the product of the likelihood for the length frequency, the conditional age-at-length, and the "linking" component being the sub-sample for length associated with the age sampling.

If the sub-sample of length is truly at random then the linking component consists entirely of "constants" (in terms of population parameters) and so does not need to be included for estimation purposes. Alternatively, if the sampling is biased, but the bias depends only on the characteristics of the length sample, then the linking component can still be ignored (even across a time series, despite the fact that the "constant" varies).

However, if sub-sampling for length is not random and depends upon population parameters then the linking component is potentially important. To adhere to a strict likelihood approach, it would be necessary to include the population parameters driving the bias in an appropriate parameterization to account for the biased selection process. When a time series of length and age data are used it is important to check for potential bias in the length sub-sampling and to consider if it could be driven by population parameters. If that could be occurring in some years, then the associated age data should perhaps be removed or the annual biases should be estimated using a joint likelihood that includes an appropriately parameterized bias function in the probability vector of the linking likelihood component.

Of course, one does not necessarily need to adhere to a strict likelihood approach. It can be argued that any bias in the sub-sampling for age can be ignored when the age data are used as conditional age-at-length. The argument being that the linking component may potentially provide information about population parameters, if the bias truly is driven by them, but by ignoring the component, potential information is forgone, but existing information in the other data is not compromised.

An important point emphasized by the full joint likelihood is the linkage of the length and age data in terms of their sample sizes. This is perhaps obvious in hindsight, but when "tuning" of age and length data is done during a stock assessment (i.e., an iterative adjustment of effective sample sizes to ensure that input variance assumptions are consistent with residual variances) it is crucial to maintain the consistency of the age and length sample sizes. That is, they must *not* be tuned independently. The relative contributions of each year's age and length data to the total log likelihood of a full age and length time series will be proportionally maintained if effective sample sizes are scaled by the same multiplier both between and within years.

Agenda Item G.4.a
Attachment 7
September 2007

Status and Future Prospects for the Darkblotched Rockfish Resource in Waters off Washington, Oregon, and California as Assessed in 2007

by

Owen S. Hamel

DRAFT August 22, 2007

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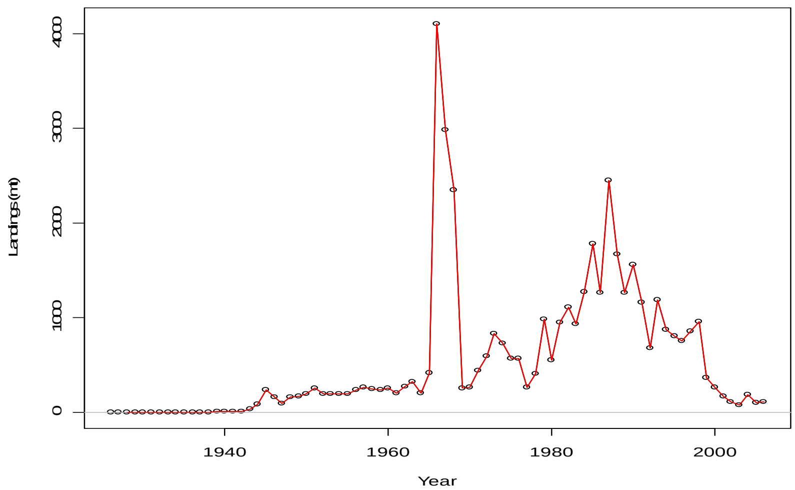
Status and Future Prospects for the Darkblotched Rockfish Resource in Waters off Washington, Oregon, and California as Assessed in 2007

This assessment applies to the darkblotched rockfish (*Sebastes crameri*) for the combined US Vancouver, Columbia, Eureka and Monterey INPFC areas. The largest landings (removals between 2,300 and 4,200 metric tons (mt)) of darkblotched were taken from 1966-1968, primarily by foreign vessels. From 1969 to 1981, the fishery proceeded with more moderate landings of between 200 and 1000 mt per year, with the foreign fishery ending in 1977. A second peak in landings occurred between 1982 and 1993, with landings exceeding 1,100 mt in 10 of 12 years, reaching over 2,400 mt in 1987. Management measures reduced landings to below 950 mt since 1994, below 400 mt since 1999, and below 200 mt in recent years.

Landings history from 1928-2006



Landings estimates for the past 10 years

Year	*Landings(mt)*
1997	824
1998	944
1999	362
2000	262
2001	173
2002	113
2003	80
2004	189
2005	105
2006	113

This assessment used the SS2 model, version 2.00f. New data and changes to the data used in the previous assessment were applied to this new assessment. They are as follows:

Landings data for 1981-2004 were updated, and new landings data were added for 2005 and 2006. Fishery length compositions for 1977-2004 were updated, with new 2005 and 2006 length compositions added. Discard estimates were updated for 2003 and 2004, and a new estimate from 2005 was added. Trawl fishery discard length compositions for 2002-2006 were used for the first time. The 1999-2004 NWFSC Slope Survey biomass indices and length compositions were recalculated based upon changes in stratum area estimates and updates in the database, and the 2005 and 2006 NWFSC Slope Survey biomass indices and length compositions were added. The POP Survey was not used in this assessment, and the NWFSC Shelf Survey (30-100fm, 55-183m, 2003-2006) was included for the first time. The "super years" from the AFSC Slope Survey were excluded, as was the 1977 Triennial Shelf Survey. New GLMM-based biomass indices and CVs were calculated for all four surveys used in this assessment. Conditional age-at-length data were included for the first time in this assessment, using only recently produced age data (otoliths read 2004–present). These recent reads included fishery otoliths from 1991, 1998, and 2003-2006, AFSC Slope Survey otoliths from 2001, NWFSC slope and shelf otoliths from 2003-2006, and fishery discard otoliths from 2004 and 2005.

A number of sources of uncertainty were explicitly included in this assessment. For example, allowance was made for uncertainty in natural mortality and the parameters of the stock-recruitment relationship. There were also other sources of uncertainty that were not included in the current model, including the degree of connection between the stocks of darkblotched rockfish off British Columbia and those in PFMC waters; the effect of the PDO, ENSO and other climatic variables on recruitment, growth and survival of darkblotched rockfish; and gender-based differences in survival.

A reference case was selected based on extensive model testing and an attempt was made to balance the sources of uncertainty.

Retrospective of past 10 years

Year	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Catch (mt)	860	1007	393	430	283	184	109	254	139	149	
Discards(mt)	36	63	31	168	110	71	29	65	34	36	
Landings(mt)	824	944	362	262	173	113	80	189	105	113	
ABC	256	256	256	256	302-349	187	205	240	269	294	456
OY					130	168	172	240	269	200	290
F	0.168	0.221	0.086	0.085	0.050	0.029	0.015	0.031	0.015	0.015	
Expl. Rate	0.134	0.161	0.065	0.066	0.040	0.024	0.013	0.027	0.014	0.014	
1+ Biomass	6416	6251	6002	6456	6993	7770	8638	9470	10030	10605	11094
Sp. Output	4415	3906	3272	3176	3230	3567	4071	4660	5231	6013	6853
Sp. Out. sd	410	416	424	439	472	533	610	695	791		
Sp. Out. cv	0.093	0.107	0.129	0.138	0.146	0.149	0.150	0.149	0.151		
Recruits(10^3)	2271	576	5188	4728	547	570	1761	1903	2005	1958	
Rec. sd	389	166	771	714	119	111	320	408	622	1577	
Rec. cv	0.171	0.288	0.149	0.151	0.218	0.196	0.182	0.215	0.310	0.805	
Depletion	0.144	0.127	0.107	0.104	0.105	0.116	0.133	0.152	0.171	0.196	0.224
Depl. sd											0.030
Depl. cv											0.135

The point estimate for the depletion of the spawning output at the start of 2007 is 22.4%. The ABC (using the F50% MSY proxy) and OY (from the rebuilding plan) for 2007 in the above table reflect current management based on the 2005 assessment. Under the current model the ABC for 2007 would be somewhat lower (421 mt). For West Coast rockfish, a stock is considered overfished when it is below 25% of virgin spawning biomass, and recovered when it reaches 40% of virgin spawning biomass. Overfishing is considered to be occurring when catch exceeds the ABC specified for a particular year. Based on this assessment, darkblotched rockfish on the West

Coast remain below the overfished threshold, but the spawning biomass appears to have increased steadily over the past 5 or 6 years. Since 2001, overfishing occurred only once, with estimated catch exceeding the ABC by 14 mt (5.8%) in 2004.

With the stock extending northwards into Canadian waters, management and assessment of stock status might be improved through greater cooperation with British Columbia.

Major quantities from assessment

	Value	*sd*	*cv*
$SpOut_0$ (10^8 eggs)	30,640	708	0.023
B_0 (mt)	34,509		
R_0 (10^3 fish)	3,295	89	0.027
$SpOut_{msy}$	12,256		
F_{msy}	0.041		
Basis for above	$F_{50\%SPR}$		
Exploitation rate at MSY	0.038		
MSY	621		

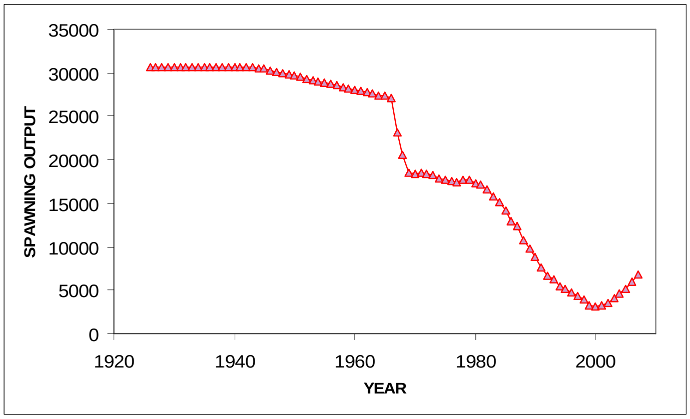
Reference points

	F_{msy}=F_{spr} (0.5)	**F_{msy} = F_{Btarg}(B_{40})**	**Calculated F_{msy}**
SPR	**0.5**	**0.5**	**0.422**
F	**0.041**	**0.041**	**0.054**
Exploitation Rate	**0.038**	**0.038**	**0.048**
MSY (mt)	**621**	**621**	**644**
Sp. Out. $_{msy}$	**12,256**	**12,256**	**9,376**
B/B_0 (Sp. Out.)	**0.40**	**0.40**	**0.306**
1+ Biomass	**16,528**	**16,528**	**13,331**

*Note that when steepness = 0.6, the reference F_{spr} = 0.5 will get you to B_{40}; therefore, the first two columns in the above table are identical (due to the fact that expected recruitment at B_{40} = $0.8R_0$ when steepness = 0.6)

The point estimates of summary (age 1+) biomass show an upward trend over the past ten years, increasing by nearly 50% in that time.

1+ Biomass Levels from 1928 to 2007

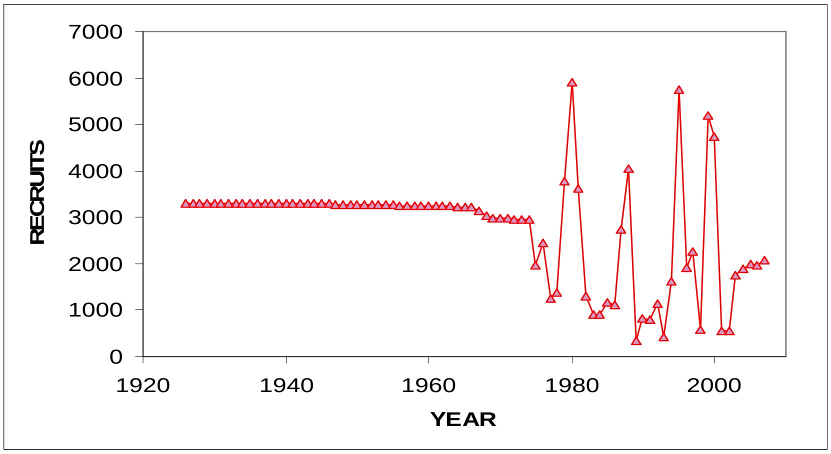


Biomass estimates for the past 10 years

Year	*Total 1+ biomass(mt)*
1998	6,251
1999	6,002
2000	6,456
2001	6,993
2002	7,770
2003	8,638
2004	9,470
2005	10,030
2006	10,605
2007	11,094

The first year for which recruitment appears to be reliably estimated is 1975. The recruitment pattern for darkblotched rockfish is similar to that of many rockfish species, with highly variable recruitment from year to year. With a few exceptions, the 1980s and 1990s provided rather poor year-classes compared with average historical recruitment levels, although the 1999 and 2000 year-classes appear to be two of the four largest year-classes since 1975.

Recruitment estimates (1928-2006)

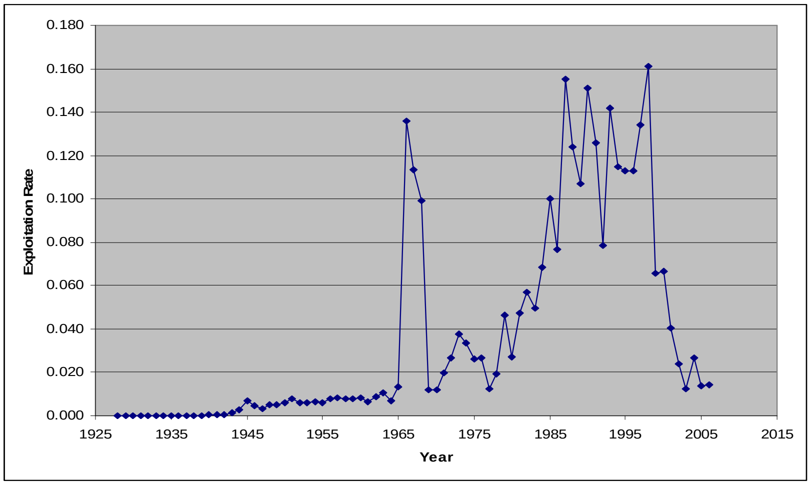


Recruitment estimates for the past 10 years
(Thousands of age-0 recruits)

Year	*Recruitment*
1997	2,271
1998	576
1999	5,188
2000	4,728
2001	547
2002	570
2003	1,761
2004	1,903
2005	2,005
2006	1,958

The exploitation rate (percent of biomass taken) on fully-selected animals peaked near 14% in the mid-1960's when foreign fishing was intensive. The exploitation rate dropped by the late 1960's, but increased slowly and steadily from the late 1970's to 1987 at near 15% and stayed high until 1998 with the continuing decline in exploitable biomass. Over the past 10 years the exploitation rate has fallen from over 13% (with a peak of 16% in 1998) to under 2%.

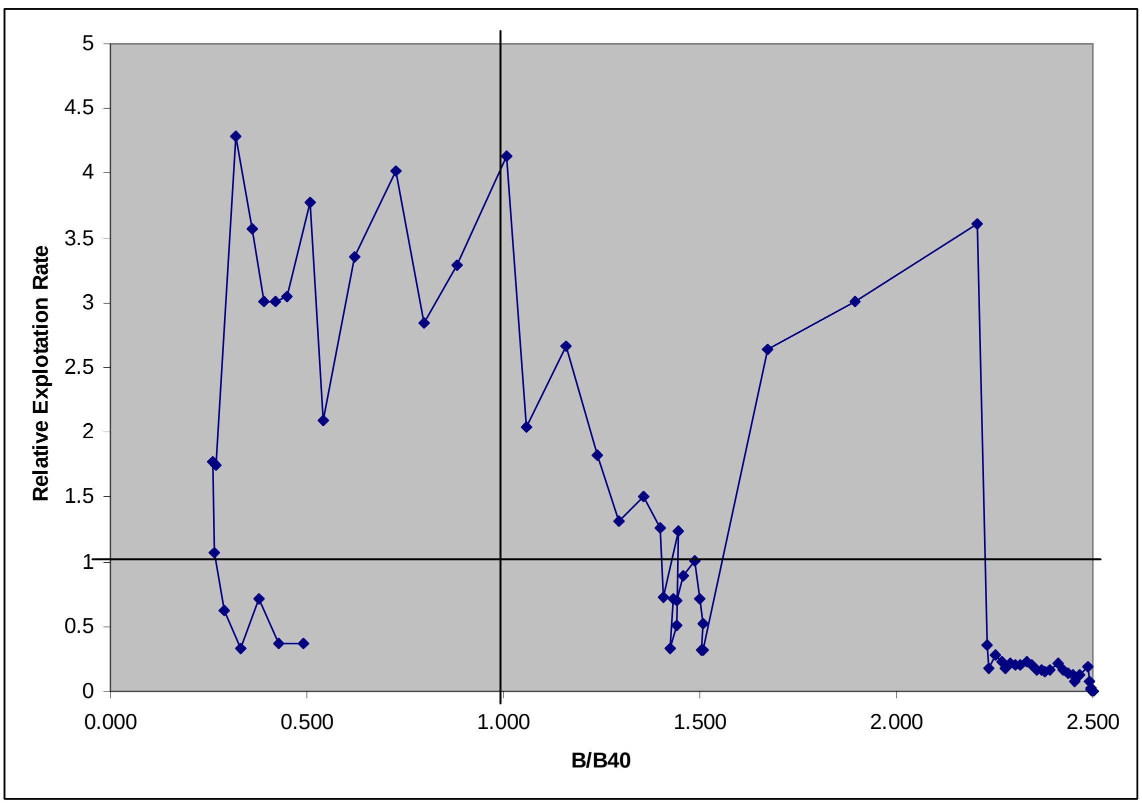
Exploitation rate estimates (1928-2007)



Exploitation rate for the past 10 years

Year	*Exploitation rate*
1997	0.1340
1998	0.1611
1999	0.0654
2000	0.0666
2001	0.0404
2002	0.0237
2003	0.0126
2004	0.0268
2005	0.0138
2006	0.0141

Relative Exploitation rate versus B/Bmsy for 1928-2006



The major axes of uncertainty are steepness and natural mortality. The decision table below uses natural mortality (M) as the major axis of uncertainty. The three landings series are based upon 2006 fishing mortality rate (F_{2006}; "Low Landings"), 40:10 rule catches (with 2007 and 2008 landings to meet catch OYs; "Medium Landings"), and 2005 rebuilding plan F (F = 0.0463, with 2007-8 OYs; "High Landings"). Discard, and thus total catch, is estimated within the model.

			LOW STATE M = 0.05			MEDIUM STATE M = 0.07			HIGH STATE M = 0.09		
	Year	Landings	Catch	Sp. Out.	Depl.	Catch	Sp. Out.	Depl.	Catch	Sp. Out.	Depl.
Low Landings	2007	119	156	2891	9.2%	156	6853	22.4%	156	15092	45.8%
	2008	123	161	3176	10.1%	161	7597	24.8%	162	16608	50.4%
	2009	127	167	3392	10.8%	167	8186	26.7%	167	17769	53.9%
	2010	130	171	3551	11.3%	172	8658	28.3%	171	18670	56.6%
	2011	134	176	3672	11.7%	177	9061	29.6%	176	19432	58.9%
	2012	138	182	3769	12.0%	182	9425	30.8%	181	20103	61.0%
	2013	142	187	3856	12.3%	187	9766	31.9%	186	20683	62.7%
	2014	146	192	3943	12.6%	193	10094	32.9%	191	21179	64.2%
	2015	151	199	4037	12.9%	198	10418	34.0%	198	21606	65.5%
	2016	155	204	4137	13.2%	204	10744	35.1%	203	21983	66.7%
Medium Landings	2007	220	288	2891	9.2%	289	6853	22.4%	289	15092	45.8%
	2008	251	329	3078	9.8%	330	7497	24.5%	330	16509	50.1%
	2009	272	357	3153	10.0%	358	7946	25.9%	357	17532	53.2%
	2010	282	371	3142	10.0%	371	8252	26.9%	370	18272	55.4%
	2011	290	382	3080	9.8%	383	8477	27.7%	381	18864	57.2%
	2012	298	394	2987	9.5%	393	8657	28.3%	391	19360	58.7%
	2013	305	403	2880	9.2%	402	8811	28.8%	400	19766	59.9%
	2014	313	414	2770	8.8%	412	8951	29.2%	411	20088	60.9%
	2015	320	424	2662	8.5%	422	9088	29.7%	420	20346	61.7%
	2016	327	433	2555	8.1%	432	9226	30.1%	429	20557	62.3%
High Landings	2007	220	288	2891	9.2%	289	6853	22.4%	289	15092	45.8%
	2008	251	329	3078	9.8%	330	7497	24.5%	330	16509	50.1%
	2009	371	487	3153	10.0%	488	7946	25.9%	488	17532	53.2%
	2010	372	490	3039	9.7%	490	8147	26.6%	489	18169	55.1%
	2011	373	492	2875	9.2%	491	8272	27.0%	490	18661	56.6%
	2012	375	496	2684	8.6%	494	8356	27.3%	492	19065	57.8%
	2013	377	500	2486	7.9%	497	8419	27.5%	495	19384	58.8%
	2014	380	504	2291	7.3%	502	8476	27.7%	499	19628	59.5%
	2015	384	510	2104	6.7%	506	8535	27.9%	504	19816	60.1%
	2016	388	516	1922	6.1%	512	8602	28.1%	509	19965	60.5%

As this stock remains overfished, a rebuilding analysis will be conducted and further exploration of catch series' will be performed for that analysis.

Future research needs include:

- A thorough review of species composition in historical rockfish landings and a tabulation of estimated landings by species to be used in assessments.

- Investigation into the best available methods and data for constructing and using conditional age at length compositions from data taken across space and time within years.

- A thorough investigation of historical darkblotched rockfish mortality in the shrimp fishery.

- Mapping of “trawlable” and “untrawlable” habitat and construction of a prior on survey q.

1. Introduction

The assessment utilized combined data from the International North Pacific Fisheries Commission (INPFC) U.S. Vancouver, Columbia, Eureka and Monterey areas. The darkblotched rockfish (*Sebastes crameri*) population in these areas was modeled as a single stock.

Darkblotched rockfish (*Sebastes crameri*) are found from the Bering Sea to near Santa Catalina I., California at depths of 29-549 m (16-300 fm; Eschmeyer et al.1983). Commercially important concentrations are found from Northern CA through the Canadian border, on or near the bottom, in depths of approximately 183-366 m (100-200 fm) (Figure 1). 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)*. 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. In the early years of the fishery, darkblotched rockfish were designated as part of the "Pacific ocean perch" market category for red-colored northern slope rockfish.

There are no clear stock delineations for darkblotched rockfish in U.S. waters. No distinct breaks are seen in the fishery landings and catch distributions (Figure 1). Survey catches imply a continuous distribution over most of the range, with the largest catches occurring over a swath of latitude and depth. Recent analyses indicate some genetic changes in the stock along the coast, but no distinct stock breaks. Genetic and geographic distance was correlated, with mean average dispersal distances of 1-100 km (Gomez-Uchida and Banks, 2005). Genetic structure between northern California and Washington samples are somewhat different, but overall the level of genetic differentiation is small. For the purpose of this assessment, the species is treated as a unit stock from the Mexican border to the U.S.-Canadian border. However, management actions on a coast-wide stock should account for problems in effort concentration because areas of high concentration do exist.

Darkblotched rockfish display sexually dimorphic growth. As with many other *Sebastes* species, females grow faster than and reach larger sizes than males (Nichol 1990, Rogers et al 2000, Rogers 2003). In National Marine Fisheries Service (NMFS) survey data, 80% of fish over 40 cm fork length (fl) were females. 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 can reach 610,000 eggs, with all larvae released in one batch. Late-stage larvae and pelagic juvenile darkblotched rockfish are found closer to the surface than many other rockfishes.

Darkblotched rockfish migrate to deeper waters with increasing size and age (Lenarz 1993, Nichol 1990, Rogers 2003). In NMFS surveys tows, they averaged 21 cm fl in less than 100 fm, 29 cm in 100-200 fm, and 35 cm in 200-300 fm. Although aging is uncertain, analysis of 2003-2004 NWFSC Shelf-Slope Survey data indicates depth migration is either more dependent upon length than age, or that the rate of growth changes with depth. There is some evidence of diurnal vertical migration in darkblotched rockfish. Hannah et al. (2005) determined that catch was reduced at night using a conventional bottom trawl.

The fishery targeting the slope rockfish assemblage has always used bottom trawl gear. Although Eschmeyer et al. (1983) indicated darkblotched rockfish are found on soft bottoms, submersible observations indicate darkblotched rockfish are associated with rocks or other bottom structures (Waldo Wakefield, NMFS, Newport, OR 97365, pers. comm.).

Prior to 1965, darkblotched rockfish off of the U. S. West Coast were harvested almost entirely by Canadian and U. S. vessels. Most of the vessels were of multi-purpose design and used in other fisheries, such as salmon and herring, when not engaged in the groundfish fishery (Forrester et al. 1978). Generally under 200 gross tons and less than 33 meters (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. Estimated landings from 1956 to 1965 average around 270 mt with a somewhat lower average catch level over the preceding 12 years, and minimal catches prior to 1944. Catches increased dramatically after 1965 with the introduction of large distant-water fishing fleets from the Soviet Union and Japan. Both nations employed large factory stern trawlers as their primary method for harvesting. These vessels generally operated independently by processing and freezing their own catches. Support vessels, such as refrigerated transports, oil tankers, and supply ships permitted the large stern trawlers to operate at sea for extended periods of time. Peak removals by all nations combined are estimated at over 4,000 mt in 1966 and over 3,000 mt in 1967. These numbers are based upon a re-analysis of the foreign catch data (Rogers, 2003). Catches declined rapidly following these peak years, and the fishery proceeded with more moderate landings of between 200 and 1000 mt per year from 1969 through 1981, with the foreign fishery ending in 1977. A second peak in catches occurred between 1982 and 1993 with landings exceeding 1,100 mt in 10 of 12 years, reaching a high of over 2,400 mt in 1987. Management measures and a declining stock reduced landings to below 900 mt by 1994, below 400 mt in 1999, and below 200 mt in recent years.

Prior to 1977, darkblotched rockfish stocks in the northeast Pacific were managed by the Canadian Government within its waters, and by the individual states in waters (out to three miles) off of the United States. With implementation of the Magnuson Fishery Conservation and Management Act (MFCMA) in 1977, 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) (Rogers et al. 2000). Observer data collected off Oregon in 1986 and 1987 indicated that slope rockfish were caught primarily in 134 - 282 fm (Rogers 1994). The fishery targeting those rockfish used bottom trawl gear utilizing rollers (roller gear) with 3.5 inch codend mesh, reduced from the mesh size used in the mid-1970's. About five percent of the catch was discarded due to small size. Nichol (1990) stated that fishermen were not harvesting the largest darkblotched rockfish in 1986-1987 because they were mainly fishing in less than 200 fm. Several changes occurred in the 1990's. Minimum codend mesh size was increased from 3 to 4.5 inches through regulatory changes in 1992 and 1995. Beginning in 1994, the Sebastes complex was divided into northern and southern areas, for purposes of setting annual specifications and trip limits. An assessment of the major species in the Sebastes complex (Rogers et al. 1996) led to a species-specific Allowable Biological Catch in 1997.

In recent years, managers have acted to reduce the catch of darkblotched rockfish (Tables 1, 3). The species was fully assessed in 2000 (Rogers et al 2000) and as a result of that assessment, was declared overfished. Since that time, it has been managed as part of a group of eight other slope rockfishes, including Pacific ocean perch for the areas south of $40^0$10' and splitnose rockfish for the area north of that boundary. In 2001, darkblotched rockfish was given an individual Optimum Yield (OY) (Methot and Rogers 2001). However, landings of darkblotched rockfish continue to be governed by trip limits established for the Northern and Southern minor slope rockfish complexes. Since September 2002, managers have used Rockfish Conservation Areas

(RCA's) in addition to landings limits to control darkblotched rockfish fishing mortality. RCA's are large closed areas intended to protect overfished rockfish species. The boundaries of the RCA's and landings limits outside them have varied by year, gear type, and season. The seaward boundary of the trawl RCA has ranged from 150 to 250 fm, while the shoreward boundary has ranged from 100 fm to the shore. Trawl gear that is used shoreward of the RCA is required to have small footropes (<8" diameter), which increases the risk of gear loss in rocky areas. Reductions in landings 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 $40^{o}10'$ have also been required to use nets that are designed to be more selective for flatfish.

Management targets were exceeded from the time they were first implemented in 1997 through 2002 (Table 4). Landings goals were not met in 1997-2001 and the assumed discard rate was underestimated in 2002. The estimated darkblotched discard rate fell by roughly one-third from 2002 to 2003, with slighter decreases in 2004 and 2005 (Table 5). This trend is most likely attributable to combined changes in trip limits and the extent of closed areas. Although northern slope rockfish trip limits did not increase from 2002 to 2003, the area between 100 and 200 fm was closed throughout the year, with the shoreward boundary set no deeper than 50 fm during six months in 2003. The RCA areas in 2003 appeared to effectively change the distribution of the catch. In 2002, distribution of the catch was similar to that in the survey catches. In 2003, most of the landings and catch were from outside those areas. In 2004, trip limits were set 2-4 times higher than in 2003 during January-September, in conjunction with a seaward RCA boundary of 150 fm between May and September. This combination produced a sharp increase in catch that exceeded the ABC in 2004, but the larger retention allowances yielded a discard rate similar to that in the 2003 fishery. During 2005 and 2006, trip limits were roughly twice as high as in 2003, but unlike 2004, the area between 100 and 200 fm was closed throughout the year. In both 2004 and 2005, the entire area shoreward of 250 fm was closed for the last three months of the year.

Research surveys have been undertaken to provide fishery-independent information about the abundance, distribution, and biological characteristics of darkblotched rockfish. A coast–wide Shelf Survey of the rockfish resource was conducted in 1977 (Gunderson and Sample 1980) and was repeated every three years (thus referred to as the "Triennial" survey) through 2004. The National Marine Fisheries Service (NMFS) coordinated a cooperative research survey of the Pacific ocean perch stocks off Washington and Oregon with the Washington Department of Fisheries (WDF) and the Oregon Department of Fish and Wildlife (ODFW) in March-May 1979 (Wilkins and Golden 1983). This survey was repeated in 1985. Two slope surveys have been conducted on the West Coast in recent years. The first, conducted by the research vessel Miller Freeman, was discontinued after 2001. The second is an ongoing cooperative survey conducted by commercial fishing vessels, which started in 1998 and expanded to cover the shelf beginning in 2003.

2. Data

2.1. Removals and regulations

Darkblotched landings were estimated for the fishery off the West Coast of the continental United States from 1928 through 2006 (Figure 2; Tables 2-3). In this assessment estimates of landings for 1928-1980 are unchanged from the previous assessment. For the period 1928-1962, darkblotched landings were estimated by apportioning combined rockfish landings using the earliest available species proportions in a given area. Since the fleet fished shallower than 100 fm in years before 1945-1948, the available darkblotched proportions were reduced for those years. Landings from 1963-1977 were mainly available in the literature, but some estimation was required. 1978-1980 landings were taken from CalCom and Tagart (1985). Landings from 1981-2006 were extracted from PacFIN on June 14, 2007, with auxiliary data from Tagart (pers. comm.) for 1981 and 1982, and from the At-Sea-Hake Observer Program (Vanessa Tuttle, pers. comm.) for 1991-2006. At-sea hake catch was also estimated for the years 1981-1990. Darkblotched rockfish has been sorted since 2000. Previous estimates were based on applying port-sampling species ratios to mixed rockfish landings.

Discards

The discard rate in 1986 was estimated using 1985-1987 observed darkblotched rockfish catch and discard in the Oregon and Washington bottom trawl fisheries (Rogers 1993). Fishermen attributed those discards to small sizes rather than management limits or other market considerations (Rogers 1994). Five percent of the 1985-1987 observed catch was discarded.

Data from another set of fishery observations conducted during 1995-1998 off Oregon and Washington were not used in this assessment. Due to time constraints, the observers only recorded discarded catch for darkblotched rockfish. At that time, darkblotched rockfish landings were recorded in the logbooks and landings tickets as part of a mixed group of rockfish.

Annual discard rates for 2000 through 2002 were computed using a combination of fish ticket, species composition, logbook, and observer data from that period. Fish ticket landed catch, as adjusted by species composition sampling of rockfish market categories, was used as the measure of landed tonnage in each area. Area discards of darkblotched rockfish were estimated by multiplying area- and depth-specific observed ratios of discarded darkblotched rockfish per metric ton of target species by retained amounts of target species (derived from logbooks and expanded to match area fish-ticket amounts). Discard estimates for 2000 and 2001 were computed using pooled observer data from September 2001 through August 2004. For 2002 observer data from only that year were used. Discard rates for each year were calculated by dividing the estimated discard by the sum of discard plus landed catch. The discard rates for 2003-2005 were calculated using the amounts of retained and discarded darkblotched rockfish reported by the observer program for those years (Table 5).

Fishery Length compositions

Fishery length compositions (Table 9; Figures 25-28) were estimated from PacFIN for the years 1977-1978 and 1981-2006. Fishery length compositions were not taken from the previous assessment for the years 1979-1980 as those compositions looked substantially different from the ones derived from PacFIN for adjoining years, and therefore did not appear to be consistent with the rest of the data.

Fishery length compositions were constructed using BDS data retrieved from PacFIN on 5/31/2007. Length, age and sex data were acquired at the trip level, and then aggregated to the state level as was done in the 2005 assessment. For each trip, the length composition of the sampled individuals was scaled up to represent the length composition of the trip landings through use of an expansion factor. In this assessment, the expansion factor was calculated as:

$$\text{Expansion Factor} = (WT_{total}/WT_{sampled})^{0.9} ,$$

with total weight divided by sample weight being the equivalent of total estimated number over sampled number. The exponent 0.9 was used rather than capping the expansion factor at a specific value (such as 500), in acknowledgment of the reduced information that occurs with any expansion to the trip level. In practice this reduced the largest expansion factor from 739 to 382, which is less than the cap of 500 that is frequently applied. The initial effective N value (input N) for each state was calculated via Stewart's Method (Ian Stewart, pers. Comm.), which for fisheries is:

$$N_{effective} = N_{trips} + 0.138 N_{fish} \quad \text{if } N_{fish}/N_{trips} < 44$$
$$N_{effective} = 7.06 N_{trips} \quad \text{if } N_{fish}/N_{trips} \geq 44$$

Ideally the relative effective sample size for each state would be equal to the relative landings for each state. In order to account for lack of proportional sampling in each state, the effective N for each state was down weighted using the geometric mean of the product of the ratio of individual state landings to total (3 State) landings and the ratio of individual state effective N to the sum of the effective Ns for all 3 states as follows:

$$W_s = \sqrt{\left(\left(\frac{Land_s}{Land_T}\right)\left(\frac{EffN_s}{EffN_T}\right)\right)}$$

where *Land* represents landings, *s* indexes the states, *T* represents total or sum of individual states, and *EffN* is initial effective sample size (input N). These W_s were used as weighting factors in summing the normalized length compositions L_s of the states before renormalizing:

$$\vec{L}_T = \frac{\sum_{s=1}^{3} W_s \vec{L}_s}{\sum_{s=1}^{3} W_s}$$

Total input N was calculated by summing the individual state estimated initial effective N values and then multiplying this sum by a down weighting factor equal to the sum of the W_s (which is always ≤ 1) (Table 7A). This was done in order to down weight the input N in cases where sampling was unbalanced. This down weighting factor has varied between 0.49 and 0.98, and has been above 0.9 in all years since 1995.

The length composition of discarded darkblotched rockfish in 1986 was estimated using data from observed groundfish trawls in that year (Rogers, 2005). The length compositions of discards in more recent years (2002-2006) were calculated with observer data from boats using bottom trawl gear. Individual lengths were scaled up by a straight expansion factor to the total discard for each observed tow. Due to significant missing sex data across the full range of length bins, all discard length-, age- and conditional age-at-length compositions were developed as combined-sex length compositions (Figure 29-30). Input N values for discard length compositions were calculated via Stewart's Method (Table 7B).

Fishery conditional age-at-length compositions

Conditional age-at-length compositions were constructed from age and length data available from PacFIN for the years 2003-2006. These years were used because all of the ages in PacFIN for those years were from otoliths aged between 2004 and 2007, a period in which ageing methods have been invariant, with three agers doing all of the ageing. Double read analysis indicates minimal or no bias between agers and relatively good precision. In constructing conditional age-at-length compositions, instead of expanding samples up to trips, as with the length data, each age-at-length data point was considered independent for the purposes of creating each composition, although total input N (across all length bins) was still based on Stewart's method as described above. This total input N was spread among the length bins according to the number of fish contributing to data in that bin.

Since rockfish grow significantly in a single year and fishing occurs throughout the year, length bins were pooled according to estimated growth for each age. The bins were 0-10 cm, 11-15 cm, 16-20 cm, 21-24 cm, 25-27 cm, and 28-30 cm, with two centimeter bins for length from 31 cm to 50 cm, and a plus group at 51 cm and above.

2003 was the only year with ages available from all three states, and differences by data sources were noted. However, the majority of darkblotched rockfish landings (~70-80%) have been made in Oregon in recent years, and therefore the fact that age data from Oregon have dominated in recent years is appropriate.

A number of new ages (from otoliths read in 2006 and 2007) were available from the cooperative ageing lab for fish caught in the California fishery between 1986 and 1998. These data were not available in PacFIN, as the ager and date-aged columns were empty for age data from California for those years. Although these data were limited to California, they are the only age data available from those years. Rather than use all the years, including those with relatively few samples, only data from the years 1991 and 1998, with around 350 new ages apiece (Table 8), were used in the assessment. The remaining years had half that many new ages or fewer. The compositions (e.g. Figures 49-50 (2006)) and input sample sizes (Table 8) were developed by the same method as described above for the PacFIN data.

2.2. Surveys

NMFS Cruises

The results from four fishery-independent surveys are used in this assessment:

1. The NWFS Triennial Shelf Survey that was conducted every third year from 1980-2004
2. The AFSC Slope Survey for the years 1997 and 1999-2001.
3. The NWFSC Slope Survey for the years 1999-2006.
4. The shelf portion of the NWFSC survey for the years 2003-2006.

Neither the 1977 Triennial Shelf Survey, due to concerns about the first year of the survey's implementation, nor the AFSC Slope Survey "super years", consisting of combined data from multiple years of partial coastal coverage, were used in this assessment. The "POP" survey from 1979 and 1985 was not used as selectivity likely changed between the two years which used separate methods, and the previous solution of mirroring the AFSC Slope Survey was unlikely to produce realistic selectivities for the POP survey. The two years of data were also relatively insignificant given all the other data available.

Indices

Indices of abundance were derived from each of the above surveys and years using a generalized linear mixed model (GLMM) for each survey. (Helser et al., 2004; Table 6). The GLMM models occurrence of darkblotched rockfish in a survey haul as a binomial process and the size of the non-zero catches with a lognormal model. Coefficients of variation (CVs) about the indices were produced from the GLMM as well. In the last assessment, the GLMM approach was used for the NWFSC and AFSC slope surveys but not for the Triennial Survey (or the POP Survey). In this assessment, the GLMM approach was used for all four surveys, utilizing two latitudinal strata, the combined U.S. Vancouver and Columbia INPFC areas, and the combined Eureka and Monterey INPFC areas. While darkblotched rockfish are occasionally seen in the Conception INPFC area, the numbers there are negligible compared to those further north. Depth ranges were limited to those which were covered in all years of each survey. For three of the four surveys two depth strata were used. For both slope surveys, depth strata of 100-164 fm (183-300 m) and 164-310 fm (300-567 m) were used. For the Triennial Survey, depth strata of 30-100 fm (55-183 m) and 100-200 fm (183-366 m) were used. Since the shelf portion of the NWFSC Survey covers only depths from 30-100 fm (55-183 m), this survey was modeled using a single depth stratum.

Length compositions

Length compositions (Table 9) were derived for each survey, except for the 1999 NWFSC Slope Survey, for which length data were not available and the 2004 Triennial Survey where age compositions, instead of length compositions, were used (Figures 31-46).

Length, age, and sex data were acquired at the tow level, and then aggregated within INPFC areas and depth strata. For each trip, the length composition of the sampled individuals was scaled up to represent the length composition of the trip landings through use of an expansion factor. In this assessment, the expansion factor was calculated as:

$$\text{Expansion Factor} = (WT_{total}/WT_{sampled})$$

with total weight divided by sample weight being the equivalent of total estimated number over sampled number. No down weighting exponent was used, as the survey data are taken at the tow level rather than the trip level. The initial effective N (input N) was calculated via Stewart's Method (Ian Stewart, pers. Comm.), which for surveys is

$$N_{effective} = N_{trips}+0.0707N_{fish} \quad \text{if } N_{fish}/N_{trips} < 55$$
$$N_{effective} = 4.89N_{trips} \quad \text{if } N_{fish}/N_{trips} \geq 55$$

where N_{fish} is the total number of fish sampled across all trips (Table 7C).

Age compositions

The 2004 Triennial Survey age composition is included in this assessment as derived in the 2005 assessment (figures 47-48).

Conditional-age-at length compositions

Conditional age-at-length compositions were constructed from age and length data using the same methods as for survey length compositions. These compositions were constructed for the 2001 AFSC Slope Survey and the 2003-2006 NWFSC Slope and Shelf Surveys (e.g. Figures 51-54) (2006). These years and surveys were used because all of the ages in PacFIN for those years were from otoliths aged between 2004 and 2007, a period in which ageing methods have been invariant, with three agers doing all of the ageing. Double read analysis indicates minimal or no bias between agers and relatively good precision. Total input N for each year was based on

Stewart's method as described above (Table 8). This total input N was spread among the length bins according to the number of fish contributing to data in that bin.

A summary of data sources and years included in the base model is given in Table 10.

2.3. Biology and life history

Natural mortality

In the 2000 and 2003 assessments, M = 0.05 was selected based on fit to the data (Rogers et al. 2000). Lenarz (1993) suggested a range of natural morality estimates (0.025-0.05) based on a maximum age range of 60-105 years, using Hoenig's method. In 2005, indirect estimates of M for darkblotched rockfish from Gunderson et al. (2003) were considered in selecting a value for M. Gunderson estimated M based on a meta-analysis of the relationship of the Gonadosomatic Index or GSI (ovary weight/somatic body weight). This method produced a value of M = 0.107 for darkblotched rockfish with a 95% confidence interval of 0.07-0.14. The 2005 assessment used 0.07 based on balancing the estimates using GSI and Hoenig's method.

However, the correct interval to use when conducting meta-analyses and predicting an unobserved point is a prediction interval, not a confidence interval. The prediction interval for both Hoenig's method and the GSI method are quite large ((0.005 - 0.375) for Hoenig's (using log-log regression), and either (-0.186 - 0.323) (untransformed) or (0.062-0.205) (log-log) for Gunderson's method). In addition, the values of both maximum age and GSI for darkblotched are towards the edge of the data used in constructing the meta-analyses, so assuming a linear relationship in either space is somewhat suspect. Therefore it is hard to define what the correct prediction interval is for either method. However, observation error in the data used in the meta-analysis can cause prediction intervals to be too wide, and therefore the situation may not be quite as dire. In any case, M continues to be a very difficult parameter to pin down. In this assessment, M was not changed from the value used in the last assessment. In so far as this value does balance the point estimates well, there is support for using this value. A profile over M was conducted as part of the sensitivity analysis.

Sex ratio, maturation and fecundity

In this assessment, the sex ratio at birth is assumed to be 1:1. Maturity-at-length for females was based on the work of Nichol (1990) with 50% maturity occurring at 34.5 cm (Figure 3):

$$P_{Mat} = \frac{1}{-e^{(-0.6449L+22.2)}}$$

Fecundity-at-weight was derived by converting Nichol's (1990) fecundity-at-length equation (Figure 4) using his length-weight relationship:

$$Eggs = 14{,}580W + 132{,}500W^2,$$

where W = weight in kg.

Length-weight relationship

The length-weight relationship was estimated by Rogers (2005) using available survey data. Sexes were combined because means did not differ substantially. The equation was fit to mean weight at length from 6374 fish measured in West Coast surveys:

$$W = 0.000021L^{2.96142}$$

where W is weight (kg) and L is fork length (cm). This equation differs slightly from Nichol's (1990) equation, but this difference in the weight-length relationship results in quite minimal changes to the resultant weight and fecundity-at-age estimates.

Length at age

Length at age was estimated within the assessment model. No latitudinal or temporal changes in length at age were assumed, although male and female growth rate and L_∞ were estimated separately. The CV of length at age was also estimated and allowed to change linearly with mean length at age (Figure 8).

Ageing error

Aging error was derived using the 2005 double reads of otoliths by ager 1, and double reads between agers 4 and 5, who are the current readers of darkblotched rockfish otoliths. The standard deviation in age given the initial age (first reading) for ages 2-75 was estimated using a linear relationship:

SD_{age} =0.138+.07 * initial age (actual std used for ages less than 10)

Actual estimated SDs were used for ages 2-9 because they were based on a large number of fish and varied slightly from the values predicted by the relationship. The standard deviation for ages 0 and 1 were assumed to be one-third and two thirds of that for age 2.

2.4 Changes in data from the 2005 assessment

Changes in data for this assessment included updated landings data for 1980-2004 (minor changes) and new 2005 and 2006 landings data; updated 2003 and 2004 discard rate estimates, and a new 2005 discard rate estimate; new 2005 and 2006 NWFSC Slope Survey data; addition of the 2003-2006 NWFSC Shelf Survey data; and new GLMM estimates for all surveys. Conditional age-at-length data are used for the first time in this assessment from the fishery for 1991, 1998 and 2003-2006; from observer data for 2004 and 2005, from the AFSC Slope Survey for 2001; and from both the shelf and slope portions of the NWFSC Survey for 2003-2006.

Data from the two years of the POP Survey are no longer used in this assessment. Mean weight data from the discard fishery and mean size-at-age data are no longer used as the conditional-age at-length data encompasses the same data sources and provide similar information.

3. Assessment model

3.1 History of Modeling approaches

There have been six previous assessments of darkblotched rockfish off of the U. S. West Coast (Lenarz 1993, Rogers et al. 1996, Rogers et al. 2000, Methot and Rogers 2001, Rogers 2003 and Rogers 2005). These assessments began with life-history based analyses of sustainable catch rates and have progressed to statistical age-based modeling. The first full assessment of the darkblotched rockfish stock was conducted in 2000. That assessment was updated twice in 2001 and 2003. This current assessment represents the third full assessment for this species.

Lenarz (1993) reviewed the available life-history and fishery information on the species. Based on Hoenig's (1983) method and a maximum age of 60-105 years, the rate of natural mortality was estimated to be between 0.025 and 0.05. From these values, the target fishing mortality rate ($F_{35\%}$) was estimated to be between 0.04 and 0.06, and the overfishing level ($F_{20\%}$) was estimated to be between 0.07 and 0.11. ABC was not estimated. All of the length frequency data available at that time indicated that average size had decreased from 1983 to 1993 which was consistent with estimated fishing impacts.

Rogers et al. (1996) considered 13 commercially-important rockfish species using an F = M approach, modified in an attempt to derive ABC's given the target fishing mortality of $F_{35\%}$. The AFSC Shelf Survey biomass index was averaged over 1980-1995 for several species, and a proxy adjustment factor was developed based on the ABC's from available stock assessments for West Coast rockfish and the particulars of each species. For darkblotched rockfish the proxy was 0.8. The ABC was determined assuming natural mortality rate of 0.05. Darkblotched rockfish was the only species that was also assessed using a simple stock synthesis model (Methot 1990), primarily to confirm the F = M approach. That two-sex model covered the period from 1980-1995, and included two indices: the Triennial Shelf Survey and a Pacific ocean perch bycatch effort index, as well as length and age composition data from the survey and fishery. The model was structured to have northern and southern fisheries, and the population was assumed to be in equilibrium in 1979, with a previous equilibrium catch of 300 mt. The model produced estimates of age-one recruitment for 1980-1993, dome-shaped selectivity for the Shelf Survey and southern fishery asymptotic selectivity for the northern fishery and bycatch index with catchability for the Shelf Survey 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 provide 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. Five abundance indices were used: the AFSC Slope Survey, POP Survey (Wilkins and Golden 1983) and a commercial trawl fishery logbook CPUE index (Ralston 1999) were added to the AFSC shelf and POP bycatch indices used in the 1996 assessment. Length composition data included all years of the slope, shelf, and POP surveys. A single fishery was assumed and discard was included only in a sensitivity run, because it complicated the model without substantially changing the results. Fishery selectivity was assumed to be asymptotic, but survey selectivity was allowed to be dome-shaped. Age-one recruitments were estimated for 1963-1998, with the 1999 recruitment fixed at an assumed value.

Two models were presented in the 2000 assessment: a STAT team model and a STAR panel model. Both models had 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 and assumed a Beverton-Holt type stock-recruitment relationship. The STAR panel model assumed all weights on the likelihood components were either 1 or 0, assumed no prior knowledge about the fitted parameters, and placed no bounds on the estimated recruitments. The logbook and bycatch indices were considered less reliable than the other indices, and the STAT model considered the Shelf Survey more reliable than the slope or POP surveys. The STAT model estimated similarly dome-shaped selectivities for all three surveys. The steepness parameter prior had a mean = 0.8, with CV of 0.1, and the estimated value was 0.83.

Uncertainty in the 2000 assessment was expressed both through choice of the two models and through assumptions regarding the amount of foreign catch of darkblotched rockfish relative to that estimated for Pacific ocean perch. The target fishing mortality ($F_{50\%}$), was about 0.032, regardless of model or foreign catch assumption. Given the range of foreign catch, spawning depletion in 1999 was estimated to be between 0.17 and 0.28 in the STAT model, and 0.13 and 0.26 in the STAR model. The projected ABC yields averaged over the years 2000-2002 ranged from 272 mt to 330 mt, given uncertainty in both the model and the amount of foreign catch.

In the 2001 update selectivities and survey catchabilities were fixed at the values estimated in the 2000 assessment. Only the age-one recruitments were re-estimated, with 2000 and 2001 recruitments 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 ABC was 187 mt.

The 2003 assessment was a comprehensive update of the 2000 assessment: the data were extended though 2002 and all the fitted parameters were estimated, but the model structure and values assumed for fixed parameters were not changed. Newly available age compositions were not included in the model because they were not compatible with the growth curve and the aging error parameters that were fixed in the 2000 model. (See the data section in this document for more information). Management-related discard was added to the 2001 and 2002 landings, using rates assumed by the Pacific Fishery Management Council (16% in 2001 and 20% in 2002. Revised foreign catch estimates for 1966-1976 were taken from Rogers (2003). The estimated fishing mortality rate at $F_{50\%}$ was 0.032, the spawning depletion was 11% in 2004, and the 2004 ABC was 240 mt.

The 2005 assessment (Rogers, 2005) used Stock Synthesis 2 (SS2 v1.) and a Beverton-Holt stock recruitment relationship was assumed. The landings history was extended back to 1928, with the 1927 population assumed to be in unfished equilibrium. The AFSC slope and POP surveys were assumed to have the same length selectivity in order to be able to include length data from the AFSC Slope Survey for 1985. Only age compositions based upon ages read in 2004 were included in the model due to the difficulty of age assignment of darkblotched rockfish and the variability in ages by readers over time. Discard data for 1986 and 2000-2004 were added and discard rates and retention curves were estimated within the model. The AFSC Slope Survey indices were re-estimated using a GLM model, and the NWFSC Slope Survey index (1999-2004) and length compositions (2000-2004) were added to the model. Also, elements of the growth curve were estimated within the assessment model. All of these features are carried forward into the current assessment model, except that the POP Survey is no longer used and age and conditional age-at-length data are based upon age reading conducted during the years 2004-2007.

3.2 Current Model

Model

This assessment uses SS2 version 2.00 f , released by Dr. Richard Methot on June 20, 2007. The parameters, both those that were estimated and those that were fixed, for the base model are given in Table 11.

Length and age bins

The length frequency bins were the same as in the 2005 assessment. The first bin contained all fish less than 7 cm, followed 1 cm length bins up to 32 cm, and then 2 cm bins from 33-34 cm to 49-50 cm, and a maximum bin of all fish ≥ 51cm in length.

As there are relatively few old fish in recent survey and fishery data, the number of age bins was reduced in this assessment, with single year bins from 0 to 29 and a plus group at 30 years of age and older. This is a reduction from the previous plus group at 44 years of age. However, given the uncertainty in the ageing seen both in double reads and in bomb-radiocarbon validation work using darkblotched rockfish with estimated ages in the 30s and 40s (Figure 5), it is unlikely that substantial information has been lost.

Growth

Growth parameters were estimated within the model, including the size at age 1.7, the size at age 29, the von Bertalanffy growth rate parameter (K) and the CV of length at age 1.7. Exponential offsets were also estimated for the CV at age 29, for male size at age 29 and for von Bertalanffy K. Table 12 gives the estimates of these values for the current model and those arrived at in the previous two assessments.

Recruitment, stock-recruitment steepness and natural mortality

R_0 is estimated in the model, along with recruitment deviations from 1975 through 2005, with σ_r = 0.8. Natural mortality is set at 0.07 which is the value used in the 2005 assessment and which balances the estimates from various meta-analyses. The model is able to estimate both natural mortality (M) and stock recruitment steepness (h) independently or together. However, some caution should be exercised in accepting these values, especially that for steepness. In the previous assessment, steepness was estimated to be 1, so it was set in the final model at 0.95. The current assessment estimates h to be 0.35 when both h and M are estimated within the model (M estimated at 0.098) and 0.595 when M is set at 0.07. This latter steepness value is within the range of steepness estimated (0.55-0.65) in the 2003, 2005 and 2007 assessments of Pacific ocean, which is a related species. In the base model, therefore, h is set at 0.6 and M at 0.07. There is one extra caveat in dealing with steepness in this model, in that the spawning output is assumed to be quadratic function of individual female weight (or biomass), so the interpretation of steepness is somewhat different than in other assessments which assume a linear function.

Selectivity and Retention

In initial runs, all 6 parameters of the double normal selectivity function were estimated for the fishery and each survey, along with the inflection point and slope of the logistic retention function. Various blocking schemes on fishery selectivity were tested in an effort to account for changes in depth of fishing and codend mesh size. However, these blocks resulted either in unrealistic selectivity patterns, due to the sparseness or vagaries of the data, or almost no change at all. Therefore a single selectivity pattern was assumed for all years of the fishery. Retention was blocked to reflect changes in recent years. The length at the inflection point was allowed to change in 2000 and the asymptotic retention was allowed to change in both 2000 and 2003.

Although fishery selectivity was initially allowed to be domed shaped, in practice it was asymptotic in these initial runs. Similarly, the NWFSC Slope Survey was essentially asymptotic, with only the last length showing a drop in selectivity. However under certain combinations of h and M, fishery selectivity was estimated to be noticeably domed shape whereas the NWFSC Slope Survey remains asymptotic except for the last bin. While a hypothesis could be constructed to explain a pattern such as this, it seems counterintuitive that the survey would be less domed shape than the fishery. To avoid this issue, in all final runs for both the fishery and the NWFSC Slope Survey selectivities were forced to be asymptotic, while the others are allowed to be domed shaped (Figures 9-14). The pattern of retention changed in recent years due to regulations (Table 1; Figure 10). Modeled and observed discards are shown in Figures 17-19

Weighting

Iterative re-weighting was applied to the base model, and the sensitivities used the same final weights as the base model. Length, age, and conditional age-at-length composition data were downweighted when necessary but not upweighted. The recruitment deviation RMSE was close to the input value (0.77 vs. 0.8) and was not reweighted. Similarly, since the RMSE for each of the surveys was no more than 1.13 times the input CV (NWFSC slope), and in two cases far less than the input CV (AFSC slope and NWFSC shelf – both with only 4 points), these were not reweighted either.

Likelihood contributions

The objective function, which was minimized to obtain the point estimates of the model parameters, included contributions by the data (survey biomass indices, fishery and survey length, age and conditional age-at-length composition data) and well as priors (essentially non-informative except for the prior on h in sensitivity runs which is that provided by Dorn's recent meta-analysis).

4. Results

4.1. Reference model results

Figures 15, 16, 20, 21, and 22 show the time trajectories of the estimates of summary biomass, fishery exploitation rate, recruitment, and depletion in spawning output (see Table 13 as well). The fit to the stock-recruitment relationship (Figure 20) indicates a substantial amount of variability. The exploitation rate first peaked at around 9-13% in 1966-1968 due to fishing by foreign fleets. The maximum exploitation rate of around 15% was attained in both 1987 and 1998, averaging around 11% in the intervening years. The fishing mortality rate has been less than 3% over the past 5 years, and less than 1.3 % in 2005 and 2006. Figures 6 and 7 provide a comparison of the time trajectories of spawning biomass, depletion and summary (1+) biomass for the current and the 2005 assessments.

The fits of the base model to the various indices are summarized in Figures 23-24 (survey biomass indices), and Figures 25-48 (composition data). The estimated growth parameters are given in Table 12.

While many other specifications have similar overall likelihoods, the base model appears to fit the overall pattern of the Triennial Survey index (Figure 23) better and that of the NWFSC Slope Survey indices as well as those other specifications. This does not necessarily show up in the likelihoods, as the issue is the strength of patterns of residuals in fits to the two long time series. Both of these series have anomalous low 2001 indices (Figures 23 and 24).

The major quantities and likelihoods from the assessment are given in Table 14. Values for the original, pre-reweighting run is given there as well ("Norewt").

4.2. Retrospective analysis

Retrospective analyses were conducted as if the assessment were carried out in the years from 2002 to 2006. (without the last 1-5 years of data). Estimates (or projections) of depletion in 2007 from these analyses range from 13.7% to 29.2% (Table 14). No consistent retrospective pattern was seen.

4.3 Sensitivity Analysis and profiles

One strict sensitivity run was done for the final model (Table 14):

1) "Fec=WT" Fecundity is set to female spawner biomass as is done in most West Coast groundfish assessments.

A number of profiles over natural mortality and steepness were performed as well (Tables 15-18):

1) h = 0.3, 0.4, 0.5, 0.7, 0.8 and 0.95 (this last as in 2005 model).
2) M = 0.04, 0.05, 0.06, 0.08, 0.09, 0.10.
3) h estimated within the model (using Dorn's prior for steepness).
4) h and M both estimated within the model (using Dorn's prior).
5) h fixed at 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9; M estimated.
6) M fixed at 0.04, 0.05, 0.06, 0.08, 0.09, 0.10; h estimated (using Dorn's prior).

The results from profiling over h with M estimated or over M with h estimated, and estimating both h and M, indicate that the likelihood surface is relatively flat and that a variety of combinations of steepness and natural mortality fit the data relatively well. The profiles show the conflict between the Triennial Survey, which favors somewhat lower values for M or h (i.e. productivity) and the rest of the likelihood, which favors somewhat higher M or h.

5. STAR panel summary

Several requests were made during the STAR panel (July 16-20) to check the input data or model, to make changes to the data or model, and to conduct sensitivity analyses

Checks:

A. Compare absolute scale and trends of GLMM and area swept biomass indices. The GLMM indices had similar trends but were at different scales than the area swept indices. However, differences in scale are absorbed into the catchability parameters.
B. Compare GLMM indices. They had consistent trends.
C. Compare number of trips/hauls, number of fish, and input Ns.
D. Compare input and output effective Ns for last iteration. This showed adequate tuning for length frequencies.
E. Tabulate the standard deviation of standardized residuals for each time series. These showed adequate tuning.
F. Compare age data across states. These did not show contrary trends, so any issues with unbalanced and changing sampling over time would not greatly affect the assessment.
G. Perform likelihood profiles over R0. This showed some tension between data sets, and also that the use of continuous F rather than Pope's equation for F resulted in estimating the catch (request J).
H. Conduct sensitivity runs across σ_r to see if starting point matters. For the range 0.6 to 1.0, output regresses towards 0.8. for input of 1.5, expands to 1.7. Appears to be stable within a reasonable range of σ_r.
I. Sensitivity with no fishery conditional age-at-length data. This resulted in a much lower depletion level in 2007 (13% vs. 23%).
J. See G.
K. See (2) below.
L. see D.
M. see E,F.
N. Recalculate input N values for conditional age-at-length data (see 3. below).
Q. Plot raw catches within strata for Triennial Survey to compare spatial distribution across years. Data was very noisy but no clear pattern to indicate shift in population.

Requested Changes:

1. Use Pope's equation for F, rather than continuous F. This changed the likelihoods a little bit, but not the overall result. (Request J. above).
2. Use expanded length bins for fishery conditional age-at-length data. Instead of using 1-cm bins for fish through 32 cm, used 5 cm down to 2 cm bins to account for growth throughout the year. (request K. above)
3. Use effective N from Stewart's formula for entire composition for a single year and fleet for conditional age-at-length data, and rescale number of fish in each length bin to get input N's for each length bin. This avoids counting each trip again in each length bin.
4. Use Dorn's prior for h to find steepness for this species. The STAR panel preferred to use the median value of the prior (h = 0.5) while I chose to have the model calculate steepness using the prior (h = 0.6) (see Table 16 for comparison).

Sensitivities:

O. Run four sensitivities with high and low h and M to see range of uncertainty. The resulting range of depletion was 4% to 50%.
P. Do retrospective analysis to look for retrospective patterns. None were found.

6. Future research

Future research needs include:

- A thorough review of species composition in historical rockfish landings and a tabulation of estimated landings by species to be used in assessments.

- Investigation into the best available methods and data for constructing and using conditional age at length compositions from data taken across space and time within years.

- A thorough investigation of historical darkblotched rockfish mortality in the shrimp fishery.

- Mapping of “trawlable” and “untrawlable” habitat and construction of a prior on survey q.

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Table 1. Recent management regulations affecting darkblotched rockfish landings.

Area	Year	Period	Bimonthly Landings (lbs)	RCA Depth (fm)		Small footrope required
				min	max	
N of 40° 10’	2000	Jan-June	3000			for shelf rockfish
		Jul-Oct	5000			for shelf rockfish
		Nov-Dec	3000			for shelf rockfish
	2001	Jan-Jun	1500			for shelf rockfish
		Jul-Oct1	2000			for shelf rockfish
		Oct2-Dec	0			for shelf rockfish
	2002	Jan-Aug	1800			
		Sep	600	0	250	
		Oct	600	100	250	shoreward of RCA
		Nov-Dec	1800	100	250	shoreward of RCA
	2003	Jan-Dec	1800	0-100	200-250	shoreward of RCA
	2004	Jan-Apr	4000	60-75	200	shoreward of RCA
		May-Sep	8000	60-75	150	shoreward of RCA
		Oct	8000	0	250	shoreward of RCA
		Nov-Dec	1800	0	250	shoreward of RCA
	2005	Jan-Feb	4000	75	200	shoreward of RCA
		Mar-Oct	4000	100	200	shoreward of RCA
		Nov-Dec	4000	75	200	shoreward of RCA
	2006	Jan-Feb	4000	75	200	shoreward of RCA
		Mar-Oct	4000	100	200	shoreward of RCA
		Nov-Dec	4000	75	200	shoreward of RCA
S of 40° 10’	2000	Jan-Jun	3000			
		Jul-Aug	7000			
		Sep-Dec	20000			
	2001	Jan-Jun	14000			
		Jul-Dec	25000			
40° 10’ to 36°	2002	Jan-Apr	50000			
		May-Aug	5000			
		Sep	600	0	250	
		Oct	600			
		Nov-Dec	1800			
40 °10’ to 38°	2003	Jan-Dec	1800	0-60	200-250	shoreward of RCA
	2004	Jan-Apr	7000	75	150	shoreward of RCA
		May-Sep	50000	75-100	150	shoreward of RCA
		Oct	50000	75	150	shoreward of RCA
		Nov-Dec	10000	0	200	shoreward of RCA
	2005	Jan-Feb	4000	75	200	shoreward of RCA
		Mar-Oct	4000	100	200	shoreward of RCA
		Nov-Dec	4000	75	200	shoreward of RCA
	2006	Jan-Feb	4000	75	200	shoreward of RCA
		Mar-Oct	4000	100	200	shoreward of RCA
		Nov-Dec	4000	75	200	shoreward of RCA

Table 2. Estimates of darkblotched rockfish landings from 1928-1977 for domestic and foreign fleets (Rogers 2005).

Year	California	Oregon	Washington	Foreign	Total
1928	1	0	0		1
1929	2	0	0		3
1930	2	0	0		3
1931	1	0	0		1
1932	1	0	0		1
1933	1	0	0		1
1934	1	0	0		2
1935	2	0	0		2
1936	2	0	0		2
1937	1	1	0		2
1938	5	1	0		5
1939	7	0	0		7
1940	5	2	0		8
1941	4	5	0		9
1942	2	7	0		10
1943	12	26	0		39
1944	48	43	0		91
1945	101	133	2		236
1946	76	83	1		160
1947	48	52	1		100
1948	122	35	3		160
1949	98	72	1		171
1950	119	80	2		201
1951	158	101	2		261
1952	86	107	2		195
1953	106	86	2		194
1954	99	100	2		201
1955	95	100	2		197
1956	102	136	7		244
1957	130	135	4		269
1958	126	114	6		246
1959	108	130	5		243
1960	100	151	7		258
1961	53	142	8		203
1962	55	213	7		276
1963	107	208	8		323
1964	50	150	8		208
1965	67	340	8		415
1966	55	259	8	3807	4129
1967	45	242	8	2706	3001
1968	55	7	8	2288	2358
1969	65	27	11	153	256
1970	77	33	6	149	265
1971	91	63	9	278	441
1972	111	107	3	374	595
1973	1	58	9	768	836
1974	253	110	24	346	733
1975	66	99	109	293	567
1976	136	248	72	118	574
1977	120	98	45		263

Table 3. Estimated landings for 1978-2006. State values from PacFIN (extracted June14, 2007) except for 1978-1980 California from CalCom, and 1978-1982 Oregon and 1978-1980 Washington from Tagart (1985 and pers. comm.). At-Sea Hake "landings" (including discards) from Vanessa Tuttle, At-Sea Hake Observer Program (pers. comm.) for 1991-2006, and extended back to 1981 using a ratio estimator from years with data.

Year	California	Oregon	Washington	Other	At Sea Hake	Total
1978	78	163	189	0	-	410
1979	159	752	81	0	-	992
1980	164	244	98	0	-	557
1981	522	352	37	0	46	957
1982	170	920	24	0	3	1116
1983	510	407	22	0	0	940
1984	596	585	82	0	11	1274
1985	802	838	111	0	36	1787
1986	417	623	215	0	10	1265
1987	1647	686	68	0	19	2420
1988	750	789	108	0	8	1655
1989	441	737	91	0	6	1275
1990	870	764	16	0	0	1651
1991	333	776	54	0	45	1208
1992	187	451	20	0	29	687
1993	285	892	9	0	8	1194
1994	292	549	9	0	15	864
1995	367	339	28	0	49	783
1996	408	296	19	0	6	730
1997	452	346	22	0	4	824
1998	498	413	20	0	14	944
1999	113	228	10	0	11	362
2000	114	132	9	0	8	262
2001	87	66	8	0	12	173
2002	51	52	7	0	3	113
2003	12	62	2	0	4	80
2004	39	136	7	0	7	189
2005	18	68	1	7	11	105
2006	24	72	2	5	11	113

Table 4. Management performance (Bold indicates overfishing).

Year	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
ABC	256	256	256	256	302-349	187	205	240	269	294
OY					130	168	172	240	269	200
Landings(mt)	824	944	362	262	173	113	80	189	105	113
Modeled Discards(mt)	36	63	31	168	110	71	29	65	34	36
Estimated Catch (mt)	**860**	**1007**	**393**	**430**	283	184	109	**254**	139	149

Table 5. Input discard rates used in the assessment.

Year	Discard %	CV
1986	5	0.3
2000	32	0.2
2001	41	0.2
2002	47	0.1
2003	33	0.1
2004	21	0.1
2005	24	0.1

Table 6. GLMM-based biomass indices used in the assessment model.

A. Triennial Shelf Survey

	Vancouver-Columbia				Eureka-Monterey				Total	
	55-183 m		183-366 m		55-183 m		183-366 m		Biomass	
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV
1980	103.75	0.307	244.82	0.358	36.37	0.801	763.81	0.538	1189.48	0.377
1983	354.01	0.240	723.88	0.259	113.63	0.477	583.36	0.379	1824.50	0.206
1986	163.89	0.247	755.76	0.336	42.58	0.553	616.24	0.668	1640.63	0.325
1989	327.39	0.247	374.04	0.365	61.15	0.418	381.94	0.410	1178.75	0.234
1992	249.36	0.283	662.51	0.362	21.55	0.638	169.85	0.465	1128.75	0.265
1995	96.28	0.310	398.74	0.371	16.76	0.633	185.18	0.396	717.89	0.261
1998	236.01	0.321	447.25	0.328	13.43	0.624	104.67	0.381	818.37	0.236
2001	128.29	0.310	322.64	0.317	50.48	0.431	88.14	0.359	601.20	0.225
2004	125.65	0.318	721.36	0.352	78.09	0.581	447.48	0.376	1396.86	0.258

B. AFSC Slope Survey

	Vancouver-Columbia				Eureka-Monterey				Total	
	183-299 m		300-567 m		183-299 m		300-567 m		Biomass	
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV
1997	406.35	1.13	77.27	0.61	47.99	0.73	20.22	1.38	577.95	0.81
1999	148.17	0.85	135.19	0.53	44.83	0.85	44.93	0.95	407.40	0.41
2000	267.21	0.87	155.37	0.72	14.14	0.63	40.35	1.17	520.12	0.53
2001	534.69	1.00	46.49	1.45	60.59	0.81	36.07	1.09	723.91	0.76

C. NWFSC Slope Survey

	Vancouver-Columbia				Eureka-Monterey				Total	
	183-299 m		300-567 m		183-299 m		300-567 m		Biomass	
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV
1999	314.72	0.601	196.19	1.077	130.61	0.559	80.57	0.673	789.87	0.430
2000	613.94	0.504	241.01	1.298	75.74	0.518	84.98	0.834	1098.18	0.456
2001	186.64	0.662	178.36	0.673	60.52	0.553	38.40	0.969	495.34	0.416
2002	403.79	0.648	88.82	1.415	220.63	0.465	60.86	0.614	827.17	0.410
2003	2816.52	0.589	626.37	0.651	182.25	0.478	162.40	0.700	3885.43	0.467
2004	321.93	0.523	231.89	0.761	340.01	0.726	239.14	1.339	1253.52	0.431
2005	882.72	0.613	205.35	0.753	394.49	0.555	194.65	1.064	1788.60	0.405
2006	546.36	0.458	513.89	0.617	104.83	0.839	222.19	0.617	1486.74	0.352

D. NWFSC Shelf Survey

	Vancouver-Columbia		Eureka-Monterey		Total	
	55-183 m		55-183 m		Biomass	
Year	Median	CV	Median	CV	Median	CV
2003	240.74	1.790	161.21	1.188	421.99	1.391
2004	220.86	1.073	39.69	1.369	264.88	1.011
2005	189.52	0.629	48.87	0.796	243.67	0.590
2006	141.27	0.579	74.96	0.802	227.60	0.526

Table 7. A. Raw numbers of fish and trips sampled and input Ns used for fisheries length compositions.

Year	WA fish	OR fish	CA fish	WA trips	OR trips	CA trips	Total Fish	Total Trips	Input N	ReWt N
1977	0	304	0	0	5	0	304	5	22	16
1978	0	200	0	0	2	0	200	2	9	7
1981	0	0	199	0	0	31	199	31	44	34
1982	0	300	459	0	2	57	759	59	89	68
1983	0	0	792	0	0	115	792	115	165	126
1984	0	70	1925	0	1	161	1995	162	333	253
1985	0	201	2966	0	2	206	3167	208	486	370
1986	0	0	2437	0	0	145	2437	145	278	211
1987	0	0	2704	0	0	124	2704	124	412	313
1988	0	0	1337	0	0	92	1337	92	187	142
1989	0	0	1107	0	0	92	1107	92	144	110
1990	0	100	873	0	1	91	973	92	183	139
1991	0	200	764	0	2	75	964	77	143	109
1992	0	0	429	0	0	49	429	49	58	44
1993	0	0	566	0	0	56	566	56	66	50
1994	0	200	595	0	2	51	795	53	119	90
1995	0	188	793	0	7	55	981	62	182	138
1996	370	833	1044	28	23	81	2247	132	425	323
1997	586	802	947	32	22	58	2335	112	405	308
1998	456	541	1353	28	13	80	2350	121	413	314
1999	342	611	770	26	13	40	1723	79	283	215
2000	653	507	906	20	15	53	2066	88	338	257
2001	892	1406	897	25	43	60	3195	128	538	409
2002	1129	681	994	48	22	48	2804	118	455	346
2003	580	1567	590	28	64	38	2737	130	479	364
2004	616	1678	562	20	72	33	2856	125	499	379
2005	117	1416	571	9	59	34	2104	102	386	293
2006	505	1252	0	10	55	0	1757	65	244	185

Table 7. B. Raw numbers of fish and hauls sampled and input Ns used for discard length composition data

Year	Fish	Hauls	Input N	ReWt N
1986			100	38
2002	674	34	127	48
2003	856	41	159	60
2004	797	72	182	69
2005	1529	108	319	121
2006	1123	114	269	102

Table 7. C. Raw numbers of fish and hauls sampled and input Ns used for survey length composition data.

Survey	Year	Fish	Hauls	Input N	ReWt N
Triennial	1980	656	11	54	38
	1983	4438	43	210	149
	1986	1834	38	168	119
	1989	6054	85	416	295
	1992	1445	33	135	96
	1995	2389	106	275	195
	1998	2943	110	318	226
	2001	2980	184	395	280
	2004	3578	152	405	288
AFSC slope	1997	313	20	42	27
	1999	228	26	42	27
	2000	223	20	36	23
	2001	324	14	37	24
NW slope	2000	25	296	46	32
	2001	44	491	79	54
	2002	51	1023	123	85
	2003	60	1736	183	126
	2004	45	527	82	57
	2005	45	1017	117	81
	2006	64	1130	144	99
NW shelf	2003	35	632	80	80
	2004	36	488	71	71
	2005	61	960	129	129
	2006	64	792	120	120

Table 8. Number of trips (fishery) or hauls, number of fish, and total input Ns for conditional age-at-length and age compositions used in the assessment.

Fleet	Year	Trips/Hauls	Fish	Total input N	ReWT N
Fishery	1991	38	360	88	88
	1998	16	341	63	63
	2003	88	1996	363	363
	2004	48	1443	247	247
	2005	26	662	117	117
	2006	16	370	67	67
Discard					
	2004	47	246	81	81
	2005	80	504	150	150
Triennial	(Age composition)				
	2004	134	1121	213	151
AFSC slope					
	2001	18	191	32	32
NWFSC slope	2003	57	406	87	87
	2004	45	281	65	65
	2005	45	362	71	71
	2006	64	479	99	99
NWFSC shelf	2003	34	253	52	52
	2004	36	202	51	51
	2005	61	357	87	87
	2006	64	455	97	97

Table 9. Percentage of annual fishery and survey length samples in each length bin.

Year	Fleet	Sex	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1977	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	2.3
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	1.3
1978	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
1983	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1985	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
1987	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	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
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	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
		M	0.0	0.0	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
1990	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.4
		M	0.0	0.0	0.0	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	0.5
1992	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1993	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.5
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1
1994	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
1997	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1998	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.4
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.4
1999	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.7
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.9
2000	Fish	F	0.0	0.0	0.0	0.0	0.0	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	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6
2001	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
		M	0.0	0.0	0.0	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	0.1
2002	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.5
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.4
2003	Fish	F	0.0	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	0.1	0.0	0.2	0.1	0.6
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3
2004	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		M	0.0	0.0	0.0	0.0	0.0	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	0.1
2006	Fish	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 9(cont.) Percentage of fishery and survey length samples in each length bin.

Year	Fleet	Sex	25	26	27	28	29	30	31	32	33	35	37	39	41	43	45	47	49	51
1977	Fish	F	1.6	3.0	7.9	6.6	7.2	8.2	4.6	4.6	7.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	1.6	3.3	6.3	7.9	8.6	4.9	3.6	3.3	2.0	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0
1978	Fish	F	1.0	1.5	2.5	4.0	4.5	6.0	6.5	9.0	12.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.0	2.0	4.0	5.5	8.0	14.5	6.5	5.0	5.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	Fish	F	0.9	0.0	0.1	1.0	0.0	1.7	1.0	0.2	0.4	3.0	7.9	16.4	20.1	7.8	4.5	0.7	0.0	0.0
		M	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.4	0.7	4.7	18.4	8.7	0.9	0.0	0.0	0.0	0.0	0.0
1982	Fish	F	0.1	0.0	0.6	0.7	1.0	0.7	1.9	3.6	3.6	9.7	10.6	15.1	10.7	5.0	1.7	0.3	1.8	0.4
		M	0.5	0.3	0.2	0.6	0.4	1.1	0.9	1.6	4.9	12.6	6.5	1.6	0.4	0.5	0.1	0.1	0.1	0.0
1983	Fish	F	0.1	0.2	0.2	0.3	0.2	0.6	0.7	0.5	2.5	4.3	12.9	10.7	15.9	6.6	3.4	0.6	0.5	0.2
		M	0.0	0.1	0.1	0.1	0.5	0.5	1.1	1.3	4.8	10.8	11.4	6.3	1.8	0.1	0.2	0.0	0.2	0.2
1984	Fish	F	0.0	0.1	0.1	0.7	1.2	1.2	0.8	1.9	3.2	6.3	11.8	10.0	10.7	8.2	3.6	0.8	0.2	0.0
		M	0.2	0.1	0.1	0.3	0.9	0.8	0.8	1.7	6.5	12.4	8.7	5.6	0.6	0.1	0.1	0.0	0.0	0.0
1985	Fish	F	0.1	0.1	0.5	0.4	0.7	1.8	2.4	3.5	5.7	7.0	7.9	8.5	7.1	4.2	2.9	0.3	0.1	0.0
		M	0.2	0.2	0.6	0.4	1.4	1.6	2.4	4.1	8.5	12.0	8.0	4.2	1.8	0.6	0.2	0.1	0.1	0.0
1986	Fish	F	0.0	0.1	0.2	0.2	0.7	1.2	1.6	4.6	12.3	8.2	9.8	8.6	7.5	2.8	1.2	0.2	0.0	0.0
		M	0.0	0.2	0.3	0.5	0.8	1.7	2.7	3.6	8.9	11.4	7.2	2.5	0.4	0.0	0.0	0.0	0.0	0.0
1987	Fish	F	0.1	0.0	0.0	0.0	0.2	0.4	0.7	1.7	7.1	12.0	13.0	8.3	3.8	1.3	0.1	0.1	0.0	0.0
		M	0.0	0.0	0.0	0.2	0.4	1.3	1.8	4.5	13.8	17.0	9.3	2.0	0.4	0.2	0.0	0.1	0.0	0.0
1988	Fish	F	0.0	0.2	0.2	0.1	0.4	0.2	0.3	1.1	9.0	13.1	10.8	11.4	4.9	1.1	0.3	0.2	0.0	0.0
		M	0.1	0.1	0.2	0.1	0.3	0.7	0.8	3.4	11.6	16.1	9.5	3.0	0.5	0.0	0.0	0.0	0.0	0.0
1989	Fish	F	0.1	0.4	0.6	0.8	1.1	0.6	2.0	2.1	6.8	15.2	7.0	7.1	4.0	2.5	1.1	0.0	0.0	0.0
		M	0.1	0.6	0.8	0.4	0.7	1.5	1.4	3.9	15.0	15.3	5.7	2.4	0.4	0.0	0.0	0.0	0.0	0.0
1990	Fish	F	0.0	0.4	0.7	1.2	0.5	1.0	1.8	2.7	6.6	7.9	10.2	8.2	4.8	5.2	2.2	0.7	0.5	0.0
		M	0.0	0.2	0.1	0.4	1.3	2.2	2.1	2.7	11.5	11.4	7.2	4.6	1.5	0.2	0.0	0.0	0.0	0.0
1991	Fish	F	1.2	0.9	0.6	0.9	1.3	1.0	2.0	1.5	3.7	7.7	9.3	10.1	7.2	9.3	3.9	1.4	0.1	0.0
		M	0.4	1.1	0.9	0.6	1.0	1.0	0.7	1.5	7.4	10.4	5.7	4.1	0.9	0.4	0.0	0.0	0.0	0.0
1992	Fish	F	0.0	0.5	0.2	0.3	1.0	0.7	2.2	3.0	4.4	7.5	9.8	12.4	8.1	5.8	1.4	0.2	0.0	0.0
		M	0.0	0.0	0.1	1.3	1.0	2.6	0.9	2.1	5.5	12.3	10.5	4.6	0.7	0.3	0.0	0.3	0.0	0.0
1993	Fish	F	0.2	0.0	0.4	0.9	1.2	1.9	3.2	2.5	3.5	8.5	8.7	5.8	3.6	1.0	0.7	0.3	0.1	0.0
		M	0.1	0.2	0.1	2.6	1.1	3.1	3.3	3.5	13.4	16.8	7.7	2.6	1.4	0.3	0.0	0.0	0.0	0.0
1994	Fish	F	0.2	0.0	0.0	0.4	0.4	1.6	1.7	3.1	6.9	8.3	7.2	9.5	5.7	4.5	1.7	0.4	0.0	0.0
		M	0.0	0.1	0.0	0.3	0.5	1.9	1.8	4.4	11.7	11.6	9.5	4.8	0.9	0.1	0.0	0.2	0.0	0.0
1995	Fish	F	0.1	0.4	0.0	0.0	0.3	0.4	1.5	3.0	6.7	8.7	11.1	9.0	8.9	4.3	1.2	0.2	0.0	0.0
		M	0.0	0.3	0.1	0.3	0.3	0.6	3.9	5.6	10.1	13.7	6.4	1.8	0.4	0.0	0.2	0.0	0.0	0.0
1996	Fish	F	0.2	0.3	0.4	0.8	0.5	1.0	1.1	1.5	6.8	7.2	7.8	7.2	5.9	3.3	1.9	0.5	0.1	0.0
		M	0.2	0.4	0.4	0.6	0.8	1.9	3.8	6.3	14.6	15.6	5.2	2.2	0.6	0.2	0.1	0.1	0.1	0.0
1997	Fish	F	0.5	0.8	0.4	1.1	1.4	2.0	1.7	3.5	6.3	7.5	7.2	7.6	6.2	3.6	2.8	0.4	0.2	0.0
		M	0.3	0.8	0.4	0.8	1.7	3.2	3.0	5.1	10.5	10.9	5.4	2.9	0.9	0.3	0.1	0.0	0.0	0.0
1998	Fish	F	0.5	0.6	1.1	1.3	1.5	1.1	2.2	2.0	6.0	6.7	9.6	7.3	7.3	5.0	1.7	0.4	0.0	0.0
		M	0.7	1.7	1.4	1.6	1.4	1.7	1.8	3.2	11.3	9.6	5.7	2.6	0.9	0.1	0.0	0.2	0.1	0.0
1999	Fish	F	1.8	3.2	4.0	3.7	3.3	4.2	2.0	1.8	4.0	7.6	7.7	4.3	3.1	2.1	1.3	0.4	0.1	0.0
		M	1.6	4.3	2.7	3.4	3.1	3.2	2.5	2.4	7.0	6.4	3.5	2.1	0.3	0.0	0.0	0.0	0.0	0.0
2000	Fish	F	0.6	1.1	1.5	4.5	4.2	4.1	4.4	5.0	4.9	4.5	5.0	5.5	4.9	2.6	1.5	0.2	0.0	0.0
		M	0.1	1.8	2.1	3.9	5.1	5.1	2.6	3.9	6.9	6.0	4.0	2.0	0.5	0.1	0.1	0.0	0.0	0.0
2001	Fish	F	0.4	0.7	0.9	2.3	2.1	5.2	6.6	7.0	9.3	5.1	2.9	3.0	1.8	1.5	1.1	0.4	0.0	0.0
		M	0.2	0.5	1.4	3.2	4.0	6.7	7.4	6.8	7.6	5.6	2.7	1.8	0.7	0.2	0.1	0.1	0.0	0.0
2002	Fish	F	0.4	0.5	0.6	1.1	1.0	1.8	2.6	4.3	12.4	7.0	4.5	4.4	5.6	5.7	1.6	0.6	0.1	0.0
		M	0.4	0.6	0.9	1.3	1.8	2.8	4.8	6.6	10.0	9.9	2.6	1.5	0.5	0.0	0.0	0.0	0.0	0.0
2003	Fish	F	0.2	0.2	0.5	0.6	0.5	0.8	1.0	1.1	8.7	13.4	9.0	6.0	4.7	4.5	2.0	0.5	0.2	0.0
		M	0.2	0.2	0.5	1.1	1.0	1.5	2.0	4.1	14.3	9.7	6.2	1.7	0.8	0.3	0.3	0.0	0.0	0.0
2004	Fish	F	0.1	0.6	0.7	0.8	1.5	1.6	1.8	2.7	4.5	8.8	6.1	7.6	7.1	3.5	2.2	1.1	0.1	0.1
		M	0.5	0.2	0.8	1.1	2.5	3.1	4.6	4.1	12.8	11.1	5.7	1.8	0.4	0.2	0.1	0.0	0.0	0.0
2005	Fish	F	0.2	0.4	0.8	1.1	1.6	2.5	3.4	4.7	7.7	8.8	9.4	6.3	4.1	2.1	0.6	0.5	0.1	0.1
		M	0.2	0.6	1.2	1.3	1.5	3.9	5.2	4.6	10.3	9.9	4.1	1.9	0.5	0.1	0.0	0.0	0.0	0.0
2006	Fish	F	0.1	0.1	0.3	0.7	0.3	1.8	3.2	6.9	9.2	6.8	8.4	4.6	3.1	2.4	1.0	0.2	0.0	0.1
		M	0.1	0.1	0.1	1.0	1.3	3.5	6.8	6.2	14.1	10.0	5.2	2.1	0.3	0.2	0.1	0.0	0.0	0.0

Table 9. (cont) Percentage of fishery and survey length samples in each length bin.

Year	Fleet	Sex	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1986	Disc		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.6	0.7	1.5	1.0	1.3	2.2	2.6	6.7	9.8
2002	Disc		0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.6	0.5	0.4	0.3	1.2	1.4	0.6	0.9	0.9	0.9	1.9	2.4
2003	Disc		0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.9	0.6	1.0	0.2	0.4	0.9	1.8	0.2	0.2	0.5	2.7	3.7
2004	Disc		0.0	0.1	0.0	0.0	0.0	0.4	0.8	1.4	1.5	1.2	1.3	3.3	3.5	2.0	1.6	1.3	2.3	0.9	0.3
2005	Disc		0.0	0.1	0.0	0.2	0.0	0.5	0.8	2.2	2.8	1.5	1.8	3.7	5.4	2.9	1.4	1.3	2.1	1.6	1.1
2006	Disc		0.0	0.0	0.0	0.1	0.0	0.2	1.6	1.1	1.1	1.4	1.2	3.1	5.5	4.1	3.2	7.4	6.1	3.9	2.1
1980	Tri	F	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.0	0.1	0.2	0.4	0.6	1.4	0.1	0.7	0.8	1.0	3.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.2	0.3	0.2	0.8	0.9	1.5	0.7	0.6	0.6	0.8	0.7
1983	Tri	F	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.4	2.1	3.8	2.2	2.9	3.1	4.4	4.0	3.5
		M	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.2	0.2	0.6	2.1	3.2	3.2	2.6	3.8	6.6	5.5	4.0
1986	Tri	F	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.4	1.3	0.9	0.6	0.3	0.8	1.7	1.5	0.7	0.6	1.1	1.7
		M	0.1	0.0	0.0	0.0	0.1	0.0	0.3	0.5	1.0	0.8	0.5	0.3	0.3	1.1	1.6	0.7	0.6	1.5	1.5
1989	Tri	F	0.0	0.0	0.0	0.0	0.0	0.1	0.6	3.8	6.6	2.9	0.5	1.5	3.3	6.2	3.2	3.7	1.4	2.0	2.1
		M	0.0	0.0	0.0	0.1	0.0	0.2	0.8	3.8	6.5	4.5	0.8	1.4	4.2	5.7	3.3	2.5	1.6	1.8	1.3
1992	Tri	F	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.2	0.4	0.1	0.0	0.2	1.9	4.0	2.5	0.6	1.1	1.6
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.5	0.3	0.1	0.4	1.8	2.9	2.9	1.1	0.7	3.1
1995	Tri	F	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.8	2.3	1.2	0.2	0.1	0.6	1.3	0.9	0.9	1.0	2.6	4.5
		M	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.1	2.4	1.2	0.2	0.2	0.5	1.1	2.0	1.2	1.1	2.9	4.7
1998	Tri	F	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.8	0.3	0.1	0.7	1.2	0.8	1.6	2.5	4.7	7.7	8.2	3.6
		M	0.0	0.0	0.0	0.0	0.0	0.7	1.3	1.1	0.1	0.2	0.6	1.4	1.1	1.1	3.3	5.4	8.2	7.5	5.3
2001	Tri	F	0.0	0.0	0.1	0.2	0.1	0.2	1.4	3.6	2.3	0.6	0.3	1.2	3.9	8.7	8.4	2.3	0.2	0.4	0.4
		M	0.0	0.0	0.1	0.2	0.0	0.2	1.1	3.1	2.0	0.8	0.3	1.1	4.2	7.7	7.6	2.8	0.4	0.2	0.5
2004	Tri	F	0.0	0.1	0.0	0.0	0.0	0.1	0.8	1.3	1.4	0.2	0.2	0.3	0.7	0.8	0.3	0.3	0.6	1.0	1.9
		M	0.0	0.1	0.0	0.0	0.0	0.3	1.0	2.7	1.5	0.3	0.3	0.4	0.7	0.8	0.6	0.4	0.7	0.7	2.3
1997	AFSC	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	5.6	5.5	4.8	3.9	3.7	8.5
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	5.6	12.4	5.7	1.8	3.2	5.3
1999	AFSC	F	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.1	0.1	0.1	0.2	0.1	0.3	1.9
		M	0.0	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	1.5	0.0	0.0	0.2	0.3
2000	AFSC	F	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	0.1	1.0	1.0	3.7	6.8	8.2
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.0	3.0	5.3	11.1	16.3
2001	AFSC	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.6	1.4	1.2	0.7	0.1
		M	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	0.4	1.1	1.4	0.5	0.3	0.4
2000	NWSL	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.1	0.3	0.0	0.1	1.4	1.3	1.7
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.7	0.3	0.0	0.1	0.1	0.0	0.1	0.2	0.8
2001	NWSL	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.7	0.9	2.7	6.1	1.9	1.0	0.3	0.7
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.8	0.5	2.3	4.9	3.2	1.6	0.5	0.3
2002	NWSL	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.4	1.9	1.1	1.0	0.3	2.5	7.1	9.7
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.9	1.5	0.5	0.3	2.0	5.6	8.8
2003	NWSL	F	0.0	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	0.3	0.6	1.4	1.9
		M	0.0	0.0	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	0.2	0.7	1.6	1.8
2004	NWSL	F	0.0	0.0	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	3.6	0.9	1.3	3.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	6.0	6.7
2005	NWSL	F	0.0	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	0.1	0.1	0.2	0.1	0.1
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.3
2006	NWSL	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.7	0.2	1.0	1.2	1.7	1.3	0.7
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.5	1.0	0.9	1.9	1.3	1.1
2003	NWSH	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.1	0.3	0.3	0.4	0.8	2.4	6.7	8.2	11.0
		M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.6	0.7	1.5	1.0	1.3	2.2	2.6	6.7	9.8
2004	NWSH	F	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.6	0.5	0.4	0.3	1.2	1.4	0.6	0.9	0.9	0.9	1.9	2.4
		M	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.9	0.6	1.0	0.2	0.4	0.9	1.8	0.2	0.2	0.5	2.7	3.7
2005	NWSH	F	0.0	0.1	0.0	0.0	0.0	0.4	0.8	1.4	1.5	1.2	1.3	3.3	3.5	2.0	1.6	1.3	2.3	0.9	0.3
		M	0.0	0.1	0.0	0.2	0.0	0.5	0.8	2.2	2.8	1.5	1.8	3.7	5.4	2.9	1.4	1.3	2.1	1.6	1.1
2006	NWSH	F	0.0	0.0	0.0	0.1	0.0	0.2	1.6	1.1	1.1	1.4	1.2	3.1	5.5	4.1	3.2	7.4	6.1	3.9	2.1
		M	0.0	0.0	0.0	0.1	0.1	0.4	1.3	1.3	2.1	1.1	1.1	2.0	5.3	4.3	3.1	5.9	6.4	4.1	1.9

Table 9. (cont) Percentage of fishery and survey length samples in each length bin.

Year	Fleet	Sex	25	26	27	28	29	30	31	32	33	35	37	39	41	43	45	47	49	51
1986	Disc		8.1	10.1	7.4	10.8	19.6	19.6	7.4	6.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	Disc		8.0	5.0	2.1	2.5	2.0	2.6	2.3	4.7	14.1	13.0	6.4	1.4	1.2	0.6	0.2	0.0	0.0	0.0
2003	Disc		0.8	0.4	2.5	2.7	3.8	2.7	3.4	8.6	24.9	18.7	10.1	5.3	2.9	0.5	0.9	0.4	0.0	0.0
2004	Disc		2.3	1.9	1.9	2.5	1.2	2.4	3.7	9.1	18.6	22.5	10.9	10.4	3.2	5.1	1.0	0.0	0.0	0.0
2005	Disc		0.6	4.0	5.9	5.2	5.6	6.2	7.7	6.3	17.8	16.9	8.5	2.4	1.1	0.2	0.2	0.0	0.1	0.0
2006	Disc		0.6	0.5	0.8	0.6	1.5	4.6	6.6	7.0	17.4	12.1	9.6	2.1	4.0	2.5	0.6	0.2	0.0	0.3
1980	Tri	F	3.4	4.0	4.4	4.3	1.7	1.5	3.5	3.8	6.9	3.3	3.7	2.3	1.0	0.9	0.6	0.0	0.0	0.0
		M	1.3	2.3	1.7	3.7	2.7	4.2	5.4	3.6	4.1	5.1	3.7	0.0	0.4	0.0	0.0	0.0	0.0	0.0
1983	Tri	F	3.4	4.0	2.3	1.5	0.5	0.6	0.6	0.4	0.7	0.8	0.9	2.1	2.1	1.1	0.4	0.1	0.0	0.0
		M	3.7	3.7	2.6	1.1	0.5	0.7	0.4	0.4	0.6	2.2	2.0	0.9	0.2	0.1	0.0	0.0	0.0	0.0
1986	Tri	F	2.0	3.3	3.3	2.6	4.6	4.2	3.8	3.0	4.9	2.3	1.2	0.9	1.0	0.7	0.4	0.2	0.1	0.0
		M	2.0	4.2	3.8	3.8	6.4	4.1	4.6	3.4	2.8	1.8	0.5	1.0	0.6	0.2	0.0	0.0	0.0	0.0
1989	Tri	F	1.8	1.7	1.4	1.0	0.9	0.9	1.0	0.3	1.0	0.9	0.7	0.6	0.5	0.0	0.1	0.0	0.0	0.0
		M	1.7	1.1	1.5	1.1	1.1	1.2	0.5	0.7	1.1	0.4	0.3	0.3	0.1	0.1	0.0	0.0	0.0	0.0
1992	Tri	F	2.9	2.5	4.7	9.6	7.1	4.5	2.6	0.8	0.8	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
		M	2.6	1.9	9.3	11.1	7.7	3.1	0.9	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	Tri	F	3.9	2.4	2.4	1.7	1.3	1.6	0.9	0.8	2.2	3.3	3.4	3.0	3.7	2.6	1.0	0.4	0.0	0.0
		M	4.0	2.4	1.6	1.4	1.1	0.9	1.5	1.5	5.3	6.0	3.5	0.6	0.1	0.1	0.0	0.0	0.0	0.0
1998	Tri	F	3.2	2.9	2.7	1.9	1.1	0.6	0.4	0.3	0.6	0.5	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0
		M	3.4	2.9	2.8	1.8	0.8	0.8	0.8	0.6	0.9	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0
2001	Tri	F	0.8	0.9	0.9	0.5	1.1	0.5	2.5	3.0	10.6	0.7	0.4	0.6	0.2	0.2	0.0	0.1	0.0	0.0
		M	0.6	0.7	0.8	0.4	0.6	0.7	2.2	1.5	2.3	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2004	Tri	F	2.6	4.2	5.3	4.1	3.4	4.4	3.3	2.4	3.4	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
		M	3.2	8.1	7.3	4.6	4.9	5.5	4.0	2.0	2.3	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	AFSC	F	12.9	3.0	2.3	0.1	0.1	0.0	0.0	0.1	0.8	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
		M	2.3	1.4	1.6	0.0	0.3	0.1	0.3	0.2	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	AFSC	F	0.0	1.0	7.7	11.6	11.3	7.3	6.2	2.0	1.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	0.7	2.8	13.4	14.5	7.4	4.7	0.9	0.6	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	AFSC	F	7.6	1.3	2.6	2.8	2.1	3.9	4.5	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	6.2	2.4	0.4	4.2	1.7	1.7	0.8	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	AFSC	F	1.0	0.7	1.3	1.6	2.1	2.4	3.7	11.1	16.3	7.5	0.8	0.1	0.6	0.1	0.4	0.0	0.0	0.0
		M	1.0	1.3	2.6	1.9	1.0	1.6	10.5	13.0	6.4	0.5	0.1	0.6	0.4	0.0	0.0	0.0	0.0	0.0
2000	NWSL	F	0.0	1.1	2.2	7.4	6.1	10.3	2.4	1.2	0.4	0.0	2.0	3.9	5.9	4.0	3.3	0.0	0.0	0.0
		M	1.3	0.2	2.6	4.9	6.3	3.5	2.1	0.2	3.4	12.0	2.7	1.3	0.7	0.7	0.0	0.0	0.0	0.0
2001	NWSL	F	0.6	0.8	1.2	0.6	1.4	1.2	1.6	5.8	6.1	1.7	2.7	4.8	1.5	0.5	0.0	0.0	0.0	0.0
		M	0.3	1.8	1.8	0.4	1.2	2.5	3.5	5.3	6.0	10.0	6.6	0.8	0.0	0.1	0.0	0.0	0.0	0.0
2002	NWSL	F	8.0	5.6	1.2	1.6	2.3	1.8	1.6	1.4	1.9	0.7	0.6	0.1	0.2	0.0	0.3	0.1	0.0	0.0
		M	6.6	6.6	2.1	1.9	2.4	1.9	1.3	1.4	1.8	0.6	0.9	0.5	0.2	0.0	0.0	0.0	0.0	0.0
2003	NWSL	F	1.3	1.1	2.4	2.6	1.7	0.6	0.8	2.6	8.0	14.1	7.6	4.2	2.5	3.1	3.0	0.8	0.2	0.0
		M	1.2	2.0	2.4	1.9	1.6	0.6	0.9	1.8	10.6	8.3	1.8	1.2	0.3	0.0	0.0	0.0	0.0	0.0
2004	NWSL	F	3.3	3.5	4.8	5.2	4.1	3.5	2.5	2.4	2.1	1.4	0.7	0.5	0.4	0.1	0.3	0.0	0.0	0.0
		M	3.6	3.1	5.3	6.3	5.4	3.6	1.6	2.2	1.8	3.0	2.7	0.6	0.3	0.2	0.0	0.0	0.0	0.0
2005	NWSL	F	0.2	0.3	0.8	1.1	0.7	1.6	2.8	3.5	5.8	12.7	11.7	4.4	0.4	0.6	0.2	0.6	0.0	0.0
		M	0.4	0.6	1.0	1.7	2.0	2.2	2.8	8.1	19.4	8.1	3.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0
2006	NWSL	F	1.4	0.7	1.1	1.8	1.2	5.0	3.8	3.8	7.0	5.2	5.2	4.2	1.7	1.5	0.6	0.0	0.0	0.0
		M	0.5	0.8	1.8	2.2	3.3	4.5	4.7	3.9	9.9	5.5	3.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0
2003	NWSH	F	5.9	2.7	2.2	2.5	2.6	1.7	0.3	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	7.8	4.6	2.4	2.8	3.6	1.5	0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	NWSH	F	9.2	10.0	7.2	3.0	1.6	2.2	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	9.8	15.8	6.1	2.3	3.2	2.0	0.3	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	NWSH	F	0.9	0.9	4.5	4.9	5.6	4.2	0.5	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		M	1.1	2.1	7.6	7.0	4.7	2.2	1.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	NWSH	F	1.2	1.5	0.6	0.9	0.7	2.0	1.3	0.8	0.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
		M	1.2	0.7	0.9	0.2	1.5	1.0	1.6	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 10. Data sources and years included in the Base Model.

Indices	Years
Triennial Shelf	1980 1983 1986 19891992 1995 1998 2001 2004
AFSC Slope	1997 1999-2001
NWFSC Slope	2000-2006
NWFSC Shelf	2003-2006
Discard	1986, 2000-2005
Length Comps	
Fishery landings	1977-1978, 1981-2006
Fishery discard	1986, 2002-2006
Triennial Shelf	1980 1983 1986 19891992 1995 1998 2001
AFSC Slope	1997 1999-2001
NWFSC Slope	2000-2006
NWFSC Shelf	2003-2006
Age Comps	
Triennial Shelf	2004
Age-at-length	
Fishery landings	1991, 1998, 2003-2006
Fishery discard	2004 2005
AFSC Slope	2001
NWFSC Slope	2003-2006
NWFSC Shelf	2003-2006

Table 11. Parameters in the base model.

Mortality and growth				
1	0.07	Fixed	Natural mortality (M)	
2	0	Fixed	Old offset	
3	14.8923	Estimated	Size at age 1.7 (in cm)	
4	42.174	Estimated	Size at age 29 (females)	
5	0.214137	Estimated	Von-Bertalanffy K (females)	
6	0.0620961	Estimated	cv of size at age (young)	
7	0.0244513	Estimated	cv of size at age offset (old)	
8	0	Fixed	M offset Male	
9	0	Fixed	M offset old male	
10	0	Fixed	Male offset for size at age 1.7	
11	-0.12589	Estimated	Male offset for size at age 29	At age 29: 37.19cm
12	0.261982	Estimated	Male offset for K	Male K = 0.28
13	0	Fixed	offsest for cv of size	
14	0	Fixed	offset for cv of size	
biology_parms				
15	2.10E-05	Fixed	scalar for weight at length	
16	2.96142	Fixed	Exponent for weight at length	
17	34.59	Fixed	size at 50% maturity	
18	-0.6429	Fixed	logistic parameter for maturity ogive	
19	0.1458	Fixed	eggs/kg intercept	
20	1.325	Fixed	Fec.slope	
21	2.10E-05	Fixed	scalar for weight at length	
22	2.96142	Fixed	Exponent for weight at length	
#_size_sel:	Fishery		Fishery selectivity	
1	34.9749	Estimated	Peak	
2	0.414884	Estimated	Width of peak	
3	3.90223	Estimated	VarAscend	
4	5.5315	Estimated	Var Descending	
5	-2.17195	Estimated	Initial	
6	9	Fixed	Final	
#_retention	Fishery			
7	26.6126	Estimated	size at 50% selectivity through 1999	
8	2.00004	Estimated	logarithmic slope	
9	1	Fixed	final	
10	0	Fixed	intial	
#_size_sel:	Triennial			
11	21.5886	Estimated	Peak	
12	-5.99999	Estimated	Width of peak	
13	3.54535	Estimated	VarAscend	
14	4.05594	Estimated	Var Descending	
15	-1.60493	Estimated	Initial	
16	-2.50929	Estimated	Final	
#_size_sel:	AFSC sl			
17	23.1085	Estimated	Peak	
18	-1.02227	Estimated	Width of peak	
19	2.36933	Estimated	VarAscend	
20	2.30353	Estimated	Var Descending	
21	-5	Fixed	Initial	
22	-3.64927	Estimated	Final	
#_size_sel:	NWFSC sl			
23	24.3454	Estimated	Peak	
24	1.26326	Estimated	Width of peak	
25	3.1702	Estimated	VarAscend	
26	4.02345	Estimated	Var Descending	
27	-5	Fixed	Initial	
28	9	Fixed	Final	
#_size_sel:	NWFSC sh			
29	16.4491	Estimated	Peak	
30	-1.24981	Estimated	Width of peak	
31	0.184223	Estimated	VarAscend	
32	2.85191	Estimated	Var Descending	
33	-1.18676	Estimated	Initial	
34	-5	Fixed	Final	
sel_parm_blockparms				
35	26.0001	Estimated	size at 50% selectivity 2000 -	
36	0.64867	Estimated	final retention 2000 -	
37	0.781212	Estimated	final retention 2003 -	

Table 12. Growth parameters estimated in the model

Assessment model year	2000	2005	2007
Female Length at age 1.7	14.92	11.79	14.89
Female length at age 40	41.70	42.93	42.25
Female VBK	0.16	0.20	0.21
CV of length at age at age 1.7	0.10	0.06	0.062
CV of length at age at age 40	0.04	0.06	0.064
Male Length at age 1.7	14.92	11.79	14.89
Male length at age 40	37.40	37.88	37.20
Male VBK	0.21	0.25	0.28
CV of length at age at age 1.7	0.08	0.06	0.062
CV of length at age at age 40	0.04	0.06	0.064

Table 13. Time series of total and summary biomass, spawning output, depletion, recruitment and F.

Year	Total Biom.	Sum. Biom.	Sp. Out.	Depletion	Recruit	F
1928	34527	34509	30641	1.000	3295	0.0000
1929	34527	34509	30640	1.000	3295	0.0001
1930	34524	34506	30638	1.000	3295	0.0001
1931	34521	34503	30635	1.000	3295	0.0000
1932	34521	34503	30634	1.000	3295	0.0000
1933	34520	34502	30634	1.000	3295	0.0000
1934	34520	34502	30633	1.000	3295	0.0001
1935	34518	34501	30632	1.000	3295	0.0001
1936	34517	34499	30630	1.000	3295	0.0001
1937	34516	34498	30629	1.000	3295	0.0001
1938	34514	34497	30628	1.000	3295	0.0002
1939	34510	34492	30624	0.999	3295	0.0002
1940	34504	34486	30617	0.999	3295	0.0003
1941	34497	34480	30611	0.999	3295	0.0003
1942	34490	34472	30603	0.999	3294	0.0003
1943	34482	34464	30594	0.998	3294	0.0012
1944	34445	34427	30558	0.997	3294	0.0029
1945	34358	34340	30472	0.994	3292	0.0075
1946	34128	34111	30246	0.987	3288	0.0052
1947	33984	33966	30097	0.982	3285	0.0032
1948	33905	33887	30009	0.979	3284	0.0052
1949	33771	33753	29866	0.975	3281	0.0056
1950	33631	33614	29718	0.970	3278	0.0066
1951	33468	33450	29546	0.964	3275	0.0086
1952	33252	33234	29322	0.957	3271	0.0065
1953	33111	33093	29167	0.952	3268	0.0064
1954	32978	32960	29020	0.947	3265	0.0067
1955	32844	32826	28873	0.942	3262	0.0066
1956	32720	32703	28737	0.938	3259	0.0082
1957	32556	32538	28562	0.932	3256	0.0091
1958	32373	32356	28369	0.926	3252	0.0084
1959	32222	32204	28205	0.921	3248	0.0083
1960	32080	32062	28050	0.915	3245	0.0089
1961	31929	31912	27888	0.910	3242	0.0070
1962	31841	31823	27785	0.907	3240	0.0096
1963	31684	31667	27619	0.901	3236	0.0112
1964	31487	31469	27413	0.895	3232	0.0073
1965	31413	31395	27325	0.892	3230	0.0146
1966	31135	31118	27044	0.883	3224	0.1464
1967	27150	27133	23219	0.758	3128	0.1229
1968	24415	24399	20513	0.669	3045	0.1081
1969	22421	22405	18470	0.603	2969	0.0129
1970	22621	22605	18450	0.602	2968	0.0132
1971	22828	22812	18480	0.603	2969	0.0217
1972	22862	22846	18407	0.601	2966	0.0292
1973	22742	22726	18240	0.595	2960	0.0412
1974	22380	22364	17886	0.584	2945	0.0368
1975	22125	22114	17640	0.576	1978	0.0288
1976	22025	22012	17553	0.573	2453	0.0292
1977	21875	21868	17466	0.570	1240	0.0134
1978	21967	21959	17665	0.577	1389	0.0207
1979	21820	21800	17738	0.579	3786	0.0501
1980	21030	20998	17276	0.564	5921	0.0291
1981	20736	20716	17170	0.560	3626	0.0509
1982	20197	20189	16636	0.543	1315	0.0621
1983	19639	19634	15862	0.518	909	0.0551
1984	19271	19266	15172	0.495	913	0.0766
1985	18460	18454	14204	0.464	1163	0.1101
1986	16993	16987	12966	0.423	1121	0.0826
1987	15941	15926	12376	0.404	2729	0.1655
1988	13670	13648	10816	0.353	4054	0.1320
1989	12219	12218	9777	0.319	342	0.1155
1990	11257	11252	8917	0.291	820	0.1672
1991	9966	9962	7598	0.248	798	0.1425
1992	9101	9095	6644	0.217	1140	0.0886
1993	8721	8719	6221	0.203	439	0.1559
1994	7776	7768	5508	0.180	1625	0.1244
1995	7155	7124	5133	0.168	5748	0.1226
1996	6678	6668	4787	0.156	1923	0.1251
1997	6428	6416	4415	0.144	2271	0.1555
1998	6254	6251	3906	0.127	576	0.1992
1999	6031	6002	3272	0.107	5188	0.0830
2000	6482	6456	3176	0.104	4728	0.0819
2001	6996	6993	3230	0.105	547	0.0489
2002	7773	7770	3567	0.116	570	0.0288
2003	8648	8638	4071	0.133	1761	0.0152
2004	9480	9470	4660	0.152	1903	0.0311
2005	10041	10030	5231	0.171	2005	0.0154
2006	10615	10605	6013	0.196	1958	0.0154
2007	11105	11094	6853	0.224	2087	

Table 14. Model results from retrospective and sensitivity analyses.

Derived Quantities of Interest	Base	Norewt	Fec=WT	Retro 06	Retro 05	Retro 04	Retro 03	Retro 02
Depletion in 2007	22.4%	22.6%	27.2%	26.7%	29.2%	26.8%	13.7%	14.6%
2007 spawning output	6,853	6,894	4,407	8,195	8,955	8,307	4,112	4,331
Unfished spawning output	30,641	30,557	16,225	30,742	30,720	30,995	30,083	29,662
SO_{MSY}	12,256	12,223	6,490	12,297	12,288	12,398	12,033	11,865
MSY_{B40} (landings+discard)	621	623	648	629	636	644	620	620
F_{MSY}	0.041	0.042	0.045	0.042	0.042	0.041	0.040	0.040
Exploitation rate at MSY	0.038	0.038	0.041	0.038	0.038	0.038	0.038	0.038
$F_{2006/}F_{MY}$	0.370	0.377	0.323	0.317	0.298	0.369	0.582	0.571
Likelihoods								
Objective function	2217.05	*2684.42*	2217.02	*1940.29*	*1566.90*	*1207.24*	*857.23*	*789.64*
Triennial Survey index	4.93	5.01	5.25	6.08	6.88	5.47	2.23	2.07
AFSC Slope Survey index	0.49	0.52	0.50	0.55	0.59	0.61	0.48	0.66
NWFSC Slope Survey index	4.67	4.72	4.65	4.71	4.67	4.86	1.03	1.04
NWFSC Shelf Survey index	0.03	0.02	0.03	0.04	0.00	0.00	0.00	0.00
Discard	7.61	10.50	7.62	7.44	8.35	2.98	3.73	2.72
Fishery and discard length	531.91	770.74	531.52	500.60	467.63	411.13	346.57	313.59
Triennial Survey length	246.83	331.45	247.00	239.42	232.09	225.30	213.15	211.14
AFSC Slope Survey length	55.56	85.29	55.54	54.68	54.94	54.32	55.95	52.85
NWFSC slope length	150.11	215.85	150.05	139.74	122.64	90.56	52.38	22.40
NWFSC shelf length	55.84	55.79	55.77	38.33	17.89	7.74	0.00	0.00
Fishery and discard age	571.20	591.78	571.36	527.58	388.74	248.15	123.39	124.74
Triennial Survey age	16.10	24.87	16.13	18.41	18.96	0.00	0.00	0.00
AFSC Survey age	45.02	44.73	45.05	42.73	41.61	42.30	42.91	43.35
NWFSC slope age	283.17	291.27	283.18	205.13	119.24	67.49	0.00	0.00
NWFSC shelf age	227.86	233.73	227.83	139.22	66.60	31.00	0.00	0.00
Catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recruitment	15.62	18.05	15.46	15.53	15.98	15.24	15.32	14.97
Parameter priors	0.10	0.11	0.10	0.10	0.10	0.10	0.09	0.10
Parameters								
Natural mortality	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Steepness	0.6	0.95	0.6	0.6	0.6	0.6	0.6	0.6

Table 15. Model results from profiling over natural mortality rate values.

Derived Quantities of Interest	Base	M.04	M.05	M.06	M.08	M.09	M.10
Depletion in 2007	22.4%	5.9%	9.2%	14.5%	32.9%	45.8%	60.2%
2007 spawning output	6,853	1,876	2,891	4,467	10,281	15,092	22,055
Unfished spawning output	30,641	32,070	31,393	30,791	31,237	32,981	36,644
SO_{MSY}	12,256	12,828	12,557	12,316	12,495	13,192	14,658
MSY_{B40} (landings+discard)	621	399	471	541	721	859	1,068
F_{MSY}	0.041	0.028	0.033	0.037	0.046	0.050	0.054
Exploitation rate at MSY	0.038	0.027	0.031	0.034	0.041	0.043	0.046
F_{2006}/F_{MY}	0.370	1.897	1.082	0.627	0.226	0.142	0.090
Likelihoods							
Objective function	2217.05	2254.46	2231.75	2220.83	2216.80	2217.96	2219.46
Triennial Survey index	4.93	7.99	4.90	3.83	7.68	11.16	14.59
AFSC Slope Survey index	0.49	0.38	0.39	0.44	0.54	0.58	0.61
NWFSC Slope Survey index	4.67	5.38	4.97	4.76	4.65	4.67	4.71
NWFSC Shelf Survey index	0.03	0.06	0.04	0.03	0.03	0.03	0.03
Discard	7.61	8.41	8.02	7.76	7.54	7.50	7.49
Fishery and discard length	531.91	550.42	543.01	536.86	528.28	525.86	524.40
Triennial Survey length	246.83	243.35	244.45	245.88	246.91	246.27	245.25
AFSC Slope Survey length	55.56	56.15	55.98	55.78	55.36	55.19	55.07
NWFSC slope length	150.11	152.79	151.57	150.67	149.79	149.63	149.54
NWFSC shelf length	55.84	58.12	57.22	56.46	55.41	55.12	54.92
Fishery and discard age	571.20	574.22	570.34	569.86	572.79	574.03	574.88
Triennial Survey age	16.10	15.40	15.62	15.85	16.34	16.52	16.64
AFSC Survey age	45.02	44.22	44.46	44.76	45.20	45.31	45.36
NWFSC slope age	283.17	285.09	284.06	283.45	283.03	282.90	282.76
NWFSC shelf age	227.86	229.59	228.89	228.30	227.53	227.28	227.09
Catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recruitment	15.62	22.79	17.70	16.05	15.63	15.81	16.04
Parameter priors	0.10	0.11	0.10	0.10	0.10	0.10	0.10
Parameters							
Natural mortality	0.07	0.04	0.05	0.06	0.08	0.09	0.10
Steepness	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Table 16. Model results from profiling over stock-recruitment steepness values.

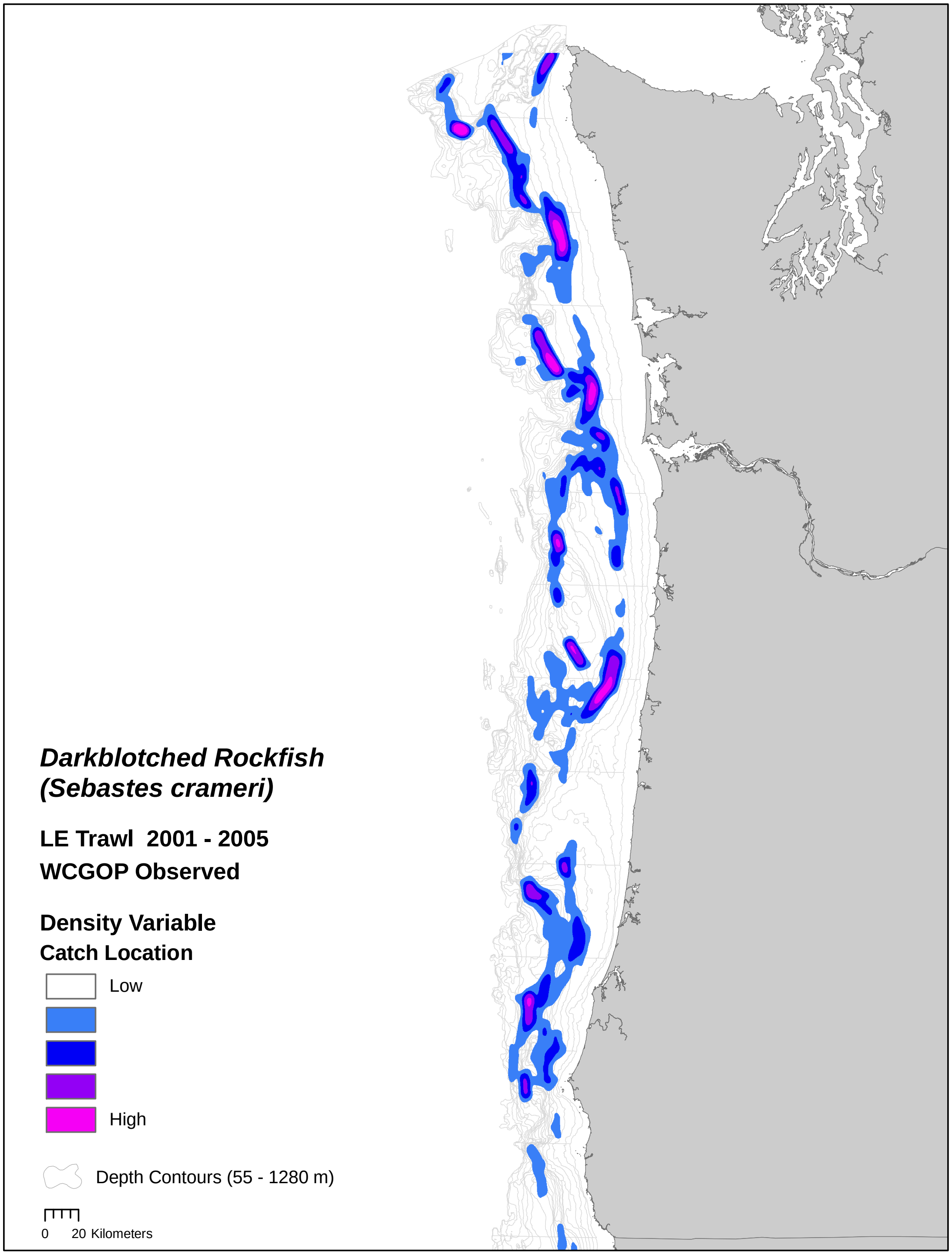
Derived Quantities of Interest	Base	h.3	h.4	h.5	h.7	h.8	h.95	hest
Depletion in 2007	22.4%	6.9%	10.8%	16.0%	29.2%	35.4%	43.1%	22.0%
2007 spawning output	6,853	2,356	3,504	5,000	8,843	10,704	13,017	6,749
Unfished spawning output	30,641	34,085	32,414	31,289	30,336	30,218	30,178	30,665
SO_{MSY}	12,256	13,634	12,966	12,515	12,134	12,087	12,071	12,266
MSY_{B40} (landings+discard)	621	245	408	526	703	776	870	616
F_{MSY}	0.041	0.016	0.027	0.035	0.047	0.051	0.056	0.041
Exploitation rate at MSY	0.038	0.014	0.024	0.032	0.042	0.046	0.050	0.037
F_{2006}/F_{MY}	0.370	2.733	1.101	0.597	0.256	0.195	0.146	0.379
Likelihoods								
Objective function	2217.05	2244.18	2225.64	2218.67	2217.45	2218.39	2219.79	2217.25
Triennial Survey index	4.93	7.85	4.83	4.03	6.72	8.64	11.07	4.85
AFSC Slope Survey index	0.49	0.41	0.42	0.45	0.53	0.56	0.58	0.49
NWFSC Slope Survey index	4.67	5.58	5.08	4.81	4.61	4.58	4.56	4.68
NWFSC Shelf Survey index	0.03	0.08	0.05	0.04	0.03	0.02	0.02	0.03
Discard	7.61	8.10	7.84	7.69	7.57	7.55	7.52	7.62
Fishery and discard length	531.91	543.66	538.33	534.57	530.25	529.27	528.49	532.03
Triennial Survey length	246.83	241.51	243.57	245.50	247.47	247.67	247.66	246.77
AFSC Slope Survey length	55.56	55.62	55.66	55.63	55.47	55.39	55.32	55.56
NWFSC slope length	150.11	152.64	151.32	150.53	149.90	149.80	149.72	150.12
NWFSC shelf length	55.84	58.09	57.03	56.29	55.62	55.52	55.46	55.86
Fishery and discard age	571.20	571.81	569.75	570.18	571.88	572.19	572.32	571.15
Triennial Survey age	16.10	15.62	15.75	15.92	16.26	16.39	16.51	16.10
AFSC Survey age	45.02	44.40	44.59	44.84	45.13	45.18	45.20	45.02
NWFSC slope age	283.17	284.46	283.64	283.29	283.12	283.08	283.03	283.18
NWFSC shelf age	227.86	229.23	228.56	228.13	227.68	227.57	227.45	227.87
Catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recruitment	15.62	25.02	19.12	16.69	15.12	14.90	14.77	15.65
Parameter priors	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.29
Parameters								
Natural mortality	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Steepness	0.6	0.3	0.4	0.5	0.7	0.8	0.95	0.595

Table 17. Model results from profiling over stock-recruitment steepness (h) and estimating natural mortality (M).

Derived Quantities of Interest	Base	h.3Mest	hMest	h.4Mest	h.5Mest	h.6Mest	h.7Mest	h.8Mest	h.9Mest
Depletion in 2007	22.4%	26.5%	26.7%	26.8%	27.2%	28.1%	29.5%	31.6%	34.5%
2007 spawning output	6,853	9,782	9,250	8,969	8,659	8,677	8,950	9,500	10,317
Unfished spawning output	30,641	36,850	34,685	33,458	31,784	30,871	30,350	30,053	29,889
SO_{MSY}	12,256	14,740	13,874	13,383	12,713	12,348	12,140	12,021	11,955
MSY_{B40} (landings+discard)	621	392	492	549	629	675	707	735	766
F_{MSY}	0.041	0.021	0.028	0.033	0.040	0.044	0.047	0.049	0.052
Exploitation rate at MSY	0.038	0.019	0.025	0.029	0.035	0.039	0.042	0.045	0.047
F_{2006}/F_{MY}	0.370	0.503	0.401	0.358	0.308	0.278	0.253	0.227	0.200
Likelihoods									
Objective function	2217.05	2214.78	2215.24	2215.26	2215.89	2216.64	2217.44	2218.31	2219.18
Triennial Survey index	4.93	6.12	6.06	6.05	6.11	6.36	6.82	7.54	8.54
AFSC Slope Survey index	0.49	0.53	0.53	0.52	0.52	0.52	0.53	0.54	0.55
NWFSC Slope Survey index	4.67	4.96	4.87	4.81	4.72	4.65	4.61	4.57	4.55
NWFSC Shelf Survey index	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02
Discard	7.61	7.51	7.53	7.54	7.55	7.56	7.57	7.57	7.56
Fishery and discard length	531.91	526.73	527.45	527.98	528.96	529.67	530.14	530.34	530.28
Triennial Survey length	246.83	244.50	245.14	245.58	246.37	246.98	247.46	247.82	248.04
AFSC Slope Survey length	55.56	55.17	55.24	55.30	55.38	55.44	55.46	55.46	55.43
NWFSC slope length	150.11	149.83	149.86	149.87	149.90	149.90	149.89	149.87	149.83
NWFSC shelf length	55.84	55.35	55.41	55.45	55.52	55.57	55.61	55.62	55.63
Fishery and discard age	571.20	573.91	573.38	573.04	572.48	572.14	571.91	571.80	571.76
Triennial Survey age	16.10	16.27	16.25	16.24	16.23	16.24	16.27	16.32	16.38
AFSC Survey age	45.02	45.17	45.16	45.16	45.14	45.14	45.13	45.13	45.14
NWFSC slope age	283.17	282.86	282.92	282.96	283.03	283.08	283.11	283.13	283.13
NWFSC shelf age	227.86	227.37	227.46	227.51	227.60	227.65	227.67	227.66	227.62
Catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recruitment	15.62	18.37	17.63	17.12	16.24	15.59	15.13	14.81	14.62
Parameter priors	0.10	0.11	0.34	0.10	0.10	0.10	0.10	0.10	0.10
Parameters									
Natural mortality	0.07	0.106	0.098	0.093	0.083	0.076	0.070	0.067	0.064
Steepness	0.6	0.3	0.35	0.4	0.5	0.6	0.7	0.8	0.9

Table 18. Model results from profiling over estimating natural mortality (M) and estimating stock recruitment steepness (h) using Dorn's prior.

Derived Quantities of Interest	Base	M.04 h est	M.05 h est	M.06 h est	M.07 h est	M.08 h est	M.09 h est	hMest	M.10 h est
Depletion in 2007	22.4%	12.3%	16.5%	19.7%	22.0%	23.8%	25.4%	26.7%	26.9%
2007 spawning output	6,853	3,779	5,001	5,958	6,749	7,517	8,372	9,250	9,439
Unfished spawning output	30,641	30,774	30,307	30,255	30,665	31,561	32,992	34,685	35,053
SO_{MSY}	12,256	12,309	12,123	12,102	12,266	12,624	13,197	13,874	14,021
MSY_{B40} (landings+discard)	621	507	571	608	616	597	550	492	479
F_{MSY}	0.041	0.037	0.041	0.042	0.041	0.038	0.033	0.028	0.027
Exploitation rate at MSY	0.038	0.035	0.038	0.039	0.037	0.034	0.030	0.025	0.024
F_{2006}/F_{MY}	0.370	0.747	0.516	0.420	0.379	0.367	0.376	0.401	0.408
Likelihoods									
Objective function	2217.05	2232.19	2223.79	2219.54	2217.25	2216.01	2215.39	2215.24	2215.25
Triennial Survey index	4.93	3.51	3.77	4.34	4.85	5.29	5.70	6.06	6.13
AFSC Slope Survey index	0.49	0.41	0.44	0.47	0.49	0.50	0.52	0.53	0.53
NWFSC Slope Survey index	4.67	4.66	4.62	4.63	4.68	4.73	4.81	4.87	4.89
NWFSC Shelf Survey index	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
Discard	7.61	7.99	7.78	7.68	7.62	7.58	7.55	7.53	7.52
Fishery and discard length	531.91	542.79	537.72	534.39	532.03	530.18	528.63	527.45	527.24
Triennial Survey length	246.83	246.96	247.34	247.19	246.77	246.25	245.66	245.14	245.04
AFSC Slope Survey length	55.56	56.07	55.85	55.69	55.56	55.44	55.33	55.24	55.23
NWFSC slope length	150.11	150.80	150.45	150.25	150.12	150.02	149.93	149.86	149.84
NWFSC shelf length	55.84	56.67	56.32	56.06	55.86	55.69	55.53	55.41	55.38
Fishery and discard age	571.20	570.51	570.16	570.54	571.15	571.86	572.64	573.38	573.53
Triennial Survey age	16.10	15.72	15.91	16.02	16.10	16.15	16.20	16.25	16.26
AFSC Survey age	45.02	44.61	44.80	44.93	45.02	45.08	45.12	45.16	45.17
NWFSC slope age	283.17	283.85	283.51	283.31	283.18	283.08	282.98	282.92	282.91
NWFSC shelf age	227.86	228.59	228.26	228.04	227.87	227.72	227.58	227.46	227.44
Catch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recruitment	15.62	15.46	14.93	15.13	15.65	16.32	17.03	17.63	17.74
Parameter priors	0.10	3.58	1.92	0.84	0.29	0.09	0.14	0.34	0.38
Parameters									
Natural mortality	0.07	0.04	0.05	0.06	0.07	0.08	0.09	0.098	0.10
Steepness	0.6	0.88	0.81	0.70	0.595	0.50	0.41	0.35	0.35


Darkblotched Rockfish
(Sebastes crameri)
LE Trawl 2001 - 2005
WCGOP Observed
Density Variable
Catch Location
Low
High
Depth Contours (55 - 1280 m)
0
20 Kilometers

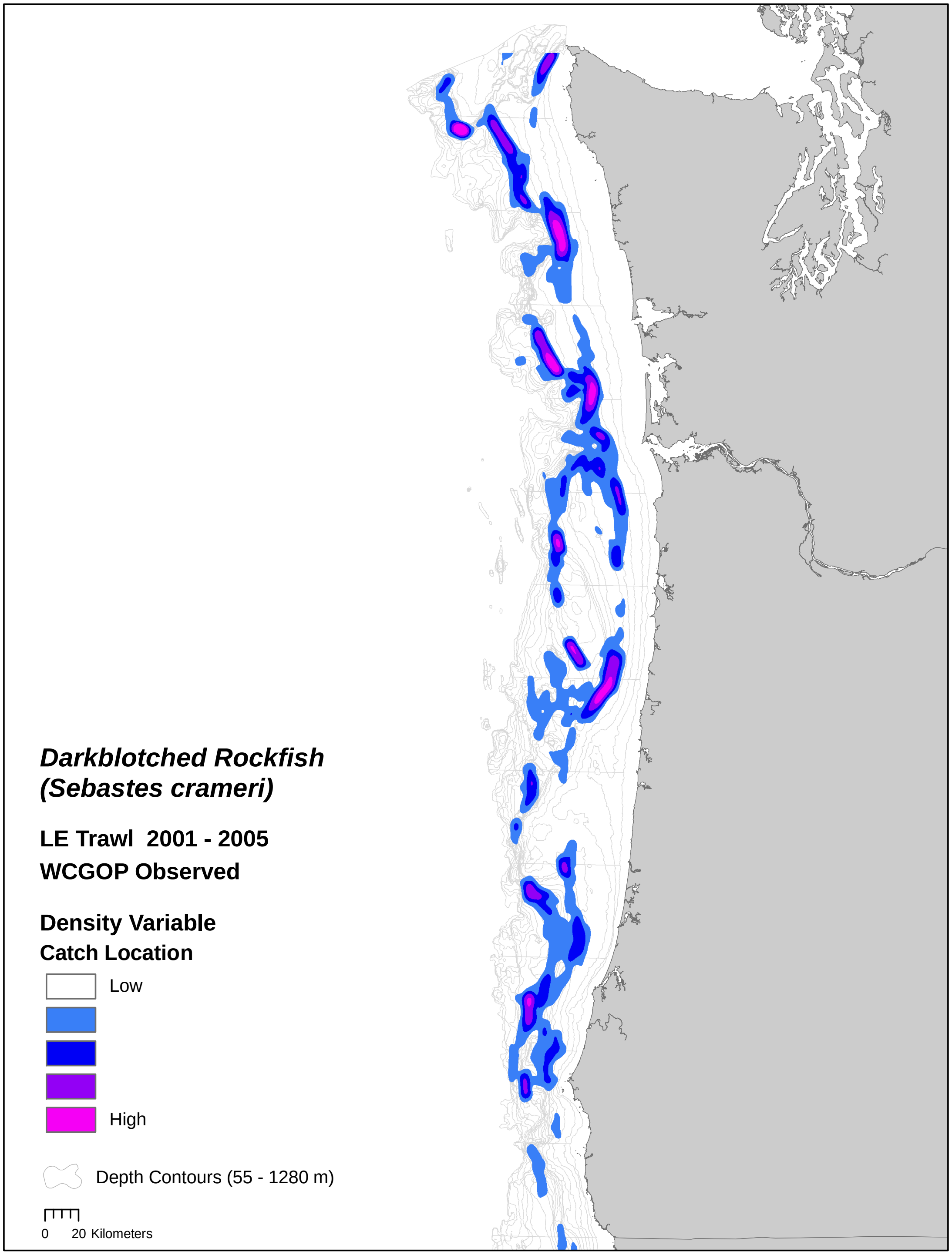


Figure 1. Map of density of occurrence of darkblotched rockfish off of (A) Washington and Oregon and (B) Northern and Central California (next page).

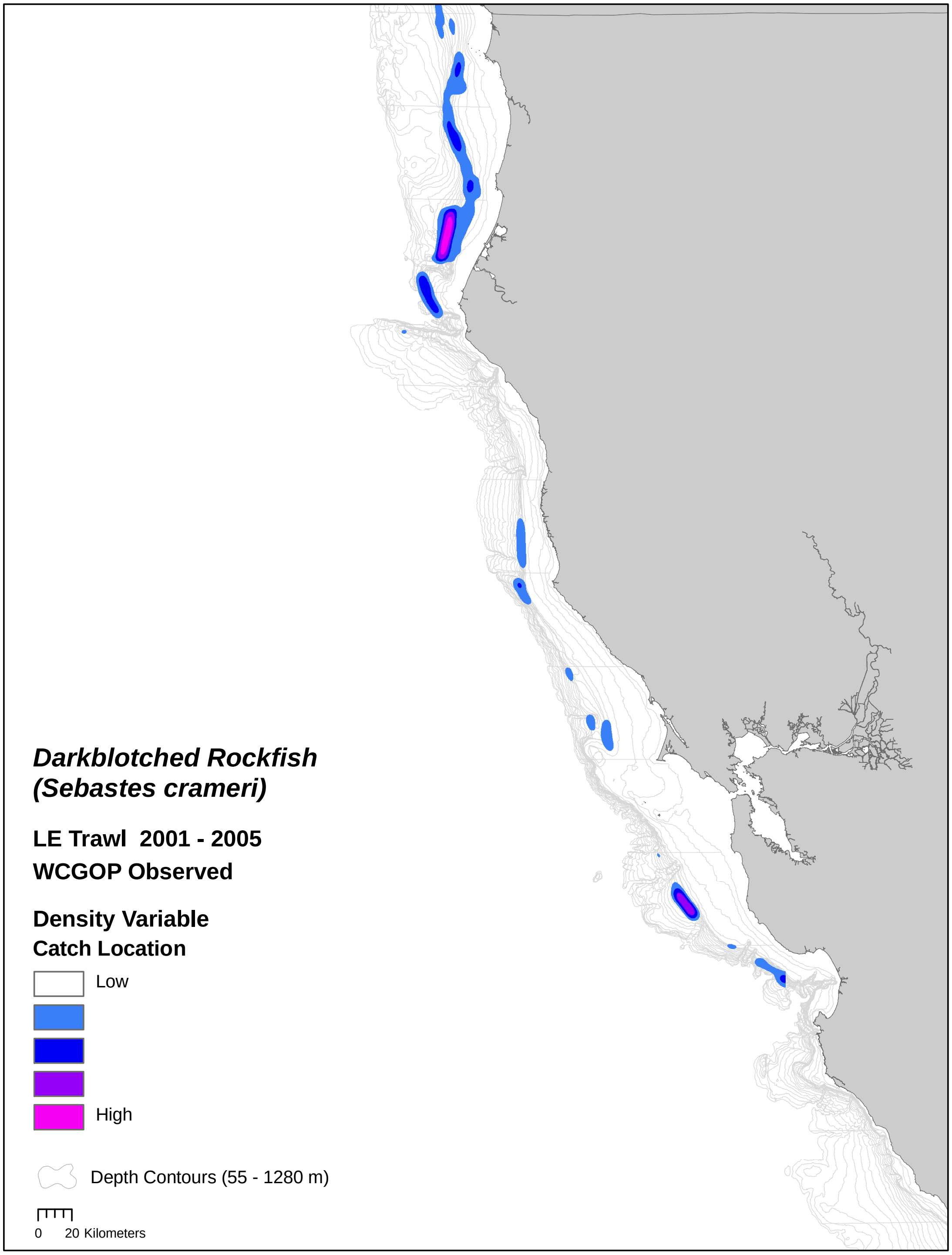


Figure 1 (cont.)

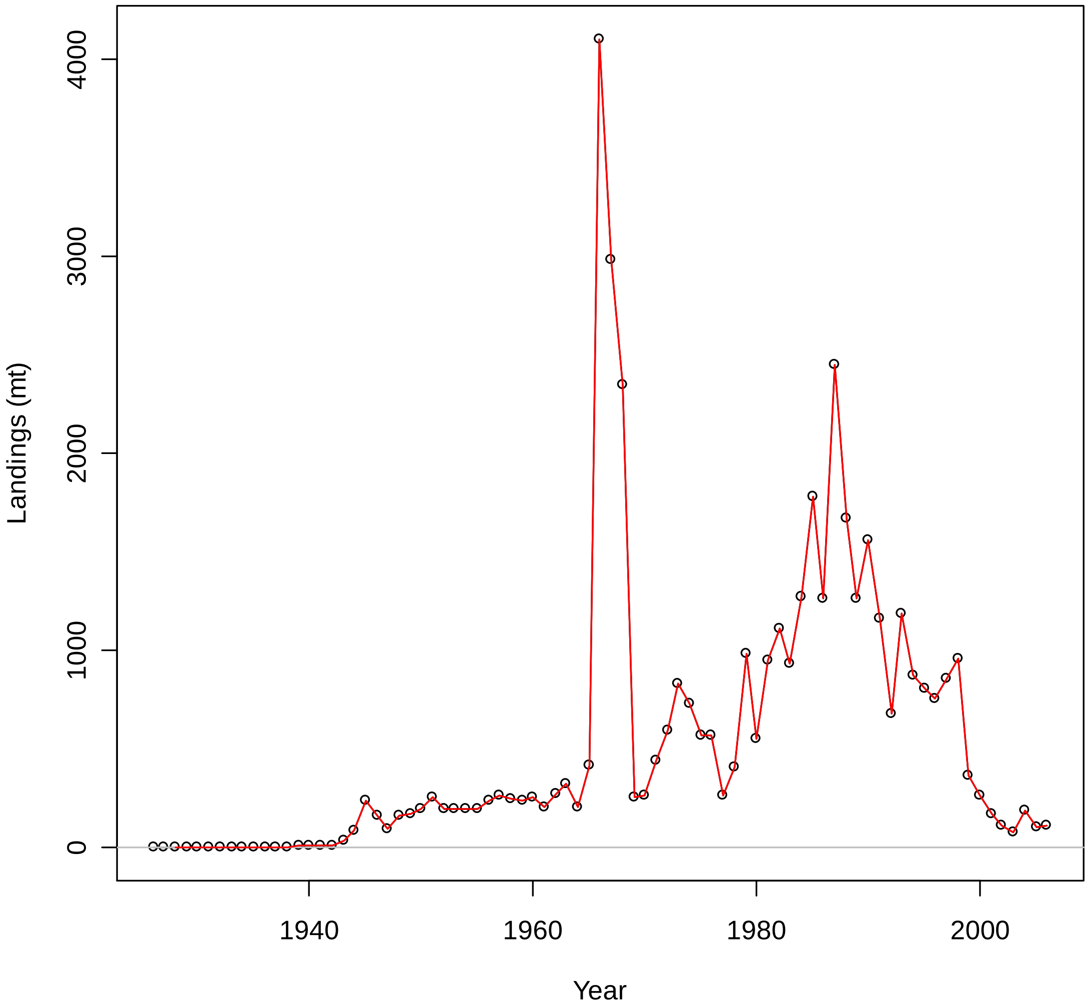


Figure 2. Time series of estimated fishery landings.

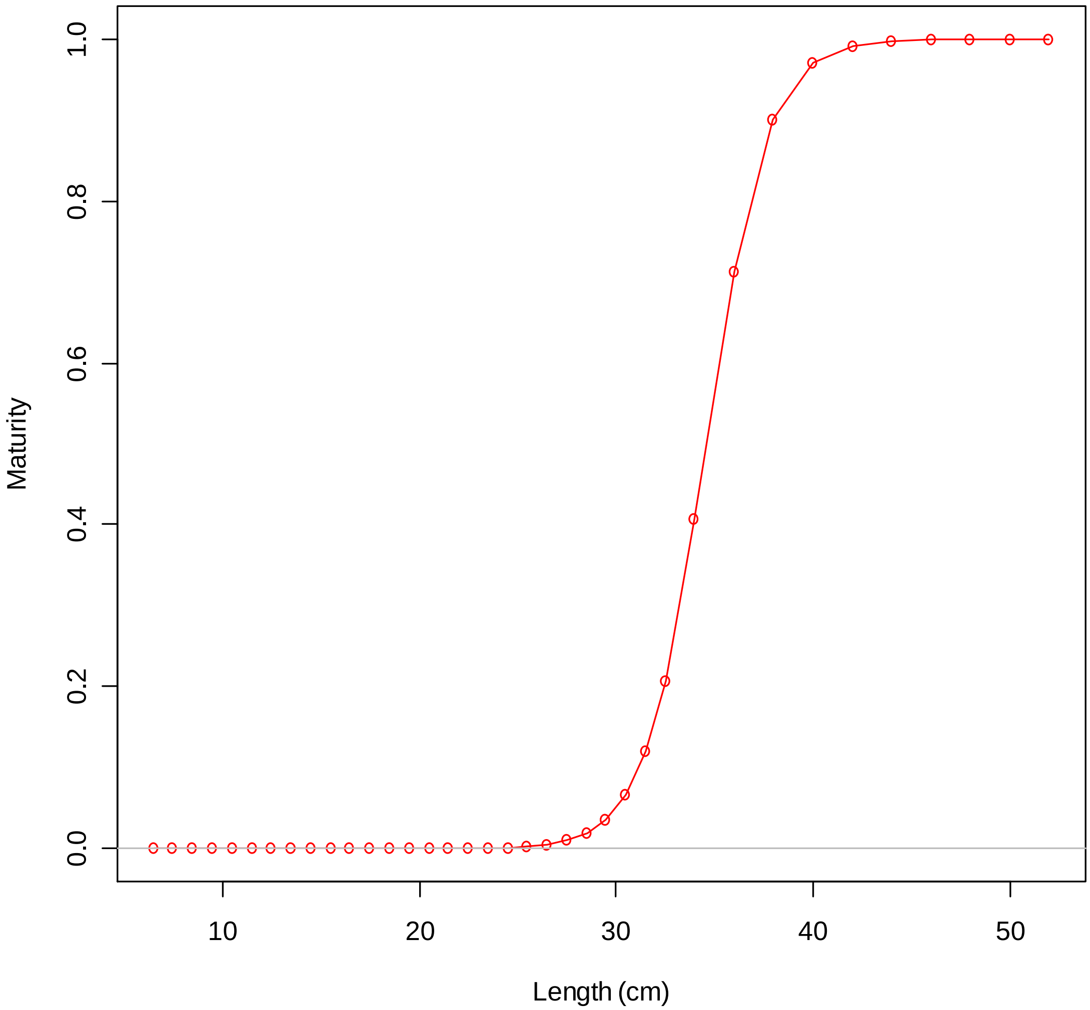


Figure 3. Maturity ogive for female darkblotched rockfish.

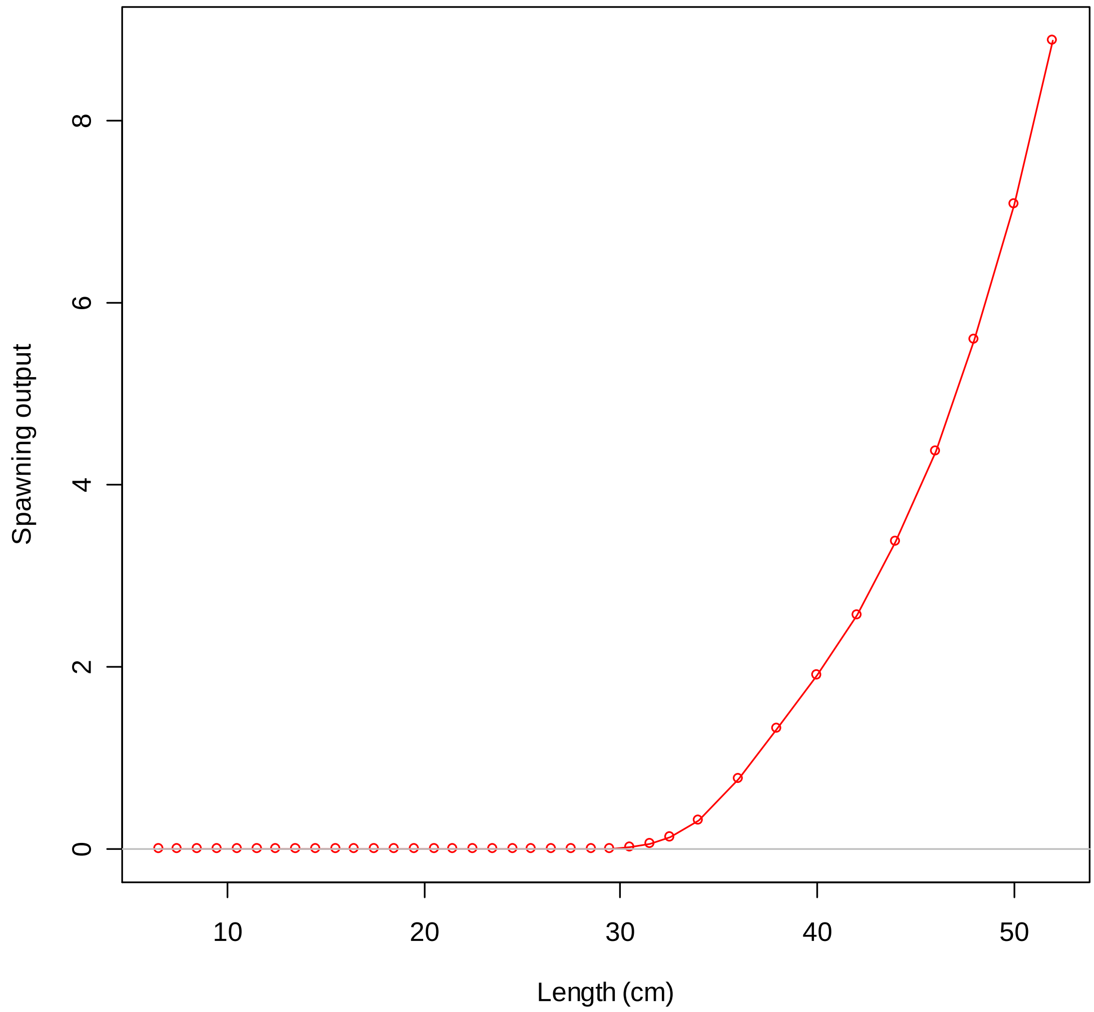


Figure 4. Length to spawning output relationship.

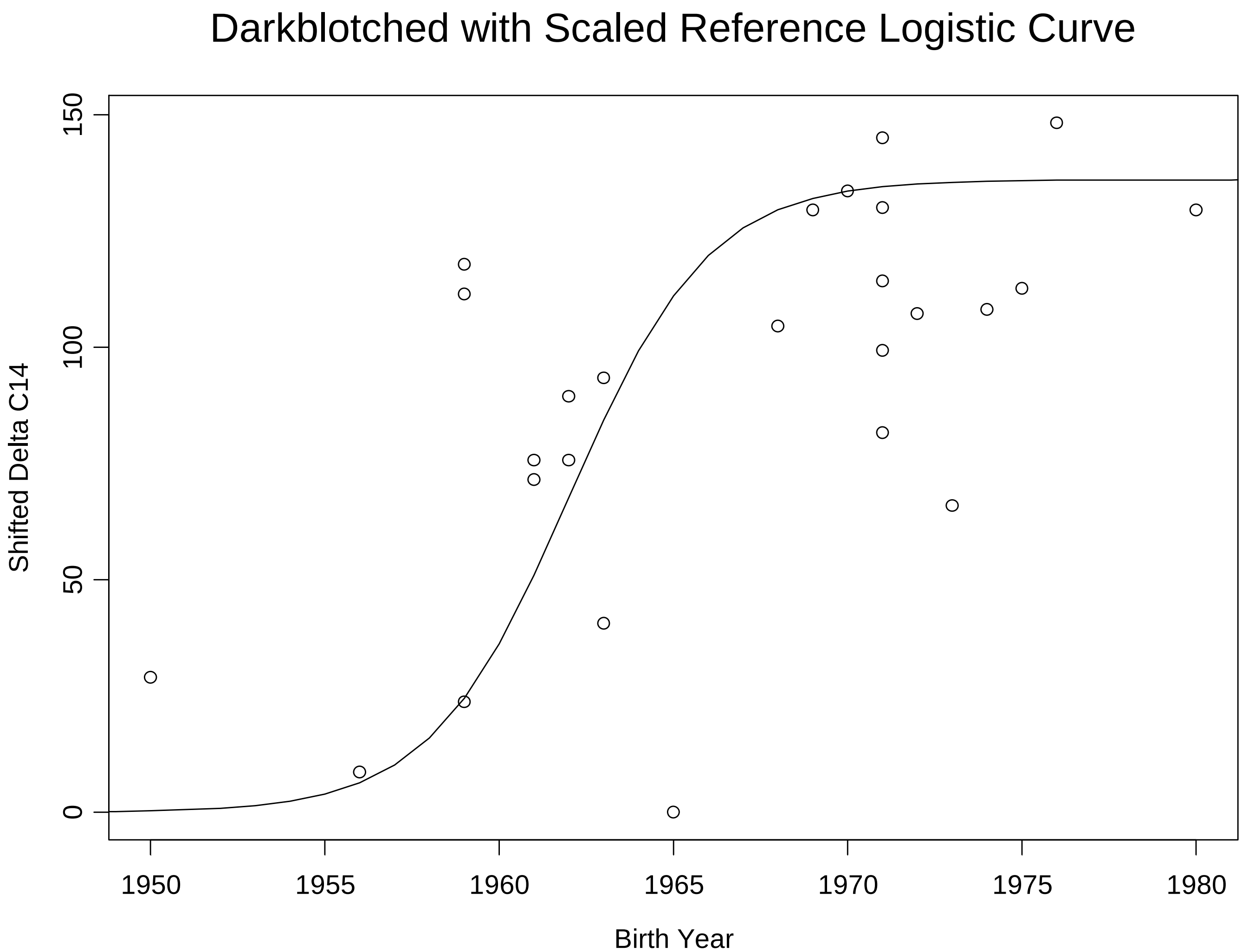
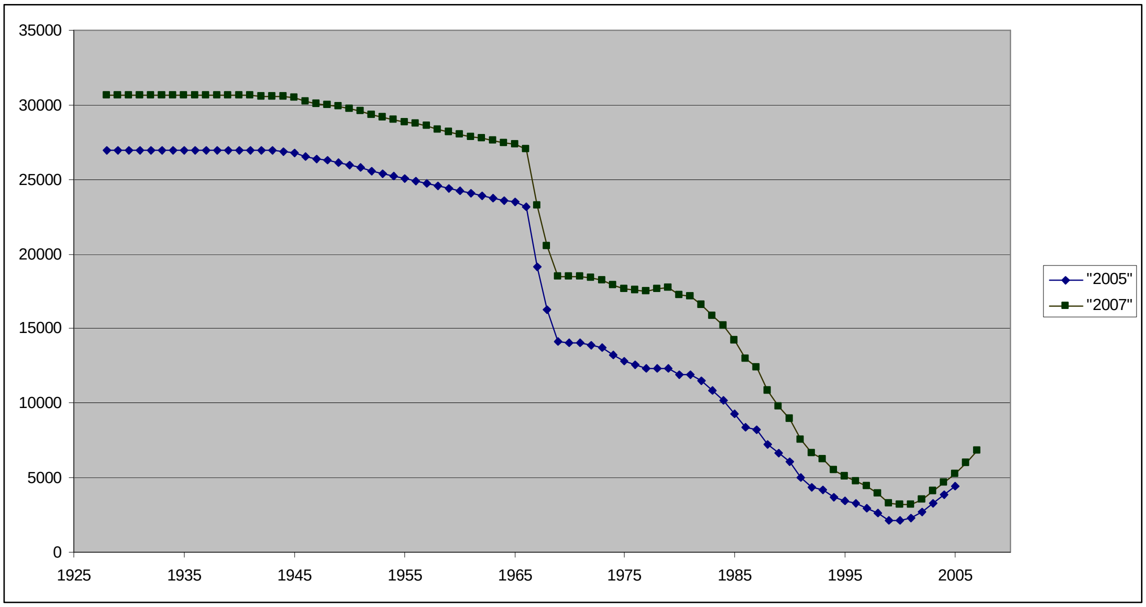


Figure 5. Comparison of darkblotched rockfish bomb radiocarbon values at annulus based birth to expected curve based on reference. Otoliths were collected in 2000-2002 and aged in 2003. A number of the otoliths appear to be underaged by as much as 10 years or more, and a few appear to be overaged.

(A)



(B)

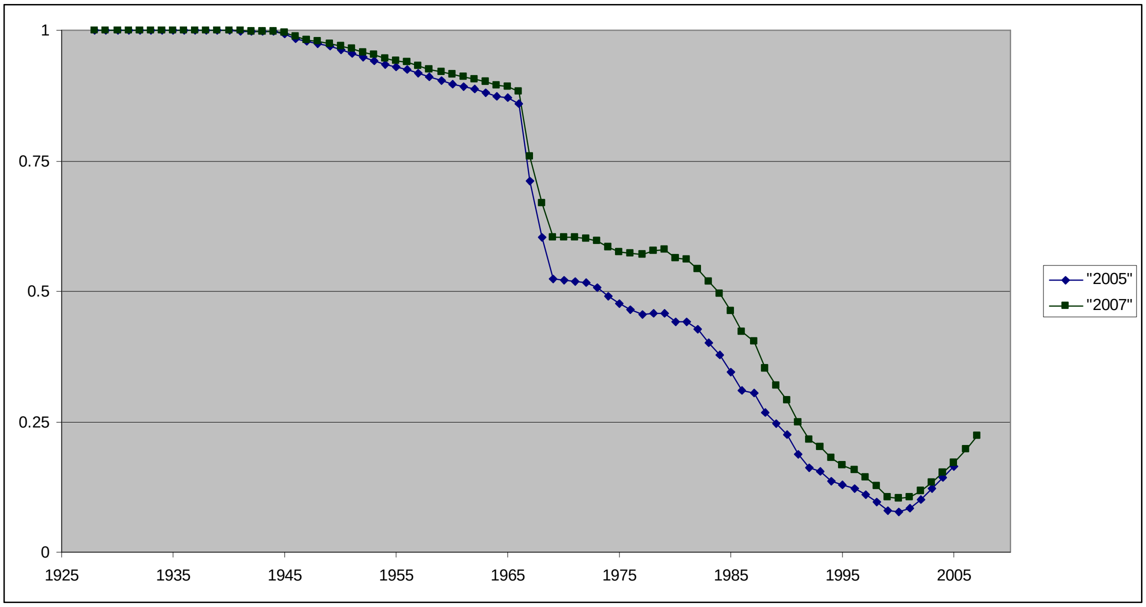


Figure 6. Comparison of histories of spawning output (A) and depletion (B) between the 2005 and 2007 assessments.

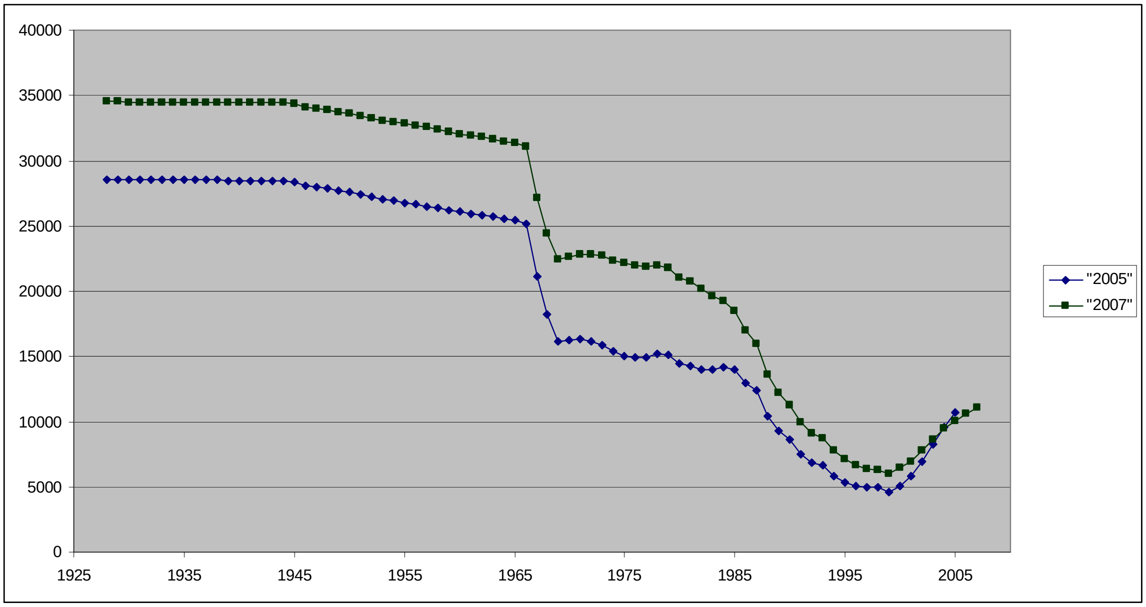


Figure 7. Comparison of time history of summary biomass for 2005 and 2007 assessments. The difference in virgin biomass (and virgin spawning output in the previous figure) is due to similar estimation of productivity at moderate stock sizes and a lower steepness value (0.6 (2007) versus 0.95 (2005)), which indicates increased recruitment at virgin biomass (e.g. at B_{40} (40% of spawning output, in this case), average recruitment = $0.8R_0$ when h = .6, and $0.98R_0$ when h = .95).

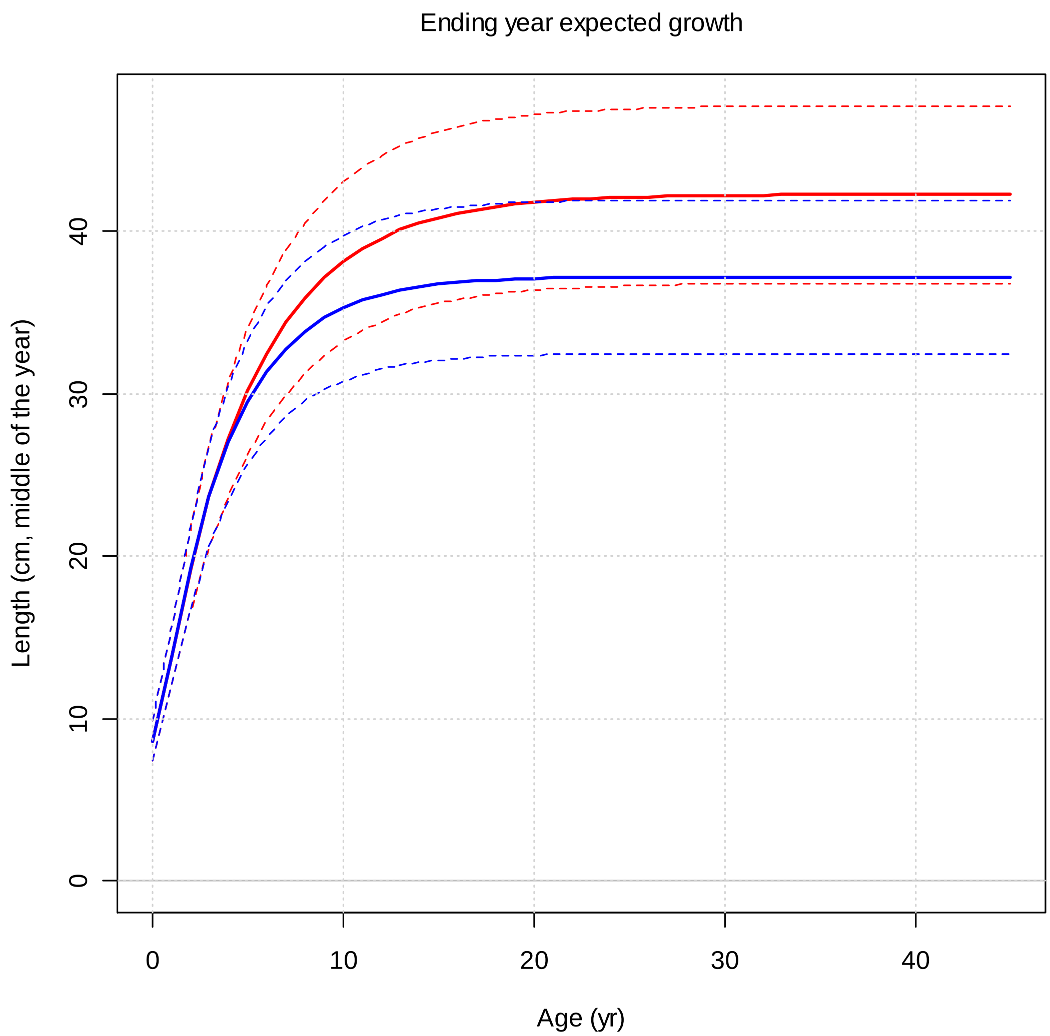


Figure 8. Growth curve for female (upper) and male darkblotched rockfish estimated in the model.

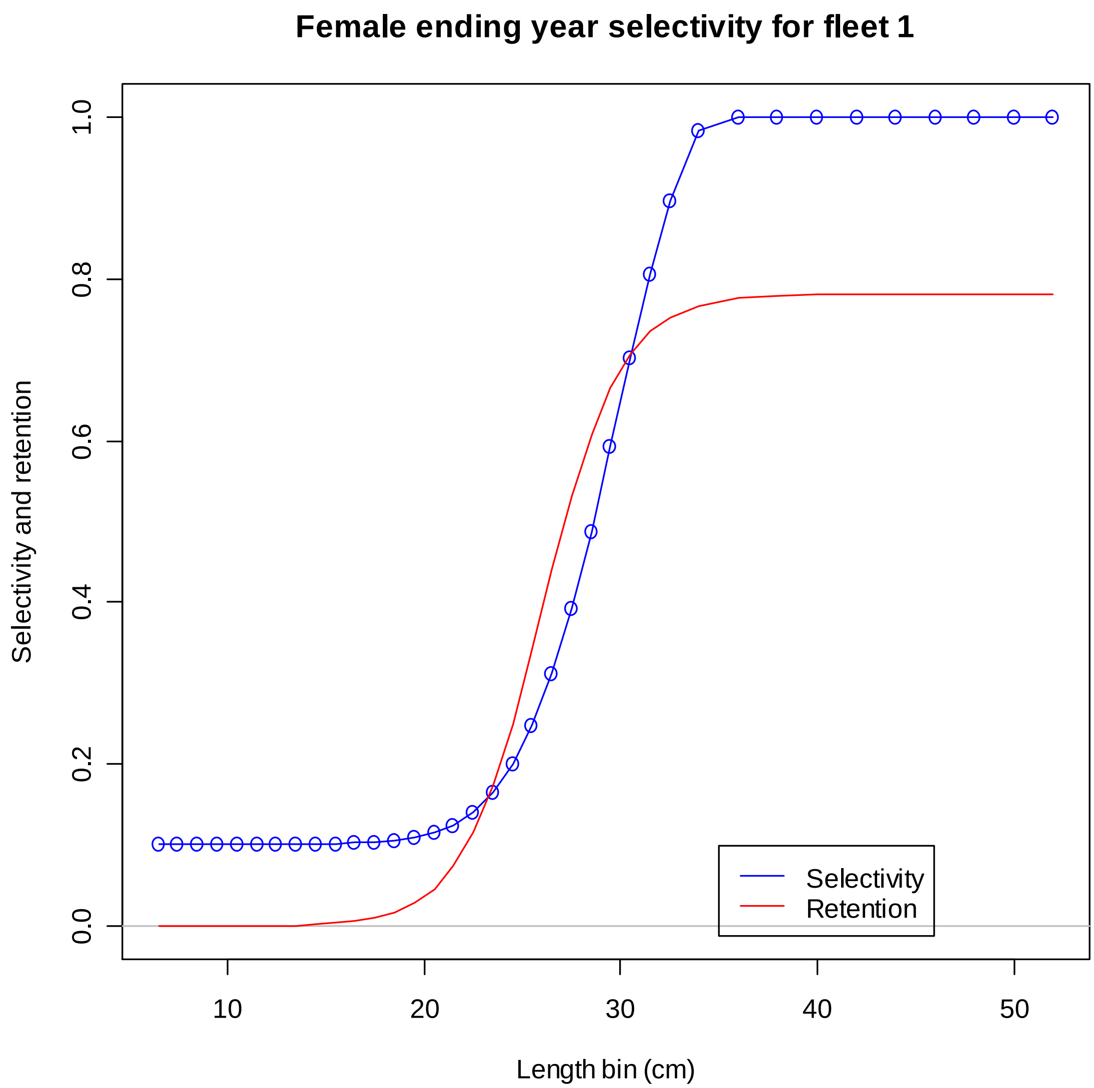


Figure 9. Male and female fishery selectivity and 2003-2006 retention (as the proportion retained at length).

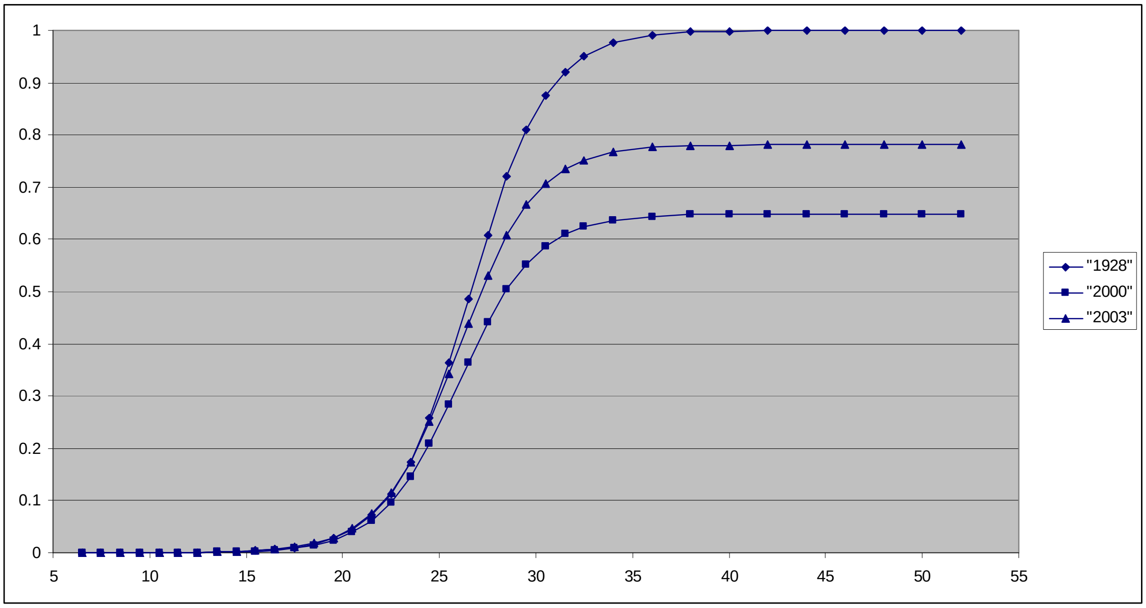


Figure 10. Retention in the three periods (through 1999, 2000-2002, 2003-)

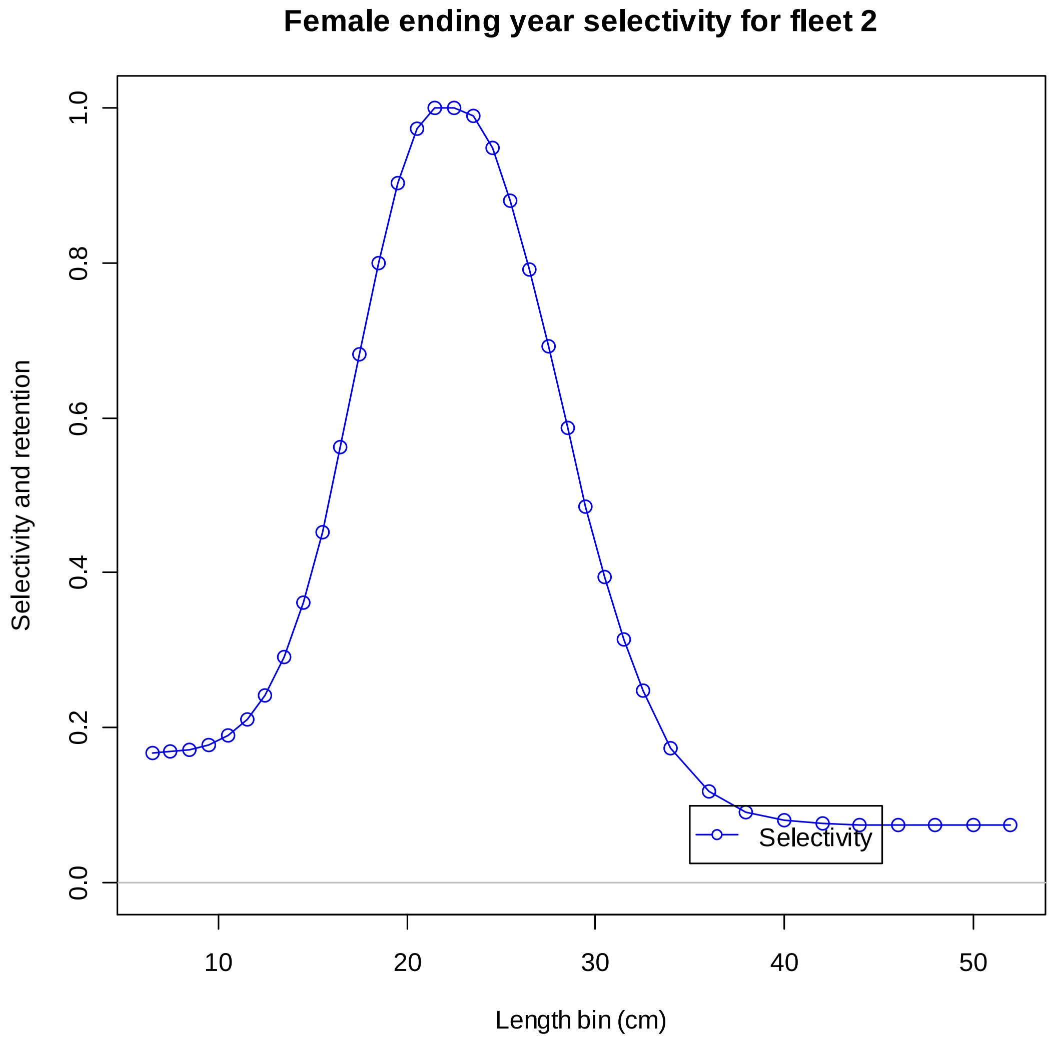


Figure 11. Male and Female selectivity for the Triennial Shelf Survey.

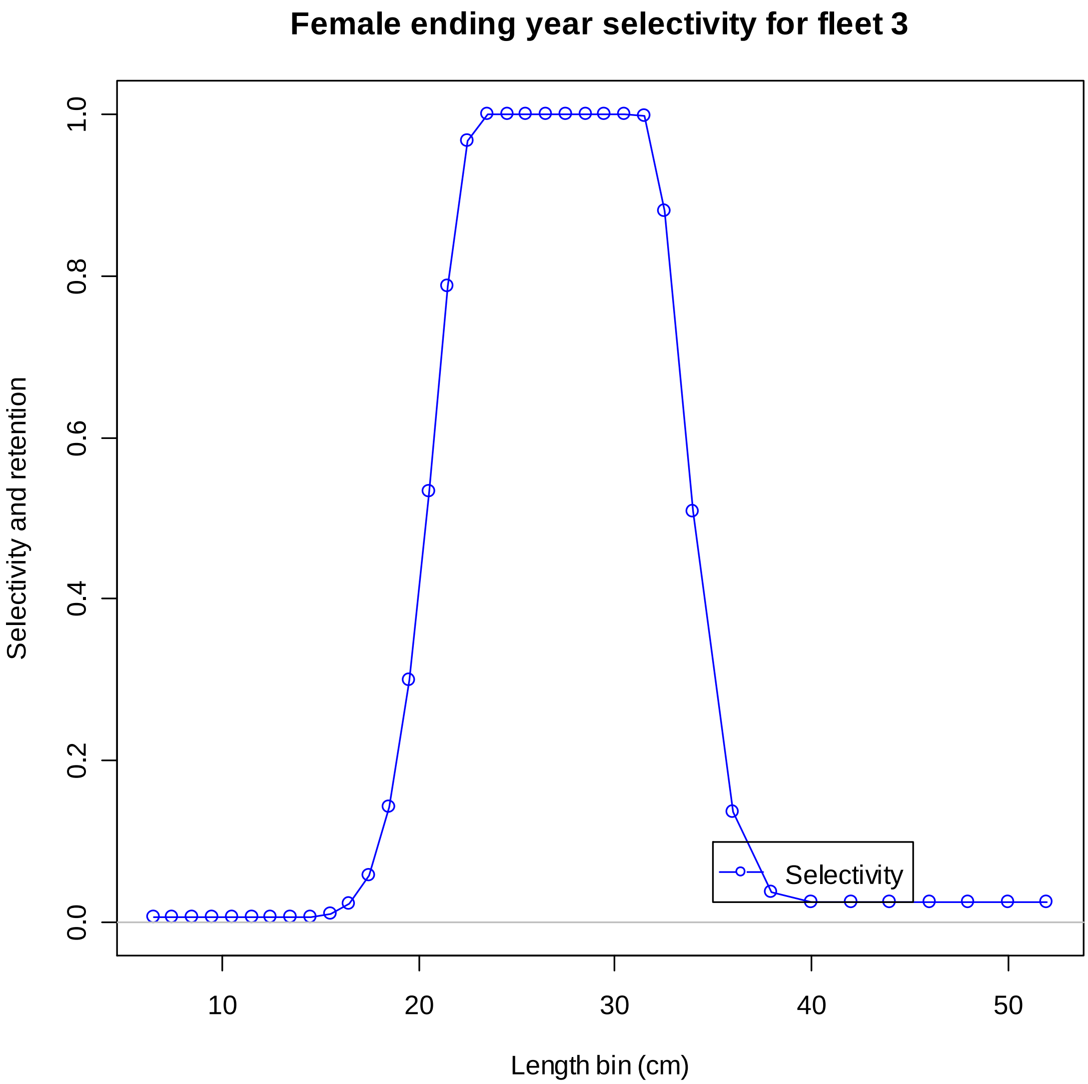


Figure 12. Male and female selectivity for the AFSC Slope Survey.

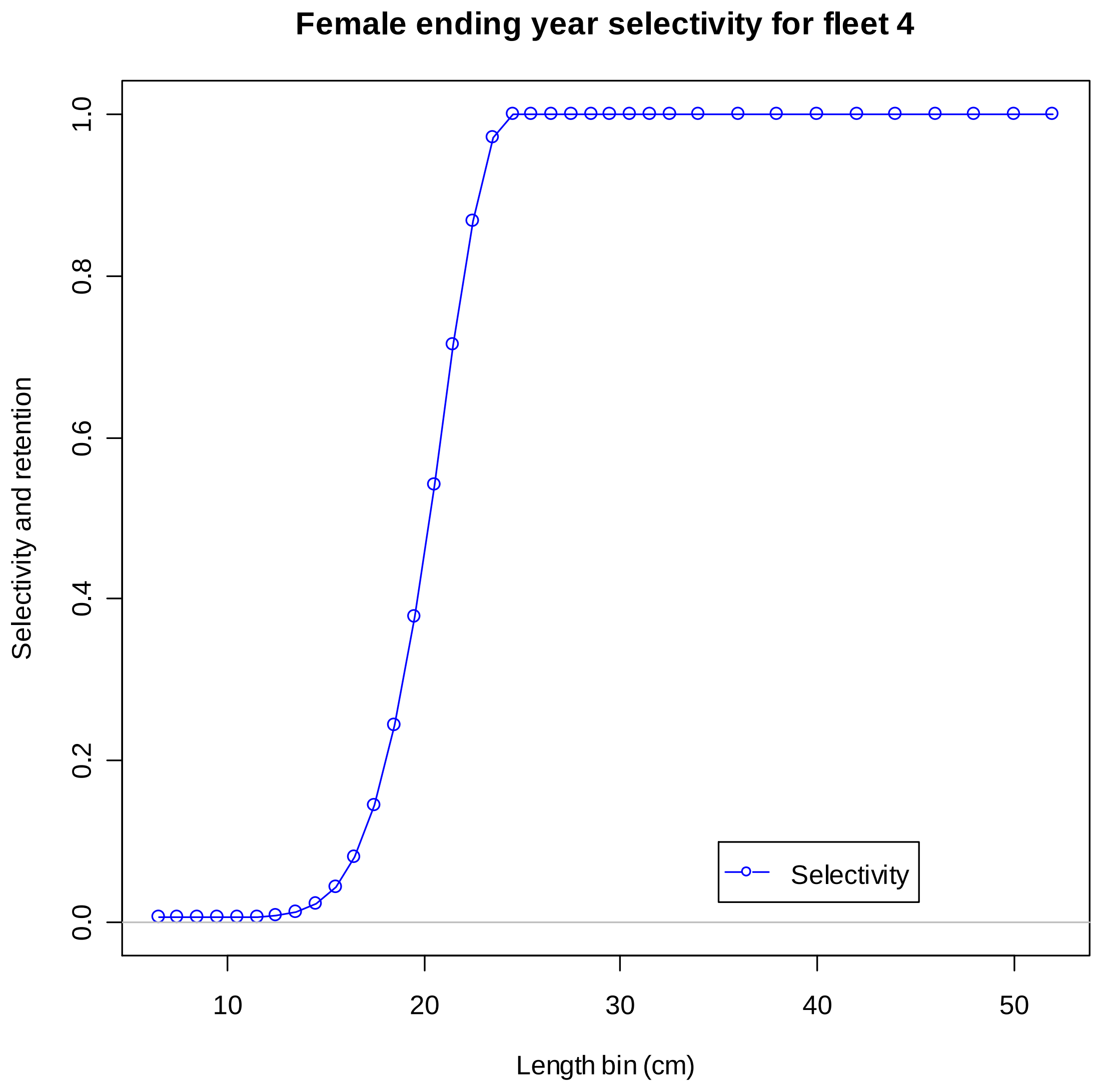


Figure 13. Male and female selectivity for the NWFSC Slope Survey.

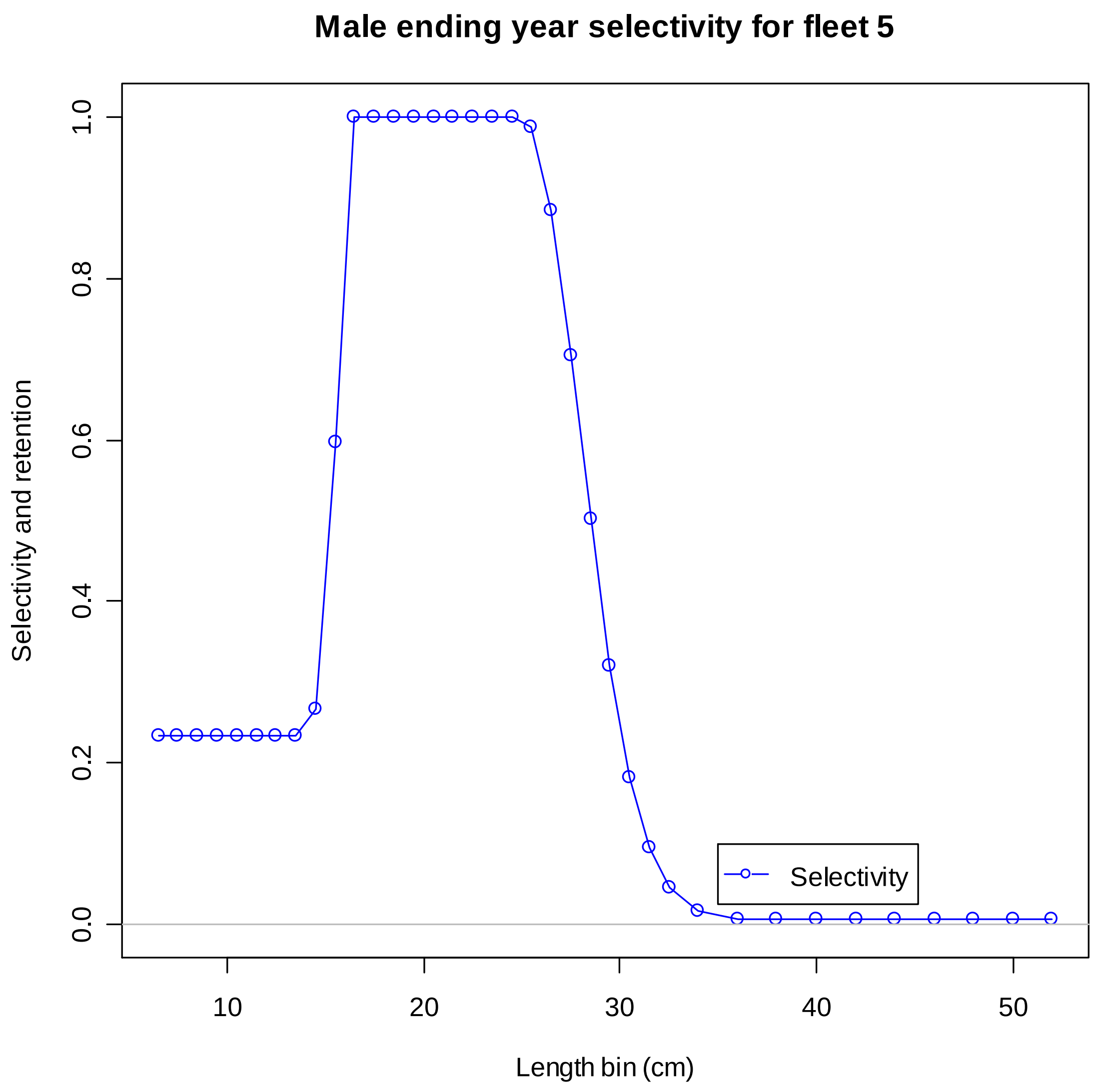


Figure 14. Male and female selectivity for the NWFSC Shelf Survey.

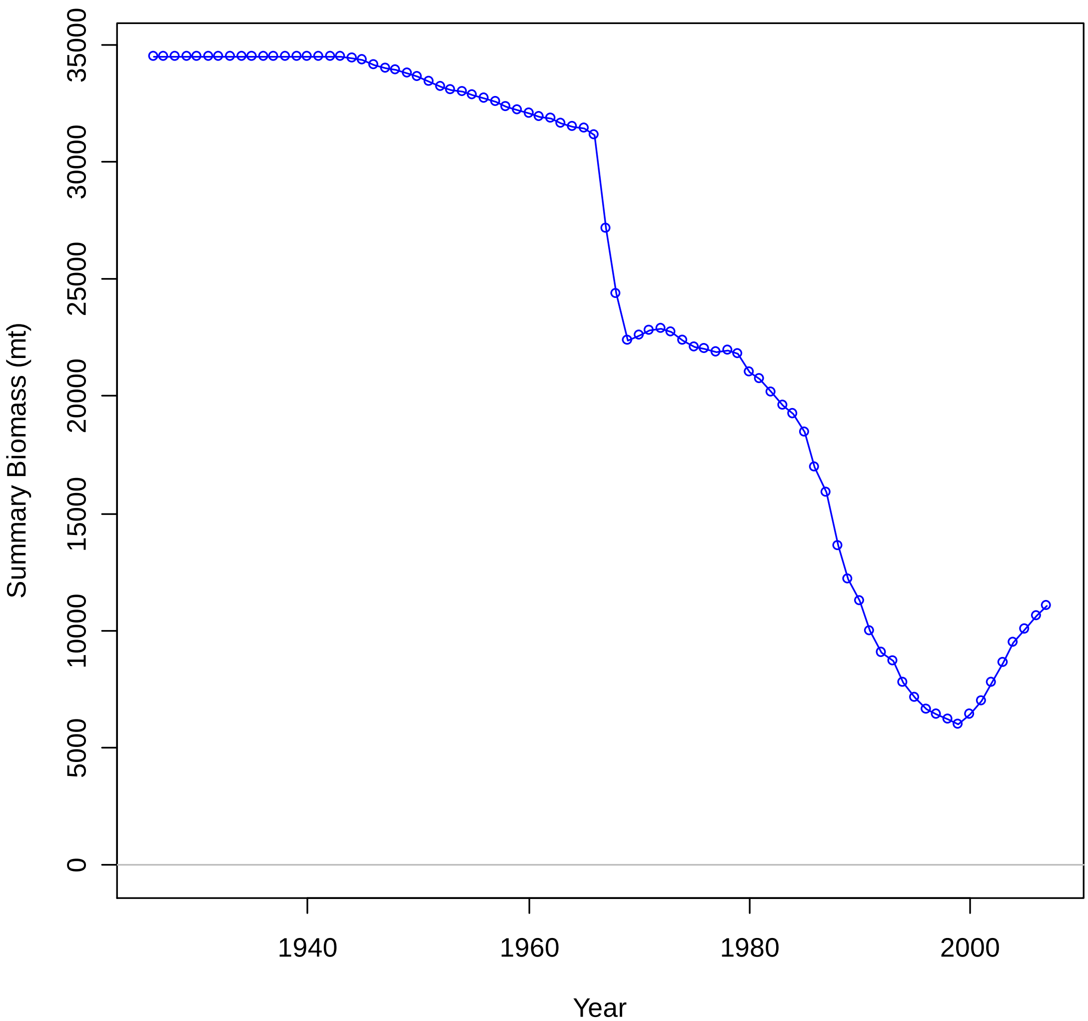


Figure 15. Time series of summary biomass.

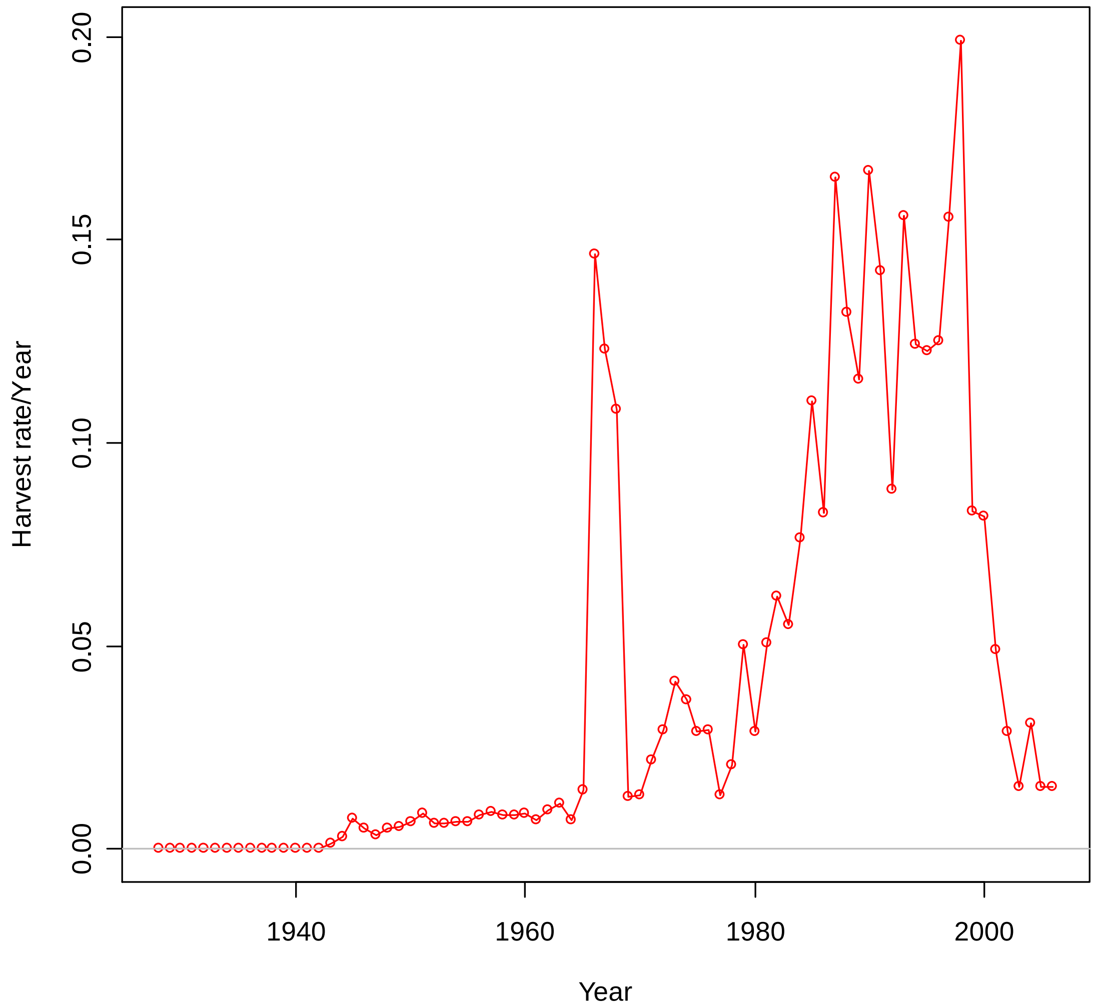


Figure 16. Time series of exploitation rate (catch/summary biomass).

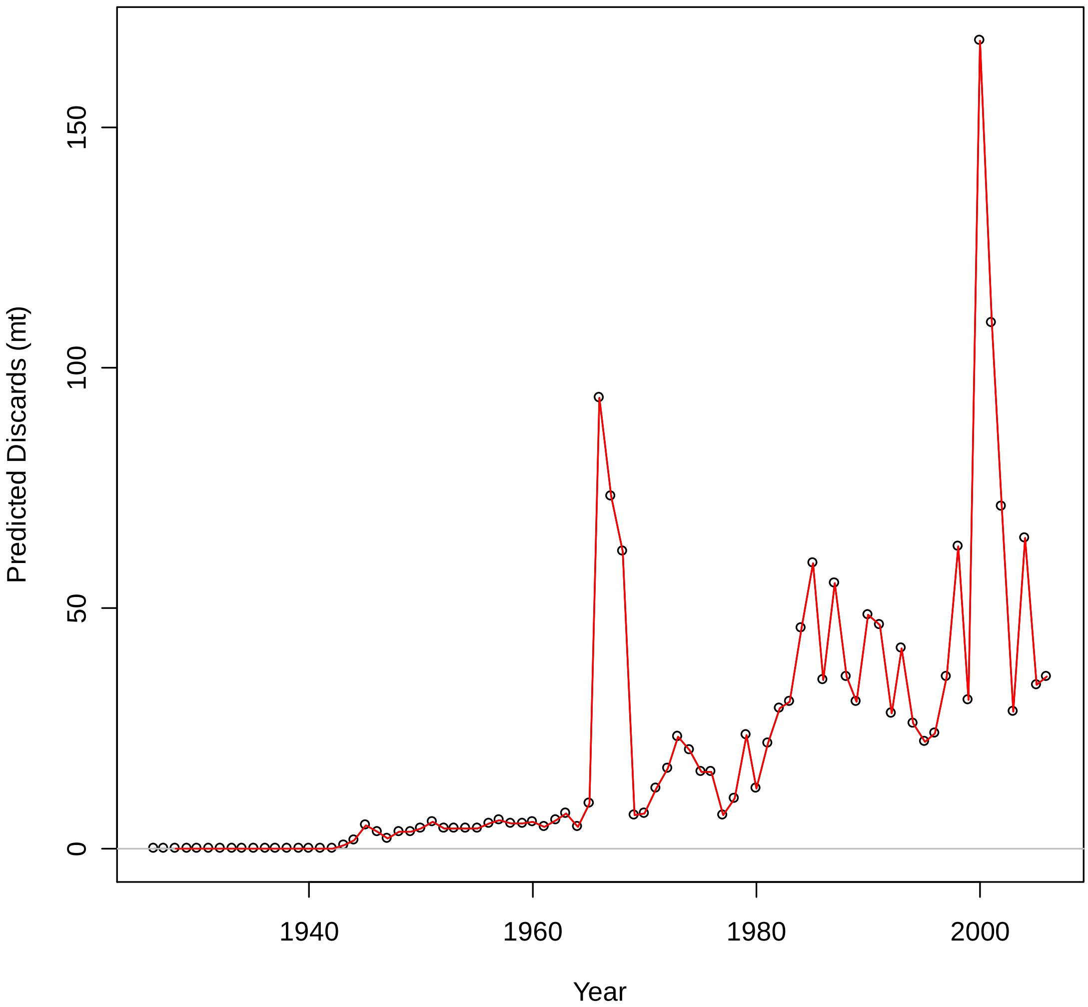


Figure 17. Time series of estimated discards.

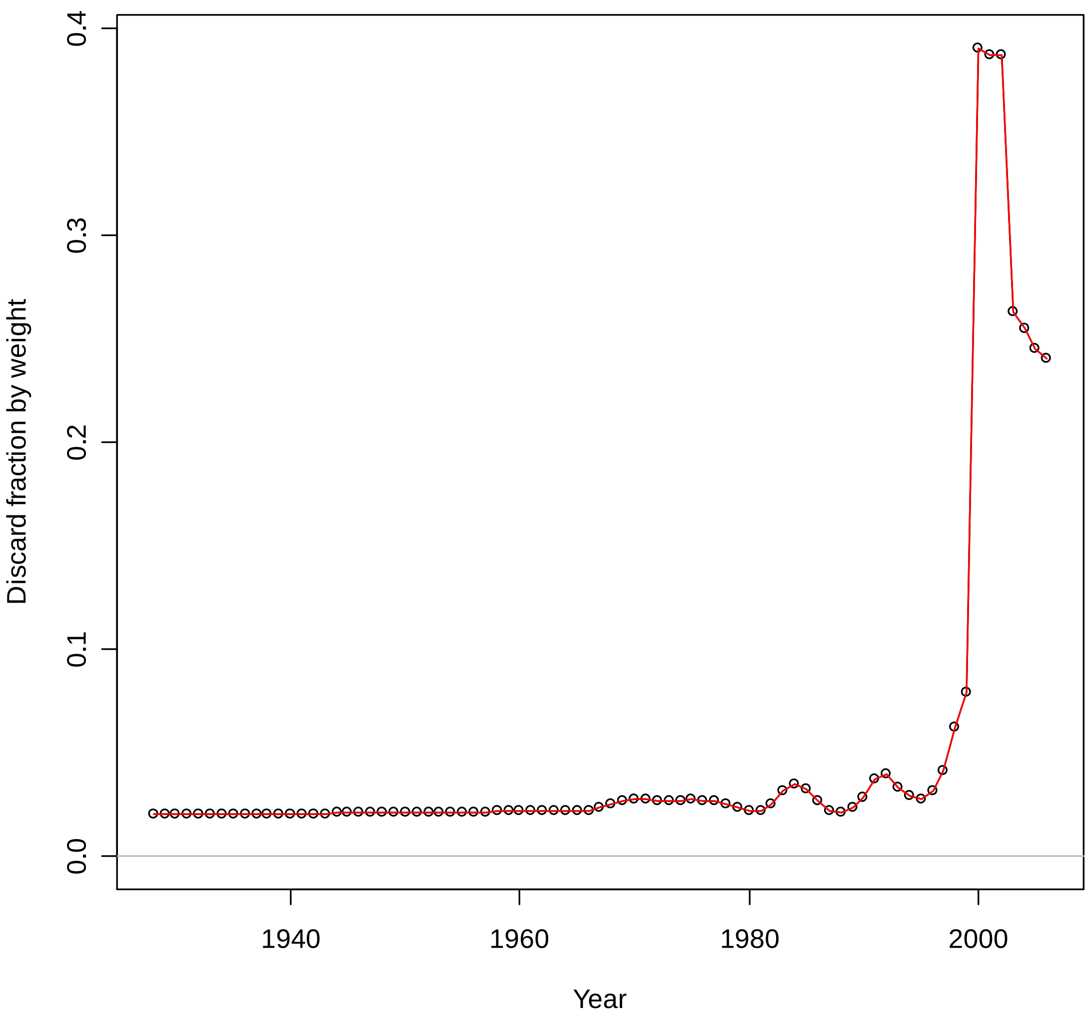


Figure 18. Time series of estimated discard fraction.

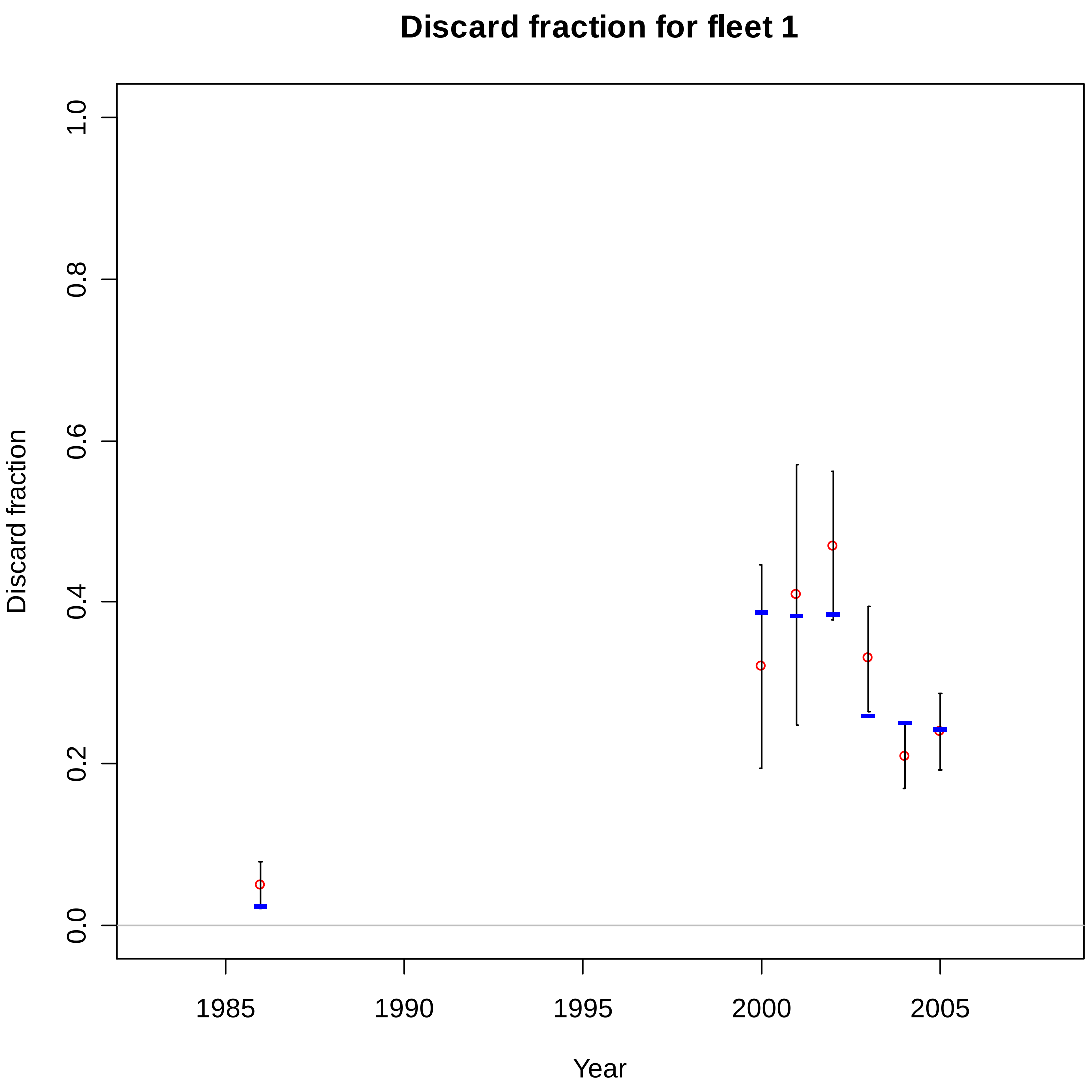
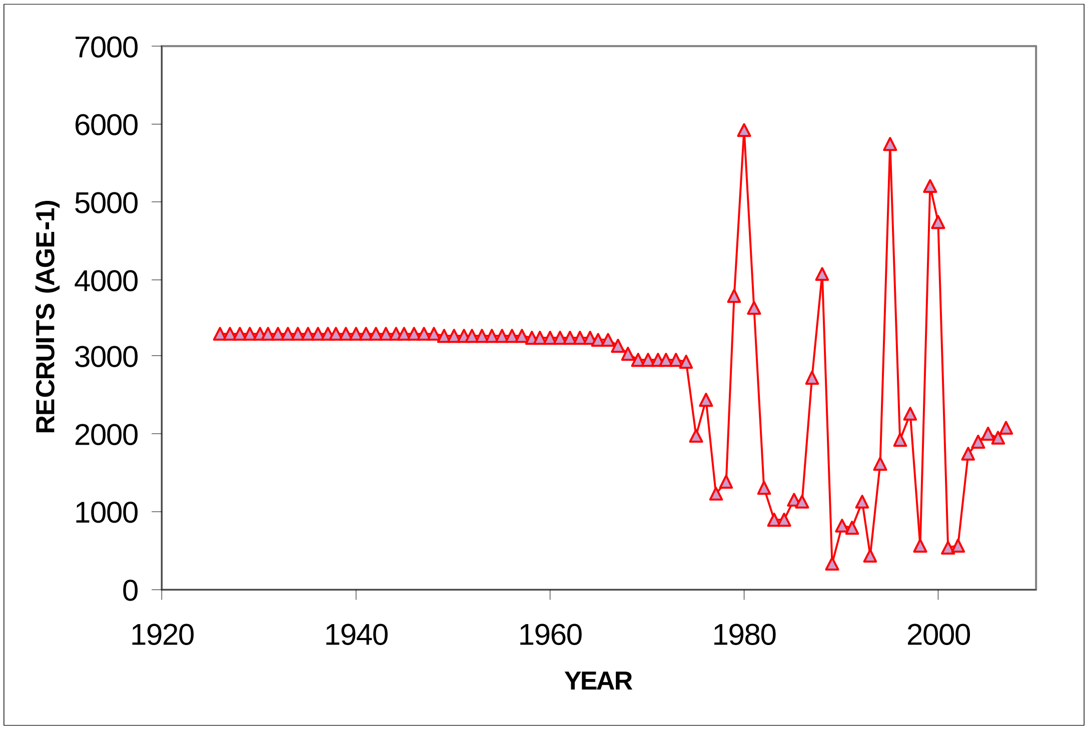


Figure 19. Fit to discard fraction data.



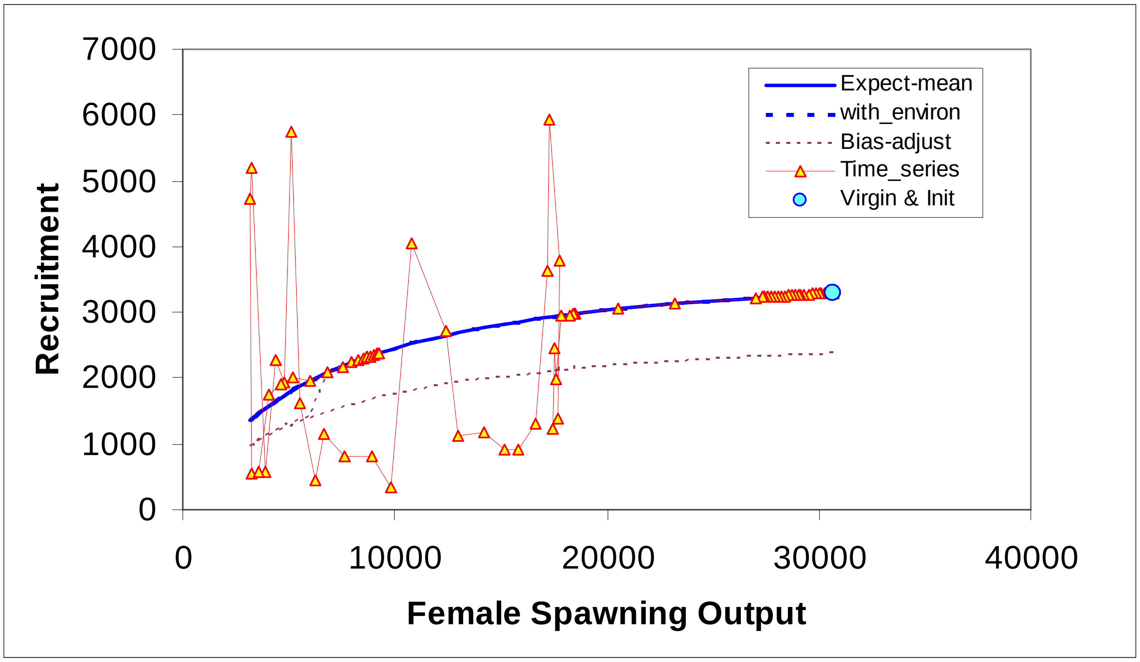


Figure 20. Time series of recruitment and spawner-recruit curve.

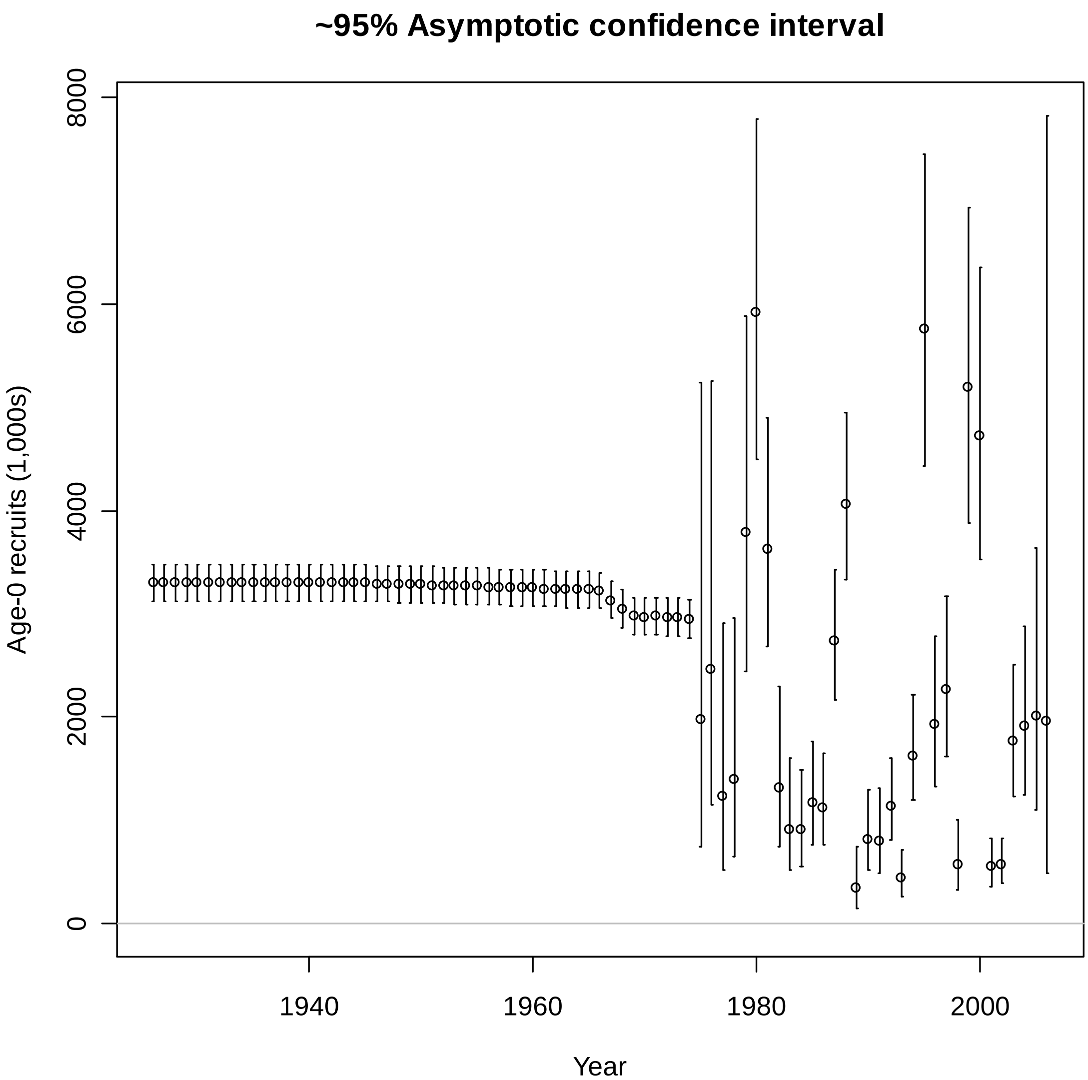


Figure 21. Time series of recruitment with confidence intervals.

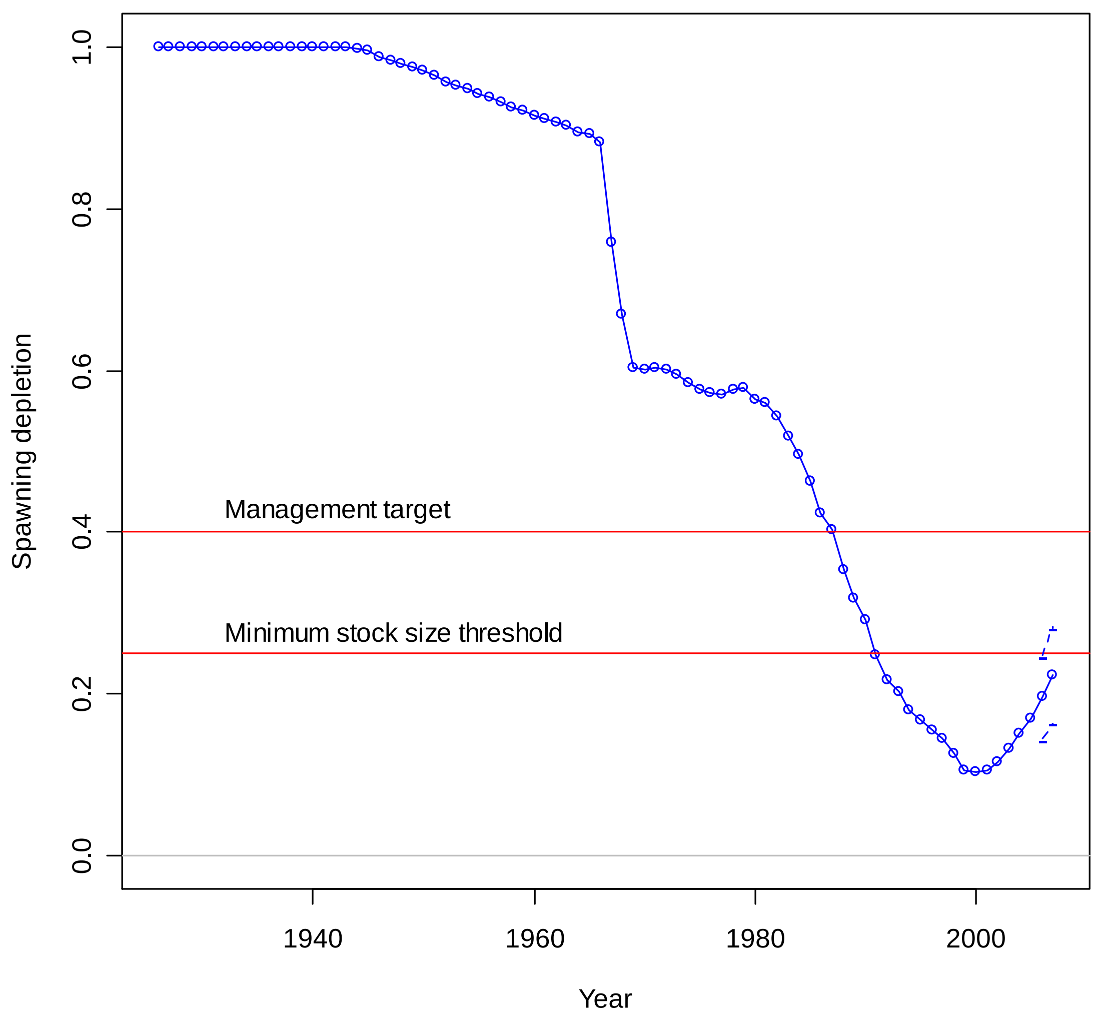
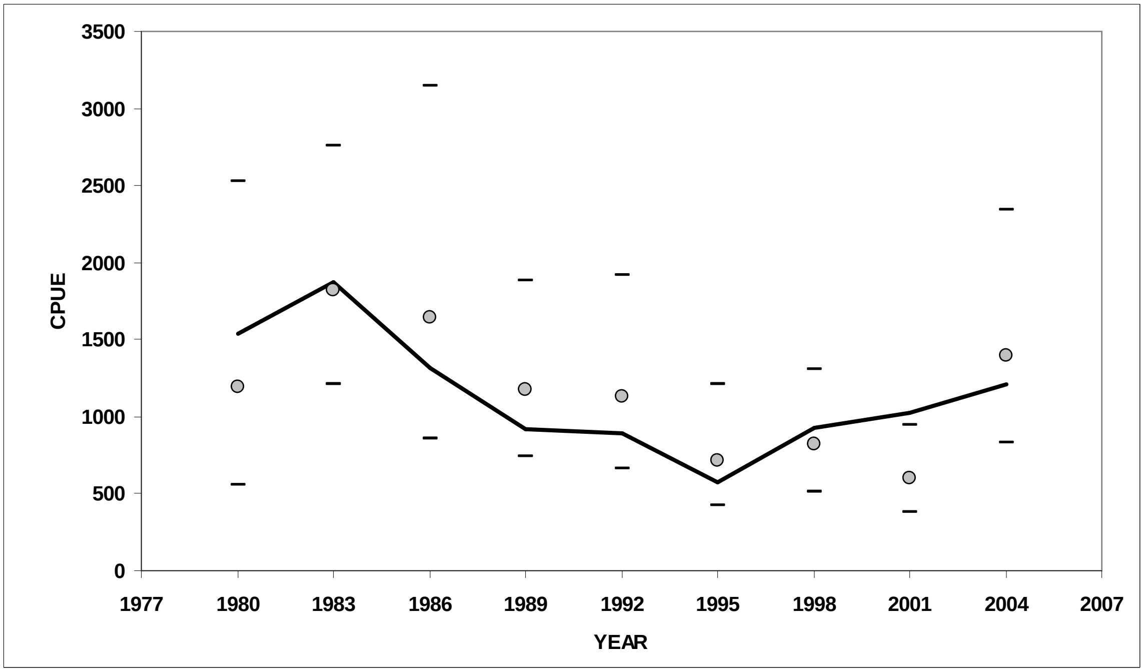


Figure 22. Time series of spawning output depletion level.



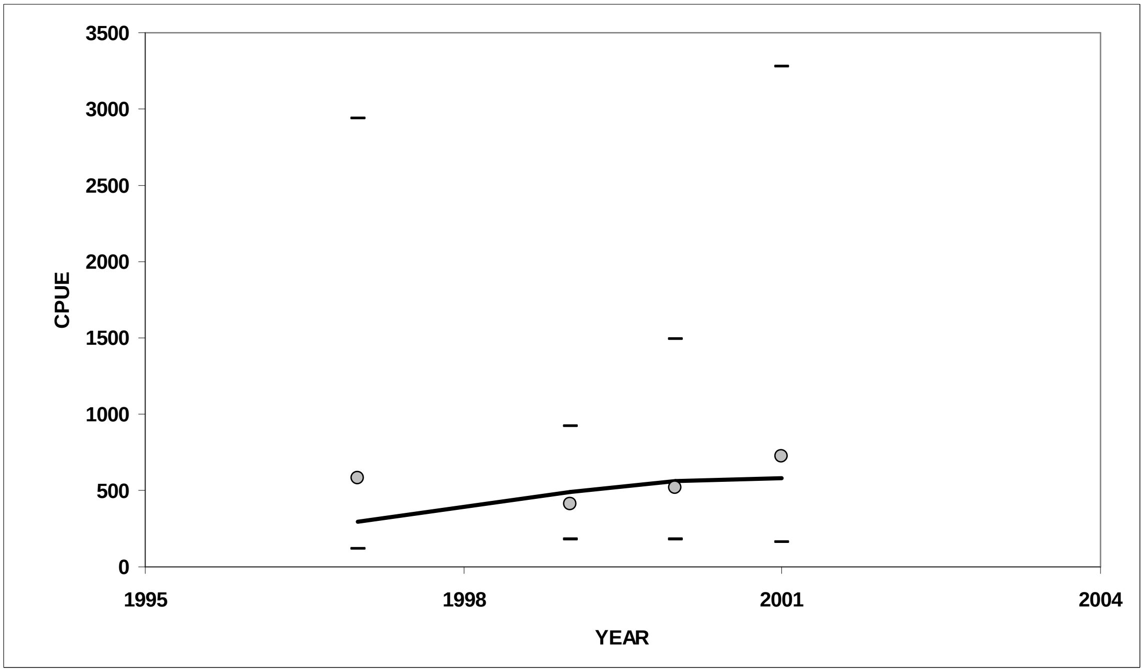
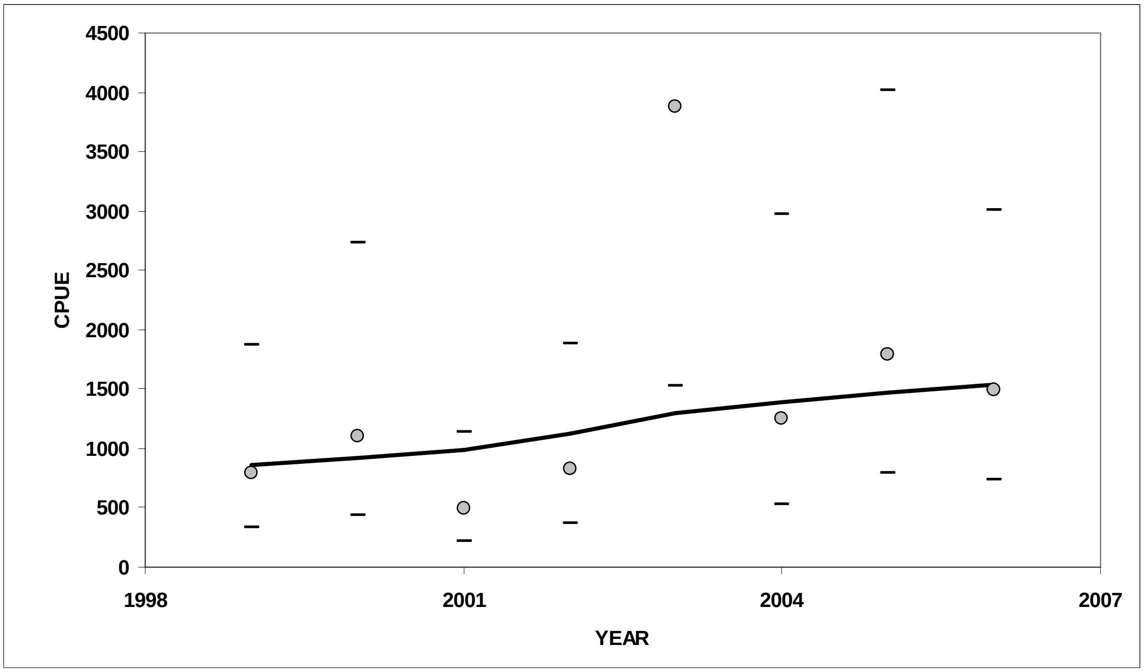


Figure 23. Model fits to Triennial shelf and AFSC Slope Survey indices



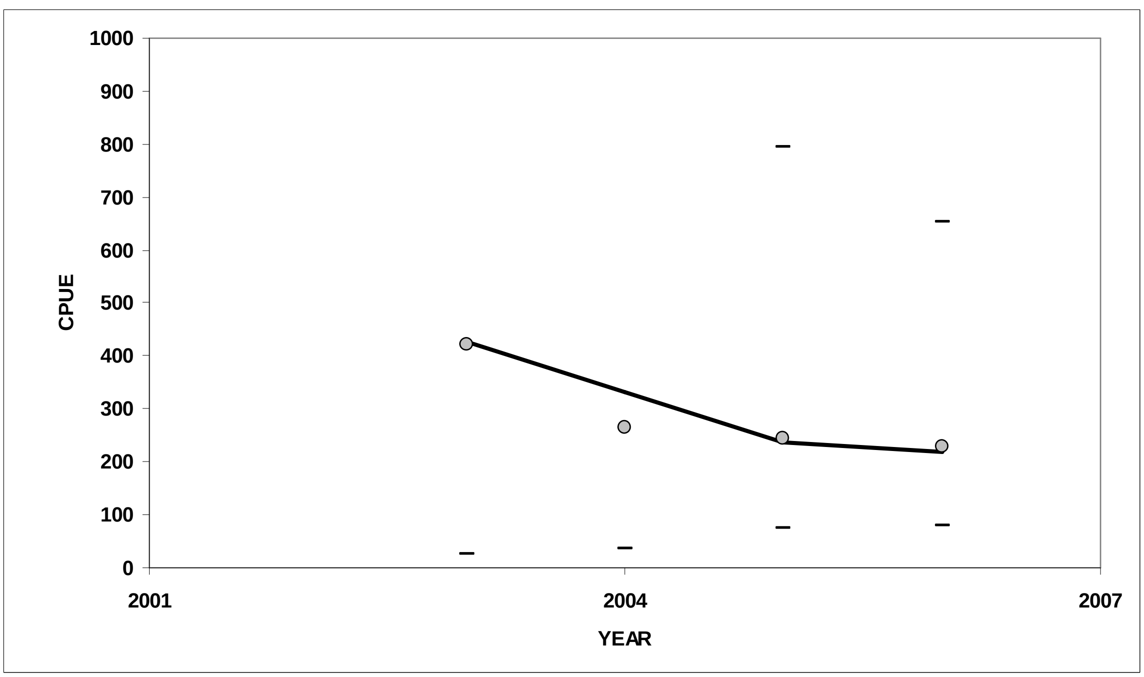


Figure 24. Model fits to NWFSC slope (top) and Shelf Survey indices.

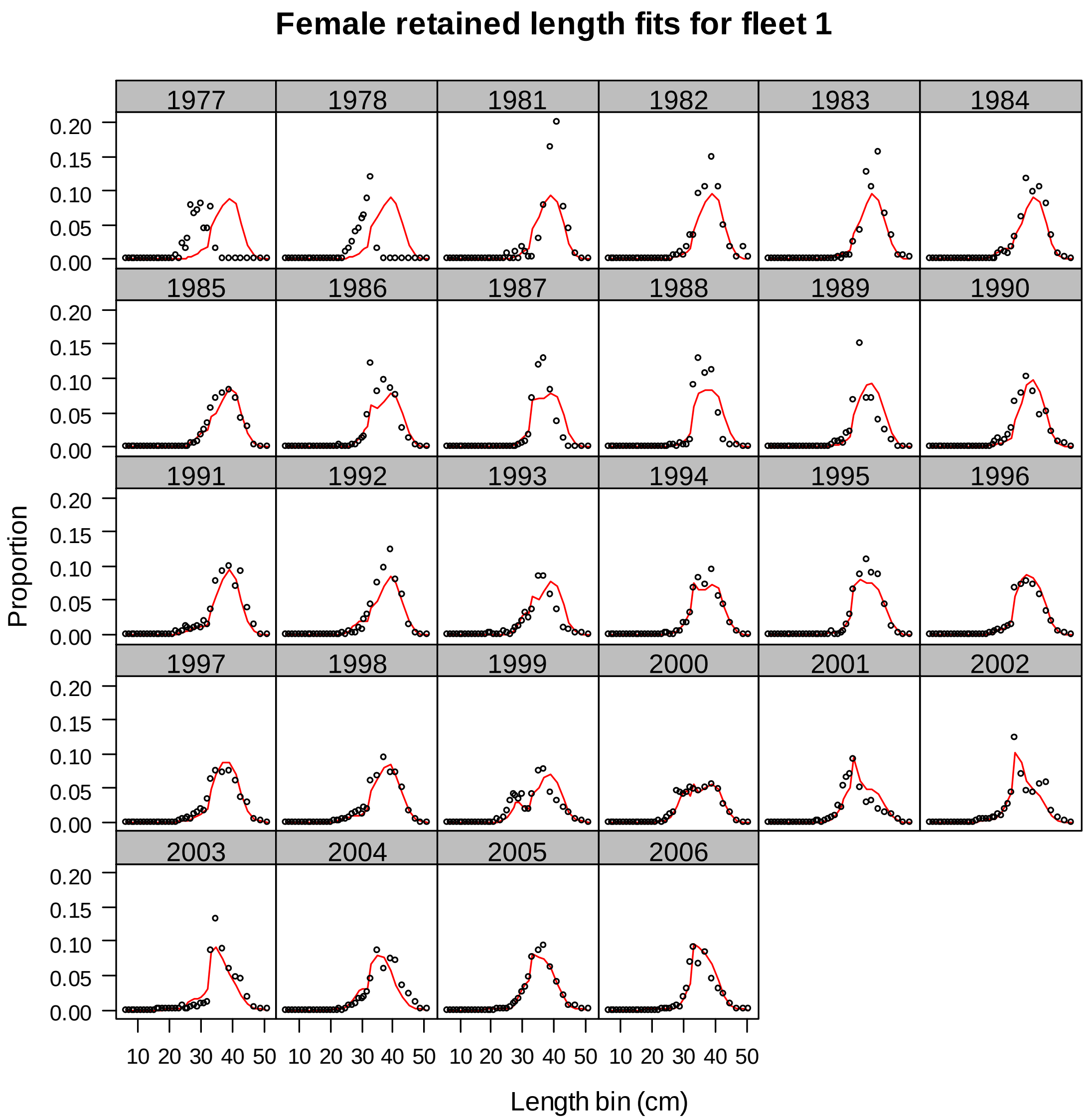


Figure 25. Female fishery length compositions and model fits.

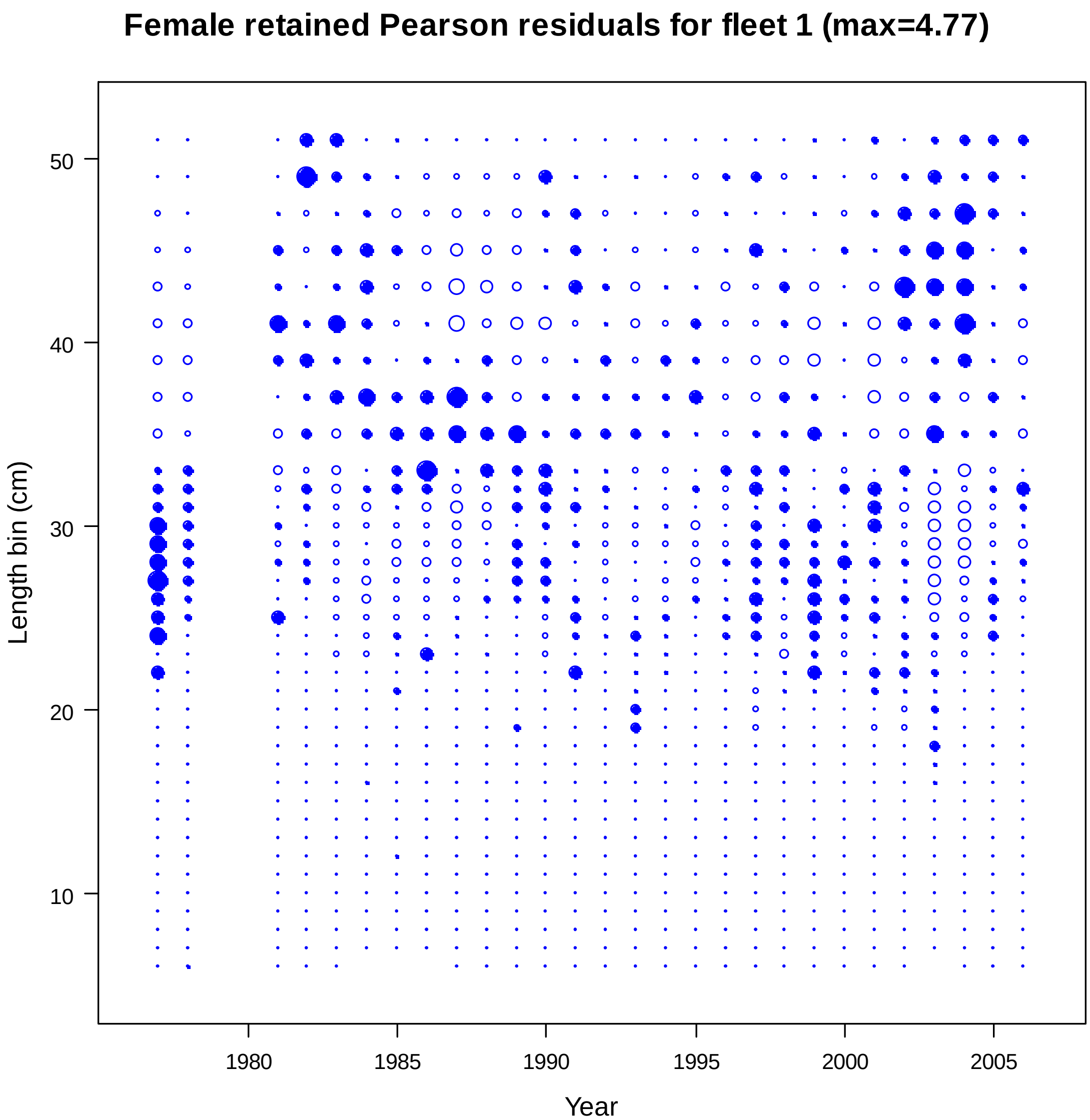


Figure 26. Pearson residuals for female length composition fits to fishery data.

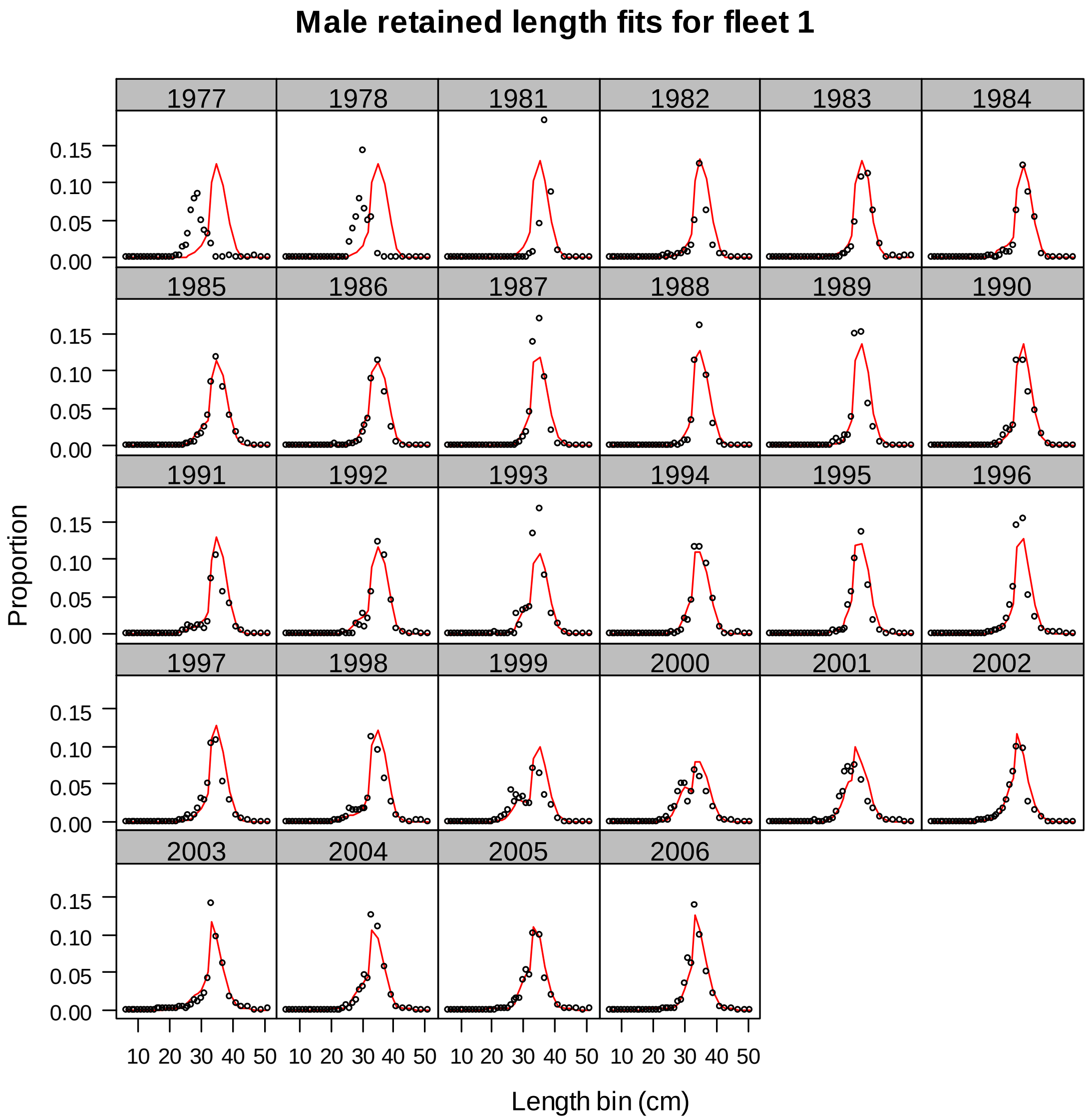


Figure 27. Male fishery lengths compositions and model fits

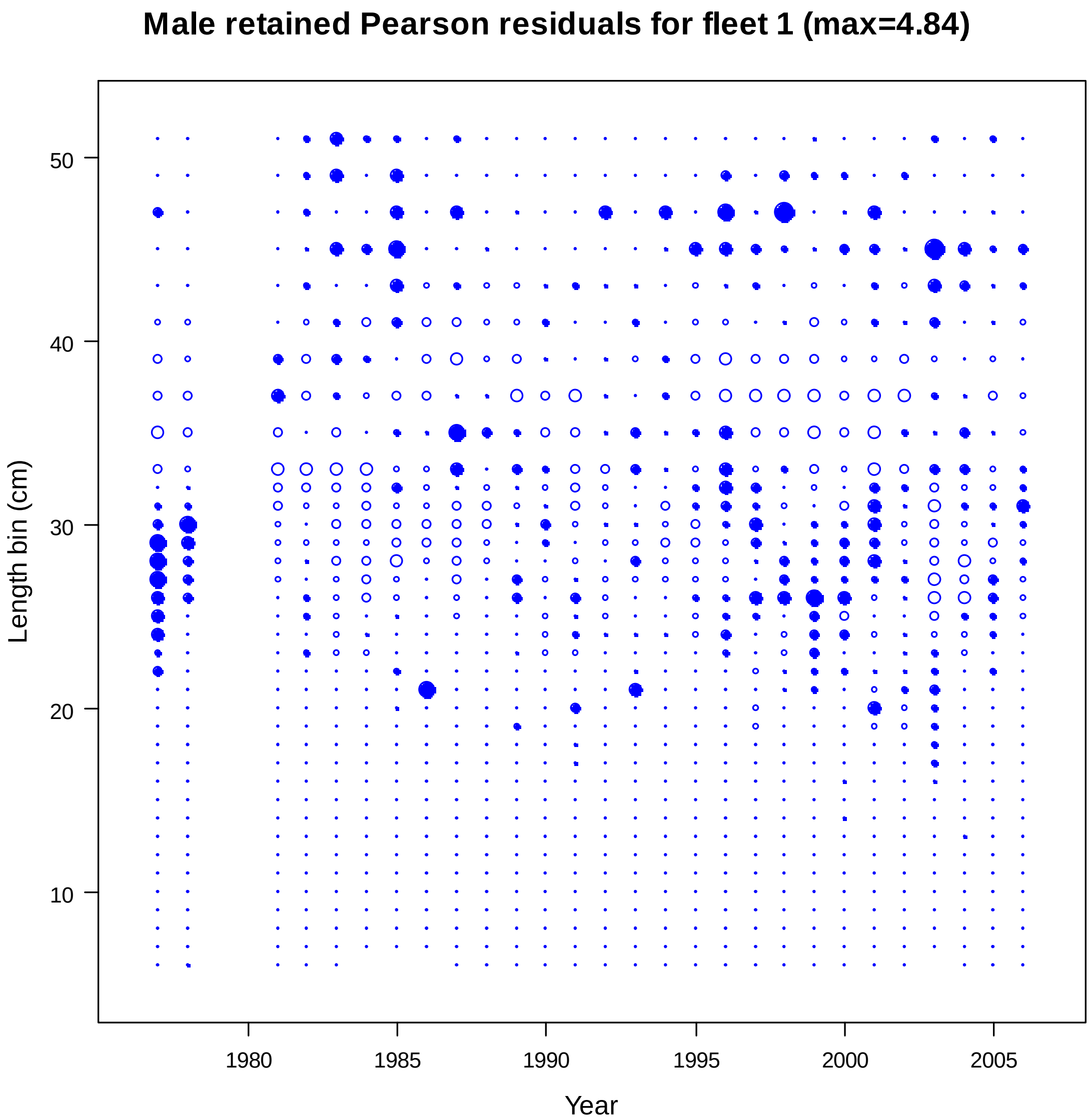


Figure 28. Pearson residuals for male length composition fits to fishery data.

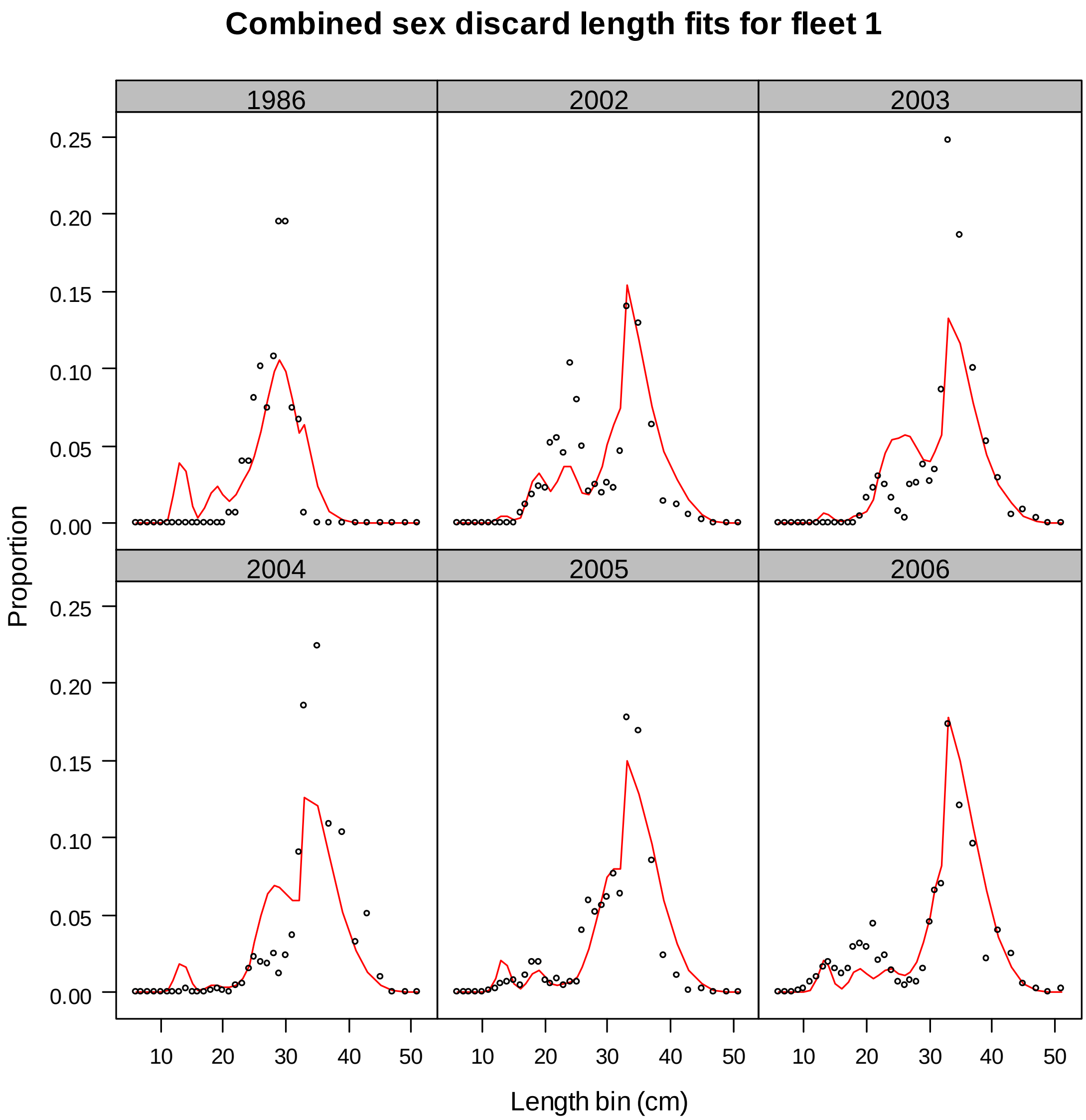


Figure 29. Fishery discard length compositions and model fits.

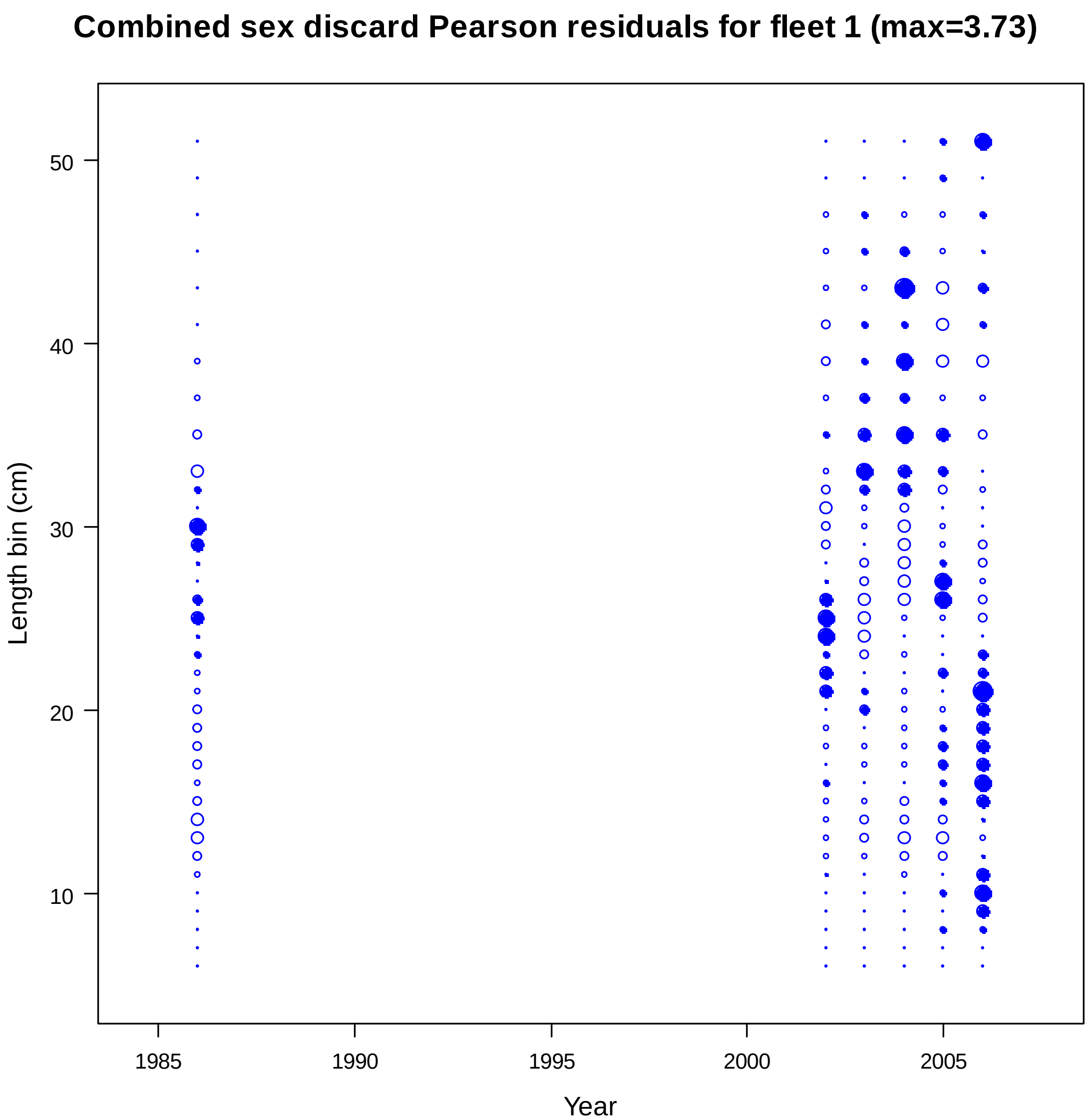


Figure 30. Pearson residuals for length composition fits to fishery discard data.

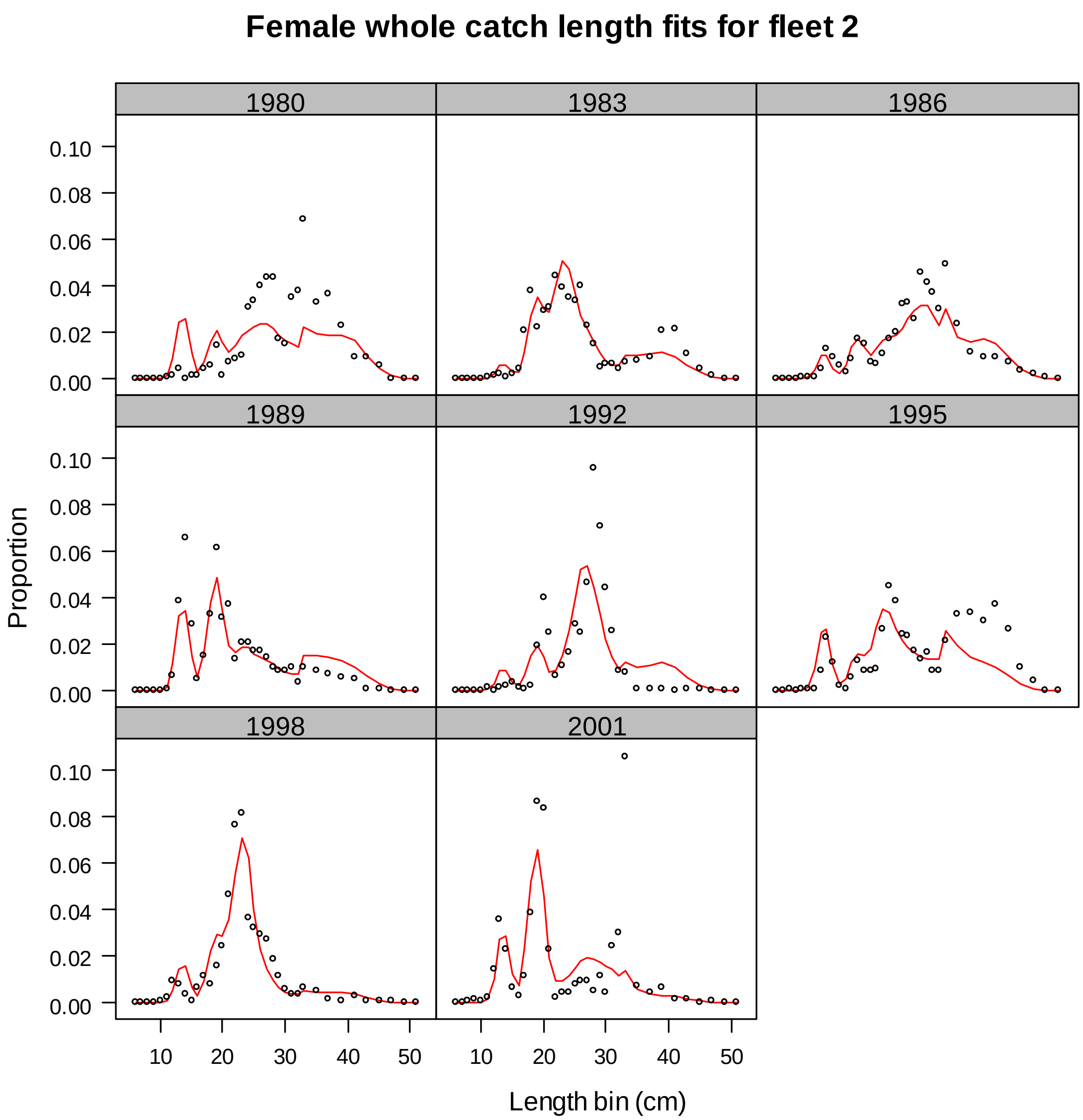


Figure 31. Triennial Shelf Survey female length compositions and model fits.

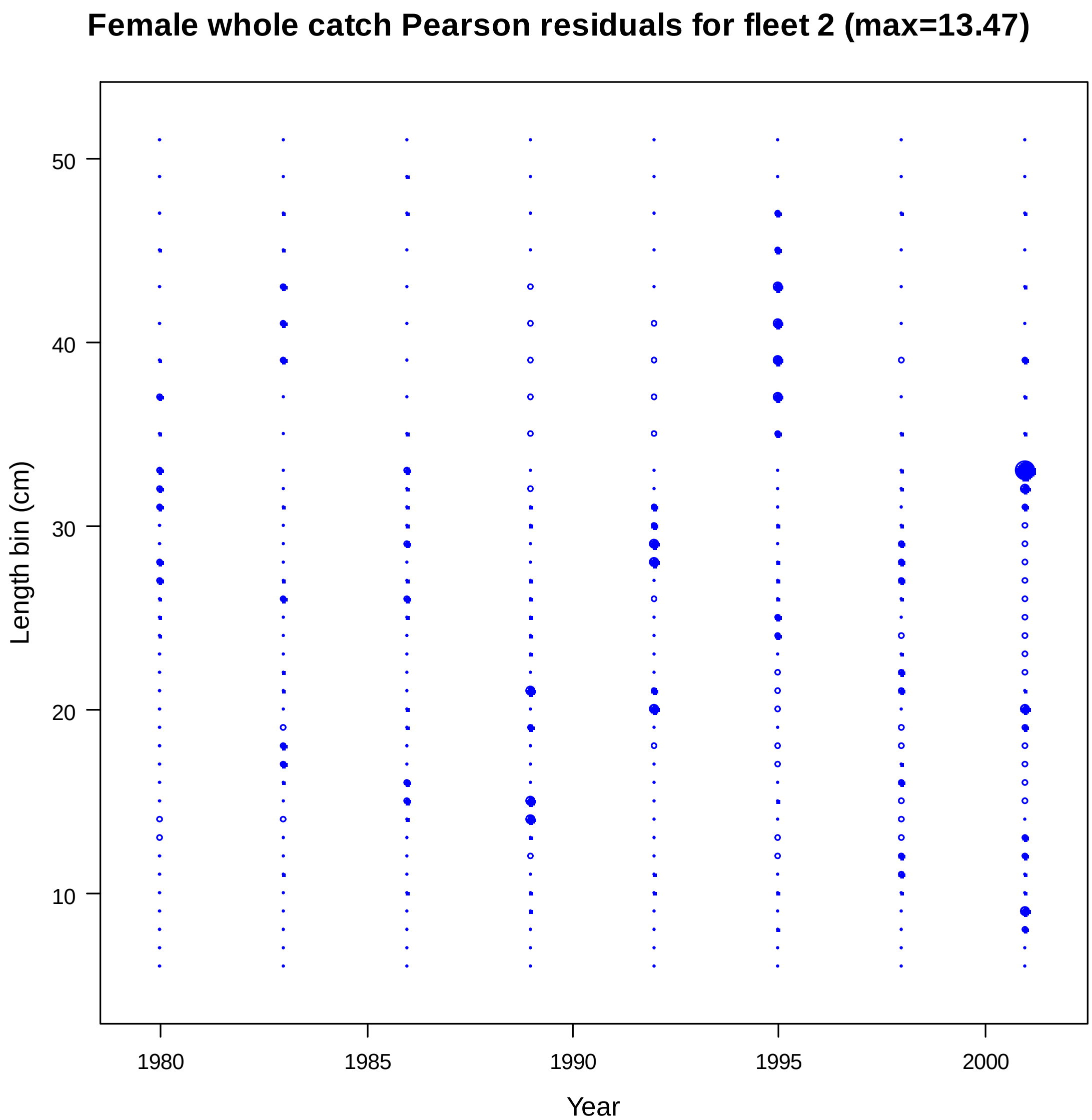


Figure 32. Pearson residuals for female length composition fits to Triennial Survey data.

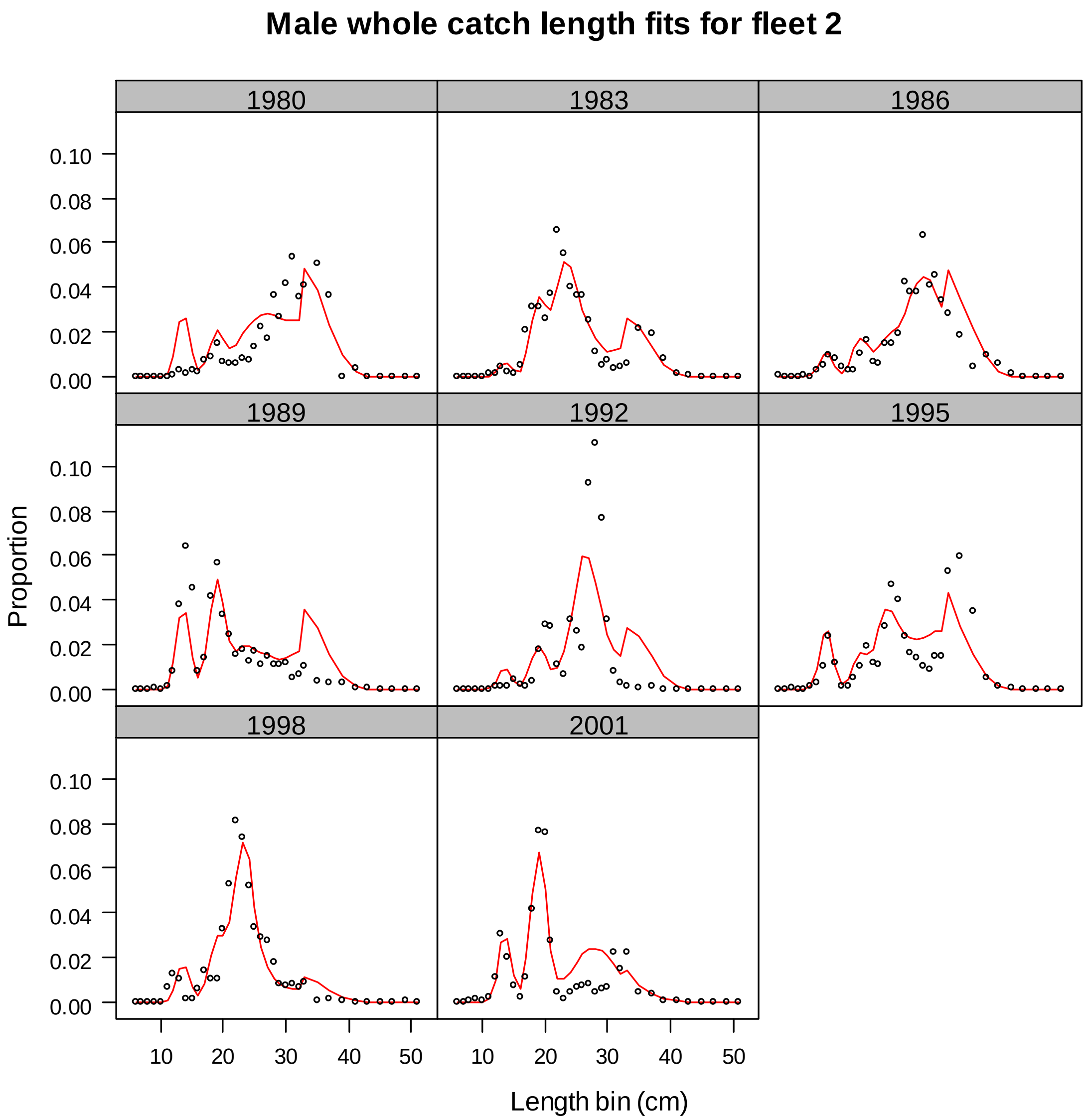


Figure 33. Triennial Shelf Survey male length compositions and model fits

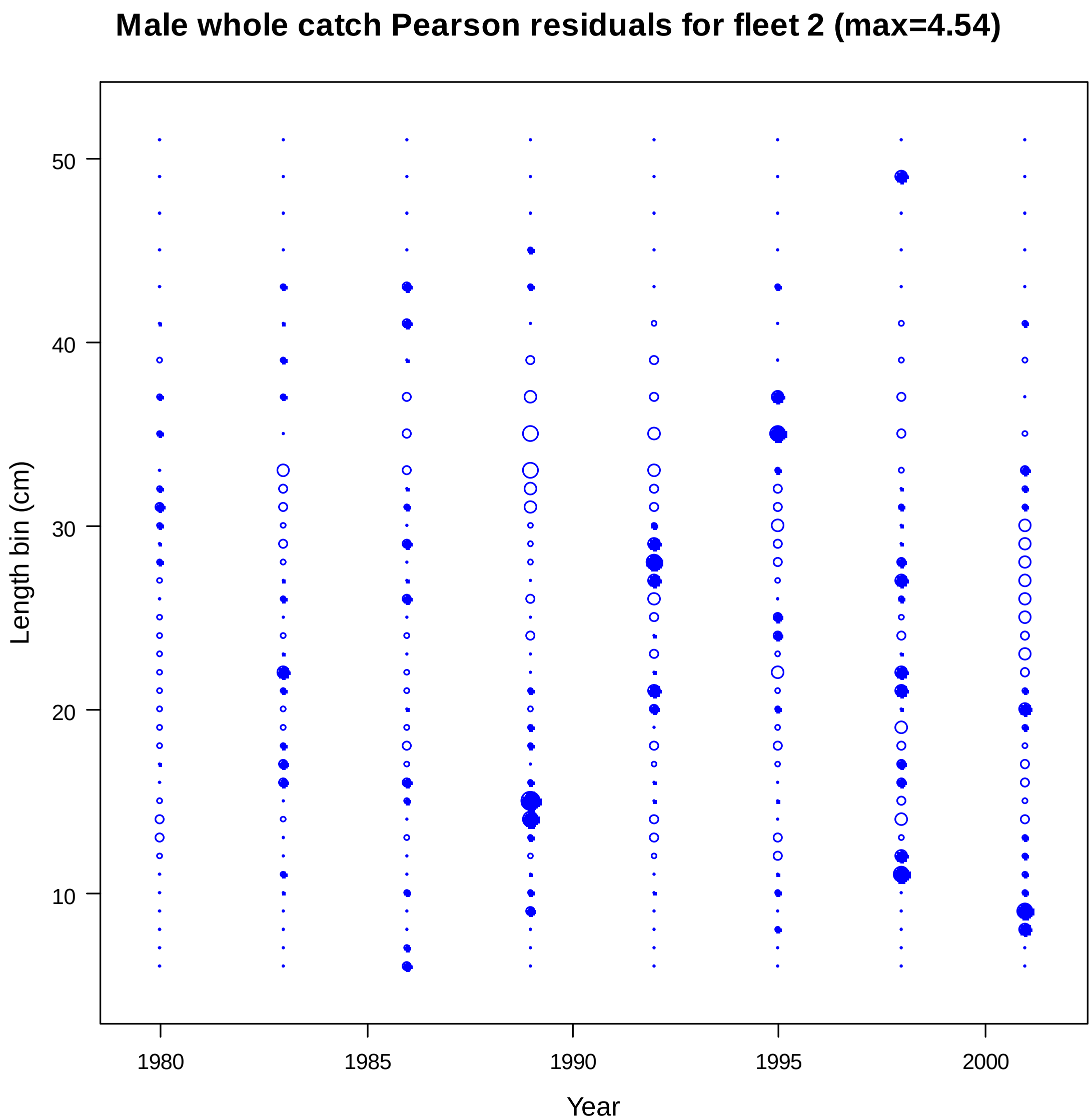


Figure 34. Pearson residuals for male length composition fits to Triennial Survey data.

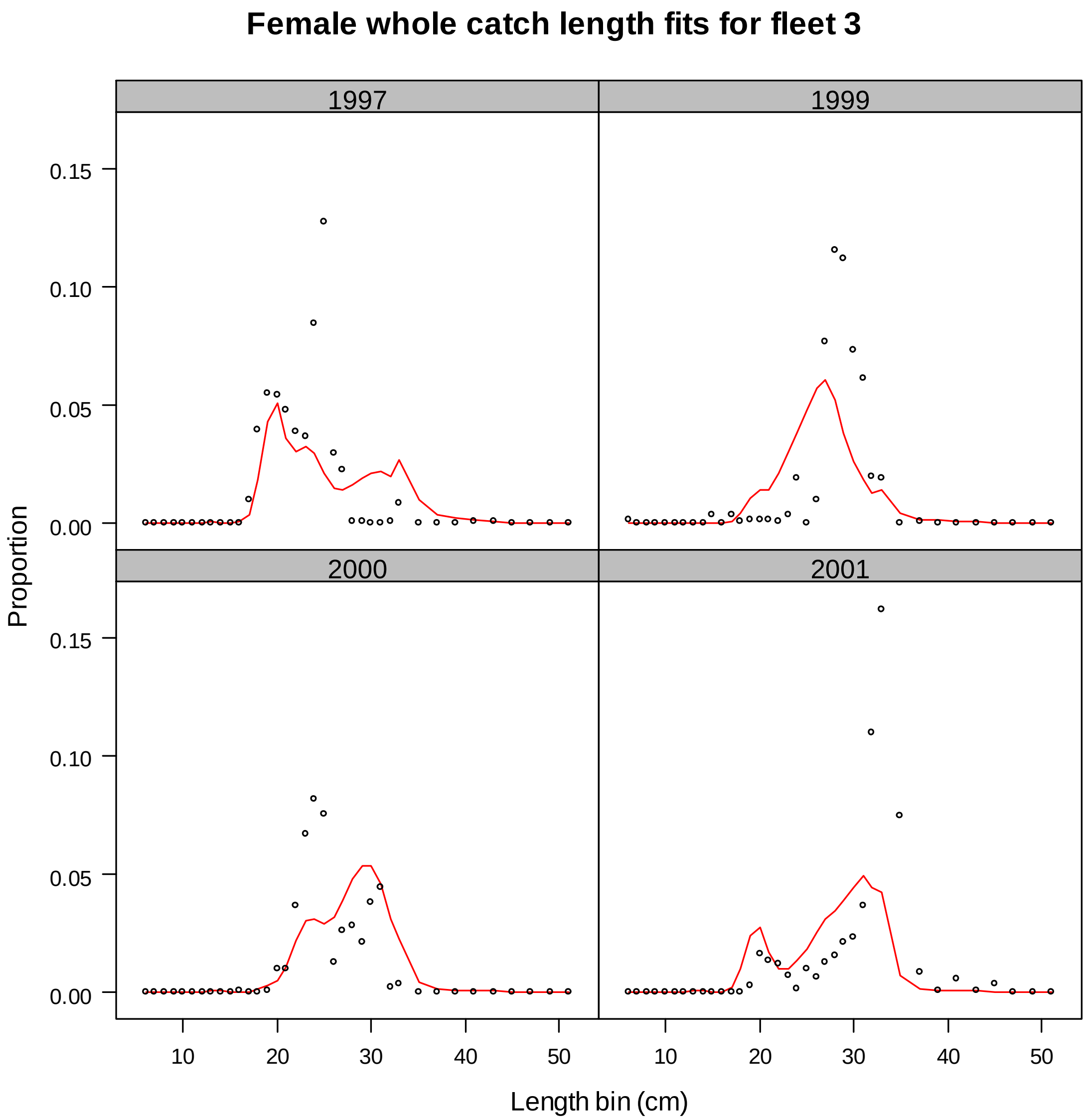


Figure 35. AFSC Slope Survey female length compositions and model fits

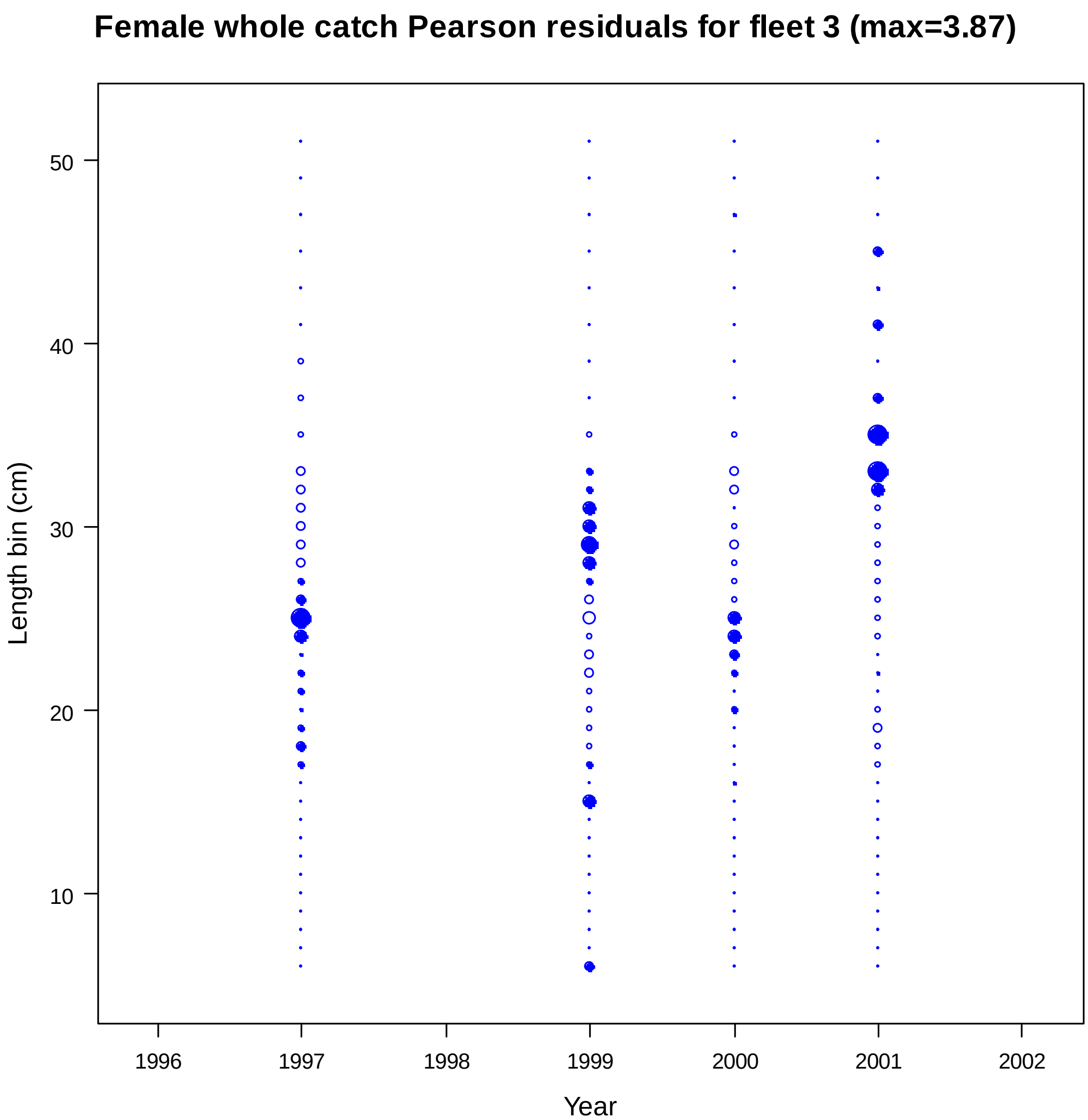


Figure 36. Pearson residuals for female length composition fits to AFSC Slope Survey data.

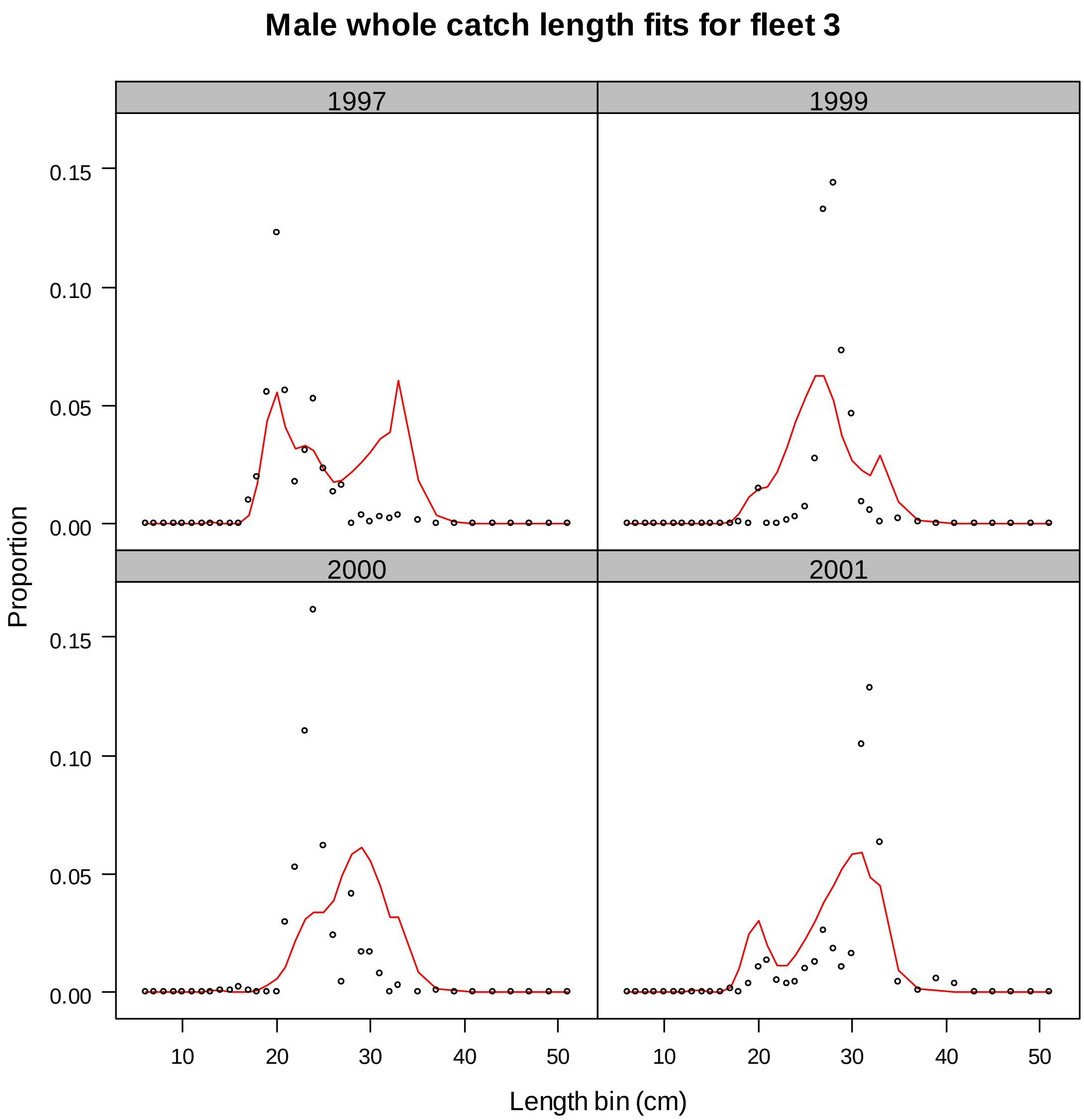


Figure 37. AFSC Slope Survey male length compositions and model fits

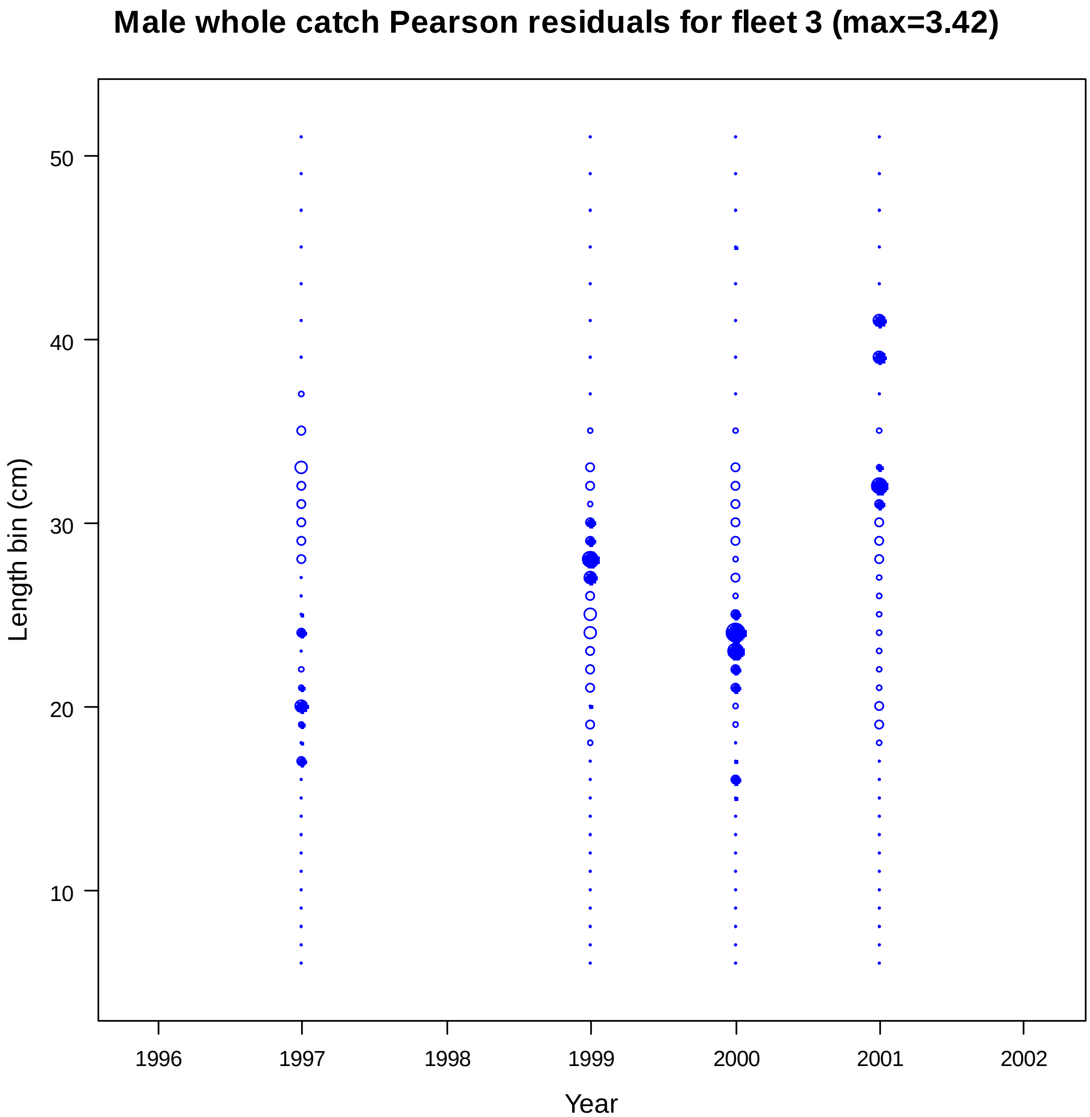


Figure 38. Pearson residuals for male length composition fits to AFSC Slope Survey data.

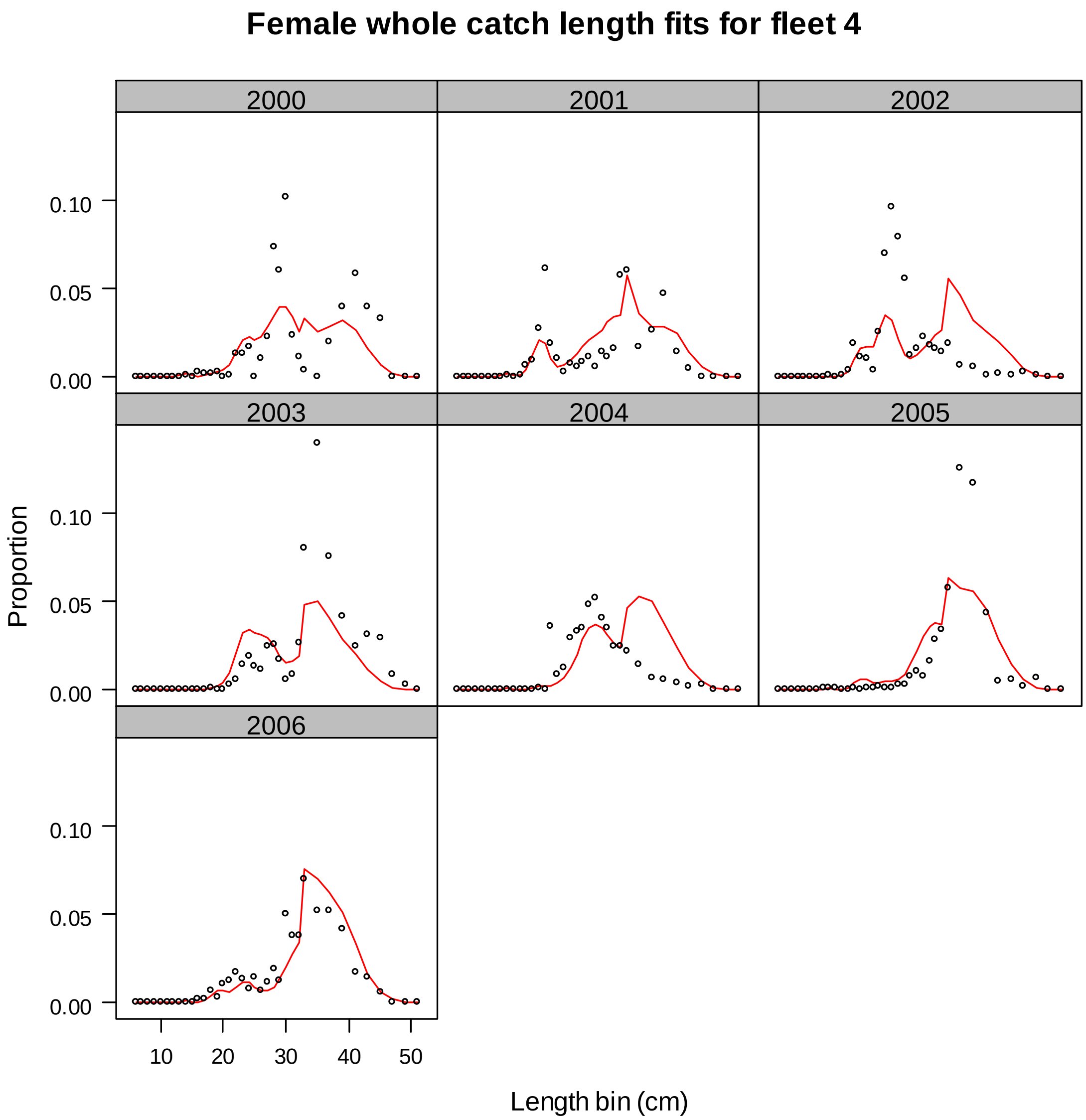


Figure 39. NWFSC Slope Survey female length compositions and model fits

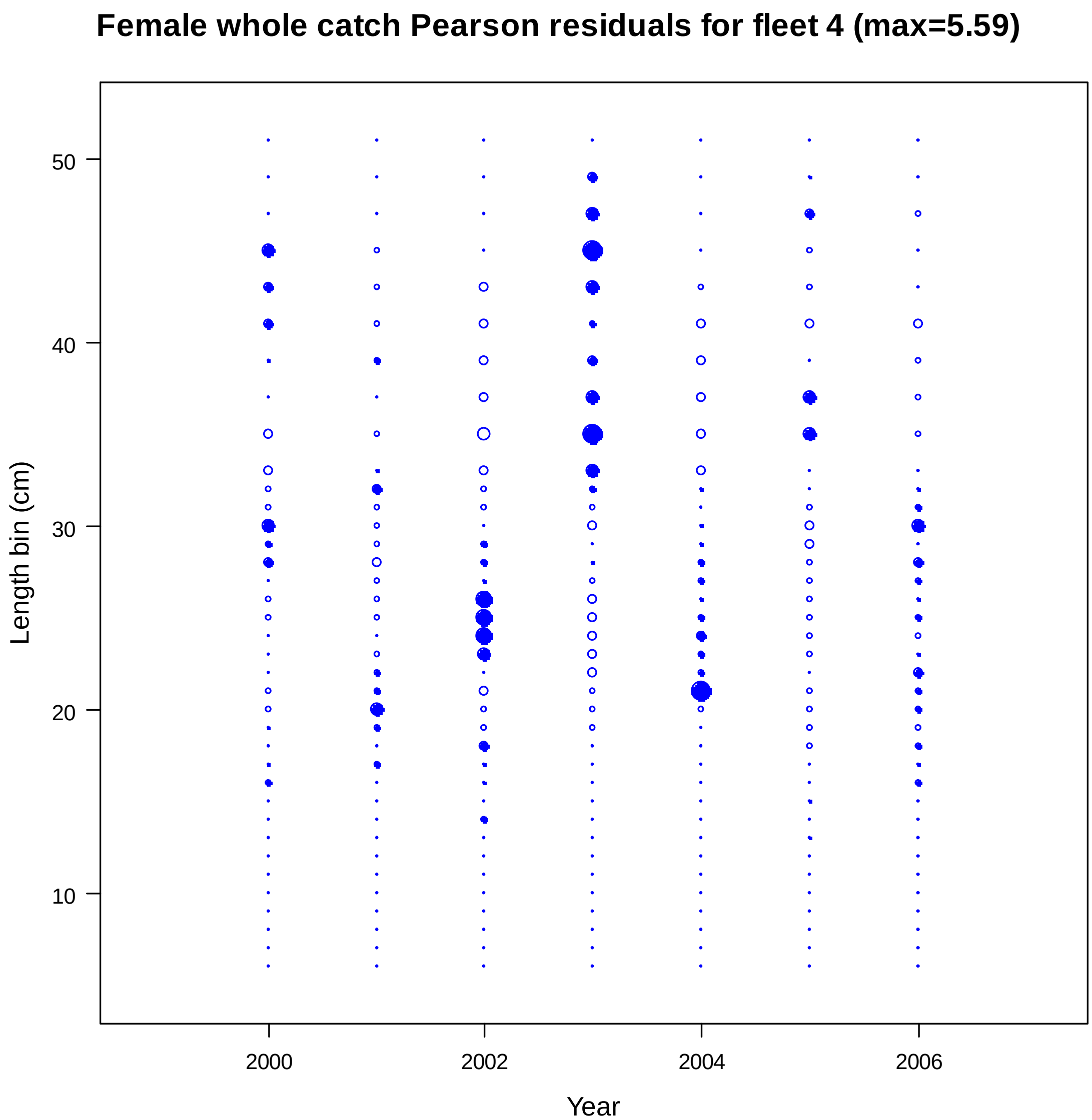


Figure 40. Pearson residuals for female length composition fits to NWFSC Slope Survey data.

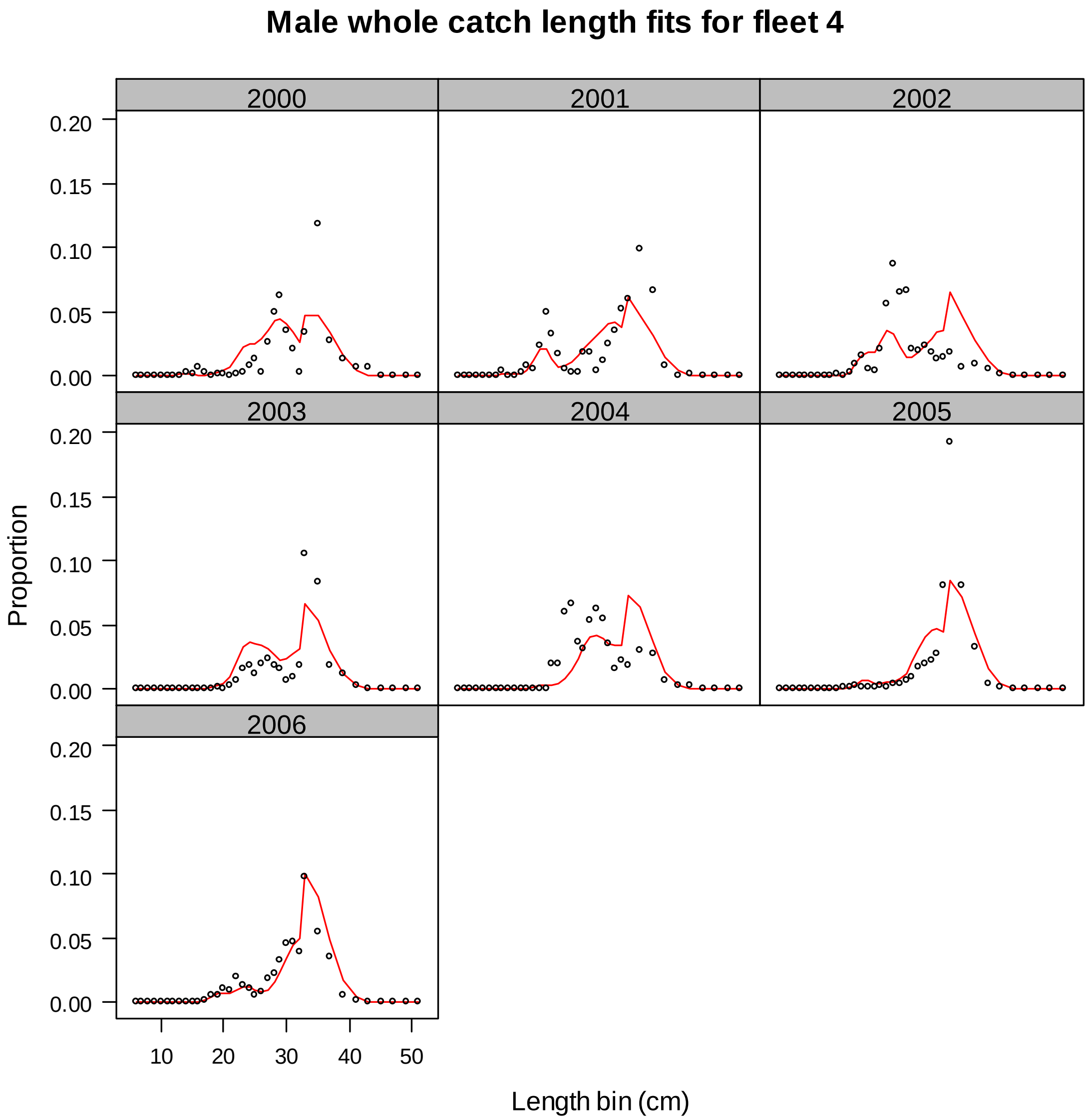


Figure 41. NWFSC Slope Survey male length compositions and model fits

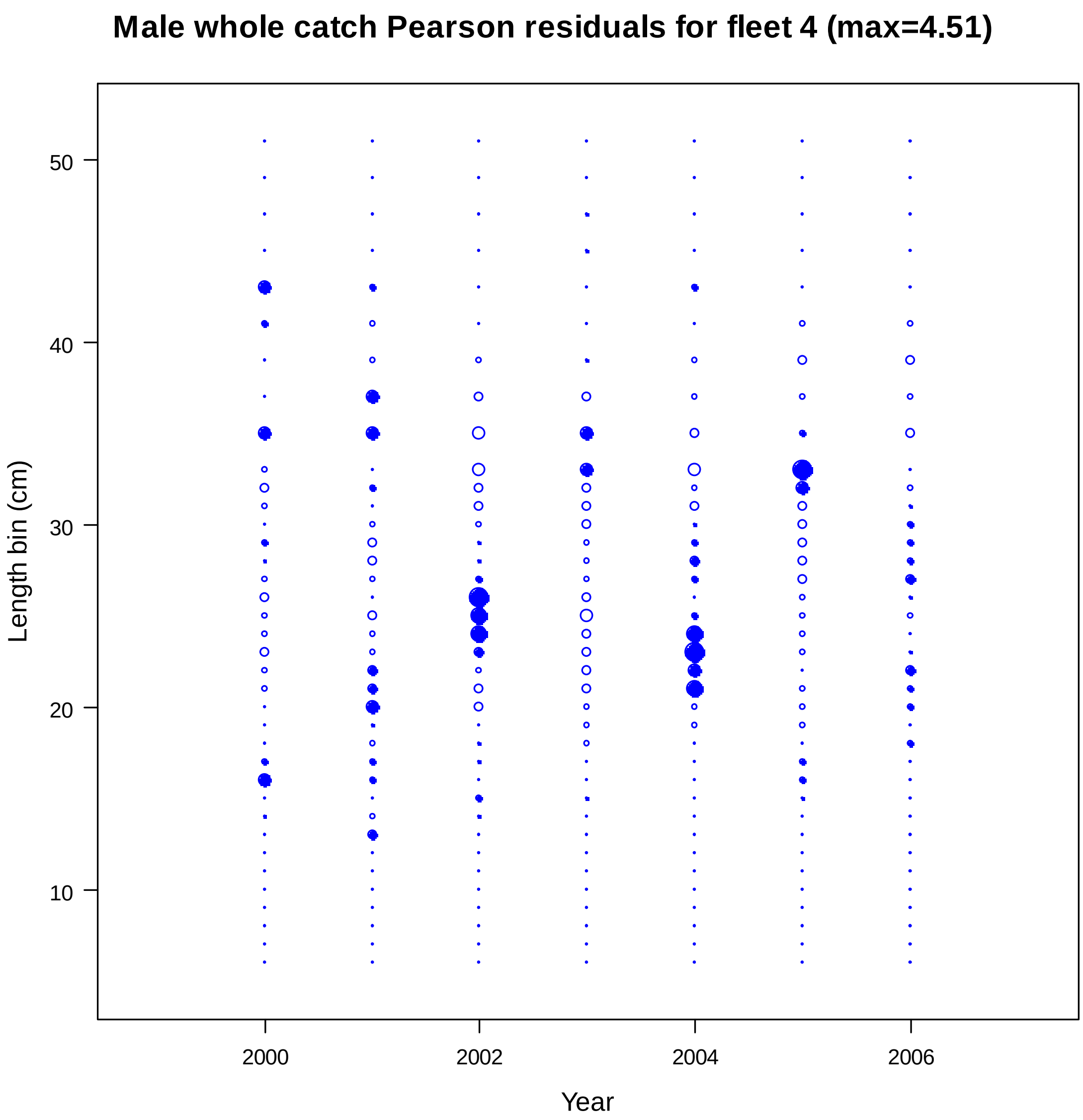


Figure 42. Pearson residuals for male length composition fits to NWFSC Slope Survey data.

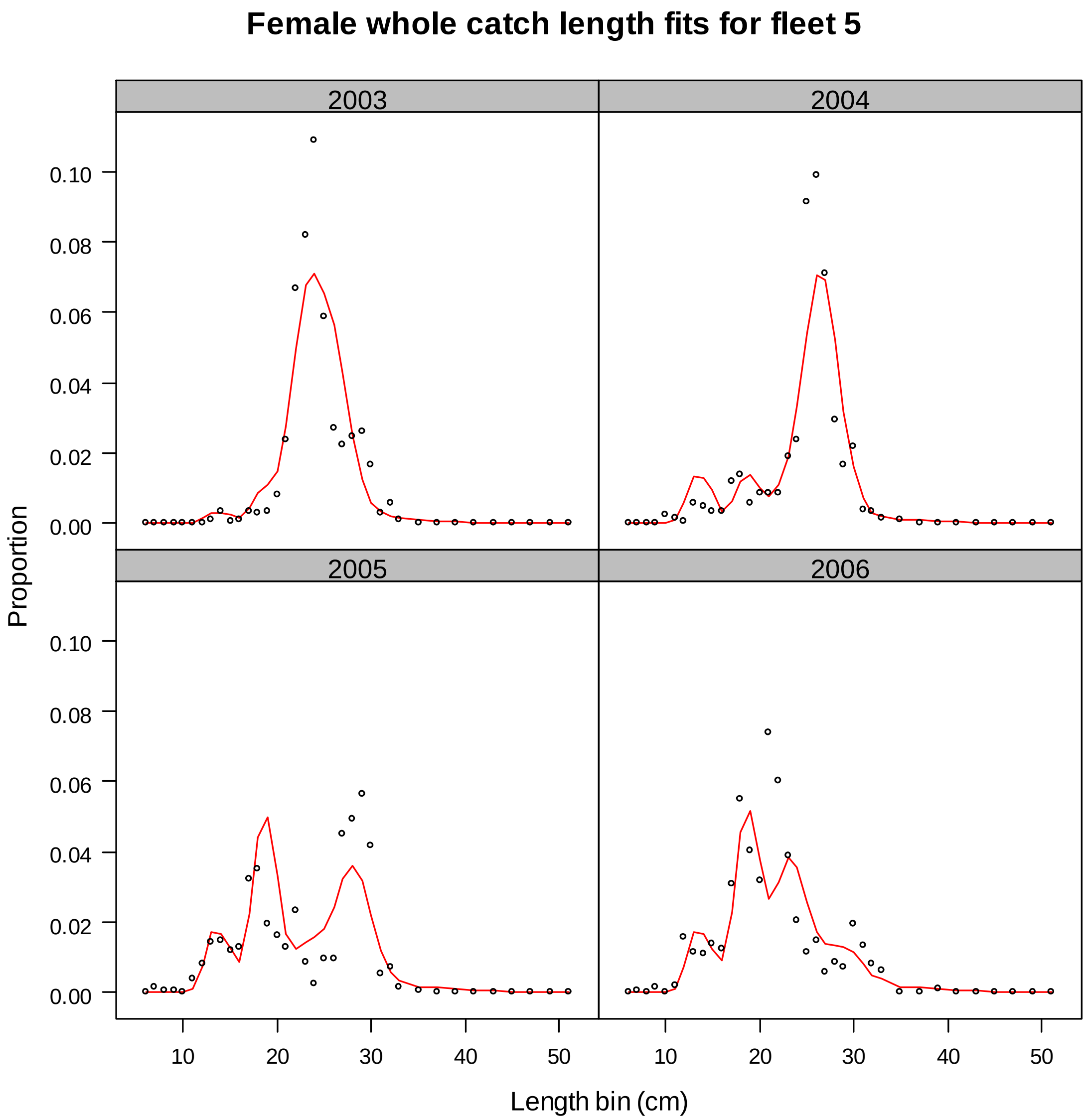


Figure 43. NWFSC Shelf Survey female length compositions and model fits

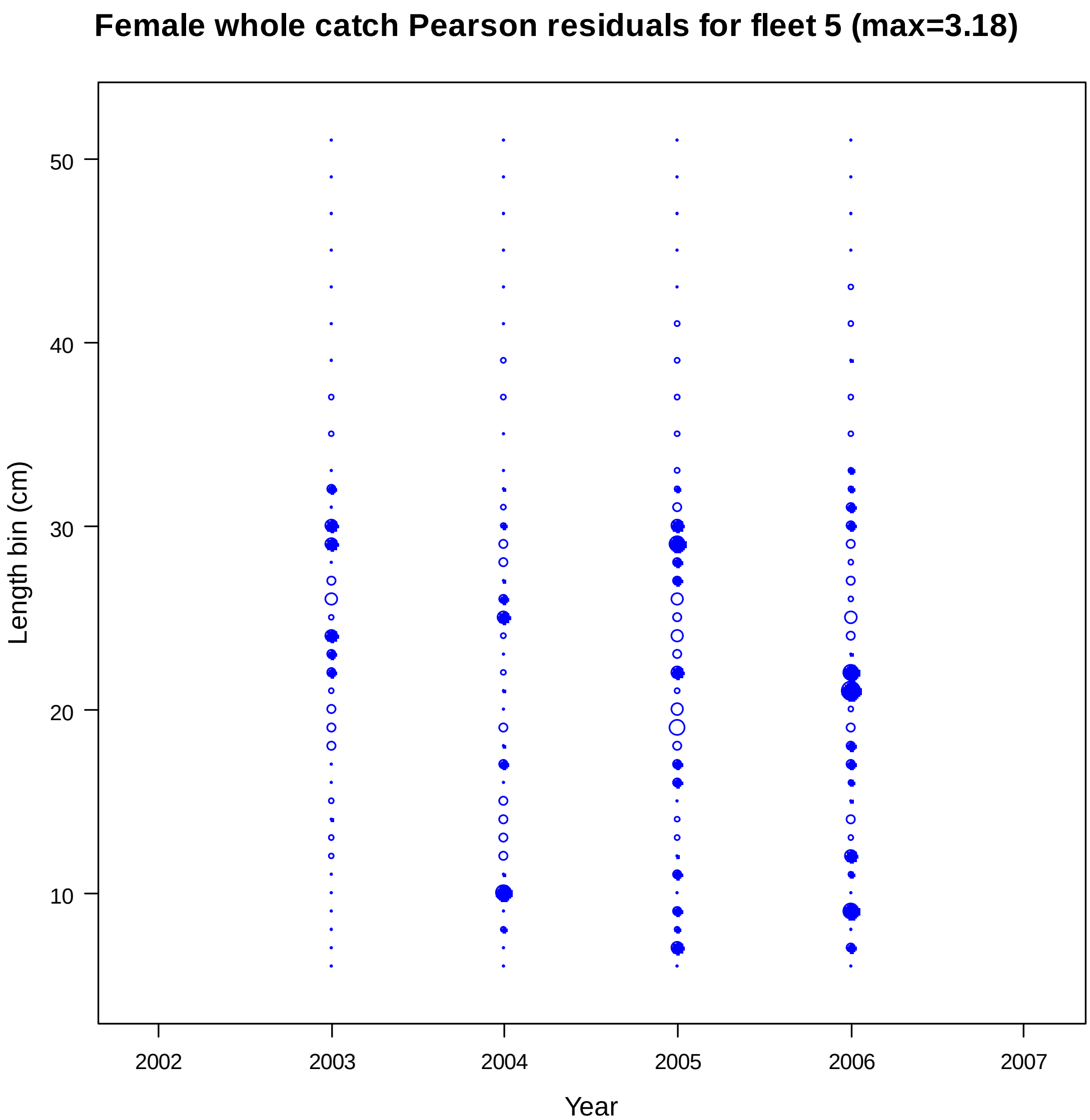


Figure 44. Pearson residuals for female length composition fits to NWFSC Shelf Survey data.

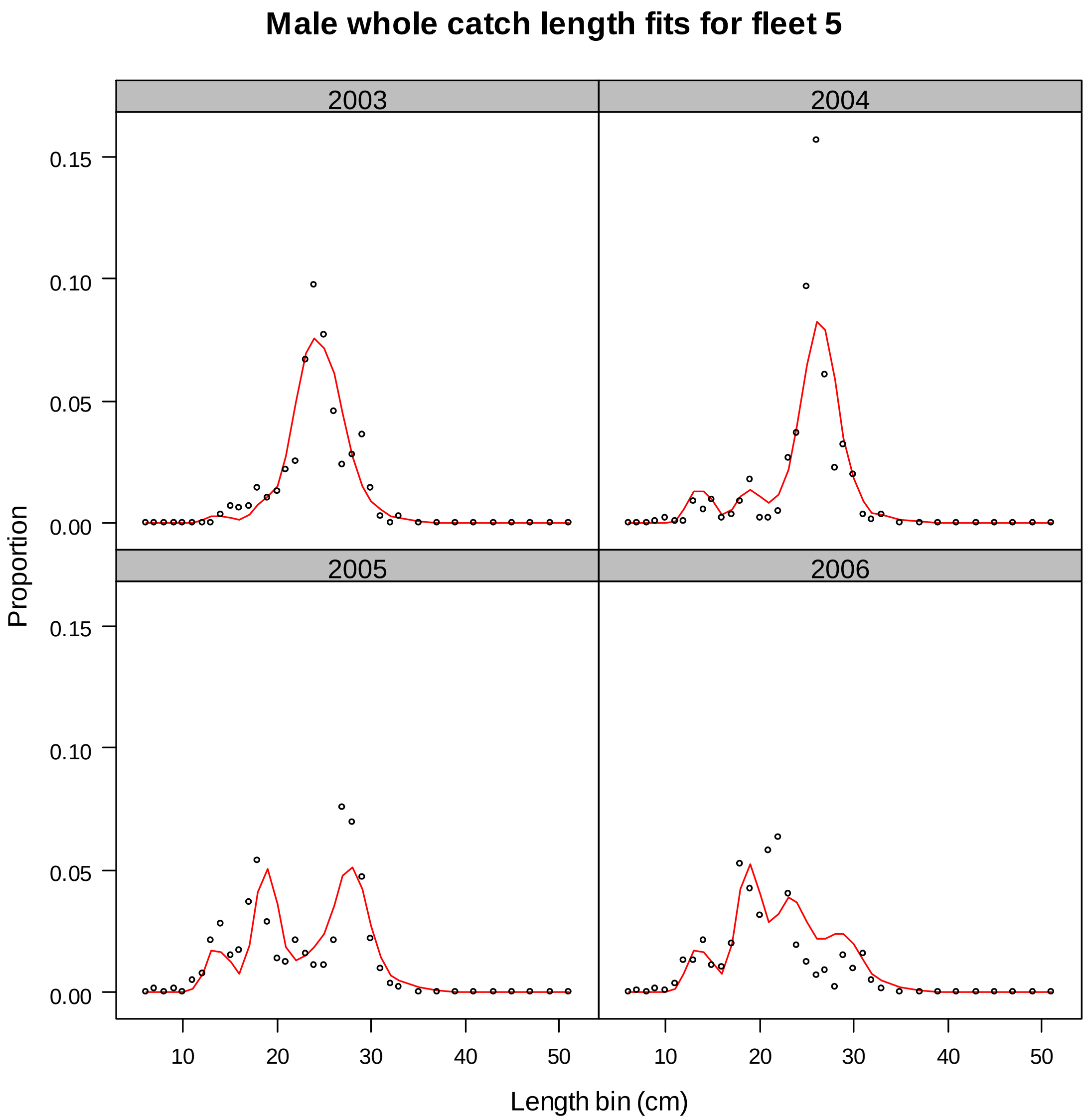


Figure 45. NWFSC Slope Survey male length compositions and model fits

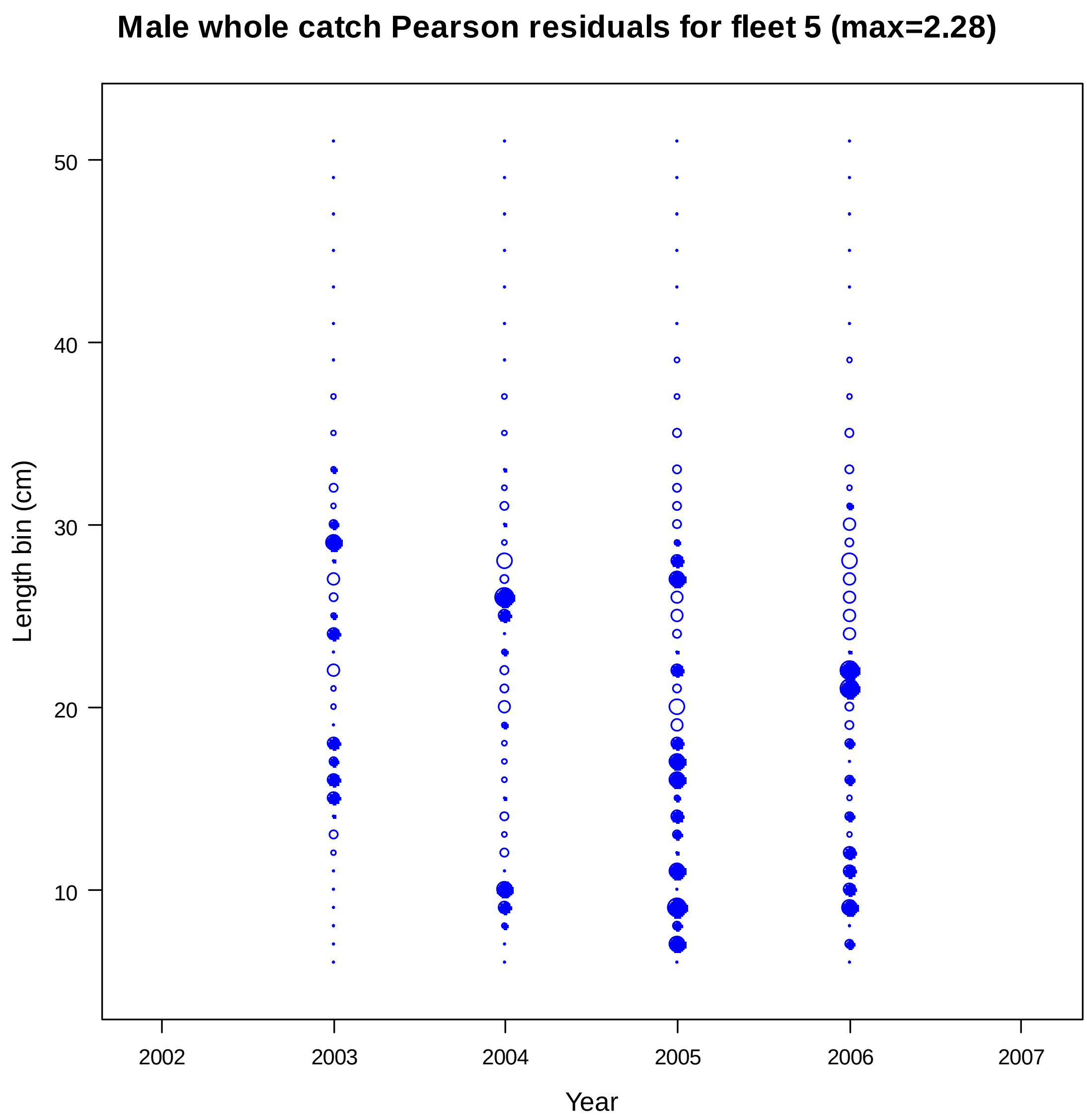


Figure 46. Pearson residuals for male length composition fits to NWFSC Shelf Survey data.

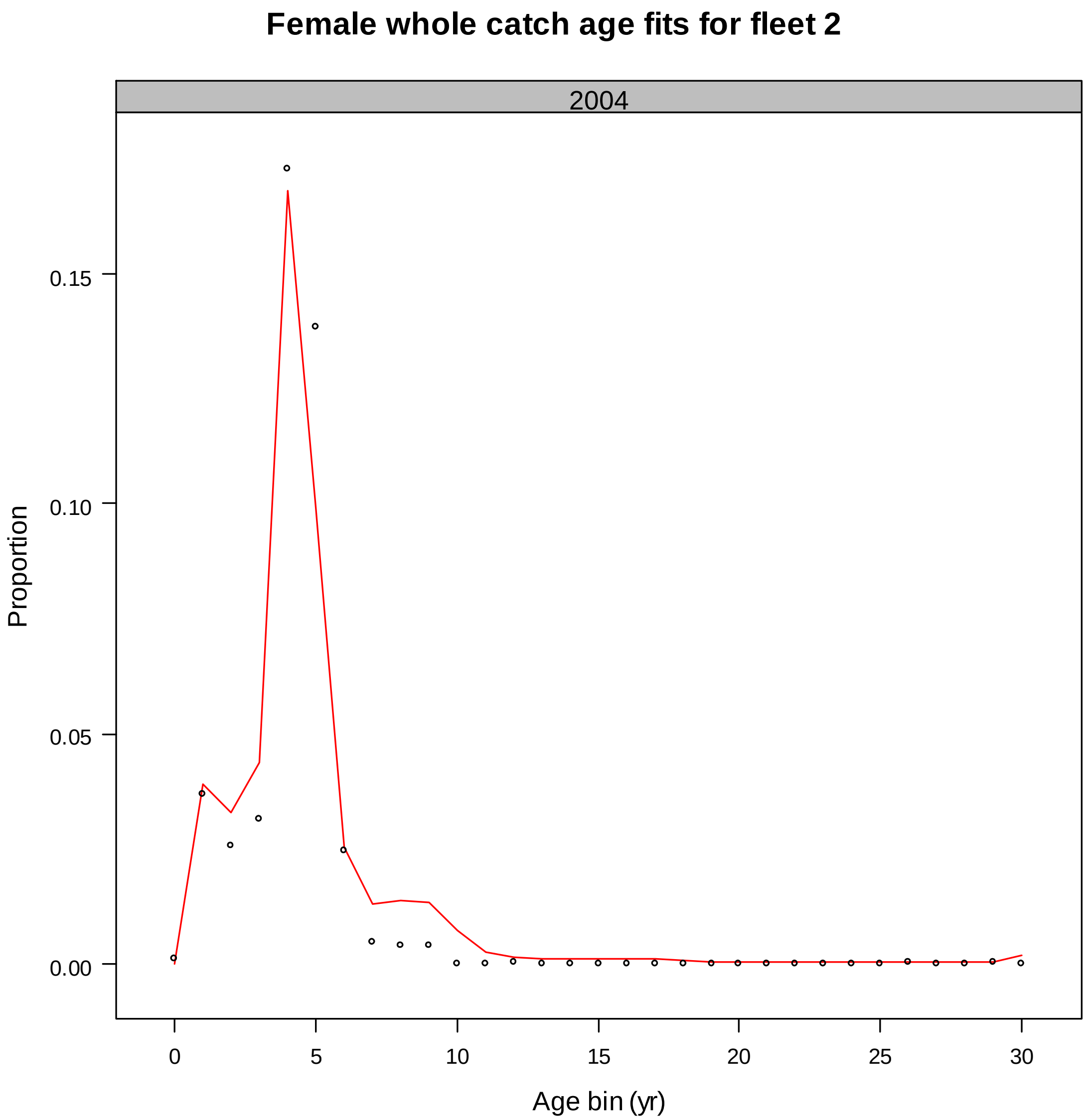


Figure 47. Triennial female 2004 age composition and model fit.

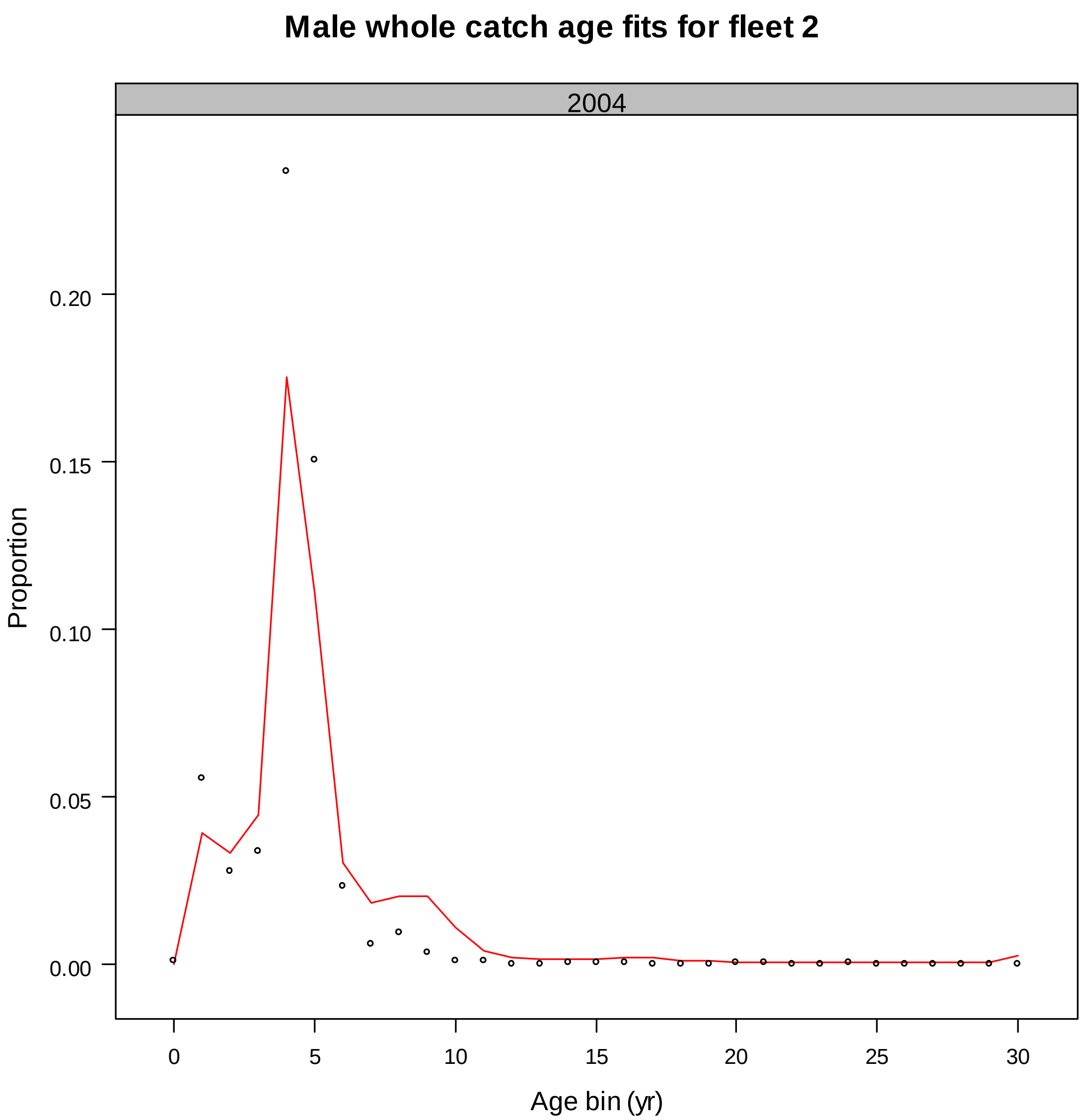


Figure 48. Male Triennial 2004 age composition and model fit.

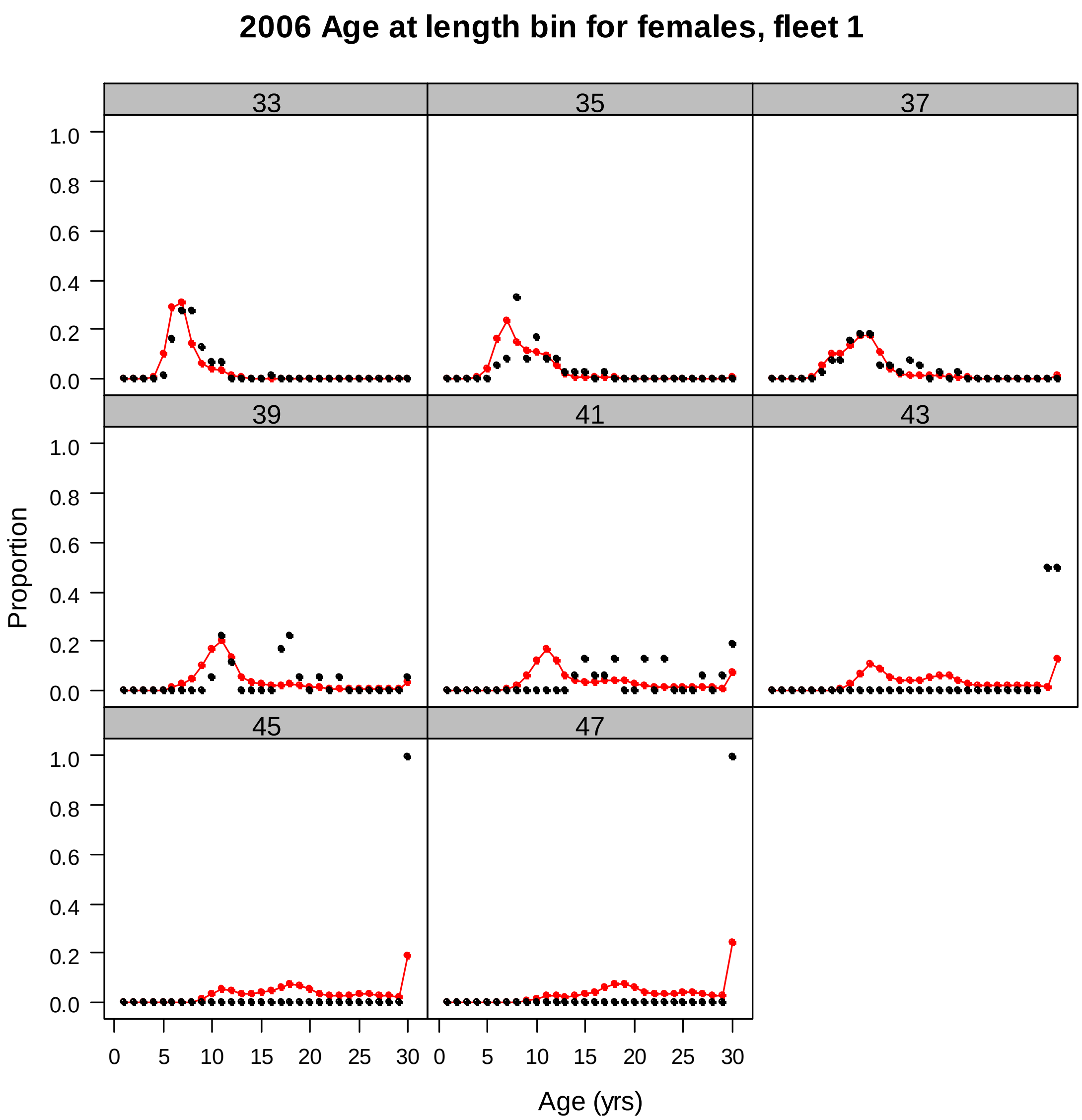


Figure 49. Fishery female 2006 conditional age-at-length data and model fits.

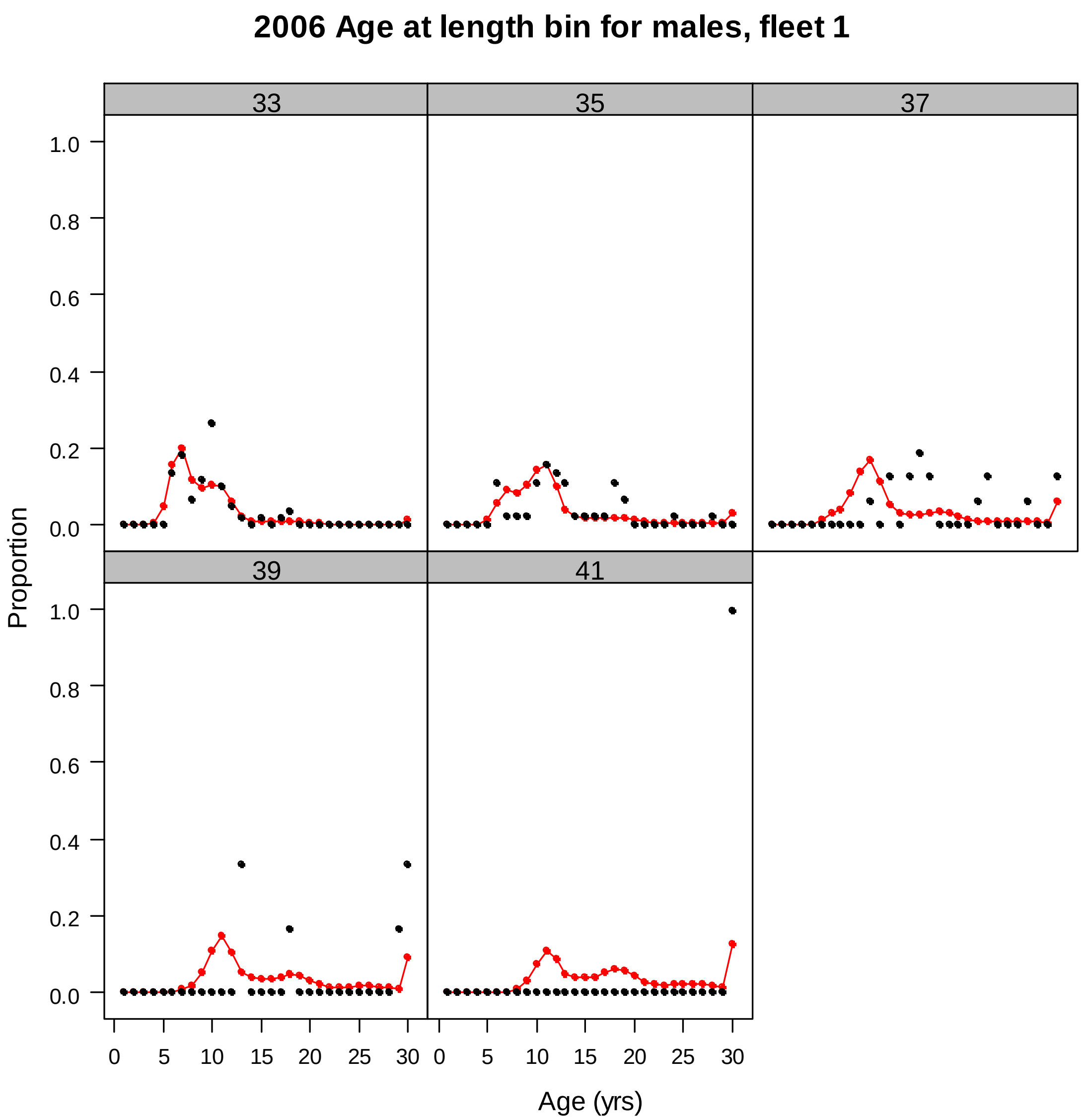


Figure 50. Fishery male 2006 conditional age-at-length data and model fits.

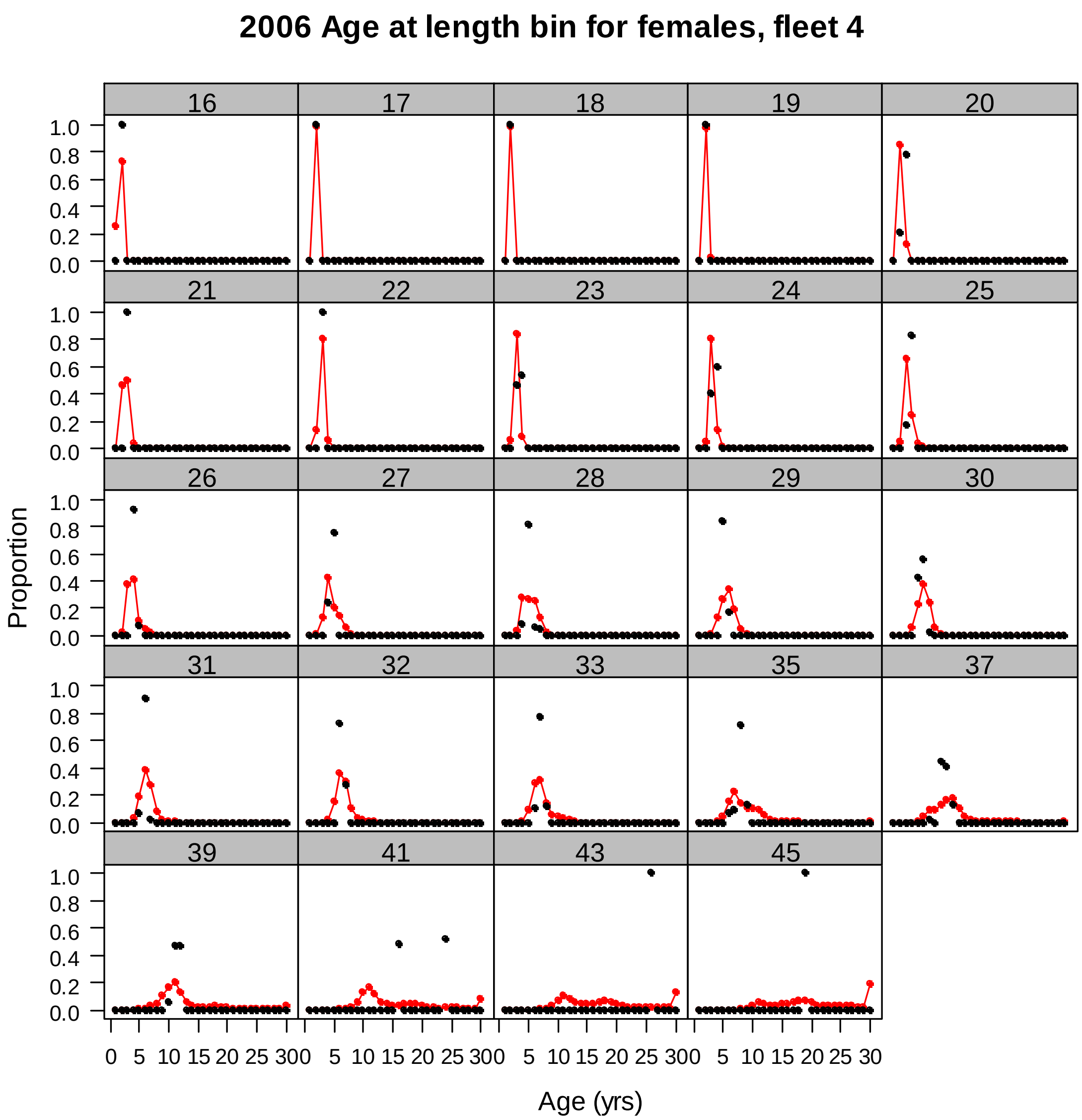


Figure 51. NWFSC Slope Survey female 2006 conditional age-at-length data and model fits.

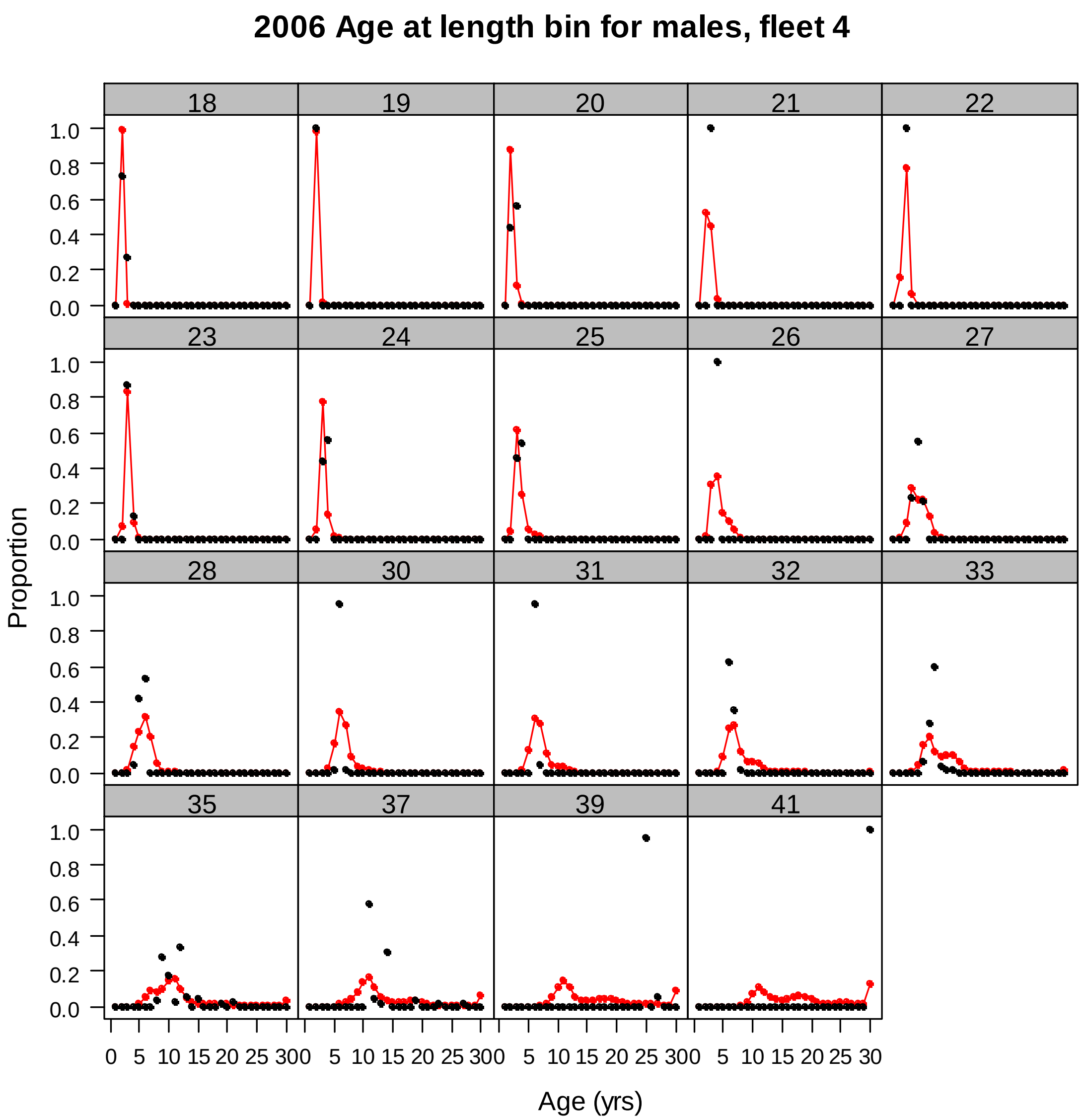


Figure 52. NWFSC Slope Survey male 2006 conditional age-at-length data and model fits.

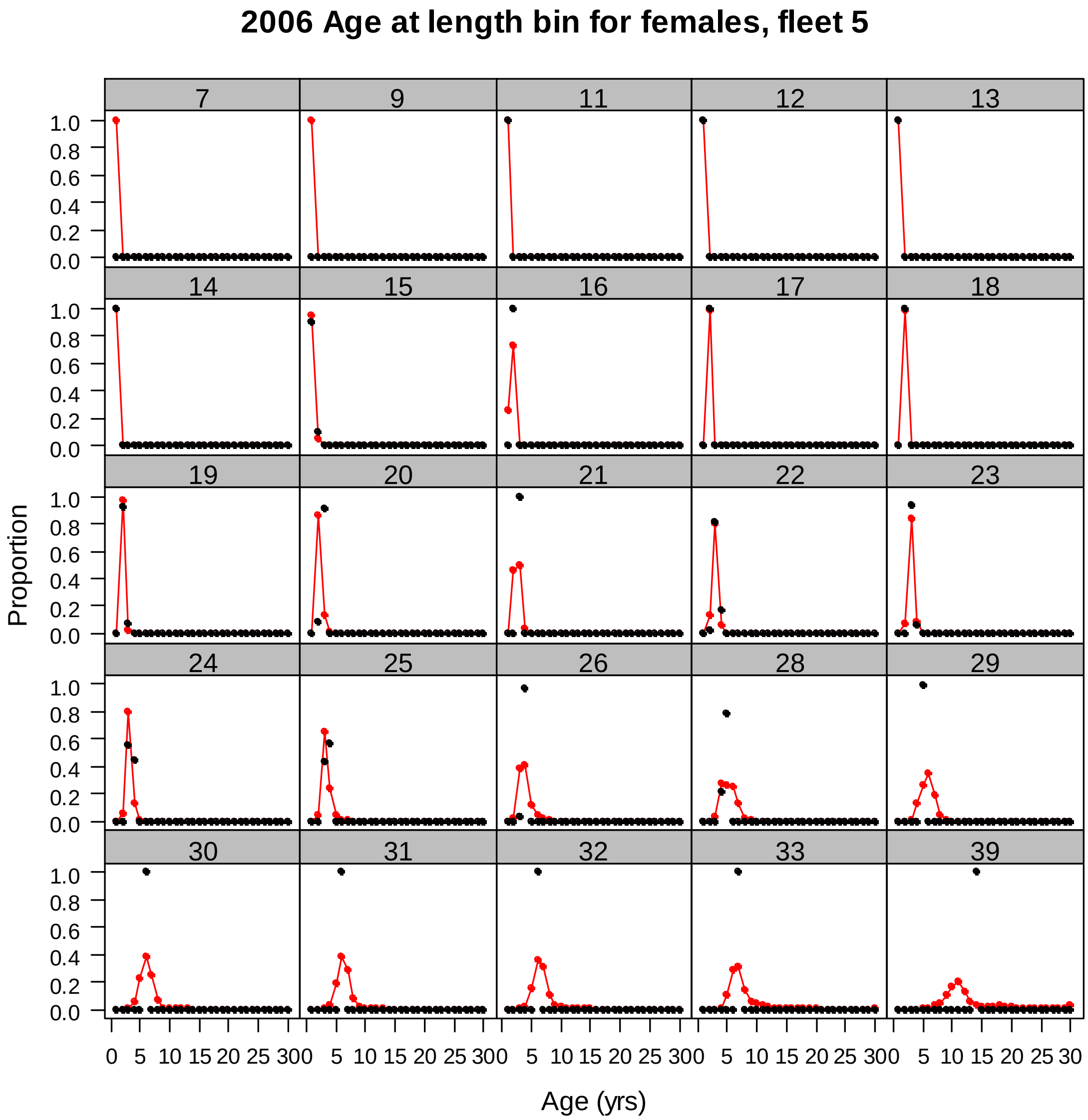


Figure 53. NWFSC Shelf Survey female 2006 conditional age-at-length data and model fits.

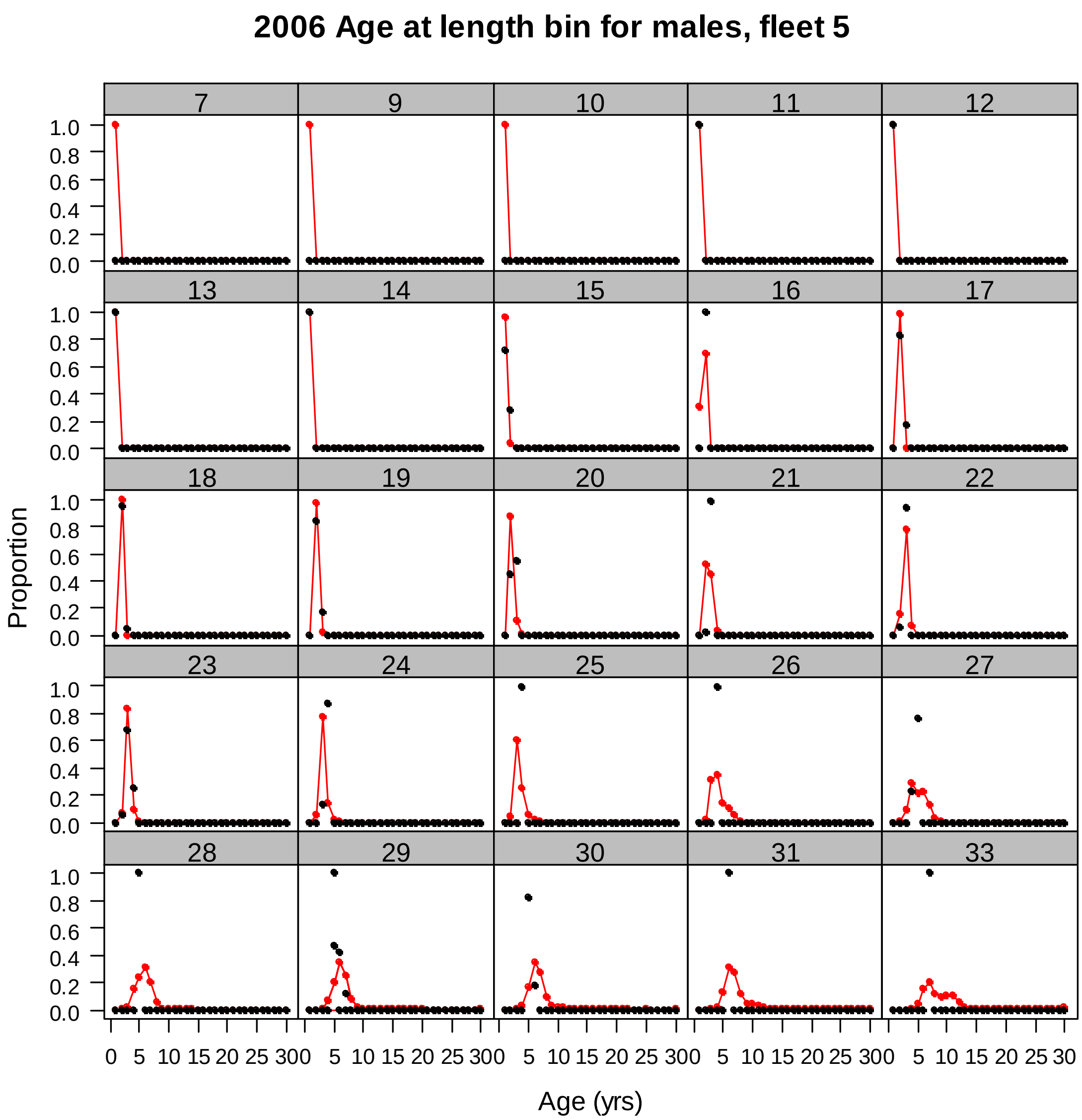


Figure 54. NWFSC Shelf Survey male 2006 conditional age-at-length data and model fits.

Appendix: Input Files

Starter File:

```
##  SS2 Version 2.00.f
dat.txt
ctl.txt
0  #Read SS2.PAR 1= yes
1  #Verbosity
1  #detailed .rep file
0  #number of boostrap files to create
9  # Phases greater than this are set to -1
Code_version_:_
10 #burn in for mcmc chain
2  #thinning intervalfor mcmc
0.0 #jitter initial param values
0.01   #push init param values from bounds
-1     #min year for spbio sd report (neg value to styr-2; virgin level)
-1     #max " (neg = endyr)
0.0001 #convergence criterion
0 #retrospecitive year beyond which obs data nullified (0 = no retro, neg value = # years
to ignore)
1 #fishery keeper (1 = normal, 0 = set all to 0 (for dynamic Bzero)
0.06 # Ball Park F
1999 # year for above
1 #F method = 1 = popes (as in V.1.xx), 2 = continuous F
1 #summary age
1 #forecast option 0-4
1 #MSY option 0-4
0 #Do output for rebuilder package
1999 #year declared for rebuilder package
-1 #start year for rebuilding package (-1 sets to endyr+1)
```

Control File:

```
##  SS2 Version 2.00.f
##
1 # Morphs
1 # Sub-Morphs
1 # Areas
1  1  1  1  1 # Areas per Type
# Recruitment Distribution Pattern
1  # Recruitment distribution
0 # Allow Seasonal Recruitment Interaction
0 # Allow Migration
0  0  0 #dummy for migration
2 # Blocks
1  2  #blocks in each design
2000 2006
2000  2002  2003  2006
0.5 # Recruit Fraction Female
1000 # Sub-Morph Ratio Between/Within
-1  # Sub-Morph Distribution
# Natural Mortality & Maturity
4 # last age for M young
15 # first age for M old
1.7 #age for growth Lmin
29 #Age for growth Lmax
0.1 #SD constant added to Length at age (0.1 to mimic SS2 v 1.xx)
0 #Variability about growth (0 CV~f(LAA) (as in SS2v1.xx),1 CV~f(A), 2 sd~(LAA), ,3
sd~f(A)
1 #maturity option - 1 L logistic, 2 age log. 3 read mat at age
2 # first age allowed to mature
3  #Mg parm offset option
1 #MG parm adjust method
-7 #MG parm dev phase
# Maturity & Growth Parameters
```

```
# min   max    init     prior pr_type  sd      phase   env     UseDev  Minyr   Maxyr   DevSD
        use_bl bl_type
0.01    0.15    0.07    0.08    0       0.8     -3      0       0       0       0       0
        0       0       # natM Young
-3      3       0       0       0       0.8     -3      0       0       0       0       0
        0       0       # natM old exp offset
12      16      14.5    14.6    0       5       2       0       0       0       0       0
        0       0       # Lmin
40      60      42.44   42.5    0       10      2       0       0       0       0       0
        0       0       # Lmax
0.05    0.25    0.215   0.2     0       0.8     3       0       0       0       0       0
        0       0       # VBK
0.05    0.25    0.065   0.07    0       0.8     3       0       0       0       0       0
        0       0       # CV Young
-3      3       0       0       0       0.8     4       0       0       0       0       0
        0       0       # CV old offset
-3      3       0       0       0       0.8     -3      0       0       0       0       0
        0       0       # Male natmort offset
-3      3       0       0       0       0.8     -3      0       0       0       0       0
        0       0       # male natmore offset
-3      3       0       0       0       0.8     -5      0       0       0       0       0
        0       0       # Male Lmin offset
-3      3       -0.12   0       0       0.8     3       0       0       0       0       0
        0       0       # Male Lmax offset *
-3      3       0.233   0       0       0.8     3       0       0       0       0       0
        0       0       # Male VBK offset *
-3      3       0       0       0       0.8     -6      0       0       0       0       0
        0       0       # Male cv Y offset
-3      3       0       0       0       0.8     -6      0       0       0       0       0
        0       0       # Male cv old offset
-3      3       2.10E-05 0      0       0.8     -3      0       0       0       0       0
        0       0       # F L to wt coeff
-3      3       2.96142 2.64694 0       0.8     -3      0       0       0       0       0
        0       0       # F L to Wt exp
0       60      34.59   55      0       0.8     -3      0       0       0       0       0
        0       0       # Mat infl
-3      3       -0.6429 -0.25   0       0.8     -3      0       0       0       0       0
        0       0       # Mat logistic slope (negative)
-3      3       0.1458  1       0       0.8     -3      0       0       0       0       0
        0       0       # fecund intercept
0       2       1.325   1       0       0.8     -3      0       0       0       0       0
        0       0       # fecund multiplier
-3      3       2.10E-05 0      0       0.8     -3      0       0       0       0       0
        0       0       # Male L to wt coeff
-3      3       2.96142 2.64694 0       0.8     -3      0       0       0       0       0
        0       0       # Male L to wt exp
0       1       1       1       0       50      -50     0       0       0       0       0
        0       0       # Recruitment apportionment by growth pattern
0       1       1       1       0       50      -50     0       0       0       0       0
        0       0       # Rec app by Area
0       1       1       1       0       50      -50     0       0       0       0       0
        0       0       # Rec app by Season
0       1       1       1       0       50      -50     0       0       0       0       0
        0       0       # Cohort growth deviation

0 # Environmental Custom Flag
0 # TimeBlock Custom Flag


3 #Recruitment Function 1 BH w/flat top, 2 Ricker, 3 BH, 4 none
# Recruitment Parms
# Low   High    Init    Prior PrType    SD      phase
3       31      8.2     8       0       10      1       # R0
0.2     0.95    0.6     0.507   2       0.141   -2      # h
0       2       0.8     0.8     0       0.8     -1      # sigma R
-5      5       0       0       0       1       -3      # Env link coeff
-5      5       0       0       0       1       -3      # Init Equilb offset to virgin
-1      1       0       0       0       100     -1      # placeholder for Autocorrelation


0 #Index of Env Var
```

```
2 #Env target param - 1 = rec devs, 2 = R0, 3 = h
1 #Rec dev type 0 = none, 1 = devvector (sum=0), 2 = simple deviations
1975 #First year of rec resid
2005 #Last year of rec resid
-8 # Lower bound
8  #Upper bound
3  #Phase
1900  #First year of full bias correction linear ramp for this year - plus-age to this
year
# Initial Fishing Mortality Parameters
0  1  0  0.01  0  99  -1

# Catchability Specification
0  0  0  0  1  0
0  0  0  0  1  0
0  0  0  0  1  0
0  0  0  0  1  0
0  0  0  0  1  0

# Catchability Parameters
#-10  10  -1 -1  0  99  1
#-10  10  -1.5 -1.5  0  99  1
#-10  10  -1.8 -1.7  0  99  1
#-10  10  -1.8 -1.7  0  99  1

# Selectivity Specification
#Type   Retent  Moffset Special
#Length
24      1       0       0 #Fishery
24      0       0       0 #Triennial
24      0       0       0 #AFSC slope
24      0       0       0 #NW slope
24      0       0       0 #NW shelf

10      0       0       0 #AGe selects 10 = flat
10      0       0       0
10      0       0       0
10      0       0       0
10      0       0       0

# Selectivity Parameter
#Peak
#Width
#Var Asc
#Var desc
#init
#Final
#Low    High    Init    Prior   PrType  SD      Phase   env     usedev  minyr   maxyear sd
        block   blswitch
20      45      36      32      0       50      2       0       0       0       0       0.5
        0       0       # 1 = baseparm*exp(blockparm)
-6      4       1       0       0       50      2       0       0       0       0       0
        0       0
-1      9       4       4       0       50      3       0       0       0       0       0
        0       0

-1      9       5       5.5     0       50      3       0       0       0       0       0
        0       0

-5      9       -2      -2      0       50      2       0       0       0       0       0
        0       0

-5      9       9       5       0       50      -3      0       0       0       0       0
        0       0

15      70      27      35      0       99      2       0       0       0       0       0.5
        1       2
0.1     10      2       1       0       99      2       0       0       0       0       0.5
        0       0       # 1 = parm + blockparm
0.001   1       1       1       0       99      -3      0       0       0       0       0.5
        2       2       # 2 = parm' = blockparm
```

0	0	0	0	0	99	-3	0	0	0	0	0.5
	0	0									
10	45	21	23	0	50	2	0	0	0	0	0
	0	0									
-6	4	-4	-1	0	50	2	0	0	0	0	0
	0	0									
-1	9	4	4	0	50	3	0	0	0	0	0
	0	0									
-1	9	4	6	0	50	4	0	0	0	0	0
	0	0									
-5	9	-2	-4	0	50	2	0	0	0	0	0
	0	0									
-5	9	-3	-1	0	50	3	0	0	0	0	0
	0	0									
10	45	23	28	0	50	2	0	0	0	0	0
	0	0									
-6	4	-1	-1	0	50	2	0	0	0	0	0
	0	0									
-1	9	2	4	0	50	3	0	0	0	0	0
	0	0									
-1	9	2	4	0	50	3	0	0	0	0	0
	0	0									
-5	9	-5	-4	0	50	-4	0	0	0	0	0
	0	0									
-5	9	-4	-2	0	50	3	0	0	0	0	0
	0	0									
10	45	25	28	0	50	2	0	0	0	0	0
	0	0									
-6	4	3	1	0	50	2	0	0	0	0	0
	0	0									
-1	9	3	4	0	50	3	0	0	0	0	0
	0	0									
-1	9	4	4	0	50	3	0	0	0	0	0
	0	0									
-5	9	-5	-4	0	50	-4	0	0	0	0	0
	0	0									
-5	9	9	1	0	50	-3	0	0	0	0	0
	0	0									
8	45	18	20	0	50	2	0	0	0	0	0
	0	0									
-6	4	-1	-1	0	50	3	0	0	0	0	0
	0	0									
-1	9	0	2	0	50	3	0	0	0	0	0
	0	0									
-1	9	3	4	0	50	4	0	0	0	0	0
	0	0									
-5	9	-1	-3	0	50	4	0	0	0	0	0
	0	0									
-5	9	-5	-4	0	50	-3	0	0	0	0	0
	0	0									

```
1 # 2 = new (v2.00.c) sel parm adjust method, 1 old
0 # Environmental Custom Flag
```

```
1 # TimeBlock Custom Flag # 1
#-10 10 0 0   0  50  3
#-5 9 -4 -4   0  50  4
#-5 9 8 8   0  50  4
15  70  25  30  0  99  4
0.3  1  .7  .7  0  99  3
0.3  1  .8  .8  0  99  3

-4 #selparm_dev_phase
# Variance Adjustment Factors
0  0  0  0  0   # const added to survey cv
0  0  0  0  0   # const added to discard sd
0  0  0  0  0   # const added to body weight sd
.76  .71  .64  .69  1   # mult scalar for length comps
1 .71  1  1  1   # mult scalar for age comps
1  1  1  1  1   # mult scalar for length at age obs

# Degrees of Freedom for Discard & Mean Body Weight
30
30
# Lambdas
1 # Max Lambda Phase
0 # sd offset
# CPUE Lambda
0
1
1
1
1
# Discard Lambda
1
0
0
0
0
# Mean Body Weight
0
# Length Composition
1
1
1
1
1
# Age Composition
1
1
1
1
1
# Mean Size at Age
0
0
0
0
0
# Initial Equilibrium
0
# Recruitment Deviations
1
# Prior Lambda
1
# Deviation Time Series
1
# Crash Penalty lambda
50
0.9 # Max Allowable Harvest Rate
999
```

Data File:

```
##rewt half length discard n for rewt
##  SS2 Version 2.00f
1928 # start year
2006 # end year
1       # N seasons per year
12      # Months per season
1       # Spawning Season
1       # N fishing fleets
4       # N surveys
FISHERY%TRIENNIAL%SLOPE%NWSLOPE%NWSHELF #Names divided by "%"
0.5  0.7  0.92  0.6  0.6 #Timing of each fishery/survey (.42 POP)
2       # Number of Genders
45      # Accumulator age
# Catch
0       #inital equilibrium catch
# Landings
1  #1928
3
3
1
1
1
2
2
2
2
5
7
8
9

10
39
91
236
160
100
160
171
201
261
195
194
201
197
244
269
246
243
258
203
276
323
208
415
4129
3001
2358
256
265
441
595
836
733
567
574
263
410
992
```

```
557
956.5 #1981-2004 updated 6.14.2007
1116.2 #Tagart 1982 value for Oregon = 920
939.9
1273.8
1787.1
1265.2
2420.0
1655.1
1274.9
1650.9
1208.1
687.4
1193.7
864.4
783.0
729.6
824.1
944.0
361.8
262.0
173.2
112.6
80.0
189.0
104.7 #2005 New 6.14.2007
113.3 #2006 New 6.14.2007

25   # number of Survey data points
1980  1  2  1189  0.377  # Triennial
1983  1  2  1825  0.206
1986  1  2  1641  0.325
1989  1  2  1179  0.234
1992  1  2  1129  0.265
1995  1  2  718   0.261
1998  1  2  818   0.236
2001  1  2  601   0.225
2004  1  2  1397  0.258
1997  1  3  578   0.813 #AFSC slope
1999  1  3  407   0.407
2000  1  3  520   0.526
2001  1  3  724   0.755
#1979  1  4  4555  0.41  #POP (not GLMM'd) added .2 to cvs
#1985  1  4  5595  0.37
1999  1  4  790        0.430  #NWFSC slope
2000  1  4  1098 0.456
2001  1  4  495  0.416
2002  1  4  827  0.410
2003  1  4  3885 0.467
2004  1  4  1254 0.431
2005  1  4  1789 0.405
2006  1  4  1487 0.352
2003  1  5  422  1.391 #NWFSC shelf
2004  1  5  265  1.011
2005  1  5  244  0.590
2006  1  5  228  0.526
2   # Discards Type 1 = biomass(mt), 2 = fraction of total
7   # Discards N observations
1986  1  1  0.05  0.3
2000  1  1  0.32  0.2
2001  1  1  0.41  0.2
2002  1  1  0.47  0.1
2003  1  1  0.33  0.1
2004  1  1  0.21  0.1  #Updated based on new info
2005  1  1  0.24  0.1  #NEW
0   # Mean Body Weight
#2002  1  1  1  0.52  0.3
#2003  1  1  1  0.73  0.3

# Composition Conditioners
-0.0001 #compress tails until observed proportion is greater than (- = no compression)
```

```
0.0001 #Add to obs and exp proportions then renormalize
37 # Number of Length Bins
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  35  37  39  41  43  45  47  49  51

57   # Length Composition Observations
#Year   Seas    Fleet   Gender  Part    effn    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
        35      37      39      41      43      45      47      49      51      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      35      37      39      41      43      45      47
        49      51
1977    1       1       3       2       22      0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0
        0.006578947     0       0.023026316     0.016447368     0.029605263     0.078947368
        0.065789474     0.072368421     0.082236842     0.046052632     0.046052632
        0.075657895     0.016447368     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0.003289474     0.003289474
        0.013157895     0.016447368     0.032894737     0.0625  0.078947368     0.085526316
        0.049342105     0.036184211     0.032894737     0.019736842     0       0
        0.003289474     0       0       0       0.003289474     0       0
1978    1       1       3       2       9       0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0.01    0.015   0.025   0.04    0.045   0.06    0.065   0.09    0.12
        0.015   0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0.02    0.04    0.055   0.08
        0.145   0.065   0.05    0.055   0.005   0       0       0       0       0       0
        0       0
1981    1       1       3       2       44      0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0.009352168     0       0.000923447     0.009658981     0
        0.017071936     0.009914631     0.002308139     0.004315309     0.029660242
        0.079223767     0.163936007     0.201138023     0.07768508      0.045483208
        0.007295434     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0.001580486     0       0.001576187     0
        0.004283547     0.007270873     0.046535231     0.184208021     0.087405632
        0.009173651     0       0       0       0       0
1982    1       1       3       2       89      0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0
        0.000209381     0       0.000276902     0.001000681     0.00038614      0.005672158
        0.006879098     0.010054919     0.006879155     0.01852027      0.035607596
        0.035969079     0.09680007      0.106453931     0.150588258     0.107370175
        0.050012385     0.016759029     0.003351308     0.018290696     0.003854013     0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0.002052348     0.000400223     0.00490636
        0.003430074     0.001632034     0.005899893     0.004138135     0.010646879
        0.008556366     0.01623941      0.049246598     0.12613895      0.064697219
        0.015629436     0.004155975     0.005121676     0.000582645     0.000582645
        0.000582645     0.000425247
1983    1       1       3       2       165     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0.001558261     0.000755252     0.001921727     0.001684603     0.002958102
        0.001907771     0.005548072     0.006593778     0.005409392     0.025342831
        0.042579281     0.129231481     0.106978782     0.158768882     0.066233371
        0.034024602     0.006325025     0.004974093     0.002342174     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       4.20147E-05     0.000553799     0.000278982     0.00073901
        0.001073818     0.001301158     0.004911195     0.004834157     0.010500749
        0.013123356     0.047878464     0.108049036     0.113874963     0.062764421
        0.017942506     0.000784066     0.002421205     0       0.001894812     0.001894812
1984    1       1       3       2       333     0.00    0       0       0       0       0
        0       0       0       0       0.0001455       0       0       0       0       0
        0       0       0.000273317     0.000479761     0.000723049     0.001014262
        0.007088889     0.012052446     0.011529141     0.00817034      0.018918255
        0.032310116     0.062905043     0.118295281     0.099920392     0.107032918
        0.081542127     0.035738699     0.008357854     0.002410767     0       0       0
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        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0.001903934     0.002068308     0.000882328
        0.000807418     0.003281165     0.009473278     0.007829539     0.0083354
        0.016750228     0.064557223     0.123650076     0.087221681     0.055677021
        0.005926855     0.001267992     0.001232823     0       0       0.000226573
1985    1       1       3       2       486     0.00    0       0       0       0       0
        6.46695E-05     0       0       0       0       0       0       0       0
        0.000356996     5.30603E-05     0.000379775     0.001248356     0.000821946
        0.001327191     0.004531869     0.00414171      0.007254773     0.017542105
        0.023968267     0.034859106     0.057125733     0.070378564     0.079307216
        0.08456412      0.07108764      0.042441247     0.028954555     0.002628247
        0.001280595     0.000285876     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       3.98455E-05     0
        0.000421666     0.000121728     0.000439149     0.002210422     0.001835626
        0.005776825     0.004297625     0.013519143     0.016396334     0.023866345
        0.041263531     0.084824282     0.119990452     0.079574708     0.04171739
        0.017789248     0.006301526     0.002437656     0.001143502     0.001143502
        0.000285876
1986    1       1       3       2       278     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0.002071054     0       0.000159037     0.000739251     0.001897864     0.002365606
        0.007196057     0.012056497     0.016022808     0.045839908     0.123178156
        0.081935263     0.097712823     0.085617346     0.075472013     0.028118091
        0.011721602     0.001773021     6.52695E-05     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0.002071054     0       0.000159037     6.52695E-05     0.000366787     0.001610705
        0.003423968     0.005407715     0.00795615      0.01719403      0.026988024
        0.036217687     0.089140217     0.114044498     0.072261733     0.024888035
        0.004263426     0       0       0       0       0
1987    1       1       3       2       412     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0
        5.13221E-05     5.13221E-05     0.000393739     0.000781583     0.000356925
        0.00034488      0.000240063     0.001776388     0.004286446     0.007125981
        0.01730589      0.071290522     0.119509346     0.12964213      0.082883901
        0.037657544     0.013366455     0.001432218     0.000578332     0.000119354     0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       7.33442E-05     0.000184316     0.000172226
        0.000261177     0.000351181     0.000270387     0.002035782     0.003762314
        0.012557375     0.018388235     0.044763024     0.138283505     0.170281506
        0.092834757     0.019667667     0.003648208     0.002094189     0       0.000986991
        0       0.000189475
1988    1       1       3       2       187     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0.000661529     0.000196366     0.000196366     0.002288348     0.001753395
        0.000845588     0.004490349     0.001996761     0.003119104     0.011005669
        0.090355708     0.131260802     0.108269463     0.113863453     0.049264139
        0.011334184     0.003469253     0.002226819     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0.00061068      0.000838988     0.002180599
        0.001374062     0.002724592     0.007244706     0.007556083     0.033517473
        0.115773569     0.160844237     0.094703317     0.030369262     0.005380377     0
        0.000284758     0       0       0
1989    1       1       3       2       144     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0.000788562     0       0
        0       0       0.000342101     0.000684202     0.003813284     0.006497847
        0.008279591     0.011320896     0.006280937     0.019584264     0.021176669
        0.068227491     0.152058179     0.070295726     0.070753187     0.039862396
        0.02535664      0.01054275      0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0.000788562
        0       0       0       0.000342101     0       0.000840567     0.005667921
        0.008389814     0.004228372     0.006906767     0.014798088     0.014258987
        0.038924843     0.150251382     0.15339481      0.056826018     0.024289354
        0.004111149     0       0       0.000116543     0       0
1990    1       1       3       2       183     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0.003509186     0.007076532     0.012307275     0.005499779
        0.010292605     0.0178002       0.026634944     0.066443951     0.078963855
        0.102143846     0.081646352     0.047993095     0.051572853     0.022488357
        0.00733607      0.004945395     0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0.002037258     0.000794896     0.004306384     0.012841297
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        0.021916993   0.020533715   0.026667583   0.115233875   0.113686381
        0.07186936    0.046307552   0.015132791   0.002017621   0      0      0
        0
1991    1      1      3      2      143    0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0
        0.004502616   0.001125654   0.004171721   0.011722977   0.008692469
        0.006130147   0.008949655   0.012865958   0.009707662   0.020097676
        0.01521165    0.036985609   0.077349652   0.092913414   0.100668455
        0.071645477   0.093169508   0.03928339    0.014403562   0.000973144   0
        0      0      0      0      0      0      0      0      0      0      0
        0.000156387   0.000156387   0      0.000936875   0      0      0.000253575
        0.005315507   0.004363072   0.011188102   0.009460796   0.006194133
        0.010109999   0.009935742   0.006951237   0.015268149   0.074181058
        0.104470409   0.057022386   0.041166472   0.008699816   0.0035995     0
        0      0      0
1992    1      1      3      2      58     0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        0      0.001834152   0      0.005064503   0.002045318   0.003100424
        0.010497037   0.006619798   0.021779543   0.029846103   0.044157496
        0.074575408   0.097876095   0.123876327   0.08100722    0.058061504
        0.014121777   0.001502666   0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        0      0      0.001834152   0      0.000376819   0.000587985   0.012786846
        0.010456193   0.025858325   0.009282842   0.020880342   0.055033373
        0.123374151   0.105258023   0.045698233   0.007414299   0.002535094   0
        0.002657951   0      0
1993    1      1      3      2      66     0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0.001326852   0.001326852
        0.000529545   0.000627547   0.000698097   0.00465315    0.001749212   0
        0.003644621   0.008934061   0.012401269   0.019291458   0.032008647
        0.025389116   0.035429065   0.084834623   0.086639714   0.057803359
        0.035916937   0.010201857   0.006681646   0.002653704   0.001326852   0
        0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0.002967805   0.000627547   0      0.000891664
        0.00066896    0.001951283   0.000514647   0.025643361   0.010762748
        0.031407735   0.032932631   0.035250464   0.133968983   0.168430268
        0.077328712   0.026204645   0.013801075   0.002579289   0      0      0
        0
1994    1      1      3      2      119    0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0
        0.000486962   0.0005523     0.001261186   0.002080256   0.000206603
        8.08674E-05   0.00395701    0.003671261   0.016330346   0.017242556
        0.031433589   0.068712007   0.083310377   0.072308072   0.09507374
        0.057324993   0.044985485   0.016925356   0.004257853   0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0.000774224   0.000387112
        0.001110299   0.000206603   0.002941659   0.00509324    0.019123151
        0.017938335   0.044080903   0.117328466   0.115705675   0.094963222
        0.047738785   0.009108951   0.000720429   0.000162525   0.002415603   0
        0
1995    1      1      3      2      182    0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        7.5112E-05    0.000842581   0.00103051    0.004328691   0.000298303
        0.000353183   0.003162351   0.003903803   0.01492967    0.030259922
        0.067003728   0.086987607   0.110947827   0.090413201   0.089036943
        0.043183575   0.01205678    0.001709596   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        0      0      0.000176592   0.000151496   0      0.000257318   0.003482031
        0.001496789   0.003280135   0.003258285   0.006303803   0.038715587
        0.05642791    0.100674695   0.137462385   0.064107783   0.018006873
        0.003596029   0.000210132   0.001868772   0      0      0
1996    1      1      3      2      425    0.00   0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0
        4.4132E-05    9.79892E-05   0.001017638   0.001810586   0.002524783
        0.003911297   0.008358274   0.00499809    0.010147499   0.011154298
        0.014841308   0.068020984   0.072108902   0.078021995   0.072263013
        0.058561772   0.032922472   0.018824588   0.004818657   0.001283494   0
        0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0.000738064   0.002115989
        0.002135368   0.003965466   0.003747479   0.006087129   0.008217658
        0.019305634   0.037848989   0.063050967   0.146403653   0.155591814
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        0.05245478      0.021938869     0.005684752     0.001754296     0.00126601
        0.00137796      0.000583352     0
1997    1       1       3       2       405     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0
        0.000107574     0.001286331     0.003112263     0.004527188     0.007768017
        0.004160193     0.010876911     0.013772948     0.020018207     0.016811859
        0.034504001     0.062972004     0.074900139     0.071906155     0.075918314
        0.061748173     0.036327925     0.028495065     0.004323518     0.00234148      0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0.000240184     0       0.000765582     0.001101765
        0.002852196     0.007999562     0.003568754     0.007733687     0.01729388
        0.031664628     0.029503885     0.05100225      0.105120983     0.109387124
        0.054315905     0.028789816     0.009183832     0.002756809     0.000764451
        7.64451E-05     0       0

1998    1       1       3       2       413     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0.00077297
        0.001710499     0.000595458     0.003524946     0.004954793     0.006429663
        0.010992014     0.013309321     0.015245814     0.011396353     0.021977456
        0.019643736     0.059829735     0.067030796     0.095875499     0.072577318
        0.073341428     0.049825482     0.017456194     0.003512397     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0.000684321     0.001993926     0.002259521     0.003921156
        0.006969045     0.017105825     0.014467784     0.015986877     0.014165177
        0.016693662     0.017883009     0.031793267     0.113308959     0.095849058
        0.057319504     0.025982234     0.009297566     0.001010899     0.000466569
        0.00206659      0.000773178     0
1999    1       1       3       2       283     0.00    0       0       0       0       0
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        0.003302169     0.002475511     0.007438374     0.01766571      0.031852205
        0.040150355     0.037303993     0.032815354     0.042094662     0.019545283
        0.018221781     0.039840287     0.076460423     0.076567399     0.042771808
        0.031086862     0.020513626     0.012963533     0.00433673      0.000994425
        0.000133616     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0.00063759      0.001029413
        0.005024613     0.008747049     0.015627039     0.042818832     0.026758096
        0.034498175     0.031109732     0.032229715     0.024779777     0.023918037
        0.070250385     0.064077541     0.034598183     0.020983278     0.003197983
        0.000267232     0.000133616     0       0.000267232     0.000133616
2000    1       1       3       2       338     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0
        0.000639877     0.000362422     0.001323518     0.00590163      0.0110556
        0.014979416     0.045363009     0.042304294     0.040805138     0.044344475
        0.049902656     0.049267739     0.045232306     0.050065879     0.054747034
        0.04862616      0.025973569     0.015225913     0.001696292     0.00044911      0
        0       0       0       0       0       0       0       0       5.81063E-05     0
        0.000116213     0       0       0       0       0       0.001520227     0.001269471
        0.006045863     0.001421582     0.017725991     0.020600764     0.039255683
        0.051223399     0.051232118     0.026024049     0.039170777     0.068554806
        0.060494894     0.040467463     0.019758711     0.004838564     0.0008137
        0.000921161     5.04885E-05     0.000169932     0
2001    1       1       3       2       538     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0.0004126
        0.000565224     0.000962535     0.000343335     0.001009835     0.004227819
        0.006504627     0.009313837     0.023128351     0.021078364     0.052456174
        0.066198822     0.069522369     0.09263898      0.050794878     0.029205079
        0.030043291     0.018447661     0.014555963     0.010743217     0.003761249
        5.33968E-05     0.000274668     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0.002724611     0
        0.0004126       0.000310116     0.000618003     0.002438096     0.004869561
        0.013859663     0.031992527     0.039997801     0.067099195     0.073832988
        0.067634494     0.076321501     0.056361103     0.027166211     0.018112717
        0.006746372     0.00168807      0.000578438     0.000993656     0       0
2002    1       1       3       2       455     0.00    0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0.000704333
        0.003054397     0.003202724     0.005323664     0.003790139     0.00547812
        0.005839653     0.010556814     0.010297423     0.018084463     0.025823854
        0.043051972     0.123735428     0.07028114      0.044852441     0.043882823
        0.055643925     0.057480583     0.016076684     0.006399192     0.000755325     0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0.00119196      0.001413878     0.002684754
```

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	0.004116186	0.00368149	0.005571691	0.009152354	0.012983777
	0.017642843	0.027593557	0.047985141	0.066330273	0.099895195
	0.098660903	0.026263208	0.014791388	0.005179363	7.96834E-05
	0.000155753	0	0.000311506	0
2003	1	1	3	2	479	0.00	0	0	0	0	0
	0	0	0	0	6.16818E-05	9.17458E-05	0.000726288
	6.01282E-05	0.00059285	0.000393383	0.001726721	0.001387374
	0.006224385	0.002365948	0.001755124	0.004615748	0.006238493
	0.004538233	0.00755836	0.009809054	0.011480538	0.086516108
	0.134030401	0.089972147	0.060373103	0.047144544	0.044701015
	0.019539008	0.004892412	0.002024299	0.000262553	0	0	0
	0	0	0	0	0	0	0	6.16818E-05	0.000151874
	0.000402705	0.00036798	0.000578488	0.001309846	0.001552878
	0.003261087	0.002742601	0.002099171	0.002431258	0.004591832
	0.011443694	0.010047596	0.014893835	0.020495555	0.040983798
	0.142879073	0.09689387	0.061865398	0.017075806	0.008368159
	0.002962136	0.003078653	0	0	0.00037938
2004	1	1	3	2	499	0.00	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	7.32641E-05	0	0.000598524	0.006170027	0.00674888	0.00803408
	0.014796286	0.016238221	0.017587649	0.026779299	0.045130183
	0.088193406	0.060646497	0.075707574	0.07144489	0.035479158
	0.022235967	0.011319017	0.000713445	0.000596483	0	0	0
	0	0	0	0	2.78887E-05	0	0	0	0	0
	0	0	0	0	2.78887E-05	0.000158889	0.005454061
	0.00152489	0.008370252	0.011447853	0.02484531	0.031404379
	0.045674303	0.041021577	0.127518985	0.111140163	0.057467138
	0.018281841	0.003935684	0.00191987	0.001286177	0	0	0
2005	1	1	3	2	386	0.00	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	8.7425E-05	4.31757E-05	0.001553216	0.001683198	0.004324975
	0.007606499	0.011145276	0.016083496	0.025052334	0.034088456
	0.04672868	0.077008893	0.087901845	0.094300228	0.062991708
	0.040743933	0.020965344	0.005835447	0.005011961	0.001185878
	0.0005718	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.000576343	0.000161272
	0.001173837	0.002167191	0.005559964	0.011543479	0.013498114
	0.015441683	0.038886897	0.052027269	0.046117082	0.102524631
	0.099080228	0.041466011	0.018567018	0.004904467	0.000555271
	0.000413116	0.000137705	0	0.000284654
2006	1	1	3	2	244	0.00	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0.000253014	0.000927719	0.000674705	0.000506029	0.002704169
	0.007110264	0.002624141	0.017605568	0.031712362	0.069000176
	0.091869841	0.067975115	0.08383897	0.045817189	0.030987837
	0.023855064	0.009679905	0.001777844	0.000337352	0.000933291	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.000253014	0.000421691	0.000506029
	0.000755674	0.001083829	0.009770011	0.012830207	0.035375247
	0.068107835	0.06173724	0.14102891	0.09982894	0.051576337
	0.020851345	0.003219011	0.001787269	0.000676857	0	0	0
#Discard
#1986	1	1	0	1	100	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.006756757
	0.006756757	0.040540541	0.040540541	0.081081081	0.101351351
	0.074324324	0.108108108	0.195945946	0.195945946	0.074324324
	0.067567568	0.006756757	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	127	0	0	0	0	0
	0.000500134	0.000500134	0.000500134	0	0.000500134	0.006299151
	0.011800624	0.018445049	0.023404997	0.023231734	0.052289594
	0.055042128	0.04520059	0.104138479	0.079559171	0.05004554
	0.020914966	0.024717381	0.019531991	0.025855856	0.022694644
	0.047039058	0.140564336	0.129710719	0.063745901	0.014279025
	0.011893171	0.005696519	0.00189884	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	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       1       0       1       159     0       0       0       0       0       0
        0       0.000219668     0       0.000219668     0.000329503     0.000329503
        0.000109834     0.004497106     0.0159139       0.022500811     0.029892874
        0.025016281     0.016417594     0.008035254     0.003723185     0.02541656
        0.02650659      0.038107796     0.026789967     0.034143595     0.086330864
        0.248692702     0.18653093      0.100521041     0.053012453     0.02922873
        0.00521923      0.00858063      0.003713731     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       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       0       1       182     0       0       0       0       0       0
        0.000365581     0.000365581     0.002267614     0.00019591      0.000561491
        0.00058773      0.000757402     0.001978696     0.001025588     0.00058773
        0.004638996     0.005118755     0.015263086     0.022691885     0.019499513
        0.018964023     0.025106964     0.012075538     0.024002538     0.037024115
        0.090885288     0.185661575     0.224603071     0.108596001     0.104098616
        0.032060425     0.051123474     0.009696903     0.00019591      0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       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       1       0       1       319     0       0       0.000334883     0
        0.000358919     0.000900125     0.002784916     0.00542258      0.006575631
        0.007663917     0.00432837      0.010849396     0.019930111     0.01958284
        0.008053074     0.005210488     0.008367227     0.004215873     0.006536775
        0.00640007      0.040282497     0.059461948     0.052043795     0.055854351
        0.062035752     0.076944303     0.063453959     0.178174789     0.169324467
        0.085323657     0.023708242     0.01091535      0.001618782     0.002383113     0
        0.000624914     0.000334883     0       0       0       0       0       0       0
        0       0       0       0       0       0       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       1       0       1       269     0       0       0.000288101     0.001258454
        0.002739218     0.006330344     0.010016292     0.016065028     0.019907314
        0.015747628     0.012170974     0.015308526     0.028993369     0.030891774
        0.029568479     0.043854442     0.02024746      0.023354889     0.013841023
        0.006147608     0.004566981     0.007677204     0.006206044     0.015034299
        0.045687408     0.066375188     0.07006814      0.174153773     0.120797089
        0.0964466       0.021237724     0.040098953     0.024616323     0.005566923
        0.002214352     0       0.002522077     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0
#Discard by half for it rewt
1986    1       1       0       1       50      0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0.006756757
        0.006756757     0.040540541     0.040540541     0.081081081     0.101351351
        0.074324324     0.108108108     0.195945946     0.195945946     0.074324324
        0.067567568     0.006756757     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       64      0       0       0       0       0
        0.000500134     0.000500134     0.000500134     0       0.000500134     0.006299151
        0.011800624     0.018445049     0.023404997     0.023231734     0.052289594
        0.055042128     0.04520059      0.104138479     0.079559171     0.05004554
        0.020914966     0.024717381     0.019531991     0.025855856     0.022694644
        0.047039058     0.140564336     0.129710719     0.063745901     0.014279025
        0.011893171     0.005696519     0.00189884      0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        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       1       0       1       80      0       0       0       0       0       0
        0       0.000219668     0       0.000219668     0.000329503     0.000329503
        0.000109834     0.004497106     0.0159139       0.022500811     0.029892874
        0.025016281     0.016417594     0.008035254     0.003723185     0.02541656
```

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        0.02650659      0.038107796     0.026789967     0.034143595     0.086330864
        0.248692702     0.18653093      0.100521041     0.053012453     0.02922873
        0.00521923      0.00858063      0.003713731     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       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       0       1       91      0       0       0       0       0       0
        0.000365581     0.000365581     0.002267614     0.00019591      0.000561491
        0.00058773      0.000757402     0.001978696     0.001025588     0.00058773
        0.004638996     0.005118755     0.015263086     0.022691885     0.019499513
        0.018964023     0.025106964     0.012075538     0.024002538     0.037024115
        0.090885288     0.185661575     0.224603071     0.108596001     0.104098616
        0.032060425     0.051123474     0.009696903     0.00019591      0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       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       1       0       1       160     0       0       0.000334883     0
        0.000358919     0.000900125     0.002784916     0.00542258      0.006575631
        0.007663917     0.00432837      0.010849396     0.019930111     0.01958284
        0.008053074     0.005210488     0.008367227     0.004215873     0.006536775
        0.00640007      0.040282497     0.059461948     0.052043795     0.055854351
        0.062035752     0.076944303     0.063453959     0.178174789     0.169324467
        0.085323657     0.023708242     0.01091535      0.001618782     0.002383113     0
        0.000624914     0.000334883     0       0       0       0       0       0       0
        0       0       0       0       0       0       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       1       0       1       135     0       0       0.000288101     0.001258454
        0.002739218     0.006330344     0.010016292     0.016065028     0.019907314
        0.015747628     0.012170974     0.015308526     0.028993369     0.030891774
        0.029568479     0.043854442     0.02024746      0.023354889     0.013841023
        0.006147608     0.004566981     0.007677204     0.006206044     0.015034299
        0.045687408     0.066375188     0.07006814      0.174153773     0.120797089
        0.0964466       0.021237724     0.040098953     0.024616323     0.005566923
        0.002214352     0       0.002522077     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0
#Triennial
1980  1  2  3  0       54  0  0  0  0  0  0.0006  0.0016  0.0044  0  0.0014  0.0016  0.004
0.0059  0.0141  0.0011  0.0071  0.0084  0.0103  0.0305  0.0339  0.0402  0.044  0.0434
0.0171  0.0151  0.0348  0.0378  0.0692  0.0327  0.0365  0.0226  0.0096  0.0094  0.0058  0
0  0  0  0  0  0  0  0  0.001  0.003  0.0016  0.0028  0.0023  0.0078  0.009  0.0147
0.0066  0.0059  0.0056  0.0079  0.0074  0.0132  0.0227  0.0171  0.0368  0.0272  0.042
0.0541  0.0356  0.0414  0.0513  0.0366  0  0.0036  0  0  0  0  0
1983  1  2  3  0       210  0  0  0  0  0  0.0006  0.0011  0.0019  0.001  0.0019  0.0043
0.0205  0.038  0.0223  0.0293  0.031  0.0442  0.0396  0.0352  0.034  0.0398  0.0232
0.0151  0.005  0.0062  0.0061  0.004  0.0072  0.0075  0.009  0.0205  0.0212  0.011
0.0044  0.0013  0.0001  0  0  0  0  0  0.0001  0.0012  0.0013  0.0043  0.002  0.0017
0.0055  0.0207  0.0315  0.0316  0.026  0.0377  0.0656  0.0553  0.0402  0.0369  0.0365
0.0256  0.0112  0.0053  0.0074  0.0036  0.0043  0.0063  0.0216  0.0197  0.0085  0.0015
0.0006  0  0  0  0
1986  1  2  3  0       168  0  0  0  0  0.0005  0.0003  0.0004  0.0044  0.0125  0.009
0.0057  0.0029  0.0082  0.0173  0.0148  0.0073  0.0063  0.0105  0.0169  0.0201  0.0325
0.0332  0.0256  0.0458  0.0418  0.0375  0.0304  0.0492  0.0233  0.0116  0.0092  0.0096
0.007  0.0036  0.002  0.0008  0  0.0007  0.0003  0  0  0.0007  0.0001  0.003  0.0052
0.0097  0.0082  0.0047  0.0026  0.0032  0.0106  0.0163  0.0069  0.0061  0.0153  0.0148
0.0197  0.0424  0.0378  0.0378  0.064  0.0412  0.0459  0.0343  0.0282  0.0184  0.0048
0.0096  0.0056  0.0016  0  0  0  0
1989  1  2  3  0       416  0  0  0  0.0002  0.0002  0.0005  0.0061  0.0384  0.0657
0.0285  0.0049  0.015  0.0332  0.0615  0.0318  0.0374  0.0136  0.0204  0.0206  0.0175
0.0168  0.0141  0.0097  0.0087  0.0086  0.0101  0.0033  0.0097  0.0088  0.0071  0.0055
0.0047  0.0004  0.0008  0.0002  0  0  0  0  0  0.0008  0.0003  0.0018  0.0083  0.0378
0.0647  0.0453  0.0079  0.0139  0.0419  0.0571  0.0333  0.0246  0.0157  0.0177  0.0125
0.0172  0.011  0.0151  0.0111  0.0114  0.012  0.0053  0.0069  0.0105  0.0039  0.0033
0.0028  0.0009  0.0005  0.0002  0  0  0
1992  1  2  3  0       135  0  0  0  0  0.0002  0.0016  0  0.0015  0.0022  0.0035  0.0014
0.0004  0.0021  0.019  0.0399  0.0247  0.0061  0.0108  0.0161  0.0287  0.025  0.0466
0.0958  0.0707  0.0447  0.0256  0.0084  0.0078  0.0005  0.0007  0.0004  0.0002  0.0006
```

```
0.0007  0  0  0  0  0  0  0  0.0002  0  0.0013  0.0015  0.0016  0.0048  0.0025  0.0011
0.0038  0.0179  0.0288  0.0287  0.0109  0.007  0.0312  0.0263  0.0188  0.0929  0.111
0.0769  0.0313  0.0085  0.0031  0.0016  0.0009  0.0013  0.0002  0  0  0  0  0  0
1995  1  2  3  0      275  0  0  0.0004  0  0.0003  0.0006  0.0007  0.0082  0.023  0.0121
0.002  0.0006  0.0056  0.0132  0.0085  0.0089  0.0096  0.0264  0.0454  0.0386  0.0243
0.0237  0.0172  0.0134  0.0164  0.0086  0.0083  0.0215  0.0327  0.0337  0.03  0.037
0.0262  0.0101  0.0043  0  0  0  0  0.0004  0  0.0003  0.0013  0.0027  0.0107  0.0239
0.0122  0.0017  0.0016  0.005  0.0108  0.0195  0.0121  0.0111  0.0287  0.047  0.0403
0.024  0.0162  0.0141  0.0108  0.0093  0.0147  0.0147  0.0529  0.0599  0.0354  0.0055
0.0011  0.0008  0  0  0  0
1998  1  2  3  0      318  0  0  0  0  0.0003  0.0022  0.0093  0.0078  0.0032  0.0009
0.0067  0.0116  0.0079  0.0155  0.0246  0.0465  0.0765  0.0818  0.0362  0.0321  0.0294
0.0271  0.0189  0.0111  0.0055  0.0036  0.0034  0.0064  0.0047  0.0013  0.0003  0.0029
0.0004  0.0003  0.0003  0  0  0  0  0  0  0  0.007  0.0129  0.0106  0.0012  0.0016
0.0061  0.0139  0.0107  0.0105  0.0327  0.0535  0.0817  0.0745  0.0525  0.0337  0.0293
0.0277  0.0181  0.0084  0.0075  0.0084  0.0064  0.0087  0.0008  0.0016  0.0003  0  0  0
0  0.001  0
2001  1  2  3  0      395  0  0  0.0009  0.0016  0.0005  0.0023  0.0143  0.0359  0.0226
0.0063  0.003  0.0117  0.0386  0.0867  0.0836  0.0232  0.0022  0.0044  0.0039  0.0076
0.009  0.0093  0.0049  0.0111  0.0045  0.0246  0.0304  0.1062  0.0068  0.0043  0.0064
0.0017  0.0016  0.0002  0.0006  0  0  0  0  0.0009  0.0016  0.0003  0.0024  0.0113
0.0307  0.0198  0.0076  0.0025  0.011  0.0422  0.0774  0.0761  0.0275  0.0043  0.0015
0.0045  0.0064  0.0071  0.0083  0.0042  0.0059  0.0066  0.0224  0.0149  0.0225  0.0044
0.0033  0.0004  0.0007  0  0  0  0  0
#2004  1  2  3  0     405  0  0.0007  0.0004  0  0.0004  0.0013  0.008  0.0126  0.0135
0.0018  0.002  0.0033  0.0066  0.008  0.0033  0.0033  0.0063  0.0101  0.0187  0.0261
0.0415  0.0527  0.0411  0.0341  0.0442  0.0329  0.0239  0.0336  0.0071  0.0071  0.0005
0.0003  0.0004  0  0  0  0.0001  0  0.0007  0.0004  0  0.0004  0.0025  0.0097  0.0267
0.0148  0.0028  0.0028  0.004  0.0065  0.0078  0.0062  0.0037  0.0071  0.0066  0.0231
0.0324  0.0805  0.0727  0.0464  0.0493  0.0549  0.0404  0.0203  0.023  0.0062  0.0013
0.0003  0.0003  0.0001  0  0  0  0
#AFSC
1997  1  3  3  0      42  0  0  0  0  0  0  0  0  0  0  0  0.0099  0.0396  0.0556  0.0545
0.0484  0.039  0.0366  0.085  0.1285  0.03  0.0226  0.0009  0.0009  0.0004  0  0.0009
0.0084  0.0003  0  0  0.0008  0.0005  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0.0099
0.0198  0.0561  0.1236  0.0567  0.0178  0.0315  0.0533  0.0232  0.0138  0.0164  0  0.0033
0.0009  0.0032  0.0021  0.0038  0.0013  0.0004  0  0.0001  0  0  0  0  0
1999  1  3  3  0      42  0.0014  0  0  0  0  0  0  0  0  0.0034  0  0.0034  0.0005
0.0014  0.0014  0.0018  0.0005  0.0034  0.0189  0  0.0098  0.0772  0.116  0.113  0.0734
0.0615  0.0199  0.0194  0.0001  0.0011  0.0004  0.0001  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0.0005  0  0.0152  0  0  0.0015  0.0028  0.0074  0.0277  0.1335  0.1448
0.0736  0.0469  0.0092  0.0058  0.0005  0.0024  0.0005  0  0  0  0  0  0  0
2000  1  3  3  0      36  0  0  0  0  0  0  0  0  0  0.0001  0.0006  0  0  0.0007  0.0101
0.01  0.0366  0.0676  0.0821  0.0756  0.0131  0.026  0.0282  0.021  0.0385  0.0448
0.0022  0.0034  0  0.0002  0.0002  0  0.0002  0.0002  0.0003  0  0  0  0  0  0  0  0  0
0  0.0007  0.0006  0.0019  0.0007  0  0  0  0.0299  0.0533  0.1108  0.1628  0.0624
0.0239  0.0041  0.0416  0.0169  0.0173  0.0078  0  0.0027  0.0002  0.0005  0  0  0
0.0001  0  0  0
2001  1  3  3  0      37  0  0  0  0  0  0  0  0  0  0  0  0  0  0.003  0.0162  0.0138
0.0121  0.0074  0.0013  0.0101  0.0068  0.0126  0.0159  0.0213  0.0238  0.0368  0.1106
0.1632  0.0754  0.0084  0.0008  0.0058  0.0006  0.0039  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0.0014  0  0.0037  0.0106  0.0135  0.0053  0.0034  0.0042  0.0101  0.0129
0.0261  0.0185  0.0104  0.0163  0.1051  0.1296  0.064  0.0046  0.0008  0.0058  0.0039  0
0  0  0  0
# POP # 1979  1  4  3  0  78  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0.011  0.021
0.014  0.02  0.055  0.051  0.04  0.049  0.061  0.054  0.029  0.017  0.021  0.024  0.025
0.006  0.003  0.002  0.002  0  0.001  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0.004
0.007  0.024  0.019  0.036  0.017  0.026  0.04  0.058  0.069  0.051  0.026  0.016  0.043
0.036  0.011  0.008  0.004  0  0  0  0  0
# 1985  1  4  3  0    205  0  0  0  0  0  0  0  0  0  0  0  0  0  0.001  0.002  0.012  0.011
0.008  0.021  0.043  0.034  0.032  0.045  0.058  0.046  0.043  0.03  0.032  0.026  0.004
0.005  0.005  0.005  0.001  0.001  0.001  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0.003  0.013  0.017  0.012  0.021  0.04  0.036  0.038  0.064  0.069  0.058  0.064  0.049
0.015  0.019  0.006  0.005  0.001  0  0  0  0  0  0
#NWFSC Slope and Shelf
2000	1	4	3	0	46	0	0	0	0	0	0
	0	0	0.000719347	0	0.002472138	0.001406115	0.001406115
	0.002819034	0	0.00071448	0.013552271	0.013446374	0.016939868
	0	0.010745129	0.022304662	0.073931755	0.061157049	0.1028647
	0.023696561	0.0115264	0.004181701	0	0.020293282	0.039464483
	0.059196724	0.039909532	0.032887032	0	0	0	0	0
```

```
        0       0       0       0       0       0       0.002125462     0.00070917
        0.006690594     0.002812286     0       0.000698439     0.001406115     0
        0.001373314     0.002095344     0.008094524     0.012508235     0.002230945
        0.025701386     0.049054231     0.062974307     0.035100691     0.021124224
        0.002457977     0.033610445     0.119811842     0.027476135     0.013154791
        0.006577395     0.006577395     0       0       0       0
2001    1       4       3       0       79      0       0       0       0       0       0
        0       0       0.001230496     0       0.000717904     0.006849279     0.00949804
        0.027383138     0.061277025     0.018617255     0.010225538     0.002640537
        0.007275526     0.006000075     0.008308387     0.011524563     0.005988288
        0.013767361     0.011677244     0.01628674      0.057666125     0.061119135
        0.016837983     0.026615893     0.047780213     0.014559002     0.004852909     0
        0       0       0       0       0       0       0       0       0       0
        0.004068122     0       0       0.001973619     0.007672991     0.005199115
        0.02290083      0.049420236     0.032377764     0.016325665     0.004542887
        0.002786092     0.002769371     0.018230207     0.01827242      0.004205179
        0.011811012     0.025400473     0.034766939     0.052916008     0.060207707
        0.099753544     0.066273569     0.007931206     0       0.001496387     0       0
        0       0
2002    1       4       3       0       123     0       0       0       0       0       0
        0       0       0.001044436     0       0.001068986     0.004077679     0.019285241
        0.011193339     0.010209487     0.003424601     0.02519036      0.070657637
        0.097064281     0.079620477     0.056097769     0.012345736     0.01589208
        0.023109528     0.017606678     0.016315885     0.014008219     0.019262343
        0.006875332     0.005770886     0.001066832     0.001565721     0.000478359
        0.002972802     0.000997777     0       0       0       0       0       0       0
        0       0       0       0.000497453     0.001044436     0       0.00256436
        0.009344938     0.015279632     0.00461289      0.003429626     0.020434336
        0.055651928     0.087920621     0.065948487     0.066459435     0.020870487
        0.019036012     0.023715372     0.01889618      0.013316523     0.013919496
        0.01829055      0.006051125     0.009022778     0.004658974     0.00183189      0
        0       0       0       0
2003    1       4       3       0       183     0       0       0       0       0       0
        0       0       0       0       0       0       0.000584258     0.000194753
        0.000327155     0.002607145     0.005906372     0.014184258     0.019210801
        0.012870511     0.011284605     0.024243956     0.026013986     0.017202956
        0.005783083     0.008358143     0.026492952     0.080301901     0.140792306
        0.076130062     0.041690489     0.024760041     0.030918922     0.029620126
        0.00838577      0.002406085     0       0       0       0       0       0       0
        0       0       0       0.000194753     0       0       0.000194753     0.000584258
        0.000209158     0.002381218     0.007052933     0.015507437     0.017969078
        0.012067755     0.020107098     0.023659061     0.018548727     0.015623372
        0.005792757     0.009440231     0.017858237     0.106462876     0.083184375
        0.017991974     0.011767468     0.002567479     0.000120818     0.000264654
        0.000178892     0       0
2004    1       4       3       0       82      0       0       0       0       0       0
        0       0       0       0       0       0       0       0.001015773     0
        0.035759822     0.008939989     0.012732802     0.029854244     0.033407434
        0.034683068     0.048218443     0.052378488     0.040714979     0.034723744
        0.024585239     0.02447 0.021313088     0.01371321      0.006900374     0.005365957
        0.004141758     0.001447013     0.002694744     0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0.019313948     0.019400277     0.060112432     0.066522804
        0.036303209     0.031270666     0.053124787     0.062822909     0.05433433
        0.035761839     0.015756455     0.021900715     0.0176179       0.030349491
        0.027178998     0.006468059     0.002794385     0.001906626     0       0       0
        0
2005    1       4       3       0       117     0       0       0       0       0       0
        0       0.000408042     0.000408042     0.000408042     0       0       0.00116009
        0       0.001303232     0.000756616     0.00164726      0.001305986     0.00120196
        0.002297208     0.003144863     0.007977066     0.010515688     0.007116156
        0.016010377     0.028427142     0.034508325     0.057794188     0.126779627
        0.11749635      0.044031134     0.004229274     0.005577086     0.002234605
        0.006367646     0.000333258     0       0       0       0       0       0       0
        0       0       0       0.000408042     0.001224082     0.001728045     0.00244812
        0.001598852     0.001276498     0.001004433     0.002330615     0.001477765
        0.003363797     0.003685233     0.006225287     0.00963288      0.016851718
        0.019993447     0.021958964     0.027826005     0.081385545     0.194095414
        0.081241307     0.03250564      0.003373917     0.000622318     0.000302808     0
        0       0       0
```

```
2006    1       4       3       0       144     0       0       0       0       0       0
        0       0       0       0       0.001611022     0.00202593      0.006890246
        0.002348124     0.010200502     0.012321913     0.016850418     0.013232019
        0.007410074     0.01402603      0.006813102     0.01131459      0.018453737
        0.011847005     0.05042789      0.037862066     0.03823314      0.070317746
        0.052107919     0.052231502     0.041514101     0.01699581      0.014641447
        0.005548414     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0.000743991     0.005557854     0.005106761
        0.009810658     0.009239292     0.019192087     0.012694072     0.010731289
        0.005106056     0.008068024     0.018399921     0.022265594     0.032585447
        0.045221471     0.04654681      0.039092142     0.098510965     0.054697295
        0.035804888     0.004656319     0.000744317     0       0       0       0       0
2003    1       5       3       0       80      0       0       0       0       0
        0       0.001033821     0.003264143     0.000531555     0.001149471     0.003392429
        0.002938114     0.003538456     0.007976506     0.02370056      0.067252426
        0.082275886     0.109710051     0.059207467     0.027327386     0.02220029
        0.024764507     0.026308795     0.016675531     0.002833845     0.00589196
        0.000842187     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0.003447576
        0.007131976     0.00600761      0.006903103     0.014829148     0.01007645
        0.013133561     0.022230416     0.025623431     0.067271506     0.098096009
        0.077884364     0.046089472     0.023893868     0.02790095      0.036467756
        0.014665631     0.002575431     0       0.002956357     0       0       0       0
        0       0       0       0       0
2004    1       5       3       0       71      0       0       0.00027594      0
        0.002448397     0.001519763     0.000661263     0.005662886     0.004779793
        0.003598197     0.003378604     0.011815219     0.013935385     0.005812924
        0.008524054     0.00856587      0.008629711     0.019087377     0.023924967
        0.091738083     0.099560714     0.071640511     0.029552661     0.016490101
        0.022183872     0.003844784     0.00340005      0.001700108     0.000850054     0
        0       0       0       0       0       0       0       0       0.00027594
        0.000928634     0.002363772     0.000506588     0.000928634     0.008866361
        0.005732523     0.009576892     0.002006809     0.003689611     0.008724934
        0.01807031      0.002376524     0.002209511     0.005109017     0.026786053
        0.037356414     0.09765774      0.15803127      0.060791353     0.023030613
        0.032380378     0.020073973     0.00340005      0.001700025     0.003844784     0
        0       0       0       0       0       0       0       0
2005    1       5       3       0       129     0       0.001279818     0.000403396
        0.000475512     0       0.004091402     0.007985199     0.014101043     0.014713385
        0.011784319     0.013129034     0.032630652     0.03505006      0.019626015
        0.016237509     0.012772582     0.023271685     0.008541256     0.002617619
        0.009484516     0.00947093      0.045459762     0.049488995     0.056483747
        0.042102431     0.00535363      0.007262106     0.001275875     0.000637938     0
        0       0       0       0       0       0       0       0       0.001279818
        0.000403396     0.001540318     0       0.005066564     0.007695525     0.021602481
        0.028440509     0.014884242     0.017506652     0.036957565     0.053992163
        0.02907414      0.013563242     0.012527669     0.021274657     0.015645061
        0.010801028     0.01073795      0.021075598     0.075897358     0.070230643
        0.047104401     0.021915264     0.00969971      0.003356481     0.001997149     0
        0       0       0       0       0       0       0       0
2006    1       5       3       0       120     0       0.000473618     0       0.001481883
        0       0.001780672     0.015558792     0.011480106     0.010835133     0.013642557
        0.012347498     0.031147869     0.055124212     0.040702169     0.031806935
        0.074143528     0.060517819     0.038936704     0.020735223     0.011616848
        0.014982584     0.005846379     0.008828632     0.00740037      0.019593427
        0.013496899     0.007946555     0.006096397     0       0       0.00110666      0
        0       0       0       0       0       0       0.000473618     0       0.001481883
        0.001030881     0.003642106     0.01288739      0.013454683     0.021318183
        0.011039329     0.01057915      0.01992001      0.052647764     0.042879959
        0.031311619     0.058633377     0.063668279     0.040594269     0.019455111
        0.012265951     0.007043895     0.008837809     0.001850027     0.015361347
        0.009796713     0.01610065      0.004898357     0.001198171     0       0       0
        0       0       0       0       0       0
31 # 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

1 # Number of Aging Error Matrices
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
```

```
0.05   0.1   0.158113883  0.324442842  0.376192055  0.484366512  0.719693812  0.737838276
0.758854932  0.781541625  0.83763068  0.907620383  0.977610085  1.047599788  1.117589491
1.187579194  1.257568896  1.327558599  1.397548302  1.467538004  1.537527707  1.60751741
1.677507113  1.747496815  1.817486518  1.887476221  1.957465924  2.027455626  2.097445329
2.167435032  2.237424735  2.307414437  2.37740414  2.447393843  2.517383546  2.587373248
2.657362951  2.727352654  2.797342356  2.867332059  2.937321762  3.007311465  3.077301167
3.14729087  3.217280573  3.5

556   # Age and Conditional Age-at-length Composition Observations
1991   1      1      1      2      1      16     19     2.0    0      0      0
       0.5    0.5    0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      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      1      1      2      1      20     22     3.5    0      0      0
       0      0.928571429   0.071428571   0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      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      1      1      2      1      23     25     4.9    0      0      0
       0      0      0.45   0.35   0      0.05   0      0      0.05   0.05   0
       0      0      0      0      0      0      0      0      0      0.05   0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      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      1      1      2      1      26     27     5.2    0      0      0
       0      0      0.047619048   0.19047619    0.380952381   0.095238095
       0.047619048   0.047619048   0.047619048   0.047619048   0      0.047619048
       0      0      0      0.047619048   0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      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      1      1      2      1      28     28     3.0    0      0      0
       0      0      0      0      0.333333333   0.333333333   0.333333333   0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      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      1      1      2      1      29     29     5.4    0      0      0
       0      0      0      0.045454545   0      0.136363636   0.454545455
       0.272727273   0.045454545   0      0      0      0      0      0      0
       0      0.045454545   0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      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      1      1      2      1      30     30     3.5    0      0      0
       0      0      0      0      0      0      0.214285714   0      0.285714286
       0.285714286   0      0      0      0      0      0.071428571   0      0
       0.071428571   0      0.071428571   0      0      0      0      0      0
       0      0      0      0      0      0      0      0      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      1      1      2      1      31     31     9.9    0      0      0
       0      0      0      0      0      0      0.025  0      0.025  0.025  0.175
       0.15   0.05   0.05   0.05   0.025  0.025  0.075  0.025  0.025  0      0
       0.025  0      0      0.05   0.025  0.175  0      0      0      0      0
       0      0      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      1      1      2      1      32     32     6.2    0      0      0
       0      0      0      0      0      0      0      0      0      0      0
       0.04   0.04   0.04   0.08   0.12   0.04   0.08   0.08   0      0      0
       0.08   0.04   0      0.08   0      0.28   0      0      0      0      0
       0      0      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	1	1	2	1	33	33	6.4	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0.052631579	0	0	0.052631579	0.052631579	0			
	0.105263158	0.052631579	0.105263158	0	0.052631579	0	0				
	0.210526316	0.315789474	0	0	0	0	0	0	0		
	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	1	1	2	1	34	34	0.5	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.142857143	0	0	0.142857143		
	0	0	0.285714286	0	0	0	0	0.428571429	0		
	0	0	0	0	0	0	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	1	1	2	1	35	35	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	0.5	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							
1991	1	1	2	2	1	11	15	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	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							
1991	1	1	2	2	1	16	19	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	0	0	0	0.5	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							
1991	1	1	2	2	1	20	22	2.7	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	0	0	0	0	0	0	0	0	
	0.636363636	0.363636364	0	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	1	2	2	1	23	25	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	0	0	0	0	0	0.1
	0.3	0.5	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							
1991	1	1	2	2	1	26	27	4.2	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	0.235294118	0.588235294	0.117647059	0	0	0.058823529				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1991	1	1	2	2	1	28	28	7.2	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	0.068965517	0.206896552	0.24137931	0.206896552	0				
	0.137931034	0	0	0	0	0.034482759	0	0.034482759			
	0	0	0	0	0	0.034482759	0	0	0		
	0.034482759										
1991	1	1	2	2	1	29	29	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	0	0	0	0	0	0

	0	0	0	0.027027027	0.081081081	0.081081081	0.054054054				
	0.189189189	0.081081081	0.054054054	0	0	0.081081081	0				
	0	0	0.081081081	0.027027027	0.054054054	0.027027027	0				
	0	0	0.027027027	0	0.135135135						
1991	1	1	2	2	1	30	30	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	0	0	0	0	0	0	0
	0	0	0	0	0	0.04	0	0.04	0.08	0.08	0
	0.12	0	0.04	0	0.04	0.08	0.04	0	0	0.04	0
	0.04	0.12	0	0.24							
1991	1	1	2	2	1	31	31	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	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.055555556	0.055555556	0.111111111	0.055555556	0	0				
	0.055555556	0.055555556	0	0.055555556	0.055555556	0	0				
	0.5										
1991	1	1	2	2	1	33	33	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
	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							
1998	1	1	1	2	1	16	19	1.4	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1998	1	1	1	2	1	20	22	3.1	0	0	0
	0.111111111	0.777777778	0.111111111	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	1	2	1	23	25	1.8	0	0	0
	0	0.2	0.6	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	0	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	1	1	2	1	26	27	2.3	0	0	0
	0	0	0	0.769230769	0.076923077	0.076923077	0.076923077				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	1	2	1	28	28	3.7	0	0	0
	0	0	0	0.047619048	0.285714286	0.19047619	0.19047619				
	0.142857143	0	0	0	0.095238095	0	0.047619048	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	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	1	1	2	1	29	29	3.1	0	0	0
	0	0	0	0	0	0.277777778	0.222222222	0.055555556			
	0.055555556	0.222222222	0.055555556	0	0.055555556	0	0				
	0	0.055555556	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	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	1	1	2	1	30	30	8.1	0	0	0
	0	0	0	0	0	0.02173913	0.195652174	0.217391304			

```
        0.086956522    0      0.043478261    0.02173913     0.043478261    0.108695652
        0.086956522    0.02173913     0.02173913     0.02173913     0.02173913     0
        0      0      0.02173913     0.02173913     0      0      0.02173913
        0.02173913     0      0      0      0      0      0      0      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      1      1      2      1      31     31     6.8    0      0      0
        0      0      0      0      0      0      0      0.051282051    0.128205128
        0.025641026    0.025641026    0.051282051    0.128205128    0.051282051
        0.076923077    0.102564103    0.025641026    0.051282051    0.025641026
        0.025641026    0.051282051    0.025641026    0      0      0.025641026    0
        0.025641026    0.102564103    0      0      0      0      0      0      0
        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      1      1      2      1      32     32     3.7    0      0      0
        0      0      0      0      0      0      0      0.047619048    0
        0.047619048    0.047619048    0.047619048    0      0.095238095    0.047619048
        0.142857143    0      0      0.047619048    0.095238095    0.142857143    0
        0.047619048    0      0      0      0      0.19047619     0      0      0
        0      0      0      0      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      1      1      2      1      33     33     4.2    0      0      0
        0      0      0      0      0      0      0      0      0      0      0
        0      0.05   0.05   0.05   0      0      0.05   0      0.05   0.05   0
        0.05   0      0      0.2    0      0.45   0      0      0      0      0
        0      0      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      1      1      2      1      34     34     0.7    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      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
1998    1      1      2      2      1      16     19     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      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
1998    1      1      2      2      1      20     22     5.4    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      0      0      0
        0.935483871    0.064516129    0      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      1      2      2      1      23     25     1.8    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      0      0      0      0      0      0
        0.8    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
1998    1      1      2      2      1      26     27     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      0      0      0      0      0      0
        0.071428571    0.571428571    0.142857143    0.071428571    0.071428571
        0.071428571    0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0
1998    1      1      2      2      1      28     28     4.2    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      0.041666667    0.333333333    0.25   0      0.041666667    0
```

	0	0.041666667	0.041666667	0.083333333	0	0.041666667	0				
	0	0	0.125	0	0	0	0	0	0	0	0
1998	1	1	2	2	1	29	29	4.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0.107142857	0.071428571	0.035714286	0.071428571				
	0.035714286	0.035714286	0.142857143	0.035714286	0.107142857						
	0.035714286	0.035714286	0.107142857	0.071428571	0	0.035714286					
	0	0	0	0	0	0	0	0.071428571			
1998	1	1	2	2	1	30	30	2.8	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	0	0	0	0	0	0
	0	0	0	0	0.0625	0	0.0625	0	0	0.0625	0
	0	0.0625	0.125	0.0625	0	0.125	0.0625	0.0625	0	0.0625	0
	0	0.125	0	0.125							
1998	1	1	2	2	1	31	31	1.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.090909091	0.272727273	0	0	0	0	0	0	0		
	0	0	0	0.090909091	0	0	0.545454545				
1998	1	1	2	2	1	32	32	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	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.333333333	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.666666667						
1998	1	1	2	2	1	35	35	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
	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							
2003	1	1	1	2	1	11	15	2.4	0	0	
	0.708333333	0.208333333	0.083333333	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	1	2	1	16	19	8.3	0	0	0
	0.773809524	0.214285714	0.011904762	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	1	2	1	20	22	4.3	0	0	0
	0.159090909	0.659090909	0.159090909	0.022727273	0	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	1	2	1	23	25	5.6	0	0	0
	0.035087719	0.368421053	0.140350877	0.280701754	0.105263158						
	0.035087719	0.035087719	0	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	1	1	2	1	26	27	11.2	0	0	0
	0	0.052631579	0.298245614	0.245614035	0.280701754	0.035087719					
	0.035087719	0.01754386	0	0.01754386	0	0	0.01754386				
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	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	1	1	2	1	28	28	27.9	0	0	0
	0	0.003533569	0.091872792	0.212014134	0.431095406	0.141342756					
	0.042402827	0.007067138	0	0.021201413	0	0.007067138	0				
	0	0.021201413	0.014134276	0.007067138	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	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	1	1	2	1	29	29	41.5	0	0	0
	0	0	0.018957346	0.170616114	0.345971564	0.213270142					
	0.08056872	0.042654028	0.047393365	0.004739336	0.009478673						
	0.004739336	0.004739336	0.004739336	0.009478673	0.004739336						
	0.023696682	0.009478673	0.004739336	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	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	1	1	2	1	30	30	31.1	0	0	0
	0	0	0.012658228	0.056962025	0.189873418	0.265822785					
	0.075949367	0.088607595	0.063291139	0.03164557	0.037974684						
	0.006329114	0.037974684	0.025316456	0.018987342	0.03164557						
	0.018987342	0	0	0	0	0.006329114	0.012658228				
	0.006329114	0	0	0	0.012658228	0	0	0	0		
	0	0	0	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	1	1	2	1	31	31	20.9	0	0	0
	0	0	0	0.066037736	0.028301887	0.056603774					
	0.075471698	0.018867925	0.047169811	0.122641509	0.018867925						
	0.056603774	0.075471698	0.075471698	0.075471698	0	0.018867925					
	0.047169811	0.037735849	0.009433962	0.028301887	0.047169811	0					
	0.009433962	0	0	0.08490566	0	0	0	0	0		
	0	0	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	1	1	2	1	32	32	17.7	0	0	0
	0	0	0	0	0.011111111	0.033333333	0.022222222				
	0.033333333	0.033333333	0.066666667	0.011111111	0.033333333						
	0.077777778	0.088888889	0.055555556	0.066666667	0.033333333						
	0.088888889	0.066666667	0.055555556	0.055555556	0.033333333	0					
	0.011111111	0.022222222	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							
2003	1	1	1	2	1	33	33	15.0	0	0	0
	0	0	0	0	0	0	0.013157895	0.013157895	0		
	0	0	0	0	0.026315789	0.039473684	0.013157895				
	0.026315789	0.013157895	0.052631579	0.171052632	0.026315789						
	0.078947368	0.065789474	0.013157895	0.026315789	0.013157895						
	0.065789474	0.342105263	0	0	0	0	0	0	0		
	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	1	1	2	1	34	34	6.3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.03125	0	0.09375
	0.03125	0.03125	0.0625	0	0.03125	0.71875	0	0	0	0	0
	0	0	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	1	1	2	1	35	35	2.6	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.076923077	0	0.076923077	0	0	0	0.846153846	0			
	0	0	0	0	0	0	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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2003    1       1       1       2       1       36      36      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       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
2003    1       1       1       2       1       37      37      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       0       0       0       0       0
        0       0       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       1       2       2       1       11      15      2.8     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       0       0       0       0.392857143
        0.464285714     0.142857143     0       0       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       1       2       2       1       16      19      10.8    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       0       0       0       0.054545455
        0.754545455     0.181818182     0.009090909     0       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       1       2       2       1       20      22      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       0       0       0       0       0.113636364
        0.704545455     0.022727273     0.113636364     0       0       0       0       0
        0       0       0       0.045454545     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0
2003    1       1       2       2       1       23      25      10.5    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       0       0       0       0.018691589
        0.439252336     0.224299065     0.242990654     0.074766355     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       1       2       2       1       26      27      25.6    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       0       0       0       0       0
        0.007692308     0.184615385     0.369230769     0.2     0.146153846     0.023076923
        0.023076923     0.015384615     0       0.007692308     0       0       0.015384615
        0       0       0       0       0.007692308     0       0       0       0       0
        0       0       0       0
2003    1       1       2       2       1       28      28      58.2    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
        0.001692047     0.037225042     0.219966159     0.280879865     0.172588832
        0.091370558     0.016920474     0.016920474     0.010152284     0.013536379
        0.013536379     0.013536379     0.037225042     0.020304569     0.010152284     0
        0.020304569     0.003384095     0.00676819      0       0.003384095     0
        0.00676819      0.003384095     0       0       0
2003    1       1       2       2       1       29      29      45.3    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       0       0       0       0       0
        0       0.091304348     0.134782609     0.139130435     0.069565217     0.060869565
        0.052173913     0.026086957     0.034782609     0.039130435     0.026086957
        0.043478261     0.039130435     0.017391304     0.013043478     0.026086957
        0.034782609     0.030434783     0.02173913      0.008695652     0.013043478
        0.004347826     0.017391304     0.008695652     0       0.047826087
2003    1       1       2       2       1       30      30      28.0    0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
```

```
     0    0    0    0    0    0    0    0    0    0    0
     0    0.007042254    0.028169014    0.021126761    0.035211268    0.021126761
     0.035211268    0.014084507    0.056338028    0.049295775    0.014084507
     0.070422535    0.042253521    0.049295775    0.021126761    0.049295775
     0.063380282    0.077464789    0.070422535    0.056338028    0.056338028
     0.028169014    0.028169014    0.028169014    0    0.077464789
2003 1    1    2    2    1    31   31   7.3  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    0    0    0    0    0
     0    0    0    0.027027027    0    0    0    0    0
     0.027027027    0    0.027027027    0    0.027027027    0    0
     0.054054054    0.027027027    0    0.027027027    0.054054054    0.081081081
     0.027027027    0.054054054    0    0.567567568
2003 1    1    2    2    1    32   32   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    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0.066666667    0    0    0    0    0.066666667    0
     0.133333333    0    0    0.066666667    0    0    0.666666667
2003 1    1    2    2    1    33   33   0.8  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    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0.25 0    0    0    0    0    0
     0    0    0    0.75
2003 1    1    2    2    1    34   34   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    0    0    0    0    0    0
     0    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
2003 1    1    2    2    1    37   37   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
     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
2004 1    1    1    2    1    20   22   1.0  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    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0    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    1    2    1    23   25   7.1  0    0    0
     0    0.144578313    0.626506024    0.156626506    0    0.048192771
     0.024096386    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    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    1    2    1    26   27   9.6  0    0    0
     0    0.053571429    0.553571429    0.142857143    0.160714286    0.071428571
     0    0    0.017857143    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    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    1    2    1    28   28   17.5 0    0    0
     0    0.029411765    0.088235294    0.264705882    0.37254902    0.156862745
     0.068627451    0.009803922    0    0.009803922    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    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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2004	1	1	1	2	1	29	29	25.2	0	0	0
	0	0	0.006802721	0.142857143	0.265306122	0.360544218
	0.149659864	0.047619048	0.006802721	0	0.006802721	0
	0.006802721	0	0	0	0	0	0.006802721	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	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	1	2	1	30	30	19.5	0	0	0
	0	0	0.00877193	0.00877193	0.157894737	0.263157895
	0.254385965	0.149122807	0.043859649	0.026315789	0.035087719
	0.00877193	0.00877193	0.00877193	0.00877193	0.00877193	0
	0	0	0	0.00877193	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	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	1	2	1	31	31	13.7	0	0	0
	0	0	0	0	0.0125	0.15	0.2125	0.1	0.1	0.0625	0.0625
	0.0625	0.05	0.025	0.05	0.025	0.025	0.0125	0.0125	0	0.0125	0.0125
	0	0	0	0	0	0.0125	0	0	0	0	0
	0	0	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	1	2	1	32	32	9.9	0	0	0
	0	0	0	0	0	0.017241379	0	0.017241379
	0.068965517	0.051724138	0.086206897	0.086206897	0.068965517
	0.051724138	0.051724138	0.034482759	0.051724138	0.051724138
	0.103448276	0.086206897	0	0.034482759	0.068965517	0	0
	0.017241379	0.017241379	0.034482759	0	0	0	0	0
	0	0	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	1	2	1	33	33	8.9	0	0	0
	0	0	0	0	0	0	0.019230769	0	0
	0.038461538	0	0	0.019230769	0.096153846	0.096153846
	0.038461538	0.019230769	0.057692308	0.057692308	0.019230769
	0.019230769	0.057692308	0.057692308	0.057692308	0.019230769
	0.019230769	0.019230769	0.288461538	0	0	0	0	0
	0	0	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	1	2	1	34	34	4.6	0	0	0
	0	0	0	0	0.037037037	0	0	0	0	0
	0	0	0	0.037037037	0	0	0.037037037	0
	0.037037037	0	0.037037037	0.074074074	0.074074074	0
	0.037037037	0	0.037037037	0.592592593	0	0	0	0
	0	0	0	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	1	2	1	35	35	2.1	0	0	0
	0	0	0	0	0	0	0	0.083333333	0	0
	0	0	0	0	0	0	0	0	0	0.083333333
	0	0	0.166666667	0	0	0	0	0.666666667	0
	0	0	0	0	0	0	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	1	2	1	36	36	0.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.2	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0.8	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	0
2004	1	1	2	2	1	20	22	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
	0.583333333	0.416666667	0	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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2004	1	1	2	2	1	23	25	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	0.014184397
	0.127659574	0.609929078	0.205673759	0.042553191	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	2	2	1	26	27	22.8	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	0	0	0	0	0
	0.022556391	0.285714286	0.338345865	0.248120301	0.052631579
	0.015037594	0.015037594	0	0.007518797	0	0.007518797	0
	0	0	0	0.007518797	0	0	0	0	0	0
	0	0	0	0	0
2004	1	1	2	2	1	28	28	41.1	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
	0.025	0.15	0.225	0.279166667	0.175	0.070833333	0.020833333
	0.020833333	0.004166667	0.0125	0.008333333	0.004166667	0	0
	0	0.004166667	0	0	0	0	0	0	0	0
	0	0
2004	1	1	2	2	1	29	29	29.8	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	0	0	0	0	0	0
	0.011494253	0.040229885	0.16091954	0.189655172	0.189655172
	0.114942529	0.045977011	0.028735632	0.022988506	0.005747126
	0.017241379	0.034482759	0.022988506	0.028735632	0	0.022988506
	0.011494253	0.022988506	0.005747126	0	0	0.005747126	0
	0.011494253	0	0.005747126
2004	1	1	2	2	1	30	30	13.7	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	0	0	0	0	0	0	0	0	0
	0	0	0.05	0.0875	0.075	0.0625	0.05	0.0875	0.0625	0.0125	0.05
	0.0125	0.1125	0.075	0.0125	0.025	0.0125	0.025	0.025	0.025	0.025	0.025
	0	0.0125	0.0125	0.0625
2004	1	1	2	2	1	31	31	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	0	0	0	0	0	0
	0	0	0.04	0	0	0	0	0.04	0	0.08	0
	0	0	0.08	0.12	0.04	0.08	0	0.04	0.12	0	0.04
	0	0.04	0.04	0.24
2004	1	1	2	2	1	32	32	0.7	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	0	0	0	0	0	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	0.25
	0	0	0	0.5
2004	1	1	2	2	1	33	33	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	0	0	0	0	0	0
	0	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
2004	1	1	2	2	1	34	34	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	0	0	0	0	0	0
	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	0.5
2005	1	1	1	2	1	20	22	0.2	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
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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
2005	1	1	1	2	1	23	25	1.9	0	0	0
	0	0.090909091	0.545454545	0.363636364	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	1	2	1	26	27	5.1	0	0	0
	0	0	0.344827586	0.551724138	0	0.068965517	0
	0.034482759	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	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	1	1	2	1	28	28	8.0	0	0	0
	0	0	0.133333333	0.288888889	0.222222222	0.111111111
	0.155555556	0.066666667	0.022222222	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	1	1	2	1	29	29	13.3	0	0	0
	0	0	0	0.093333333	0.346666667	0.32	0.146666667
	0.066666667	0.013333333	0	0	0.013333333	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	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	1	1	2	1	30	30	11.1	0	0	0
	0	0	0	0	0.238095238	0.174603175	0.317460317
	0.174603175	0.015873016	0.015873016	0.015873016	0	0
	0.031746032	0.015873016	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	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	1	1	2	1	31	31	6.7	0	0	0
	0	0	0	0	0.026315789	0.105263158	0.026315789
	0.105263158	0.026315789	0.157894737	0.052631579	0.052631579
	0.131578947	0.157894737	0.026315789	0.052631579	0	0	0
	0.026315789	0.026315789	0.026315789	0	0	0	0	0
	0	0	0	0	0	0	0	0	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	1	1	2	1	32	32	3.2	0	0	0
	0	0	0	0	0	0.111111111	0.055555556	0.111111111
	0	0.055555556	0.055555556	0	0.166666667	0	0.111111111
	0	0	0	0.055555556	0.166666667	0.055555556	0	0
	0	0.055555556	0	0	0	0	0	0	0
	0	0	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	1	1	2	1	33	33	4.2	0	0	0
	0	0	0	0	0	0	0	0	0	0.041666667
	0	0	0	0	0.083333333	0.083333333	0.083333333
	0.083333333	0.083333333	0	0.125	0.083333333	0	0
	0.041666667	0.041666667	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	0	0	0
2005	1	1	1	2	1	34	34	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	0.125
	0	0.125	0	0	0	0.75	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
```

```
2005  1            1            1            2            1            35           35           1.6          0            0            0
      0            0            0            0            0            0            0            0            0            0            0
      0            0            0            0            0            0            0.111111111  0.111111111  0
      0            0.111111111  0            0            0.111111111  0            0            0.555555556
      0            0            0            0            0            0            0            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            1            1            2            1            36           36           0.7          0            0            0
      0            0            0            0            0            0            0            0            0            0            0
      0            0            0            0            0            0            0            0.25         0            0            0
      0            0            0            0            0            0.75         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
2005  1            1            1            2            1            37           37           0.2          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            0
      0            0            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            1            2            2            1            20           22           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
      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
2005  1            1            2            2            1            23           25           4.8          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            0            0            0            0            0            0
      0.592592593  0.259259259  0.074074074  0.037037037  0.037037037  0
      0            0            0            0            0            0            0            0            0            0            0
      0            0            0            0            0            0            0            0            0
2005  1            1            2            2            1            26           27           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            0            0            0            0
      0.261904762  0.333333333  0.214285714  0.142857143  0.047619048  0
      0            0            0            0            0            0            0            0            0            0            0
      0            0            0            0            0            0            0            0            0
2005  1            1            2            2            1            28           28           15.6         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            0            0            0            0            0            0
      0.034090909  0.170454545  0.238636364  0.125        0.170454545  0.102272727
      0.022727273  0.011363636  0            0.022727273  0            0.022727273  0
      0.034090909  0.011363636  0            0.011363636  0.011363636  0.011363636
      0            0            0            0            0            0            0
2005  1            1            2            2            1            29           29           18.6         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            0            0            0            0            0            0
      0.019047619  0.076190476  0.095238095  0.20952381   0.133333333
      0.085714286  0.047619048  0.019047619  0.038095238  0.019047619
      0.038095238  0.028571429  0.00952381   0.038095238  0.047619048
      0.028571429  0            0.019047619  0.019047619  0.019047619  0
      0.00952381   0            0            0            0
2005  1            1            2            2            1            30           30           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            0            0            0            0            0            0            0
      0            0.022222222  0            0.044444444  0.088888889  0.044444444  0
      0.044444444  0.022222222  0            0.044444444  0            0.066666667
      0.044444444  0.044444444  0.044444444  0.022222222  0.066666667
      0.066666667  0.066666667  0.133333333  0.088888889  0.022222222  0
      0.022222222  0
2005  1            1            2            2            1            31           31           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       0       0       0       0       0       0
        0       0       0.058823529     0       0       0.117647059     0       0
        0.058823529     0       0       0       0       0       0.117647059     0
        0.058823529     0       0.058823529     0       0.117647059     0       0       0
        0       0.411764706
2005    1       1       2       2       1       32      32      1.6     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       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0.111111111
        0       0       0       0       0.888888889
2005    1       1       2       2       1       33      33      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       0       0       0       0       0       0
        0       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
2006    1       1       1       2       1       20      22      0.2     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       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2006    1       1       1       2       1       23      25      1.4     0       0       0
        0       0       0       0.625   0.25    0.125   0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       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       1       1       2       1       26      27      3.1     0       0       0
        0       0       0.117647059     0.470588235     0.176470588     0.176470588     0
        0       0       0       0       0       0       0       0.058823529     0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       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       1       1       2       1       28      28      11.2    0       0       0
        0       0       0.016129032     0.161290323     0.274193548     0.274193548
        0.129032258     0.064516129     0.064516129     0       0       0       0
        0.016129032     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       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       1       1       2       1       29      29      6.5     0       0       0
        0       0       0       0.055555556     0.083333333     0.333333333     0.083333333
        0.166666667     0.083333333     0.083333333     0.027777778     0.027777778
        0.027777778     0       0.027777778     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       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       1       1       2       1       30      30      7.1     0       0       0
        0       0       0       0.025641026     0.076923077     0.076923077     0.153846154
        0.179487179     0.179487179     0.051282051     0.051282051     0.025641026
        0.076923077     0.051282051     0       0.025641026     0       0.025641026     0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       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       1       1       2       1       31      31      3.3     0       0       0
        0       0       0       0       0       0       0       0.055555556     0.222222222
        0.111111111     0       0       0       0       0.166666667     0.222222222
        0.055555556     0       0.055555556     0       0.055555556     0       0       0
        0       0       0       0.055555556     0       0       0       0       0       0
        0       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       1       1       2       1       32      32      2.9     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0.0625  0.125   0.0625  0.0625  0.125   0       0       0.125   0       0.125   0
        0       0       0.0625  0       0.0625  0.1875  0       0       0       0       0
        0       0       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       1       1       2       1       33      33      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       0.5     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
2006    1       1       1       2       1       34      34      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       0       0       0       0       0
        0       0       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       1       1       2       1       35      35      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       0       0       0       0       0
        0       0       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       1       2       2       1       23      25      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       0       0       0       0       0
        0.25    0.25    0.375   0       0.125   0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2006    1       1       2       2       1       26      27      5.8     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       0       0       0       0       0       0
        0       0.15625 0.25    0.34375 0.15625 0.03125 0.03125 0       0       0.03125 0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2006    1       1       2       2       1       28      28      10.9    0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0.133333333     0.183333333     0.066666667     0.116666667     0.266666667
        0.1     0.05    0.016666667     0       0.016666667     0       0.016666667
        0.033333333     0       0       0       0       0       0       0       0       0
        0       0       0
2006    1       1       2       2       1       29      29      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       0       0       0       0       0       0       0
        0       0.111111111     0.022222222     0.022222222     0.022222222     0.111111111
        0.155555556     0.133333333     0.111111111     0.022222222     0.022222222
        0.022222222     0.022222222     0.111111111     0.066666667     0       0       0
        0       0.022222222     0       0       0       0.022222222     0       0
2006    1       1       2       2       1       30      30      2.9     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0.0625  0       0.125   0       0.125
        0.1875  0.125   0       0       0       0       0.0625  0.125   0       0       0
        0.0625  0       0       0.125
2006    1       1       2       2       1       31      31      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       0
```

	0	0	0	0	0	0	0	0	0.333333333	0	
	0	0	0	0.166666667	0	0	0	0	0	0	
	0	0	0	0	0.166666667	0.333333333					
2006	1	1	2	2	1	32	32	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
	0	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							
2004	1	1	0	1	1	6	10	0.3	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	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	0	1	1	11	15	2.0	0	0	
	0.360267704	0.639732296	0	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	0	1	1	16	19	6.9	0	0	0
	0.18687718	0.633465624	0.015283836	0.16437336	0	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	0	1	1	20	22	23.5	0	0	0
	0.028177033	0.815321692	0.079759691	0.031086902	0	0.006389873					
	0.012065037	0	0	0	0	0.027199771	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	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	0	1	1	23	25	11.9	0	0	0
	0	0.459105107	0.433720654	0.094300618	0.012873622	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	0	1	1	26	27	6.6	0	0	0
	0	0	0.855328304	0.019638039	0.007517975	0.109997706	0				
	0.007517975	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	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	0	1	1	28	28	9.6	0	0	0
	0.008361935	0	0.008361935	0.111673272	0.206642815	0.082251627					
	0.025085806	0	0	0	0	0.55762261	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	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	0	1	1	29	29	9.3	0	0	0
	0.006191144	0	0	0.071905774	0.241350402	0.153387248					
	0.089539286	0	0	0.412861571	0	0.006191144	0				
	0.006191144	0.012382288	0	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	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	0	1	1	30	30	5.6	0	0	0
	0	0	0.112206577	0	0.416327063	0	0				
	0.15298569	0.014413174	0	0.014413174	0	0.014413174	0				
	0.079015935	0.167398864	0	0.014413174	0	0	0	0			

```
     0   0.014413174   0   0   0   0   0   0   0   0
     0   0   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   0   1   1   31  31  2.0 0   0   0
     0   0   0   0   0.683483227   0.129163295   0   0
     0.129163295   0   0   0   0   0   0.037691579   0   0
     0.010249302   0   0   0.010249302   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   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   0   1   1   32  32  1.3 0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0.499759277   0   0   0   0   0   0   0   0
     0   0   0.420927421   0   0   0   0.079313303   0   0
     0   0   0   0   0   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   0   1   1   33  33  1.7 0   0   0
     0   0   0   0   0   0   0   0   0   0.135301967
     0   0   0.039482925   0   0   0   0   0   0   0
     0   0   0.039482925   0   0   0   0.715966752   0.06976543
     0   0   0   0   0   0   0   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   0   1   1   35  35  0.3 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   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0
2005 1   1   0   1   1   1   5   0.6 0   0.5 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
     0   0   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   1   0   1   1   6   10  6.5 0   0.902615215
     0.097384785   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   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   1   0   1   1   11  15  28.0    0   0.027508021
     0.925548717   0.041075355   0   0.005867908   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   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   1   0   1   1   16  19  12.5    0   0
     0.181179359   0.694366592   0.058753328   0.015530433   0.050170288   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   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   1   0   1   1   20  22  14.6    0   0   0
     0   0.108146403   0.837391598   0.003658727   0   0   0
     0.050803272   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
     0   0   0   0   0   0   0   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   1   0   1   1   23  25  28.3    0   0   0
     0   0.235490856   0.656550272   0.064892281   0.022111163   0.014317768
     0.00319436    0   0   0   0.0034433   0   0   0   0
     0   0   0   0   0   0   0   0   0   0   0
```

	0	0	0	0	0	0	0	0	0	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	1	0	1	1	26	27	17.0	0	0	0
	0	0	0.525418748	0.251239335	0.136687013	0.062880344	0				
	0.003728904	0	0	0	0	0	0	0.010022829	0		
	0	0.010022829	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	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	1	0	1	1	28	28	14.6	0	0	0
	0	0	0.008942898	0.425634874	0.042357471	0.315330958					
	0.178824073	0.006614778	0.022294948	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	1	0	1	1	29	29	15.8	0	0	0
	0	0	0	0.021200933	0.28160237	0.27102761	0.015048084				
	0.077760663	0.003762021	0.263111014	0.057176617	0.003762021	0					
	0.003667656	0	0	0	0	0	0	0	0		
	0.001881011	0	0	0	0	0	0	0	0	0	
	0	0	0	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	1	0	1	1	30	30	8.0	0	0	0
	0	0	0	0.004005645	0.295551827	0	0.028039518				
	0.324406324	0.017602319	0	0	0.004005645	0.008011291	0				
	0.299557472	0	0.010808667	0.004005645	0	0	0				
	0.004005645	0	0	0	0	0	0	0	0	0	
	0	0	0	0	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	1	0	1	1	31	31	1.8	0	0	0
	0	0	0	0	0	0	0.138378637	0.16724949			
	0.083624745	0	0	0	0	0.145475333	0	0	0		
	0	0	0	0	0	0	0.465271795	0	0	0	
	0	0	0	0	0	0	0	0	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	1	0	1	1	32	32	0.6	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.5	0	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	0	0	0
	0	0	0	0							
2005	1	1	0	1	1	33	33	1.2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.776895387	0	0	0.223104613	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	1	34	34	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	0	0	0	0	0
	0	0	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	1	0	1	1	36	36	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	0	0	0	0	0
	0	0	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	1	0	1	1	37	37	0.3	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       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       2       3       0       1       1       -1      213     0.00110392
        0.037170243     0.02591038      0.031416999     0.173777906     0.13906161
        0.024789484     0.004510081     0.003999326     0.003803302     0       0
        0.000139717     0       0       0       0       0.00E+00        0.00E+00        0
        0       0       0       0.00E+00        0       0       0.000275636     0       0
        0.000132646     0       0.00110392      0.055804462     0.027995229     0.033750929
        0.238206031     0.151271425     0.023363925     0.005680731     0.009593011
        0.003336342     0.000902929     0.000810247     0       0       0.000255318
        0.000252794     0.000252794     9.31E-05        9.31E-05        0       0.000255318
        0.000524036     0       9.31E-05        0.000269875     0       0       0       0
        0       0
2001    1       3       1       0       1       14      14      1.0     0       0
        0.833333333     0.166666667     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       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       3       1       0       1       15      15      1.5     0       0
        0.888888889     0.111111111     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       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       3       1       0       1       16      16      2.6     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       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2001    1       3       1       0       1       17      17      1.4     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       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2001    1       3       1       0       1       18      18      0.7     0       0       0.5
        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       0
        0       0       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       3       1       0       1       19      19      0.3     0       0       0.5
        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       0
        0       0       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       3       1       0       1       20      20      0.5     0       0       0
        0.666666667     0.333333333     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       3       1       0       1       21      21      0.2     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       0       0
```

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2001	1	3	1	0	1	22	22	0.3	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2001	1	3	1	0	1	23	23	0.3	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2001	1	3	1	0	1	24	24	1.0	0	0	0
	0.166666667		0.666666667		0.166666667		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	3	1	0	1	25	25	0.2	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2001	1	3	1	0	1	26	26	1.0	0	0	0
	0	0.166666667		0.5	0.333333333		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	3	1	0	1	27	27	1.5	0	0	0
	0	0	0.444444444		0.555555556		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	3	1	0	1	28	28	3.1	0	0	0
	0	0.055555556		0.166666667		0.777777778		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	3	1	0	1	29	29	1.2	0	0	0
	0	0	0.285714286		0.571428571		0.142857143		0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	3	1	0	1	30	30	0.2	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	0	0
	0	0	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	3	1	0	1	31	31	0.2	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	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2001	1	3	1	0	1	32	32	0.3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.5	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	0	0
	0	0	0	0							
2001	1	3	1	0	1	33	33	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	0	0	0	0	0
	0	0	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	3	2	0	1	14	14	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	0	0	0	0.833333333		
	0.166666667		0	0	0	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	3	2	0	1	15	15	1.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.888888889		
	0.111111111		0	0	0	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	3	2	0	1	16	16	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	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							
2001	1	3	2	0	1	17	17	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	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							
2001	1	3	2	0	1	18	18	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	0.5	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							
2001	1	3	2	0	1	19	19	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	0	0	0	0.5	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							
2001	1	3	2	0	1	20	20	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	0.666666667	
	0.333333333		0	0	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	3	2	0	1	21	21	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	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							
2001	1	3	2	0	1	22	22	0.9	0	0	0
	0	0	0	0	0	0	0	0	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	0	0							
2001	1	3	2	0	1	23	23	0.9	0	0	0
	0	0	0	0	0	0	0	0	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	0	0							
2001	1	3	2	0	1	24	24	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	0	0	0	0	0.166666667	
	0.666666667		0.166666667		0	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	3	2	0	1	25	25	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	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							
2001	1	3	2	0	1	26	26	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	0	0	0	0	
	0.166666667		0.5	0.333333333		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	3	2	0	1	27	27	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
	0.444444444		0.555555556		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	3	2	0	1	28	28	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	
	0.055555556		0.166666667		0.777777778		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	3	2	0	1	29	29	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	0	0	0	0	0	0
	0.285714286		0.571428571		0.142857143		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	3	2	0	1	31	31	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
	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							
2001	1	3	2	0	1	32	32	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
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0.5	0	0	0.5	0	0
	0	0	0	0							
2003	1	4	1	0	1	13	13	0.2	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	4	1	0	1	14	14	0.2	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	4	1	0	1	16	16	0.4	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	4	1	0	1	17	17	0.5	0	0	0
	0.212571178		0.787428822		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	18	18	0.9	0	0	0
	0.96119347		0.03880653		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	19	19	1.5	0	0	0
	0.717395643		0.282604357		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	20	20	1.1	0	0	0
	0.183215095		0.816784905		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	21	21	2.2	0	0	0
	0.073463623		0.746708151		0.179828225		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	22	22	2.3	0	0	0
	0	0.544643034		0.455356966		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	23	23	3.2	0	0	0
	0	0.67802646		0.063755877		0.169406616		0.088811047		0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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       1       0       1       24      24      3.0     0       0       0
        0       0.89912206      0.024120629     0.076757311     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       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       1       0       1       25      25      1.9     0       0       0
        0       0.556946009     0.033135541     0.047085469     0.362832982     0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       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       1       0       1       26      26      0.9     0       0       0
        0       0.088378937     0.005662567     0.891390986     0.014567511     0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       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       1       0       1       27      27      1.3     0       0       0
        0       0       0.040315059     0.162626956     0.747023655     0       0.05003433
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       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       1       0       1       28      28      3.6     0       0       0
        0       0       0.022971224     0.002684482     0.323296895     0.316027846
        0.022807441     0.312212111     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       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       1       0       1       29      29      4.3     0       0       0
        0       0       0       0       0.217587058     0.216047018     0.291179346
        0.203878455     0.057003328     0.007152397     0       0       0       0       0
        0.007152397     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       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       1       0       1       30      30      3.6     0       0       0
        0       0       0       0       0.289671331     0.298373979     0.298275078
        0.112521237     0       0       0       0       0.001158375     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       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       1       0       1       31      31      1.7     0       0       0
        0       0       0       0       0       0       0.14586162      0.291723239
        0.008759029     0       0.519770271     0       0       0.005466247     0       0
        0       0.013269972     0       0       0.015149623     0       0       0       0
        0       0       0       0       0       0       0       0       0       0       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       1       0       1       32      32      1.3     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0.039949172     0       0       0.109045287     0.725785397     0       0       0
        0.085270972     0       0       0       0       0       0       0       0.039949172
        0       0       0       0       0       0       0       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       1       0       1       33      33      1.9     0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0.015847998     0.348397818     0       0.005683071     0       0
        0       0.113011522     0       0.003826117     0       0       0       0
```

	0.513233474	0	0	0	0	0	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	1	0	1	34	34	1.7	0	0	0
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	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	0						
2003	1	4	1	0	1	35	35	0.4	0	0	0
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	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	0						
2003	1	4	1	0	1	36	36	0.2	0	0	0
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	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	0						
2003	1	4	2	0	1	13	13	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	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						
2003	1	4	2	0	1	14	14	0.4	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	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						
2003	1	4	2	0	1	16	16	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	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						
2003	1	4	2	0	1	17	17	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	0.012327489	
	0.831726137	0.155946374	0	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	2	0	1	18	18	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	0.005606495	
	0.815548663	0.178844842	0	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	2	0	1	19	19	3.6	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	0	0	0.792886829
	0.207113171	0	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	2	0	1	20	20	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	0	0	0	0.161191626
	0.650360042	0.188448332	0	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	2	0	1	21	21	3.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.169471087	
	0.756778372		0.036752637		0	0.036997904		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	2	0	1	22	22	4.5	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	0	0	0	0.017824367	
	0.567418934		0.358750509		0.05600619		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	2	0	1	23	23	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	0	0	0	0	0	
	0.678045057		0.195376509		0.023562212		0.103016222		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	2	0	1	24	24	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	0	0	0	0	0.132904829	
	0.644800031		0.086953516		0.006233986		0.04303588		0.04303588		0
	0.04303588		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2003	1	4	2	0	1	25	25	1.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.33795271		0.496432007		0.086739145		0.078876138		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	2	0	1	26	26	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	
	0.177017796		0.08225928		0.740722925		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	2	0	1	27	27	1.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.016601088		0.273203944		0.123325523		0.400389053		0	0.186480393	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
2003	1	4	2	0	1	28	28	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	0	0	0	0	0	0	
	0.005885364		0.027151368		0.358929411		0.473567845		0.035174449		
	0.00288406		0.003818979		0.012786466		0.066111406		0.003062013		0
	0	0	0.001357606		0.009271032		0	0	0	0	0
	0	0	0	0	0	0	0				
2003	1	4	2	0	1	29	29	4.5	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	0	0	0	0	0
	0	0.015412305		0.312557301		0.395787675		0.065646092		0	
	0.030445877		0.030445877		0	0.035476351		0	0	0	
	0.026668384		0.060891755		0	0	0.026668384		0	0	0
	0	0	0	0	0						
2003	1	4	2	0	1	30	30	0.8	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	0	0	0	0	0	0

	0	0	0	0	0	0.041597828		0.01520158		0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.116001063		0.827199529		0	0	0			
2003	1	4	2	0	1	31	31	0.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.024704903		0	0	0.059974129		0	0	0	0	0
	0	0	0	0	0	0	0.915320967				
2003	1	4	2	0	1	32	32	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
	0	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							
2003	1	4	2	0	1	34	34	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
	0	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							
2003	1	4	2	0	1	35	35	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
	0	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							
2004	1	4	1	0	1	14	14	0.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	4	1	0	1	16	16	0.4	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	4	1	0	1	18	18	0.4	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	4	1	0	1	19	19	0.4	0	0	0
	0.943697958		0	0.056302042		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	20	20	1.6	0	0	0
	0.04539174		0.876011182		0.078597078		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	21	21	1.5	0	0	0
	0.09860085		0.247040797		0.654358352		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	22	22	4.5	0	0	0
	0.020110928		0.587097342		0.39279173		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	23	23	2.6	0	0	0
	0	0.661351129		0.338648871		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	24	24	2.4	0	0	0
	0	0.88868454		0.11131546		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	25	25	3.5	0	0	0
	0	0.330646891		0.441696203		0.227656906		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	26	26	2.2	0	0	0
	0	0.178160064		0.673145214		0.078727823		0.069966898		0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	27	27	2.8	0	0	0
	0	0.105873815		0.894126185		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	28	28	2.6	0	0	0
	0	0	0.551566811		0.157192746		0.291240443		0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	29	29	1.0	0	0	0
	0	0	0.358744937		0	0	0.205273816		0.435981247		0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	30	30	0.8	0	0	0
	0	0	0	0	0.133310654		0.27588043		0.314928486		0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0.27588043		0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	31	31	0.6	0	0	0
	0	0	0	0	0	0.173121908		0	0	0	0
	0	0	0.440764278		0	0.386113814		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	32	32	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	0	0	0	0	0
	0	0	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	1	0	1	33	33	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	0	0	0	0	0
	0	0	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	1	0	1	34	34	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	0	0	0	0	0
	0	0	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	2	0	1	16	16	0.6	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	0	0	0	0.484255131		
	0.484255131	0.031489739	0	0	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	2	0	1	17	17	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	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							
2004	1	4	2	0	1	18	18	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	0.87756465	
	0.12243535	0	0	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	2	0	1	19	19	2.4	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	0	0	0.584702019	
	0.395644204	0	0	0.019653776	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	2	0	1	20	20	2.4	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	0	0	0.212153373	
	0.610365711	0.177480916	0	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	2	0	1	21	21	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	0	0	0	0	0	0	
	0.893073668	0.106926332	0	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	2	0	1	22	22	2.8	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	0	0	0	0	0	
	0.92174904	0.07825096	0	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	2	0	1	23	23	4.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.885632081		0.114367919		0	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	2	0	1	24	24	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	0	0	0	0	0	
	0.870944867		0.129055133		0	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	2	0	1	25	25	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	0	0	0	0	0	
	0.60277404		0.39722596		0	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	2	0	1	26	26	1.6	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	0	0	0	0	0	
	0.244230143		0.755769857		0	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	2	0	1	27	27	1.6	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	0	0	0	0	0	
	0.096206048		0.903793952		0	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	2	0	1	28	28	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	0.272890341		0.358046478		0.059811184		0	0	0	0
	0.154625999		0	0	0.154625999		0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
2004	1	4	2	0	1	29	29	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	0	0	0	0	0	0
	0	0.046881482		0.139220567		0.186404763		0	0.335413093		0
	0	0	0	0.119359143		0	0.119359143		0	0	0
	0	0.053361811		0	0	0	0	0	0	0	0
2004	1	4	2	0	1	30	30	2.4	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	0	0	0	0
	0	0	0	0.044365577		0	0	0	0	0	
	0.112953709		0.050498138		0.158475772		0.112953709		0	0	
	0.047813816		0	0	0	0	0	0.112953709		0.098948552	
	0	0.049134757		0.211902261							
2004	1	4	2	0	1	31	31	0.8	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	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.405725224		0.20147046		0	0	0	0	0.185743496	
	0	0	0	0	0	0	0.20706082				
2004	1	4	2	0	1	32	32	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
	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							
2004	1	4	2	0	1	33	33	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
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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	1							
2005	1	4	1	0	1	9	9	0.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	1	0	1	13	13	0.5	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	1	0	1	15	15	0.2	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
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	1	0	1	16	16	0.4	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	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	1	0	1	17	17	0.5	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	1	0	1	18	18	0.5	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							
2005	1	4	1	0	1	19	19	0.2	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							
2005	1	4	1	0	1	20	20	0.5	0	0	0
	0.227802859		0.162528217		0.609668924		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	0	0	0	0	0	0	0
	0	0	0	0	0	0	0				
2005	1	4	1	0	1	21	21	1.3	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

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0 0 0 0 0 0
2005 1 4 1 0 1 22 22 2.2 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 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
2005 1 4 1 0 1 23 23 2.5 0 0 0
0 0.102451333 0.622778941 0.274769725 0 0 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
2005 1 4 1 0 1 24 24 1.4 0 0 0
0 0.118777533 0.881222467 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
2005 1 4 1 0 1 25 25 3.2 0 0 0
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0 0 0 0 0 0 0
2005 1 4 1 0 1 26 26 2.3 0 0 0
0 0 0.197655987 0.802344013 0 0 0 0 0
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0 0 0 0 0 0
2005 1 4 1 0 1 27 27 2.3 0 0 0
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2005 1 4 1 0 1 28 28 3.2 0 0 0
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0 0 0 0 0 0 0
2005 1 4 1 0 1 29 29 4.5 0 0 0
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0.185354772 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0
2005 1 4 1 0 1 30 30 1.8 0 0 0
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0.48868196 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 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 1 0 1 31 31 1.3 0 0 0
0 0 0 0 0 0.482631182 0 0 0.49173332
0 0 0.004934922 0 0 0 0 0.010350288 0
0 0 0 0 0.010350288 0 0 0 0 0
0 0 0 0 0 0 0 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  1  0  1  32  32  1.1  0  0  0
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     0.249675577  0  0  0  0  0  0  0  0  0
     0  0  0.264245754  0.06353635  0  0  0  0.264245754
     0  0  0  0  0  0  0  0  0  0  0
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2005 1  4  1  0  1  33  33  1.4  0  0  0
     0  0  0  0  0  0  0  0.157230624  0  0
     0.104123346  0.103768904  0  0  0.104123346  0  0  0
     0.104123346  0.104123346  0  0.218383743  0  0  0  0
     0  0.104123346  0  0  0  0  0  0  0  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  1  0  1  34  34  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  0.202854183  0.594291633  0.202854183  0  0
     0  0  0  0  0  0  0  0  0  0  0
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2005 1  4  1  0  1  35  35  0.2  0  0  0
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     1  0  0  0  0  0  0  0  0  0  0
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     0  0  0  0
2005 1  4  1  0  1  36  36  0.2  0  0  0
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     0  0  0  0  0  1  0  0  0  0  0
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     0  0  0  0  0  0  0  0  0  0  0
     0  0  0  0
2005 1  4  2  0  1  10  10  0.2  0  0  0
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     0  0  0  0  0  0  0  0  1  0  0
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     0  0  0  0  0  0  0  0  0  0  0
     0  0  0  0
2005 1  4  2  0  1  11  11  0.4  0  0  0
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     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
2005 1  4  2  0  1  12  12  0.5  0  0  0
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     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  0
2005 1  4  2  0  1  13  13  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  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
2005 1  4  2  0  1  14  14  0.5  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  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							
2005	1	4	2	0	1	15	15	0.4	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	0.600407558		
	0.399592442		0	0	0	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	2	0	1	16	16	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	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							
2005	1	4	2	0	1	17	17	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	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							
2005	1	4	2	0	1	18	18	0.5	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	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							
2005	1	4	2	0	1	19	19	0.7	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	0	0	0	0	0	0	0	0.113787428	
	0.886212572		0	0	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	2	0	1	20	20	0.5	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	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							
2005	1	4	2	0	1	21	21	0.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.749309725		0.250690275		0	0	0	0	0	0	0
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	0	0	0	0	0	0	0				
2005	1	4	2	0	1	22	22	2.7	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	0	0	0	0	0	0	0	0	
	0.18316579		0.676147377		0.140686833		0	0	0	0	0
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	0	0	0	0	0	0	0	0			
2005	1	4	2	0	1	23	23	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	
	0.012188196		0.901664127		0.086147676		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	2	0	1	24	24	3.8	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	0	0	0	0	0	0
	0.802475461		0.197524539		0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
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2005	1	4	2	0	1	25	25	4.3	0	0	0
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	0.253196191		0.746803809		0	0	0	0	0	0	0
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	0	0	0	0	0	0					
2005	1	4	2	0	1	26	26	3.4	0	0	0
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	0.002660357		0.194865633		0.788952373		0.013521636		0	0	0
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2005	1	4	2	0	1	27	27	2.9	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0.036868763		0.157602033		0.805529205		0	0	0	0	0
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2005	1	4	2	0	1	28	28	3.6	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
	0.502808401		0.083937093		0.128456373		0.055006719		0.111784905		
	0.013132114		0.104874396		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2005	1	4	2	0	1	29	29	3.8	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	0.006282836		0.006282836		0.032687186		0.018797144		0.110188913	
	0.006935176		0.77739463		0	0	0.015089423		0.007544711		
	0.018797144		0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	2	0	1	30	30	2.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0.017827399		0.032873134		0.018015507	
	0	0.015843003		0	0.005300169		0.008589627		0.017179254		0
	0	0.840058284		0	0	0	0	0	0.035723997		0
	0	0.008589627									
2005	1	4	2	0	1	31	31	1.8	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	0	0	0	0	0	0.143403546	
	0	0	0.143403546		0	0	0.143403546		0.068140735		
	0.143403546		0.036518096		0.057736918		0.057736918		0	0	0
	0	0.206253152									
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	0	0	0	0							
2006	1	4	1	0	1	11	11	0.4	0	0	1
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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							
2006	1	4	1	0	1	12	12	0.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	1	0	1	13	13	1.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	1	0	1	14	14	0.5	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	1	0	1	15	15	1.0	0	0	
	0.216987756		0.783012244		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	16	16	1.8	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	1	0	1	17	17	2.0	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	1	0	1	18	18	1.6	0	0	0
	0.459045414		0.540954586		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	19	19	1.6	0	0	0
	0.40352088		0.59647912		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	20	20	2.6	0	0	0
	0.16755087		0.83244913		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	21	21	1.4	0	0	0
	0	0.923521451		0.076478549		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	22	22	0.8	0	0	0
	0	0.248237085		0.751762915		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	23	23	1.8	0	0	0
	0	0.080369373	0.816442713	0.056708918	0.046478996	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	24	24	0.8	0	0	0
	0	0	0.833543243	0.166456757	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	25	25	4.9	0	0	0
	0	0	0.420789989	0.559936888	0.019273123	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	26	26	3.2	0	0	0
	0	0	0.067554647	0.916036506	0.016408847	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	27	27	3.6	0	0	0
	0	0	0	0.723837235	0.276162765	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	28	28	8.7	0	0	0
	0	0	0	0.111663456	0.774664874	0.11367167	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	29	29	4.9	0	0	0
	0	0	0	0.065139384	0.090397374	0.71331832	0.131144922				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	30	30	2.8	0	0	0
	0	0	0	0	0.025700629	0	0.442085071	0.407663756			
	0.124550544	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	31	31	1.6	0	0	0
	0	0	0	0	0	0	0	0.051844982	0.473302542		
	0.474852476	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	32	32	0.4	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0.477160494	0	0	0	0	0	0	0	
	0.522839506	0	0	0	0	0	0	0	0	0	

	0	0	0	0	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	1	0	1	33	33	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	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							
2006	1	4	1	0	1	34	34	0.2	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	2	0	1	13	13	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	0.727969689		
	0.272030311		0	0	0	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	2	0	1	14	14	0.9	0	0	0
	0	0	0	0	0	0	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
	0	0	0	0							
2006	1	4	2	0	1	15	15	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	0.437521414		
	0.562478586		0	0	0	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	2	0	1	16	16	0.6	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	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							
2006	1	4	2	0	1	17	17	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	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							
2006	1	4	2	0	1	18	18	1.8	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	0	0	0	0	0.872553462	
	0.127446538		0	0	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	2	0	1	19	19	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	0	0	0	0.441803291	
	0.558196709		0	0	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	2	0	1	20	20	0.8	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	0	0	0	0	0.45723264	
	0.54276736		0	0	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	2	0	1	21	21	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	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							
2006	1	4	2	0	1	22	22	2.8	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	0	0	0	0	0	
	0.236390162		0.54915272		0.214457118		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	2	0	1	23	23	2.4	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	0	0	0	
	0.047471652		0.416581115		0.535947233		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	2	0	1	24	24	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	0	0	0	0	0	0
	0.473630138		0.41487947		0.111490391		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	2	0	1	25	25	3.6	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	0	0	0	0	0	0
	0.0213506		0.957298801		0.0213506		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	2	0	1	26	26	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	0	0	0	0	0
	0	0.953492751		0.046507249		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	2	0	1	27	27	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	0	0	0	0	0	0
	0	0.6272312		0.354399028		0.018369772		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	2	0	1	28	28	10.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0.06201666		0.280363386		0.594659306		0.032168199		0.012394501	
	0.018397949		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
2006	1	4	2	0	1	29	29	6.5	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	0	0	0	0	0
	0	0	0	0.034180505		0.282616496		0.17835917		0.029051474	
	0.336938222		0.050457703		0	0.043122959		0	0	0	
	0.016221997		0	0.029051474		0	0	0	0	0	0
	0	0	0								
2006	1	4	2	0	1	30	30	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	0	0	0
	0	0	0	0	0	0	0.576893798		0.040716147		

	0.01413057		0.304215796		0	0	0	0	0.032505895		0
	0	0	0.015768897		0	0	0	0.015768897		0	0
	0										
2006	1	4	2	0	1	31	31	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	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.948165425	
	0	0.051834575		0	0	0					
2006	1	4	2	0	1	32	32	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
	0	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							
2003	1	5	1	0	1	8	8	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	0
	0	0	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	5	1	0	1	9	9	0.4	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	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	10	10	0.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	12	12	0.7	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	13	13	0.4	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	14	14	0.6	0	0	
	0.671838047		0.328161953		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	5	1	0	1	15	15	0.7	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	16	16	0.7	0	0	
	0.436687715		0.563312285		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	5	1	0	1	17	17	3.7	0	0	
	0.348476897		0.539724936		0.111798167		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	5	1	0	1	18	18	3.9	0	0	0
	0.924960203		0.075039797		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	5	1	0	1	19	19	4.5	0	0	0
	0.654699297		0.345300703		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	5	1	0	1	20	20	2.6	0	0	0
	0.793833771		0.206166229		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	5	1	0	1	21	21	0.9	0	0	0
	0.42068568		0.57931432		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	5	1	0	1	22	22	0.7	0	0	0
	0	0.806101973		0.193898027		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	5	1	0	1	23	23	0.9	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	24	24	0.6	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	25	25	0.4	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	1	0	1	26	26	0.6	0	0	0
	0	0.669091241		0.16545438		0.16545438		0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	5	1	0	1	27	27	0.7	0	0	0
	0	0.506346063	0.253173031	0.240480906	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	5	1	0	1	28	28	0.2	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	5	2	0	1	9	9	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	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							
2003	1	5	2	0	1	10	10	0.6	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	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							
2003	1	5	2	0	1	11	11	0.7	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	0	0	0	0	0	0.362365427	0.238940762		
	0.398693811	0	0	0	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	5	2	0	1	12	12	0.7	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	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	0							
2003	1	5	2	0	1	13	13	1.7	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	0	0	0	0	0	0.155274003	0.689451993		
	0.155274003	0	0	0	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	5	2	0	1	14	14	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	0	0	0.677697437		
	0.322302563	0	0	0	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	5	2	0	1	15	15	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	0.384444565		
	0.615555435	0	0	0	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	5	2	0	1	16	16	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	0.257435715		
	0.742564285	0	0	0	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	5	2	0	1	17	17	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	0.121850983		
	0.673636151		0.204512866		0	0	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	5	2	0	1	18	18	3.5	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	0	0	0	0.798402416	
	0.157183095		0.044414489		0	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	5	2	0	1	19	19	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	0	0	0	0	0.722649187	
	0.19868093		0.078669883		0	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	5	2	0	1	20	20	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	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							
2003	1	5	2	0	1	21	21	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	0	0	0	0.716525649	
	0.094231929		0.189242422		0	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	5	2	0	1	22	22	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	0	0	0	0.363164091	
	0.393009194		0.243826715		0	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	5	2	0	1	23	23	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	0	0	0	0	
	0.857597396		0	0.142402604		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	5	2	0	1	24	24	2.6	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	0	0	0	0	0.100786817	
	0.633246855		0.122251048		0.14371528		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	5	2	0	1	25	25	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	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							
2003	1	5	2	0	1	26	26	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	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							
2003	1	5	2	0	1	28	28	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	0	0	0	0	0	0
	0.17557503		0	0	0.82442497		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	1	0	1	3	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	0	0	0	0	0
	0	0	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	1	0	1	5	5	0.6	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	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	6	6	0.3	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	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	1	0	1	7	7	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	0
	0	0	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	1	0	1	8	8	1.3	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	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	1	0	1	9	9	1.3	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	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	1	0	1	10	10	1.1	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	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	1	0	1	11	11	1.0	0	0.796583585	
	0.203416415		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	12	12	0.7	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	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	13	13	1.8	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	14	14	1.6	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	15	15	1.3	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	0	0	0
	0	0	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	1	0	1	16	16	0.7	0	0	
	0.562853943		0.437146057		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	17	17	0.7	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	18	18	0.2	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	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	19	19	0.9	0	0	0
	0.037847909		0.962152091		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	20	20	1.3	0	0	0
	0.012423793		0.987576207		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	21	21	2.7	0	0	0
	0.019409845		0.980590155		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	22	22	2.0	0	0	0
	0.012432099		0.987567901		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	23	23	0.7	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	24	24	0.2	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	25	25	1.1	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
	0	0	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	1	0	1	26	26	0.2	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	27	27	0.2	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	1	0	1	28	28	0.2	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	5	2	0	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	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							
2004	1	5	2	0	1	4	4	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
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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							
2004	1	5	2	0	1	5	5	0.6	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	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							
2004	1	5	2	0	1	6	6	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	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							
2004	1	5	2	0	1	7	7	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	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							
2004	1	5	2	0	1	8	8	1.8	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	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							
2004	1	5	2	0	1	9	9	1.6	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
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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							
2004	1	5	2	0	1	10	10	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	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							
2004	1	5	2	0	1	11	11	0.6	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	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							
2004	1	5	2	0	1	12	12	0.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.186269889		0.813730111	
	0	0	0	0	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	2	0	1	13	13	1.8	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	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							
2004	1	5	2	0	1	14	14	3.4	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	0	0.85620587		
	0.14379413		0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0				
2004	1	5	2	0	1	15	15	0.7	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	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	0							
2004	1	5	2	0	1	16	16	0.7	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	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	0							
2004	1	5	2	0	1	17	17	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	0	0	0.670545525		
	0.329454475		0	0	0	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	2	0	1	18	18	0.7	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	0	0	0	0	0	0	0	0.39355359	
	0.60644641		0	0	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	2	0	1	19	19	0.7	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	0	0	0	0	0	0	0	0.331042227	
	0.668957773		0	0	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	2	0	1	20	20	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	0.011956018	
	0.672326441		0.315717541		0	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	2	0	1	21	21	3.4	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	0	0	0.008751116	
	0.755737786		0.235511098		0	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	2	0	1	22	22	2.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.357958153		0.642041847		0	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	2	0	1	23	23	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	0	0	0	0	
	0.820050088		0.179949912		0	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	2	0	1	24	24	0.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.325410397		0	0.674589603		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	2	0	1	25	25	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	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							
2005	1	5	1	0	1	2	2	0.2	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	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	1	0	1	4	4	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
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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							
2005	1	5	1	0	1	6	6	0.8	0.208089945		
	0.791910055		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	7	7	1.1	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
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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							
2005	1	5	1	0	1	8	8	2.8	0.312375124		
	0.687624876		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	9	9	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
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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							
2005	1	5	1	0	1	10	10	1.8	0	0.728713208	
	0.271286792		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	11	11	1.2	0	0.059423841	
	0.940576159		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	12	12	3.0	0	0.031502524	
	0.968497476		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	13	13	5.2	0	0	
	0.977409534		0.022590466		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	14	14	3.0	0	0	1
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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	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       1       0       1       15      15      1.5     0       0
        0.830339889     0.169660111     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
2005    1       5       1       0       1       16      16      1.9     0       0
        0.049769416     0.950230584     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
2005    1       5       1       0       1       17      17      2.6     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       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2005    1       5       1       0       1       18      18      0.9     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       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
2005    1       5       1       0       1       19      19      0.6     0       0       0
        0.522983656     0.477016344     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       20      20      1.1     0       0       0
        0.396362077     0.603637923     0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       21      21      0.4     0       0       0
        0.44109589      0.55890411      0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       22      22      1.7     0       0       0
        0       0.148959814     0.851040186     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       23      23      0.9     0       0       0
        0       0.165883079     0.834116921     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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       1       0       1       24      24      2.2     0       0       0
        0       0.011092006     0.988907994     0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       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	1	0	1	25	25	1.7	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	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	1	0	1	27	27	0.4	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	5	2	0	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
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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							
2005	1	5	2	0	1	4	4	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
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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							
2005	1	5	2	0	1	6	6	0.8	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	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							
2005	1	5	2	0	1	7	7	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	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							
2005	1	5	2	0	1	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	0	0	0.019474148		0.980525852		0
	0	0	0	0	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	2	0	1	9	9	5.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.903639981		0.096360019	
	0	0	0	0	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	2	0	1	10	10	2.7	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	0	0	0	0	0	0.791950284		0.208049716	
	0	0	0	0	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	2	0	1	11	11	1.6	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	0	0	0.092022293		0.907977707	
	0	0	0	0	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	2	0	1	12	12	3.5	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	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							
2005	1	5	2	0	1	13	13	5.4	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	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							
2005	1	5	2	0	1	14	14	4.5	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
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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							
2005	1	5	2	0	1	15	15	2.6	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	0	0	0	0.629300599		
	0.329110575		0.041588826		0	0	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	2	0	1	16	16	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	0	0	0.077322646		
	0.922677354		0	0	0	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	2	0	1	17	17	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	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							
2005	1	5	2	0	1	18	18	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	0	0	0	0.730182162	
	0.269817838		0	0	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	2	0	1	19	19	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	0.060347956	
	0.939652044		0	0	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	2	0	1	20	20	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	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							
2005	1	5	2	0	1	21	21	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	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							
2005	1	5	2	0	1	22	22	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	0	0	
	0.21943912		0.78056088		0	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	2	0	1	23	23	2.6	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	0	0	0	0	0	
	0.177494615		0.822505385		0	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	2	0	1	24	24	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	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							
2005	1	5	2	0	1	26	26	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
	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							
2005	1	5	2	0	1	27	27	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
	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							
2006	1	5	1	0	1	2	2	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	0	0	0	0	0
	0	0	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	1	0	1	4	4	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	0	0	0	0	0
	0	0	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	1	0	1	6	6	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	0
	0	0	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	1	0	1	7	7	2.4	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	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	1	0	1	8	8	2.3	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	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	1	0	1	9	9	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
	0	0	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	1	0	1	10	10	2.4	0	0.904734126	
	0.095265874		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	11	11	2.2	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	1	0	1	12	12	5.0	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	1	0	1	13	13	7.4	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	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	1	0	1	14	14	6.7	0	0	
	0.927916044		0.072083956		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	15	15	2.4	0	0	
	0.082481831		0.917518169		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	1	0	1	16	16	2.4	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
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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							
2006	1	5	1	0	1	17	17	5.2	0	0	
	0.021980981		0.813481928		0.164537091		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	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	1	0	1	18	18	2.2	0	0	0
	0.941166592		0.058833408		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	19	19	1.1	0	0	0
	0.556156756		0.443843244		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	20	20	0.4	0	0	0
	0.43653286		0.56346714		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	21	21	1.3	0	0	0
	0.034399902		0.965600098		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	23	23	0.6	0	0	0
	0	0.214463307		0.785536693		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	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	1	0	1	24	24	0.2	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	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	1	0	1	25	25	0.6	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	0	0
	0	0	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	1	0	1	26	26	0.6	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	0	0
	0	0	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	1	0	1	27	27	0.6	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	0	0
	0	0	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	1	0	1	28	28	0.4	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	0
	0	0	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	1	0	1	31	31	0.2	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	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	5	2	0	1	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	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	5	2	0	1	4	4	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	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	5	2	0	1	5	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	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	5	2	0	1	6	6	0.6	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	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							
2006	1	5	2	0	1	7	7	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	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	5	2	0	1	8	8	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	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	5	2	0	1	9	9	4.1	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	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	5	2	0	1	10	10	2.4	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	0.715471344		0.284528656	
	0	0	0	0	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	2	0	1	11	11	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	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							
2006	1	5	2	0	1	12	12	2.6	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	0	0	0	0.827731705		
	0.172268295		0	0	0	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	2	0	1	13	13	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	0	0.946410513		
	0.053589487		0	0	0	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	2	0	1	14	14	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	0	0	0	0	0.835404208		
	0.164595792		0	0	0	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	2	0	1	15	15	2.8	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	0	0	0	0.452425945		
	0.547574055		0	0	0	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	2	0	1	16	16	3.5	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	0	0	0.019532397		
	0.980467603		0	0	0	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	2	0	1	17	17	3.7	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	0	0	0	0	0	0	0.05751955		
	0.94248045		0	0	0	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	2	0	1	18	18	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	0	0	0	0.062491245		
	0.683220891		0.254287864		0	0	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	2	0	1	19	19	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	0	0	0	0.127525232	
	0.872474768		0	0	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	2	0	1	20	20	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
	0	0	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	2	0	1	21	21	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	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							
2006	1	5	2	0	1	22	22	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	0	0	0	0	0	
	0.232142857		0.767857143		0	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       2       0       1       23      23      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
        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
2006    1       5       2       0       1       24      24      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
        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
2006    1       5       2       0       1       25      25      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       0       0       0       0       0       0
        0.82048109      0.17951891      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       2       0       1       26      26      0.9     0       0       0
        0       0       0       0       0       0       0       0       0       0       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
2006    1       5       2       0       1       28      28      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
        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   # Mean Size at Age Observations
0 # Number of Environmental Variables
0   # Environmental Observations
999
```

Forecast File:

```
##  SS2 Version 2.00.c
0.5 #  Target SPR
10 # Number of Forecast Years
10 # Number of Forecast Years with Std Dev
1 # Recruitment Deviation Emphasis
0 # Fraction log-bias adjustment Before End Year+1
0 # Fraction log-bias adjustment After End Year
0.40 #  Top of 40:10 Option
0.10 #  Bottom of 40:10 Option
1.0 #  OY Scalar to ABC
2006 #  First Year for Forecast & MSY Calcs
2006 #  Last Year for Forecast & MSY Calcs
1 # Relative F Flag
1  #Fleet 1 (Season 1)
999
200
228
273
283
292
299
306
313
321
328
```

Agenda Item G.4.a
Attachment 8
September 2007

Darkblotched Rockfish

STAR Panel Meeting Report

NOAA Western Regional Center
7600 Sand Point Way NE
Seattle, Washington 98115
July 16-20, 2007

STAR Panel
Tom Jagielo, Washington Department of Fish of Wildlife, SSC member, (Chair)
Patrick Cordue, Center for Independent Experts (CIE)
Stephen Smith, Center for Independent Experts (CIE)
Larry Jacobson, Northeast Fisheries Science Center (NEFSC)

PFMC
John Wallace (GMT) Representative
Pete Leipzig, (GAP) Representative

STAT
Owen Hamel, Northwest Fisheries Science Center (NWFSC)

Overview

A STAR Panel met at the NOAA Sand Point facility from July 16-20, 2007 to review a draft assessment of darkblotched rockfish. The assessment was conducted with SS2 and modelled one fishery and four fishery-independent surveys. Length, age, and conditional age-at-length observations were also included. The assessment was one of the first to employ conditional age-at-length data.

The Panel was initially concerned about the large differences in scale between the area-swept and GLMM indices for three of the four trawl surveys. However, the trends estimated by each method were similar, so the choice of method did not unduly influence the assessment results.

The Panel discussed the issue of properly computing effective sample sizes for multinomial distributions, particularly with respect to the conditional age-at-length data. Ian Stewart gave a presentation that helped the Panel understand the basis for the starting point used to tune effective sample sizes in the model. The subject of how to best determine effective sample sizes with respect to conditional age-at-length data was not resolved at the meeting.

The Panel and STAT discussed at length the value chosen for steepness during the meeting. Historical precedent, meta priors, and model sensitivities were examined. The Panel and STAT did not reach full agreement on this issue (see Areas of Disagreement, below).

STAR and STAT members agreed that the range of uncertainty was not fully captured in model runs. The major axes of uncertainty considered were steepness, and natural mortality, but, for example, uncertainty in catch was not evaluated. A full Bayesian MCMC analysis may provide a useful tool for evaluating the full range of uncertainty in the assessment (see Research Recommendations, below).

The Panel concluded that the final assessment represents the best scientific information available and that the assessment was suitable for use by managers. The Panel commends the STAT for excellent presentations, wellwritten and complete documentation, and their willingness to respond to the Panel's requests for additional analyses.

Requests Made to the STAT during the Meeting

Round 1 Requests

A: Compare absolute scale and trends of area-swept biomass indices with GLMM biomass indices. Also tabulate base model estimates of *q* for each time series and the "implied" estimates of *q* for the area-swept time series.

Reason: To determine if the scale and/or trends of the GLMM indices differed from those of the area-swept indices. Also, to perform a "reality" check on the estimated *q*s for each GLMM and/or the corresponding *q*s for the area-swept indices (as if they had been fitted instead).

Response: The GLMM indices were substantially larger than the area-swept indices for every survey except the AFSC slope time series. The trends were very similar for every time series except the NWFSC shelf survey. The estimated *q*s for the GLMM time series ranged from 0.14 to 0.44, and for the area swept time series they ranged from 0.18 to 2.0.

Discussion/conclusion: Concern was raised by some members of the Panel with regard to the large differences in scale between the GLMM and area-swept indices. However, because the trends were very similar for most time series (with the exception of a short "recruitment" series) it was decided not to pursue this issue at the current meeting. There was discussion with regard to whether the estimates of *q* could be used to perform a "reality check" in the absence of informed priors. The Panel had mixed views on this, but as there was no obvious cause for concern about the estimated *q*s in the base model, the decision was made not to pursue the issue at the current meeting.

B: Compare GLMM biomass time series on the same plot. Tabulate or otherwise display CVs.

Reason: To better judge if the trends of the different time series were consistent given their CVs.

Response/conclusion: The three "adult" biomass time series showed consistent trends (with the exception of the 2003 spike in the NWFSC slope series).

C: Tabulate or otherwise compare the number of trips and number of fish sampled in each length frequency series with the initial effective *n*. Also tabulate the final multipliers required to get to each effective *n* in the base run. Repeat for age frequencies.

Reason: To better understand the level of sampling underlying the length and age data, and how these related to the initial effective sample sizes and those used in the base model.

Discussion/conclusion: For the length frequency data some understanding of the temporal and spatial extent of sampling was gained and the sample sizes are now available for reference. For the conditional age-at-length data "sample sizes" were presented within length classes which was not particularly helpful. The original assessment calculated effective sample sizes for conditional age data independently for each length class in a year when the number of trips for a length class was taken to be the number of trips from which age data for that length group were obtained. The STAR panel noted that effective sample sizes for all length groups in the same year was linked. For example, the number of trips sampled was the same for all length groups while the number of ages collected from each length bin is a random variable.

D: Plot initial effective *n* and output *n* for each year for each time series (length and age frequencies).

Reason: This was a mis-specified request – see Request L below.

Discussion/conclusion: These were briefly looked at and, for some time series, the trends of the initial effective *n* differed from those of the output *n*. This was assumed to be due to the interaction between data sets (e.g., when a segment of a time series has no "competition", it will fit well and hence increase the effective *n* in these years; and conversely, when a segment of a time series is in conflict with other data its fit may be poor and the associated effective *n* will decrease).

E: Tabulate SD of standardized residuals for each time series.

Reason: To see if the tuning had been effective for the length and age data (and to see to what extent the residuals of the biomass indices were consistent with the input variance assumptions).

Response: This was not completed – some clarification on what was required was sought by the STAT.

F: Compare age data across states.

Reason: To determine if there was substantial variation in the age frequencies between states.

Response: This was not done due to time constraints.

G: Do likelihood profiles over R_0 – split into components down to stock-recruit component – tabulate current depletion and five year projections.

Reason: To ascertain which components of the total likelihood were influential in the determination of the base model estimate of biomass and where the "preference" of each component lay.

Response: A comprehensive table of likelihoods was produced over a range of R_0 values which resulted in a 2007 depletion range which was monotonic from 13% to 48%. The largest contributions to the total likelihood came from the age and length data (as would be expected). However, the greatest contrast in likelihood components were seen in the triennial survey abundance time series, the fishery and discard length data, the fishery and discard age data, the NWFSC slope age data, and a component labelled "catch". Two of the indices favored low R_0, two favored R_0 near the base estimate, and one favored high R_0 (the fishery and discard age data).

Discussion/conclusion: The components with the greatest contrast in likelihood are the ones which are potentially most “influential” in determining the base model estimate of R_0 (and hence depletion). It was concluded that there was some “tension” between the data sets, as is typical in many assessments, and that a change in their relative weightings could substantially alter the assessment results. It was not understood by meeting participants what the component labelled “catch” referred to. It was hypothesized that it must relate to some fitting procedure involving the input landings. See Request J below.

H: Sensitivity runs to base using sigmaR = 0.6 and 1.5 – tabulate output sigmaR.

Reason: To ascertain if there was any consistency in the output sigmaR, or if it was primarily dependent on the initial input value.

Response/conclusion: Input values of 0.6, 0.8, 1.0, and 1.5 gave corresponding output values of 0.74, 0.77, 0.83, and 1.72. It was concluded that there was some stability (except for very large values of sigmaR).

I: Sensitivity run to base with no fishery conditional age-at-length data.

Reason: To determine if the exclusion of the fishery age-at-length data made any substantive difference to the assessment results.

Response: The biomass trajectory for the sensitivity run reached a lower minimum level than the base model and had a depletion in 2007 of 13% compared to the base model of 23%.

Discussion/conclusion: It was concluded that this was a substantial difference and that the meeting participants would have to carefully consider how best to use the fishery age-at-length data.

Round 2 Requests

J: Determine what the likelihood component labelled “catch” is.

Reason: This likelihood component was potentially influential and nobody was sure where it was coming from.

Response: Investigation revealed that the landings data were being fitted because the option for continuous F (as opposed to Pope’s approximation) had been selected by the STAT for the catch equation (i.e., Baranov catch equation). The STAT changed the control file to select Pope’s approximation and reran the likelihood profiles on R_0. The results from the altered model were almost identical to the original profiles but the range of depletion increased somewhat as did the "preferences" of the other likelihood components (i.e., the R_0 at which they were minimized). The result was some easing of the "tension" between the data sets.

Discussion/conclusion: The option to use continuous F was a relatively recent innovation in SS2 and was not documented in the technical documentation. For this assessment it appears that the results are not affected by the choice of catch equation. However, the strong preference shown by the "catch" likelihood component was disconcerting as were the relatively large differences between the specified landings and the (model) predicted landings. It is not necessary to fit landings in order to implement the Baranov catch equation — total catch can be specified as a function of landings, discard rate, and discard mortality, and F calculated using an iterative procedure. This option should be offered as an alternative to that of fitting the landings.

K: Explore alternative treatments of the fishery conditional age-at-length data. In particular, enlarging of the smaller length bins, or truncation of the smaller length bins. Compare biomass trajectories.

Reason: The conditional age-at-length data appeared to contain quite a lot of data for fish between 20 cm and 30 cm, at which stage in their life cycle they average perhaps 3 cm of growth per year. Because sampling occurs throughout the year a basic assumption of the assumed multinomial distribution is violated to some extent (i.e., the proportions of age at given length are not constant). This issue is similar to better known problems in specifying length and size bins for fishery age-length keys. Two alternative treatments of the data were suggested, both of which mitigate the problem to some extent.

Response: Expanded length bins for smaller fish of 5 cm, tapering down to 2 cm, were used in one run. In the alternative run the length bins of 28 cm and less were deleted. For both runs the biomass trajectories were very similar to the base model.

Discussion/conclusion: For the base model the violation of the multinomial assumption of constant proportion at age is of no consequence.

L: As for Request D, but compare the input and output effective *n* for the *last* iteration (before achieving the base model).

Reason: To look at whether the tuning had been adequate.

Response: The average values of the effective sample sizes in the base model were similar to the output effective samples from the base model. Some differences in trend were seen, as in Request D.

Discussion/conclusion: Given similar average values, it appeared that the tuning had been adequate.

M: Complete requests E & F.

Reason: See Requests E & F above.

Response:

Request E: The SD of the standardized residuals for the biomass indices and length frequencies were tabulated. Two of the biomass time series had standard deviations substantially lower than 1. The standard deviations of the length frequencies ranged from 0.7 to 1.

Request F: Age frequencies and length frequencies for the fishery were presented graphically by year and state. No fish from California were ever seen in the plus group (30 years), but there were only two years when age data were available from all states for comparison. There were some years in which large fish were present in the California length samples.

Discussion/conclusion:

Request E: To satisfy the statistical assumptions of the model, it is necessary that standardized residuals have a SD not too different from 1. For short time series it is not unexpected to see large deviations from this expectation, and that is not a problem. Tuning appears to have been adequate for the length frequencies. The age data were not considered and it remains a topic for research as how best to jointly tune length and conditional age-at-length data.

Request F: It was concluded that although there may be an issue with spatial variation in age and unbalanced sampling, any corrective action would have no consequences for the output of the assessment. Therefore, the issue was not pursued.

Round 3 Requests

Candidate base model configuration:

- Use all existing data sets with conditional age-at-length for the fishery with expanded length bins for smaller fish.
- Estimate *q*s analytically as median unbiased.
- h = median of Dorn darkblotched prior.
- M = 0.07.
- sigmaR = 0.8.
- Tune using same procedure as in original base.

N: For all conditional age-at-length data, calculate initial effective *n* using Stewart's formula applied to the total number of trips and fish within year (rather than within length bin). Derive the effective *n* within length bins by scaling with the proportions of aged fish within length bins. Graphically compare the initial effective *n* calculated by the two methods. Run as an alternative candidate base model (fully tuned). Choose the base model.

Reason: There was concern that it was inappropriate to apply the equations for determining effective sample size for age-at-length data to the number of trips which delivered a number of fish within a given length class. Applying the equations to the total number of trips and aged fish appeared to be a reasonable alternative.

Response: The alternative method of calculating effective *n* for age-at-length data produced lower total effective *n* within each year of each time series. However, the pattern of sample sizes across length bins was very similar for both methods. The alternative candidate base model gave results almost identical to the first candidate base model. The STAT chose the alternative candidate as the base model.

Discussion/conclusion: Ian Stewart gave a brief presentation on the origins of the equations used to calculate initial effective *n* from number of samples and number of fish. The two equations (one for surveys and one for fisheries) were derived from a meta-analysis of the 2005 stock assessments. The data sources included in the study were mainly length frequencies, but there were also age frequencies and conditional age-at-length data. The Panel acknowledged the work as a good attempt to help standardize tuning of effective sample sizes in the 2007 round of stock assessments. However, there was concern that the equations developed were not appropriate for conditional age-at-length data due to the small number of such data sets included in the meta-analysis. The equations presented seemed to summarize current practice rather than estimate optimum values. There was also concern that the approach was not getting at the basic issue of assigning an appropriate level of observation error to the length and age data as a starting point for tuning (which involves the addition of extra variance as an acknowledgement of faulty model structure and compromised assumptions). Two alternatives were suggested. There were analytical options available for estimating effective sample size and a general bootstrapping approach could be used (which could be applied to length and associated conditional age-at-length data).

For this particular assessment, the Panel concluded that the results were not sensitive to effective sample sizes within the range explored.

O: Run four sensitivities to the base with low and high M (0.04, 0.10) and h (low, high – from prior).

Reason: To explore possible dimensions of uncertainty.

Response: The low and high *h* runs gave 2007 depletion ranging from 9% to 29% (base = 16%). The low and high *M* runs gave a 2007 depletion range of 4% to 50%. Two other sensitivities were also run: "no fish lengths" and "no fish lengths or ages" which gave depletion estimates of 12% and 9%, respectively. Estimated virgin spawning biomass showed little variation over all the runs (+- 10%).

Discussion/conclusion: The large sensitivity to *M* was noted compared to *h* but some of this was ascribed to the "larger range" used for *M*. An informed prior for *M* was constructed assuming a normal distribution with the mean equal to the base model *M* (0.07) and with the range between the low and high *M* taken to represent 95% of the density. New high and low values of *M* were then taken to be the mean of the lower and upper quartiles of the density (low *M* = 0.05, high *M* = 0.09). The Panel participants agreed to use *M* as a single dimension of uncertainty. This decision was revisited and *h* was added as an additional dimension of uncertainty (i.e., nine alternative states of nature were used in decision tables, being the combinations of low, high, and base values of *M* and *h*).

Later in the meeting the STAT requested reconsideration of the values of *h* to be used. The proposal was that *h* be estimated in the base model configuration using the Dorn prior and that the estimated *h* then be fixed and accepted for the base model (with low and high *h* determined as before assuming a similar variance around the point estimate). Members of the Panel argued against this approach asserting that the estimate so obtained could not be considered any more reliable than the median of the Dorn prior (despite all of the problems with the prior). The STAT agreed to think about the issues and adopt one approach or the other before proceeding to the final runs.

P: Do a retrospective analysis on the base model (4-5 years).

Reason: To check for retrospective patterns.

Response: There were no strong retrospective patterns in the biomass trajectories.

Discussion/conclusion: The Panel participants were divided on the usefulness of checking for retrospective patterns. However, because there were no strong patterns, the discussion was academic. There was agreement that a lack of retrospective pattern was not a useful diagnostic for the reliability of an estimator. However, there was disagreement on whether a retrospective pattern was an indicator of a problem with an assessment.

Q: Plot raw catch rates within strata for triennial surveys to compare distribution across years.

Reason: To see if there has been a major temporal shift in the spatial distribution of darkblotched rockfish within the survey area.

Response: The data were very noisy but there was no evidence of a general shift in distribution.

Discussion/conclusion: The area covered by the triennial survey contains a substantial, but unknown, proportion of non-trawlable ground. If there has been a substantial shift in the distribution of darkblotched rockfish and the species has a "ground preference", it is possible that a bias has been introduced into the relative abundance time series (e.g., if darkblotched densities tend to be higher on non-trawlable ground and there was a temporal shift from strata with little non-trawlable ground to strata with much more non-trawlable ground – for whatever reason). Given the presented data it was concluded that there was no obvious cause for concern.

Technical merits and deficiencies

- The use of conditional age-at-length data appears technically superior to the common practice of using dependent length and age frequencies (i.e., where the length data have been sub-sampled for age).

- The procedure used to specify initial multinomial effective sample size for tuning the model with age and length composition data has the advantage of standardization between assessments, but questions remain about its applicability and especially to conditional age-at-length data.

- GLMM diagnostics for the indices of abundance were not available for review.

- There is a problem in assuming constant proportions at age in conditional age-at-length, particularly for small fish where fishery samples are aggregated annually. The bins used to aggregate conditional age-at-length from the fishery were expanded for small sizes to accommodate rapid growth during the year while samples were collected. This procedure does not completely solve the problem.

- Conditional age data from the fishery were not scaled to account for differences in age-at-length and landings in different regions along the coast.

- Uncertainty about the catch history was not fully explored.

- Full uncertainty about model estimates was not explored as could have been done with an MCMC analysis. The asymptotic variances that were presented likely understate uncertainty in biomass, fishing mortality and other model estimates.

- Maps illustrating the spatial overlap of the various surveys, the fishery, and habitat were not available in the assessment but would have been useful in understanding and interpreting survey, fishery and other data.

Areas of Disagreement

- The STAT team and the Panel disagreed on procedures for establishing the steepness parameter *h*, which was fixed in the model and has substantial effects on model estimates and projections. All parties agreed that the model data contained little or no information on the value of *h*. The Panel advocated using the median of "Dorn's prior", calculated excluding darkblotched rockfish. The STAT team decided to estimate steepness based on model data and Dorn's prior in a preliminary model run and then fix steepness at the estimate for final runs. The STAT felt that the estimation procedure provided a better fit to trends in the survey data not necessarily reflected in the log likelihood.

Unresolved Problems and Major Uncertainties

- As in other West Coast groundfish assessments, there is considerable uncertainty associated with fixed and estimated parameters including natural mortality and steepness.

- Use of the triennial survey as an index of abundance for darkblotched rockfish was questioned because rocky habitats used by rockfish are not well sampled by trawl gear.

Concerns raised by GMT and GAP representatives during the meeting

The GAP and GMT representatives raised no major issues of concern during the meeting.

Research recommendations

<u>For the next assessment</u>

- 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.

- Assessment data and background information should be presented clearly and completely before dealing with assessment models and modelling results. Data tables should be distributed at the start of the review.

- Future assessments should include complete sets of model diagnostics for GLMM standardized abundance indices, and other types of model runs.

- 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.

General or long term

- 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.

- A full Bayesian assessment.

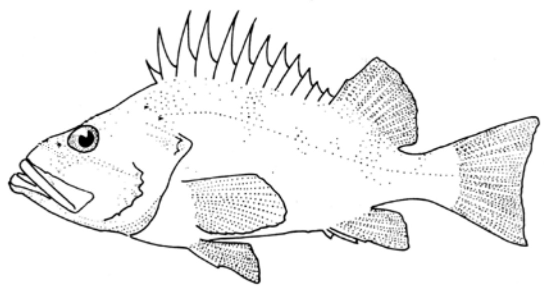
- It would be useful to routinely check model estimates of survey catchability to determine if they imply implausible biomass estimates. This can be done by comparing the prior and posterior for q in a fully Bayesian assessment. Other approaches involve calculating bounds for plausible q values, comparison of model and minimum swept-area biomass estimates from trawl surveys.

- 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.

Agenda Item G.4.a
Attachment 9
September 2007

Revised Draft

Status of cowcod, *Sebastes levis*, in the Southern California Bight



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Southwest Fisheries Science Center
Fisheries Ecology Division
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August 22, 2007

Cowcod drawing adapted from Fish Bulletin No. 157 (CDF&G, 1972)

Executive Summary

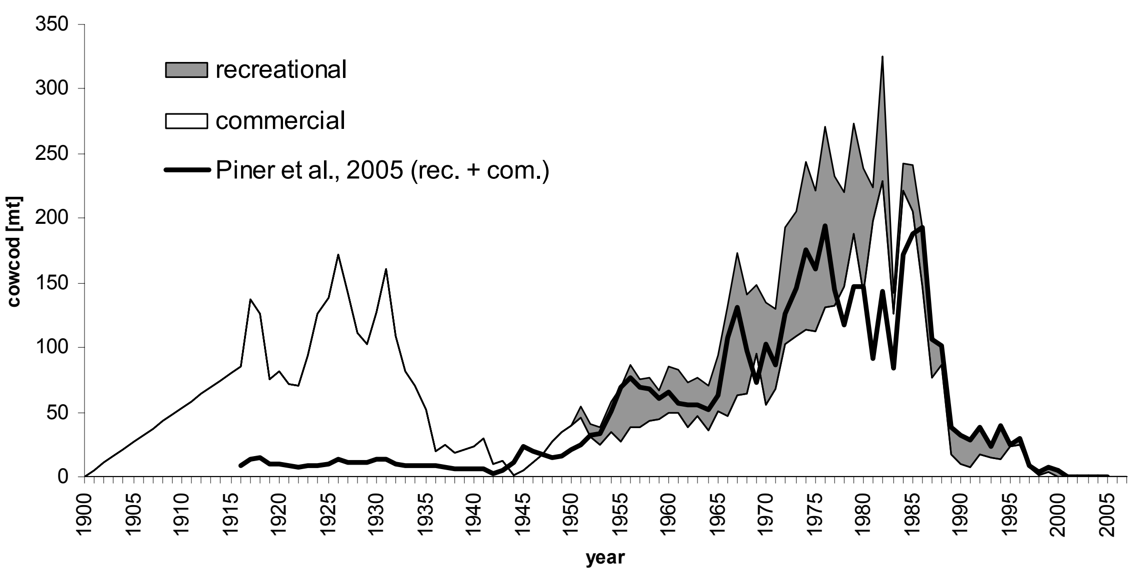
Stock: This is an assessment of *Sebastes levis* in the Southern California Bight (SCB), defined as U.S. waters off California and south of Point Conception (34°27'). Waters north and south of the SCB are not considered in this assessment due to sparse data and possible differences in abundance trends (Piner et al., 2005). The assumption of an isolated stock remains untested, and no information is available regarding dispersal across the northern or southern stock boundaries.

Catch: Retention of cowcod has been prohibited since January 2001. Recreational catches in this assessment are identical to those in the previous assessment, but estimates of commercial catches have been updated to reflect three additional data sources: 1) recovered port samples from Southern California (1983-1985), 2) regional summaries of total rockfish landings (1928-1968) provided by the NMFS SWFSC Environmental Research Division, and 3) California rockfish landings by region (1916-1927), published in CDF&G Fish Bulletin No. 105 (1958). From 2001 to the present, we assume a discard rate of 0.25 metric tons per year, per fishery (Table ES1).

Table ES1: Recent catch [metric tons] of cowcod in the Southern California Bight

Year	Commercial	Recreational	Total
1997	7.30	1.85	9.15
1998	1.21	2.81	4.03
1999	3.47	3.77	7.24
2000	0.45	4.49	4.94
2001	0.25	0.25	0.5
2002	0.25	0.25	0.5
2003	0.25	0.25	0.5
2004	0.25	0.25	0.5
2005	0.25	0.25	0.5
2006	0.25	0.25	0.5

Figure ES1: Estimated cowcod catch, 1900-2006



Data and assessment: The model is an age-structured production model, with three estimated parameters: virgin recruitment (R_0), catchability for the CPFV logbook index, and catchability for the visual survey biomass estimate. In the previous assessment (Piner et al., 2005), the selectivity curves for the combined recreational/commercial fishery and CPFV logbook index were inadvertently set equal to female fecundity. Changing the selectivity curve to mirror the female maturity schedule, as originally intended, causes the 2005 estimate of depletion to drop from 17.8% to 9.4%. In this assessment, the commercial fishery (all gears combined) is separated from the recreational fishery. Gear selectivity for the commercial fleet is set equal to the female maturity schedule, as was the intention of Piner et al. (2005). Cowcod length data from a CDF&G observer study are used to estimate a selectivity curve for the recreational fishery and CPFV logbook index. Changes to the historical catch data (Fig. ES1) are described in detail in the main document. The period modeled in the 2005 assessment (1916-2007) was extended (1900-2007) by assuming a linear ramp in catch from 0.1 metric tons in 1900 to the revised catch estimate for 1916. The length-at-age relationship was slightly adjusted based on evidence that lengths recorded during the ageing process were total length rather than fork length. An index derived from Commercial Passenger Fishing Vessel (CPFV) logbook data was reconstructed using a revised spatial stratification, but logbook data from 2001 to the present are excluded due to the effects of management. The estimate of cowcod biomass in 2002 from the submersible line-transect survey is modeled as a relative abundance index with a prior probability distribution on catchability, as in the previous assessment. The steepness parameter (h) in the Beverton-Holt stock-recruitment curve was fixed at 0.6 based on a recent meta-analysis of several rockfish stocks, as opposed to 0.5 in the previous assessment. Natural mortality (M) was fixed at 0.055. The base model was bracketed by evaluating alternative values of steepness (0.4 and 0.8), and by examining the effect of removing the CPFV logbook index. Removing the CPFV index reduces the model to a deterministic trajectory that is forced through the 2002 biomass estimate. Stock Synthesis 2 (SS2), version 2.00c was used to fit the model.

Unresolved problems and major uncertainties

The most important unresolved problem for this assessment is the lack of data to inform us about productivity of the stock and recent biomass trends. The base model fixes steepness at 0.6 based on the expectation of a prior distribution from a meta-analysis of rockfish steepness parameters. The CPFV logbook index of relative abundance ends in 2000, and no informative abundance indices are currently available to monitor recent trends. Together, these characteristics imply that conclusions regarding rebuilding success are highly uncertain. Indications of recent stock increases are inferred from the model but have not been confirmed by observations.

It is likely that the base model underestimates our uncertainty about this stock's status. Simple models such as this require stronger assumptions (e.g. fixed steepness and natural mortality, recruitments drawn from the stock-recruitment curve, catches are known without error), and estimates from the base model are unrealistically precise. To better capture our uncertainty about the stock's status, the Stock Assessment Team (STAT) identified the steepness parameter and the inclusion of the CPFV logbook index as the two dominant sources of uncertainty in the model. Other sources of uncertainty such as natural mortality, historical catch, gear selectivity, and recruitment variability are also important to consider, but are difficult to estimate with the available data. Our analyses show that estimates of both steepness (h) and the natural mortality rate (*M*) are highly uncertain, and both parameters are treated as fixed and known. Models without the visual survey were not considered due to unreasonably high estimates of annual exploitation rate (total catch divided by summary biomass). The exploitation rates in the base model are also quite high considering what we know about the life history characteristics of cowcod, and the STAT considers this issue an important topic for future research.

Historical commercial landings are based on a ratio estimator that tracks rockfish landings in the Southern California Bight, rather than statewide rockfish landings. The amount of cowcod in these landings is estimated using data from relevant ports and gear types, using the earliest data for which we have actual samples. However, our uncertainty in the percentage of cowcod in total rockfish landings is not well understood, and this percentage is assumed to be constant over the historical period. Sensitivity analyses for different levels of historical landings are explored.

The CPFV logbook index is a long-term time series (1963-2000) of relative abundance which shows declining catch rates over time in the SCB. It is estimated from logbook records of catch and effort that are aggregated by year, month, and CDFG block. This level of aggregation makes it difficult to determine the amount of effective effort for cowcod. Given the model assumptions, the biomass trajectory is unable to match the rate of decline exhibited by this index, i.e. a 'hyperdepletion' pattern exists.

The biomass estimate from the 2002 visual survey is expanded to represent the biomass in the entire SCB via an estimated catchability coefficient with an informative prior distribution. This data point and the CPFV survey provide conflicting information about the status of the stock in 2002. The influence of the visual survey on model results is largely determined by the assumed precision of the prior on the catchability coefficient. The STAT believes that a reasonable lower bound for the CV of the prior (20%) was derived in Appendix 4 of the previous assessment. The base model uses a CV of 50%, based on the previous assessment. Future surveys should aim for adequate spatial coverage within the SCB to avoid this issue.

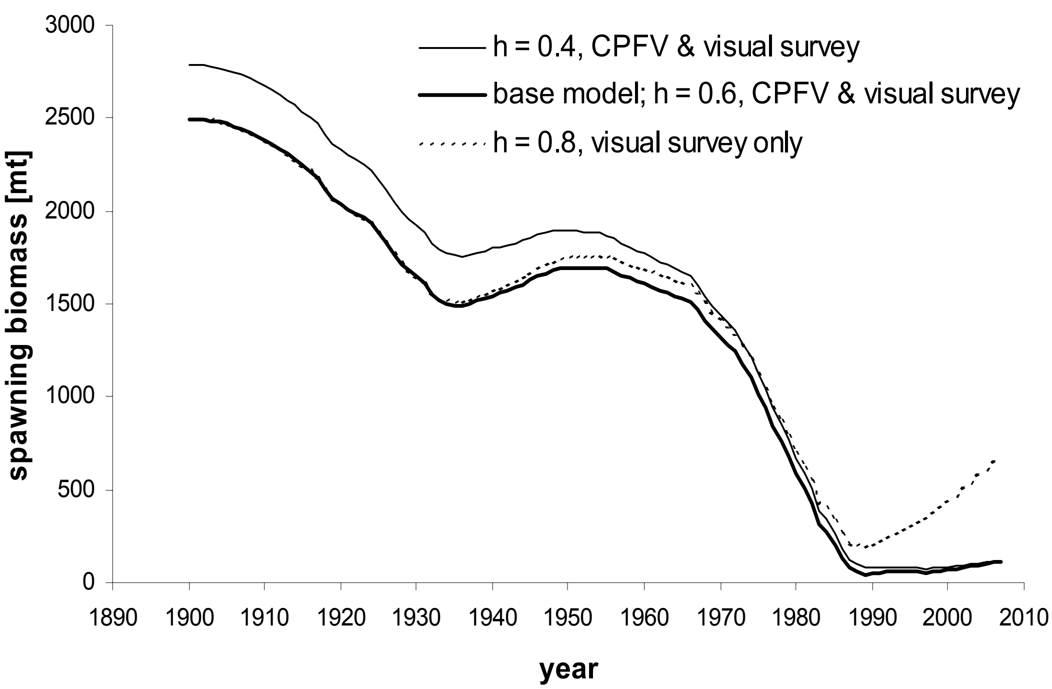
Reference points: For *Sebastes*, the PFMC currently uses $F_{50\%}$ as a proxy for the fishing mortality rate that achieves maximum sustainable yield (F_{MSY}). Spawning biomass (SB) in 2007 is estimated to be between 4.1% and 27.3% of the unfished level (Table ES2). The poor precision of this estimate is due to 1) a lack of data to inform our estimates of stock productivity, and 2) conflicting information from fishery-dependent and fishery–independent data. However, even the most optimistic model presented here, which assumes a high-productivity stock and ignores declines in CPFV catch rates, suggests that spawning biomass was below 25% from 1981-2005 (Fig. ES2). Retention of cowcod is prohibited and bycatch is thought to be minimal, so it is unlikely that overfishing is currently an issue. In the previous assessment and a previous draft of this report, spawning biomass was reported as mature biomass of males and females. In this document spawning biomass refers to the biomass of mature females only.

Table ES2: Reference points from the base model (h = 0.6) and alternative low- and high-productivity models.

Reference Point	Model Description h = 0.4 CPFV Logbook + Visual Survey	 h = 0.6 CPFV Logbook + Visual Survey	 h = 0.8 Visual Survey	units
Unfished summary (age-1+) biomass	5923	5303	5308	metric tons
Unfished female spawning biomass (SB_0)	2785	2494	2496	metric tons
Unfished recruitment (R_0)	123	110	110	1000s of fish
40% of SB_0 (proxy for SB_{MSY})	1114	997	998	metric tons
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	2.7%	2.7%	2.7%	percent
Spawning biomass in 2007 (SB_{2007})	115	113	681	metric tons
SB_{2007} / SB_0	4.1%	4.6%	27.3%	percent

Spawning stock biomass: Estimates of female spawning stock biomass in 2007 are highly uncertain. The current models suggest that spawning biomass has declined from an unfished biomass of 2494-2785 mt to 113-681 mt in 2007 (Fig. ES2, Table ES2).

Figure ES2: Time series of spawning biomass



Relative depletion: Estimates of relative depletion in 2007 range from 4.1% to 27.3% (Fig. ES3). Indications of recent stock increases (Table ES3) are inferred from the model but have not been confirmed by observations.

Figure ES3: Time series of depletion (biomass as a percentage of unfished biomass).

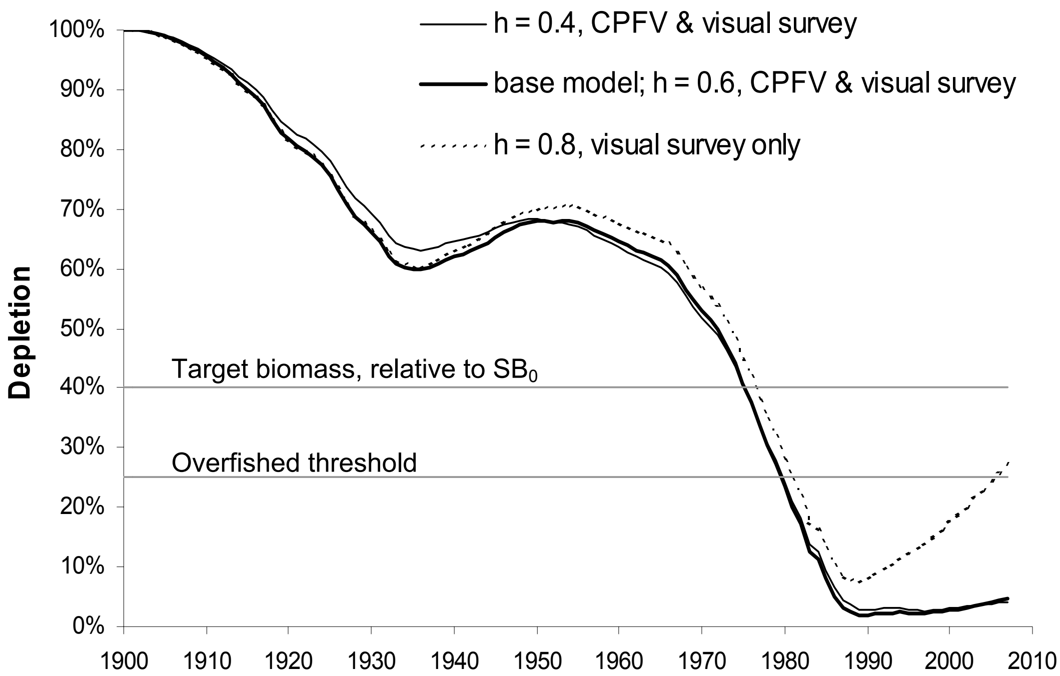


Table ES3: Recent trends in cowcod biomass and depletion

	h = 0.4, CPFV index & visual survey			h = 0.6, CPFV index & visual survey			h = 0.8, visual survey only		
year	Age 1+ biomass [mt]	SB [mt]	SB/SB_0	Age 1+ biomass [mt]	SB [mt]	SB/SB_0	Age 1+ biomass [mt]	SB [mt]	SB/SB_0
1998	183	77	2.8%	156	59	2.4%	941	375	15.0%
1999	191	81	2.9%	167	65	2.6%	1007	407	16.3%
2000	195	84	3.0%	174	69	2.8%	1072	437	17.5%
2001	201	88	3.1%	184	74	3.0%	1140	469	18.8%
2002	211	93	3.3%	198	80	3.2%	1213	503	20.2%
2003	221	97	3.5%	212	87	3.5%	1288	538	21.5%
2004	230	102	3.7%	226	93	3.7%	1364	573	22.9%
2005	239	107	3.8%	241	100	4.0%	1440	608	24.4%
2006	248	111	4.0%	256	107	4.3%	1517	644	25.8%
2007	257	115	4.1%	271	113	4.6%	1595	681	27.3%

Recruitment: Predicted recruitments were taken directly from the assumed stock-recruitment relationship, estimating only virgin recruitment. The base model suggests that recruitment declined rapidly from about 1970-1990, followed by an increasing trend (Fig. ES4, Table ES4).

Figure ES4: Time series of estimated recruitment

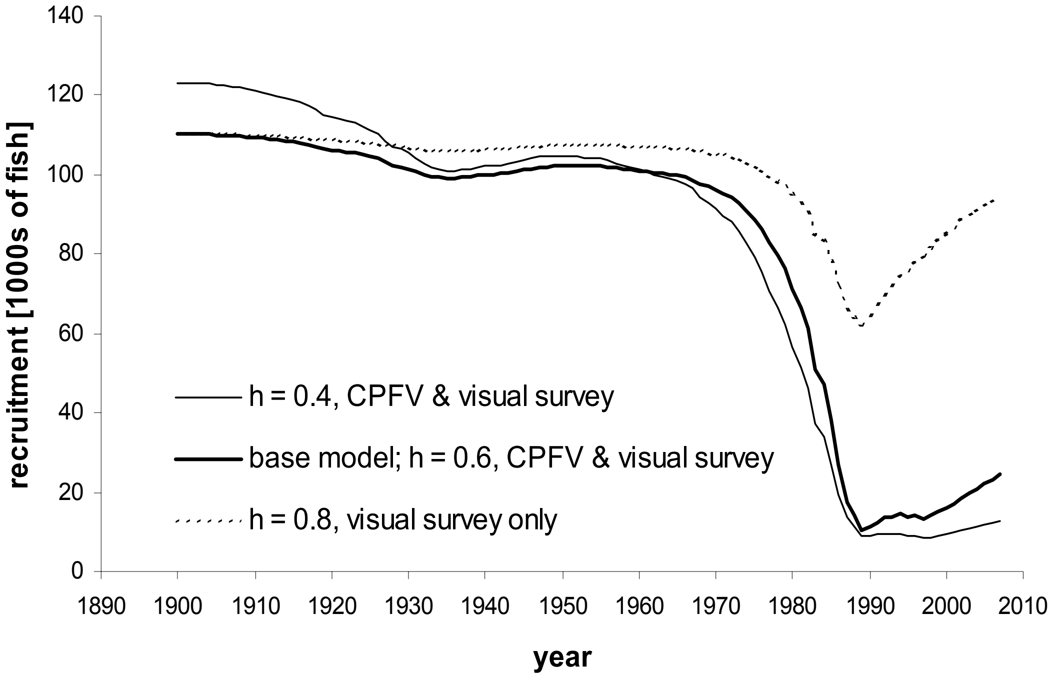


Table ES4: Estimated recruitments from the base model's stock-recruitment curve.

Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Rec.	**14.1**	**15.3**	**16.1**	**17.0**	**18.3**	**19.6**	**20.9**	**22.1**	**23.3**	**24.5**

Exploitation status: The 2005 assessment combined landings from the recreational and commercial fisheries into a single fishery. The selectivity curve correction increased the estimates of annual exploitation rate (total catch / age 1+ biomass) after the mid-1980s (Fig. ES5). However, this comparison does not reflect changes among models in the exploitation rate at the target fishing mortality ($F_{50\%}$). A comparison of relative exploitation rates (each model's annual exploitation rates divided by its exploitation rate at target F) is a more informative comparison of exploitation histories (Fig. ES6). The higher relative exploitation rates from the 2007 base model are mainly the result of increased estimates of historical catches and catches from the mid-1980s. The current model separates the catch into a commercial fishery (all gears combined) and a recreational fishery (Fig. ES7).

Figure ES5: Estimated annual exploitation rates (total catch / age 1+ biomass) from the previous assessment, showing the effect of changing the selectivity curve to mirror the female maturity schedule rather than female fecundity.

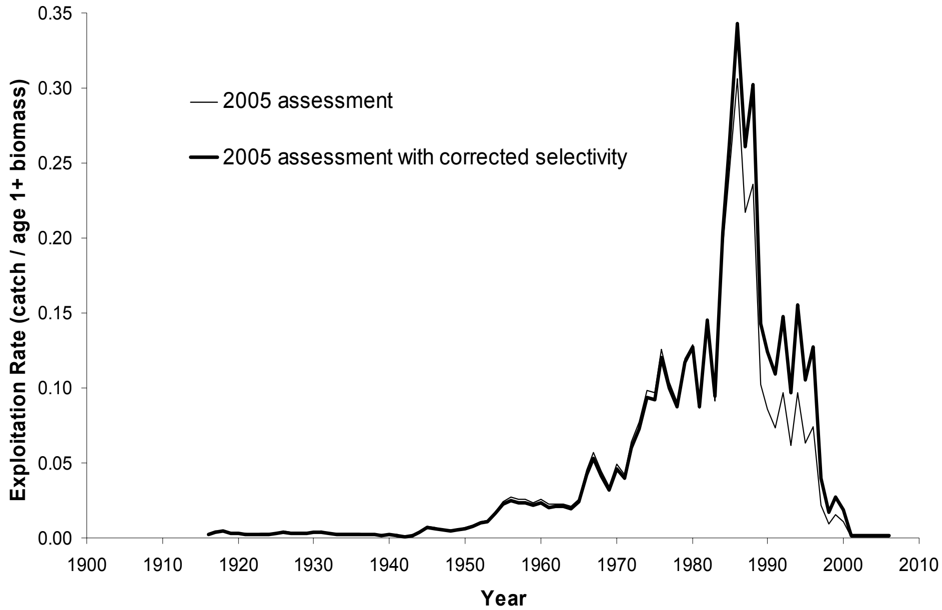


Figure ES6: Comparison of annual exploitation rates (total catch / age 1+ biomass) from the current assessment and previous models, relative to their respective exploitation rates at the target fishing mortality rate ($F_{50\%}$). A value of 1 is the relative exploitation rate at the target mortality rate ($F_{50\%}$).

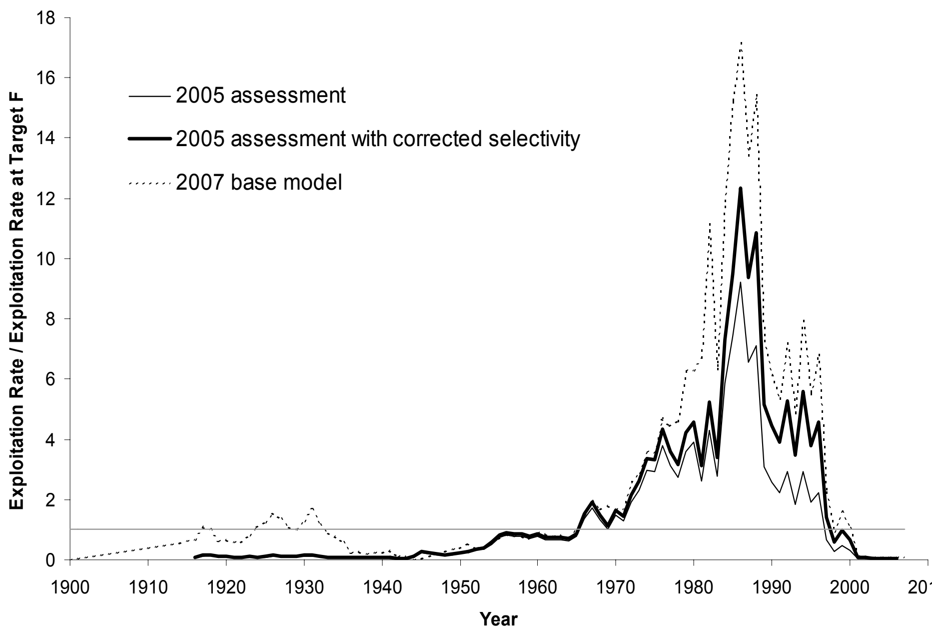


Figure ES7: Exploitation rates (catch / age 1+ biomass) by fishery for the 2007 base model.

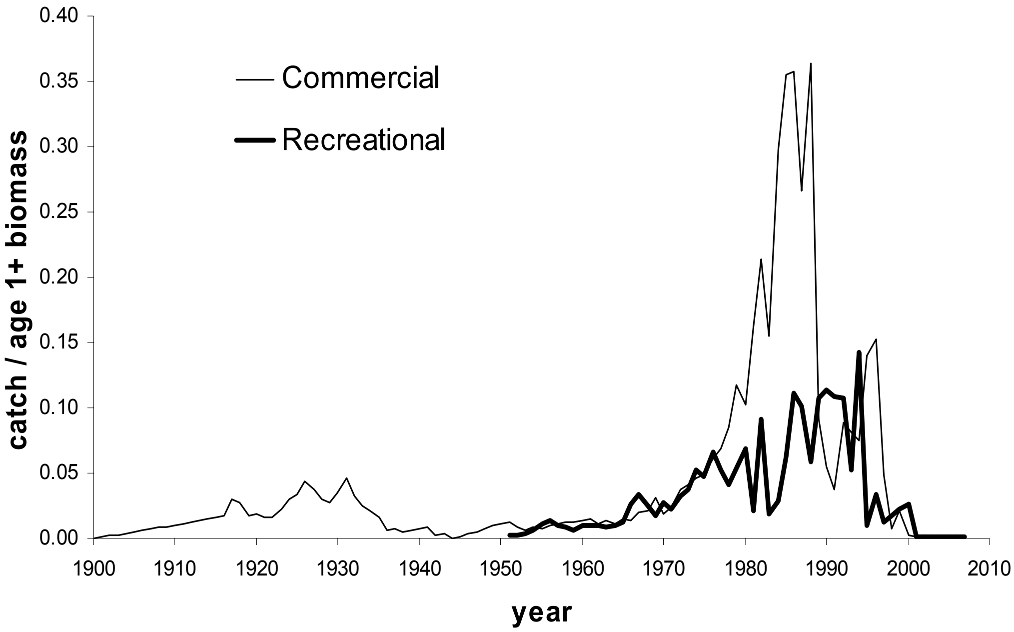


Table ES5: Recent exploitation rates (catch / age 1+ biomass) from the 2007 base model. Rates since 2001 are based on assumed catch (discard) of 0.5 mt per year.

Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Expl.	0.0257	0.0434	0.0283	0.0027	0.0025	0.0024	0.0022	0.0021	0.0020	0.0018

The history of exploitation according to the base model is summarized here with two phase diagrams. Figure ES8(a) shows annual exploitation rate (catch / age 1+ biomass) relative to the exploitation rate at $F_{50\%}$, plotted against spawning biomass relative to target spawning biomass ($SB_{40\%}$). Figure ES8(b) replaces exploitation rates with spawning potential ratios (SPR), the ratio of equilibrium spawning output per recruit under fished conditions to spawning output per recruit in the virgin population.

Figure ES8(a): Phase diagram of cowcod exploitation history (relative exploitation rate)

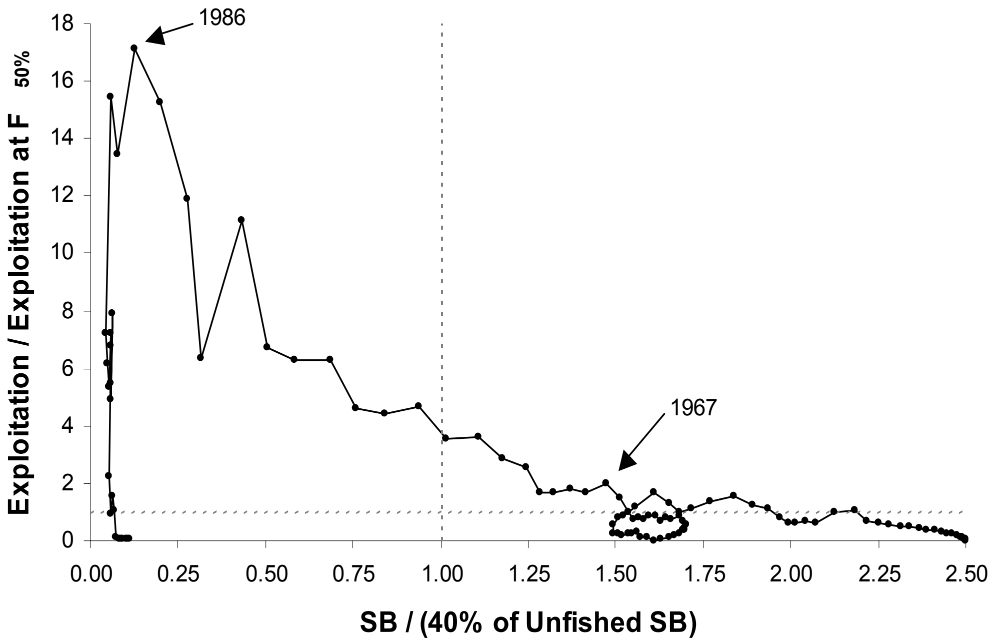
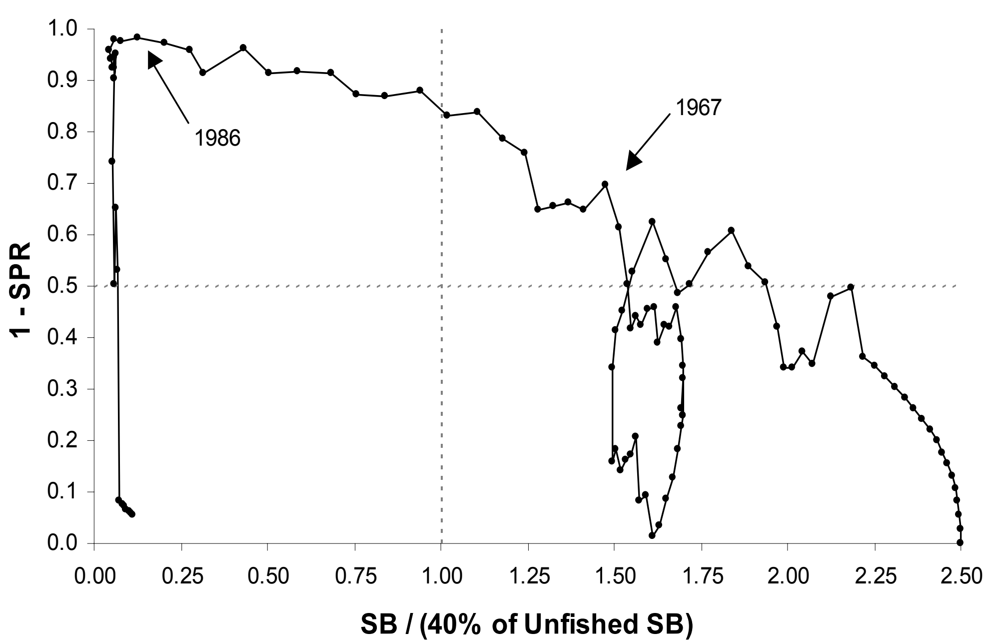


Figure ES8(b): Phase diagram of cowcod exploitation history (SPR)



Management performance: Retention of cowcod is currently prohibited. Catch statistics suggest that landings in the SCB have not exceeded the OY limits in recent years. Piner et al. (2005) and Butler et al. (1999) describe the history of management measures.

Table ES6: Recent management performance

Years	ABC [mt]	OY [mt]	Catch [mt]
2001-2004	5	2.4	< 1
2005-2006	5	2.1	< 1

Forecasts / Rebuilding Projections: These will be presented as part of a separate rebuilding analysis.

Decision table: Three alternative states of nature were defined during the Stock Assessment Review (STAR) panel, bracketing values of the Beverton-Holt steepness parameter and considering models with and without the CPFV logbook index (Table ES7). In this table, projected catches are divided equally between the commercial and recreational fisheries, based on relative catches in each fishery during the period 1990-1999.

Table ES7: Spawning biomass and depletion (% Virgin) trajectories for alternative management actions and states of nature.

		Landings [mt]		Low Productivity Stock Steepness (h) = 0.4 Visual survey and CPFV logbook index		Base Model Steepness (h) = 0.6 Visual survey and CPFV logbook index		High Productivity Stock Steepness (h) = 0.8 Visual Survey only	
Management Action	**Year**	**Comm.**	**Rec.**	**Sp. Bio. [mt]**	**% Virgin**	**Sp. Bio. [mt]**	**% Virgin**	**Sp. Bio. [mt]**	**% Virgin**
	2008	0.25	0.25	119	4.3%	120	4.8%	718	28.7%
	2009	0.25	0.25	123	4.4%	127	5.1%	755	30.2%
	2010	0.25	0.25	126	4.5%	135	5.4%	792	31.7%
	2011	0.25	0.25	130	4.7%	142	5.7%	830	33.3%
Status quo catch (zero retention, 0.5 mt assumed discard)	2012	0.25	0.25	134	4.8%	150	6.0%	868	34.8%
	2013	0.25	0.25	137	4.9%	158	6.3%	906	36.3%
	2014	0.25	0.25	141	5.1%	166	6.7%	945	37.8%
	2015	0.25	0.25	145	5.2%	175	7.0%	983	39.4%
	2016	0.25	0.25	149	5.3%	184	7.4%	1021	40.9%
	2017	0.25	0.25	153	5.5%	193	7.8%	1059	42.4%
Management Action	**Year**	**Comm.**	**Rec.**	**Sp. Bio. [mt]**	**% Virgin**	**Sp. Bio. [mt]**	**% Virgin**	**Sp. Bio. [mt]**	**% Virgin**
	2008	0.49	0.49	119	4.3%	120	4.8%	718	28.7%
	2009	0.52	0.52	122	4.4%	127	5.1%	755	30.2%
	2010	0.55	0.55	126	4.5%	134	5.4%	792	31.7%
	2011	0.58	0.58	129	4.6%	141	5.7%	829	33.2%
Landings from F90% Harvest Control Rule applied to base model	2012	0.61	0.61	133	4.8%	149	6.0%	867	34.7%
	2013	0.64	0.64	136	4.9%	156	6.3%	905	36.3%
	2014	0.67	0.67	139	5.0%	164	6.6%	943	37.8%
	2015	0.71	0.71	143	5.1%	172	6.9%	981	39.3%
	2016	0.74	0.74	146	5.2%	181	7.3%	1018	40.8%
	2017	0.78	0.78	150	5.4%	190	7.6%	1056	42.3%

Research and data needs

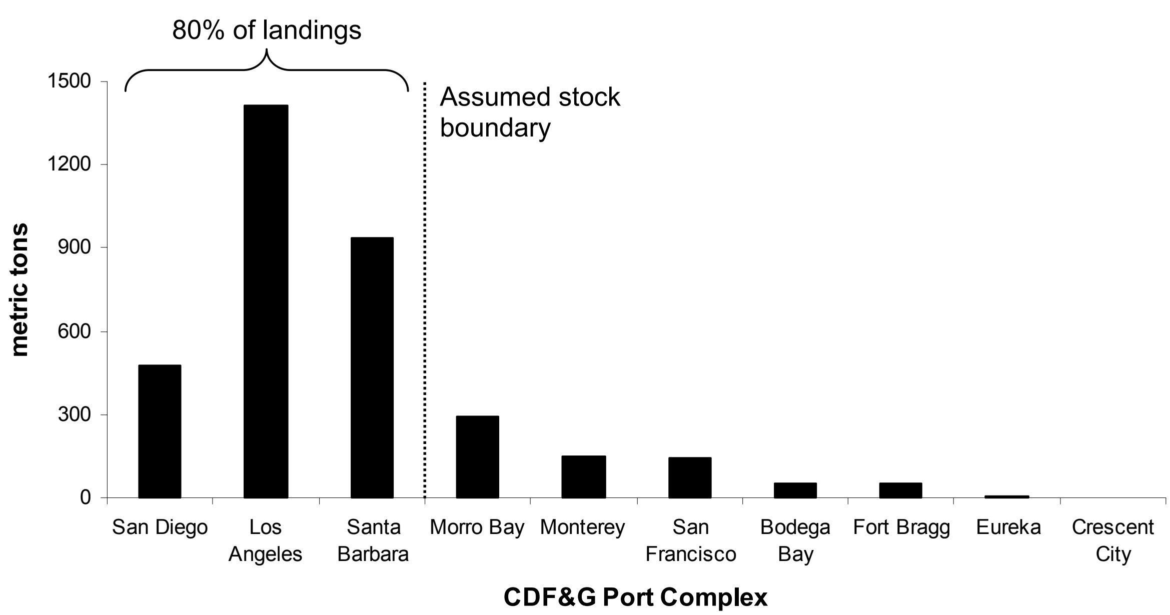
There is an urgent need for an informative abundance index that can monitor the recovery of this stock. The submersible line-transect survey (Yoklavich et al., in review) used in this assessment is a direct measure of cowcod abundance and was formally reviewed in 2004. A pilot study for an acoustical-optical survey (D. Demer, pers. comm.) has estimated cowcod abundance by first estimating rockfish biomass using echosounders, and then apportioning that biomass to species based on video and still camera images. These types of non-lethal surveys could potentially monitor the recovery of cowcod, and given the projected length of time to recovery it may be sufficient to conduct the surveys on a less-than-annual basis.

Our understanding of uncertainty in historical landings estimates could improve from additional analysis. Sampling coverage in Southern California has been sparse relative to the number of sampling strata. This becomes particularly problematic for rare species such as cowcod. The assumption that recreational catch was zero prior to 1951 should be reevaluated.

The accelerated schedule for this assessment did not allow for a complete review of all available data sets (e.g. CalCOFI, West Coast Slope/Shelf Combination Groundfish Survey, etc.). Future assessments should revisit all available data sources.

Regional management: The current model assumes that cowcod in the Southern California Bight are isolated from cowcod north of Point Conception and south of the U.S.-Mexico border. This assumption remains untested. Cowcod landings in California (1969-2005) primarily occur within the current stock boundaries (Fig. ES9). The magnitude of Mexican catches is unknown.

Figure ES9: Cowcod Landings by California Port Complex, 1969-2005



Introduction

This assessment revises the last full assessment of cowcod, *Sebastes levis*, in the Southern California Bight (Piner et al., 2005). The stock boundary (Fig. 1) is defined as U.S. waters off California and south of Point Conception (34°27'). Waters north and south of the SCB are not considered in this assessment due to sparse data and possible differences in abundance trends (Piner et al., 2005). The assumption of an isolated stock remains untested, and no information is available regarding dispersal across the northern or southern stock boundaries.

The current assessment was originally prepared as an "update" stock assessment. While preparing the update, an error was discovered in the previous assessment's specification of the selectivity curve. The Stock Assessment Team (STAT) also proposed several revisions including new estimates of historical landings, a corrected growth curve, and a two-fishery model. The Scientific and Statistical Committee (SSC) concluded that the assessment did not meet the terms of reference for an update assessment due to the resulting changes in depletion, historical exploitation rates, and consistency with the visual survey. The SSC agreed that further analysis of the proposed revisions would be fruitful, and the Council requested a review of the assessment during the darkblotched rockfish Stock Assessment Review (STAR) panel.

Due to the accelerated schedule, this report focuses on six topics: (1) correcting the selectivity error from the previous assessment, (2) correcting length data that were used in estimating the growth curve, (3) a revision of the historical catch series based on recovery of a substantial number of "early" southern California port samples from CDFG and an improved stratification scheme, (4) analysis of the recreational CPUE time series to better account for the last two years in the time series and to obtain a more parsimonious statistical model, (5) consideration of developing a two-fishery model (commercial and recreational), and (6) evaluating the effect of using a Bayesian prior distribution of spawner-recruit steepness obtained from a recently conducted hierarchical meta-analysis.

The STAT refers the reader to the previous two cowcod assessments (Butler et al., 1999; Piner et al., 2005) for general information regarding the fisheries and biology of cowcod. Due to time constraints some items from the Stock Assessment Terms of Reference have been omitted.

Data

Life History Parameters

Weight-at-length and maturity-at-length relationships for cowcod were published by Love et al. (1990), and their estimates are used in this assessment. Natural mortality (M) was estimated using the method of Beverton (1992), and estimates of total mortality (Z) were calculated from Hoenig's (1983) method and a catch curve regression (Table 1). Age data used for the catch curve were prepared for the 1999 cowcod assessment and are further described by Butler et al. (1999, 2003). The slope of the catch curve based on ages 12-44 (Fig. 2) was –0.055, with a 95% confidence interval of (-0.072, -0.038). We assume that natural mortality is constant with respect to age, and M is fixed at 0.055 in the base model. Profiles over a range of natural mortality rates are presented in the Uncertainty Analysis section.

A previous study examined length-at-age for 131 cowcod from the commercial fishery,129 cowcod from the recreational fishery, and 4 juveniles caught as bycatch in the spot prawn fishery (Butler et al., 2003). Cowcod otoliths in the study were primarily collected prior to

1993, and evidence suggests that the recorded lengths were total length, rather than fork length as reported in the study. Prior to 1993, the standard measure of fish length used by California's port samplers was total length (D. Pearson, pers. comm.). In 1993 a decision was made to adopt fork length as the standard measure of length, and all lengths in the CALCOM database were converted to fork length. We confirmed that lengths from the commercial samples used in the age study were total length by examining a subset of the original port samplers' data sheets and also by comparing aged fish to matching records in CALCOM. Since the lengths of the aged fish appear to be total length, the conversion from fork length to total length in the 2005 assessment was unnecessary. We fit the von Bertalanffy growth function (VBGF) to length-at-age data, external to the model, treating lengths as total length. We compared predicted length at age from the 2005 assessment with results from the base model (Table 2, Fig. 3).

To specify the error structure for the length-at-age model, we plotted the CV of observed lengths at age versus mean length at age, using only ages with greater than four observed lengths (Fig. 4). To approximate the observed level of variability in length at age, we extrapolated the linear fit shown in Figure 4 to a CV of 26.5% at a length of 16.2 cm (predicted mean length at age 2). We visually evaluated the error structure by plotting the 95% confidence intervals of the fitted VBGF against the observed data (Fig. 5). The revised growth curve has a small, but noticeable effect on the spawning biomass trajectory (Fig. 6, dotted line) but only changes depletion by about 0.5% (Table 3).

Landings

Historical commercial landings, 1916-1968

Butler et al. (1999) developed a time series of historical landings (1916-1981) of cowcod by the commercial fisheries using a ratio estimator applied to published landings of total rockfish in California (CDF&G Fish Bulletin No. 149, 1970). Since their assessment, other sources of information have become available that provided us an opportunity to revise the historical landings. As described below, we used this information to develop a ratio estimator stratified by port complex and gear group, based on the earliest available data from the SCB.

In his "Rockfish Review" (CDF&G Fish Bulletin No. 105, 1958), J.B. Phillips provided a record of total rockfish landings by region (Southern, Central, and Northern California) for the period 1916-1956 (Table 4). These data combine the genus *Sebastolobus* (thornyheads) with *Sebastes*, and include rockfish caught in foreign waters but landed at U.S. ports. The regional data show that the relative proportion of California's commercial rockfish landed in each area has changed dramatically over time (Fig. 7). This result prompted us to develop a ratio estimator that tracks rockfish landings in the SCB rather than statewide rockfish landings.

The NMFS SWFSC Environmental Research Division (ERD) currently hosts a live-access server (http://las.pfeg.noaa.gov/LAS/CA_market_catch.html) with commercial landings originally published in the CDF&G Fish Bulletin series. Similar to the data from Fish Bulletin No. 105, rockfish landings in this dataset include thornyheads (up to 1977), however, the ERD data exclude fish caught in foreign waters. We queried this database to obtain total rockfish landings by region for the period 1928-1968 (Table 4). The 6 geographic regions in the ERD database are San Diego (San Diego County), Los Angeles (Los Angeles and Orange Counties), Santa Barbara (San Luis Obispo Santa Barbara, and Ventura Counties), Monterey (Santa Cruz and Monterey Counties), San Francisco (Sonoma, Marin, San Mateo and San Francisco

Counties, plus San Francisco Bay), and Eureka (Del Norte, Humboldt and Mendocino Counties). The "Southern" area described by Phillips (CDF&G Fish Bulletin No. 105, 1958) is spatially equivalent to the San Diego, Los Angeles, and Santa Barbara regions in the ERD database. The "Central" area is spatially equivalent to the ERD's Monterey and San Francisco areas, and the "Northern" area is equivalent to the ERD's Eureka region. When the ERD data from Southern California are spatially aggregated to mimic the Southern rockfish landings in Fish Bulletin No. 105, the ERD landings are consistently smaller than the Fish Bulletin landings. This is expected, because the ERD data only include fish caught in U.S. waters. To account for this difference, we calculated annual estimates of "foreign-caught rockfish" (Table 5) as the difference between the sum of the ERD landings in the San Diego, Los Angeles, and Santa Barbara regions and the "Southern" landings in Fish Bulletin No. 105. To estimate the amount of foreign-caught rockfish prior to 1928, we used a ratio estimator based on the years 1928-1933. This estimate (0.74%) was applied as a correction factor to the Fish Bulletin Southern-area data for years 1916-1927.

The "Santa Barbara" region as defined in the Fish Bulletin series (and hence the ERD database) includes San Luis Obispo (SLO) County, which is north of Point Conception and is therefore outside the stock boundary as defined in this assessment. Therefore, it was necessary to adjust the rockfish landings in this region to exclude catches north of Point Conception. Beginning in 1949, CDF&G's Fish Bulletin series reported port-specific rockfish landings for the Santa Barbara region. We entered these data and observed that in the mid-1950s rockfish landings in the Santa Barbara region increased dramatically due to landings at Morro Bay and Avila (Fig. 8, Table 5). We subtracted the rockfish landed at these two ports to create an "adjusted Santa Barbara" region that reflects rockfish catch within the assumed stock boundary (Table 5). In doing so, we assume that annual rockfish landings are zero at other ports north of Point Conception but within the Santa Barbara region (e.g. San Simeon). This is unlikely to have a major effect on our results due to the relative size of landings at Morro Bay and Avila compared to other ports in the region. For the years 1928-1949, we extrapolated Morro Bay and Avila landings using a ratio estimator based on the fraction of rockfish in the Santa Barbara region landed at each port during the years 1949-1951 (Table 5). The rockfish catch in Avila was not reported in 1952-53 or 1958-61, so we calculated ratio estimates for these years using catches in proximal years (Table 5).

To extend our time series of rockfish landings in the Los Angeles, San Diego, and adjusted Santa Barbara regions back to 1916, we subtracted our estimates of foreign-caught rockfish from the total rockfish landings in the Southern area. We then used a ratio estimator based on landings from 1928-1933 to estimate the fraction of rockfish caught in each region during the period 1916-1927. For example, we divided the sum of rockfish landings in the Los Angeles region from 1928-1933 by the sum of rockfish landings in the San Diego, Los Angeles, and adjusted Santa Barbara regions during the same years. We assume that this percentage (64.6%) of rockfish caught in the Southern area and landed in the Los Angeles region is constant from 1916-1927. By the same method, ratio estimates for the San Diego and adjusted Santa Barbara regions were 33.4% and 0.97%, respectively. The final time series of historical rockfish landings by region, 1916-1968, is illustrated in Fig. 9.

The final step in deriving the historical commercial landings was to determine the fraction (by weight) of the rockfish landings that was cowcod. We based our estimates on 5-year averages from the earliest years for which we have actual samples (1984-1988) in all port complexes (Table 6). Gear types were chosen to be consistent with the historical fisheries. Hook & line was the dominant gear group for rockfish prior to 1944 (CDF&G Fish Bulletin No. 126, 1964), and prior to 1968 it was illegal to process a trawl net south of Ventura County (Frey, 1971). Therefore, we estimated the percentage of rockfish that was cowcod in the Los Angeles and San Diego regions from their respective hook and line fisheries. In Santa Barbara the trawl fishery developed in the mid-1940s, so we based our estimates on the combination of line and trawl gears beginning in 1944, and on the hook and line fishery for years prior to 1944. The annual fraction of cowcod in rockfish landings was variable, but without trend, in the San Diego hook and line fishery, whereas the fraction in the Los Angeles and Santa Barbara fisheries showed steep declines during the 1980s (Fig. 10).

The 1984-88 ratio estimate of the fraction of cowcod in the Los Angeles hook & line fishery is large relative to other fisheries and relative to subsequent years in the same fishery. Most of the strata were well sampled during this period (Table 7), but it is unknown whether estimates based on these five years are representative of previous years. The results of additional analyses are presented under “Responses to STAR panel requests.” As a sensitivity analysis, we compared the base model to a model with one half of the estimated historical commercial catch (Table 8). The effect on depletion in 2007 was less than 1%.

Revised CALCOM landings, 1969-1985

Landings from 1969 through 1985 were re-estimated for this assessment because a total of 611 new market samples were recovered following the 2005 assessment. The new samples all came from southern California port complexes (Santa Barbara, Los Angeles, and San Diego), and were collected in 1983, 1984, and 1985. In Piner et al. (2005), no samples were available for the SCB prior to 1986. Thus, landings prior to 1986 for the SCB relied on samples collected in 1986. These samples were used to estimate the landings back to 1969 using the standard expansion protocols developed by CALCOM (California Cooperative Survey: CDFG, Belmont, CA; PSMFC, Belmont, CA; NMFS, Santa Cruz, CA).

Appendix A describes changes to CALCOM since the last assessment that affect cowcod landings between 1969 and 1985. Don Pearson (NMFS, SWFSC, FED) is preparing a extensive publication that describes the relative reliability of California commercial landings by species.

Landings since 1986 have not changed since the last assessment, with the obvious exception of an additional two years of data (we assume 0.25 mt discard per year, per fishery). Retention of cowcod has been prohibited since January 2001. Figure 11 illustrates the differences between the revised CALCOM landings (1969 – present) and those used in the 2005 assessment. The recovered market samples from 1984 and 1985 resulted in a 34% and 46% increase in cowcod landings, respectively. The revised estimation method increased estimates of cowcod landings from 1969-1983, largely due to the recovered market samples from 1984 and 1985. Figure 12 shows the contribution of each gear group to commercial landings.

The final time series of estimated cowcod landings is provided as Table 9. Although very little catch information is available prior to 1916, rockfish are known to have been commercially important since at least 1875 (CDF&G Fish Bulletin No. 105, 1958). In this assessment, cowcod landings were assumed to increase linearly from 0.01 mt in 1900 to the estimated catch in 1916 of 85.36 mt.

Recreational landings, 1951-2000

Landings from the recreational fishery (1980 – 2000) were queried from the online RecFIN database using the following criteria: Southern California, ocean only, party boat and private rentals, catch type A + B1. Recreational catch from 1951 through 1979 is assumed to be the same as reported in the previous assessment (Table 9).

Length data

CDF&G conducted creel onboard observer surveys from 1975-78 and 1986-89 for the CPFV fishery in Southern California. The survey data were never published, but a brief description is provided in Piner et al. (2005). These data were evaluated for the purpose of estimating a selectivity curve for the recreational fishery and CPFV logbook index.

The length compositions from the 1970s were assigned to 'shift years' (Nov-Apr) to mimic the approach used for the CPFV logbook index (Fig. 13). In summer months the effective effort for cowcod decreases due to targeting of pelagic species (Butler et al., 1999). The data from shift-year 1974 were removed due to small sample sizes. Larger fish were caught in 1977, a year in which a larger proportion of observed offshore locations were visited (Fig. 14). In 1978, the vast majority of cowcod caught on observed trips were from a single block, so data from this year were not included in our analysis. An examination of cowcod length versus depth fished did not show a conclusive pattern (Fig. 15). Since these patterns are only representative of the observed trips, not the fishery, we examined annual changes in effort data from CPFV logbooks (months of November through April and blocks where at least one cowcod was caught in that year). These data suggest that the spatial distribution of the observer data for these three years is not a reflection of the distribution of effort in the fishery (Fig 16).

A major change since the previous assessment was our choice to model separate commercial and recreational fisheries, using the length comps from 1975-77 to estimate a simple logistic selectivity curve for the recreational fishery and CPFV index (Fig. 17). At first, we attempted to develop a model with freely estimated selectivity parameters for the recreational fishery. However, even after tuning effective sample sizes, the length data tended to overwhelm the likelihood components for the CPFV index and visual. This effect seemed unreasonable given that length data are only being used to estimate a selectivity curve, and not changes in recruitment. Therefore in the base model recreational selectivity is fixed at the model-estimated values, and length data were removed.

Length data from the commercial fisheries were obtained from CALCOM, and we plotted length compositions by major gear group (Fig. 18). The net fisheries had the largest sample size, but length compositions varied considerably among years and showed no clear modal progression (Fig. 19). For lack of better information, we set the commercial selectivity curve (for all gears combined) equal to the female maturity curve, as was the intention of Piner et al. (2005). The final selectivity curves used in the base model are illustrated in Figure 20.

CPFV Logbook CPUE

K. Hill (SWFSC) provided logbook data from commercial passenger fishing vessels (CPFV) for the period 1964-2000. The data are aggregated by year, month, and CDFG block and include the catch (in numbers) of cowcod and total rockfish. Prior to 1964, cowcod were combined with total rockfish, and data after 2000 were excluded due to the effects of management. Additional information about the CPFV logbook data is available in Hill and Schneider (1999), Butler et al. (1999), and Piner et al. (2005). Although the raw data for the index have not changed, we chose to revisit the model structure due to the importance of the index in this assessment.

Butler et al. (1999) used a generalized additive model to estimate separate trends in CPUE (catch per unit effort) for each pseudo-block. Pseudo-blocks were defined as single blocks if a continuous time series was available. Blocks with missing data in some years were aggregated into pseudo-blocks according to quartiles of mean CPUE to complete the time series for that pseudo-block. Complete time series in each pseudo-block allowed Butler et al. to estimate a year-area interaction term in the standardization model. Blocks in the 1st quartile of mean CPUE were excluded from the analysis, as they were unlikely to be informative about trends in cowcod abundance. The spatial stratification and year-area interaction term were attempts to capture onshore/offshore movement of the fishery over time. The final index was an area-weighted sum of 30 time series of relative abundance (Fig. 44 in Butler et al., 1999). A problem with this approach, however, is that blocks are aggregated based on quartiles of mean catch rate, and not by spatial relationships.

We began our analysis by visually inspecting the stratification scheme used in the 1999 assessment (Fig. 21). Blocks with complete time series ("independent" blocks, shown in grey) were primarily around the islands and nearshore areas, while the offshore fishing areas (e.g. Tanner, Cortes, San Nicolas Island, 43-Fathom) were estimated as part of the aggregated pseudo-blocks, each of which covers a large portion of the SCB. This might limit the model's ability to track movement of the fishery over time. Also, areas of contiguous habitat were often modeled as several independent time series. For example, the 1999 stratification fits six CPUE trends around Catalina Island, and six trends around Santa Barbara Island/hidden reef (Fig. 21). Given the inherent variability of logbook data, we were concerned about over-fitting the data. A year-area interaction term adds considerable complexity to a GLM model, requiring (30-1 blocks)×(37-1 years) = 1044 parameters, although a GAM may have a smaller effective number of parameters. Since the final index was an area-weighted sum of the individual time series, we calculated the amount of cowcod habitat (defined as area between 50-300m) in each pseudo-block (Table 10). Pseudo-blocks 2, 3, and 4 account for 15%, 23%, and 21% of the total area, respectively. Each of the remaining 27 blocks had areas (weights) of between 4.2% and 0.2%of the total habitat. The final index, therefore, was largely driven by the area-weighted sum of pseudo-blocks 2, 3, and 4, and integrated trends over large areas.

The 2005 assessment used a simplified spatial stratification (Fig. 22), defining 3 pseudo-blocks, weighted by the number blocks in each pseudo-block. This reduces the number of parameters in the year-area interaction term, but retains the assumption that abundance trends are identical among blocks with similar mean CPUE.

To address these issues, we developed a new spatial stratification that is based largely on the assumption that adjacent (or nearby) blocks are likely to have similar trends in CPUE (Fig. 23). Similar to the previous two assessments, we excluded blocks below the first quartile of mean CPUE, as well as any data from the months of May-October due to seasonal changes in target species. We also excluded data from blocks that represent data of uncertain location, and catch reported in blocks that don't exist. Blocks with very sparse time series (<3 years with positive catch of cowcod) were dropped from the analysis. Finally, we defined a fishing "season" to include the month of November through April the following year.

We plotted changes in mean CPUE by region and decade, and noted a consistent pattern of declining CPUE across regions (Fig. 24). Data from three regions (North Islands, San Nicolas, and San Pedro Channel) showed an initial increase in CPUE, followed by steep declines. The reason for this initial increase is unknown at this time, although more detailed knowledge of these fishing grounds may have improved targeting during the initial phase of fishery development.

An additional source of information in the CPFV data is the catch (in numbers) of total rockfish. Minami et al. (2007) used the abundance of co-occurring species (tuna) as a covariate in their model for shark bycatch. Although the CPFV data are heavily aggregated, we feel it is reasonable to assume that blocks with high rockfish catch (excluding cowcod) in a given year and month are likely to have more cowcod than blocks that have reported little or no rockfish catch. We acknowledge that some cowcod were probably reported as part of the rockfish total (and perhaps vice-versa), but for this analysis we assume the reported values are correct. In our revised CPFV index we include the natural log of total rockfish catch as a covariate, after subtracting the mean of the log-transformed data to remove correlation between the intercept and slope parameters.

Our revised index is a delta-GLM model (Lo et al., 1992, Stefansson, 1996), composed of a binomial GLM with logit link and a normal linear model for the natural log of cowcod CPUE, defined as cowcod per angler hour. In both models, the initial set of covariates was year, month, region, and log(rockfish). Given the inherent variability of the logbook data and the large amount of data (7,782 observations), we used the Bayesian Information Criterion (BIC) in stepwise model selection routines (Table 11). The stepwise procedure was initiated with models that included all 2-way interactions and associated main effects. According to this criterion, month effects were not supported by the data (results omitted to simplify presentation). The BIC 'best' models for the components of the delta-GLM were

Binomial GLM: $cpue^{*} = year + region + logRF$, ($cpue^{*}=1$ if $cpue>0$, else $cpue^{*}=0$)

Gaussian GLM: $\log(cpue) = year + region + logRF + region{:}logRF$

The binomial GLM did not converge when the year:region interaction term was included (68 cells had either all zeros or ones), but the data did not support any of the other 2-way interactions. As an approximate test for the year:region interaction, we compared a main-effects negative binomial model ($\Delta BIC=0$) to a model with main-effects and a year:region interaction term ($\Delta BIC>1600$). This suggests that the data do not support the inclusion of the year:region interaction term, given the observed level of variability. The negative binomial model was not considered for the final index due to potential bias in parameter estimates (Minami et al., 2006). We attempted to fit zero-inflated negative binomial (ZINB) models, but had problems with model convergence. We then compared the fit of our revised model structure to the spatial stratification used in the 1999 assessment, with and without the year:block interaction term (Table 11). In both cases, the revised model structure was the BIC-preferred model.

To compare the revised index (Table 12) to previous results (Table 7 in Butler et al., 1999, and Table 3 in Piner et al., 2005) we scaled the trends to a unit mean and plotted them on a log scale (Fig. 25). We also compared CVs from each version of the index, prior to any iterative reweighting procedure (Fig. 25). In the 2005 assessment, the population trajectory was unable to fit the CPFV index in 1999 and 2000 without a substantial inflation of the original CVs. The revised index produces estimates for these last two years that are more consistent with the predicted trend in abundance. CVs for the revised index are consistently larger than the 2005 index for years after 1982. We compared the fit of the base model using the 2005 CPFV index, to the base model with the revised index, without iteratively reweighting the CVs. There is a 206 point reduction in the total negative log likelihood when the model is fit to the revised index. Tuning the model with the 2005 index results in CVs 4.5 times larger than the original values, while the tuned CVs of the revised index are 2.4 times the original values. The model fit to the revised CPFV logbook index with iteratively reweighted CVs is shown in Figure 26. Clearly, the model still has trouble fitting the revised index, but we feel that the improvement in fit is substantial, especially given the parsimonious model structure.

Visual line-transect survey

No changes have been made to this index or its implementation in the assessment. The survey is briefly described as item 8 under "Responses to STAR panel requests" and fully documented in Yoklavich et al. (in press). A formal review of the survey was conducted in 2004 and it was included in the 2005 assessment as a relative index with a prior distribution on catchability, with mean 0.75 and standard error of 0.5 (Piner et al., 2005, Appendix IV).

Whereas the visual survey had a very minor effect on the 2005 assessment, models with the corrected selectivity curve (including this assessment) are highly sensitive to the visual survey and removing the survey causes a substantial change in estimated levels of depletion (Table 13). We ran sensitivities of the base model to the assumed value of the prior's CV. Appendix IV of the 2005 assessment estimated catchability of the visual survey as 0.751 with a standard error of 0.147. We profiled over CVs of 1%, 20%, 50%, and 100% (Table 14).

Other data sources

The STAR panel requested a list of data sets that were not included in this assessment. For each data set we have included references to the literature, previous assessments, or preliminary analyses included in this report.

1. California Cooperative Fisheries Investigations (CalCOFI) (www.calcofi.org; Butler et al., 2003; Piner et al., 2005)
2. Los Angeles County and Orange County sanitation departments outfall trawl indices (Butler et al., 2003; Piner et al., 2005)
3. Acoustic in combination with Remotely Operated Vehicle Survey (Piner et al., 2005; D. Demer, pers. comm.)
4. Cowcod intensive sampling (Piner et al., 2005)
5. NWFSC Hook and Line survey (Piner et al., 2005)
6. RecFIN recreational fishery CPUE (Piner et al., 2005; see item 9 under "Responses to STAR panel requests")
7. NMFS NWFSC West Coast Slope/Shelf Combination Groundfish survey (see item 14 under "Responses to STAR panel requests")

Assessment model

The model is an age-structured production model, with three estimated parameters: virgin recruitment (R_0), catchability for the CPFV logbook index, and catchability for the visual survey biomass estimate. The likelihood is composed of three components: the CPFV logbook index, the 2002 visual survey, and the prior distribution for catchability of the visual survey. Natural mortality (M) is fixed at 0.055. Recruitments are drawn from a Beverton-Holt stock recruitment curve, with steepness (h) fixed at 0.6. Catches are assumed known without error, and are divided into a commercial and recreational fishery. Gear selectivity for the commercial fishery mirrors the female maturity schedule, and selectivity for the recreational fishery was internally estimated from length data, but later fixed in the model. Length at age was estimated externally and fixed in the model.

Major changes in the base model since the last assessment include 1) correction of the gear selectivity curve for the commercial fishery, 2) revised historical landings estimates, 3) modeling separate commercial and recreation fisheries rather than a single combined fishery, 4) a revised selectivity curve for the recreational fishery and the CPFV logbook index, 5) a revised model structure for the CPFV logbook CPUE index, and 6) a correction to the data used in the length-at-age analysis.

Incremental changes due to the two corrections (selectivity and growth) are presented in Table 3, with comparisons to the base model and alternative states of nature. The assessment model was fit using Stock Synthesis 2, version 2.00c. Data, control, and forecast files are attached as Appendix B.

Uncertainty analysis

We profiled each component of the base model's negative log likelihood (NLL) over a grid of values for natural mortality (0.04 – 0.07) and the Beverton-Holt steepness parameter (0.3 – 0.9). The results suggest that the data do not support models with combinations of high steepness and high natural mortality (Table 15). A bivariate 95% confidence region is bounded by a difference of 3 likelihood points from the minimum (min(NLL) + $\chi_2^2(0.95)/2$, where $\chi_2^2(0.95) \cong 6$). For most assumed values of steepness, the goodness-of-fit is similar across the three different assumptions about natural mortality. The CPFV logbook index dominates the total NLL, with an improved fit for lower values of steepness.

The two major axes of uncertainty defined for this assessment are steepness and inclusion of the CPFV logbook index. Other sources of uncertainty such as natural mortality, historical catch, gear selectivity, and recruitment variability are also important to consider, but are difficult to estimate with the available data. Our analyses show that estimates of both steepness and the natural mortality rate are highly uncertain, and both parameters are treated as fixed and known. Models without the visual survey were not considered due to unreasonably high estimates of annual exploitation rate (total catch divided by summary biomass). The exploitation rates in the base model are also quite high considering what we know about the life history characteristics of cowcod, and the STAT considers this issue an important topic for future research.

Markov Chain Monte Carlo simulations were generated for the base (3-parameter) model, and we also attempted to estimate steepness and natural mortality with informative priors, as per the request of the STAR panel. Results are presented as Appendix C.

Informative prior on steepness

The steepness parameter (*h*) of the Beverton-Holt stock-recruitment relationship is a major axis of uncertainty in this assessment, and was fixed (assumed known) in all models discussed up to this point. We estimated steepness using an informative beta prior distribution based on a meta-analysis of steepness for west-coast rockfish (M. Dorn, pers. comm.), and compare results to the base model (Table 16). The steepness and virgin recruitment parameters are highly correlated (-0.999). As a result, the reduced value of steepness (0.3) is associated with an increase in estimated virgin biomass, and MSY is reduced to zero. The overall fit is similar to the base model, indicating that the data do not effectively discriminate between very different interpretations of the stock.

Responses to STAR panel requests

1. Determine how harvest rate was calculated in Figure ES4 (and in SS2).

   The STAR panel noted that in the draft assessment, the comparison of harvest rates in the 2005 assessment to harvest rates in the 'corrected' 2005 assessment was incorrect, since harvest rates (catch divided by vulnerable biomass) depend on selectivity. The STAT clarified the definitions of "harvest rate" and "exploitation rate" as used in SS2, and identified two measures of fishing intensity:
   a) Total catch divided by age "x+" biomass (aka "exploitation rate")
   b) SPR (equilibrium spawning output per recruit under fished conditions, divided by spawning output per recruit under no fishing)

2. Compare biomass estimates from the three assessments on the same basis, i.e., female spawning stock biomass and base model plus plots of exploitation rate from each model on a comparable basis.

   Spawning biomass trends from the 2005 assessment, the 2005 assessment with corrected selectivity curve, and 2007 base model are shown in Fig. 6. Revised estimates of historical landings in the 2007 assessment produce an increased estimate of virgin biomass, relative to the 2005 assessment.

   Exploitation rates for the 2005 assessment were compared using age 11+ biomass (Fig. 27). Predicted mean length at age 11 is approximately 43 cm, the assumed length of 50% maturity, and 50% selectivity in the commercial fishery. Using this metric, exploitation rates for the 2007 model are very high, even exceeding 1 in one year (Fig. 28). The STAR panel suggested bracketing our uncertainty in these rates (see response to request #7) by calculating 'lower-bound' exploitation rates based on length at 50% selectivity in the recreational fishery (Fig. 28). The assumed length at 50% selectivity is 34 cm for the recreational fishery, and predicted length at age 8 is approximately 35 cm. Fishing intensity, defined as 1 – SPR, was also compared among the three models (Fig. 29).

3. Obtain CalCOFI data with the intent of looking at the time series again to see if it can provide information for the recent years for monitoring recovery of the stock.

There was insufficient time under the accelerated assessment schedule to complete an adequate analysis of the most recent CalCOFI data. These data were not previously examined because the assessment was classified as an update, and the time series was not included in the 2005 assessment. The STAT agrees that future assessments should investigate recent results from this survey, as it might provide information about trends in spawning stock biomass.

4. Obtain more details on the recovered CALCOM data with respect to whether or not the data were representative of landings in general or were more restricted with respect to species, etc.

   Don Pearson (pers. comm.) provided an Excel chart showing the distribution of landings between market categories, with information on how sample coverage was used to estimate the landings (Fig. 30). The distribution of actual samples suggests that the recovered samples were not directed toward a particular market category.

5. Further investigation of the GLM analysis of CPFV [*sic*] requires more models to be run. In particular, need models for no log(rockfish catch), log(rockfish catch) for binomial model only. Compare annual trends for predicted CPFV [*sic*] from all three models.

   The STAT presented time series of CPUE based on delta-GLM models with the log(rockfish catch) covariate in both GLMs, in the binomial GLM only, and in neither GLM (Fig. 31). The STAT and STAR panel disagreed about the appropriateness of including this covariate in the standardization model, but agreed that the differences had little effect on the assessment as a whole. The trend in the CPUE index is primarily driven by the binomial GLM (Fig. 32).

   In the CPFV fishery, the probability of catching a cowcod increases with (log) total rockfish catch (Tables 11 and 17). Species associations have previously been used to determine effective effort and/or as a proxy for habitat (Stephens and MacCall, 2004; Minami et al., 2007). In some years and regions, there is a negative correlation between the log(CPUE) and log(rockfish catch) (Figs. 33 and 34, Table 18). One possible explanation for this is the rockfish bag-limit (15 fish). An angler that catches a large number of rockfish could be limited in the number of cowcod he or she could retain. This effect would be lessened if catch were shared among anglers on a given trip. Standardized residual plots from the GLM for positive observations are presented in Figure 35.

6. Plot CPUE data from CPFV series over time by region.

   As described in the Data section, the STAT developed a revised CPUE index from the CPFV logbook data. Model selection for this index was based on the BIC criterion, evaluated for a set of candidate models that included all main effects and 2-way interactions whenever possible. The best from the set of candidate models did not have an interaction between years and spatial strata. The STAR panel expressed some concern about this result, indicating that the set of candidate models was perhaps too limited to detect a year-area interaction. Specifically, the panel recommended evaluating a set of models with an intermediate number of effective parameters (e.g. GAMs), that would allow for year-area interactions without imposing such a severe penalty for increased model complexity.

The STAT presented several time series of average CPUE by region (e.g. Fig. 36). These plots suggest that a year-area interaction may exist, and the STAT agrees that this is an important topic for future research. However, a comparison of indices used in the past three assessments (including the 1999 GAM-based index) suggests that the index may be relatively robust to these alternative model specifications (Fig. 25).

7. Plot selectivity curve against the commercial length frequencies.

The 2007 base model assumes that gear selectivity for the commercial fishery mirrors the female maturity schedule, with 50% selectivity at a length of 43 cm. The STAT presented length frequency data from the net and hook-and-line fisheries, aggregated across years (Fig. 37). Logistic selectivity curves were fitted to the data, external to the model, and compared to the assumed selectivity curve in the base model.

For the net fishery, the ascending limb of the selectivity curve might be better approximated by a curve shifted to the left of the maturity ogive. If fish are selected at lengths smaller than the current model assumption, this would inflate exploitation rates (catch / summary biomass) that are based on the current selectivity curve. The length-frequency data from the hook-and-line fishery are more consistent with the assumed length at 50% selectivity, but the slope of the curve at the inflection point may be reduced relative to current assumption. The STAT and STAR panel agreed that selectivity curves for the commercial fisheries should be re-examined in future assessments.

8. Present background information on visual survey including copy of paper to appear in the Canadian Journal of Fisheries and Aquatic Science.

The STAT distributed a draft of Yoklavich et al. (in press) to the panel, and a brief summary of the visual survey:

- Manned submersible visual survey in 2002
- Sampled eight rocky banks within the Cowcod Conservation Area
- Banks were chosen from prior information that they were likely cowcod habitat
- Transects within 1.5km^2 blocks randomly chosen from grid placed over banks
- Survey biomass estimate of cowcod in the study area: 940 mt (CV = 25%)

The STAT summarized the survey's treatment in the 2005 assessment:

- Survey treated as relative index of abundance with prior on (log) catchability
- Analysis of CPUE and estimated habitat area suggests q = 0.75 with standard error 0.147 (Appendix IV, Piner et al., 2005). This is likely to be a minimum estimate of the actual error in this estimate.
- CV of the prior for (log) catchability was fixed at 0.5.

The STAT also provided a sensitivity analysis comparing models based on different values of the CV for the prior probability distribution for the catchability parameter (Table 14). As illustrated in Tables 13 and 14, the assessment is very sensitive to the visual survey data and the assumed precision of its catchability coefficient (in effect, the 'weight' given to the survey). This emphasizes the need for future surveys to provide adequate coverage of areas inside and outside the CCAs.

9. Contact observer program re: CPFV observer data from charter boat on species composition.

   During the panel, it was suggested that recent data from CPFV observer programs in Southern California might inform recent trends. The STAT obtained location-specific data from 1999-2006 (Wade Van Buskirk, pers. comm.), during which time a total of 35 cowcod were recorded as kept or returned, based on a query of the recommended NODC8, ALPHA5, and RecFIN species codes. The database contained records from over 16,000 site visits. Although efforts could be made to better determine effective effort for cowcod, it appears that this species is not observed often enough in these surveys to provide meaningful trend information.

10. Follow up with knowledgeable Southwest Fisheries Science Center staff concerning the LA outfall bottom trawl survey and CalCOFI data. STAT should present these data in supporting documentation as being used historically.

    The STAR panel requested that the CalCOFI data and outfall bottom trawl survey data be presented in the current assessment. The STAT agrees that these and other potentially informative data sources should be catalogued and examined during the course of a full stock assessment. During the 2005 assessment both data sets were evaluated, but ultimately omitted. The STAT was unable to complete additional analyses of these two data sets, given the accelerated schedule.

11. Need to know how many samples were taken in recent years versus what we see now with the recovered market samples. Construct a table of distribution of found samples by port, market category and year by gear. Do something simple to see how sensitive model results are to our concerns about the landings once a base model has been developed

    An unresolved issue in this assessment is the accuracy of the estimated proportion of cowcod in the historical rockfish catch. Some members of the STAR panel expressed concern that the samples used to determine these proportions could be less representative of the fishery than samples taken in later years.

    The STAT compared the number of samples taken from 1984-1988 (the five years used to determine the percentage of cowcod in total rockfish catch) with adjacent years for which we have samples (Table 19). The STAR panel concluded that there was little evidence that samples taken during this time period were less representative than adjacent years.

12. Would like to see a plot of the prior on the catchability for the visual survey and final estimate.

    The STAT plotted the prior distribution for log catchability along with the point estimate (posterior mode) from the fitted model (Fig. 38). This illustrates how the CPFV logbook index and visual transect survey provide conflicting information about stock status in 2002. Since this plot does not take into account posterior uncertainty, we compare MCMC draws from the posterior with the prior distribution in Appendix C.

13. Call from Observer Program. There may be observer data. Follow up.

    See response to item 9.

14. NWFSC staff working on NWFSC survey and sending all tows in SCB. Follow up.

    Jim Hastie and Beth Horness provided data from the West Coast Slope/Shelf Combination Groundfish survey, including the number, combined weight, and individual lengths of cowcod caught during all tows in the SCB from 2003-2006. Trawl surveys are limited as indices of abundance for cowcod, in that they cannot access rocky, high-relief habitat. The survey caught a total of 45 cowcod over the 4-year period, between the depths of 127 and 288 meters. There were 141 tows between 50-300m. For each of these tows, the STAT calculated the number of cowcod per hectare of area swept by the trawl (Table 20). The proportion of tows that caught at least one cowcod ranged from 7% - 17%. The number of tows within the 50-300m depth range ranged from 30 – 41 per year. Given the short time series, the limitations regarding trawlable habitat, and the large number of zero observations the STAT feels that this index is not suitable for the current assessment, but suggests that it be re-evaluated in future assessments.

15. Calculate harvest rate as total catch over summary biomass defined by 50% selectivity for the recreational fishery.

    See response to item 2 and Fig. 28.

16. Sensitivity runs for the abundance indices:

    a) Drop visual, keep CPFV
    b) Keep visual, drop CPFV
    c) Keep visual and CPFV add power term for CPFV

    Removing the visual survey has a dramatic effect on the 2005 assessment with corrected selectivity curve (Table 13) and the 2007 assessment. Depletion in 2007 is estimated at 2.1% when the visual survey is removed (Table 21). The STAT did not use models without the visual survey to bracket uncertainty because the associated exploitation rates (total catch over age 11+ summary biomass) became impossibly high, exceeding 1.5 in some years.

    The "Visual Survey only" run in Table 21 only differs from the "high-productivity" model (Table ES2, third column) in that steepness is fixed at 0.6 versus 0.8. Both models are simply calculating the level of virgin recruitment required to match the 2002 visual survey biomass estimate, given the model assumptions.

    The STAR panel requested a run in which the CPFV logbook index is fit with a power term (Table 21). This relaxes the proportionality assumption and improves the fit to the CPFV index and visual survey. Adding the additional parameter adds complexity that is not, in the STAT's opinion, well understood or justified. Instead, the STAT recommends additional research regarding the nature of the observed hyperdepletion pattern.

17. Investigate the impact of different scenarios for the level of landings during the historical period in this fishery. Try runs of the model with one half and double (or some other factor at the STAT discretion) the landings from 1900 to 1968 using the case with both visual and CPFV in the model.

    The STAT completed model runs with +/- 50% of the historical commercial catch from 1900-1968 (Table 22). Estimates of spawning biomass in 2007 are relatively insensitive to this change, but estimates of unfished spawning biomass range from 4646 mt to 6063 mt. Absolute depletion changes by less than 1% in either direction, but the relative change is about +/-12%.

18. The Panel requested an MCMC run on the full model with the following characteristics.

    Results from preliminary Bayesian models are presented as Appendix C.

19. STAT to provide summary of runs to date to establish the range of uncertainties to be captured with the base run.

    The STAR panel requested a set of runs profiling values of natural mortality and steepness, for models with both the CPFV logbook index and the visual survey as well as models with either the CPFV index or visual survey. The STAT produced estimates of unfished spawning biomass, 2007 spawning biomass and 2007 depletion for 27 model runs (Table 23). Natural mortality was fixed at either 0.04, 0.055, or 0.07., and steepness was fixed at 0.4, 0.6, or 0.8.

    Models that included both the CPFV index and visual survey produced estimates of depletion ranging from 3.8% to 8.9% and estimates of SB_0 between 2008 mt and 3153 mt. Removing the CPFV logbook index (using only the visual survey) produced estimates of depletion between 18.8% and 30.5%, with SB_0 between 2143 and 3465 mt.

    We bracket uncertainty in this assessment using three values of steepness (0.4, 0.6, and 0.8) and by excluding the CPFV logbook index from the model with steepness fixed at 0.8. The estimated biomass trajectory from the model that assumes a relatively high level of productivity and ignores the declining catch rates in the CPFV index still falls below the overfished threshold from 1981 until 2005 (Fig. ES3).

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Tables

Table 1. Mortality estimates; natural (M) or total (Z)

Method	M	Z	range (if available)
Hoenig (1983); GM regression for all groups		0.072	n/a
Catch curve; age at full recruitment = 12		0.055	(0.038, 0.072)
Beverton (1992); Tmax = 55	0.045		(0.027, 0.064)

Table 2. Parameters for the revised growth curve, compared to values in the 2005 assessment.

parameter [units]	2005 assessment (converted from SS2 .tpl file)	2007 assessment
L_∞ [mm, total length]	914	870
k [$years^{-1}$]	0.056	0.052
t_0 [years]	-0.46	-1.94

Table 3. Incremental changes associated with corrections to selectivity and growth in the 2005 assessment, with comparisons to the 2007 base model and possible alternative (low- and high-productivity) states of nature. Natural mortality is fixed at 0.055 in all models. Increased estimates of virgin biomass are largely due to revised estimates of historical landings. The high-productivity (h=0.8) model calculates the level of virgin recruitment required to match the 2002 biomass estimate, given the model assumptions. Therefore, likelihood components are not informative and are not reported for this model.

	2005 (SS2 v1.23d, h = 0.5, M = 0.055)			**2007 assessment (SS2 v2.00c)**		
	(unchanged)	selex = maturity	selex = maturity & revised growth	h = 0.4 CPFV index & visual survey	h = 0.6 CPFV index & visual survey	h = 0.8 Visual survey only
Reference Points						
Unfished female spawning biomass (SB_0)	1522	1660	1568	2785	2494	2496
Unfished summary (age-1+) biomass	3191	3481	3333	5923	5303	5308
40% of SB_0 (proxy for SB_{MSY})	609	664	627	1114	997	998
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	3.3%	2.8%	2.9%	2.7%	2.7%	2.7%
Female spawning biomass in final year	271	157	155	115	113	681
SB in final year / unfished SB	17.8%	9.4%	9.9%	4.1%	4.6%	27.3%
Parameter Estimates						
Unfished recruitment (R_0)	59.6	65.0	69.2	123.1	110.2	110.3
Catchability for CPFV logbook index	1.46E-05	5.95E-05	5.72E-05	1.97E-04	2.08E-04	n/a
Catchability for visual survey	1.49	2.34	2.36	3.06	3.19	0.75
Initial fishing mortality	9.25E-05	6.13E-04	6.48E-04	n/a	n/a	n/a
Likelihood components						
Total negative log likelihood	13.43	14.98	14.36	17.22	17.91	n/a
CPFV logbook index	12.23	11.83	11.16	12.28	12.67	n/a
Visual survey	0.23	0.63	0.64	0.99	1.05	n/a
Prior on visual survey	0.91	2.52	2.56	3.95	4.19	n/a
penalties	0.06	0.00	0.00	0.00	0.00	n/a

Table 4. Regional rockfish landings (metric tons) from CDF&G Fish Bulletin No. 105 (1958) and the NMFS SWFSC ERD Live-Access Server (http://las.pfeg.noaa.gov/LAS/CA_market_catch.html).

	CDF&G Fish Bulletin No. 105			NMFS ERD Live Access Server					
year	Southern	Central	Northern	San Diego	Los Angeles	Santa Barbara	Monterey	San Francisco	Eureka
1916	966.62	1258.10	6.48						
1917	1559.70	1953.81	12.74						
1918	1422.29	2286.85	29.72						
1919	850.46	1591.24	6.84						
1920	923.72	1622.13	9.28						
1921	806.94	1339.01	13.91						
1922	794.00	1151.53	10.37						
1923	1063.85	1244.55	3.39						
1924	1426.24	715.81	9.29						
1925	1564.44	895.04	30.12						
1926	1941.86	1448.95	29.71						
1927	1611.49	1230.84	56.40						
1928	1373.50	1489.87	48.65	554.76	769.85	46.65	1037.07	452.80	48.65
1929	1389.53	1231.60	116.94	641.80	687.26	44.60	744.37	487.23	116.94
1930	1415.63	1747.90	113.84	477.91	906.13	21.15	1281.84	466.06	113.84
1931	1617.81	1635.24	48.06	400.30	1182.35	30.91	1162.02	473.23	48.06
1932	1135.48	1380.64	40.48	298.47	797.37	34.76	929.54	451.10	40.48
1933	907.47	1250.11	14.12	252.63	588.30	46.54	734.27	515.84	14.12
1934	857.00	1178.65	52.70	129.53	510.38	127.60	762.08	413.50	57.76
1935	741.23	1377.44	72.72	77.85	373.92	177.65	975.39	402.05	72.72
1936	424.05	1579.23	85.01	69.72	122.80	181.88	1188.37	390.87	85.01
1937	460.65	1425.30	60.52	65.18	156.84	166.26	954.94	470.30	60.52
1938	309.18	1092.21	248.39	33.82	126.04	72.76	838.72	253.49	248.15
1939	389.66	779.56	342.66	92.01	140.83	91.19	602.61	176.25	341.65
1940	396.32	958.58	264.72	66.63	153.11	136.40	752.37	206.21	264.06
1941	470.11	867.78	206.88	42.15	202.95	131.57	662.24	205.29	206.26
1942	192.96	329.34	123.36	10.13	74.46	38.27	297.51	31.76	123.36
1943	226.43	402.58	623.90	5.17	89.07	38.61	310.60	91.98	623.75
1944	43.38	363.18	2506.52	4.63	10.34	22.14	331.89	31.28	2505.76
1945	92.92	617.92	5315.58	4.56	26.97	44.95	533.96	84.16	5313.17
1946	161.19	608.31	4293.16	8.71	79.60	48.78	508.01	100.30	4005.49
1947	185.46	785.98	2883.46	8.79	131.60	26.85	690.04	95.94	2496.14
1948	287.68	886.56	1792.71	24.12	200.08	36.11	748.25	122.98	1594.18
1949	412.09	847.60	1492.66	36.64	258.88	61.88	611.25	236.35	1274.85
1950	427.87	1555.09	1698.35	33.67	294.00	85.96	1106.22	448.88	1555.57
1951	470.81	2440.55	2074.55	14.55	328.93	121.63	1440.72	999.83	2051.35
1952	366.25	3301.04	1195.31	9.47	218.59	108.15	1676.93	1624.11	1089.52
1953	298.74	3845.54	1402.36	14.71	179.44	88.66	1953.92	1891.82	1335.43
1954	583.02	3702.04	1448.42	14.10	247.22	263.09	2348.59	1353.71	1262.75
1955	1810.39	2595.75	1346.19	48.45	199.07	1532.34	1886.96	708.79	1224.17
1956	1481.43	3882.16	1414.68	35.07	257.45	1168.67	2547.45	1334.71	1304.76
1957				32.08	227.86	1522.51	2481.72	1278.15	1675.42
1958				141.03	228.89	1425.89	2656.71	1902.85	1609.67
1959				94.83	264.46	671.00	2130.96	2232.76	1365.33
1960				89.91	238.78	1280.67	1616.42	1492.34	1299.30
1961				98.52	174.94	1052.77	1464.21	1007.77	884.82
1962				70.09	172.42	916.79	1294.95	902.29	808.21
1963				112.15	220.54	1180.38	1118.88	1069.85	1331.18
1964				87.01	207.47	718.63	986.50	793.93	767.33
1965				132.79	248.71	786.04	1187.70	714.95	1081.89
1966				136.44	226.38	1026.92	1535.84	731.57	821.78
1967				167.07	250.56	1313.09	1155.41	388.93	1074.81
1968				126.06	242.67	1187.51	1086.20	264.96	1271.15

Table 5. Data and derived quantities used to develop ratio estimates of total rockfish landings in the SCB. Gray shading indicates ratio estimate (see text for details). "Ratio years" are the range of years over which ratio estimates were calculated. Sources include the NMFS SWFSC ERD Live Access Server and several volumes of the CDF&G Fish Bulletin (FB) series.

	FB 105	NMFS ERD live-access server			foreign catch	Major SLO Ports		Source of	adjusted	ratio
year	Southern	San Diego	Los Angeles	Santa Barbara	landed in U.S.	Morro Bay	Avila	SLO catch	Santa Barbara	years
1916	966.62	330.18	620.06		7.11			ratio	9.27	1928-33
1917	1559.70	532.76	1000.51		11.47			ratio	14.96	1928-33
1918	1422.29	485.83	912.36		10.46			ratio	13.64	1928-33
1919	850.46	290.50	545.55		6.26			ratio	8.16	1928-33
1920	923.72	315.52	592.54		6.80			ratio	8.86	1928-33
1921	806.94	275.63	517.63		5.94			ratio	7.74	1928-33
1922	794.00	271.21	509.33		5.84			ratio	7.61	1928-33
1923	1063.85	363.39	682.43		7.83			ratio	10.20	1928-33
1924	1426.24	487.18	914.90		10.49			ratio	13.68	1928-33
1925	1564.44	534.38	1003.54		11.51			ratio	15.00	1928-33
1926	1941.86	663.30	1245.65		14.29			ratio	18.62	1928-33
1927	1611.49	550.45	1033.73		11.86			ratio	15.45	1928-33
1928	1373.50	554.76	769.85	46.65	2.24	17.44	13.90	ratio	15.31	1949-51
1929	1389.53	641.80	687.26	44.60	15.86	16.68	13.28	ratio	14.64	1949-51
1930	1415.63	477.91	906.13	21.15	10.44	7.91	6.30	ratio	6.94	1949-51
1931	1617.81	400.30	1182.35	30.91	4.25	11.56	9.21	ratio	10.14	1949-51
1932	1135.48	298.47	797.37	34.76	4.88	13.00	10.35	ratio	11.41	1949-51
1933	907.47	252.63	588.30	46.54	19.99	17.40	13.86	ratio	15.27	1949-51
1934	857.00	129.53	510.38	127.60	89.49	47.72	38.01	ratio	41.88	1949-51
1935	741.23	77.85	373.92	177.65	111.81	66.43	52.92	ratio	58.30	1949-51
1936	424.05	69.72	122.80	181.88	49.65	68.02	54.18	ratio	59.69	1949-51
1937	460.65	65.18	156.84	166.26	72.37	62.17	49.52	ratio	54.56	1949-51
1938	309.18	33.82	126.04	72.76	76.56	27.21	21.67	ratio	23.88	1949-51
1939	389.66	92.01	140.83	91.19	65.63	34.10	27.16	ratio	29.93	1949-51
1940	396.32	66.63	153.11	136.40	40.18	51.01	40.63	ratio	44.76	1949-51
1941	470.11	42.15	202.95	131.57	93.44	49.20	39.19	ratio	43.18	1949-51
1942	192.96	10.13	74.46	38.27	70.11	14.31	11.40	ratio	12.56	1949-51
1943	226.43	5.17	89.07	38.61	93.57	14.44	11.50	ratio	12.67	1949-51
1944	43.38	4.63	10.34	22.14	6.27	8.28	6.60	ratio	7.27	1949-51
1945	92.92	4.56	26.97	44.95	16.45	16.81	13.39	ratio	14.75	1949-51
1946	161.19	8.71	79.60	48.78	24.10	18.24	14.53	ratio	16.01	1949-51
1947	185.46	8.79	131.60	26.85	18.22	10.04	8.00	ratio	8.81	1949-51
1948	287.68	24.12	200.08	36.11	27.37	13.50	10.76	ratio	11.85	1949-51
1949	412.09	36.64	258.88	61.88	54.69	20.62	22.95	FB 80	18.30	
1950	427.87	33.67	294.00	85.96	14.24	41.23	28.68	FB 86	16.05	
1951	470.81	14.55	328.93	121.63	5.71	38.91	28.63	FB 89	54.08	
1952	366.25	9.47	218.59	108.15	30.04	32.53	25.91	FB 95, ratio	49.72	1949-51
1953	298.74	14.71	179.44	88.66	15.94	56.38	5.04	FB 102, ratio	27.23	1954-56
1954	583.02	14.10	247.22	263.09	58.61	183.91	43.30	FB 102	35.88	
1955	1810.39	48.45	199.07	1532.34	30.52	1393.82	119.73	FB 105	18.79	
1956	1481.43	35.07	257.45	1168.67	20.23	1026.90	69.94	FB 105	71.83	
1957		32.08	227.86	1522.51		1298.20	71.55	FB 108	152.76	
1958		141.03	228.89	1425.89		1136.08	88.64	FB 108, ratio	201.17	1954-57
1959		94.83	264.46	671.00		470.07	36.68	FB 111, ratio	164.25	1954-57
1960		89.91	238.78	1280.67		910.70	71.06	FB 117, ratio	298.92	1954-57
1961		98.52	174.94	1052.77		550.97	42.99	FB 121, ratio	458.81	1954-57
1962		70.09	172.42	916.79		602.72	56.92	FB 125	257.15	
1963		112.15	220.54	1180.38		652.24	230.78	FB 129	297.36	
1964		87.01	207.47	718.63		467.92	114.14	FB 132	136.56	
1965		132.79	248.71	786.04		453.99	40.04	FB 135	292.00	
1966		136.44	226.38	1026.92		666.11	82.68	FB 138	278.13	
1967		167.07	250.56	1313.09		721.16	96.73	FB 144	495.20	
1968		126.06	242.67	1187.51		612.31	34.81	FB 149	540.39	

Table 6. Estimated percentages (by weight) of cowcod in rockfish landings based on 5-year averages (1984-1988). Estimates for the Los Angeles, San Diego, and Santa Barbara (1916-1943) strata are from their respective hook-and-line fisheries. The estimate for the Santa Barbara (1944-1968) stratum is based on the combined trawl and hook-and-line fisheries.

Region (time period)	% cowcod, 1984-88
Santa Barbara (1916-1943)	4.95%
Santa Barbara (1944-1968)	5.56%
Los Angeles (1916-1968)	12.85%
San Diego (1916-1968)	2.10%

Table 7. Number of port samples and number of sampled rockfish (RF) by stratum (year, gear, port complex) for the five earliest-sampled years in the SCB (1984-1988).

Year	SB Hook & Line		SB Trawl		LA Hook & Line		SD Hook & Line	
	# samp.	# RF	# samp.	# RF	# samp.	# RF	# samp.	# RF
1984	11	297	11	366	15	485	19	492
1985	19	514	6	196	38	1098	19	739
1986	43	1335	5	215	38	1262	64	2388
1987	3	99	7	315	37	1422	55	2007
1988	15	537	0	0	9	316	25	848

Table 8. Effect of a 50% decrease in the estimated historical commercial catch (1900-1968).

Reference Point	Base model	Historical commercial catch (1900-68) reduced by half	units
Unfished summary (age-1+) biomass	5303	4646	metric tons
Unfished spawning biomass (SB_0)	2494	2185	metric tons
Unfished recruitment (R_0)	110	96.5	1000s of fish
40% of SB_0 (proxy for SB_{MSY})	997	874	metric tons
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	2.7%	2.7%	percent
Spawning biomass in 2007 (SB_{2007})	113	112	metric tons
SB_{2007} / SB_0	4.6%	5.1%	percent

Table 9. Estimated recreational and commercial landings of cowcod [mt] in the Southern California Bight, 1900-2007.

year	recreational	commercial	total	year	recreational	commercial	total
1900		0.01	0.01	1954	24	34.05	58.05
1901		5.34	5.34	1955	42	27.62	69.62
1902		10.68	10.68	1956	49	37.80	86.80
1903		16.01	16.01	1957	37	38.43	75.43
1904		21.35	21.35	1958	33	43.54	76.54
1905		26.68	26.68	1959	22	45.09	67.09
1906		32.02	32.02	1960	36	49.18	85.18
1907		37.35	37.35	1961	33	50.05	83.05
1908		42.68	42.68	1962	35	37.92	72.92
1909		48.02	48.02	1963	30	47.21	77.21
1910		53.35	53.35	1964	34	36.07	70.07
1911		58.69	58.69	1965	43	50.97	93.97
1912		64.02	64.02	1966	85	47.41	132.41
1913		69.35	69.35	1967	110	63.22	173.22
1914		74.69	74.69	1968	77	63.87	140.87
1915		80.02	80.02	1969	53	94.98	147.98
1916		85.36	85.36	1970	79	55.92	134.92
1917		137.73	137.73	1971	62	68.06	130.06
1918		125.59	125.59	1972	90	102.51	192.51
1919		75.10	75.10	1973	97	108.79	205.79
1920		81.57	81.57	1974	129	114.26	243.26
1921		71.26	71.26	1975	109	112.47	221.47
1922		70.11	70.11	1976	140	131.35	271.35
1923		93.94	93.94	1977	100	132.44	232.44
1924		125.94	125.94	1978	73	147.75	220.75
1925		138.15	138.15	1979	86	187.52	273.52
1926		171.48	171.48	1980	96.43	142.62	239.05
1927		142.30	142.30	1981	26.55	197.59	224.14
1928		111.30	111.30	1982	96.99	228.55	325.54
1929		102.48	102.48	1983	15.13	126.55	141.68
1930		126.78	126.78	1984	21.22	221.14	242.35
1931		160.80	160.80	1985	35.99	204.75	240.73
1932		109.27	109.27	1986	45.99	146.99	192.98
1933		81.64	81.64	1987	29.14	76.62	105.76
1934		70.36	70.36	1988	13.91	86.60	100.52
1935		52.56	52.56	1989	20.60	17.38	37.98
1936		20.19	20.19	1990	21.60	10.41	32.01
1937		24.22	24.22	1991	20.90	7.10	28.00
1938		18.08	18.08	1992	20.70	17.21	37.91
1939		21.50	21.50	1993	9.68	14.85	24.53
1940		23.28	23.28	1994	26.01	13.63	39.65
1941		29.10	29.10	1995	1.75	23.30	25.04
1942		10.40	10.40	1996	5.36	24.57	29.93
1943		12.18	12.18	1997	1.85	7.30	9.15
1944		1.83	1.83	1998	2.81	1.21	4.03
1945		4.38	4.38	1999	3.77	3.47	7.24
1946		11.30	11.30	2000	4.49	0.45	4.94
1947		17.58	17.58	2001	0.25	0.25	0.50
1948		26.87	26.87	2002	0.25	0.25	0.50
1949		35.05	35.05	2003	0.25	0.25	0.50
1950		39.37	39.37	2004	0.25	0.25	0.50
1951	9	45.57	54.57	2005	0.25	0.25	0.50
1952	10	31.05	41.05	2006	0.25	0.25	0.50
1953	13	24.88	37.88	2007	0.25	0.25	0.50

Table 10: Area (km^2) between 50-300m in pseudo-blocks as defined by Butler et al. (1999).

pseudo-block	area [km^2]	% of total habitat
3	1417	23.2%
4	1289	21.1%
2	910	14.9%
684	254	4.2%
685	203	3.3%
667	195	3.2%
690	164	2.7%
710	163	2.7%
878	137	2.2%
683	125	2.0%
762	108	1.8%
867	108	1.8%
765	106	1.7%
740	82	1.3%
739	82	1.3%
861	81	1.3%
850	79	1.3%
806	73	1.2%
682	69	1.1%
725	64	1.0%
738	59	1.0%
761	54	0.9%
829	52	0.9%
709	46	0.7%
708	45	0.7%
707	43	0.7%
724	39	0.6%
807	38	0.6%
737	16	0.3%
719	9	0.2%

Table 11: Model selection for the delta-GLM CPFV logbook index. BIC selects the revised spatial stratification over the 1999 model structure, with and without the year-area interaction term. * Due to minor differences between the data used in the 1999 index and the revised index, it was impossible to exactly replicate the spatial stratification from the 1999 assessment.

Spatial stratification	model	distribution	# of parameters	BIC	delta-BIC
1999*	log(cpue) = year + month + pseudo.block	normal	70	9089.8	182.8
1999	log(cpue) = year + month + pseudo.block + year:pseudo.block	normal	1032	12095.9	3188.9
revised	log(cpue) = year + region	normal	48	9079.4	172.4
revised	log(cpue) = year + region + log.RF	normal	49	8914.5	7.6
revised	log(cpue) = year + region + log.RF + region:log.RF	normal	58	8907.0	0.0
revised	log(cpue) = year + region + log.RF + year:region	normal	382	10360.8	1453.8
1999	cpue = year + month + pseudo.block	binomial	69	8617.4	913.9
1999	cpue = year + month + pseudo.block + year:pseudo.block	binomial	1031	failed to converge	
revised	cpue = year + region	binomial	47	8901.0	1197.5
revised	cpue = year + region + log.RF	binomial	48	7703.5	0.0
revised	cpue = year + region + log.RF + year:region	binomial	381	failed to converge	

Table 12: Revised CPFV logbook index with jackknife CVs

year	index	CV
1963	0.51167	0.330
1964	0.39318	0.253
1965	0.27507	0.225
1966	0.23974	0.231
1967	0.14688	0.246
1968	0.17299	0.178
1969	0.18585	0.237
1970	0.20804	0.273
1971	0.25156	0.195
1972	0.13262	0.211
1973	0.22675	0.141
1974	0.21390	0.157
1975	0.26081	0.149
1976	0.15214	0.152
1977	0.13932	0.198
1978	0.10625	0.218
1979	0.08861	0.187
1980	0.06066	0.167
1981	0.08139	0.168
1982	0.04213	0.190
1983	0.06033	0.154
1984	0.05002	0.178
1985	0.03699	0.205
1986	0.04158	0.196
1987	0.02307	0.225
1988	0.03375	0.241
1989	0.02558	0.234
1990	0.03275	0.212
1991	0.04156	0.182
1992	0.03030	0.244
1993	0.03317	0.349
1994	0.02111	0.290
1995	0.01769	0.337
1996	0.01610	0.299
1997	0.00879	0.458
1998	0.01075	0.274
1999	0.00309	0.444
2000	0.00291	0.672

Table 13. Effect of removing visual survey from the 2005 assessment (with corrected selectivity). Steepness was fixed at h = 0.5.

Reference Point	2005 assessment (selex = maturity) with visual survey	without visual survey	units
Unfished summary (age-1+) biomass	3481	3389	metric tons
Unfished spawning biomass (SB_0)	3320	3232	metric tons
Unfished recruitment (R_0)	65.0	63.3	1000s of fish
40% of SB_0 (proxy for SB_{MSY})	1328	1293	metric tons
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	2.8%	2.8%	percent
Spawning biomass in end year (SB_{end})	313	61	metric tons
SB_{end} / SB_0	9.4%	1.9%	percent
Catchability coefficient for visual survey	2.3	n/a	n/a

Table 14. Profile over the CV of the prior distribution for catchability of the visual survey.

	CV of prior on (log) catchability for visual survey			
Reference Points	**1%**	**20%**	**50%**	**100%**
Unfished spawning biomass (SB0)	2542	2521	2495	2484
Unfished summary (age-1+) biomass	5405	5361	5306	5282
40% of SB0 (proxy for SBMSY)	1017	1008	998	994
Spawning biomass in final year	266	204	118	78
SB in final year / unfished SB	10.5%	8.1%	4.7%	3.1%
Parameter Estimates				
Unfished recruitment (R0)	112.3	111.4	110.3	109.8
Catchability for CPFV logbook index	1.71E-04	1.84E-04	2.07E-04	2.23E-04
Catchability for visual survey	0.75	1.20	2.98	5.75
Likelihood components				
Total negative log likelihood	28.6	25.1	18.4	13.9
CPFV logbook index	21.6	17.9	12.9	11.1
Visual survey	6.99	4.41	1.20	0.21
Prior on visual survey	0.01	2.77	4.27	2.66

Table 15. Bivariate likelihood profiles for the Beverton-Holt steepness parameter (h) and natural mortality (M), with associated estimates of unfished female spawning biomass, depletion, catchability for the visual survey, and MSY.

Total Negative Log Likelihood (NLL)

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	16.5	16.6	16.6
0.45	17.5	17.4	17.3
0.60	18.1	17.9	17.7
0.75	18.6	18.3	18.1
0.90	19.4	21.6	26.0

Visual Survey NLL

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	0.91	0.92	0.93
0.45	1.02	1.01	1.00
0.60	1.08	1.05	1.01
0.75	1.11	1.04	0.86
0.90	1.06	0.42	0.17

CPFV Index NLL

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	11.99	11.98	11.94
0.45	12.38	12.39	12.35
0.60	12.65	12.67	12.66
0.75	12.99	13.10	13.78
0.90	14.06	19.44	25.02

Visual Survey Prior (NLL)

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	3.63	3.70	3.72
0.45	4.06	4.04	3.98
0.60	4.34	4.19	4.03
0.75	4.46	4.14	3.43
0.90	4.23	1.68	0.68

Unfished Spawning Biomass (SB_0)

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	3387	3052	2754
0.45	3068	2692	2373
0.60	2886	2494	2170
0.75	2762	2361	2037
0.90	2663	2271	1958

Catchability for 2002 visual survey

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	2.89	2.92	2.94
0.45	3.12	3.11	3.08
0.60	3.27	3.19	3.10
0.75	3.34	3.17	2.78
0.90	3.22	1.88	1.35

Depletion (SB_{2007} / SB_0)

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	3.7%	3.9%	4.1%
0.45	3.8%	4.2%	4.6%
0.60	4.0%	4.6%	5.2%
0.75	4.2%	5.0%	6.4%
0.90	4.7%	10.2%	16.8%

MSY

Steepness	Natural Mortality 0.040	0.055	0.070
0.30	0.00	0.00	0.00
0.45	39.57	46.20	51.54
0.60	53.19	61.19	67.39
0.75	57.87	65.89	71.99
0.90	59.71	67.79	73.94

Table 16. Comparison of base model results (fixed h = 0.6) to a model that estimates steepness with a prior probability distribution from a meta-analysis of rockfish stocks.

Reference Points	base model	estimate steepness with prior
Unfished spawning biomass (SB0)	2494	3063
Unfished summary (age-1+) biomass	5303	6514
40% of SB0 (proxy for SBMSY)	997	1225
Spawning biomass in final year	113	119
SB in final year / unfished SB	4.6%	3.9%
MSY	61.2	0.0
Parameter Estimates		
Unfished recruitment (R0)	110.2	135.4
Catchability for CPFV logbook index	2.08E-04	1.91E-04
Catchability for visual survey	3.19	2.92
Steepness	**0.6 (fixed)**	**0.30**
Likelihood components		
Total negative log likelihood	17.9	17.3
CPFV logbook index	12.7	12.0
Visual survey	1.05	0.92
Prior on visual survey	4.19	4.42

Table 17. Summary statistics from the binomial GLM in the CPFV logbook delta-GLM model.

```
Call: glm(formula = cpue ~ season + region + logRF, family = binomial, data = bindat)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.4471  -0.7508  -0.3831   0.7736   2.8519

Coefficients:
                        Estimate Std. Error z value Pr(>|z|)
(Intercept)              0.94993    0.31499   3.016 0.002563 **
season1964              -0.09233    0.31936  -0.289 0.772505
season1965               0.25317    0.31383   0.807 0.419826
season1966               0.15198    0.30862   0.492 0.622389
season1967              -0.27623    0.31847  -0.867 0.385747
season1968               0.15311    0.31134   0.492 0.622864
season1969              -0.53414    0.31098  -1.718 0.085864 .
season1970              -0.37944    0.31557  -1.202 0.229219
season1971              -0.24020    0.31200  -0.770 0.441376
season1972              -0.14216    0.30483  -0.466 0.640962
season1973               1.02891    0.30179   3.409 0.000651 ***
season1974               0.68591    0.30422   2.255 0.024158 *
season1975               1.38708    0.30923   4.486 7.27e-06 ***
season1976               0.77587    0.30034   2.583 0.009786 **
season1977               0.22333    0.29943   0.746 0.455744
season1978               0.68891    0.37217   1.851 0.064157 .
season1979               0.13610    0.31073   0.438 0.661377
season1980               0.47993    0.29158   1.646 0.099772 .
season1981               0.47224    0.29235   1.615 0.106246
season1982              -0.01647    0.29626  -0.056 0.955675
season1983               0.71169    0.29634   2.402 0.016324 *
season1984               0.18727    0.29598   0.633 0.526914
season1985              -0.41398    0.31015  -1.335 0.181947
season1986              -0.15969    0.31048  -0.514 0.607013
season1987              -0.73989    0.31100  -2.379 0.017355 *
season1988              -0.72032    0.30421  -2.368 0.017893 *
season1989              -0.60857    0.30795  -1.976 0.048135 *
season1990              -0.45486    0.30450  -1.494 0.135235
season1991              -0.07619    0.29725  -0.256 0.797718
season1992              -0.37193    0.31357  -1.186 0.235574
season1993              -1.27221    0.34226  -3.717 0.000201 ***
season1994              -1.11143    0.33248  -3.343 0.000829 ***
season1995              -1.05965    0.32653  -3.245 0.001174 **
season1996              -0.86865    0.31566  -2.752 0.005925 **
season1997              -1.72993    0.38497  -4.494 7.00e-06 ***
season1998              -0.94803    0.32510  -2.916 0.003545 **
season1999              -2.04664    0.44463  -4.603 4.16e-06 ***
season2000              -2.10206    0.59788  -3.516 0.000438 ***
regionBackside_Catalina -1.05866    0.20891  -5.068 4.03e-07 ***
regionNorth_islands     -2.65911    0.19323 -13.762  < 2e-16 ***
regionOceanside         -1.67080    0.24216  -6.900 5.21e-12 ***
regionOffshore_banks    -0.65207    0.20922  -3.117 0.001830 **
regionSan_Clemente      -2.10109    0.21342  -9.845  < 2e-16 ***
regionSan_Nicolas       -1.77770    0.20612  -8.625  < 2e-16 ***
regionSan_Pedro_Channel -1.31484    0.19457  -6.758 1.40e-11 ***
regionSB_Hidden_Reef    -1.59668    0.20143  -7.927 2.25e-15 ***
regionSouth_coastal     -2.68037    0.21435 -12.504  < 2e-16 ***
logRF                    0.76015    0.02590  29.347  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

    Null deviance: 9789.1  on 7781  degrees of freedom
Residual deviance: 7273.4  on 7734  degrees of freedom
```

Table 18. Summary statistics from the Gaussian GLM in the CPFV logbook delta-GLM model.

```
glm(formula = log(cpue) ~ season + region + logRF + region:logRF, family = gaussian)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-4.4785  -0.8141   0.0913   0.9178   5.7089

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                  -1.209800   0.283006  -4.275 1.99e-05 ***
season1964                   -0.236781   0.312932  -0.757 0.449331
season1965                   -0.685057   0.300901  -2.277 0.022891 *
season1966                   -0.798242   0.296449  -2.693 0.007136 **
season1967                   -1.163025   0.307126  -3.787 0.000156 ***
season1968                   -1.124844   0.299193  -3.760 0.000174 ***
season1969                   -0.833012   0.304861  -2.732 0.006332 **
season1970                   -0.778900   0.308135  -2.528 0.011541 *
season1971                   -0.637021   0.304601  -2.091 0.036601 *
season1972                   -1.308468   0.298521  -4.383 1.22e-05 ***
season1973                   -1.011320   0.278340  -3.633 0.000285 ***
season1974                   -1.021159   0.283891  -3.597 0.000328 ***
season1975                   -0.908640   0.276620  -3.285 0.001035 **
season1976                   -1.376032   0.281108  -4.895 1.05e-06 ***
season1977                   -1.358337   0.287368  -4.727 2.41e-06 ***
season1978                   -1.721394   0.330868  -5.203 2.13e-07 ***
season1979                   -1.789598   0.296210  -6.042 1.76e-09 ***
season1980                   -2.244806   0.278192  -8.069 1.10e-15 ***
season1981                   -1.949369   0.278580  -6.998 3.35e-12 ***
season1982                   -2.492199   0.287642  -8.664  < 2e-16 ***
season1983                   -2.291038   0.282161  -8.120 7.32e-16 ***
season1984                   -2.373959   0.290507  -8.172 4.81e-16 ***
season1985                   -2.493257   0.312544  -7.977 2.27e-15 ***
season1986                   -2.462944   0.310977  -7.920 3.57e-15 ***
season1987                   -2.832696   0.315551  -8.977  < 2e-16 ***
season1988                   -2.460784   0.307497  -8.003 1.86e-15 ***
season1989                   -2.785799   0.312227  -8.922  < 2e-16 ***
season1990                   -2.599893   0.305297  -8.516  < 2e-16 ***
season1991                   -2.488713   0.292618  -8.505  < 2e-16 ***
season1992                   -2.708233   0.316565  -8.555  < 2e-16 ***
season1993                   -2.195748   0.366933  -5.984 2.49e-09 ***
season1994                   -2.737882   0.350334  -7.815 8.08e-15 ***
season1995                   -2.942286   0.342562  -8.589  < 2e-16 ***
season1996                   -3.132509   0.326410  -9.597  < 2e-16 ***
season1997                   -3.233369   0.435156  -7.430 1.49e-13 ***
season1998                   -3.497139   0.340066 -10.284  < 2e-16 ***
season1999                   -4.050691   0.509022  -7.958 2.65e-15 ***
season2000                   -4.068197   0.707020  -5.754 9.80e-09 ***
regionBackside_Catalina      -1.270068   0.160118  -7.932 3.24e-15 ***
regionNorth_islands          -1.279452   0.150594  -8.496  < 2e-16 ***
regionOceanside              -2.154937   0.222795  -9.672  < 2e-16 ***
regionOffshore_banks          0.524952   0.156033   3.364 0.000779 ***
regionSan_Clemente           -1.124961   0.181650  -6.193 6.90e-10 ***
regionSan_Nicolas            -0.310789   0.169905  -1.829 0.067493 .
regionSan_Pedro_Channel      -1.738109   0.148275 -11.722  < 2e-16 ***
regionSB_Hidden_Reef         -0.506515   0.161100  -3.144 0.001686 **
regionSouth_coastal          -1.758563   0.197066  -8.924  < 2e-16 ***
logRF                        -0.005808   0.100492  -0.058 0.953919
regionBackside_Catalina:logRF -0.129265   0.131973  -0.979 0.327441
regionNorth_islands:logRF    -0.277307   0.111539  -2.486 0.012978 *
regionOceanside:logRF        -0.627487   0.189999  -3.303 0.000972 ***
regionOffshore_banks:logRF   -0.307573   0.149875  -2.052 0.040257 *
regionSan_Clemente:logRF     -0.042219   0.153253  -0.275 0.782967
```

```
regionSan_Nicolas:logRF       -0.359699   0.127861  -2.813 0.004944 **
regionSan_Pedro_Channel:logRF -0.233015   0.109458  -2.129 0.033369 *
regionSB_Hidden_Reef:logRF    -0.451922   0.121956  -3.706 0.000216 ***
regionSouth_coastal:logRF     -0.890979   0.132332  -6.733 2.06e-11 ***
---
(Dispersion parameter for gaussian family taken to be 1.733394)

    Null deviance: 7477.7  on 2511  degrees of freedom
Residual deviance: 4255.5  on 2455  degrees of freedom
```

Table 19. Number of port samples taken by gear, port complex, market category, and year in the SCB, 1983-1990. Species compositions from 1984-1988 (grey) were used to estimate the fraction of total rockfish that was cowcod in the historical fisheries. HKL = hook and line, TWL = trawl, OLA = Los Angeles, OSB = Santa Barbara, OSD = San Diego. Source: CALCOM, 2007.

Sum of sample_ct			year								
gear_grp	port_complex	mark_cat	1983	1984	1985	1986	1987	1988	1989	1990	Grand Total
HKL	OLA	250		3	9	1	3				16
		667		2	12	13	14	2	3		46
		956		6	3	8	7	3	10		37
		959		4	14	16	13	4	17		68
	OLA Total			15	38	38	37	9	30		167
	OSB	245							1		1
		250		3	8	17	2	2	1		33
		667			1	2	1	6	12	3	25
		956	1	3	6	16		2	7	1	36
		959	1	5	3	8		5	13	2	37
		960			1						1
	OSB Total		2	11	19	43	3	15	34	6	133
	OSD	250	10	17	8	52	35	15	5	3	145
		252		1							1
		269				1					1
		657								1	1
		667		1	8	3	3	4		1	20
		956						1	1		2
		959			3	8	17	5	10	4	47
	OSD Total		10	19	19	64	55	25	16	9	217
HKL Total			12	45	76	145	95	49	80	15	517
TWL	OSB	245		1							1
		250	5	2	1		5				13
		253	2	6							8
		956		1	3	4	1				9
		959		1	2						3
	OSB Total		7	11	6	4	6				34
TWL Total			7	11	6	4	6				34
Grand Total			19	56	82	149	101	49	80	15	551

Table 20. Summary of West Coast Slope/Shelf Combination Groundfish survey data within the Southern California Bight. Analysis restricted to tows between 50-300m. cc = cowcod.

Survey Year	# tows	sum area (sq m)	# cowcod	prop. pos.	avg. cc per hectare (avg. of ratios)	sum(cc) / sum(hectares)
2003	30	527239	4	0.067	0.072	0.076
2004	34	606968	11	0.118	0.185	0.181
2005	36	616654	11	0.167	0.179	0.178
2006	41	634469	19	0.146	0.275	0.299

Table 21. Comparison of requested model runs to base model (see item 16 under Responses to STAR panel requests).

	Model Description				
	base model, h = 0.6	h = 0.6	h = 0.6	h = 0.6	
Reference Point	CPFV Logbook & Visual Survey	CPFV Logbook only	Visual Survey only	CPFV Logbook with power term & Visual Survey	units
Unfished summary (age-1+) biomass	5303	5267	5764	5403	metric tons
Unfished female spawning biomass (SB_0)	2494	2477	2711	2541	metric tons
Unfished recruitment (R_0)	110	109	120	112	1000s of fish
40% of SB_0 (proxy for SB_{MSY})	997	991	1084	1016	metric tons
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	2.7%	2.7%	2.7%	2.7%	percent
Spawning biomass in 2007 (SB_{2007})	113	52	658	264	metric tons
SB_{2007} / SB_0	4.6%	2.1%	24.3%	10.4%	percent
CPFV catchability exponent	1 (fixed)	1 (fixed)	n/a	1.56	n/a
Visual survey log catchability	1.16	n/a	-0.286	0.468	metric tons

Table 22. Sensitivity to historical commercial catch estimates (+/- 50% relative to the base model).

Reference Point	Base model	Historical commercial catch (1900-68) reduced by 50%	Historical commercial catch (1900-68) increased by 50%	units
Unfished summary (age-1+) biomass	5303	4646	6063	metric tons
Unfished spawning biomass (SB_0)	2494	2185	2851	metric tons
Unfished recruitment (R_0)	110	96.5	126.0	1000s of fish
40% of SB_0 (proxy for SB_{MSY})	997	874	1141	metric tons
Exploitation rate at $F_{50\%}$ (proxy for F_{MSY})	2.7%	2.7%	2.7%	percent
Spawning biomass in 2007 (SB_{2007})	113	112	115	metric tons
SB_{2007} / SB_0	4.6%	5.1%	4.0%	percent

Table 23. Summary of runs requested to help bracket uncertainty in the base model. The three final models (shown in grey) used steepness values of 0.4, 0.6, and 0.8, and included either the visual survey and CPFV logbook index or only the visual survey. Models with only the CPFV index were not considered due to extreme estimates of exploitation rates.

		M = 0.04			M = 0.055			M = 0.07		
		Steepness			Steepness			Steepness		
Data	**Quantity**	**0.4**	**0.6**	**0.8**	**0.4**	**0.6**	**0.8**	**0.4**	**0.6**	**0.8**
Visual Survey & CPFV index	**SB_0**	3153	2886	2727	2785	2494	2324	2471	2170	2008
	SB_{2007}	119	115	117	115	113	121	111	112	179
	depletion	3.8%	4.0%	4.3%	**4.1%**	**4.6%**	5.2%	4.5%	5.2%	8.9%
Visual Survey only	**SB_0**	3465	3145	2943	3062	2711	2496	2721	2359	2143
	SB_{2007}	652	677	701	635	658	681	613	634	653
	depletion	18.8%	21.5%	23.8%	20.7%	24.3%	**27.3%**	22.5%	26.9%	30.5%
CPFV index only	**SB_0**	3123	2866	2713	2761	2477	2314	2449	2155	2005
	SB_{2007}	51	47	50	53	52	79	54	56	171
	depletion	1.6%	1.6%	1.9%	1.9%	2.1%	3.4%	2.2%	2.6%	8.5%

Figures

Figure 1. Map of stock boundary from Piner et al. (2005), showing INPFC areas.

Figure 2. Catch curve estimation of total mortality (Z). The assumed age at full recruitment is 12 years old, and ages greater than 44 years were excluded due to consistently small sample sizes.

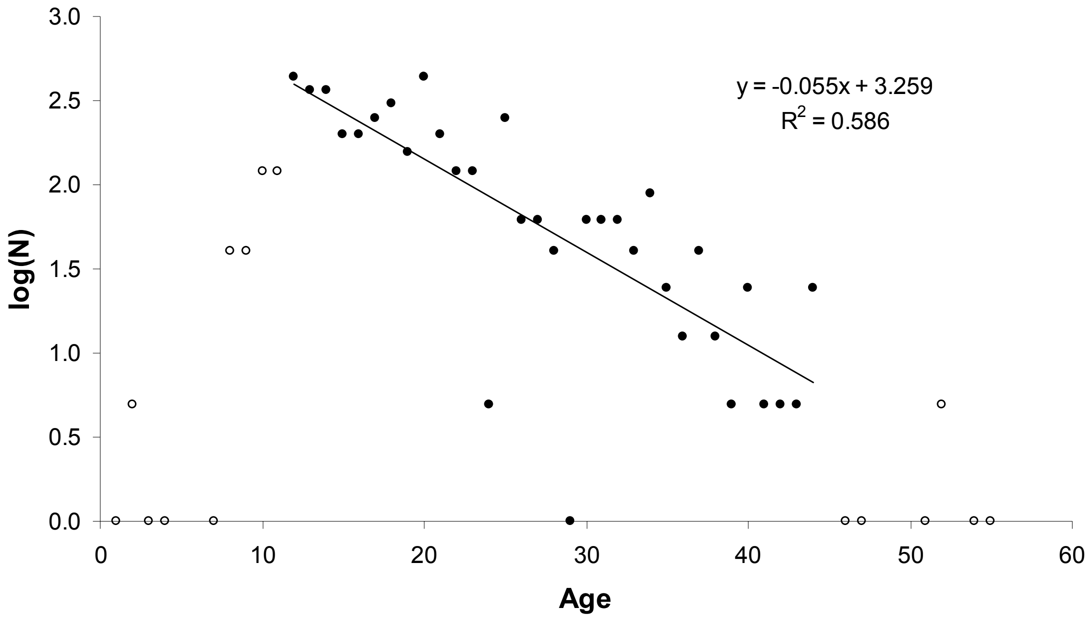


Figure 3. von Bertalanffy growth curve fit to length-at-age data (sexes combined).

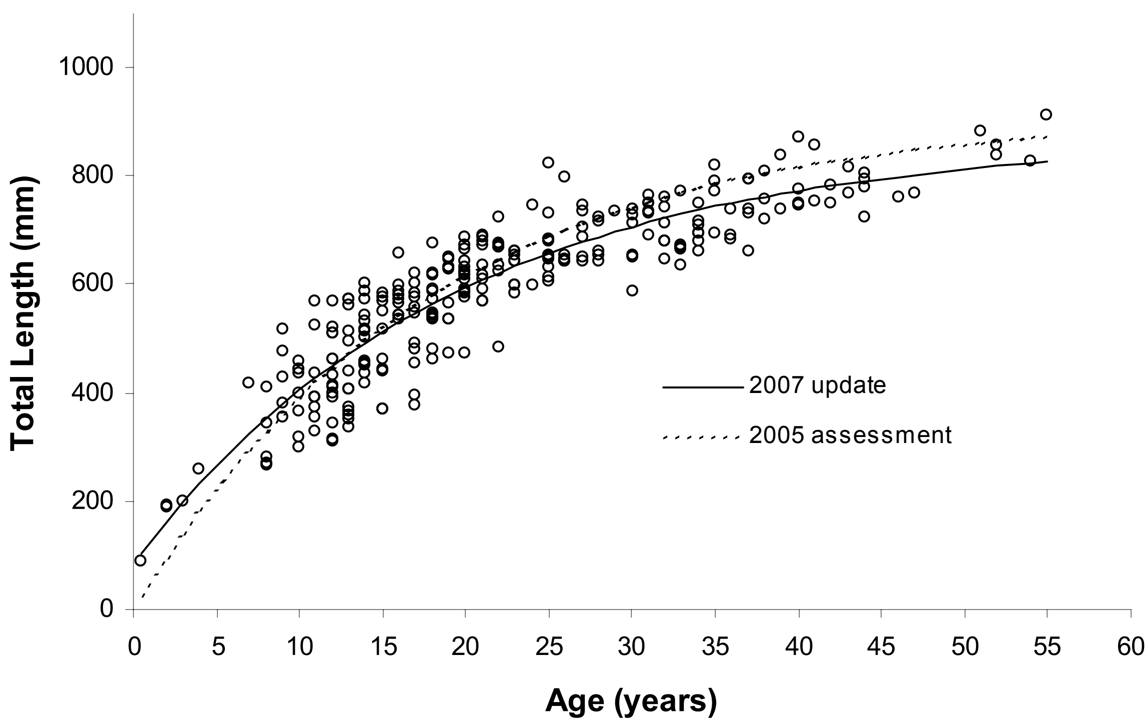


Figure 4. CVs of length at age versus mean length for cowcod. The linear trend was extrapolated to better approximate the observed variability in length at age (see Figure 5).

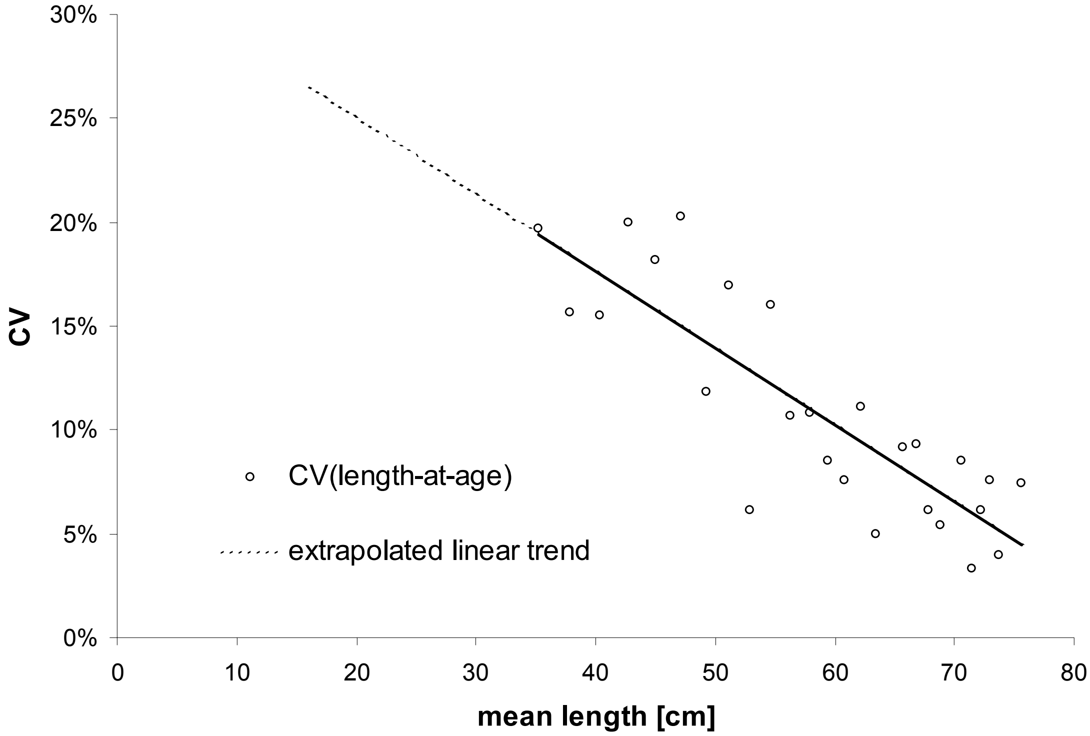


Figure 5. Updated von Bertalanffy growth curve, assumed CVs as a function of age, and 95% confidence intervals used in the base model.

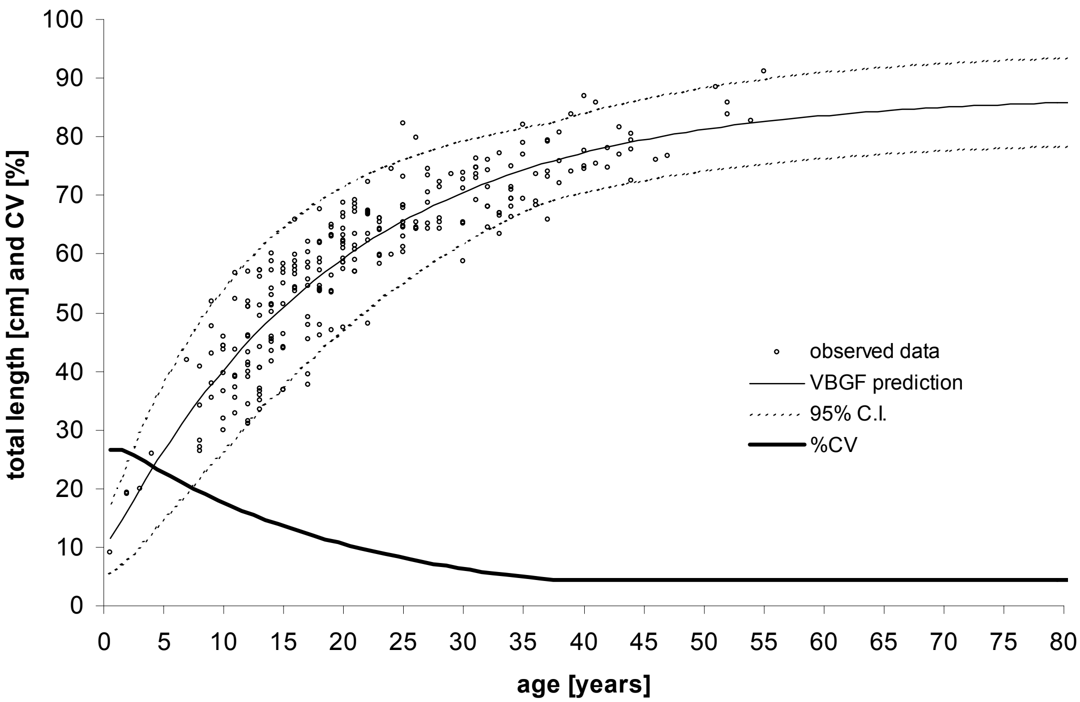


Figure 6. Incremental effects of the corrected selectivity curve and growth function on the spawning biomass trajectory for cowcod, with comparison to the base model.

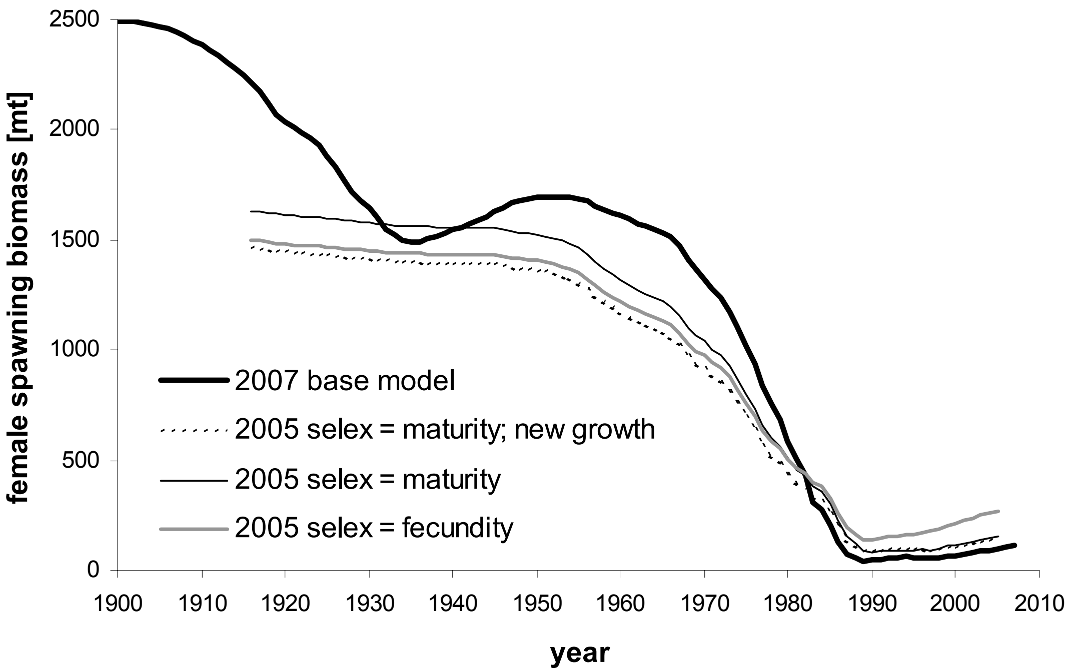


Figure 7. Total rockfish landings by area in California, 1916-1968. See text for definition of regions. Data from 1916-1927 are from CDF&G Fish Bulletin No. 105 (1958), and data after 1927 are from the NMFS SWFSC ERD Live-Access Server.

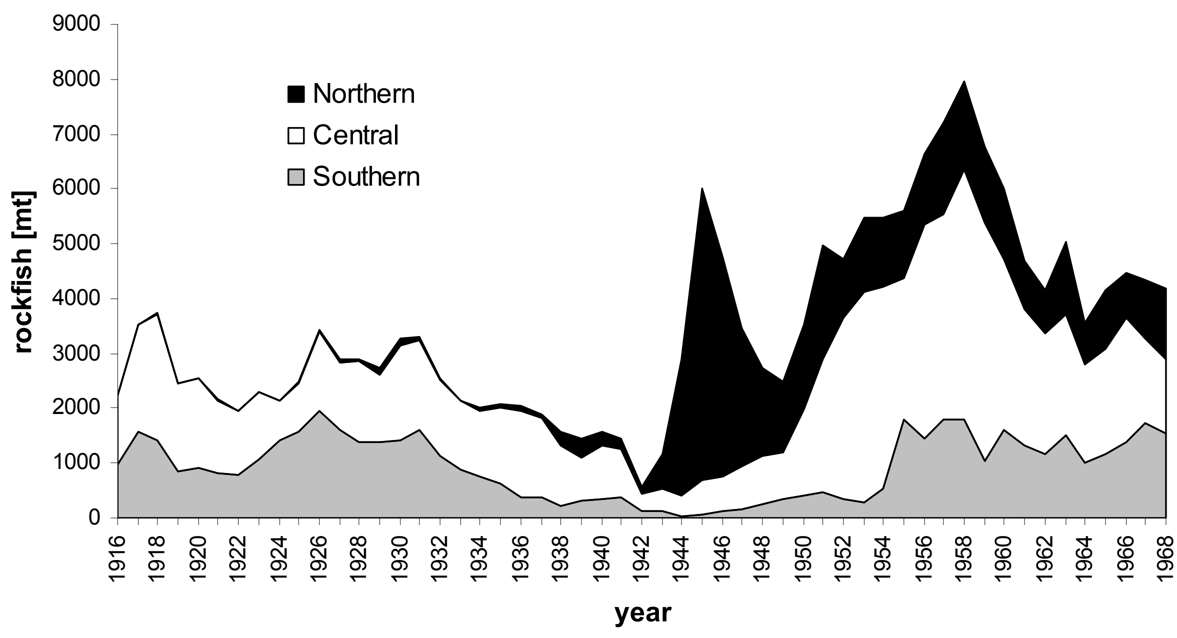


Figure 8. Total rockfish landings in Southern California, 1928-1968, from the ERD database. Landings include thornyheads (genus *Sebastolobus*) and exclude foreign catch. Increased catch in the Santa Barbara region (1954+) is largely due to landings at Morro Bay and Avila.

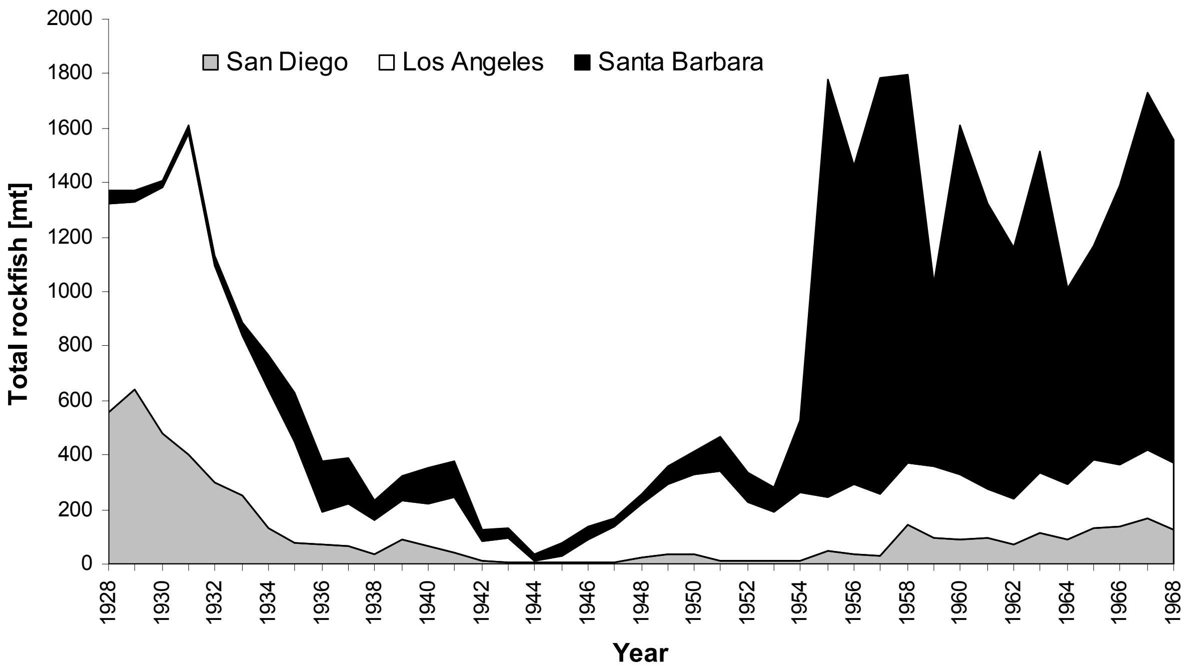


Figure 9. Total rockfish landings in Southern California by region, 1916-1968. Catch in the Santa Barbara region has been adjusted to exclude landings at Morro Bay and Avila (Table 2).

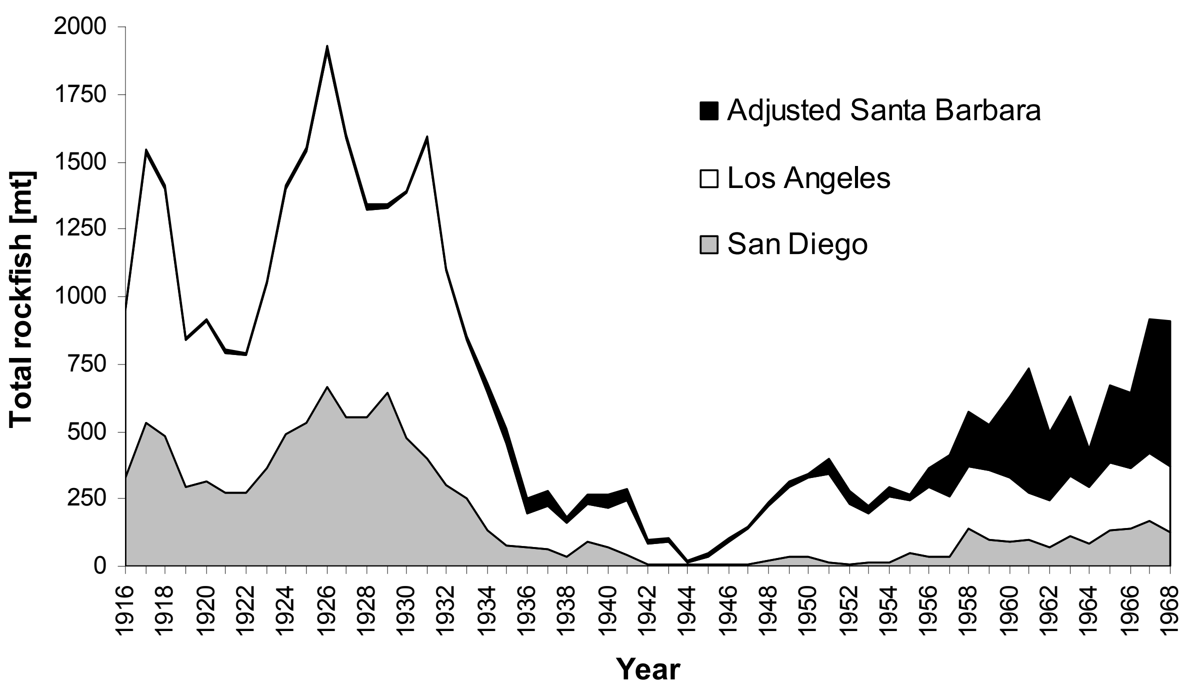


Figure 10. Percent cowcod in rockfish landings, 1984-2000, by year, port, and gear. Moving averages for the Santa Barbara hook & line fishery do not include data from 1988 (open circle).

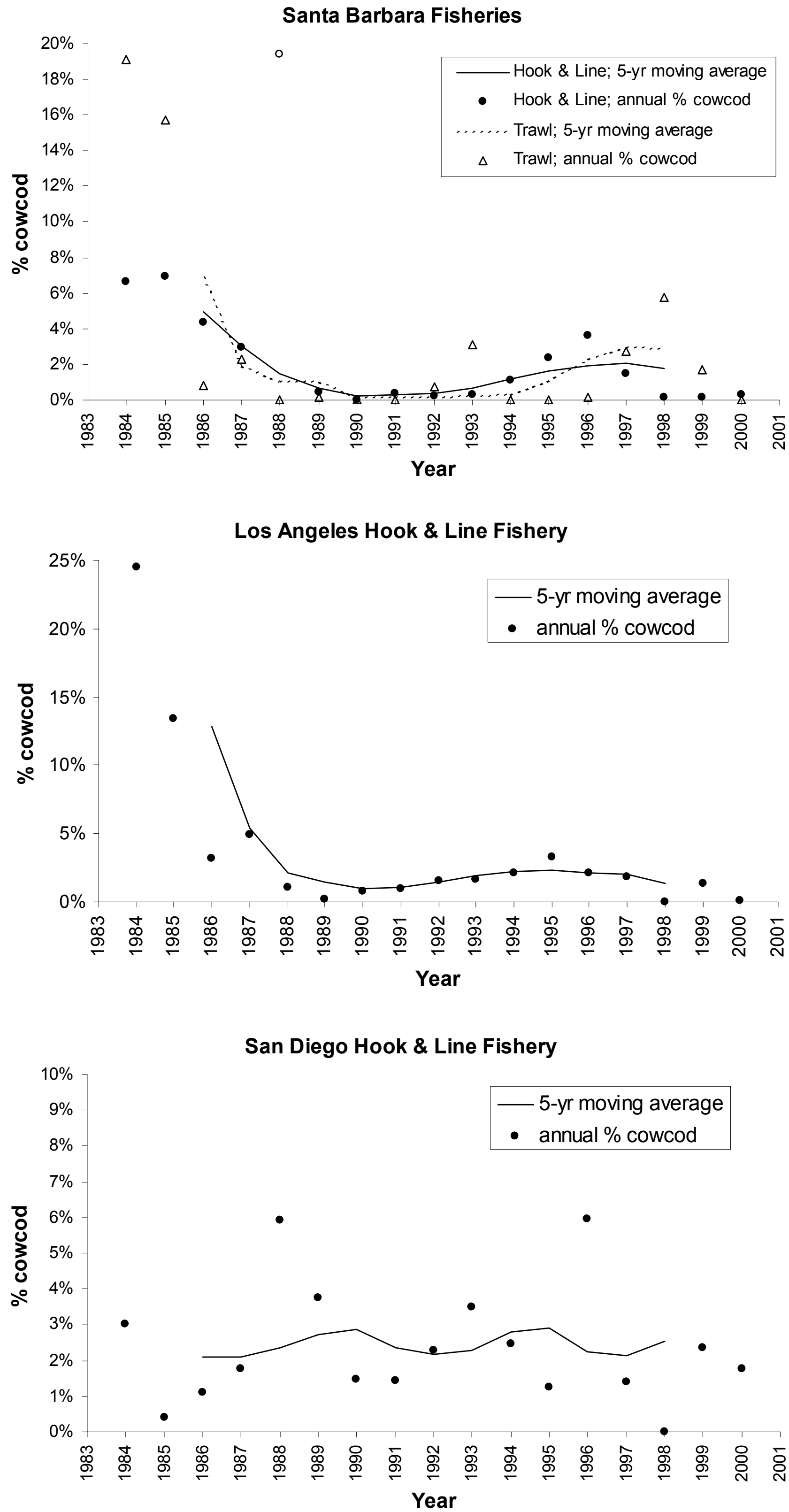


Figure 11. Southern California cowcod landings, 1969-2000, from CALCOM. The 2007 estimates reflect recovered port samples from the region (1983-1985) and the revised expansion procedure.

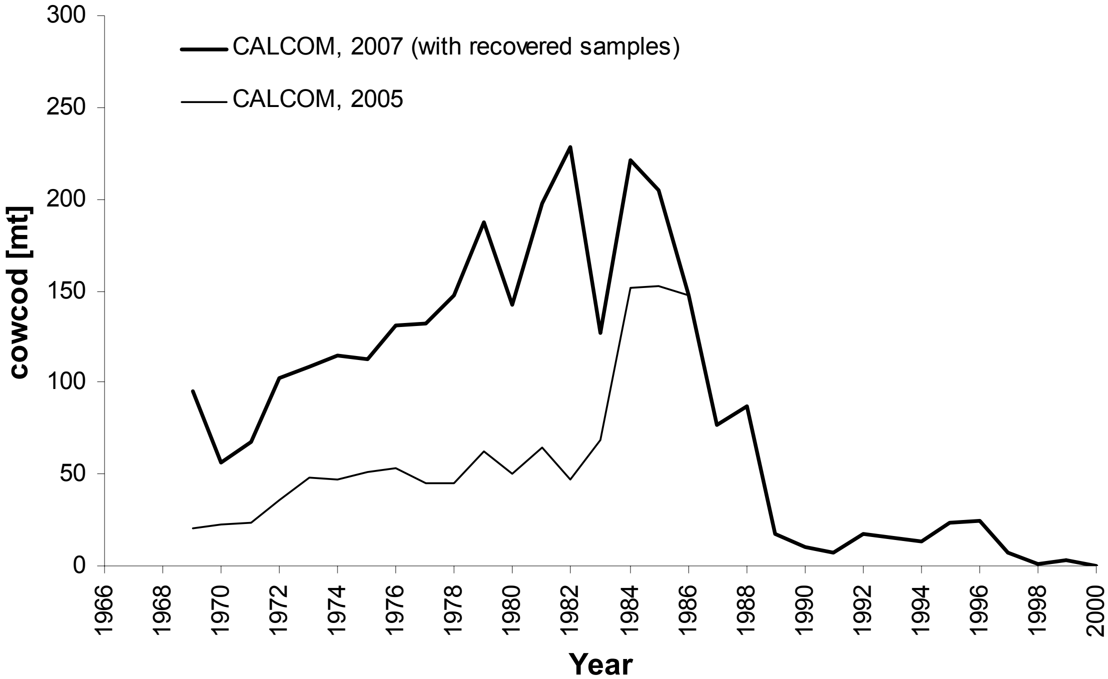


Figure 12. Commercial catches of cowcod by gear type (CALCOM, 2007). Gear groups are hook & line (HKL), trawl (TWL), net (NET), and other (OTH).

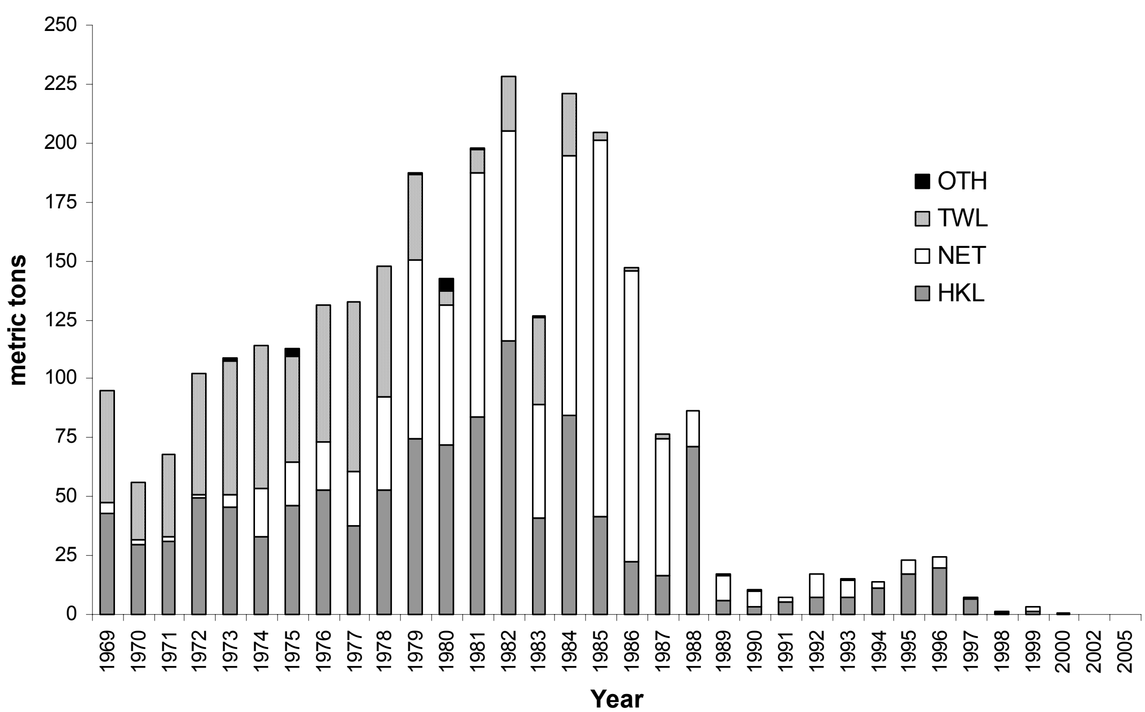


Figure 13. Length compositions by shift-year from CDFG onboard observer creel surveys

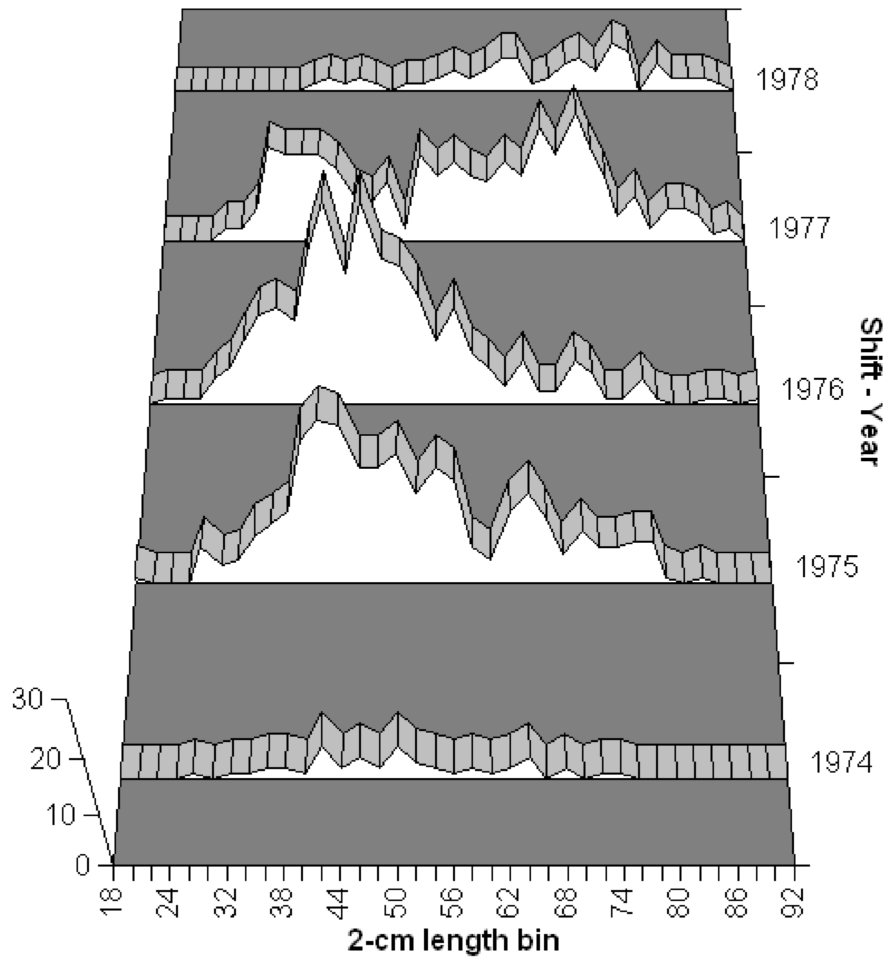


Figure 14. Locations of cowcod caught during 1970s CPFV observer study. Light grey = 1-9 cowcod, dark grey = 10 – 49 cowcod, black = 50+ cowcod.

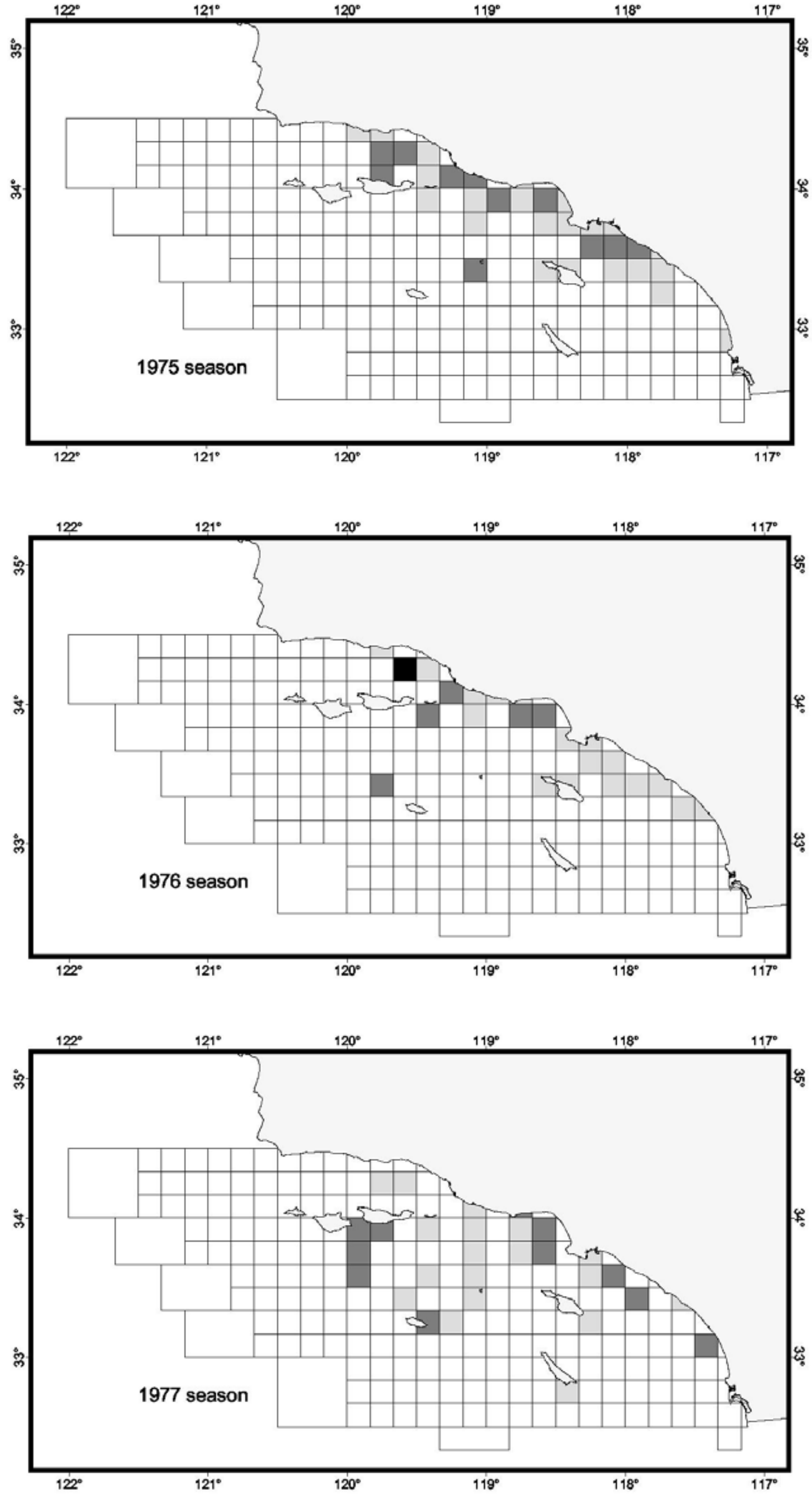


Figure 15. Length of cowcod versus depth fished from CPFV observer data from the SCB. Years are "shift-years" as described in text. The group of larger fish in 1977 was all caught in a single month and block.

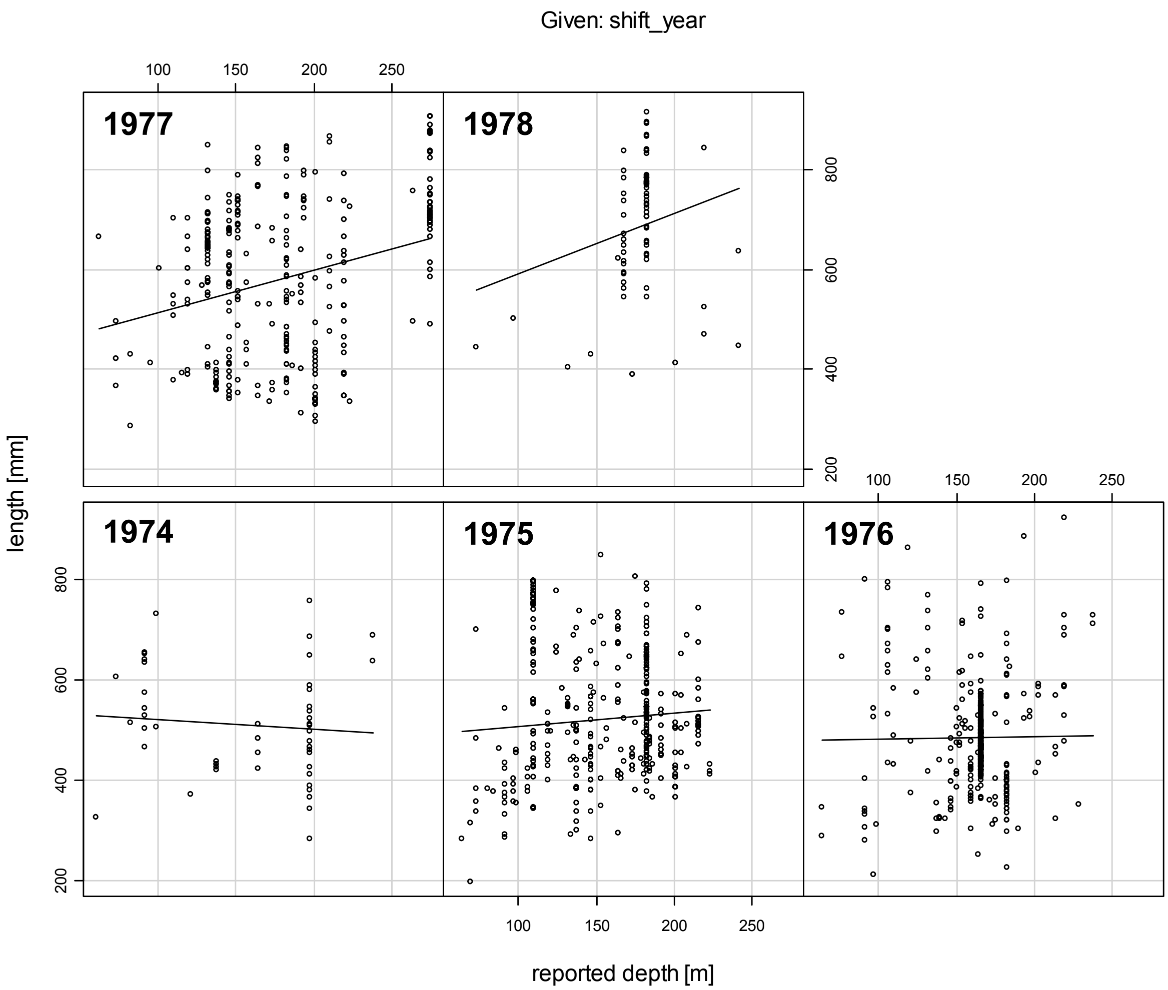


Figure 16: Distribution of effort recorded in CPFV logbook database. Effort is defined as the sum of angler hours between the months of Nov - Apr. for blocks in which 1+ cowcod were caught.

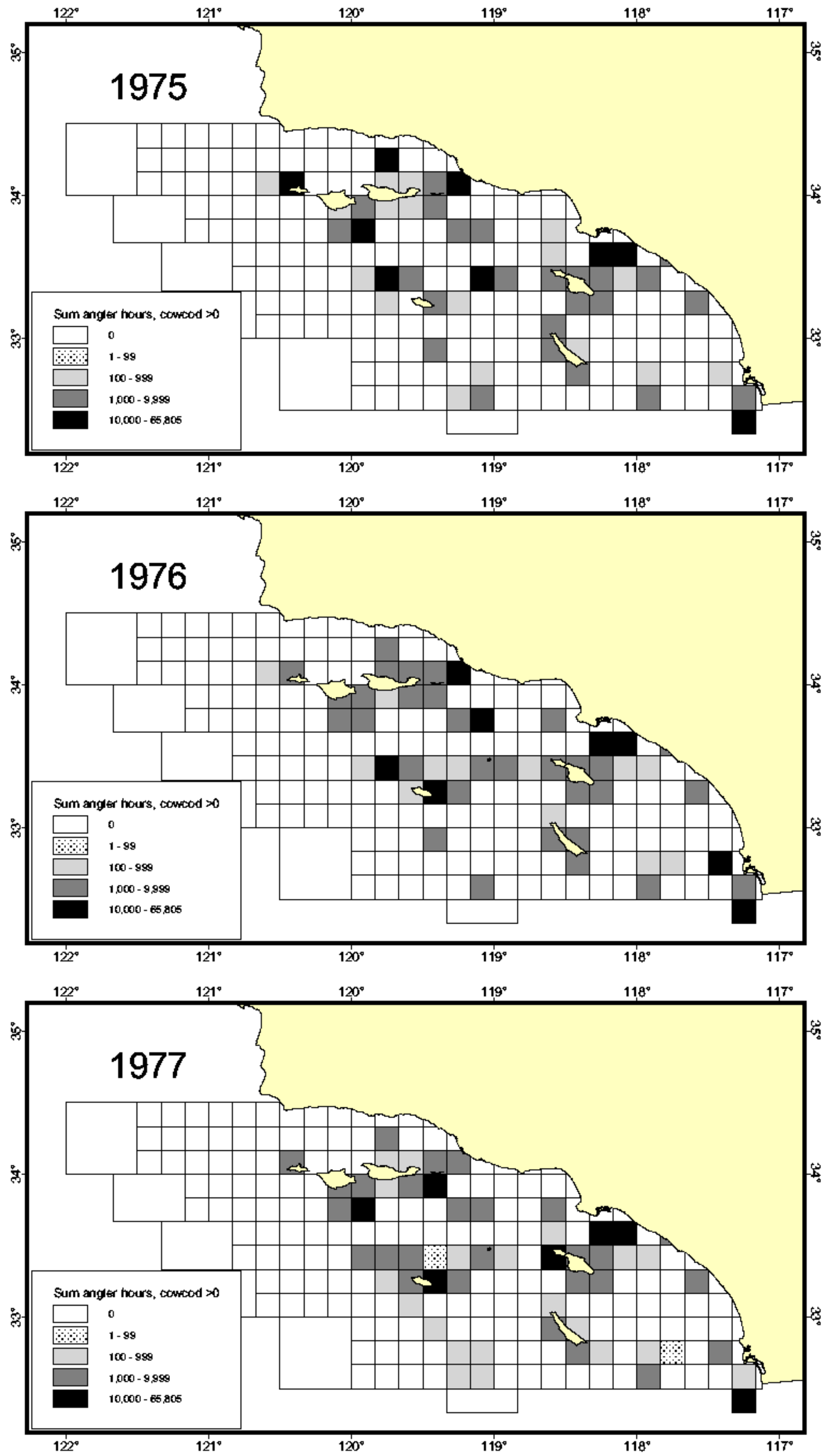


Figure 17: Comparison of selectivity curves; solid black line is curve fitted to 1970s CPFV observer data, broken line mirrors the female maturity schedule.

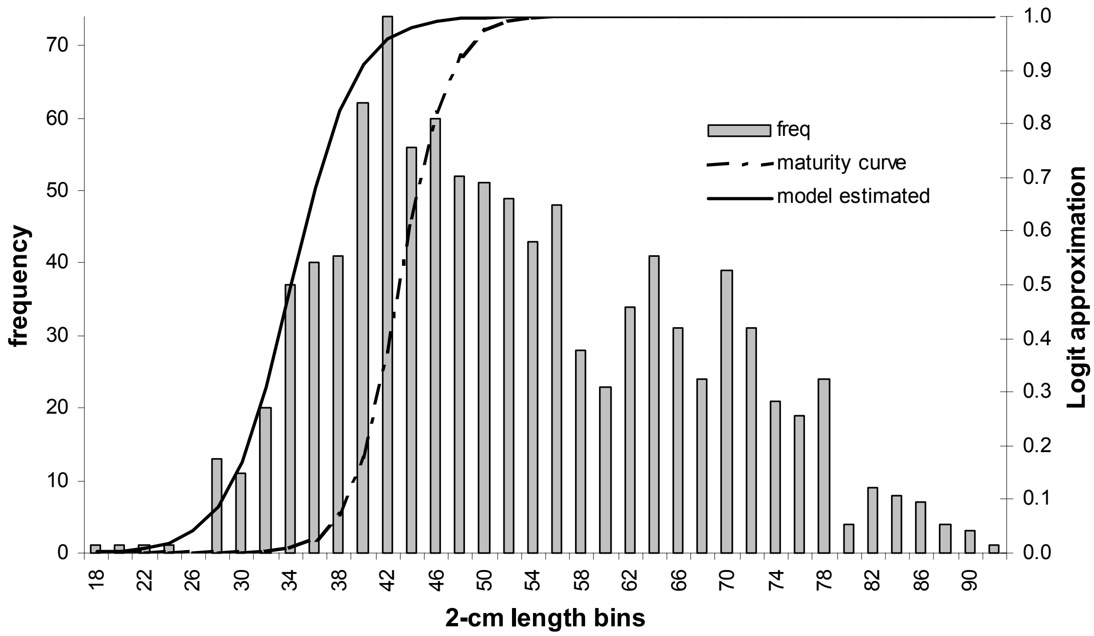


Figure 18: Cowcod length compositions from commercial fisheries, by gear group, in the SCB. TWL = trawl, HKL = hook and line.

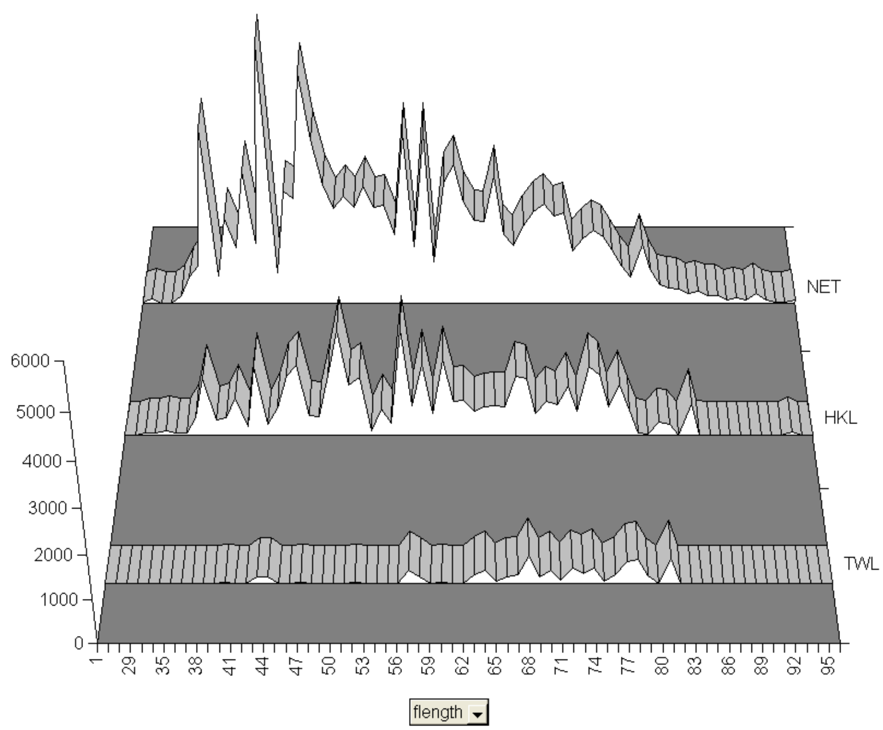


Figure 19: Cowcod length compositions from the commercial net fishery in the SCB.

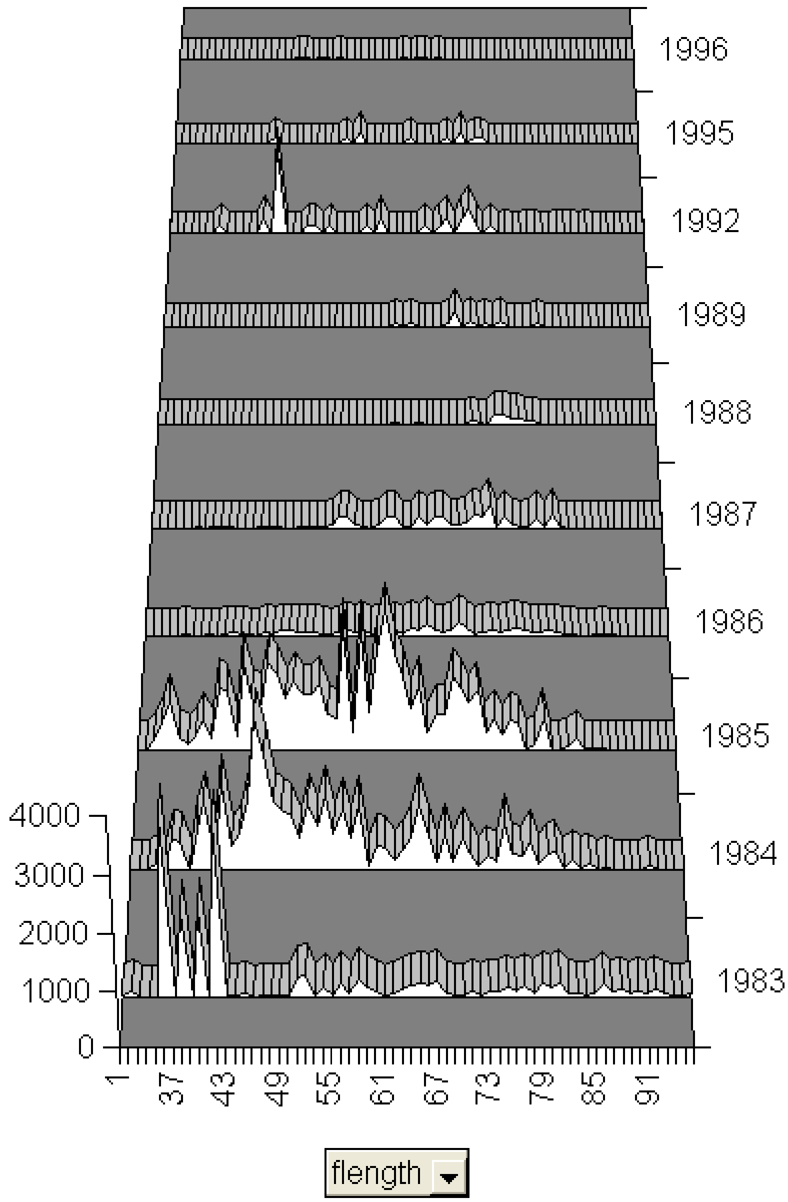


Figure 20. Final selectivity curves for the base model.

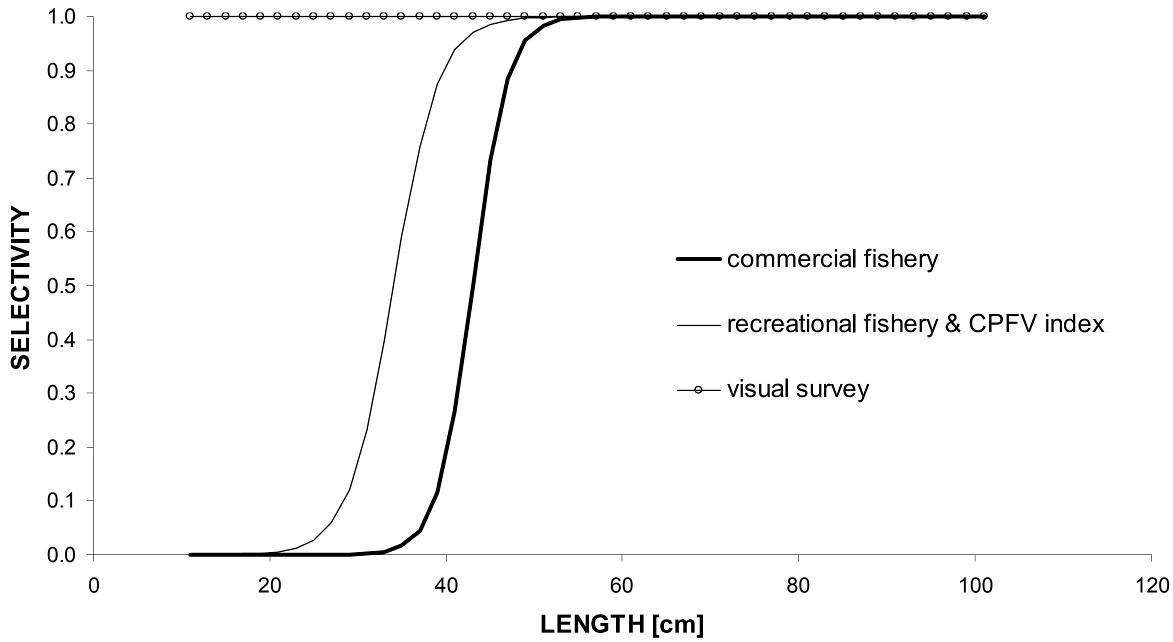


Figure 21: Spatial stratification of the 1999 CPFV logbook index (Butler et al., 1999).

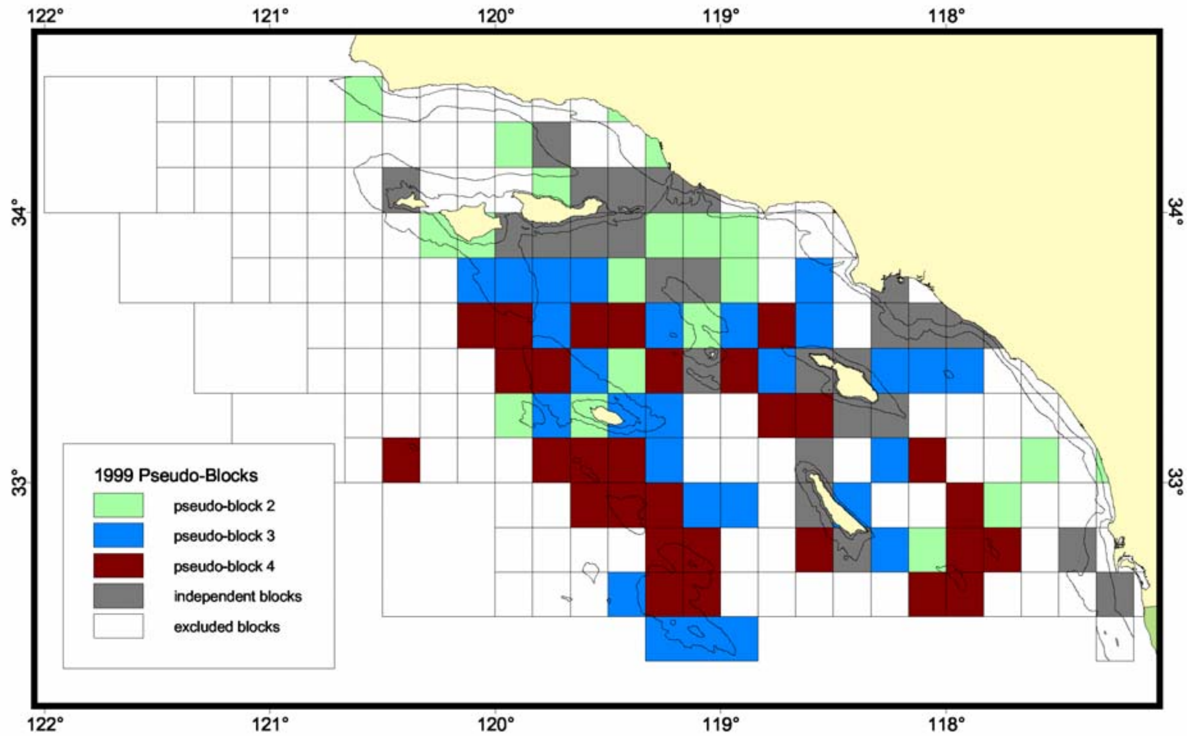


Figure 22: Spatial stratification of the 2005 CPFV logbook index (Piner et al., 2005).

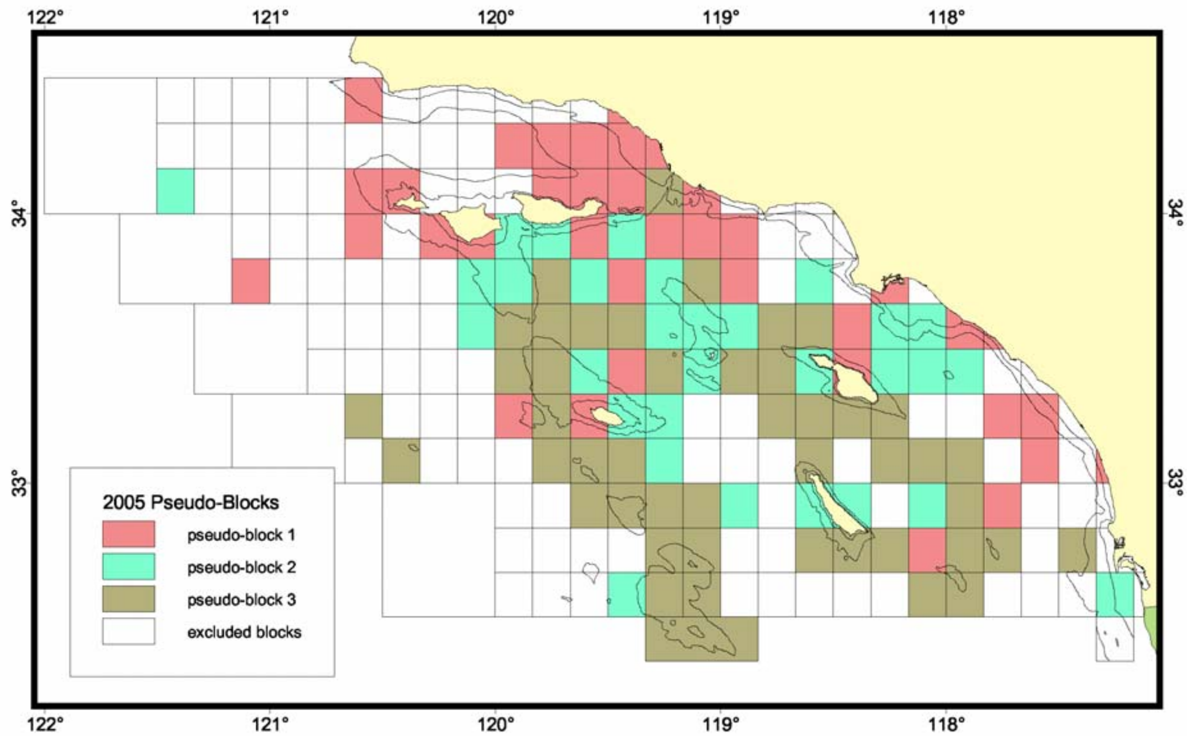


Figure 23: Spatial stratification of the CPFV logbook index in the 2007 assessment.

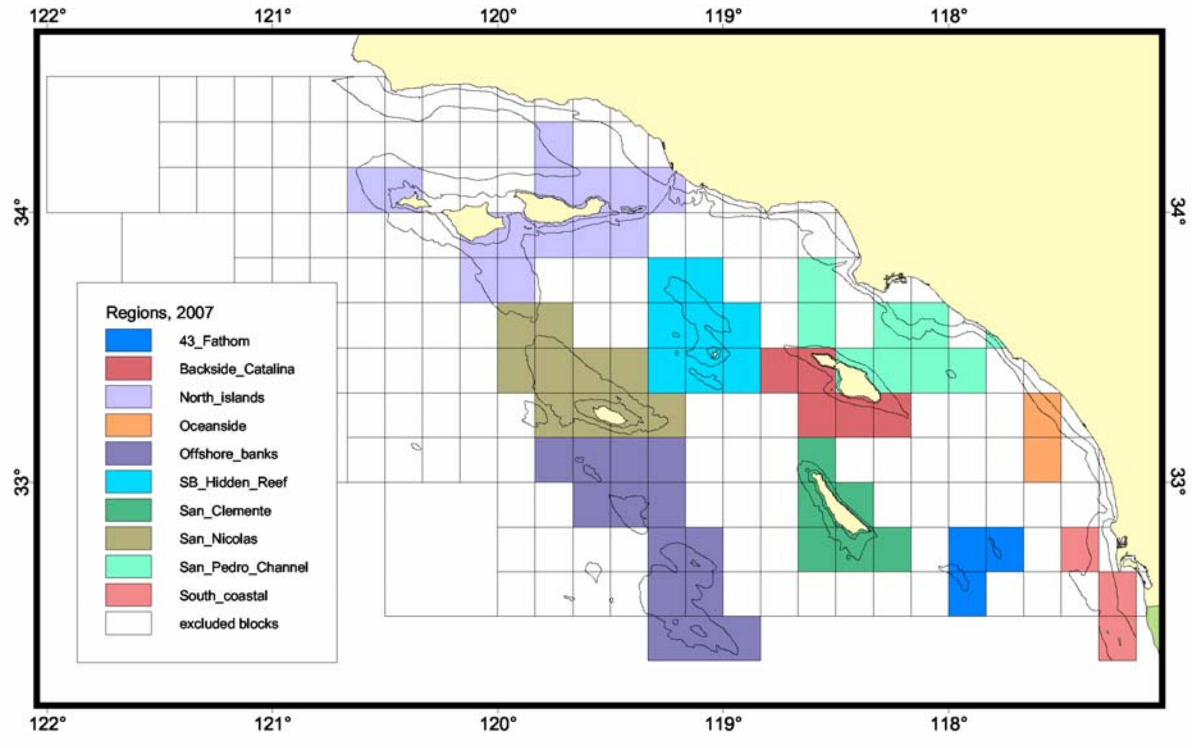


Figure 24: Changes in average cowcod CPUE by decade and region.

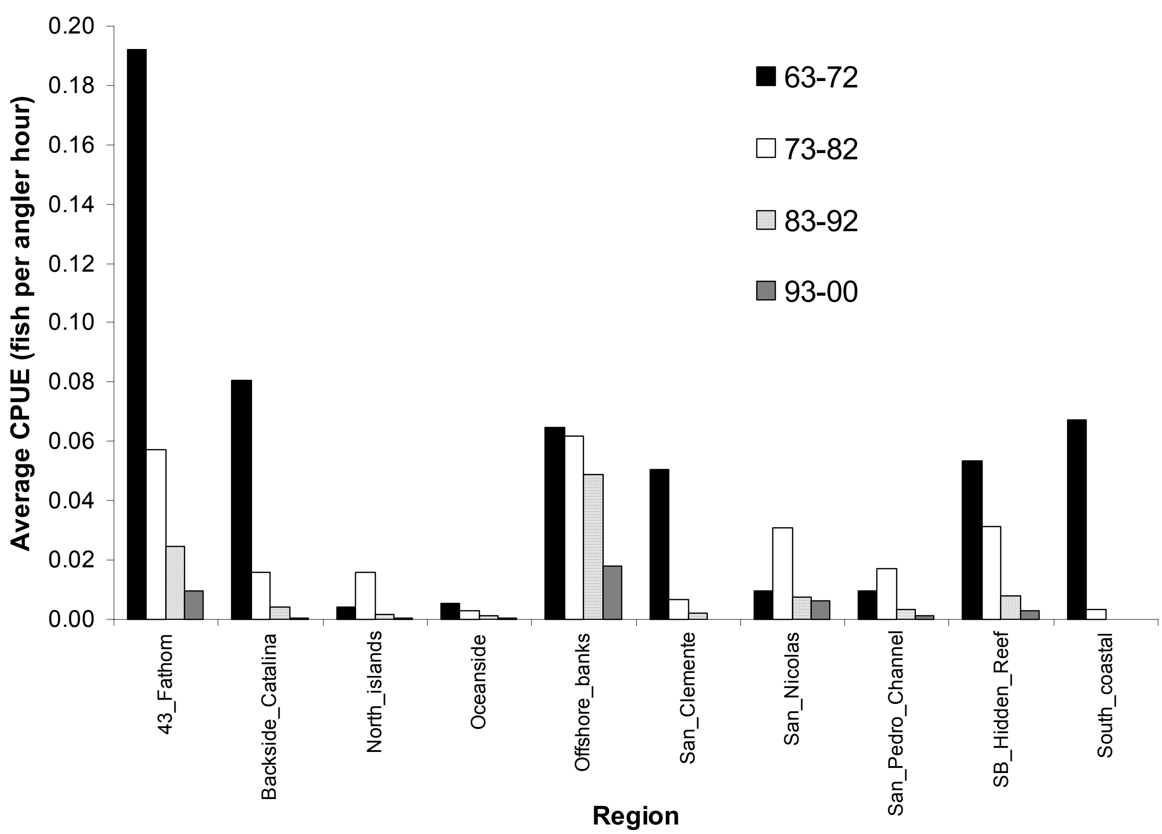


Figure 25: Comparison of CPFV logbook indices and unweighted CVs from the 2007 assessment to results from previous assessments. Note the log scale for indices. The axis for the CVs has been vertically extended to visually separate the two sets of data.

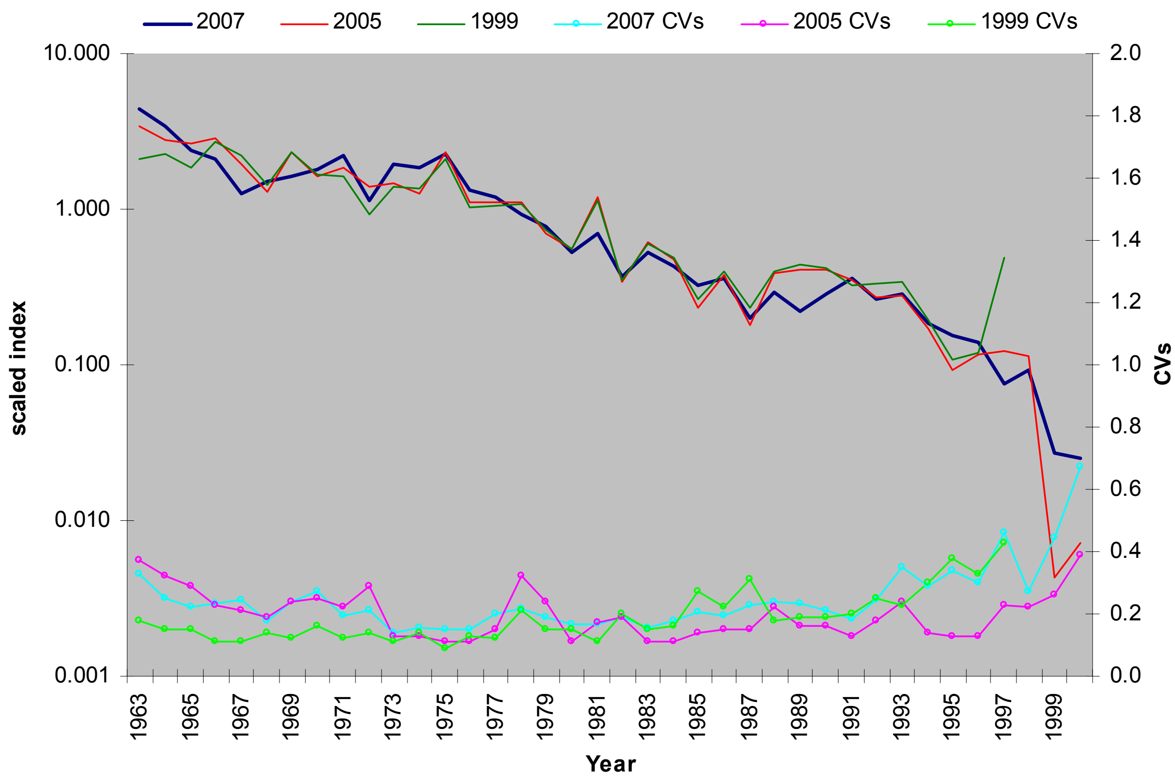


Figure 26: Base model fit to the revised CPFV logbook index, with tuned CVs.

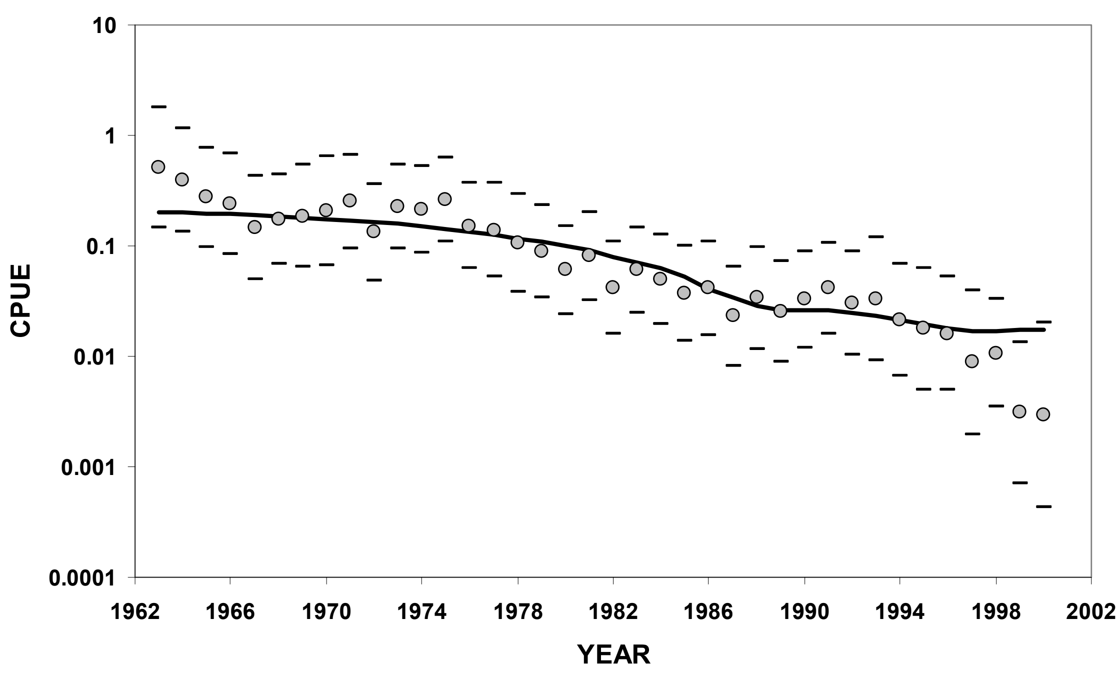


Figure 27: Effect of the corrected selectivity curve in the 2005 assessment on exploitation rates (catch divided by age 11+ biomass).

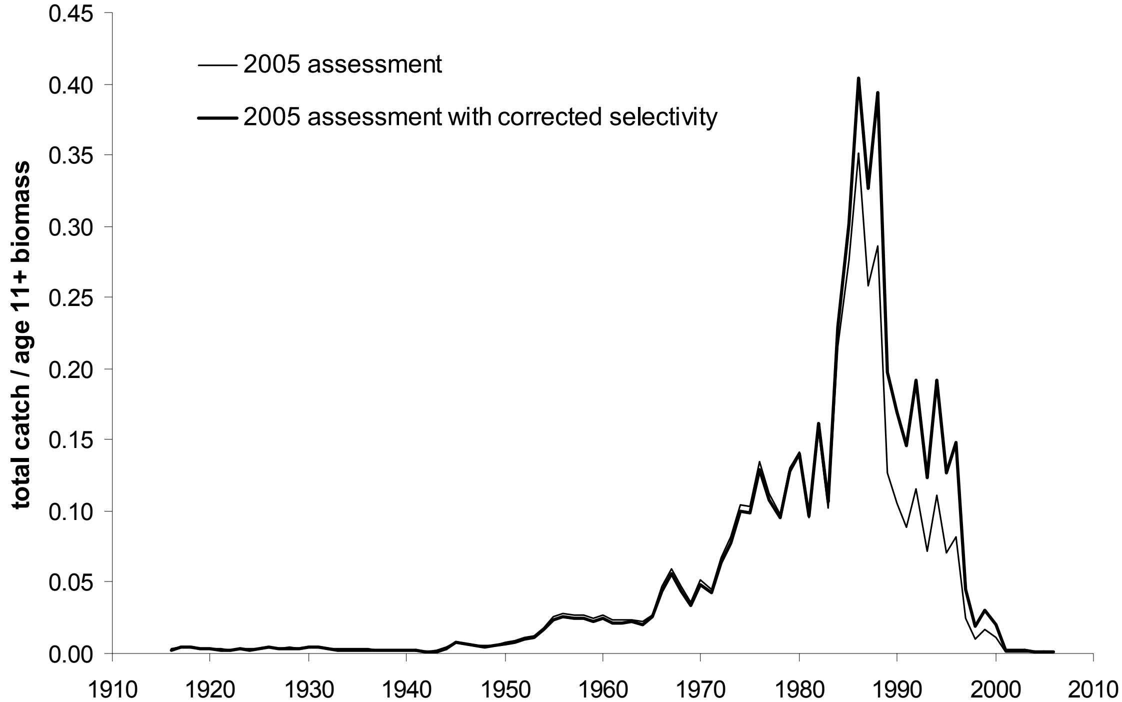


Figure 28: Exploitation rates based on alternative summary ages for the 2007 base model.

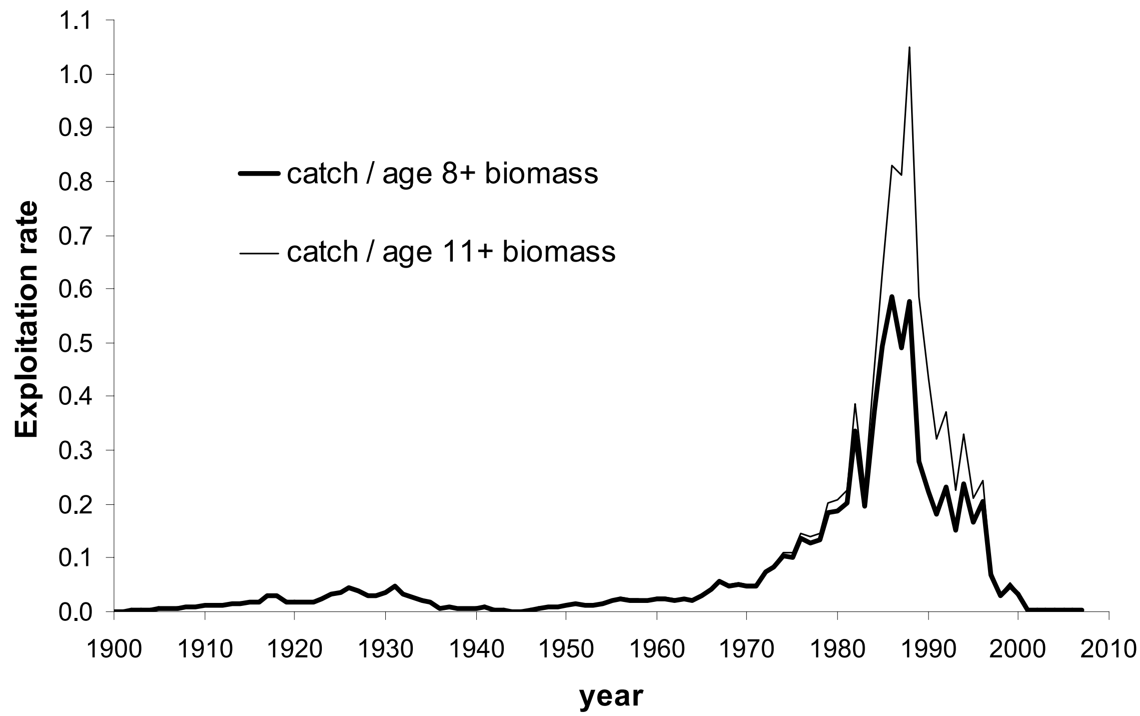


Figure 29: Time series of fishing intensity defined as 1 – SPR.

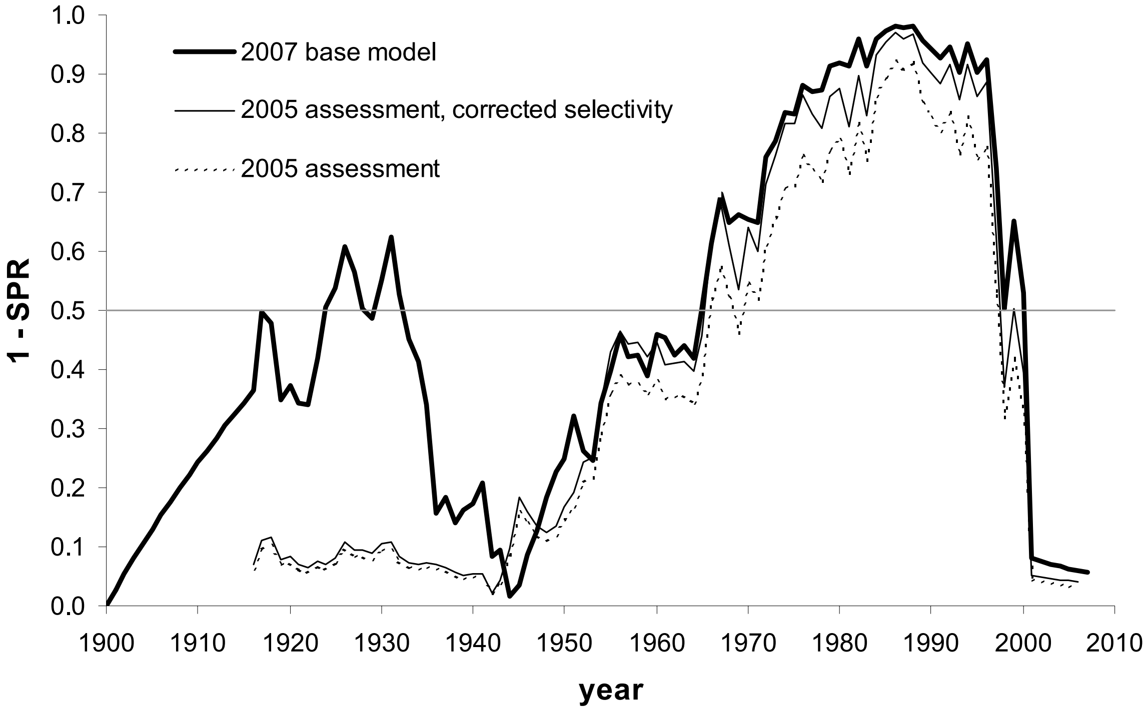


Figure 30: Rockfish landings in the southern California bight (1983 – 1985) by market category and method with which sample coverage was used to estimate the landings (CALCOM, 2007).

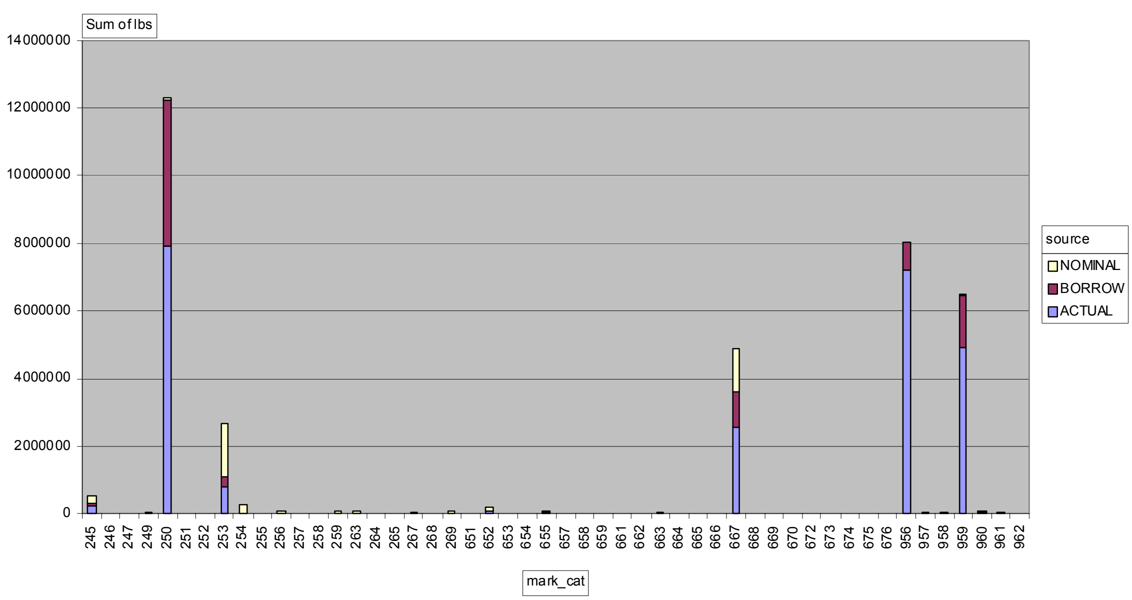


Figure 31: CPFV logbook indices, with and without log(rockfish catch) as a covariate.

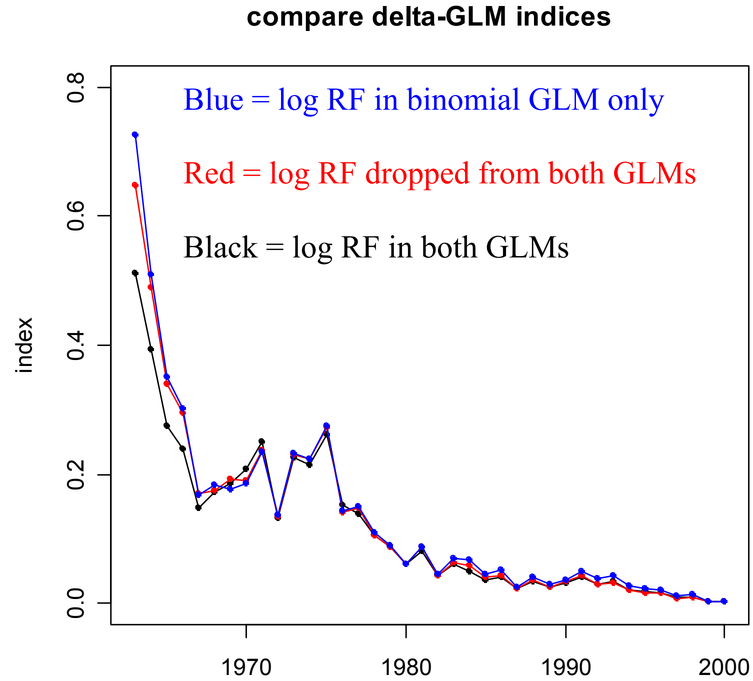
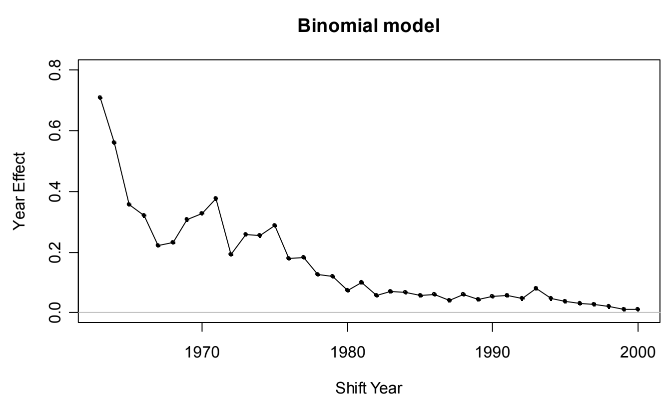


Figure 32: Components of the delta-GLM model from the revised CPFV logbook index.



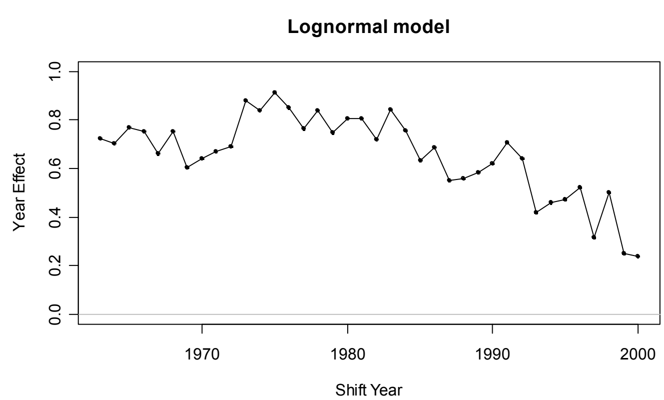


Figure 33: Natural log of CPUE (number of cowcod per angler hour) as a function of log(rockfish catch) with mean subtracted, by shift-year (aka "season") defined as the months of November – April. All regions are combined. Data for the 1963 season are in the lower left corner, and years increase from left to right, then upward by row.

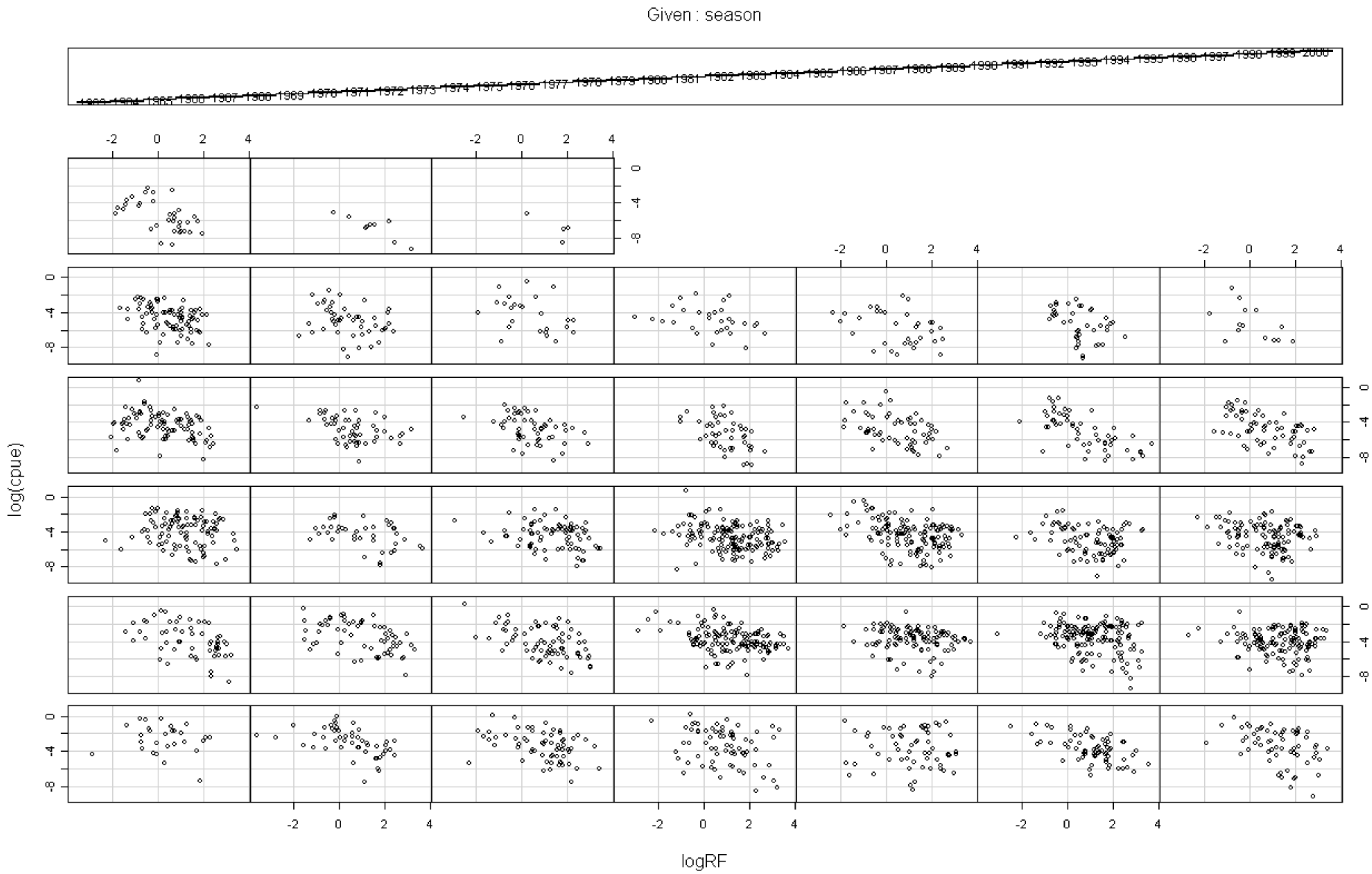


Figure 34: Natural log of CPUE (number of cowcod per angler hour) as a function of log(rockfish catch) with mean subtracted, shown by region (see Fig. 23) for all years. Data from 43-fathom bank are in the lower left corner, and regions progress as per the legend from left to right, and upward by row.

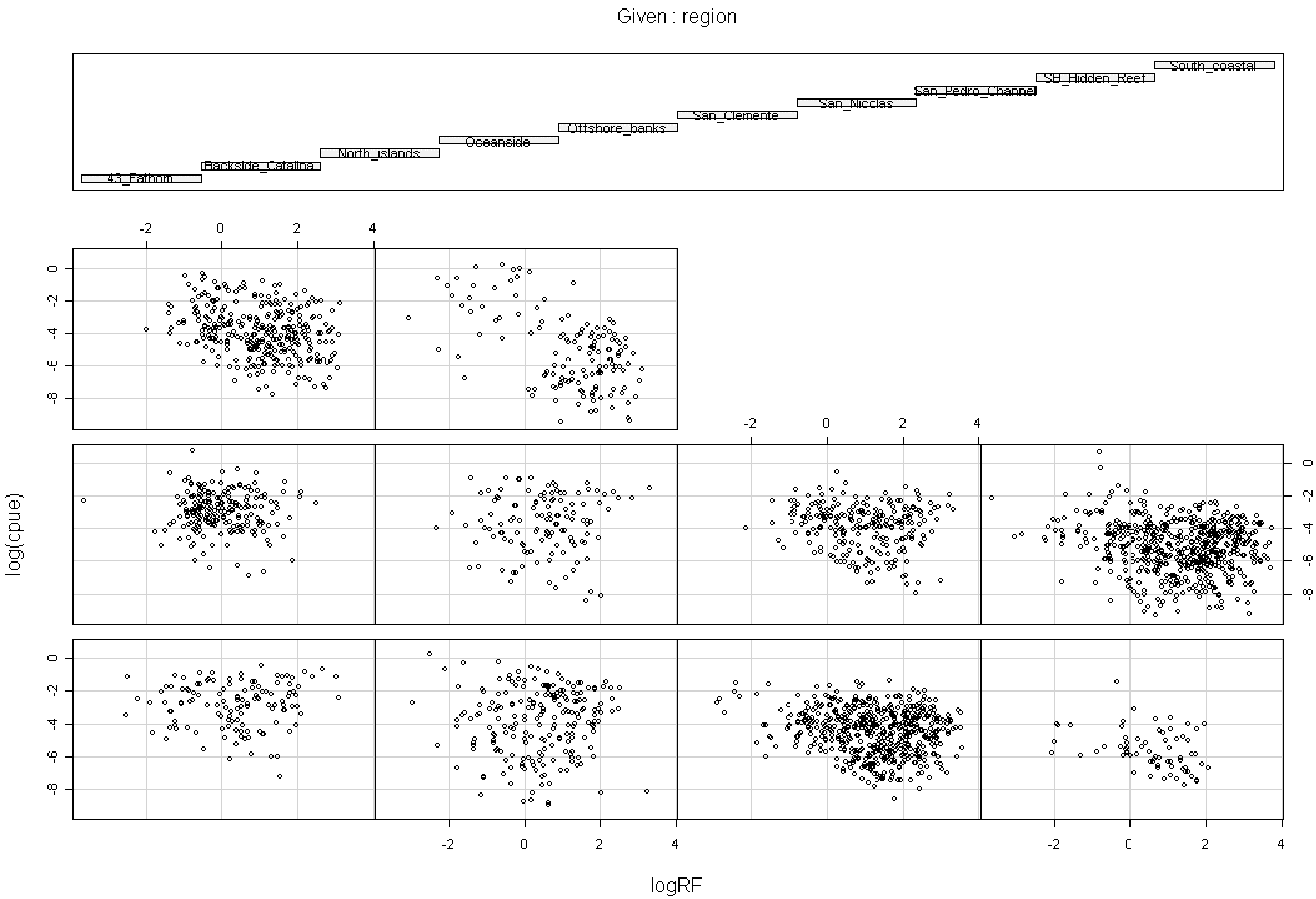


Figure 35: Standardized residual plots from the “BIC-best” Gaussian GLM for log(CPUE).

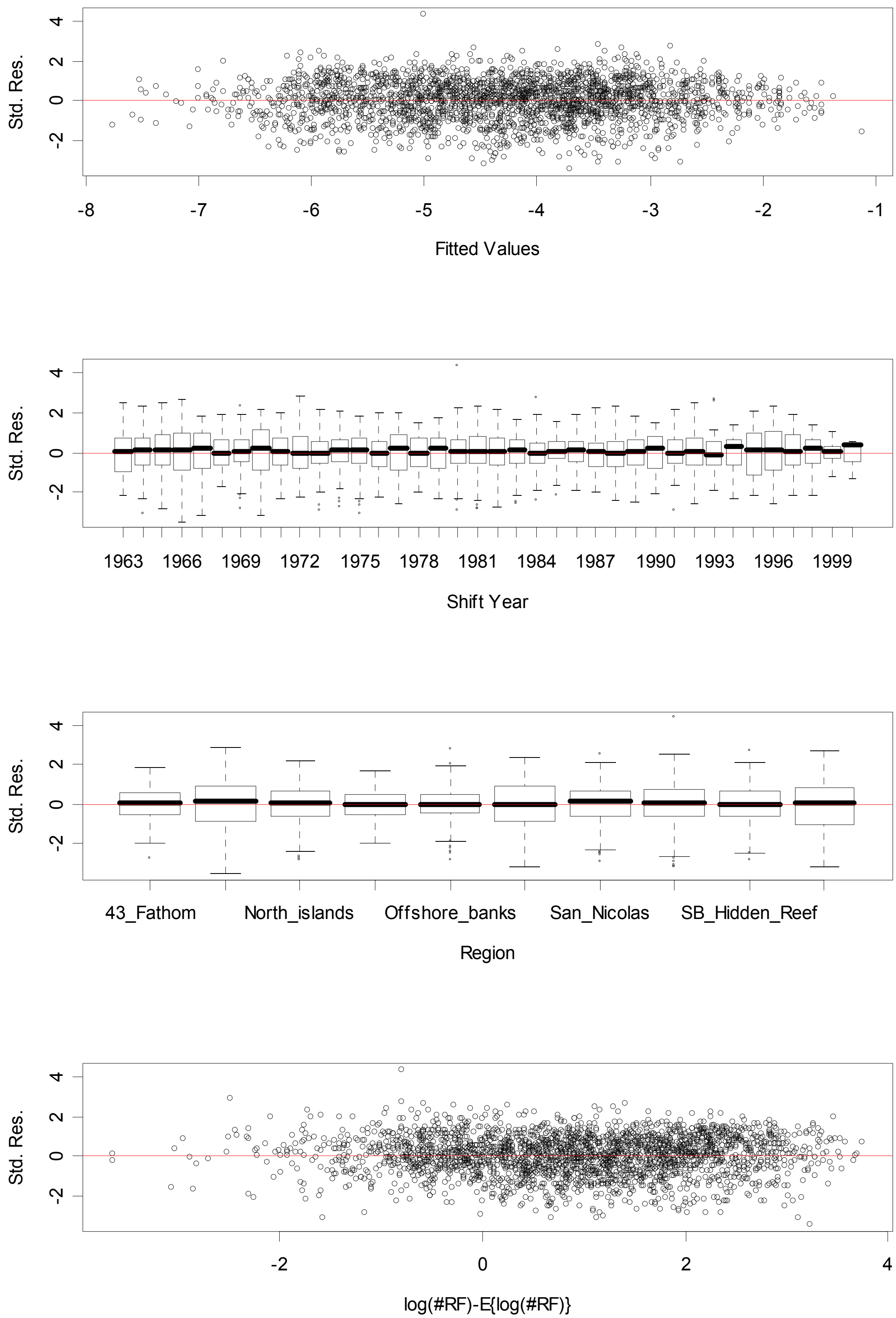


Figure 36: Time series of mean CPUE, by region, for the CPFV logbook data.

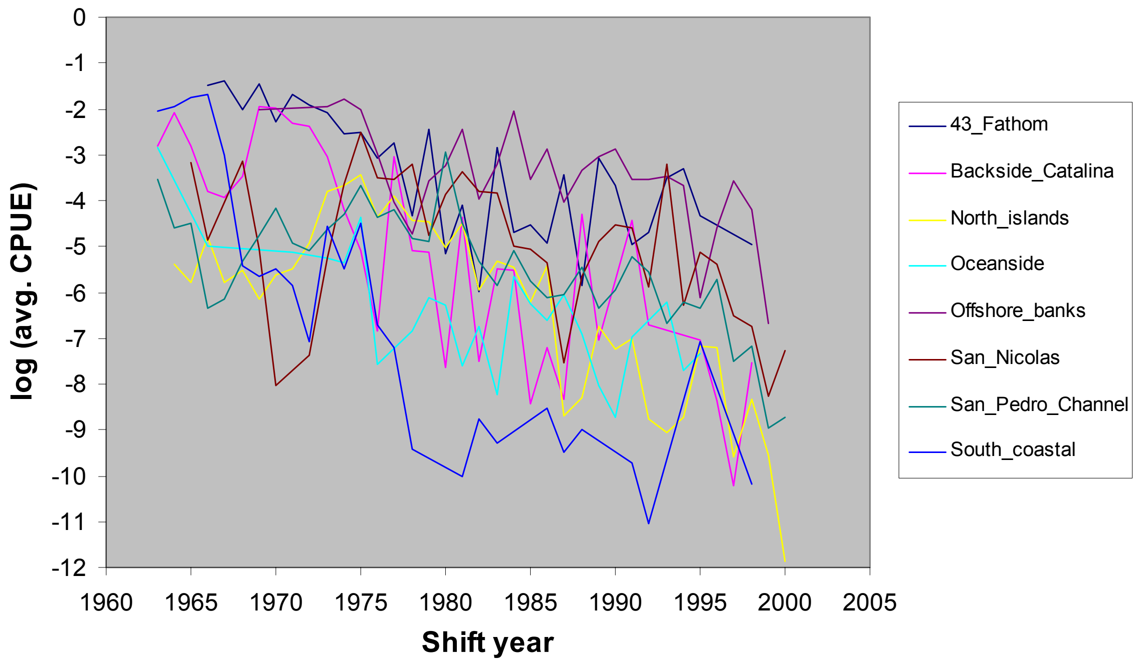


Figure 37: Length frequencies from the a) commercial net and b) hook-and-line fisheries.

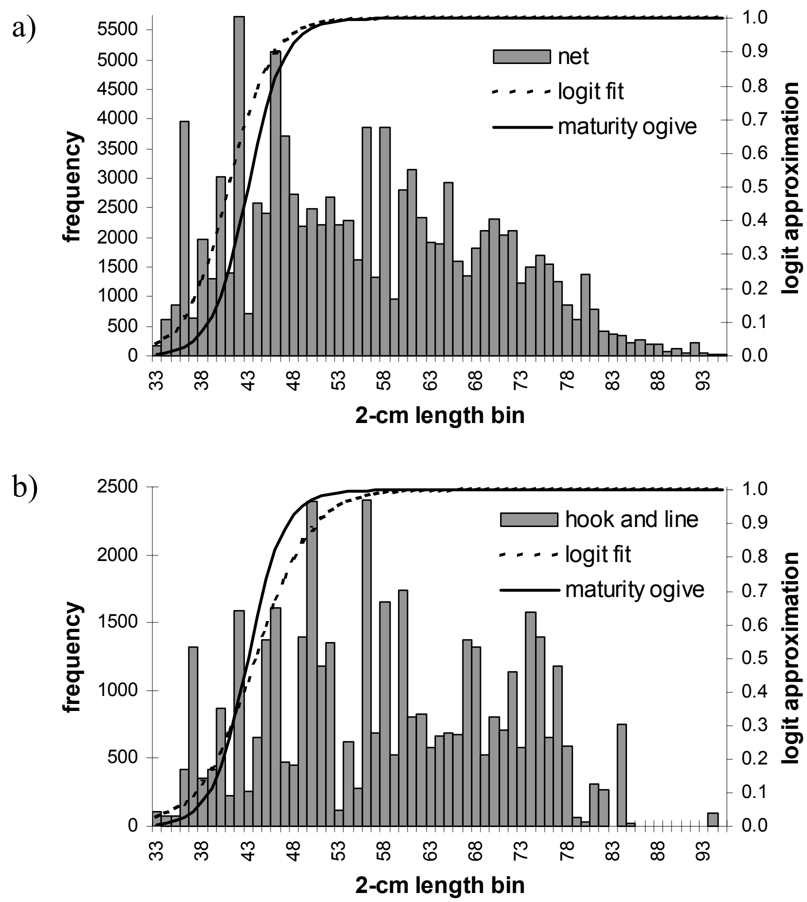
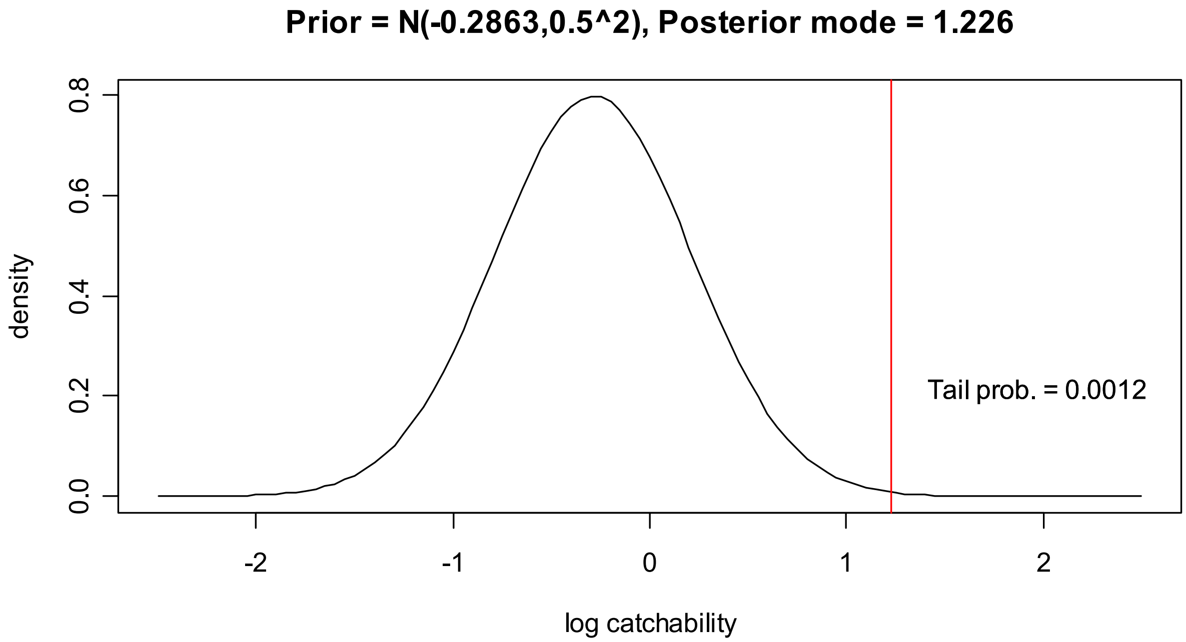


Figure 38: Comparison of the prior probability distribution for the logarithm of the visual survey catchability parameter to the posterior mode. See Appendix C for a comparison of the prior and MCMC draws from the marginal posterior distribution.



Appendix A

California Commercial Rockfish Landing Estimation Methods for 1969-1983

In September 2005, the California Cooperative Groundfish Survey (CCGS) incorporated newly acquired commercial landings statistics from 1969-77 into the CALCOM database. Species-specific rockfish landings were estimated using stratified species compositions gathered during the earliest years when port sampling was conducted. Stratification of CCGS port samples typically includes year, port, gear, quarter, and market category as classification variables. However, analysis of the data indicated that during the earlier period, when no port samples were available (1969-77), at least one market category had been redefined, resulting in serious errors in the landing estimates. In October 2006, the 1969-77 landings were re-estimated using a ratio estimator approach that dropped market category as a classification variable. In addition, since port samples for Los Angeles, Santa Barbara, and San Diego were not available until 1984, the landings for these three ports were re-estimated for 1978 through 1983 using the same approach. The ratio estimator was based on pooling the three earliest years in which port sampling was conducted, with stratification by port, gear, and quarter (i.e., market category was dropped). Species compositions that could be applied to the combined "rockfish" landings during the earlier time period were estimated as the sum of the landings for a species divided by the sum of the total rockfish landings by port, gear, and quarter. A brief explanation of the reasons for the re-estimation of early landings statistics is provided here.

When the yelloweye rockfish (*Sebastes ruberrimus*) stock assessment was being conducted in 2005 (Wallace et al. 2006), it was noticed that yelloweye landings between 1969 through 1977 were estimated to be unrealistically high. This initiated a careful examination of expansion procedures to determine the cause. The current approach to estimating rockfish landings in California relies on stratifying by year, port, gear, condition (live or dead), market category, and quarter. Market category usage has been highly dynamic over time (Figure A1). Note, for example, that there are currently over 50 defined market categories, whereas during the 1970s there were less than 20 categories in use. This highlights why market category is an essential stratum for catch expansions. However, its use depends on the assumption that market category definitions are stable, especially when they are applied over an extended time period. While new market categories can be added, it is important that the definition of existing market categories must not change within an expansion time interval; if they do, landing estimates can be strongly affected. This is what occurred in the early 1980's with market category 265 (currently defined as nominal "yelloweye rockfish").

In the 1970's, a large fraction of the rockfish was landed in market category 265 (up to 18% of the landings) (see Figure A2). Because not all strata (=years) had been sampled, species compositions gathered later in the time series were applied to these earlier landings: this was a mistake. As can be seen in Figure A2, the fraction of rockfish landed in market category 265 declines to nearly zero in 1982 and remains very small thereafter.

In Figure A3, the species compositions using samples from market category 265 before 1982 (n=26) are compared to compositions taken from 1991-1993 (n=31). Less than 2% of market category 265 was actually *Sebastes ruberrimus* prior to 1982, while more than 98% was later on. Furthermore, market category 265 nearly disappears after 1982 and market category 959 (defined as "group red"), starts to show up in 1983 (Figure A2). Examination of the species composition of market category 959 after 1982 indicates that many of the species previously landed in market category 265 were landed in market category 959. Taken altogether we feel that this indicates that market category 265 was redefined in 1982.

The next question that needs to be asked is what market category was used to land yelloweye rockfish if market category 265 was not being used. In Figure A4, it can be seen that the majority of *S. ruberrimus* have been landed in the well-sampled market category 250 ("unspecified rockfish"). Large landings are also made in market category 959 after 1982. Figure A4 is based on actual samples and does not represent all estimated landings, but it is clear that market category 265 does not account for the preponderance of landings.

Given that yelloweye rockfish sorting practices in commercial markets have changed markedly, it is not surprising that landings estimates of other species have been altered as well. This is because the total catch of all *Sebastes* spp. must still sum to the reported "rockfish" catch. Since estimates of yelloweye rockfish catch in the 1970s were reduced, catch estimates for other taxa were increased.

Currently the CCGS is preparing a written report on the reliability of landing estimates for all groundfish in the database, with a final version due by the end of 2007. Nonetheless, current landing estimates in CALCOM are now deemed to be the best available data by the State of California. The report that is in preparation will provide guidance to authors on how reliable the estimates are for any given species.

Wallace, F., T. Tsou, T. Jagielo, and Y. W. Cheng. 2006. Status of yelloweye rockfish off the U.S. west coast in 2006. In: Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, 2130 SW Fifth Ave., Suite 224, Portland, OR, 97210.

Fig A1: Rockfish Landings and Number of Market Categories

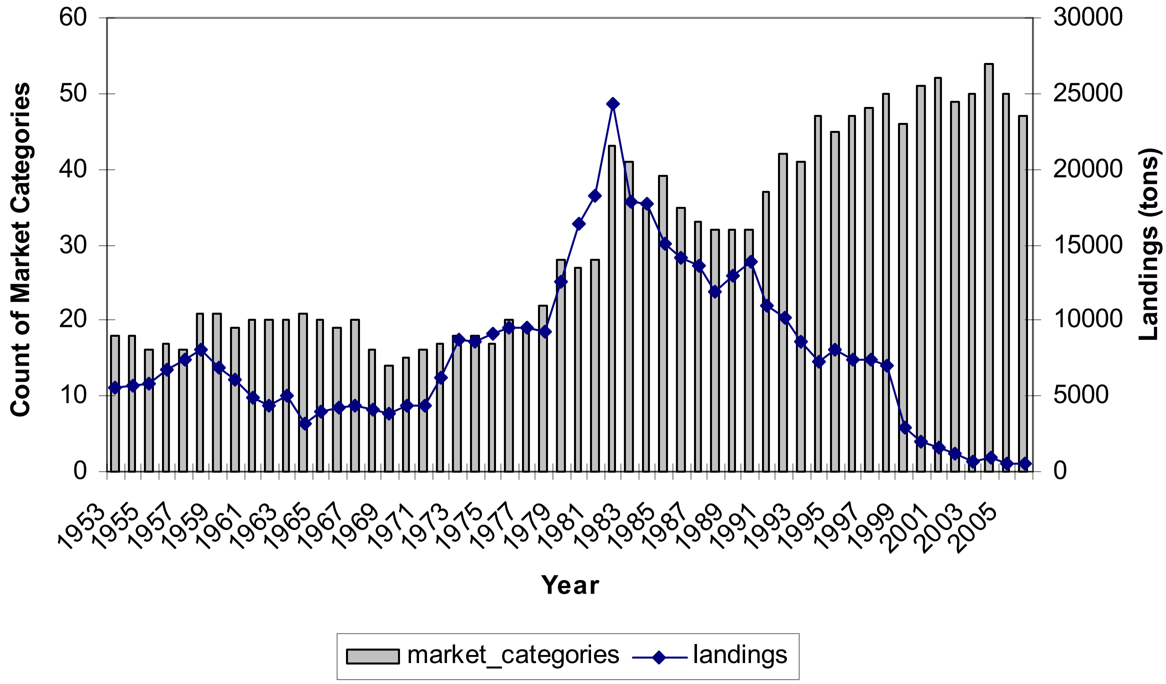


Fig. A2: Percent of Rockfish Landings By Selected Market Cateories

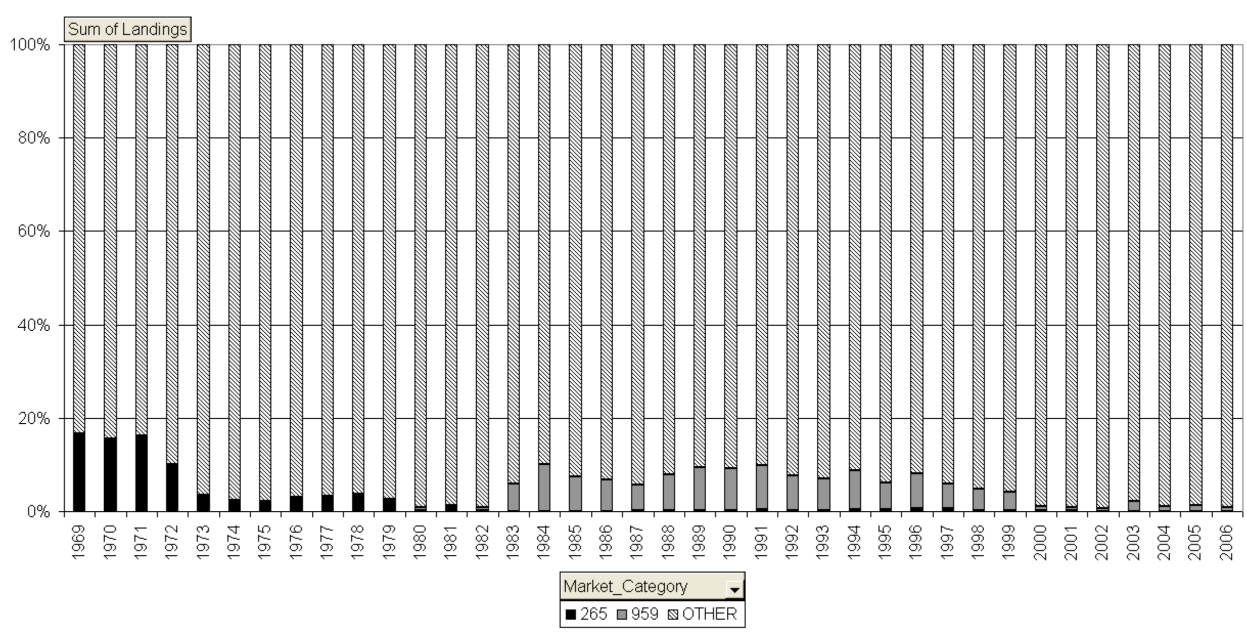


Fig. A3: Market Category 265 Species Composition

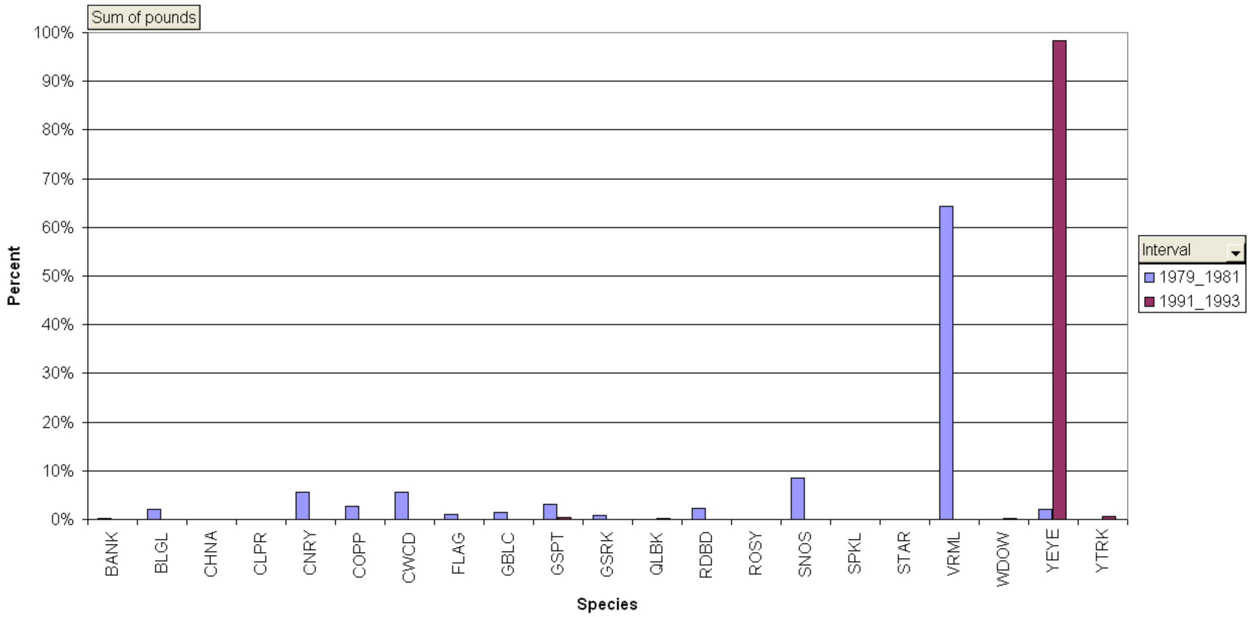
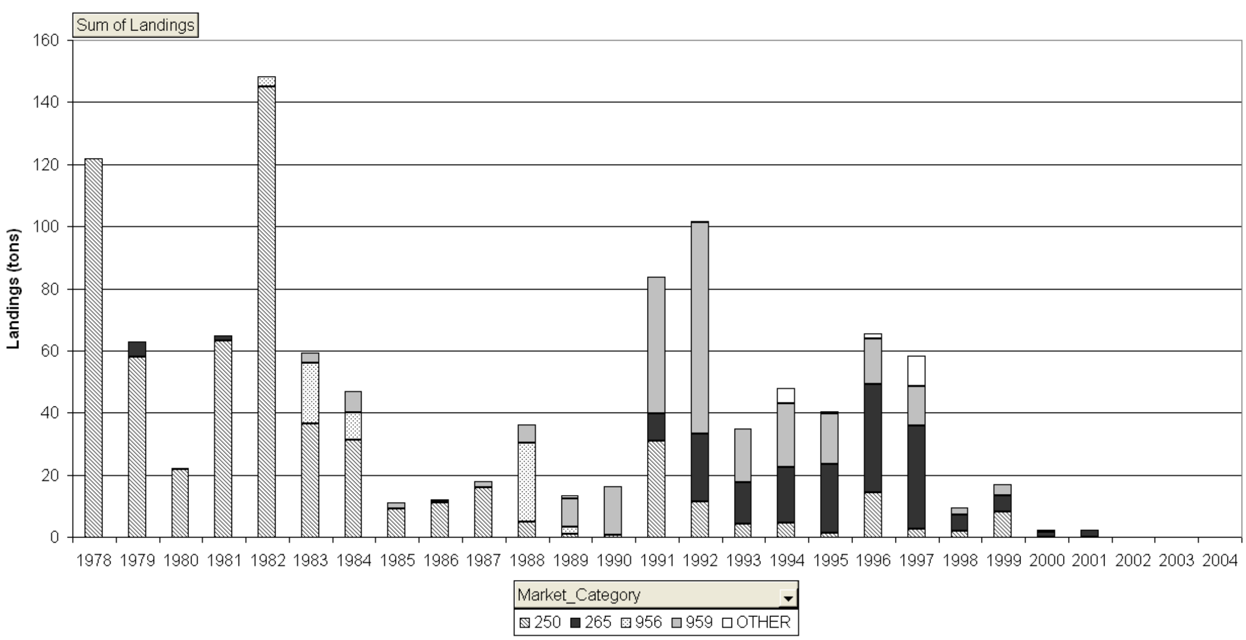


Fig. A4: Actual Yelloweye Landings By Market Category



Appendix B: Stock Synthesis 2 files for base model

```
##
##  SS2 Version 2.00c
##
##  Data & Control Files
moo3_base.dat
moo3_base.ctl
##
0       # Read PAR File (0 = No, 1 = Yes)
1       # Verbosity Flag
1       # Write Report File
0       # Number of Bootstrap Files
4       # Last Phase
Code_version_:_        # Code Version Label
1       # Burn In MCMC
1       # Thinning MCMC
0.0     # Jitter Value
0.01    # Push Value
-1      # Min Year SP_BIO
-1      # Max Year SP_BIO
1.0e-6  # Convergence Criteria
0       # Retrospective Year
1       # Keep Catches; set to 0 when calc'ing dynamic B0
0.2     # Ball Park F
1990    # Ball Park Year
1       # Pope's Approximation
1       # Summary Age
1       # Forecast Option # 0 = no forecast; 1 = use target F
1       # MSY Option; 1 = set F(msy) = F(spr)
0       # West Coast Groundfish Rebuilder Program Option
-1      # Start Year Rebuilder
-1      # End Year Rebuilder

# control file for 2007 cowcod assessment
# Stock Synthesis 2, version 2.00c
# E.J. Dick, NMFS SWFSC Santa Cruz Lab
# July 2007

1       #_N_Growth_Patterns
1       #_N_submorphs
1       #_N_areas
1 1 1 1 #_area_assignments_for_each_fishery_and_survey

1       #_recruit_design_(G_Pattern_x_birthseas_x_area)_X_(0/1_flag)
0       #_recr_distr_interaction
0       #_Do_migration
0 0 0   #_movement_pattern_(for_each_season_x_source_x_destination)_input_(0/1_flag)_minage_maxage

0       #_Nblock_Designs
```

```
0.5     #_fracfemale
1000    #_submorph_between/within
1       #vector_submorphdist_(-1_first_val_for_normal_approx)
1       #_natM_amin
2       #_natM_amax

2       #_Growth_Age-at-L1 (Amin)
37      #_Growth_Age-at-L2 (Amax)
0       #_SD_add_to_LAA (set equal to 0.1 to mimic SS2 v1.xx)
0       #_CV_Growth_Pattern (0 = CV(LAA))

1       #_maturity_option; 1 = length logistic
1       #_First_Mature_Age that can spawn, as per specified maturity ogive
3       #_parameter_offset_approach; 3 = offsets same as SS2 v1.xx
1       #_env/block/dev_adjust_method(1/2)
-1      #_MGparm_Dev_Phase

# mortality & growth_parms
# LO    HI      INIT    PRIOR   PR_type SD              PHASE
0.01    0.1     0.055   0.055   0       0.007653        -1      0 0 0 0 0.5 0 0         # natural mortality young
0       0       0       0       0       0.007653        -1      0 0 0 0 0.5 0 0         # natural mortality old (offset)
10      20      16.2    16.2    0       10              -1      0 0 0 0 0.5 0 0         # length at Amin
70      80      75.6    75.6    0       0.8             -1      0 0 0 0 0.5 0 0         # length at Amax
0.01    0.25    0.052   0.052   0       0.8             -1      0 0 0 0 0.5 0 0         # k, von Bertalanffy growth coef.
0.01    0.5     0.265   0.265   0       99              -1      0 0 0 0 0.5 0 0         # CV young
0       1       -1.781  -1.781  0       0.8             -1      0 0 0 0 0.5 0 0         # CV old (exp. offset)

#_wt-len, maturity, and [eggs/kg]=a+b*weight
-3      3       1.01e-5 1.01e-5 0       0.8     -1      0 0 0 0 0.5 0 0
-3      3       3.093   3.093   0       0.8     -1      0 0 0 0 0.5 0 0
-3      3       43      43      0       0.8     -1      0 0 0 0 0.5 0 0
-3      3       -0.5106 -0.5106 0       0.8     -1      0 0 0 0 0.5 0 0
0       1       1       1       0       0.8     -1      0 0 0 0 0.5 0 0
0       1       0       0       0       0.8     -1      0 0 0 0 0.5 0 0

# recruitment apportionment
-4      4       0       0       -1      99      -3      0 0 0 0 0.5 0 0         #_recrdistribution_by_growth_pattern
-4      4       0       0       -1      99      -3      0 0 0 0 0.5 0 0         #_recrdistribution_by_area 1
-4      4       4       0       -1      99      -3      0 0 0 0 0.5 0 0         #_recrdistribution_by_season 1
1       1       1       1       -1      99      -3      0 0 0 0 0.5 0 0         #_cohort_growth_deviation

0 #_custom_MG-env_setup

0 #_custom_MG-block_setup

#_Spawner-Recruitment
1 #_SR_function
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE
2       8       7       4.5     -1      100     1       # virgin recruitment
0.2     1       0.6     0.597   2       0.183   -2      # steepness
0       2       0.01    0.4     0       1000    -3      # sigma-r
```

```
-5      5       0       0       0       1       -3      # env-link
-5      5       0       0       0       1       -3      # offset for initial equilibrium
0       0.5     0       0       -1      99      -2      # [reserve for future autocorrelation]

0       #_SR_env_link
1       #_SR_env_target_1=devs;_2=R0;_3=steepness
0       #do_recr_dev:  0=none; 1=devvector; 2=simple deviations

#first_yr       last_yr min_log_res    max_log_res    phase
2006    2005    -15     15      -3      #_recr_devs
1492    #_first_yr_fullbias_adj_in_MPD

#_initial_F_parms
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE
0       0.2     0       0       0       1000    -1
0       0.2     0       0       0       1000    -1

#_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  E  F
0 0 0 0 1 0
0 0 0 0 1 0
0 0 0 2 0 0
0 0 0 2 1 0

#_Q_parms(if_any)
#_LO    HI      INIT    PRIOR   PR_type SD      PHASE
-14     -1      -9.5    -9      -1      1000    1       # catchability for CPFV index
-2.3    2.3     1       -0.2863 0       0.5     1       # catchability for visual survey

#_size_selex_types
#_Pattern Discard Male Special
1 0 0 0 # 1
1 0 0 0 # 2
5 0 0 2 # 3
0 0 0 0 # 4

#_age_selex_types
#_Pattern Discard Male Special
10 0 0 0 # 1
10 0 0 0 # 2
10 0 0 0 # 3
11 0 0 0 # 4

#_selex_parms
# LO    HI      INIT    PRIOR   PR_type SD      PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn
#_size_sel: 1 -- commercial fishery; mirrors maturity ogive
40      46      43      43      0       1000    -1      0 0 0 0 0.5 0 0
5       6       5.767   5.767   0       1000    -1      0 0 0 0 0.5 0 0
#_size_sel: 2 -- recreational fishery
```

```
10      50      34.06   35      0       1000    -1      0 0 0 0 0.5 0 0
5       15      7.52    7       0       1000    -1      0 0 0 0 0.5 0 0
#_size_sel: 3 -- CPFV index; mirrors recreational fishery
10      50      -1      35      0       1000    -1      0 0 0 0 0.5 0 0
5       15      -1      7       0       1000    -1      0 0 0 0 0.5 0 0
#_size_sel: 4
#_age_sel: 1
#_age_sel: 2
#_age_sel: 3
#_age_sel: 4 -- visual survey
0       1       0       0       0       1000    -1      0 0 0 0 0.5 0 0
79      80      80      80      0       1000    -1      0 0 0 0 0.5 0 0

1       #_env/block/dev_adjust_method(1/2)
0       #_custom_sel-env_setup
0       #_custom_sel-block_setup
-1      #_selparmdev-phase

#_Variance_adjustments_to_input_values
#_1 2 3 4
0 0 0.2916 0   #_add_to_survey_CV
0 0 0 0 #_add_to_discard_CV
0 0 0 0 #_add_to_bodywt_CV
1 0 1 1 #_mult_by_lencomp_N
1 1 1 1 #_mult_by_agecomp_N
1 1 1 1 #_mult_by_size-at-age_N

30      #_DF_for_discard_like
30      #_DF_for_meanbodywt_like

1       #_maxlambdaphase
0       #_sd_offset

#_lambdas_(columns_for_phases)
0       # commercial fishery
0       # recreational fishery
1       # CPFV logbook index
1       # visual survey
0       #_discard:_1
0       #_discard:_2
0       #_discard:_3
0       #_discard:_4
0       #_meanbodyweight
0       #_lencomp:_1
0       #_lencomp:_2
0       #_lencomp:_3
0       #_lencomp:_4
0       #_agecomp:_1
0       #_agecomp:_2
0       #_agecomp:_3
0       #_agecomp:_4
```

```
0       #_size-age:_1
0       #_size-age:_2
0       #_size-age:_3
0       #_size-age:_4
0       #_init_equ_catch
0       #_recruitments
1       #_parameter-priors
0       #_parameter-dev-vectors
100     #_crashPenLambda
0.9     #_maximum allowed harvest rate
999

# data file for 2007 cowcod assessment
# Stock Synthesis 2, version 2.00c
# Revised July 2007
#
# MODEL DIMENSIONS
# ----------------
1900    # start year
2007    # end year
1       # number of seasons per year
12      # vector with N months in each season
1       # spawning occurs at the beginning of this season
2       # number of fishing fleets
2       # number of surveys
#
# string containing names for all fisheries and
# surveys, delimited by the "%" character
commercial%recreational%CPFV%visual
# fraction of season elapsed before CPUE measured or survey conducted
0.5 0.5 0.5 0.5
#
1       # number of genders; females are gender 1
80      # accumulator age
#
# CATCH DATA
# ----------
0 0     # initial equilibrium catch for each fishery
# catch biomass (mtons); catch is retained catch, not total catch
# comm  rec     year
0.01    0       # 1900
5.34    0
10.68   0
16.01   0
21.35   0
26.68   0
32.02   0
37.35   0
42.68   0
48.02   0
53.35   0       # 1910
```

```
58.69   0
64.02   0
69.35   0
74.69   0
80.02   0
85.36   0
137.73  0
125.59  0
75.1    0
81.57   0       # 1920
71.26   0
70.11   0
93.94   0
125.94  0
138.15  0
171.48  0
142.3   0
111.3   0
102.48  0
126.78  0       # 1930
160.8   0
109.27  0
81.64   0
70.36   0
52.56   0
20.19   0
24.22   0
18.08   0
21.5    0
23.28   0       # 1940
29.1    0
10.4    0
12.18   0
1.83    0
4.38    0
11.3    0
17.58   0
26.87   0
35.05   0
39.37   0       # 1950
45.57   9
31.05   10
24.88   13
34.05   24
27.62   42
37.80   49
38.43   37
43.54   33
45.09   22
49.18   36      # 1960
50.05   33
```

```
37.92   35
47.21   30
36.07   34
50.97   43
47.41   85
63.22   110
63.87   77
94.98   53
55.92   79      # 1970
68.06   62
102.51  90
108.79  97
114.26  129
112.47  109
131.35  140
132.44  100
147.75  73
187.52  86
142.62  96.43   # 1980
197.59  26.55
228.55  96.99
126.55  15.13
221.14  21.22
204.75  35.99
146.99  45.99
76.62   29.14
86.60   13.91
17.38   20.60
10.41   21.60   # 1990
7.10    20.90
17.21   20.70
14.85   9.68
13.63   26.01
23.30   1.75
24.57   5.36
7.30    1.85
1.21    2.81
3.47    3.77
0.45    4.49    # 2000
0.25    0.25
0.25    0.25
0.25    0.25
0.25    0.25
0.25    0.25
0.25    0.25
0.25    0.25    # 2007
#
# ABUNDANCE INDICES
# -----------------
#
39      # number of observations
```

```
#
#year   season  type    value           SE from delta-GLM
1963    1       3       0.511667932     0.3302199
1964    1       3       0.39318353      0.2527121
1965    1       3       0.275071085     0.2246714
1966    1       3       0.239739296     0.2308946
1967    1       3       0.146883176     0.2463383
1968    1       3       0.172989635     0.1777022
1969    1       3       0.185848155     0.2369852
1970    1       3       0.208035274     0.2734493
1971    1       3       0.251555595     0.1952652
1972    1       3       0.132619837     0.211407
1973    1       3       0.22675229      0.1413628
1974    1       3       0.213903213     0.1574918
1975    1       3       0.260807514     0.1488574
1976    1       3       0.152136187     0.1515156
1977    1       3       0.139320919     0.1980102
1978    1       3       0.106248194     0.2184173
1979    1       3       0.088607116     0.1867767
1980    1       3       0.060658815     0.1674501
1981    1       3       0.081386727     0.1680148
1982    1       3       0.042134063     0.190058
1983    1       3       0.060328342     0.1540601
1984    1       3       0.050024814     0.1784306
1985    1       3       0.036993343     0.2046437
1986    1       3       0.041577946     0.1963785
1987    1       3       0.023065175     0.2253322
1988    1       3       0.033749003     0.24057
1989    1       3       0.025582052     0.2341604
1990    1       3       0.032747243     0.2118718
1991    1       3       0.041559421     0.182387
1992    1       3       0.030297922     0.2437875
1993    1       3       0.033171318     0.3494245
1994    1       3       0.021107241     0.2903738
1995    1       3       0.017687439     0.3372674
1996    1       3       0.016099821     0.2987764
1997    1       3       0.008792843     0.4584879
1998    1       3       0.010754417     0.2743454
1999    1       3       0.003092846     0.443594
2000    1       3       0.002914665     0.6721232
2002    1       4       940     0.25
#
# DISCARD BIOMASS
# ---------------
#
1       # 1=biomass(mt) discarded; 2=fraction of total catch discarded
0       # number of observations
#
# MEAN BODY WEIGHT
# ----------------
0       # number of observations
```

```
#
# COMPOSITION CONDITIONERS
# -----------------------
-1      # negative value causes no compression
0.0001  # constant added to proportions at length & age (renormalized to sum to 1 after constant is added)
#
# LENGTH COMPOSITION
# ------------------
#
46      # number of length bins
# vector containing lower edge of length bins
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 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98
100
#
0       # number of lines of length comp observations
#
# AGE COMPOSITIONS
# ----------------
0       # number of age bins
0       # number of unique ageing error matrices
0       # number of age observations
#
# MEAN SIZE-AT-AGE
# ----------------
-1      # number of size-at-age observations; negative value excludes from likelihood
#
# ENVIRONMENTAL DATA
# ------------------
0       # number of environmental variables
0       # number of environmental observations
#
999     # end of data file

# forecast file for cowcod assessment, 2007
0.5     # target SPR
1       # number of forecast years
1       # number of forecast years with stddev
1       # emphasis for the forecast recrutment devs that occur prior to endyyr+1
0       # fraction of bias adjustment to use with forecast_recruitment_devs before endyr+1
0       # fraction of bias adjustment to use with forecast_recruitment_devs after endyr
0.40    # topend of 40:10 option; set to 0.0 for no 40:10
0.10    # bottomend of 40:10 option
1.0     # OY scalar relative to ABC
1990    # first yr for average fish selex to use in MSY and forecast
2000    # last yr for average fish selex to use in MSY and forecast
1       # for forecast:  1=set relative F from endyr; 2=use relative F read below
1 1     # relative F for forecast when using F;  seasons; fleets within season
999     # verification read for end of the correct number of relative F reads
0.25    # year 1, comm. fleet
0.25    # year 1, rec. fleet
```

Appendix C: Results of a Preliminary Bayesian Analysis

The STAR panel requested a MCMC run for a model with the following specifications:

1. Use Dorn's prior for h.
2. M: Normal with 95% within 0.04 and 0.07.
3. q: for Visual as before.
4. Recruitment fixed, no recruit deviations (recdevs)
5. R0: uniform prior on log R0
6. Log(q): uniform for CPFV (bounds at author's discretion).
7. Thinning, burn-in and total number of runs will be determined based on how much time this takes---author's discretion.

We presented preliminary results for this request, which appeared promising at first. Subsequent, longer runs failed to converge, as was clearly apparent from visual inspection of trace plots and running means (e.g. Fig. C1). Simulations with alternative starting values were explored, with similar results. Two runs with fixed natural mortality were simulated for 10 million iterations, thinned to every 10,000th iteration, and appeared to be making progress towards convergence but took four days to complete. Results of this analysis were not complete as of this report.

The base model has fixed steepness and natural mortality, estimating only virgin recruitment and catchability coefficients for the CPFV index and visual survey. MCMC is easy for this model, so we ran two simulations. Each chain consisted of 450,000 iterations, thinned every 30th iteration, for a total of 15,000 samples per chain. Visual inspection of the trace plots (Fig. C2) suggest that a burn-in of 5000 samples was more than sufficient. The first chain was initialized with the MLEs, and appeared to converge immediately. MCMC diagnostics were generated with the "boa" package in R (Table C1, http://www.public-health.uiowa.edu/boa). A thinning interval of 30 appeared to be sufficient, the convergence criteria were met, and parameter correlations were sufficiently small (Table C1, Fig. C3). We plotted posterior densities for each chain and model parameter (Fig. C4).

Although this is one of the simplest models for generating MCMC simulations, it does provide some useful information. The point estimate of depletion from the current base model is based on the posterior mode. The posterior distribution for depletion is necessarily skewed as it approaches zero (depletion cannot be negative). As illustrated by the MCMC results we see that the mode < median < mean (Table C2, Fig. C5). From the MCMC results, the posterior mean for depletion is 5.1%, with a 95% posterior interval of (2.8%, 8.3%), compared to the base model's point estimate (posterior mode) of 4.55% with a 95% asymptotic interval of (2.1%, 7.0%). This suggests that for severely depleted stocks, the posterior mode might present an overly pessimistic point estimate of depletion. Of course, as stocks rebuild this effect will usually diminish.

Not surprisingly, the precision of the parameter estimates and derived quantities from this model are unrealistically high (Table C2, Figs. C4 and C5). Simple models with limited data necessarily make strong assumptions, such as fixing steepness and natural mortality and not estimating recruitment deviations. The 3-parameter model suggests that we know unfished recruitment to within 2000 fish and MSY to within one metric ton. In short, the MCMC results from this simple model do not solve the problems associated with quantifying our uncertainty about stock status.

We conclude this preliminary analysis with a comparison of the prior and posterior distributions for log catchability of the visual survey (Fig. C6). The results are qualitatively similar to the comparison of the point estimate and prior in Fig. 38, but the MCMC results provide more information about our uncertainty regarding this parameter. All 20,000 samples (chains combined) were larger than the prior mean, illustrating the strong tension between the CPFV index and visual survey in the base model.

Table C1: Output from Bayesian Output Analysis Program (BOA) for MCMC, version 1.1.6-1 (http://www.public-health.uiowa.edu/boa)

```
LAGS AND AUTOCORRELATIONS:
==========================

Chain: parm.c1
--------------
             Lag 1        Lag 5       Lag 10       Lag 50
Qparm1  0.05059082 -0.003040157 -0.001018786  0.001758045
Qparm2  0.07085449 -0.008748758  0.003910217  0.001163979
SRparm1 0.15567511 -0.011644322  0.014002676 -0.005173011

Chain: parm.c2
--------------
             Lag 1        Lag 5       Lag 10       Lag 50
Qparm1  0.08559620  0.012673099  0.001173011 -0.001624859
Qparm2  0.06745626 -0.001882962 -0.013923475 -0.009092964
SRparm1 0.16756270 -0.019647828 -0.007815128 -0.010236029

CROSS-CORRELATION MATRIX:
=========================

Chain: parm.c1
--------------
        Qparm1     Qparm2     SRparm1
Qparm1  1
Qparm2  0.3833836  1
SRparm1 -0.5392519 -0.6908106 1

Chain: parm.c2
--------------
        Qparm1     Qparm2     SRparm1
Qparm1  1
Qparm2  0.3771232  1
SRparm1 -0.5330452 -0.6946958 1


HIGHEST PROBABILITY DENSITY INTERVALS:
======================================

Alpha level = 0.05

Chain: parm.c1
--------------
        Lower Bound Upper Bound
Qparm1    -8.693740    -8.30580
Qparm2     0.483681     1.70890
SRparm1    4.696540     4.71214

Chain: parm.c2
--------------
        Lower Bound Upper Bound
Qparm1    -8.686700    -8.29990
Qparm2     0.461683     1.70944
SRparm1    4.696580     4.71241

SUMMARY STATISTICS:
===================

Bin size for calculating Batch SE and (Lag 1) ACF = 50
```

```
Chain: parm.c1
--------------
             Mean          SD     Naive SE     MC Error     Batch SE   Batch ACF
Qparm1  -8.492155 0.099174685 9.917468e-04 1.203833e-03 1.123891e-03  0.06224635
Qparm2   1.096091 0.313570001 3.135700e-03 3.276657e-03 3.381300e-03 -0.03303373
SRparm1  4.703869 0.004201987 4.201987e-05 4.529227e-05 5.000215e-05 -0.08289252

             0.025       0.5     0.975 MinIter MaxIter Sample
Qparm1  -8.6869597 -8.491095 -8.298476    5001   15000  10000
Qparm2   0.4823342  1.097150  1.708005    5001   15000  10000
SRparm1  4.6974300  4.703250  4.713710    5001   15000  10000

Chain: parm.c2
--------------
             Mean          SD     Naive SE    MC Error     Batch SE   Batch ACF
Qparm1  -8.494836 0.099321550 9.932155e-04 0.001303578 1.164007e-03  0.11249145
Qparm2   1.091375 0.317588837 3.175888e-03 0.003198754 3.452430e-03 -0.07255780
SRparm1  4.703946 0.004233298 4.233298e-05 0.000052233 5.121901e-05  0.02502094

             0.025       0.5     0.975 MinIter MaxIter Sample
Qparm1  -8.6896645 -8.494055 -8.302354    5001   15000  10000
Qparm2   0.4684662  1.092055  1.717138    5001   15000  10000
SRparm1  4.6974000  4.703395  4.713730    5001   15000  10000


BROOKS, GELMAN, AND RUBIN CONVERGENCE DIAGNOSTICS:
==================================================

Iterations used = 10001:15000

Potential Scale Reduction Factors
---------------------------------
  Qparm1   Qparm2  SRparm1
1.000212 1.000119 1.000269

Multivariate Potential Scale Reduction Factor = 1.000300

Corrected Scale Reduction Factors
---------------------------------
        Estimate    0.975
Qparm1  1.000213 1.001469
Qparm2  1.000183 1.001064
SRparm1 1.000582 1.002069


GEWEKE CONVERGENCE DIAGNOSTIC:
==============================

Fraction in first window = 0.1
Fraction in last window = 0.5

Chain: parm.c1
--------------
           Qparm1    Qparm2    SRparm1
Z-Score 0.1815178 1.3707555 -0.4795196
p-value 0.8559612 0.1704512  0.6315690

Chain: parm.c2
--------------
           Qparm1    Qparm2    SRparm1
Z-Score 0.1994390 0.9027804 -1.0762908
p-value 0.8419194 0.3666425  0.2817972
```

```
HEIDLEBERGER AND WELCH STATIONARITY AND INTERVAL HALFWIDTH TESTS:
=================================================================

Halfwidth test accuracy = 0.1

Chain: parm.c1
--------------
        Stationarity Test  Keep Discard   C-von-M Halfwidth Test      Mean    Halfwidth
Qparm1             passed 10000       0 0.1265813         passed -8.492155 2.359470e-03
Qparm2             passed 10000       0 0.2134562         passed  1.096091 6.422131e-03
SRparm1            passed 10000       0 0.1401630         passed  4.703869 8.877121e-05

Chain: parm.c2
--------------
        Stationarity Test  Keep Discard   C-von-M Halfwidth Test      Mean    Halfwidth
Qparm1             passed 10000       0 0.2181740         passed -8.494836 0.0025549662
Qparm2             passed 10000       0 0.2935478         passed  1.091375 0.0062694434
SRparm1            passed 10000       0 0.3730528         passed  4.703946 0.0001023748


RAFTERY AND LEWIS CONVERGENCE DIAGNOSTIC:
=========================================

Quantile = 0.025
Accuracy = +/- 0.005
Probability = 0.95

Chain: parm.c1
--------------
         Thin Burn-in Total Lower Bound Dependence Factor
Qparm1     1       2  3802        3746           1.014949
Qparm2     1       2  3897        3746           1.040310
SRparm1    1       2  3942        3746           1.052322

Chain: parm.c2
--------------
         Thin Burn-in Total Lower Bound Dependence Factor
Qparm1     1       2  3929        3746           1.048852
Qparm2     1       3  4061        3746           1.084090
SRparm1    1       2  3797        3746           1.013615
```

Table C2: Posterior summaries of derived quantities, based on combined samples from chains 1 and 2 (20,000 samples total).

	0.025	**median**	**mean**	**0.975**
SPB_Vir	2482	2497	2498	2523
Recr_Vir	109663	110314	110379	111467
SPB_2007	70	123	128	209
Depl.endyr	2.8%	4.9%	5.1%	8.3%
Bmsy	1985	1997	1998	2018
MSY	60.9	61.3	61.3	61.9

Figure C1: Example of trace plots from one MCMC run as per STAR panel request. 500,000 iterations. M = Mgparm1, R0 = SRparm1, h = SRparm2, CPFV catchability = Qparm1, visual survey catchability = Qparm2.

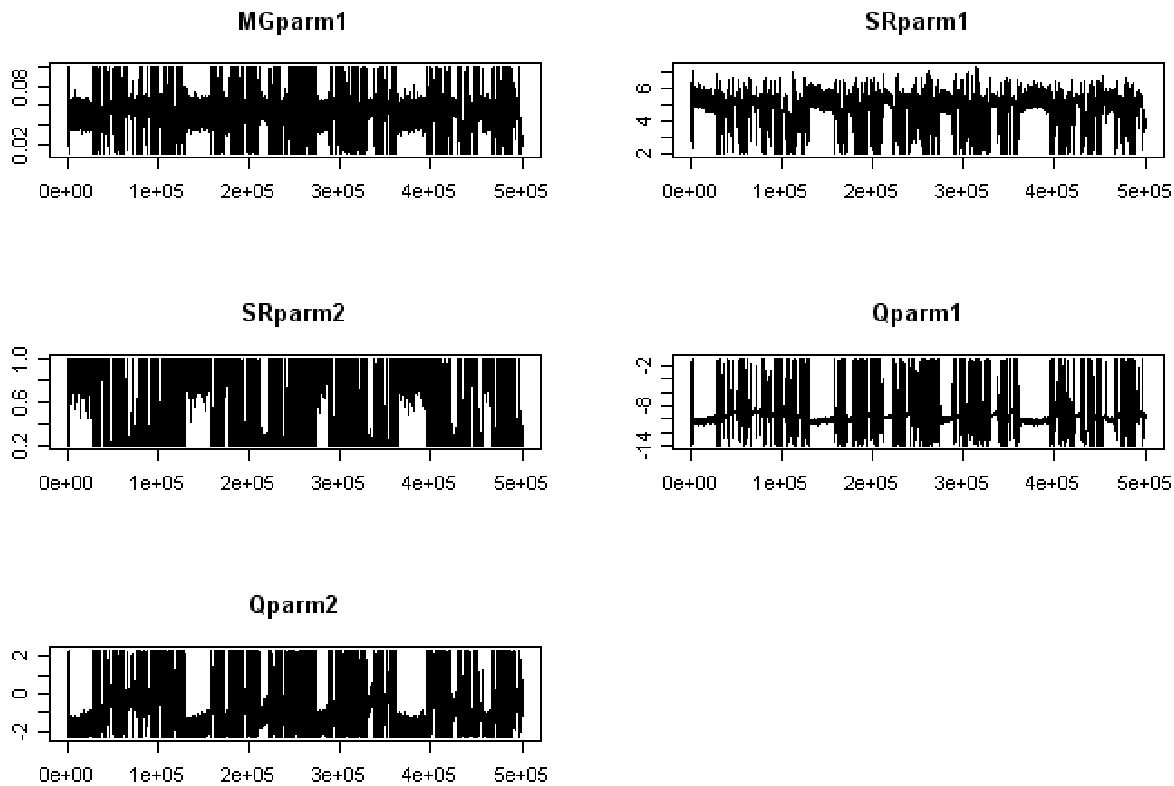


Figure C2: Trace plots from 2 MCMC simulations for the 3-parameter base model. Chain 1 was initialized with values from the optimization stage (posterior modes) and chain 2 was initialized with alternative values. The first 5000 iterations were removed from both chains prior to analysis.

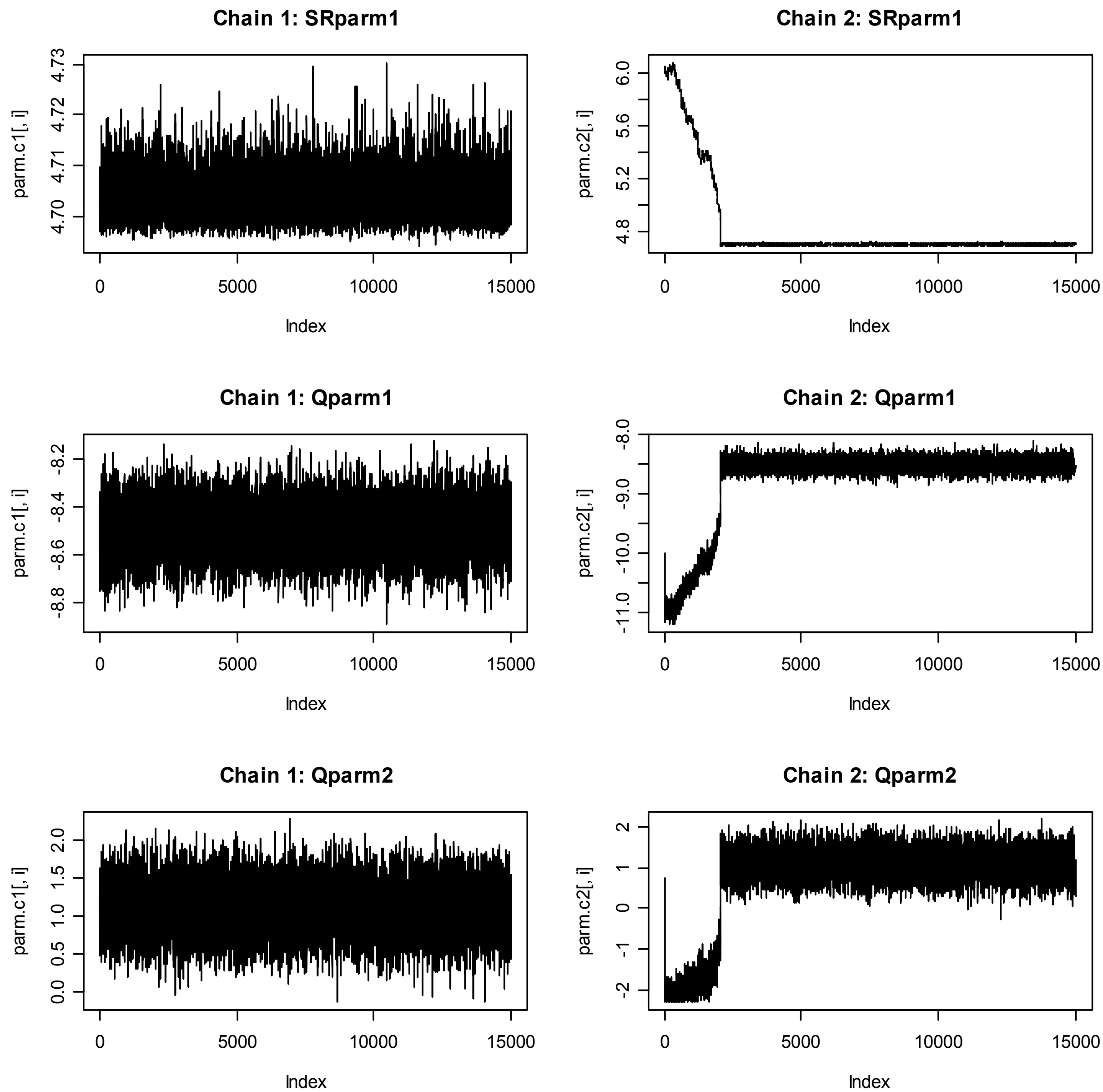


Figure C3: Scatterplot of posterior simulations from the 3-parameter base model.

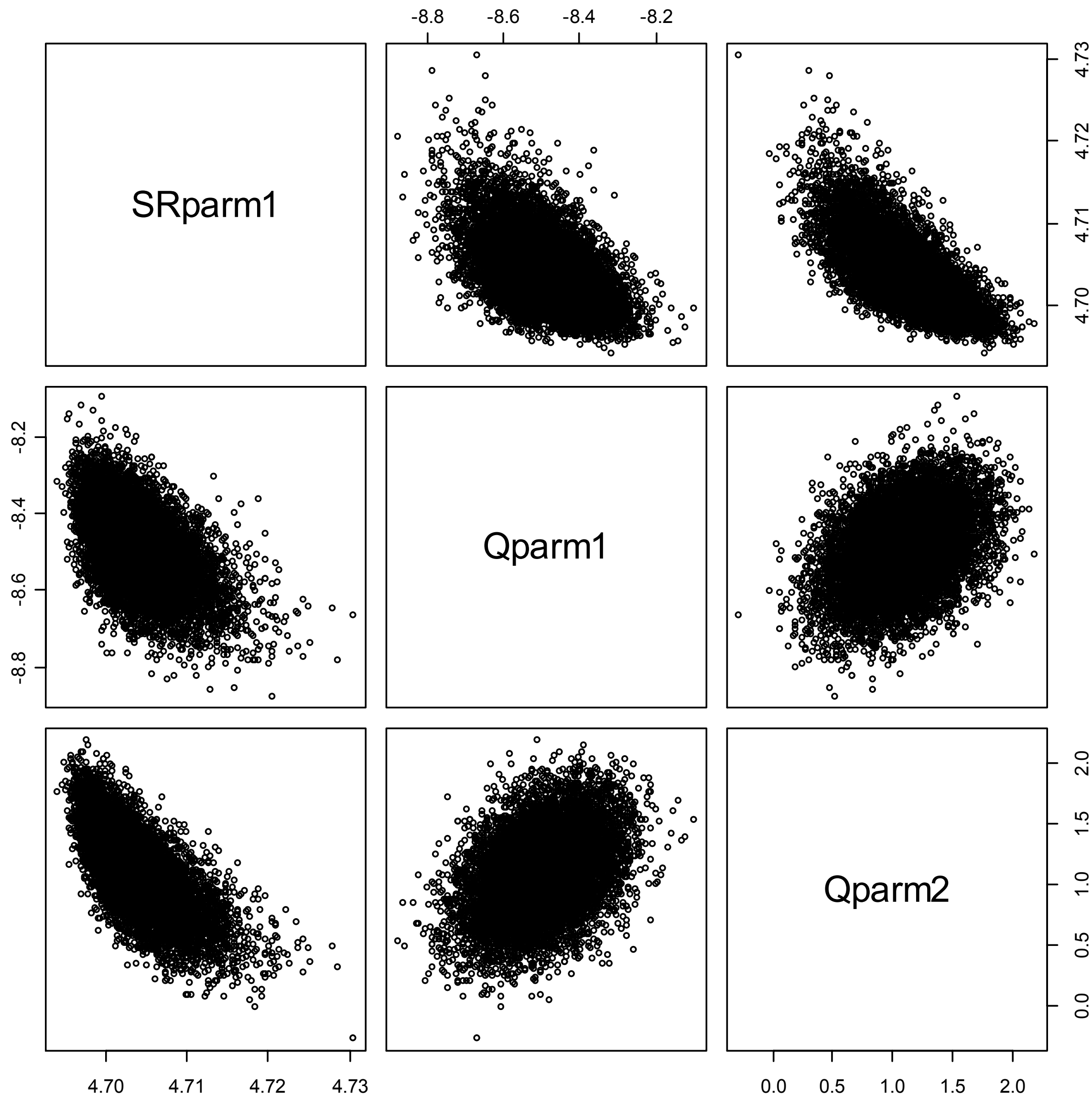


Figure C4: Posterior densities of parameters in the 3-parameter base model. Qparm1 = log catchability for the CPFV index, Qparm2 = log catchability for the visual survey, and Srparm1 = log unfished recruitment. Results are shown for two chains (solid and dotted lines) of 300,000 iterations each, thinned every 30 iterations, for a total of 10,000 samples per chain.

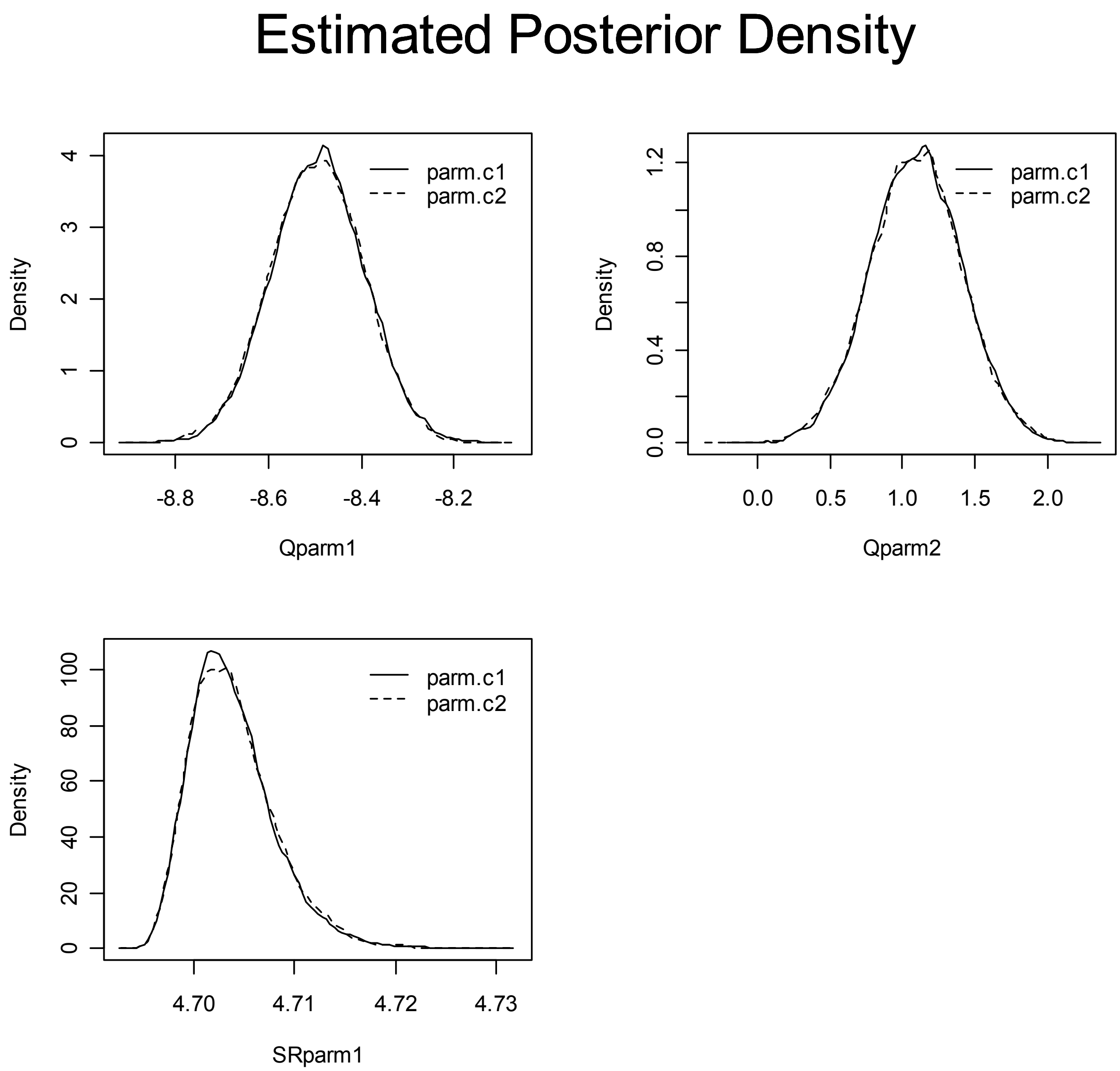


Figure C5: Posterior densities of derived quantities from the 3-parameter base model. Results are shown for two chains (solid and dotted lines) of 300,000 iterations each, thinned every 30 iterations, for a total of 10,000 samples per chain.

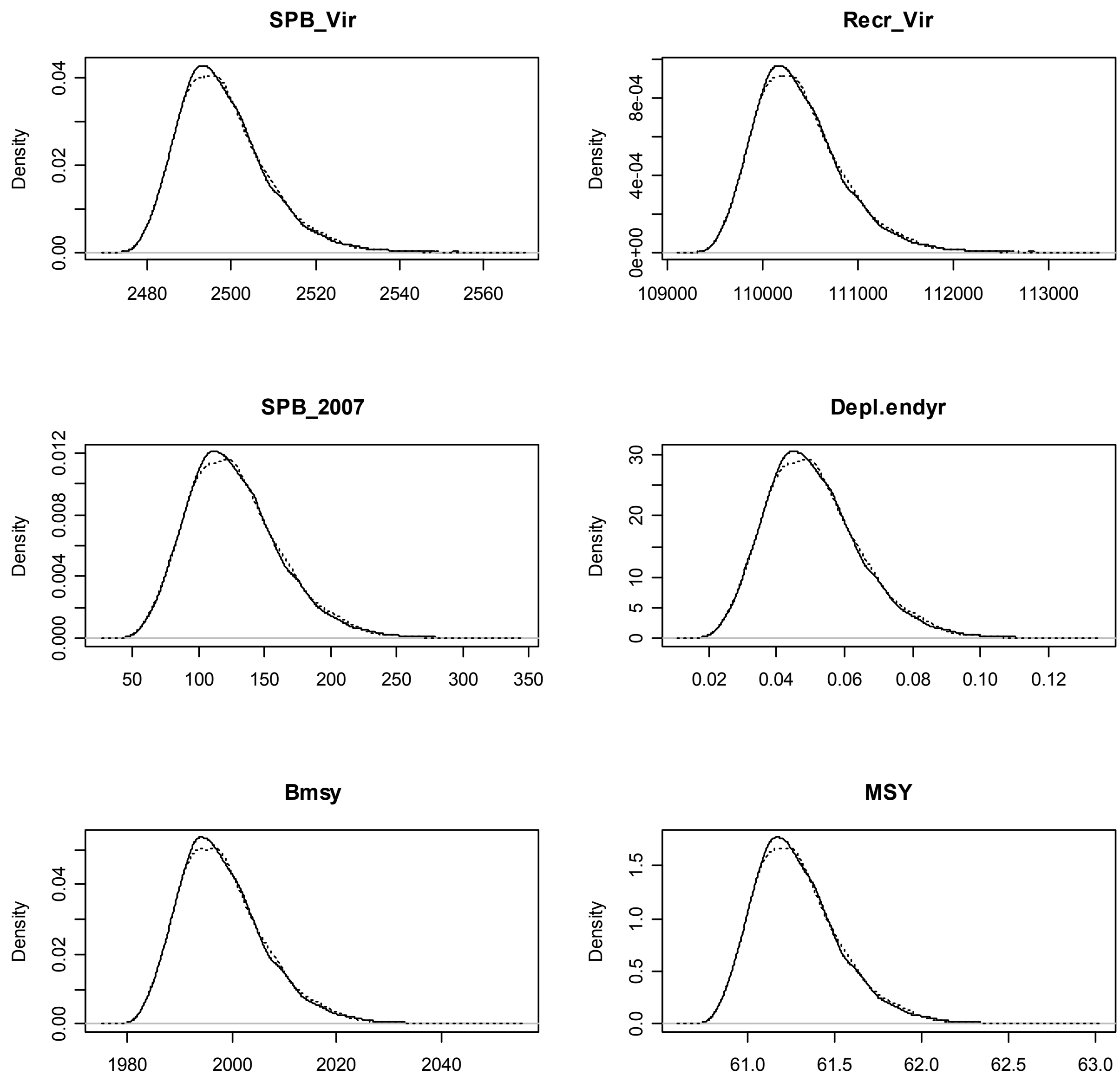
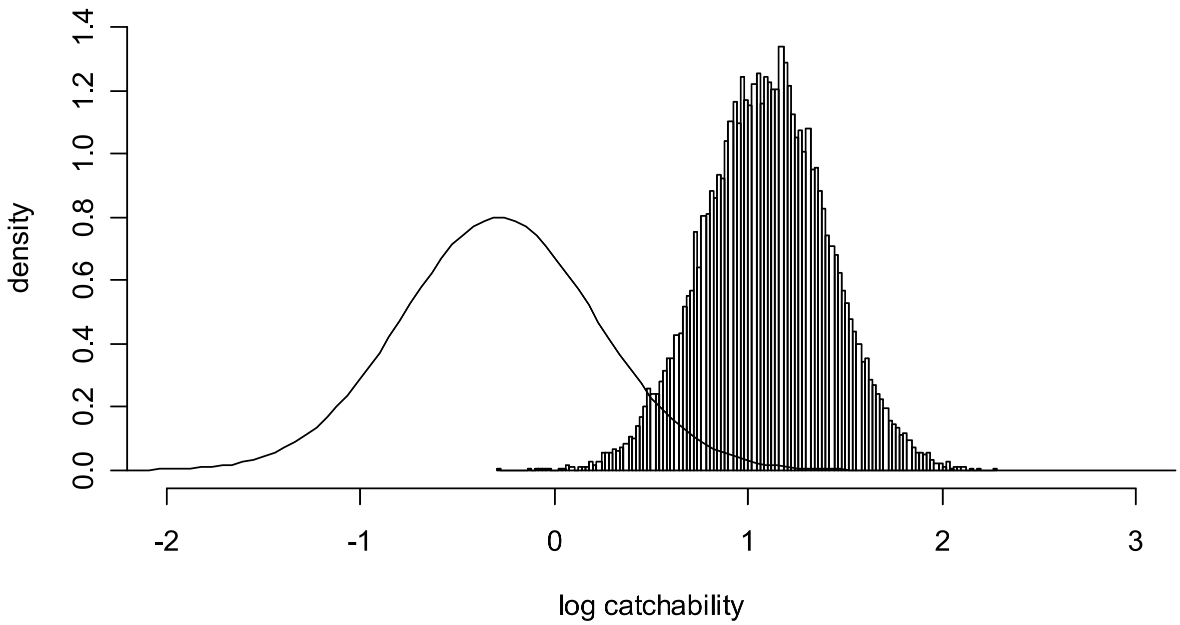


Figure C6: Comparison of the prior distribution for log catchability and 20,000 draws from the posterior distribution. The prior is normal with mean –0.2863 and standard deviation 0.5. The posterior mean is 1.09, with a 99% posterior interval of (0.29, 1.89).



Agenda Item G.4.a
Attachment 10
September 2007

Cowcod

STAR Panel Meeting Report

NOAA Western Regional Center
7600 Sand Point Way NE
Seattle, Washington 98115
July 16-20, 2007

STAR Panel
Tom Jagielo, Washington Department of Fish of Wildlife, SSC member, (Chair)
Patrick Cordue, Center for Independent Experts (CIE)
Stephen Smith, Center for Independent Experts (CIE)
Larry Jacobson, Northeast Fisheries Science Center (NEFSC)

PFMC
John Wallace (GMT) Representative
Pete Leipzig, (GAP) Representative

STAT
E.J. Dick, Southwest Fisheries Science Center (SWFSC)

Overview

A STAR Panel (Panel) met at the NOAA Sand Point facility from July 16-20, 2007 to review a draft assessment of cowcod rockfish. The assessment was conducted with SS2 using information from a visual survey in one year, and a recreational fishery (CPFV) logbook data series. A full assessment was previously conducted in 2005 and was subsequently updated in June of 2007. The 2007 update revealed errors in the 2005 assessment. Given the extent of the changes required to correct the error, the SSC recommended that a full assessment and review should be conducted in the (limited) remaining time in 2007.

The main error in the 2005 assessment was that fishery selectivity had erroneously been set to female fecundity. When corrected, this apparently caused a very large difference in estimated harvest rates. The Panel requested a fuller exploration of what was causing the differences and it was found that the comparison presented to the SSC was misleading. There had been another error in the 2005 assessment which had exaggerated the apparent difference. When consistently defined harvest rates were compared between the corrected and uncorrected runs they were similar.

The CPFV time series was constructed using a GLM analysis which used non-cowcod rockfish catch as an explanatory variable. The Panel was concerned that: 1) the GLM approach does not allow "errors in variables" (i.e., explanatory variables must not be random variables), 2) the use of non-cowcod catch as an explanatory variable could remove a valid signal in cowcod abundance, and 3) rockfish catches may vary widely from year to year while cowcod habitat does not. The STAT, while acknowledging these concerns, preferred to retain non-cowcod rockfish catch as an explanatory variable (as a proxy for cowcod habitat) and demonstrated that the CPFV time series is not sensitive to this decision.

A set of recently discovered CalCom landing sample records increased the estimated historical landings for cowcod considerably during the 1980s (and in earlier years because the cowcod proportion in these samples is applied to total rockfish landings). The plausibility of the historical catch series caused much discussion, but the assessment results were robust to the range of catch history assumptions explored.

Natural mortality and steepness were the primary dimensions of uncertainty explored at the meeting. The assessment results were generally insensitive to the assumed values of these parameters. Assessment results were much more sensitive to the inclusion or exclusion of the CPFV and visual survey data sets, which were the only abundance data in the model. The visual survey (conducted in one year only) and a prior on its catchability coefficient suggest current cowcod biomass is at a higher abundance level (approximately 23% depletion) than the much longer CPFV data series which suggests lower abundance (approximately 4% depletion). The base model includes both data sets but the CPFV time series dominates the model resulting in low estimated depletion levels (and high exploitation rates in the late 1980s).

Additional data (visual surveys, NWFSC bottom trawl survey data, or other types of information for current and recent years, see below) are required to better characterize current cowcod biomass and depletion levels. It is crucial that new data are collected to enable the effective monitoring of cowcod abundance.

The STAR Panel encouraged the STAT to conduct an MCMC analysis to better quantify uncertainty in the assessment. The STAT team made good initial progress, but did not complete a full MCMC analysis in time for review at the meeting. The STAT offered to keep working on this, and noted it could be included as an Appendix in the final assessment document. The Panel agreed, and recommended that the next full assessment should include a full MCMC analysis. The simple model structure for cowcod makes it an ideal case for MCMC approaches.

The final assessment represents the best information currently available for management purposes, but it is not an ideal assessment. The base model is unsatisfactory in terms of lack of abundance data for recent years, the plausibility of estimated exploitation rates during the late 1980s and in the apparent contradiction between the CPFV time series and the visual survey estimate. Also, the assessment uncertainty is not adequately captured by the three presented runs. A full Bayesian assessment would be preferable for this stock but it was unable to be produced within the given timeframe.

The Panel recognized that the assessment was changed from an update to a full assessment at the Council's request in June, which allowed very little time for the STAT to prepare an exhaustive full assessment. The Panel commends the STAT for their excellent documentation, presentations, and work during the STAR Panel meeting.

Discussion and Requests Made to the STAT during the Meeting (Note: names of particular scientists in the original notes were replaced by their affiliation in this section of the report).

A. Determine how measures of harvest rate were calculated in Figure ES-4 (and in SS2).

   Reason: Figure ES-4 in the draft compared estimated annual harvest rates for the 2005 assessment to show the impact of erroneously using the fecundity curve instead of the maturity curve for the selectivity in the last assessment. There was considerable change in annual harvest rates and questions were raised about how the harvest rate is calculated in SS2.

   Response: In SS2, harvest rates are calculated as landings/vulnerable biomass while fishing intensity is reported as either 1) catches over summary biomass or 2) 1-SPR where SPR = equilibrium spawning output per recruit under fished conditions / spawning output per recruit under no fishing.

   Discussion: The panel opted to use catch over summary biomass during the meeting to standardize the metric for comparing between models.

B. Compare biomass estimates from the three assessments on the same basis, i.e., female spawning stock biomass and base model plus plots of exploitation rate from each model on a comparable basis.

   Reason: Given the change in landings data from previous assessments and the correction for the selectivity curve used in the 2005 assessment, the Panel needed to see how the estimates from the current model compared to those from previous assessments.

   Response: Plots of total biomass trajectories were presented with the 2007 model using landings based on assumptions that h=0.6 (expectation of prior from meta-analysis) and cowcod made up 6.425% by weight of total rockfish landed in historical L.A. hook-and-line fishery. Plots of harvest rates expressed as total catch / summary biomass (ages 9+, ~38 cm) were also presented.

   Discussion: The impact of the revised CALCOM landings for 1969 to 1985 based upon the 611 recently discovered market samples for 1983 to 1985 was evident in the increased biomass estimated in the 2007 assessment for those years. Overall the annual harvest rates from all three assessments did not differ greatly in trend. The main difference between the annual harvest rates was the higher rates estimated for the 1980s in the 2007 assessment.

C. Contact the Southwest Fisheries Science Center regarding access to CalCOFI data with the intent of looking at the time series again to see if it can provide information for the recent years for monitoring recovery of the stock.

   Reason: The previous STAR Panel (May 9-13 2005) for cowcod had recommended not using the CalCOFI catch of cowcod larvae as an index of abundance because the index was: 1) extremely variable, 2) affected by variability in environmental conditions and 3) cowcod larvae are extremely rare in the catches. No data were presented in the current assessment that could be used to estimate trends in biomass since 2002 or to corroborate model estimates for this period and the CalCOFI data may be a qualitative indicator of recent stock conditions.

   Response: Messages were left to determine if recent CalCOFI data are available.

   Discussion: The Panel is not trying to reverse the previous panel's recommendation concerning use of CalCOFI data in modelling. It is possible that this index (and potentially other data sources) may be informative on the current conditions of the stock (at least in a qualitative sense), and thus should be presented.

.

D. Obtain more details on the recovered CalCom data with respect to whether or not the data were representative of landings in general or were more restricted with respect to species, etc.

   Reason: Insufficient information was available to the Panel on the features of the 611 new market samples with respect to the distribution of the landings by port, gear and market category each year.

   Response: A histogram of the distribution of landings by market categories for all three years in total was presented along with an indication of how the sample coverage was used to estimate the landings.

   Discussion: While the histogram did not indicate anything pathological in the distribution of samples with respect to market categories, no information was presented on the distribution by year for ports, gear and market category.

E. Further investigation of the GLM analysis of CPFV requires more models to be run. In particular, models for no Log rock fish catch and log rock fish catch for binomial model only. Compare annual trends for predicted CPFV from all three models.

   Reason: Concerns were expressed about the inclusion of rockfish catch (excluding cowcod) in both the binomial and lognormal GLM models for the CPFV data. Based on model results, the STAT hypothesized that 1) rockfish catch is an indicator of rockfish habitat, which indicates a higher probability of a positive (non-zero) catch of cowcod in the binomial model and 2) high rockfish catches would depress cowcod catch because of bag limits in the lognormal model.

   Response: Predicted CPFV catch rate for the original model, model with log rockfish catch only in the binomial part of the model and a model without log rockfish catch were presented.

   Discussion: There were differences in the three time series in the early 1960s with the log rockfish catch only in the binomial part of the model indicating a higher level of biomass than the other two models. However, there was little difference in the annual trends for the three series and in the most recent period there was very little difference between predicted catch rates. Details presented on model fits suggested that the binomial model was driving the trend in the predicted catch rates for all three models.

F. Plot LPUE data from CPFV series over time by region.

   Reason: The GLM model did not include an interaction term between year and region and therefore the model assumed that catch rates by region were parallel over time although they may differ in scale. However, the general pattern of nearshore areas being fished out first suggested that there might be such a pattern in the data.

Response: Plots of LPUE data from the CPFV series were plotted by region over time.

Discussion: These data are quite noisy but there appears to be some evidence that trends do differ for some of the regions. However, the patterns are complex and could not be easily modelled in the time available.

G. Plot selectivity curve against the commercial length frequencies.

Reason: The assessment had compared the selectivity curve (assumed the same as the maturity ogive) against the length compositions from the commercial fishery. The Panel was interested in seeing the selectivity curve compared with the length frequencies from the net and hook and line fisheries.

Response: Plots for the two commercial fishery length frequencies were presented.

Discussion: The length frequencies were derived by pooling data of varying sample sizes over years. The Panel recommended that there should be more work on estimating commercial selectivities for the next assessment.

H. Present background information on visual survey including copy of paper to appear in the Canadian Journal of Fisheries and Aquatic Science.

Reason: The Panel requested background information on this survey given that the assessment model appeared to be highly sensitive to the inclusion or exclusion of this abundance index.

Response: A draft of Yoklavich et al. (in press) was distributed and a brief summary of the survey and how it was used in the 2005 assessment was presented.

Discussion: It was difficult to evaluate the fit of the model to this index and more information on the distribution of the prior and the final estimate were requested.

I. Contact Observer Program re: CPFV observer data from charter boat on species composition.

Reason: The observer data were suggested as a possible source of monitoring information that may provide data on recent trends.

Response: A reply to this query indicated that there may be information; the STAT will follow up.

J. Determine if NWFSC trawl survey in the area has any data on cowcod.

Reason: The trawl survey data was suggested as a possible source of monitoring information that may provide data on recent trends.

Response: Information was obtained and presented later (see below).

Round 2 requests:

K. Replace Figure ES-4 with the new figure on harvest rates (see item A above). Move original figure from the executive summary into supporting document and include explanation of issues with comparing harvest rates in this manner. Also, the exploitation axis in the phase plot in Figure ES-6 will need to be redefined according to the discussion in A.

Reason: The Panel wanted a clear presentation of historical harvest rates.

Response: The STAT presented a time series of fishing intensity, defined as total catch divided by the biomass of ages 11+ (chosen because predicted length at age 11 is approximately the length at 50% maturity specified in the model for the commercial fishery). There was little difference in fishing intensity between the 2005 model with the mis-specified selectivity curve and the corrected 2005 model. The STAT re-examined results related to harvest rates in the 2005 assessment and found that the 2005 assessment had an error in the definition of relative harvest rate. The relative harvest rate should be based on the estimated harvest rate at MSY. When this was done for the 2005 assessment with mis-specified selectivity; the relative harvest rates are shown to be 14 times the rate at MSY, which is more consistent with the results from the current assessment. The plot of exploitation history in the 2005 assessment (pg. 6, Piner et al. 2005) shows relative rates between 2.5 – 3 times the rate at MSY. This result is obtained if harvest rates are divided by the annual exploitation rate (yield / summary biomass) at target F, instead of the harvest rate at MSY. The units of the annual exploitation rate are not the same as that for harvest rate and it is inappropriate to define relative harvest rates with exploitation rate as the denominator. The Panel noted that it is inappropriate to compare annual harvest rates from the 2005 model and the 'corrected selectivity' model due to the change in gear selectivity. However, it now appears that the perception of cowcod exploitation history (relative harvest rates) was incorrect in the 2005 assessment due to an error in the choice of denominator when calculating relative harvest rates (HR / HR_{MSY}). Therefore, the selectivity error in the 2005 assessment was only partly responsible for the dramatic change in perception regarding exploitation history, as the STAT stated in the draft assessment document.

Discussion: The Panel was satisfied with the explanation of the difference.

L. Follow up on the outfall and CalCOFI data. STAT should present these data in supporting documentation as being used historically.

Reason: These data had been used in past assessments of cowcod and while the associated abundance index will not be used in the model, the presence or absence of catches of larval cowcod may provide qualitative indications for the most recent period for which no commercial monitoring data is available.

Response: STAT will look into the possibility of obtaining recent outfall data. If possible, this data will be presented in the supporting documentation. The STAT will also attempt to obtain the CalCOFI data, but does not believe that a thorough analysis can be completed in time for presentation to the Panel. This index has the potential of providing information about progress in rebuilding and the STAT recommends this as a topic for future research.

Discussion: The Panel agreed that the data should be available and presented in future assessments, if only for qualitative use.

M. Need to know how many samples were taken in recent years versus what we see now with the recovered market samples. Construct a table of distribution of found samples by port, market category and year by gear. Do something simple to see how sensitive model results are to our concerns about the landings once a base model has been developed.

Reason: Follow-up on item D (above).

Response: Table of numbers of samples by gear, port complex and market category for 1983 to 1990 were presented as requested.

Discussion: There did not seem to be any obvious patterns in the distribution of the recovered samples from 1983 to 1985 compared to later years. The Panel did not see any reason to suggest that these samples were less representative of the fishery than samples in later years.

N. Would like to see a plot of the prior on the catchability for the visual survey and final estimate.

Reason: Follow-up on item H (above).

Response: The estimate of log(q) for the visual survey from SS2 was compared to the distribution specified for the prior distribution (normal distribution with mean equal to log(0.75) and CV equal to 0.50). The ML estimate for log(q) was in the far right tail of the prior at the 0.9988 percentile.

Discussion: The specification of the prior for log(q) for the visual survey had been arrived at during the 2005 STAR Panel for cowcod. The results from this year's assessment suggest that the CPFV time series is contradictory to the visual survey estimate. An appropriate test for discordance between the prior and the final estimate would require using a Bayesian model for the assessment model using the MCMC option in SS2/ADMB.

O. Call from Observer Program. There may be observer data. Follow up.

Reason: See item I above.

Response: A preliminary query of the RecFIN database showed a very small number of cowcod in the RecFIN sample data. The STAT will follow up.

Discussion: The Panel recommended that a thorough investigation of these data be prepared for the next assessment of this stock.

P. NWFSC staff working on NWFSC survey and sending all tows in SCB. Follow up.

Reason: See J above.

Response: Data were provided from the West Coast Slope/Shelf Combination Groundfish survey, including the number and weight of cowcod caught during all tows in the SCB from 2003–2006. Trawl surveys are limited as indices of abundance for cowcod, in that they cannot access rocky, high-relief habitat. The survey caught a total of 45 cowcod over the 4-year period, between the depths of 127 and 288 meters. There were 141 tows between 50–300m. For each of these tows, the STAT calculated the number of cowcod per hectare of area swept by the trawl. For these years, the proportion of tows that caught at least one cowcod ranged from 7%–17%. The number of tows within the 50–300m depth range ranged from 30–41 per year. Given the short time series, the limitations regarding trawlable habitat, and the large number of zero observations, the STAT feels that this index is not suitable for modelling in the current assessment but agrees that it be re-evaluated in future assessments.

Discussion: The data are limited and no information was available, given the short notice, to plot out the tow stations to compare with cowcod grounds in the Southern California Bight area. While there appears to be an indication of a small increase in the mean number per tow of cowcod in the survey, the Panel agreed that these data should be reconsidered for the next assessment. Participants reported that there was a cooperative hook and line survey in the SCB for the last 4 or 5 years that may provide data on cowcod.

Q. Calculate harvest rate as total catch over summary biomass defined by 50% selectivity for the recreational fishery.

Reason: To date summary biomass had been calculated with respect to the selectivity of the commercial fishery where 50% selectivity corresponded to 11 years of age. The recreational fishery selected younger fish and therefore represented a portion of the population not vulnerable to the commercial fishery.

Response: Harvest rate was calculated for both the commercial fishery and the recreational fishery (50% selectivity corresponded to age 8) with the summary biomass defined appropriately for the respective selectivity.

Discussion: There was some confusion about what the total catch was in the previous calculations of harvest rate by the STAT during this meeting. Clarification that total catch was actually commercial catch lead to concern about the high (exceeding 0.6) and possibly implausible harvest rates presented for both the commercial and recreational fishery in the mid-1980s in preliminary runs. The Panel hypothesized that such high harvest rates might be implausible because of the nature of the fish and fishery. Sensitivity runs for different landing scenarios may provide insight into this issue.

R. Sensitivity runs for the abundance indices:
   a. Drop visual, keep CPFV
   b. Keep visual, drop CPFV
   c. Keep visual and CPFV add power term for CPFV.

Reason: Previous issues with the discordance between the prior for log(q) for the visual survey and the ML estimate suggested that the sensitivity of the model to this index and the CPFV needed further exploration. Residuals from the fit of the model to the CPFV index suggested that there might be a nonlinear relationship between CPFV and biomass.

Response: The different options given above were evaluated with respect to change in the depletion estimates. For case a, the depletion level was estimated to be 0.021 compared to 0.046 when both indices were included. Using only the visual survey (case b), the depletion level was estimated to be 0.243. Adding a power term to the CPFV relationship resulted in a small change in likelihood but estimated log(q) for the visual survey was now 0.468 which was in much closer agreement with the prior than the previous estimate. Depletion for the power model was 0.10 and the maximum harvest rate for the commercial fishery was less than 0.6.

Discussion: The visual survey is only one point in time and appears to scale the biomass estimate at a higher level than that predicted by the CPFV. By itself, the visual survey provides a more optimistic status for the stock biomass than the CPFV. The merits of either not using contradictory abundance indices in a model or including all data even though they may be contradictory were discussed without resolution. Further discussion was deferred until the Bayesian MCMC fit of the model had been completed.

S. Investigate the impact of different scenarios for the level of landings during the historical period in this fishery. Try runs of the model with one half and double (or some other factor at the STAT discretion) the landings from 1900 to 1968 using the case with both visual and CPFV in the model.

Reason: Sensitivity analyses for landings data are a standard component of a complete assessment.

Response: Runs of the model using two landing scenarios, halving the catch from 1900 to 1968 and 1.5 times the catch from the same period were presented. The scenarios were compared by using depletion level estimates. Halving the catch resulted in a depletion level of 0.051 (original series = 0.046) and 1.5 times the catch resulted in a depletion level of 0.04.

Discussion: While there were differences in the biomass estimates in the initial part of the series for these two scenarios and the run with the original landing series, they resulted in very similar estimates of depletion level. The Panel decided that there was little reason to pursue this line of investigation and the landings were accepted as is for this assessment.

T. The Panel requested an MCMC run on the full model with the following characteristics:

-Use Dorn's prior for h.
-M: Normal with 95% within 0.04 and 0.07.
-q: for Visual as before.
-Recruitment fixed, no recruit deviations (recdevs)
-R_0: uniform prior on log R_0
-Log(q): uniform for CPFV (bounds at author's discretion).
-Thinning, burn-in and total number of runs will be determined based on how much time this takes---author's discretion.

Response: The STAT presented two short exploratory MCMC runs for cowcod; the first as defined above, and the second with the visual survey dropped. In the first case, the posterior mean for M was close to the mean of the prior while the mean of the posterior for h was close to 1.0. Log(R_0) was higher than the ML estimate at around 5.5. However, the visual survey log(q) posterior mean was much closer to the prior mean than the ML results. In the second run, the posterior mean for h was close to the lower bound of 0.2 set for the prior.

Discussion: While only one chain was run for this analysis using the ML estimates as starting values, the trace plots did not indicate pathological behaviour with respect to the values being sampled. However, the autocorrelation estimates were high with long memory, suggesting that a large thinning interval (~1 in 1000) should be used for the final analyses. There was not time to evaluate any convergence diagnostics or the implications of the models in terms of biomass and depletion estimates and associated credible regions. The STAT was reluctant to use this kind of analysis in this assessment to capture the uncertainty in the assessment because the results, especially for h and Log(R_0) differed from the ML version of the model. The STAT will include a more thorough evaluation of the Bayesian models runs which will be included in the supporting documentation as an appendix. The Panel recommended that the Bayesian analysis be used for the next assessment and that the preliminary Bayesian results should not be used by managers at this time.

U. STAT to provide summary of runs to date to establish the range of uncertainties to be captured with the base run.

Reason: The Bayesian analysis had been suggested as a means of trying to capture the uncertainty in this assessment. Given that this analysis will not be used, other means of trying to explore the dimensions of uncertainty with respect to h, M and abundance indices were needed.

Response: A series of runs of the model were made with h = (0.4, 0.6, 0.8) and M = (0.04, 0.055, 0.07) for each model including the visual survey and CPFV index, visual survey only and CPFV only.

Discussion: Depletion estimates were less than 10% for both models with the CPFV index included while depletion ranged from 18.8 to 30.5% for the model with only the visual survey. In the end the STAT set M=0.055 and profiled over h and the different models. The lower bound was set at h=0.4 for the visual plus CPFV model, the base was set at h=0.6 for the same model while the upper bound was set at h=0.8 for the visual only model. The STAT was confident that these runs would adequately cover the range of uncertainties for management. The Panel was not in total agreement that the range of uncertainties had been addressed.

Technical Merits and/or Deficiencies of the Assessment

- The cowcod assessment is suitable for use by managers and the best available information at this time.

- Reasons underlying the very high harvest rates in the mid-1980s were not adequately explored.

- The abundance indices used in this assessment, CPFV (1963–2000) and the visual survey (2002) do not provide recent information on the potential recovery of this stock. Other abundance indices such as the NWFSC trawl survey, observer data from the CPFV trips post-2000, SCB hook and line survey in addition to data series used in previous assessments (e.g., CalCOFI, outfall) could have been used on at least a qualitative basis to corroborate conditions after 2000.

- Uncertainties in the catch history were not fully explored.

- The use of rockfish catch as an explanatory variable in the GLM analysis of the CPFV data was not justified.

- An evaluation of why the CPFV index should be used as an indicator of abundance for cowcod was not fully explored.

Areas of Disagreement

A) Within the STAR Panel

- One Panel member expressed concern as to the validity of the landings series based on the fact that landings from 1916 through the 1920s were high compared to the landings from 1970s and 1980s. However, total rockfish landings from 1916 to 1920s and 1930s are comparable to the late 1960s in CDF&G Bulletin (No. 105, 1958). Overall it is difficult to evaluate the plausibility of these landings without any information on the number of vessels (or anglers) present, fleet capacity, markets, recreational fishing patterns, or the amount the effort expended during those time periods.

- One Panel member suggested that in the assessment document, the model estimates after 2002 (the last year with data) should be labelled "projections" and not described as "estimates" because readers may have a tendency to mistakenly interpret the slight increasing trends in model results after 2001 as evidence of positive changes in the stock. The rest of the STAR panel members noted that all numbers in model outputs, including projections, are "estimates" and that proper uncertainty calculations would be sufficient to describe the change in uncertainty during 2000-2001.

B) Between the STAR Panel and the STAT

- The STAR Panel and the STAT team disagreed regarding the CPFV log book data index used in the final base model to estimate trends in abundance. The STAR panel noted that 1) rockfish catch should not be used as an independent variable in modelling because this could remove a valid signal in cowcod abundance and 2) measurement errors in rockfish catch violate modelling assumptions. The STAT team pointed out that 1) rockfish catches may be a measure of habitat for rockfish (for proportion positive models) or bag-limit effects (for the size of positive catches), 2) rockfish model parameters were statistically significant, and 3) similar approaches have been used in published studies. The STAR panel expressed doubt about rockfish catches as a habitat measure because rockfish catches may vary substantially from year to year, probably in response to rockfish abundance rather than changes in habitat. Rockfish catches likely include substantial measurement errors that violate assumptions about independent variables in the model and it is likely that the measurement errors in rockfish and cowcod catches are correlated. The Panel was not concerned about the consequences of this disagreement with the STAT because the effects of these assumptions on estimated trends for the fishery as a whole were minor.

Unresolved Problems and Major Uncertainties

- Recently recovered port sample data for 1984-1985 show surprisingly high proportions of cowcod in California commercial landings, particularly for trawl landings in the Santa Barbara region and hook and line landings in the Los Angeles region. Application of these proportions to historical years is problematic.

- Uncertainty about whether CPFV catch rates should be used as an index of abundance. Questions about the use of these catch rates were also raised at the 2005 Star Panel for cowcod.

- The video survey currently consists of a single year of data and would benefit from validation through replication.

- Models used to standardize CPFV data and estimate trends in cowcod abundance assumed that trends in cowcod abundance over time were the same in every region (no interactions between region and time) although differences in trends were evident in data plots. Modelling results should not be taken as evidence that trends in abundance of cowcod were similar in all regions.

- As in other West Coast groundfish assessments, there is considerable uncertainty associated with fixed and estimated parameters, including natural mortality and steepness.

- CPFV and visual data sets may be contradictory and, if so, should not be used in the base model. Resolution of this problem would help to reduce uncertainty in final biomass estimates.

- The runs of this year's model limiting uncertainty to a range of h and combination of abundance indices does not fully capture uncertainty about current stock conditions. Base case estimates for 2003 to the present are driven entirely by assumptions about the spawner-recruit relationship and current low catch levels.

- As with many West-Coast assessments, stock structure remains a major uncertainty.

Concerns raised by GMT and GAP representatives during the meeting

The GAP and GMT representatives raised no major issues of concern during the meeting.

Research recommendations

For the next assessment

- Present and consider all available data potentially relevant to abundance trends in recent and historical years (e.g., outfall surveys, CalCOFI data, NWFSC bottom trawl data, observer data, and hook and line survey data). Data for recent and current trends are important in tracking progress towards rebuilding. Historical data may be useful in corroborating trends in CPFV logbook data.

- Enhance modelling procedures for standardizing CPFV data, particularly in representing potential interactions between year and region.

- Provide reviewers with complete sets of model diagnostics for standardized abundance indices based on CPFV and other types of data.

- Conduct additional video surveys to provide direct measures of current cowcod biomass and to facilitate interpretation of the existing video survey data. Ideally, video sampling should be carried out both inside and outside the Cowcod Conservation Areas so that extrapolation to the entire stock is not required.

- Reconstruct the cowcod rockfish catch history using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical rockfish landings needs to be done comprehensively across all rockfish species to ensure efficiency and consistency.

- A preliminary query of the RecFIN database showed a very small number of cowcod in the RecFIN sample data. The Panel recommended that a thorough investigation of these data be prepared for the next assessment of this stock.

- Re-examine the assumption that commercial selectivity at length is the same as maturity at length.

- Conduct a full Bayesian assessment if possible. Cowcod are an ideal potential case because of the simple model structure and uncertainties about key model parameters and data.

General or long term

- Develop surveys that track trends in abundance of cowcod. The NWFSC bottom trawl shelf and slope surveys should, in particular, be evaluated for cowcod.

- For the historical and recent fisheries, evaluate the relative capacity of fishing fleets and markets for cowcod to determine how much catch might have reasonably been taken during historical periods and whether relatively high fishing mortality rates during the late 1980s are plausible.

- Evaluate the hypothesis that CPFV indices are nonlinear measures of stock biomass.

- 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.

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Status of the U.S. canary rockfish resource in 2007

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Executive Summary

Stock

This assessment reports 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 2006. The resource is modeled as a single stock. Spatial aspects of the coast-wide population are addressed through geographic separation of data sources/fleets where possible and consideration of residual patterns that may be a result of inherent stock structure. There is currently no genetic evidence that there are distinct biological stocks of canary rockfish off the U.S. coast and very limited tagging data to describe adult movement, which may be significant across depth and latitude. Future efforts to specifically address regional management concerns will require a more spatially explicit model that likely includes the portion of the canary rockfish stock residing in Canadian waters off Vancouver Island.

Catches

Catch of canary rockfish is first reported in 1916 in California. Since that time, annual catch has ranged from 46.5 mt in 2004 to 5,544 in 1982 and totaled almost 150,000 mt over the time-series. Canary rockfish have been primarily caught by trawl fleets, on average comprising ~85% of the annual catches, with the Oregon fleet removing as much as 3,941 mt in 1982. Historically just 10% of the catches have come from non-trawl commercial fisheries, although this proportion reached 24% and 358 mt in 1997. Recreational removals have averaged just 6% of the total catch, historically, but have become relatively more important as commercial landings have been substantially reduced in recent years. Recreational catches reached 59% of the total with 30 mt caught in 2003. Total catches after 1999 have been reduced by an order of magnitude in an attempt to rebuild a stock determined to be overfished on the basis of the 1999 assessment.

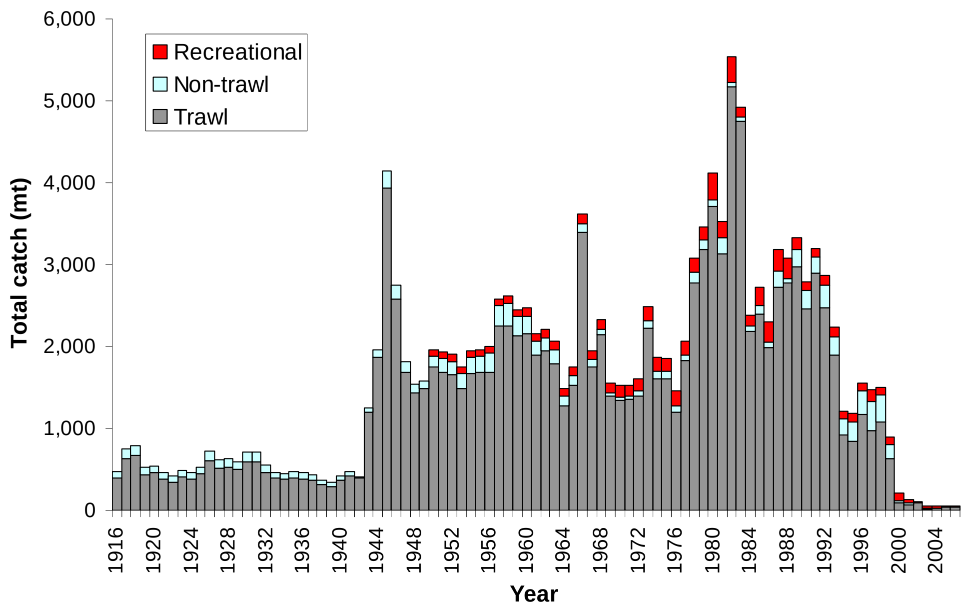

Figure a. Canary rockfish catch history by major source, 1916-2006.

Table a. Recent commercial fishery catches (mt) by fleet.

Year	Southern California trawl	Northern California trawl	Oregon trawl	Washington trawl	Southern California non-trawl	Northern California non-trawl	Oregon-Washington non-trawl	At-sea whiting bycatch
1997	31.96	142.66	589.85	203.44	29.78	73.80	254.42	3.63
1998	8.41	149.45	716.05	203.01	23.33	57.25	250.13	5.47
1999	7.36	96.25	387.85	139.97	8.53	28.59	123.97	5.63
2000	1.71	11.24	46.62	32.66	2.52	5.50	10.25	2.35
2001	1.44	9.43	33.13	19.65	1.60	4.96	11.00	4.05
2002	0.36	14.62	32.60	33.29	0.02	0.08	3.15	5.24
2003	0.23	0.31	5.02	6.24	0.00	0.08	6.89	0.93
2004	0.61	1.95	7.67	7.73	0.02	0.06	4.68	5.22
2005	0.72	2.84	4.91	25.90	0.06	0.09	1.79	1.44
2006	3.57	2.28	2.91	15.64	0.00	0.00	3.11	1.09

Data and Assessment

This assessment used the Stock Synthesis 2 integrated length-age structured model. The model includes catch, length- and age-frequency data from 11 fishing fleets, including trawl, non-trawl and recreational sectors. Biological data is derived from both port and on-board observer sampling programs. The National Marine Fisheries Service (NMFS) triennial bottom trawl survey and Northwest Fisheries Science Center (NWFSC) trawl survey relative biomass indices and biological sampling provide fishery independent information on relative trend and demographics of the canary stock. The Southwest Fisheries Science Center (SWFSC)/NWFSC/Pacific Whiting Conservation Cooperative (PWCC) coast-wide pre-recruit survey provides a source of recent recruitment strength information.

New analysis of the triennial survey data led to separating the series into two parts (1980-1992, 1995-2004) to allow for potential changes in catchability due to timing of survey operations. Accommodation of potential changes in fishery selectivity due to management actions including the adoption of canary-specific trip limits in 1995, small-footrope requirements in 1999, closure of the RCA in 2002 and use of selective flatfish trawl starting in 2005 was also added in this assessment. These and other changes have resulted in a change in the estimate of current stock status and large increase in the perception of uncertainty regarding this quantity in comparison to the most recent 2005 and earlier assessments.

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 stock productivity (via the steepness parameter of the stock-recruitment relationship) are presented. The base case model (steepness = 0.51) is considered to be twice as likely as the two alternate states (steepness = 0.35, 0.72) based on the results of a meta-analysis of west coast rockfish (M. Dorn, personal communication). In order to best capture this source of uncertainty, all three states of nature will be used as probability-weighted input to the rebuilding analysis.

Stock biomass

Canary rockfish were relatively lightly exploited until the early 1940's, when catches increased and a decline in biomass began. The rate of decline in spawning biomass accelerated during the late 1970s, and finally reached a minimum (13% of unexploited) in the mid 1990s. The canary rockfish spawning stock biomass is estimated to have been increasing since that time, in response to reductions in harvest and above average recruitment in the preceding decade. However, this trend is very uncertain. The estimated relative depletion level in 2007 is 32.4% (~95% asymptotic interval: 24-41%, ~75% interval based on the range of states of nature: 12-56%), corresponding to 10,544 mt (asymptotic interval: 7,776-13,312 mt, states of nature interval: 4,009-17,519) of female spawning biomass in the base model.

Figure b. Estimated spawning biomass time-series (1916-2007) for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

Table b. Recent trend in estimated canary rockfish spawning biomass and relative depletion level.

Year	Spawning biomass (mt)	~95% confidence interval	Range of states of nature	Estimated depletion	~95% confidence interval	Range of states of nature
1998	5,499	4,177-6,820	2,761-8,241	16.9%	NA	8.1-26.2
1999	5,826	4,296-7,357	2,610-9,073	17.9%	NA	7.6-28.8
2000	6,364	4,618-8,111	2,644-10,144	19.5%	NA	7.7-32.2
2001	7,149	5,190-9,109	2,918-11,477	22.0%	NA	8.5-36.4
2002	7,910	5,750-10,070	3,184-12,779	24.3%	NA	9.3-40.6
2003	8,603	6,264-10,942	3,417-13,985	26.4%	NA	10.0-44.4
2004	9,226	6,736-11,715	3,628-15,076	28.3%	NA	10.6-47.9
2005	9,749	7,140-12,359	3,795-16,019	29.9%	NA	11.1-50.9
2006	10,183	7,482-12,884	3,918-16,825	31.3%	23.1-39.4	11.4-53.4
2007	10,544	7,776-13,312	4,009-17,519	32.4%	24.1-40.7	11.7-55.6

Recruitment

The degree to which canary rockfish recruitment declined over the last 50 years is closely related to the level of productivity (stock-recruit steepness) modeled for the stock. High steepness values imply little relationship between spawning stock and recruitment, while low steepness values cause a strong correlation. After a period of above average recruitments, recent year-class strengths have generally been low, with only 1999 and 2001 producing large estimated recruitments (the 2007 recruitment is based only on the stock-recruit function). There is little information other than the pre-recruit index to inform the assessment model about recruitments subsequent to 2002, so those estimates will likely be updated in future assessments. As the larger recruitments from the late 1980s and early 1990s move through the population in future projections, the effects of recent poor recruitment will tend to slow the rate of recovery.

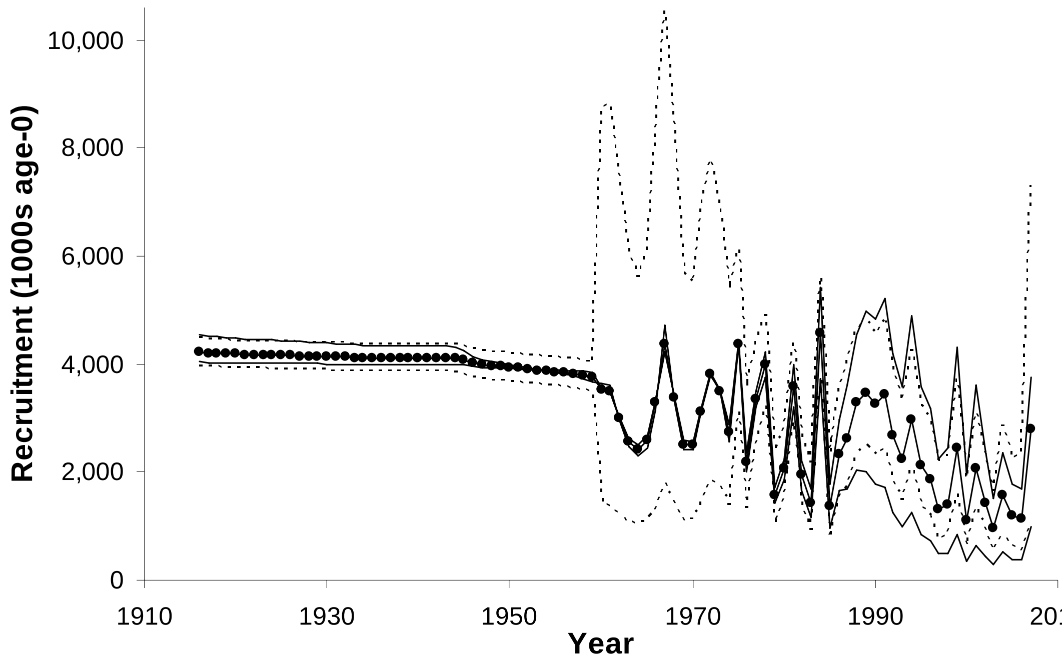

Figure c. Time series of estimated canary rockfish recruitments for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

Table c. Recent estimated trend in canary rockfish recruitment.

Year	Estimated recruitment (1000s)	~95% confidence interval	Range of states of nature
1998	1,391	841-2,299	484-2,453
1999	2,449	1,606-3,735	841-4,318
2000	1,099	638-1,893	351-1,938
2001	2,061	1,359-3,124	643-3,613
2002	1,432	905-2,267	447-2,383
2003	955	547-1,667	302-1,515
2004	1,565	854-2,869	520-2,373
2005	1,182	627-2,231	390-1,771
2006	1,144	548-2,389	367-1,699
2007	2,807	1,078-7,313	991-3,745

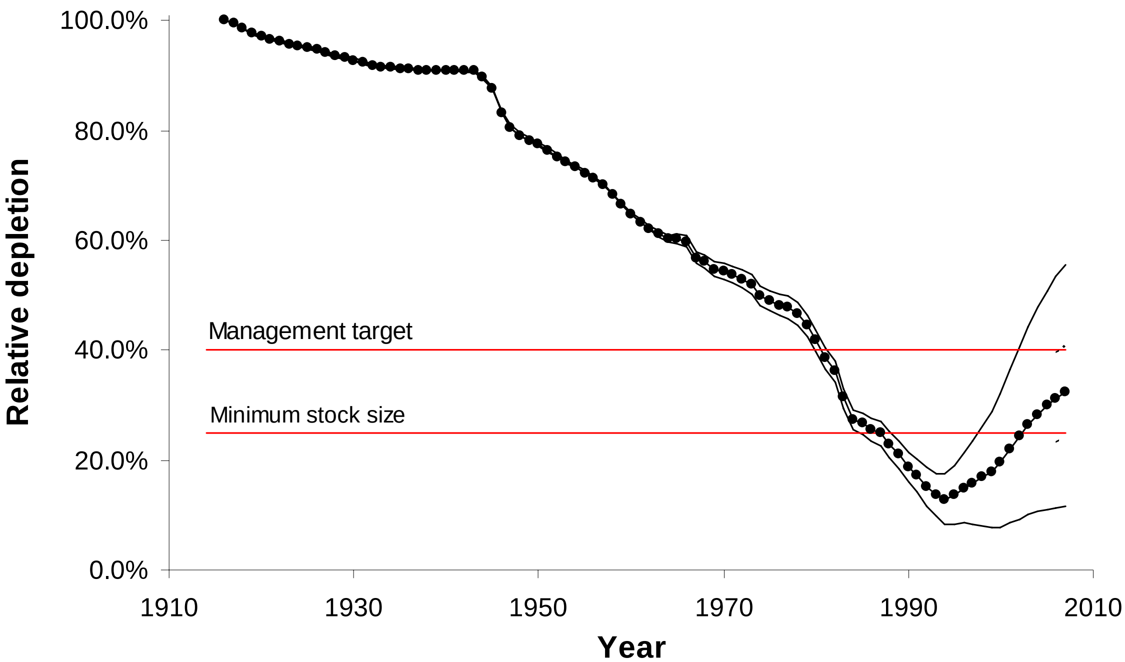

Figure d. Time series of depletion level as estimated in the base case model (round points) with approximate asymptotic 95% confidence interval (2006-2007 only, dashed lines) and alternate states of nature (light lines).

Reference points

Unfished spawning stock biomass was estimated to be 32,561 mt in the base case model. This is slightly smaller than the equilibrium value estimated in the 2005 assessment. The target stock size ($SB_{40\%}$) is therefore 13,024 mt. Maximum sustained yield (MSY) applying current fishery selectivity and allocations (a 'bycatch-only' scenario) was estimated in the assessment model to occur at a spawning stock biomass of 12,394 mt and produce an MSY catch of 1,169 mt (SPR = 52.9%). This is nearly identical to the yield, 1,167 mt, generated by the SPR (54.4%) that stabilizes the stock at the $SB_{40\%}$ target. The fishing mortality target/overfishing level (SPR = 50.0%) generates a yield of 1,161 mt at a stock size of 11,161 mt.

When selectivity and allocation from the mid 1990s (1994-1998) was applied, to mimic reference points under a targeted fishery scenario, the yield increased to 1,578 mt from a slightly smaller stock size (12,211 mt), but a similar rate of exploitation (SPR=52.5%). This is due to higher relative selection of older and larger fish when the fishery was targeting instead of avoiding canary rockfish. These values are appreciably higher than those from previous assessment models due primarily to the difference in steepness.

Exploitation status

The abundance of canary rockfish was estimated to have dropped below the $SB_{40\%}$ management target in 1981 and the overfished threshold in 1987. In hindsight, the spawning stock biomass passed through the target and threshold levels at a time when the annual catch was averaging more than twice the current estimate of the MSY. The stock remains below the rebuilding target, although the spawning stock biomass appears to have been increasing since 1999. The degree of increase is very sensitive to the value for steepness (state of nature), and is projected to slow as recent (and below average) recruitments begin to contribute to the spawning biomass. Fishing mortality rates in excess of the current F-target for rockfish of $SPR_{50\%}$ are estimated to have begun in the late 1970s and persisted through 1999. Recent management actions appear to have curtailed the rate of removal such that overfishing has not occurred since 1999, and recent SPR values are in excess of 95%. Relative exploitation rates (catch/biomass of age-5 and older fish) are estimated to have been less than 1% since 2001. These patterns are largely insensitive to the three states of nature.

Table d. Recent trend in spawning potential ratio (SPR) and relative exploitation rate (catch/biomass of age-5 and older fish).

Year	Estimated SPR (%)	Range of states of nature	Relative exploitation rate	Range of states of nature
1997	31.6%	16.9-41.9	0.0889	0.0607-0.1652
1998	33.2%	16.8-44.3	0.0873	0.0576-0.1778
1999	48.9%	26.1-61.0	0.0506	0.0323-0.1146
2000	84.0%	65.7-89.7	0.0112	0.0070-0.0271
2001	89.7%	76.5-93.5	0.0067	0.0041-0.0165
2002	92.2%	81.9-95.1	0.0050	0.0031-0.0126
2003	95.4%	88.3-97.2	0.0023	0.0014-0.0058
2004	96.3%	90.6-97.8	0.0020	0.0012-0.0051
2005	96.3%	90.5-97.7	0.0021	0.0013-0.0055
2006	96.5%	90.7-97.9	0.0019	0.0011-0.0049

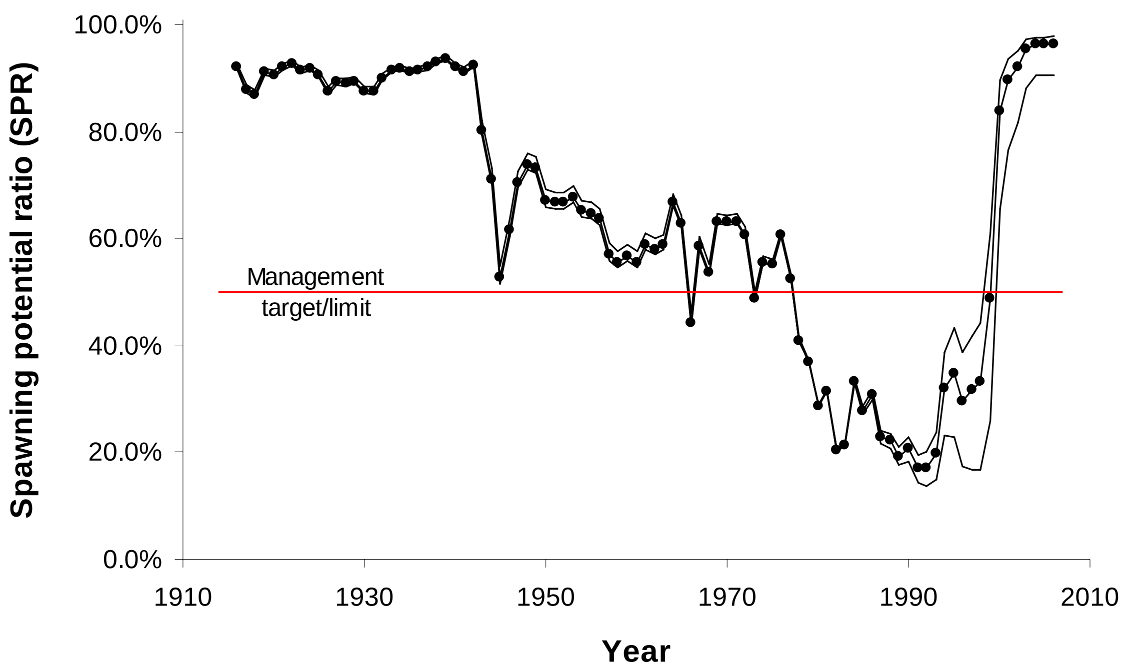

Figure e. Time series of estimated spawning potential ratio (SPR) for the base case model (round points) and alternate states of nature (light lines). Values of SPR below 0.5 reflect harvests in excess of the current overfishing proxy.

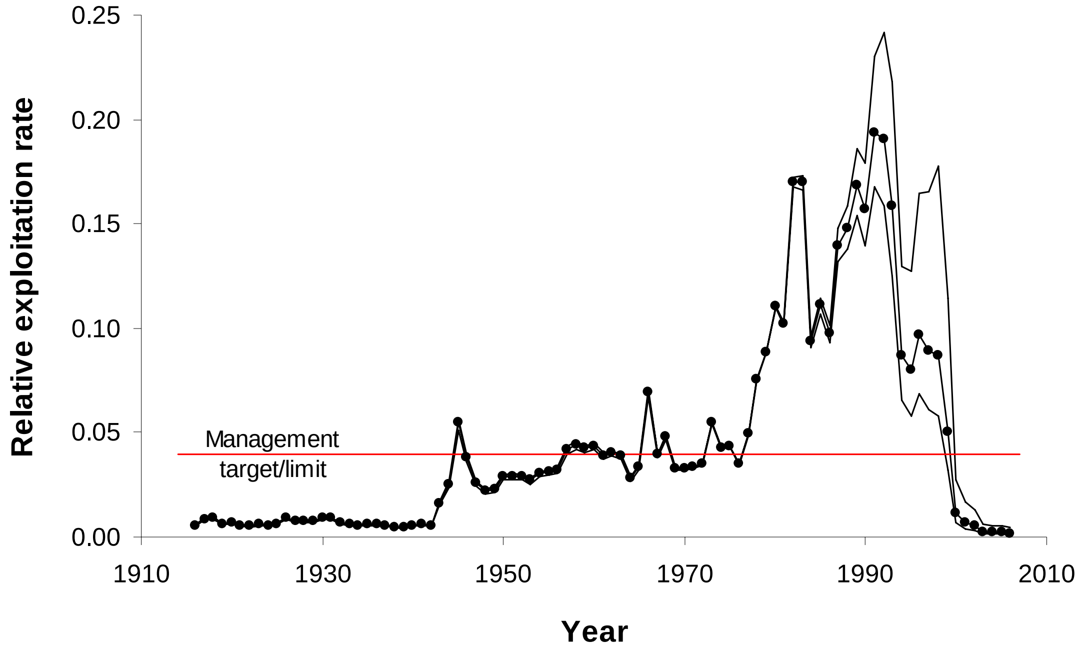

Figure f. Time series of estimated relative exploitation rate (catch/age 5 and older biomass, lower panel) for the base case model (round points) and alternate states of nature (light lines). Values of relative exploitation rate in excess of horizontal line are above the rate corresponding to the overfishing proxy from the base case.

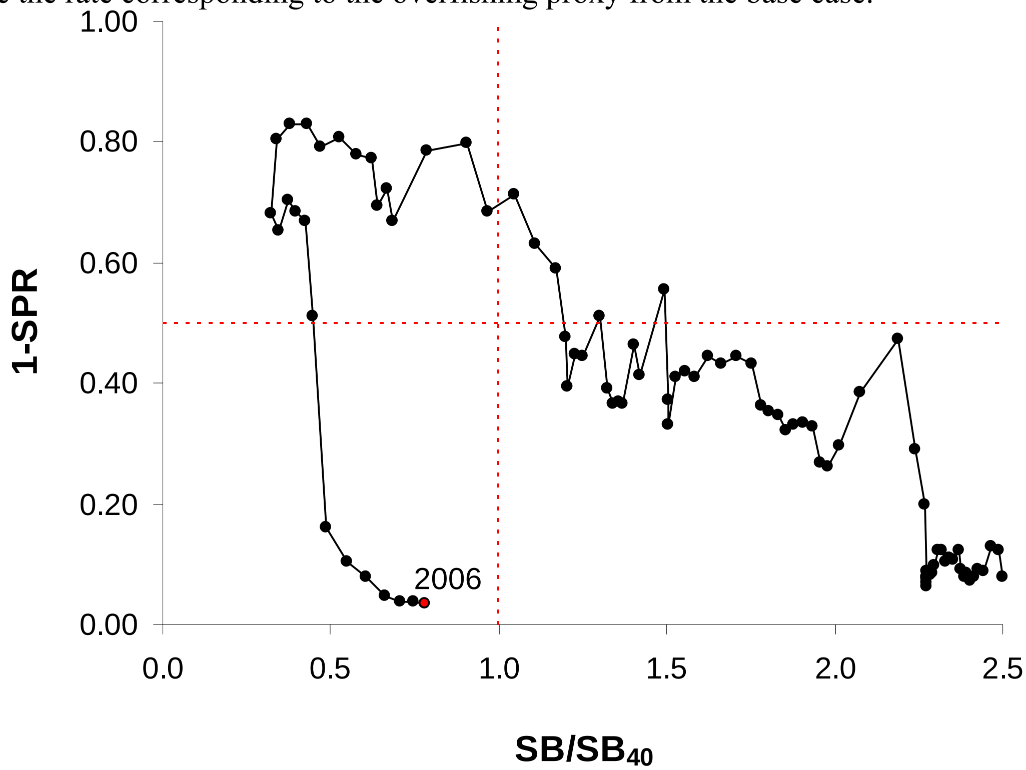

Figure g. Estimated spawning potential ratio relative to the proxy target of 50% vs. estimated spawning biomass relative to the proxy 40% level from the base case model. Higher biomass occurs on the right side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

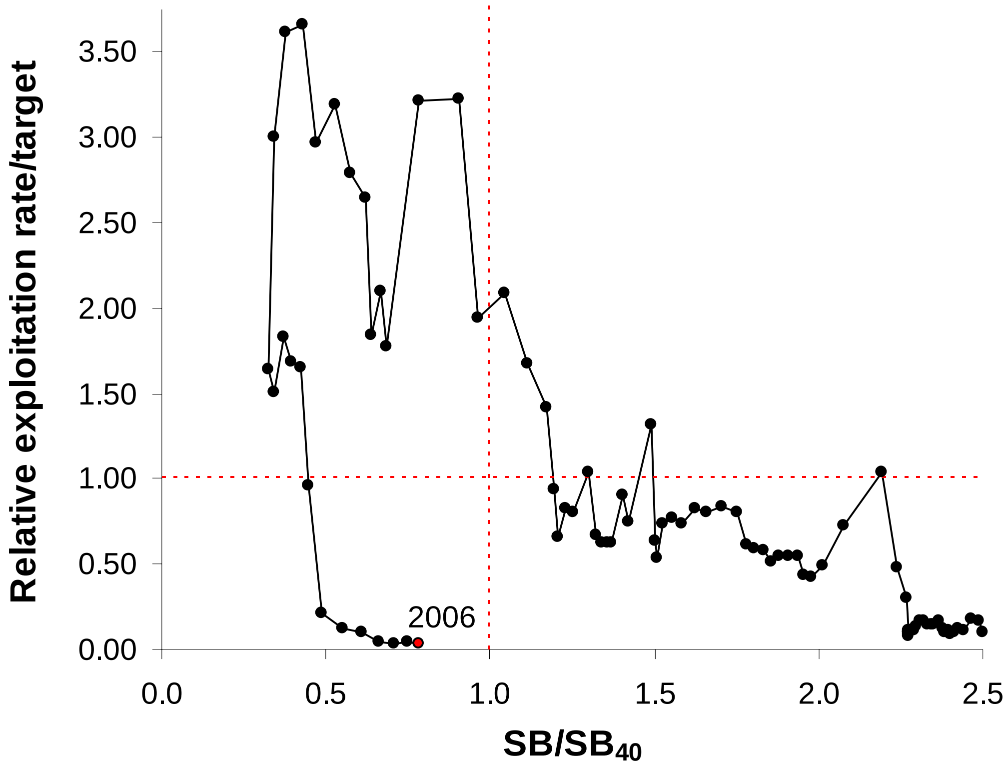

Figure g. Phase plot of estimated fishing intensity vs. relative spawning biomass for the base case model. Fishing intensity is the relative exploitation rate divided by the level corresponding to the overfishing proxy (0.040). Relative spawning biomass is annual spawner abundance divided by the 40% rebuilding target.

Management performance

Following the 1999 declaration that the canary rockfish stock was overfished the canary OY was reduced by over 70% in 2000 and by the same margin again over the next three years. Managers employed several tools in an effort to constrain catches to these dramatically lower targets. These included: reductions in trip/bag limits for canary and co-occuring species, the institution of spatial closures, and new gear restrictions intended to reduce trawling in rocky shelf habitats and the coincident catch of rockfish in shelf flatfish trawls. In recent years, the total mortality has been near the OY, but well below the ABC. Since the overfished determination in 1999, the total 7-year catch (644 mt) has been only 13% above the sum of the OYs for 2000-2006. This level of removals represents only 35% of the sum of the ABCs for that period. The total 2006 catch (47 mt) is <1% of the peak catch that occurred in the early 1980s.

Table e. Recent trend in estimated total canary rockfish catch and commercial landings (mt) relative to management guidelines.

Year	ABC (mt)	OY (mt)	Commercial landings (mt)[1]	Total Catch (mt)
1997	1,220[2]	1,000[2]	1,113.8	1,478.8
1998	1,045[2]	1,045[2]	1,182.4	1,494.2
1999	1,045[2]	857[2]	665.7	898.0
2000	287	200	60.6	208.4
2001	228	93	42.8	133.6
2002	228	93	48.6	106.8
2003	272	44	8.5	51.0
2004	256	47.3	10.7	46.5
2005	270	46.8	10.9	51.4
2006	279	47	8.2	47.1

[1]Excludes all at-sea whiting, recreational and research catches.
[2]Includes the Columbia and Vancouver INPFC areas only.

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. Specifically, there appears to be conflicting information between the length- and age-frequency data regarding the degree of stock decline, making the model results sensitive to the relative weighting of each. This issue is explored in the assessment, but cannot be fully resolved at this time. The relationship between the degree of dome in the selectivity curves and the increase in female natural mortality with age remains a source of uncertainty that is included in model results, as it has been in previous assessments for canary rockfish. Uncertainty in the steepness parameter of the stock-recruitment relationship is significant and will likely persist in future assessments; this uncertainty is included in the assessment and rebuilding projections through explicit consideration of the three states of nature.

Forecasts

The forecast reported here will be replaced by the rebuilding analysis to be completed in September-October 2007 following SSC review of the stock assessment. In the interim, the total catch in 2007 and 2008 is set equal to the OY (44 mt). The exploitation rate for 2009 and beyond is based upon an SPR of 88.7%, which approximates the harvest level in the current rebuilding plan. Uncertainty in the rebuilding forecast will be based upon the three states of nature for steepness and random variability in future recruitment deviations for each rebuilding simulation. Current medium-term forecasts predict slow increases in abundance and available catch, with OY values for 2009 and 2010 increasing by nearly four times the value of 44 mt from the 2005 assessment. This is largely attributable to the revised perception of steepness, based on meta-analysis of other rockfish species. The following table shows the projection of expected canary rockfish catch, spawning biomass and depletion.

Table f. Projection of potential canary rockfish ABC, OY, spawning biomass and depletion for the base case model based on the SPR= 0.887 fishing mortality target used for the last rebuilding plan (OY) and $F_{50\%}$ overfishing limit/target (ABC). Assuming the OY of 44 mt is met in 2007 and 2008.

Year	ABC (mt)	OY (mt)	Age 5+ biomass (mt)	Spawning biomass (mt)	Depletion
2007	973	44	25,995	10,544	32.4%
2008	978	44	26,417	10,840	33.3%
2009	981	162	26,859	11,072	34.0%
2010	980	162	26,995	11,194	34.4%
2011	992	164	27,018	11,254	34.6%
2012	1,026	169	27,440	11,266	34.6%
2013	1,074	177	27,985	11,260	34.6%
2014	1,124	185	28,656	11,280	34.6%
2015	1,171	193	29,445	11,368	34.9%
2016	1,214	200	30,332	11,545	35.5%
2017	1,253	207	31,297	11,812	36.3%
2018	1,290	213	32,317	12,156	37.3%

Decision table

Because canary rockfish is currently managed under a rebuilding plan, this decision table is only intended to better compare and contrast the base case with uncertainty among states of nature. The results of the rebuilding plan will integrate these three states of nature as well as projected recruitment variability. Further, various alternate probabilities of rebuilding by target and limit time-periods as well as fishing mortality rates will be evaluated in the rebuilding analysis. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

Table g. Decision table of 12-year projections for alternate states of nature (columns) and management options (rows) beginning in 2009. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

			State of nature					
			Low steepness (0.35)		Base case (steepness = 0.51)		High steepness (0.72)	
Relative probability			0.25		0.5		0.25	
Management decision	Year	Catch (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)
Rebuilding SPR 88.7% catches from low steepness state of nature	2009	56	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	56	12.0%	4,100	34.5%	11,236	60.1%	18,932
	2011	56	11.9%	4,078	34.8%	11,339	60.8%	19,156
	2012	59	11.8%	4,042	35.0%	11,396	61.2%	19,270
	2013	62	11.7%	4,003	35.1%	11,436	61.3%	19,313
	2014	65	11.6%	3,979	35.3%	11,502	61.4%	19,343
	2015	67	11.6%	3,984	35.7%	11,638	61.7%	19,423
	2016	70	11.7%	4,025	36.4%	11,866	62.2%	19,590
	2017	72	12.0%	4,102	37.4%	12,188	63.0%	19,852
	2018	74	12.3%	4,209	38.7%	12,591	64.1%	20,199
Rebuilding SPR 88.7% catches from base case	2009	162	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	162	11.8%	4,058	34.4%	11,194	60.0%	18,890
	2011	164	11.7%	3,994	34.6%	11,254	60.5%	19,069
	2012	169	11.4%	3,914	34.6%	11,266	60.8%	19,138
	2013	177	11.2%	3,831	34.6%	11,260	60.7%	19,135
	2014	185	11.0%	3,762	34.6%	11,280	60.7%	19,118
	2015	193	10.9%	3,719	34.9%	11,368	60.8%	19,150
	2016	200	10.8%	3,710	35.5%	11,545	61.2%	19,266
	2017	207	10.9%	3,733	36.3%	11,812	61.8%	19,475
	2018	213	11.0%	3,781	37.3%	12,156	62.8%	19,767
Rebuilding SPR 88.7% catches from high steepness state of nature	2009	273	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	271	11.7%	4,014	34.2%	11,150	59.8%	18,845
	2011	272	11.4%	3,905	34.3%	11,164	60.3%	18,978
	2012	277	11.0%	3,780	34.2%	11,130	60.3%	19,001
	2013	285	10.7%	3,654	34.0%	11,079	60.2%	18,951
	2014	293	10.3%	3,542	34.0%	11,055	60.0%	18,891
	2015	300	10.1%	3,459	34.1%	11,100	59.9%	18,880
	2016	307	9.9%	3,408	34.5%	11,235	60.2%	18,953
	2017	313	9.9%	3,389	35.2%	11,461	60.7%	19,122
	2018	319	9.9%	3,394	36.1%	11,763	61.5%	19,374
Status quo (catch = 44 mt)	2009	44	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	44	12.0%	4,104	34.5%	11,241	60.1%	18,937
	2011	44	11.9%	4,088	34.9%	11,349	60.8%	19,166
	2012	44	11.8%	4,057	35.0%	11,411	61.2%	19,285
	2013	44	11.7%	4,024	35.2%	11,456	61.4%	19,334
	2014	44	11.7%	4,005	35.4%	11,529	61.5%	19,371
	2015	44	11.7%	4,018	35.8%	11,673	61.8%	19,459
	2016	44	11.9%	4,069	36.6%	11,911	62.3%	19,635
	2017	44	12.1%	4,157	37.6%	12,244	63.2%	19,908
	2018	44	12.5%	4,277	38.9%	12,660	64.3%	20,268

Research and data needs

Progress on a number of research topics would substantially improve the ability of this assessment to reliably and precisely model canary rockfish population dynamics in the future and provide better monitoring of progress toward rebuilding:

1. Expanded Assessment Region: Given the high occurrence of canary rockfish close to the US-Canada border, a joint US-Canada assessment should be considered in the future.
2. Many assessments are deriving historical catch by applying various ratios to the total rockfish catch prior to the period when most species were delineated. A comprehensive historical catch reconstruction for all rockfish species is needed, to compile a best estimated catch series that accounts for all the catch and makes sense for the entire group.
3. Habitat relationships: The historical and current relationship between canary rockfish distribution and habitat features should be investigated to provide more precise estimates of abundance from the surveys, and to guide survey augmentations that could better track rebuilding through targeted application of newly developed survey technologies. Such studies could also assist determining the possibility of dome-shaped selectivity, aid in evaluation of spatial structure and the use of fleets to capture geographically-based patterns in stock characteristics.
4. Meta-population model: The spatial patterns show patchiness in the occurrence of large vs. small canary; reduced occurrence of large/old canary south of San Francisco; and concentrations of canary rockfish near the US-Canada border. The feasibility of a meta-population model that has linked regional sub-populations should be explored as a more accurate characterization of the coast-wide population's structure. Tagging of other direct information on adult movement will be essential to this effort.
5. Increased computational power and/or efficiency is required to move toward fully Bayesian approaches that may better integrate over both parameter and model uncertainty.
6. Additional exploration of surface ages from the late 1970s and inclusion into or comparison with the assessment model, or re-aging of the otoliths could improve the information regarding that time period when the stock underwent the most dramatic decline. Auxiliary biological data collected by ODFW from recreational catches and hook-and-line projects may also increase the performance of the assessment model in accurately estimating recent trends and stock size.
7. Due to inconsistencies between studies and scarcity of appropriate data, new data is needed on both the maturity and fecundity relationships for canary rockfish.
8. Re-evaluation of the pre-recruit index as a predictor of recent year class strength should be ongoing as future assessments generate a longer series of well-estimated recent recruitments to compare with the coast-wide survey index.
9. Meta-analysis or other summary of the degree of recruitment variability and the relative steepness for other rockfish and groundfish stocks should be ongoing, as this information is likely to be very important for model results (as it is here) in the foreseeable future.

Rebuilding projections

The rebuilding projections will be added to this document after the assessment has been reviewed in September 2007.

Table h. Summary of recent trends in estimated canary rockfish exploitation and stock levels from the base case model; all values reported at the beginning of the year.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Commercial landings (mt)[1]	1,182.4	665.7	60.6	42.8	48.6	8.5	10.7	10.9	8.2	NA
Total catch (mt)	1,494.2	898.0	208.4	133.6	106.8	51.0	46.5	51.4	47.1	NA
ABC (mt)	1,045[2]	1,045[2]	287	228	228	272	256	270	279	172
OY	1,045[2]	857[2]	200	93	93	44	47.3	46.8	47.0	44
SPR	33.2%	48.9%	84.0%	89.7%	92.2%	95.4%	96.3%	96.3%	96.5%	NA
Exploitation rate (catch/age 5+ biomass)	0.0873	0.0506	0.0112	0.0067	0.0050	0.0023	0.0020	0.0021	0.0019	NA
Age 5+ biomass (mt)	17,125	17,733	18,659	20,078	21,275	22,333	23,583	24,402	25,317	25,995
Spawning biomass (mt)	5,499	5,826	6,364	7,149	7,910	8,603	9,226	9,749	10,183	10,544
~95% Confidence interval	4,177-6,820	4,296-7,357	4,618-8,111	5,190-9,109	5,750-10,070	6,264-10,942	6,736-11,715	7,140-12,359	7,482-12,884	7,776-13,312
Range of states of nature	2,761-8,241	2,610-9,073	2,644-10,144	2,918-11,477	3,184-12,779	3,417-13,985	3,628-15,076	3,795-16,019	3,918-16,825	4,009-17,519
Recruitment (1000s)	1,391	2,449	1,099	2,061	1,432	955	1,565	1,182	1,144	2,807
~95% Confidence interval	841-2,299	1,606-3,735	638-1,893	1,359-3,124	905-2,267	547-1,667	854-2,869	627-2,231	548-2,389	1,078-7,313
Range of states of nature	484-2,453	841-4,318	351-1,938	643-3,613	447-2,383	302-1,515	520-2,373	390-1,771	367-1,699	991-3,745
Depletion	16.9%	17.9%	19.5%	22.0%	24.3%	26.4%	28.3%	29.9%	31.3%	32.4%
~95% Confidence interval	NA	NA	NA	NA	NA	NA	NA	NA	23.1-9.4	24.1-40.7
Range of states of nature	8.1-26.2	7.6-28.8	7.7-32.2	8.5-36.4	9.3-40.6	10.0-44.4	10.6-47.9	11.1-50.9	11.4-53.4	11.7-55.6

[1]Excludes all at-sea whiting, recreational and research catches.
[2]Includes the Columbia and Vancouver INPFC areas only.

Table i. Summary of canary rockfish reference points from the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

Quantity	Estimate	~95% Confidence interval	Range of states of nature
Unfished spawning stock biomass (SB_0, mt)	32,561	30,594-34,528	34,262-31,498
Unfished 5+ biomass (mt)	86,036	NA	91,980-82,744
Unfished recruitment (R_0, thousands)	4,210	3,961-4,458	4,540-4,035
Reference points based on SB$_{40\%}$			
MSY Proxy Spawning Stock Biomass ($SB_{40\%}$)	13,024	12,237-13,811	12,599-13704.7
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	54.4%	54.4-54.4	45.8-68.5
Exploitation rate resulting in $SB_{40\%}$	0.0457	NA	0.0277-0.0600
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	1,574	1,477-1,672	996-2,034
Reference points based on SPR proxy for MSY			
Spawning Stock Biomass at SPR (SB_{SPR})(mt)	11,161	10,487-11,835	1,654-14,053
$SPR_{MSY\text{-}proxy}$	50.0%	NA	NA
Exploitation rate corresponding to SPR	0.0528	NA	0.0524-0.0539
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	1,572	1,476-1,668	238-1,962
Reference points based on estimated MSY values			
Spawning Stock Biomass at *MSY* (SB_{MSY}) (mt)	12,211	11,529-12,893	9,524-15,042
SPR_{MSY}	52.5%	52.1-52.8	37.0-70.5
Exploitation Rate corresponding to SPR_{MSY}	0.0487	NA	0.0254-0.0794
MSY (mt)	1,578	1,481-1,675	1,002-2,104

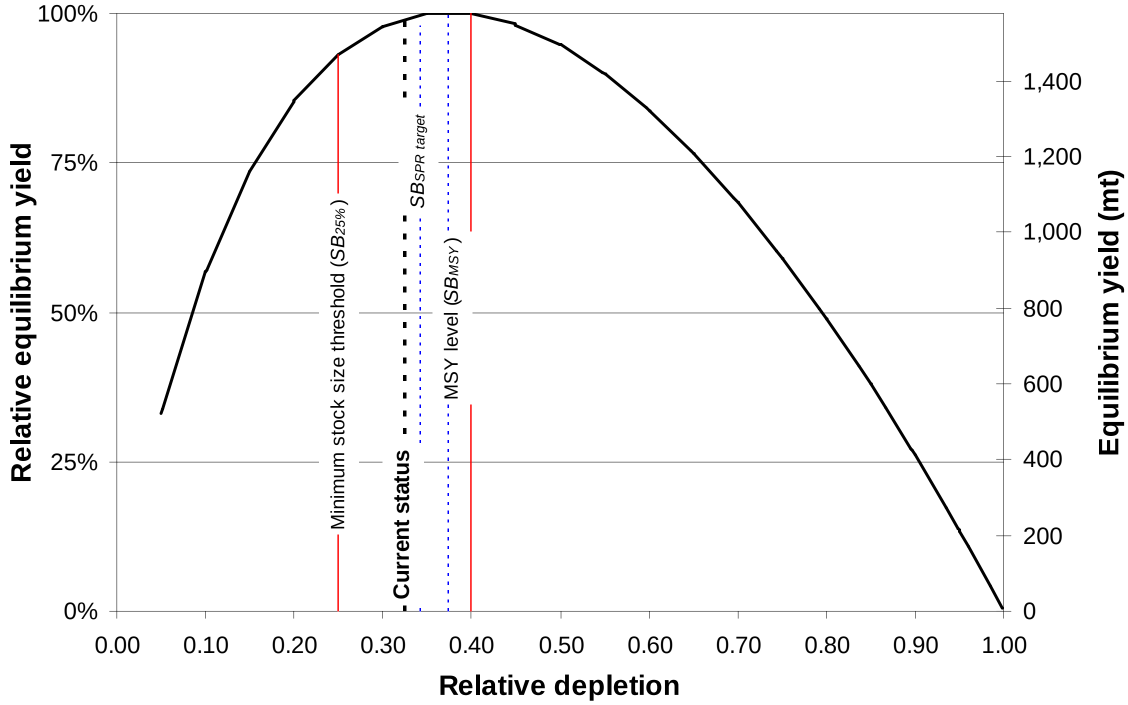

Figure h. Equilibrium yield curve (derived from reference point values reported in table i) for the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

1. Introduction

1.1 Distribution and Stock Structure

Canary rockfish (*Sebastes pinniger*) are distributed in the northeastern Pacific Ocean from the western Gulf of Alaska to northern Baja California; however, the species is most abundant from British Columbia to central California (Miller and Lea 1972, Hart 1973, Love et al. 2002). Adults are primarily found along the continental shelf shallower than 300 m, although they are occasionally observed in deeper waters. Juvenile canary rockfish are found in shallow and intertidal areas (Love et al. 2002).

There exists little direct information regarding the likely stock structure of canary rockfish off the U.S. Pacific coast. Limited tagging research conducted off Oregon found that of 10 canary rockfish recovered, 4 moved over 25 km, and 3 moved more than 100 km (DeMott 1983). A single canary from that study moved 326 km to the south, and those that moved the farthest also moved to much greater depths than the shallow reefs at which they had been tagged. Early genetic research found patterns suggestive of some population structuring between the northern California/southern Oregon and northern Oregon/southern Washington, but this work was based on limited sampling and also found evidence of reduced gene flow between shallow and deeper areas (Wishard et al. 1980). There is ongoing research on the population genetics of canary rockfish, which may be more tractable with modern methods such as microsatellites (Gomez-Uchida et al. 2003), however there is currently no published research indicating separate stocks of canary rockfish within U.S. waters.

There are few biogeographic boundaries clearly applicable to rockfish on the U.S. and Canadian west coasts. South of Point Conception, a much different and more diverse mix of rockfish species occurs than farther to the north (Love et al. 2002). However, canary rockfish are not found in large numbers south of Point Conception. The divergence zone at the northern edge of Vancouver Island likely creates a barrier for pelagic dispersal and productivity for many species (Ware and McFarlane 1989); therefore it is the southern portion of the B.C. canary resource is most likely to have dynamics linked to the U.S. resource. It is likely that canary rockfish cross the U.S. Canadian border as pelagic larvae, juveniles, and possibly adults making their ontogenetic shift to deeper water or moving between areas of rocky habitat.

The 2002 assessment integrated what had previously been separate north-south assessments based on the observations of highest density occurring near headlands and International North Pacific Fisheries Commission (INPFC) boundaries commonly used to delineate management and assessment areas (Methot and Piner 2002). They reasoned that splitting stocks or assessments at any INPFC boundaries would divide high-density areas that most likely are biologically linked. This logic was followed in the 2005 assessment, separating fishing fleets geographically (Figure 1) to account for potential spatial patterns while retaining a coast-wide assessment area (Methot and Stewart 2005). All U.S. assessments have used the U.S.-Canadian border as the northern boundary for the stock, although the basis for this choice appears to be largely based on consistency with current management needs.

Given the lack of clear information regarding the status of distinct biological populations, this assessment treats the U.S. canary rockfish resource from the Mexican border to the Canadian border as a single coast-wide stock.

1.2 Life history and ecosystem interactions

Canary rockfish spawn in the winter, producing pelagic larvae and juveniles that remain in the upper water column for 3-4 months (Love et al. 2002). These juveniles settle in shallow water around nearshore rocky reefs, where they may congregate for up to three years (Boehlert 1980, Sampson 1996) before moving into deeper water. The mean size of individuals captured in the trawl survey shows a characteristic ontogenetic shift to deeper water with increasing body size (Figure 2). The degree to which this ontogenetic shift may be accompanied by a component of latitudinal dispersal from shallow rocky reefs is unknown.

Adult canary rockfish primarily inhabit areas in and around rocky habitat. They form very dense schools, leading to an extremely patchy population distribution that is reflected in both fishery and survey encounter rates (see discussion of data below). This distribution may have effects on the calculation and interpretation of population indices and age- or size-composition data.

Canary rockfish are reported to have a diverse diet. Pelagic juveniles consume copepods, amphipods and krill; adults consume krill and many species of small fish (Love et al. 2002). The degree to which variability in food supply may affect body condition, spawning success or annual growth is unknown. Canary rockfish are a medium to large-bodied rockfish; achieving a maximum size of around 70 cm. Female canary rockfish reach slightly larger sizes than males.

Canary rockfish are relatively long-lived, with a maximum observed age of 95 years, however only males are commonly observed above the age of 50, while females tend to be rare above age 30. The degree to which this pattern reflects behavioral differences translating to reduced availability to fishery and survey fishing gear, or an increase in relative mortality for older females has been the focus of much discussion and remains unclear. A similar pattern has been observed for yellowtail rockfish (*Sebastes flavidus*), a closely related, but more pelagic species with a similar distribution (Wallace and Lai 2005).

Although ecosystem factors have not been explicitly modeled in this assessment, there are several important aspects of the recent California current ecosystem that appear to warrant consideration. Lingcod, a potentially important predator of small canary have rebuilt over the last decade from an overfished level to over 50% of the estimated unexploited equilibrium spawning biomass (Jagielo and Wallace 2005). To the extent that the component of natural mortality of canary rockfish added by predation from lingcod and other predators has been increasing over recent years, recruitment may be underestimated. This effect could also lead to longer than predicted rebuilding times for canary rockfish. The effects of the Pacific Decadal Oscillation (PDO) on California current temperature and productivity (Mantua et al. 1997) may also contribute to non-stationary dynamics for canary rockfish. The prevalence of a strong 1999 year-class for many west coast groundfish species suggest that environmentally driven recruitment variation may be correlated among species with relatively diverse life-history strategies. Much research is currently underway to explore these phenomena, and it appears likely that more explicit exploration of ecosystem processes and influences may be possible in future canary rockfish stock assessments.

1.3 Historical and Current Fishery

The rockfish fishery off the U.S. Pacific coast developed first off California late in the 19th century and was catching an average of almost 2,500 metric tons per year over the period 1916-1940 (Bureau of Commercial Fisheries 1949). To the north, the rockfish fishery developed slowly and became established during the early 1940s, when the United States became involved in World War II and wartime shortages of red meat created an increased demand for other sources of protein (Harry and Morgan 1961, Alverson et al. 1964). Rockfish catches dropped somewhat following the war, and were generally stable from the 1950s to the 1960s.

Historically, the vast majority of canary rockfish off the U.S. Pacific coast have been harvested by commercial trawling vessels, followed by hook-and-line (primarily vertical longline), shrimp trawls, and various miscellaneous gears (e.g., nets and pots). In 1977, when the Magnuson Fishery Conservation and Management Act (MFCMA) was enacted, the large foreign-dominated rockfish fishery that had developed since the late 1960s was replaced by a domestic fishery that continues today. Canary rockfish were also sought by recreational anglers and considered to be a moderately important species caught in the private vessel and charter boat fisheries off Washington, Oregon, and northern California.

A full description of the historical catch reconstruction for canary rockfish is provided under "2.3.1 Historical fishery reconstruction". Reconstructed historical catches from 1916 to 2006 ranged from 46.5 mt in 2004 to 5,544 in 1982 and totaled almost 150,000 mt over the time-series (Figure 3). Canary rockfish have been caught primarily by the trawl fleets, on average comprising ~85% of the annual catches, with the Oregon fleet removing a peak of 3,941 mt in 1982. Historically just 10% of the catches have come from non-trawl commercial fisheries, although this proportion reached 24% and 358 mt in 1997. Recreational removals have averaged just 6% of the total catch, historically, but have become relatively more important as commercial landings have been substantially reduced in recent years, recreational catches reached 59% of the total with 30 mt caught in 2003. Total catches after 1999 have been reduced by an order of magnitude in an attempt to rebuild a stock determined to be overfished on the basis of the 1999 assessment (Figure 4). Recent fishery removals (landings and discards) have been distributed very heterogeneously across the coast relative to total trawl effort, with a very few locations producing most of the canary catch (Figure 5).

1.4 Management History and performance

The first regulations established on the canary rockfish fishery off the U.S. Pacific coast were implemented in 1983 as trip limits (40,000 lb per trip) on the Sebastes complex (a market category that includes mixed-rockfish species) harvested from the U.S. Vancouver and Columbia INPFC areas (PMFC, 2002). Commercial vessels were not required to separate most rockfish catches into individual species, but rather, only into mixed-species categories, such as the Sebastes complex. Port biologists in each state routinely sample particular market categories (e.g., Sebastes complex) to determine the actual 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). Stratified, multistage sampling designs are currently used in the port sampling programs for purposes of evaluating the species compositions of the total landings, as well as for obtaining biological data on individual species (Crone 1995, Sampson and Crone 1997).

From 1983 through 1994, canary rockfish were monitored as part of the Sebastes complex, with various trip limits imposed over this 10-yr span. In 1993 and 1994, commercial fishermen communicated that fewer canary rockfish were being caught in their rockfish tows (PMFC, 2002). The 1994 canary rockfish stock assessment (Sampson and Stewart 1994) confirmed that the observed declines in the field were likely the result of a population that had not responded favorably to recent levels of fishing pressure and further recommended that the canary rockfish quota (Acceptable Biological Catch or ABC) be reduced to allow the stock to recover. Beginning in 1995, the ABC for canary rockfish was reduced nearly 60%, to 1,250 mt. In 1995, trip limits specific to canary rockfish (cumulative monthly trip limit of 6,000 lb) were imposed and commercial vessels were expected to sort the canary rockfish from the mixed-species categories, such as the Sebastes complex. For 1998, catches of canary rockfish were regulated using a two-month cumulative trip limit of 40,000 lb for the Sebastes complex, of which, no more than 15,000 lb (38%) could be composed of canary rockfish, i.e., although this species was allocated its own market category, it is still being managed as part of the mixed-species complex. The ABC was further reduced to 1,045 mt.

The two stock assessments conducted in 1999 (California and Washington-Oregon) found the stock to be depleted and an overfished determination was made for 2000. Subsequently, commercial and recreational fishing opportunities were severely restricted and recent removals have been primarily from bycatch. Canary rockfish have become a limiting species for fisheries that target other commercially important species on the continental shelf. The OY in 2003 was 44 mt; only about 1% of the peak annual catches of the early 1980s. Management regulations were sufficiently strict to keep the catch that year to only 51 mt. Canary rockfish remains one of the most intensively followed species by regulatory agencies, NGO's (conservation groups) and industry. Table xx summarizes the coast-wide ABC's and catch in recent years.

Beginning in 2000, shelf rockfish species (including canary) could no longer be retained by vessels using bottom trawl footropes with a diameter of greater than 8 inches. The use of small footrope gear increases the risk of gear loss in rocky areas. This restriction was intended to provide an incentive for fishers to avoid high-relief, rocky habitat, thus reducing the exposure of many depleted species to trawling. This incentive was reinforced through reductions in landing limits for most shelf rockfish species.

During 2002 the "Rockfish Conservation Area" (RCA) was implemented to reduce bycatch of overfished rockfish species such as canary in the northern portion of the coast and bocaccio rockfish in the south. The RCA has since been used as a management tool in each year, prohibiting most commercial fishing on the continental shelf. Specific boundaries for the RCA have varied between bimonthly periods in response to changing discard rates and fishery dynamics. In 2003, the shoreward boundary of the RCA ranged from the shoreline to 100 fm (183 m), and the seaward boundary from 200 to 250 fm (366-457 m). Small-footrope gear was required shoreward of the RCA when these areas were open, and retention of canary rockfish was limited to 100 to 300 lbs per month for the limited entry trawl fisheries north and south of 40º10'. Retention of canary rockfish was prohibited in the limited entry fixed gear fishery. In 2004, the shoreward boundary of the RCA ranged from the shoreline to 75 fm (137 m) and the seaward boundary from 150 to 250 fm (274-457 m). This dynamic pattern of the closed area extending from the shoreline (or 75 fm) out to 150 fm (274 m), 200 fm (366 m) or 250 fm (457 m) has continued through 2007. Deeper depths are generally closed in the winter months and there are a number of latitudinal differences in the extent of the current RCA, however the large majority of depths deeper than 75 fm (137 m) where canary rockfish occur are now closed to all commercial on-bottom fishing for groundfish. It is possible that by closing most of the depth range of the species the RCA has influenced the size range of canary rockfish available to the fishery. Smaller canary rockfish are available to the fishery when the shoreward boundary is set at 137 m, while some of the larger fish may occur in the closed area.

Bimonthly trip limits have remained very small in recent years. Beginning in 2005, the modified "flatfish" trawl gear has been required shoreward of the RCA. This gear was found to reduce the catch-per-unit-effort of canary rockfish relative to standard commercial gear in pilot experiments (King et al. 2004).

Recreational limits have also been substantially reduced over recent years. After first reducing bag limits, since 2003 all three states have allowed no retention of canary rockfish during recreational fishing. Mortality associated with this fishery is now comprised of discard mortality from fish that are caught while targeting other species such as Pacific halibut (*Hippoglossus stenolepis*) or other rockfish.

Beginning in 2000, when the stock was first managed as an overfished species management harvest guidelines were dramatically reduced (Table 1). Since that time, the fishery has been far below ABC levels (< 300 mt). Although commercial landings have been well below OY values, total catch has exceeded the OY in most recent years (Table 1, Figure 4). The cumulative ABC from 2000-2006 has been 1,820 mt, with the associated OYs summing to less than one-third of that value, at 571 mt. Cumulative commercial landings have been just 190 mt, however the best estimate of total catch, based on discard estimates and other sources of mortality has been 645 mt.

1.5 Fisheries in Canada and Alaska

Canary rockfish in Canadian waters appear to have similar life-history characteristics (Stanley et al. 2005). Longevity appears consistent with our coast, with a maximum observed age of 84 years, although they may mature somewhat later, around 13 years old. The rapid disappearance of females older than age 20-25 is clearly observed in the Canadian samples summarized in 2005 (Stanley et al. 2005; p.15).

The canary rockfish resource in Canadian waters is estimated to be stable in each of three areas: the coast of Vancouver Island, central Queen Charlotte Sound and the north coast (Stanley et al. 2005). Removals by the trawl fishery have been relatively stable since 1996 (Figure 6) at just under 500 mt for the Vancouver Island area, but were around twice that level over the preceding decade. Indices of abundance for the west coast of Vancouver Island indicate a decline of 29-77% (shrimp survey) and 92-95% (U.S. triennial trawl survey extending into Canadian waters in a few years) of values observed in the mid-1970s (Stanley et al. 2005), indicating a trend similar to that observed in the U.S. over this time period.

It is difficult to conclude what the current status of canary rockfish is off Alaska. In the federal waters off the Gulf of Alaska, canary rockfish are assessed and managed as a minor part of an assemblage including seven species of demersal shelf rockfishes (DSR; O'Connell et al. 2005, O'Connell and Carlile 2006). The primary component of this 'non-commercial' group is yelloweye rockfish (*Sebastes ruberrimus*), although quillback (*Sebastes maliger*), copper (*Sebastes caurinus*), china (*Sebastes nebulosus*), tiger (*Sebastes nigrocinctus*) and rosethorn (*Sebastes helvomaculatus*) are also included. The primary biomass estimate of yelloweye rockfish is based on submersible observations. The exploitable biomass of yelloweye was estimated to have increased 5% from 2005 to 19,558 mt in 2006. Recent removals indicated that overfishing is not occurring. The ABC for yelloweye was inflated by 4.2% in 2006 to account for the other species in the assemblage based on the relative species distribution of the catch. Canary rockfish have comprised around 1% of the DSR catch over the period 2001-2005, accounting for < 4 mt each year. No direct indices of canary abundance in the Gulf of Alaska have been reported.

2. Assessment

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 2003-2006 (NWFSC survey) and 1980-2004 (Triennial survey)
2) Pre-recruit survey index of recruitment strength from 2001-2006
3) Estimates of fecundity, maturity, length-weight relationships and ageing error from various sources
4) Commercial (targeted and bycatch) and recreational landings from 1916-2006
5) Estimates of discard rates, total mortality and discard mortality (recreational only) from various sources
6) Research catches from 1977-2006
7) Fishery biological data (age and length) from 1968-2004

Data availability by source and year, as well as a delineation between data available for the 2005 assessment and what is new in this analysis, is presented in Table 2. A description of each of the specific data sources is presented below.

2.1 Fishery Independent Data

2.1.1 NWFSC trawl survey

Since the completion of the 2005 canary rockfish stock assessment, a large quantity of data from a new fishery independent source, the NWFSC shelf and slope trawl survey, has become available. Three sources of information are produced by this survey: an index of relative abundance, length-frequency distributions, and age-frequency distributions. Since canary rockfish are only found on the continental shelf, only those years in which the NWFSC survey included the shelf depths are considered here (2003-2006).

The NWFSC survey is based on a random-grid design; covering the coastal waters from a depth of 55 m to 700 fm (technical memoranda describing the specific methods used in this survey are currently in review). This design uses four vessels per year, assigned to a roughly equal number of randomly selected grid cells divided into two 'passes' of the coast 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 encounters canary infrequently, generally in less than 10% of the total tows conducted (Table 3, including slope tows, beyond the depth distribution for canary). However, when canary aggregations are encountered catches can be as large as 4.9 mt in a single 12-15 minute tow; this equates to an average density of approximately 1 kg $\cdot 2.5\ m^{-2}$. During the period 2003-2006, there have been only 5 tows that captured more than 200 kg of canary rockfish, 2004: 924 kg, 2005: 907 kg, 2006: 4,942, 1,250 and 653 kg. These large tows and many of the smaller ones are located primarily off the northern Washington coast near the Canadian border, or off northern California (Figure 7). The presence of infrequent very large tows creates a strongly right-skewed distribution of catch rates, still visible after log-transformation (Figure 8). These very large catches do not appear to be dominated by either very large individuals or very small individuals (Figure 9), indicating that these areas represent neither recruitment 'hot-spots', nor unexploited 'pockets' of very old canary rockfish.

Two indices of abundance are available from this time series: a design-based estimator relying on the mean catch-per-unit-effort in each of several strata, and an index based on a Generalized Linear Mixed Model (GLMM) approach which was endorsed by the trawl survey workshop for use in west coast stock assessments. These two methods are based on fundamentally different approaches to the data. In the GLMM approach, vessel-specific differences in catchability (due to engine power, trawling experience of the skipper, etc.) are explicitly captured via inclusion of random effects. In contrast, the design-based estimator relies on the balance of the design (which may be difficult to assess, given that this balance must occur through random allocation of cells in quality habitat for the species of interest). Further, due to the presence of a large number of tows capturing none of a given species and a few tows showing very high catch rates, the design-based estimator may be very sensitive to one or a small number of very large tows. The GLMM approach explicitly models both the zero catches as well as allows for skewness in the distribution of catch rates through the use of a Gamma or lognormal error structure. These factors result in the GLMM approach being much more robust to a few large tows and likely more reflective of actual trends in population abundance, especially for patchily-distributed or infrequently encountered species like canary rockfish.

The biomass index based on either method shows similar trends of relatively flat biomass over the period 2003-2005 and an increase in 2006 (Table 4, Figure 10). The increase in the design-based estimator, largely a function of the 3 large tows in 2006 is clearly biologically implausible, and the associated variance renders this point quite uninformative in an assessment model context. In contrast, the 2006 value for the GLMM based estimator, while still heavily leveraged by the single very large tow in 2006 (Figure 11), is at least on the same order of magnitude as the rest of the time-series, although the variance remains large.

Survey catches of smaller canary (< 40 cm, the length at 50% maturity) show a spatial pattern that differs from total catch rates. Small canary are encountered across the coast, with no very large catch rates, but many smaller ones, especially in Central and southern California (Figure 12). This pattern differs substantially from catches observed in the triennial survey (see section below) even in 2004 (Figure 13), when both surveys were conducted nearly simultaneously. This is perhaps related to differences in survey design; the NWFSC design being randomized, while the triennial survey included limited searches from fixed transect lines (Figure 14); however this link is speculative at best. However, the NWFSC survey has expended slightly greater relative effort in shallow water where small canary might be more common than the triennial survey (Figure 15).

Twenty-eight bins from 12 to 66 cm were used to summarize the length frequency of the survey catches in each year, the first bin including all observations less than 12 cm and the last bin including all fish larger than 66 cm. These bins are populated with a modest, but consistent degree of sampling: 32-56 tows and 423-623 fish per year (Table 5). Broadly, the length frequency distributions for the NWFSC survey from 2003-2006 show a range of sizes captured from a few 12-14 cm individuals out to some 64 cm females (Figure 17). No clear cohorts, nor any obvious trend, are visible in the length data; however the size distributions for both males and females in 2006 showed very few small canary rockfish.

Age-frequency data from the NWFSC survey was compiled 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 to using conditional age-composition observations is that in addition to being able to estimate the basic growth parameters ($L_{age\text{-}1}$, $L_{age\text{-}20}$, K) inside the assessment model, the distribution of lengths at a given age, usually governed by two parameters -- the CV of length at some young age and the CV at a much 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, that 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 for the NWFSC trawl survey age data.

Age distributions included 35 bins from age 1 to age 35, with the last bin including all fish of greater age. Approximately half as many fish were sampled for age as for length, but these fish were collected from a similar number of tows (Table 5). These distributions show a tight range of ages at a given length, and clearly show the growth trajectory of females reaching larger sizes than males for a given age (Figure 18). It is often useful for interpretation to compute the marginal age-compositions, and include these in the assessment model (with the likelihood contribution turned off, so they do not affect model fit in any way) for comparison of the ‘implied’ fit to the margin of the age-length key. The marginal age compositions allow for easier visual tracking of strong cohorts (although this information is still imparted to the model using conditional age-at-length observations, it is harder to visualize) and offer a view of the data more familiar for those accustomed to diagnosing model fit based on marginal age-composition data. Although these NWFSC age distributions seem to show some diagonal structure, close inspection reveals that it does not track consistently through any of the recent cohorts (Figure 19). This time series is short, and does not encompass the period when substantial reductions in the canary population occurred, and so may be relatively uninformative in the assessment model, except for estimation of growth parameters.

2.1.2 Triennial trawl survey

The largest source of fishery-independent data regarding the abundance of canary rockfish is the triennial shelf trawl survey conducted by NMFS starting in 1977 (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. In some parts of the coast this led to a very non-random allocation of stations with regard to the entire shelf area (Figure 14). In general, all of the surveys were conducted in the mid summer through early fall: the survey in 1977 was conducted from early July through late September; the surveys from 1980 through 1989 ran from mid July to late September; the survey in 1992 spanned from mid July through early October; the survey in 1995 was conducted from early June to late August; the 1998 survey ran from early June through early August; and the 2001, 2004 surveys were conducted in May-July (Figure 20). The initial year of the survey in 1977 was based on a sampling design that spanned from 50 to 260 fm (91 to 475 m), i.e., it did not come as far inshore (30 fm) as the subsequent surveys conducted on a triennial basis from 1980 to 2001. The index was constrained in all years to only Monterey-US Vancouver INPFC areas and depths from 55-366m to produce the only consistent time-series available. Surveys that have extended south of Monterey have detected only very small abundances relative to the north, so lack of sampling in this area does not influence the relative index. Because of the large number of 'water hauls' eliminated in 1977, especially in the US Vancouver INPFC area, and because the sampling depths were not the same as the other years, the 1977 survey year was not used in the assessment. A full description of the water haul issue can be found in Zimmerman et al. (2001).

The bottom trawl survey provides information on the spatial distribution of canary rockfish from approximately 34 to 49° North latitude and 55-300+ m bottom depth. The pattern of increasing mean body size with depth is similar to that observed in the NWFSC survey. Catch rates are generally lower than those observed in the NWFSC survey (Figure 8), but the general areas where canary have been found recently are quite consistent (Figure 7). The small fish found shallower than 90m occur patchily along the coast, not spread over wide areas as seen in the NWFSC survey (Figure 12). Small canary rockfish were notably absent from the triennial survey in 2004, when they were observed quite frequently in the NWFSC survey (Figure 13). This is not due to sampling intensity, as the number of tows and fish sampled are similar to those in the NWFSC survey (Table 6).

A relative index of stock biomass was derived from the triennial shelf trawl survey using both the design- and GLMM-based approaches (Table 4, Figure 16). Both methods generally show a decline in the population through the mid 1990s and then a flat or slightly increasing trajectory. For the design-based approach, the catch-per-unit-effort (CPUE) index was created from the swept-area estimates of biomass (Gunderson and Sample 1980) from samples in the 30-200 fm (55-366 m) depth range. The same stratification was used for the GLMM-based estimates, which, although they show a similar trend, are somewhat lower on an absolute scale. This is likely largely due to the difference between the arithmetic mean catch rate for the design-based approach being much larger than the median of the lognormal distribution of catch rates assumed in the GLMM analysis. When plotted on a more appropriate scale, the GLMM-based index appears smoother, and shows a stronger and more consistent increase in abundance since the mid-1990s (Figure 11). This index is slightly lower than the NWFSC, indicating a difference in either catchability, selectivity (also supported by the difference in length distributions in 2004), or both. It is uncertain why the 1980 observation was lower than 1983 when the population was likely declining rapidly under very large removals, but this pattern is present for both index approaches and for other species, as well.

Size distributions (fork length in cm) were calculated following the standard estimation methods used throughout the survey series (Dark and Wilkins 1994). The numbers of fish and number of hauls represented in each year of the survey are presented in Table 6. Length-frequency distributions by sex for canary rockfish sampled in the survey for the years 1983-2004 (lengths were collected over a very limited geographic range in 1980, and have been excluded in past assessments) show a modest decline in mean size between 1983 and 2001 (Figure 21). However, relatively large fish of both sexes were again encountered in 2004.

Conditional age-frequency distributions were calculated using the same approach applied to the NWFSC trawl survey ages. These distributions were based on a very heterogeneous number of fish among years, with 1983 having the largest relative sample size and some years missing entirely (Table 6). The pattern of relatively little variation about the dimorphic growth curve is evident in the conditional plots for males and females (Figure 22, Figure 23) as it was for the NWFSC data. Note that no otoliths were analyzed from the surveys conducted in 1986 or 1998. In 1992 all age samples were taken from north of 46°N and, although the sample size is relatively small, may not be representative of the coast-wide population. When summed to the marginal distributions (again used for interpretation, but not contributing to the total likelihood) little evidence of strong or consistent cohorts is evident in either the female or male age distributions (Figure 24). The abundance of males at ages greater than 20-25 is evident in the triennial survey distributions, although the data are clearly quite noisy. This pattern is observed in all of the canary datasets available and was a topic of much investigation in the 2002 and 2005 assessments. It was generally concluded that this pattern was due to a combination of reduced availability of larger females to survey and fishery gear, as well as increased natural mortality of older females beginning after maturation (approximately 7-8 yrs); however this is a topic for continued exploration.

2.1.3 Pre-recruit survey

A mid-water trawl survey of pre-recruit pelagic juvenile rockfish (*Sebastes* sp.) and Pacific hake (*Merluccius productus*) has been conducted by the Southwest Fisheries Science Center (SWFSC) since 1981. Until 2000, this survey consisted of 1-3 passes over a relatively limited area from 36º-39º North latitude (the “core-area”) off the central California coast (roughly 25% of the U.S. coastline). Beginning in 2001, the PWCC/NWFSC contributed a second vessel, and the geographic extent of this survey was dramatically increased to cover nearly the entire U.S. coastline. The survey spanned 35º-45º from 2001-2003, 33º-47º in 2004, and 33 º-48 º in 2005-2006. In 2006, a workshop was held to evaluate the application of pre-recruit indices as auxiliary information to estimate and predict year class strengths in stock assessments and to better understand how the distribution of specific species and the extent of survey coverage might influence the use of these data (Pre-Recruit Survey Workshop, September 13-15, 2006, SWFSC, Summary Report Prepared by: J. Hastie and S. Ralston).

The pre-recruit catches of canary rockfish over this time series were compared with assessment model estimates of recruitment and the distribution of catch rates in those years with nearly coast-wide coverage (2001-2006) were compared with catch rates within the “core-area”. Smoothed catch rates by latitude show that much of the pre-recruit catch has occurred north of the “core-area” over the period 2001-2006, with 2005 and 2006 showing almost no catch south of 40º (Figure 25). Based on this analysis, the pre-recruit survey workshop recommended not using the longer core-area index for canary and other species with more northerly or southerly distributions, but instead using the shorter coast-wide index (Pre-Recruit Survey Workshop, September 13-15, 2006, SWFSC, Summary Report Prepared by: J. Hastie and S. Ralston).

Subsequent to the pre-recruit workshop, three estimators were developed as relative indices of recruitment strength based on the 2001-2006 pre-recruit catches ("Coastwide Pre-Recruit Indices from SWFSC and PWCC/NWFSC Midwater Trawl Surveys (2001-2006)", S. Ralston, SWFSC, unpublished analysis). All three of these indices showed a very similar trend for canary rockfish among recent years, with 2002 and 2004 being somewhat stronger year classes than 2001, 2003 and 2005-2006 (Figure 26). The ANOVA was the recommended approach, because it accounts for a number of likely factors influencing pre-recruit catches including depth, vessel, and period effects as well as a year x latitude interaction. In contrast to the index values, the sampling variance estimated from each approach differed substantially, with an average CV from the design-based estimator of 0.31, 0.32 from the Delta-GLM approach and 0.05 from the ANOVA-based analysis. The largest of these was used, since it had a comparable value to the CVs of the trawl surveys. This appeared preferable to merely applying a constant CV over the time series since it at least captured some of the inter-annual differences due to sampling variance. The final index used for comparison in this assessment is shown in Figure 27.

2.1.4 Canadian survey data

The NMFS triennial trawl survey extended into Canadian waters in a few years. The trend in biomass for the Canadian area has been used as a relative index of the Canadian resource off Vancouver Island and shows a declining trend similar to that observed in adjacent U.S. waters. A Canadian fishery-independent groundfish bottom trawl survey for the area off Vancouver Island was initiated in 2004, but since no more recent data is available it does not yet constitute an index. A fishery-independent shrimp survey was conducted off Vancouver Island over the period 1975-2005. This index has been quite variable, but has shown a 60-80% decline depending on how it analyzed (Stanley et al. 2005). In total, Canadian surveys for the area most likely to be linked to the U.S. resource, the waters off Vancouver Island, have shown similar declining trends to those observed for U.S. areas.

2.1.5 Other fishery independent data

A cooperative fishery independent hook-and-line survey targeting rockfish in the Southern California Bight has been conducted annually by the NWFSC using chartered sport-fishing vessels since 2004. This survey is based on multi-hook rod and reel gear similar to that used in the recreational fishery. Around 100 representative 'stations' comprised of a patch of rocky bottom or set of GPS coordinates over likely habitat are sampled each year using a fixed number of hooks for a fixed duration at each site. Catch rates, length- and age-frequency distributions as well as individual weights and genetic samples are routinely collected for all species encountered. Although this survey shows promise for use in Vermilion (*Sebastes miniatus*) and bocaccio rockfish stock assessments, few canary have yet been encountered (30 in all years combined). Data from this survey were not included in this assessment; however it may prove worth investigating in the future.

Beginning in 2005, Oregon State researchers performed hook-and-line sampling at 17 locations from Washington to California (personal communication, D. Sampson and S. Heppell, Oregon State University). This project also used chartered sport fishing vessels to sample areas of rocky habitat with known canary rockfish populations using rod-and-reel gear. During 2005 and 2006, 528 canary rockfish were collected; sex, weight, length, age, and maturity information was recorded for each. Many relatively large and old female canary rockfish were observed among the fish captured. Final assignment to sex of all sampled canary is pending histological analysis and, when complete, may be used for comparison with predicted age-and length-compositions in future assessments. The appropriate selectivity curve to apply to these data to make them comparable to model predictions is unknown, and would likely need to be derived within the assessment model.

Another cooperative project was performed by the NWFSC in 2005 to assess the applicability of using echo-integration and underwater video cameras to enumerate widow rockfish (*Sebastes entomelas*). A cable-mounted towed camera sled, and a midwater trawl net with no codend and a video camera mounted in the net were successfully used to observe both widow and canary rockfish. This project was preliminary, but documented that these species could be located and enumerated via these methods and that length-frequency data could be collected as fish were herded through the trawl gear (but not actually captured). No quantitative results are available for canary rockfish and the project has not been extended, due to reductions in funding for cooperative research.

A similar project specifically targeting canary rockfish was undertaken in 2006 by OSU researchers (personal communication, D. Sampson and S. Heppell, Oregon State University). This effort used 'rock-hopper' bottom trawl gear to sample very rough bottom habitat with a trawl net that included a camera mounted near an angled grate (instead of a cod-end) at the back of the trawl. The grate was used to move canary out of the trawl and through the field of view at a relatively fixed distance from the trawl-mounted camera. From the recorded video, fish passing through the net could be enumerated, identified to species, and length estimated based on lasers mounted with the camera. A number of trawl sets were made during 2006, and some very dense aggregations of canary rockfish were encountered. Enumeration of the fish encountered is ongoing and results, including density estimates, may be available soon, although not in time for comparison with this stock assessment (personal communication, S. Heppell, OSU). These density estimates may allow insight into the encounter rate of other surveys and commercial fishing operations of large canary aggregations as well as the size and frequency of these aggregations. Further, this type of research could provide valuable data, in the form of an index of abundance, to the canary assessment if it can be conducted in a systematic fashion over broad areas of the coast.

2.2 Biological Data

The following section outlines a number of biological parameters estimated outside the assessment model from a variety of data sources. These values are treated as fixed and therefore uncertainty reported for the stock assessment results does not include any uncertainty associated with these quantities.

2.2.1 Weight-Length

The weight-length relationship is based on the standard power function:

$$W = a\ (L^b)$$

where weight is measured in grams and length in centimeters. The parameters used are those from the 2005 assessment and represent weight-length data pooled from all sources (fishery and survey) and both sexes (Table 7, Figure 28). Canary rockfish were roughly: 0.06 kg at 15 cm, 0.51 kg at 31 cm, 1.19 kg at 41 cm, 2.31 kg 51 cm and 5.29 kg at 67 cm.

2.2.2 Maturity and fecundity

Canary rockfish off the U.S. Pacific coast exhibit a protracted spawning period ranging from September through March, probably peaking in January and February (Love et al. 2002). Like many *Sebastes* species, canary rockfish are ovoviviparous, whereby eggs are internally fertilized within females and hatched eggs are released as live young (Love et al. 2002). Past assessments have explored maturity-at-age and maturity-at-length relationships for female canary rockfish from a variety of data sources. Maturity information is generally sparse, and has not been collected in a systematic fashion across time, and does not always agree between studies. The most consistent maturity schedules have been based on specimens sampled during the months of September through February, which generally represent the spawning months for canary rockfish off Oregon and Washington. Further, to minimize biases likely present in the original sample data, maturity information for ages (and lengths) with extremely low sample sizes (e.g., <10 specimens) have been omitted from the maturity-related analysis and occasional old (and large) fish (e.g., >20 years of age and >55 cm in length) that were recorded as immature have been removed from the analysis, given the strong likelihood that the maturity of these animals was misidentified. The maturity schedule for female canary rockfish used in the 2005 assessment model was based on observations from the Oregon and Washington combined trawl fishery and is retained in the current assessment as no new maturity data are yet available. The length at 50% maturity is 40.5 cm, with only 5% mature at 29 cm and 93% by 51 cm (Table 7, Figure 28).

Although some rockfish show fecundity relationships that increase more steeply with length than does body weight (e.g., darkblotched; Rogers 2005) there are no data suggesting this pattern for canary rockfish. The only published fecundity data (Gunderson et al. 1980) show a linear relationship with length, although this is only over a limited range of lengths, and similar to the assumption that fecundity is a function of weight (Figure 29). In this assessment, fecundity was assumed to be proportional to female body weight (Table 7, Figure 28), and therefore estimates of spawning biomass, not spawning output are used in the calculation of reference points.

2.2.3 Natural Mortality

Beginning with the 1990 canary assessment (Golden and Wood 1990), this species has been modeled with a single natural mortality rate for males and young females and an increasing rate of natural mortality with age for females. Golden and Wood used an estimate of M = 0.06 for males of all ages and young females and 0.15 for old females. Subsequent assessments conducted in 1994 (Sampson and Stewart 1994) and 1996 (Sampson 1996) relied on similar model configurations and used roughly the same estimates of M, with a constant M of 0.06 for males of all ages and young females (less than 9 years of age), and age-dependent M for older females that increased in a linear fashion from 0.06 (age 9) to roughly 0.18 (age 25). Early research applicable to groundfish stocks found off the Pacific coast of Canada also indicated that old female canary rockfish were much less common in the sample data than were males, and supported total mortality estimates (Z) for males in the range of 0.03-0.07 and 0.11-0.24 for females (Archibald et al. 1981). Recent review of data for canary rockfish stock off Canada led to the conclusion that an age-averaged M of 0.02-0.04 for males and 0.06-0.08 for females was generally appropriate (Stanley et al. 2005).

This assessment remains consistent with older analyses and fixes the rate of natural mortality at 0.06 for males and young females. The degree of increase for older females (age 14+) is treated as an estimated parameter as in 2002 (there M was linked directly to maturity) and 2005.

2.2.4 Ageing Precision and Bias

Much new information has been collected on ageing error and imprecision since the 2005 assessment was completed. A cross-read study was initiated between the Cooperative Ageing Program (CAP, a joint effort between the NWFSC and Pacific States Marine Fisheries Commission that has replaced an older Oregon Department of Fish and Wildlife ageing lab) and Washington Department of Fish and Wildlife age readers. These two facilities exchanged thousands of otoliths for duplicate comparative age readings and re-read many historically collected structures that had been aged at different times and by different methods (break-and-burn or surface ageing - done prior to about 1983) and readers. An additional (and substantial) effort was made to age many structures that had been collected over the last 30 years but never aged. These new data allowed (required) a full reconsideration of ageing bias and imprecision for available methods and readers across all ageing data available for canary rockfish.

In the 2005 assessment, a single ageing error key determining the level of bias in observed vs. true age and imprecision (the degree of variability in observed age at true age) was used to 'smear' model expectations in the observation sub-model of SS2 and generate appropriate predictions to compare with observed age-frequency data (Methot 2005). Age-validation of break-and-burn age readings through the bomb radiocarbon method (Piner et al. 2005) had indicated that there was a small negative bias associated with the production aging of canary rockfish at the CAP lab. Although based on a small number of individual fish (n=16), the average production age was 2.9 years less than the estimated age via bomb radiocarbon analysis. A linear relationship assuming no bias at age 0 was fit to the observations; this fit resulted in an estimated bias of -2.77 years at age 30 (Figure 30). This relationship was applied to all ages used in the model. The appropriate level of imprecision was estimated by comparing independent readings from two age readers. It was assumed that each reader has a normal distribution of possible age readings for each fish. The standard deviation of this normal distribution was estimated by computing a normal distribution of possible ages for each age reader, computing the probability that they would agree, be off by 1, 2, 3 or 4 years, then using the Excel Solver routine to search for the value of the standard deviation that would best match the observed frequency distribution of comparisons between the two readers. All historically surface-read ages were excluded, due to known (but not quantified in the assessment) levels of bias and imprecision associated with using this method for a long-lived species (Boehlert and Yoklavich 1984).

No new radiocarbon studies have been conducted, although a simulation experiment was performed to elucidate whether the small sample size associated with the 2005 study would translate into more uncertainty in the stock assessment results if the degree of bias were estimated inside the assessment model likelihood (I. Stewart and K. Piner, manuscript in review). The result of this exercise was that this source of uncertainty did translate into slightly wider confidence intervals for management quantities. Further, it was found that the assumption of linear bias was appropriate (relative to two other functional forms) given information in the other data in the assessment model, and that increases in the sample size were unlikely to resolve the uncertainty in functional form.

For the current 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 (personal communication).

Very close agreement was observed between recent CAP ages and older reads done by ODFW during the mid-1980s (Figure 31). This consistency within a single facility over time is not surprising, as break-and-burn methods and equipment have not changed substantially over this period and experienced readers generally train their replacements and others in the lab. When CAP and ODFW ages were compared with recent WDFW ages, a slight negative bias was observed for the CAP ages, especially for the oldest fish in the samples (Figure 32). This pattern was in part responsible for the recent additional work completed by WDFW and very consistent with the estimates of bias generated by the radiocarbon validation (Piner et al. 2005).

Re-ageing of historical samples read by ODFW for WDFW in the mid-1980s revealed two problematic issues. Very large dispersion, was observed in comparative reads (as much as 50-60 years in some cases) indicating that some type of error had occurred in the raw data, transfer of data between labs, or translation of data between databases over time (Figure 33). Because of this result these age data were not included in the current assessment, and an extensive effort to supplement those years with recent age reading was made by WDFW where additional samples existed that had not previously been aged. The end result was that the sample sizes remained roughly equivalent for the Washington fishery over that time period but the quality of the data has been substantially improved. Second, an excess of fish aged to be 25 years old was observed (Figure 33). It was discovered that this pattern existed only for a small subset of years in the mid-1980s and was due to an effort to make the ageing process more efficient. Specifically, the ager would not spend large amounts of additional time counting rings beyond the oldest age used in stock assessments at the time (25), but would just record the age as 25+, the "+" not being carried through from paper to electronic data. The few cases of this type of age "binning" that remained in the ODFW and WDFW databases were re-aged for consistency with current needs (this and recent assessment models explicitly deal with fish to 35 years).

A further comparison of historical surface-read ages and current WDFW break-and-burn techniques was also performed. Like many other species (Boehlert and Yoklavich 1984), surface methods for canary appear quite biased above approximately age 20, and never record ages in excess of about 40 years (Figure 34).

A statistical program to simultaneously estimate bias and imprecision from multiple ageing methods was written by A. Punt, (University of Washington) for use in generating inputs to SS2. This program estimates the underlying age distribution of a sample from up to four double- or cross-reads for each age structure, 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 bias (none, linear, type 2) and the imprecision (constant CV, or type 2 increase in CV with age). Because the technique requires that the underlying age structure of each sample be estimated, a reasonably large quantity of data spread over the entire range of ages present in the sample is needed (personal communication, A. Punt, unpublished results). A few very old ages do not contribute appreciable information but require many more parameters in the underlying model and create instability during estimation. For this reason, each analysis must be truncated at a maximum age that is well represented in all samples.

Four separate canary rockfish data sets were available for this analysis: 1) CAP x CAP/ODFW, 2) WDFW x surface, 3) WDFW x CAP and 4) WDFW x WDFW x CAP. Evaluation of these data showed a very long tail of old ages, with most of the individual reads between the ages of ~5-20 (Figure 35). Exploration of the estimability of ageing bias and imprecision over various maximum ages resulted in the choice of age 20 as the largest age to include in the analysis. A step-wise approach to complexity resulted in a final model where WDFW ages were assumed to be unbiased and have a linear CV with age, CAP/ODFW ages had a linear bias and linear CV, and surface ages had a type 2 form of bias and linear CV. Functional forms were extrapolated from age 20 to age 35, the maximum age in the assessment model (Figure 36). The relationships obtained from this analysis were very consistent with both visual inspection of the raw data, and comparison with the radiocarbon analysis used in the 2005 assessment (Table 8, Figure 32, Figure 34).

2.2.5 Research removals

Research catches have historically been only a tiny fraction of the total removals from the canary rockfish population. However, as total mortality has been very low since 2000, the relative contribution of research removals to the total has increased. This was particularly true in 2006, when research catches comprised 7.8 mt out of an estimated 47.1 mt of total removals (Table 9). Research catches are now explicitly accounted for in the stock assessment.

2.3 Fishery Dependent Data

2.3.1 Historical Catch Reconstruction

In the 2005 assessment, a reconstruction of historical removals was undertaken to more realistically reflect both the cumulative removals that have occurred from the coast-wide canary rockfish population as well as capture some of the variability during the time series. Documented landings of "rockfishes" were assembled from a variety of sources; this type of aggregated data was all that was available as individual species were not routinely identified until the 1960s. Since most landings were not identified by gear type, the focus of this effort was directed at trawl landings or mixed categories. Results are shown in Figure 3 and Table 9.

By state, historical catches were derived via the following data sources and methods:

California: Previous assessments used a ratio of 0.176 trawl-caught canary rockfish to total rockfish catch over the period 1942-1963. Based on landings derived from the California Department of Fish and Game bulletins summarized in a historical review (Bureau of Commercial Fisheries 1949), this ratio was applied back to the beginning of fully documented landings in California in 1916. Fish and Wildlife Service current fishery statistics series documents were available for nearly all of the period 1942-1964 (1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965) and closely matched the total from the source above and the implied total from the ratio. The division of these landings between the northern and southern fleets was unknown, so they were included as aggregate observations, but it seems likely that the removals may be appropriately characterized through the northern selectivity pattern, as the stock would have been quite lightly exploited during this period. A similar approach was used to reconstruct the California non-trawl landings, although these fleets represented a much smaller proportion of the total rockfish category (0.034). Early reports indicate that rockfish comprised only 5% of the total catches of the early non-trawl fishery in California (Clark 1935), and that the proportion of nearshore species, such as black rockfish (*Sebastes melanops*) may have been much higher in the early years (before the mid 1940s) of the non-trawl fishery (Scofield 1948, Phillips 1964). However, this landings reconstruction generates reasonable cumulative total removals prior to that period, and the reconstructed series is quite close to the series used in the 2002 assessment.

Oregon: For the previous assessment, as time-series of total rockfish landings was derived from the following sources: 1928-1949 from Cleaver (1951), 1950-1953 from Smith (1956), 1954-1955 from Fish and Wildlife Service current fishery statistics series (1955, 1956), 1956 from the Pacific Fisherman Yearbook (1957), 1957-1961 from the Fish and Wildlife series (1958, 1959, 1960, 1961, 1962), 1962-1967 from the Oregon fish commission (Meierjurgen et al. 1966) and 1968-1970 from the Pacific Marine Fisheries commission annual reports (1970a, 1971). Additional series were available from the Fish and Wildlife series 1942-1953, 1962-1964, the Pacific Fisherman yearbook series from 1944-1945 (1947), and the National Fisherman 1968-1969 (1970b). There was very close agreement between the landings from these additional series and the series used in the reconstruction. For the period 1967-1970, the ratio of canary landings to the total rockfish landings was 0.241 (range = 0.075-0.374). This ratio was applied throughout the time series to approximate the canary landings by year.

Washington: Total rockfish catch prior to 1967 was derived for the current assessment from the following sources: 1930-1941 and 1956 from the Pacific Fisherman yearbook, 1942-1955 and 1957-1964 from the Fish and Wildlife series, 1965-1970 from the Pacific Marine Fisheries Commission reports. These series were quite similar with two exceptions, the catches from 1945, estimated to be 7,300 mt in the Pacific Fisherman Yearbook and 11,552 mt in the Fish and Wildlife series, and the landings from 1958-1960. The Fish and Wildlife statistics were used where available, because they specifically excluded Pacific ocean perch (POP) landings, where the Pacific Fisherman yearbook was somewhat unclear on whether POP had been included in the rockfish totals or not. The landings from the Pacific Fisherman in 1963-1966 and the National Fisherman 1967-1968 were much higher than the PMFC reports, also presumably due to the inclusion of POP. For the period 1967-1970, the ratio of U.S. canary landings to the total rockfish landings was 0.079 (range = 0.050-0.119). This ratio reflects the exclusion of both the portion of the landings caught in Canadian waters, estimated to be 0.149 in 1953 (Alverson 1956), and the portion of the total rockfish landings that are specifically canary, estimated to be 24% in Oregon by the above ratio. This value, 0.079, was applied throughout the time series to approximate the Washington canary landings by year.

No further changes were made to the historical reconstruction during this assessment, as no new information has become available.

2.3.2 Recent Landings (1981 to present)

Recent landings reflect the most current information from the PacFIN, CalCOM, NORPAC, RECFIN and State recreational databases. Commercial landings estimates of canary rockfish from 1981 to 2006 were generated from the PacFIN database (Extraction: June, 2007, Daspit et al. 1997) for Oregon and Washington. California commercial landings were based on the CalCOM data and species and gear expansions for the period prior to 1981 where the two sources do not currently agree. The at-sea catches occurring incidentally to the whiting fishery were generated from the NORPAC database (V. Tuttle, personal communication) and included in the trawl totals.

A new commercial fleet is included in this assessment in an effort to better describe the current removals from the canary rockfish resource and to best utilize all of the available biological data. Bycatch of canary rockfish in the at-sea whiting fishery has previously been added to trawl fishery removals, and biological sampling information used for comparative purposes only. This source is now treated as a separate fleet, so that both removals and biological data can be included following the same methods applied to other fleets. This source of mortality occurs as a very small percentage (by weight) of canary bycatch during midwater trawling for whiting. Mandatory on-board observers sample as many rockfish as possible (focusing on overfished species) in addition to their primary goal of sampling whiting as they are processed.

2.3.3 Discards

Discard of canary rockfish by commercial trawling vessels was assumed to be minor prior to 1995, when trip limits specific to this species went into effect. Some research

(Sampson and Stewart 1994, from: Pikitch et al., 1988), indicated that market-induced discard (e.g., unacceptable sizes or lack of a market) was insignificant and the small amounts (roughly 1%) of discard in the 1980s and early 1990s were due to management-related causes (e.g., regulations on rockfish species in general). In the 1996 assessment (Sampson 1996), a discard rate of 1.23% was developed for trawl-related catches made from 1983 to 1994, when canary rockfish where regulated as part of the Sebastes complex, and a rate of 16% was used for 1995. The 16% discard rate for the trawl fishery was established by the Groundfish Management Team (GMT) of the Pacific Fishery Management Council (PFMC) following discussions regarding predicted levels of discard (150 mt) associated with the newly adopted harvest guideline in 1995 for canary rockfish in the northern INPFC areas (roughly 1,000 mt). The value of 16% was based on the discard rate calculated for widow rockfish as part of the Pikitch et al. study (1988).

The 2005 assessment used the discard rates developed in previous assessments up to 1999. These were 0.0123% for all commercial fleets until 1994 and then 16% for all commercial fleets until 1999. Beginning with the year 2001, there were discard observations collected by the West Coast Groundfish Observer Program that were considered applicable to some fleets. The trawl fleets had a discard rate based on at-sea observer data on a year-specific basis for 2002-2004, with pooled estimates from all years used to generate estimates for 2000-2001 (2000 was included because regulatory changes in footrope size made this year more similar to the subsequent period than the late 1990s). These estimates ranged from 14.8% (California trawl fleet in 2000) to 75.7% for the Washington trawl fleet in 2000, and are given in Table 10. The non-trawl fleets were assumed to have discarded 4 mt coast-wide in each year, based on the total discard mortality calculated for 2003 associated with nearshore rockfish fisheries and the fixed gear sablefish fishery by the Groundfish Management Team (J. Hastie; personal communication). Recreational discarding was incorporated through the use of the landed and discarded dead (A + B1) categories.

Discard rates used for 2004 and 2006 were calculated to be consistent with total mortality estimates created for the Pacific Council and the GMT. By working backward from the total mortality, or total discard by weight and the current landings estimate, a likely discard rate was developed for each fleet. Because the delineations over geography, between gear types and tribal vs. non-tribal sectors often differ from GMT "scorecards" and other summaries available from the Council, it may be misleading to compare the actual discard rates and comparisons should focus on total mortality values. Where updated landings, bycatch estimates or research catches were available the most up to date information has been included in this assessment.

Biological sampling has been conducted as part of the West Coast Groundfish Observer program since its inception in 2001. These data were not used in the 2005 assessment. The current assessment treats observations of the discarded canary rockfish in a similar manner to those collected from port samples. Biological observations from each tow are expanded from the fish actually measured to the total number of fish in the biological sample. This number is then further expanded to the estimated total number of fish in the discard for that tow. Expanded length- (or age-) frequencies were then brought to the fleet level by multiplying each value by the ratio of total discarded weight for that fleet to the total discard that was sampled by the observer program. This allowed port and observer samples to be combined into a set of biological observations representing the entire catch of canary rockfish for that fleet and year. Observer samples comprised most of the biological data for the commercial trawl and non-trawl fleets in 2004-2006, due to limitations on landing canary restricting the access of port samplers to a very small fraction of the total mortality.

2.3.4 Recreational Fishery

Estimates of recreational catch from 1980-2006 were generated through use of the RecFIN information system and also obtained directly from the states of Oregon and Washington. For much of the time series (but to a lesser degree in Washington), estimates were based on data gathered using MRFFS sampling protocols. However, in more recent years, estimates for some segments of the recreational fishery have relied primarily on data collection programs administered by the state agencies. The MRFFS procedure has generally been used to estimate effort of recreational fishermen, through use of phone surveys, and species catch composition and CPUE through port sampling of individual trips. The recreational fleet in California was divided (around San Francisco Bay) into southern and northern components, in the assessment, to reflect the tendency for the southern fleet to capture much smaller canary than the northern fleet. Recreational landings were compiled from the following sources by state and time period: Washington, 1975-2006 from state sampling program (F. Wallace, personal communication). Oregon: 1981-2000 from RecFIN, 2001-2006 from State sampling (D. Bodenmiller, personal communication), California: Estimates from the 1999 assessment (Williams, 1999) 1950-1979; 1980-2006 RecFIN split into northern and southern areas through post-stratification of the RecFIN estimates. Missing data from 1990-1992 were interpolated based on adjacent years. CPFV landings were added where missing (1993-1995) based on CPFV landings expanded from the logbooks (D. Wilson-Vandenberg personal communication; July, 2005). In Washington and Oregon, catches prior to the late 1970s were small enough in comparison to other removals that no reconstruction was attempted.

An analysis is currently underway to revise the methods used to estimate recreational catches from California for all species. Results from this effort are expected to be available in late 2007 and may substantially revise the time-series for some species. Qualitative evaluation of the magnitude of change on canary estimates was provided by California Department of Fish and Game staff and suggested no large effect on canary removals, but this topic will likely need to be revisited in the next assessment cycle.

Recreational length-frequency distributions were compiled from data available through RecFIN. Oregon and Washington were combined and the distributions constructed through weighting the length frequencies by the sampled catch via the standard RecFIN method. California length-frequency distributions used the raw length-frequency observations, and were divided into the northern and southern fleets based on the county in which the sampling took place. The northern area included all counties north of the San Francisco bay area. Counties which were not adjacent to the coast were excluded because the location of the fishing activity was unknown.

2.3.5 Foreign Catches

From the late 1960s through the early 1970s, foreign trawling enterprises harvested considerable amounts of rockfish off Washington and Oregon, and along with the domestic trawling fleet, landed large quantities of canary rockfish. Foreign catch estimates have not been revised in the current assessment, but follow those used in the 2002 and 2005 assessments, and reflect the large body of work that has gone into a thorough allocation of species to the foreign removals (see: Rogers 2003). These removals are included in the trawl fleets by state as was done in the 2002 and 2005 assessments.

2.3.6 Fishery Logbooks

A California trawl fishery CPUE time series was developed in the 2002 assessment through the use of GLM techniques applied to censored logbook data. This CPUE series was not updated for the 2005 assessment and was removed from the final model due to uncertainty about the proportionality of canary catch rates to population abundance. The California Department of Fish and Game charter boat logbook CPUE series, generated in the 2002 assessment was also removed from the final assessment model in 2005 for similar reasons. Given recent spatial and temporal closures imposed on the recreational fisheries from all three states, as well as regulations prohibiting the retention of canary rockfish, it is doubtful that a meaningful extension could be generated for this series. These data are generally consistent with model trends and would provide little new information; they are therefore not included in the base case model for this assessment.

2.3.7 Fishery Biological Sampling

Commercial landings of rockfish and the biological characteristics of these landings were not consistently sampled for scientific purposes until the early 1960s (Niska 1976). Statewide sampling programs to determine species compositions of the landed catches began in the late 1960s (Golden and Wood 1990). The first rigorous monitoring programs that included routine collection of biological data (e.g., sex, age, size, maturity states, etc.) were begun 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 that have completed their fishing trips. The sampling sites are commonly processing facilities located at ports along the coasts of California, Oregon and Washington. The monitoring programs currently in place are generally based on stratified, multistage sampling designs.

Commercial length-frequency distributions were developed for each fleet for which observations were available, following the same bin structure as was used for research observations. A variety of methods and stratification schemes for expanding the length-frequency data were explored as a result of both sparse (few trips and/or individual fish) sampling in many years for some fleets, and patchy (most trips or individuals coming from one or more portions of the spatial strata) sampling over space within and among years. 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. These expanded length observations were then combined within years for each fleet. Where observer data and port data were both available, observations were weighted based on the ratio of landings to discards for that fleet in that year. Age frequencies were computed in the same manner. Sampling statistics for each fleet and year are given in Table 11, Table 12, Table 13, Table 14, Table 15, and clearly show the different sampling targets employed over different time periods and between state agencies.

The weighted length-frequency distributions are shown in Figure 37, Figure 38, Figure 39, Figure 40, Figure 41, Figure 42, Figure 43, Figure 44, Figure 45, and Figure 46. Where a large proportion of the annual observations were recorded as unidentified sex, both sexes were combined and are treated as such in the model. By fleet, a number of important patterns are visible in the data. The southern California trawl samples, although clearly quite noisy, show the somewhat smaller fish generally encountered in the southern extent of the species range (Figure 37). The much more data rich northern California trawl fleet captured much larger fish than the southern fleet in the early part of the time-series and has shown a decline in mean length of the catch from 1978 to the mid-1990s, with little change thereafter (Figure 38). The Oregon trawl fleet has also shown a decline in size of canary captured from the late 1970s to the mid 1990s (Figure 39). The length data from the Washington trawl fleet prior to 1976 are not delineated to sex and it is unclear why the 1975 observation shows such small fish (Figure 40); this observation was removed pending further investigation of the raw data. Sex-specific length distributions from the Washington trawl fleet show a similar pattern to those in the Oregon trawl fleet with perhaps slightly less decline in mean size of canary encountered (Figure 41). Both the southern and northern California non-trawl fleets show very large declines in mean size of canary rockfish through the entire time-series (Figure 42). The Oregon-Washington non-trawl fleet shows a drop in mean size only between 1995 and 2000, although data are mostly absent prior to this period (Figure 43). All three recreational fleets appear to target much smaller canary rockfish, in the 25-30 cm range (Figure 44, Figure 45). The canary rockfish captured as bycatch in the at-sea whiting fishery appear to be limited to a very small range of sizes between 42 and 58 cm (Figure 46).

Weighted age-frequency distributions were compiled by fleet for break-and-burn ages only. Although surface ages could be used with the newly developed bias and imprecision described above this task was not completed for the current assessment. Recent ages from Washington are separated such that the appropriate age-error key can be applied in the assessment model (duplicate observations occurred only for the Washington trawl fleet). The possibility of treating all commercial age data as conditional age-at-length data was explored, and the entire set of compositions were compiled, but model run time (> 12 hrs) prohibited this approach at present. Therefore, marginal commercial age-frequency distributions were compiled and are presented in Figure 47, Figure 48, Figure 49, Figure 50, Figure 51, Figure 52, and Figure 53. As described below, the non-orthogonal nature of length and age data was considered when data weighting was performed.

Age data for southern and northern California were very sparse (no data between 1986 and 2000), but only fish younger than age 18 have been observed in recent years (Figure 47, Figure 48). Age compositions for the Oregon trawl fleet show a clear decline in both males and females older than ~ age 20 throughout the time-series. Further, the sex-ratio skewed toward males at older ages is also quite pronounced (Figure 49). Only a modest decline in older fish (mostly the males) is visible in the Washington trawl age data from either ageing lab (Figure 50, Figure 51). Data for the Oregon and Washington non-trawl fleet is sparse enough that little pattern can reliably be discerned (Figure 52). Age data from the at-sea whiting fishery was available only for 2003-2005 and shows little pattern, although canary < age 6 are never encountered in this mid-water fishery, indicating the potential for a behavioral difference with age (Figure 53). No age data are included for any of the recreational fleets. Although some age data are available from the Oregon recreational fleet, they are not included in the current assessment, but should be explored in the future.

Although lack of fit due to changes in growth over time can be diagnosed through model results, a preliminary evaluation of the mean size at age for the most reliably aged fish (WDFW aged in the last year) was performed. No clear trends were visible over the age range of 6-15 although inter-annual variability and sampling noise can be hard to delineate (Figure 54). Based on this and other preliminary exploration of the raw data, no effort was made in this assessment to explore changes in canary growth rates over time.

In aggregate, the biological data from fishery sources shows no evidence of strong year-classes moving through the population. This could be due to low recruitment variability, noisy data, or both. Further, declines in mean size and age seem to show a latitudinal cline, with more extreme declines to the south, and very little decline observed in Washington. The degree to which this is due to changes in selectivity, differential fishing mortality by latitude or other factors is unknown.

In the 2005 assessment, sparse (< 5 trips sampled) length- or age-frequency observations from commercial sources were aggregated into "super-years"; the SS2 model can generate similarly aggregated predictions for direct comparison. This approach has the benefit of allowing the data to inform the model about the relative selectivity for a fishing fleet without erroneously appearing to add information about recruitment deviations that may be due to small noisy samples or spatial changes in sampling effort over time. Re-evaluation of this approach led to the conclusion that, when weighted (and iteratively re-weighted) appropriately, there is no strong reason to add pre-processing to the data.

2.4 History of Modeling Approaches

2.4.1 Previous assessments

The first formal assessment of the canary rockfish resource off the U.S. Pacific coast was done in 1984 (Golden and Demory 1984).The final results from the initial assessment in 1984 were largely based on qualitative examinations of trends in age and size distributions generated from both fishery and survey data. The 1984 research also included exploratory efforts to fit dynamic models to time series data, using tools such as, Virtual Population Analysis and Stock Reduction Analysis. However, due largely to highly variable sample data and its lack of availability in all years, results from the modeling were not considered scientifically valid. The 1984 assessment concluded that the canary rockfish resource was generally stable at that time and that the current restrictions were still applicable, i.e., the ABC for canary rockfish was roughly 2,700 mt in the early 1980s.

The canary rockfish assessment conducted in 1990 (Golden and Wood 1990) was the first evaluation to incorporate separable catch-at-age analysis and in particular, the first to use the Stock Synthesis Model (Methot 1989, 2000). All subsequent stock assessments have used the Stock Synthesis Model to evaluate the status of the canary rockfish population off the U.S. Pacific coast, although the model has undergone considerable development since the first program was presented in 1988. The basic theoretical foundation and parameter estimation techniques utilized in early synthesis models are described in Methot (2000). Data sources included in the 1990 assessment model were commercial landings from the fishery (1967-89), age-distribution data from the fishery (1980-88), commercial trawl effort index from the fishery (logbook data from 1980-87), CPUE index from the survey (1977-89), and size-distribution data from the survey (1977-89). The Columbia INPFC area was the only portion of the canary rockfish resource formally modeled in 1990. The 1990 assessment was the first to propose the two, broad assumptions (alternative scenarios or states of nature) regarding the absence of old females in the sample information relative to males: (1) the females are subject to a different rate of natural mortality than males (e.g., age-dependent natural mortality for females or possibly, constant, but elevated natural mortality rates for females); or (2) the females are less vulnerable to the fishing and sampling gears (e.g., dome-shaped selectivity for females and asymptotic selectivity for males). The scenarios above have been generally explored in all subsequent assessments. Based on a $F_{35\%}$ management model, results from the 1990 assessment indicated the ABC for the canary rockfish resource in the Columbia INPFC area should be decreased by roughly 30% from 2,100 mt to 1,500 mt; no changes were recommended for ABCs for the other INPFC areas (800 mt for the U.S. Vancouver INPFC area and 600 mt for the Eureka INPFC area). Through 1989, the fishery had not achieved the ABCs recommended for canary rockfish.

The assessment conducted in 1994 again utilized the age-based version of the Stock Synthesis Model to evaluate the status of the canary rockfish population in the Columbia, INPFC area, as well as the U.S. Vancouver INPFC area (Sampson and Stewart 1994). The data sources in the previous assessment (1990) were updated with statistics from the 1990s, with the exception of the commercial trawl effort index from the fishery, which was omitted from the set of data sources due to sample and estimation biases associated with logbook data. Results from the 1994 assessment (for both scenarios described above) clearly indicated that the current level of F exerted on the canary rockfish population exceeded $F_{20\%}$ (the overfishing threshold at that time) and thus, the researchers recommended that the ABC be reduced to allow the stock to recover (Sampson and Stewart 1994). Ultimately, the Pacific Fishery Management Council (PFMC) adopted an ABC for canary rockfish of 1,250 mt for 1995-96, which was a substantial reduction (nearly 60%) from the previous ABC of 2,900 mt (1991-94).

In 1996, the canary rockfish stock was assessed using similar modeling methods and configurations as were used in the previous assessment conducted in 1994 (Sampson 1996). Data sources were again updated with newly derived statistics (1995-96) and an age-based version of the Stock Synthesis Model was employed. One difference between the 1994 and 1996 assessments was the manner in which error associated with age-distribution data from the fisheries was accommodated. In the 1996 assessment, a single, percent-agreement error structure was used to describe the variability in the age-related data, whereas in 1994, an error-transition matrix was used to standardize multiple sets of age estimates generated from two age readers. Newly obtained data supported findings from the 1994 analyses and final results further indicated that the canary rockfish stock had suffered fishing in excess of

$F_{20\%}$. For both scenarios, annual yields based on $F_{35\%}$ were estimated to be roughly 1,200 mt per year for 1997-99.

In 1999, two age-structured stock assessments were adopted. An assessment was completed by Williams et al. (1999) for the southern INPFC areas (Eureka and Monterey). A separate assessment was conducted for the Northern INPFC areas (Columbia and US Vancouver) by Crone et al. (Crone et al. 1999). Both assessments concluded that the abundance of canary rockfish was below the overfished threshold. A major source of uncertainty was the role that natural mortality and adult movements played in the relative lack of old females. The northern assessment was performed using an age-based stock synthesis model and relied on age distributions to summarize changes in the age-structure. The Southern assessment was a length-based (although still age-structured) model in an ADMB format. The paucity of otolith-aged fish in the Southern area was the reason why lengths were used in the south to describe changes in the age-structure. That assessment also tried to account for effects of sized-based removals on population growth. The subsequent rebuilding analysis relied upon recruitment information from the northern area where the larger portion of the stock occurs.

The 2002 assessment unified the previous northern and southern assessments into a coast-wide model. New data that had become available since the previous assessment conducted in 1999 were: Commercial fisheries landing data for 1999-2001; Biological data from the commercial trawl fisheries for 1999-2001, including sex, age, and length information, research survey data from the NMFS shelf trawl survey for 2001, including CPUE and biological data and the CPUE from the California recreational fishery. However, previously assembled fishery size- and age-composition data were not re-compiled. This assessment focused on the exploration of two states of nature that were considered in previous assessments: age-dependent M for females versus dome-shaped female selectivity. Together with the STAR panel, it was concluded that these need not represent discrete hypotheses and that both scenarios could be modeled simultaneously. The 2002 assessment concluded that the canary stock was still at very low levels, 8% of the estimated unexploited conditions.

The 2005 assessment converted and updated the 2002 effort using Stock Synthesis 2. The largest changes were: Re-configure the spatial separation of fisheries to separate northern and southern California due to the large north-south difference in occurrence of larger fish and the widely varying north-south distribution of fishery sampling. Fishery removals were divided among 10 fleets: 1) Southern California trawl, 2) Northern California trawl, 3) Oregon trawl, 4) Washington trawl, 5) Southern California non-trawl, 6) Northern California non-trawl, 7) Oregon and Washington non-trawl, 8) Southern California recreational, 9) Northern California recreational, 10) Oregon and Washington recreational. Oregon and Washington non-trawl and recreational landings were combined due to the relatively small total removals by those fisheries and their low level of consistent biological sampling. Recalculate all the fishery catch, size and age composition data. Introduce the mean size-at-age data from the survey and fishery to provide additional information on growth and to attempt to better differentiate age selectivity from size-selectivity. Extend the modeled period back to 1916 when first significant catches occurred. Extend maximum age in the data file to 35+ per request from previous review. Switch from age-based selectivity to length-based selectivity. That pattern assumed asymptotic selectivity for males and allowed dome-shaped selectivity for females.

Selectivity was the subject of much exploration, ultimately leading to the choice of a length-based parameterization. Information from radiocarbon studies of canary ageing techniques was included to guide the degree of bias likely occurring in production ageing, and the degree of ageing precision was re-estimated from double-read projects. Differential male-female selectivity was allowed for the data sources with suitable data (northern California trawl, Oregon trawl, Washington trawl, shelf trawl survey). Iterative re-weighting was used to adjust all input sample sizes and survey standard error, in some cases resulting in large increases (or decreases) in input sample size relative to the number of trips/hauls actually sampled. Trawl and recreational fishery CPUE were dropped from the model because there has been insufficient work to validate the potential degree of non-linearity in the abundance to CPUE relationship. The parameters defining the variability in size-at-age were fixed at values estimated outside the model from the trawl survey size-age data, rather than allow the model to update these values. The factor that most influenced the model result is the exclusion of a male-female difference in selectivity which causes the ending biomass to be highest among these model runs and the steepness parameter to have the highest value (0.45). The eight parameters used to implement this selectivity difference for three fisheries and the triennial survey caused the base model to fit 24 log-likelihood units better than the model configuration without these parameters, with most of the improvement coming from two parameters for the OR and the WA trawl fisheries. Without allowing for differential male-female selectivity, the smaller decline in abundance during the 1980s-1990s degrades the fit to the trawl survey by 1.2 log-likelihood units, and so is the worst fit to the trawl survey among all these sensitivity runs. At the SSC review of the canary rockfish assessment (Sept. 27-30, 2005; Seattle, WA) it was concluded that the parametric variance around a single base model underestimated the overall uncertainty in the canary rockfish assessment. After considerable deliberation, the SSC and STAT concluded that the Base and Alternate models were equally likely and supported a statistically based blend of the two models as the basis for the rebuilding analysis. The level of relative depletion for the 2005 base case was estimated to be 0.038 when the stock reached its minimum level in 2000, then increasing to 0.057 in 2005. In the alternate 2005 model, the minimum was 0.065 in 1999 and the value in 2005 was estimated to be 0.113.

A retrospective over the canary rockfish assessments since 1994 shows that there has been a large degree of consistency in relative population trend, although estimates of absolute scale have varied substantially among years and alternate models within years (Figure 55).

2.4.2 Pre-assessment workshop, GAP and GMT input

Based on suggestions received before and during the pre-assessment workshop held in April, 2007, a number of questions regarding canary life history and data sources were explored. Participants in the pre-assessment workshop provided valuable observations and information on the canary rockfish resource. Movement of schools of canary among fishing grounds has been observed, specifically near the Canadian border. Anecdotal reports of changes in latitudinal and depth distribution associated with water temperature and possibly El Nino cycles were also discussed. No clear trends in the diel cycles of water column use were identified, although this too was a source of discussion. Behavioral changes due to tidal currents were also generally noted. Infrequent encounters with large canary rockfish in shallow water were reported, indicating that there may be factors other than ontogenetic movement to deeper water that govern canary distribution.

There was general agreement among fishermen contacted that appreciable discarding of canary rockfish before management-imposed limits became important was quite unlikely. This is understood to be caused by the price, desirability and lack of incentive for sorting of smaller fish. This is very important in light of the current assumption of a 1% discard rate prior to the mid-1990s.

A question was raised regarding the effect of Bycatch Reduction Devices (BRDs) in the pink shrimp fishery. Oregon Department of Fish and Wildlife researchers (personal communication, R. Hannah) have investigated the magnitude and species composition of rockfish bycatch in the pink shrimp fishery before, during and after transition to full use of BRDs (Hannah and Jones 2007). Rates of canary bycatch were 0.03-0.84% from various time periods within 1981-2000. Little relationship between shrimp landings and canary landings is present (Figure 56). Bycatch of canary rockfish in the pink-shrimp fishery appears to have been an infrequent occurrence, with years of high encounter rates quite rare. The ratio of canary bycatch (reasonably represented by landings prior to 2000) to pink shrimp catch has been variable, with large value observed in 1988. BRDs were required in 2003, but allowed and used in portions of the fishery during 2001-2002, leaving 2000 as the year when canary landings were highly restricted, but BRDs not yet fully used. BRDs have subsequently reduced the capture of canary and other rockfish to the degree that observer activities were suspended in 2006 due to extremely low rates of bycatch. Observer coverage has resumed in 2007 as part of an effort to justify the clean nature of the current pink-shrimp fishery. Although there is some potential for discarded bycatch of canary rockfish in 2000 (that would be unaccounted for in this assessment) it is unlikely to be a major source of bias in stock assessment results.

2.4.3 Response to the review panel recommendations in 2005

The STAR and “Follow-up” panel reports from the 2005 review outlined a number of research and modeling recommendations that should be explored in subsequent assessments. In the current assessment, as many of these recommendations as was possible were evaluated and substantial progress was made on many of them. Progress is outlined below by specific recommendation.

- *Consideration of a regional analysis of fishery dynamics, and potential linkages with Canadian canary resources.*

  This topic remains an important area for future research. Information on adult movement and collaboration with Canadian scientists will be essential to making progress toward more spatially explicit and geographically comprehensive analyses.

- *Evaluate the determination of appropriate weighting of data sources.*

  The use of conditional age-at-length data reduces the need for subjective weighting of age and length data from the same fish treated independently in the likelihood calculation. Further, the introduction of a method for generating input sample sizes that accounts for both the number of fish and the number of trips or hauls sampled has greatly reduced the need for extensive iterative re-weighting. As in many assessments, conflicting signal from different sources of data are explored through sensitivity testing.

- *Field studies of relative abundance of canary rockfish in different habitats using alternative gears such as hook-and-line gear and submersible line transects should be continued. Careful thought is needed to design studies that augment traditional bottom trawl surveys and can be integrated into the assessment.*

  Efforts described above have succeeded in pilot studies documenting methods for surveying canary rockfish abundance through the use of hook-and-line, open-codend trawl gear and video technology. Although not yet attempted over broad spatial scales, substantial progress toward new methods has been made.

- *Assessment results for canary rockfish depend on distinguishing between relatively subtle processes such as increasing natural mortality for females and domed-shaped sex-specific fishery selectivity. The selection of one model configuration over another may depend more on the parametric form used to model the process rather than the underlying process itself. There needs to be more testing of stock assessment models using simulated data to get a better sense of how well these processes can be estimated.*

  The approach to selectivity parameterization and complexity is the basis for much exploration in this assessment. Broad simulation studies of assessment model behavior are very much warranted for many aspects of stock assessment, but not particularly tractable during the development of a model for one specific species. However, the use of the bootstrap function built into SS2 allows evaluation of the estimability of model parameters conditioned on data availability and error structure and the model results themselves. A limited bootstrap has been completed for this assessment.

- *The approach of modeling the fisheries of each state separately as competing fisheries operating on a unit stock is needs to be investigated more fully. Differences between state fisheries could be due to different historical patterns of exploitation in each state or simply an artifact of different sampling methods.*

  Exploration into combining fleets is made in this assessment. Moving toward more spatially explicit models will require geographic separation of fleets, and so fleet simplification appears less important than a better understanding of how assessment models are sensitive to this approach in a general context.

- *The canary rockfish assessment states: "Several of the issues raised here: meta-analysis for survey q, meta-analysis for recruitment variability, and alternative procedures for inclusion of recruitment indexes are not unique to the canary rockfish assessment. Work on these issues during the 2006 off-cycle year would improve consistency in approach among all the assessments." The Panel strongly supports this recommendation.*

  These topics remain important areas for future research and may be addressed in 2008 stock assessment workshops.

2.5 Model Description

2.5.1 Link from the 2005 to current assessment model

The bridge from the 2005 stock assessment model to the current base case followed three general steps: 1) upgrade to the newest version of SS2, requiring a switch from double-logistic selectivity (no longer supported) to double normal selectivity; 2) rebuild all of the data inputs to reflect the best information currently available, including catch series, fishery biological data, and GLMM-based indices of survey abundance and 3) re-evaluate estimation of steepness, growth and selectivity parameters. A thorough description of the 2007 assessment model is presented separately below; this section linking the two models is intended only to more clearly identify where substantive changes were made.

The double-normal selectivity option used in the current base case model is simpler than the double-logistic used in the 2005 assessment by 2 parameters (6 vs. 8). Selectivity is now modeled via: an initial selectivity for the smallest length (or age) bin, an ascending width (normal shape, except scaled between the initial and peak values), a parameter describing the location (in length or age) of the peak of selectivity, the width of the flat top to selectivity, a descending width and a final selectivity at the largest length (or age) bin (Methot 2007). By fixing the initial selectivity at 0, and the width of the top to a very small quantity (this parameter becomes redundant as the descending width or final selectivity become large) the selectivity shapes estimated in the 2005 assessment were closely matched. Where near asymptotic selectivity was estimated, the descending width was also fixed, since it no longer had any influence on the derived selectivity curve. This change had very little effect on assessment results (Figure 57).

Rebuilding the data streams was performed as described above. This incorporated substantial new assessment data (Table 2), as well as the addition of the at-sea whiting fleet, research catches, the improved ageing-error definitions and the introduction of conditional age-at-length data for survey fleets. Because of the use of conditional age data in place of marginal age-frequency distributions and mean-length at age data used in 2005 the parameters describing the distribution of length at a given age were also freely estimable. These changes had a larger effect than the selectivity parameterization, serving to increase the estimate of SB0 and current stock size, but had little effect on relative trend over the time series (Figure 57).

Changes to the stock-recruit relationship included fixing steepness at 0.511 (see description of priors and model below), estimating a reduced time series of recruitment deviations (1960+ instead of 1952+ in the 2005 assessment), and increasing the degree of recruitment variability (σ_r) from 0.4 to 0.5. The coast-wide pre-recruit index was included to add information regarding the most recent recruitment strengths. The use of discrete time-blocks for changes in fishery selectivity prior to recent management actions was revisited and a more a priori approach to adding these blocks was used that resulted in fewer selectivity parameters and no changes prior to 1995 for any fleets except the Washington and Oregon trawl fisheries (see exploration of complexity in selectivity parameters below). The triennial survey index was partitioned into two time-periods (1980-1992 and 1995-2004) based on the change in survey timing; for each period a separate catchability parameter was applied. In aggregate, these changes result in a similar time series of spawning biomass prior to the early 1990s, but a much more rapid recovery since that period (Figure 57).

2.5.2 Summary of data for fleets and areas

Fishery removals were divided among 11 fleets: 1) Southern California trawl, 2) Northern California trawl, 3) Oregon trawl, 4) Washington trawl, 5) Southern California non-trawl, 6) Northern California non-trawl, 7) Oregon and Washington non-trawl, 8) Southern California recreational, 9) Northern California recreational, 10) Oregon and Washington recreational and 11) the canary bycatch from the at-sea whiting fishery. Removals associated with research projects (the trawl surveys, and other much smaller sources of permitted mortality due to scientific research) are treated as a fishing fleet, only in that the removals are included in the total. The data available for each fleet are described in Table 2; data that were not previously included in the assessment are clearly identified.

2.5.3 Modeling software

This assessment used the Stock Synthesis 2 modeling framework written by Dr. Richard Methot at the NWFSC. The most recent version (2.00g) was used, since it included many improvements and corrections to the older version (1.20) used during the 2005 assessment (Methot 2007). The change in SS2 version required a re-parameterization of the selectivity function, moving from the very generic double logistic to a somewhat simpler and more stable double-normal curve. For the selectivity shapes modeled in this assessment, there was very little change due to the version and selectivity upgrade. The most important change from version 1.20 to 2.00 involved a revision of the calculation of the linear ramp for natural mortality. This produced a small change in the estimated value for natural mortality for old females (Figure 58) that had a small effect on the estimation of SB_0.

2.5.4 Sample 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 (as is required by SS2) and used as the starting point for iterative re-weighting. Initial input sample size for compositional data was based on a method developed by the author and S. Miller, as part of the data and modeling workshop in 2006 (see background materials). Briefly, this method was based on analysis of the input and model-derived effective sample sizes from stock assessments completed in 2005 for west coast groundfish. It makes the input sample size a function of both the number of fish sampled and the number of trips or hauls sampled. A piece-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. These values are likely to represent a reasonable starting point that generally reflects the degree of observation error commensurate with sampling a given number of fish from a given number of samples.

This assessment follows the iterative re-weighting approach to developing consistency between the input 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 of 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 the length, age and survey data from all fleets. This consisted of comparing the mean input sample size for compositional data with the mean effective sample size based on model fit. Where the input sample size was greater, this implied the model was unable to fit the data in a manner that was consistent with the level of variability expected in the data and so a multiplicative scalar was used to reduce the input sample size for all length- or age-composition samples for that fleet accordingly. For index data, the mean input standard error was compared with the root-mean-squared-error of the model fit to assess consistency of data and model fit. Where the mean effective sample size was greater than the mean input sample size, no change was made. This choice reflects the post-hoc nature of model tuning and the potential for increasing weight on those data sources that are consistent with model predictions, thereby reducing the perceived uncertainty in model results. Table 16 shows the results of this re-weighting for compositional data, with the length data from a few fleets down-weighted slightly and the at-sea whiting bycatch data down-weighted substantially. This is not unexpected, since the sampling for at-sea data is on a per haul basis, and those fishing operations tend to move only when the large aggregations of whiting they are targeting move. Therefore, fish within hauls would be expected to be less representative of independent samples, and even fish from multiple hauls may be collected from a very small geographic area. Table 17 reports the results for index data. A small additional variance component was added to the early triennial observations (0.04) and the pre-recruit index (0.11) resulting in reasonably close agreement between mean input standard errors and root-mean-squared-errors as well as a similar degree of observation error for all survey indices. Both the late-period triennial observations and the NWFSC survey series fit better than would be expected, based on input variances, so no change in input values was warranted. Iterative re-weighting had little effect on overall model results, although broad scale weighting of length and age data (see below) showed a much greater effect.

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 theoretically appealing to treat the age data as conditional to the length observations (as described above) and avoid duplication of the information content. This is the approach taken for survey data. However, due to the technical constraints described above (run times), this approach was not feasible for all of the commercial sampling in this assessment at this time. Instead the approach taken is to use the lambda values (emphasis; a direct multiplier on the likelihood component) reducing the lambdas to 0.5 for length and age data from a given fleet where both types of data are available. This is consistent with previous canary assessments, and many other west coast groundfish assessments.

2.5.5 Priors

Uniform (noninformative) priors were applied to all estimated parameters in the base case model. Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation. All parameter bounds and priors are provided in this document (Table 18).

The use of a prior on stock-recruitment steepness (M. Dorn, AFSC, personal communication) was explored during the STAR panel. Concern over the influence of recently revised (2007 assessments) steepness profiles led to the recalculation of the posterior predictive distribution from the meta-analysis performed in 2006 removing the darkblotched rockfish profile. The revised prior was shifted to slightly lower steepness values than the earlier analysis, resulting in a distribution with the mean of the middle 50% equal to 0.511, the mean of the lower 50% equal to 0.345 and the mean of the upper 50%

equal to 0.72 (Figure 59). Many preliminary model runs explored the estimation of steepness with and without informative priors. Based on the tendency of the model to estimate an implausibly high value for steepness, the base case uses the mean of the middle 50% of the prior distribution (0.511) as a point estimate, and a 'states-of-nature" approach to uncertainty in this parameter.

2.5.6 General model specifications

Stock synthesis has a broad suite of structural options available for each application. Where possible, the 'default' or most commonly used approaches are applied to this stock assessment.

The assessment is sex-specific, including separate growth curves for males and females, and therefore tracking the spawning biomass of only females for use in calculating management quantities. Further, as has been done in previous canary assessments (and discussed above) natural mortality is allowed to increase (linearly) for females starting at age 6 and reaching an estimated asymptote at age 14, after which mortality is constant. Males and young females are assumed to have a natural mortality of 0.06.

For the internal population dynamics, ages 0-39 are individually tracked, with the accumulator age of 40 determining when the 'plus-group' calculations are applied. As there is little growth occurring at this age and the data are accumulated at age 35, this should be a robust choice (there needs to be enough space between the data 'plus-group' and that of the dynamics to avoid ageing error moving very old fish into observations of younger ages where this is unwarranted).

There are no explicit areas structuring the modeled dynamics of this assessment. No seasons are used to structure removals or biological predictions, so 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. Since the time-series is started in 1916, 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 on females, size-based selectivity, and dimorphic growth is can vary appreciably due to differential mortality by age and sex.

2.5.7 Estimated and fixed parameters

A full list of all estimated parameters and values of key parameters that are fixed is provided in Table 18.

Time-invariant sex-specific growth is fully estimated in this assessment. This requires nine parameters, 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 in this assessment. Recruitment deviations are estimated for each year of the period informed by the data (1960+) based on evaluation of the variance of the early deviations. This approach may underestimate uncertainty in recruitment variability (and therefore derived quantities like spawning biomass) in the early years of the model. However, it provides for an efficient maximum likelihood minimization and may reduce unwarranted patterns in early deviations.

Double-normal selectivity was used for all fishing and survey fleets in the base case model. The initial selectivity parameter was fixed to a value of -9.0 resulting in the smallest length bin always having a derived selectivity value of 0.0. An exception to this was applied to the NWFSC trawl survey, where the initial selectivity was estimated, based on the frequency of small fish relative to all other fleets in the model. The ascending width parameter was estimated for all fleets, as was the peak and final selectivity parameters. For fishing fleets, the width of the flat-top on selectivity was fixed at -4.0, as this parameter is often redundant. For surveys this parameter was estimated. Where estimated selectivity curves were strongly asymptotic, then the descending width parameter was fixed at a value of 4.0 to avoid full redundancy as the estimated final selectivity parameter approached the upper bound and the derived selectivity value for lengths greater than the peak selectivity approached 1.0. For fleets that showed strongly dome-shaped selectivity, the descending width parameter was estimated to allow the ability to fit a greater range of domed shapes. For survey fleets, catchability parameters were directly estimated.

A relatively simple approach to time-blocks was applied. When a time-block was added to the specification for a fleet, three parameters were allowed to vary: the ascending width, the peak and the final selectivity parameter. This was intended to allow flexibility in the full curve (ascending side, location and descending side) with the minimum amount of parameters.

2.6 Model Selection and Evaluation

2.6.1 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, and 2) follow generally accepted methods of approaching similar models and data. 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.

The fleet structure from the 2005 assessment is retained, and as the fundamental organization of the data the choice of how to divide fleets (and therefore what degrees of complexity are feasible for modeling of selectivity) is certainly very important. However, with the 'mirror' selectivity curves between fleets, a nested approach can be taken to the complexity of the fleet structure that allows model comparison without necessarily estimating separate selectivity curves for each fleet. This is explored below.

The use of a fixed value for natural mortality for males and young females is also a very important assumption. The effect of this choice was explored through the use of a likelihood profile, but in reality natural mortality is likely to vary over time (and possibly space) and may be non-stationary where predation or environmental factors have directional instead of random patterns during the modeled period.

Growth is assumed to be time-invariant. This is a common assumption that has very important implications for estimation of selectivity and management quantities.

The most important assumption in this model is the use of a point estimate (0.511) for steepness derived from meta-analysis of west coast rockfish species (M. Dorn, AFSC, personal communication). This choice was the subject of extensive exploration prior-to and during the STAR panel and its importance is reflected in the states of nature reported in this document.

2.6.2 Alternate models explored

Many variations on the base case model were explored during this analysis (leading up to and during the STAR panel), only the most relevant and recent of which are reported in this document. Many of these are reported as sensitivity analyses, retrospective analyses, or are based on alternate weightings of the input data. All of these types of runs are described below.

Prior to the STAR panel, a detailed exploration was made to evaluate: 1) the complexity in the number of fleets, 2) the use of time-blocks in selectivity to approximate changes in the fishery, 3) the application of sex-specific selectivity and 4) the use of age-based instead of length-based selectivity.

By forcing the selectivity curve for one or more fleets to be identical to another fleet ('mirroring' in SS2), evaluation of the degradation in fit caused by reducing the fleet complexity is possible. Because this approach is dynamic (the estimated values for selectivity parameters are not manually fixed at the same values for multiple fleets, but are applied to multiple fleets during estimation) the results should be similar to combining the data outside the assessment model. All combinations that were explored produced large degradations in total model likelihood. Combining even relatively minor fleets (with regard to data quality and quantity) still produced substantial degradation in model fit: southern and northern California fleets were combined for recreational (+98 negative log-likelihood units), non-trawl (+84 negative log-likelihood units) and trawl gears (+45 negative log-likelihood units).

A step-wise approach to adding time-varying selectivity parameters was utilized, based on changes in management that, *a priori*, might reasonably induce changes in fishery selectivity, either through fishing behavior or through spatial changes in fishing opportunity. This is in contrast to the 2005 assessment's block structure which was developed through searching for time-periods where parameters could be added to make the largest improvements in model fit. That (somewhat *post-hoc*) approach sought to characterize the removals as accurately as possible, and generally attributed lack-of-fit to process error (change in selectivity) over observation error. That approach led to different time blocks for every fleet in the model (Table 19), some close to regulatory changes, others corresponding more to changes in data availability (the first year of age data available) or just visually identified 'breaks' in the raw observations..

Based on known and likely very influential changes in management, four candidate time-blocks were identified for use in this assessment: 1) 1995, when the first canary-specific trip limits were imposed, 2) 2000, when canary were first managed as overfished and OYs were drastically reduced, 3) 2002, when the Rockfish Conservation Areas (RCA) were first implemented, eliminating large portions of historical fishing grounds from legal rockfish harvest, and 4) 2005, when selectivity flatfish trawl gear was required shoreward of the RCA. The improvement in model fit (in negative log-likelihood) ranged from negligible to 90 units among fleets and time-blocks (Table 20). Those improvements of more than 10 likelihood units are retained in the base case. Three parameters would require at least 6 units of likelihood in a strict likelihood ratio test; however there are many reasons why these tests are not exactly applicable to assessment models and might overestimate the number of parameters needed. This choice was somewhat subjective and could be explored in future assessments. Generally, all but the 2005 block was warranted for addition in one or more fleets, with all but the two California trawl fleets and the northern California recreational fleet requiring one to three time blocks. In aggregate, this approach substantially improved the fit to the compositional data, although at the cost of 36 additional parameters. The ascending width, peak and final selectivity parameters were estimated for each block. A single exception was that, later in model evaluation, the ascending width parameter for the northern California non-trawl fleet was found to be poorly defined and was fixed at a value of 3.5. This had no obvious effect on modeled results or uncertainty about those results.

During the STAR panel, it was generally agreed that including an additional time block for trawl fleets with appreciable data prior to the conversion of older fishing gear to high-rise and larger footrope gear was warranted. Although this transition in gear was not instantaneous, 1979 emerged as a reasonable approximation to the average year for the Oregon and Washington trawl fisheries (California fleets did not have data prior to this period). This block was therefore added to the base case following the approach used for later changes in fishery selectivity.

Given the degree of exploration devoted to sex-specific selectivity curves in the 2005 assessment, it seemed worthwhile to explore how the fit to the data might be improved by adding sex-specific offsets to selectivity (2 parameters, one defining the difference at the peak selectivity, the second the difference at the final selectivity). Previous assessment models found that allowing females to be less selected than males at larger sizes or older ages improved model fit. The results of this exploration did not support addition of selectivity parameters to allow sex specific selectivity; little improvement for any fleet (maximum of -4 units of log-likelihood) was observed (Table 21). On further exploration it was determined that the peak parameters in the 2005 assessment had been fixed, likely due to behavior of the double-logistic used in that version of SS2. With these parameters now estimated, it would appear that this year's assessment model has more ability to match selectivity with dimorphic growth and create sex-specific expectations that are quite consistent with the observed data without the introduction of sex-specific selectivity curves.

A final exploration into age-based selectivity was performed, both with and without offsets allowed for male vs. female selectivity. The results of this exercise were somewhat inconclusive (Table 22): the Oregon and Washington trawl fleets fit better (-34 log likelihood units together), but other fleets showed little change, and survey fleets fit worse (+29 units total). There are many reasons to favor length-based selectivity as a default over age-based selectivity based on biological and fishery processes. Swimming speed, foraging behavior and other physical processes are clearly a function of fish size, as are vulnerability to a specific fishery mesh- or hook-size. Although there may be behaviors that are fundamentally age-based, these are less obviously related to selectivity. It appeared to be inconsistent to have both age-and length based selectivity for relatively similar fleets within the same model, so length-based selectivity was retained throughout.

Many runs were explored estimating steepness with varying degrees of constraint and various selectivity options. These runs were generally very consistent with regard to the model's inability to estimate the quantity. In all cases the estimated value for steepness was very close to 1.0. Values of this magnitude for a long-lived rockfish are quite implausible. That the model has gone from very low estimates of steepness in recent assessments to very high estimates in this assessment likely reflects pathological behavior of age-structured models dealing with relatively noninformative data from a one-way trip and low recruitment variability in general. In the base case model leading up to the STAR panel this parameter was fixed at 0.35, the maximum likelihood value for the survey index data (considered to be the most informative source for this parameter due to the rate of increase in the index of relative abundance). Discussion at the panel resulted in little agreement on whether the information from this series was reliable, however when the decision was made to partition the series into two periods (1980-1992, 1995-2004) the issue became moot as there was no appreciable curvature in the likelihood surface for this component in the profile on steepness. See the likelihood profile section below for more detail on this supporting analysis.

2.6.3 Convergence status

It is the author's experience that convergence testing through use of overdispersed 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 that produces low (~20-40%) rates of successful model estimation. When too much over-dispersion is included the approach is very inefficient, when too little, other minima are unlikely to be identified.

With a large quantity of data from many sources and many selectivity parameters to estimate, this assessment was relatively poorly behaved, and worse, showed many signs of convergence even when the global minimum was not reached. Preliminary convergence trials were performed (prior to the STAR panel) using a 'jitter' value of 0.1 for the base case model. Jitter is an SS2 option which allows 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. Twenty-five of these trials got close to the global minima, 17 appeared to converge based on inverting the Hessian and small gradients, but only 4 actually reached the global MLE. There are many potentially contributing factors, but this behavior may be primarily due to multivariate parameter correlation and 'ridges' in the likelihood surface making the search difficult. Further, conflicting signal from various data sources can cause shifts that yield very similar results, but with different combinations of parameters or values for specific likelihood components. Results of runs that appeared to converge all showed very similar levels of ending depletion and spawning biomass, suggesting that only very minor components in the likelihood were affecting the last stages of the search algorithm. This exercise was repeated for the final base-case model (after the STAR panel) and did not reveal any new likelihood minima. These results, in conjunction with other convergence checks, indicate that it is likely that the base case model result represents the global minimum.

2.7 Response to STAR panel recommendations

During the STAR panel review a large number of auxiliary analyses were performed to explore data sources, better understand model performance and to converge on a single base case model on which both the STAT and STAR panel were in agreement. These goals were largely achieved, and there were no outstanding disagreements between the STAT and the STAR panel. There were many areas of future research identified.

Basic data exploration focused primarily on the triennial survey and how survey catches may have been influenced by methodological changes. Patterns in catch rate as a function of time of day, and day of the year were both evaluated. Although no conclusive evidence was found for either of these factors to directly affect catch rates for canary rockfish, the large change in triennial survey timing between 1980-1992 and 1995-2004 (Figure 20) was identified as a major concern. The decision was made to allow for changes in catchability between these two periods pending a more thorough evaluation of catch rates of multiple species. Exploration of mean length (and the total mortality rate implied by observed declines in mean length) for various fleets was conducted, as was consistency of length-frequency data with mean weight observations from early (1991-2003) at-sea whiting bycatch. Evaluation of the likelihood contribution of each fleet to profiles on key model output such as steepness, natural mortality, and equilibrium recruitment was made for a series of models intermediate to the original STAT base case and the final base case presented here. Various approaches to determining a value of recruitment variability (σ_r) were applied and consideration was given to consistency of reference points and the time-series of recruitment deviations, as well as potential bias in each method. There was a discussion of calculating reference points based on fishery selectivity and allocation from a period of targeted canary fishing rather than bycatch only. Numerous other sensitivity analyses were also performed.

Specific changes made during the STAR review to the original base case developed by the STAT included:

1) Use uniform priors instead of diffuse normal priors
2) Use the analytic solutions for catchability parameters instead of treating them as free parameters.
3) Include the coast-wide pre-recruit index in the base case.
4) Use the mean of the middle 50% of the steepness prior (0.511) as the base case; consider this value to be twice as likely as the mean of the lower 25% (0.345) and the mean of the upper 25% (0.72) in reporting uncertainty via a 'states-of-nature' approach instead of using only the asymptotic intervals and for decision table and rebuilding analyses.
5) Begin recruitment deviations in 1960 instead of the first year of the modeled period (1916).
6) Use a value for recruitment variability (σ_r) of 0.50 reflecting a compromise between the level of variability observed from relatively unconstrained deviations and iterative tuning (instead of 0.30, derived only from iterative tuning).
7) Allow the initial selectivity parameter for the NWFSC survey to be freely estimated.
8) Split the triennial survey time-series into two periods (1980-1992, 1995-2004) with separate catchability parameters.

2.8 Base case model results

The biological parameters estimated from the base case model appear to be quite reasonable and consistent with previous assessments (Table **23**) and inspection of the raw data. Female and male canary rockfish showed similar growth trajectories to about age 10, with females growing to a maximum size (59 cm) that was about 7 cm larger than males

(Table 24, Figure 60). Males are estimated to grow slightly faster than females, with both sexes showing a relatively tight distribution of lengths for a given age and with the relative CV decreasing with age. As in the 2005 assessment, natural mortality for females is estimated to increase from 0.06 at age 6 to 0.097 at age 14 (Figure 61, Table 25). With this difference in sex-specific natural mortality, a male-dominated sex-ratio would be expected for older ages. However, the level of fishing mortality, especially in the last 20 years, has increased the relative proportion of females over that predicted for equilibrium conditions (Figure 62).

Estimated selectivity curves for the NWFSC and triennial surveys were generally similar, although the NWFSC survey selected more small canary (Figure 63). The catchability values for the NWFSC and triennial surveys are much smaller than in the 2005 assessment. This is likely to be primarily a function of the use of GLMM-based time-series, which is smaller on an absolute scale due to accounting for lognormally distributed catch rates. Catchability for fully selected canary in the NWFSC survey was estimated to be 0.114, also 0.114 for the early triennial survey (1980-1992) and 0.054 for the later triennial survey (1995-2004).

Selectivity curves for the various fishing fleets largely showed the expected pattern of trawl fleets capturing the largest canary (Figure 64, Figure 65, and Figure 66), non-trawl fleets mixed (Figure 67, Figure 68, and Figure 69) but still capturing larger fish than the recreational fleets (Figure 70, Figure 71). The new at-sea whiting bycatch fleet captures only very large canary (Figure 69). Values estimated for each of the time blocks also generally make sense: smaller fish are becoming more common in most fleets as management moves them into shallower water. Not all time-blocks conformed to this pattern, with the Oregon-Washington non-trawl fishery 2000-2001 selectivity shifting dramatically to toward smaller fish and then back to larger fish in 2002+ (Figure 69). These patterns follow the small and then larger fish found in the length-frequency distributions for those years (Figure 43). The Washington trawl selectivity in 2000+ selects smaller fish than in previous years, but is very close to asymptotic; the cause of this is unknown (Figure 66).

The base case model was able to fit the survey indices quite well (Figure 72), despite the relatively small contribution to the total likelihood value. The root-mean-squared-error (*rmse*) for the fit to the NWFSC survey is 0.44, the early triennial survey, 0.45 and the late triennial survey 0.05 in log space. These values are close to or larger than the mean input standard errors for each (0.52, 0.43 and 0.05), except that the fit to the late triennial survey was much better than expected (Table 17). The base case model fit the coastwide pre-recruit index slightly worse than the inflated input standard error (0.31 + an additional 0.11 added) with an *rmse* of 0.5 (Figure 73). This lack of fit reflects conflict between other data sources and the index in 2001 and 2002 as well as the contribution of σ_r drawing subsequent recruitments away from the index and toward the stock-recruit expectation.

The base case model fit the length and age distributions from the NWFSC and triennial surveys slightly better than expected based on the input sample sizes (Table 16, Figure 74, Figure 75, Figure 76, and Figure 77). Although there is some lack-of-fit in specific years of the two time-series of length-frequency data (Figure 78, Figure 79), there are no strong trends in the Pearson residuals (Figure 80, Figure 81). The implied fit to the marginal age-frequency data (not included in the likelihood, but used for comparison only) was also reasonably good for both surveys although the data are clearly quite noisy (Figure 82, Figure 83). The Pearson residuals reflect the noise in the data both within and between years (Figure 84, Figure 85). Pearson residuals for the fit to survey conditional age-at-length data are somewhat difficult to interpret, but generally show the effect of small sample-sizes within rows on each year-specific key as well as a few fish that deviate from expected growth pattern dramatically (Figure 86, Figure 87, and Figure 88).

Fits to the fishery length- and age-frequency data required little tuning to make average effective sample sizes equal to or greater than average input sample sizes (Table 16, Appendix A). Fits were varied, but generally reflect the heterogeneity in data quantity and quality among fleets. It is uncertain whether patterns observed in the fit to these data (and residual plots) are a function of heterogeneity in sampling intensity over areas or ports within each fleet (observation error) or more continuous changes in fishery selectivity that is reflected in the size and age of the fish captured (process error).

The estimated recruitment deviations show relatively low variability when compared to other rockfish species, but somewhat higher variability than was observed in the 2005 assessment; the input value for the standard deviation was 0.50 and the *rmse* over the period 1960-2006 was 0.41. The choice of start year is based on the estimated variance for the deviations (Figure 89) showing that the value is very close to σ_r in 1960. Extending the series to earlier years produced little change and standard deviations for the additional deviation near 0.5. There is a period in the late 1980s and early 1990s that shows 10 sequential recruitment deviations above the zero line (Figure 89) and longer time-series of recruitment deviations tended to show some balancing in the very early values to allow for this period. The time-series of estimated recruitments shows a strong relationship with the decline in spawning biomass even with a steepness value of 0.511 (Figure 90). The increased recruitment variability and variance of those recruits (over 2005 estimates) can be seen in the time-series; further, the level of steepness used had a very large effect on the magnitude of the recruitments in the last 20 years, but very little effect prior to that period (Figure 91).

The biomass time series shows a strong decline to the mid-1990s and then a relatively rapid recovery since that time, with increasing uncertainty in the point estimate as the signal regarding recent recruitments from the data becomes weak (Figure 92). The relative magnitude of steepness plays a very large role in this recovery, as all three stats of nature generate similar time-series' prior to the early 1990s but differ by a factor of four in estimated 2007 spawning biomass. Canary rockfish were relatively lightly exploited until the early 1940's, when catches increased and a decline in biomass began. The rate of decline in spawning biomass accelerated during the late 1970s, and finally reached a minimum (13% of unexploited) in the mid 1990s. The canary rockfish spawning stock biomass is estimated to have been increasing since that time, in response to reductions in harvest and above average recruitment in the preceding decade. The estimated relative depletion level in 2007 is 32.4% (~95% asymptotic interval: 24-41%, ~75% interval based on the range of states of nature: 12-56%), corresponding to 10.544 mt (asymptotic interval: 7,776-13,312 mt, states of nature interval: 4,009-17,519) of female spawning biomass in the base model. The time series of population trends for the base case is reported in Table 26, and the uncertainty in Table 27. Predicted numbers at age from the base case for females and males are provided in Table 28 and Table 29.

2.9 Uncertainty and Sensitivity Analysis

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 stock productivity (via the steepness parameter of the stock-recruitment relationship) are presented. Much additional exploration of uncertainty due to structural choices, other fixed parameters and data weighting was performed prior to the STAR panel. Some of that exploration of other sources of uncertainty is provided below.

2.9.1 Sensitivity analysis

Sensitivity analysis was divided into three general areas of uncertainty: 1) selectivity structural choices, 2) treatment of survey data and 3) exploration of consistency between survey data, length data and age data through increasing the relative emphasis on each.

In model runs prior to the STAR panel, two alternate approaches were considered for the structure of selectivity parameters. For the first, the Washington and Oregon trawl fleets were allowed to have the slightly better-fitting age-based selectivity. This run resulted in a slight increase in the absolute magnitude of spawning biomass in recent years and a slightly higher level of current depletion. As expected from the evaluation of alternate models, the length and age data fit slightly better for these two fleets. The second sensitivity run, explored the choice of *a priori* selected time-blocks vs. those selected to most improve the model fit to compositional data. In this alternate model, those blocks which were not included in the base case model, but had been in the 2005 assessment were added back in. This required the addition of 39 parameters, but did improve the model fit by 219 units of log-likelihood. These changes resulted in a slight reduction in the estimate of current stock levels, more closely matching the results of the 2005 assessment (this sensitivity was conducted with steepness fixed at 0.35).

Three other model runs prior to the STAR panel explored the treatment of survey data relative to the base case model. The first used the design-based estimators instead of the GLMM-based values as the index of relative abundance. This run estimated slightly lower recruitments in recent years, but otherwise had little effect on model results. The second sensitivity run of this set was intended to evaluate whether non-linearity in the triennial survey abundance index (potentially caused by extrapolation into untrawlable habitat, density-dependent changes in distribution of other factors) is an important consideration in this assessment. One additional parameter was added to allow non-linearity in the relationship between vulnerable biomass and expected survey index values. This parameter was estimated to be 0.186 (the power term is 1+estimated parameter) so that the survey is found to be slightly more sensitive to changes in abundance than a linear relationship would allow. However, this had a negligible effect on model results. The third survey-related sensitivity run removed the triennial survey time-series. Other than a slight increase in the estimate of unexploited spawning biomass, this sensitivity also had little effect on model results. In aggregate, these runs showed that the treatment of the survey data is not particularly important for pre-STAR base case model results.

Following the STAR panel two additional sensitivity runs were conducted to evaluate the effects of a) splitting the triennial survey series and b) excluding the pre-recruit index. Retaining the triennial survey series as a single index reduced the estimate of current depletion from 32.4% to 29.3%, but had little additional effect of model predictions (Table 30, Figure 93). Excluding the pre-recruit index reduced the 2002 and 2004 recruitment estimates, but increased 2005 and 2006 as they tended to follow the stock-recruit expectation instead of the lower-than-average values observed in the index itself (Figure 94). It will clearly be many years before this series can be 'validated' through corroboration of recruitment strengths reliably estimated via other types of data.

Additional sensitivity runs on the pre-STAR model were intended only to highlight any inconsistencies in the information content of the main type of data included in this stock assessment, length, age and survey data. To do this, the emphasis (lambda) on each type of data was increased by an order of magnitude (from 1.0 to 10.0). When age data were greatly emphasized, estimates of unexploited spawning biomass decreased substantially, and recent trend was nearly flat, with little recovery evident since the mid-1990s. Greatly increasing the emphasis on the length data had the opposite effect; the estimate of unexploited spawning biomass went up appreciably and recent trend was rapidly increasing. By contrast, increasing the emphasis on only those sources of data from the surveys led to the same early period trend in spawning biomass (indicating this source of information lies in the age data from the one of the surveys) and little change in current stock size. This apparently conflicting signal between the age and length data in the canary assessment was identified in the 2005 assessment and underscores the importance of weighting of data sources.

2.9.2 Retrospective analysis

A retrospective analysis was conducted by running the model using data only through 2003 or 2004, 2005, and 2006 (Figure 95). The results do not show any strong patterns that would be of concern. As would be expected, the signal for recent year classes drops out as more years of data are excluded from the analysis, resulting in the expectation from stock-recruit curve dominating the estimated recruitments (Figure 96).

The second type of retrospective addresses assessment error, or at least the historical context of the current result given previous analyses. The 2007 base case model shows a relative trend over the last 50 years that is very similar to the last 5 canary rockfish stock assessments through the early 1990s (Figure 97). However, after this period the 2007 base case predicts a much more rapid recovery, based primarily on the change in steepness of the stock-recruit function. The 2002 and 2005 assessment results are quite consistent with the state-of-nature using a steepness value of 0.35. Little consistency is apparent in recruitment time-series among assessments, although the general magnitude is reasonably conserved.

2.9.3 Likelihood profiles

The likelihood profile for steepness shows that the best fitting values > 0.7 (Table 31, Figure 98). In the pre-STAR model, the only data source that showed a minimum within the biologically plausible range for steepness was the triennial survey, likely due to the information regarding the decrease and increase in the stock around the mid-1900s. This minimum (0.35) was used as the basis for the pre-STAR base case value used in this assessment. With the triennial survey split into two series, there is now less than one unit of negative log-likelihood difference in the profile values for the survey index likelihood component. This change reflects the loss of linkage between the declining and ascending portions of the series. The value of steepness is highly correlated with the stocks ability to recover in recent years and therefore current depletion level (Figure 99). This was the case in the 2005 assessment as well.

A likelihood profile was calculated for the natural mortality parameter for males and young females using the pre-STAR base case model. Natural mortality governs the basic productivity of the stock and is therefore expected to be correlated with many management quantities. The value used in the base case model (0.06) fit the data slightly worse than a value of 0.07 in terms of total likelihood, but did fit the survey data better than larger or smaller values. Although current depletion was highly correlated with natural mortality, it was not as sensitive to changes in this parameter as to steepness

2.9.4 Parametric bootstrap using SS2

There is a built-in option to create bootstrap data-sets using SS2. This feature creates a parametric bootstrap using the error assumptions and sample sizes from the input data to generate new observations about the fitted model expectations. It is therefore, not a variance estimation exercise, but an exploration of the question: If the assessment was true, and the same relative quantity of data were available, how reliably could the parameters and derived quantities be re-estimated?

This method was applied to the pre-STAR model: replicate data sets (50) were created via the bootstrap and then the (preliminary) base case model was fitted to each. Summary of any quantities in each model is possible, but for this analysis only a few key quantities were considered: unexploited spawning biomass, current (2007) spawning biomass, current depletion and the parameter defining increased natural mortality for old females. The results showed that estimation of the general trend in the canary rockfish stock is reasonably consistent with the available data. However, the degree of increase in female natural mortality tended to be underestimated. Unexploited spawning biomass was slightly overestimated and 2007 spawning biomass was underestimated, with the net result of the two being that current depletion tends to be slightly underestimated. All of these biases were well within the reasonable range of the confidence intervals for each quantity.

3. Rebuilding parameters

The rebuilding projections will be added to this document after the analysis has been completed in August 2007. The base case assessment model includes parameter uncertainty from a variety of sources, but still likely underestimates the true uncertainty in recent trend and current stock status. For this reason, the three states of nature for stock-recruit steepness will be resampled in proportion to their relative probability and combined for the rebuilding analysis, similar to the approach taken in the 2005 assessment. This will allow the rebuilding analysis will incorporate a broader range of uncertainty by including uncertainty in the fixed value for steepness as well as annual variability in future recruitments.

4. Reference points

The abundance of canary rockfish was estimated to have dropped below the $SB_{40\%}$ management target in 1981 and the overfished threshold in 1987. In hindsight, the spawning stock biomass passed through the target and threshold levels at a time when the annual catch was averaging more than twice the current estimate of the MSY. The stock remains below the rebuilding target, although the spawning stock biomass appears to have been increasing since 1999 (Figure 100). The degree of increase is very sensitive to the value for steepness (state of nature), and is projected to slow as recent (and below average) recruitments begin to contribute to the spawning biomass. The estimated relative depletion level in 2007 is 32.4% (~95% asymptotic interval: 24-41%, ~75% interval based on the range of states of nature: 12-56%), corresponding to 10,544 mt (asymptotic interval: 7,776-13,312 mt, states of nature interval: 4,009-17,519) of female spawning biomass in the base model. Fishing mortality rates in excess of the current F-target for rockfish of $SPR_{50\%}$ are estimated to have begun in the late 1970s and persisted through 1999 (Figure 101, Figure 102, Figure 104, Figure 103, and Figure 105). Recent management actions appear to have curtailed the rate of removal such that overfishing has not occurred since 1999, and recent SPR values are in excess of 95%. Relative exploitation rates (catch/biomass of age-5 and older fish) are estimated to have been less than 1% since 2001. These patterns are largely insensitive to the three states of nature.

Unfished spawning stock biomass was estimated to be 32,561 mt in the base case model. This is slightly smaller than the equilibrium value estimated in the 2005 assessment. The target stock size ($SB_{40\%}$) is therefore 13,024 mt. Maximum sustained yield (MSY) applying current fishery selectivity and allocations (a 'bycatch-only' scenario) was estimated in the assessment model to occur at a spawning stock biomass of 12,394 mt and produce an MSY catch of 1,169 mt (SPR = 52.9%). This is nearly identical to the yield, 1,167 mt, generated by the SPR (54.4%) that stabilizes the stock at the $SB_{40\%}$ target. The fishing mortality target/overfishing level (SPR = 50.0%) generates a yield of 1,161 mt at a stock size of 11,161 mt.

When selectivity and allocation from the mid 1990s (1994-1998) was applied, to mimic reference points under a targeted fishery scenario, the yield increased to 1,578 mt from a slightly smaller stock size (12,211 mt), but a similar rate of exploitation (SPR=52.5%). Similar increases are observed in the other reference points (Figure 106). This is due to higher relative selection of older and larger fish when the fishery was targeting instead of avoiding canary rockfish. These values are appreciably higher than those from previous assessment models due primarily to the difference in steepness.

As suggested by the STAR panel, the 'dynamic' unexploited spawning biomass calculation was performed for comparison with the current 'static' approach. The dynamic calculation consists of eliminating the catch time-series, and re-running the model without re-estimating any of the parameters (but starting from the maximum likelihood values). This run generates a time-series of spawning biomass estimates that can be interpreted as the level that would have occurred in the absence of fishing, conditioned on the model parameters and stock-recruitment relationship. By calculating relative depletion based on the spawning biomass estimated from each year of this series, an alternate view of the effect of fishing on the stock can be constructed. In the case of canary, the results of the two estimators are quite similar, the differences reflecting periods of relatively poor recruitment (the dynamic depletion tends to be higher than the static value as these recruitments move through the spawning biomass) or good recruitment (the dynamic depletion tends to be lower than the static value following these periods, such as has been observed in the most recent years (Figure 107).

5. Harvest projections and decision tables

The forecast reported here will be replaced by the rebuilding analysis to be completed in September-October 2007 following SSC review of the stock assessment. In the interim, the total catch in 2007 and 2008 is set equal to the OY (44 mt). The exploitation rate for 2009 and beyond is based upon an SPR of 88.7%, which approximates the harvest level in the current rebuilding plan. Uncertainty in the rebuilding forecast will be based upon the three states of nature for steepness and random variability in future recruitment deviations for each rebuilding simulation. Current medium-term forecasts predict slow increases in abundance and available catch, with OY values for 2009 and 2010 increasing by nearly four times the value of 44 mt from the 2005 assessment (Table 32). This is largely attributable to the revised perception of steepness, based on meta-analysis of other rockfish species.

Because canary rockfish is currently managed under a rebuilding plan, a decision table is presented only intended to better compare and contrast the base case with uncertainty among states of nature (Table 33). The results of the rebuilding plan will integrate these three states of nature as well as projected recruitment variability. Further, various alternate probabilities of rebuilding by target and limit time-periods as well as fishing mortality rates will be evaluated in the rebuilding analysis. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

6. Regional management considerations

The resource is modeled as a single stock. Spatial aspects of the coast-wide population are addressed through geographic separation of data sources/fleets where possible and consideration of residual patterns that may be a result of inherent stock structure. There is currently no genetic evidence that there are distinct biological stocks of canary rockfish off the U.S. coat and very limited tagging data to describe adult movement, which may be significant across depth and latitude. Future efforts to specifically address regional management concerns will require a more spatially explicit model that likely includes the portion of the canary rockfish stock residing in Canadian waters off Vancouver Island.

7. Research needs

Progress on a number of research topics would substantially improve the ability of this assessment to reliably and precisely model canary rockfish population dynamics in the future and provide better monitoring of progress toward rebuilding:

1. Expanded Assessment Region: Given the high occurrence of canary rockfish close to the US-Canada border, a joint US-Canada assessment should be considered in the future.
2. Many assessments are deriving historical catch by applying various ratios to the total rockfish catch prior to the period when most species were delineated. A comprehensive historical catch reconstruction for all rockfish species is needed, to compile a best estimated catch series that accounts for all the catch and makes sense for the entire group.

3. Habitat relationships: The historical and current relationship between canary rockfish distribution and habitat features should be investigated to provide more precise estimates of abundance from the surveys, and to guide survey augmentations that could better track rebuilding through targeted application of newly developed survey technologies. Such studies could also assist determining the possibility of dome-shaped selectivity, aid in evaluation of spatial structure and the use of fleets to capture geographically-based patterns in stock characteristics.
4. Meta-population model: The spatial patterns show patchiness in the occurrence of large vs. small canary; reduced occurrence of large/old canary south of San Francisco; and concentrations of canary rockfish near the US-Canada border. The feasibility of a meta-population model that has linked regional sub-populations should be explored as a more accurate characterization of the coast-wide population's structure. Tagging of other direct information on adult movement will be essential to this effort.
5. Increased computational power and/or efficiency is required to move toward fully Bayesian approaches that may better integrate over both parameter and model uncertainty.
6. Additional exploration of surface ages from the late 1970s and inclusion into or comparison with the assessment model, or re-aging of the otoliths could improve the information regarding that time period when the stock underwent the most dramatic decline. Auxiliary biological data collected by ODFW from recreational catches and hook-and-line projects may also increase the performance of the assessment model in accurately estimating recent trends and stock size.
7. Due to inconsistencies between studies and scarcity of appropriate data, new data is needed on both the maturity and fecundity relationships for canary rockfish.
8. Re-evaluation of the pre-recruit index as a predictor of recent year class strength should be ongoing as future assessments generate a longer series of well-estimated recent recruitments to compare with the coast-wide survey index.
9. Meta-analysis or other summary of the degree of recruitment variability and the relative steepness for other rockfish and groundfish stocks should be ongoing, as this information is likely to be very important for model results (as it is here) in the foreseeable future.

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10. Tables

Table 1. Recent trend in estimated total canary rockfish catch and commercial landings (mt) relative to management guidelines.

Year	ABC (mt)	OY (mt)	Landings (mt)[1]	Total Catch (mt)
1997	1,220[2]	1,000[2]	1,113.8	1,478.8
1998	1,045[2]	1,045[2]	1,182.4	1,494.2
1999	1,045[2]	857[2]	665.7	898.0
2000	287	200	60.6	208.4
2001	228	93	42.8	133.6
2002	228	93	48.6	106.8
2003	272	44	8.5	51.0
2004	256	47.3	10.7	46.5
2005	270	46.8	10.9	51.4
2006	279	47	8.2	47.1

[1]Excludes all at-sea whiting, recreational and research catches.
[2]Includes the Columbia and Vancouver INPFC areas only.

Table 2. Summary of data sources available in 2007. “X” denotes data used in 2005, “N” denotes new data.

	1916-1927	1928-1931	1932-1949	1950-1965	1966-1967	1968-1972	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
Catches																																								
S. CA trawl												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
N. CA trawl	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
OR trawl		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
WA trawl			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
S. CA non-trawl												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
N. CA non-trawl	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
OR/WA non-trl																				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
S. CA Rec.														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
N. CA Rec.				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
OR/WA Rec.									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
At-sea whiting																									X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
Foreign					X	X	X	X	X	X																														
Research											X			X			X			X			X			X			X			X			X		X	X	N	N
WCGOP discards																																			X	X	X	X	N	N
Fishery Data																																								
Age																																								
S. CA trawl														X	X		X	X	X																	X	X			
N. CA trawl														X	X	X	X	X	X		X														X	X	X			
OR trawl														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
WA trawl														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
OR/WA non-trl																															X	X		X	X	X		X	N	N
WCGOP discards																																						N	N	
At-sea whiting																																					N	N	N	
Length																																								
At-sea whiting																																					N	N	N	N
S. CA trawl												X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	
N. CA trawl												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
OR trawl							X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
WA trawl						X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
S. CA non-trawl												X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X					
N. CA non-trawl															X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X			
OR/WA non-trl														X								X		X						X	X	X	X	X	X	X		X		N
S. CA Rec.														X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	N	N

Table 2. Continued. Summary of data sources available in 2007. “X” denotes data used in 2005, “N” denotes new data.

	1916 - 1927	1928 - 1931	1932 - 1949	1950 - 1965	1966 - 1967	1968 - 1972	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
Fishery Data																																								
Length																																								
N. CA Rec.														X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	N	N
OR/WA Rec.														X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X			
WCGOP discards																																			N	N	N	N	N	N
Survey data																																								
Index																																								
Triennial survey														X			X			X			X			X			X			X			X			X		
NWFSC survey																																					N	N	N	N
Pre-recruit index																																			N	N	N	N	N	N
Age																																								
Triennial survey																	X						X			X			X						X			X		
NWFSC survey																																					N	N	N	N
Length																																								
Triennial survey																	X			X			X			X			X			X			X			X		
NWFSC survey																																					N	N	N	N
For comparison																																								
PGCT hook-and-line																																							N	N
YOY core area																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	N	N
NWFSC Hook and Line																																						N	N	N
N. CA trawl CPUE															X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
OR/WA Rec.																																	N	N	N					
N. CA Rec. CPFV CPUE																					X	X	X	X	X	X	X	X	X	X	X	X								

Table 3. Summary of sampling used in the calculation of biomass indices for the shelf trawl surveys.

	Triennial		NWFSC	
Year	Number of tows	Positive tows	Number of tows	Positive tows
1980	314	77	NA	NA
1983	493	185	NA	NA
1986	484	169	NA	NA
1989	452	93	NA	NA
1992	431	69	NA	NA
1995	450	43	NA	NA
1998	479	86	NA	NA
2001	474	74	NA	NA
2003	NA	NA	558	50
2004	383	63	497	41
2005	NA	NA	674	56
2006	NA	NA	652	32

Table 4. The GLMM-based survey indices of biomass (median posterior values, mt) by strata. Strata with both surveys available include both indices (Triennial/NWFSC). Note that strata-specific values represent the marginal medians and so do not add to the integrated total.

					Total	
Year	Conception-Monterey	Eureka	Columbia	US Vancouver	Triennial	NWFSC
1980	139.4	257.9	1,079.5	392.7	1,969.4	NA
1983	737.0	295.0	1,602.1	1,065.8	3,768.4	NA
1986	188.4	551.9	1,035.5	523.5	2,419.7	NA
1989	313.3	131.0	592.3	573.7	1,691.3	NA
1992	53.5	23.3	361.2	93.5	558.3	NA
1995	90.4	47.0	299.7	34.4	505.8	NA
1998	146.2	70.3	249.6	131.7	631.4	NA
2001	77.5	118.7	423.6	117.7	764.3	NA
2003	164.9	243.1	672.3	630.5	NA	1,845.5
2004	142.5/354.4	129.5/83.8	589.6/591.2	111.0/526.5	1,016.7	1,768.0
2005	353.5	368.4	424.1	566.3	NA	1,912.8
2006	129.6	655.1	266.8	3901.1	NA	5,387.4

Table 5. Summary of data used to produce NWFSC survey length and age-at-length frequencies.

	Length data		Age-at-length data	
Year	Number of Samples	Number of fish	Number of samples	Number of Fish
2003	50	423	48	262
2004	41	550	41	288
2005	56	622	55	277
2006	32	623	32	247

Table 6. Summary of data used to produce triennial survey length and age-at-length frequencies.

	Length data		Age-at-length data	
Year	Number of samples	Number of fish	Number of samples	Number of Fish
1983	44	3,064	21	1,627
1986	44	2,544	0	0
1989	77	1,411	20	254
1992	34	407	9	176
1995	41	616	37	241
1998	84	422	0	0
2001	74	398	74	367
2004	62	412	60	211

Table 7. Summary of fixed biological parameters used in this stock assessment

Quantity	Value	Source
Natural mortality	0.06	All canary assessments since 1994, males and females < age 6, with a linear ramp to an estimated value for females age 14+.
Weight-length coefficient (*a*)	0.0000155	2005 assessment, pooled over both sexes from fishery and survey data combined.
Weight-length exponent (*b*)	3.03	
Length at 50% maturity	40.5	2005 assessment Oregon and Washington trawl fisheries sampled during fall and winter months only.
Maturity logistic slope	-0.25	
Fecundity eggs/gram intercept	1.0	No fecundity relationship available, so weight is assumed to be a reasonable proxy.
Fecundity slope	0.0	

Table 8. Estimates of ageing bias (mean observed age at true age) and precision (SD of observed age at true age) for CAP and WDFW break-and-burn reads as well as surface reads.

	CAP			WDFW		Surface	
True age	Obs. age	SD	Obs. age (radiocarbon study, not used in model)	Obs. age	SD	Obs. age	SD
0.50	0.50	0.10	0.50	0.50	0.11	0.50	0.17
1.50	1.42	0.10	1.41	1.50	0.11	1.42	0.17
2.50	2.34	0.20	2.32	2.50	0.23	2.34	0.33
3.50	3.26	0.29	3.22	3.50	0.34	3.33	0.50
4.50	4.17	0.39	4.13	4.50	0.45	4.60	0.67
5.50	5.09	0.49	5.04	5.50	0.56	5.81	0.83
6.50	6.01	0.59	5.95	6.50	0.68	6.95	1.00
7.50	6.93	0.68	6.85	7.50	0.79	8.04	1.17
8.50	7.85	0.78	7.76	8.50	0.90	9.08	1.34
9.50	8.77	0.88	8.67	9.50	1.02	10.07	1.50
10.50	9.69	0.98	9.58	10.50	1.13	11.01	1.67
11.50	10.61	1.07	10.49	11.50	1.24	11.91	1.84
12.50	11.52	1.17	11.39	12.50	1.36	12.76	2.00
13.50	12.44	1.27	12.30	13.50	1.47	13.57	2.17
14.50	13.36	1.37	13.21	14.50	1.58	14.34	2.34
15.50	14.28	1.47	14.12	15.50	1.69	15.07	2.50
16.50	15.20	1.56	15.02	16.50	1.81	15.77	2.67
17.50	16.12	1.66	15.93	17.50	1.92	16.43	2.84
18.50	17.04	1.76	16.84	18.50	2.03	17.06	3.00
19.50	17.96	1.86	17.75	19.50	2.15	17.66	3.17
20.50	18.87	1.95	18.66	20.50	2.26	18.24	3.34
21.50	19.79	2.05	19.56	21.50	2.37	18.78	3.50
22.50	20.71	2.15	20.47	22.50	2.48	19.17	3.67
23.50	21.63	2.25	21.38	23.50	2.60	19.64	3.84
24.50	22.55	2.34	22.29	24.50	2.71	20.10	4.01
25.50	23.47	2.44	23.20	25.50	2.82	20.53	4.17
26.50	24.39	2.54	24.10	26.50	2.94	20.93	4.34
27.50	25.31	2.64	25.01	27.50	3.05	21.32	4.51
28.50	26.22	2.74	25.92	28.50	3.16	21.69	4.67
29.50	27.14	2.83	26.83	29.50	3.27	22.04	4.84
30.50	28.06	2.93	27.73	30.50	3.39	22.37	5.01
31.50	28.98	3.03	28.64	31.50	3.50	22.69	5.17
32.50	29.90	3.13	29.55	32.50	3.61	22.99	5.34
33.50	30.82	3.22	30.46	33.50	3.73	23.28	5.51
34.50	31.74	3.32	31.37	34.50	3.84	23.56	5.67
35.50	32.66	3.42	32.27	35.50	3.95	23.82	5.84
36.50	33.57	3.52	33.18	36.50	4.07	24.02	6.01
37.50	34.49	3.61	34.09	37.50	4.18	24.22	6.17
38.50	35.41	3.71	35.00	38.50	4.29	24.42	6.34
39.50	36.33	3.81	35.90	39.50	4.40	24.62	6.51
40.50	37.25	3.91	36.81	40.50	4.52	24.82	6.68

Table 9. Total catches (mt) of canary rockfish by fleet used in the assessment model. Foreign catches are included in state trawl fisheries. See text for description of sources.

Year	S. CA trawl N. CA trawl	Oregon trawl	WA trawl	S. CA non-trawl N. CA non-trawl	OR-WA non-trawl	At-sea whiting bycatch	S. CA rec. N. CA rec.	OR/WA rec.	Research catches
1916	397.05	0.00	0.00	76.81	0.00	0.00	0.00	0.00	0.00
1917	627.50	0.00	0.00	121.39	0.00	0.00	0.00	0.00	0.00
1918	665.34	0.00	0.00	128.70	0.00	0.00	0.00	0.00	0.00
1919	435.72	0.00	0.00	84.29	0.00	0.00	0.00	0.00	0.00
1920	454.69	0.00	0.00	87.96	0.00	0.00	0.00	0.00	0.00
1921	384.35	0.00	0.00	74.35	0.00	0.00	0.00	0.00	0.00
1922	348.06	0.00	0.00	67.33	0.00	0.00	0.00	0.00	0.00
1923	411.39	0.00	0.00	79.58	0.00	0.00	0.00	0.00	0.00
1924	382.84	0.00	0.00	74.06	0.00	0.00	0.00	0.00	0.00
1925	443.03	0.00	0.00	85.70	0.00	0.00	0.00	0.00	0.00
1926	608.69	0.00	0.00	117.75	0.00	0.00	0.00	0.00	0.00
1927	515.84	0.00	0.00	99.78	0.00	0.00	0.00	0.00	0.00
1928	518.20	8.16	0.00	100.24	0.00	0.00	0.00	0.00	0.00
1929	487.25	14.19	0.00	94.25	0.00	0.00	0.00	0.00	0.00
1930	583.22	13.14	0.00	112.82	0.00	0.00	0.00	0.00	0.00
1931	587.44	10.06	0.00	113.64	0.00	0.00	0.00	0.00	0.00
1932	454.95	3.69	0.04	88.01	0.00	0.00	0.00	0.00	0.00
1933	386.46	5.39	0.00	74.76	0.00	0.00	0.00	0.00	0.00
1934	371.63	5.86	0.30	71.89	0.00	0.00	0.00	0.00	0.00
1935	389.96	5.40	2.30	75.43	0.00	0.00	0.00	0.00	0.00
1936	371.62	13.41	2.96	71.89	0.00	0.00	0.00	0.00	0.00
1937	346.38	17.03	2.64	67.00	0.00	0.00	0.00	0.00	0.00
1938	293.58	15.47	3.90	56.79	0.00	0.00	0.00	0.00	0.00
1939	269.04	11.49	4.09	52.04	0.00	0.00	0.00	0.00	0.00
1940	288.21	68.56	9.05	55.75	0.00	0.00	0.00	0.00	0.00
1941	274.89	144.08	3.39	53.18	0.00	0.00	0.00	0.00	0.00
1942	114.41	210.19	65.81	22.27	0.00	0.00	0.00	0.00	0.00
1943	222.74	766.49	212.71	42.52	0.00	0.00	0.00	0.00	0.00
1944	518.38	1,258.48	88.40	99.22	0.00	0.00	0.00	0.00	0.00
1945	1,071.18	1,937.94	926.43	205.53	0.00	0.00	0.00	0.00	0.00
1946	900.07	1,215.83	467.02	172.12	0.00	0.00	0.00	0.00	0.00
1947	685.43	755.22	243.97	131.62	0.00	0.00	0.00	0.00	0.00
1948	524.45	519.74	396.17	100.23	0.00	0.00	0.00	0.00	0.00
1949	480.92	528.54	481.83	92.13	0.00	0.00	0.00	0.00	0.00
1950	654.04	633.70	463.03	125.54	0.00	0.00	82.80	0.00	0.00
1951	886.91	409.14	387.38	170.09	0.00	0.00	82.80	0.00	0.00
1952	864.64	418.88	369.45	166.04	0.00	0.00	82.80	0.00	0.00
1953	986.13	334.79	160.20	189.33	0.00	0.00	82.80	0.00	0.00
1954	1,019.54	421.04	229.79	195.40	0.00	0.00	82.80	0.00	0.00
1955	1,022.58	442.74	216.84	196.42	0.00	0.00	82.80	0.00	0.00
1956	1,204.82	271.93	207.15	230.84	0.00	0.00	82.80	0.00	0.00
1957	1,297.96	779.74	171.37	249.06	0.00	0.00	77.70	0.00	0.00
1958	1,438.70	599.62	216.94	275.39	0.00	0.00	88.30	0.00	0.00
1959	1,232.16	658.62	242.52	235.90	0.00	0.00	82.40	0.00	0.00
1960	1,105.60	834.55	219.31	211.60	0.00	0.00	108.40	0.00	0.00
1961	873.75	760.81	260.34	167.05	0.00	0.00	98.30	0.00	0.00
1962	792.75	795.34	362.74	151.87	0.00	0.00	104.00	0.00	0.00
1963	947.66	544.63	292.02	181.23	0.00	0.00	105.30	0.00	0.00
1964	571.02	489.43	215.56	114.41	0.00	0.00	94.20	0.00	0.00
1965	561.91	483.87	480.38	116.43	0.00	0.00	113.80	0.00	0.00
1966	534.58	2,127.32	729.91	106.31	0.00	0.00	117.90	0.00	0.00
1967	483.95	854.51	414.09	84.03	0.00	0.00	117.10	0.00	0.00
1968	686.44	788.70	671.26	60.75	0.00	0.00	120.20	0.00	0.00
1969	167.05	671.26	558.87	38.47	0.00	0.00	123.50	0.00	0.00

Table 9. Continued. Total catches (mt) of canary rockfish by fleet used in the assessment model.

Year	S. CA trawl	N. CA trawl	Oregon trawl	WA trawl	S. CA non-trawl	N. CA non-trawl	OR-WA non-trawl	At-sea whiting bycatch	S. CA rec.	N. CA rec.	OR/WA rec	Research catches
1970	188.32		679.36	472.82	44.55		0.00	0.00	139.10		0.00	0.00
1971	196.42		702.64	454.59	46.57		0.00	0.00	0.00		0.00	0.00
1972	301.71		927.41	163.00	68.85		0.00	0.00	0.00		0.00	0.00
1973	771.49		1,306.06	146.81	92.13		0.00	0.00	0.00		0.00	0.00
1974	523.44		602.41	480.92	85.05		0.00	0.00	0.00		0.00	0.00
1975	504.20		525.46	575.07	87.07		0.00	0.00	0.00		4.01	0.00
1976	454.59		283.49	454.59	85.05		0.00	0.00	0.00		2.11	0.00
1977	331.07		489.01	991.19	67.83		0.00	0.00	0.00		4.47	11.66
1978	22.10	639.95	990.18	1,126.86	3.25	130.62	0.00	0.00	150.50		10.30	0.00
1979	9.87	308.50	1,750.53	1,118.76	3.09	106.03	0.00	0.00	159.20		4.86	0.00
1980	30.38	413.40	2,309.41	945.63	14.20	75.66	0.00	0.00	136.90	159.01	34.98	5.31
1981	34.18	494.02	2,082.84	514.45	39.24	165.68	0.00	0.00	35.05	118.04	48.89	0.00
1982	0.90	797.72	3,941.26	435.11	36.91	11.58	0.00	0.00	34.33	241.28	44.47	0.00
1983	7.39	499.24	3,580.68	650.80	46.55	10.90	0.00	0.00	11.63	93.99	6.82	10.49
1984	29.61	358.07	1,188.43	612.87	56.90	3.05	0.00	0.00	31.77	75.66	26.65	0.00
1985	15.03	305.93	1,029.50	1,037.98	107.44	3.42	0.00	0.00	43.47	120.33	63.37	0.00
1986	0.79	167.71	902.13	899.06	12.40	42.16	15.64	0.00	61.40	165.45	24.21	11.78
1987	0.00	211.00	1,491.39	1,016.63	20.61	24.36	160.00	0.00	57.02	168.13	34.34	0.00
1988	0.50	226.58	1,576.42	979.31	24.35	26.44	0.00	0.00	46.59	137.65	56.59	0.00
1989	6.80	175.77	1,573.63	1,208.85	111.27	104.31	0.00	0.00	29.71	85.89	31.56	5.10
1990	15.72	310.17	1,029.44	1,099.96	69.10	139.26	17.35	0.00	10.02	61.34	38.43	0.00
1991	7.84	138.10	1,776.39	971.64	136.87	24.05	27.91	5.06	10.02	61.34	43.75	0.00
1992	6.97	218.13	1,423.29	825.03	49.38	77.80	152.43	1.81	10.02	61.34	38.43	1.17
1993	42.03	48.02	1,513.80	289.81	26.70	81.32	116.69	0.72	0.00	64.82	51.07	0.00
1994	13.89	106.05	644.15	149.54	41.37	52.81	104.87	4.83	0.00	53.46	38.78	0.00
1995	30.10	101.84	548.61	161.15	53.89	60.59	118.68	0.31	1.23	68.33	43.53	1.07
1996	101.06	116.26	758.21	189.85	72.11	52.88	166.36	1.35	2.49	60.59	25.24	0.00
1997	31.96	142.66	589.85	203.44	29.78	73.80	254.42	3.63	1.75	100.85	46.68	0.00
1998	8.41	149.45	716.05	203.01	23.33	57.25	250.13	5.47	1.14	25.46	53.49	0.97
1999	7.36	96.25	387.85	139.97	8.53	28.59	123.97	5.63	2.81	62.05	35.02	0.00
2000	1.71	11.24	46.62	32.66	2.52	5.50	10.25	2.35	0.41	76.64	18.46	0.00
2001	1.44	9.43	33.13	19.65	1.60	4.96	11.00	4.05	0.00	33.37	13.34	1.61
2002	0.36	14.62	32.60	33.29	0.02	0.08	3.15	5.24	0.21	6.00	11.13	0.13
2003	0.23	0.31	5.02	6.24	0.00	0.08	6.89	0.93	0.06	18.05	12.10	1.08
2004	0.61	1.95	7.67	7.73	0.02	0.06	4.68	5.22	1.48	9.11	5.76	2.24
2005	0.72	2.84	4.91	25.90	0.06	0.09	1.79	1.44	1.49	0.83	6.82	4.54
2006	3.57	2.28	2.91	15.64	0.00	0.00	3.11	1.09	5.73	1.03	3.98	7.78

Table 10. Canary rockfish discard rates applied to commercial fishing landings to generate the catches used in the assessment model.

Year	Southern CA trawl	Northern CA trawl	Oregon trawl	Washington trawl	Southern CA non-trawl	Northern CA non-trawl	OR-WA non-trawl
1916-1994	0.0123	0.0123	0.0123	0.0123	0.0123	0.0123	0.0123
1995-1999	0.160	0.160	0.160	0.160	0.160	0.160	0.160
2000	0.148	0.148	0.435	0.757	0.160	0.160	0.160
2001	0.282	0.282	0.600	0.644	0.160	0.160	0.160
2002	0.236	0.236	0.473	0.482	0.160	0.160	0.160
2003	0.190	0.190	0.448	0.285	NA	0.877	0.877
2004	0.646	0.646	0.512	0.381	0.730	0.730	0.730
2005	0.729	0.729	0.190	0.801	0.592	0.592	0.592
2006	0.708	0.708	0.185	0.783	NA	NA	0.776

Table 11. Summary of sampling effort generating length-frequency distributions used in the assessment model for the trawl fleets.

	Southern California		Northern California		Oregon		Washington	
Year	N trips	N fish	N trips	N fish	N trips	N fish	N trips	N fish
1968	0	0	0	0	0	0	2	402
1969	0	0	0	0	0	0	2	718
1970	0	0	0	0	0	0	1	268
1971	0	0	0	0	0	0	8	1,804
1972	0	0	0	0	0	0	2	501
1973	0	0	0	0	1	51	1	230
1974	0	0	0	0	4	370	0	0
1975	0	0	0	0	0	0	5	1,244
1976	0	0	0	0	2	89	3	716
1977	0	0	0	0	8	750	2	481
1978	7	16	63	363	7	670	5	911
1979	2	2	30	168	6	600	8	799
1980	11	25	80	261	20	996	18	1,654
1981	8	10	50	176	8	633	18	1,765
1982	4	5	72	349	20	1,358	13	1,300
1983	7	12	118	409	30	2,836	17	1,650
1984	10	64	73	312	21	2,064	17	1,550
1985	25	56	69	391	29	1,891	18	1,750
1986	3	4	53	389	16	1,545	17	1,649
1987	0	0	61	306	35	1,751	25	1,300
1988	3	3	49	269	23	1,148	19	950
1989	3	15	42	232	23	1,130	18	900
1990	6	21	43	317	22	1,099	17	850
1991	6	20	29	170	22	869	22	1,100
1992	9	43	20	186	34	1,364	20	999
1993	21	210	13	42	22	1,113	17	854
1994	6	64	10	87	15	750	15	750
1995	5	60	11	213	16	847	22	1,100
1996	12	224	12	218	19	1,162	15	750
1997	16	239	7	116	28	1,545	17	847
1998	8	114	6	96	28	1,560	25	845
1999	5	50	9	255	28	1,517	18	743
2000	5	27	5	59	18	545	7	229
2001	9	83	7	107	34	908	13	320
2002	3	10	15	263	76	1,454	38	690
2003	7	17	5	50	45	427	29	376
2004	5	7	9	88	79	433	62	574
2005	7	16	2	5	85	724	78	1,383
2006	15	30	0	0	54	355	35	623

Table 12. Summary of sampling effort generating length-frequency distributions used in the assessment model for the non-trawl and at-sea whiting fleets.

	Southern California		Northern California		Washington and Oregon		At-sea whiting	
Year	N trips	N fish	N trips	N fish	N trips	N fish	N hauls	N fish
1968	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	1	1	0	0	0	0	0	0
1979	1	10	0	0	0	0	0	0
1980	4	30	0	0	1	22	0	0
1981	0	0	1	5	0	0	0	0
1982	0	0	4	38	0	0	0	0
1983	0	0	2	6	0	0	0	0
1984	0	0	1	1	0	0	0	0
1985	4	32	0	0	0	0	0	0
1986	29	100	0	0	0	0	0	0
1987	14	120	0	0	0	0	0	0
1988	13	94	0	0	3	287	0	0
1989	27	330	0	0	0	0	0	0
1990	19	84	0	0	1	100	0	0
1991	9	65	6	142	0	0	0	0
1992	100	1,086	48	755	0	0	0	0
1993	99	345	55	1,070	0	0	0	0
1994	93	647	55	1,410	0	0	0	0
1995	54	310	29	1,013	0	0	0	0
1996	68	458	38	932	1	37	0	0
1997	57	482	23	625	11	538	0	0
1998	31	122	14	265	8	335	0	0
1999	17	109	50	679	5	168	0	0
2000	0	0	16	148	24	176	0	0
2001	5	25	24	218	29	191	0	0
2002	0	0	3	22	6	54	0	0
2003	2	2	9	33	5	27	85	165
2004	17	93	51	167	10	57	103	221
2005	6	11	29	126	8	19	180	320
2006	12	81	17	123	2	37	165	247

Table 13. Summary of sampling effort generating length-frequency distributions used in the assessment model for the recreational fleets.

	Southern California		Northern California		Washington and Oregon	
Year	N trips	N fish	N trips	N fish	N trips	N fish
1968	0	0	0	0	0	0
1969	0	0	0	0	0	0
1970	0	0	0	0	0	0
1971	0	0	0	0	0	0
1972	0	0	0	0	0	0
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	129	546	61	334	85	263
1981	70	229	45	224	35	110
1982	88	264	66	383	78	224
1983	88	246	50	197	27	50
1984	105	311	72	242	89	338
1985	179	687	104	432	110	352
1986	156	716	107	671	51	158
1987	47	149	57	469	73	248
1988	70	183	61	212	107	379
1989	120	494	19	82	42	161
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	97	211	84	337	118	530
1994	44	75	78	391	116	604
1995	70	253	51	231	100	596
1996	126	637	84	458	77	336
1997	148	1177	53	585	110	433
1998	128	592	27	144	172	738
1999	141	637	62	346	160	765
2000	58	298	30	90	101	375
2001	52	155	13	21	67	182
2002	37	100	11	17	64	154
2003	8	8	25	38	16	36
2004	93	148	28	54	19	24
2005	18	27	17	27	0	0
2006	19	38	9	14	8	16

Table 14. Summary of sampling effort generating age-frequency distributions used in the assessment model for the trawl fleets.

	Southern California		Northern California		Oregon		Washington	
Year	N trips	N fish	N trips	N fish	N trips	N fish	N trips	N fish
1968	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0
1980	0	0	0	0	8	394	11	620
1981	4	6	43	155	2	60	20	1,031
1982	0	0	51	210	0	0	3	298
1983	3	4	113	392	29	2,724	10	997
1984	10	63	68	300	19	1,856	8	646
1985	14	36	62	365	24	1,204	12	1,197
1986	0	0	0	0	16	807	17	1,308
1987	0	0	1	1	29	1,448	17	897
1988	0	0	0	0	8	397	24	948
1989	0	0	0	0	22	1,044	29	887
1990	0	0	0	0	20	998	26	850
1991	0	0	0	0	22	850	21	997
1992	0	0	0	0	32	1,280	24	999
1993	0	0	0	0	22	1,110	22	848
1994	0	0	0	0	4	200	15	749
1995	0	0	0	0	14	794	22	1,100
1996	0	0	0	0	18	1,093	16	749
1997	0	0	0	0	28	1,537	17	843
1998	0	0	0	0	28	1,554	24	829
1999	0	0	0	0	28	1,516	17	737
2000	0	0	0	0	17	506	9	227
2001	0	0	1	28	24	734	15	306
2002	1	6	5	69	52	1,009	45	595
2003	1	2	3	41	37	249	32	271
2004	1	1	4	43	68	383	69	541
2005	3	4	2	5	73	582	78	1,035
2006	0	0	0	0	0	0	23	345

Table 15. Summary of sampling effort generating age-frequency distributions used in the assessment model for the non-trawl and at-sea whiting fleets.

	Southern California		Northern California		Washington and Oregon		At-sea whiting	
Year	N trips	N fish	N trips	N fish	N trips	N fish	N hauls	N fish
1968	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	1	17	0	0
1998	0	0	0	0	4	87	0	0
1999	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0
2001	0	0	0	0	5	39	0	0
2002	0	0	0	0	1	8	0	0
2003	0	0	0	0	3	14	82	143
2004	0	0	0	0	7	33	102	175
2005	0	0	0	0	6	17	173	265
2006	0	0	0	0	0	0	0	0

Table 16. Input and effective sample sizes used for tuning the composition data in the base model.

Type of data	Fleet	Input adjustment	Average input after adjustment	Average effective N	Harmonic mean effective N
Length	S. Cal. trawl	0.91	13.90	13.93	5.54
	N. Cal. trawl	1	63.46	65.61	40.42
	OR trawl	1	135.36	212.04	110.16
	WA trawl	1	98.31	229.02	110.04
	S. Cal. non-trawl	0.84	48.28	48.12	8.67
	N. Cal. non-trawl	1	77.42	119.72	10.52
	OR-WA non-trawl	1	25.71	54.67	20.18
	S. Cal. rec	0.92	123.43	123.87	34.77
	N. Cal. rec	0.92	78.27	79.21	41.21
	OR-WA rec	0.9	109.60	109.74	42.80
	At-sea hake fishery	1	149.93	159.76	76.81
	NWFSC trawl survey	1	83.57	139.98	124.81
	Triennial survey (1980-1992)	1	167.15	250.18	156.87
	Triennial survey (1995-2004)	1	97.34	121.11	67.54
Age	S. Cal. trawl	1	6.73	7.73	3.91
	N. Cal. Trawl	0.98	51.23	51.57	7.53
	OR trawl	1	133.81	232.65	153.81
	WA trawl – WDFW error	1	57.24	75.88	13.24
	WA trawl – CAP error	1	68.49	118.71	87.84
	OR-WA non-trawl	1	8.10	21.64	15.58
	At-sea hake fishery	0.36	52.49	53.78	29.18
	NWFSC trawl survey	1	4.52	5.14	1.95
	Triennial survey (1980-1992)	1	6.08	8.06	2.39
	Triennial survey (1995-2004)	1	5.98	5.51	2.45

Table 17. Adjusted mean input standard errors and root-mean-squared error (RMSE) of fits to index data used to tune the base model. ~95% confidence interval intersection is reported as number of predictions inside the interval/number of data points.

Fleet	Additional variance added	Mean input standard error after adjustment	RMSE	~95% CI intersection
NWFSC trawl survey	0.00	0.52	0.44	4/4
Triennial survey (1980-1992)	0.04	0.43	0.45	5/5
Triennial survey (1995-2004)	0.00	0.43	0.05	4/4
Pre-recruit index	0.11	0.42	0.50	6/6

Table 18. Description of model parameters in the base case assessment model.

Parameter	Number estimated	Bounds (low, high)	Prior (Mean, SD)
Natural mortality (*M*, male and female to age 6)	-	NA	Fixed at 0.06
Natural mortality (*M*, female age 14+, as exp. offset)	1	(-3,3)	Uniform
Stock and recruitment			
Ln(R_0)	1	(5,11)	Uniform
Steepness (*h*)	-	NA	Fixed at 0.511
σ_r	-	NA	Fixed at 0.50
Ln(Recruitment deviations): 1960-2007	48	(-10, 10)	Uniform
Catchability			
Ln(*Q*) – NWFSC survey	-	Analytic solution	
Ln(*Q*) – Triennial survey (1980-1992)	-	Analytic solution	
Ln(*Q*) – Triennial survey (1995-2004)	-	Analytic solution	
Selectivity (double normal)			
Fisheries:			
Length at peak selectivity	25	(20,60)	Uniform
Width of top (as logistic)	-	NA	Fixed at -4.0
Ascending width (as exp[width])	24	(-1,10)	Uniform
Descending width (as exp[width])	7	NA	Fixed at 1.0
Initial selectivity (as logistic)	-	NA	Fixed at -9.0
Final selectivity (as logistic)	23	(-5,5)	Uniform
Surveys:			
Length at peak selectivity	2	(15,66)	Uniform
Width of top (as logistic)	2	(-4,4)	Uniform
Ascending width (as exp[width])	2	(-1,10)	Uniform
Descending width (as exp[width])	-	NA	Fixed at 1.0
Initial selectivity (as logistic)	1	(-5,5)	Fixed at -9.0
Final selectivity (as logistic)	2	(-5,5)	Uniform
Individual growth			
Females:			
Length at age 1	1	(2,10)	Uniform
Length at age 20	1	(45,75)	Uniform
von Bertalanffy *K*	1	(0.01,0.25)	Uniform
CV of length at age 1	1	(0.01,0.25)	Uniform
CV of length at age 20 offset to age 1	1	(-3,3)	Uniform
Males:			
Length at age 1 offset to females	-	NA	Fixed at 0.0
Length at age 20 offset to females	1	(-3,3)	Uniform
von Bertalanffy K offset to females	1	(-3,3)	Uniform
CV of length at age 1 offset to females	1	(-3,3)	Uniform
CV of length at age 20 offset to females	1	(-3,3)	Uniform
Total: 99 + 48 recruitment deviations = 147 estimated parameters			

Table 19. Time blocks used in the 2005 assessment to allow for changes in fishery selectivity.

Fleet	Block 1	Block 2
S. California trawl	1997-2004	NA
N. California trawl	1980-1997	1998-2004
Oregon trawl	1980-1993	1994-2004
Washington trawl	1980-1992	1993-2004
S. Cal. non-trawl	1980-1991	1992-2004
N. Cal. non-trawl	1991-1997	1998-2004
OR-WA non-trawl	1990-2004	NA
S. Cal. Recreational	1996-2002	2003-2004
N. Cal. Recreational	1989-1995	1996-2004
OR-WA Recreational	1991-2004	NA

Table 20. Relative change in total negative log likelihood caused by adding time blocks for ascending width, peak and final selectivity parameters (3 additional for each block) by commercial fishing fleet. Improvements (negative values) >10 units indicate reasonably justified complexity that was included in the approach to selectivity retained in the base case model. Blocks were generally explored in a forward direction starting with the 1995+ break point.

Time period	1995+	2000+	2002+	2005+
Regulatory change potentially causing difference in selectivity	Canary specific trip limits imposed	Canary first managed as overfished; small footrope trawl gear required	RCA closed	Selective flatfish trawl required shoreward of the RCA
S. California trawl	-2	-6	-8	-6
N. California trawl	-5	-4	-3	0
Oregon trawl	**-24**	**-90**	-1	-10
Washington trawl	-1	**-18**	-1	-2
S. California non-trawl	-2	**-50**	-1	-1
N. California non-trawl	**-44**	**-25**	**-37**	-3
OR-WA non-trawl	-8	**-11**	**-17**	-1
S. Cal. Recreational	NA	**-16**	**-12**	-1
N. Cal. Recreational	NA	-10	-6	-4
OR-WA Recreational	NA	**-15**	-7	-3

Table 21. Relative change in total negative log likelihood caused by adding offsets (difference at peak and final selectivity for females compared to males, 2 parameters) for female length-based selectivity by fleet. Only those fleets with sex-specific length or age data are included. This exploration was conducted after accounting for reasonably justified time blocks in selectivity.

Fleet	Change in negative log likelihood
Southern California trawl	-1
N. Cal. Trawl	-1
OR trawl	-4
WA trawl	0
OR-WA non-trawl	-1
At-sea whiting fishery	-1
NWFSC survey	0
Triennial survey	0

Table 22. Relative change in total negative log likelihood caused by allowing selectivity to be a function of age instead of length by fleet and then further allowing female selectivity to be offset to male selectivity. This exploration was conducted after accounting for reasonably justified time blocks in selectivity.

	Change in negative log likelihood	
Fleet	Age-based selectivity	And offset female to male selectivity
Southern California trawl	-1	NA
N. Cal. trawl	-4	NA
OR trawl	-27	0
WA trawl	-7	0
OR-WA non-trawl	+4	NA
At-sea whiting fishery	+2	NA
NWFSC survey	+16	NA
Triennial survey	+13	NA

Table 23. Comparison of summary 2005 and 2007 base case model results.

Model	2005	2007
Description	Base case	Base case
Convergence		
Maximum gradient component	0.000688	0.000085
Likelihood penalties	0.0	0.0
Negative log-likelihoods		
Total	*2,792.3*	4,393.4
Indices	*-0.2*	-8.1
Length-frequency data	*1,845.0*	2,103.7
Age-frequency data	*634.9*	2,316.0
Recruitment	*-37.0*	-17.4
Priors	*9.2*	0.0
Forecast recruitment	*-6.4*	-0.7
Select parameters		
Stock-recruit, productivity		
R_0	4,728	4,210
Steepness (*h*)	0.329	0.511
Female M age 14+	0.093	0.097
Survey catchability and selectivity		
NWFSC survey catchability (*Q*)	NA	0.114
NWFSC survey peak selectivity	NA	66.000
NWFSC survey width of selectivity top	NA	-3.863
NWFSC survey ascending width	NA	7.175
NWFSC survey final selectivity	NA	-1.660
NWFSC survey final selectivity	NA	4.459
1980-1992 Triennial survey catchability (*Q*)	0.696	0.114
1995-2004 Triennial survey catchability (*Q*)	0.696	0.054
Triennial survey peak selectivity	52.6 Not est.	66.000
Triennial survey width of selectivity top	NA	-3.465
Triennial survey ascending width	NA	7.272
Triennial survey final selectivity	NA	4.453
Individual growth		
Female and male length at age 1	6.254	4.113
Female mean length at age 20	58.077	59.096
Female von Bertalanffy *K*	0.140	0.141
Female CV of length-at-age at age 1	0.15 Not est.	0.145
Female CV of length-at-age at age 20	0.056 Not est.	0.039
Male mean length at age 20	51.668	52.029
Male von Bertalanffy *K*	0.175	0.181
Male CV of length-at-age at age 1	0.15 Not est.	0.152
Male CV of length-at-age at age 20	0.047 Not est.	0.041
Management quantities		
SB_0	34,798	32,561
2007 Spawning biomass	NA	10,544
2005 Depletion	5.7%	29.9%
2007 Depletion	NA	32.4%
2006 *SPR*	NA	96.5%
2006 Exp. rate: yield/age 5+ Biomass	NA	0.002

Table 24. Canary rockfish growth parameters.

Parameter	Value	SD
Females:		
Length at age 1	4.113	0.555
Length at age 20	59.096	0.313
von Bertalanffy *K*	0.141	0.003
CV of length at age 1	0.145	0.011
CV of length at age 20	0.039	NA
Males:		
Length at age 1	4.113	Not est.
Length at age 20	52.030	NA
von Bertalanffy *K*	0.181	NA
CV of length at age 1	0.152	NA
CV of length at age 20	0.041	NA

Table 25. Canary rockfish catchability and productivity parameters.

Parameter	Value	SD
Catchability:		
NWFSC survey catchability (*Q*)	0.114	NA
1980-1992 triennial survey catchability (*Q*)	0.114	NA
1995-2004 triennial survey catchability (*Q*)	0.054	NA
Productivity:		
R_0	4,210	127
Steepness (*h*)	0.511	Not est.
Female natural mortality (*M*) age 14+	0.097	NA

Table 26. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	SPR	Relative exploitation rate
1916	87,633	32,561	100.0%	4,210	474	92.0%	0.006
1917	87,172	32,378	99.4%	4,204	749	87.8%	0.009
1918	86,457	32,092	98.6%	4,195	794	87.0%	0.009
1919	85,722	31,796	97.7%	4,186	520	91.1%	0.006
1920	85,285	31,617	97.1%	4,180	543	90.7%	0.006
1921	84,846	31,438	96.6%	4,174	459	92.0%	0.006
1922	84,512	31,302	96.1%	4,170	415	92.7%	0.005
1923	84,237	31,194	95.8%	4,166	491	91.4%	0.006
1924	83,903	31,065	95.4%	4,162	457	92.0%	0.006
1925	83,618	30,958	95.1%	4,158	529	90.8%	0.006
1926	83,276	30,830	94.7%	4,154	726	87.6%	0.009
1927	82,755	30,633	94.1%	4,147	616	89.3%	0.008
1928	82,362	30,486	93.6%	4,142	627	89.0%	0.008
1929	81,975	30,341	93.2%	4,137	596	89.5%	0.007
1930	81,635	30,214	92.8%	4,133	709	87.6%	0.009
1931	81,199	30,050	92.3%	4,127	711	87.5%	0.009
1932	80,779	29,893	91.8%	4,122	547	90.2%	0.007
1933	80,537	29,808	91.5%	4,119	467	91.5%	0.006
1934	80,386	29,759	91.4%	4,117	450	91.8%	0.006
1935	80,261	29,722	91.3%	4,116	473	91.3%	0.006
1936	80,118	29,679	91.1%	4,114	460	91.6%	0.006
1937	79,995	29,644	91.0%	4,113	433	92.0%	0.006
1938	79,904	29,621	91.0%	4,112	370	93.1%	0.005
1939	79,879	29,624	91.0%	4,112	337	93.7%	0.004
1940	79,887	29,641	91.0%	4,113	422	92.2%	0.005
1941	79,814	29,622	91.0%	4,112	476	91.3%	0.006
1942	79,693	29,578	90.8%	4,111	413	92.5%	0.005
1943	79,642	29,558	90.8%	4,110	1,244	80.3%	0.016
1944	78,797	29,193	89.7%	4,097	1,964	71.1%	0.025
1945	77,297	28,539	87.6%	4,072	4,141	52.6%	0.055
1946	73,756	27,052	83.1%	4,014	2,755	61.6%	0.038
1947	71,703	26,192	80.4%	3,978	1,816	70.5%	0.026
1948	70,653	25,760	79.1%	3,960	1,541	73.9%	0.022
1949	69,926	25,480	78.3%	3,947	1,583	73.2%	0.023
1950	69,199	25,211	77.4%	3,935	1,959	67.1%	0.029
1951	68,132	24,824	76.2%	3,918	1,936	66.7%	0.029
1952	67,111	24,472	75.2%	3,901	1,902	66.7%	0.029
1953	66,146	24,141	74.1%	3,886	1,753	67.9%	0.027
1954	65,345	23,875	73.3%	3,873	1,949	65.2%	0.031
1955	64,368	23,529	72.3%	3,856	1,961	64.7%	0.031
1956	63,402	23,179	71.2%	3,838	1,998	63.7%	0.032

Table 26. continued. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	SPR	Relative exploitation rate
1957	62,420	22,828	70.1%	3,820	2,576	56.9%	0.042
1958	60,907	22,229	68.3%	3,789	2,619	55.5%	0.044
1959	59,394	21,640	66.5%	3,756	2,452	56.8%	0.042
1960	58,088	21,129	64.9%	3,527	2,479	55.7%	0.044
1961	56,802	20,619	63.3%	3,496	2,160	58.9%	0.039
1962	55,856	20,259	62.2%	2,997	2,207	58.0%	0.041
1963	54,876	19,899	61.1%	2,571	2,071	58.9%	0.039
1964	54,032	19,624	60.3%	2,418	1,485	66.8%	0.028
1965	53,743	19,587	60.2%	2,597	1,756	62.9%	0.033
1966	53,129	19,450	59.7%	3,288	3,616	44.3%	0.069
1967	50,664	18,492	56.8%	4,359	1,954	58.6%	0.039
1968	49,702	18,255	56.1%	3,387	2,327	53.7%	0.048
1969	48,286	17,840	54.8%	2,510	1,559	63.3%	0.033
1970	47,681	17,679	54.3%	2,497	1,524	63.1%	0.033
1971	47,193	17,472	53.7%	3,123	1,521	63.3%	0.033
1972	46,744	17,221	52.9%	3,817	1,604	60.9%	0.035
1973	46,171	16,920	52.0%	3,490	2,482	48.9%	0.055
1974	44,704	16,285	50.0%	2,745	1,863	55.7%	0.043
1975	43,963	15,979	49.1%	4,364	1,862	55.2%	0.044
1976	43,200	15,697	48.2%	2,198	1,460	60.6%	0.035
1977	42,916	15,588	47.9%	3,346	2,060	52.5%	0.049
1978	42,161	15,232	46.8%	3,986	3,074	41.0%	0.075
1979	40,366	14,472	44.4%	1,581	3,461	36.8%	0.089
1980	38,287	13,622	41.8%	2,070	4,125	28.6%	0.111
1981	35,724	12,576	38.6%	3,591	3,532	31.6%	0.102
1982	33,693	11,787	36.2%	1,941	5,544	20.3%	0.170
1983	29,669	10,206	31.3%	1,429	4,918	21.5%	0.170
1984	26,489	8,895	27.3%	4,572	2,383	33.1%	0.093
1985	25,655	8,676	26.6%	1,367	2,726	27.7%	0.111
1986	24,437	8,334	25.6%	2,321	2,303	30.7%	0.097
1987	23,679	8,114	24.9%	2,631	3,183	22.9%	0.140
1988	22,079	7,485	23.0%	3,287	3,074	22.2%	0.148
1989	20,572	6,867	21.1%	3,478	3,333	19.4%	0.169
1990	18,821	6,127	18.8%	3,267	2,791	20.7%	0.157
1991	17,686	5,616	17.2%	3,429	3,203	17.0%	0.194
1992	16,258	4,939	15.2%	2,676	2,866	17.0%	0.191
1993	15,300	4,426	13.6%	2,232	2,235	19.7%	0.159
1994	15,147	4,202	12.9%	2,982	1,210	31.9%	0.087
1995	16,043	4,463	13.7%	2,116	1,189	34.7%	0.080
1996	16,955	4,841	14.9%	1,877	1,546	29.6%	0.097
1997	17,486	5,144	15.8%	1,305	1,479	31.6%	0.089

Table 26. continued. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	SPR	Relative exploitation rate
1998	18,019	5,499	16.9%	1,391	1,494	33.2%	0.087
1999	18,475	5,826	17.9%	2,449	898	48.9%	0.051
2000	19,292	6,364	19.5%	1,099	208	84.0%	0.011
2001	20,642	7,149	22.0%	2,061	134	89.7%	0.007
2002	21,911	7,910	24.3%	1,432	107	92.2%	0.005
2003	23,036	8,603	26.4%	955	51	95.4%	0.002
2004	24,110	9,226	28.3%	1,565	47	96.3%	0.002
2005	25,039	9,749	29.9%	1,182	51	96.3%	0.002
2006	25,803	10,183	31.3%	1,144	47	96.5%	0.002
2007	26,499	10,544	32.4%	2,807	NA	NA	NA

Table 27. Asymptotic standard deviation estimates for spawning biomass and recruitment.

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)
1916	1,003	127	1955	851	132	1994	359	539
1917	1,001	127	1956	846	132	1995	416	452
1918	996	127	1957	841	132	1996	489	424
1919	992	126	1958	839	133	1997	575	350
1920	988	126	1959	835	134	1998	674	355
1921	985	126	1960	833	1,689	1999	781	522
1922	982	126	1961	833	1,712	2000	891	304
1923	979	126	1962	833	1,423	2001	1,000	433
1924	976	126	1963	833	1,163	2002	1,102	333
1925	973	126	1964	831	1,069	2003	1,193	271
1926	970	126	1965	826	1,169	2004	1,270	485
1927	966	126	1966	813	1,595	2005	1,331	385
1928	962	126	1967	802	2,021	2006	1,378	436
1929	958	126	1968	765	1,593	2007	1,412	1,425
1930	955	127	1969	725	1,072			
1931	951	127	1970	687	1,026			
1932	948	127	1971	650	1,267			
1933	945	127	1972	615	1,410			
1934	943	127	1973	580	1,221			
1935	941	127	1974	547	956			
1936	939	127	1975	507	750			
1937	937	127	1976	470	546			
1938	935	127	1977	436	459			
1939	934	127	1978	411	418			
1940	933	127	1979	393	327			
1941	932	127	1980	351	328			
1942	930	127	1981	315	360			
1943	929	127	1982	287	311			
1944	924	128	1983	257	306			
1945	918	128	1984	236	478			
1946	907	129	1985	225	381			
1947	900	130	1986	218	486			
1948	894	130	1987	215	573			
1949	888	130	1988	215	573			
1950	882	131	1989	220	568			
1951	876	131	1990	232	550			
1952	869	131	1991	251	579			
1953	862	131	1992	278	513			
1954	856	131	1993	313	449			

Table 28. Female numbers at age (1000s) predicted by the base case model 1916-2007.

Age (yr)	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
0	2,105	2,102	2,098	2,093	2,090	2,087	2,085	2,083	2,081	2,079	2,077	2,074	2,071	2,069	2,066	2,064	2,061	2,059	2,059	2,058	2,057	2,056
1	1,982	1,982	1,980	1,975	1,971	1,968	1,966	1,963	1,962	1,960	1,958	1,956	1,953	1,951	1,948	1,946	1,943	1,941	1,939	1,939	1,938	1,937
2	1,867	1,867	1,867	1,864	1,860	1,856	1,854	1,851	1,849	1,847	1,846	1,844	1,842	1,839	1,837	1,835	1,833	1,830	1,828	1,827	1,826	1,825
3	1,758	1,758	1,758	1,758	1,756	1,752	1,748	1,746	1,743	1,741	1,740	1,738	1,737	1,735	1,732	1,730	1,728	1,726	1,724	1,721	1,720	1,719
4	1,656	1,656	1,656	1,656	1,656	1,653	1,650	1,646	1,644	1,642	1,640	1,639	1,637	1,635	1,634	1,631	1,629	1,627	1,626	1,623	1,621	1,620
5	1,559	1,559	1,559	1,559	1,559	1,559	1,557	1,554	1,550	1,548	1,546	1,544	1,543	1,541	1,540	1,538	1,536	1,534	1,532	1,531	1,528	1,526
6	1,469	1,468	1,467	1,467	1,467	1,467	1,467	1,465	1,462	1,459	1,457	1,454	1,453	1,452	1,450	1,449	1,447	1,445	1,444	1,442	1,441	1,439
7	1,383	1,381	1,379	1,378	1,379	1,379	1,379	1,380	1,378	1,375	1,371	1,368	1,367	1,365	1,364	1,362	1,361	1,360	1,359	1,357	1,356	1,354
8	1,296	1,292	1,288	1,285	1,287	1,288	1,289	1,289	1,289	1,287	1,284	1,279	1,277	1,275	1,274	1,272	1,270	1,271	1,271	1,269	1,268	1,267
9	1,210	1,204	1,197	1,192	1,193	1,194	1,196	1,197	1,197	1,197	1,195	1,189	1,186	1,184	1,183	1,180	1,178	1,179	1,180	1,180	1,179	1,178
10	1,124	1,117	1,109	1,102	1,101	1,101	1,103	1,105	1,106	1,106	1,105	1,100	1,096	1,093	1,092	1,089	1,087	1,087	1,088	1,090	1,090	1,089
11	1,039	1,033	1,023	1,015	1,012	1,010	1,012	1,014	1,015	1,016	1,015	1,012	1,009	1,005	1,003	1,000	997	997	999	1,000	1,001	1,001
12	956	950	941	932	928	924	924	926	927	929	928	925	923	920	918	914	911	911	912	913	914	915
13	876	871	862	854	848	844	842	842	843	845	845	842	841	839	836	832	829	828	829	830	831	832
14	799	794	786	778	773	768	765	763	763	764	765	763	762	760	759	755	752	750	751	751	752	753
15	725	721	714	707	702	697	693	691	689	688	689	688	687	686	685	682	679	677	677	677	678	678
16	658	654	648	642	637	633	629	626	623	621	621	619	619	618	618	615	613	612	611	611	611	611
17	597	594	588	582	579	574	571	568	564	562	560	558	558	557	557	555	553	553	552	551	551	551
18	542	539	534	529	525	522	518	515	512	509	507	504	502	502	502	501	499	499	499	498	497	497
19	492	489	485	480	477	473	471	468	465	462	459	456	454	452	452	451	450	450	450	450	449	448
20	446	444	440	436	433	430	427	425	422	420	417	413	410	408	407	407	406	406	406	406	406	405
21	405	403	399	395	393	390	388	386	383	381	378	375	372	369	368	366	366	366	366	366	366	366
22	368	366	362	359	357	354	352	350	348	346	343	340	337	335	333	331	329	329	330	330	330	330
23	334	332	329	326	324	321	320	318	316	314	312	309	306	304	301	299	297	297	297	298	298	298
24	303	301	299	296	294	292	290	289	287	285	283	280	278	276	274	271	269	268	268	268	268	269
25	275	273	271	268	267	265	263	262	260	259	257	255	253	250	248	246	244	242	242	242	242	242
26	250	248	246	244	242	240	239	238	236	235	233	231	229	227	226	223	221	220	219	218	218	218
27	227	225	223	221	220	218	217	216	214	213	212	210	208	206	205	203	201	199	198	197	197	197
28	206	204	203	201	199	198	197	196	195	194	192	190	189	187	186	184	182	181	180	179	178	177
29	187	186	184	182	181	180	179	178	177	176	174	173	171	170	169	167	166	164	163	162	161	160
30	169	168	167	165	164	163	162	161	160	159	158	157	156	154	153	152	150	149	148	147	146	145
31	154	153	152	150	149	148	147	146	146	145	144	142	141	140	139	138	136	135	135	134	133	132
32	140	139	138	136	135	134	134	133	132	131	130	129	128	127	126	125	124	123	122	121	121	120
33	127	126	125	124	123	122	121	121	120	119	118	117	116	115	115	113	112	112	111	110	110	109
34	115	114	113	112	111	111	110	110	109	108	107	106	106	105	104	103	102	101	101	100	99	99
35	104	104	103	102	101	100	100	99	99	98	98	97	96	95	94	93	93	92	91	91	90	90
36	95	94	93	92	92	91	91	90	90	89	89	88	87	86	86	85	84	83	83	82	82	81
37	86	85	85	84	83	83	82	82	81	81	80	80	79	78	78	77	76	76	75	75	74	74
38	78	78	77	76	76	75	75	74	74	73	73	72	72	71	71	70	69	69	68	68	67	67
39	71	70	70	69	69	68	68	67	67	67	66	66	65	65	64	63	63	62	62	62	61	61
40	696	692	686	679	675	670	666	663	659	655	651	645	640	634	629	624	618	613	610	606	602	598

Table 28. continued.

Age (yr)	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
0	2,056	2,056	2,056	2,056	2,055	2,055	2,048	2,036	2,007	1,989	1,980	1,974	1,968	1,959	1,951	1,943	1,936	1,928	1,919	1,910	1,894	1,878
1	1,937	1,936	1,936	1,937	1,936	1,936	1,935	1,929	1,918	1,890	1,873	1,865	1,859	1,853	1,845	1,837	1,830	1,824	1,816	1,807	1,799	1,784
2	1,824	1,824	1,824	1,824	1,824	1,824	1,823	1,823	1,817	1,806	1,780	1,764	1,756	1,750	1,745	1,737	1,730	1,723	1,717	1,710	1,702	1,694
3	1,719	1,718	1,718	1,717	1,717	1,718	1,717	1,717	1,716	1,711	1,701	1,676	1,661	1,654	1,649	1,643	1,636	1,629	1,623	1,617	1,610	1,603
4	1,619	1,619	1,618	1,618	1,617	1,617	1,618	1,617	1,617	1,616	1,611	1,602	1,579	1,564	1,556	1,551	1,547	1,540	1,533	1,527	1,522	1,515
5	1,525	1,525	1,524	1,524	1,523	1,523	1,523	1,523	1,522	1,521	1,521	1,517	1,508	1,481	1,466	1,459	1,455	1,450	1,443	1,437	1,431	1,426
6	1,437	1,436	1,435	1,435	1,434	1,434	1,433	1,432	1,430	1,430	1,430	1,431	1,427	1,410	1,384	1,371	1,364	1,359	1,355	1,348	1,342	1,335
7	1,353	1,351	1,351	1,350	1,349	1,350	1,348	1,345	1,339	1,339	1,341	1,342	1,343	1,331	1,314	1,290	1,276	1,269	1,265	1,259	1,252	1,244
8	1,266	1,265	1,264	1,263	1,262	1,263	1,260	1,254	1,242	1,240	1,244	1,248	1,250	1,243	1,229	1,214	1,190	1,177	1,170	1,164	1,156	1,146
9	1,177	1,177	1,176	1,174	1,173	1,175	1,171	1,162	1,142	1,137	1,141	1,148	1,152	1,147	1,138	1,125	1,110	1,087	1,074	1,065	1,055	1,045
10	1,088	1,088	1,088	1,087	1,085	1,086	1,081	1,071	1,044	1,034	1,037	1,044	1,050	1,048	1,041	1,033	1,021	1,005	983	969	955	943
11	1,001	1,001	1,001	1,001	999	999	993	981	949	936	936	941	947	947	944	937	930	917	902	880	861	847
12	916	916	917	916	916	915	907	894	859	843	840	843	847	848	847	844	839	830	818	802	777	758
13	834	835	835	835	834	834	826	811	775	757	752	752	754	753	753	753	751	744	736	724	703	679
14	754	756	758	757	757	756	748	733	697	678	671	669	668	666	665	666	667	663	656	648	630	611
15	680	681	683	684	683	683	674	660	625	605	597	594	591	587	585	585	587	585	581	575	561	545
16	612	614	616	617	616	616	608	595	561	542	533	528	524	519	515	514	515	515	513	509	497	485
17	552	553	555	555	556	556	549	536	505	487	477	471	466	460	455	453	453	452	451	449	440	429
18	497	498	499	500	501	501	495	483	454	437	428	422	416	409	404	400	399	397	396	395	388	380
19	448	449	450	451	451	452	446	435	409	393	384	378	372	365	359	354	352	349	348	347	341	335
20	405	405	406	406	406	407	402	392	368	354	346	340	334	326	320	315	312	309	306	305	299	294
21	366	365	366	366	366	366	362	353	332	319	311	305	300	293	287	281	277	274	270	268	263	258
22	330	330	330	330	330	330	326	318	299	287	280	275	269	263	257	252	247	243	240	237	231	227
23	298	298	298	298	297	297	293	286	269	258	252	248	243	236	231	226	222	217	213	210	204	200
24	269	269	269	269	269	268	264	257	242	233	227	223	219	213	208	203	199	194	190	187	181	176
25	242	243	243	243	243	242	238	232	218	209	204	201	197	192	187	182	178	174	170	166	161	156
26	218	219	219	219	219	219	215	209	196	189	184	181	177	173	168	164	161	156	153	149	144	139
27	197	197	198	198	198	198	194	189	177	170	166	163	159	155	152	148	145	141	137	134	129	124
28	177	178	178	178	178	178	176	171	160	153	149	146	144	140	137	133	130	127	123	120	115	111
29	160	160	161	161	161	161	158	154	144	138	135	132	129	126	123	120	117	114	111	108	104	99
30	145	145	145	145	145	145	143	139	130	125	122	119	117	114	111	108	106	103	100	97	93	89
31	131	131	131	131	131	131	129	125	118	113	110	107	105	102	100	97	95	93	90	88	84	80
32	119	119	118	118	118	118	116	113	106	102	99	97	95	92	90	88	86	83	81	79	76	72
33	108	108	107	107	106	106	105	102	96	92	90	88	86	83	81	79	77	75	73	71	68	65
34	98	98	97	97	96	96	94	92	86	83	81	79	77	75	73	71	70	68	66	64	61	59
35	89	89	88	88	87	87	85	83	78	75	73	71	70	68	66	64	63	61	59	58	55	53
36	81	81	80	80	79	79	77	75	70	67	66	64	63	61	60	58	57	55	53	52	50	48
37	73	73	73	72	72	71	70	68	63	61	59	58	57	55	54	53	51	50	48	47	45	43
38	67	66	66	66	65	65	63	61	57	55	53	52	51	50	49	47	46	45	44	42	40	39
39	61	60	60	60	59	59	58	56	52	50	48	47	46	45	44	43	42	41	39	38	36	35
40	595	592	589	586	582	578	566	547	510	486	471	459	447	433	420	408	397	385	373	361	344	329

Table 28. continued.

Age (yr)	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	1,764	1,748	1,499	1,285	1,209	1,299	1,644	2,180	1,693	1,255	1,249	1,561	1,909	1,745	1,372	2,182	1,099	1,673	1,993	791	1,035	1,796
1	1,769	1,661	1,646	1,411	1,210	1,139	1,223	1,548	2,053	1,595	1,182	1,176	1,470	1,798	1,644	1,293	2,055	1,035	1,575	1,877	745	975
2	1,680	1,666	1,564	1,550	1,329	1,140	1,072	1,152	1,458	1,933	1,502	1,113	1,107	1,385	1,693	1,548	1,217	1,935	975	1,484	1,767	701
3	1,595	1,582	1,569	1,473	1,460	1,252	1,074	1,010	1,085	1,373	1,820	1,414	1,048	1,043	1,304	1,594	1,458	1,146	1,822	918	1,397	1,664
4	1,508	1,501	1,488	1,476	1,386	1,373	1,177	1,010	950	1,020	1,291	1,711	1,330	986	980	1,226	1,498	1,370	1,077	1,713	863	1,305
5	1,420	1,412	1,405	1,394	1,381	1,298	1,285	1,101	944	888	953	1,205	1,599	1,241	918	913	1,141	1,394	1,275	1,003	1,595	789
6	1,331	1,322	1,316	1,310	1,298	1,289	1,210	1,196	1,025	878	826	885	1,121	1,484	1,148	849	844	1,054	1,289	1,178	928	1,436
7	1,239	1,233	1,228	1,222	1,215	1,209	1,198	1,120	1,110	950	816	766	822	1,038	1,367	1,059	783	778	973	1,186	1,085	832
8	1,141	1,136	1,134	1,130	1,123	1,122	1,114	1,098	1,032	1,020	878	753	707	757	947	1,252	970	718	714	885	1,078	966
9	1,039	1,034	1,033	1,032	1,026	1,028	1,026	1,008	1,002	938	936	805	691	647	682	860	1,137	883	653	641	791	946
10	937	931	932	931	929	933	932	914	911	900	853	851	732	626	577	614	774	1,028	795	577	560	680
11	838	832	832	832	831	838	838	817	818	809	812	769	767	659	553	514	547	694	913	690	493	470
12	747	739	737	736	736	744	746	724	725	719	723	725	688	685	576	489	454	487	609	780	579	405
13	664	654	650	648	647	655	658	636	637	631	637	641	643	609	594	505	427	401	422	513	645	467
14	591	577	571	567	566	573	576	555	556	550	555	561	564	565	523	516	439	375	345	353	420	513
15	529	511	501	495	493	498	500	481	481	477	480	485	490	492	482	452	446	383	321	286	286	331
16	471	457	443	434	430	433	435	416	416	412	416	420	423	427	419	416	390	389	327	265	231	225
17	419	407	396	384	377	378	378	360	360	356	359	363	366	368	363	361	359	340	332	270	215	182
18	371	361	352	342	333	331	329	313	312	308	310	313	316	318	312	313	311	313	291	274	219	169
19	328	320	313	304	297	292	289	272	270	267	268	271	273	275	269	269	270	272	267	240	222	172
20	289	283	277	270	264	261	255	238	235	231	232	234	236	237	232	232	232	235	232	220	195	175
21	254	249	245	239	234	232	227	210	206	201	201	202	204	204	200	200	200	203	201	192	179	154
22	223	219	216	211	207	206	202	188	182	176	175	175	176	177	173	173	173	175	173	166	156	142
23	196	192	189	186	183	182	179	167	162	155	153	153	153	153	149	149	149	151	150	143	135	123
24	172	168	166	164	161	161	159	148	144	139	135	134	133	132	129	129	129	130	129	124	117	107
25	152	148	146	143	142	142	140	131	128	123	121	118	116	115	112	111	111	112	112	107	101	93
26	135	131	128	126	124	124	124	116	113	109	107	105	103	101	97	96	96	97	96	92	87	80
27	120	116	113	111	109	109	109	102	100	97	95	94	92	89	85	84	83	84	83	80	75	69
28	107	103	100	98	96	96	95	90	88	86	84	83	82	80	75	74	73	73	72	69	65	60
29	96	92	89	87	85	84	84	79	77	75	75	74	72	71	67	65	63	63	63	60	56	52
30	86	82	80	77	75	75	74	69	68	66	66	65	64	63	60	58	56	56	54	52	49	45
31	77	74	71	69	67	66	65	61	60	58	58	57	57	56	53	52	50	49	48	45	42	39
32	69	66	64	62	60	59	58	54	52	51	51	50	50	49	47	46	45	44	42	40	37	34
33	62	60	57	55	53	52	51	48	46	45	45	44	44	43	41	41	40	39	38	35	32	29
34	56	54	52	50	48	47	46	42	41	40	39	39	39	38	37	36	35	35	33	31	29	26
35	51	48	47	45	43	42	41	38	37	35	35	34	34	33	32	32	31	31	30	28	26	23
36	46	44	42	40	39	38	37	34	33	31	31	30	30	29	28	28	27	27	26	25	23	20
37	41	39	38	36	35	34	33	30	29	28	27	27	26	26	25	24	24	24	23	22	20	18
38	37	35	34	33	31	31	30	27	26	25	24	24	23	23	22	21	21	21	21	19	18	16
39	33	32	31	29	28	28	27	25	24	22	22	21	21	20	19	19	19	18	18	17	16	14
40	314	299	286	274	263	256	248	226	217	206	200	193	187	180	169	163	157	154	148	138	127	114

Table 28. continued.

Age (yr)	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	970	715	2,286	684	1,161	1,315	1,644	1,739	1,634	1,715	1,338	1,116	1,491	1,058	939	652	695	1,225	550	1,030	716	477
1	1,691	914	673	2,153	644	1,093	1,239	1,548	1,638	1,538	1,615	1,260	1,051	1,404	997	884	614	655	1,153	518	970	674
2	918	1,592	860	634	2,027	606	1,029	1,167	1,458	1,542	1,449	1,521	1,187	990	1,322	939	832	578	617	1,086	487	914
3	660	864	1,499	810	597	1,908	571	969	1,098	1,373	1,452	1,364	1,432	1,118	932	1,245	884	784	545	581	1,023	459
4	1,561	618	812	1,407	759	558	1,785	534	908	1,031	1,288	1,364	1,282	1,346	1,050	876	1,170	831	737	512	546	963
5	1,209	1,433	576	753	1,292	695	510	1,635	492	842	953	1,194	1,266	1,194	1,250	977	811	1,091	775	686	479	513
6	722	1,092	1,325	529	680	1,165	624	459	1,482	450	765	871	1,094	1,167	1,094	1,147	891	748	1,008	716	640	449
7	1,305	647	1,001	1,209	474	610	1,041	558	411	1,335	403	690	790	1,001	1,059	991	1,036	814	688	931	667	599
8	747	1,151	580	902	1,070	422	539	919	490	362	1,170	354	613	713	894	939	881	931	741	634	864	622
9	852	641	997	514	785	942	365	465	782	417	305	985	304	543	625	773	818	773	837	682	587	802
10	816	703	530	863	437	678	791	305	380	640	334	244	809	263	467	527	659	701	686	769	629	542
11	573	647	555	449	718	369	550	638	239	299	486	252	190	682	222	385	441	553	615	628	706	579
12	388	437	490	461	366	594	291	430	480	182	216	349	188	157	569	181	318	364	480	561	575	647
13	329	288	321	400	369	298	457	222	315	357	127	150	252	153	130	458	148	259	314	436	511	524
14	375	240	207	259	317	297	225	342	159	230	242	85	105	201	125	104	371	119	222	284	396	464
15	409	269	169	166	204	253	223	167	243	115	154	161	59	83	164	100	84	299	102	200	256	358
16	263	293	190	136	130	162	189	164	118	175	76	101	111	47	68	131	80	67	254	92	181	232
17	179	188	206	152	106	104	121	139	116	85	116	50	70	87	38	54	106	65	57	229	83	163
18	145	128	132	165	119	85	77	89	99	84	57	77	35	55	72	31	44	85	55	52	207	75
19	134	103	90	106	130	95	64	57	63	71	56	37	53	27	45	57	25	35	73	50	47	187
20	137	96	73	72	83	104	71	47	41	46	48	37	26	42	22	36	46	20	30	65	45	42
21	139	98	68	58	57	67	78	53	34	30	31	32	25	20	34	18	29	38	17	27	59	41
22	122	100	69	54	46	46	50	58	38	25	20	21	22	20	17	28	15	24	32	15	25	53
23	113	88	70	56	43	37	34	38	42	28	17	13	14	17	17	13	22	12	20	29	14	22
24	98	81	62	57	44	35	28	26	27	31	19	11	9	11	14	13	11	18	10	18	26	13
25	85	70	57	50	45	36	26	21	19	20	21	13	8	7	9	12	11	9	16	9	17	24
26	74	61	50	46	40	36	27	20	15	14	14	14	9	6	6	8	9	9	8	14	8	15
27	64	53	43	40	37	32	28	20	14	11	9	9	10	7	5	5	6	8	8	7	13	7
28	55	46	38	35	32	30	24	21	15	11	8	6	6	8	6	4	4	5	7	7	6	11
29	48	40	33	30	28	26	23	18	15	11	7	5	4	5	6	5	3	3	4	6	6	6
30	41	34	28	26	24	23	20	17	13	11	7	5	4	3	4	5	4	3	3	4	5	6
31	36	30	24	23	21	20	17	15	12	10	8	5	3	3	3	3	4	3	2	3	3	5
32	31	26	21	20	18	17	15	13	11	9	7	5	4	3	2	2	3	3	3	2	2	3
33	27	22	18	17	16	15	13	11	10	8	6	5	4	3	2	2	2	2	3	2	2	2
34	24	19	16	15	14	13	11	10	8	7	6	4	3	3	2	2	2	2	2	3	2	2
35	21	17	14	13	12	11	10	9	7	6	5	4	3	3	2	2	1	1	1	2	2	2
36	18	15	12	11	10	10	8	7	6	5	4	3	3	2	2	2	2	1	1	1	2	2
37	16	13	11	10	9	8	7	6	5	5	4	3	2	2	2	2	2	1	1	1	1	1
38	15	12	9	9	8	7	6	6	5	4	3	3	2	2	2	2	1	1	1	1	1	1
39	13	10	8	8	7	6	6	5	4	4	3	2	2	2	2	1	1	1	1	1	1	1
40	103	83	67	61	55	50	43	37	31	26	20	16	12	11	11	10	9	9	8	9	9	9

Table 28. continued.

Age (yr)	2004	2005	2006	2007
0	783	591	572	1,404
1	450	737	557	539
2	635	423	694	524
3	861	598	399	654
4	432	810	563	375
5	903	406	762	529
6	480	848	381	715
7	420	451	796	358
8	559	393	421	744
9	578	520	366	392
10	743	536	482	339
11	500	686	495	445
12	532	460	630	454
13	592	486	420	576
14	477	538	443	383
15	420	432	488	401
16	324	381	392	442
17	210	294	345	355
18	148	190	266	313
19	68	134	172	241
20	170	61	121	156
21	38	154	56	110
22	37	35	139	50
23	48	33	31	126
24	20	44	30	28
25	11	18	40	27
26	21	10	17	36
27	14	19	9	15
28	7	12	18	8
29	10	6	11	16
30	5	9	6	10
31	5	5	9	5
32	4	5	4	8
33	3	4	4	4
34	2	3	4	4
35	2	2	2	3
36	2	1	2	2
37	2	2	1	1
38	1	2	1	1
39	1	1	2	1
40	9	9	9	9

Table 29. Male numbers at age (1000s) predicted by the base case model 1916-2007.

Age (yr)	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
0	2,105	2,102	2,098	2,093	2,090	2,087	2,085	2,083	2,081	2,079	2,077	2,074	2,071	2,069	2,066	2,064	2,061	2,059	2,059	2,058	2,057	2,056
1	1,982	1,982	1,980	1,975	1,971	1,968	1,966	1,963	1,962	1,960	1,958	1,956	1,953	1,951	1,948	1,946	1,943	1,941	1,939	1,939	1,938	1,937
2	1,867	1,867	1,867	1,864	1,860	1,856	1,854	1,851	1,849	1,847	1,846	1,844	1,842	1,839	1,837	1,835	1,833	1,830	1,828	1,827	1,826	1,825
3	1,758	1,758	1,758	1,758	1,756	1,752	1,748	1,746	1,743	1,741	1,740	1,738	1,737	1,735	1,732	1,730	1,728	1,726	1,724	1,721	1,720	1,719
4	1,656	1,656	1,656	1,656	1,656	1,653	1,650	1,646	1,644	1,642	1,640	1,638	1,637	1,635	1,634	1,631	1,629	1,627	1,625	1,623	1,621	1,620
5	1,559	1,559	1,559	1,559	1,559	1,559	1,557	1,554	1,550	1,548	1,546	1,544	1,543	1,541	1,540	1,538	1,536	1,534	1,532	1,530	1,528	1,526
6	1,469	1,467	1,466	1,466	1,467	1,467	1,467	1,465	1,462	1,459	1,456	1,454	1,452	1,451	1,450	1,448	1,447	1,445	1,443	1,442	1,440	1,438
7	1,383	1,380	1,378	1,377	1,378	1,378	1,379	1,379	1,377	1,374	1,371	1,368	1,366	1,364	1,363	1,361	1,360	1,359	1,358	1,357	1,355	1,354
8	1,302	1,298	1,293	1,290	1,292	1,293	1,294	1,295	1,294	1,293	1,289	1,284	1,282	1,280	1,279	1,277	1,275	1,275	1,276	1,275	1,273	1,272
9	1,227	1,221	1,214	1,209	1,209	1,210	1,212	1,213	1,213	1,213	1,211	1,205	1,202	1,200	1,199	1,196	1,194	1,194	1,195	1,196	1,195	1,193
10	1,155	1,149	1,140	1,133	1,131	1,132	1,134	1,136	1,136	1,136	1,136	1,131	1,127	1,123	1,122	1,119	1,117	1,117	1,118	1,120	1,120	1,119
11	1,088	1,082	1,072	1,063	1,060	1,058	1,059	1,062	1,063	1,064	1,063	1,059	1,056	1,052	1,050	1,047	1,044	1,044	1,046	1,047	1,048	1,048
12	1,025	1,018	1,009	999	995	991	991	992	994	995	995	991	989	986	983	979	976	976	977	979	980	981
13	965	959	950	940	935	930	928	928	928	930	930	928	926	924	921	917	913	913	913	914	916	917
14	909	903	895	885	880	874	871	869	868	869	870	868	866	865	863	859	855	853	854	855	856	857
15	856	851	843	834	828	823	818	815	813	813	813	811	810	809	808	805	801	799	799	799	800	801
16	806	801	794	785	780	775	770	766	763	761	760	758	758	757	756	753	751	749	748	747	748	748
17	759	755	747	740	735	729	725	721	717	714	712	709	708	707	707	705	703	702	701	700	699	700
18	715	711	704	697	692	687	683	679	675	671	668	664	662	661	661	660	658	657	657	656	655	655
19	673	669	663	656	652	647	643	640	636	632	628	623	620	618	618	617	615	615	615	615	614	613
20	634	630	624	618	614	610	606	603	599	595	591	586	582	579	578	576	575	575	575	575	575	575
21	597	594	588	582	578	574	571	568	564	560	557	551	547	544	541	539	538	538	538	539	538	538
22	562	559	554	548	545	541	538	535	531	528	524	519	515	511	508	505	503	503	503	504	504	504
23	530	526	522	516	513	509	506	504	500	497	494	489	485	481	478	474	471	470	470	471	471	472
24	499	496	491	486	483	480	477	474	471	468	465	461	457	453	449	446	442	440	440	440	441	441
25	470	467	463	458	455	452	449	447	444	441	438	434	430	427	423	419	416	413	412	412	412	413
26	442	440	436	431	429	426	423	421	418	416	413	409	405	402	399	395	391	389	387	386	385	386
27	417	414	410	406	404	401	398	396	394	392	389	385	382	379	376	372	368	366	364	362	361	361
28	392	390	386	383	380	378	375	373	371	369	366	363	360	357	354	350	347	344	342	340	339	338
29	369	367	364	360	358	356	353	352	349	347	345	342	339	336	333	330	327	324	322	320	319	317
30	348	346	343	339	337	335	333	331	329	327	325	322	319	317	314	311	308	306	304	302	300	298
31	328	326	323	320	318	315	314	312	310	308	306	303	301	298	296	293	290	288	286	284	282	281
32	309	307	304	301	299	297	295	294	292	290	288	285	283	281	279	276	273	271	269	268	266	264
33	291	289	286	283	282	280	278	277	275	273	271	269	267	264	262	260	257	256	254	252	251	249
34	274	272	270	267	265	263	262	261	259	257	256	253	251	249	247	245	242	241	239	238	236	235
35	258	256	254	251	250	248	247	245	244	242	241	238	237	235	233	231	228	227	225	224	222	221
36	243	241	239	237	235	234	232	231	230	228	227	225	223	221	219	217	215	214	212	211	209	208
37	229	227	225	223	222	220	219	218	216	215	214	212	210	208	206	205	203	201	200	199	197	196
38	215	214	212	210	209	207	206	205	204	202	201	199	198	196	194	193	191	189	188	187	186	185
39	203	202	200	198	196	195	194	193	192	191	189	188	186	185	183	181	180	178	177	176	175	174
40	3,254	3,236	3,208	3,178	3,158	3,138	3,121	3,105	3,087	3,070	3,050	3,022	2,998	2,975	2,952	2,925	2,898	2,877	2,860	2,843	2,825	2,808

Table 29. continued.

Age (yr)	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
0	2,056	2,056	2,056	2,056	2,055	2,055	2,048	2,036	2,007	1,989	1,980	1,974	1,968	1,959	1,951	1,943	1,936	1,928	1,919	1,910	1,894	1,878
1	1,937	1,936	1,936	1,937	1,936	1,936	1,935	1,929	1,918	1,890	1,873	1,865	1,859	1,853	1,845	1,837	1,830	1,824	1,816	1,807	1,799	1,784
2	1,824	1,824	1,824	1,824	1,824	1,824	1,823	1,823	1,817	1,806	1,780	1,764	1,756	1,750	1,745	1,737	1,730	1,723	1,717	1,710	1,702	1,694
3	1,719	1,718	1,718	1,717	1,717	1,718	1,717	1,717	1,716	1,711	1,701	1,676	1,661	1,654	1,648	1,643	1,636	1,629	1,623	1,617	1,610	1,603
4	1,619	1,619	1,618	1,618	1,617	1,617	1,618	1,617	1,616	1,616	1,611	1,602	1,579	1,563	1,555	1,550	1,546	1,539	1,532	1,526	1,521	1,514
5	1,525	1,525	1,524	1,524	1,523	1,523	1,523	1,523	1,521	1,521	1,521	1,517	1,508	1,480	1,464	1,457	1,453	1,448	1,441	1,435	1,429	1,423
6	1,436	1,436	1,435	1,434	1,434	1,434	1,433	1,431	1,429	1,429	1,429	1,430	1,426	1,409	1,382	1,368	1,361	1,356	1,352	1,345	1,339	1,331
7	1,352	1,351	1,350	1,349	1,349	1,349	1,347	1,344	1,337	1,337	1,339	1,341	1,342	1,330	1,313	1,287	1,273	1,266	1,261	1,256	1,248	1,240
8	1,271	1,270	1,269	1,268	1,267	1,268	1,266	1,259	1,246	1,244	1,247	1,252	1,254	1,248	1,234	1,218	1,193	1,179	1,172	1,165	1,157	1,147
9	1,193	1,192	1,192	1,190	1,189	1,191	1,187	1,179	1,159	1,152	1,156	1,162	1,167	1,162	1,153	1,140	1,124	1,100	1,086	1,077	1,067	1,056
10	1,118	1,118	1,118	1,117	1,116	1,117	1,112	1,102	1,076	1,066	1,067	1,074	1,080	1,078	1,070	1,062	1,049	1,033	1,010	995	981	969
11	1,048	1,048	1,048	1,048	1,047	1,047	1,041	1,030	1,000	986	984	989	994	994	990	983	975	962	946	922	903	887
12	981	982	982	982	981	982	975	962	929	912	908	910	913	913	911	908	902	892	879	862	835	814
13	918	919	920	920	919	920	912	899	863	845	839	838	839	837	836	834	832	824	814	801	779	752
14	858	860	862	862	861	862	854	840	803	784	776	773	771	768	765	764	764	759	751	741	722	701
15	802	804	806	807	807	807	799	785	749	728	719	714	710	705	701	699	700	697	692	684	668	649
16	749	751	754	755	755	756	748	734	698	678	667	661	656	649	643	640	640	638	635	629	616	600
17	701	702	704	706	707	707	700	687	652	631	621	613	607	599	592	587	586	583	581	577	566	553
18	655	656	658	660	660	662	655	642	609	589	578	570	563	554	546	540	537	533	531	528	519	508
19	613	614	615	616	617	618	613	601	568	549	539	531	523	513	505	498	494	489	486	483	475	466
20	574	574	575	576	577	578	572	561	531	513	503	495	487	477	468	460	455	450	445	441	434	426
21	538	538	538	539	539	540	535	524	496	479	469	461	453	444	435	426	421	415	409	405	397	389
22	504	504	504	504	504	505	500	490	463	447	438	431	423	413	404	396	390	383	377	372	364	356
23	472	472	473	472	472	472	467	457	432	417	409	402	394	385	376	368	362	355	349	343	334	326
24	442	442	443	442	442	441	436	427	404	390	382	375	368	359	351	343	337	330	323	317	308	300
25	413	414	414	415	414	414	408	399	377	364	356	350	344	336	327	320	314	307	300	294	285	276
26	386	387	388	388	388	388	382	373	352	340	332	327	321	313	306	298	292	286	279	273	264	255
27	361	362	363	363	363	363	358	350	329	317	310	305	299	292	285	279	273	266	260	254	245	236
28	338	338	339	340	340	340	336	328	309	297	290	285	279	273	266	260	255	248	242	236	228	219
29	316	316	317	318	318	318	314	307	289	278	271	266	261	254	248	243	238	232	226	220	212	204
30	297	296	297	297	297	298	294	287	271	260	254	249	244	238	232	226	222	216	211	205	198	190
31	279	278	278	278	278	278	275	269	253	244	238	233	228	222	216	211	207	202	197	192	184	177
32	263	262	261	260	260	260	257	252	237	228	223	218	213	207	202	197	193	188	184	179	172	165
33	247	246	245	244	243	243	240	235	222	213	208	204	200	194	189	184	180	176	171	167	161	154
34	233	232	231	230	228	228	225	220	207	200	195	191	187	182	177	172	168	164	160	156	150	144
35	220	218	217	216	215	214	211	206	194	187	182	179	175	170	166	161	157	153	149	145	140	134
36	207	206	205	204	202	201	198	193	181	174	171	167	164	159	155	151	147	143	139	136	130	125
37	195	194	193	192	190	189	186	181	170	163	159	156	153	149	145	141	138	134	130	127	122	117
38	184	183	182	181	179	178	175	170	159	153	149	146	143	140	136	132	129	126	122	118	114	109
39	173	172	171	170	169	168	165	160	150	143	140	137	134	130	127	124	121	118	114	111	106	102
40	2,792	2,778	2,766	2,750	2,732	2,715	2,665	2,587	2,421	2,314	2,246	2,188	2,129	2,060	1,996	1,934	1,881	1,822	1,764	1,707	1,632	1,558

Table 29. continued.

Age (yr)	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	1,764	1,748	1,499	1,285	1,209	1,299	1,644	2,180	1,693	1,255	1,249	1,561	1,909	1,745	1,372	2,182	1,099	1,673	1,993	791	1,035	1,796
1	1,769	1,661	1,646	1,411	1,210	1,139	1,223	1,548	2,053	1,595	1,182	1,176	1,470	1,798	1,644	1,293	2,055	1,035	1,575	1,877	745	975
2	1,680	1,666	1,564	1,550	1,329	1,140	1,072	1,152	1,458	1,933	1,502	1,113	1,107	1,385	1,693	1,548	1,217	1,935	975	1,484	1,767	701
3	1,595	1,582	1,569	1,473	1,460	1,252	1,073	1,010	1,085	1,373	1,820	1,414	1,048	1,043	1,304	1,594	1,458	1,146	1,822	918	1,397	1,663
4	1,507	1,500	1,487	1,475	1,385	1,373	1,176	1,009	949	1,019	1,290	1,709	1,329	984	979	1,224	1,496	1,367	1,076	1,710	861	1,301
5	1,417	1,409	1,403	1,391	1,379	1,296	1,283	1,098	942	886	951	1,202	1,595	1,238	915	910	1,137	1,389	1,271	999	1,589	784
6	1,327	1,319	1,313	1,307	1,295	1,286	1,207	1,192	1,022	875	824	882	1,118	1,479	1,144	846	840	1,050	1,284	1,173	923	1,429
7	1,235	1,229	1,224	1,218	1,211	1,205	1,195	1,117	1,106	947	813	764	820	1,035	1,361	1,055	780	775	969	1,179	1,079	828
8	1,142	1,137	1,135	1,131	1,124	1,124	1,116	1,099	1,033	1,021	879	754	709	758	948	1,253	970	718	714	885	1,077	965
9	1,050	1,045	1,045	1,043	1,038	1,039	1,037	1,020	1,013	949	946	814	698	654	690	869	1,149	892	660	648	800	957
10	962	956	956	956	953	957	956	941	936	925	877	874	752	643	593	631	795	1,054	816	594	578	702
11	879	873	872	872	870	877	878	860	860	851	853	807	805	690	580	540	574	727	959	727	522	499
12	803	795	793	792	792	799	802	783	784	778	781	783	741	737	621	527	490	524	657	847	632	445
13	735	725	721	719	718	726	729	711	712	706	712	715	717	678	661	562	476	446	472	576	729	533
14	678	663	656	652	651	658	661	643	645	639	644	650	653	654	606	597	506	433	399	411	493	609
15	631	610	600	593	590	596	598	580	582	578	582	587	593	595	583	546	537	460	387	347	349	408
16	584	568	552	541	536	539	541	523	524	520	525	530	535	539	529	525	490	487	410	334	294	288
17	540	525	513	497	488	490	490	472	472	468	473	478	482	486	479	476	471	445	433	354	282	241
18	497	485	474	462	449	446	444	426	426	421	425	429	434	437	431	430	427	427	395	373	298	232
19	457	446	437	427	417	410	404	386	384	379	382	386	390	393	388	387	386	387	379	340	314	244
20	419	410	402	394	385	380	371	351	347	342	344	346	350	353	349	348	347	349	343	325	286	257
21	383	376	370	362	355	351	345	322	316	309	310	312	314	317	313	313	312	314	310	294	274	234
22	349	343	338	332	326	324	318	298	289	281	280	281	283	285	281	280	280	282	278	266	247	223
23	320	313	309	304	300	298	293	275	268	258	254	254	254	256	252	252	251	253	250	239	223	202
24	293	286	282	278	274	273	270	254	247	239	233	231	230	230	226	226	225	227	225	214	200	182
25	269	262	258	254	250	250	247	233	228	220	216	211	209	208	204	203	202	204	201	192	180	164
26	248	241	236	232	229	228	227	214	209	203	199	196	191	189	184	182	181	183	180	172	162	147
27	229	222	217	212	209	208	207	196	192	186	183	180	177	173	167	165	163	164	162	155	145	132
28	212	205	200	195	191	190	189	179	176	171	168	166	163	160	153	150	147	148	145	139	130	118
29	197	190	185	180	176	174	172	163	160	156	154	153	150	148	142	137	134	133	131	125	116	106
30	183	176	171	166	162	160	158	149	146	143	141	140	138	136	130	127	123	121	118	112	104	95
31	171	164	159	154	150	148	145	136	134	130	129	128	127	125	120	117	113	111	107	101	94	85
32	159	153	148	143	138	136	134	125	122	119	118	117	116	115	110	108	105	103	98	92	85	77
33	148	142	138	133	129	126	123	115	112	109	107	107	106	105	101	99	96	95	91	84	77	69
34	138	133	128	123	120	117	114	106	104	100	98	97	96	96	93	91	88	87	84	78	71	63
35	129	124	120	115	111	109	106	99	96	92	90	89	88	87	84	83	81	80	77	72	65	58
36	120	116	112	107	104	101	99	91	89	85	83	82	81	80	77	76	74	73	71	66	60	53
37	112	108	104	100	97	95	92	85	82	79	77	75	74	73	70	69	68	67	65	61	55	49
38	105	101	97	93	90	88	86	79	76	73	71	70	68	67	64	63	62	61	59	56	51	45
39	98	94	91	87	84	82	80	74	71	68	66	64	63	62	59	58	56	56	54	51	47	41
40	1,489	1,422	1,364	1,306	1,255	1,221	1,180	1,086	1,042	989	956	925	896	867	820	787	755	735	700	645	584	514

Table 29. continued.

Age (yr)	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	970	715	2,286	684	1,161	1,315	1,644	1,739	1,634	1,715	1,338	1,116	1,491	1,058	939	652	695	1,225	550	1,030	716	477
1	1,691	914	673	2,153	644	1,093	1,239	1,548	1,638	1,538	1,615	1,260	1,051	1,404	997	884	614	655	1,153	518	970	674
2	918	1,592	860	634	2,027	606	1,029	1,167	1,458	1,542	1,449	1,521	1,187	990	1,322	939	832	578	617	1,086	487	914
3	660	864	1,499	810	597	1,908	571	969	1,098	1,372	1,452	1,364	1,432	1,117	932	1,245	884	784	545	581	1,023	459
4	1,557	616	811	1,405	756	556	1,778	532	906	1,029	1,285	1,361	1,280	1,344	1,048	874	1,167	830	736	511	546	963
5	1,200	1,423	573	750	1,283	689	506	1,620	488	836	947	1,187	1,259	1,188	1,244	972	807	1,086	772	684	478	513
6	716	1,082	1,313	526	675	1,155	618	454	1,464	445	758	864	1,085	1,159	1,086	1,139	885	743	1,002	713	637	448
7	1,297	641	990	1,197	470	606	1,031	552	406	1,316	398	682	782	992	1,050	982	1,027	807	682	926	664	597
8	746	1,150	578	896	1,065	421	538	915	487	359	1,158	351	609	709	890	935	877	926	738	632	863	622
9	861	649	1,010	517	790	948	369	471	789	420	307	991	306	546	629	778	824	779	842	686	590	809
10	842	730	553	892	450	696	815	316	395	663	347	253	839	271	478	540	677	720	703	783	641	553
11	609	695	602	482	765	391	585	683	258	323	528	275	207	729	234	405	464	583	646	655	733	600
12	428	490	556	518	407	657	322	479	542	206	248	404	218	178	626	196	344	396	520	602	613	687
13	378	337	382	474	433	346	532	259	372	424	154	184	311	185	152	521	166	291	352	486	564	575
14	448	292	258	323	392	365	277	421	197	287	309	111	139	261	157	126	439	140	258	328	455	529
15	509	342	220	216	266	329	289	217	317	151	206	220	83	116	222	130	105	368	124	241	308	426
16	340	385	255	184	177	222	258	225	162	240	107	145	161	68	98	183	109	88	325	116	226	288
17	239	256	285	213	151	148	173	200	166	122	169	74	105	133	58	81	153	91	78	304	108	212
18	200	179	188	237	174	125	115	134	147	125	85	117	54	87	113	48	68	128	80	73	285	101
19	192	149	132	157	193	144	97	88	98	111	87	59	84	44	73	93	40	57	113	75	68	267
20	202	143	109	109	128	160	112	75	65	74	76	60	42	69	37	60	78	33	50	106	70	64
21	212	150	104	91	89	106	124	86	55	48	51	52	43	34	58	31	50	65	29	47	99	66
22	193	158	109	87	74	74	82	95	63	41	33	35	37	35	29	48	26	42	57	28	44	93
23	184	143	115	91	70	61	57	63	70	47	28	23	25	31	30	24	40	21	37	54	26	41
24	167	137	104	95	74	58	47	44	46	52	32	19	16	20	26	24	20	34	19	35	50	24
25	150	124	100	87	78	61	45	36	32	34	36	22	14	13	17	21	20	17	30	18	33	47
26	135	111	90	83	70	64	47	34	26	24	23	24	16	11	11	14	18	17	15	28	17	31
27	121	100	81	75	67	58	50	36	25	20	16	16	17	13	9	9	12	15	15	14	26	16
28	109	90	73	67	61	56	45	38	26	19	14	11	11	14	11	8	8	10	13	14	13	24
29	97	80	65	60	55	50	43	34	28	20	13	9	8	9	12	9	7	7	9	12	13	12
30	87	72	59	54	49	45	39	33	25	21	14	9	7	6	8	10	7	5	6	8	12	12
31	78	65	52	49	44	41	35	30	24	19	14	9	6	5	5	7	8	6	5	5	8	11
32	70	58	47	44	39	36	31	27	22	18	13	10	7	5	5	5	5	7	6	5	5	7
33	63	52	42	39	35	33	28	24	19	16	12	9	7	5	4	4	4	5	6	5	4	5
34	57	47	38	35	32	29	25	21	17	15	11	8	6	6	5	4	3	3	4	6	5	4
35	52	42	34	31	28	26	23	19	16	13	10	8	6	5	5	4	3	3	3	4	5	5
36	47	38	31	28	26	23	20	17	14	12	9	7	5	5	4	4	3	2	2	3	4	5
37	44	35	28	26	23	21	18	15	13	10	8	6	5	4	4	4	3	3	2	2	2	3
38	40	33	26	23	21	19	16	14	11	9	7	5	4	4	4	3	3	3	2	2	2	2
39	37	30	24	21	19	17	15	12	10	8	6	5	4	4	3	3	3	2	2	2	2	2
40	458	367	289	259	228	204	171	141	112	91	69	51	40	36	33	30	28	26	25	25	26	26

Table 29. continued.

Age (yr)	2004	2005	2006	2007
0	783	591	572	1,404
1	450	737	557	539
2	635	423	694	524
3	861	598	399	654
4	432	810	563	375
5	902	406	761	529
6	479	846	381	714
7	419	450	795	357
8	559	393	422	746
9	584	525	370	397
10	760	549	494	347
11	520	714	516	464
12	564	489	671	485
13	646	531	459	631
14	540	607	499	432
15	497	508	571	469
16	401	467	477	537
17	271	377	439	449
18	199	255	354	413
19	95	187	240	333
20	251	90	176	225
21	60	236	84	166
22	62	57	222	79
23	87	58	53	209
24	39	82	55	50
25	23	36	77	52
26	44	21	34	73
27	29	42	20	32
28	15	27	39	19
29	23	14	25	37
30	11	22	13	24
31	12	11	20	12
32	10	11	10	19
33	7	10	10	10
34	4	6	9	10
35	4	4	6	8
36	4	4	4	6
37	5	4	3	4
38	3	4	4	3
39	2	3	4	4
40	26	27	28	30

Table 30. Summary results of sensitivity to splitting the triennial time-series.

Model	2007	a
Description	Base case	No triennial split
Convergence		
Maximum gradient component	0.000085	0.000081
Likelihood penalties	0.0	0.0
Negative log-likelihoods		
Total	4,393.4	4,396.6
Indices	-8.1	-5.4
Length-frequency data	2,103.7	2,105.9
Age-frequency data	2,316.0	2,315.9
Recruitment	-17.4	-19.2
Priors	0.0	0.0
Forecast recruitment	-0.7	-0.7
Select parameters		
Stock-recruit, productivity		
R_0	4,210	4,149
Steepness (*h*)	0.511	0.511
Female M age 14+	0.097	0.096
Survey catchability and selectivity		
NWFSC survey catchability (*Q*)	0.114	0.127
NWFSC survey peak selectivity	66.000	66.000
NWFSC survey width of selectivity top	-3.863	-3.629
NWFSC survey ascending width	7.175	7.204
NWFSC survey final selectivity	-1.660	-1.801
NWFSC survey final selectivity	4.459	4.450
1980-1992 Triennial survey catchability (*Q*)	0.114	0.088
1995-2004 Triennial survey catchability (*Q*)	0.054	0.088
Triennial survey peak selectivity	66.000	66.000
Triennial survey width of selectivity top	-3.465	-3.550
Triennial survey ascending width	7.272	7.284
Triennial survey final selectivity	4.453	4.450
Individual growth		
Female and male length at age 1	4.113	4.103
Female mean length at age 20	59.096	59.098
Female von Bertalanffy *K*	0.141	0.141
Female CV of length-at-age at age 1	0.145	0.145
Female CV of length-at-age at age 20	0.039	0.039
Male mean length at age 20	52.029	52.050
Male von Bertalanffy *K*	0.181	0.180
Male CV of length-at-age at age 1	0.152	0.153
Male CV of length-at-age at age 20	0.041	0.041
Management quantities		
SB_0	32,561	32,457
2007 Spawning biomass	10,544	9,519
2007 Depletion	32.4%	29.3%
2006 *SPR*	96.5%	96.1%
2006 Exp. rate: yield/age 5+ Biomass	0.002	0.002

Table 31. Total negative log-likelihood values for the profile on steepness (*h*)

Steepness (*h*)	Negative log-likelihood
0.345	4,408.13
0.428	4,399.23
0.4695	4,396.06
0.511	4,393.42
0.56	4,390.66
0.6155	4,388.40
0.72	4,384.94

Table 32. Projection of potential canary rockfish ABC, OY, spawning biomass and depletion for the base case model based on the SPR= 0.887 fishing mortality target used for the last rebuilding plan (OY) and $F_{50\%}$ overfishing limit/target (ABC). Assuming the OY of 44 mt is met in 2007 and 2008.

Year	ABC (mt)	OY (mt)	Age 5+ biomass (mt)	Spawning biomass (mt)	Depletion
2007	973	44	25,995	10,544	32.4%
2008	978	44	26,417	10,840	33.3%
2009	981	162	26,859	11,072	34.0%
2010	980	162	26,995	11,194	34.4%
2011	992	164	27,018	11,254	34.6%
2012	1,026	169	27,440	11,266	34.6%
2013	1,074	177	27,985	11,260	34.6%
2014	1,124	185	28,656	11,280	34.6%
2015	1,171	193	29,445	11,368	34.9%
2016	1,214	200	30,332	11,545	35.5%
2017	1,253	207	31,297	11,812	36.3%
2018	1,290	213	32,317	12,156	37.3%

Table 33. Decision table of 12-year projections for alternate states of nature (columns) and management options (rows) beginning in 2009. Relative probabilities of each state of nature are based on a meta-analysis for steepness of west coast rockfish (M. Dorn, AFSC, personal communication). Landings in 2007-2008 are 44 mt for all cases. Selectivity and fleet allocations are projected at the average 2003-2006 values.

			State of nature					
			Low steepness (0.35)		Base case (steepness = 0.51)		High steepness (0.72)	
Relative probability			0.25		0.5		0.25	
Management decision	Year	Catch (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)	Depletion	Spawning biomass (mt)
Rebuilding SPR 88.7% catches from low steepness state of nature	2009	56	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	56	12.0%	4,100	34.5%	11,236	60.1%	18,932
	2011	56	11.9%	4,078	34.8%	11,339	60.8%	19,156
	2012	59	11.8%	4,042	35.0%	11,396	61.2%	19,270
	2013	62	11.7%	4,003	35.1%	11,436	61.3%	19,313
	2014	65	11.6%	3,979	35.3%	11,502	61.4%	19,343
	2015	67	11.6%	3,984	35.7%	11,638	61.7%	19,423
	2016	70	11.7%	4,025	36.4%	11,866	62.2%	19,590
	2017	72	12.0%	4,102	37.4%	12,188	63.0%	19,852
	2018	74	12.3%	4,209	38.7%	12,591	64.1%	20,199
Rebuilding SPR 88.7% catches from base case	2009	162	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	162	11.8%	4,058	34.4%	11,194	60.0%	18,890
	2011	164	11.7%	3,994	34.6%	11,254	60.5%	19,069
	2012	169	11.4%	3,914	34.6%	11,266	60.8%	19,138
	2013	177	11.2%	3,831	34.6%	11,260	60.7%	19,135
	2014	185	11.0%	3,762	34.6%	11,280	60.7%	19,118
	2015	193	10.9%	3,719	34.9%	11,368	60.8%	19,150
	2016	200	10.8%	3,710	35.5%	11,545	61.2%	19,266
	2017	207	10.9%	3,733	36.3%	11,812	61.8%	19,475
	2018	213	11.0%	3,781	37.3%	12,156	62.8%	19,767
Rebuilding SPR 88.7% catches from high steepness state of nature	2009	273	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	271	11.7%	4,014	34.2%	11,150	59.8%	18,845
	2011	272	11.4%	3,905	34.3%	11,164	60.3%	18,978
	2012	277	11.0%	3,780	34.2%	11,130	60.3%	19,001
	2013	285	10.7%	3,654	34.0%	11,079	60.2%	18,951
	2014	293	10.3%	3,542	34.0%	11,055	60.0%	18,891
	2015	300	10.1%	3,459	34.1%	11,100	59.9%	18,880
	2016	307	9.9%	3,408	34.5%	11,235	60.2%	18,953
	2017	313	9.9%	3,389	35.2%	11,461	60.7%	19,122
	2018	319	9.9%	3,394	36.1%	11,763	61.5%	19,374
Status quo (catch = 44 mt)	2009	44	12.0%	4,099	34.0%	11,072	59.0%	18,583
	2010	44	12.0%	4,104	34.5%	11,241	60.1%	18,937
	2011	44	11.9%	4,088	34.9%	11,349	60.8%	19,166
	2012	44	11.8%	4,057	35.0%	11,411	61.2%	19,285
	2013	44	11.7%	4,024	35.2%	11,456	61.4%	19,334
	2014	44	11.7%	4,005	35.4%	11,529	61.5%	19,371
	2015	44	11.7%	4,018	35.8%	11,673	61.8%	19,459
	2016	44	11.9%	4,069	36.6%	11,911	62.3%	19,635
	2017	44	12.1%	4,157	37.6%	12,244	63.2%	19,908
	2018	44	12.5%	4,277	38.9%	12,660	64.3%	20,268

11. Figures

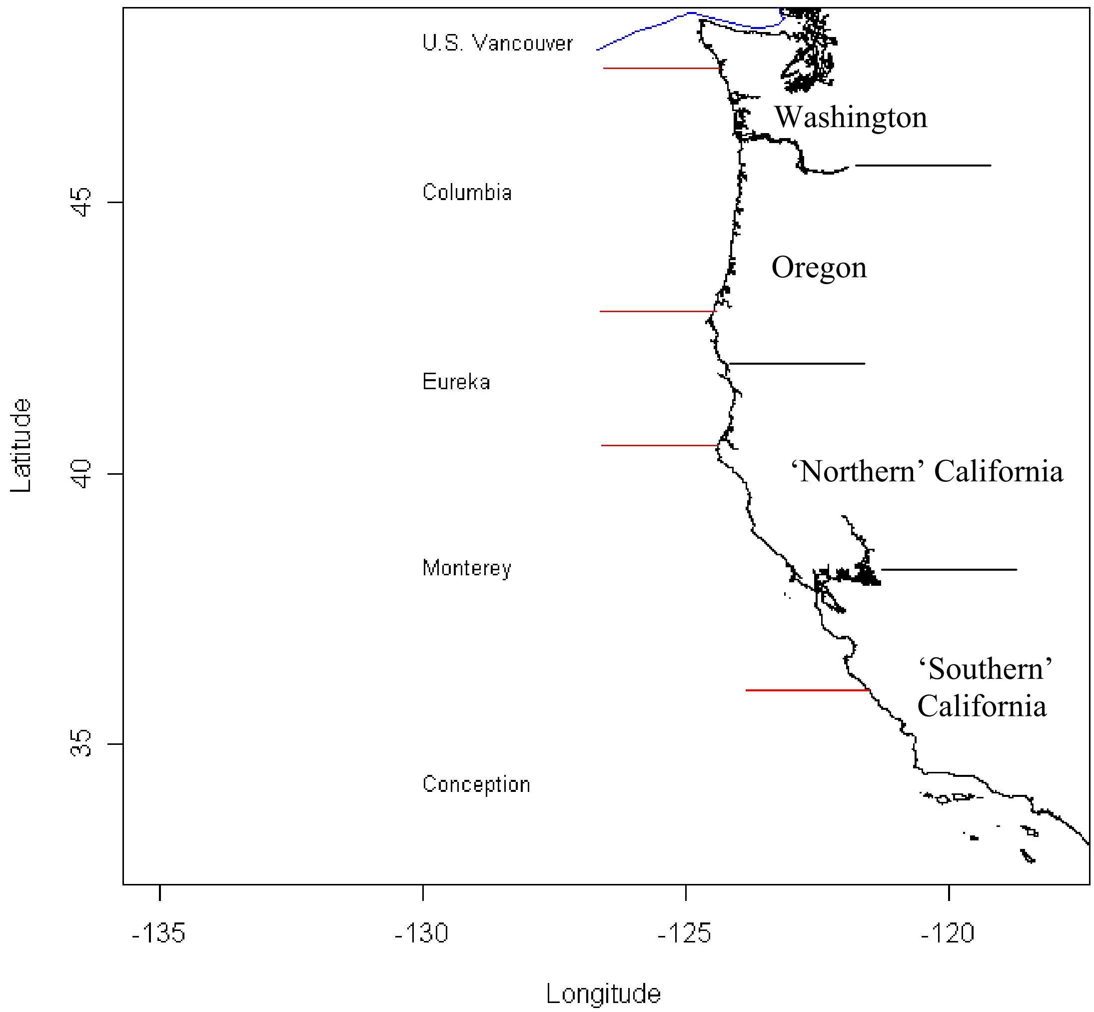


Figure 1. Map showing INPFC, and state/fleet boundaries used in the 2005 and current assessment.

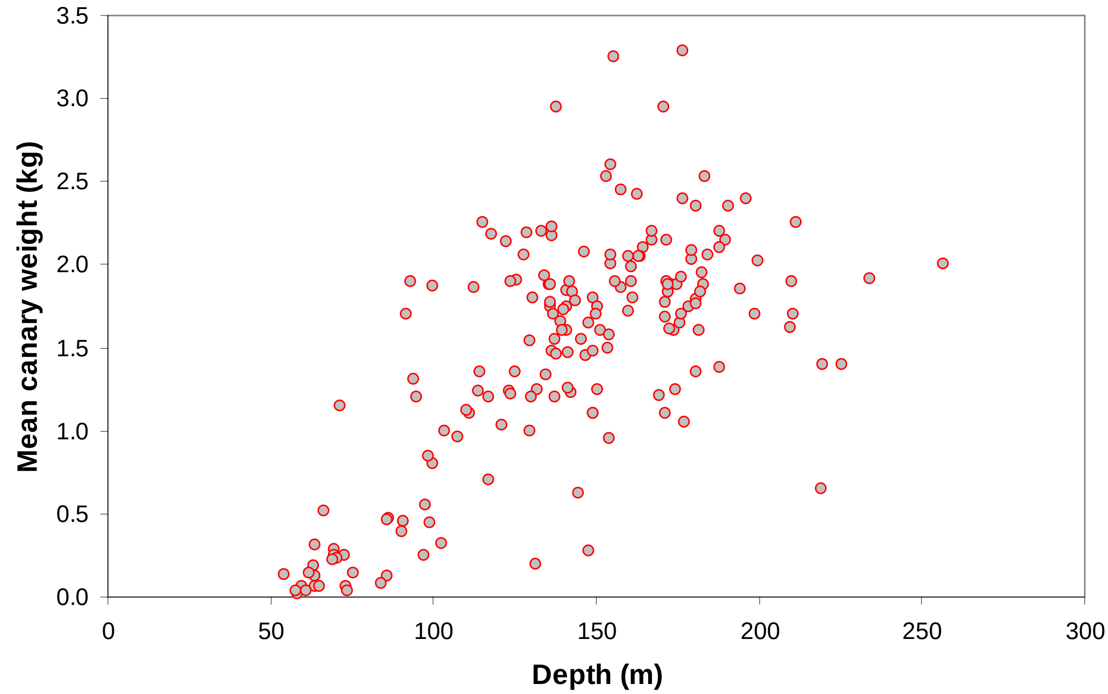


Figure 2. Relationship between mean individual weight and depth in NWFSC survey catches 2003-2006.

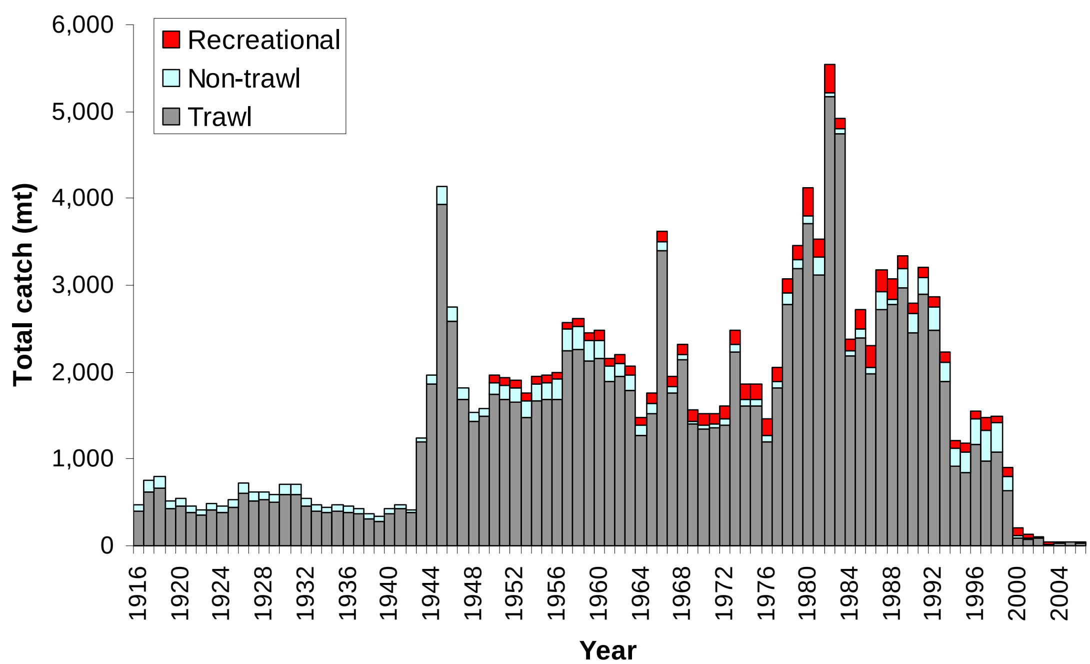


Figure 3. Distribution of total catch among trawl, non-trawl and recreational fisheries 1916-2006.

Figure 4. Distribution of recent total catch among trawl, non-trawl and recreational fisheries. Large reductions after 1999 were a result of the overfished declaration based on the 1999 stock assessment.

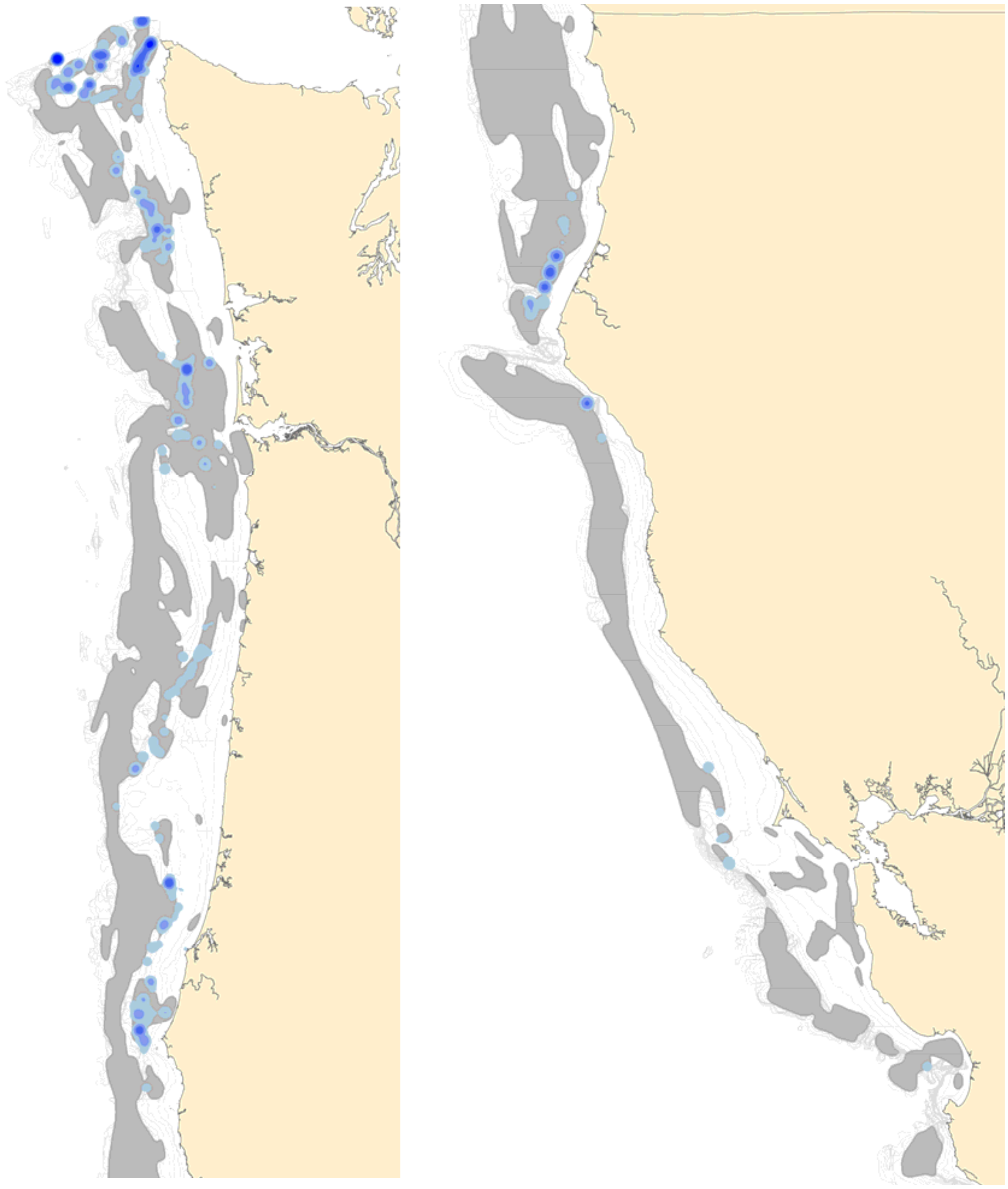


Figure 5. Contour of catch (landings and observed discards) rates of canary rockfish from the commercial trawl fishery, 2001-2005. Grey areas indicate trawl effort.

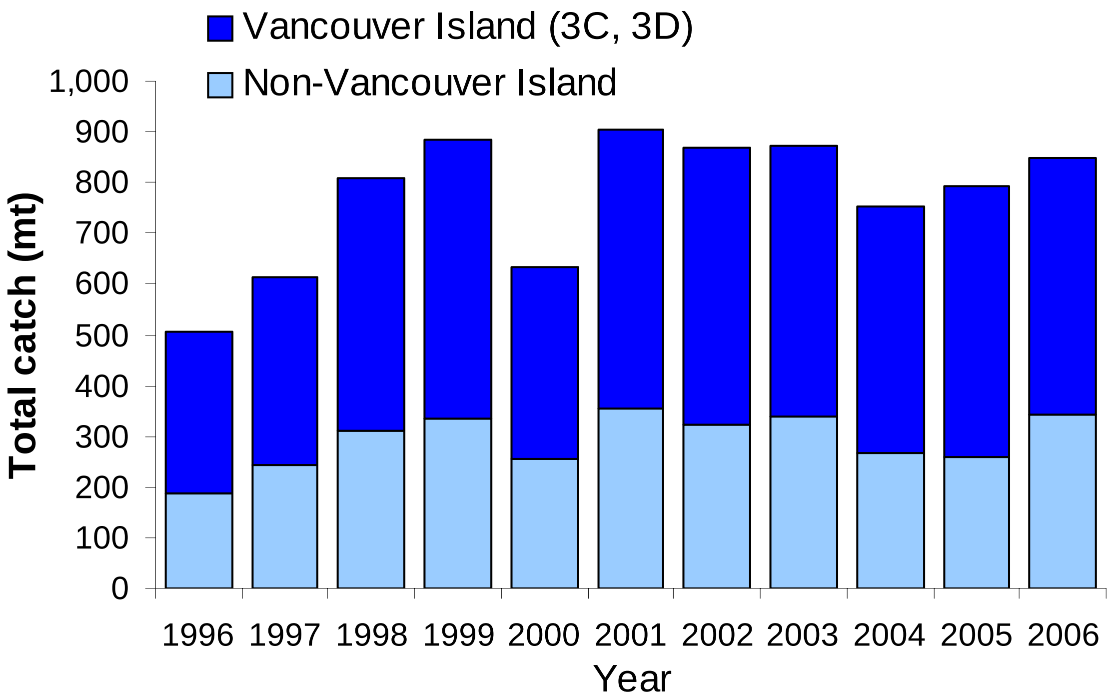


Figure 6. Recent catches of canary rockfish in the Canadian commercial fishery. Data courtesy of R. Stanley, DFO.

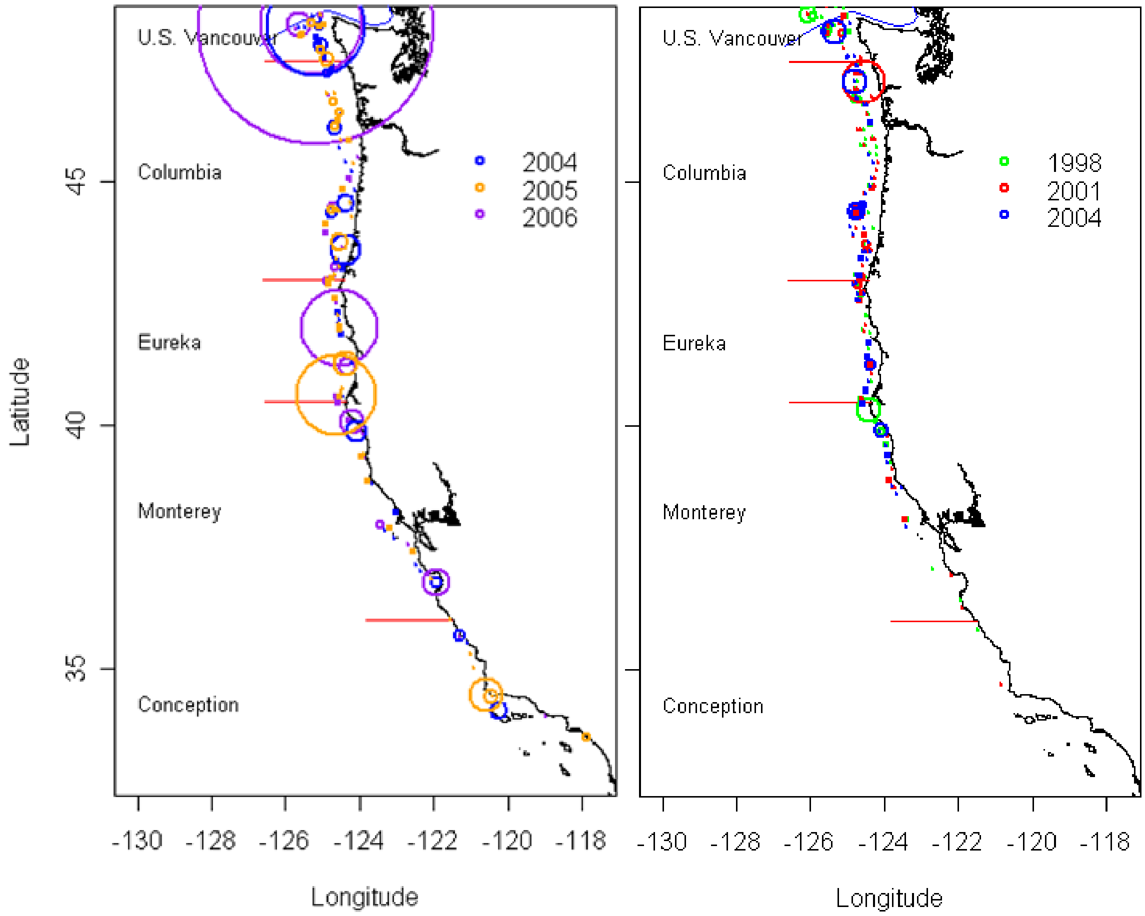


Figure 7. Distribution of canary catch rates in the recent NWFSC (left panel) and Triennial (right panel) trawl surveys. Legend circles indicate catch rates of 10 kg·ha^{-1}.

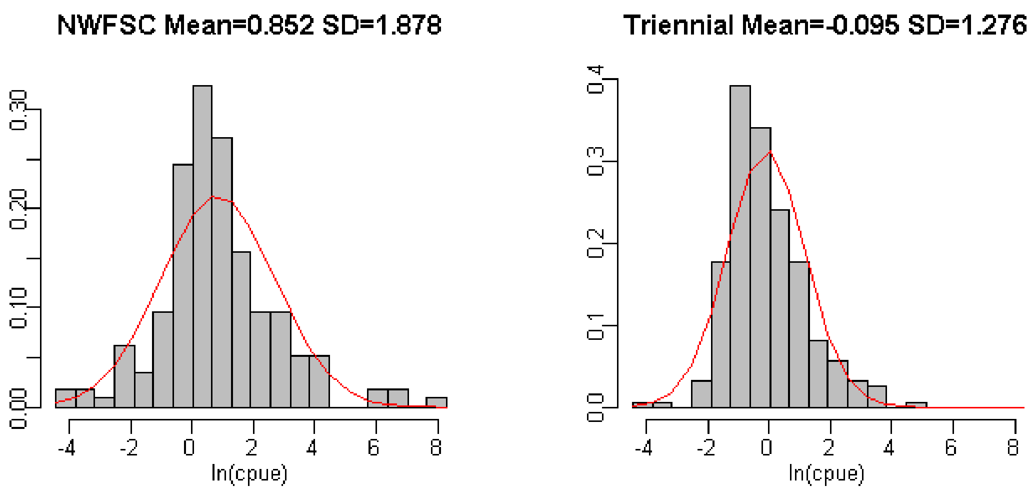


Figure 8. Frequency distribution of log (canary catch rates (kg·ha^{-1})) for positive hauls in the recent (1998-2006) NWFSC (left panel) and Triennial (right panel) trawl surveys.

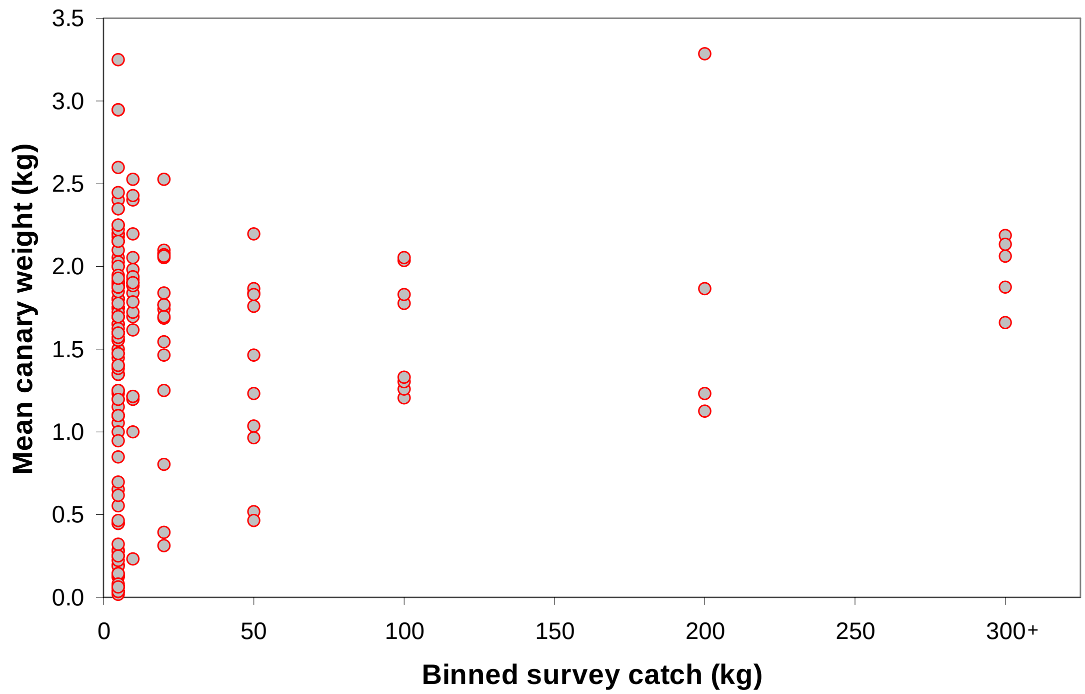


Figure 9. Mean individual weight at binned survey catch levels showing that the largest catches are not dominated by very large or very small individuals.

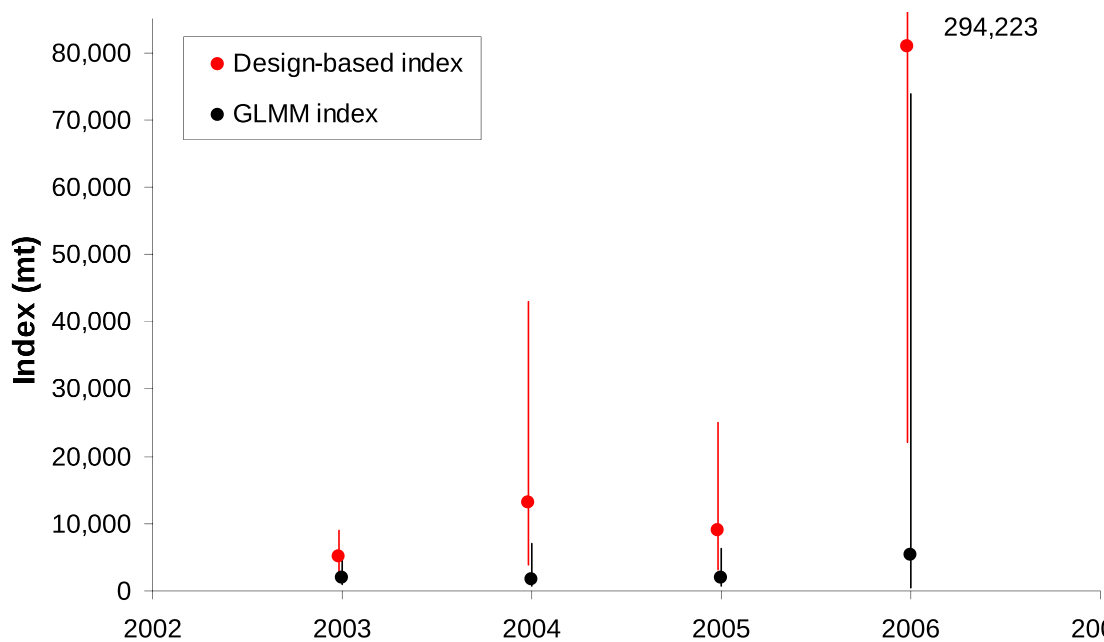


Figure 10. Comparison of GLMM vs. design-based indices of abundance from the NWFSC survey 2003-2006. Vertical lines indicate +/- 95% confidence intervals based on an assumption of lognormal error.

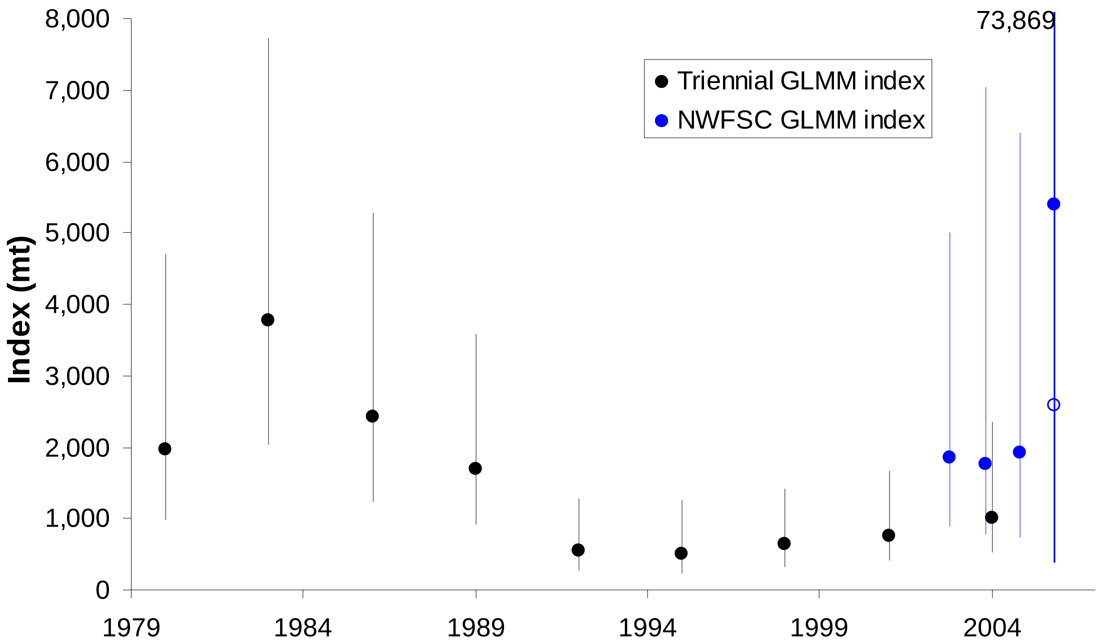


Figure 11.Triennial and NWFSC GLMM indices. The open circle for the NWFSC (2006) shows (for comparison only) the effect of removing the single largest tow from the data. Vertical lines indicate +/- 95% confidence intervals based on lognormal error.

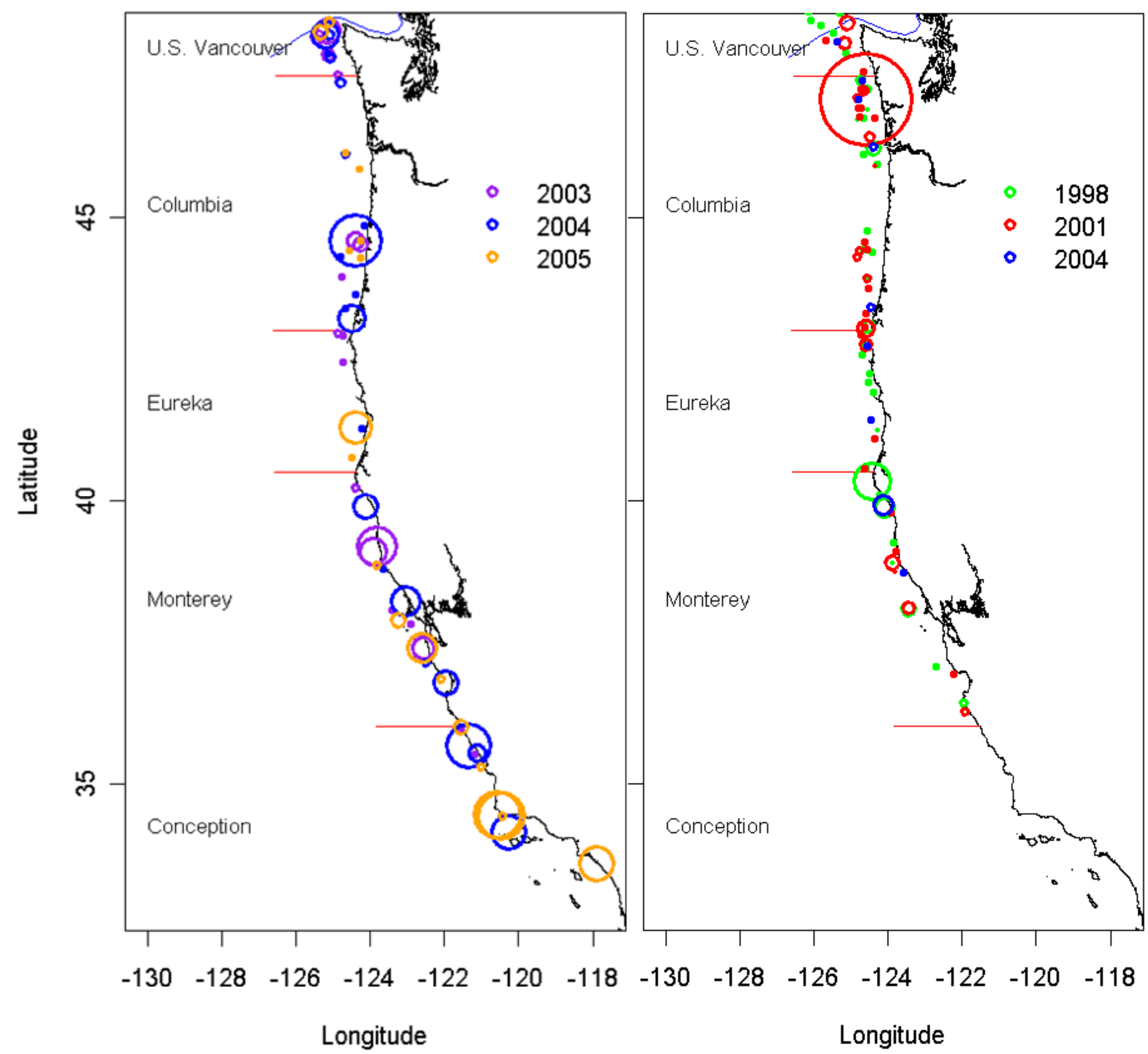


Figure 12. Survey catch rates of small (< 40 cm) canary rockfish around 2004, showing the higher catch rates for the NWFSC survey, especially south of San Francisco, relative to the Triennial trawl survey. Legend circles indicate catch rates of 10 individuals per hectare. The two are directly comparable only for 2004 when they were conducted nearly simultaneously.

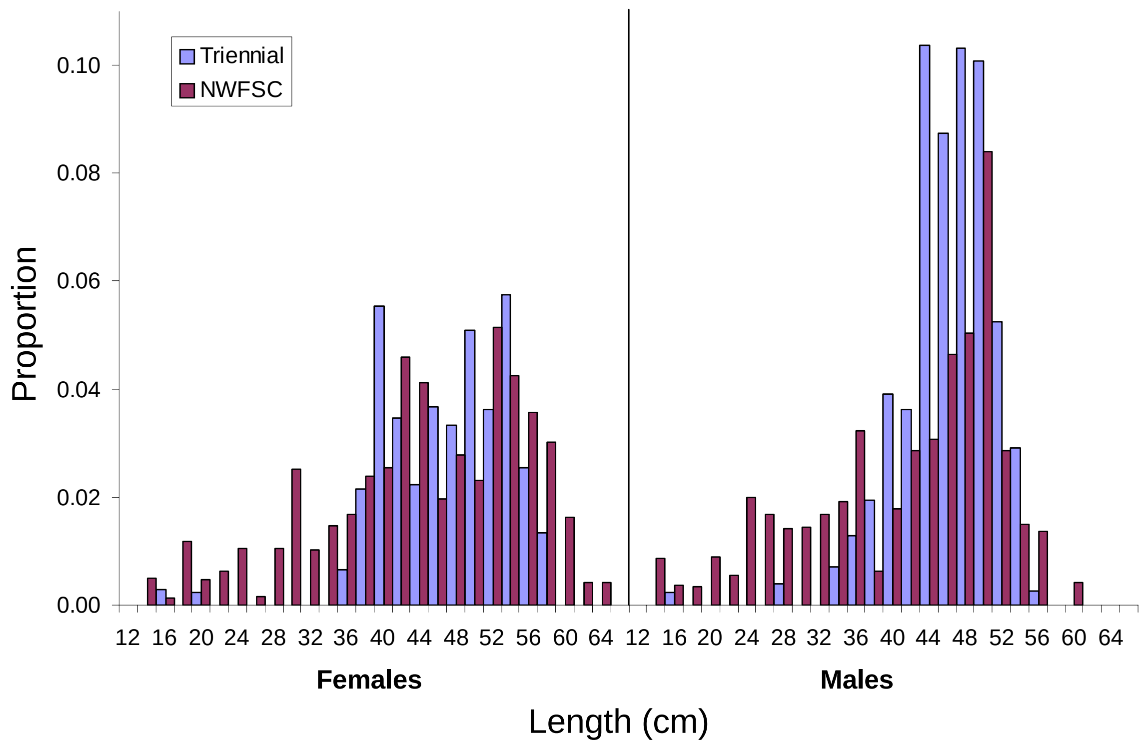


Figure 13. Length-frequency distributions for males and females from the 2004 NWFSC and triennial trawl surveys.

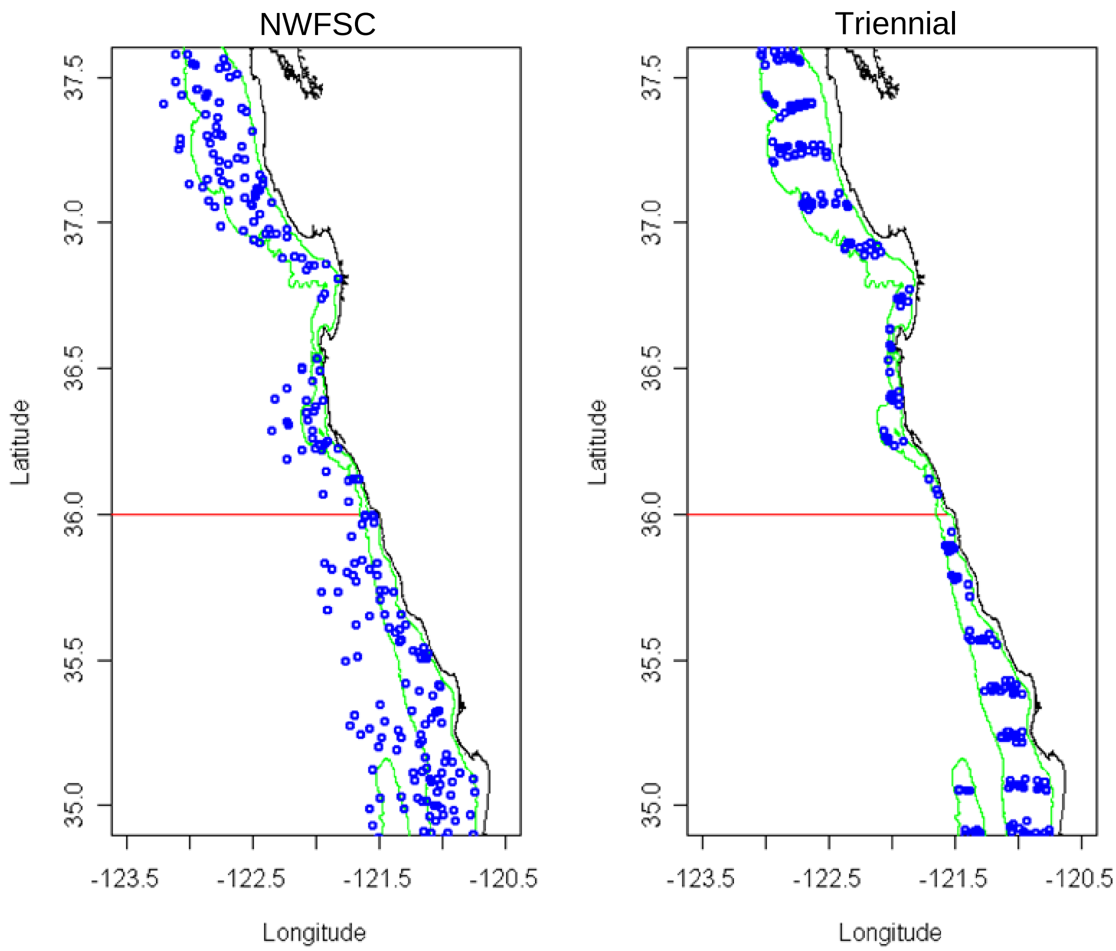


Figure 14. Survey tow locations in 2004, showing the difference in station design for the NWFSC survey relative to the Triennial trawl survey.

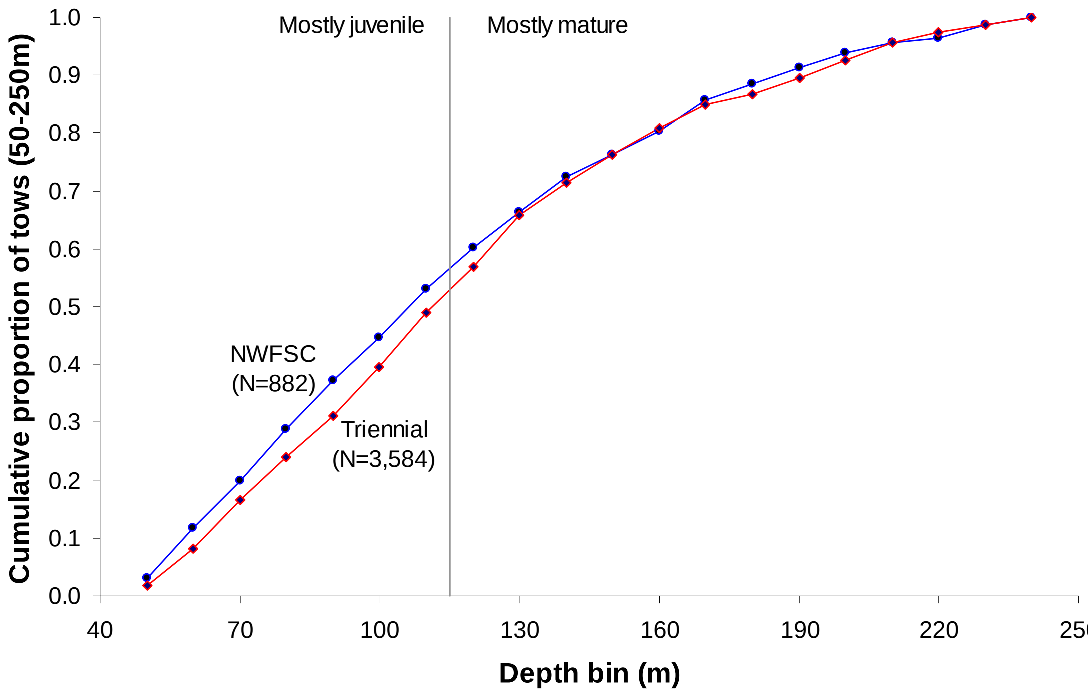


Figure 15. Relative effort (tows completed) by 10m depth bin for the NWFSC and triennial surveys.

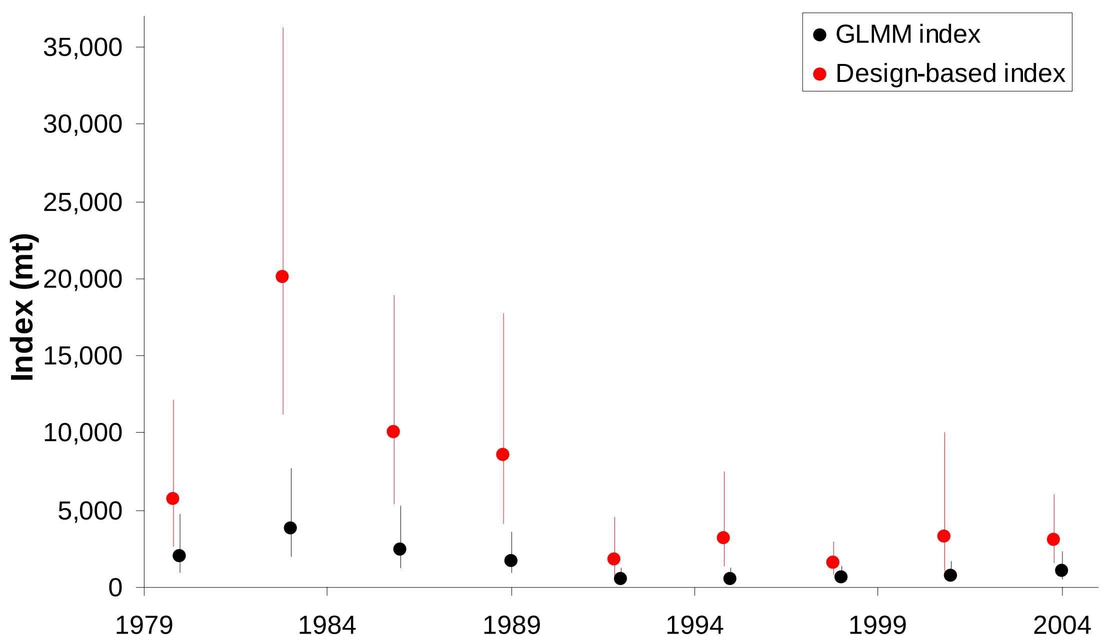


Figure 16. Comparison of GLMM vs. design-based indices of abundance from the triennial survey 1980-2004. Vertical lines indicate +/- 95% confidence intervals based on an assumption of lognormal error.

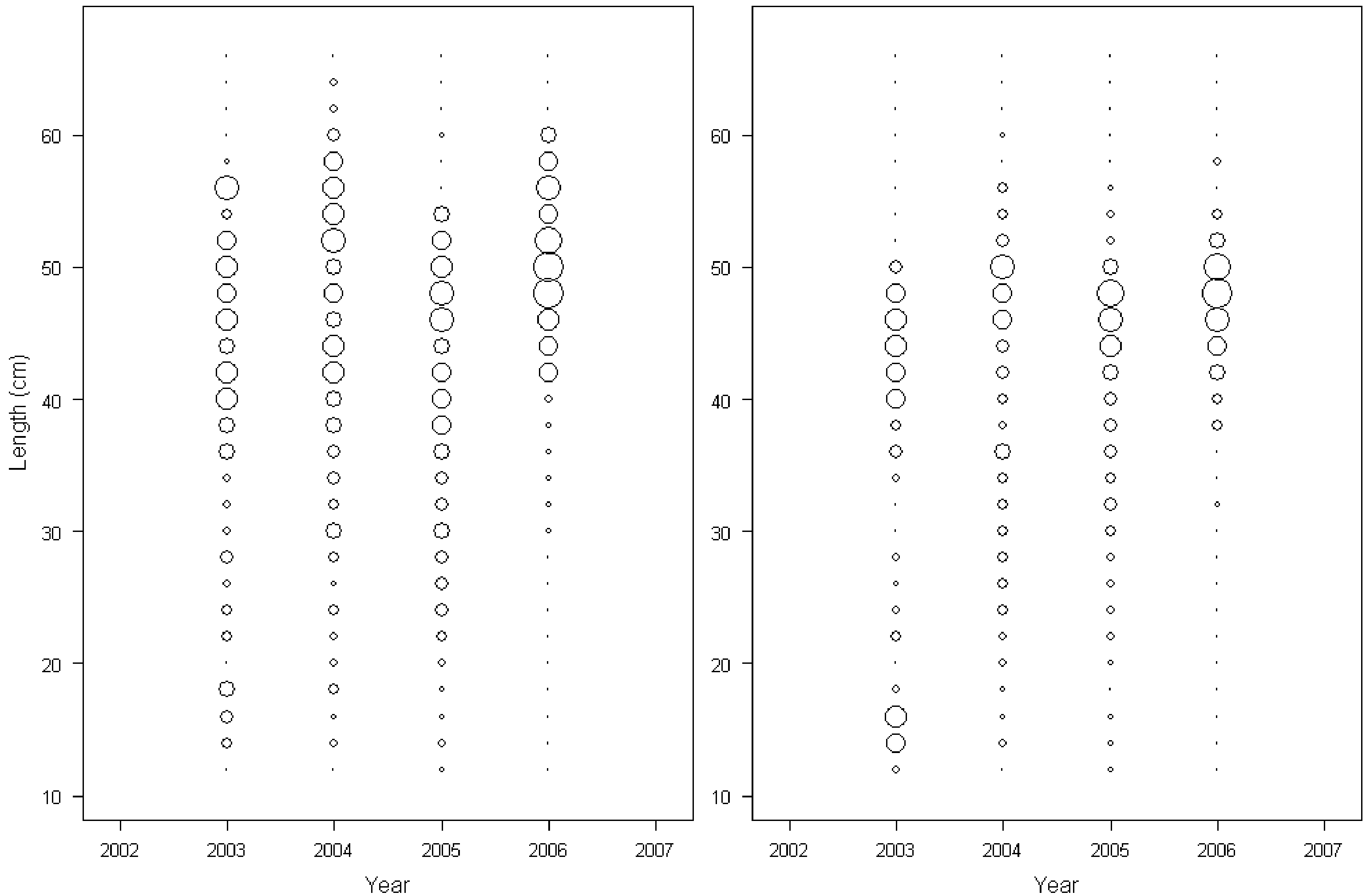


Figure 17. Length-frequency distributions for female (left panel) and male (right panel) canary rockfish from the NWFSC bottom trawl survey. The largest female bubble represents a proportion of 0.08, males represents 0.13.

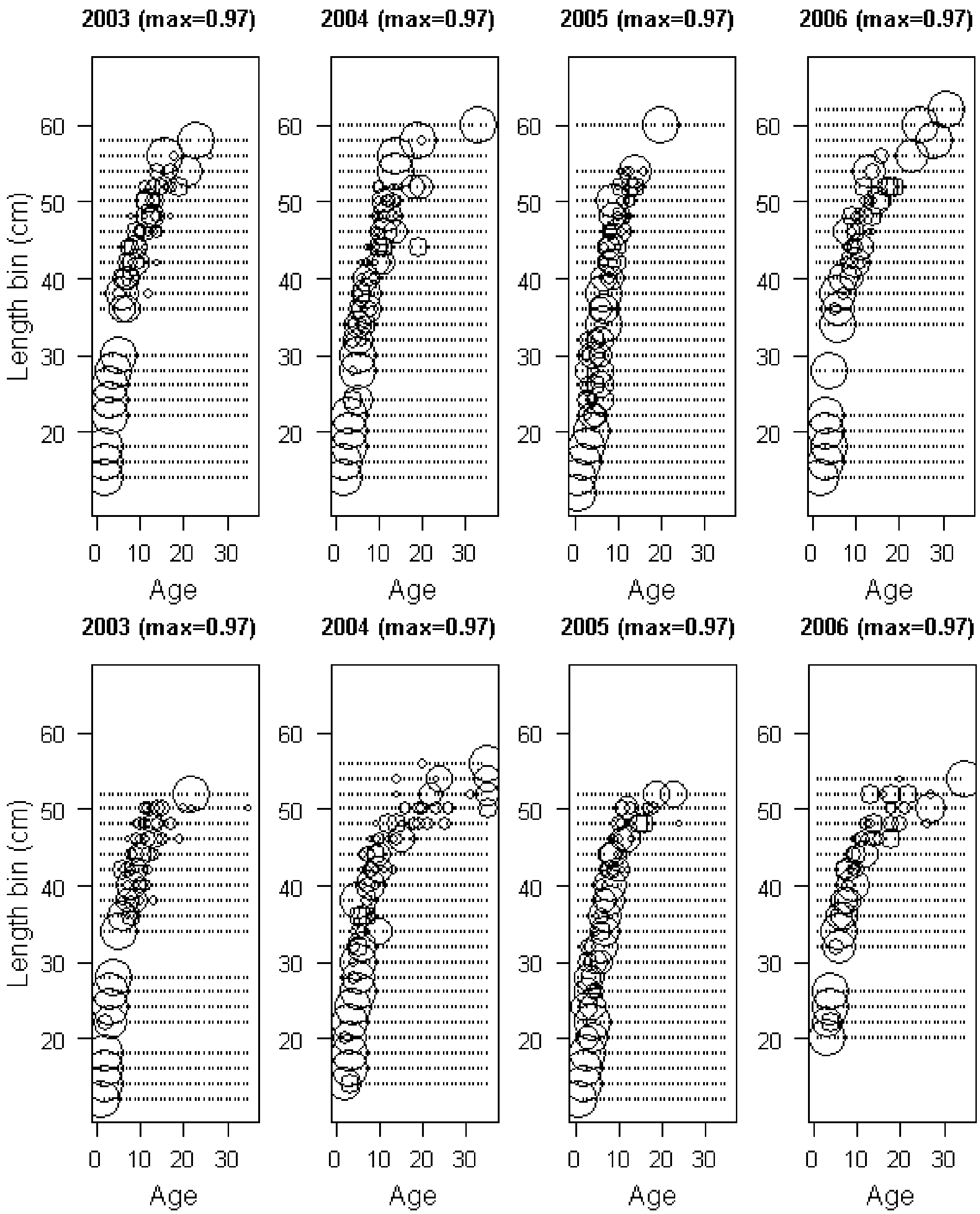


Figure 18. Conditional age-frequency distributions for female (upper panels) and male (lower panels) canary rockfish from the NWFSC survey. Largest circle in each panel represents the maximum proportion value listed in the title.

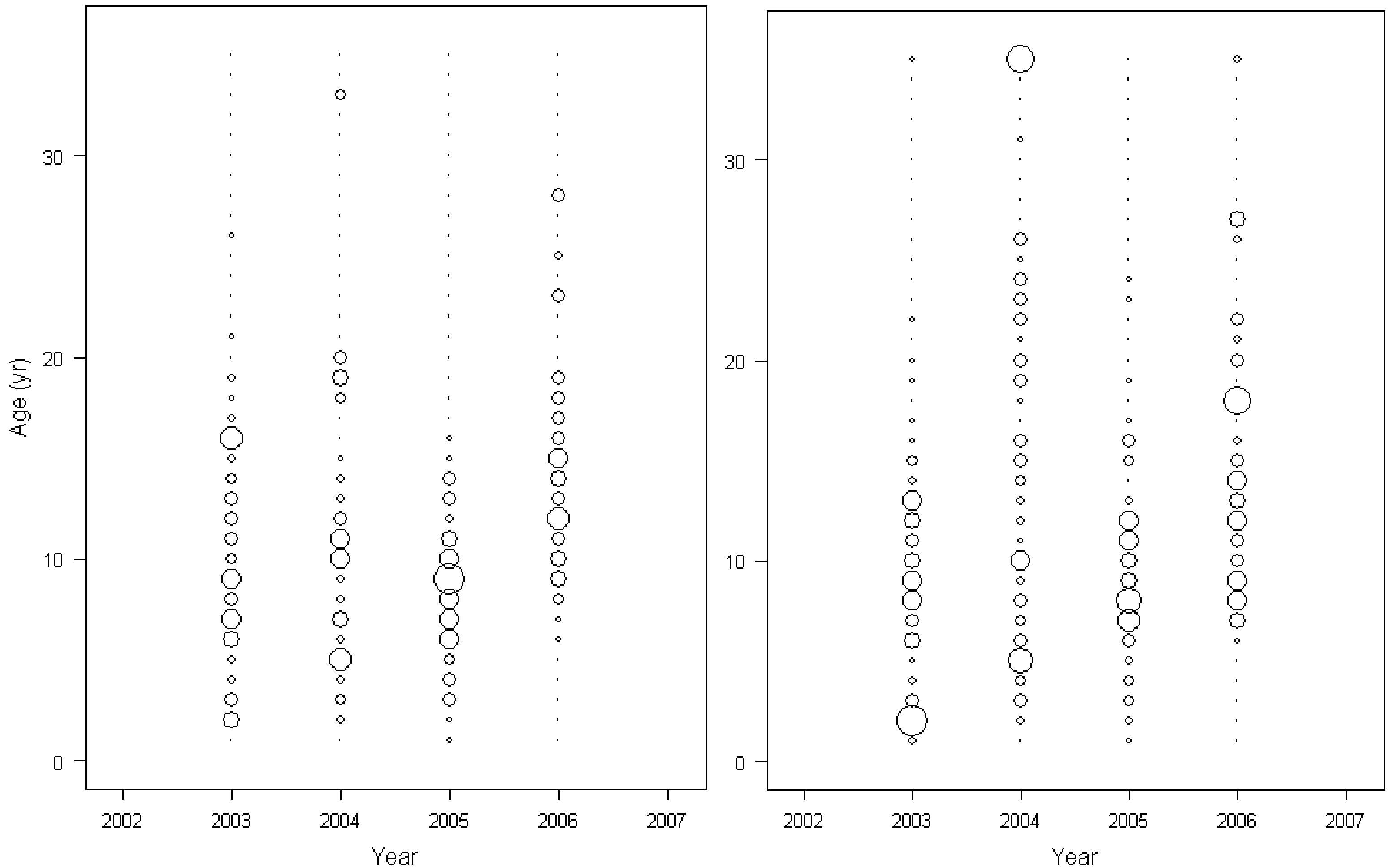


Figure 19. Marginal age-frequency distributions for female (left panel) and male (right panel) canary rockfish from the NWFSC survey. The largest female bubble represents a proportion of 0.13, males represents 0.12. Note that these plots are intended to provide another view of the age data and are for comparison only, as the conditional age-frequency distributions are contributing to the total likelihood.

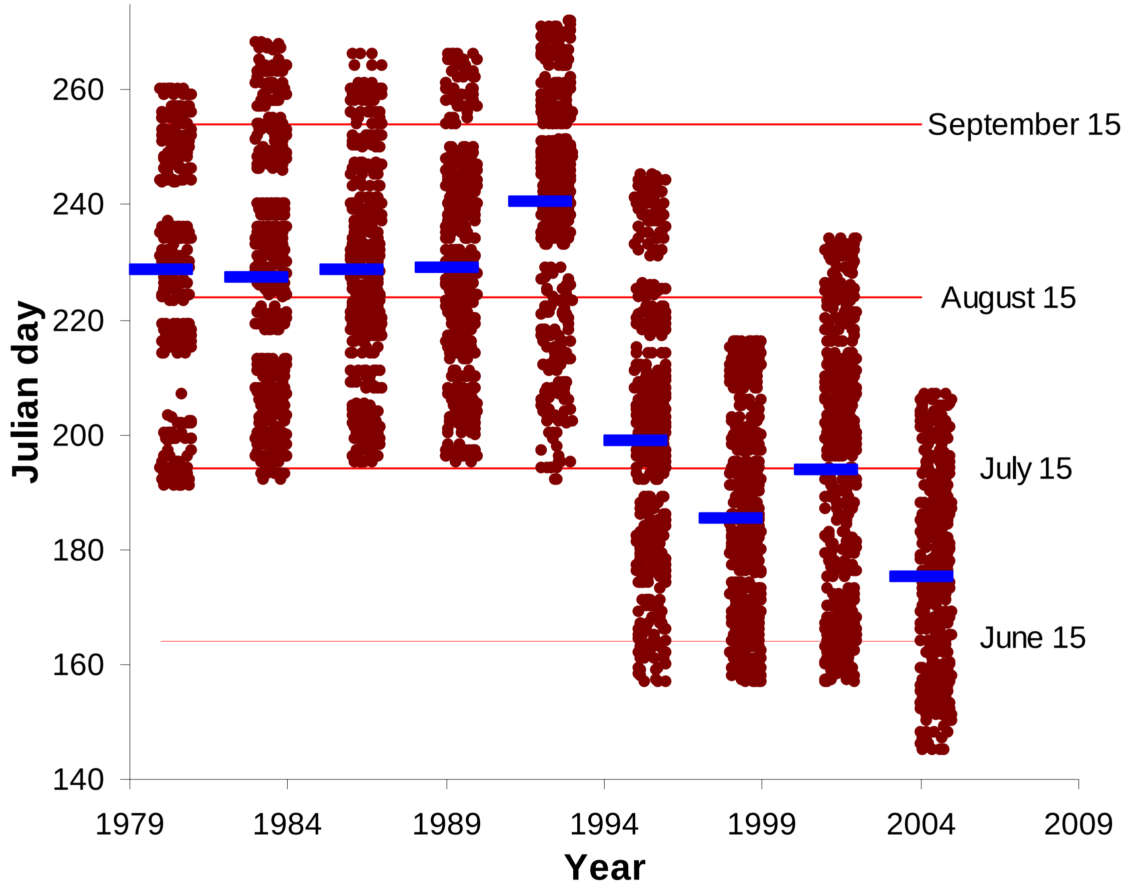


Figure 20. Distribution of dates of operation for the triennial survey (1980-2004). Solid bars show the mean date for each survey year, points represent individual hauls dates, but are jittered to allow better delineation of the distribution of individual points.

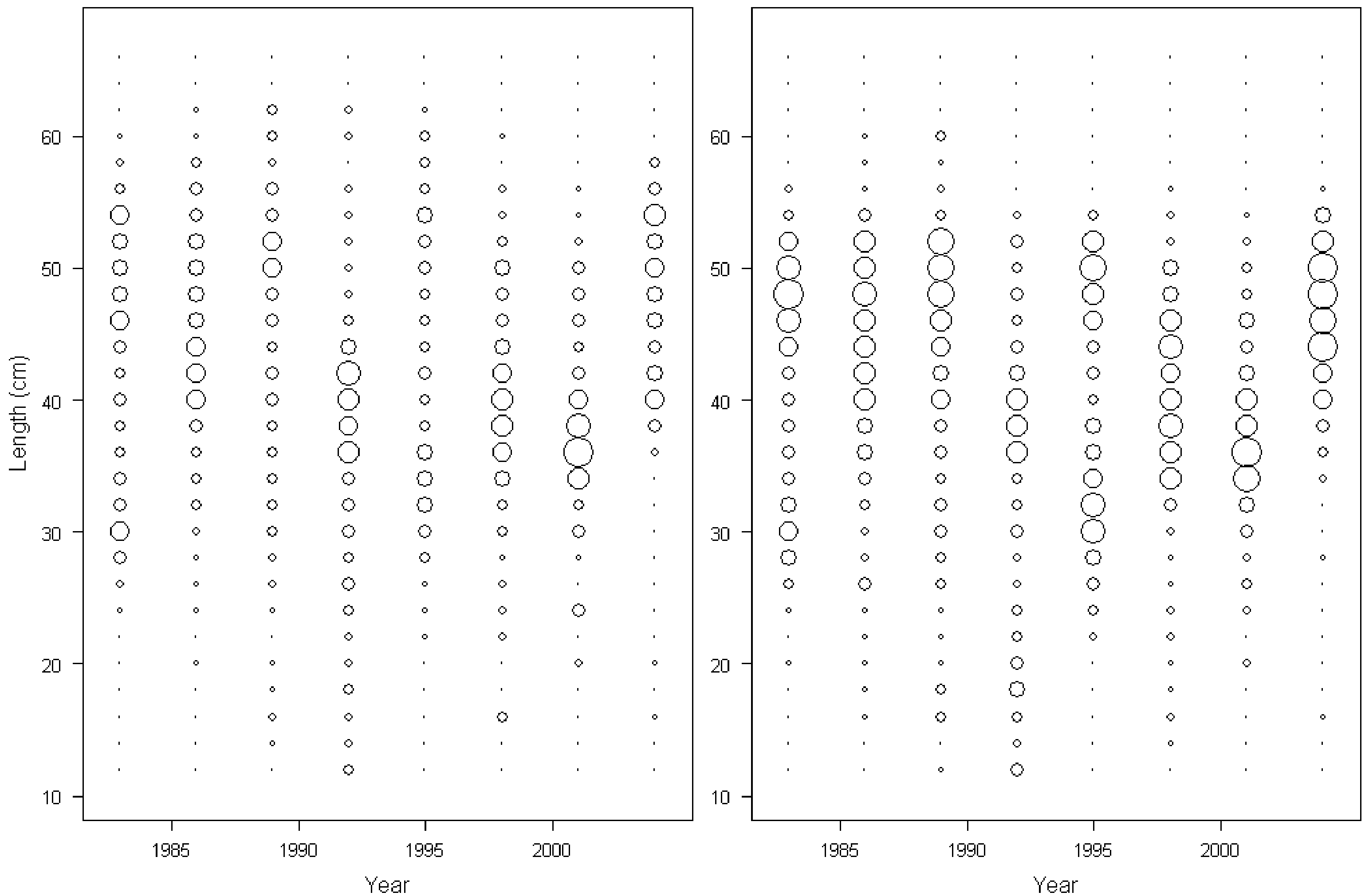


Figure 21. Length-frequency distributions for female (left panel) and male (right panel) canary rockfish from the triennial bottom trawl survey. The largest female bubble represents a proportion of 0.12, males represents 0.10.

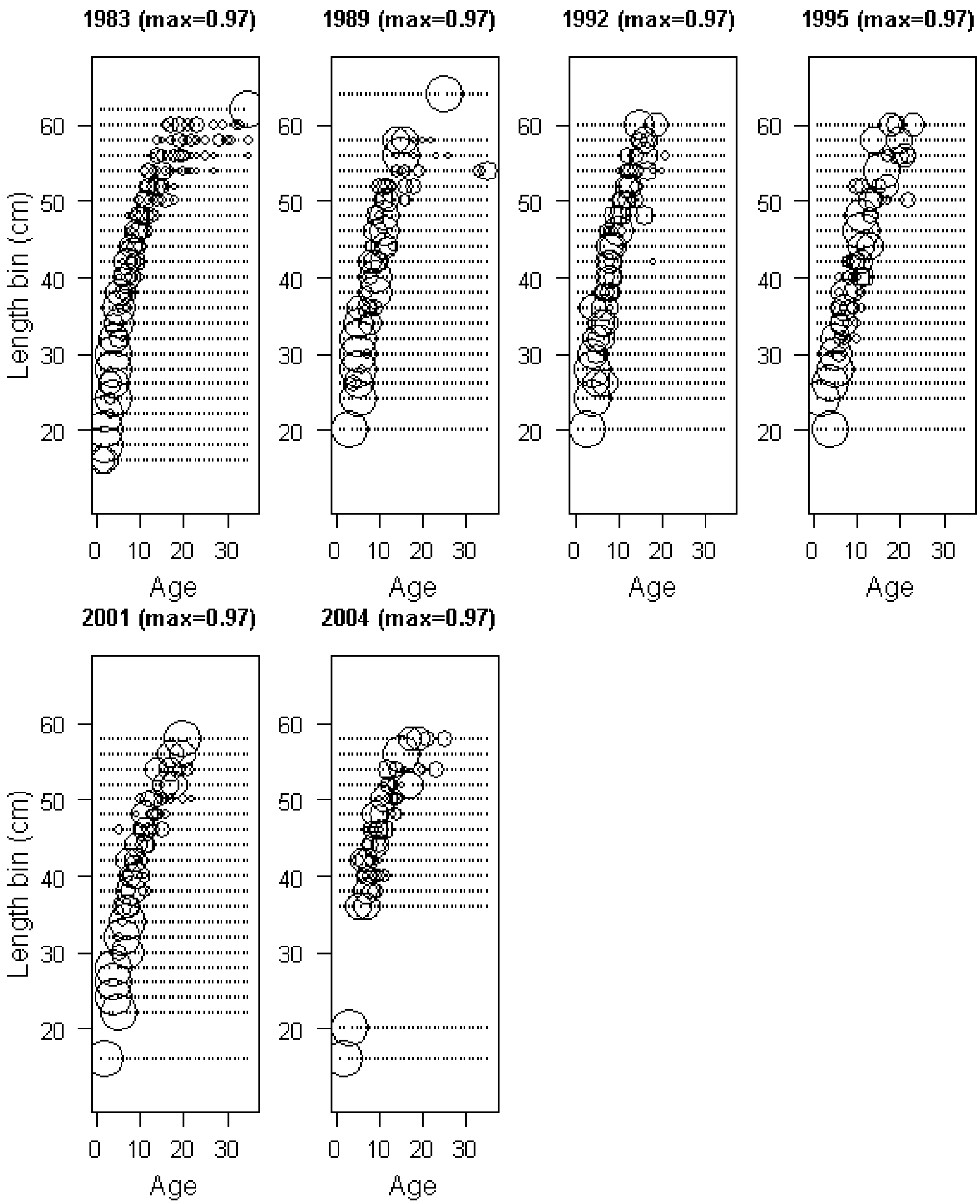


Figure 22. Conditional age-frequency distributions for female canary rockfish from the NMFS triennial survey.

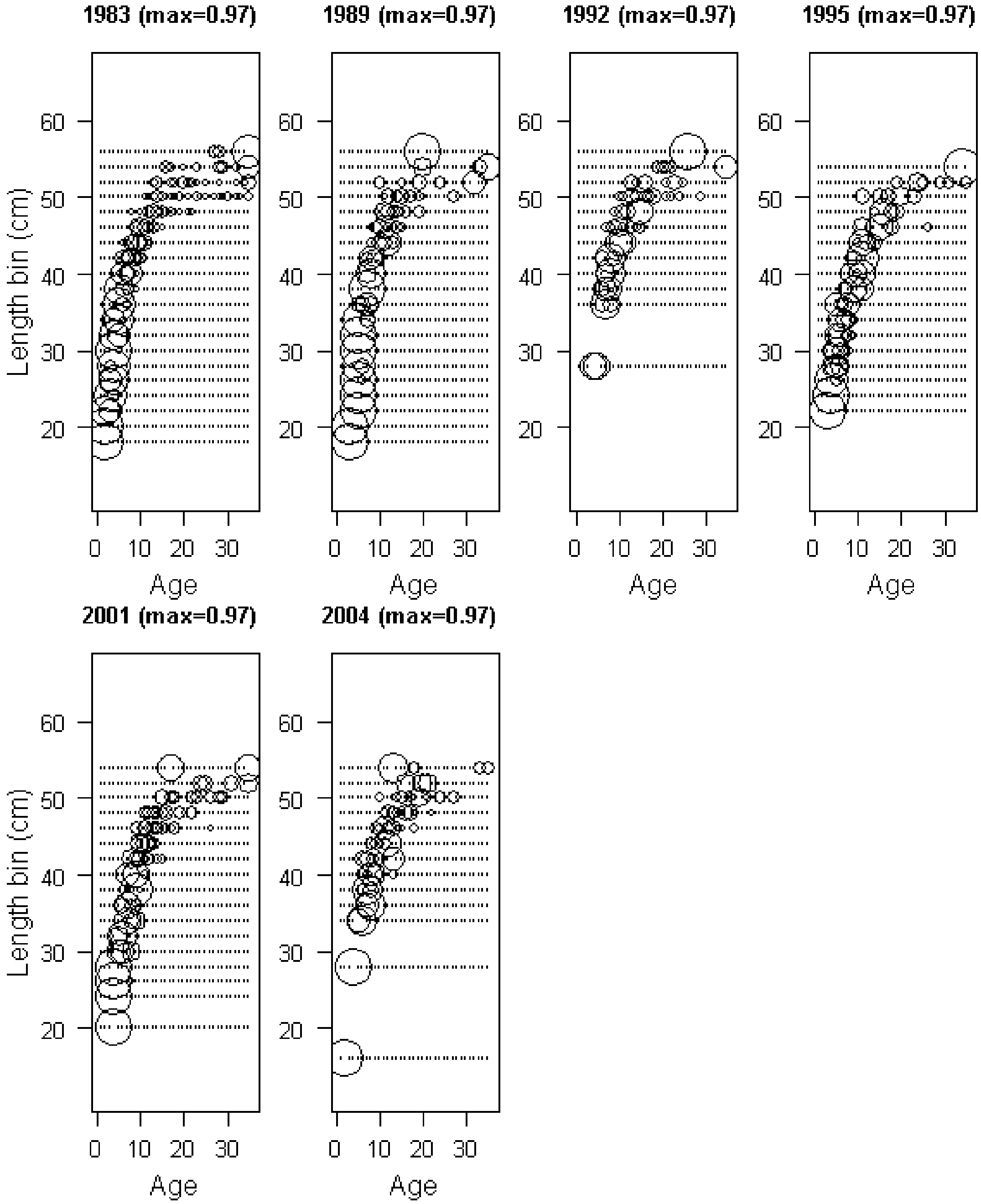


Figure 23. Conditional age-frequency distributions for male canary rockfish from the NMFS triennial survey.

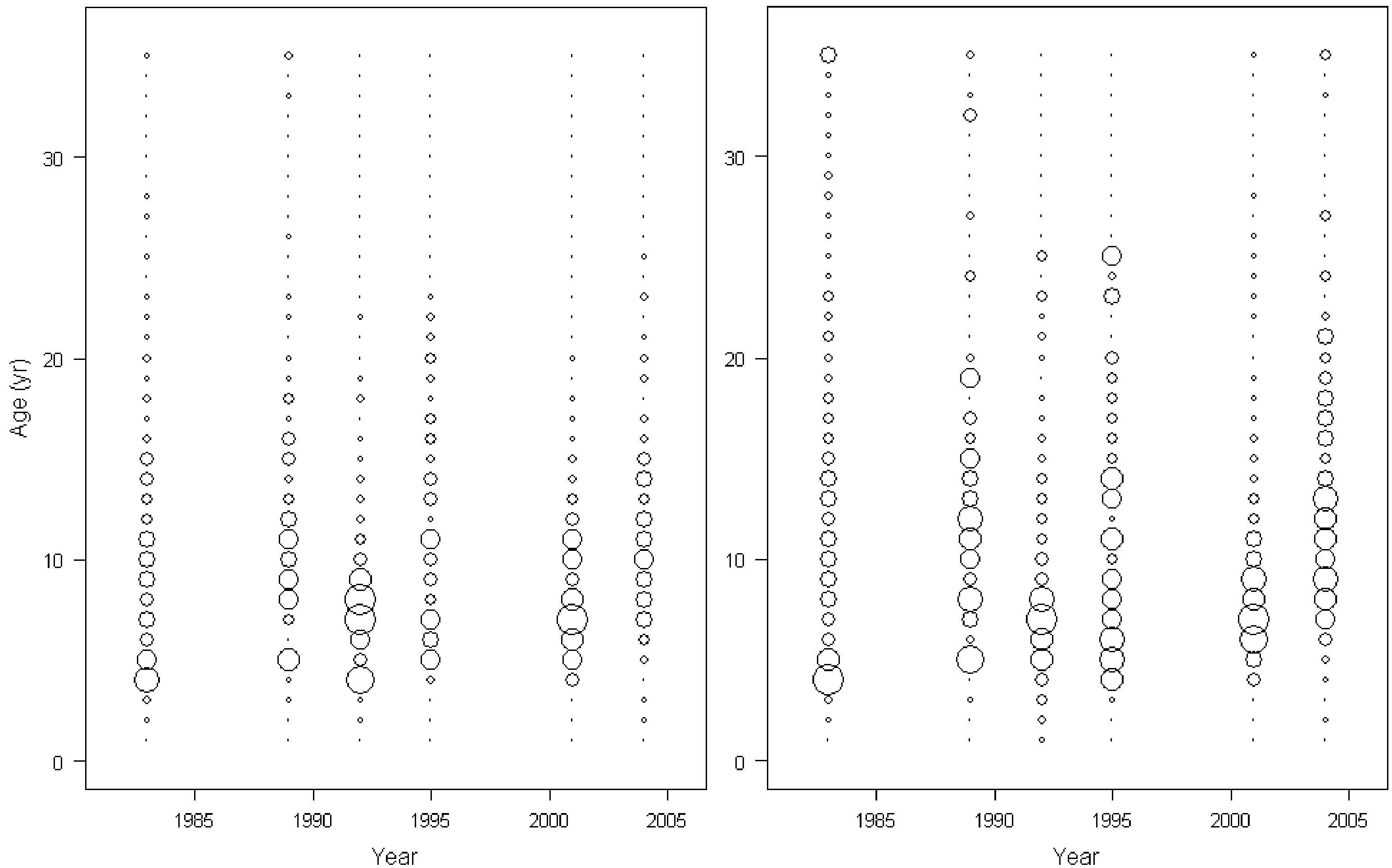


Figure 24. Marginal age-frequency distributions for female (left panel) and male (right panel) canary rockfish from the triennial survey. The largest female bubble represents a proportion of 0.12, males represents 0.10. Note that these plots are intended to provide another view of the age data and are for comparison only, as the conditional age-frequency distributions are contributing to the total likelihood.

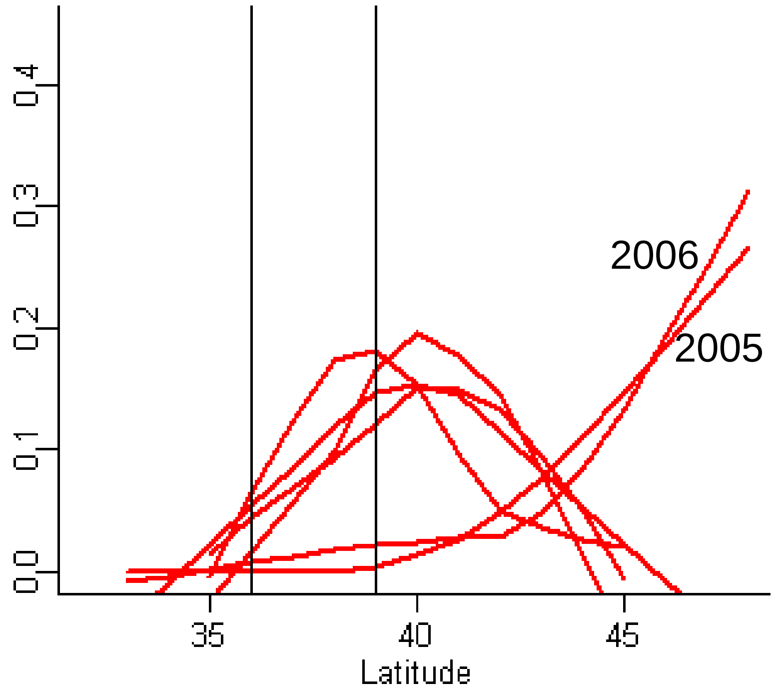


Figure 25. Coast-wide pre-recruit canary rockfish catches, 2001-2006, binned and smoothed over latitude, showing the northward distribution of catches in 2005 and 2006. Vertical lines indicate the "core area" survey conducted from 1983-2006.

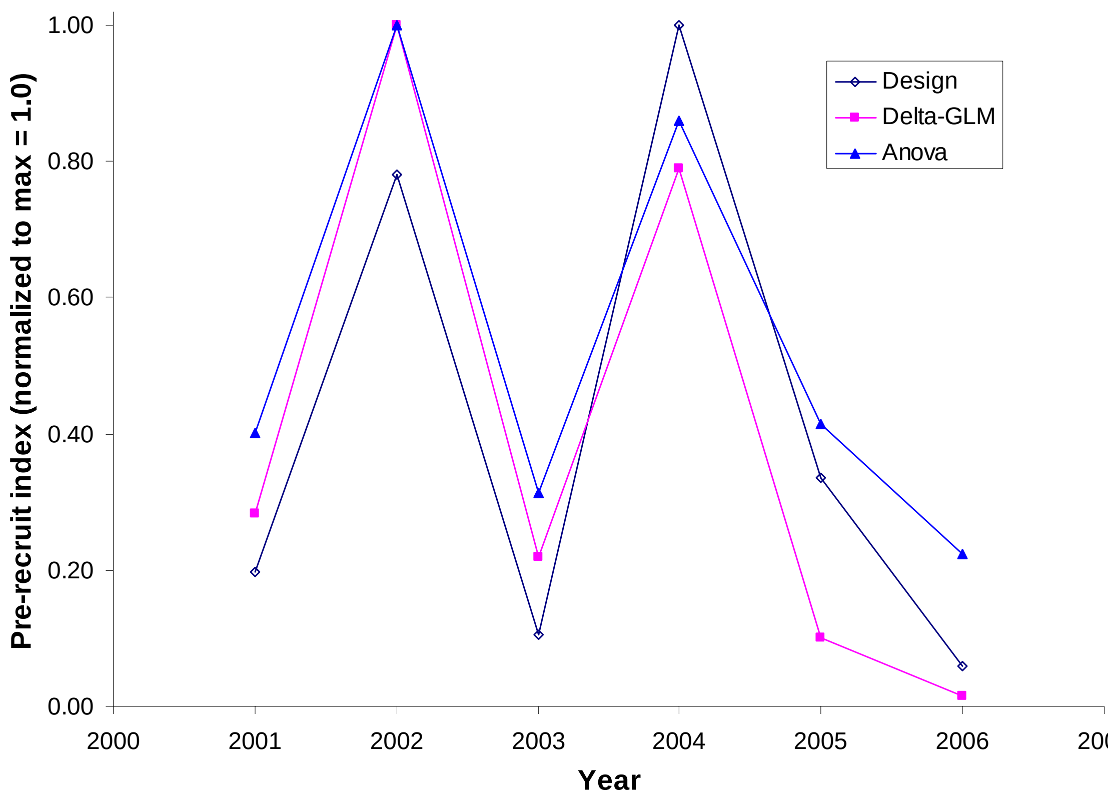


Figure 26. Comparison of alternate estimators for the pre-recruit index (Provided by S. Ralston, SWFSC).

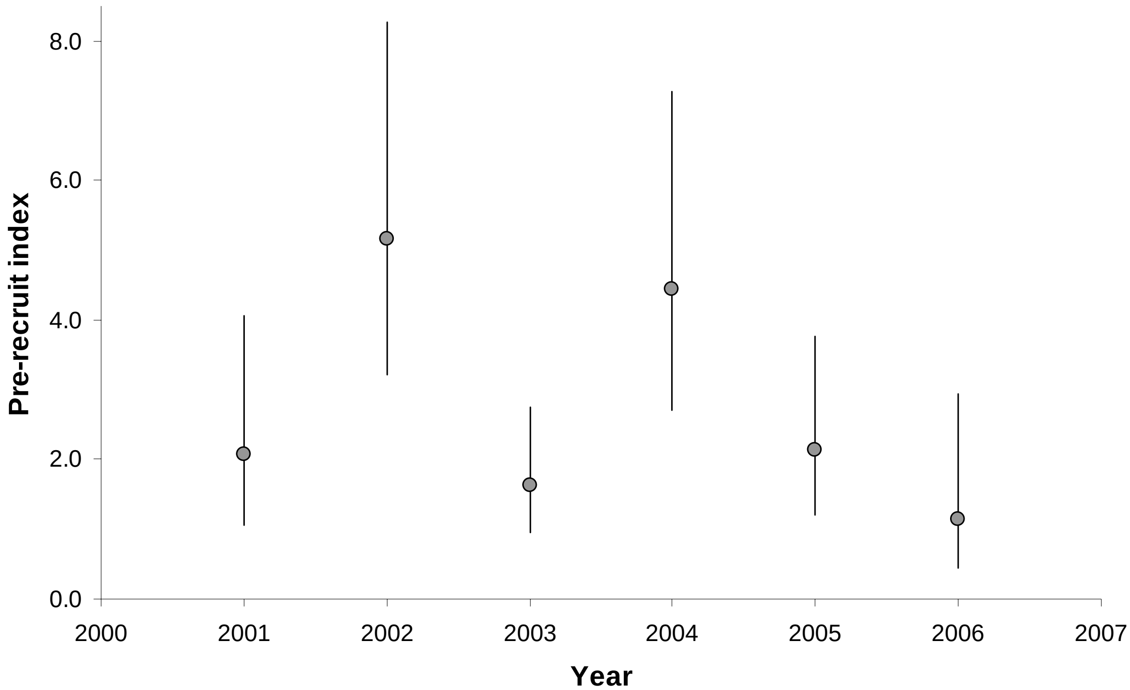


Figure 27. Coast-wide pre-recruit index for canary rockfish, 2001-2006.

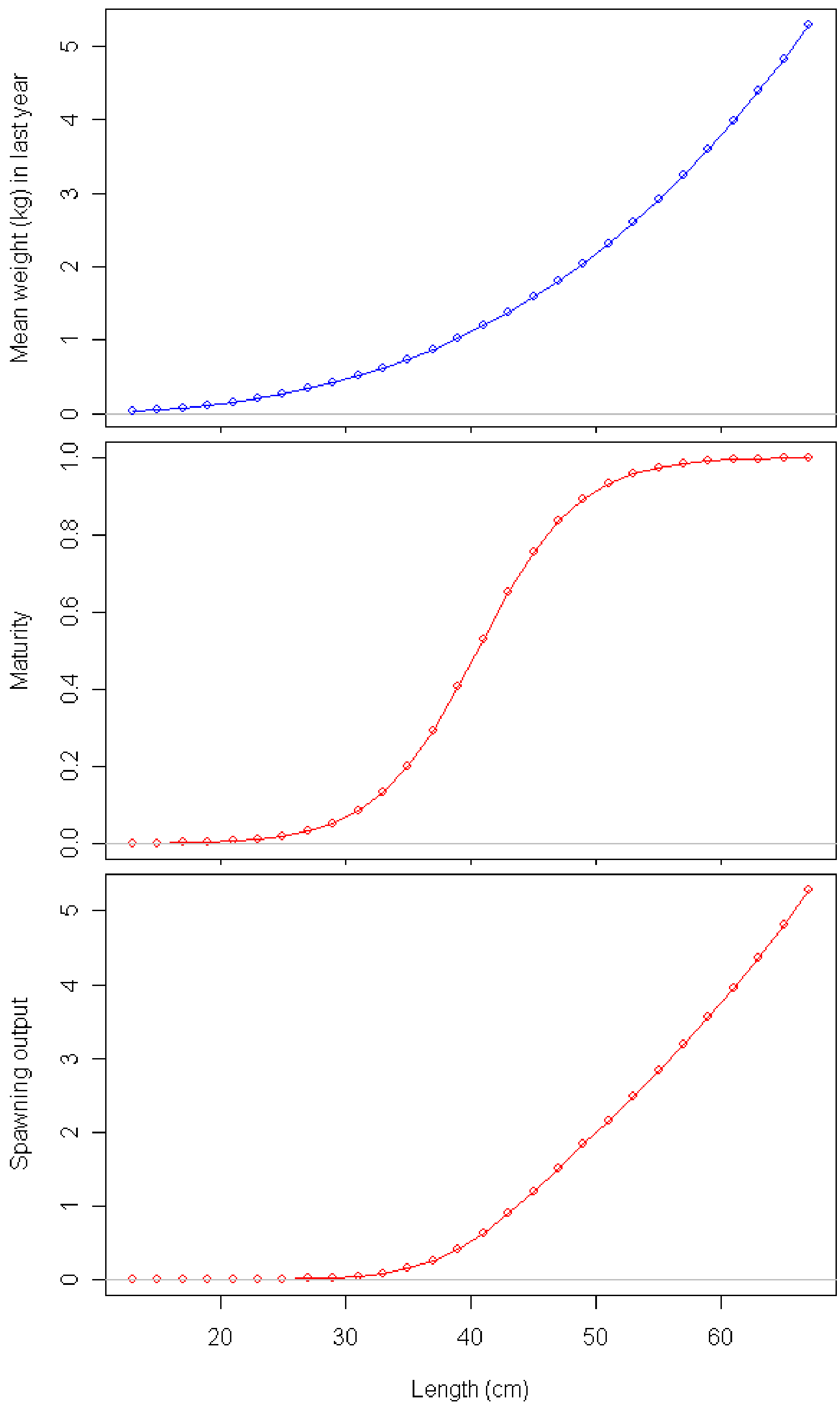


Figure 28. Biological relationships used for canary rockfish weight-length relationship (both sexes, upper panel), maturity ogive (females only, center panel) and spawning output (lower panel) as a function of length.

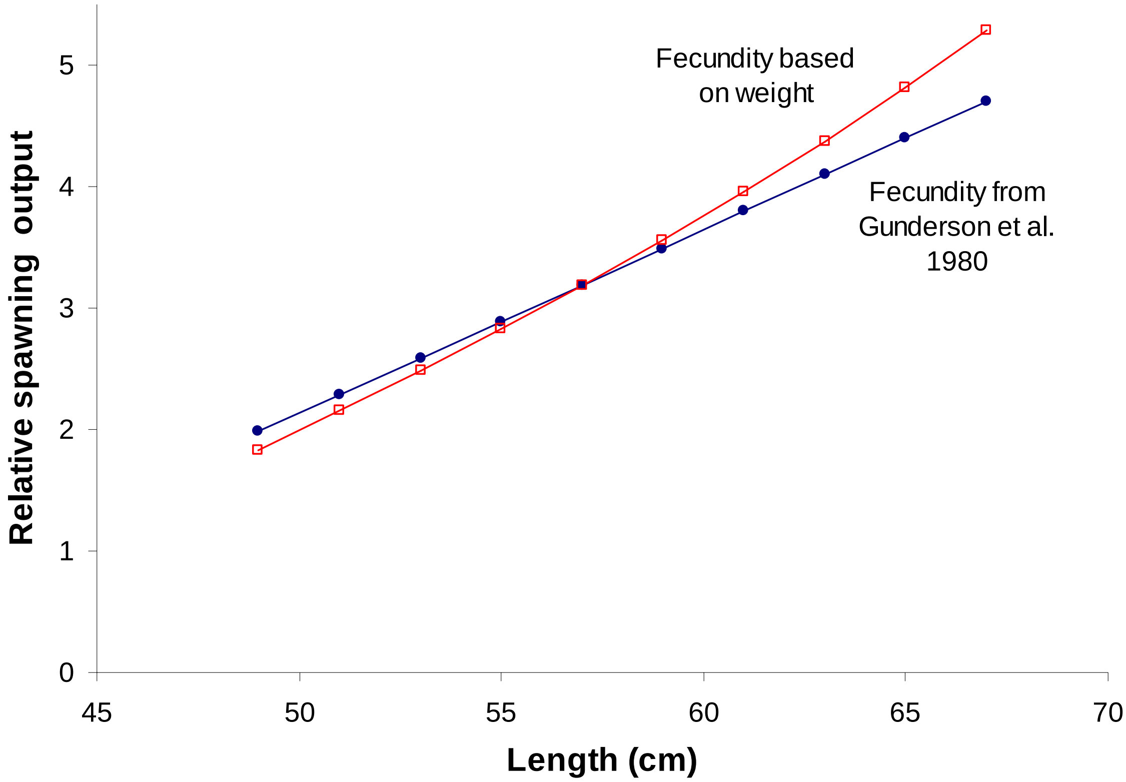


Figure 29. Fecundity-at-length relationships based on the assumption that fecundity is proportional to body weight (used in this assessment) and a linear relationship between fecundity and length using observations from a limited range of lengths (Gunderson et al. 1980).

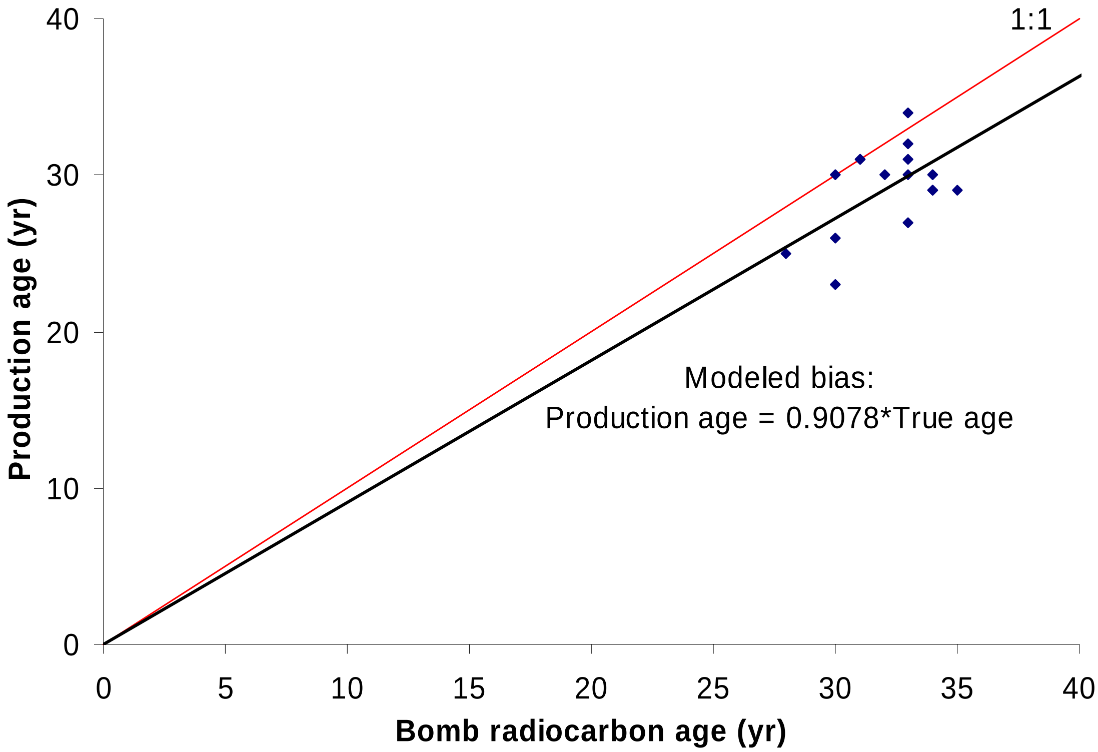


Figure 30. Ageing bias assumed in the 2005 assessment model based on bomb radiocarbon analysis of 16 canary rockfish otoliths (Data from: Piner et al. 2005).

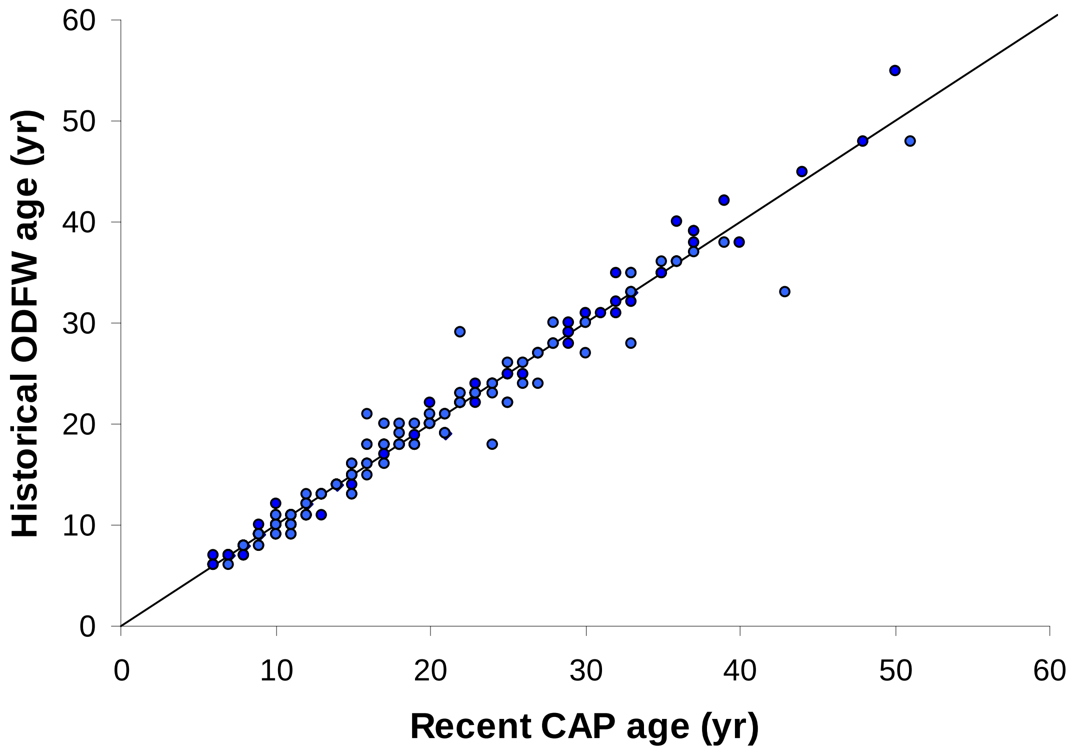


Figure 31. Comparison of cross-reads between recent CAP agers and ~100 otoliths from the mid-1980s.

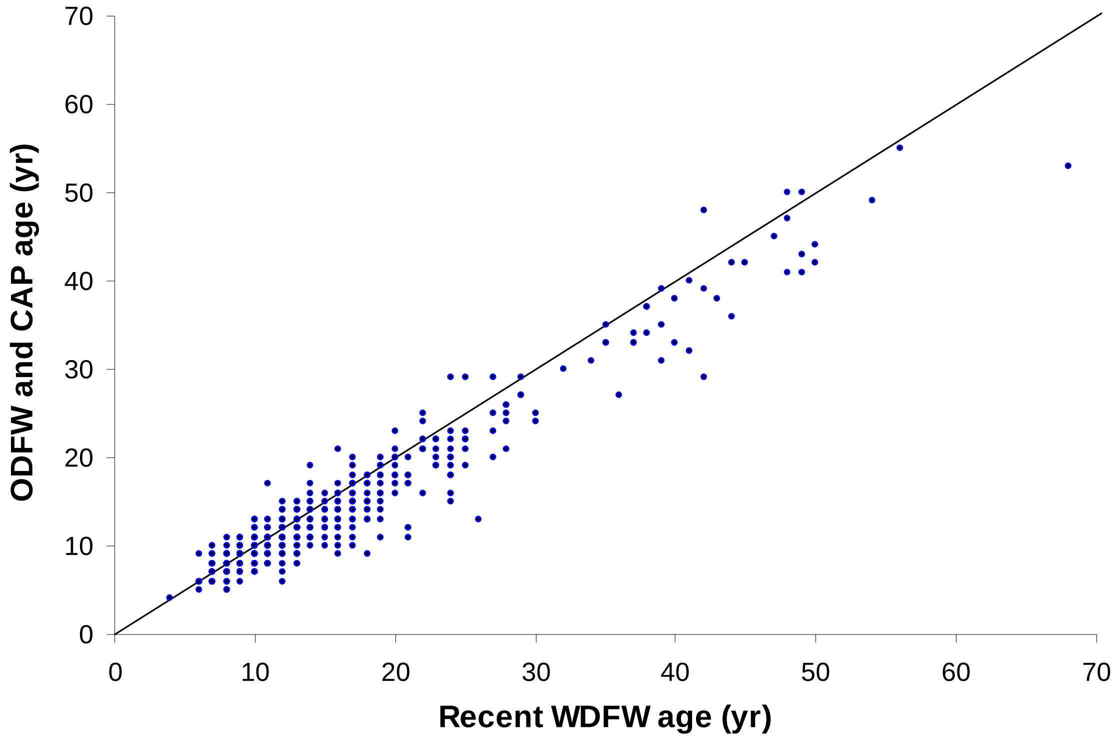


Figure 32. Comparison of cross-reads between ODFW/CAP agers and WDFW agers for ~600 otoliths. Solid line indicates the 1:1 relationship, the increased frequency of points below the line indicates a small, but consistent bias toward underageing by ODFW/CAP readers that is accounted for in the ageing error keys used in the stock assessment model.

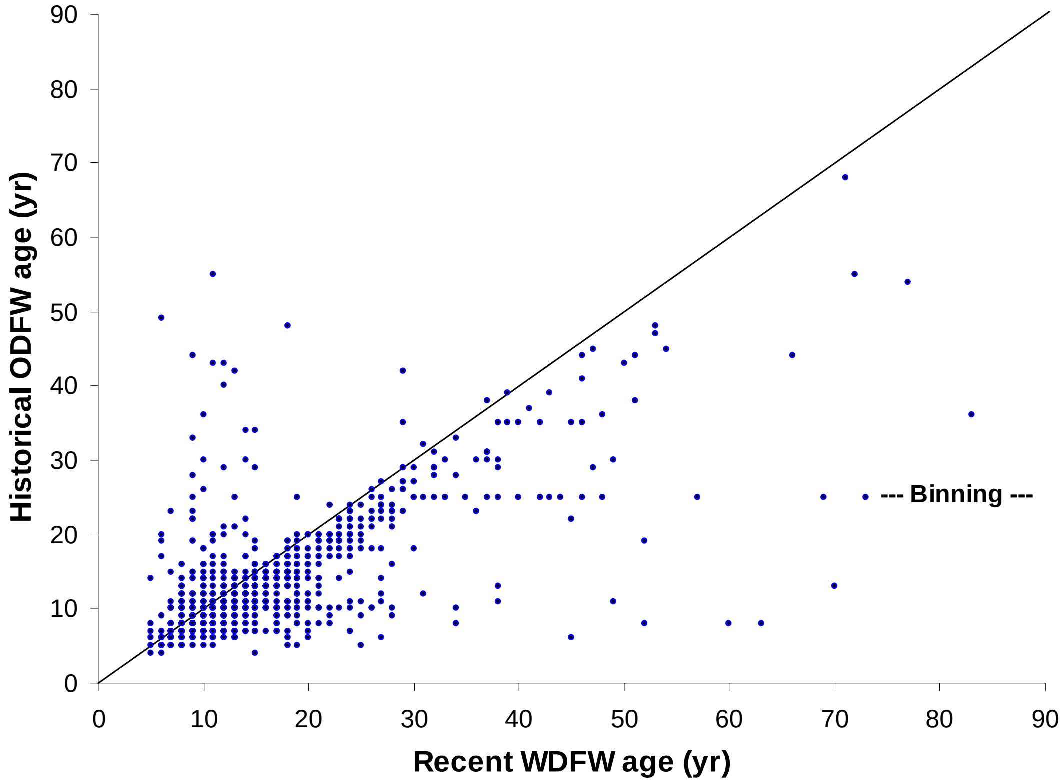


Figure 33. Comparison of cross-reads between recent WDFW agers and ~1600 otoliths from the mid-1980s. These data were the impetus to resolve both the issue of 'binned' ages and the ultimate removal of low-quality age data from the assessment data.

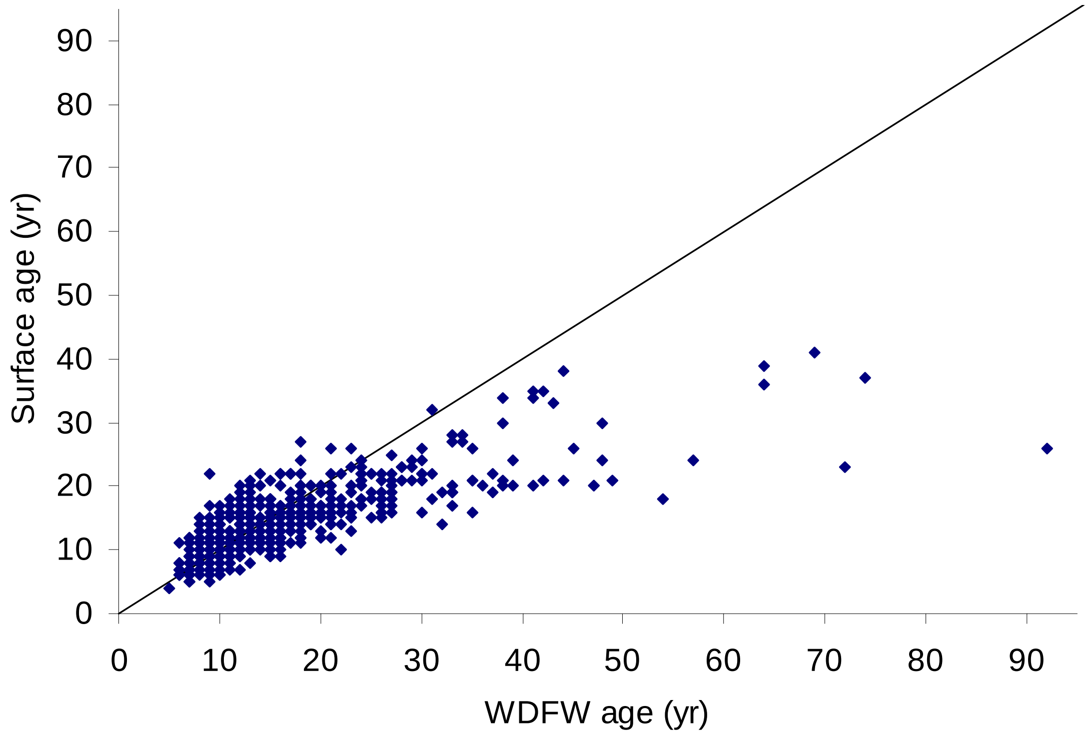


Figure 34. Comparison of cross-reads between surface read ages and WDFW agers for ~800 otoliths. Solid line indicates the 1:1 relationship; the increased frequency of points below the line at older ages indicates a bias toward underageing by ODFW surface methods.

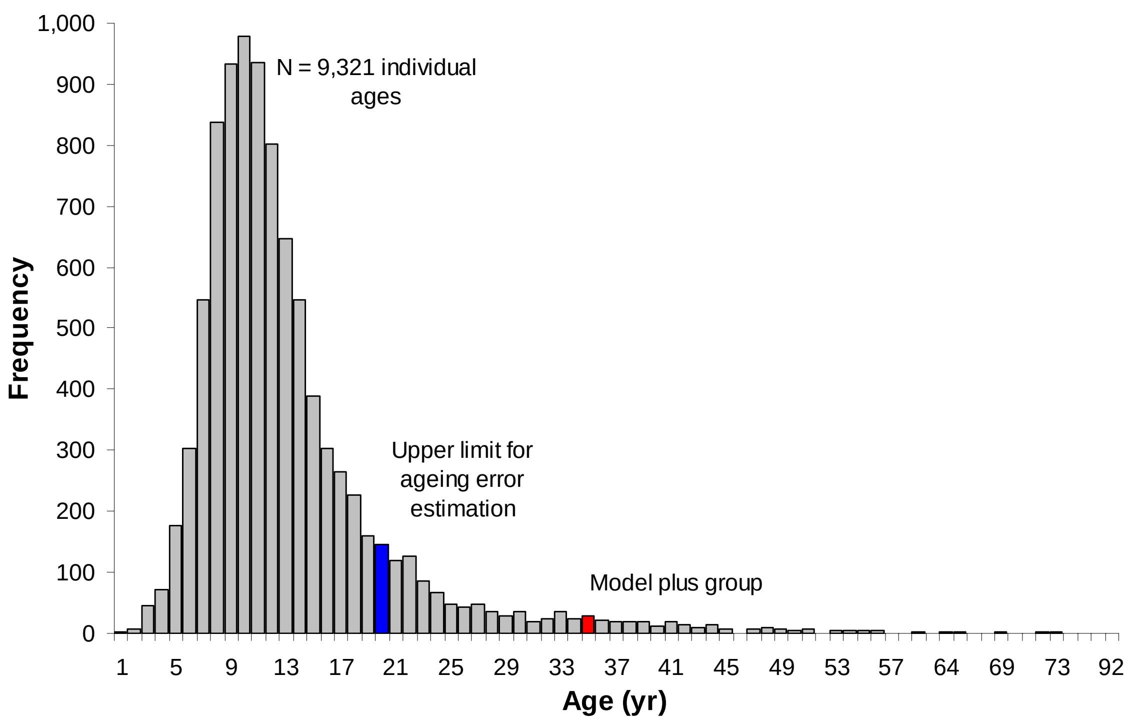


Figure 35. Distribution of double- and triple-reads used to calculate the ageing error keys.

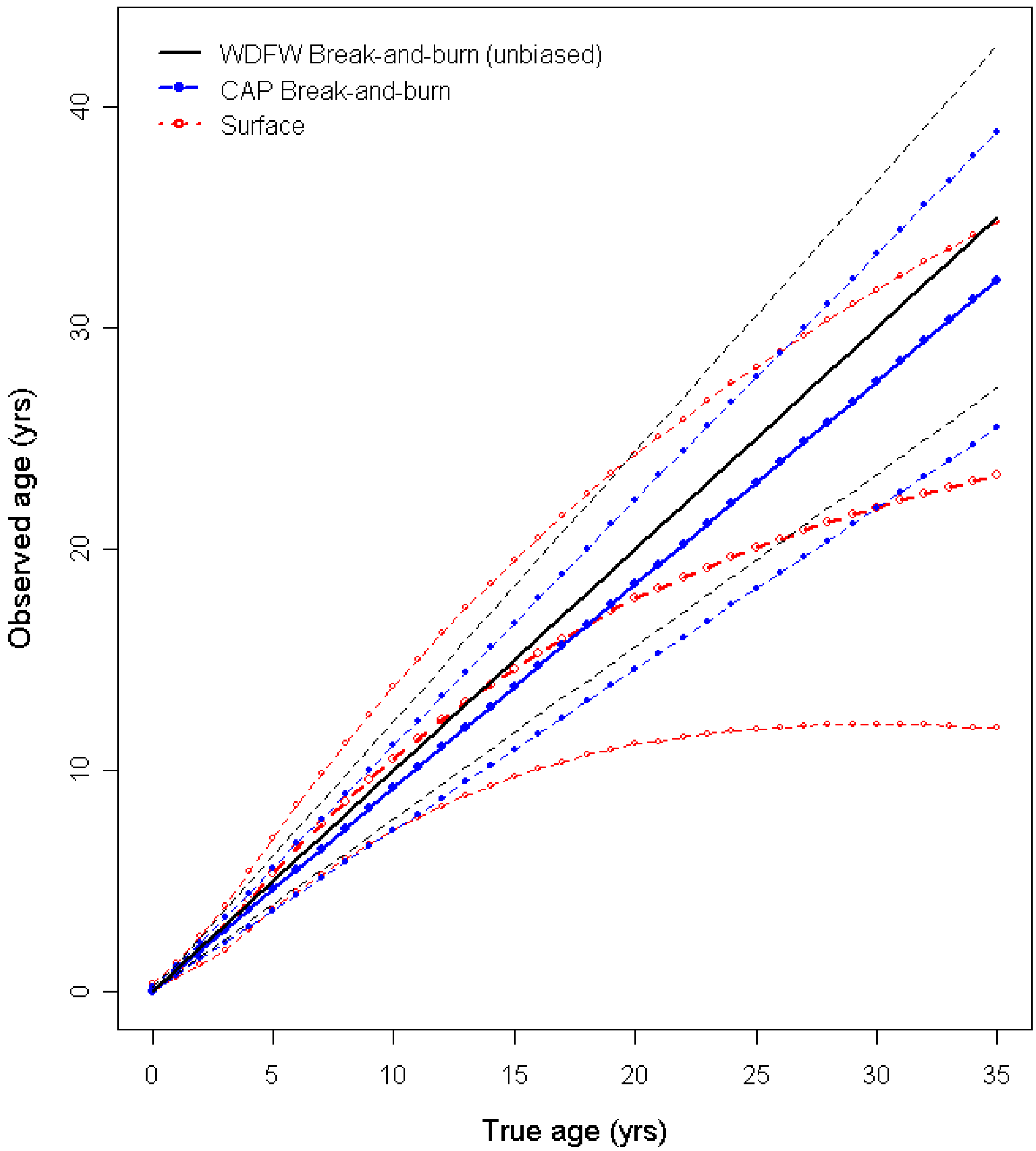


Figure 36. Estimates of relative bias and precision (+/- 1.96 SDs indicated by the lighter lines for each series) for the WDFW ageing lab, the CAP ageing lab and all ages based on surface reading methodology.

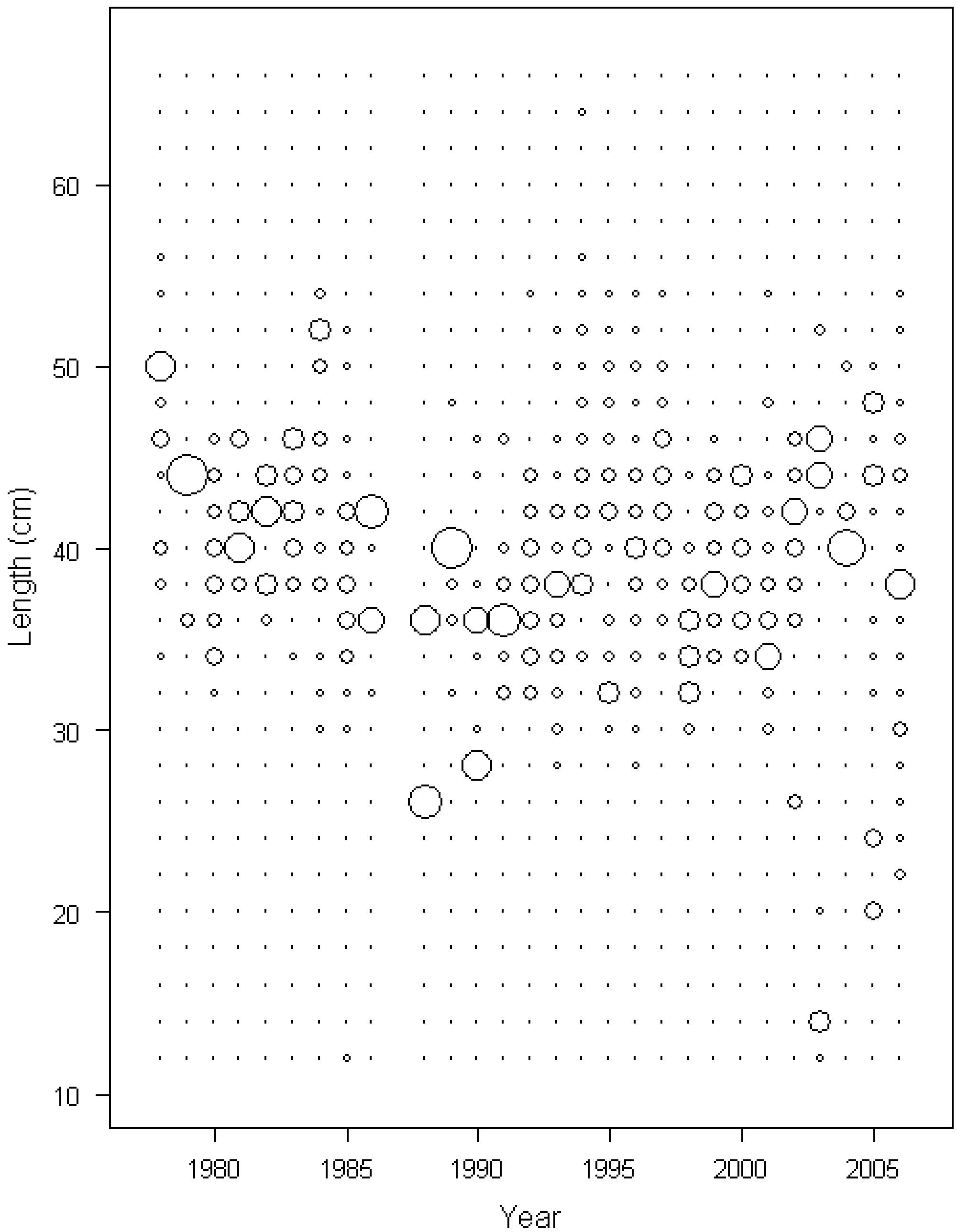


Figure 37. Length-frequency data for the southern California trawl fleet, sexes combined. The largest bubble represents a proportion of 0.85.

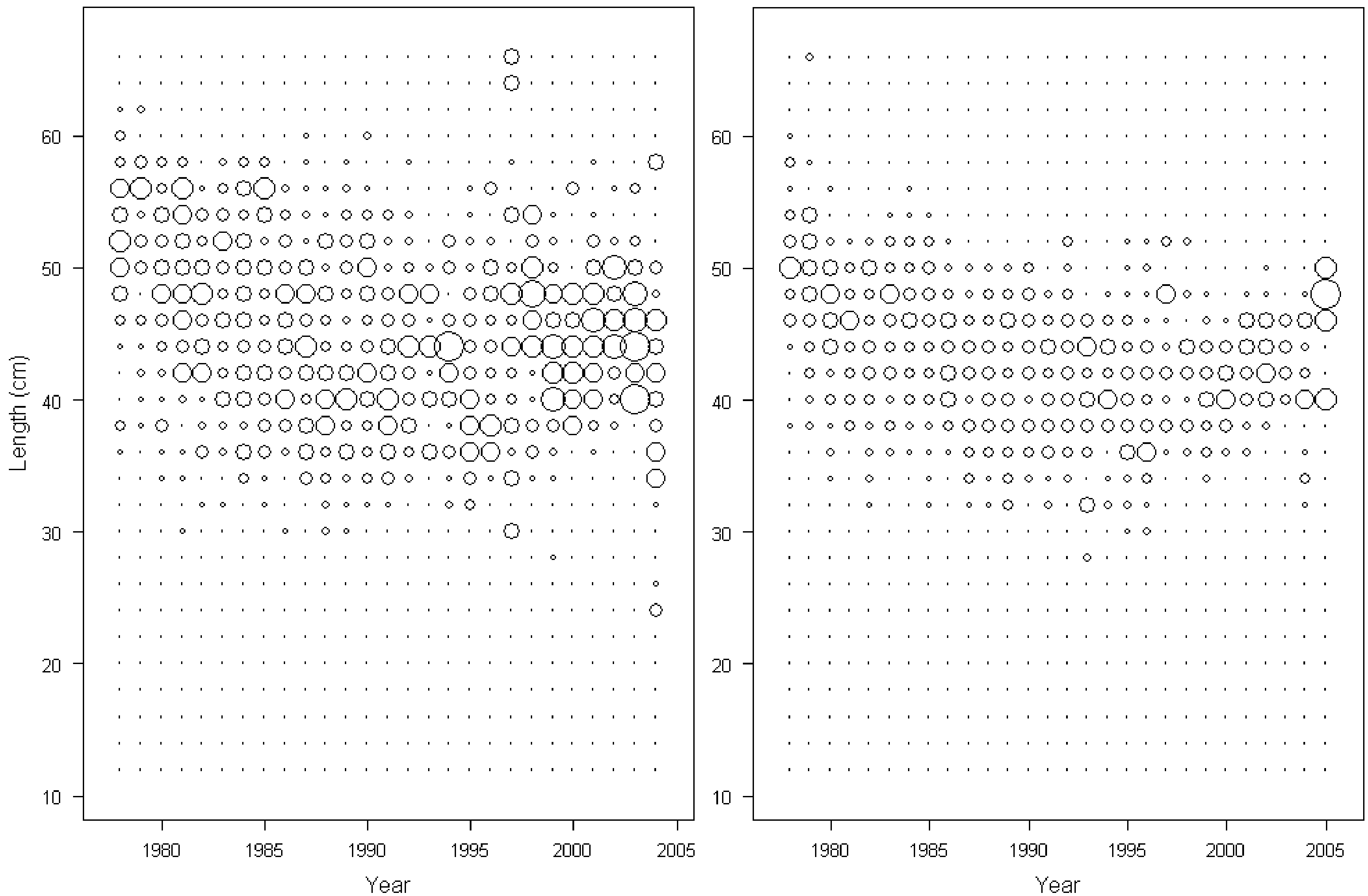


Figure 38. Length-frequency data for female (left panel) and male (right panel) canary rockfish from the northern California trawl fleet. The largest female bubble represents a proportion of 0.17, males represents 0.39.

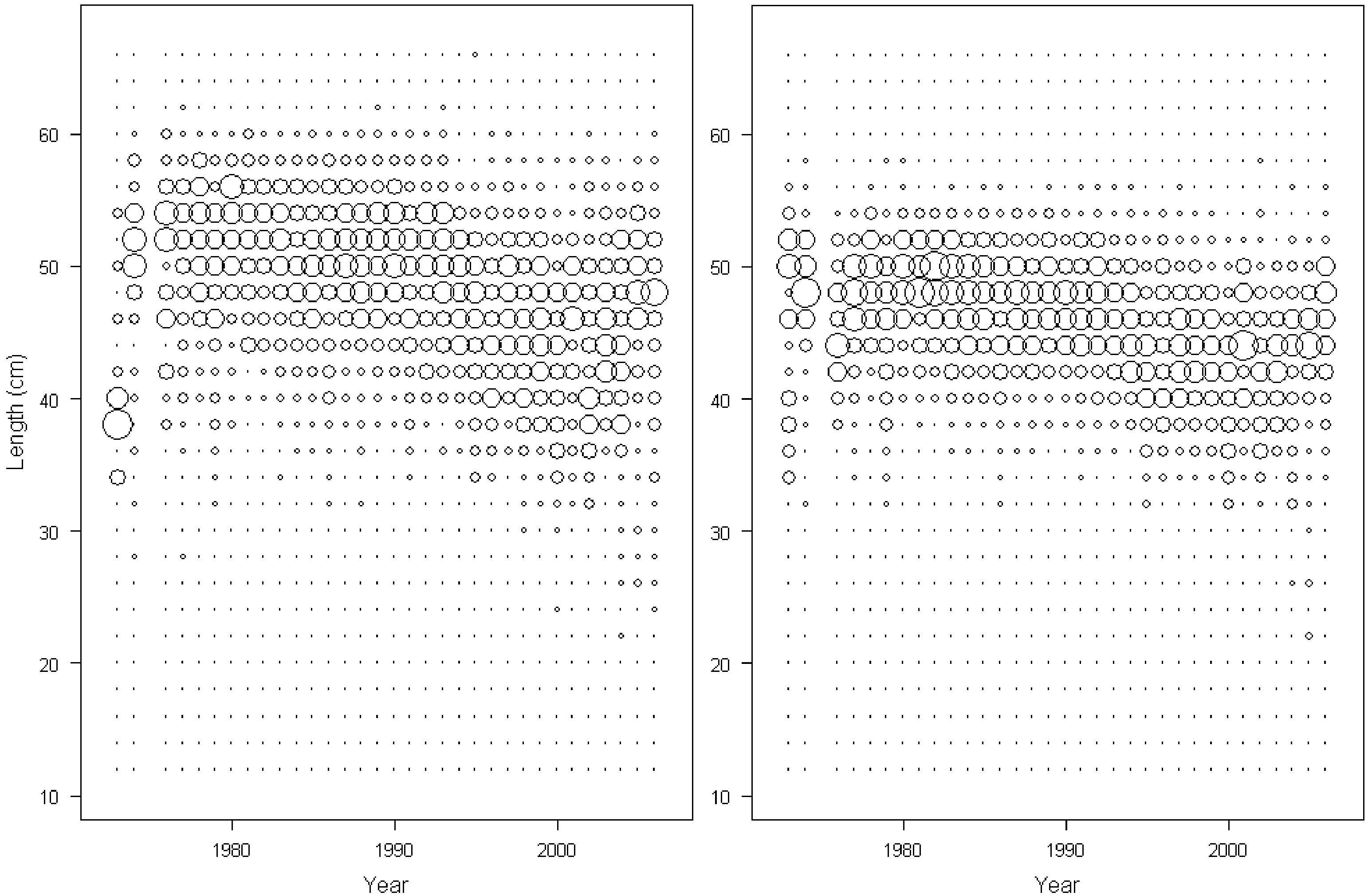


Figure 39. Length-frequency data for female (left panel) and male (right panel) canary rockfish from the Oregon trawl fleet. The largest female bubble represents a proportion of 0.15, males represents 0.20.

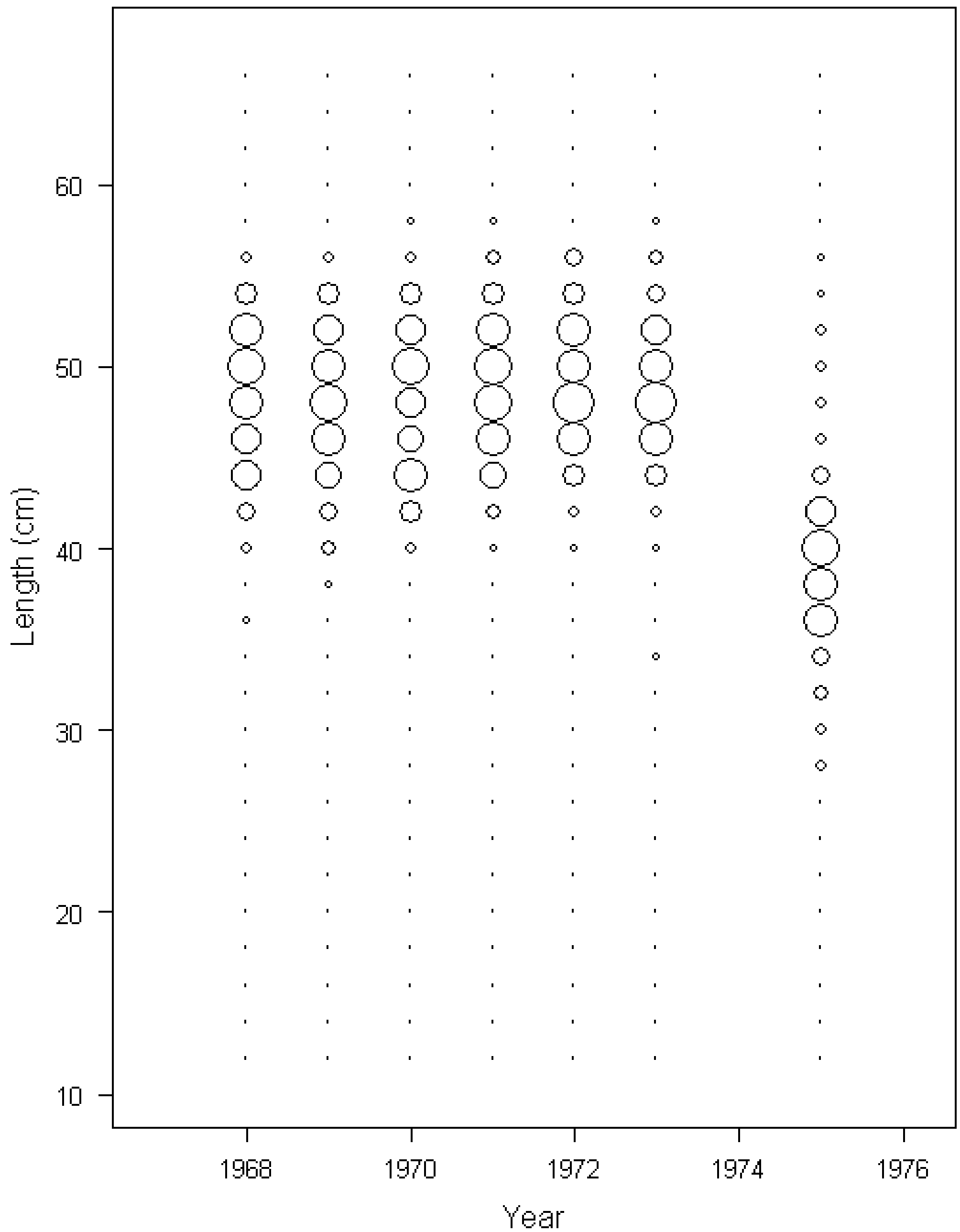


Figure 40. Combined-sex length-frequency data for the early Washington trawl fleet, when sex-specific information was not collected. The largest bubble represents a proportion of 0.27.

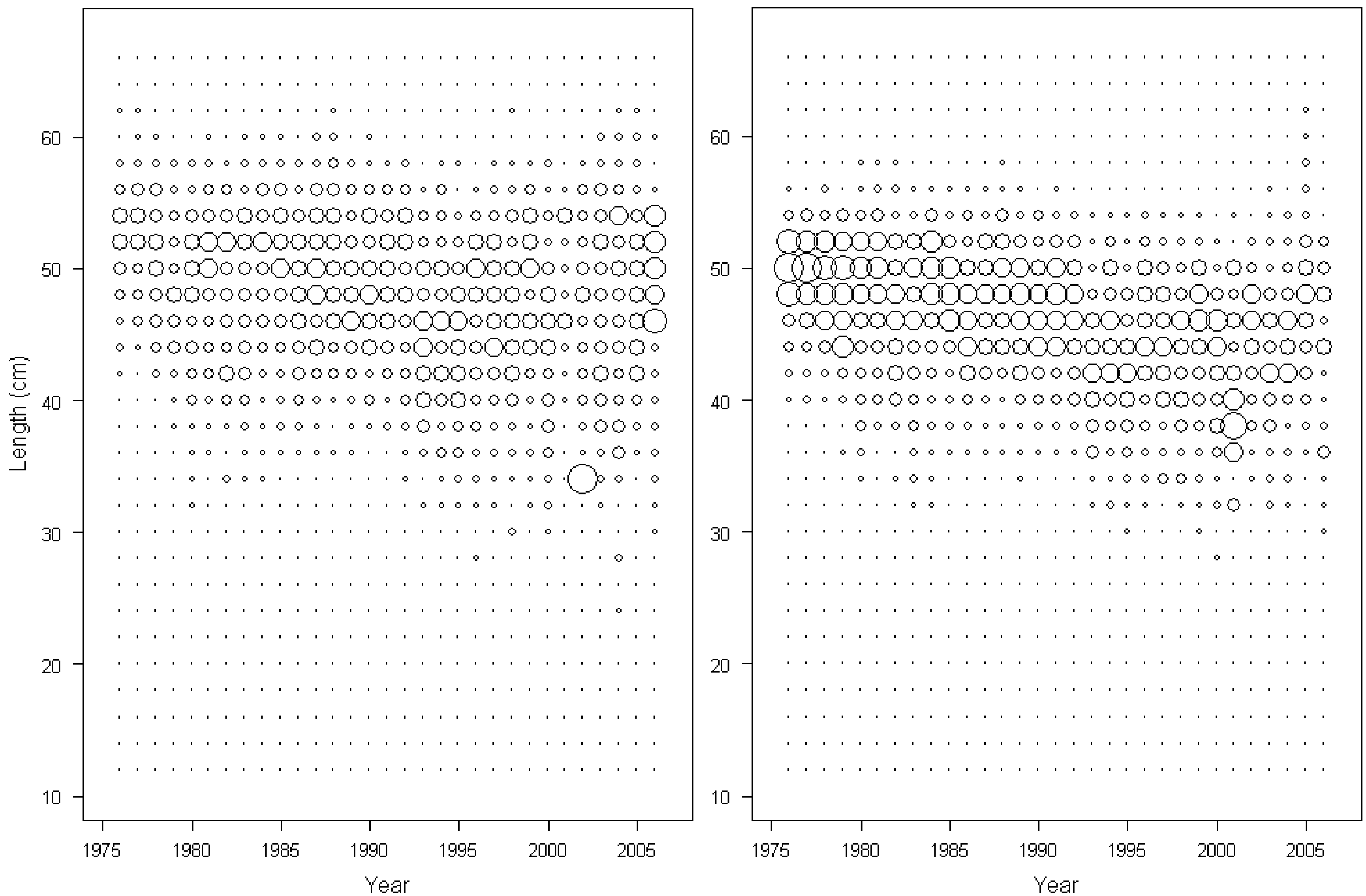


Figure 41. Length-frequency data for female (left panel) and male (right panel) canary rockfish from the Washington trawl fleet. The largest female bubble represents a proportion of 0.20, males represents 0.24.

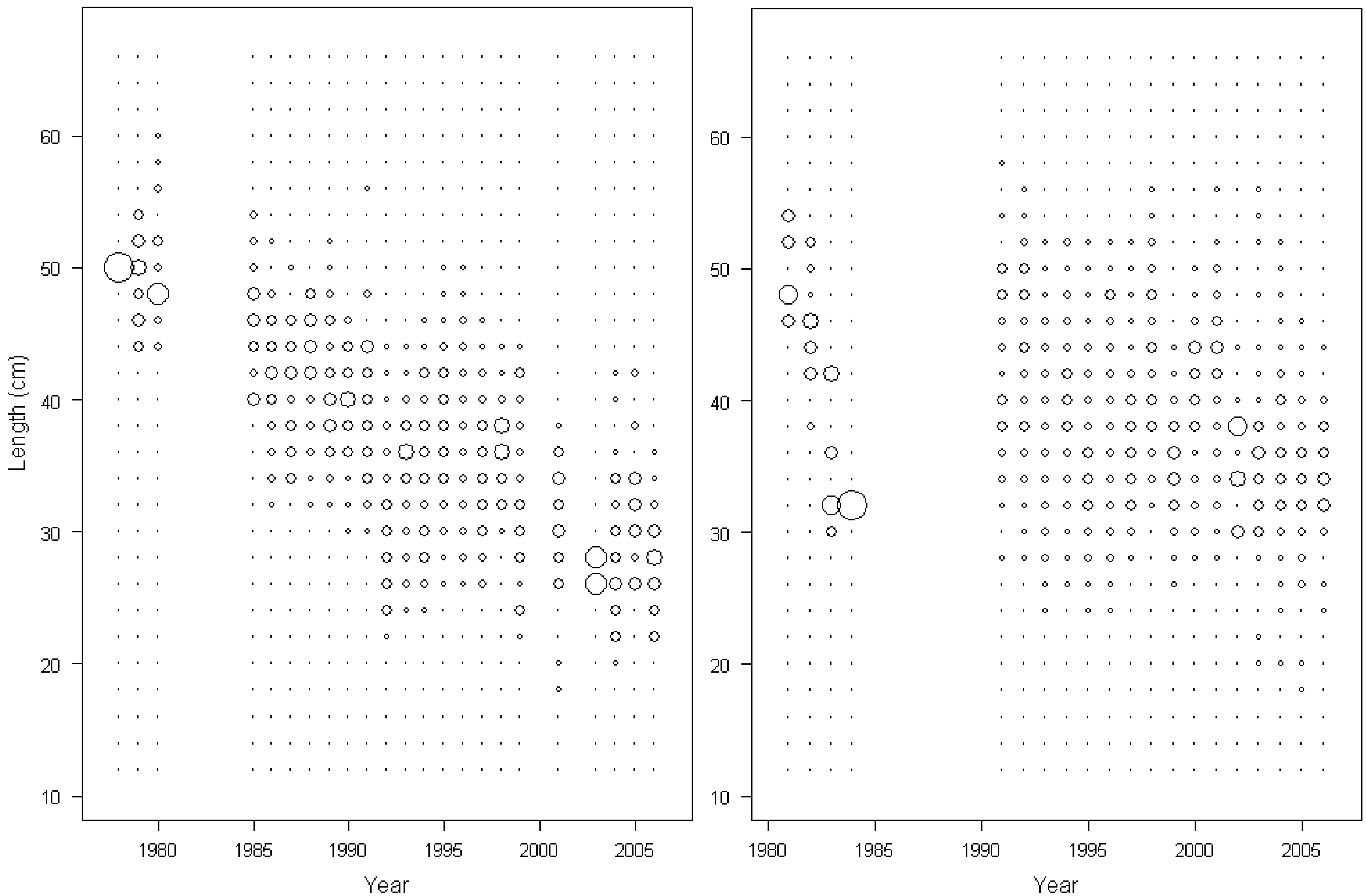


Figure 42. Length-frequency data for canary rockfish from the southern (left panel) and northern (right panel) California non-trawl fleets, sexes combined. The largest southern bubble represents a proportion of 0.97, northern represents 0.97.

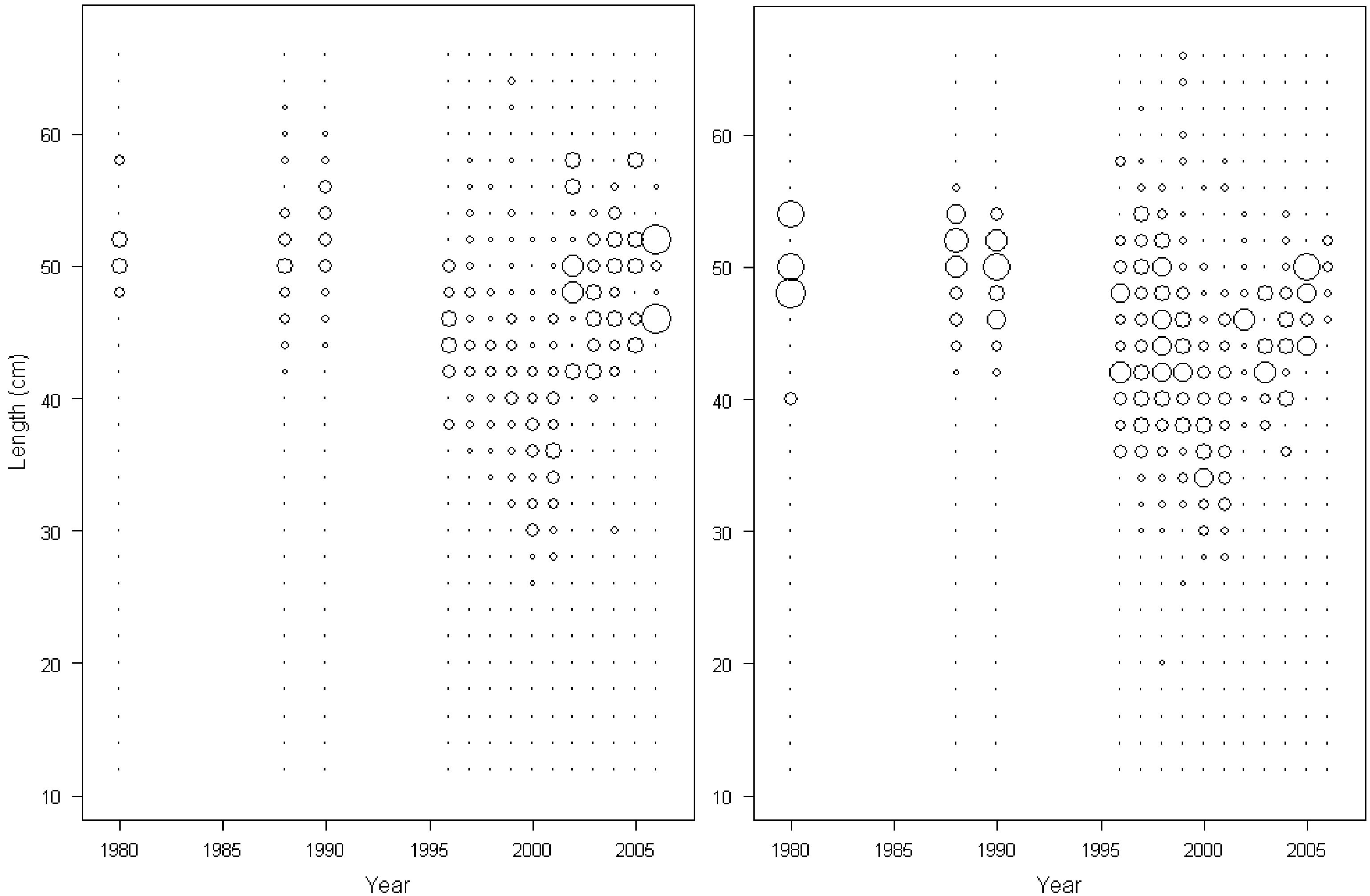


Figure 43. Length-frequency data for female (left panel) and male (right panel) canary rockfish from the combined Oregon and Washington non-trawl fleet. The largest female bubble represents a proportion of 0.41, males represents 0.22.

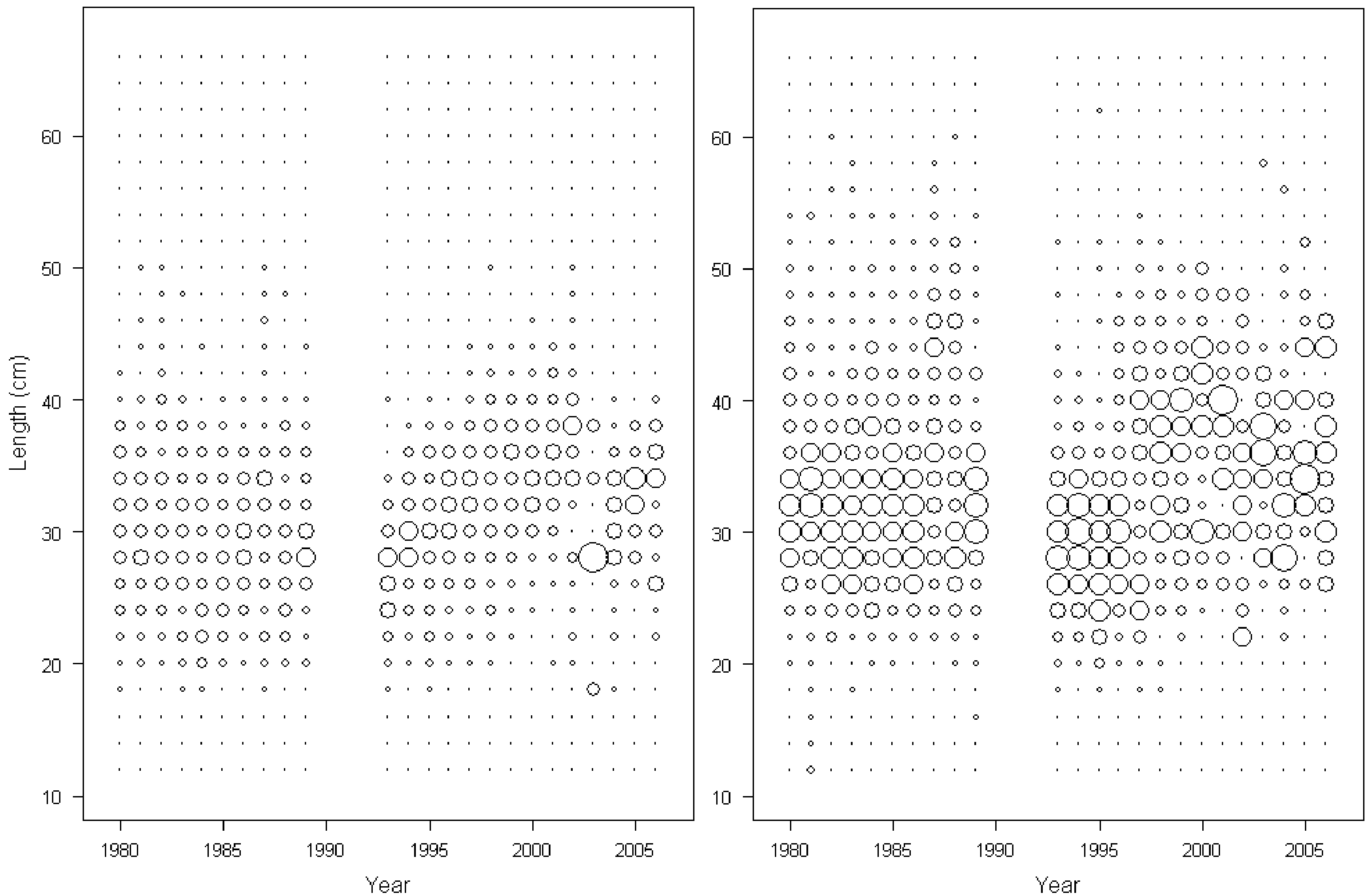


Figure 44. Length-frequency data for canary rockfish from the southern (left panel) and northern (right panel) California recreational fleets, sexes combined. The largest southern bubble represents a proportion of 0.61, northern represents 0.28.

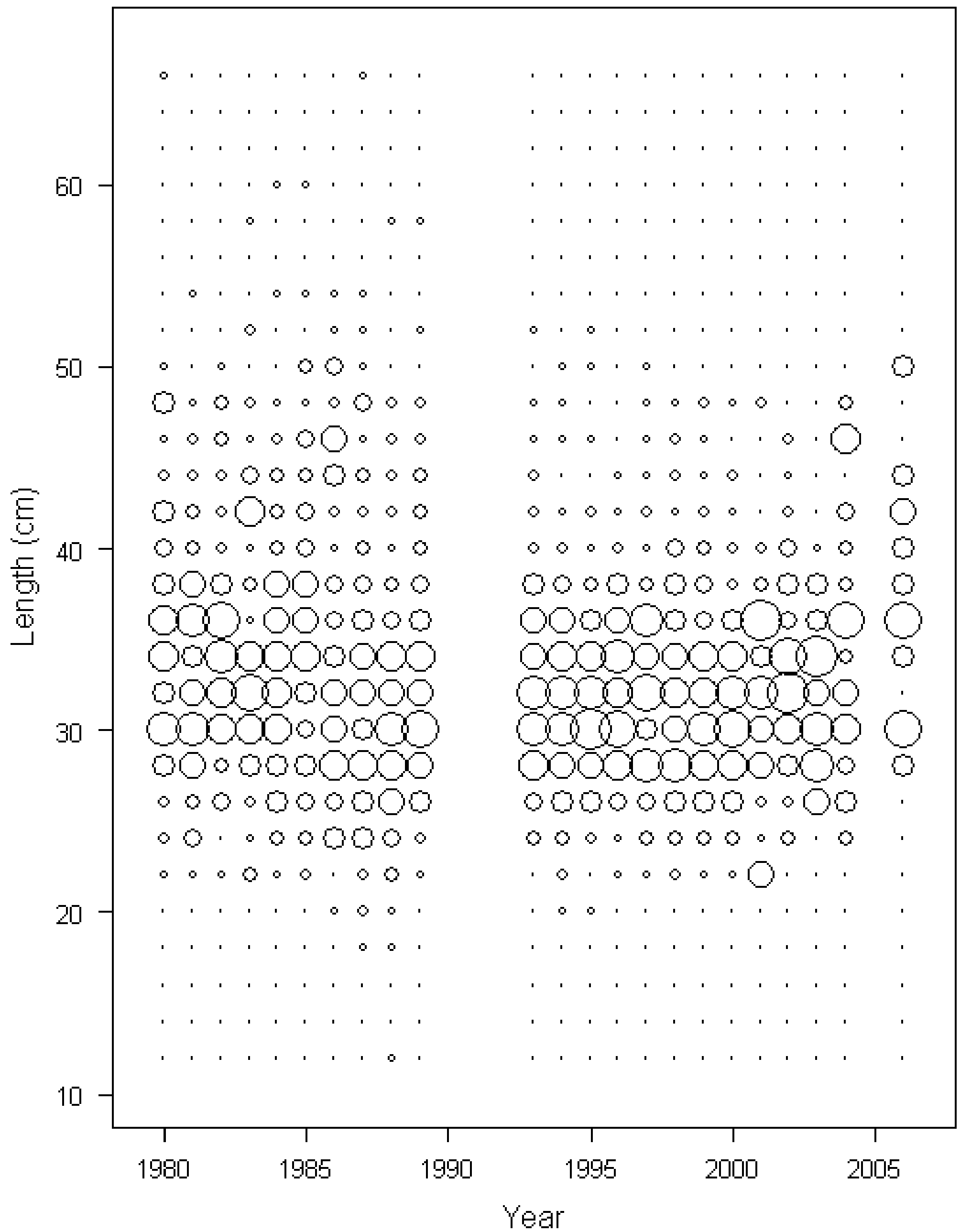


Figure 45. Length-frequency data for canary rockfish from the Oregon and Washington recreational fleet, sexes combined. The largest bubble represents a proportion of 0.28.

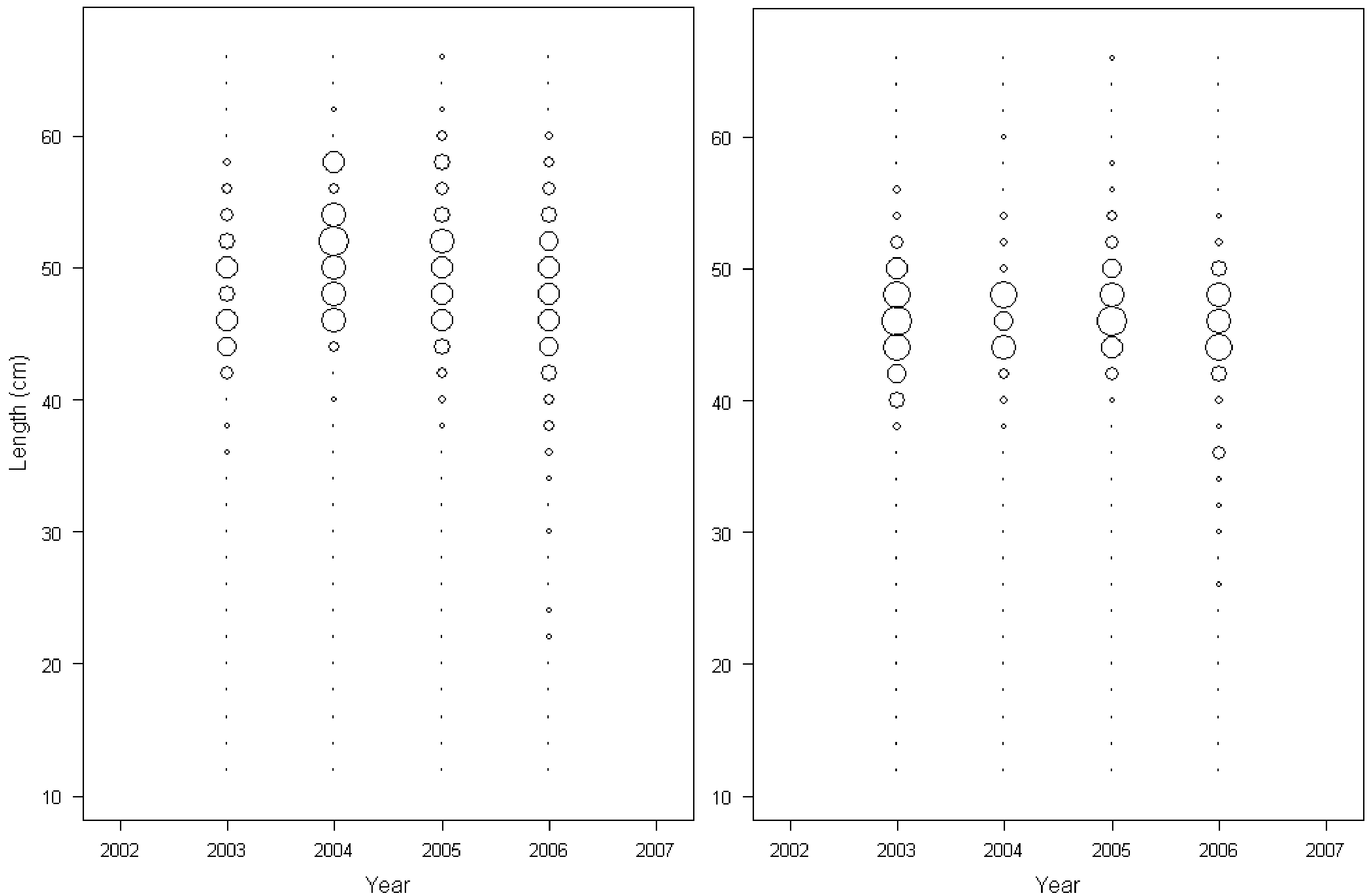


Figure 46. Length-frequency data for bycatch of female (left panel) and male (right panel) canary rockfish from the at-sea whiting fleet. The largest female bubble represents a proportion of 0.15, males represents 0.13.

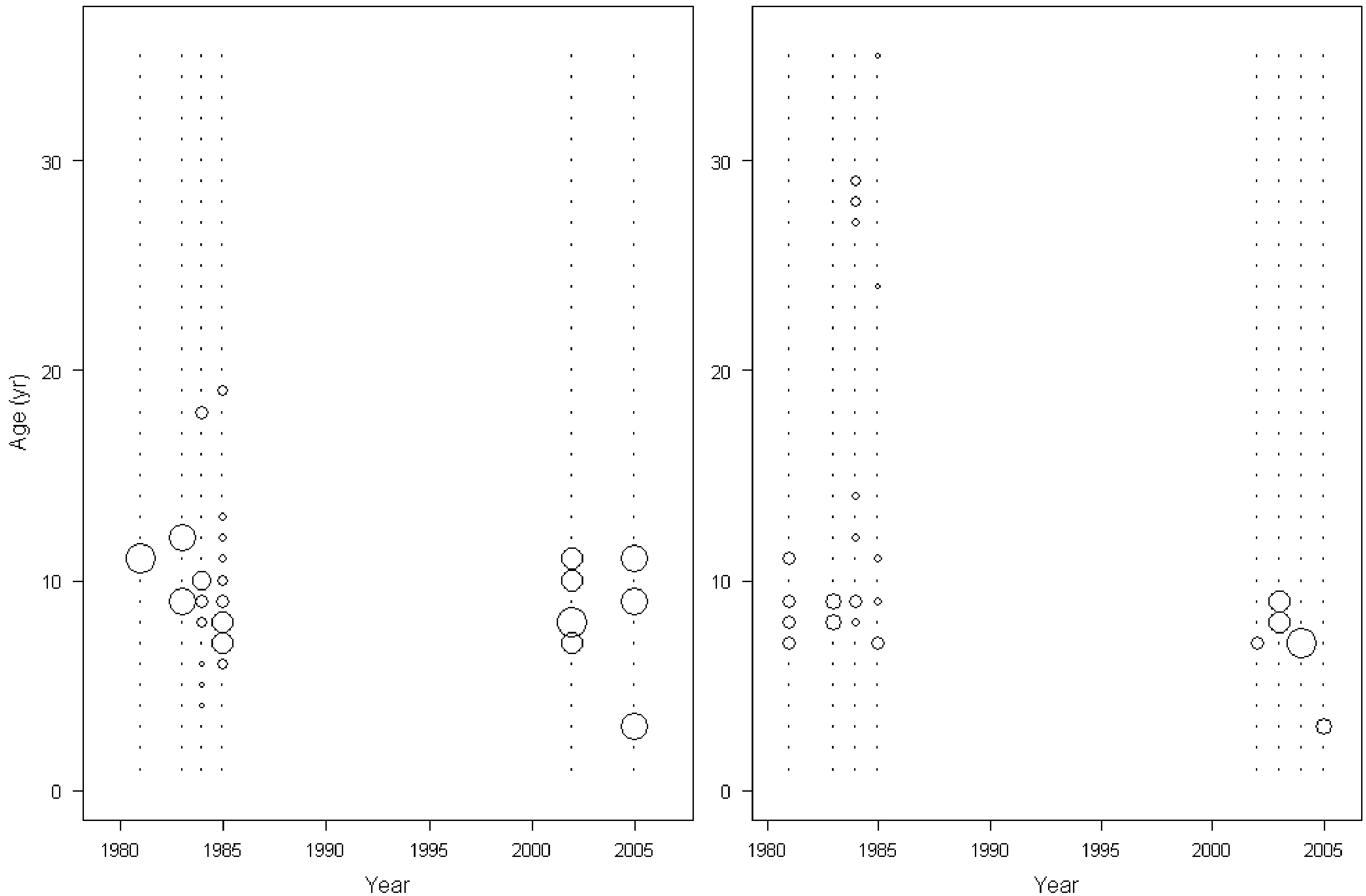


Figure 47. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the southern California trawl fleet. The largest female bubble represents a proportion of 0.31, males represents 0.97.

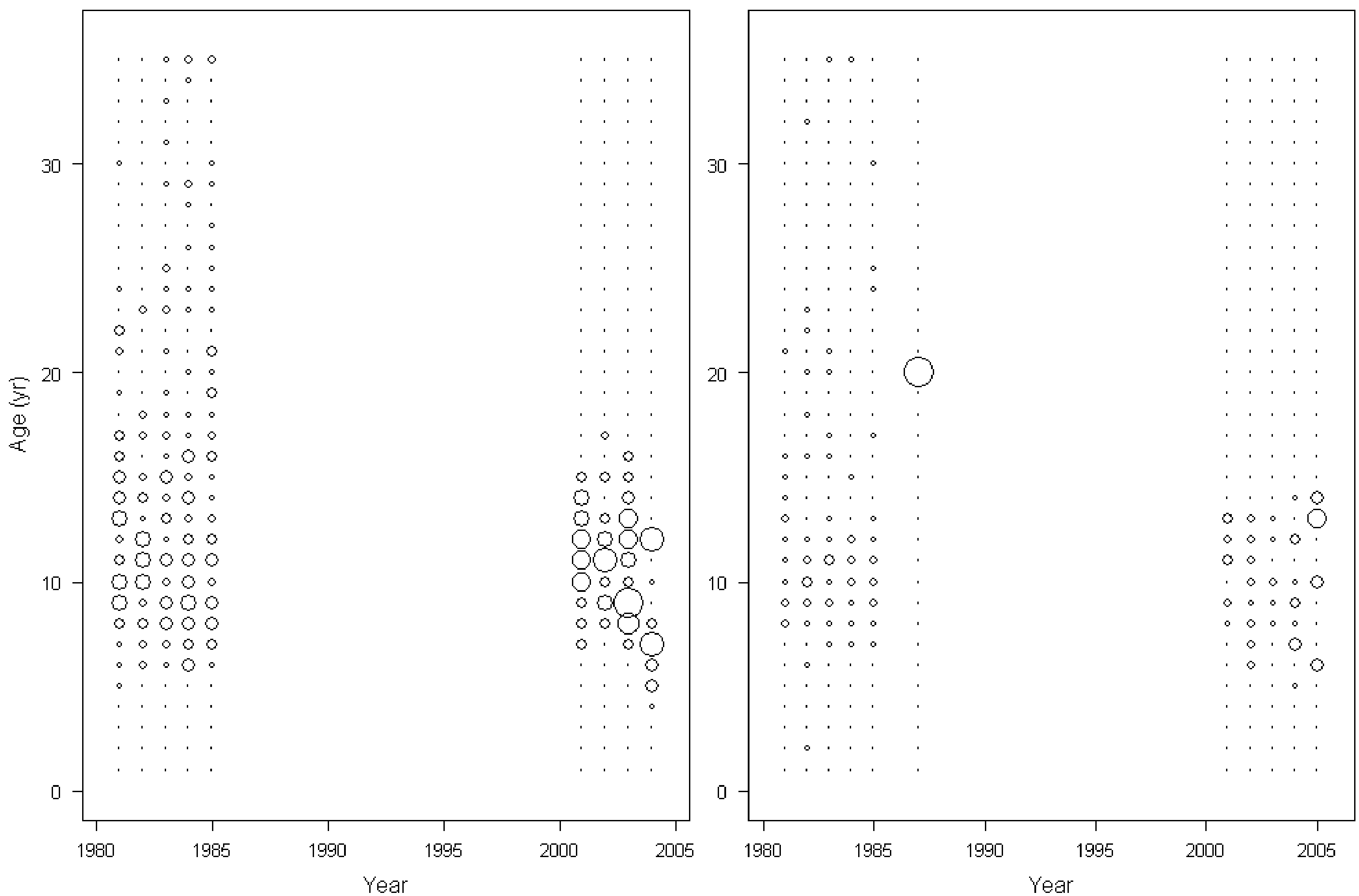


Figure 48. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the Northern California trawl fleet. The largest female bubble represents a proportion of 0.23, males represents 0.97.

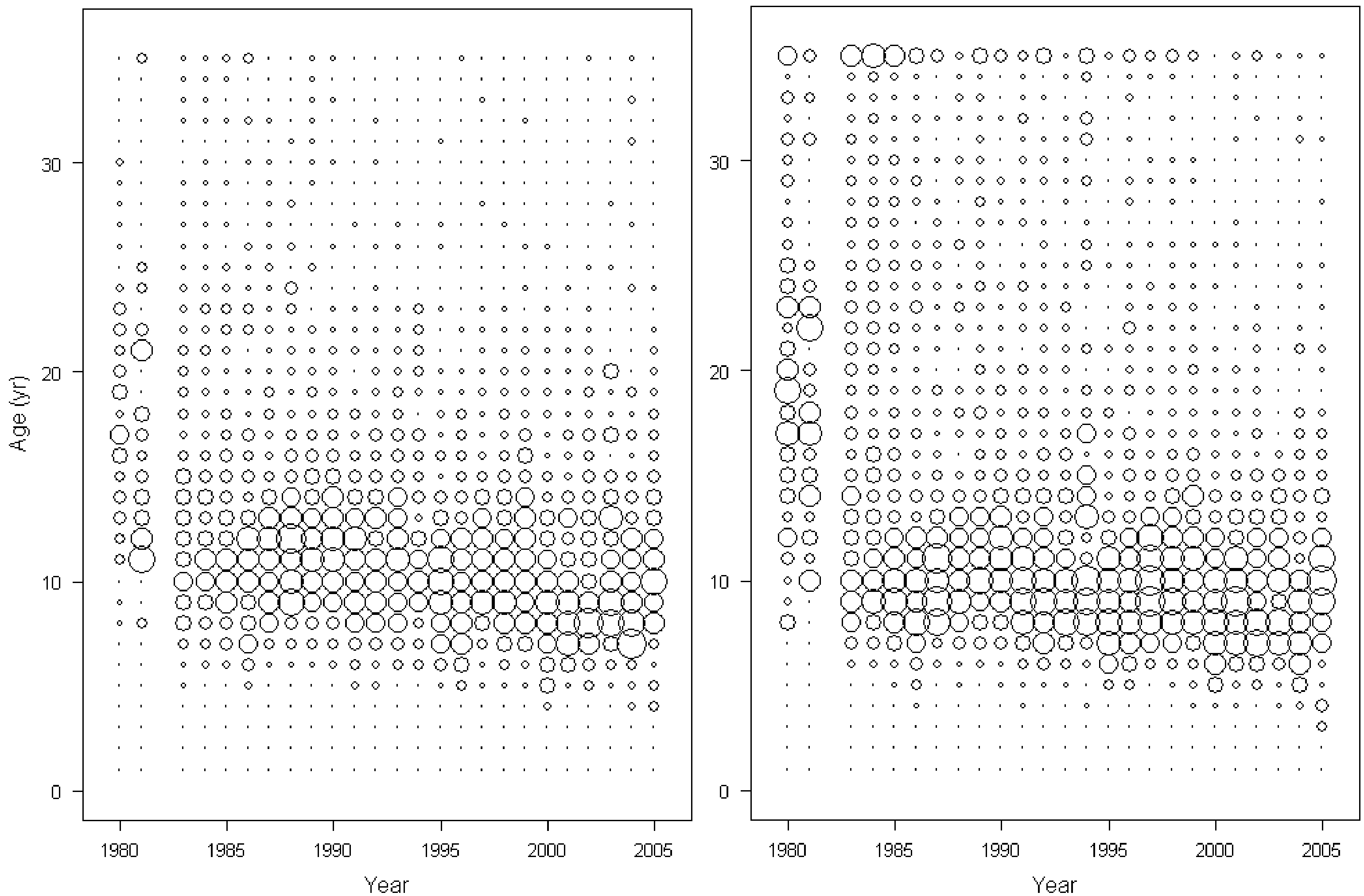


Figure 49. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the Oregon trawl fleet. The largest female bubble represents a proportion of 0.10, males represents 0.10.

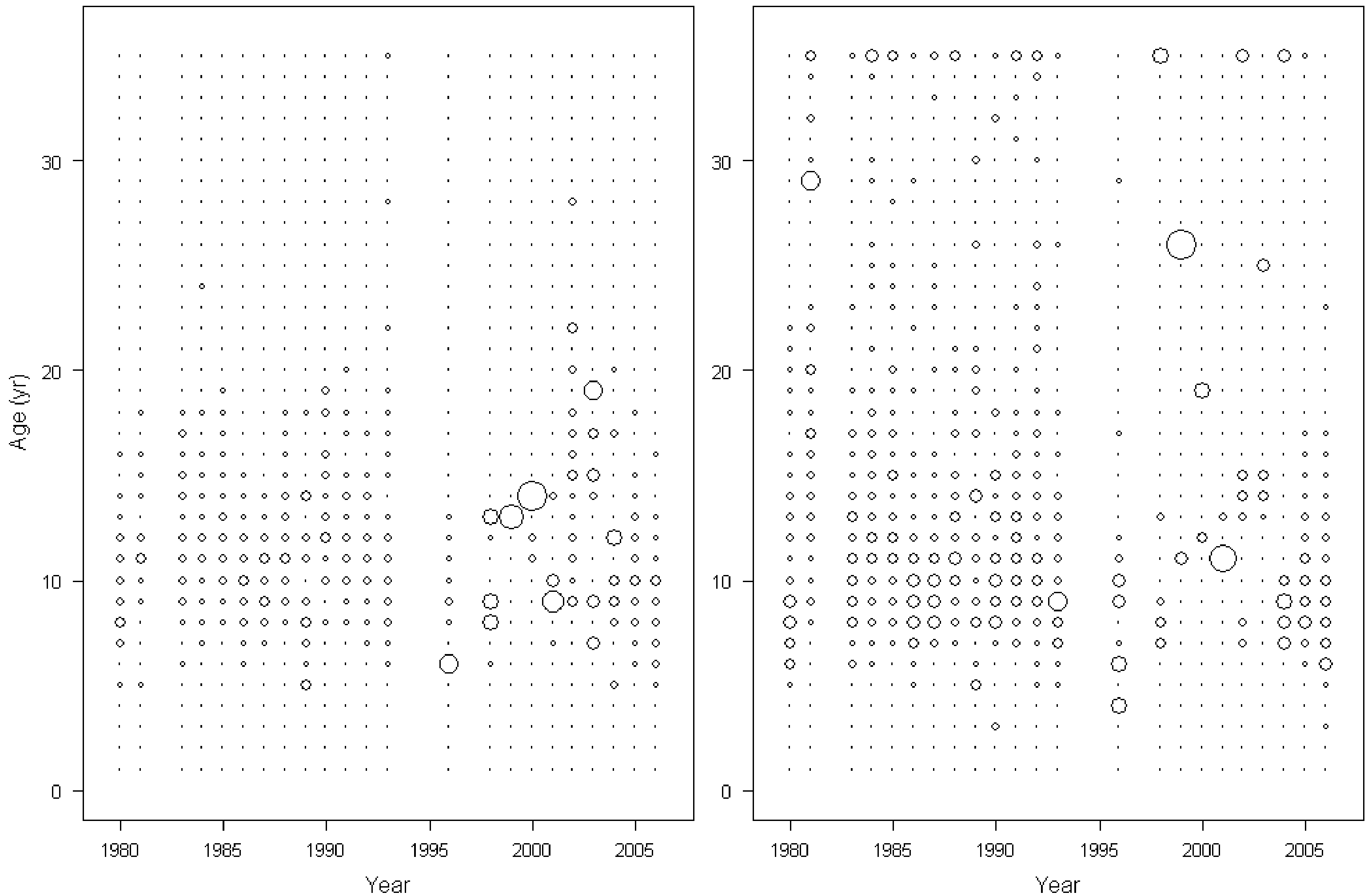


Figure 50. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the Washington trawl fleet by WDFW agers (assumed to be unbiased). The largest female bubble represents a proportion of 0.68, males represents 0.42.

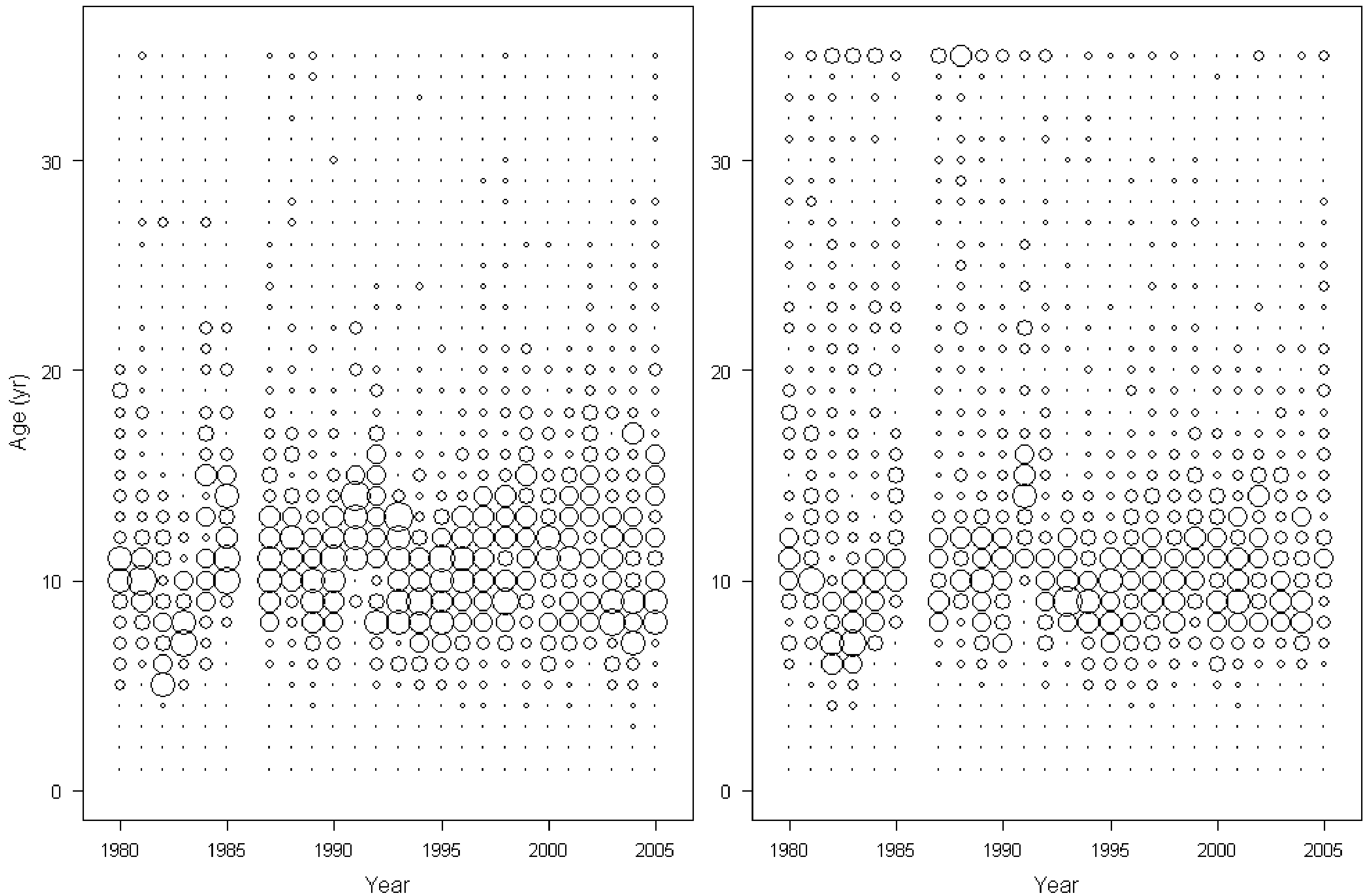


Figure 51. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the Washington trawl fleet by CAP agers. The largest female bubble represents a proportion of 0.10, males represents 0.15.

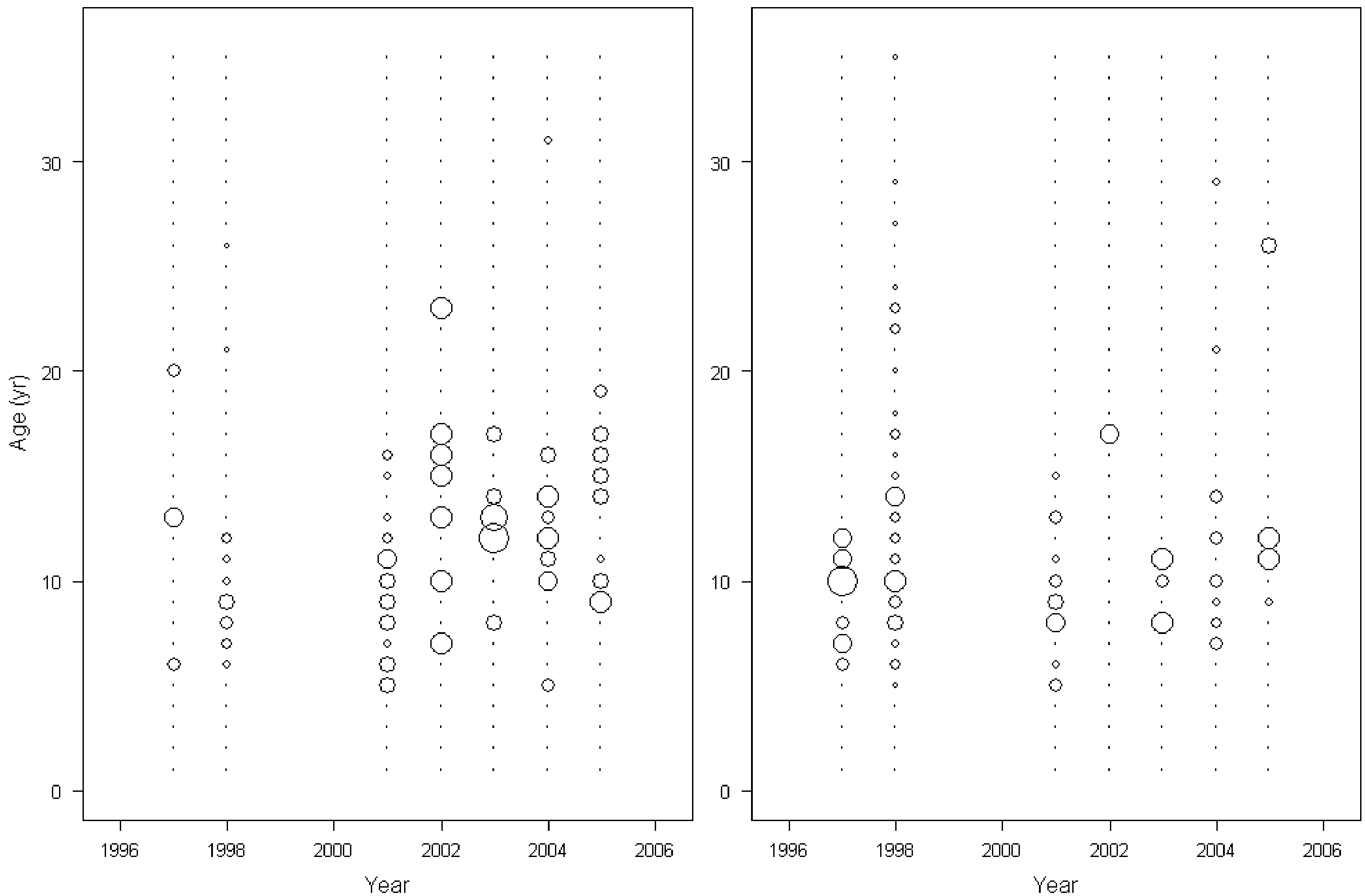


Figure 52. Age-frequency data for female (left panel) and male (right panel) canary rockfish from the Oregon and Washington non-trawl fleet. The largest female bubble represents a proportion of 0.25, males represents 0.28.

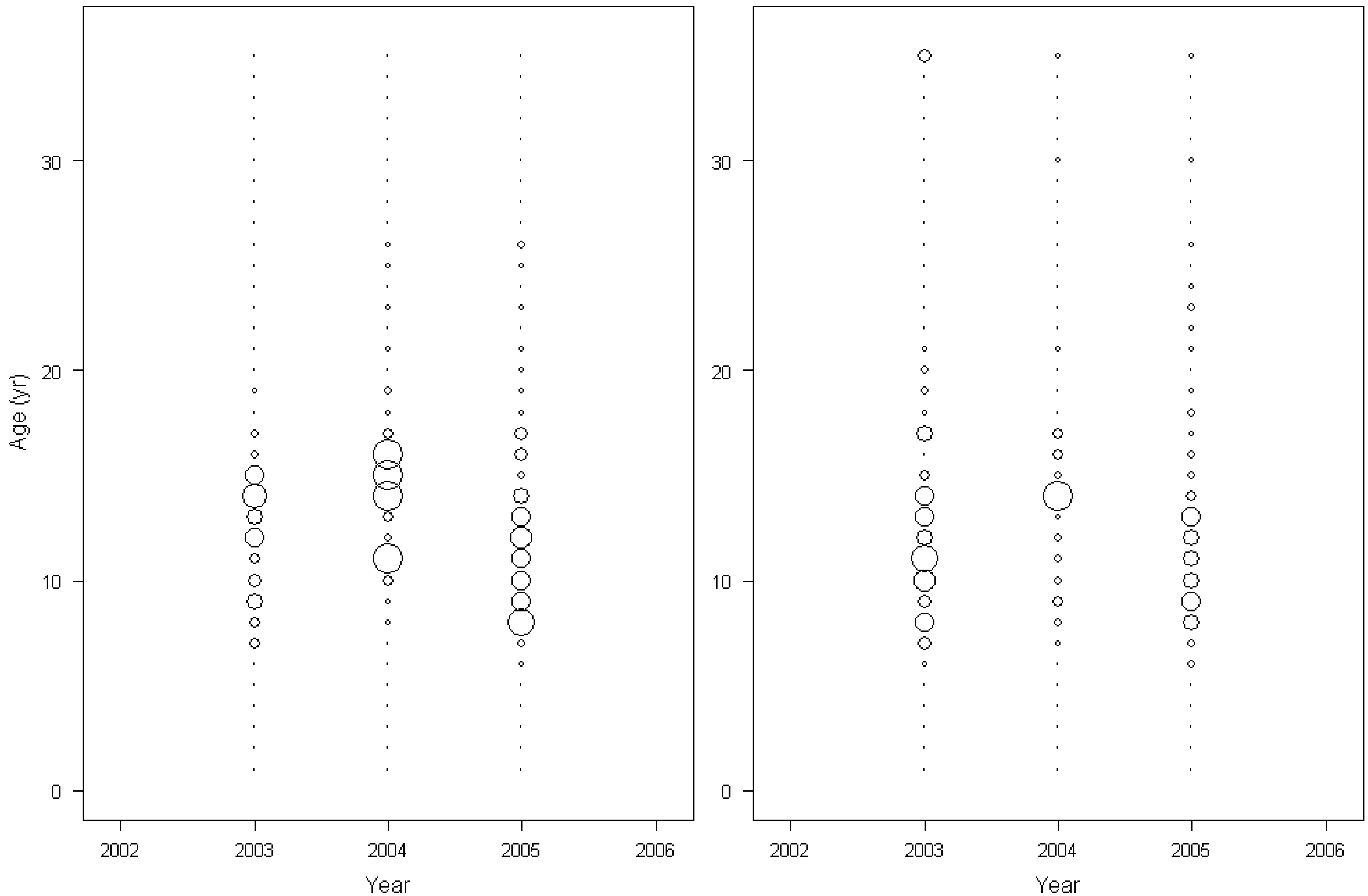


Figure 53. Age-frequency data for bycatch of female (left panel) and male (right panel) canary rockfish from the at-sea whiting fleet. The largest female bubble represents a proportion of 0.15, males represents 0.14.

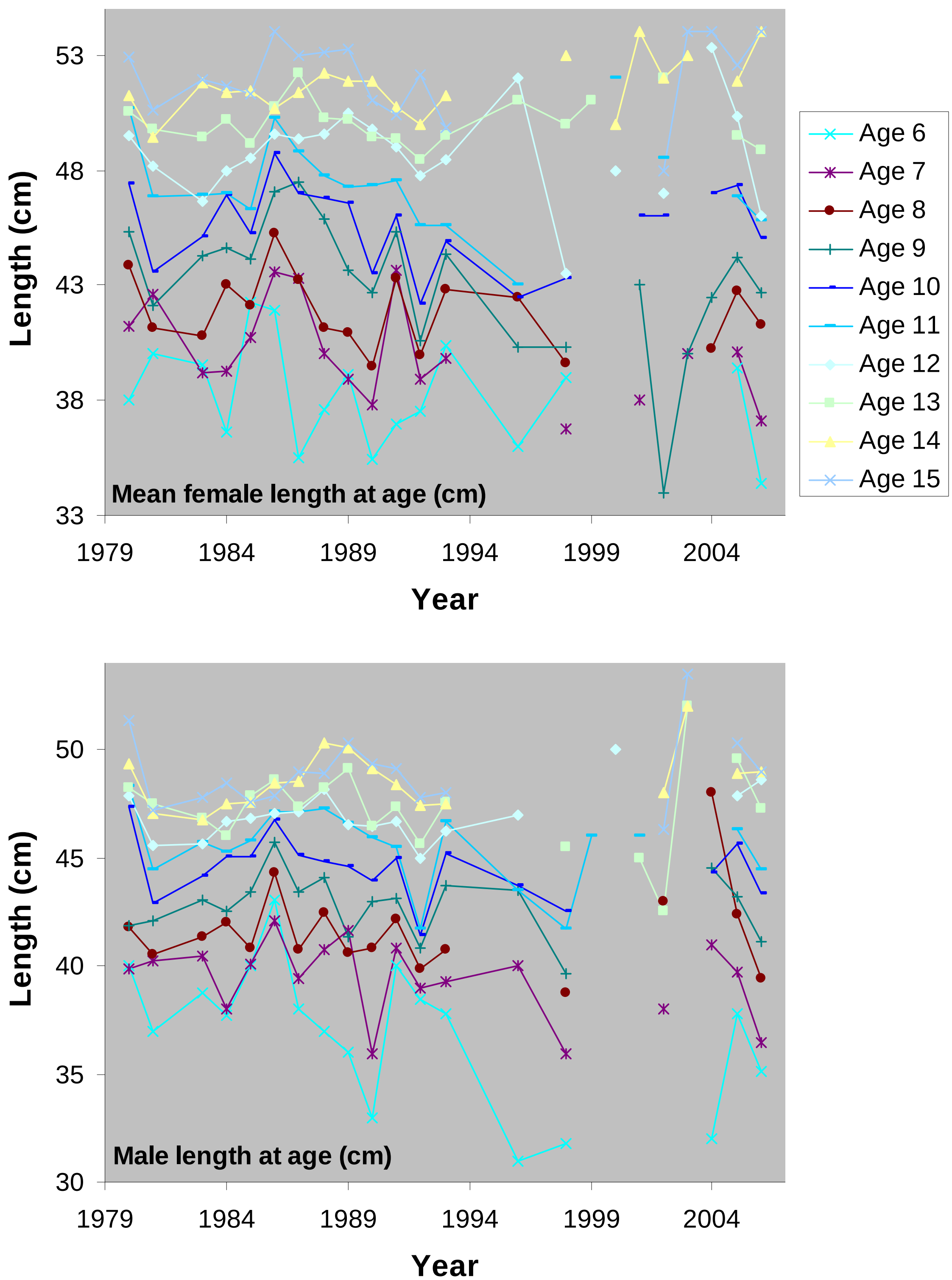


Figure 54. Mean length at observed age for the Washington trawl fleet, based only on recent WDFW age-reading.

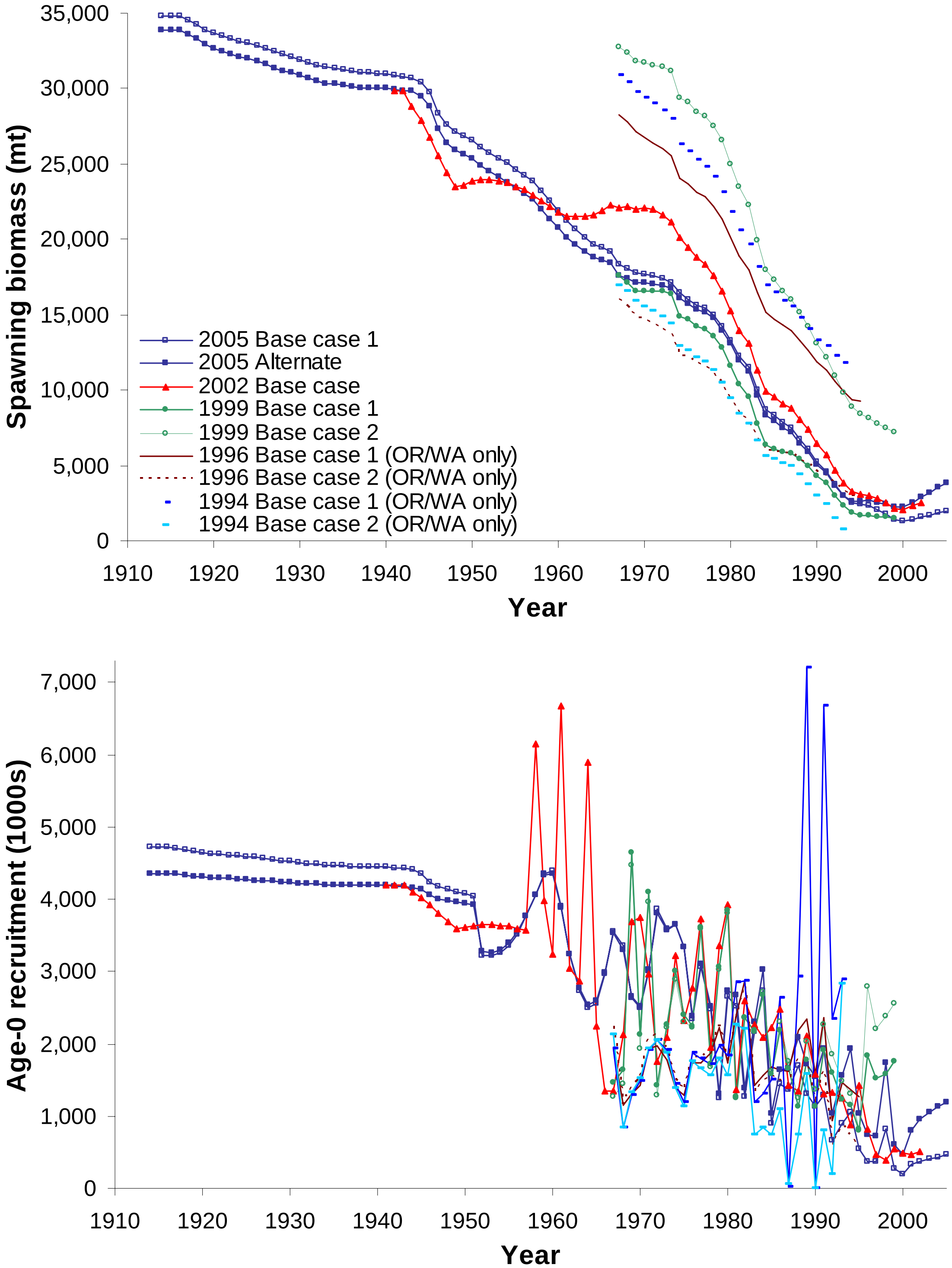


Figure 55. Retrospective analysis across stock assessments for canary rockfish, 1994-2005. Note that in most years two competing models were reported that often differed considerably in absolute scale.

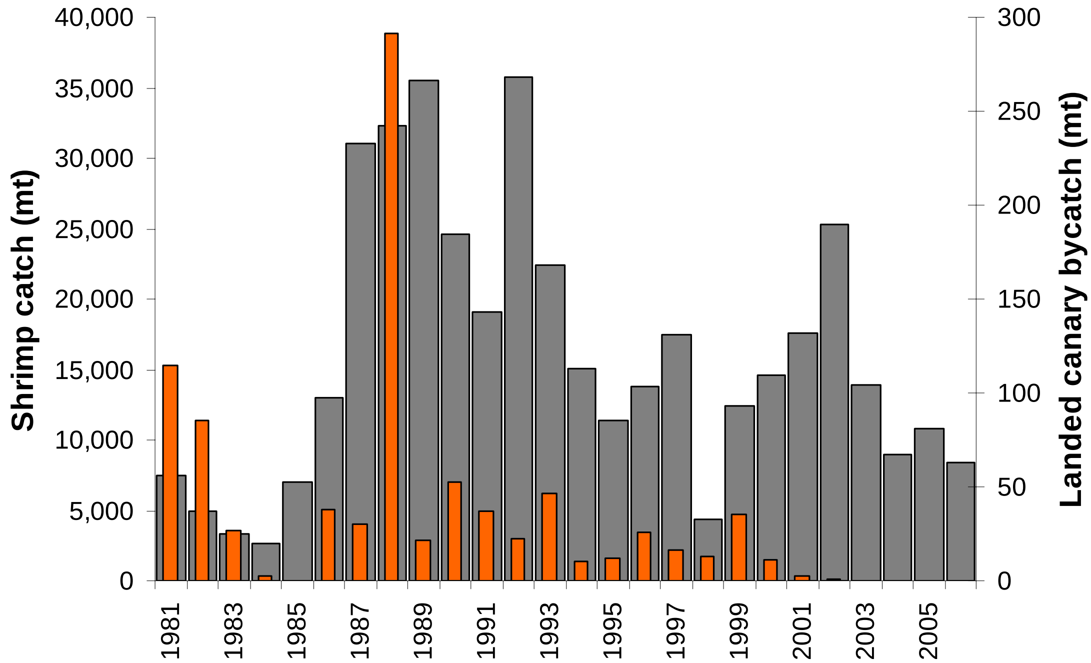


Figure 56. Landings of pink shrimp (primary axis) and canary rockfish from the pink shrimp fishery during the period 1981-2006. Bycatch excluder devices were used in 2001-2002 and required in 2003.

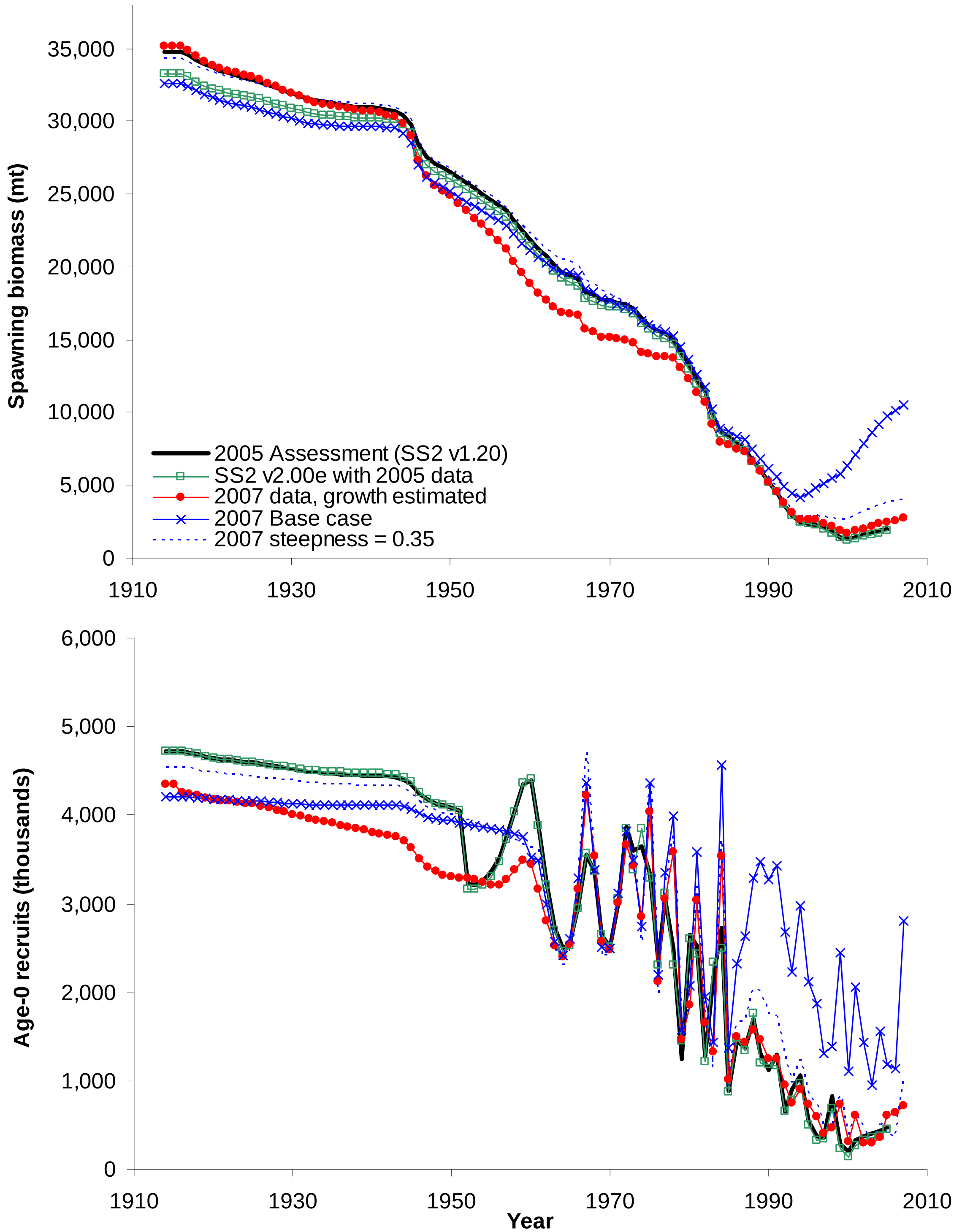


Figure 57. Link from 2005 base case assessment results through SS2 version update, data update to 2007 base case.

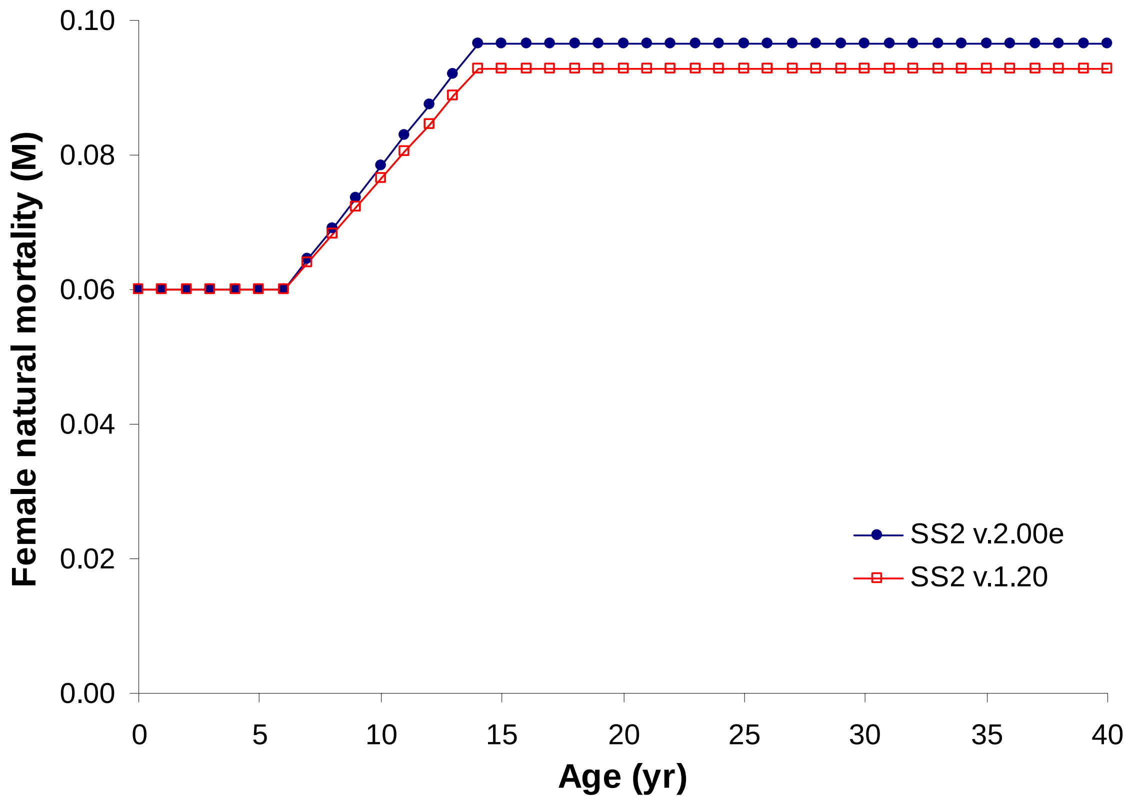


Figure 58. Difference in natural mortality estimate due to SS2 version change.

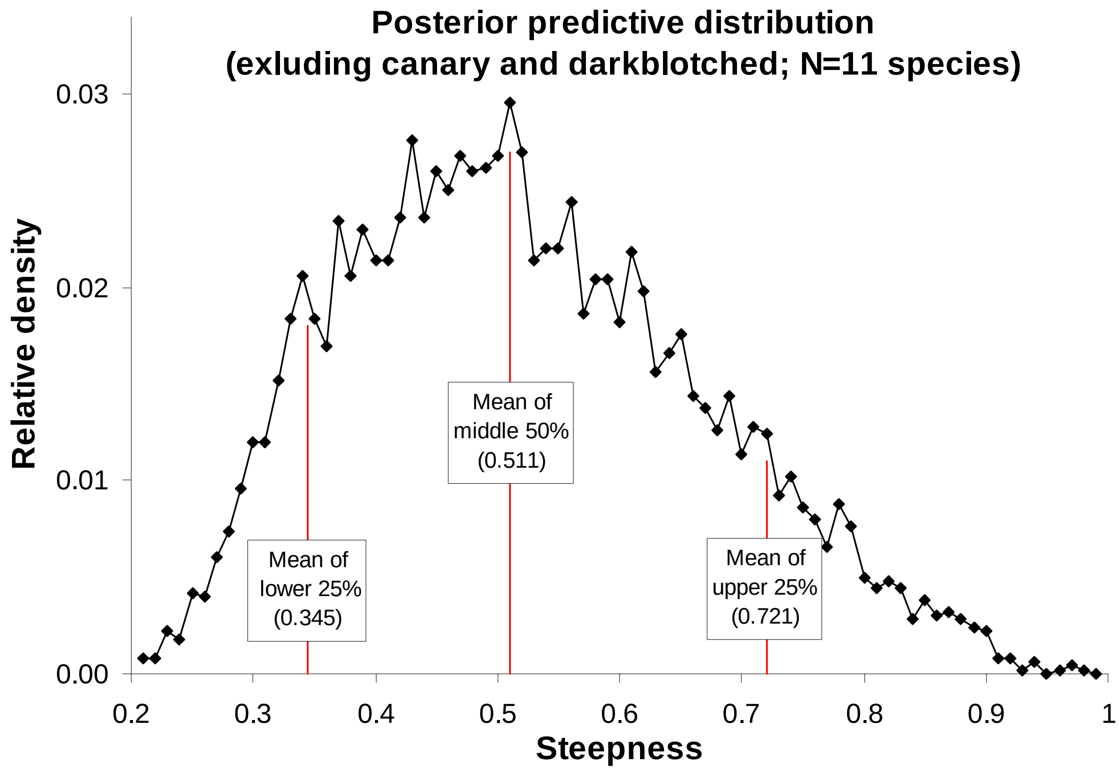


Figure 59. Revised 2007 prior for stock-recruit steepness for canary rockfish (M. Dorn, AFSC, personal communication).

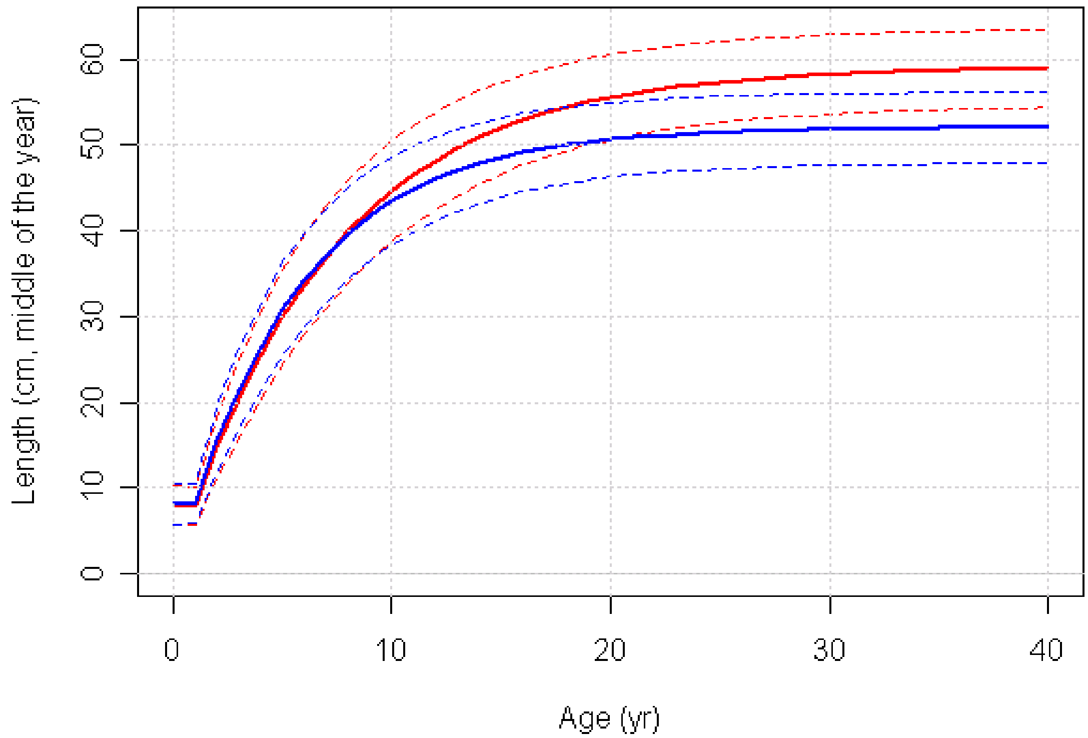


Figure 60. Growth curve for females (upper solid line) and males (lower solid line) with ~95% interval (dashed lines) indicating the expectation and individual variability of length-at-age for the base case model.

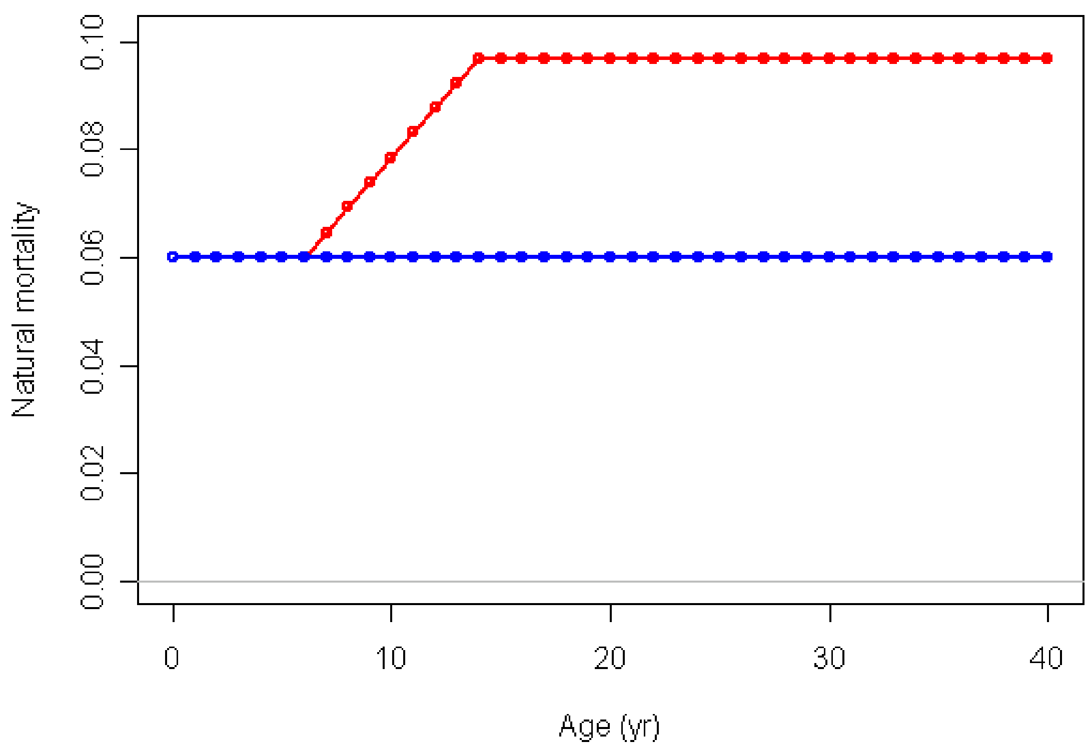


Figure 61. Natural mortality at age for males (horizontal line at 0.06) and females (linear ramp from 0.06 at age 6 to estimated value at age 14).

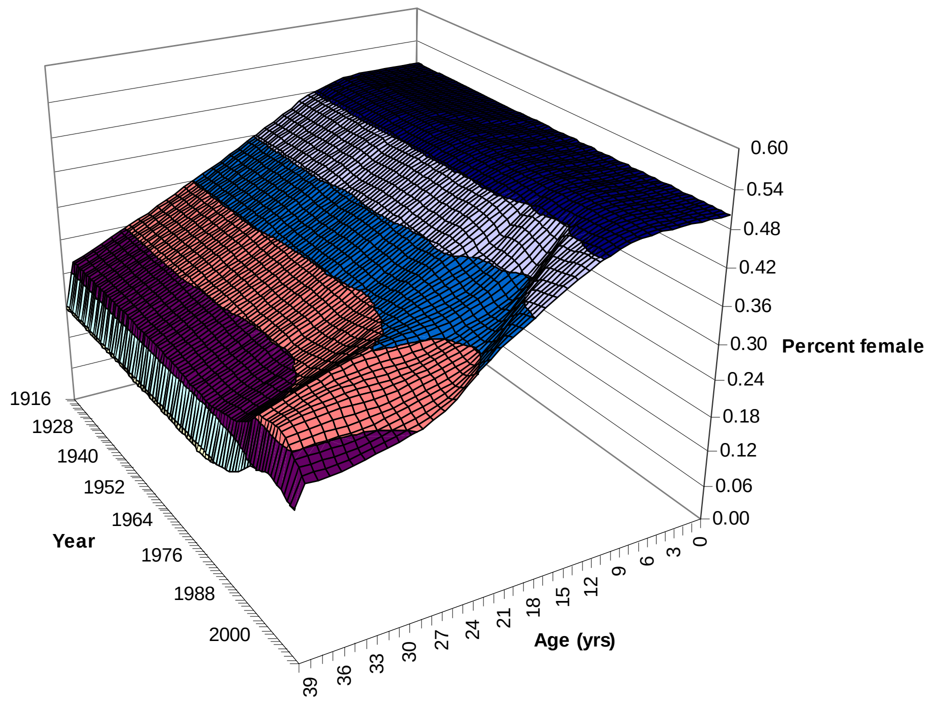


Figure 62. Change in sex-ratio over time, illustrating the effect of increasing natural mortality for females in reducing the percent female at older ages, and the effect of exploitation increasing the percent female in recent years.

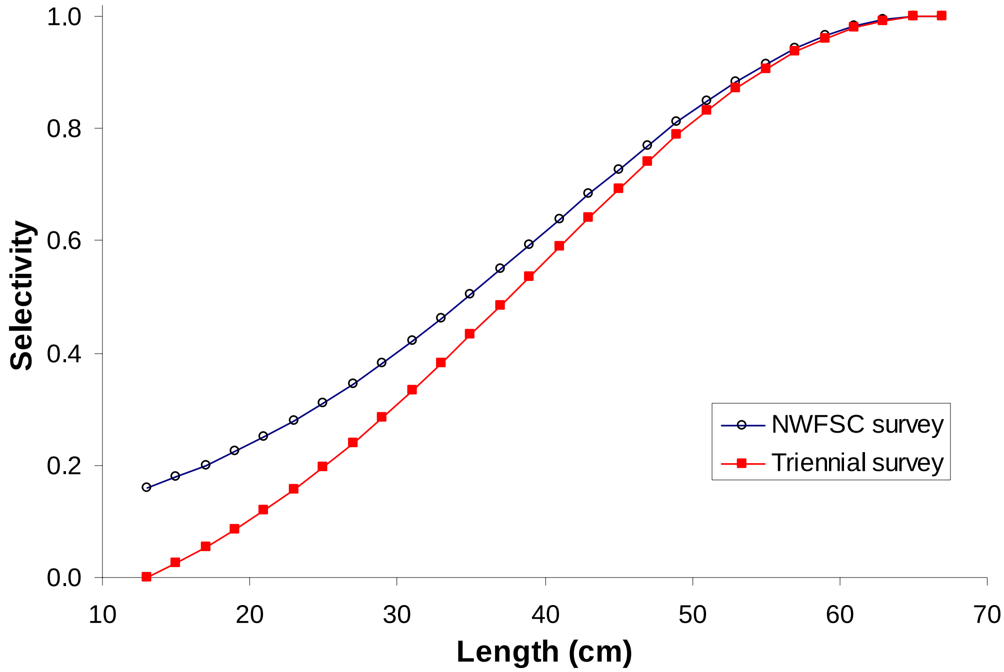


Figure 63. Estimated length-based selectivity curves for the NWFSC and triennial surveys.

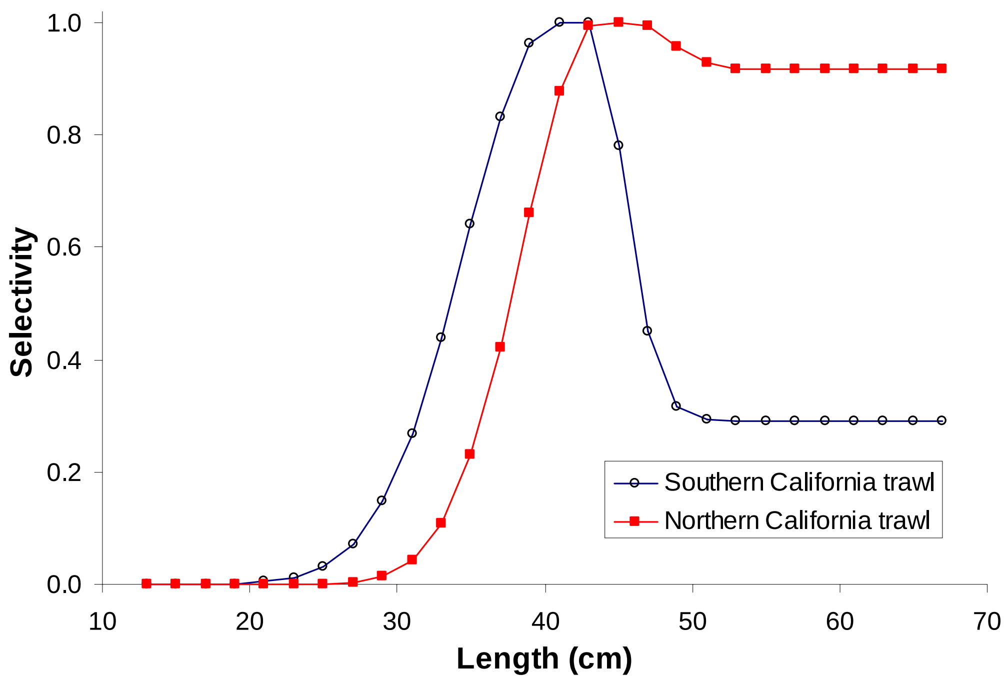


Figure 64. Length-based selectivity in the base model for the southern and northern California trawl fisheries.

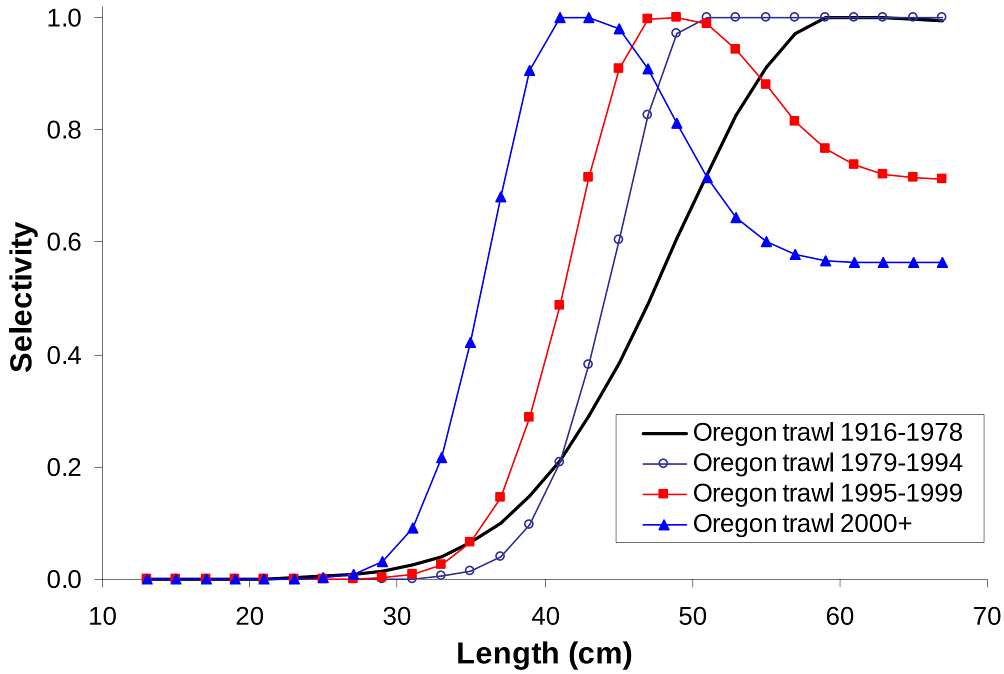


Figure 65. Length-based selectivity in the base model for the Oregon trawl fishery.

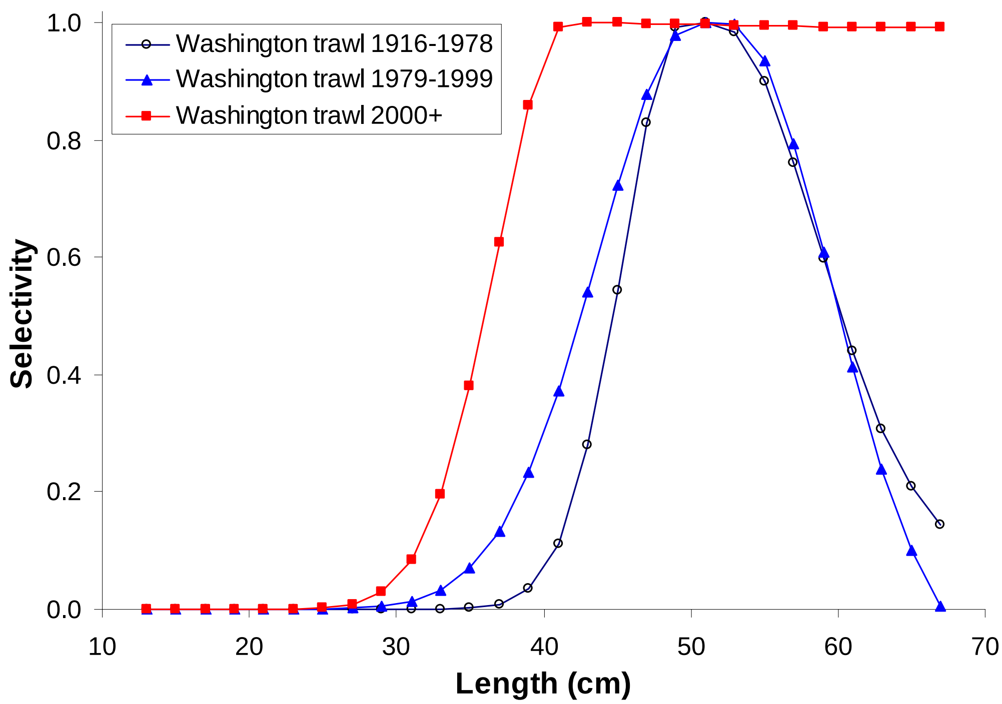


Figure 66. Length-based selectivity in the base model for the Washington trawl fishery.

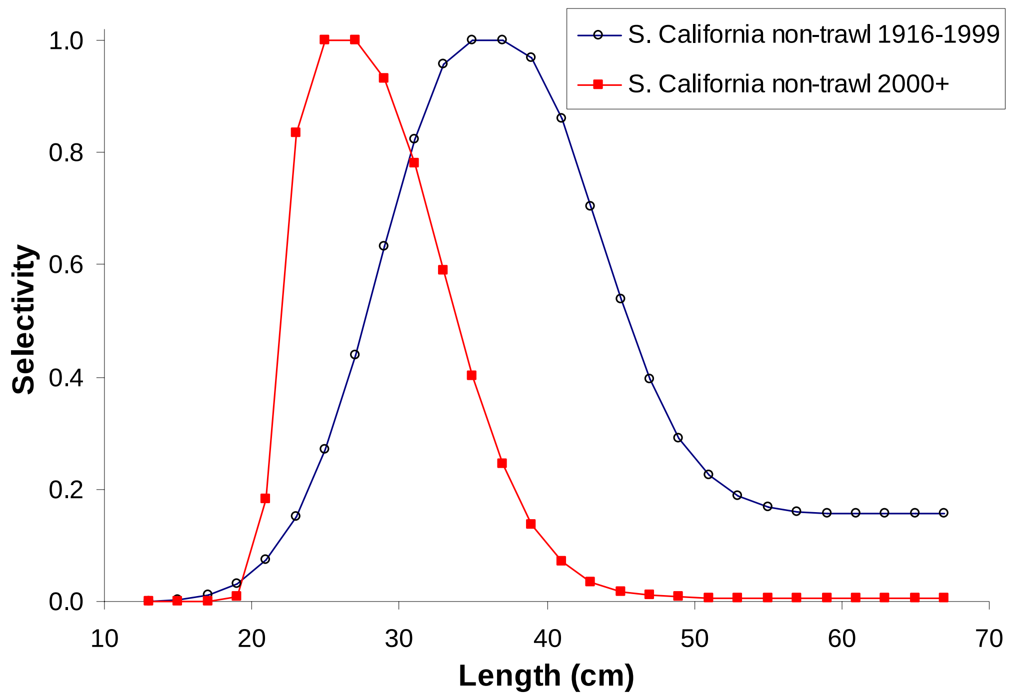


Figure 67. Length-based selectivity estimated for the southern California non-trawl fishery in the base model.

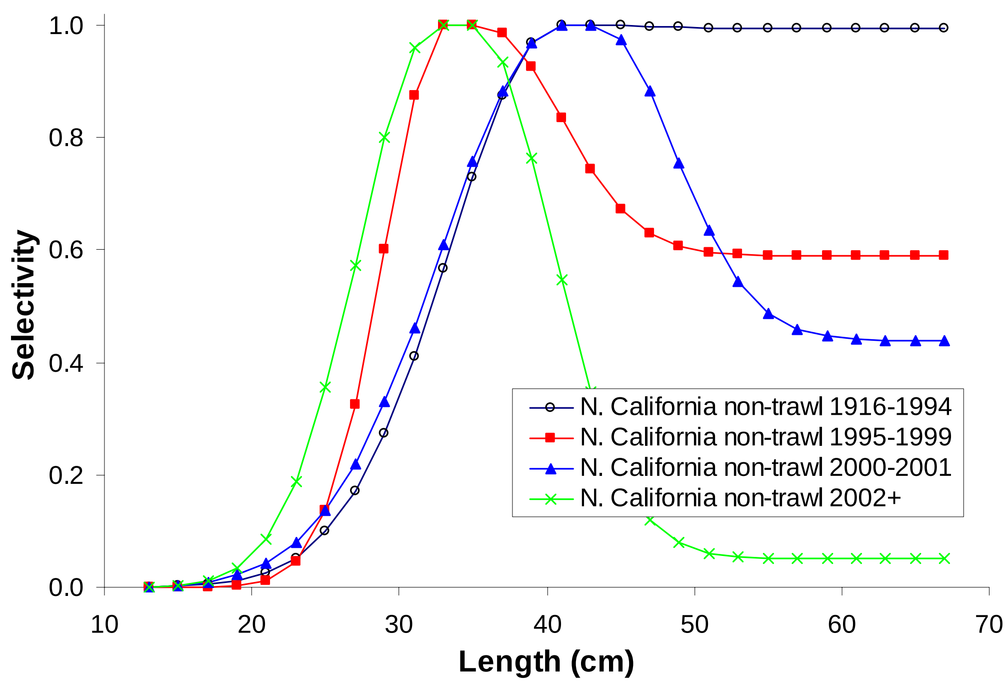


Figure 68. Length-based selectivity estimated for the Northern California non-trawl fishery in the base model.

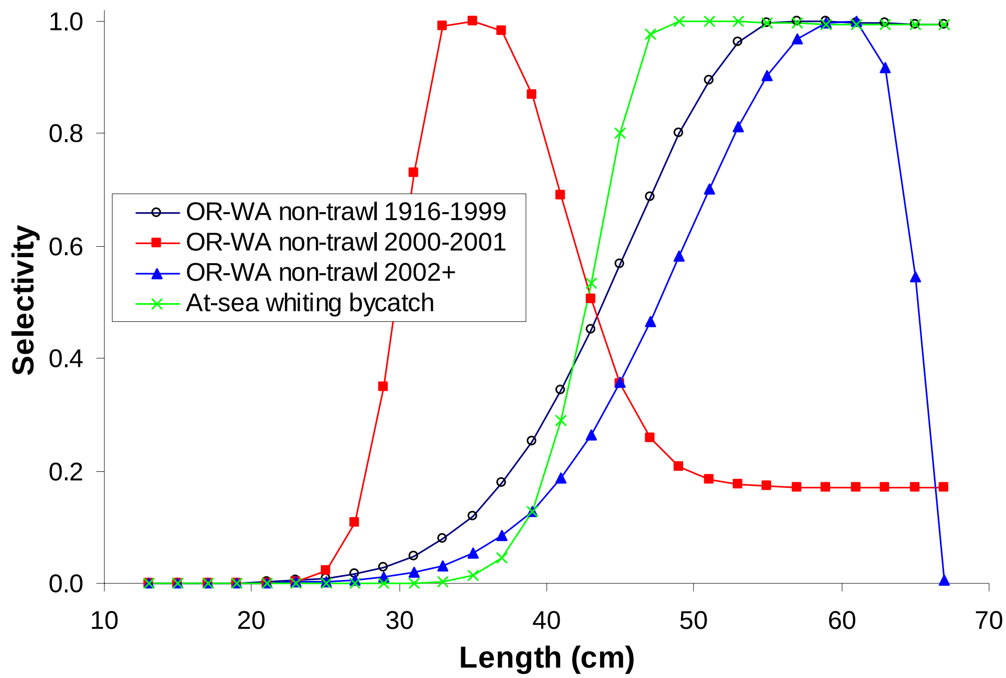


Figure 69. Length-based selectivity estimated for the Oregon-Washington non-trawl fishery and the at-sea whiting fleet in the base model.

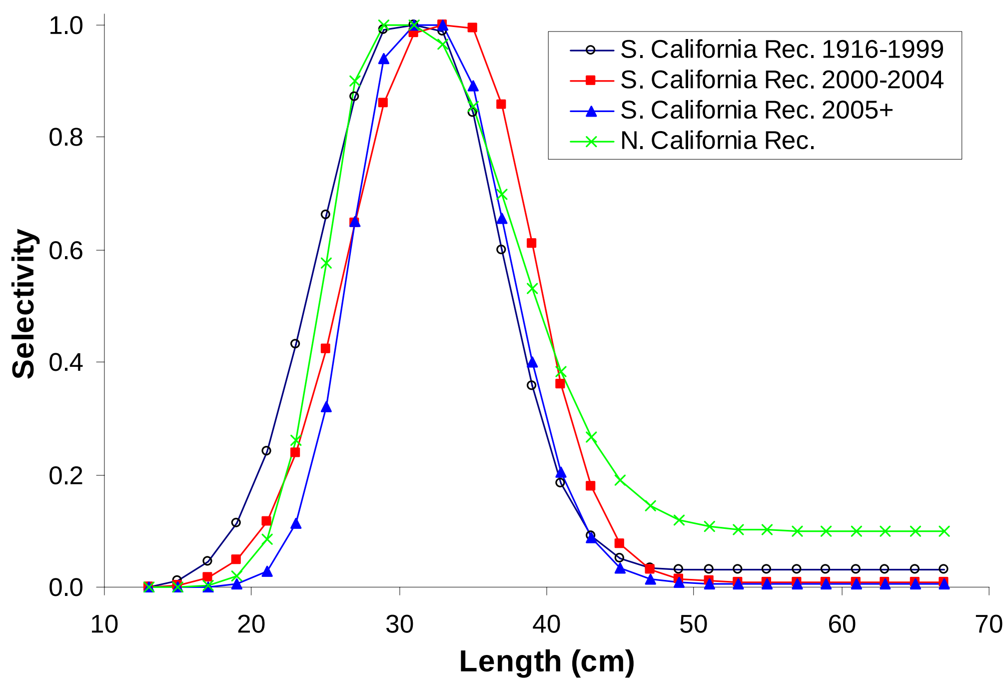


Figure 70. Length-based selectivity estimated for the Southern and Northern California recreational fisheries in the base model.

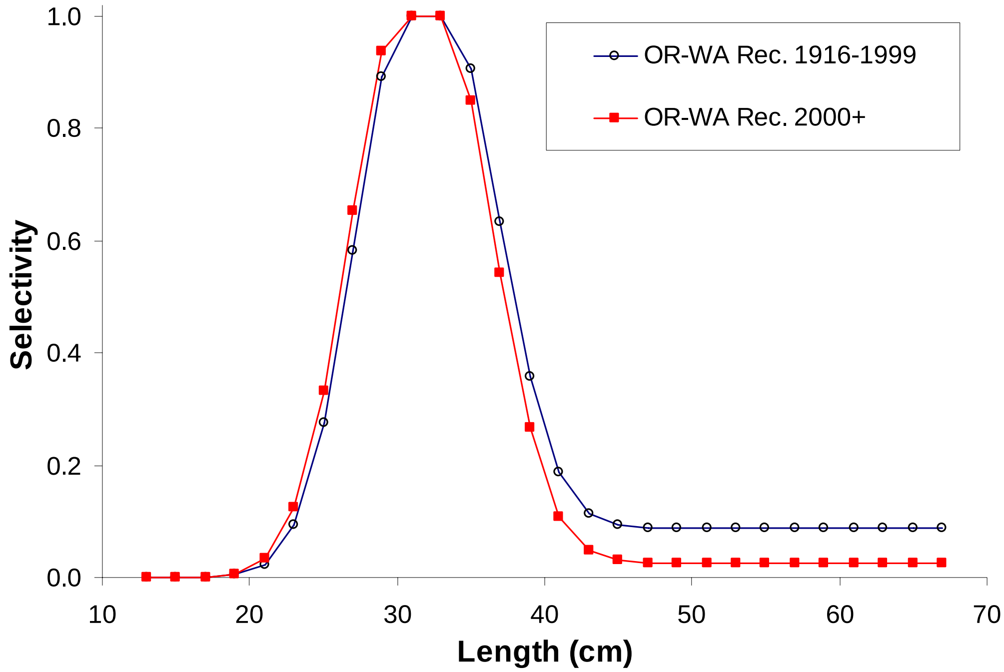


Figure 71. Length-based selectivity estimated for the Oregon-Washington recreational fishery in the base model.

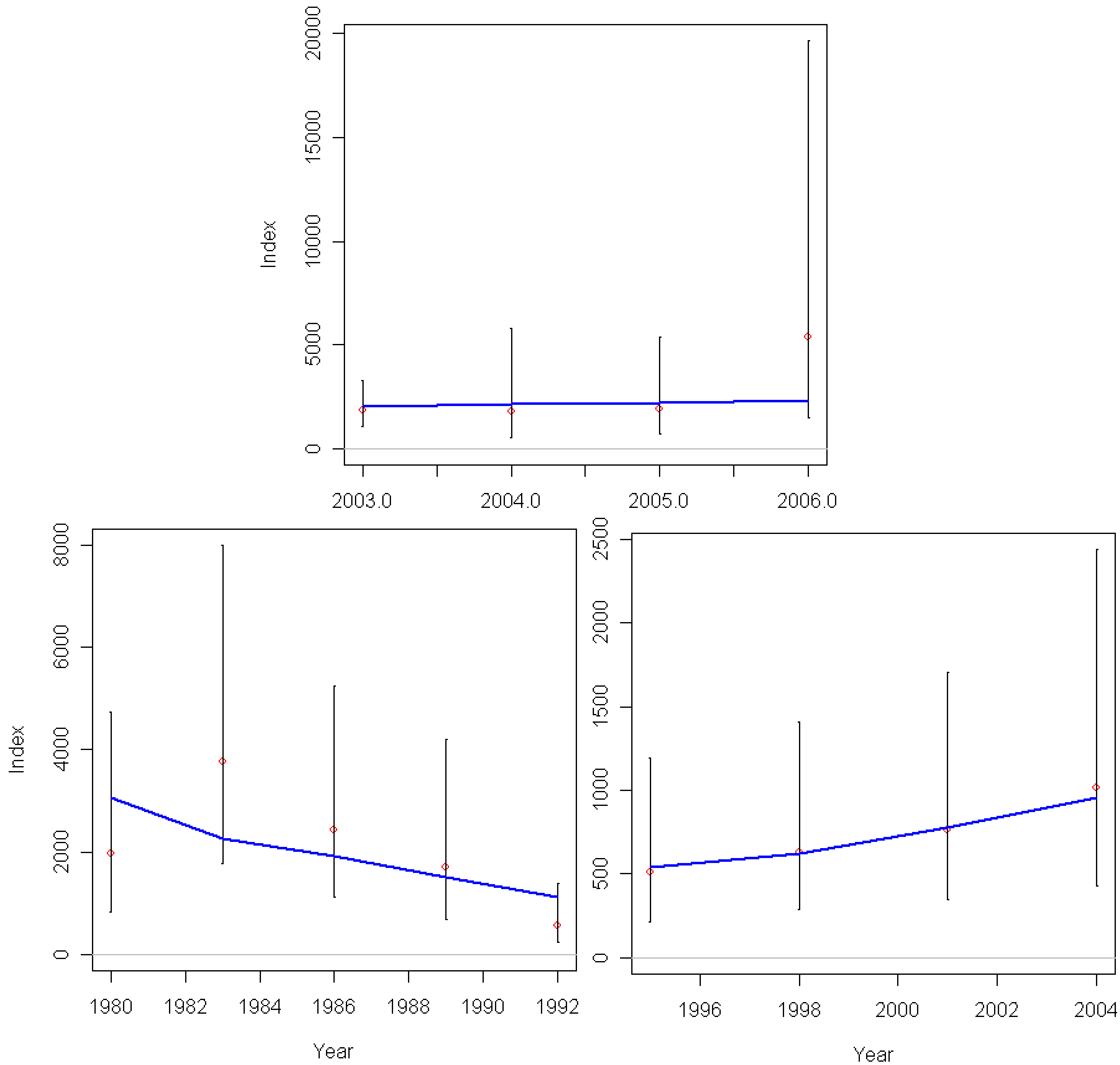


Figure 72. Fit to the NWFSC (upper panel) and triennial (lower panels) survey GLMM-based time series of relative biomass in the base case model.

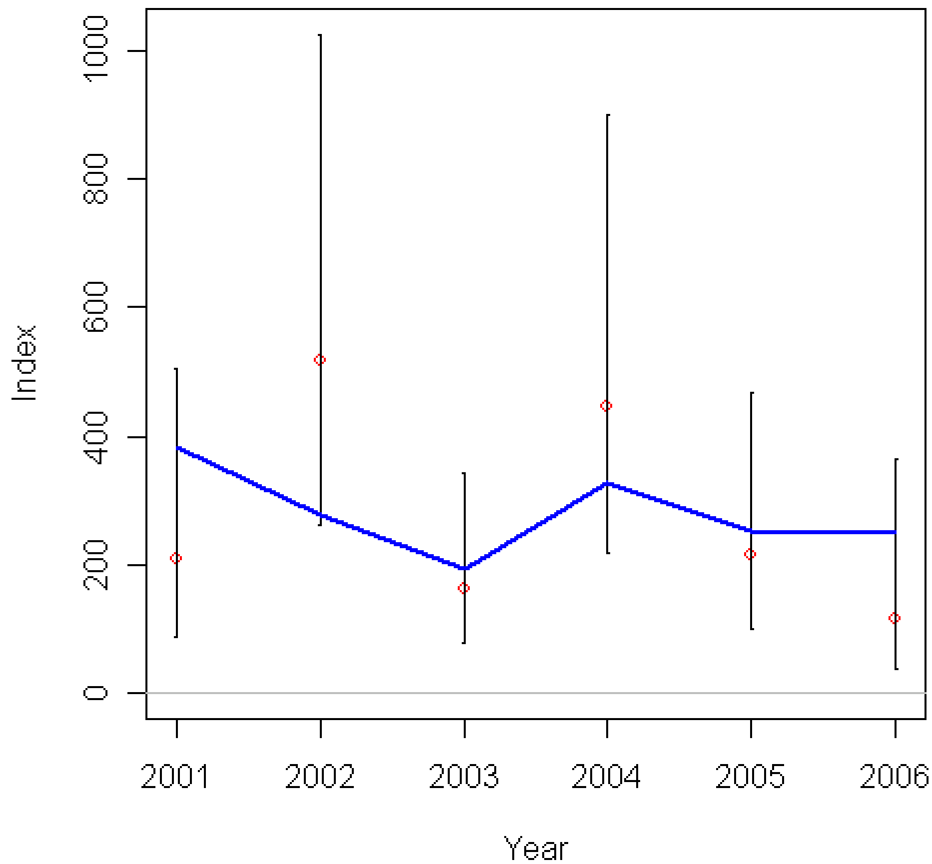


Figure 73. Fit to the coast-wide pre-recruit index.

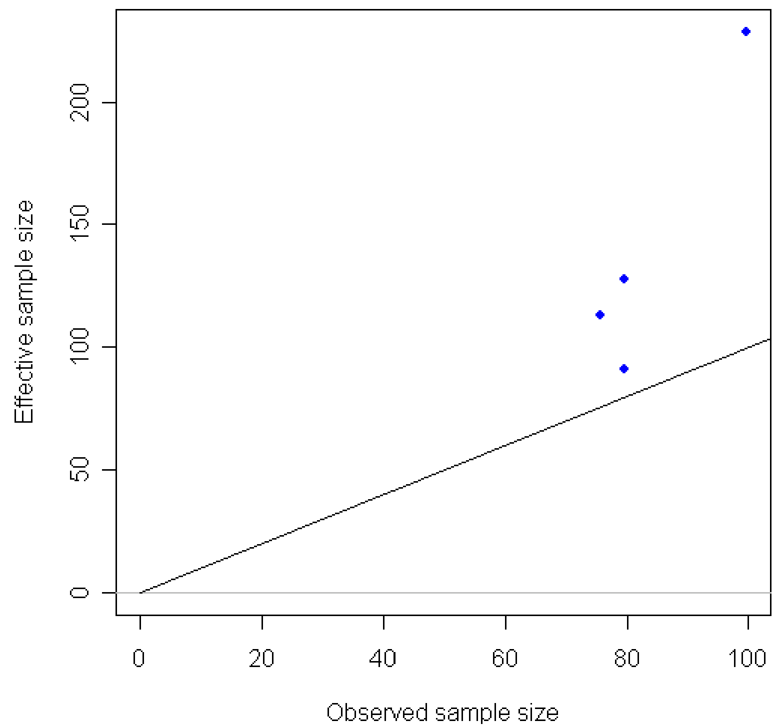


Figure 74. Observed and effective sample sizes for the sex-specific NWFSC length-frequency observations.

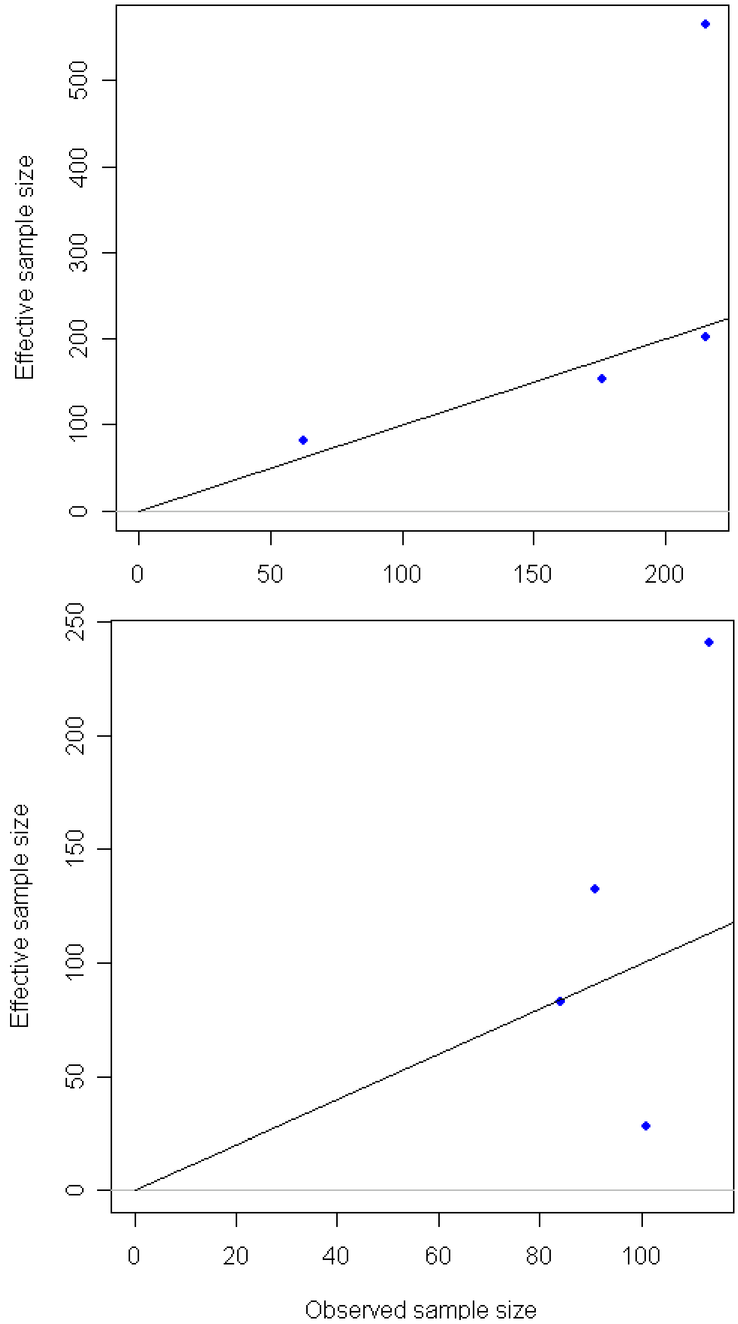


Figure 75. Observed and effective sample sizes for the sex-specific triennial length-frequency observations for 1980-1992 (upper panel) and 1995-2004 (lower panel).

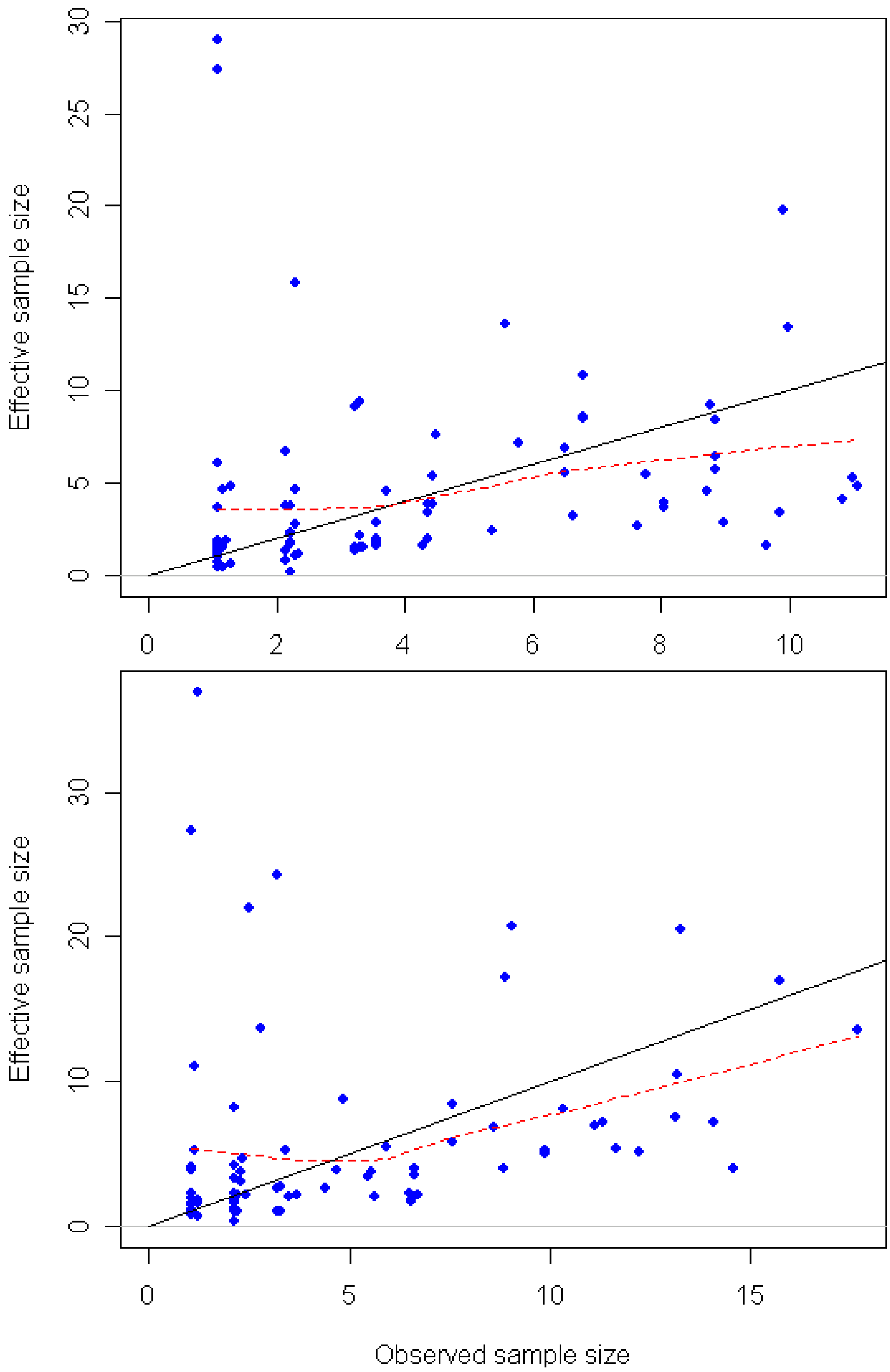


Figure 76. Observed and effective sample sizes for the female (upper panel) and male (lower panel) NWFSC survey conditional age-at-length frequency observations (sexes entered separately for conditional age data).

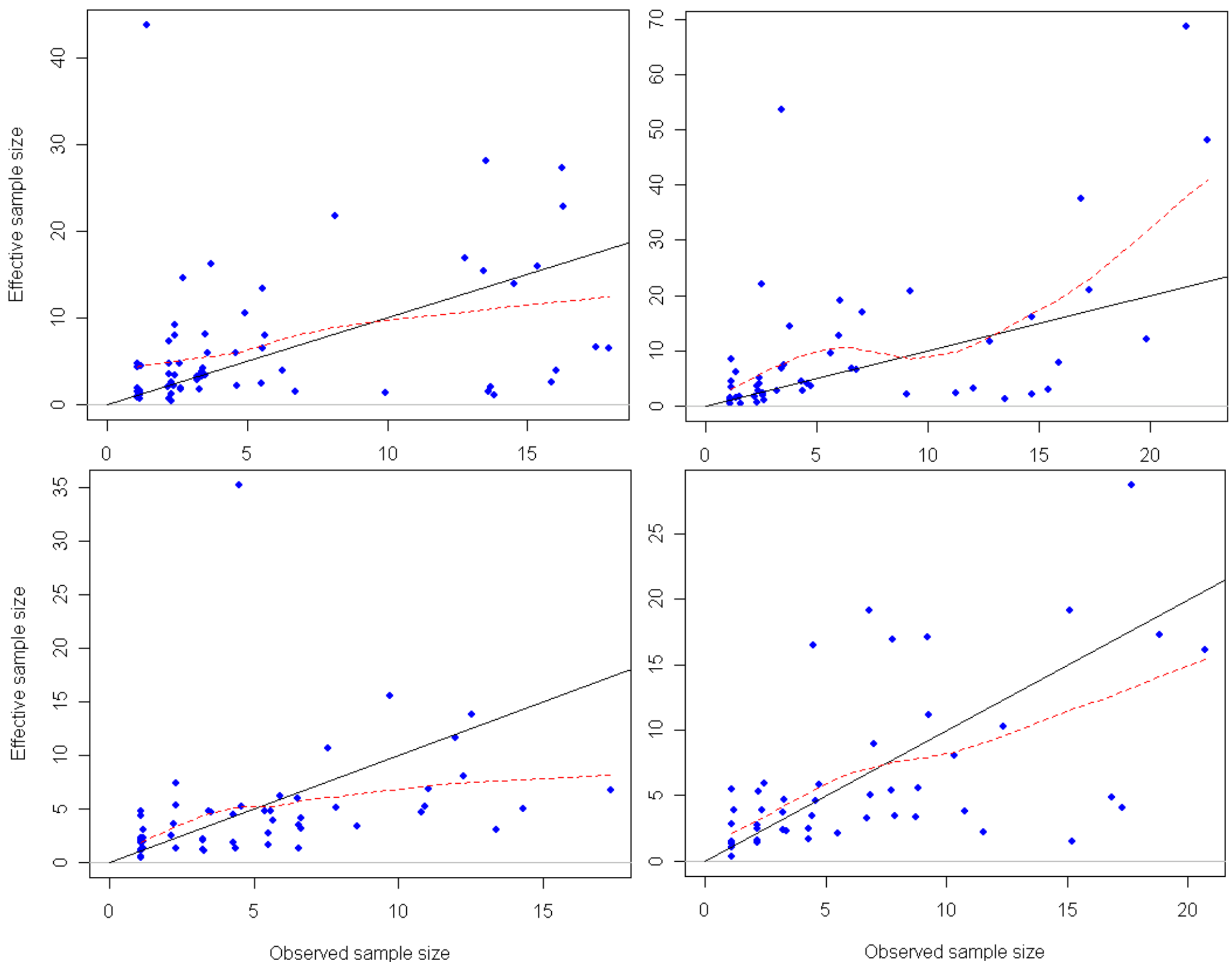


Figure 77. Observed and effective sample sizes for the female (upper panels) and male (lower panels) triennial survey conditional age-at-length frequency observations (sexes entered separately for conditional age data); 1980-1992 (left panels) and 1995-2004 (right panels).

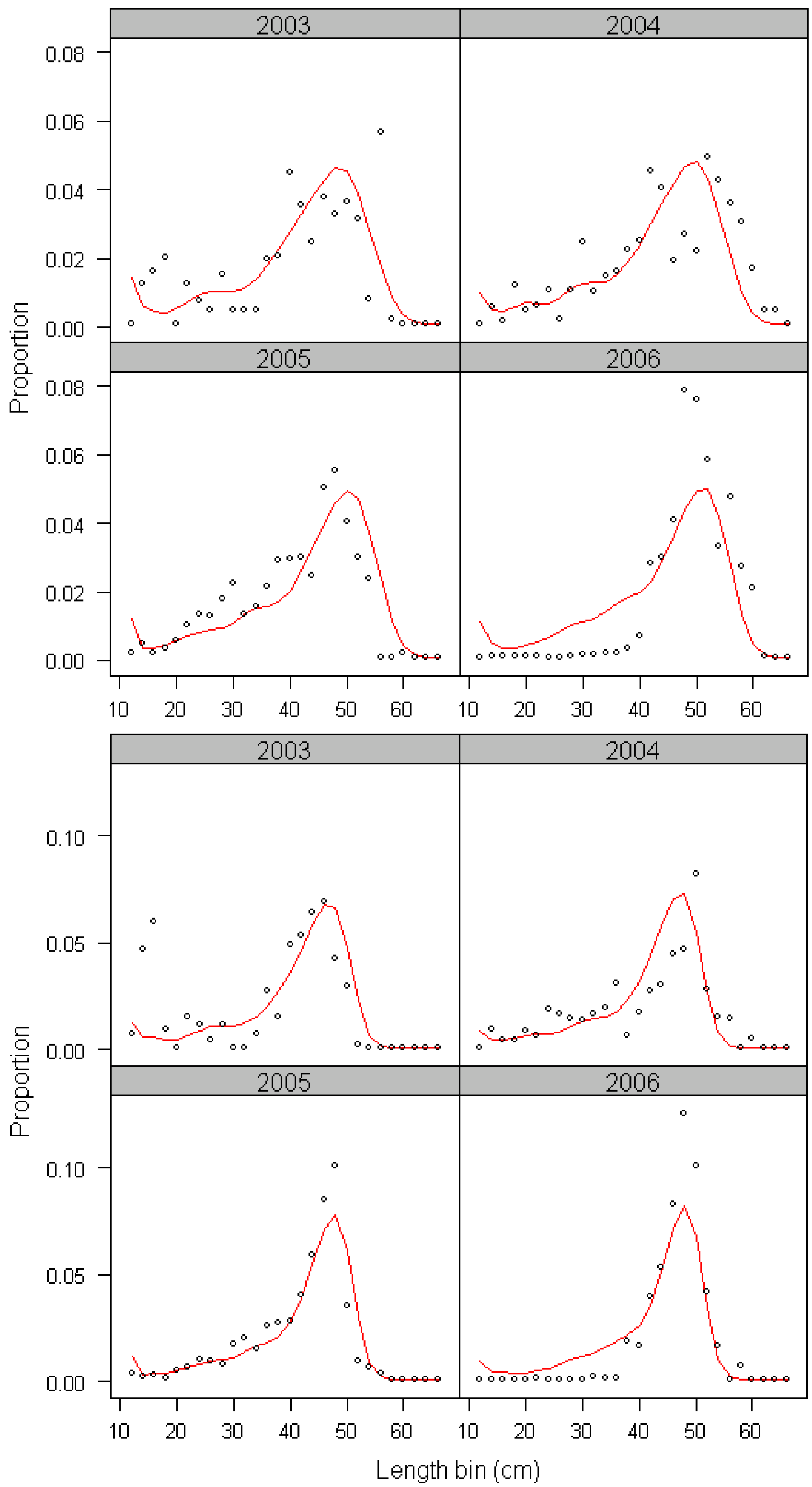


Figure 78. Fit to the NWFSC survey female (upper panel) and male (lower panel) length-frequencies.

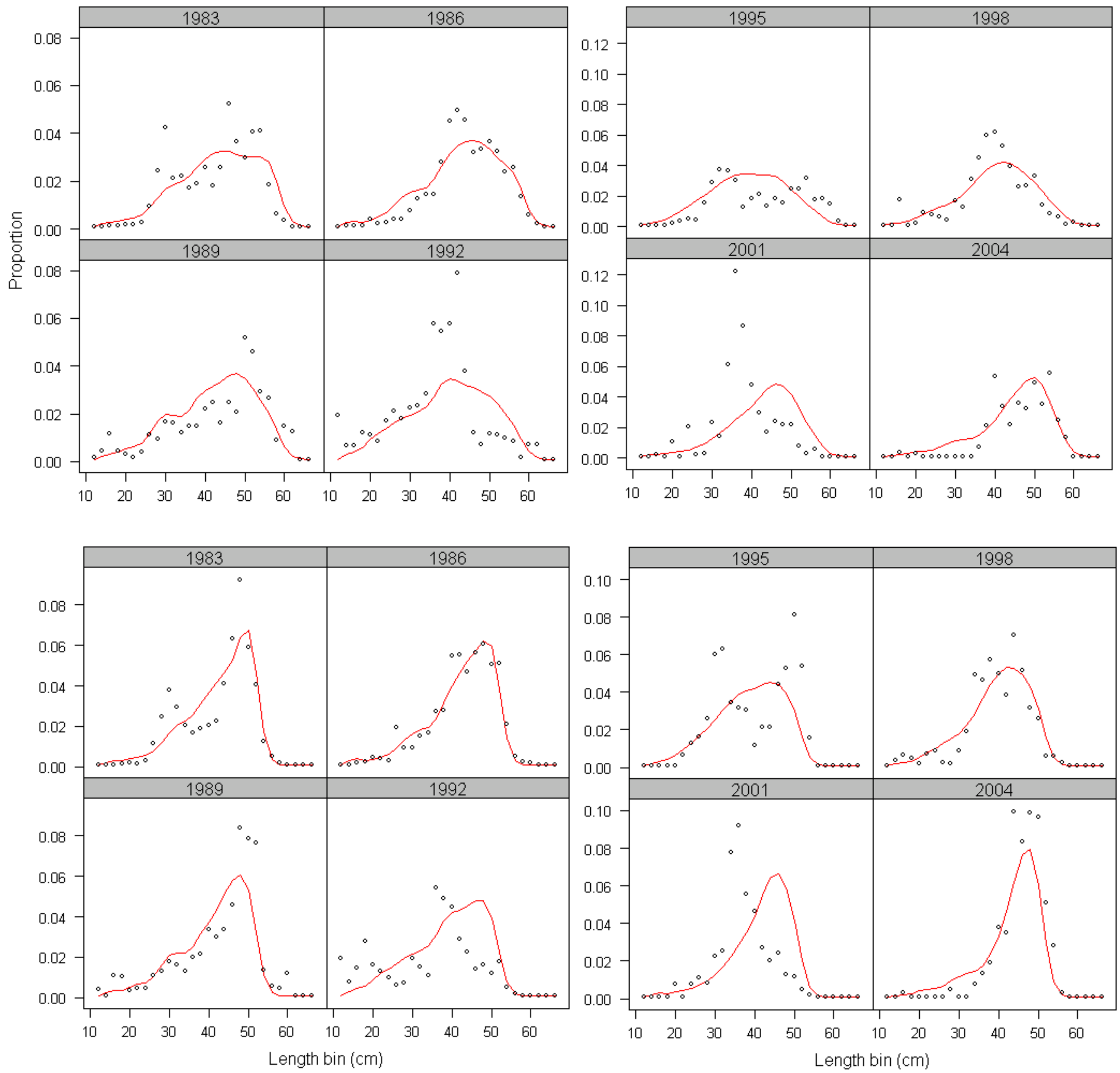


Figure 79. Fit to the triennial survey female (upper panels) and male (lower panels) length-frequencies; 1980-1992 (left panels) and 1995-2004 (right panels).

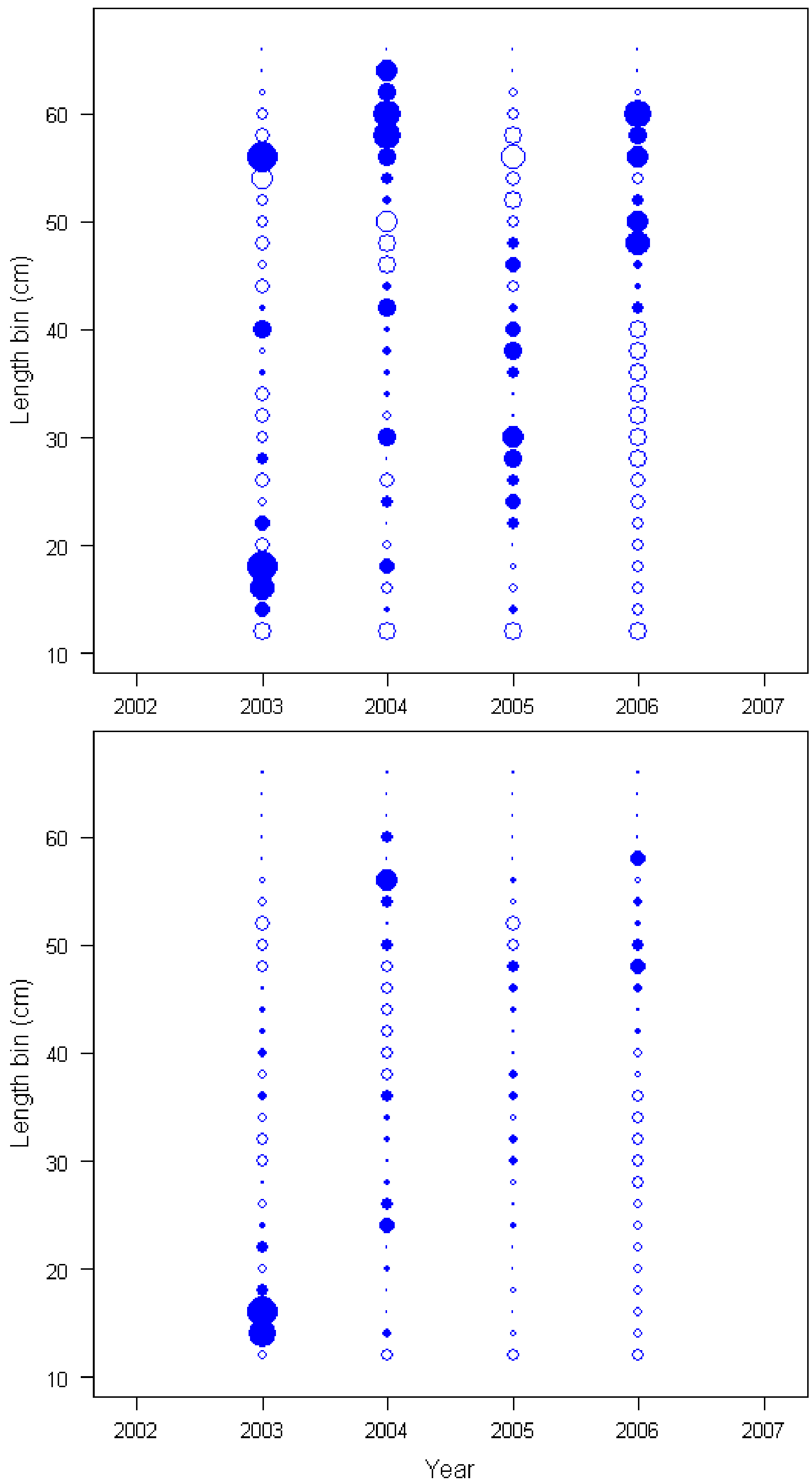


Figure 80. Pearson residuals for the fit to NWFSC survey female (upper panel, maximum = 2.66) and male (lower panel, maximum = 6.32) length-frequencies.

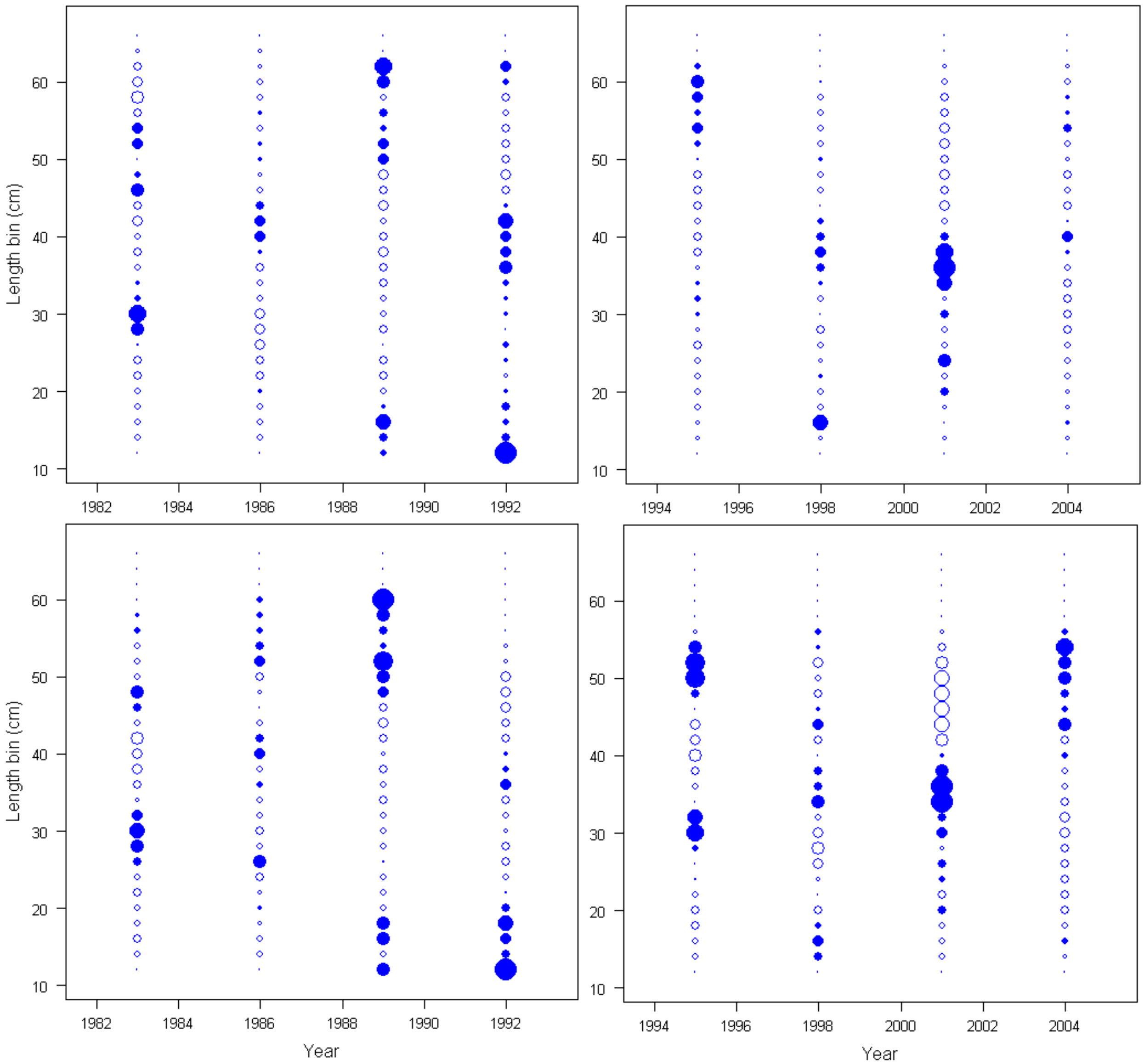


Figure 81. Pearson residuals for the fit to triennial survey female (upper panels, maximum = 4.66, 6.23) and male (lower panels, maximum = 4.78, 3.82) length-frequencies; 1980-1992 (left panels) and 1995-2004 (right panels).

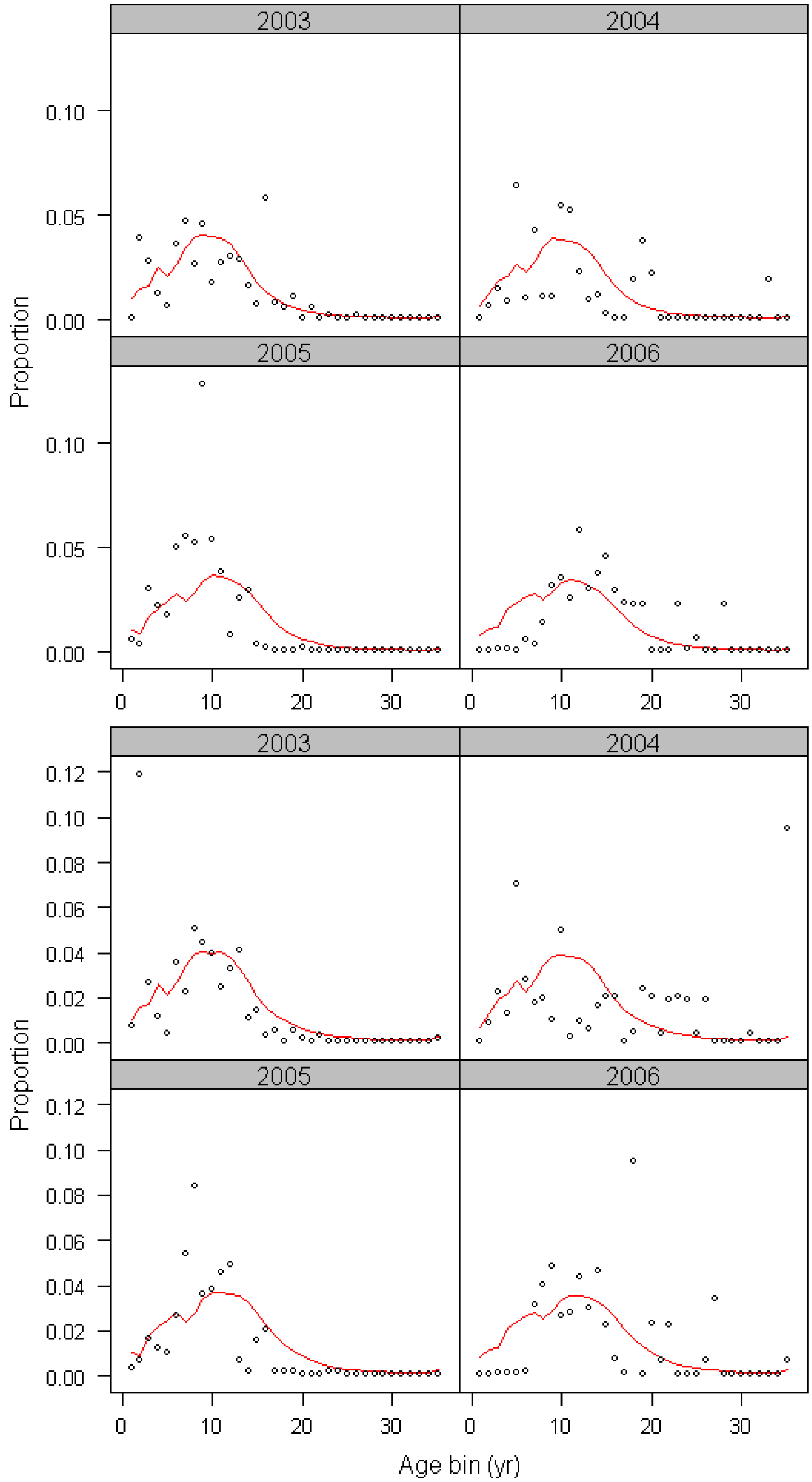


Figure 82. Implied fit to the NWFSC survey female (upper panel) and male (lower panel) marginal age-frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

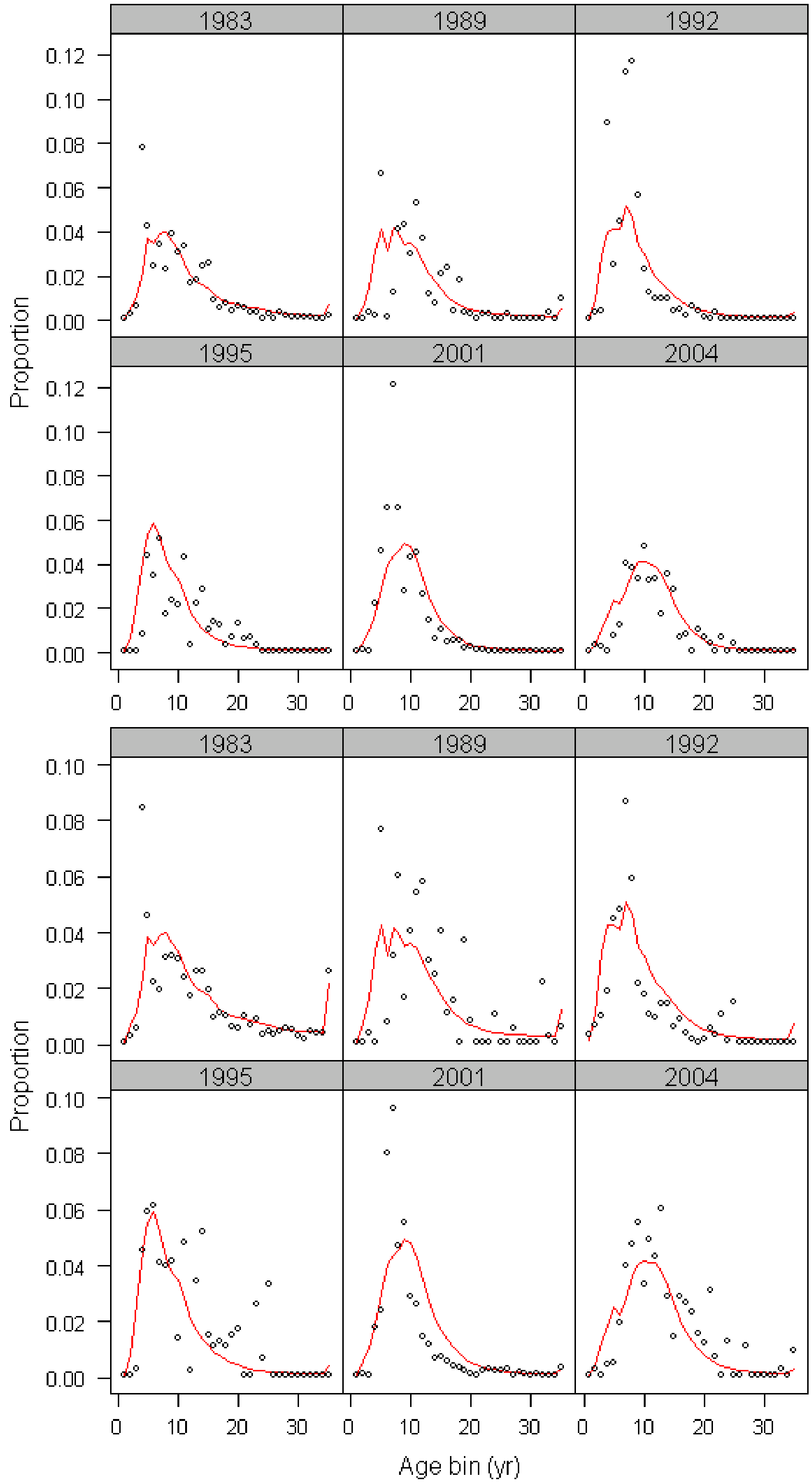


Figure 83. Implied fit to the triennial survey female (upper panel) and male (lower panel) marginal age-frequencies. Fits are provided for evaluation only, but not included in the model likelihood.

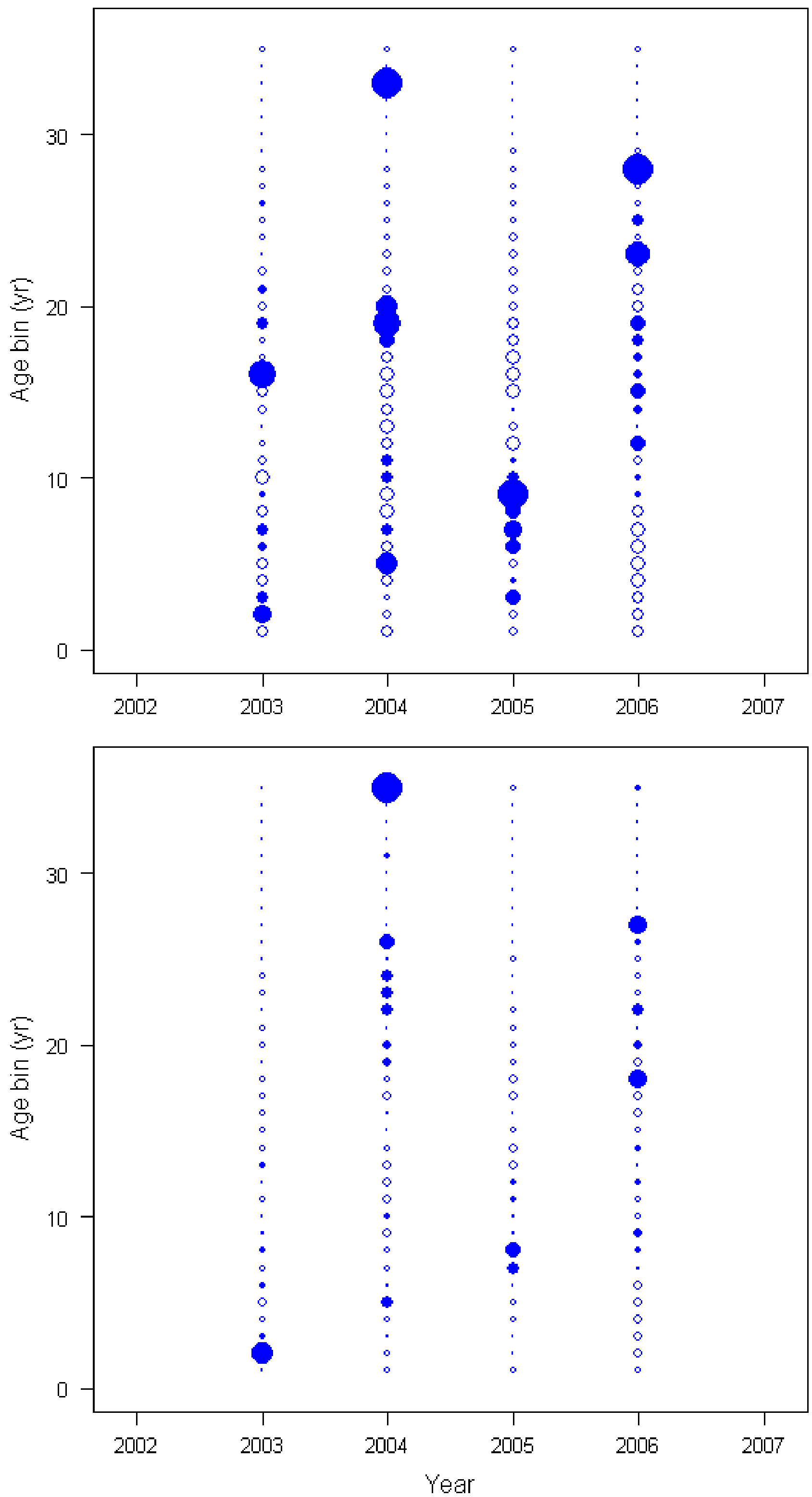


Figure 84. Pearson residuals for the implied fit to the NWFSC survey female (upper panel) and male (lower panel) marginal age-frequencies (for evaluation only, not included in the model fit).

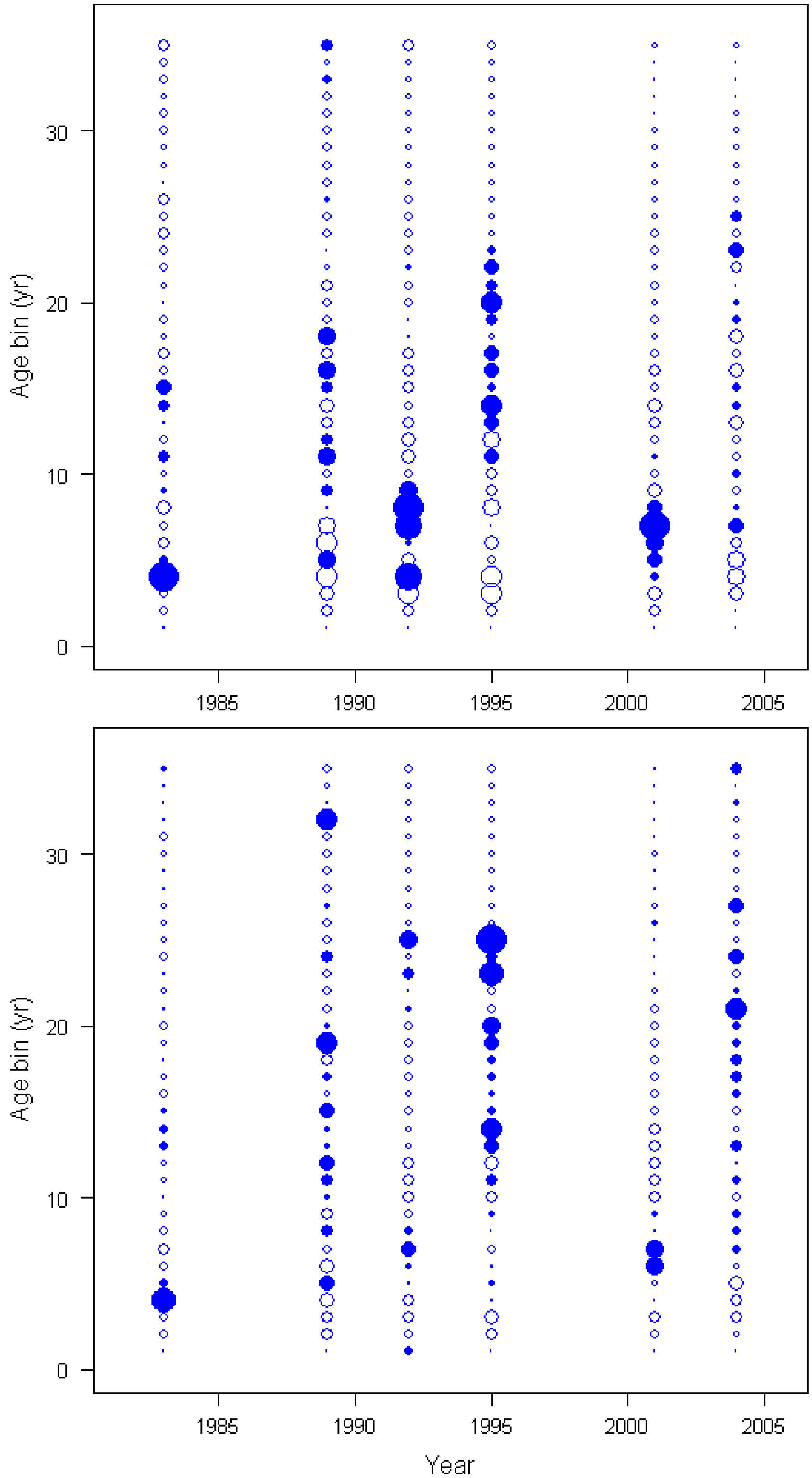


Figure 85. Pearson residuals for the implied fit to the triennial survey female (upper panel) and male (lower panel) marginal age-frequencies (for evaluation only, not included in the model fit).

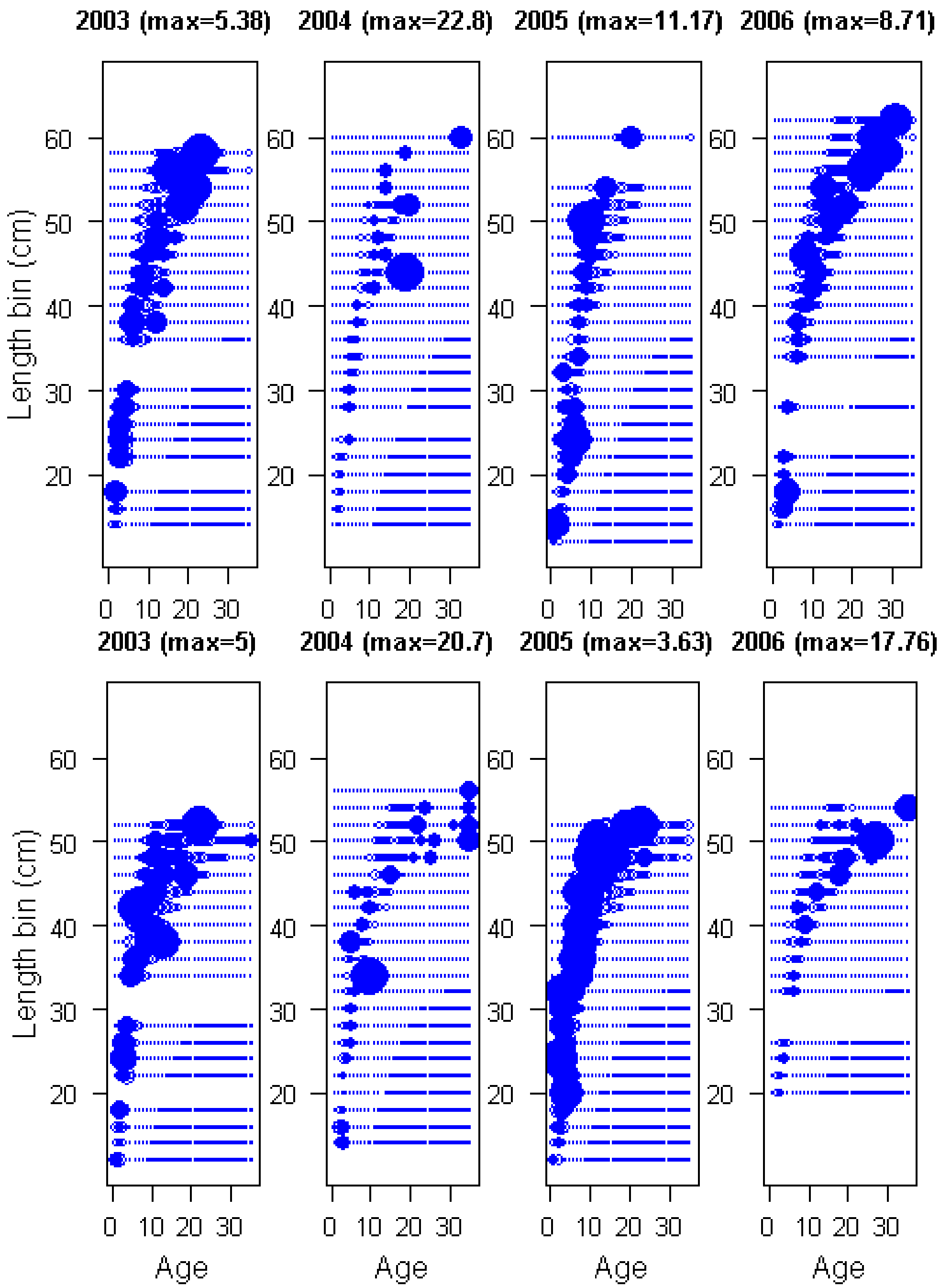


Figure 86. Pearson residuals for the fit to the NWFSC survey female (upper panels) and male (lower panels) conditional age-at-length frequencies. Each panel is scaled independently.

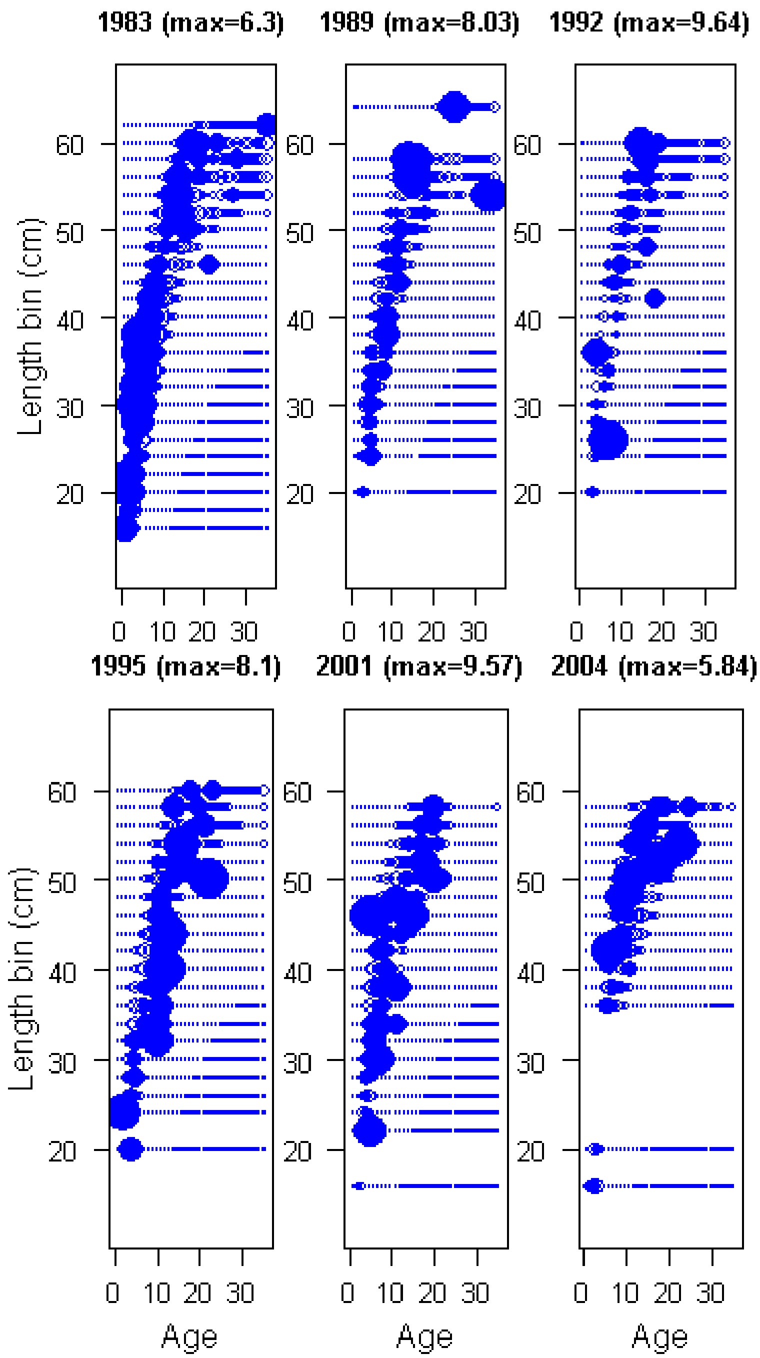


Figure 87. Pearson residuals for the fit to the triennial survey female conditional age-at-length frequencies. Each panel is scaled independently.

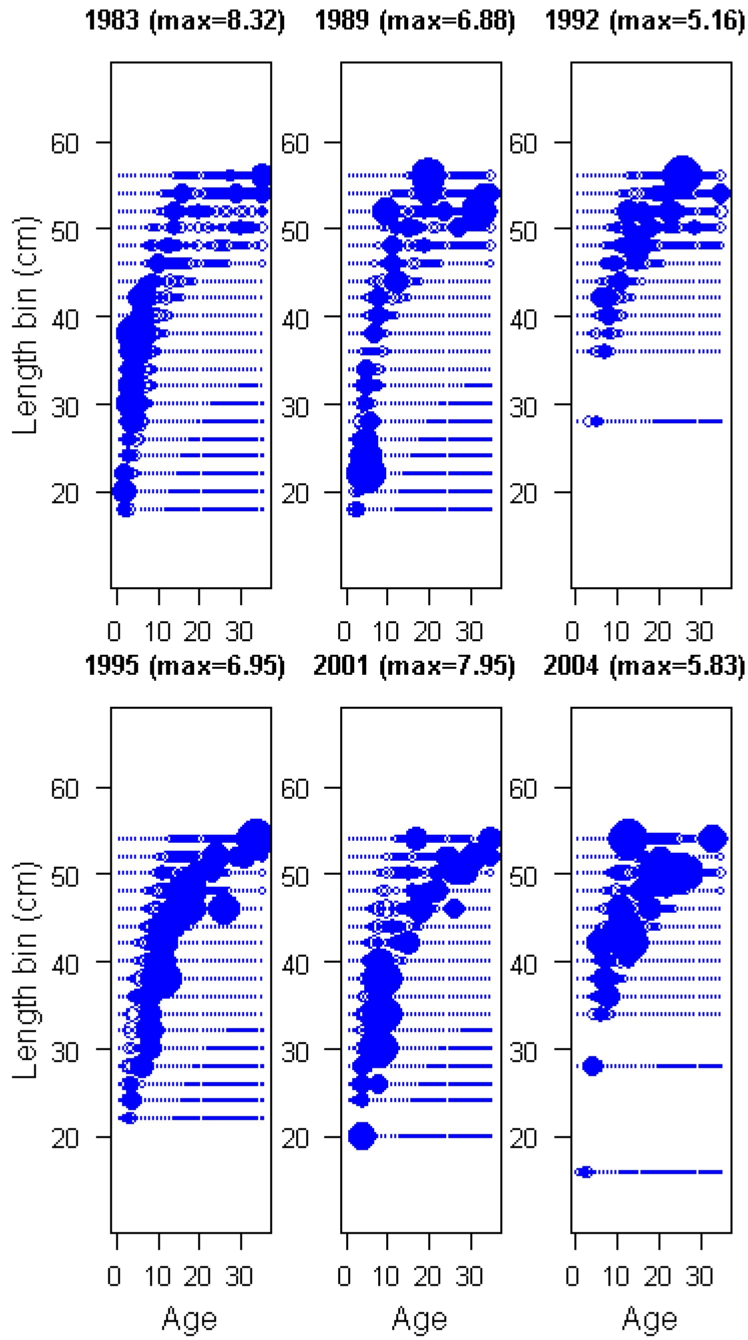


Figure 88. Pearson residuals for the fit to the triennial survey female conditional age-at-length frequencies. Each panel is scaled independently.

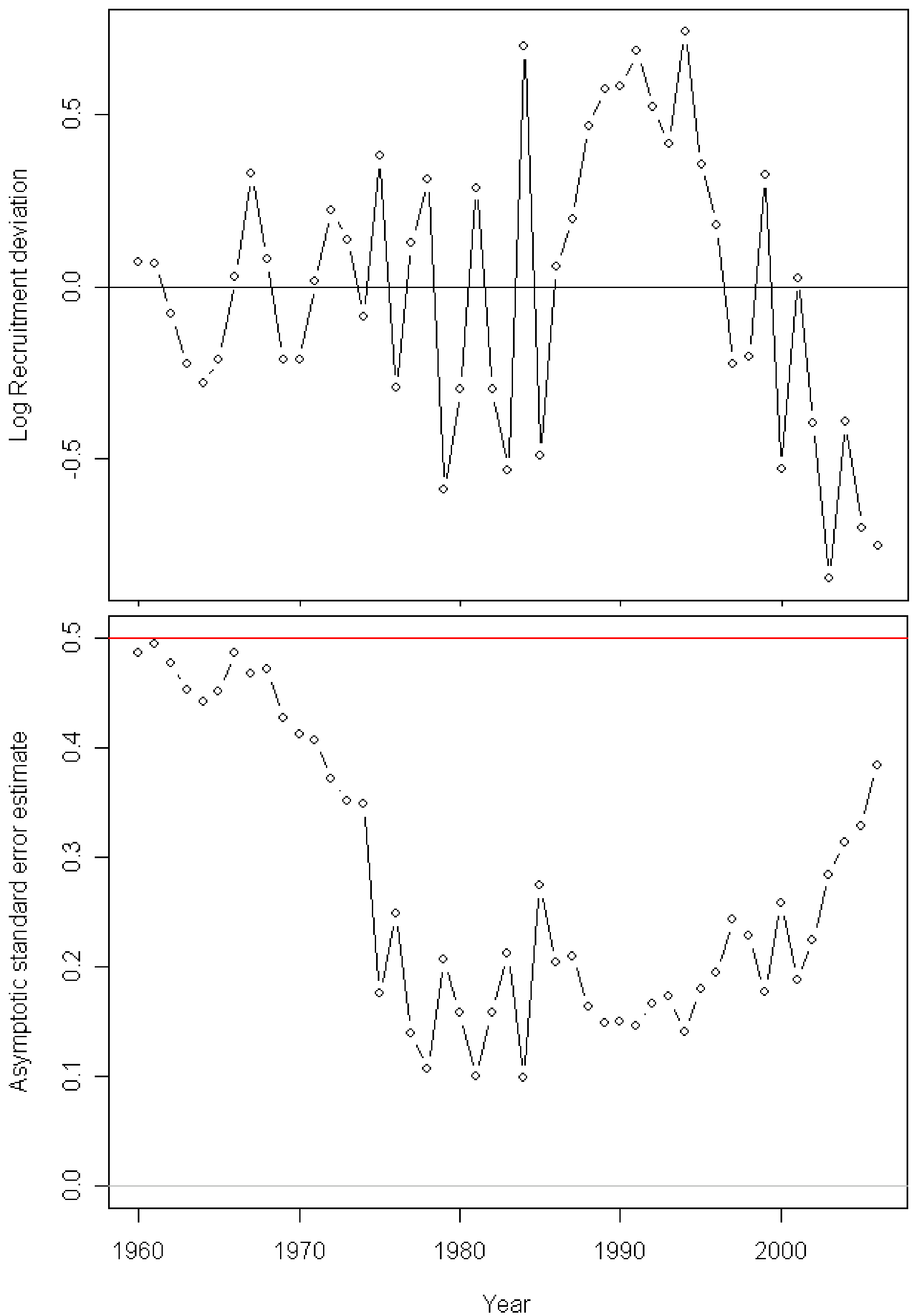


Figure 89. Log recruitment deviations (upper panel) and standard deviations of the recruitment deviations (lower panel) from the base case model run.

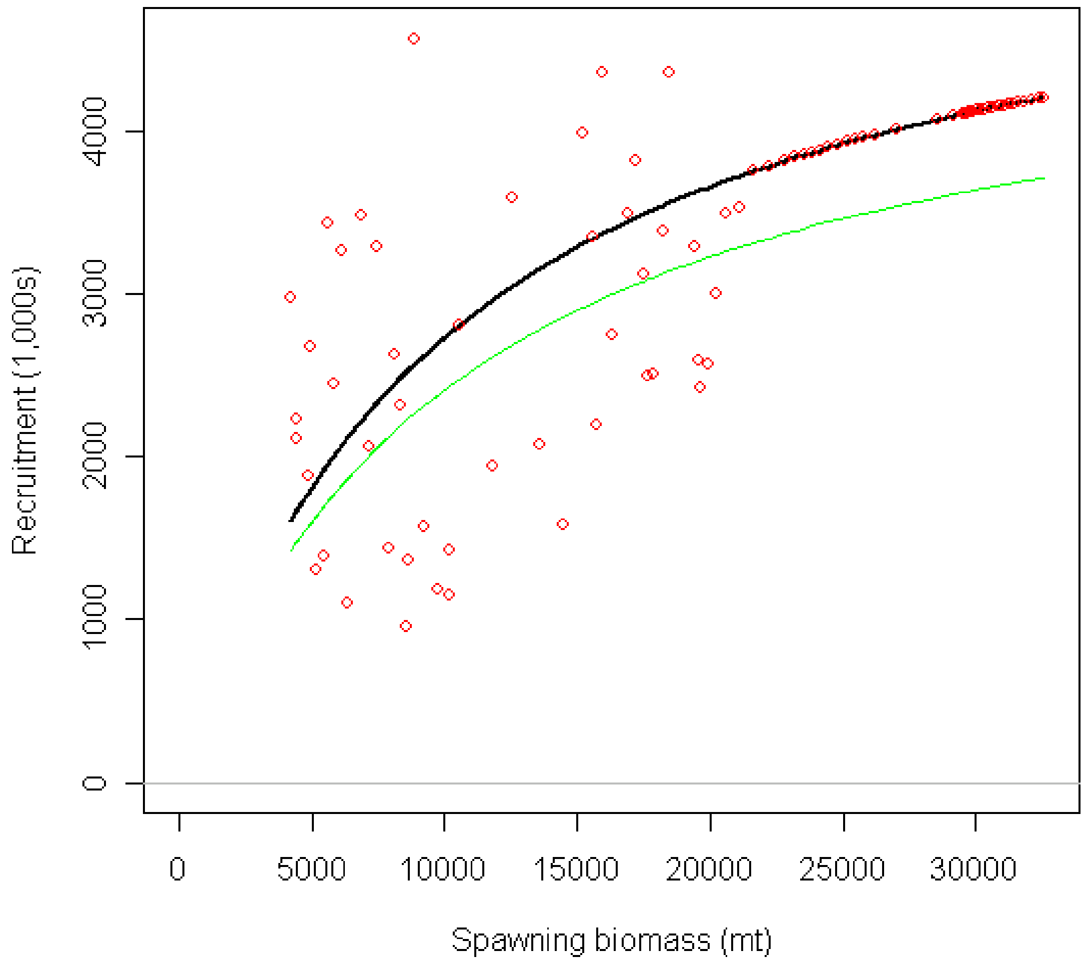


Figure 90. Stock-recruit function with predicted recruitments (points) and bias-corrected expectation (light line).

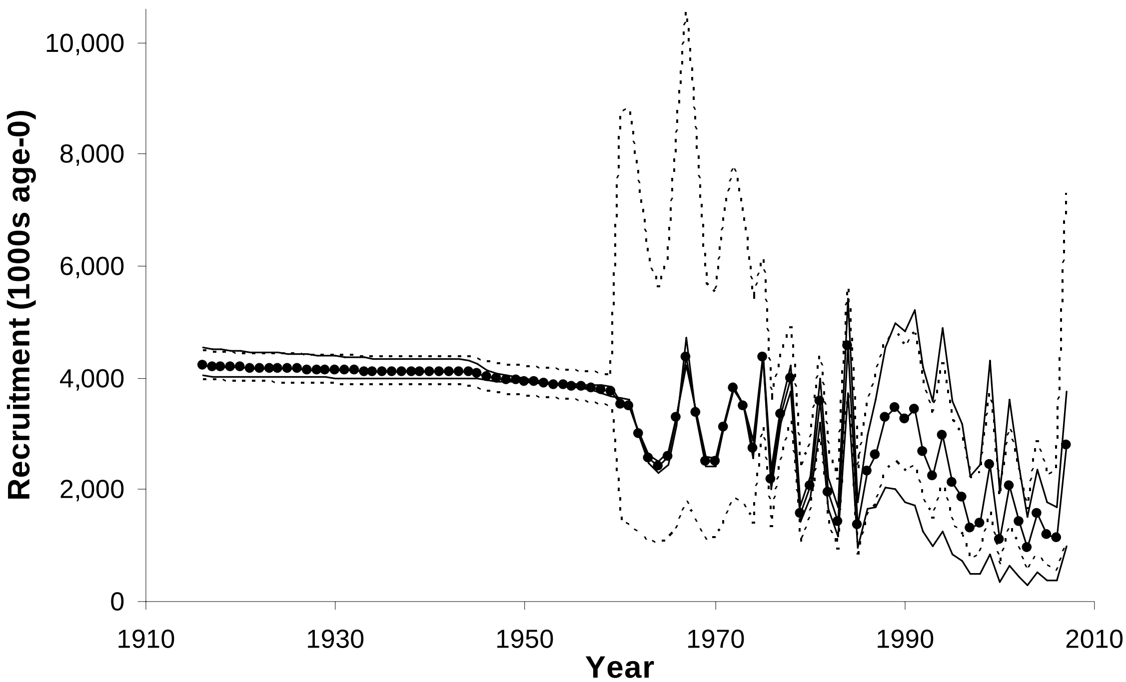


Figure 91. Time series of estimated canary rockfish recruitments for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

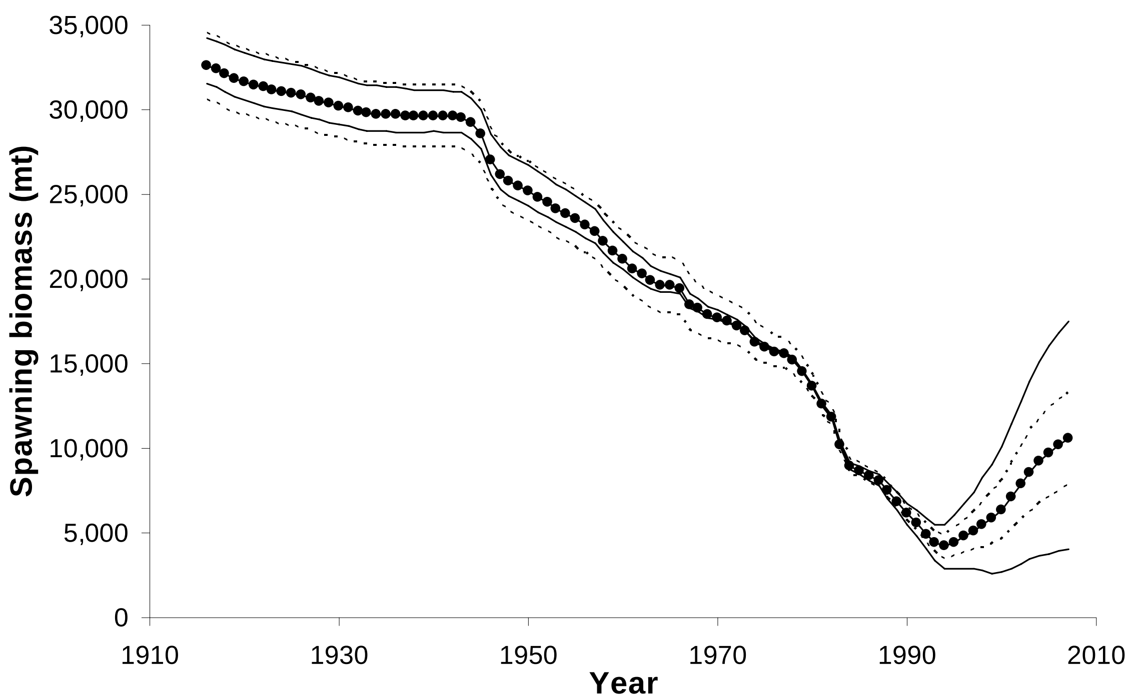


Figure 92. Estimated spawning biomass time-series (1916-2007) for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

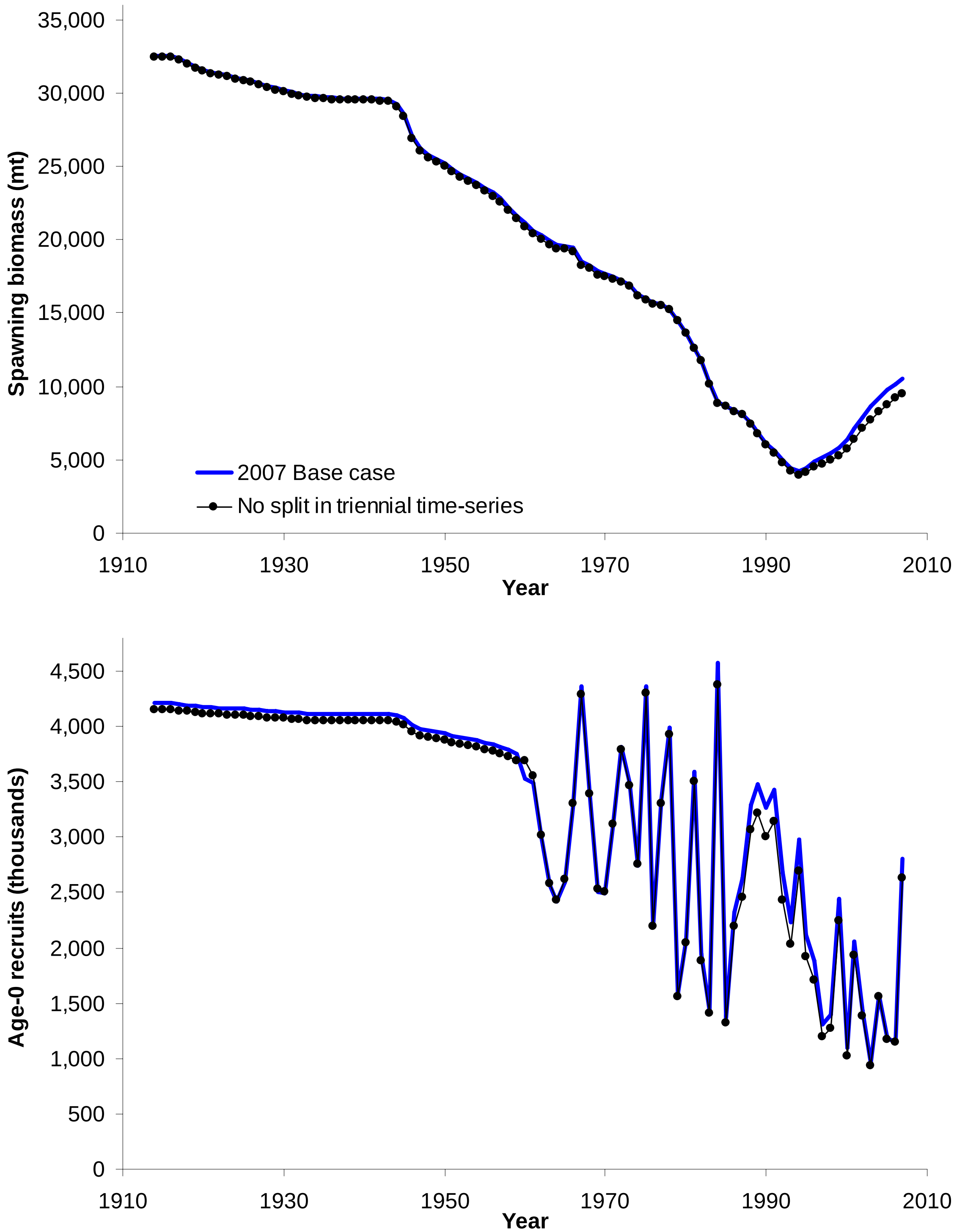


Figure 93. Analysis of sensitivity to splitting the triennial survey time-series.

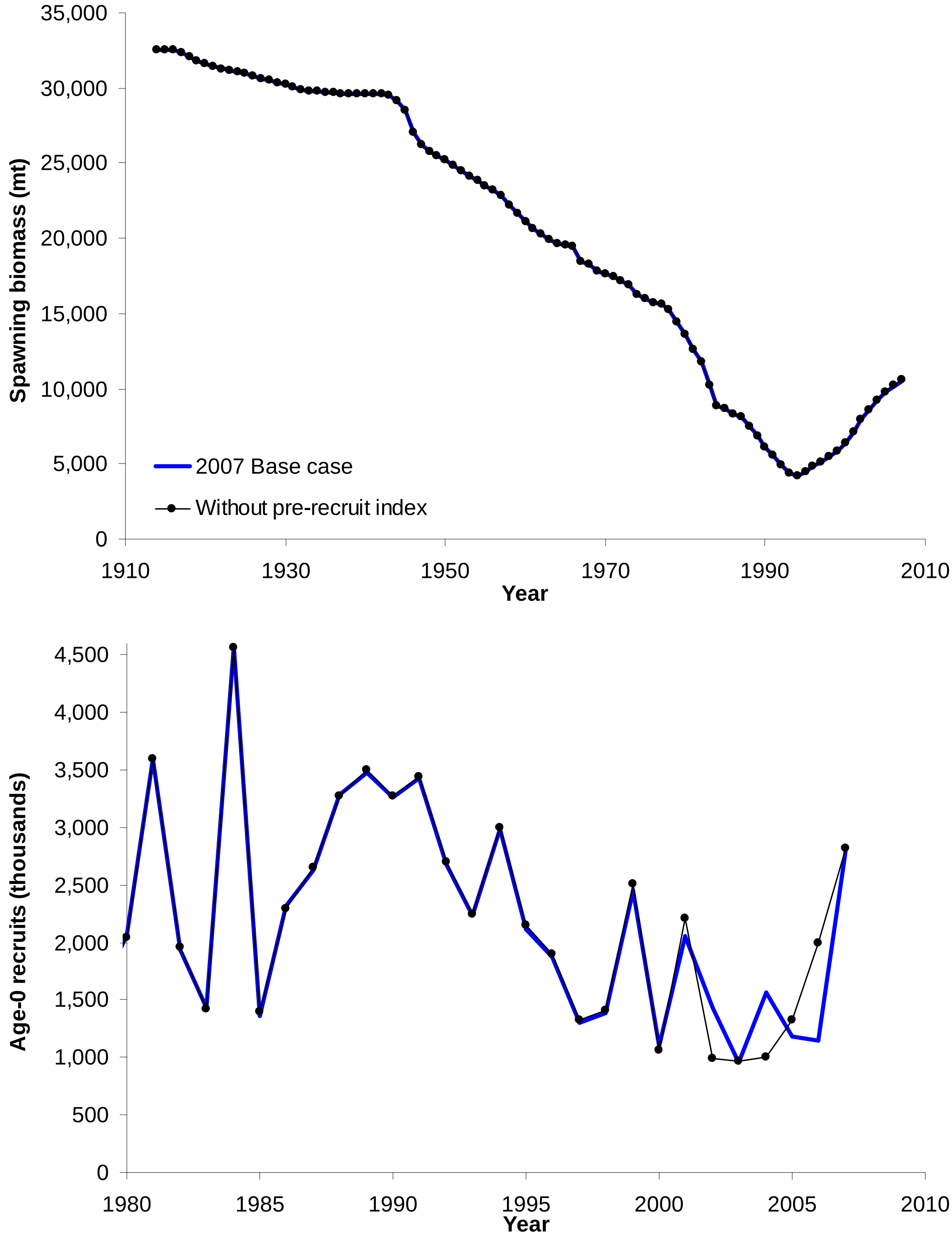


Figure 94. Analysis of sensitivity to exclusion of the pre-recruit index.

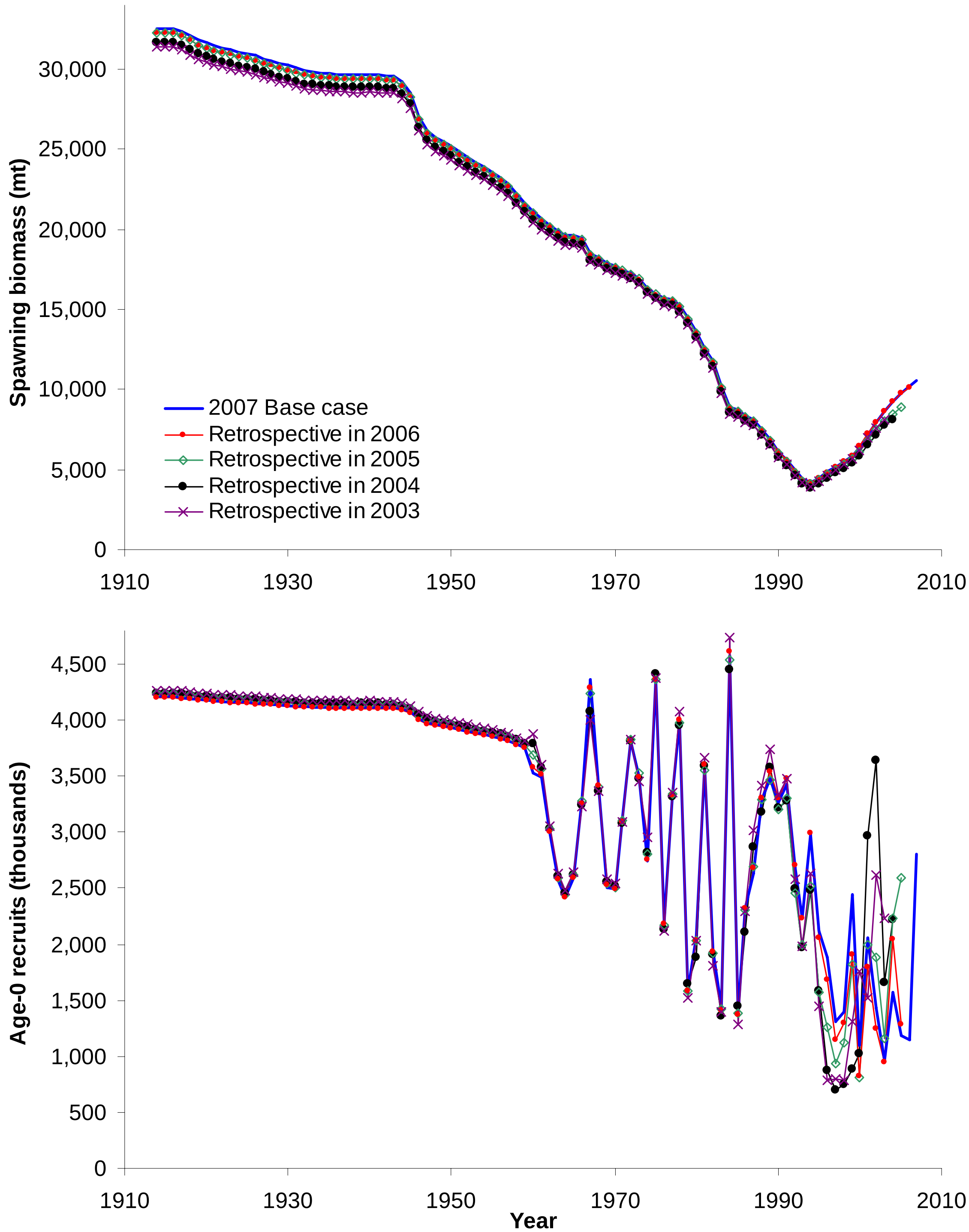


Figure 95. Results from a 4-year retrospective analysis. Each year of retrospective is performed as if the assessment were conducted in that year (i.e., retrospective in 2006 includes data through 2005).

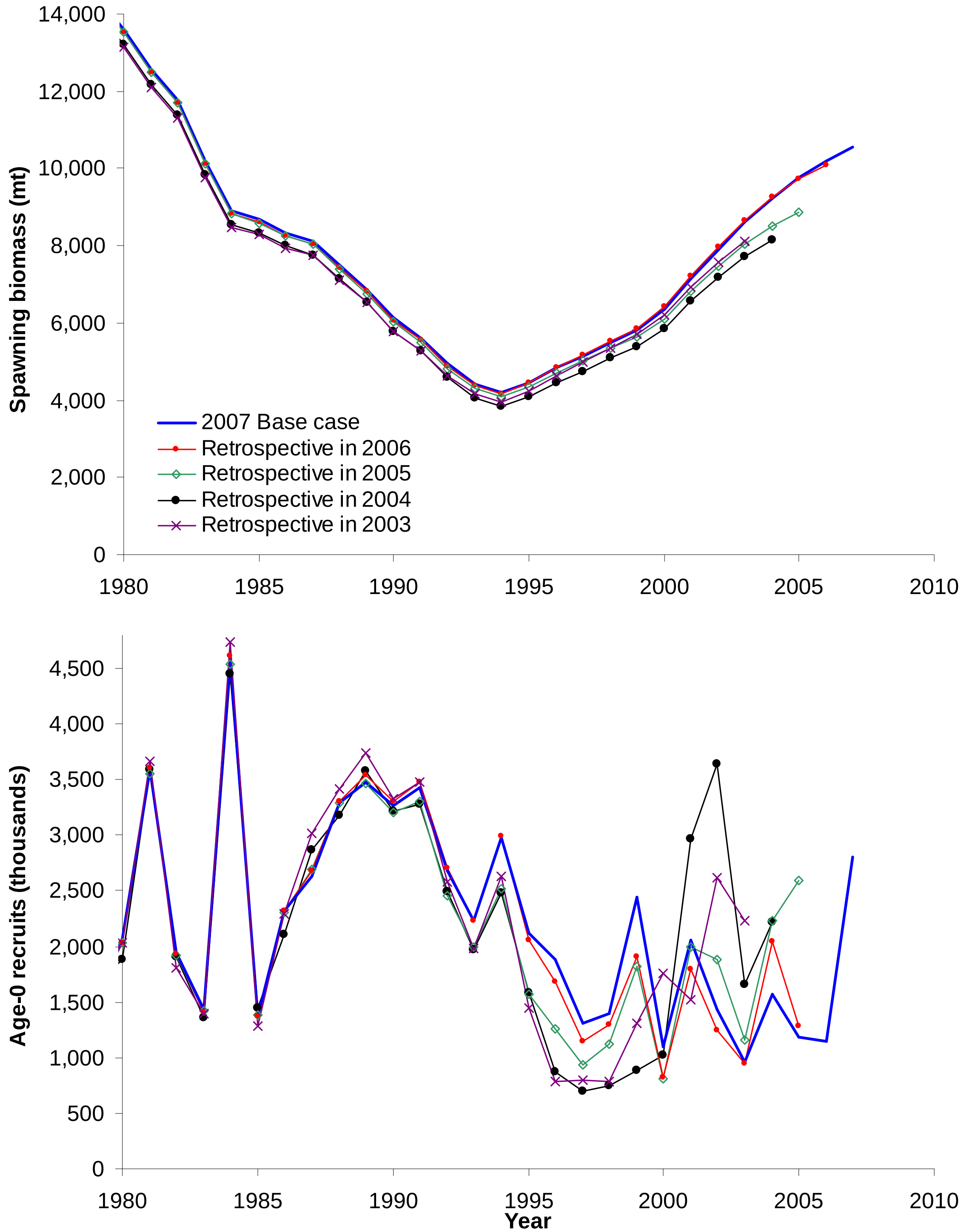
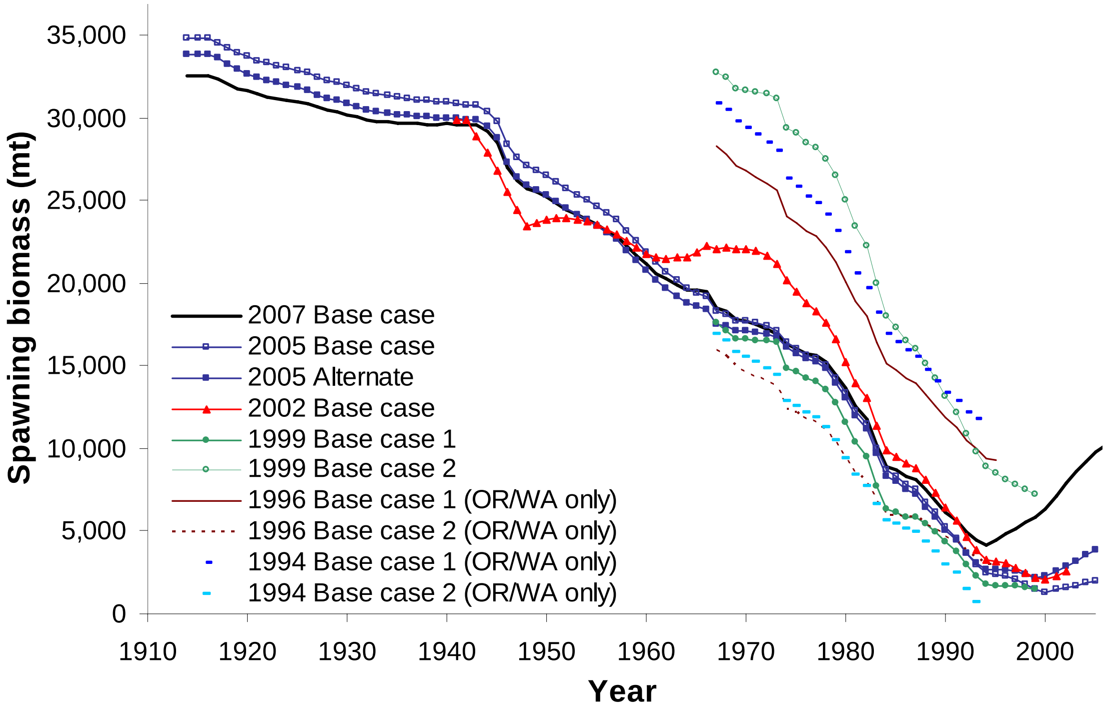


Figure 96. Focus on recent trend from a 4-year retrospective analysis. Each year of retrospective is performed as if the assessment were conducted in that year (i.e., retrospective in 2006 includes data through 2005).



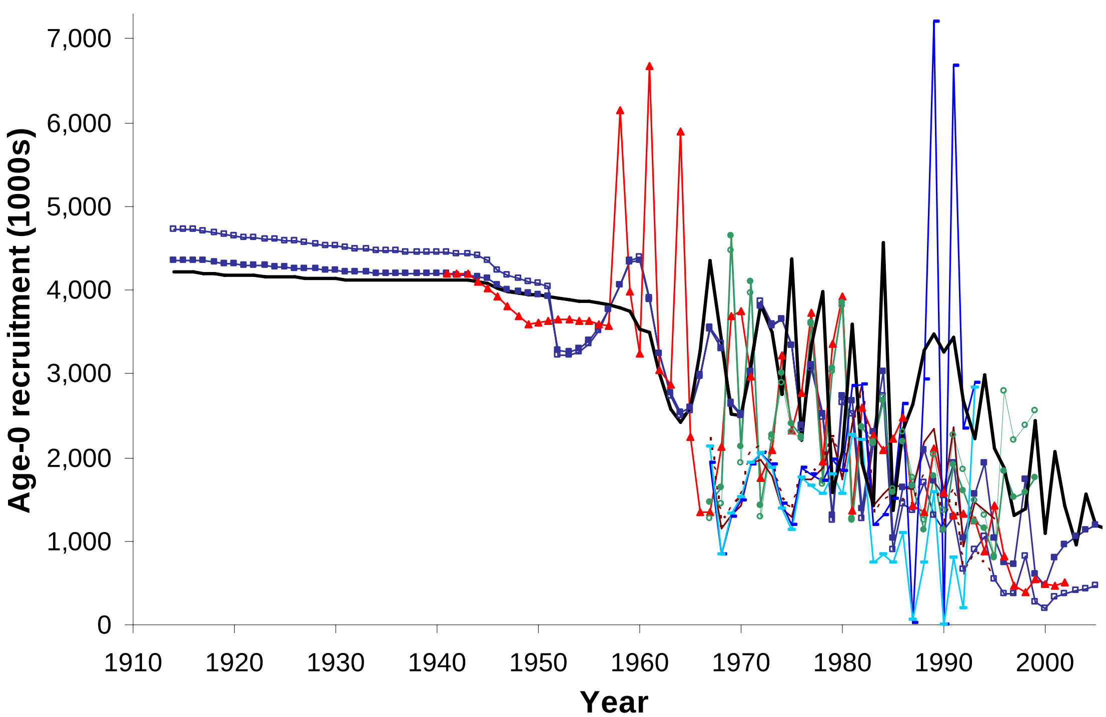


Figure 97. Retrospective analysis across stock assessments for canary rockfish, 1994-2007.

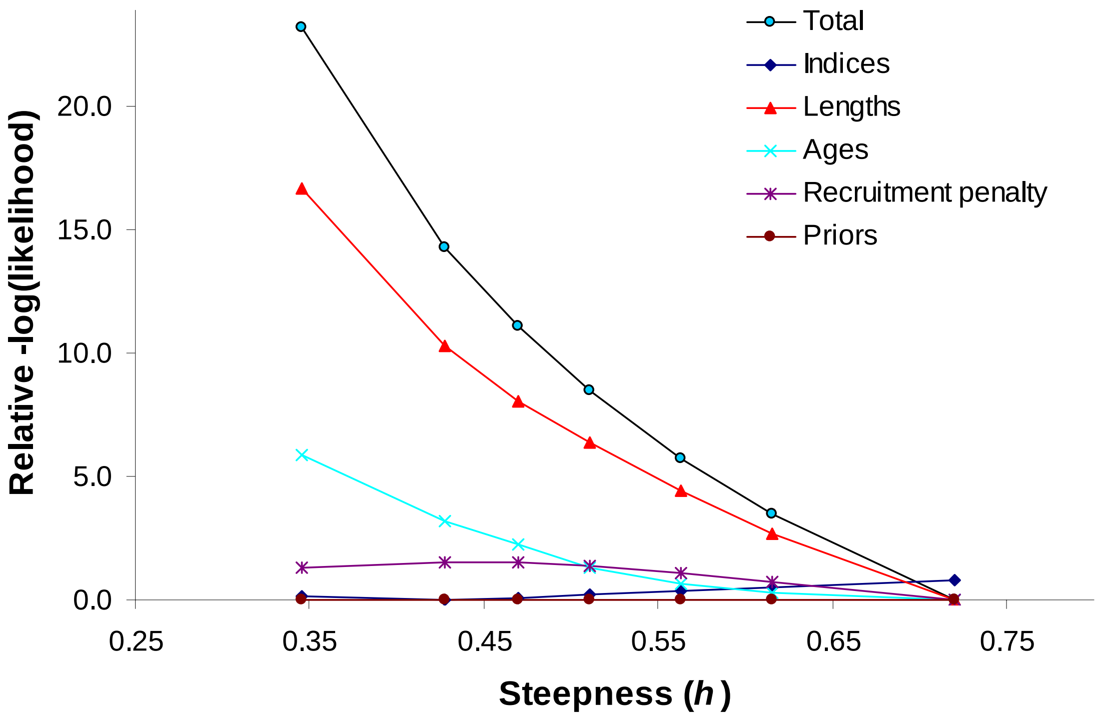


Figure 98. Relative contribution of each likelihood component to the likelihood profile for steepness of the stock-recruitment function.

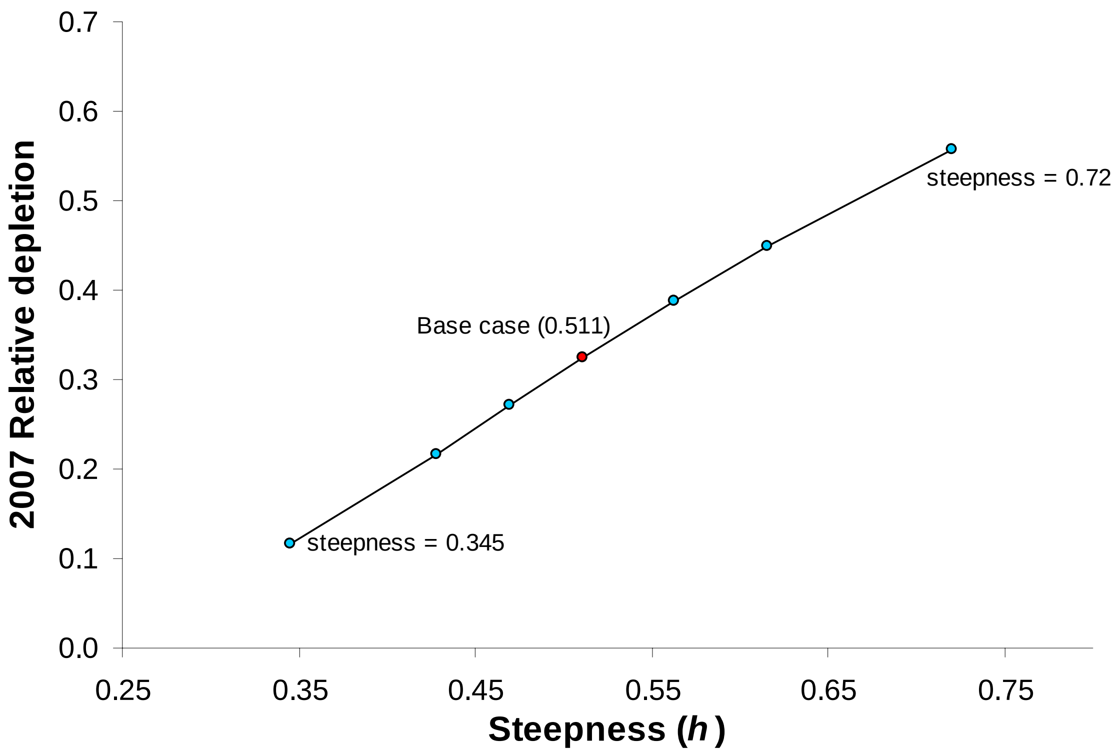


Figure 99. Relationship between 2007 relative depletion and steepness of the stock-recruitment function based on a likelihood profile.

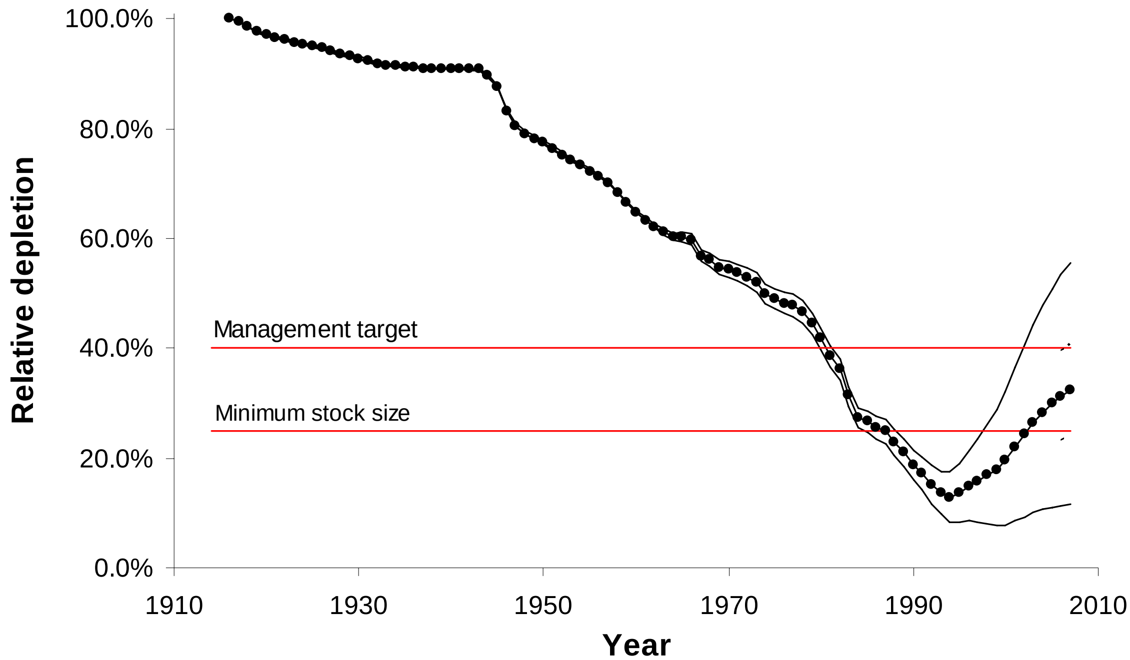


Figure 100. Time series of depletion level as estimated in the base case model (round points) with approximate asymptotic 95% confidence interval (2006-2007 only, dashed lines) and alternate states of nature (light lines).

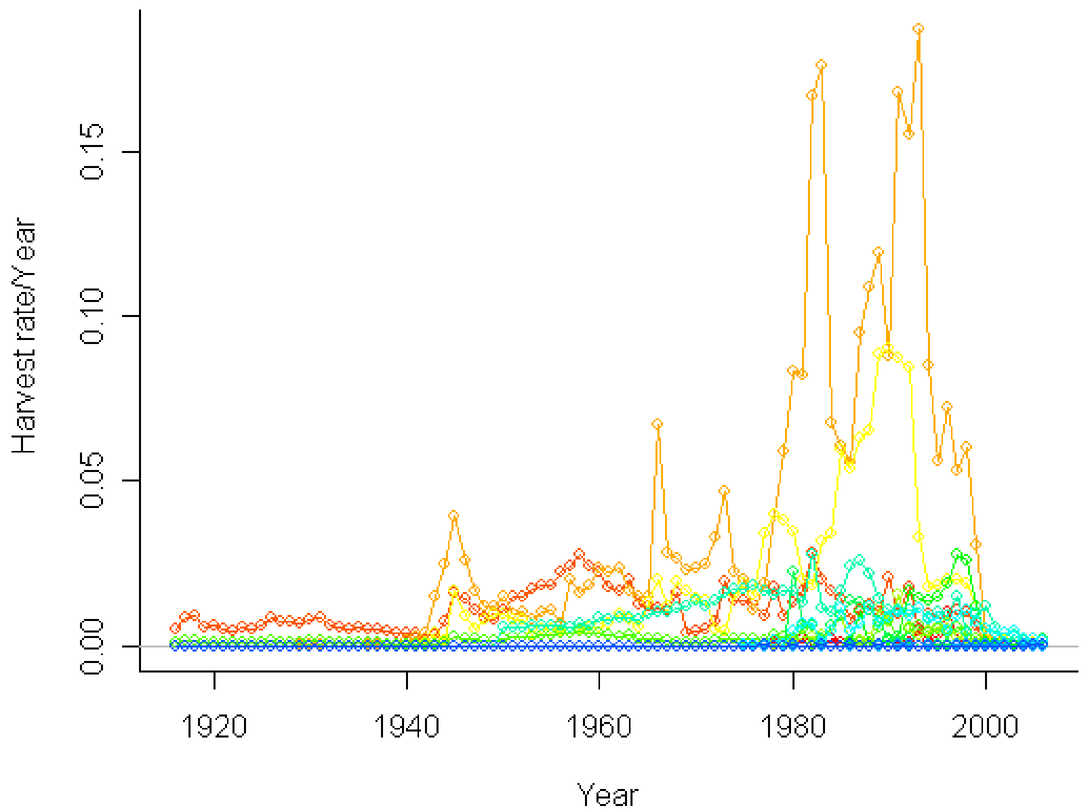


Figure 101. Time-series of harvest rate per year (F) for the fishing fleets. The Oregon trawl fleet is the upper line from 1979-1999 and the Washington trawl fleet is the second highest line 1983-1996.

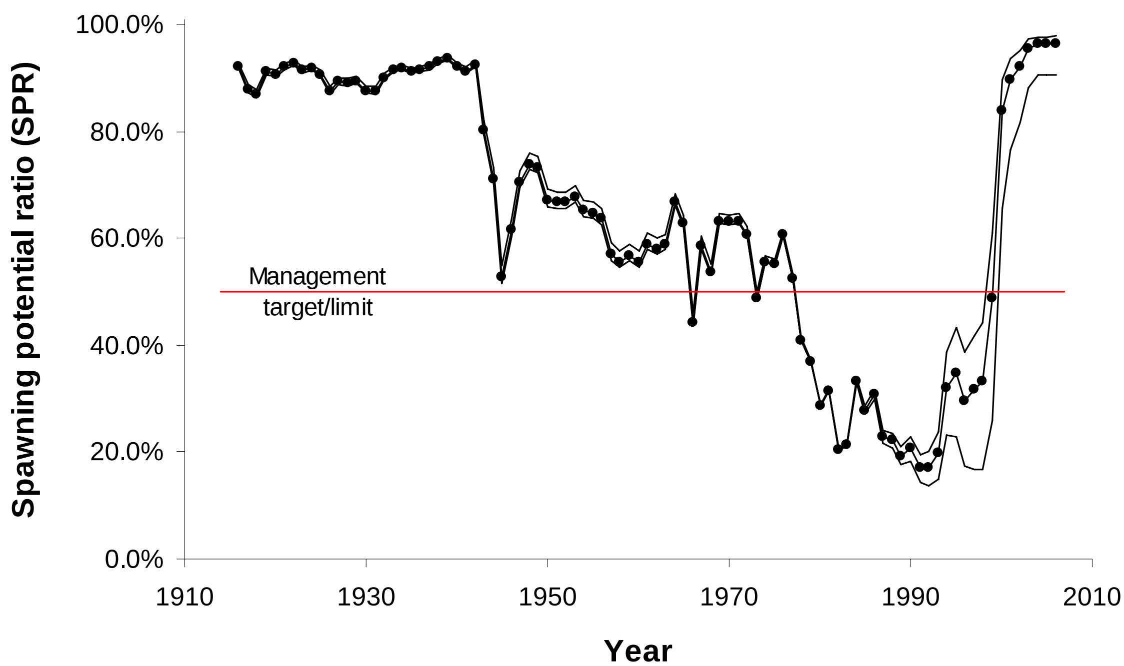


Figure 102. Time series of estimated spawning potential ratio (SPR) for the base case model (round points) and alternate states of nature (light lines). Values of SPR below 0.5 reflect harvests in excess of the current overfishing proxy.

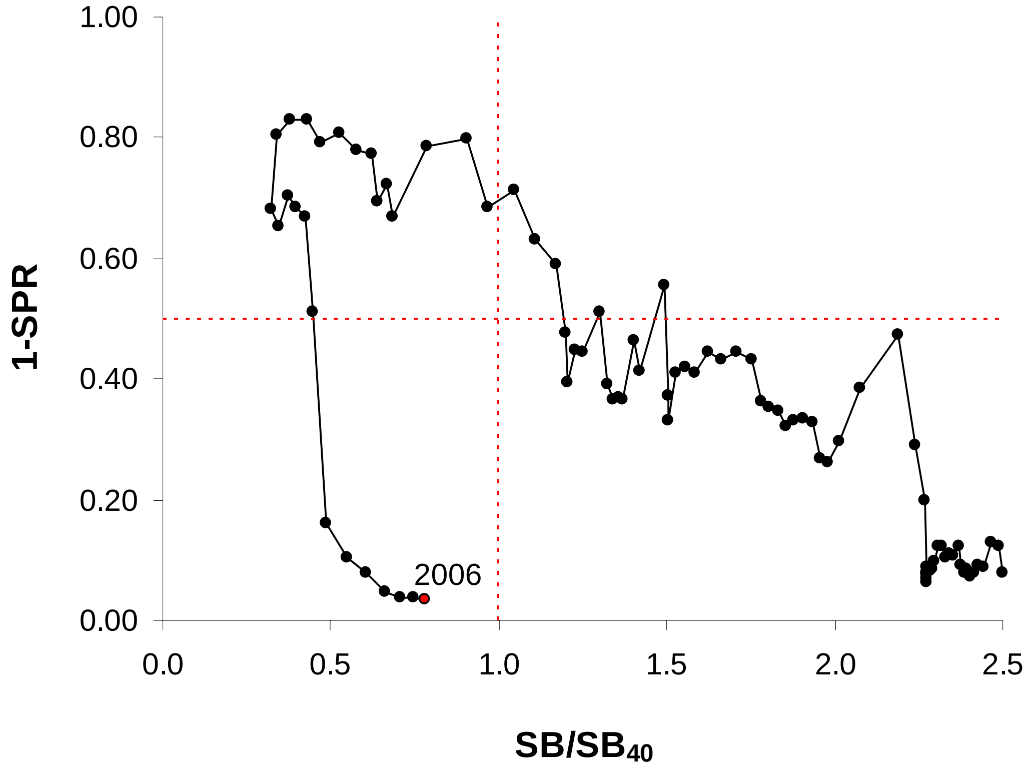


Figure 103. Estimated spawning potential ratio relative to the proxy target of 50% vs. estimated spawning biomass relative to the proxy 40% level from the base case model. Higher biomass occurs on the right side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

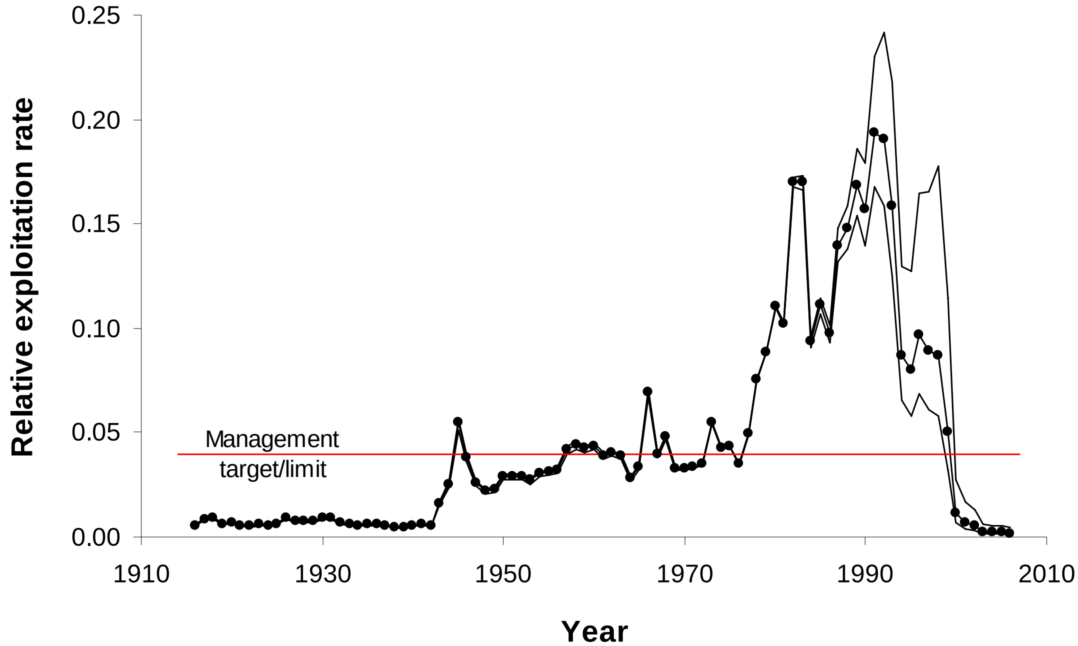


Figure 104. Time series of estimated relative exploitation rate (catch/age 5 and older biomass, lower panel) for the base case model (round points) and alternate states of nature (light lines). Values of relative exploitation rate in excess of horizontal line are above the rate corresponding to the overfishing proxy from the base case.

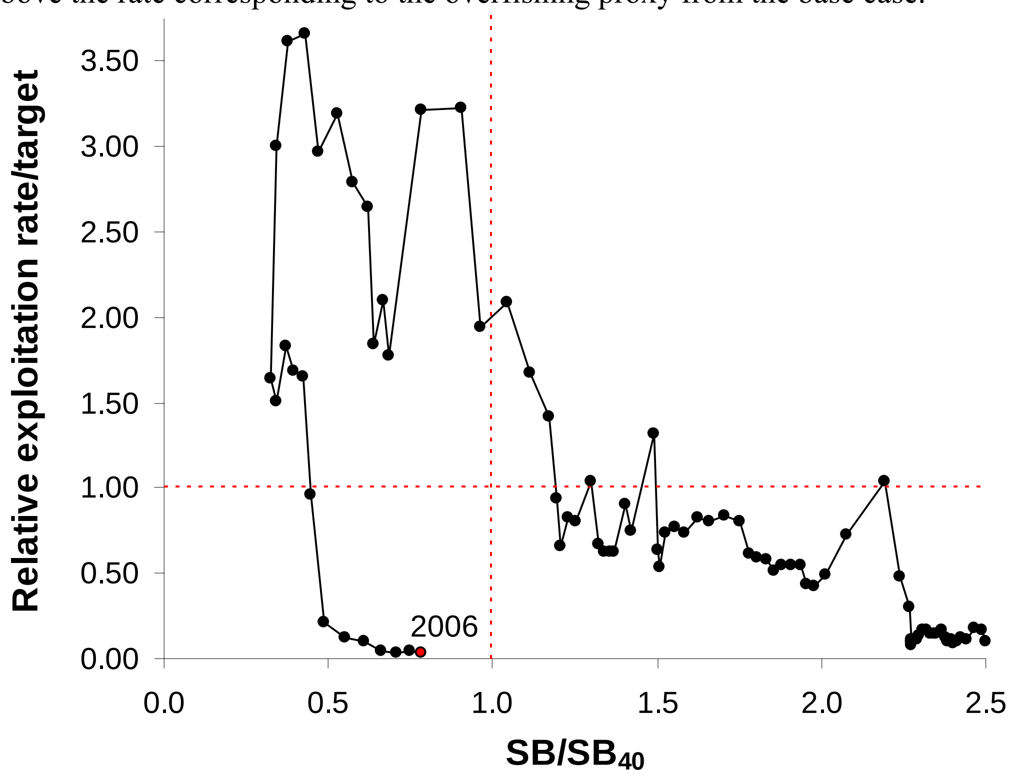


Figure 105. Phase plot of estimated fishing intensity vs. relative spawning biomass for the base case model. Fishing intensity is the relative exploitation rate divided by the level corresponding to the overfishing proxy (0.040). Relative spawning biomass is annual spawner abundance divided by the 40% rebuilding target.

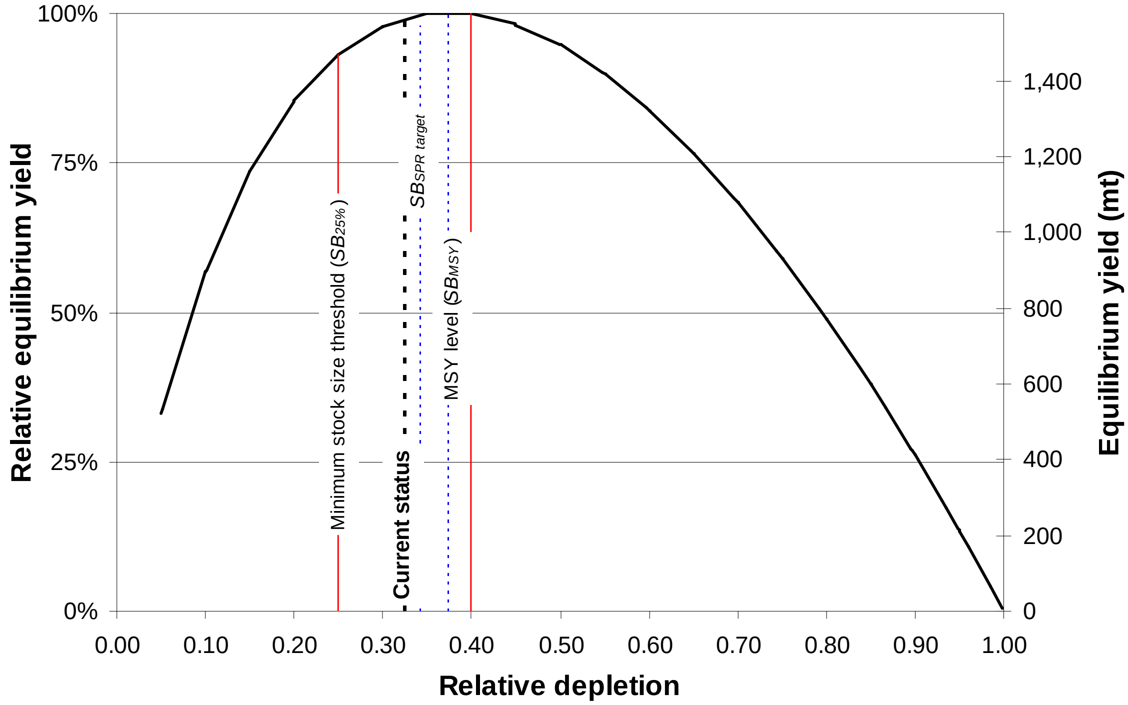


Figure 106. Equilibrium yield curve for the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

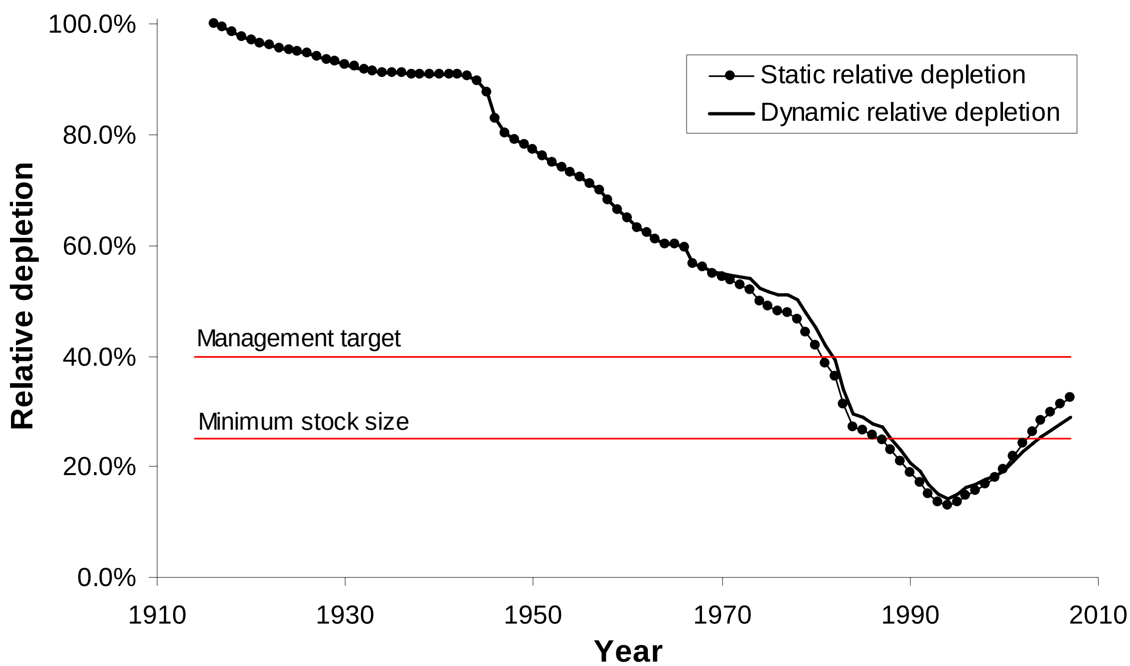


Figure 107. Comparison of the standard 'static' estimate of relative depletion (spawning biomass over unexploited spawning biomass) and the 'dynamic' estimate of spawning biomass over spawning biomass predicted for that year in the absence of any fishing.

12. Appendix A: Fits to fishery length and age data with diagnostics

In this appendix a series of three types of plots are presented for each kind of data and fishing fleet in the canary assessment model. The first plot shows the relationship between input and effective sample size, the second the fit to the compositional data and the third the Pearson residuals for the preceding fit. Length data are presented first, followed by age data.

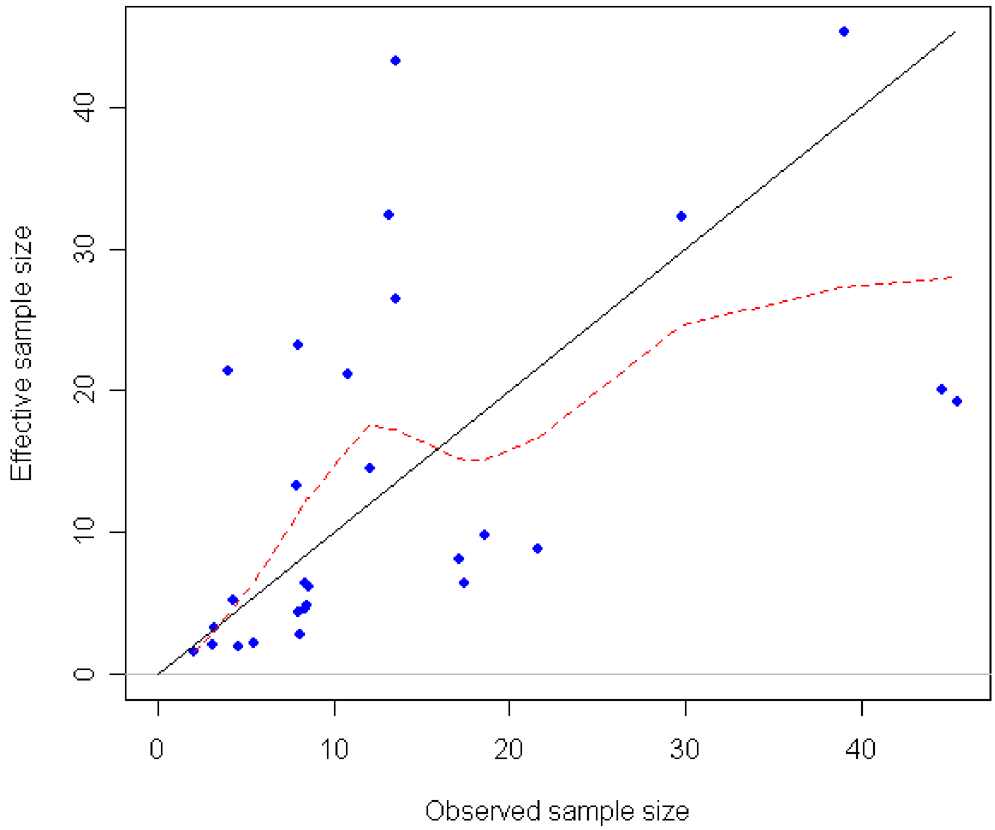


Figure 108. Observed and effective sample sizes for the Southern California trawl fleet length-frequency observations (sexes combined).

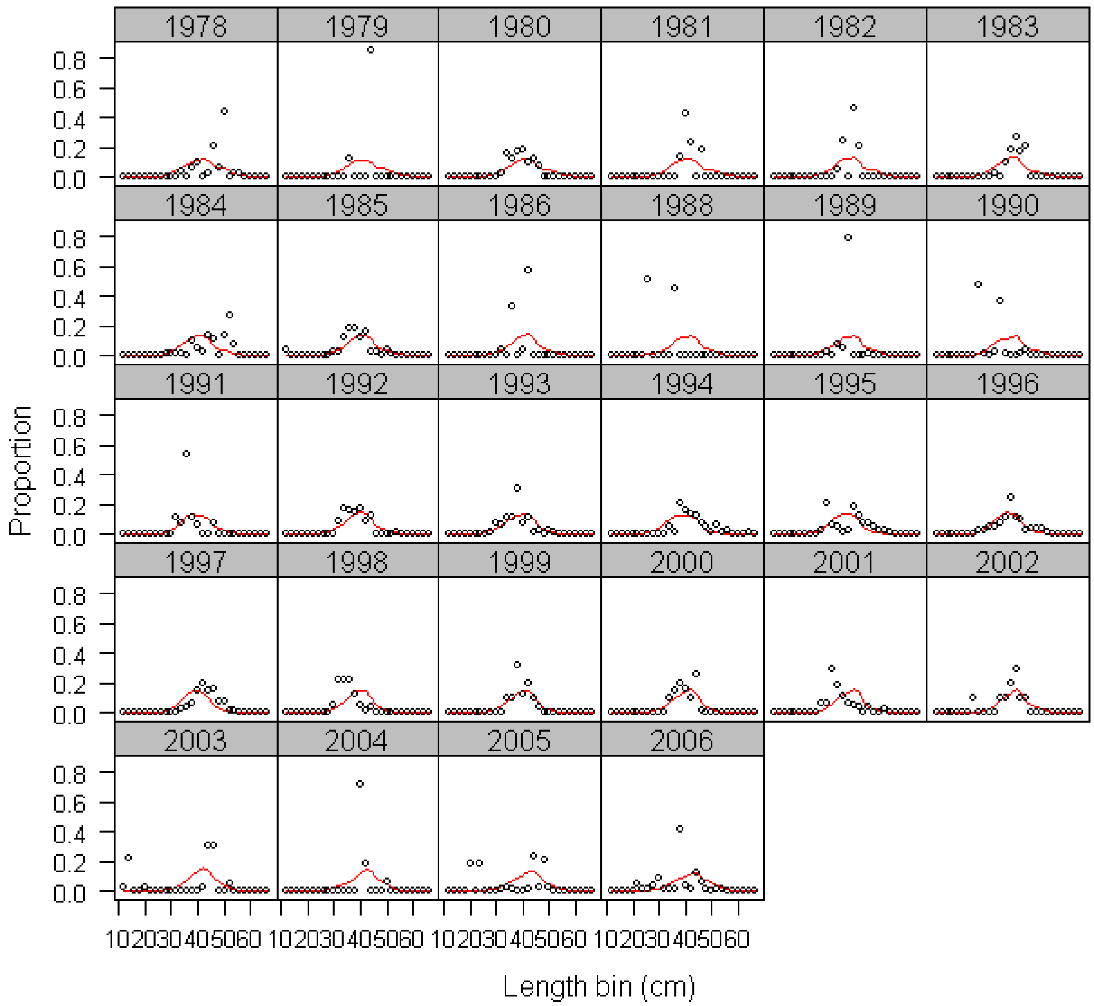


Figure 109. Fit to length-frequency observations (sexes combined) for the Southern California trawl fleet.

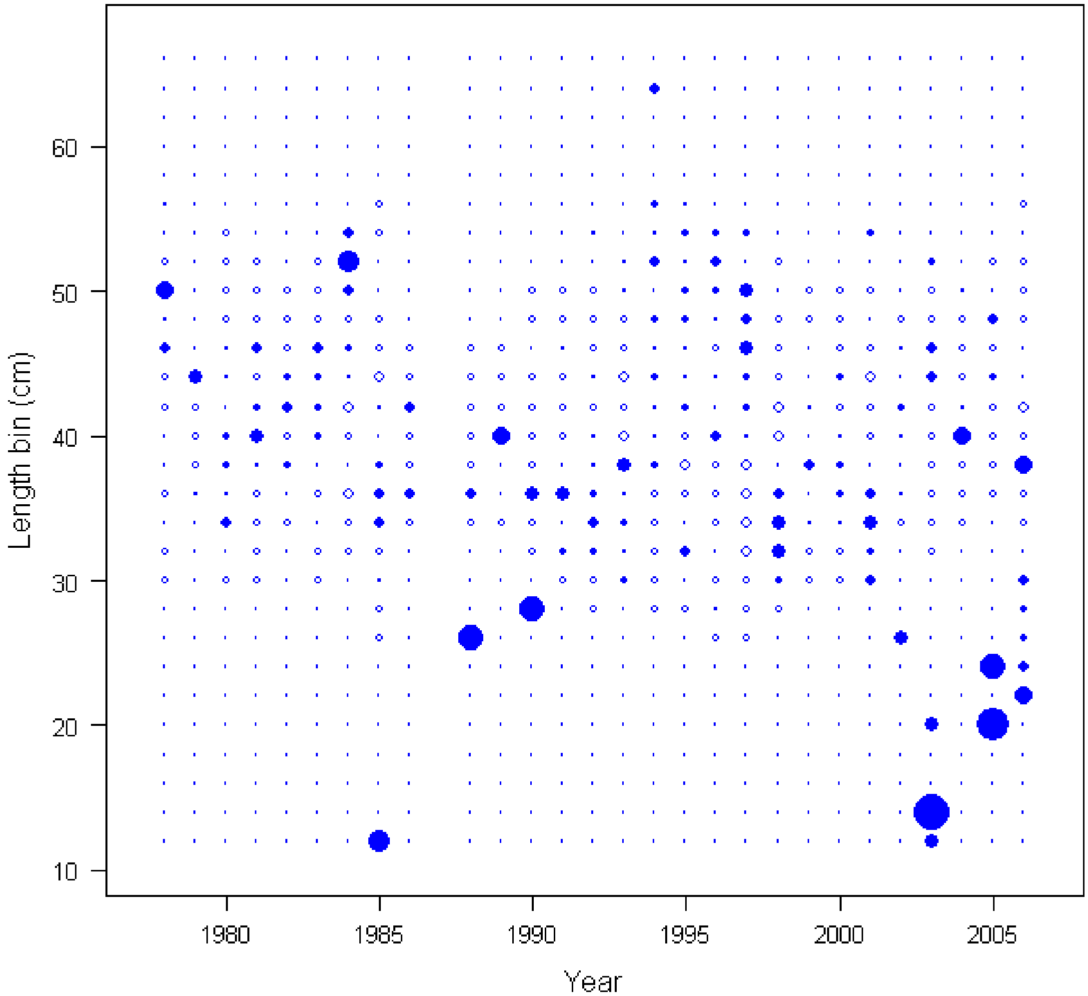


Figure 110. Pearson residuals for the fit to length-frequency observations (sexes combined) for the Southern California trawl fleet. The largest circle represents a value of 21.03; filled circles show observation greater than estimate; solid circles show observation less than estimate.

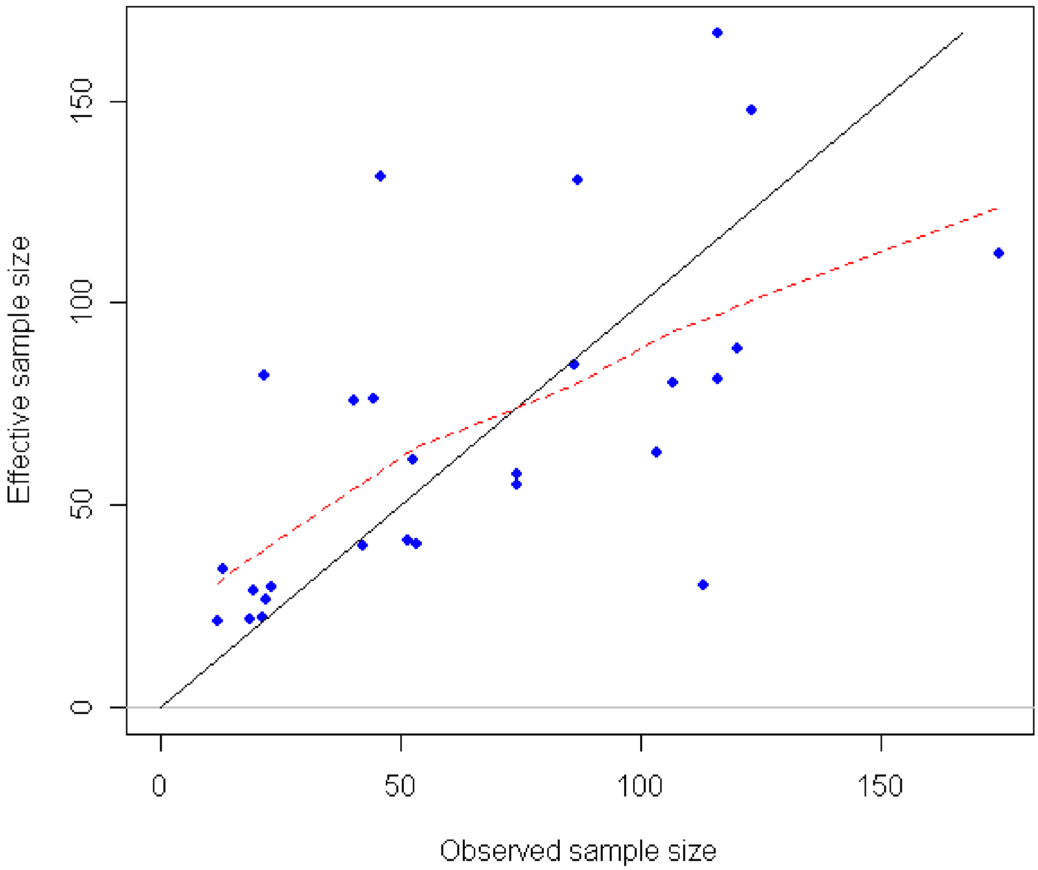
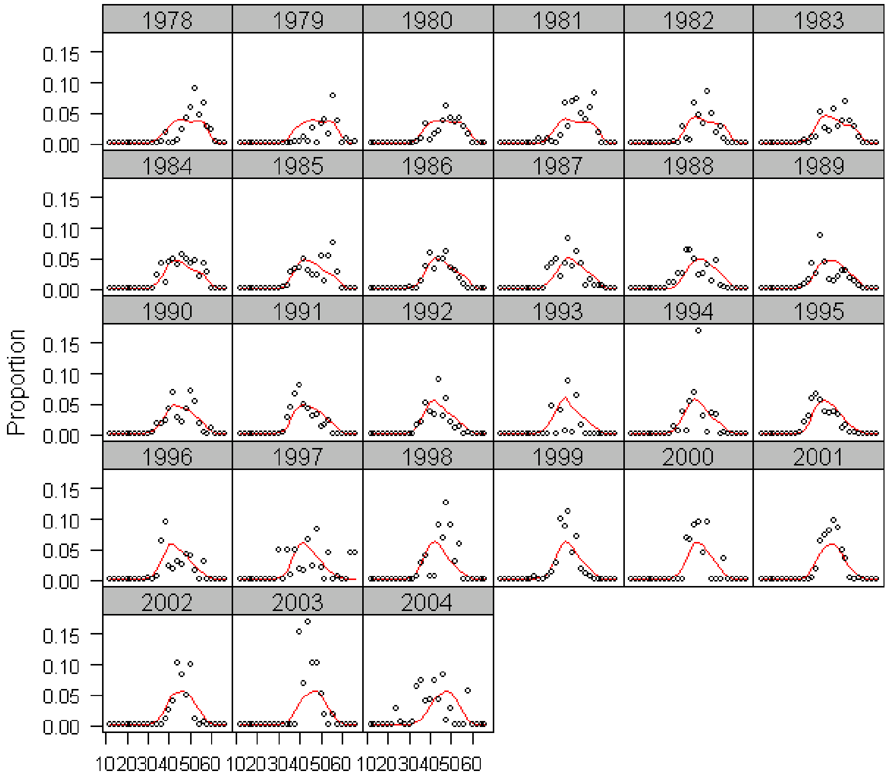


Figure 111. Observed and effective sample sizes for the Northern California trawl fleet length-frequency observations.



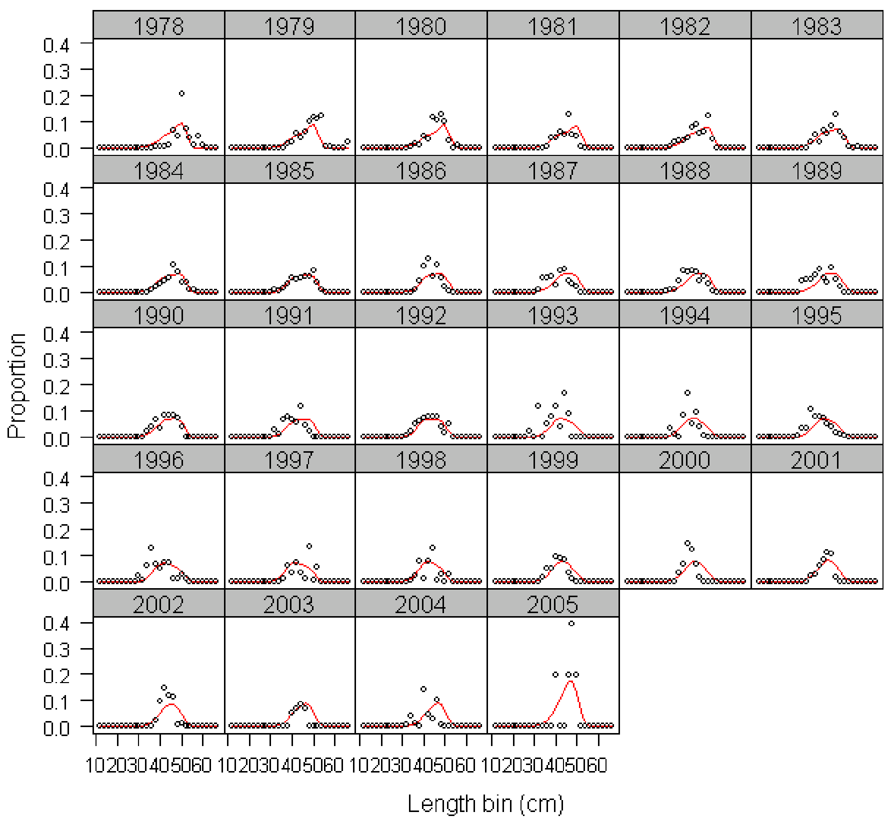


Figure 112. Fit to female (upper panel) and male (lower panel) length-frequency observations for the Northern California trawl fleet.

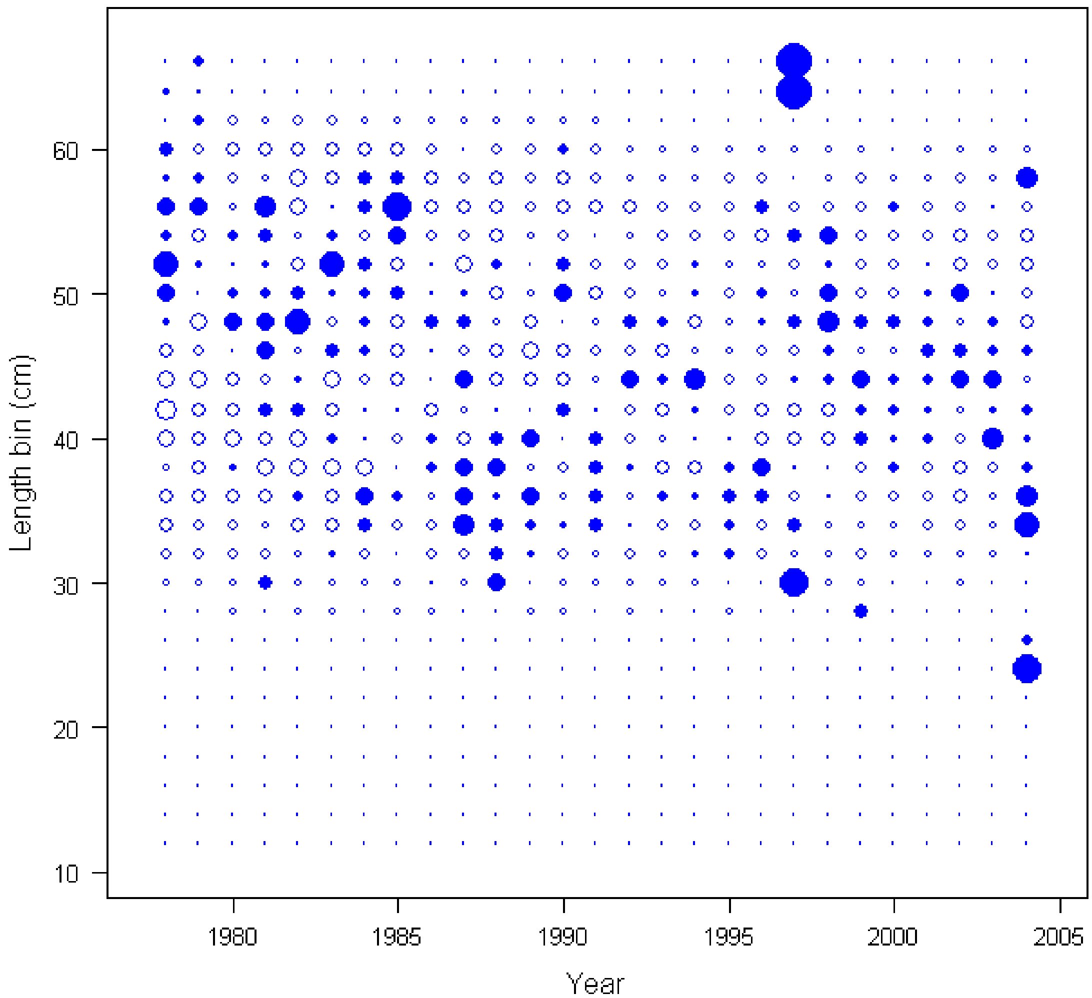


Figure 113. Pearson residuals for the fit to female length-frequency observations for the Northern California trawl fleet. The largest circle represents a value of 6.80; filled circles show observation greater than estimate; solid circles show observation less than estimate.

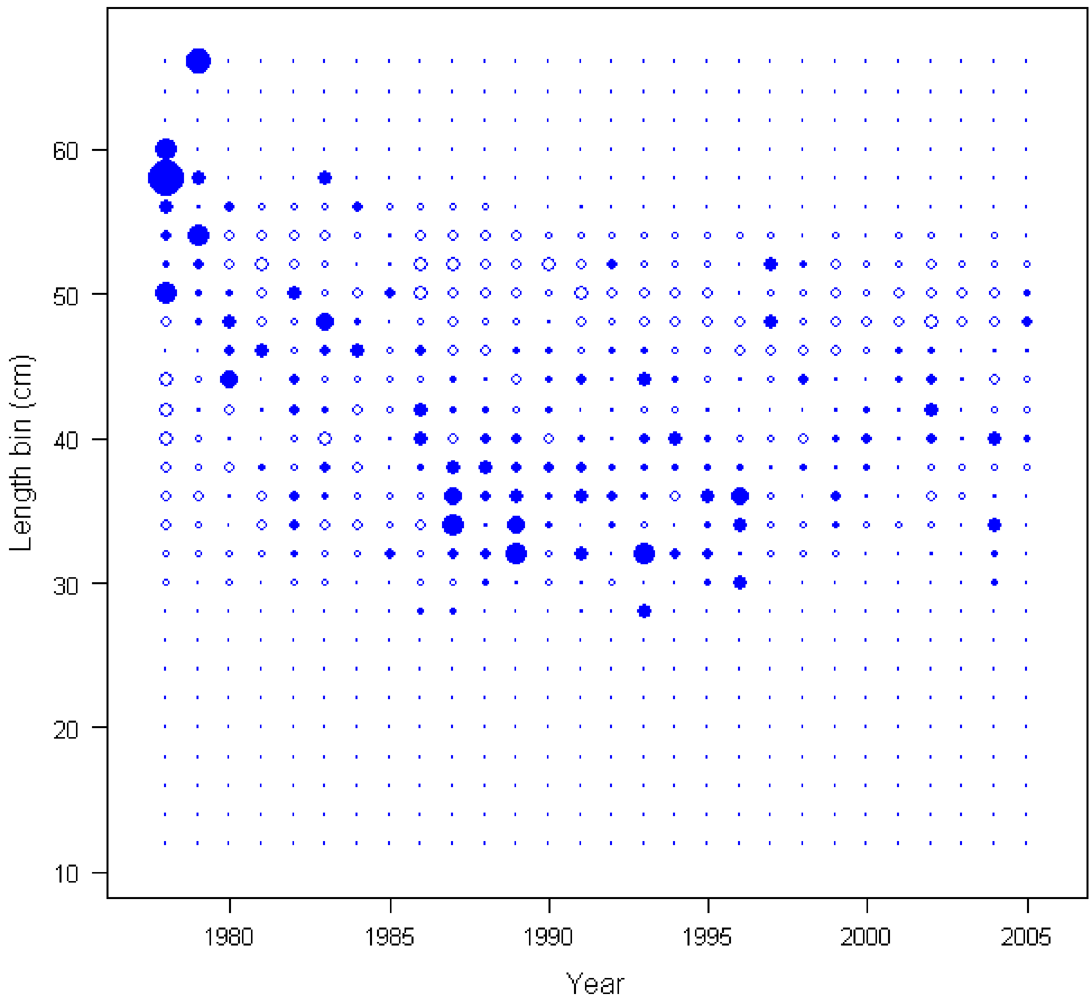


Figure 114. Pearson residuals for the fit to male length-frequency observations for the Northern California trawl fleet. The largest circle represents a value of 13.58; filled circles show observation greater than estimate; solid circles show observation less than estimate.

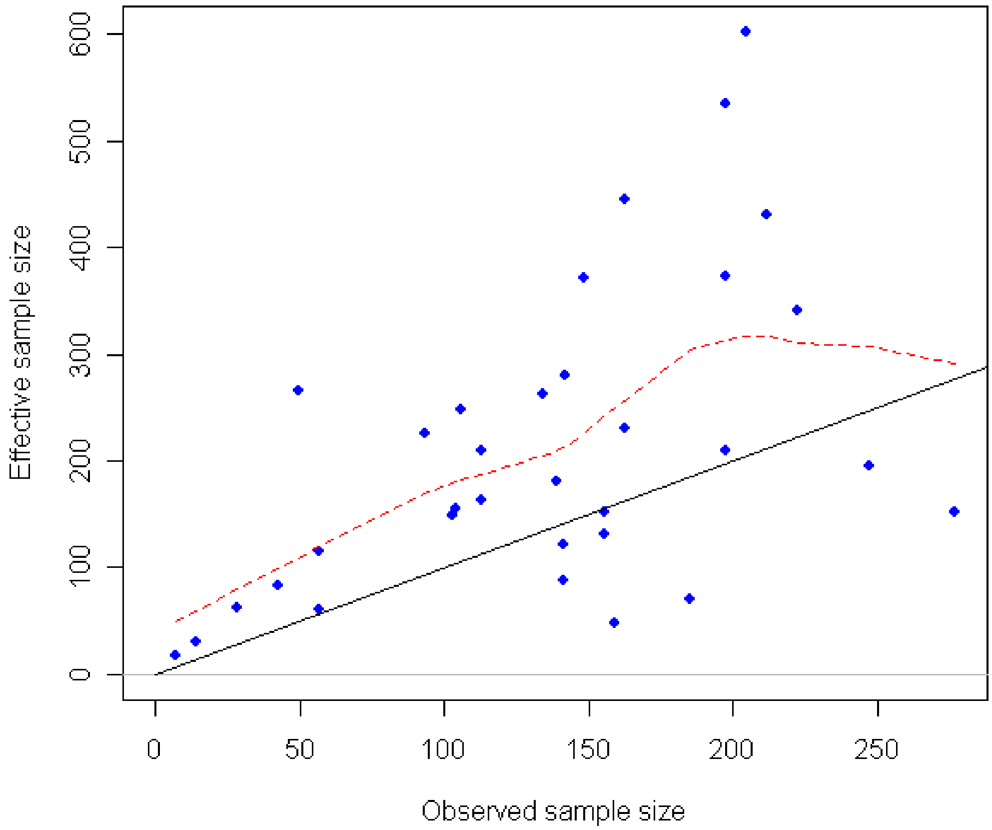


Figure 115. Observed and effective sample sizes for the Oregon trawl fleet length-frequency observations.

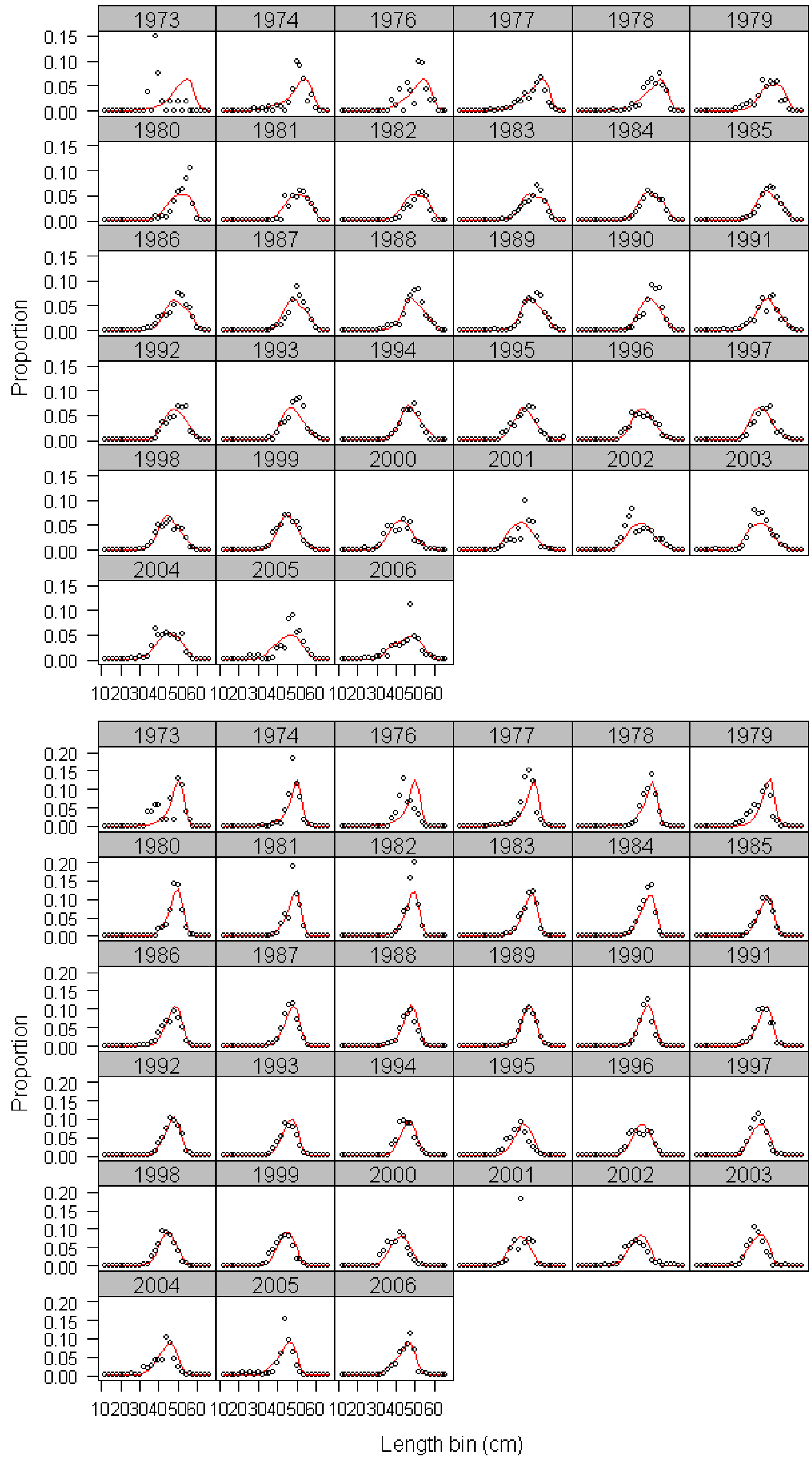


Figure 116. Fit to female (upper panel) and male (lower panel) length-frequency observations for the Oregon trawl fleet.

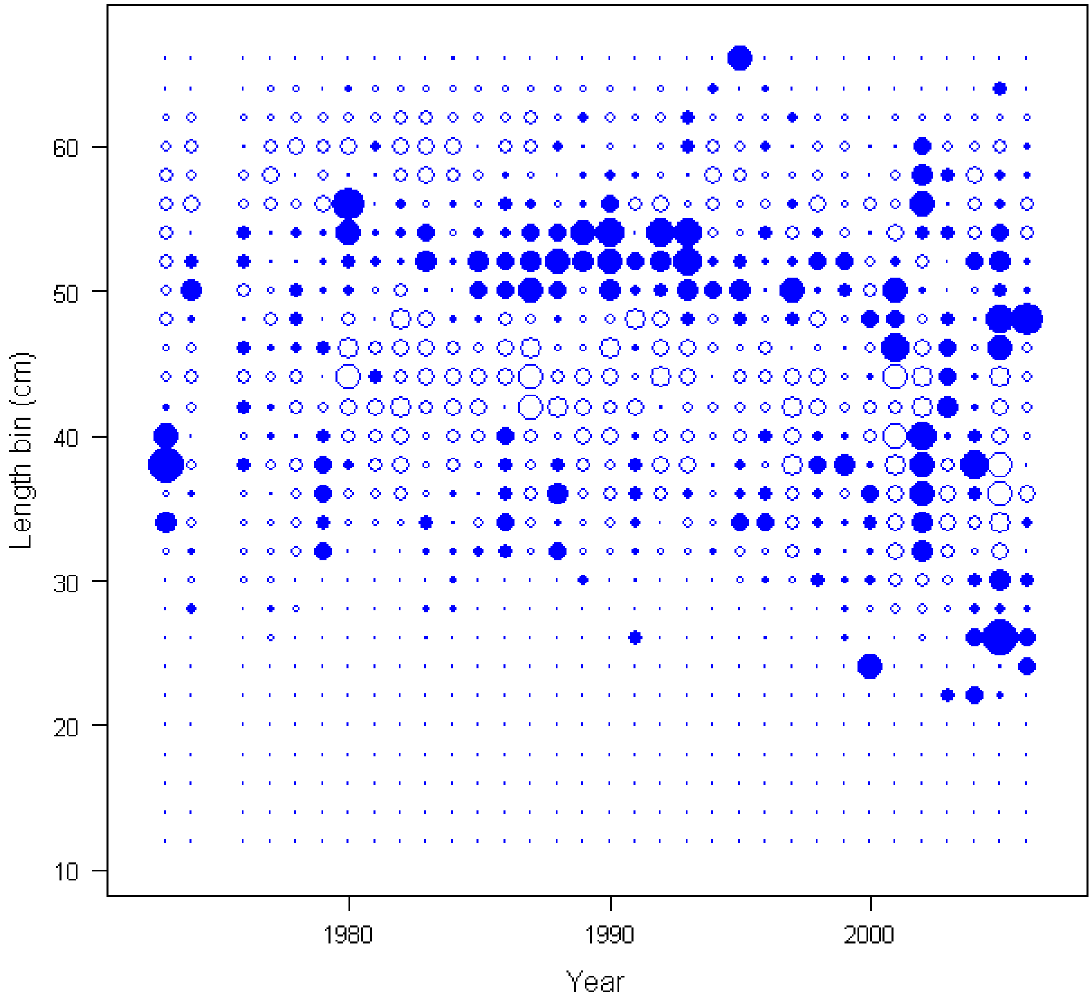


Figure 117. Pearson residuals for the fit to female length-frequency observations for the Oregon trawl fleet. The largest circle represents a value of 4.18; filled circles show observation greater than estimate; solid circles show observation less than estimate.

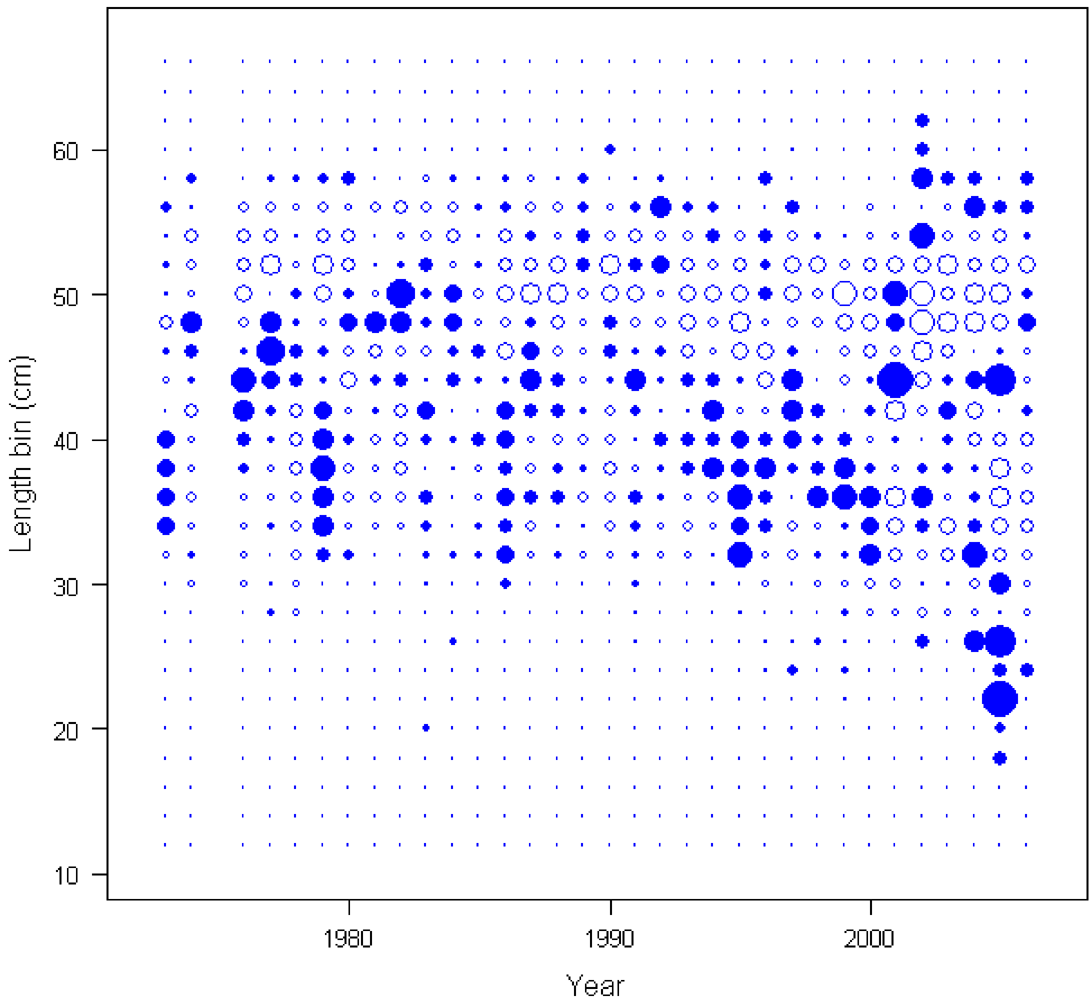


Figure 118. Pearson residuals for the fit to male length-frequency observations for the Oregon trawl fleet. The largest circle represents a value of 4.66; filled circles show observation greater than estimate; solid circles show observation less than estimate.

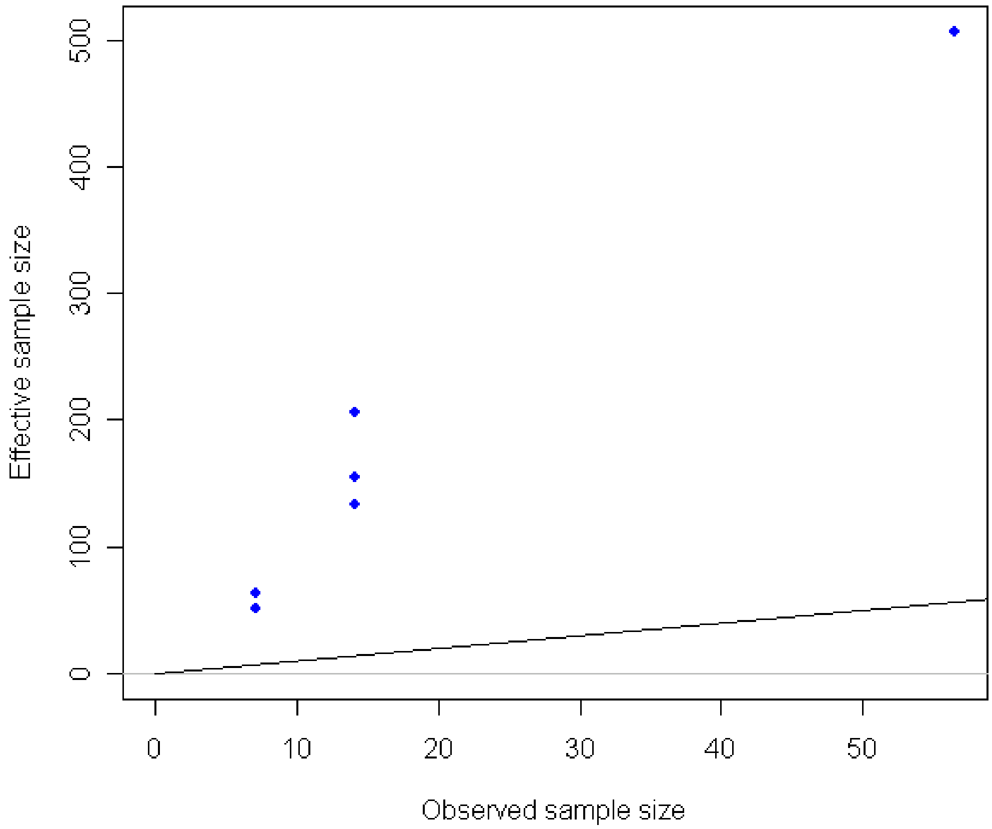


Figure 119. Observed and effective sample sizes for the Washington trawl fleet length-frequency observations (sexes combined in historical sampling).

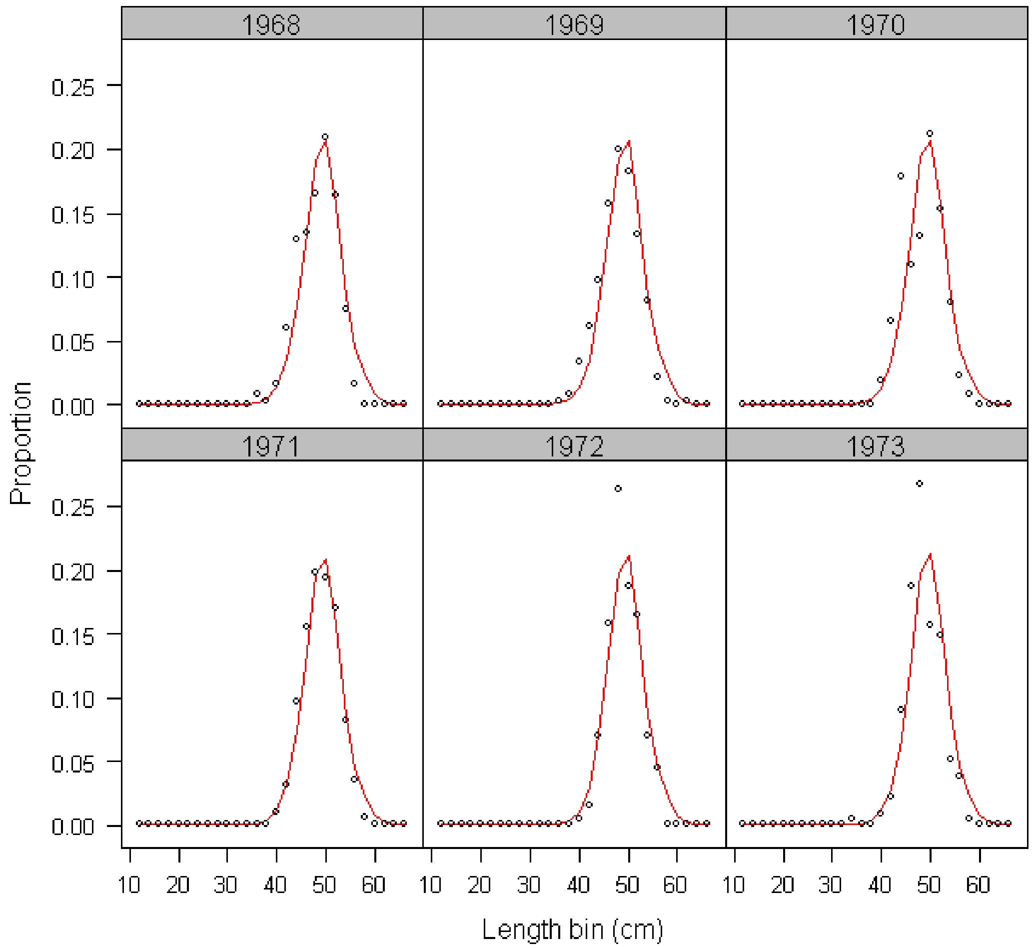


Figure 120. Fit to combined sex length-frequency observations for the Washington trawl fleet.

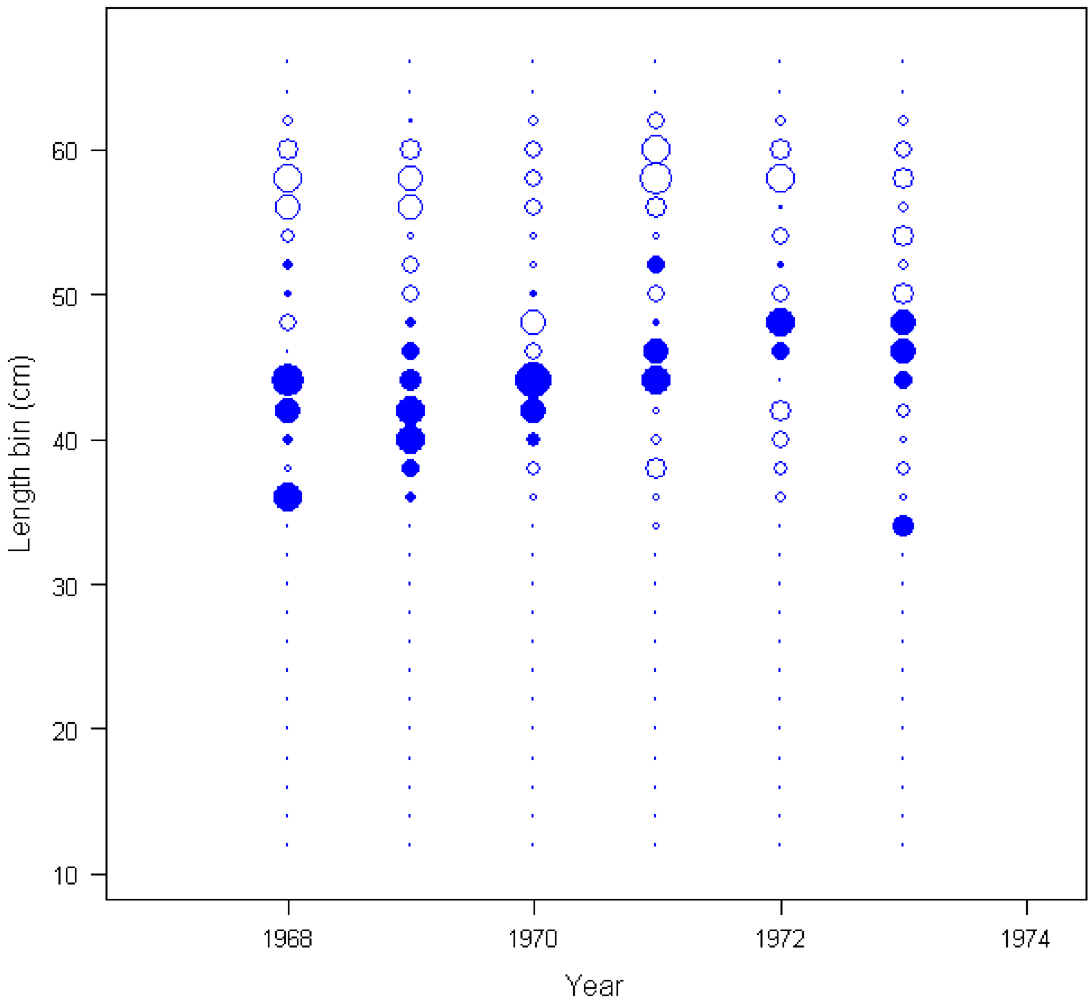


Figure 121. Pearson residuals for the fit to combined sex length-frequency observations for the Washington trawl fleet. The largest circle represents a value of 1.02; filled circles show observation greater than estimate; solid circles show observation less than estimate.

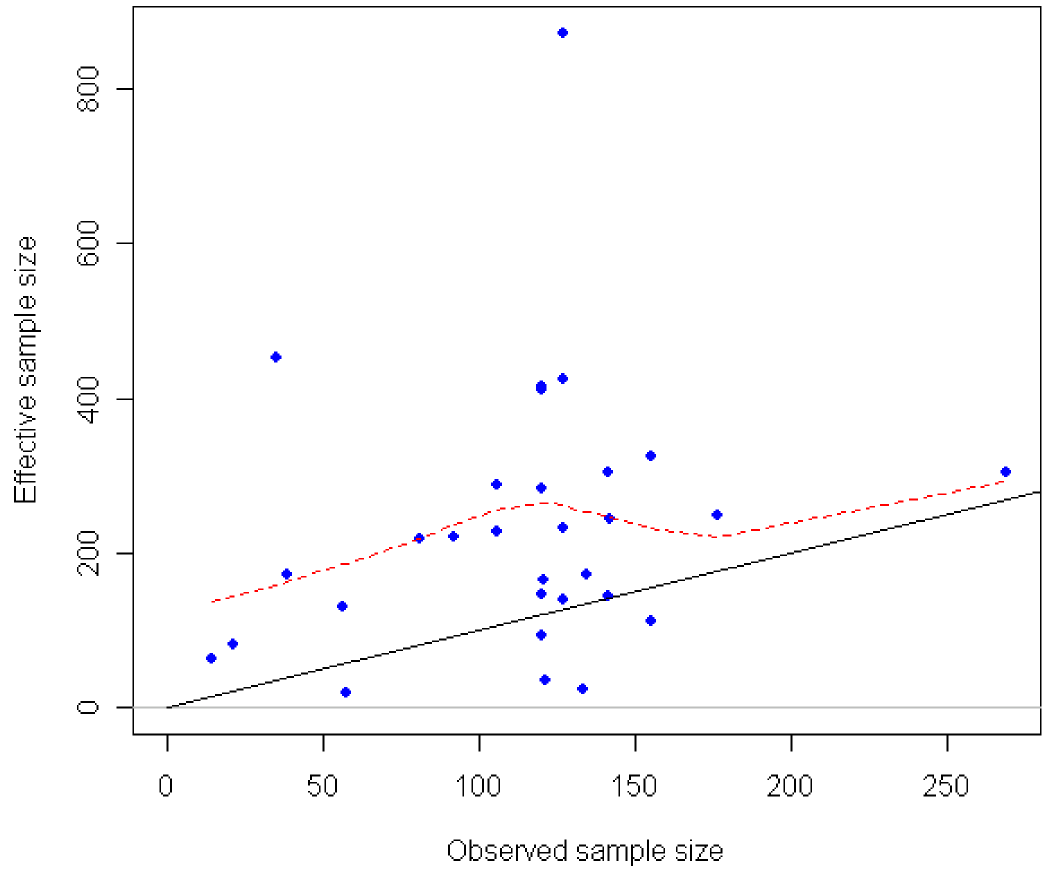
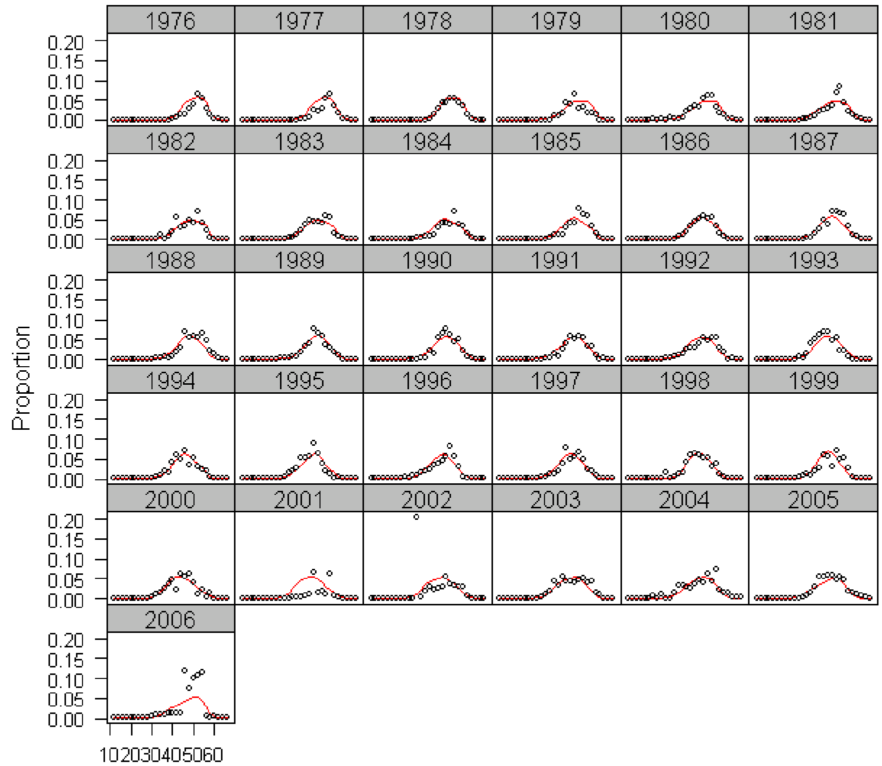


Figure 122. Observed and effective sample sizes for the sex-specific Washington trawl fleet length-frequency observations.



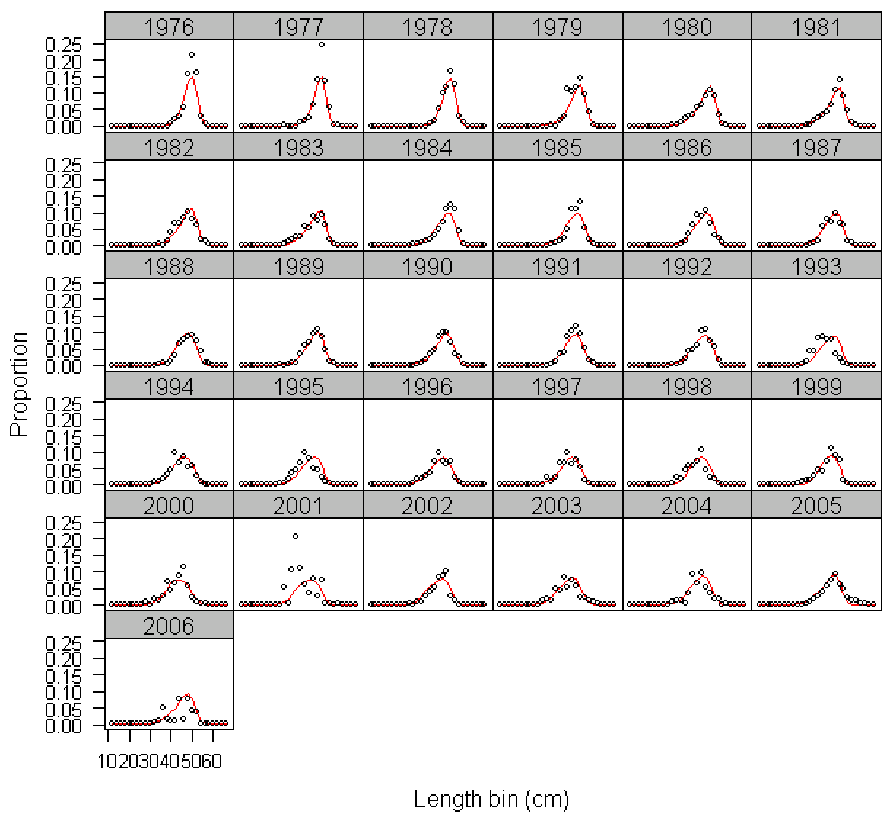


Figure 123. Fit to female (upper panel) and male (lower panel) length-frequency observations for the Washington trawl fleet.

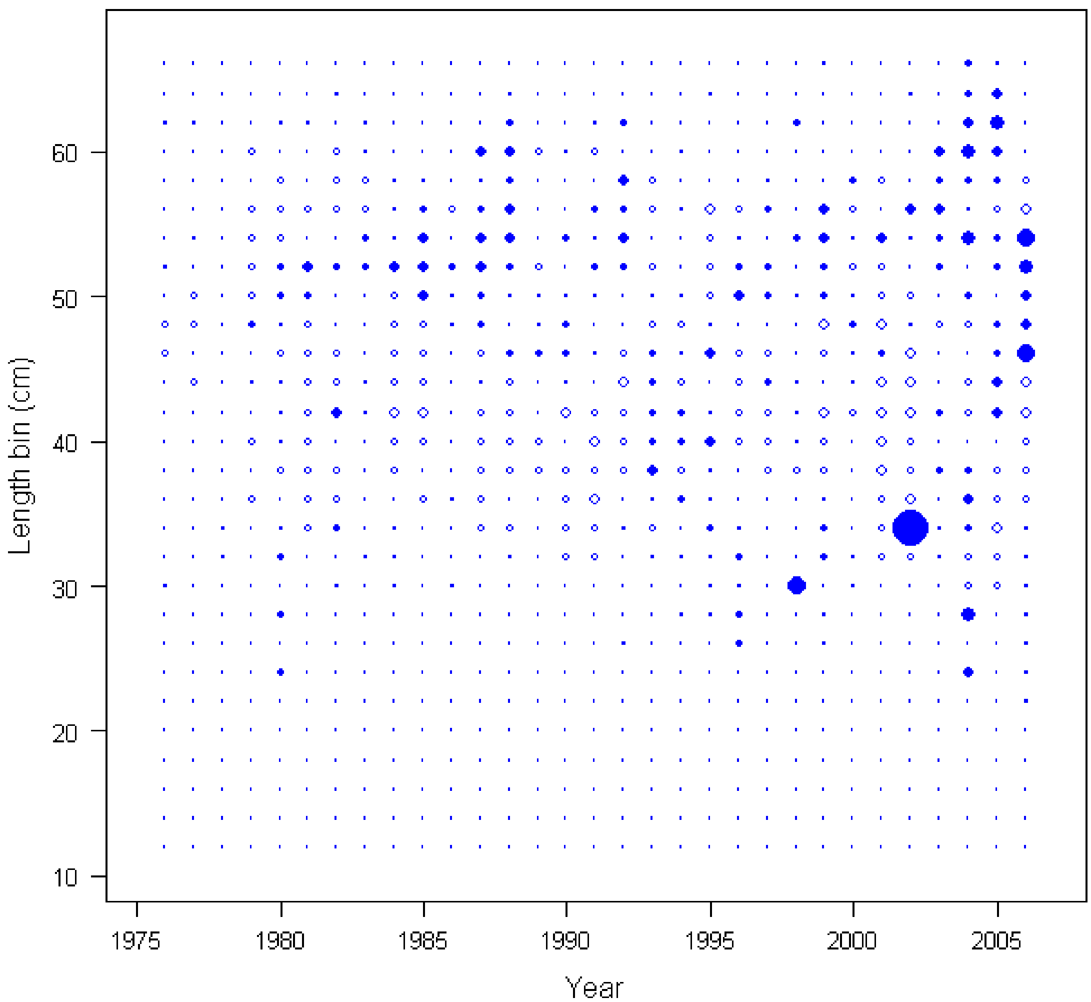


Figure 124. Pearson residuals for the fit to female length-frequency observations for the Washington trawl fleet. The largest circle represents a value of 19.73; filled circles show observation greater than estimate; solid circles show observation less than estimate.

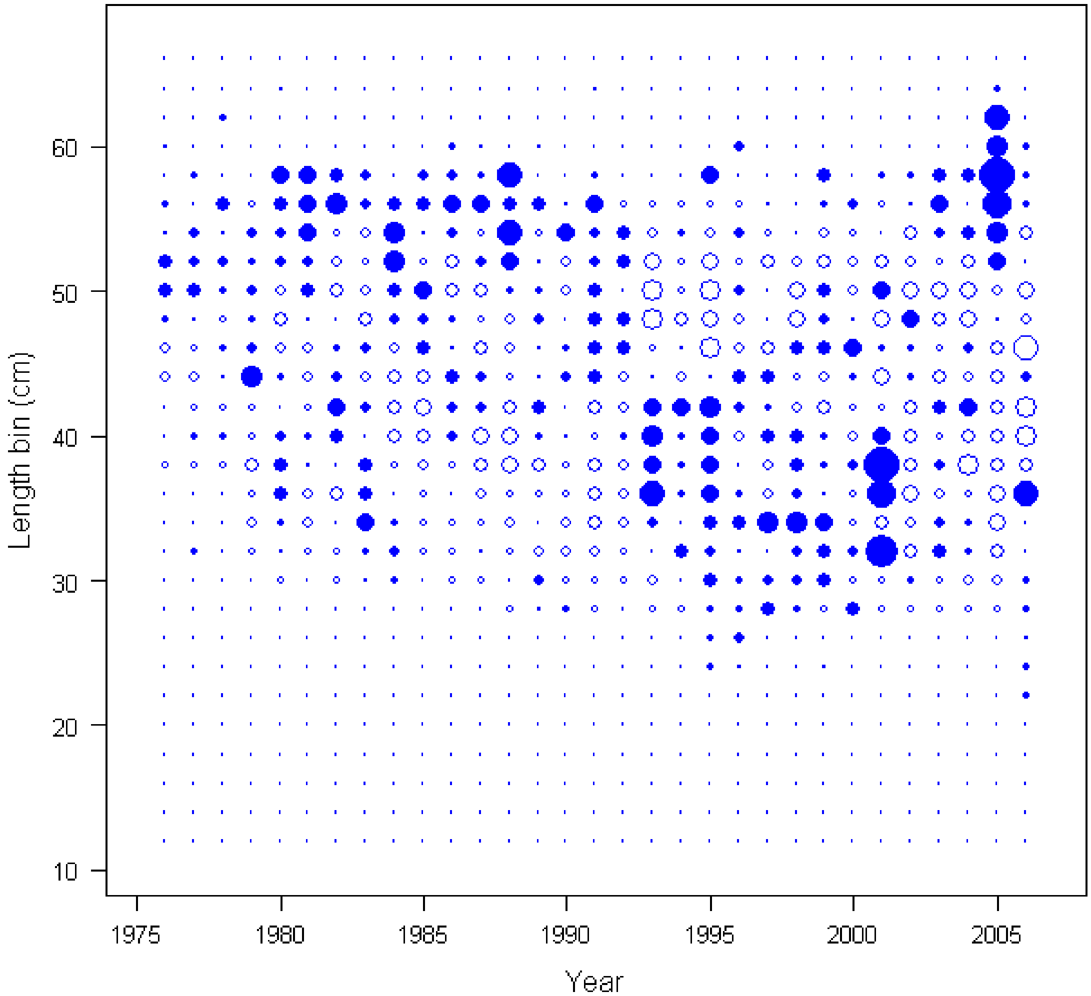


Figure 125. Pearson residuals for the fit to male length-frequency observations for the Washington trawl fleet. The largest circle represents a value of 5.81; filled circles show observation greater than estimate; solid circles show observation less than estimate.

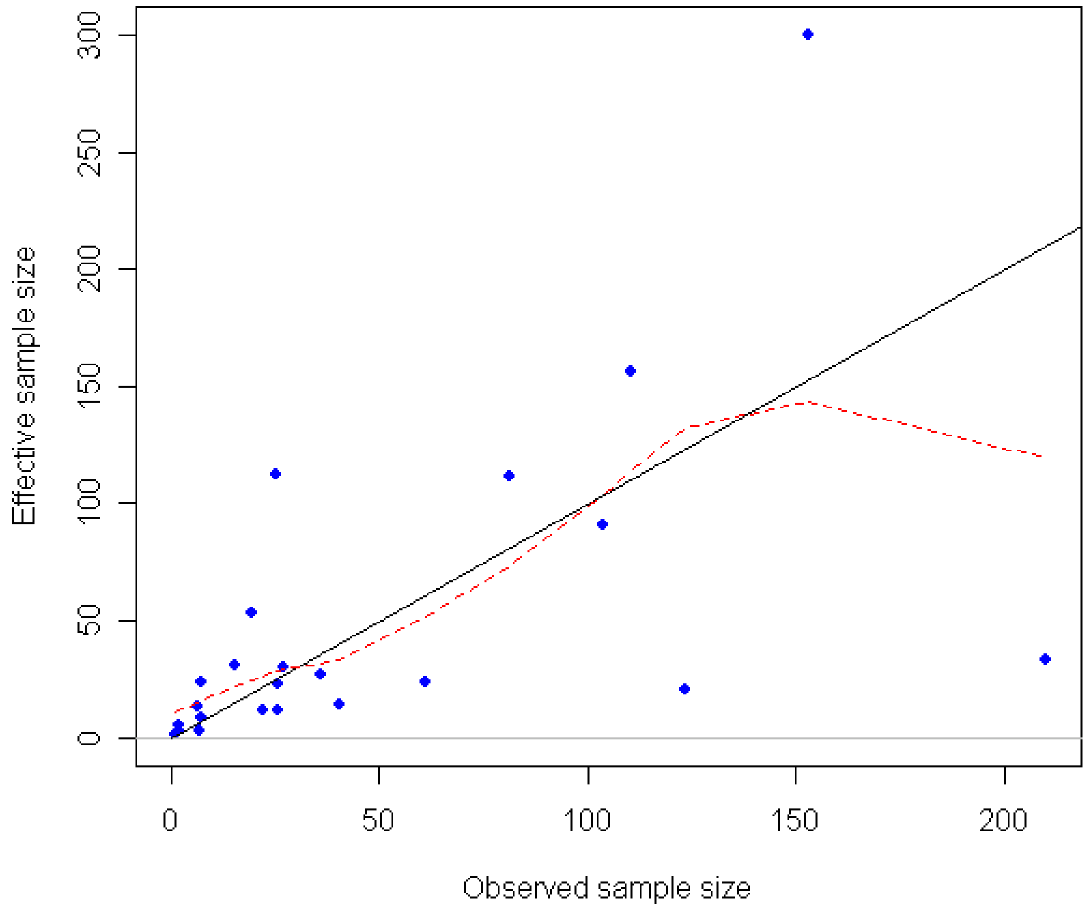


Figure 126. Observed and effective sample sizes for the southern California non-trawl fleet length-frequency observations (sexes combined).

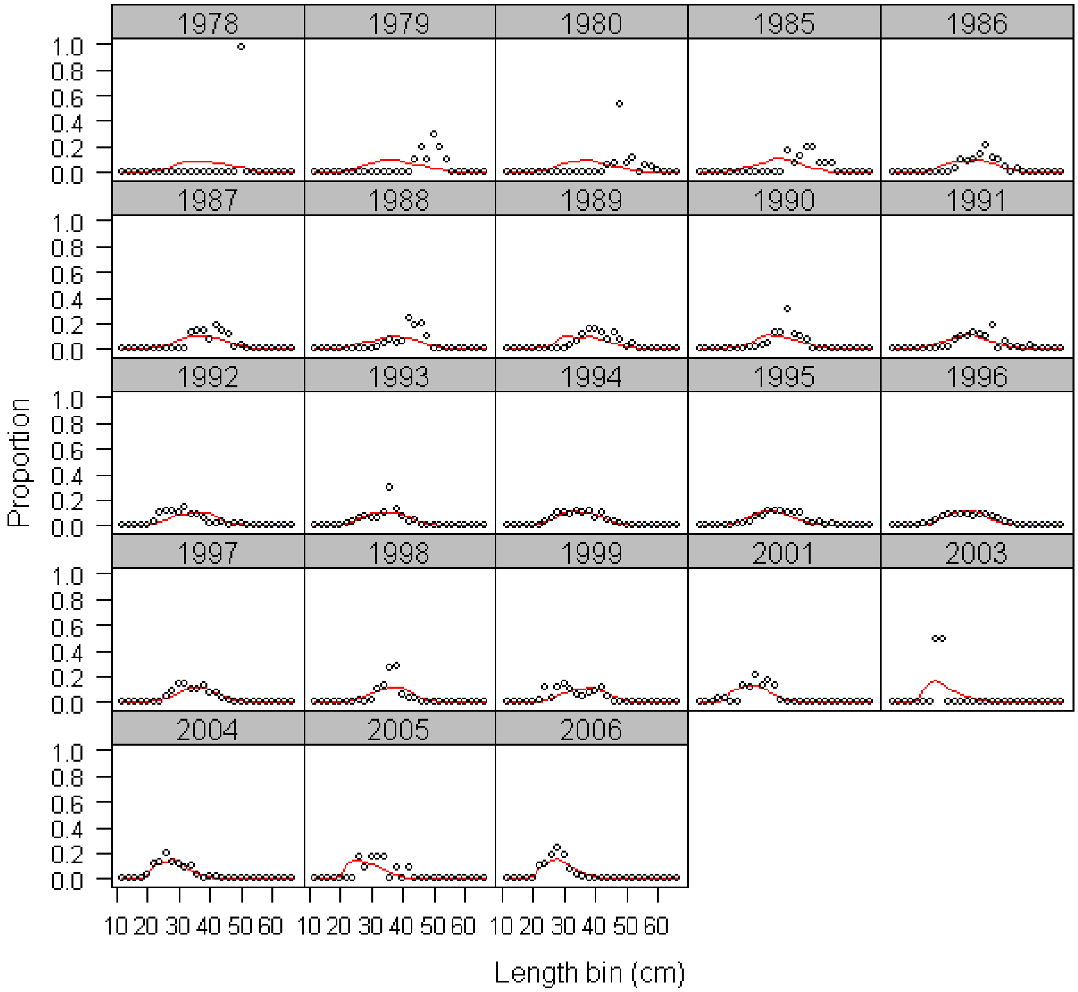


Figure 127. Fit to sexes combined length-frequency observations for the southern California non-trawl fleet.

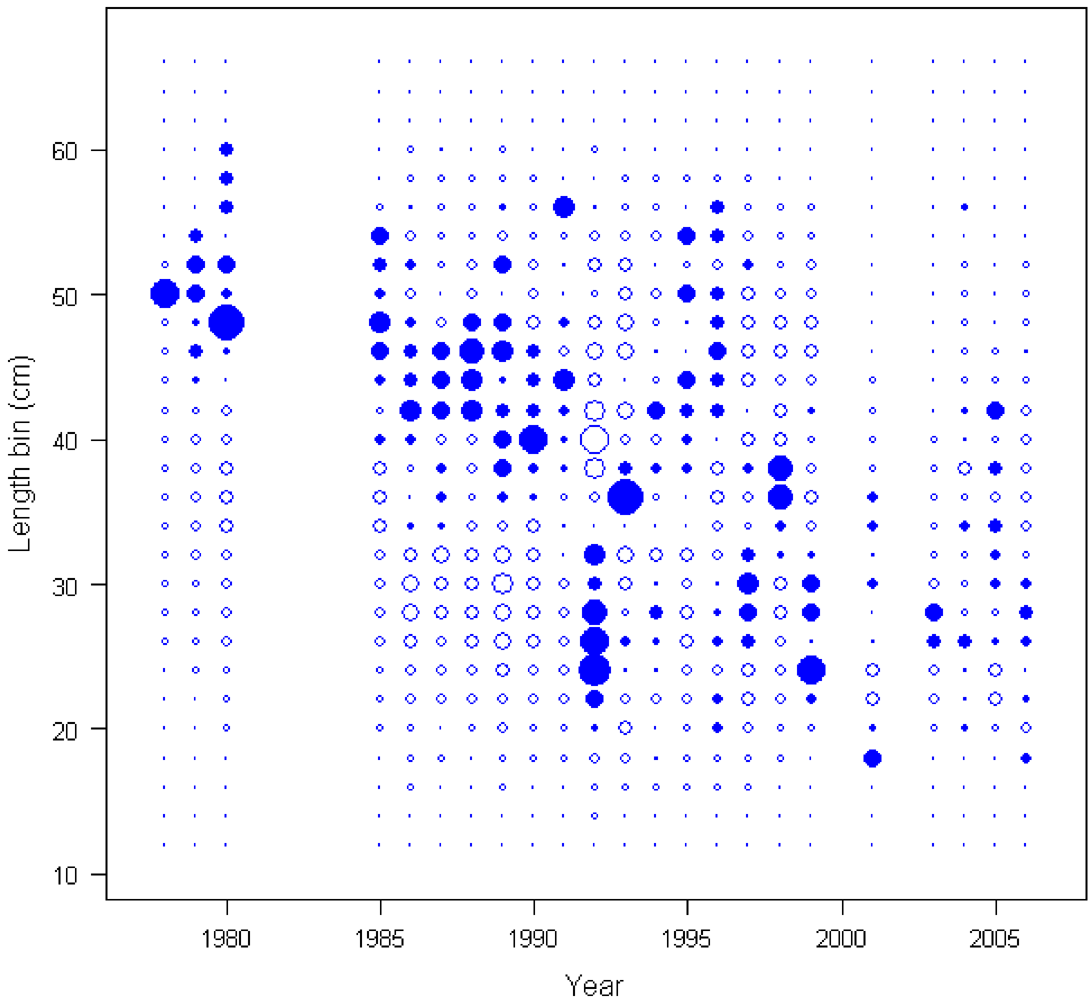


Figure 128. Pearson residuals for the fit to sexes combined length-frequency observations for the southern California non-trawl fleet. The largest circle represents a value of 7.24; filled circles show observation greater than estimate; solid circles show observation less than estimate.

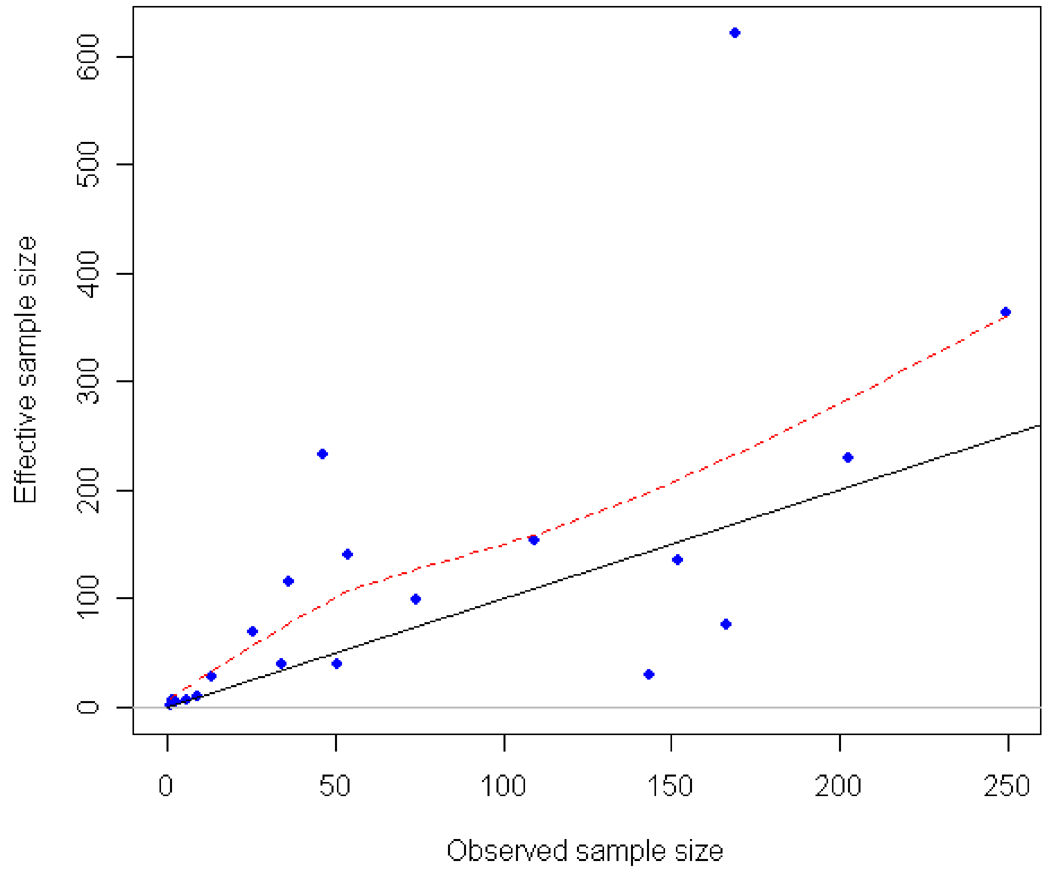


Figure 129. Observed and effective sample sizes for the northern California non-trawl fleet length-frequency observations (sexes combined).

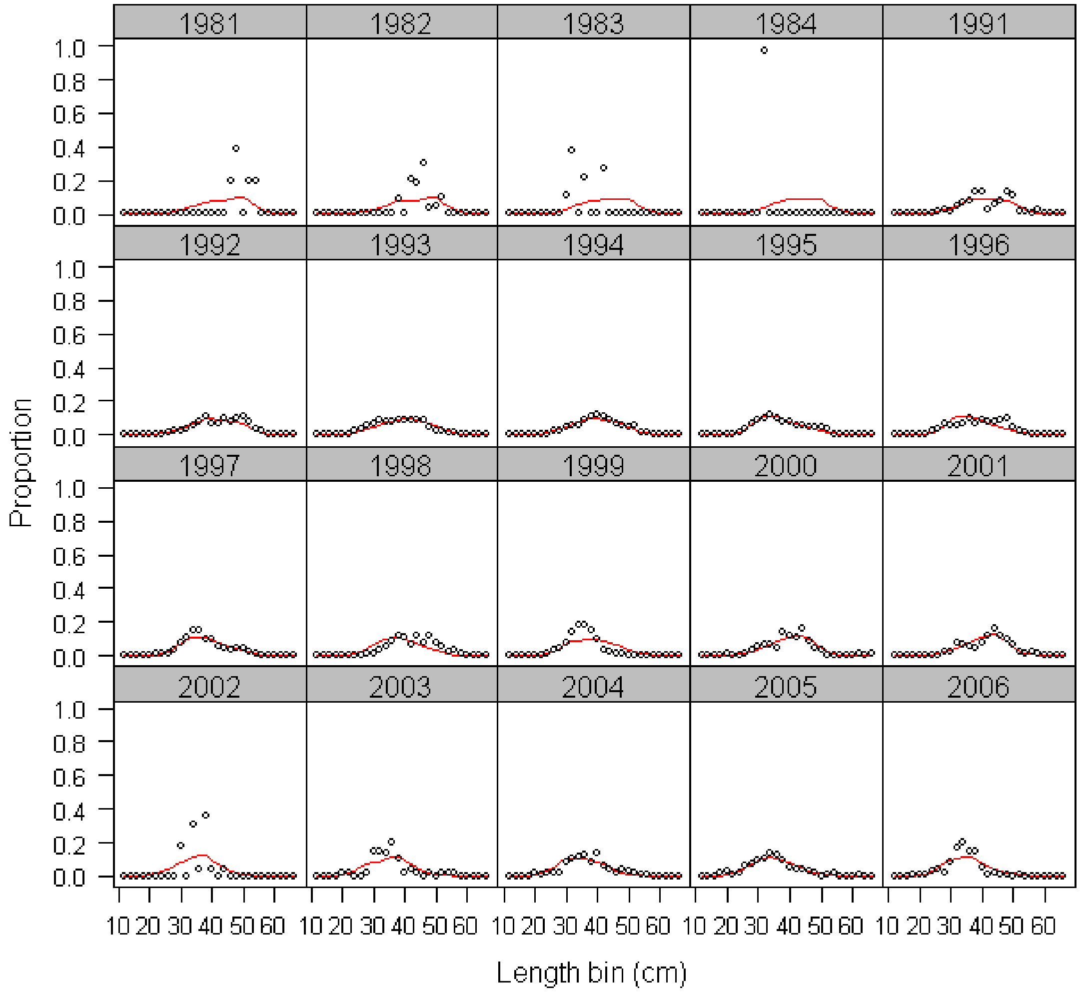


Figure 130. Fit to sexes combined length-frequency observations for the northern California non-trawl fleet.

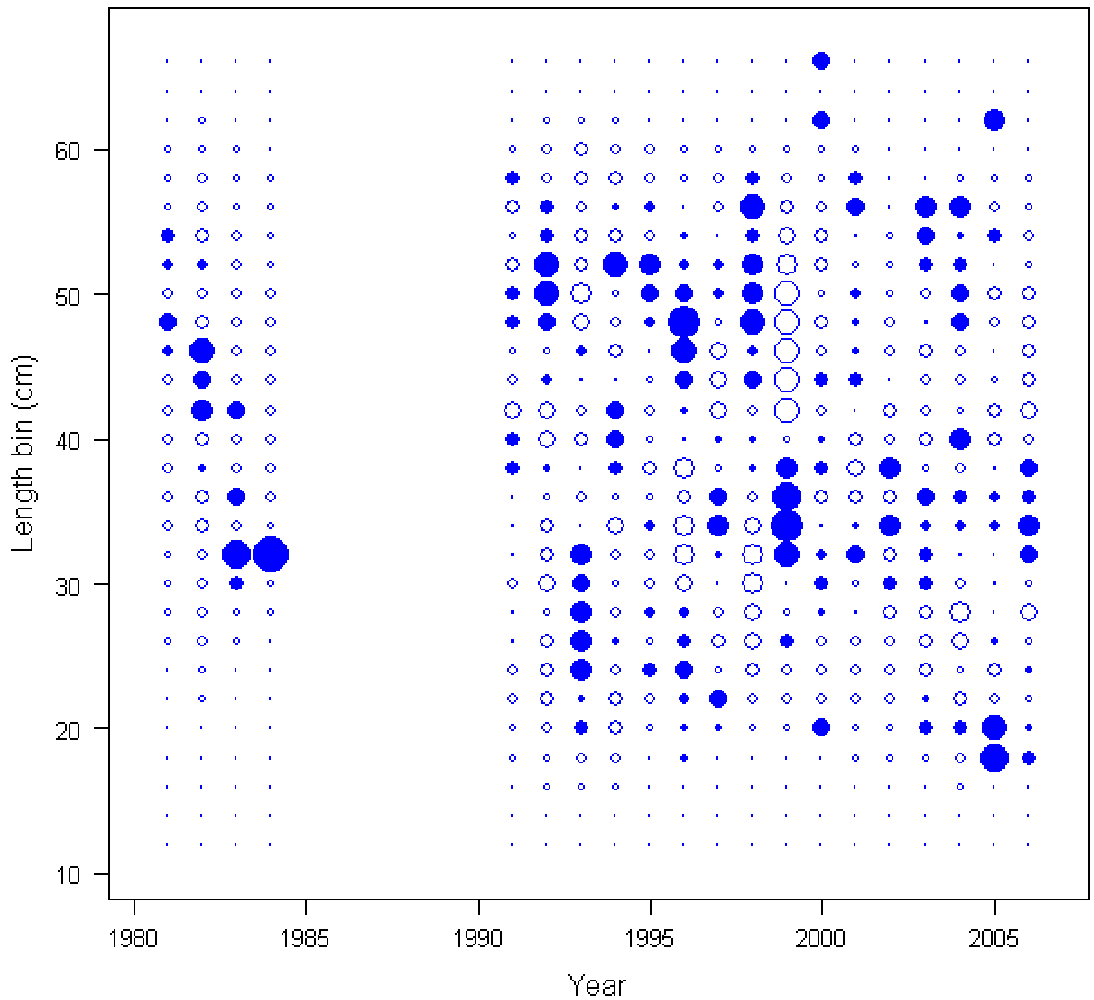


Figure 131. Pearson residuals for the fit to sexes combined length-frequency observations for the northern California non-trawl fleet. The largest circle represents a value of 5.02; filled circles show observation greater than estimate; solid circles show observation less than estimate.

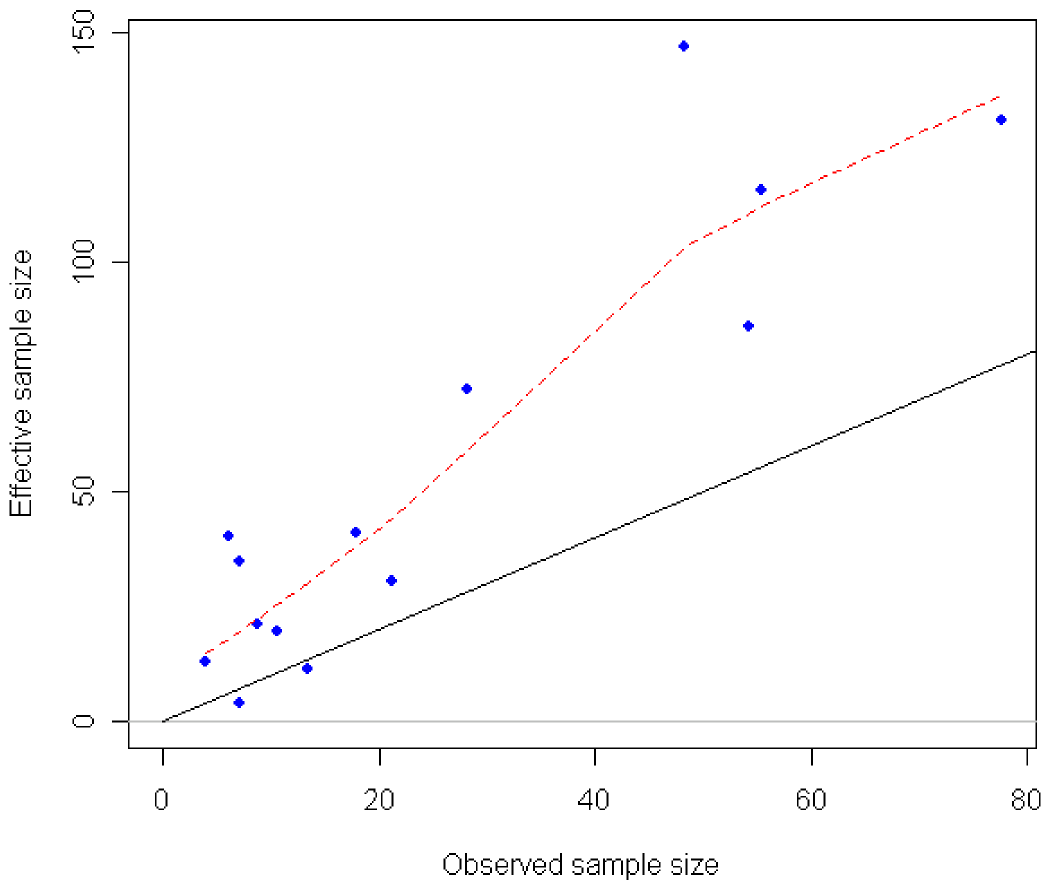


Figure 132. Observed and effective sample sizes for the sex-specific Oregon-Washington non-trawl fleet length-frequency observations.

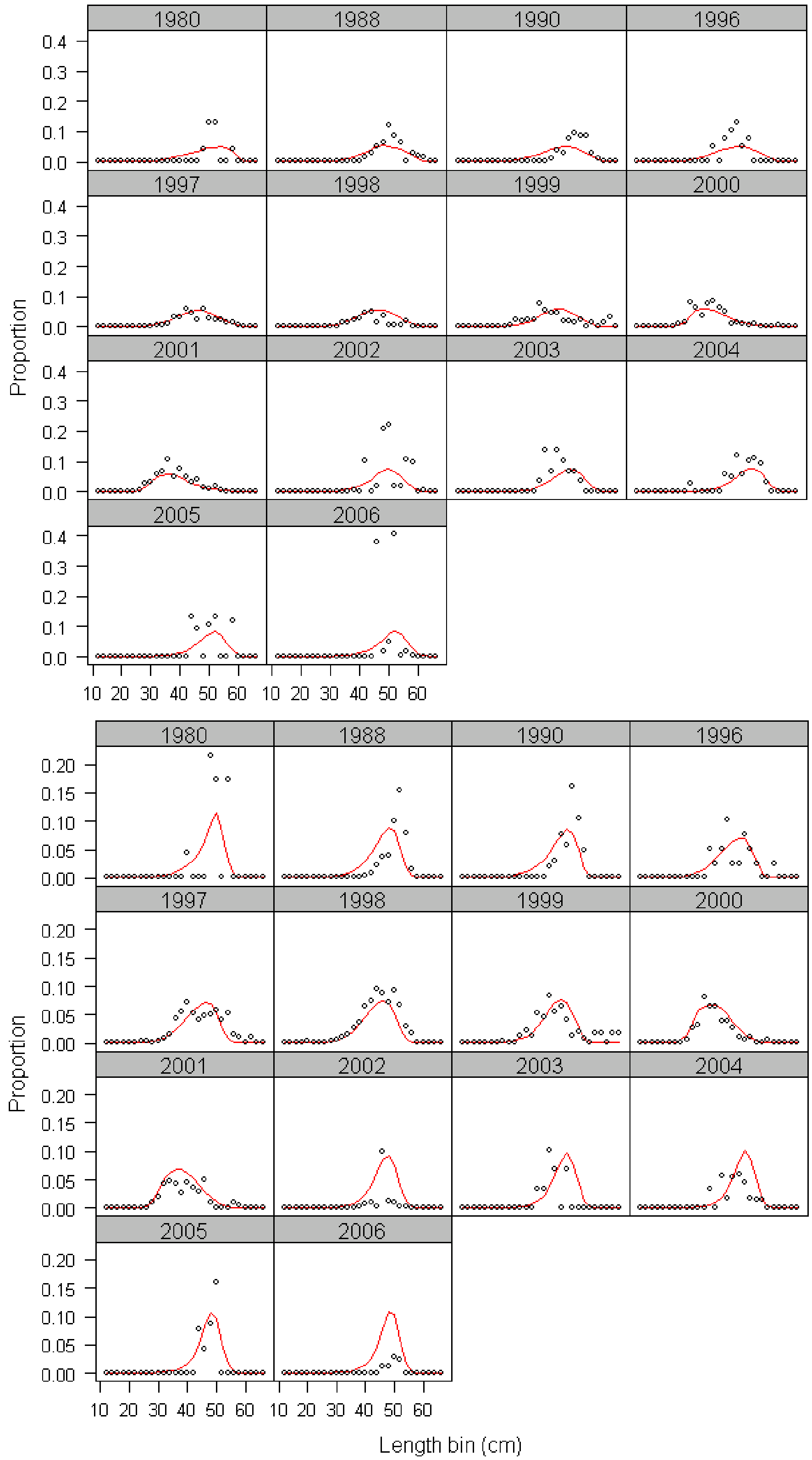


Figure 133. Fit to female (upper panel) and male (lower panel) length-frequency observations for the Oregon-Washington non-trawl fleet.

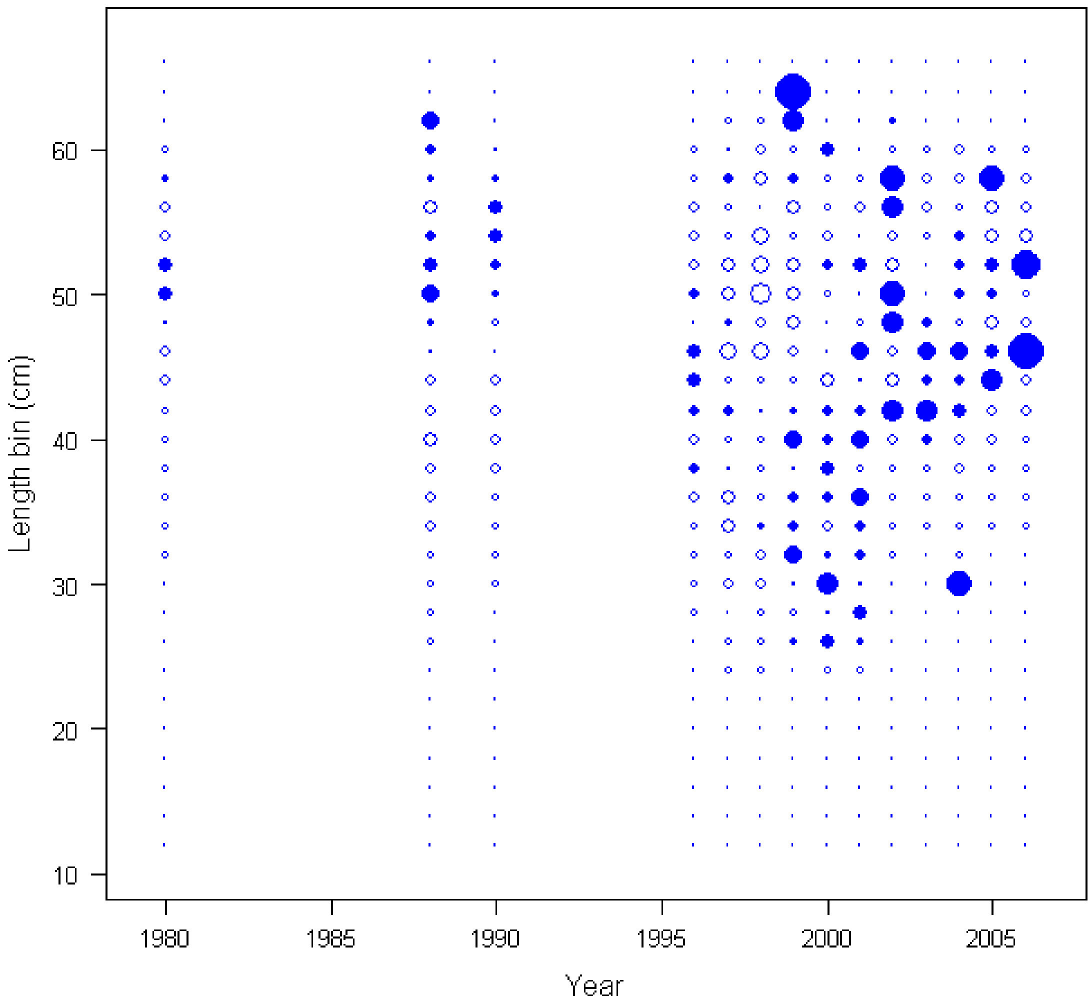


Figure 134. Pearson residuals for the fit to female length-frequency observations for the Oregon-Washington non-trawl fleet. The largest circle represents a value of 5.25; filled circles show observation greater than estimate; solid circles show observation less than estimate.

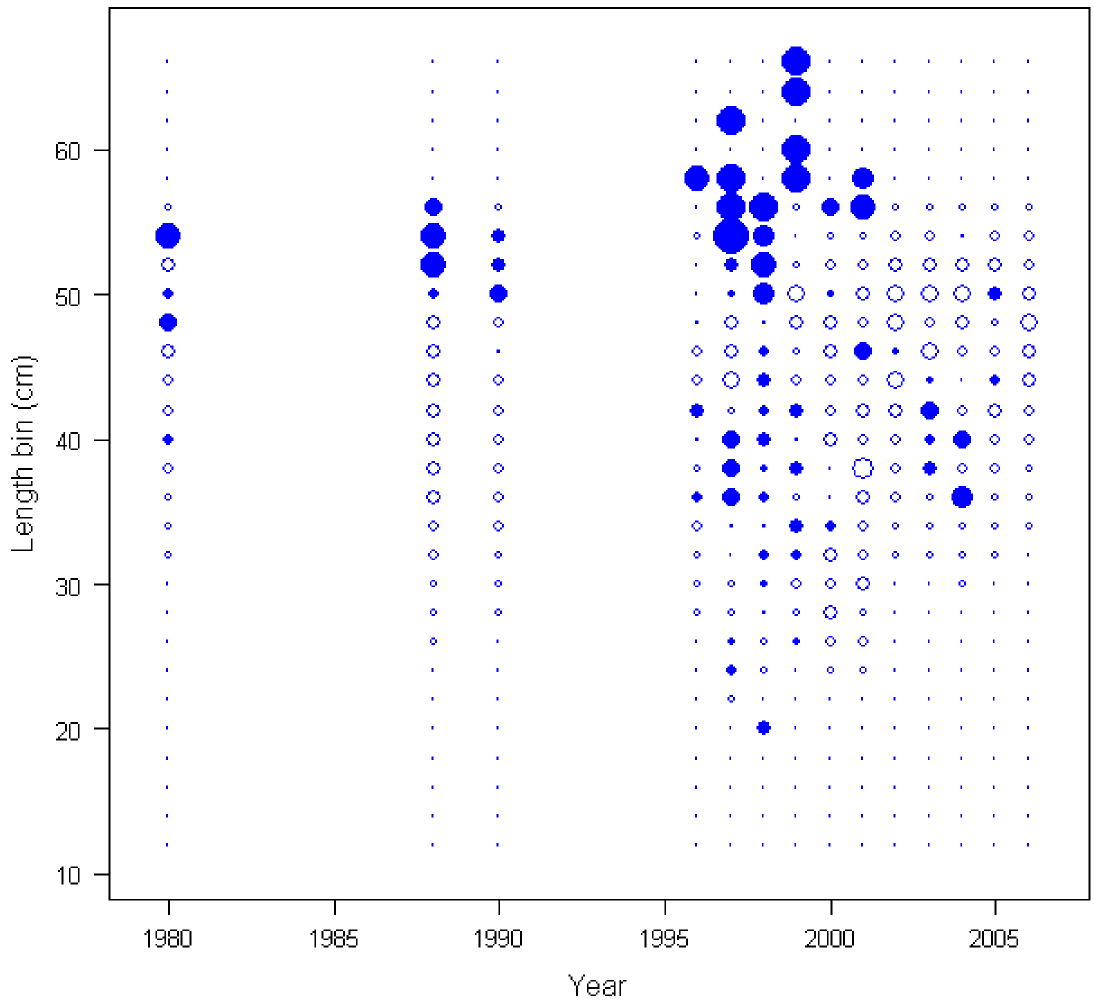


Figure 135. Pearson residuals for the fit to male length-frequency observations for the Oregon-Washington non-trawl fleet. The largest circle represents a value of 4.22; filled circles show observation greater than estimate; solid circles show observation less than estimate.

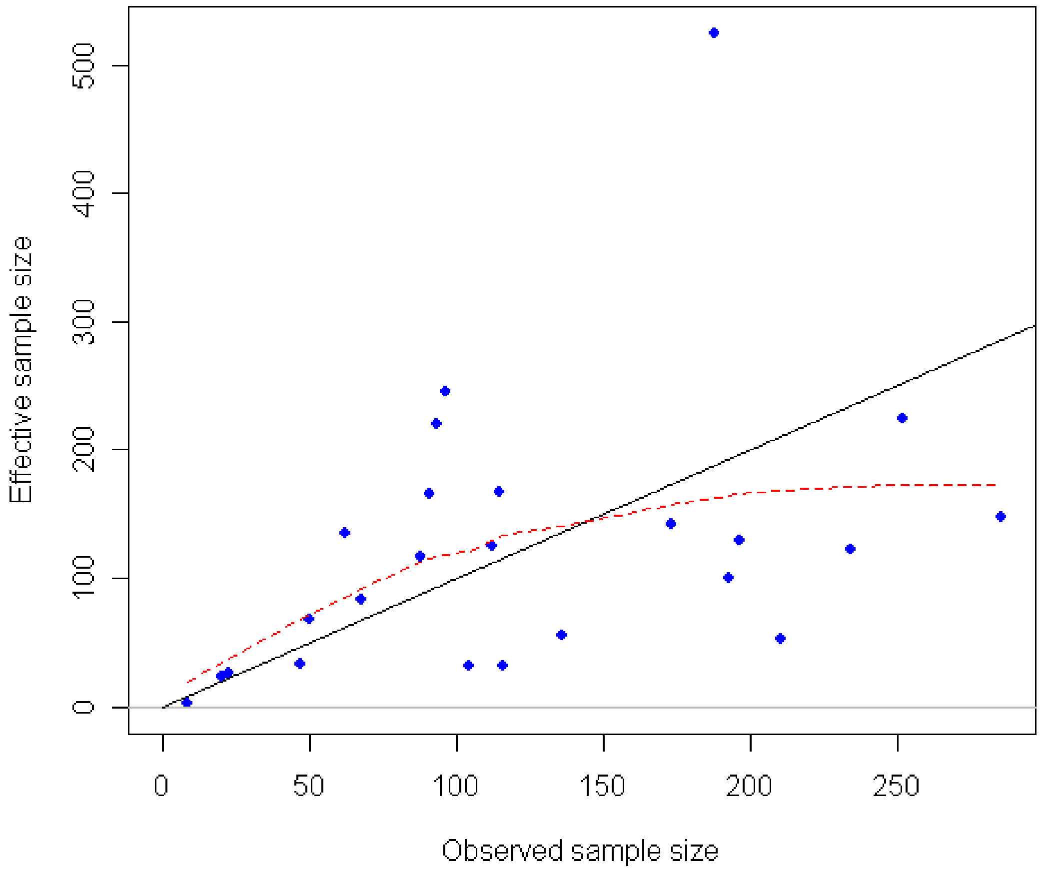


Figure 136. Observed and effective sample sizes for the combined sex southern California recreational fleet length-frequency observations.

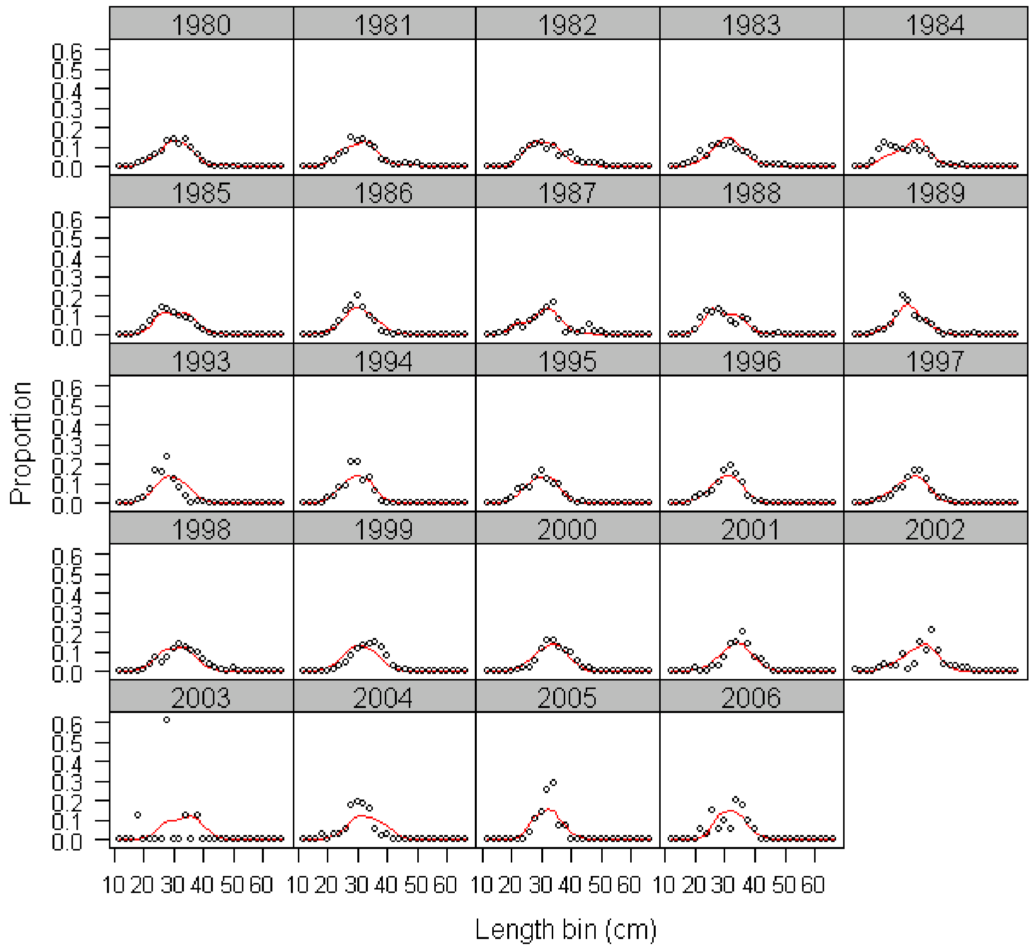


Figure 137. Fit to combined sex length-frequency observations for the southern California recreational fleet.

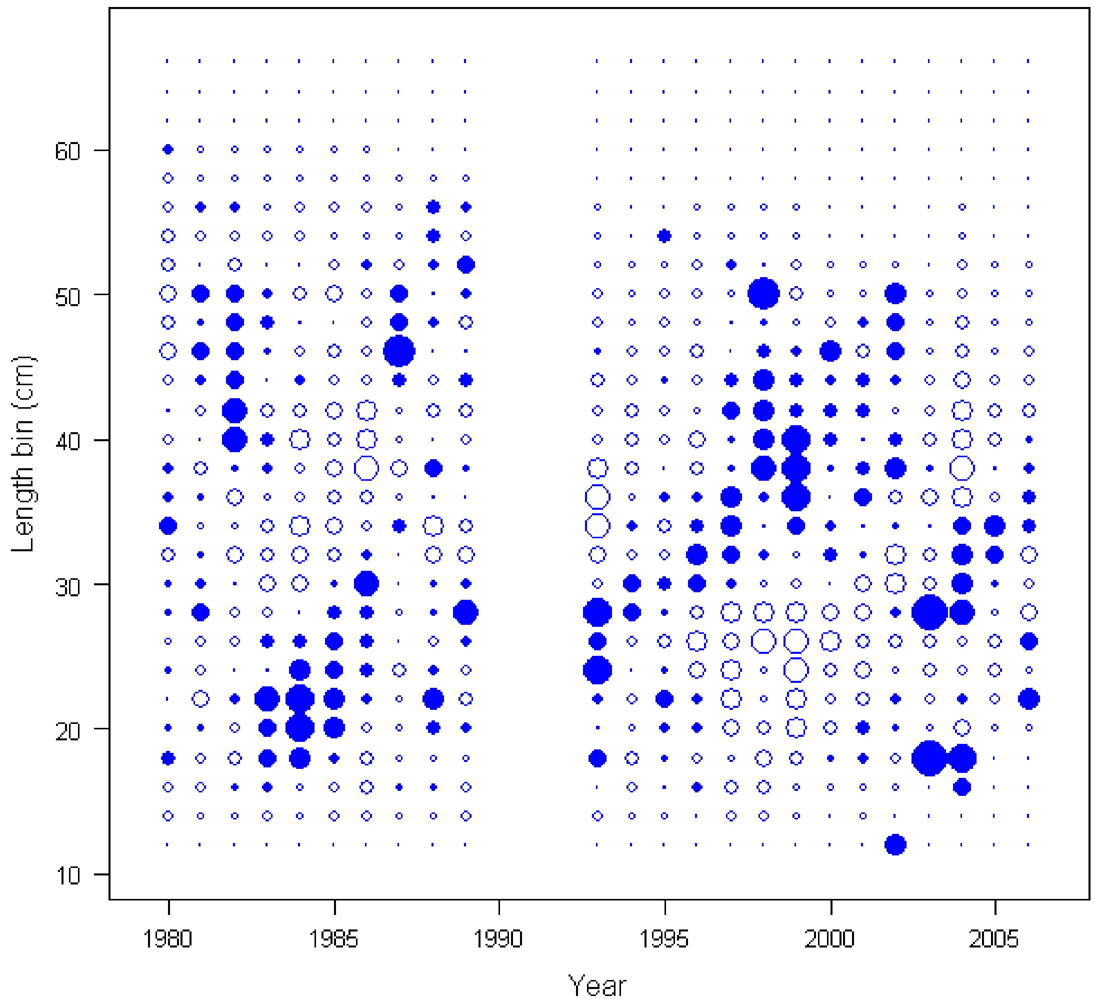


Figure 138. Pearson residuals for the fit to combined sex length-frequency observations for the southern California recreational fleet. The largest circle represents a value of 5.52; filled circles show observation greater than estimate; solid circles show observation less than estimate.

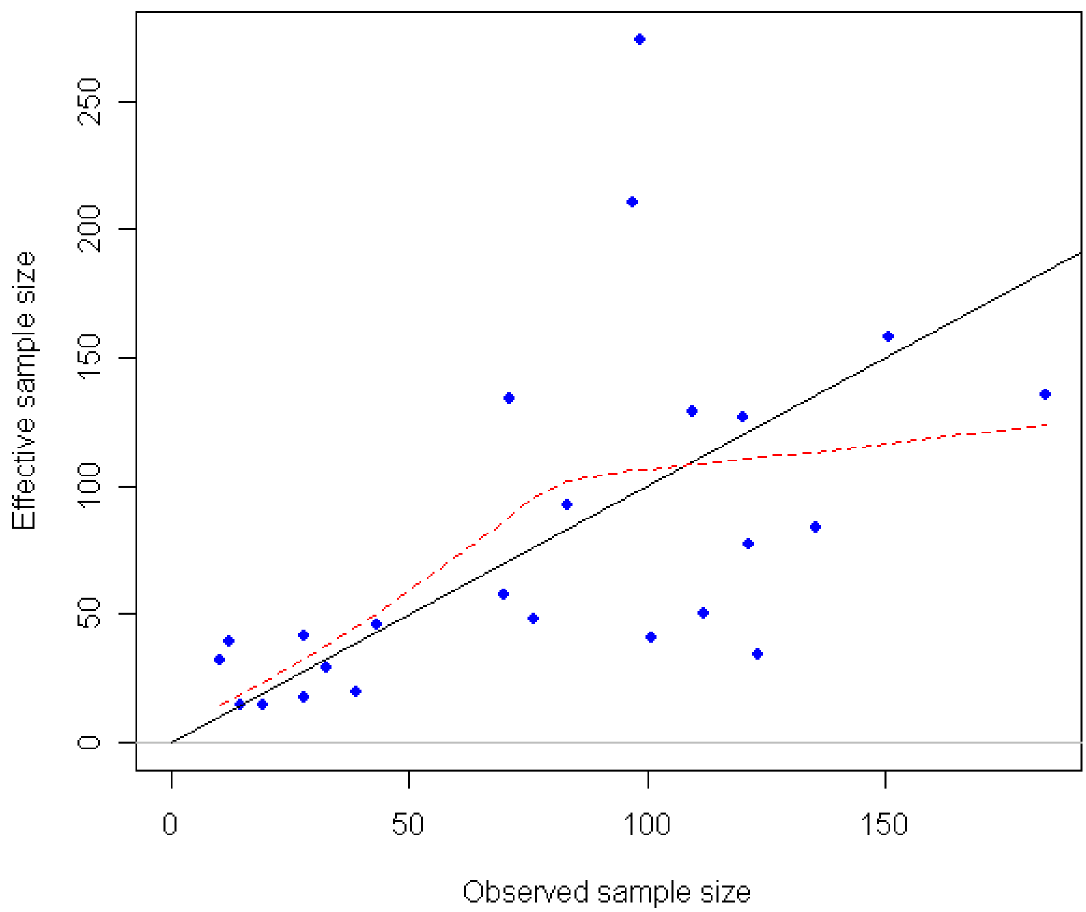


Figure 139. Observed and effective sample sizes for the combined sex northern California recreational fleet length-frequency observations.

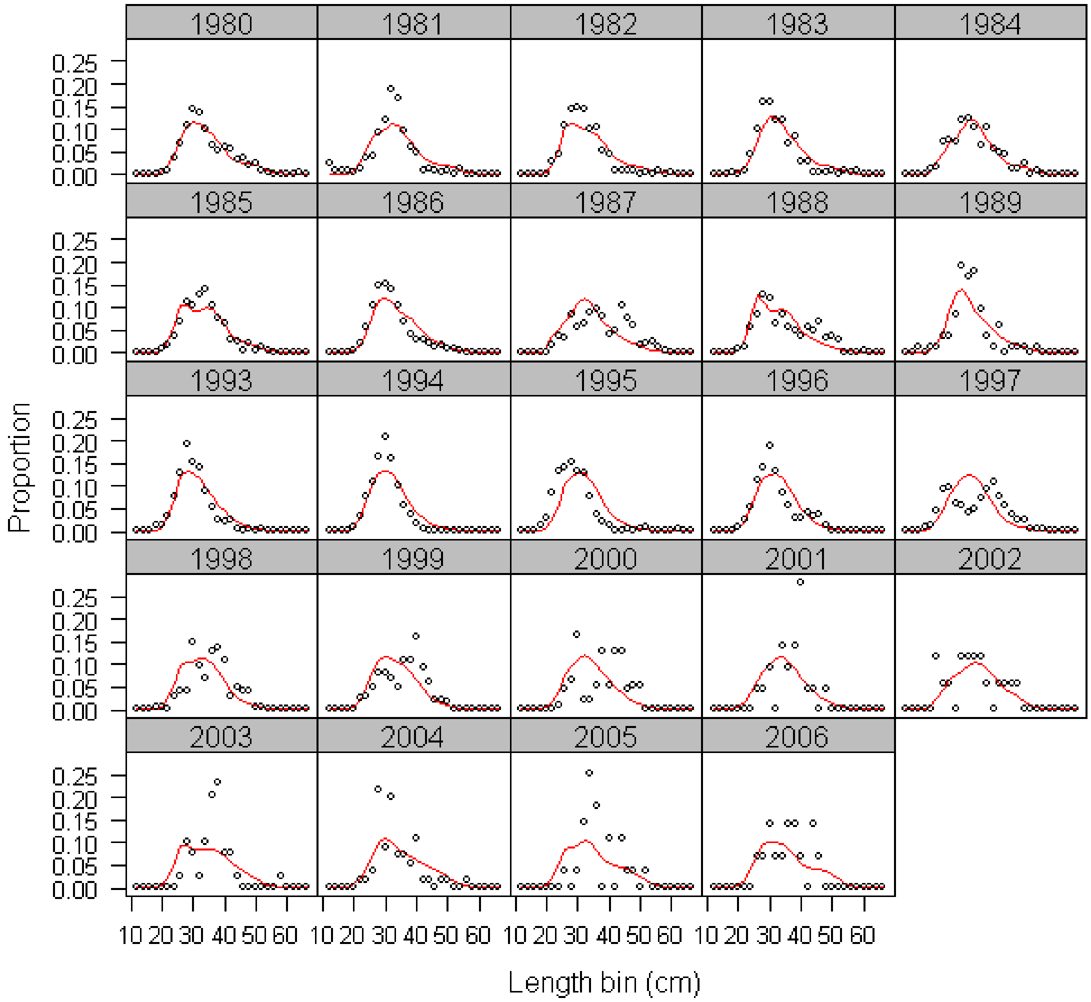


Figure 140. Fit to combined sex length-frequency observations for the northern California recreational fleet.

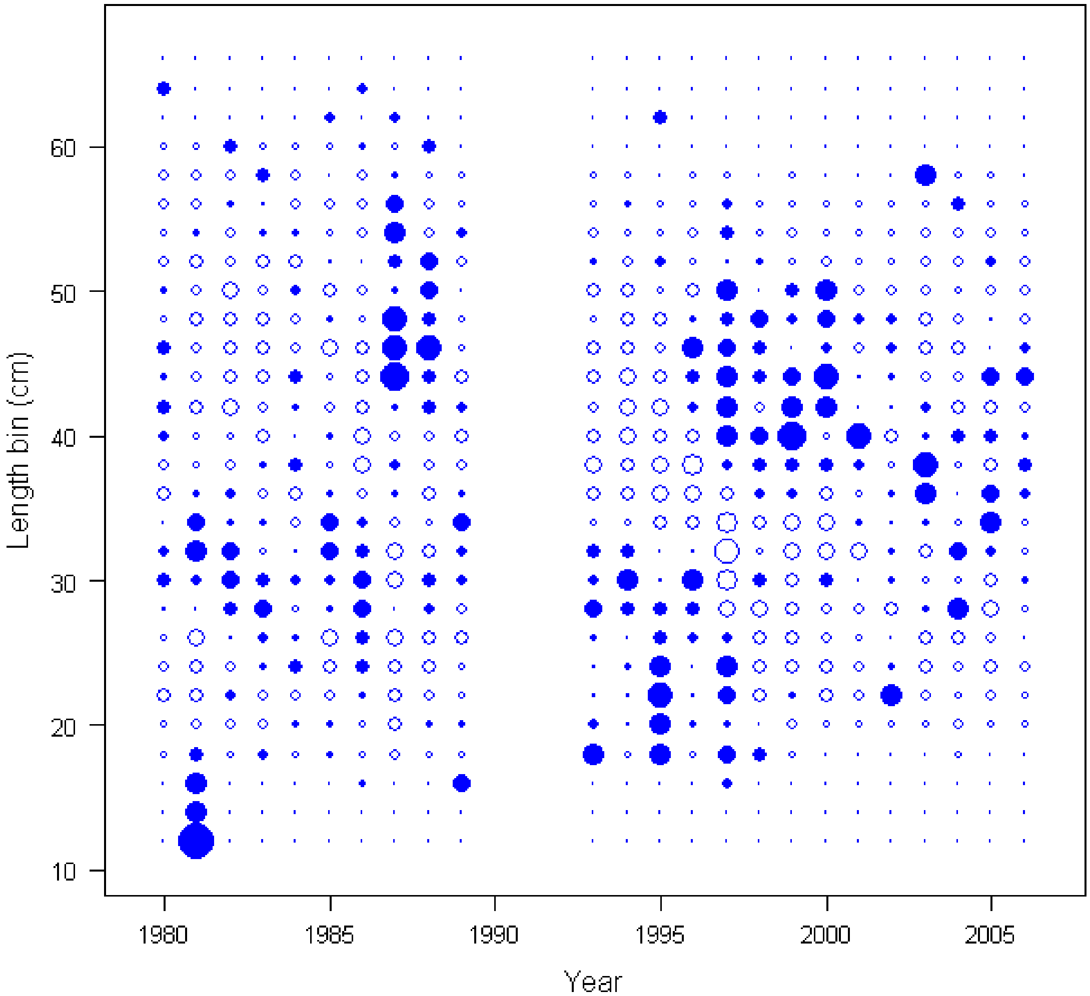


Figure 141. Pearson residuals for the fit to combined sex length-frequency observations for the northern California recreational fleet. The largest circle represents a value of 6.88; filled circles show observation greater than estimate; solid circles show observation less than estimate.

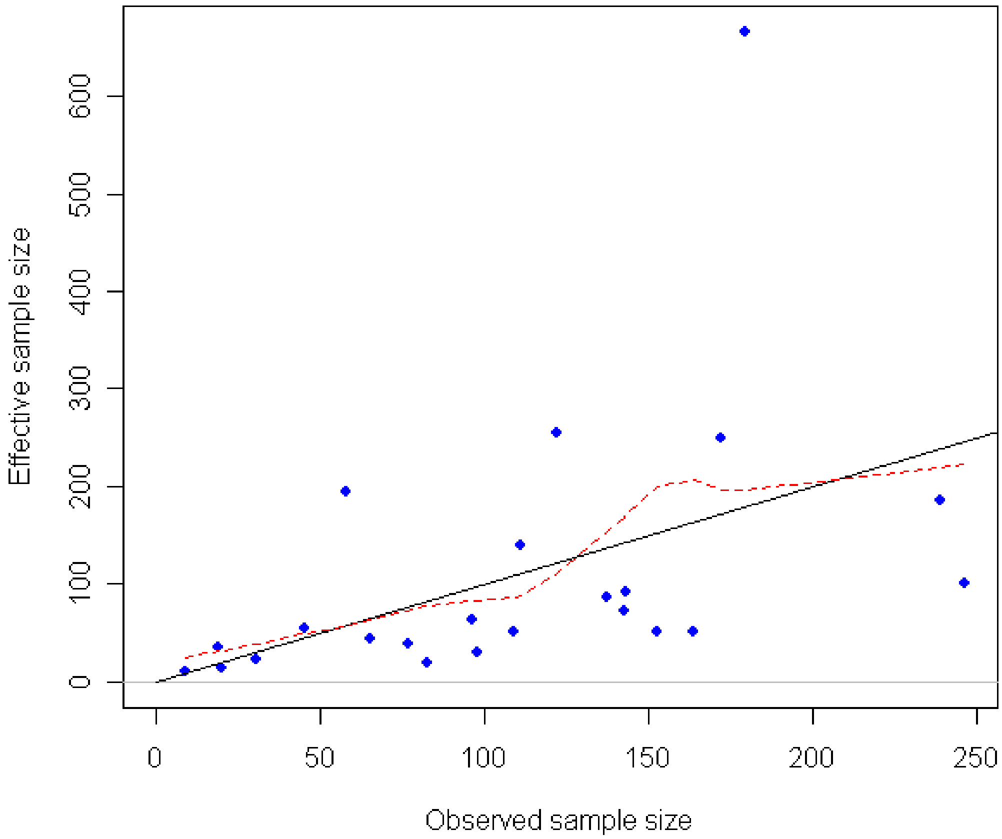


Figure 142. Observed and effective sample sizes for the combined sex Oregon-Washington recreational fleet length-frequency observations.

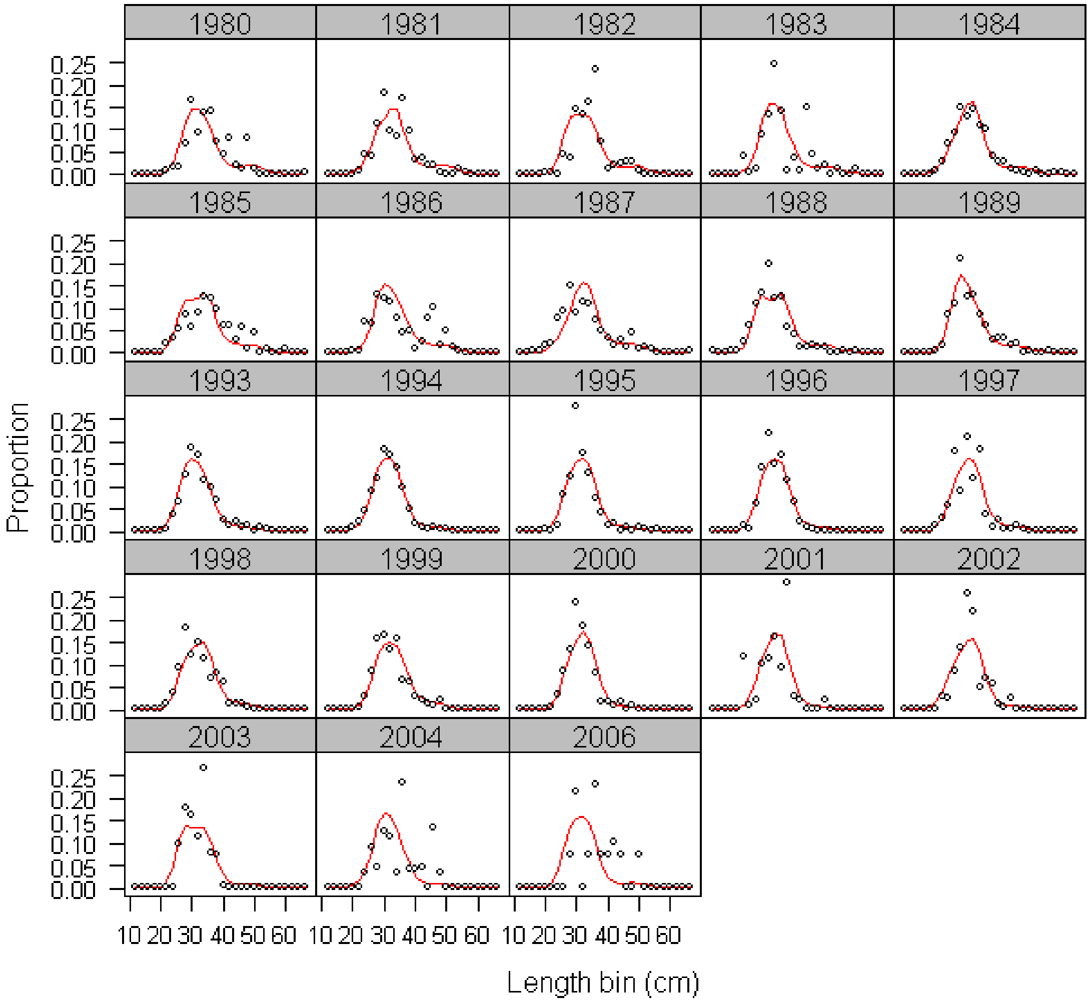


Figure 143. Fit to combined sex length-frequency observations for the Oregon-Washington recreational fleet.

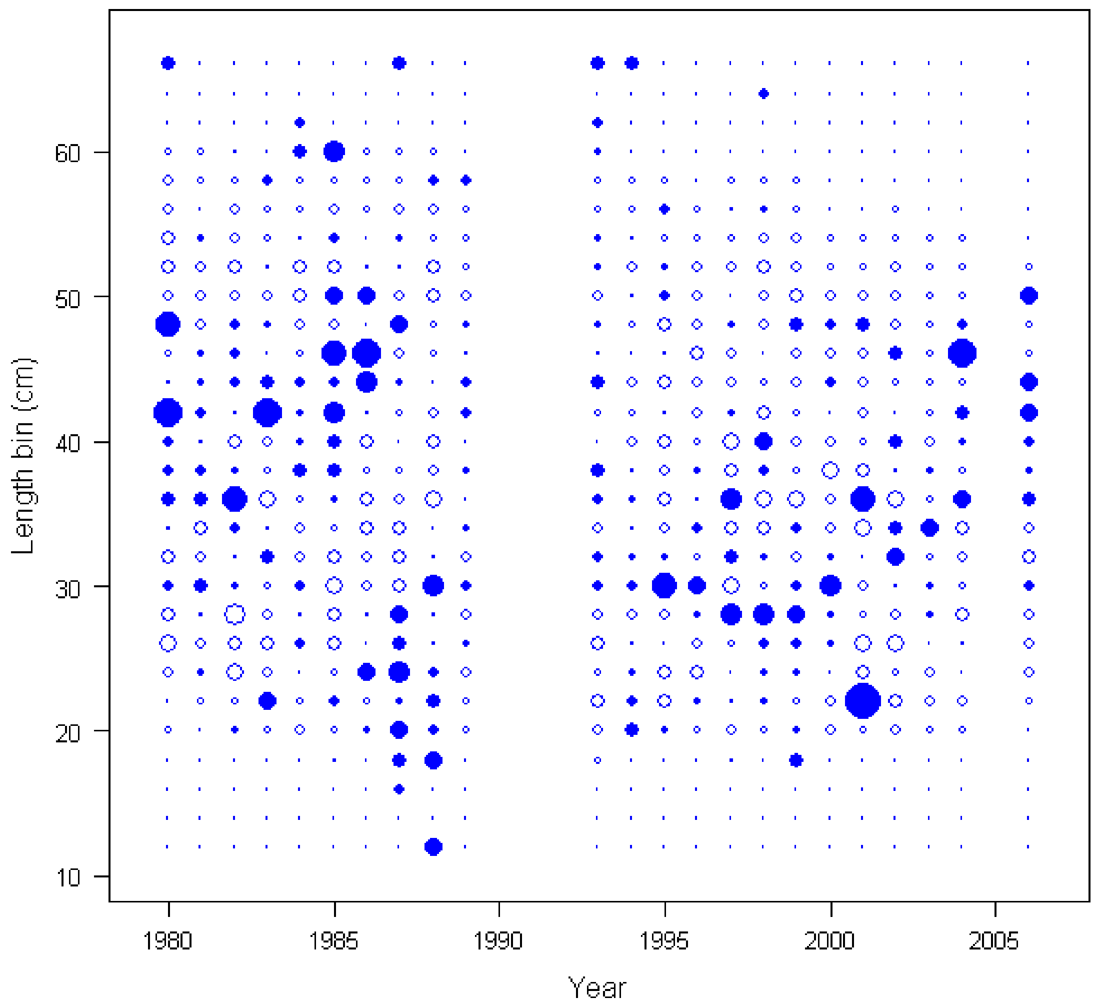


Figure 144. Pearson residuals for the fit to combined sex length-frequency observations for the Oregon-Washington recreational fleet. The largest circle represents a value of 8.81; filled circles show observation greater than estimate; solid circles show observation less than estimate.

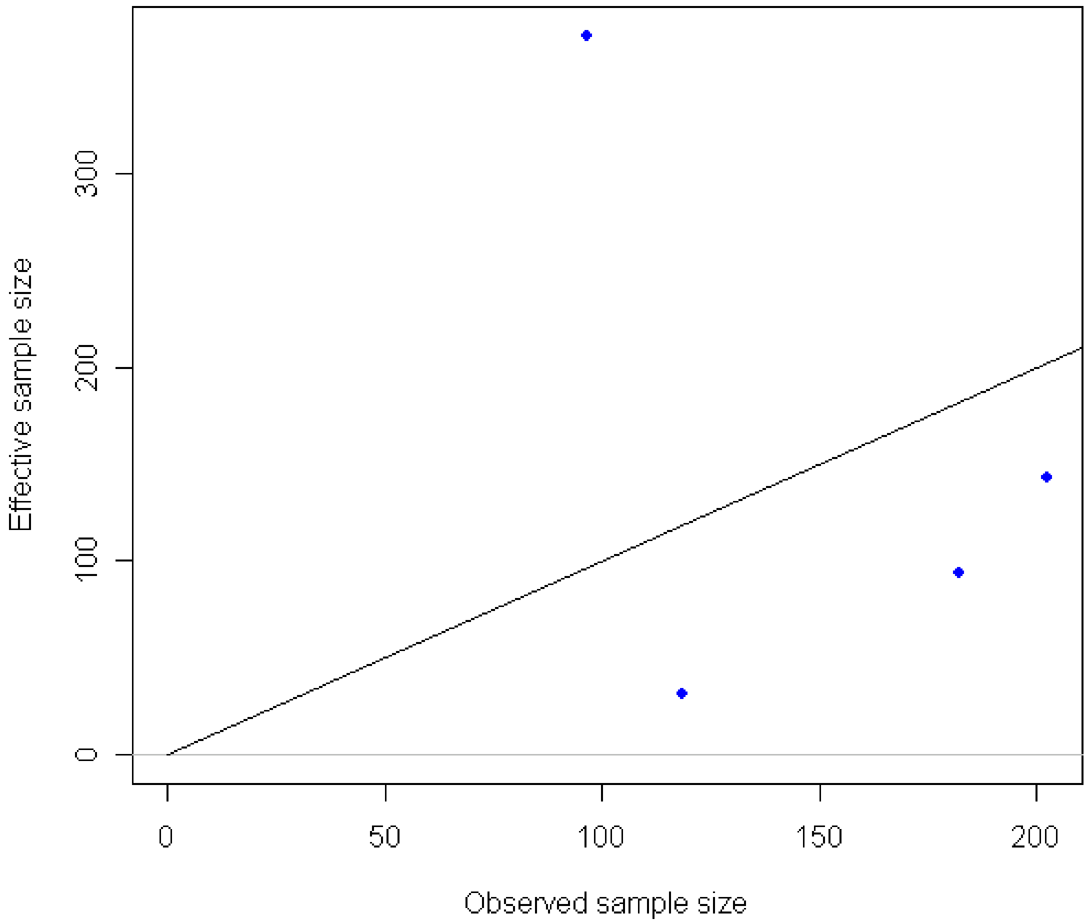


Figure 145. Observed and effective sample sizes for the sex specific at-sea whiting fleet length-frequency observations.

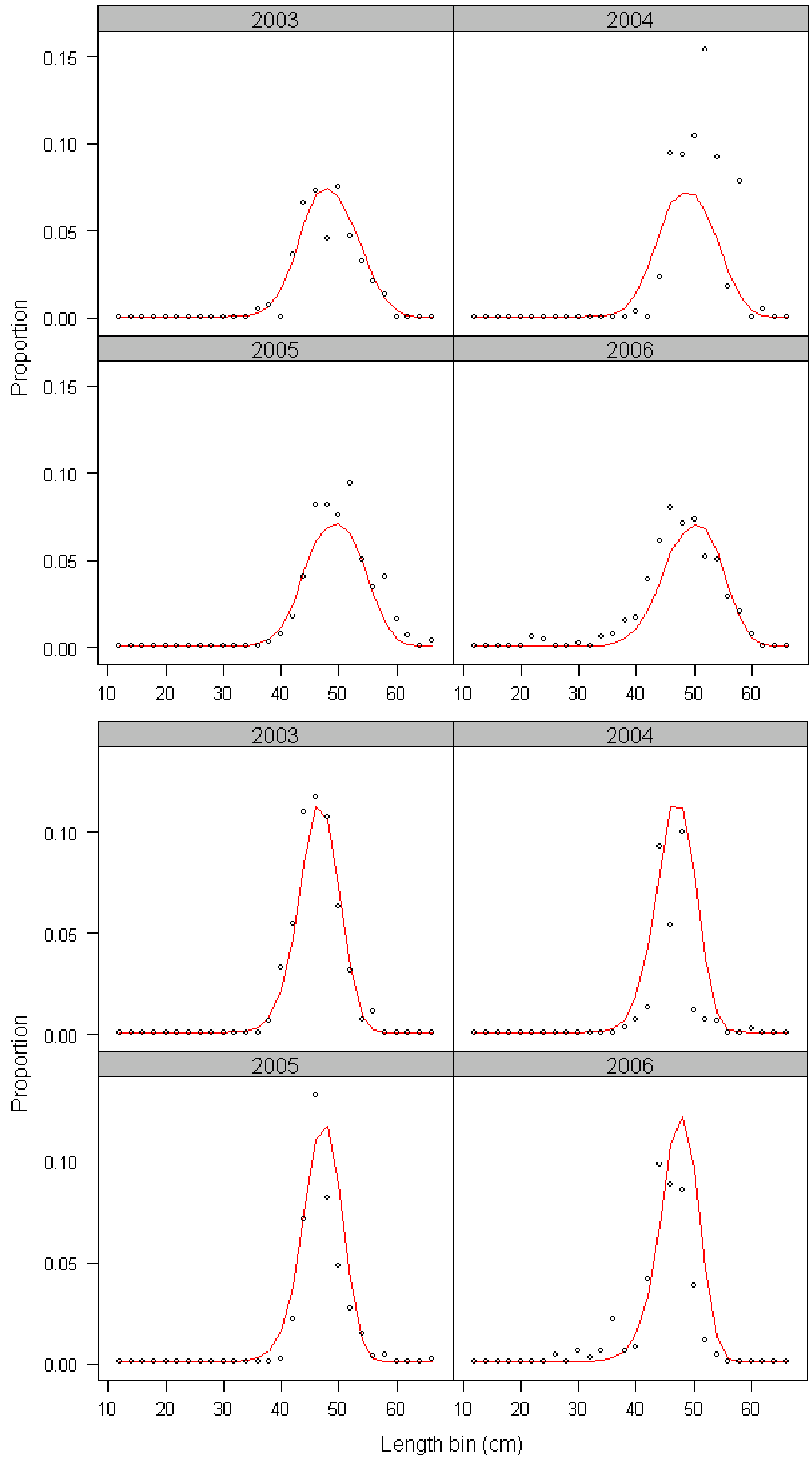


Figure 146. Fit to female (upper panel) and male (lower panel) length-frequency observations for the at-sea whiting fleet.

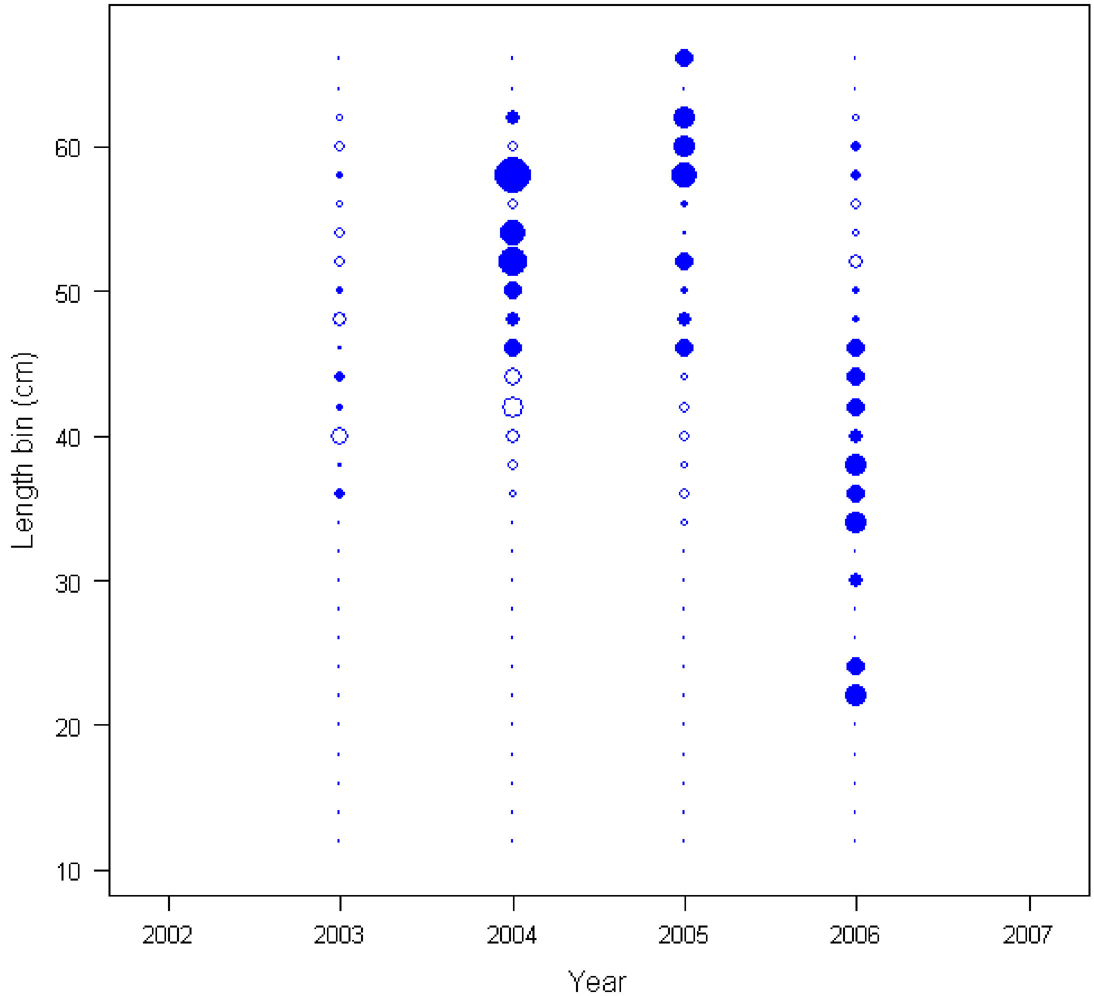


Figure 147. Pearson residuals for the fit to female length-frequency observations for the at-sea whiting fleet. The largest circle represents a value of 6.32; filled circles show observation greater than estimate; solid circles show observation less than estimate.

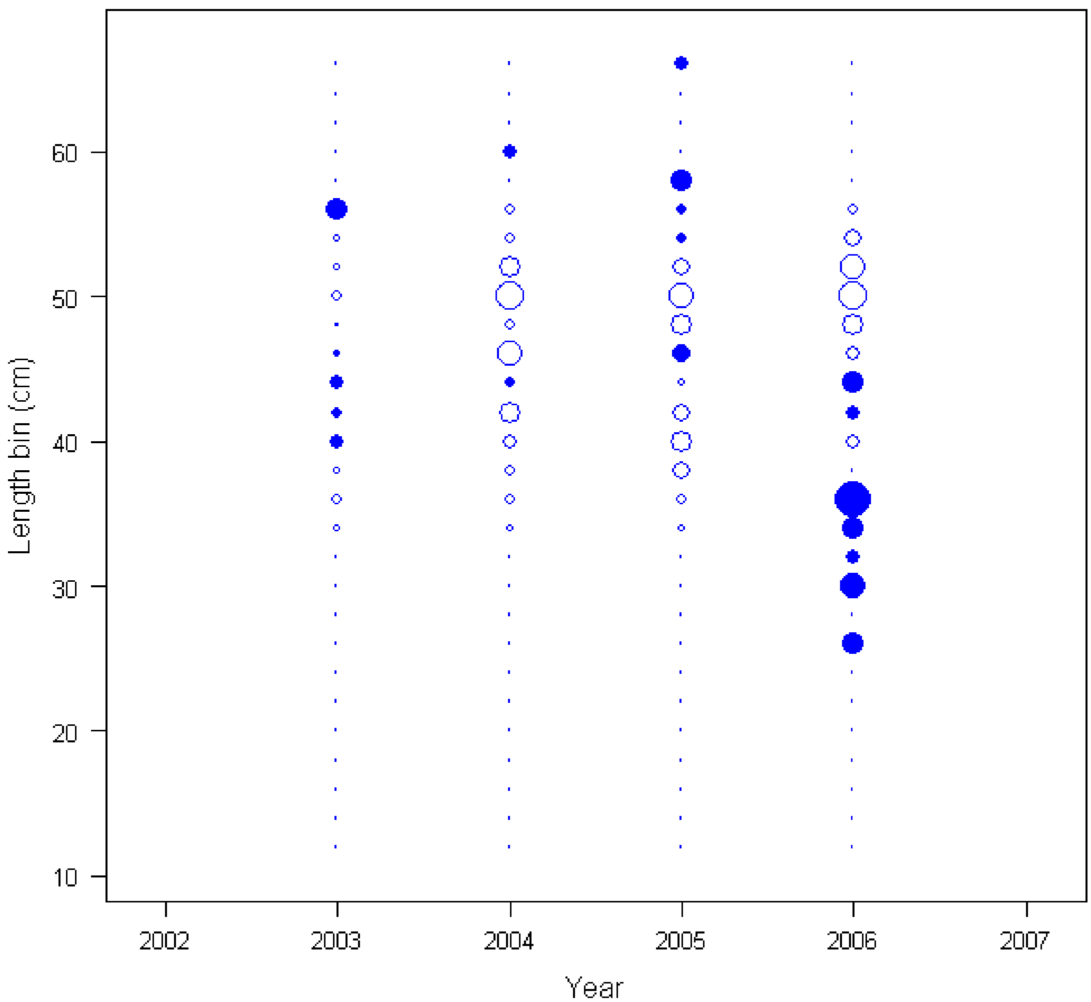


Figure 148. Pearson residuals for the fit to female length-frequency observations for the at-sea whiting fleet. The largest circle represents a value of 5.02; filled circles show observation greater than estimate; solid circles show observation less than estimate.

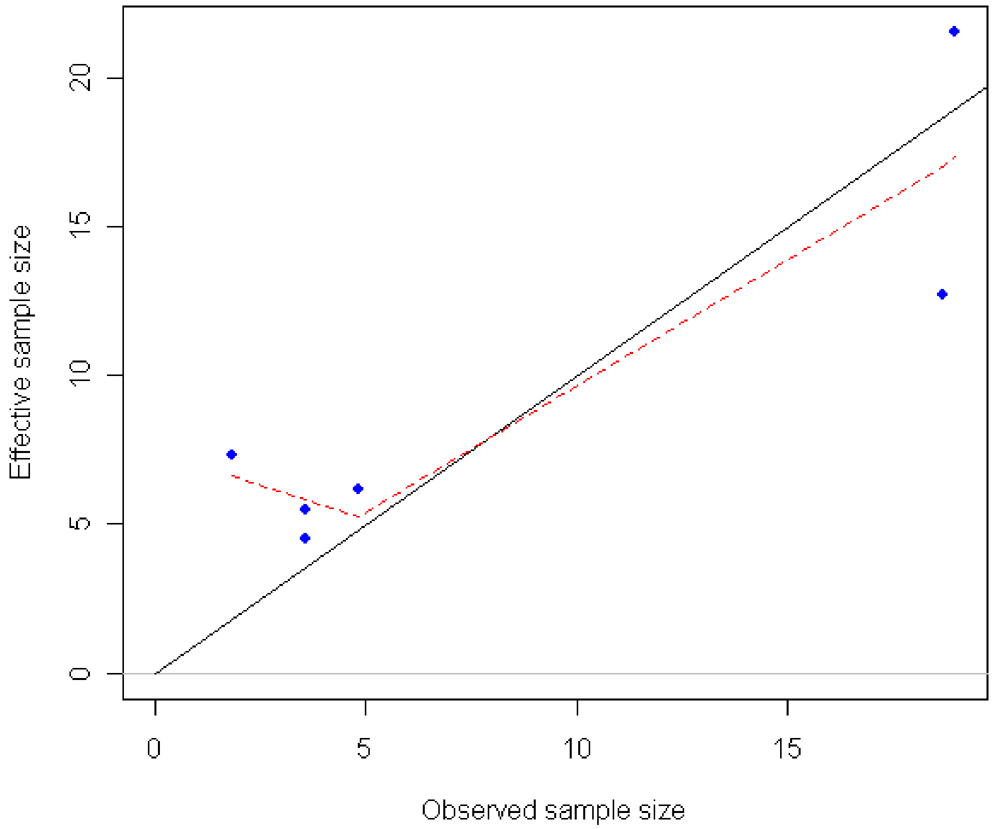


Figure 149. Observed and effective sample sizes for the sex specific southern California trawl fleet age-frequency observations.

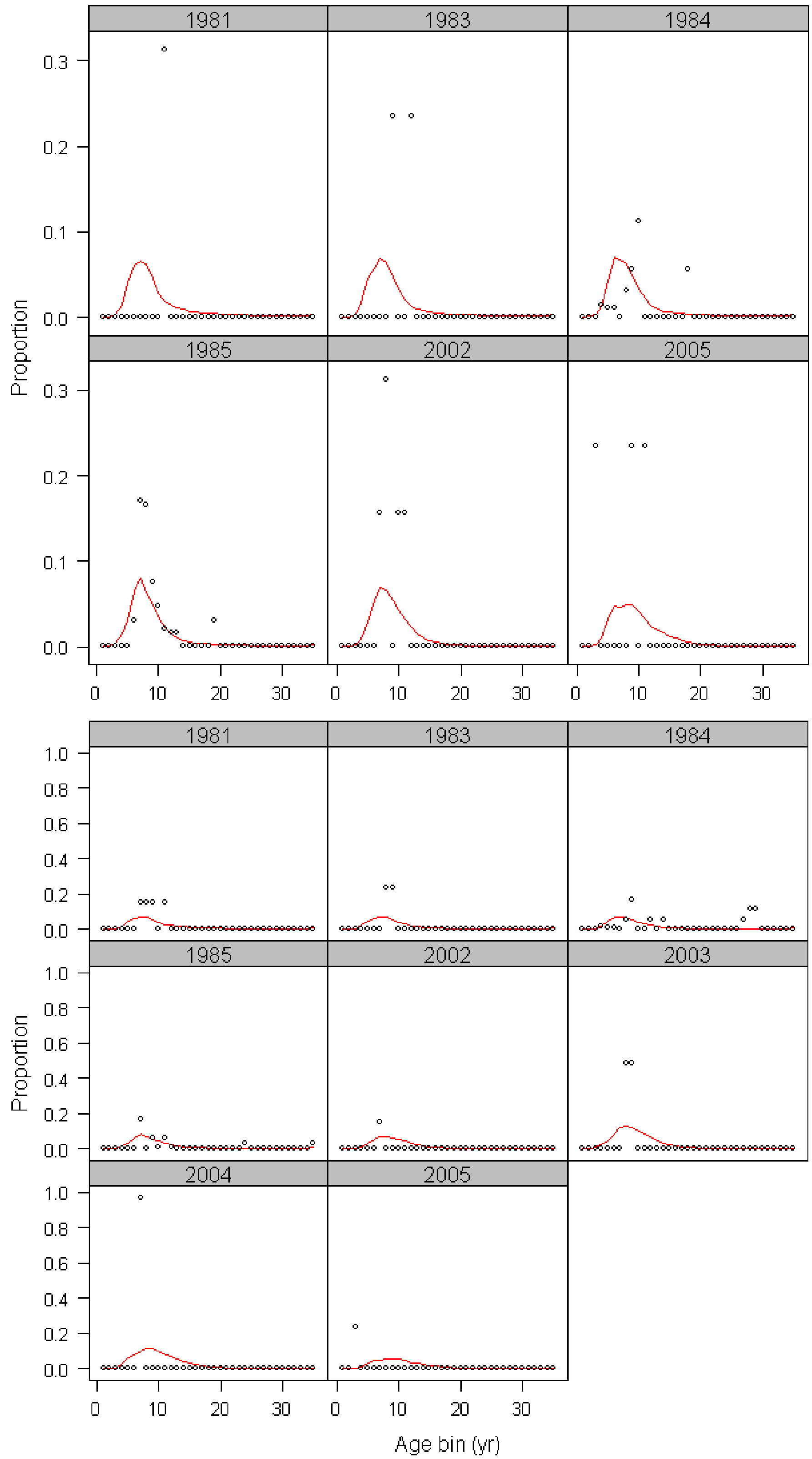


Figure 150. Fit to the southern California fishery female (upper panel) and male (lower panel) age-frequencies.

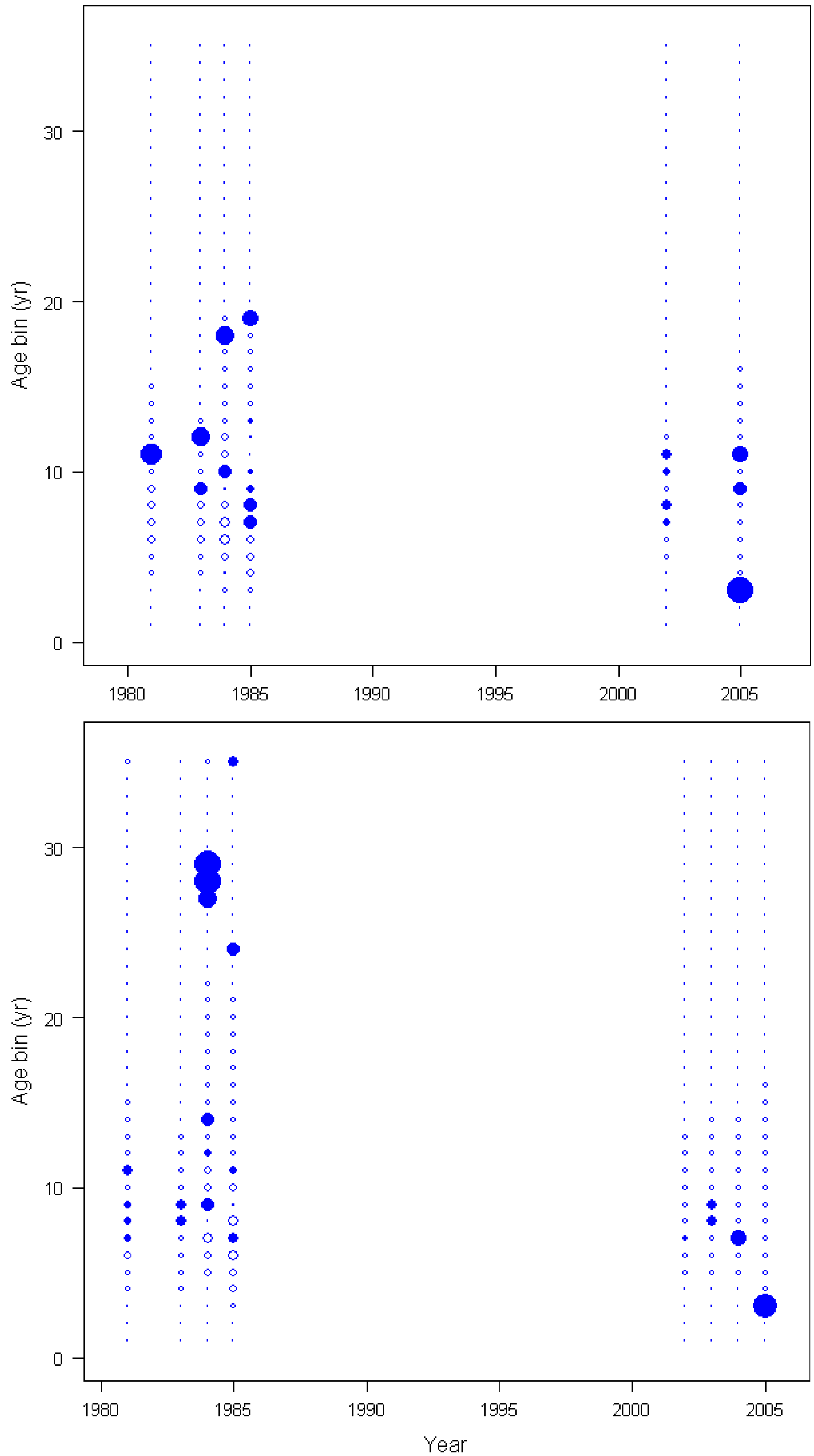


Figure 151. Pearson residuals for the fit to southern California fishery female (upper panel, maximum = 7.64) and male (lower panel, maximum = 9.56) length-frequencies.

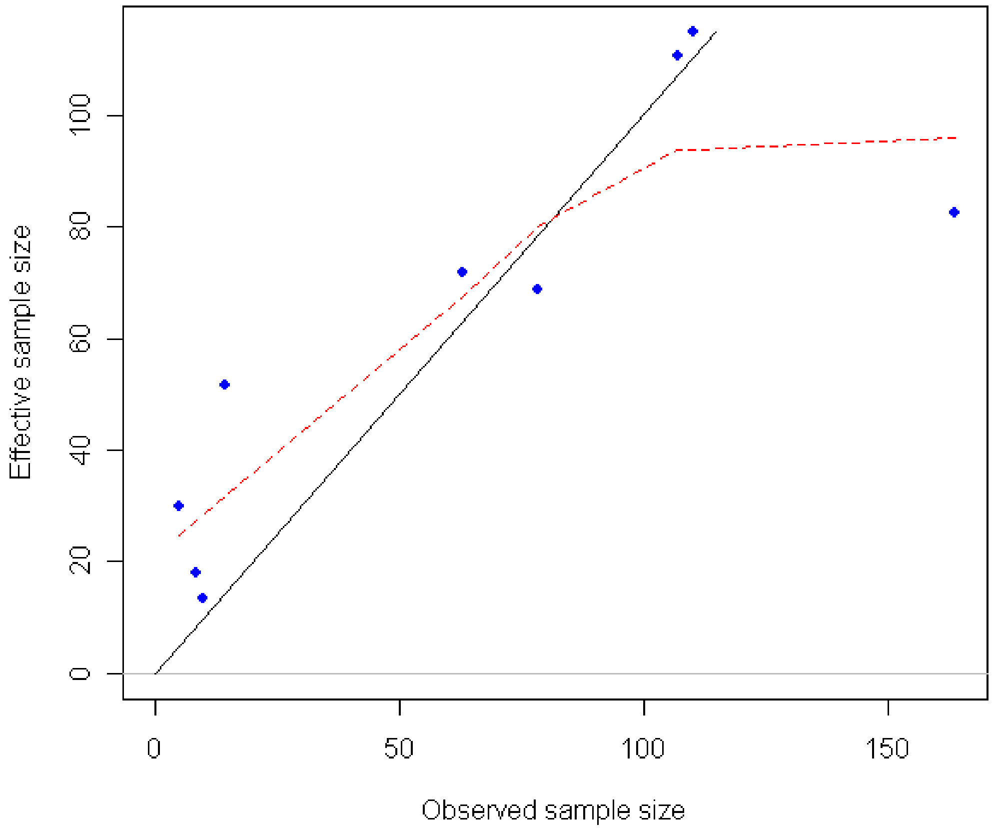


Figure 152. Observed and effective sample sizes for the sex specific northern California trawl fleet age-frequency observations.

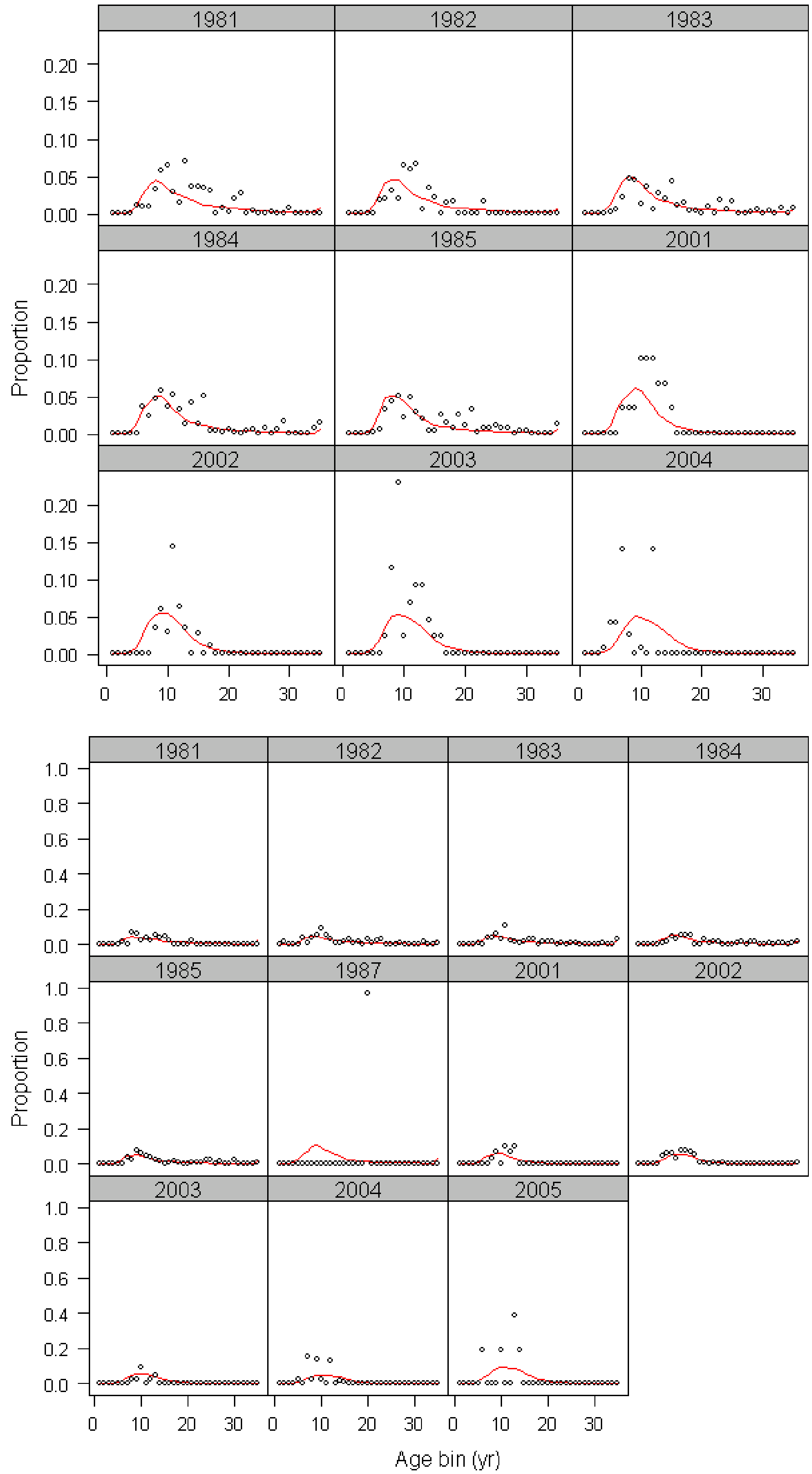


Figure 153. Fit to the northern California trawl fishery female (upper panel) and male (lower panel) age-frequencies.

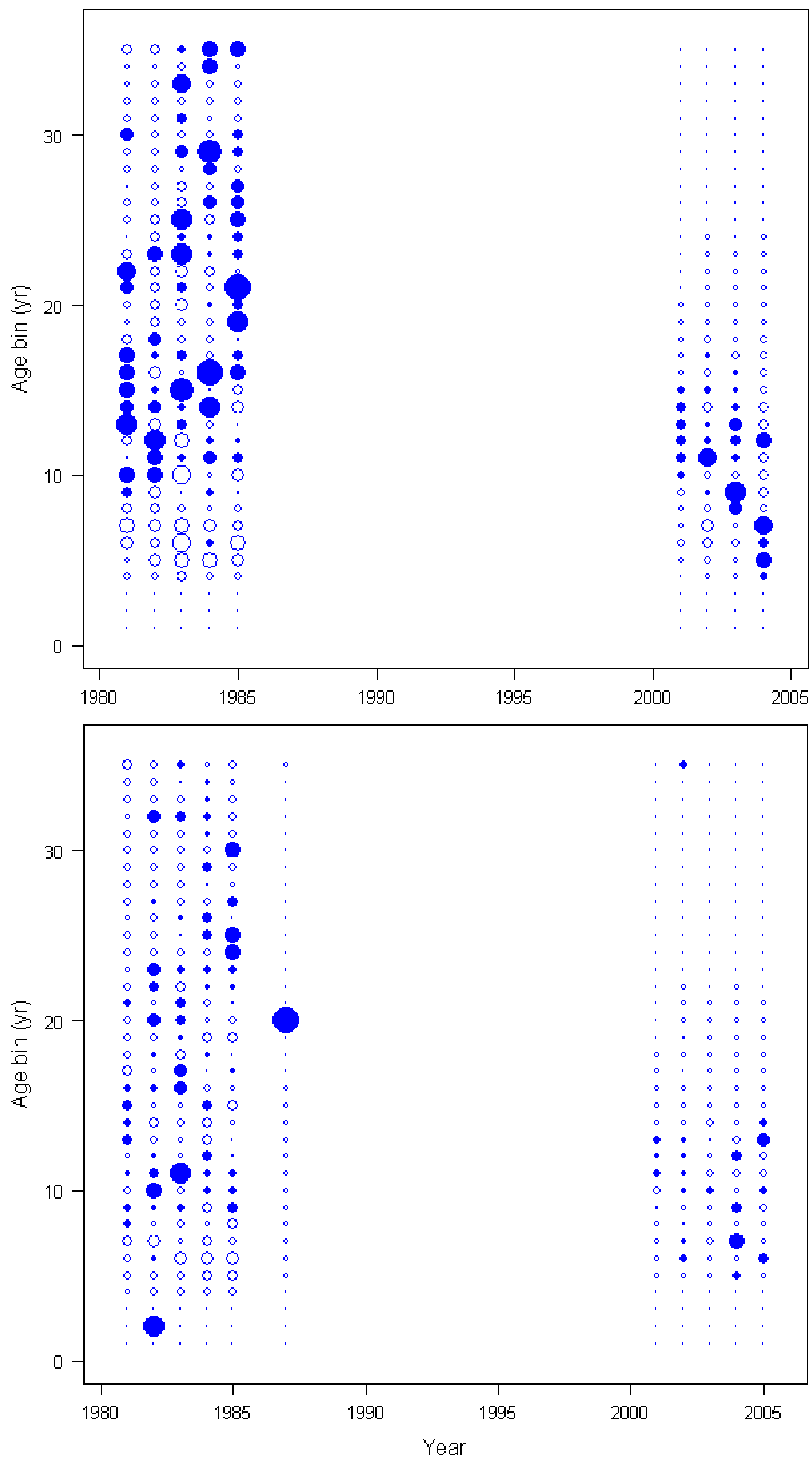


Figure 154. Pearson residuals for the fit to northern California trawl fishery female (upper panel, maximum = 4.19) and male (lower panel, maximum = 8.14) length-frequencies.

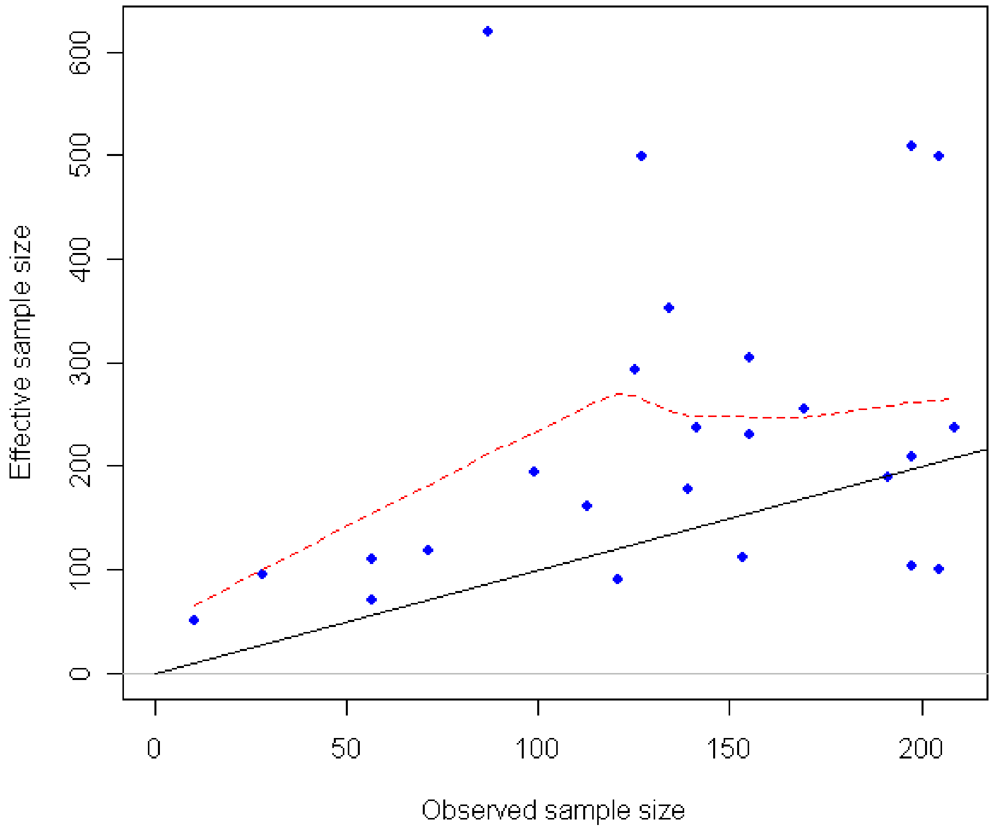


Figure 155. Observed and effective sample sizes for the sex specific Oregon trawl fleet age-frequency observations.

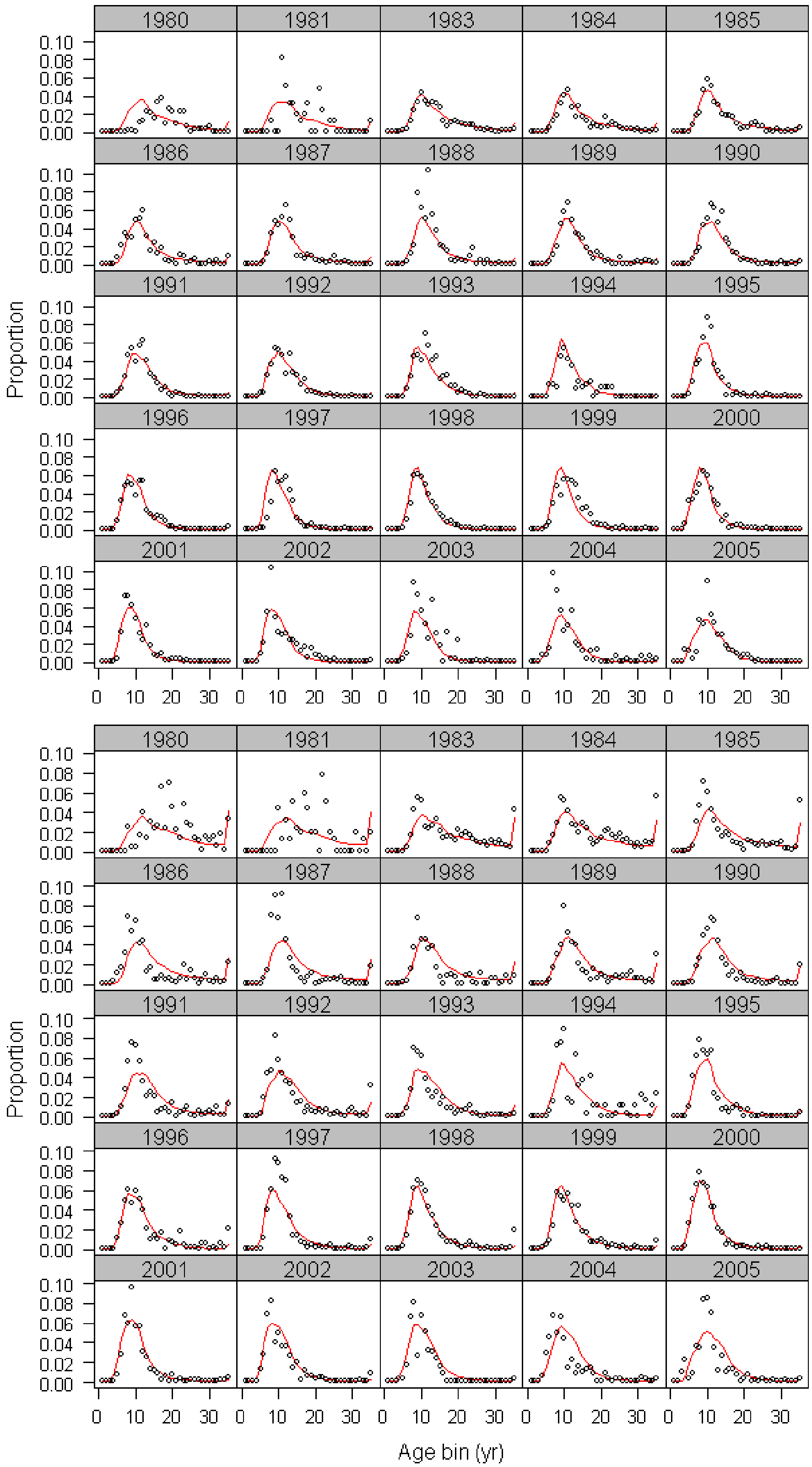


Figure 156. Fit to the Oregon trawl fishery female (upper panel) and male (lower panel) age-frequencies.

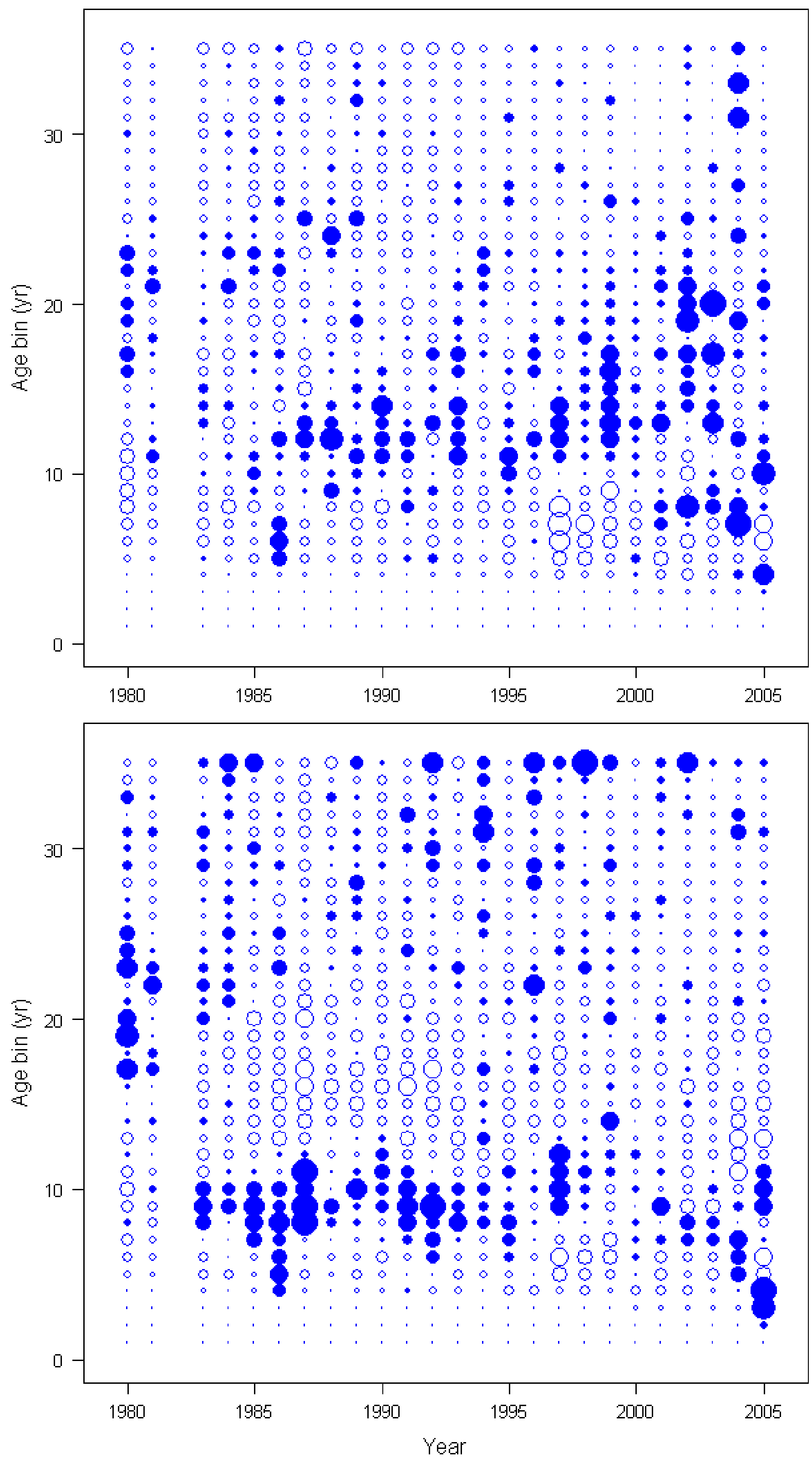


Figure 157. Pearson residuals for the fit to Oregon trawl fishery female (upper panel, maximum = 3.40) and male (lower panel, maximum = 3.64) age-frequencies.

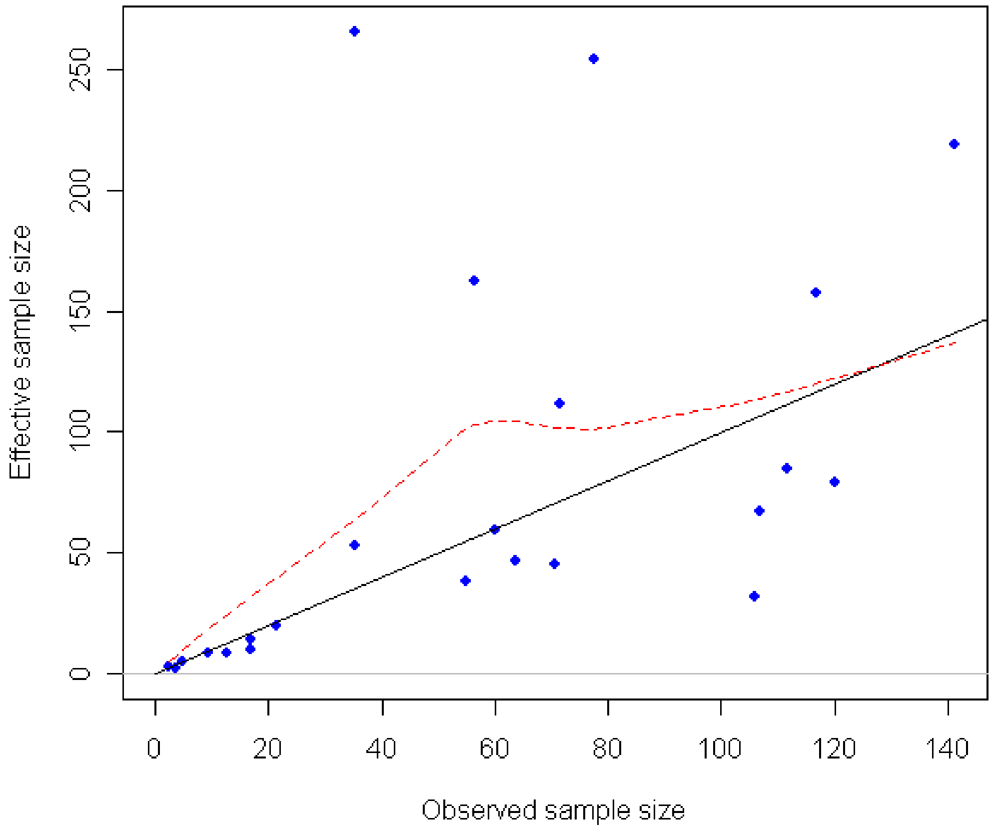


Figure 158. Observed and effective sample sizes for the sex specific Washington trawl fleet age-frequency observations based on WDFW ageing-error.

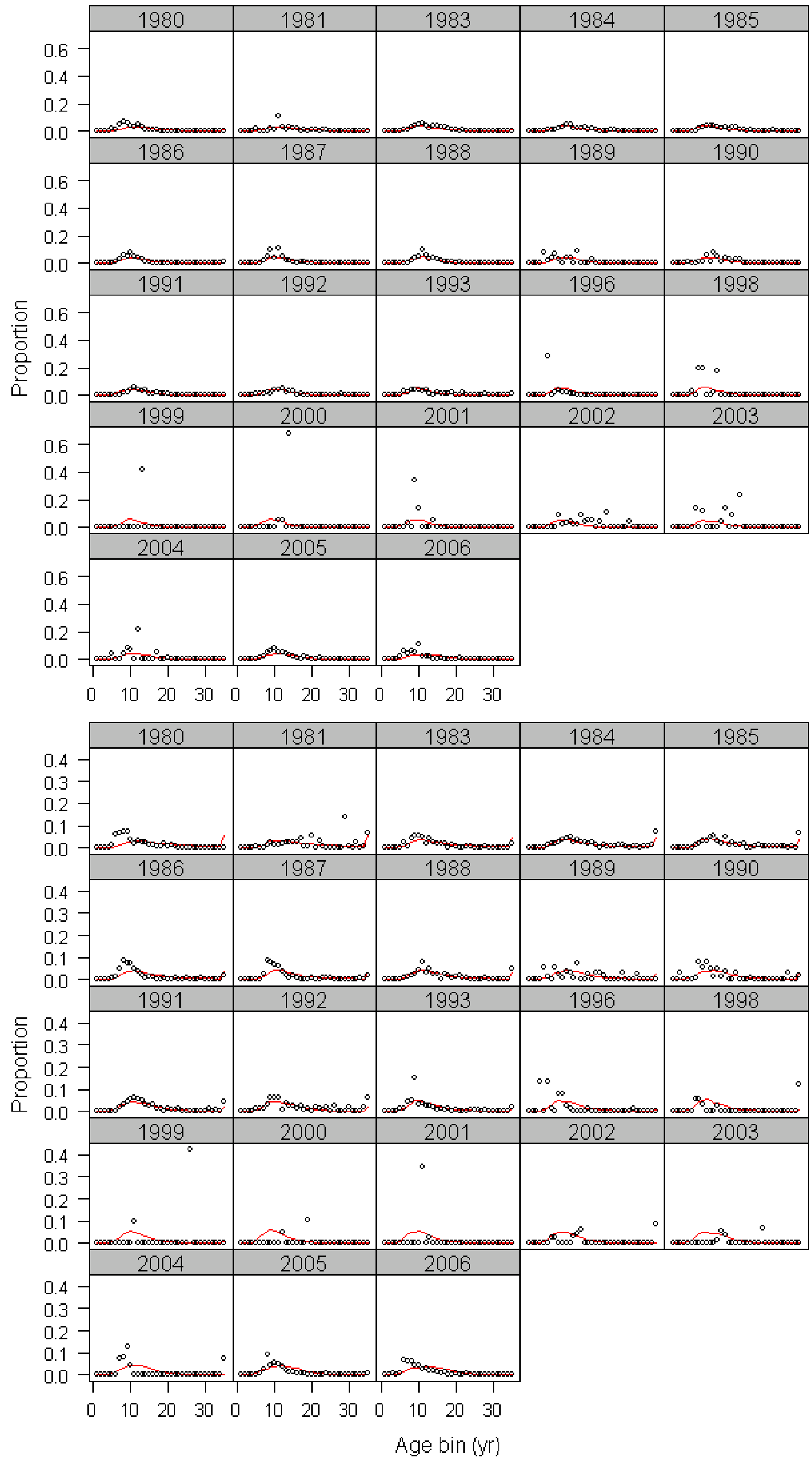


Figure 159. Fit to the Washington trawl fishery female (upper panel) and male (lower panel) age-frequencies based on WDFW ageing-error.

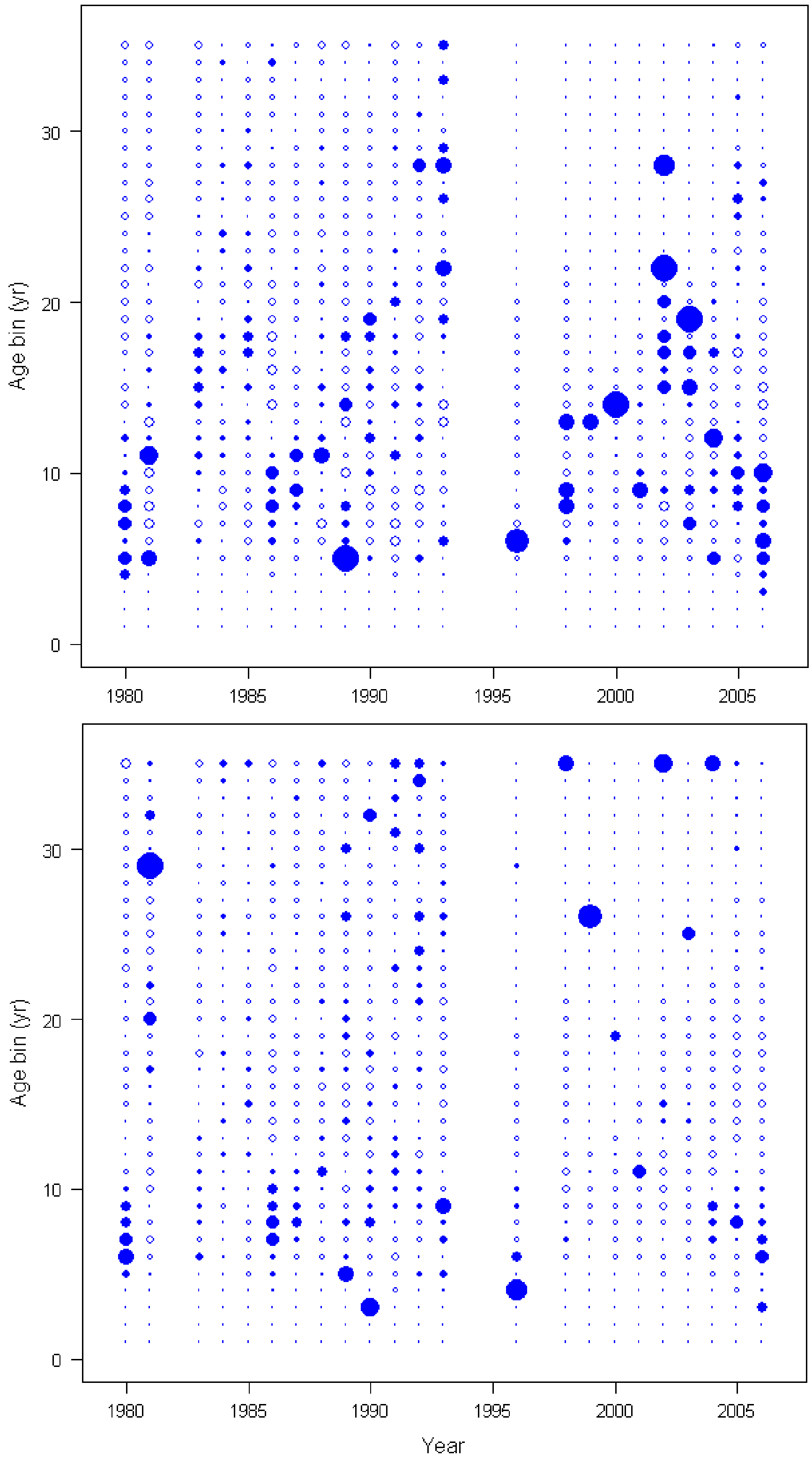


Figure 160. Pearson residuals for the fit to Washington trawl fishery female (upper panel, maximum = 8.79) and male (lower panel, maximum = 14.79) age-frequencies based on WDFW ageing-error.

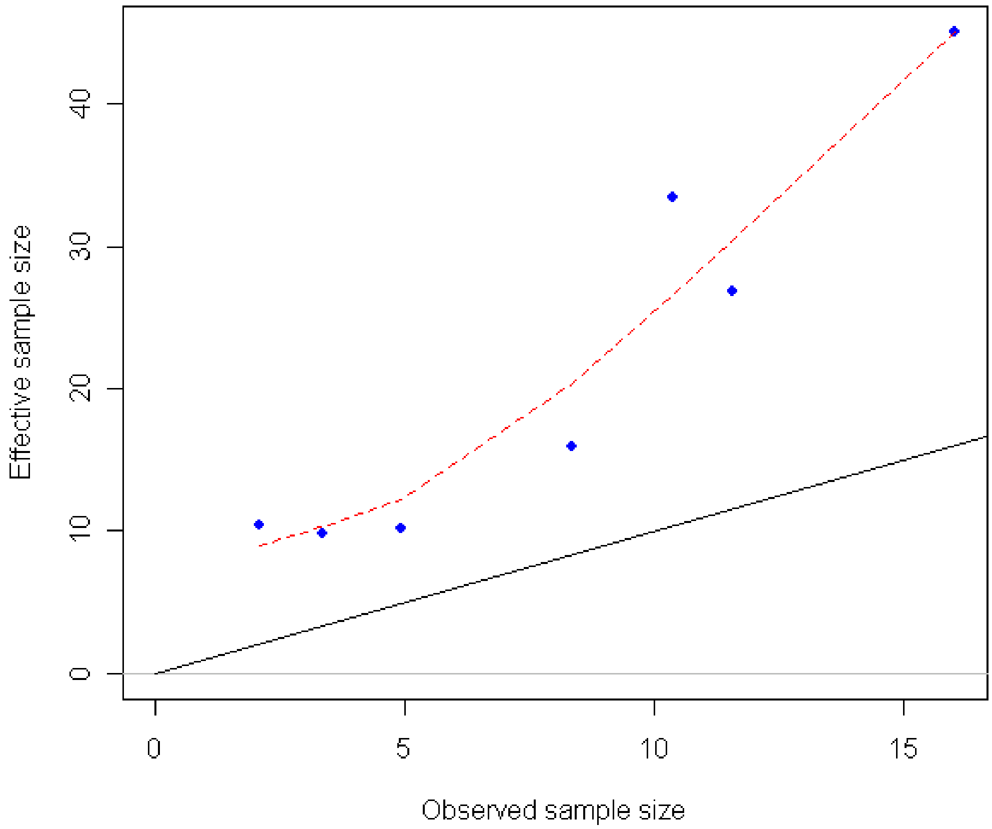


Figure 161. Observed and effective sample sizes for the sex specific Washington-Oregon non-trawl fleet age-frequency observations.

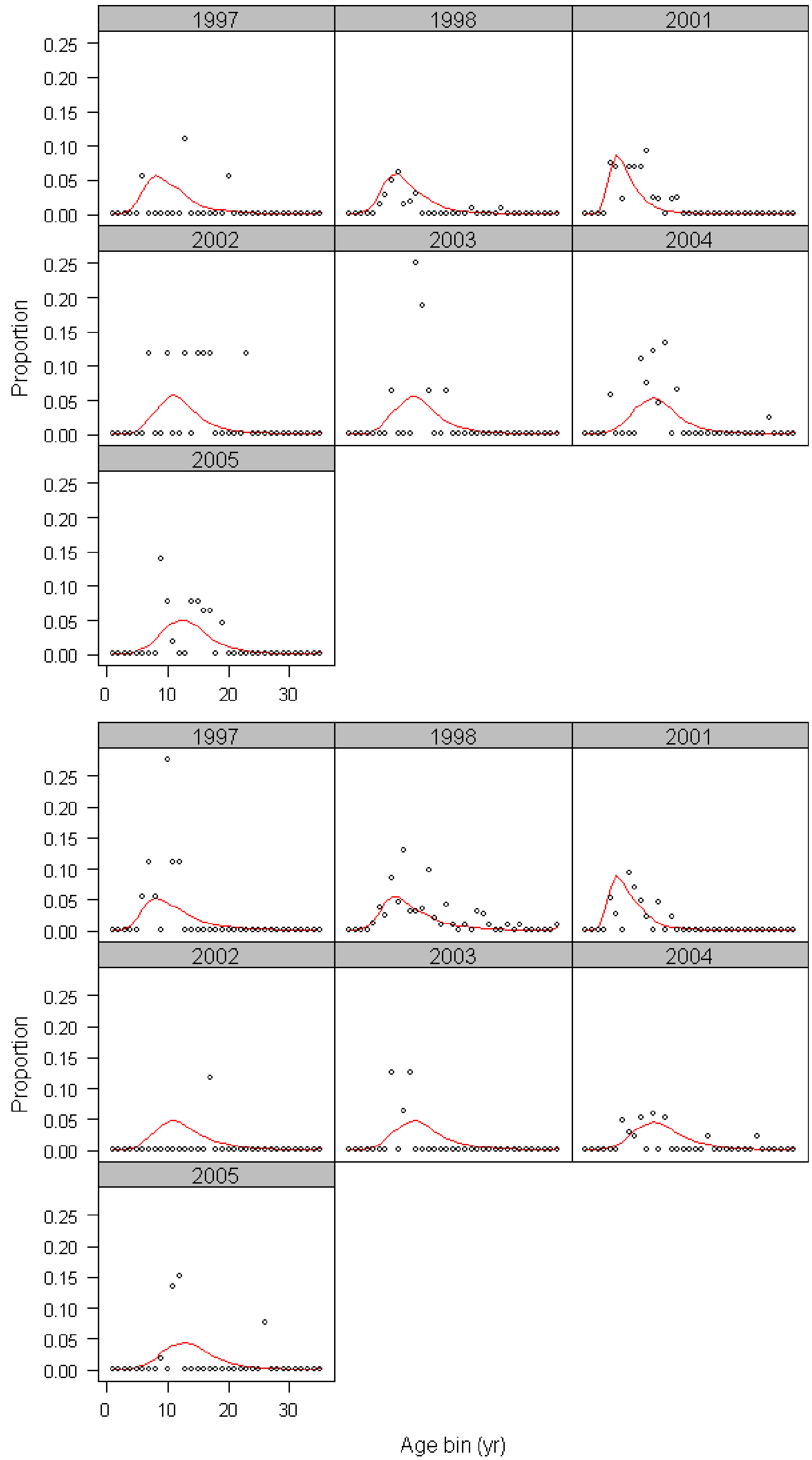
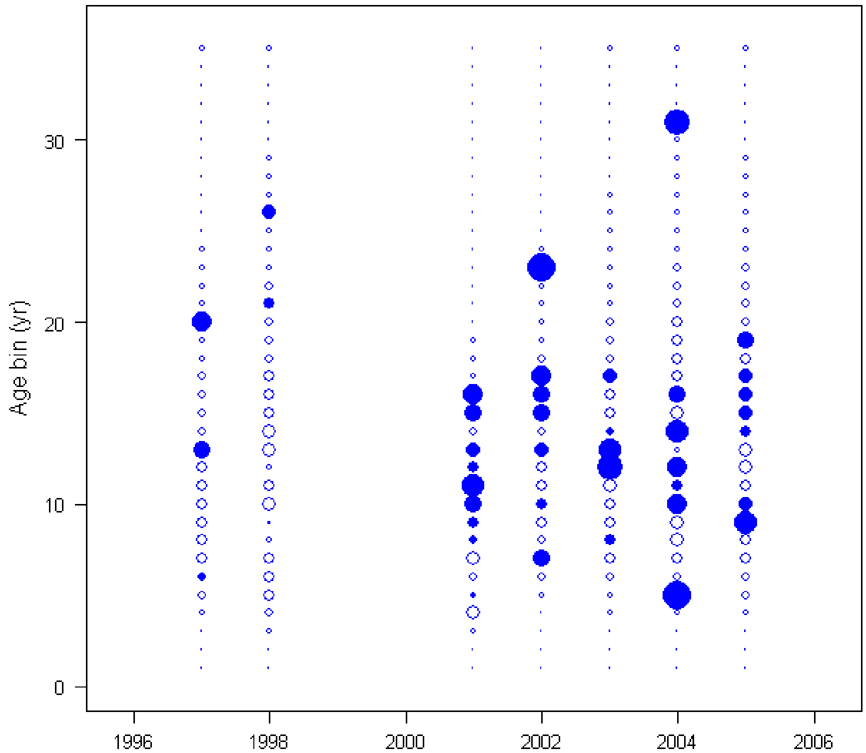


Figure 162. Fit to the Washington-Oregon non-trawl fishery female (upper panel) and male (lower panel) age-frequencies.



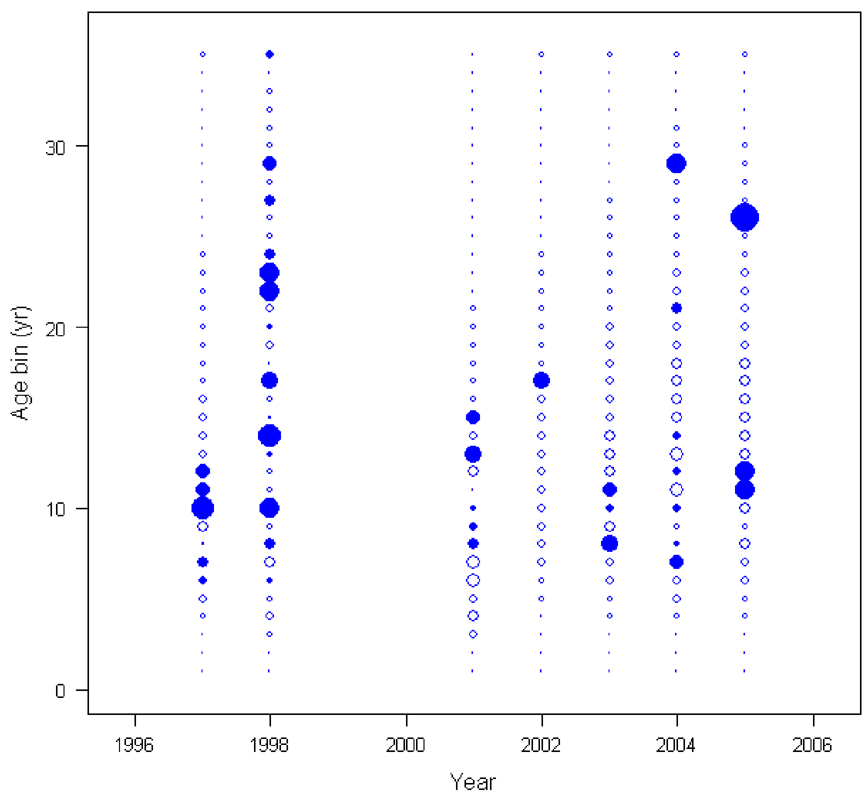


Figure 163. Pearson residuals for the fit to Washington-Oregon non-trawl fishery female (upper panel, maximum = 2.67) and male (lower panel, maximum = 3.44) age-frequencies.

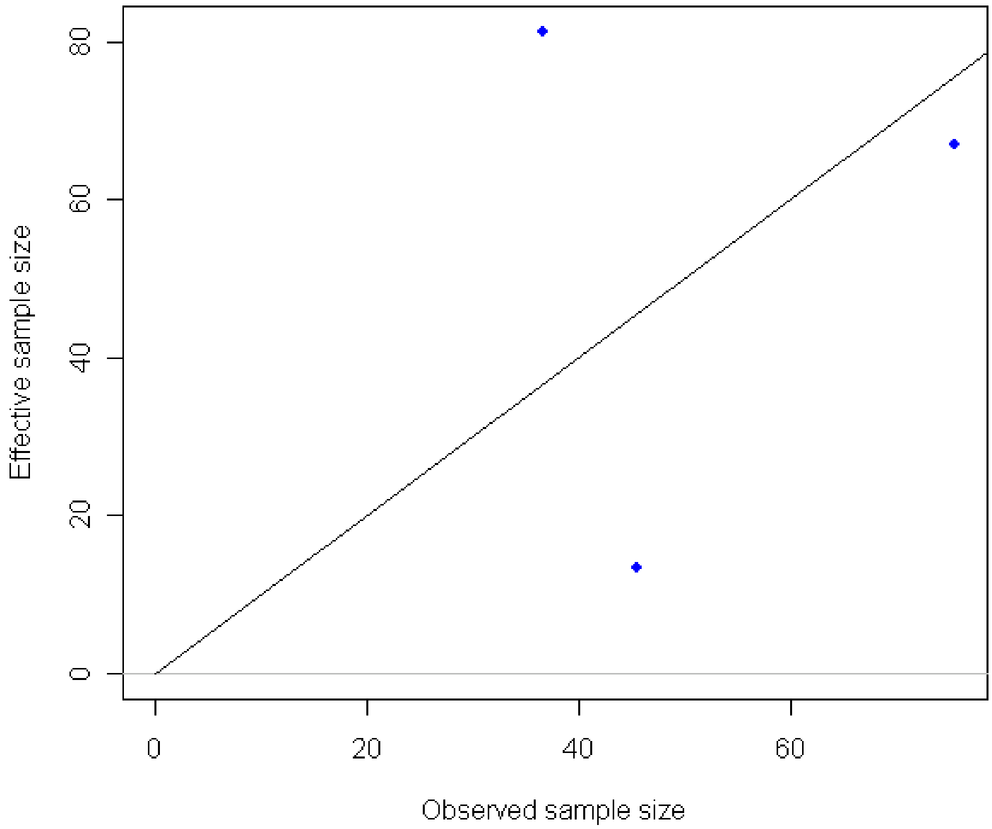


Figure 164. Observed and effective sample sizes for the sex specific the at-sea whiting bycatch fishery age-frequency observations.

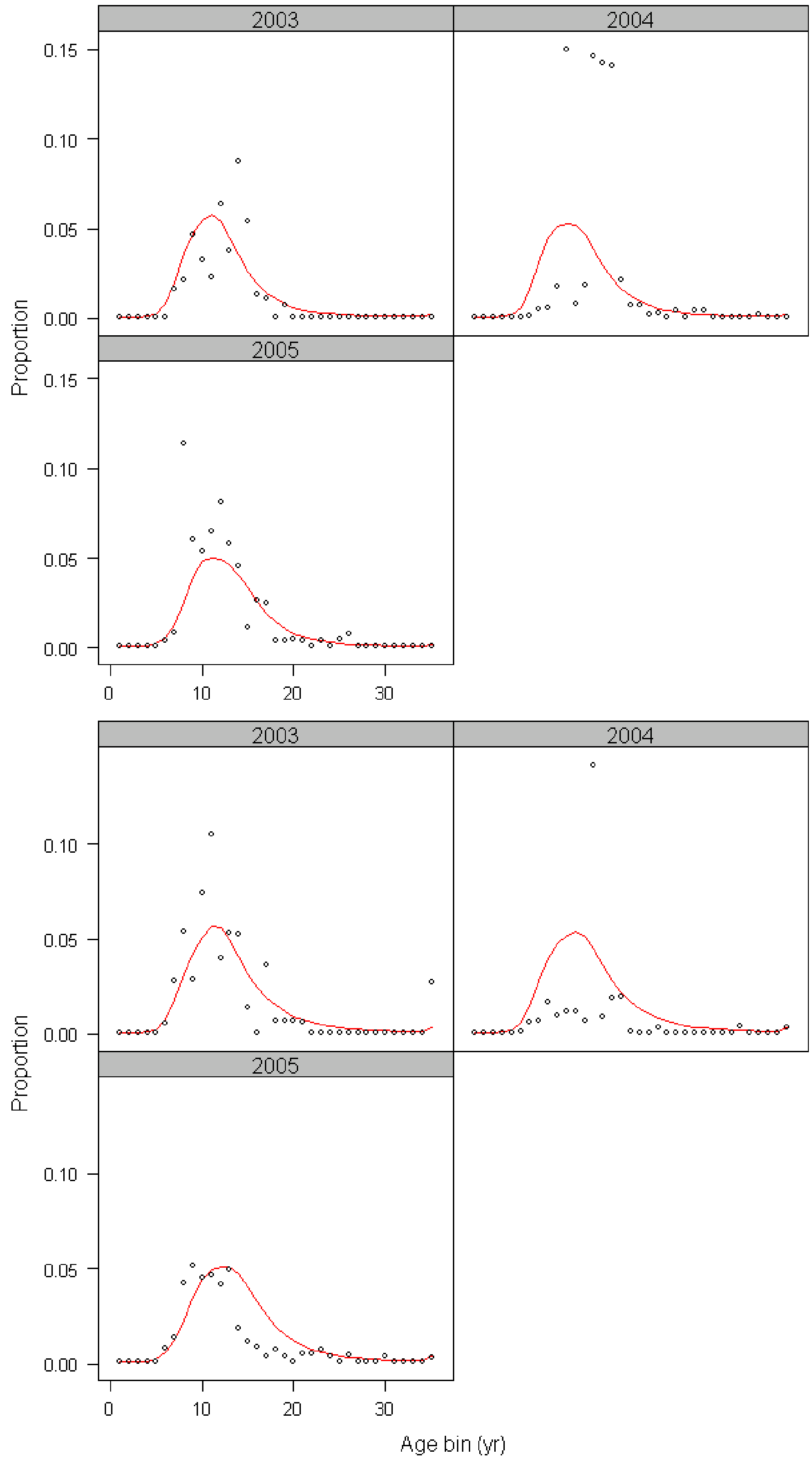


Figure 165. Fit to the at-sea whiting bycatch fishery female (upper panel) and male (lower panel) age-frequencies.

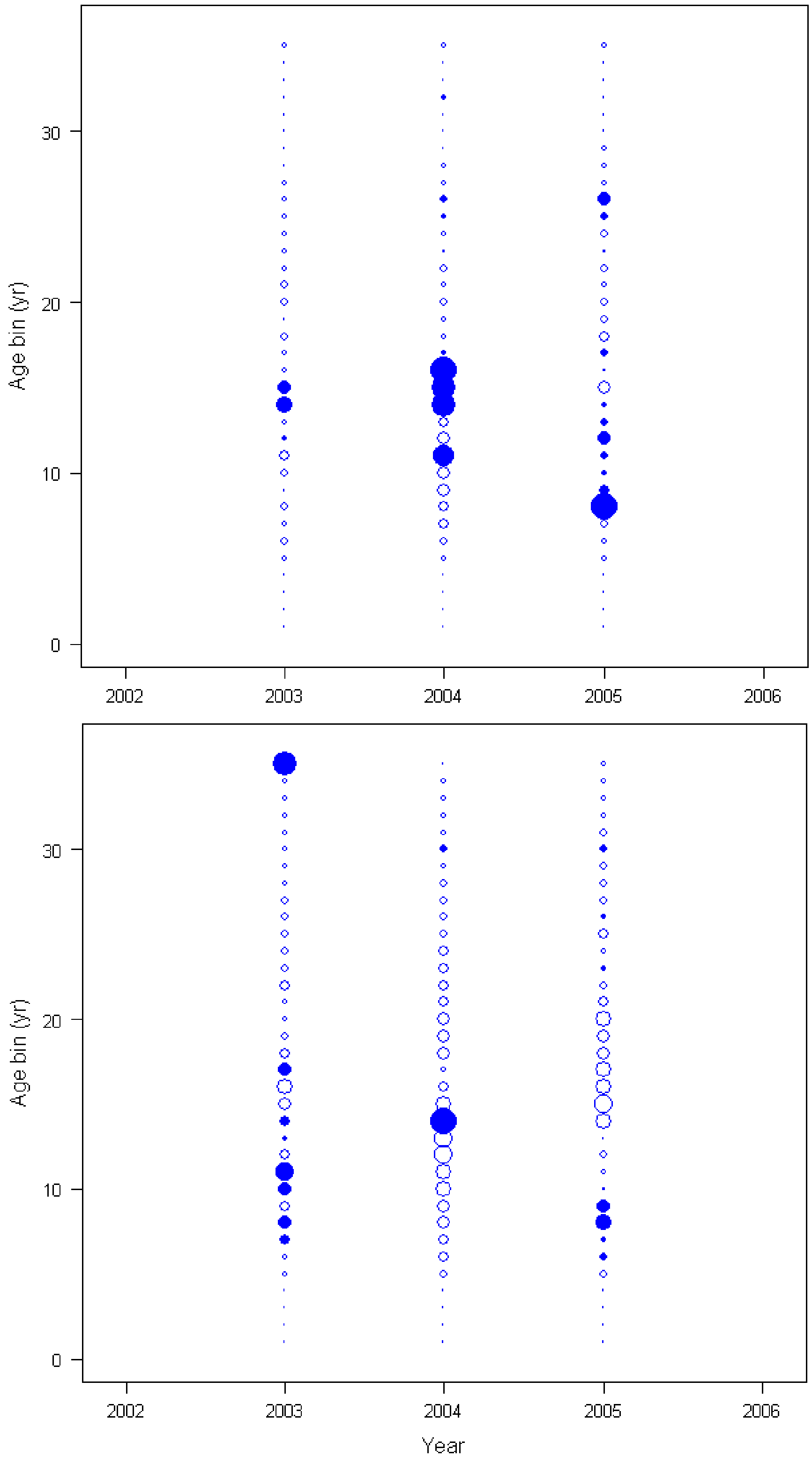


Figure 166. Pearson residuals for the fit to the at-sea whiting bycatch fishery female (upper panel, maximum = 5.43) and male (lower panel, maximum = 3.16) age-frequencies.

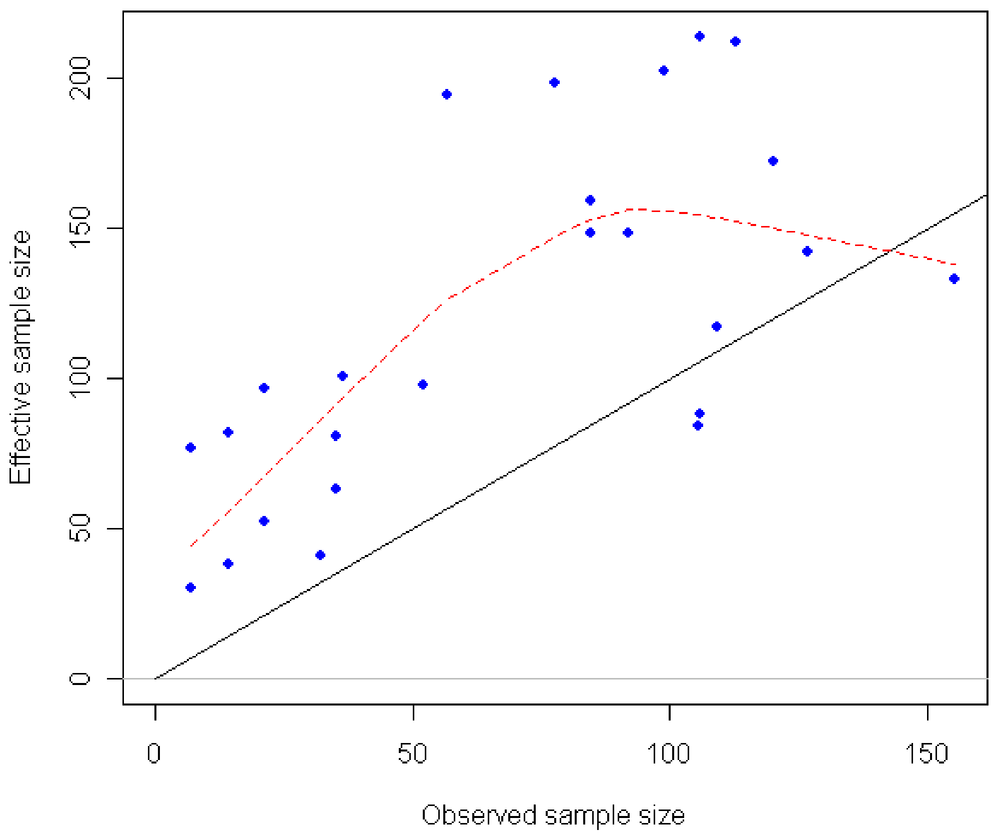


Figure 167. Observed and effective sample sizes for the sex specific Washington trawl fleet age-frequency observations based on CAP ageing-error.

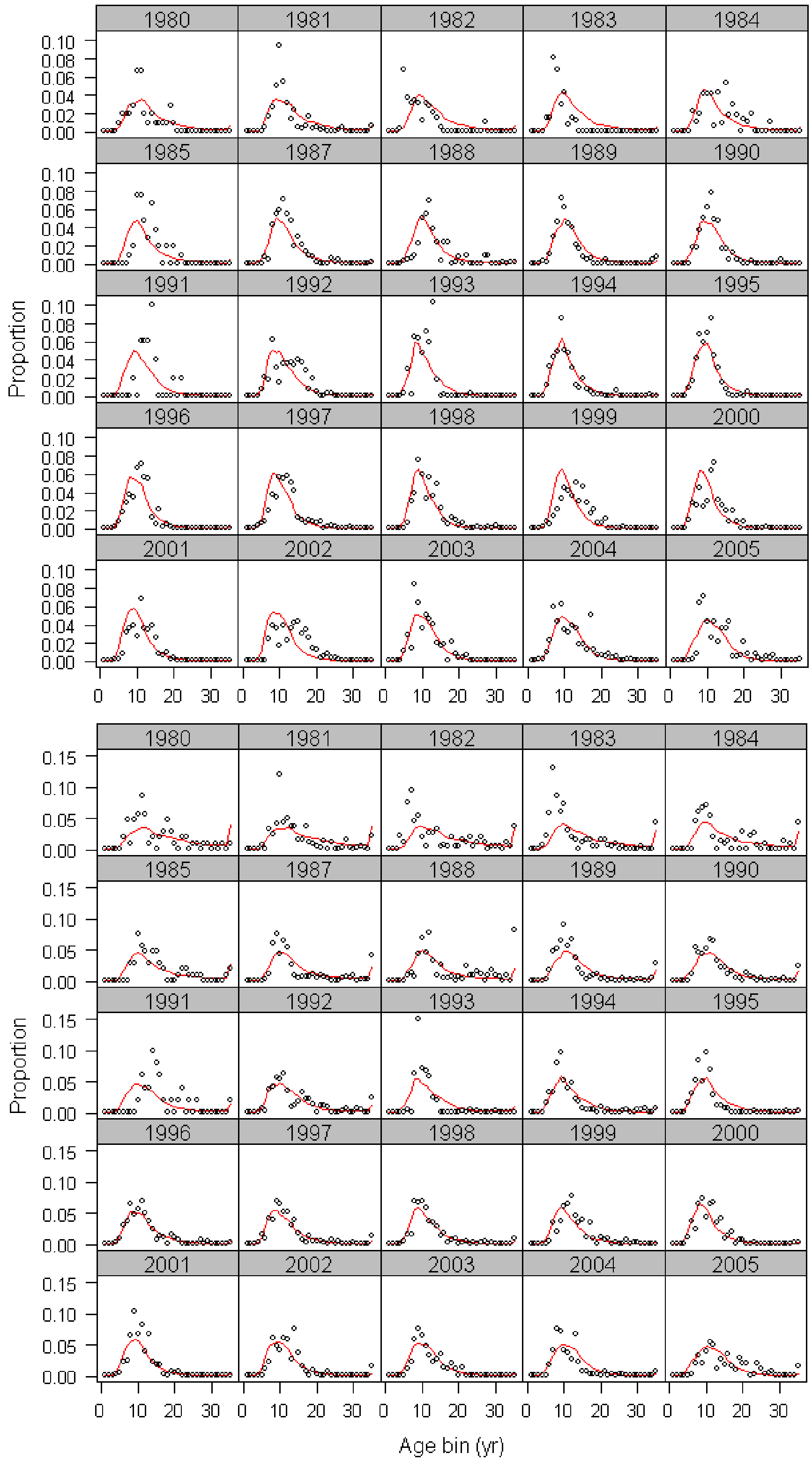


Figure 168. Fit to the Washington trawl fishery female (upper panel) and male (lower panel) age-frequencies based on CAP ageing-error.

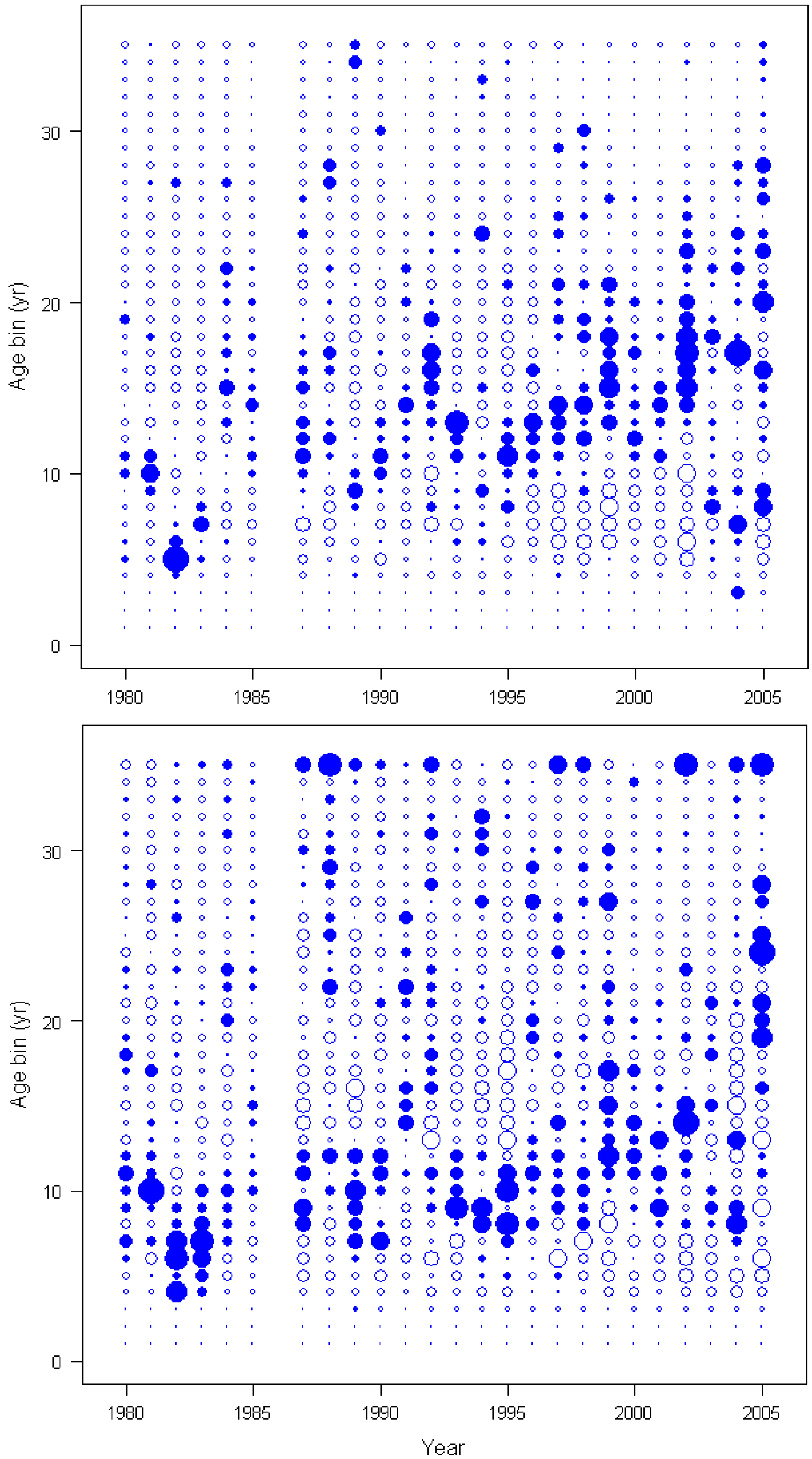


Figure 169. Pearson residuals for the fit to the Washington trawl fishery female (upper panel, maximum = 3.91) and male (lower panel, maximum = 3.15) age-frequencies based on CAP ageing-error.

13. Appendix B: SS2 Data file

.dat file for Canary rockfish assessment 2007 post-STAR review
Ian Stewart, NWFSC 206-302-2447

Global model specifications
1916 # Start year
2006 # End year
1 # Number of seasons/year
12 # Number of months/season (vector, by season)
1 # Spawning occurs at beginning of season
12 # Number of fishing fleets
5 # Number of survey fleets

Fleet names (separated by "%")
1CA_S_trwl%2CA_N_trwl%3OR_trwl%4WA_trwl%5CA_S_nontrwl%6CA_N_nontrwl%7WAOR_nontrwl%8CA_S_rec%9CA_N_rec%10WAOR_rec%11_atseahake%12_NWFSC%13_triennial%14_pre_recruit%15_WAtrl_mirror%16_NWFSC_mirror%17_tri_mirror
Fleet timing (proportion of season)
0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5

2 # Number of genders (1/2)
40 # Accumulator age

Catch section
Initial equilibrium catch (landings + discard in mt) by fishing fleet
0 0 0 0 0 0 0 0 0 0 0 0
Catch series (mt)

0.00	397.05	0.00	0.00	0.00	76.81	0.00	0.00	0.00	0.00	0.00	0.00
	#	1916									
0.00	627.50	0.00	0.00	0.00	121.39	0.00	0.00	0.00	0.00	0.00	0.00
	#	1917									
0.00	665.34	0.00	0.00	0.00	128.70	0.00	0.00	0.00	0.00	0.00	0.00
	#	1918									
0.00	435.72	0.00	0.00	0.00	84.29	0.00	0.00	0.00	0.00	0.00	0.00
	#	1919									
0.00	454.69	0.00	0.00	0.00	87.96	0.00	0.00	0.00	0.00	0.00	0.00
	#	1920									
0.00	384.35	0.00	0.00	0.00	74.35	0.00	0.00	0.00	0.00	0.00	0.00
	#	1921									
0.00	348.06	0.00	0.00	0.00	67.33	0.00	0.00	0.00	0.00	0.00	0.00
	#	1922									
0.00	411.39	0.00	0.00	0.00	79.58	0.00	0.00	0.00	0.00	0.00	0.00
	#	1923									
0.00	382.84	0.00	0.00	0.00	74.06	0.00	0.00	0.00	0.00	0.00	0.00
	#	1924									
0.00	443.03	0.00	0.00	0.00	85.70	0.00	0.00	0.00	0.00	0.00	0.00
	#	1925									
0.00	608.69	0.00	0.00	0.00	117.75	0.00	0.00	0.00	0.00	0.00	0.00
	#	1926									
0.00	515.84	0.00	0.00	0.00	99.78	0.00	0.00	0.00	0.00	0.00	0.00
	#	1927									
0.00	518.20	8.16	0.00	0.00	100.24	0.00	0.00	0.00	0.00	0.00	0.00
	#	1928									
0.00	487.25	14.19	0.00	0.00	94.25	0.00	0.00	0.00	0.00	0.00	0.00
	#	1929									
0.00	583.22	13.14	0.00	0.00	112.82	0.00	0.00	0.00	0.00	0.00	0.00
	#	1930									
0.00	587.44	10.06	0.00	0.00	113.64	0.00	0.00	0.00	0.00	0.00	0.00
	#	1931									
0.00	454.95	3.69	0.04	0.00	88.01	0.00	0.00	0.00	0.00	0.00	0.00
	#	1932									
0.00	386.46	5.39	0.00	0.00	74.76	0.00	0.00	0.00	0.00	0.00	0.00
	#	1933									
0.00	371.63	5.86	0.30	0.00	71.89	0.00	0.00	0.00	0.00	0.00	0.00
	#	1934									
0.00	389.96	5.40	2.30	0.00	75.43	0.00	0.00	0.00	0.00	0.00	0.00
	#	1935									
0.00	371.62	13.41	2.96	0.00	71.89	0.00	0.00	0.00	0.00	0.00	0.00
	#	1936									

0.00	346.38	17.03	2.64	0.00	67.00	0.00	0.00	0.00	0.00	0.00	0.00
	#	1937									
0.00	293.58	15.47	3.90	0.00	56.79	0.00	0.00	0.00	0.00	0.00	0.00
	#	1938									
0.00	269.04	11.49	4.09	0.00	52.04	0.00	0.00	0.00	0.00	0.00	0.00
	#	1939									
0.00	288.21	68.56	9.05	0.00	55.75	0.00	0.00	0.00	0.00	0.00	0.00
	#	1940									
0.00	274.89	144.08	3.39	0.00	53.18	0.00	0.00	0.00	0.00	0.00	0.00
	#	1941									
0.00	114.41	210.19	65.81	0.00	22.27	0.00	0.00	0.00	0.00	0.00	0.00
	#	1942									
0.00	222.74	766.49	212.71	0.00	42.52	0.00	0.00	0.00	0.00	0.00	0.00
	#	1943									
0.00	518.38	1258.48	88.40	0.00	99.22	0.00	0.00	0.00	0.00	0.00	0.00
	#	1944									
0.00	1071.18	1937.94	926.43	0.00	205.53	0.00	0.00	0.00	0.00	0.00	0.00
	#	1945									
0.00	900.07	1215.83	467.02	0.00	172.12	0.00	0.00	0.00	0.00	0.00	0.00
	#	1946									
0.00	685.43	755.22	243.97	0.00	131.62	0.00	0.00	0.00	0.00	0.00	0.00
	#	1947									
0.00	524.45	519.74	396.17	0.00	100.23	0.00	0.00	0.00	0.00	0.00	0.00
	#	1948									
0.00	480.92	528.54	481.83	0.00	92.13	0.00	0.00	0.00	0.00	0.00	0.00
	#	1949									
0.00	654.04	633.70	463.03	0.00	125.54	0.00	0.00	82.80	0.00	0.00	0.00
	#	1950									
0.00	886.91	409.14	387.38	0.00	170.09	0.00	0.00	82.80	0.00	0.00	0.00
	#	1951									
0.00	864.64	418.88	369.45	0.00	166.04	0.00	0.00	82.80	0.00	0.00	0.00
	#	1952									
0.00	986.13	334.79	160.20	0.00	189.33	0.00	0.00	82.80	0.00	0.00	0.00
	#	1953									
0.00	1019.54	421.04	229.79	0.00	195.40	0.00	0.00	82.80	0.00	0.00	0.00
	#	1954									
0.00	1022.58	442.74	216.84	0.00	196.42	0.00	0.00	82.80	0.00	0.00	0.00
	#	1955									
0.00	1204.82	271.93	207.15	0.00	230.84	0.00	0.00	82.80	0.00	0.00	0.00
	#	1956									
0.00	1297.96	779.74	171.37	0.00	249.06	0.00	0.00	77.70	0.00	0.00	0.00
	#	1957									
0.00	1438.70	599.62	216.94	0.00	275.39	0.00	0.00	88.30	0.00	0.00	0.00
	#	1958									
0.00	1232.16	658.62	242.52	0.00	235.90	0.00	0.00	82.40	0.00	0.00	0.00
	#	1959									
0.00	1105.60	834.55	219.31	0.00	211.60	0.00	0.00	108.40	0.00	0.00	0.00
	#	1960									
0.00	873.75	760.81	260.34	0.00	167.05	0.00	0.00	98.30	0.00	0.00	0.00
	#	1961									
0.00	792.75	795.34	362.74	0.00	151.87	0.00	0.00	104.00	0.00	0.00	0.00
	#	1962									
0.00	947.66	544.63	292.02	0.00	181.23	0.00	0.00	105.30	0.00	0.00	0.00
	#	1963									
0.00	571.02	489.43	215.56	0.00	114.41	0.00	0.00	94.20	0.00	0.00	0.00
	#	1964									
0.00	561.91	483.87	480.38	0.00	116.43	0.00	0.00	113.80	0.00	0.00	0.00
	#	1965									
0.00	534.58	2127.32	729.91	0.00	106.31	0.00	0.00	117.90	0.00	0.00	0.00
	#	1966									
0.00	483.95	854.51	414.09	0.00	84.03	0.00	0.00	117.10	0.00	0.00	0.00
	#	1967									
0.00	686.44	788.70	671.26	0.00	60.75	0.00	0.00	120.20	0.00	0.00	0.00
	#	1968									
0.00	167.05	671.26	558.87	0.00	38.47	0.00	0.00	123.50	0.00	0.00	0.00
	#	1969									
0.00	188.32	679.36	472.82	0.00	44.55	0.00	0.00	139.10	0.00	0.00	0.00
	#	1970									
0.00	196.42	702.64	454.59	0.00	46.57	0.00	0.00	120.50	0.00	0.00	0.00
	#	1971									

0.00	301.71	927.41	163.00	0.00	68.85	0.00	0.00	142.90	0.00	0.00	0.00
	#	1972									
0.00	771.49	1306.06	146.81	0.00	92.13	0.00	0.00	165.40	0.00	0.00	0.00
	#	1973									
0.00	523.44	602.41	480.92	0.00	85.05	0.00	0.00	171.20	0.00	0.00	0.00
	#	1974									
0.00	504.20	525.46	575.07	0.00	87.07	0.00	0.00	166.00	4.01	0.00	0.00
	#	1975									
0.00	454.59	283.49	454.59	0.00	85.05	0.00	0.00	180.00	2.11	0.00	0.00
	#	1976									
0.00	331.07	489.01	991.19	0.00	67.83	0.00	0.00	164.90	4.47	0.00	11.66
	#	1977									
22.10	639.95	990.18	1126.86	3.25	130.62	0.00	0.00	150.50	10.30	0.00	0.00
	#	1978									
9.87	308.50	1750.53	1118.76	3.09	106.03	0.00	0.00	159.20	4.86	0.00	0.00
	#	1979									
30.38	413.40	2309.41	945.63	14.20	75.66	0.00	136.90	159.01	34.98	0.00	5.31
	#	1980									
34.18	494.02	2082.84	514.45	39.24	165.68	0.00	35.05	118.04	48.89	0.00	0.00
	#	1981									
0.90	797.72	3941.26	435.11	36.91	11.58	0.00	34.33	241.28	44.47	0.00	0.00
	#	1982									
7.39	499.24	3580.68	650.80	46.55	10.90	0.00	11.63	93.99	6.82	0.00	10.49
	#	1983									
29.61	358.07	1188.43	612.87	56.90	3.05	0.00	31.77	75.66	26.65	0.00	0.00
	#	1984									
15.03	305.93	1029.50	1037.98	107.44	3.42	0.00	43.47	120.33	63.37	0.00	0.00
	#	1985									
0.79	167.71	902.13	899.06	12.40	42.16	15.64	61.40	165.45	24.21	0.00	11.78
	#	1986									
0.00	211.00	1491.39	1016.63	20.61	24.36	160.00	57.02	168.13	34.34	0.00	0.00
	#	1987									
0.50	226.58	1576.42	979.31	24.35	26.44	0.00	46.59	137.65	56.59	0.00	0.00
	#	1988									
6.80	175.77	1573.63	1208.85	111.27	104.31	0.00	29.71	85.89	31.56	0.00	5.10
	#	1989									
15.72	310.17	1029.44	1099.96	69.10	139.26	17.35	10.02	61.34	38.43	0.00	0.00
	#	1990									
7.84	138.10	1776.39	971.64	136.87	24.05	27.91	10.02	61.34	43.75	5.06	0.00
	#	1991									
6.97	218.13	1423.29	825.03	49.38	77.80	152.43	10.02	61.34	38.43	1.81	1.17
	#	1992									
42.03	48.02	1513.80	289.81	26.70	81.32	116.69	0.00	64.82	51.07	0.72	0.00
	#	1993									
13.89	106.05	644.15	149.54	41.37	52.81	104.87	0.00	53.46	38.78	4.83	0.00
	#	1994									
30.10	101.84	548.61	161.15	53.89	60.59	118.68	1.23	68.33	43.53	0.31	1.07
	#	1995									
101.06	116.26	758.21	189.85	72.11	52.88	166.36	2.49	60.59	25.24	1.35	0.00
	#	1996									
31.96	142.66	589.85	203.44	29.78	73.80	254.42	1.75	100.85	46.68	3.63	0.00
	#	1997									
8.41	149.45	716.05	203.01	23.33	57.25	250.13	1.14	25.46	53.49	5.47	0.97
	#	1998									
7.36	96.25	387.85	139.97	8.53	28.59	123.97	2.81	62.05	35.02	5.63	0.00
	#	1999									
1.71	11.24	46.62	32.66	2.52	5.50	10.25	0.41	76.64	18.46	2.35	0.00
	#	2000									
1.44	9.43	33.13	19.65	1.60	4.96	11.00	0.00	33.37	13.34	4.05	1.61
	#	2001									
0.36	14.62	32.60	33.29	0.02	0.08	3.15	0.21	6.00	11.13	5.24	0.13
	#	2002									
0.23	0.31	5.02	6.24	0.00	0.08	6.89	0.06	18.05	12.10	0.93	1.08
	#	2003									
0.61	1.95	7.67	7.73	0.02	0.06	4.68	1.48	9.11	5.76	5.22	2.24
	#	2004									
0.72	2.84	4.91	25.90	0.06	0.09	1.79	1.49	0.83	6.82	1.44	4.54
	#	2005									
3.57	2.28	2.91	15.64	0.00	0.00	3.11	5.73	1.03	3.98	1.09	7.78
	#	2006									

```
### Abundance indices ###
19 # Total number of observations (all fleets)

# Year   Seas   Type   Value     s(log space)
# NWFSC survey - GLMM based (n=4)
2003     1      12     1845.45   0.292
2004     1      12     1768.00 0.605
2005     1      12     1912.75   0.524
2006     1      12     5387.40 0.660
# Triennial survey - GLMM based (n=9)
1980     1      13     1969.39   0.413
1983     1      13     3768.39   0.349
1986     1      13     2419.72   0.361
1989     1      13     1691.33   0.431
1992     1      13     558.28    0.422
1995     1      17     505.81    0.439
1998     1      17     631.39    0.408
2001     1      17     764.26    0.409
2004     1      17     1016.73   0.446
# Pre-recruit index ANOVA w/ GLM CVs converted to s(log-space) (n=6)
2001     1      14     207.70  0.3414 #
2002     1      14     516.06  0.2401 #
2003     1      14     162.16  0.2688 #
2004     1      14     444.13  0.2513 #
2005     1      14     213.80  0.2888 #
2006     1      14     115.00  0.4797 #

### Discard section ###
# Discard observation setup
2        # Type: 1 = biomass (mt),2 = fraction (D/(D+R)) by weight
0        # Total number of discard observations all fleets and years
# Year Season   Type   Value          CV

# Mean body weight observations
0        # Total number of mean body weight observations
# Partition: 1=discarded catch, 2=retained catch, 0=whole catch (R+D)
# Year   Seas   Type   Partition   Value (kg) CV

-1       # Minimum proportion for compressing tails of observed compositional data
0.001    # Constant added to expected frequencies

28       # Number of length bins
# Lower edge of length bins by bin
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

### length composition data ###
270      # Total number of length observations all fleets and years
# Gender: 0=sexes combined into length bins, 1=females only (0s male bins), 2=males only (0s for female bins), 3=both males and
females, total should sum to 1.0
# Year   Seas   Type   Gender   Partition   Nsamp   Data: females then males
# 2007 Southern California trawl fleet (n=28)
1978     1      1      0      0      9.21      0      0      0      0      0      0
         0      0      0      0      0      36.75325  0      67.19697  103.95022 0      21.73913
         208.18626 61.38711  451.37755 0      21.73913  21.73913  0      0      0      0      0
         0      0      0      0      0      0      0      0      0      0      0
         0      0      0      0      0      0      0      0      0      0      0
         0      0      0      0      0      0
1979     1      1      0      0      2.28      0      0      0      0      0      0
         0      0      0      0      0      0      51.6129   0      0      0      354.32692
         0      0      0      0      0      0      0      0      0      0      0
         0      0      0      0      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      1      0      0      14.45     0      0      0      0      0      0
         0      0      0      0      121.76471 669.15126 506.66666 716.5967  768.92033 430.43613 510.92888
         285.94    0      0      0      0      0      0      0      0      0      0
         0      0      0      0      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 1 0 0 9.38 0 0 0 0 0 0
0 0 0 0 0 0 0 271.7884615 879.5896885
493.7285367 0 374.5306122 0 0 0 0 0 0
0 0 0 0 0 0 0 0 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 1 0 0 4.69 0 0 0 0 0 0
0 0 0 0 0 0 54.6 257.6422018 0 500
228.8 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 0 0
0 0 0 0 0 0 0
1983 1 1 0 0 8.66 0 0 0 0 0 0
0 0 0 0 0 37.0408163 0 115.4166667
212.0171166 309.7270766 192.0171166 238.8372093 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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 1 0 0 18.83 0 0 0 0 0 0
0 29.877551 59.755102 119.510204 109.5510204 93.5941915 24.4749711
603.1632653 324.2826087 137.0093458 810.6796117 702.5882353 0
824.2826087 1658.048033 500 0 0 0 0 0 0
0 0 0 0 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 1 0 0 32.73 171.3207547 0 0 0 0
0 0 0 0 119.9185635 90.0094961 527.6007593
787.6976493 795.7559878 515.3457244 664.0846327 102.4770777
111.295098 0 154.3269231 77.1634615 0 0 0 0
0 0 0 0 0 0 0 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 1 0 0 3.55 0 0 0 0 0 0
0 0 0 0 12.9591837 0 105.3 0 12.9591837
183.3 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 0
0 0 0 0 0 0 0 0
1988 1 1 0 0 3.41 0 0 0 0 0 0
0 81.81 0 0 0 0 71.9958879 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 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 1 0 0 5.07 0 0 0 0 0 0
0 0 0 0 21.4615384 0 53.6538462 36.9038462
532.1923077 0 0 0 0 10.7307692 0 0 0 0
0 0 0 0 0 0 0 0 0 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 1 0 0 8.90 0 0 0 0 0 0
0 0 222.7990654 7.5 3.75 11.86 171.36125 9.55 0 3.75
8.11 17.9313725 0 0 0 0 0 0 0 0
0 0 0 0 0 0 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 1 0 0 8.76 0 0 0 0 0 0
0 0 0 0.7088608 83.0546762 63.4044164 414.9436735
85.4511112 45.5111111 0.7088608 0 62.6955556 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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 1 0 0 14.93 0 0 0 0 0 0
0 0 0 0 49.7728571 99.9788093 93.5015247
85.1026188 102.1530612 48.4931973 70.1564626 4.4859813 5.1666667 0
5.1666667 10.8703704 0 0 0 0 0 0 0 0
0 0 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	1	0	0	49.98	0	0	0	0	0	0
	0	15.6185158	59.5259383	253.1475428	229.9486807	368.4702333					
	371.8077533	1050.393493	253.6125338	370.1500121	64.4630154						
	84.8043099	17.8424547	81.4494418	49.3918036	15.6442308	3.2178218					
	0	0	0	0	0	0	0	0	0	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	1	0	0	14.83	0	0	0	0	0	0
	0	0	0	0	0	40.286247	9.9955207	148.3938414	117.2055354		
	94.3406186	91.555442	50.2483862	36.6737708	12.0103093	45.8963124					
	12.0103093	16.9430016	0	0	0	12.0103093	0	0			
	0	0	0	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	1	0	0	13.28	0	0	0	0	0	0
	0	0	0	30.48	196.9303226	63.7545833	53.5945833	12.16			
	27.1145833	183.3514493	116.0076993	71.7785326	78.2133152						
	49.6639493	22.1145833	22.1145833	10.16	0	0	0	0			
	0	0	0	0	0	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	1	0	0	42.91	0	0	0	0	0	0
	0	2.5714286	58.7589286	53.643617	137.0168259	131.3431123	178.4191272				
	278.562743	600.0516522	269.2882356	253.1958774	59.0065554						
	85.5728155	99.9766617	85.5728155	42.7864078	0	0	0				
	0	0	0	0	0	0	0	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	1	0	0	48.98	0	0	0	0	0	0
	0	0	3.0851064	7.0851064	23.228554	85.3796648	125.6838593	183.3232179			
	436.7562792	574.8167819	439.4557894	483.3556633	208.3741298						
	210.5980128	29.19	58.38	0	0	0	0	0	0	0	
	0	0	0	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	1	0	0	23.73	0	0	0	0	0	0
	0	0	0	60.7042553	240.0974468	236.3539362	242.1889361				
	135.5595745	61.1304492	11.2348936	37.0948936	0	4.6	8.4148936				
	0	0	0	0	0	0	0	0	0	0	0
	0	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	1	0	0	11.90	0	0	0	0	0	0
	0	0	0	0	0	30.9288889	31.3177778	95.8288889			
	36.8577778	61.6288889	28.8777778	11.08	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	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	1	0	0	8.73	0	0	0	0	0	0
	0	0	0	0	0	7.5	11.9444444	15	12.5	7.5	
	20.0979097	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			
2001	1	1	0	0	20.45	0	0	0	0	0	0
	0	0	0	7.6905747	7.0411494	32.1920487	20.3857471	12.6034483			
	6.9730237	6.2495109	3.9730237	1	4.9730237	0	1	3.622449	0	0	0
	0	0	0	0	0	0	0	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	1	0	0	4.38	0	0	0	0	0	0
	0	1	0	0	0	0	1	1	2	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	0	0	0	0					

2003 1 1 0 0 9.35 6.128650448 49.02920359 0 0
6.128650448 0 0 0 0 0 0 0 0 0
0 6.128650448 65.41403854 65.41403854 0 0 12.2573009
0 0 0 0 0 0 0 0 0 0 0
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 0 0 5.97 0 0 0 0 0 0
0 0 0 0 0 0 0 0 351.2282658
90.00222804 0 0 0 30.00074268 0 0 0 0
0 0 0 0 0 0 0 0 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 1 0 0 9.21 0 0 0 0 130.3278392
0 130.3278392 0 0 0 11.21425302 22.42850603
11.21425302 0 0 14.00919035 158.3462199 23.29114125
142.4047275 23.29114125 0 0 0 0 0 0 0
0 0 0 0 0 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 1 0 0 19.14 0 0 0 0 0
167.0507328 55.68357759 55.68357759 111.3671552 278.4178879
55.68357759 55.68357759 55.68357759 1358.679293 111.3671552
55.68357759 389.7850431 222.7343103 55.68357759 0 55.68357759
55.68357759 0 0 0 0 0 0 0 0 0
0 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 Northern California trawl fleet (n=28)
1978 1 2 3 0 113.09 0 0 0 0 0 0
0 0 0 0 0 0 118.620576 640.855595 0
37.87037 172.292127 816.027507 1487.747031 2096.798161 3191.75492
1603.777512 2335.164309 932.833843 756.792783 82.006941 53.48563 0
0 0 0 0 0 0 0 0 0 0 6.7
0 0 280.532271 159.785714 142.948124 493.097262
2354.266288 1684.743894 7371.176821 2611.463314 1502.707674
528.929746 1582.674231 469.962406 0 0 0
1979 1 2 3 0 53.18 0 0 0 0 0 0
0 0 0 0 0 0 0 31.37931 31.37931 114.583333
31.37931 281.930233 1.865385 380.830711 454.21914 181.704828 912.439928
441.447048 10.223279 96.257377 4.178947 23.751938 0 0 0 0 0
0 0 0 0 0 0 0 0 239.010207
268.647158 652.729227 501.387821 729.824654 1183.067607
1351.687493 1302.679503 1476.261677 54.505555 89.7 0 0 0
280.733333
1980 1 2 3 0 116.02 0 0 0 0 0 0
0 0 0 0 0 67.963434 131.315789 587.133664 88.713516
288.939401 368.491804 685.828172 1171.152206 809.393528
667.799892 800.639099 495.422916 304.898459 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 138.240703 375.199351 203.075686 879.121821 620.87789
2227.287931 2024.224985 2501.730777 1888.276231 593.223662 0
233.910714 0 0 0 0 0
1981 1 2 3 0 74.29 0 0 0 0 0 0
0 0 0 124.75 0 124.75 53.4448244 8.1489362 255.4818868
1234.751363 518.8917677 1280.517625 1410.581854 919.6851325
770.2782992 1116.949268 1567.728721 350.1341303 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 93.0024225 759.482274 794.3314014 1180.161028
1033.105838 2523.177679 1033.681141 912.8045213 128.3242762 0
0 0 0 0 0 0
1982 1 2 3 0 120.16 0 0 0 0 0 0
0 0 0 0 88.4693878 32.8371428 1007.440033
323.488755 176.7080594 2458.002137 1772.1635 1246.304479 3264.786854
1813.534221 683.7733475 1058.516111 263.7513975 10.8461538 4.2884615
0 0 0 0 0 0 0 0 0 0 0
0 0 303.2238449 818.0348666 1167.88308 1113.406082
1606.889284 2910.729196 3384.928817 2145.195514 2343.928141
4794.319474 1312.38659 4.2884615 0 0 0 0 0 0

1983 1 2 3 0 174.44 0 0 0 0 0 0
0 0 0 53.6363636 291.6075229 77.6906558 441.218364
538.544462 2402.817271 1221.64721 973.0557754 2650.612503
1256.343337 1705.737494 3263.409513 1726.524794 1231.428868
464.482247 0 0 0 0 0 0 0 0 0
0 0 0 0 0 145.1014394 182.2048485 1202.329627
2517.8163 1167.65492 3270.181734 2635.771907 3990.073468 6261.49987
2948.148886 2004.594796 361.1772969 54.0395349 206.961165 0
0 0 0
1984 1 2 3 0 116.06 0 0 0 0 0 0
0 0 6.6438356 0 47.634434 749.7551379 1402.351341 315.1686367
1483.620261 1688.484195 1307.060526 1880.950895 1684.637748
1396.472342 1584.174496 656.5174063 1398.353281 893.0375056 10.9
0 0 0 0 0 0 0 0 0 0
0 13.2876712 63.0530261 97.9116912 433.7604463 796.8425966
1270.532623 1522.899657 1935.217138 3576.827901 2702.52329
1339.322596 1371.599481 340.3931452 356.1529412 0 0 0
0 0
1985 1 2 3 0 122.96 0 0 0 0 0 0
0 0 0 0 131.6391403 205.236851 1174.287597
1379.988011 1489.251662 2077.991069 1318.103597 1006.907644
959.1333095 2290.333141 569.7772609 2268.699416 3271.737375
1128.889796 0 0 0 0 0 0 0 0 0
0 0 0 0 24.7327273 451.5098311 292.9054633
658.188647 1564.19122 2381.488066 2210.192169 2546.026142
2715.40301 2788.996369 3620.307485 1820.516493 583.6080116 2.7111111
0 0 0 0 0
1986 1 2 3 0 106.68 0 0 0 0 0 0
0 0 0 45.7142857 0 27.1262136 272.4644907
799.8412897 1213.732792 699.954717 1006.509521 1038.55708
1274.744999 749.7632428 637.2293199 381.5464686 162.8707338
34.4039216 0 0 0 0 0 0 0 0 0
0 0 0 45.7142857 0 8.5882353 13.1346154 313.2680762
959.9147094 2200.004668 2727.001576 1335.099892 2259.124011
1221.029807 487.6268166 139.2749821 29.2079208 0 0 0
0 0 0
1987 1 2 3 0 103.23 0 0 0 0 0 0
0 0 0 0 0 1078.018227 1268.571344 1506.259631
606.7591491 1277.376256 2535.875084 1104.191711 1834.800406
1257.061249 175.6027272 429.1086868 192.239724 184.5454545
148.9393939 0 0 0 0 0 0 0 0 0
0 0 88.2040816 0 363.5950495 1806.253371 1735.420442
1914.220942 971.7152224 2642.324304 2682.562774 1416.198514
1010.69907 771.3737156 49.2353952 0 0 0 0 0
0 0
1988 1 2 3 0 86.12 0 0 0 0 0 0
0 0 0 218.4825371 205.7661583 497.7446001 516.6489736
1310.129926 1303.178279 1009.176446 475.697781 538.3533831
841.1609838 288.9236938 954.0637786 124.5436938 75.95 0 3.6
0 0 0 0 0 0 0 0 0 0 0
0 99.5876289 254.6893213 263.4307196 908.9894449 1770.909898
1654.45194 1787.748824 1665.893625 958.8669768 1287.201241
777.6895077 120.0891089 0 0 0 0 0 0 0
1989 1 2 3 0 74.02 0 0 0 0 0 0
0 0 0 48.1568627 142.5841176 313.0685106 881.2309814
538.9568289 1831.72314 946.6937907 342.2584096 251.5827463 417.69
617.8785149 610.7258886 380.9460606 262.9985149 97.6060606 0
0 0 0 0 0 0 0 0 0 0 0
0 57.5 988.6802263 1089.307809 1150.039032 1489.473443
1961.042627 1203.075266 845.1249546 2063.035095 1054.603658
483.9469997 82.4373738 0 21.8686869 0 0 0 0
0
1990 1 2 3 0 86.75 0 0 0 0 0 0
0 0 0 0 95.46 587.393573 614.022586 828.204582
1464.47111 2419.169212 960.1408962 699.9427342 1481.635347
2505.191785 1910.185249 618.1985544 101.9702971 26.8834951
330.340484 0 0 0 0 0 0 0 0 0
0 0 0 0 105.5843434 791.8729063 1402.144381
2518.281471 1210.52657 3112.644551 3081.663932 3096.058823

2732.753312 1367.064497 0 46.3366337 0 0 0 0
0 0
1991 1 2 3 0 52.46 0 0 0 0 0 0
0 0 0 0 50.73 369.5609804 588.0744457 869.8504854
1089.170336 670.5044593 569.519125 387.5290365 417.6859088
175.5224345 202.2009804 302.1280877 0 0 0 0
0 0 0 0 0 0 0 0 0 21.79 50.73
424.9880392 186.5823077 937.7912774 1088.95382 933.3932039
800.9637274 1592.862786 603.0278269 343.2073364 21.49 0
25.3431373 25.3431373 0 0 0 0 0
1992 1 2 3 0 45.67 0 0 0 0 0 0
0 0 0 0 17.37 264.79 369.25 928.76 656.9 591.15 1660.83
544.2716832 1093.5 368.34 167.27 253.45 0 74.95 0 0 0
0 0 0 0 0 0 0 0 0 0 0
95.32 430.5412621 961.67 1155.453316 1402.64 1482.16 1419.53 1462.87 788.88
367.96 961.35 0 0 0 0 0 0 0
1993 1 2 3 0 18.80 0 0 0 0 0 0
0 0 0 0 0 0 217.36 0 189.0016667 25.8
414.4983673 12.9 292.9183674 66.1 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
108.68 0 555.4454545 0 240.7916667 384.35 548.9983673 194.14
802.8467346 419.4638219 0 0 0 0 0 0 0
0 0 0
1994 1 2 3 0 22.01 0 0 0 0 0 0
0 0 0 0 128.24 64.12 408.7536634 64.12 584.8036634
726.0320326 1823.865376 314.246092 21.5 363.0160163 344.6336634
16.25 21.08 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 368.6836634 128.24 0
929.4373267 1842.435376 528.9974024 1055.40099 435.0097554
71.0084449 15.8613861 0 0 0 0 0 0 0
0
1995 1 2 3 0 40.39 0 0 0 0 0 0
0 0 0 7.5940594 69.4740594 109.3568276 221.0267124
242.2950414 210.8799839 132.8174257 126.64059 139.0845464 117.3491089
35.0716832 57.1665306 8.8316832 8.8316832 0 0 0 0 0
0 0 0 0 0 0 0 0 0 30.94
121.3165804 130.3287088 404.4361722 292.7457264 297.6579996
282.1150414 192.9302889 150.2449464 62.1057426 39.63 34.18 0
0 0 0 0 0 0
1996 1 2 3 0 42.08 0 0 0 0 0 0
0 0 0 14.5098039 8.9432943 40.7151125 458.6494869
692.3374081 156.2938614 123.6075065 222.3702174 178.9734653 314.7
294.7634653 104.55 0 209.1 0 0 0 0 0 0
0 0 0 0 0 0 0 0 188.4280303
64.9654545 453.0789762 967.8485779 506.204717 396.9058595
531.189829 539.4227272 94.36 106.1863636 209.1 104.55 0 0
0 0 0 0 0
1997 1 2 3 0 23.01 0 0 0 0 0 0
0 0 0 137.7021277 4.32 140.0621277 23.4774257
141.2421277 48.7380838 45.1980838 185.8617381 63.4071227
231.7656285 56.0955096 1.18 123.6346154 0 13.2574257 0
0 123.6346154 123.6346154 0 0 0 0 0 0
0 0 0 0 0 3.54 35.4806581 177.7985058
100.0677807 212.3765896 91.9587821 29.5806581 387.2270785
13.2574257 166.4726992 0 0 0 0 0 0 0
1998 1 2 3 0 19.25 0 0 0 0 0 0
0 0 0 0 3.32 13.7 58.5848936 80.2027451 13.7
10.17 186.4382353 143.3854902 259.7909804 186.2282353 63.1827451
123.0454902 0 3.32 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 10.17 44.42
161.4438144 30.51 161.8617528 269.7509804 10.17 63.1827451 6.85
59.8627451 0 0 0 0 0 0 0
1999 1 2 3 0 44.19 0 0 0 0 0 0
0 0 55.4455446 0 0 44.8796703 113.6955446
228.2996703 823.4934991 717.881124 923.302707 368.7658416
580.8982842 155.0258089 86.1755446 41.3296703 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 169.8866337 441.7534991 436.3076575 799.9000348
754.0714536 708.8616505 302.0421782 105.5888782 19.2430693 0
0 0 0 0 0 0 0

2000 1 2 3 0 13.14 0 0 0 0 0 0
0 0 0 0 0 0 0 6.490909 6.3363636 8.6472727 9.190909
4.3054545 9.1258505 0 0 0 3.2454545 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 3.2454545 6.4909091 14.2181818 12.1872727 6.3363636 1.7 0 0
0 0 0 0 0 0 0 0
2001 1 2 3 0 21.77 0 0 0 0 0 0
0 0 0 0 0 0 0.8148148 4.471243 17.3156253
19.8741457 21.8619864 26.492062 23.0518864 13.1845185 9.3810445 0.8148148
0 0.8148148 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 5.7446809 8.0647124 16.849699 23.48374
30.3116208 29.0723276 4.2781818 0 0 0 0 0 0
0 0 0
2002 1 2 3 0 51.29 0 0 0 0 0 0
0 0 0 0 0 0 0 96.75982177 236.4404013
379.4742659 979.6157276 804.1685392 471.2873252 953.9885014
96.75982177 0 62.93016997 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 33.12114209
23.3280157 17.94462746 242.4045566 933.4975571 1388.375703
1136.599202 1093.179496 69.49057881 117.8172912 24.7196395 0
0 0 0 0 0 0
2003 1 2 3 0 11.90 0 0 0 0 0 0
0 0 0 0 0 0 0 0 32.29653767
14.43719483 35.71868569 21.65579224 21.65579224 10.82789612
3.609298707 0 3.609298707 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 10.82789612 14.25004414 17.85934284 14.25004414 0
0 0 0 0 0 0 0 0 0
2004 1 2 3 0 21.14 0 0 0 0 0 0
36.40809209 6.068015348 0 0 6.068015348 86.59420292
100.3722217 54.61213813 56.25412618 100.7290548 56.25412618
112.8650855 12.1360307 38.05008014 0 0 0 76.10016028
0 0 0 0 0 0 0 0 0 0 0
0 0 6.068015348 12.1360307 56.25412618 18.20404604
6.068015348 195.3900942 60.68015348 42.47610743 138.7791349
12.1360307 0 6.068015348 0 0 0 0 0 0
0
2005 1 2 2 0 2.69 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 302.1413017 0 0 302.1413017 604.2826035
302.1413017 0 0 0 0 0 0 0 0
2007 Oregon trawl fleet (n=33)
1973 1 3 3 0 7.06 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 2.767 0.000 11.067 5.534 1.383 0.000
1.383 0.000 1.383 0.000 1.383 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
2.767 2.767 4.150 4.150 1.383 1.383 5.534 1.383 9.684 8.301 2.767
1.383 0.000 0.000 0.000 0.000 0.000
1974 1 3 3 0 28.24 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 24.747 0.000 24.747 0.000 52.608 0.000 68.672 49.493 3.501
112.604 297.103 682.084 622.474 443.902 127.509 210.032 27.861 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 24.747
3.501 3.501 47.040 62.724 31.356 297.103 589.811 1267.139 787.810 545.257 117.393
52.608 24.747 0.000 0.000 0.000 0.000
1976 1 3 3 0 14.12 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 17.878 7.734 35.757 0.000
48.312 33.346 10.144 84.571 81.658 35.757 17.878 17.878 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 17.878 30.433 71.513 109.680 56.046 58.456 38.167 28.023 7.734
0.000 0.000 0.000 0.000 0.000 0.000
1977 1 3 3 0 56.48 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 10.035 0.000 7.015 8.817 25.867 22.360 75.969 108.127 101.339
186.671 130.426 216.905 302.398 353.411 205.652 87.728 34.806 12.703 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 10.035 10.035 10.523
27.196 22.360 41.604 101.474 171.606 340.748 721.575 818.309 660.887 182.312 98.129
6.175 9.195 0.000 0.000 0.000 0.000
1978 1 3 3 0 49.42 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 4.576 0.000 0.000 5.077 2.538 52.257 33.175 41.638

	192.485	248.087	275.452	237.034	327.842	222.822	177.763	12.783	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	7.884	24.169	55.158	237.074	386.665	443.795	619.595	386.876	170.014
	20.024	7.115	0.000	0.000	0.000	0.000					
1979	1	3	3	0	42.36	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	139.595	139.595	285.251	430.908	570.503	309.497	887.753
	1863.734	1502.698	1782.579	1668.419	1812.213	595.119	674.996	87.807	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	139.595
	285.251	449.092	1007.472	1239.908	1738.589	1643.333	2917.632	3310.562	2570.775	792.297	466.007
	16.571	87.807	0.000	0.000	0.000	0.000					
1980	1	3	3	0	141.20	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	529.666	324.938	548.544	355.317
	1116.778	2677.047	4085.327	4420.780	6007.093	7404.078	2318.382	245.628	98.561	67.431	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	106.540
	0.000	12.166	186.011	1276.679	1658.574	2122.953	5007.381	10026.331	9962.347	4938.313	1549.075
	234.513	205.102	0.000	0.000	0.000	0.000					
1981	1	3	3	0	56.48	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.810	93.949	28.655	1550.905
	867.224	1582.421	1454.409	1924.873	1815.211	1391.160	1041.089	647.915	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	130.002	319.001	1033.063	1884.398	1516.291	6138.146	3655.290	2679.977	871.421
	28.655	0.000	5.805	0.000	0.000	0.000					
1982	1	3	3	0	141.20	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	9.017	0.000	0.000	0.000	400.058	548.729	2418.367
	3251.310	2956.585	4184.768	5553.225	5847.335	5019.142	1981.069	190.392	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	108.261	161.793	1054.331	2172.285	6673.095	7521.086	16415.656	20898.089	8702.756	2538.404
	0.000	25.281	0.000	0.000	0.000	0.000					
1983	1	3	3	0	211.80	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	3.850	29.134	2.194	69.169	232.232	143.434	520.891	1140.820	1700.040	2511.753
	3139.140	3302.596	4494.634	6201.973	5332.770	3416.903	1505.128	416.233	95.706	0.000	0.000
	0.000	0.000	0.000	0.000	32.894	0.000	0.000	0.000	0.000	12.089	72.013
	192.001	577.067	657.338	1839.690	4466.876	5169.244	6583.045	10375.226	10827.528	8021.602	1756.419
	244.261	0.000	0.000	0.000	0.000	0.000					
1984	1	3	3	0	148.26	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	17.522	20.731	63.507	86.288	221.446	178.029	510.951	1066.040	1818.113
	2801.550	3923.414	3349.916	3230.294	2638.690	2692.555	1212.545	136.994	54.783	0.000	5.842
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.522	0.000	0.000	42.681
	55.972	188.489	576.803	1358.854	2399.715	4744.397	6376.978	8683.630	9059.273	4197.339	866.269
	59.674	61.902	0.000	0.000	0.000	0.000					
1985	1	3	3	0	204.74	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	70.482	0.000	213.051	438.151	680.199	973.023	1883.103
	3472.248	4269.249	4698.941	4536.364	3194.266	2273.431	1420.308	742.949	57.052	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	54.159
	111.787	147.877	483.305	1726.332	2558.299	4418.456	7120.686	7123.870	6392.525	4627.339	1575.495
	296.211	29.210	0.000	0.000	0.000	0.000					
1986	1	3	3	0	112.96	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	62.230	147.967	174.093	412.692	875.275	983.481	979.619
	1159.100	1707.175	2557.653	2403.195	1702.999	1603.104	915.202	176.236	36.180	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.130	110.931
	116.014	310.297	500.720	1203.755	1899.580	2400.882	2256.635	3258.785	2590.162	1680.375	421.265
	222.148	23.984	5.493	0.000	0.000	0.000					
1987	1	3	3	0	247.10	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	9.872	292.634	781.952	760.217	1769.957
	2780.376	4721.009	6882.012	5433.266	4336.392	3042.508	1566.308	444.154	29.222	4.297	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	468.935	423.696	1362.027	3648.631	6887.822	8807.806	9129.378	5730.582	3641.156	1724.807
	76.928	0.000	0.000	0.000	0.000	0.000					
1988	1	3	3	0	162.38	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	142.237	68.896	431.438	443.590	543.976	491.472	1401.241
	2524.938	2982.357	3480.504	3572.088	2451.055	1265.547	884.575	513.358	71.306	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	38.894
	51.954	250.707	445.338	659.524	2089.245	3433.124	3759.669	4211.985	2760.504	1640.899	736.894
	42.444	13.060	0.000	0.000	0.000	0.000					
1989	1	3	3	0	162.38	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	52.444	0.000	4.272	18.637	86.693	265.565	652.639	1163.761
	2254.093	2510.662	2341.395	2967.213	2763.622	1366.293	898.639	348.098	155.498	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	45.843	20.627	394.937	590.997	1597.005	2541.268	3744.838	4205.683	3400.449	2642.521	920.867
	194.054	38.402	0.000	0.000	0.000	0.000					

1990	1	3	3	0	155.32	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	10.681	19.659	143.849	176.767	706.872	870.104
	1084.757	2037.653	3122.297	2773.690	2905.506	1521.265	745.985	211.299	17.102	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	8.978	49.944	114.918	487.226	1119.973	2372.451	3800.779	4329.034	2226.857	933.485	447.579
	55.334	0.000	28.807	0.000	0.000	0.000					
1991	1	3	3	0	141.92	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	86.511	0.000	14.428	38.336	145.081	396.569	756.014	1108.295	926.465	2404.667
	3494.247	2011.002	3593.851	3714.005	2195.521	1136.582	1078.195	400.973	47.827	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.428	14.428	43.284	43.284
	148.462	477.587	539.362	1231.479	2539.539	5231.619	5423.404	5299.238	3396.074	3284.686	422.550
	251.542	12.110	0.000	0.000	0.000	0.000					
1992	1	3	3	0	222.23	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	115.721	84.226	338.482	1564.111	3372.224	2960.916
	4114.962	4372.073	6306.535	6120.810	6331.147	1628.552	1381.475	548.907	7.947	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	61.661	538.151	1243.056	3063.813	4374.532	6927.215	9621.340	8857.575	7501.344	5368.191	961.550
	654.096	38.932	0.000	0.000	0.000	0.000					
1993	1	3	3	0	155.32	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	12.065	467.221	42.059	987.307	2210.612	2425.457
	3012.190	5169.135	5495.870	5607.836	4603.483	1537.435	1012.900	605.948	243.725	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	8.885	271.891	1205.304	2497.950	3536.264	6026.149	5401.431	5071.262	3800.353	1886.889	607.080
	203.017	0.000	0.000	0.000	0.000	0.000					
1994	1	3	3	0	105.90	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	32.208	27.112	81.736	285.624	499.882	835.149	1463.266
	1517.552	1461.971	1800.963	1293.953	688.914	339.352	17.912	0.000	9.668	34.382	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.895	17.912
	37.921	55.605	724.931	984.675	2249.048	2385.906	2226.832	2199.997	1209.730	726.068	410.231
	74.401	0.000	0.000	0.000	0.000	0.000					
1995	1	3	3	0	112.96	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	173.919	210.237	371.597	318.813	538.281	555.071
	690.314	775.748	768.604	459.198	203.750	135.526	17.509	2.442	0.000	0.000	66.512
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.883	7.187	154.642
	183.923	502.315	546.710	829.713	790.391	1079.112	726.910	441.560	282.438	135.866	44.253
	10.020	0.000	0.000	0.000	0.000	0.000					
1996	1	3	3	0	134.14	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	3.360	0.000	22.509	21.514	226.132	366.721	439.109	943.300	832.196	895.728
	801.951	850.336	735.966	580.049	512.687	158.433	87.282	61.812	0.000	7.498	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	2.284	2.284	0.000	5.643	33.966
	207.001	407.200	1009.203	1166.363	1147.551	1033.274	954.265	1132.426	1088.164	506.036	197.169
	9.781	33.345	0.000	0.000	0.000	0.000					
1997	1	3	3	0	197.68	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	45.981	202.905	251.392	823.556	981.736	1422.651
	1689.262	1685.030	1854.608	965.222	388.379	425.215	131.957	59.311	42.118	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	22.783	6.139	0.000	13.770	28.752
	102.378	407.209	1023.103	2020.949	2698.830	3085.063	2538.051	1716.999	792.469	307.146	106.658
	80.142	1.252	4.238	0.000	0.000	0.000					
1998	1	3	3	0	197.68	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	52.626	58.361	178.399	453.731	1011.004	1413.360	1296.899	1511.663
	1754.953	1165.058	1272.065	1202.941	644.173	146.375	113.829	13.165	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.186	0.000	0.000	72.852
	118.176	745.610	1159.350	1657.024	2610.224	2505.880	2395.278	1739.195	1161.664	333.896	191.658
	16.105	0.000	0.000	0.000	0.000	0.000					
1999	1	3	3	0	197.68	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	13.190	11.742	24.209	44.948	128.620	197.192	885.817	1049.915	1276.502	1713.185
	1723.515	1352.987	1406.514	1058.130	439.894	269.870	115.495	12.073	1.526	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	3.914	7.828	3.914	14.834	0.000	59.341
	132.177	764.762	1073.316	1490.506	1847.700	2069.803	1965.025	1370.473	450.852	438.714	142.545
	14.952	0.000	0.000	0.000	0.000	0.000					
2000	1	3	3	0	93.21	0.000	0.000	0.000	0.000	0.000	0.000
	4.673	0.000	0.000	4.673	9.346	24.697	39.210	38.617	29.244	32.287	49.268
	33.846	45.633	14.350	11.543	9.760	1.112	2.512	1.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21.804
	31.379	51.861	50.307	51.936	71.330	65.346	36.608	22.285	10.717	2.440	1.512
	0.000	0.000	0.000	0.000	0.000	0.000					
2001	1	3	3	0	159.30	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	3.000	0.000	6.879	42.735	157.739	428.298	467.502	379.021	950.854	476.394
	2166.331	1308.553	1223.460	592.477	105.563	113.457	48.874	27.167	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.757	41.253

	166.149	315.970	1052.224	1524.417	908.815	4022.688	1367.975	1583.057	1420.601	91.604	39.941
	5.785	0.000	0.000	0.000	0.000	0.000					
2002	1	3	3	0	276.65	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	333.258	550.507	1132.806	1569.568	1995.150	805.997	885.701
	1000.919	1009.508	905.409	480.577	513.292	490.168	227.671	111.950	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	33.606	0.000	60.367	97.114
	493.995	1179.529	1245.875	1465.947	1607.969	1459.614	1288.562	810.740	355.572	139.379	264.561
	10.865	67.211	33.606	33.606	0.000	0.000					
2003	1	3	3	0	103.93	0.000	0.000	0.000	0.000	0.000	4.807
	0.000	0.000	0.000	0.000	0.000	5.144	23.214	78.323	150.584	261.278	234.888
	244.483	191.351	126.404	93.086	86.946	35.885	27.811	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.871	0.000
	5.144	72.387	168.593	215.589	334.387	291.310	208.217	110.898	84.999	0.000	4.833
	0.000	7.871	0.000	0.000	0.000	0.000					
2004	1	3	3	0	138.75	0.000	0.000	0.000	0.000	0.000	10.667
	0.000	14.223	10.667	27.829	24.171	28.864	134.152	304.713	237.593	243.806	267.041
	237.512	243.065	197.682	251.820	74.933	37.774	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21.334	0.000	3.247	105.185
	95.677	136.858	194.950	207.240	198.434	507.344	430.473	220.999	105.724	47.409	10.661
	27.698	10.667	0.000	0.000	0.000	0.000					
2005	1	3	3	0	184.91	0.000	0.000	0.000	0.000	0.000	0.772
	0.772	31.917	6.178	28.828	2.317	6.371	6.950	15.399	69.813	89.189	69.066
	255.265	285.847	170.106	182.332	117.239	58.419	31.100	0.000	0.000	4.334	0.000
	0.000	0.000	0.000	4.633	2.317	29.601	5.405	29.601	3.089	28.828	9.282
	11.599	14.688	31.663	108.230	190.517	487.127	302.749	200.294	84.082	28.613	3.089
	8.022	0.000	0.000	0.000	0.000	0.000					
2006	1	3	3	0	102.99	0.000	0.000	0.000	0.000	0.000	0.000
	4.349	6.249	3.125	10.239	9.645	28.339	10.377	49.044	51.394	46.119	57.771
	64.085	191.158	80.055	71.653	30.535	14.906	15.467	6.187	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	3.458	0.000	0.000	3.437	3.458
	6.628	27.650	47.096	53.292	106.857	119.770	145.896	195.673	116.909	16.329	14.963
	6.788	3.486	0.000	0.000	0.000	0.000					

2007 Washington trawl fleet (n=38)

1968	1	4	0	0	14.12	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	104.085	38.004	226.321	832.678	1805.744
	1873.525	2314.542	2929.124	2288.164	1030.921	226.321	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1969	1	4	0	0	14.12	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	18.083	90.417	386.539	735.425	1168.734
	1878.545	2396.969	2178.432	1588.417	969.766	244.894	18.083	0.000	18.083	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1970	1	4	0	0	7.06	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	204.703	736.932	2006.092
	1228.219	1473.863	2374.558	1719.507	900.694	245.644	81.881	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1971	1	4	0	0	56.48	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	25.493	15.118	698.672	2224.221	6999.636
	11321.446	14441.291	14121.699	12357.950	5995.173	2521.231	373.407	6.235	0.000	6.235	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1972	1	4	0	0	14.12	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	108.600	434.400	1954.115
	4396.130	7330.157	5212.799	4564.854	1956.170	1250.156	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1973	1	4	0	0	7.06	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	18.303	0.000	0.000	36.606	91.516	384.366
	805.339	1153.099	677.217	640.611	219.638	164.728	18.303	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					

1976	1	4	3	0	21.18	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	1.008	0.000	3.023	0.000	6.046	86.268	343.811	931.058
	796.239	1838.937	2309.179	4016.321	3367.749	1844.658	887.294	126.756	204.962	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	1.008	3.023	9.070	344.819	1162.651	1691.521	3574.652	9669.922	13300.935	9859.485	1941.759
	459.482	0.000	1.008	0.000	0.000	0.000					
1977	1	4	3	0	14.12	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	33.108	33.108	108.279
	357.943	333.791	410.319	811.682	975.864	568.259	243.423	42.063	42.063	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16.554
	0.000	0.000	0.000	207.602	233.111	377.211	975.864	2103.970	3727.878	2050.781	832.307
	42.063	42.063	0.000	0.000	0.000	0.000					
1978	1	4	3	0	35.3	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	4.419	4.419	8.837	13.256	37.109	354.250	812.191
	1227.754	1256.701	1529.120	1585.175	1283.201	1008.062	363.237	115.907	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	8.837	17.675	259.606	442.456	1463.045	2897.746	3446.808	4816.816	3652.448	917.330
	378.096	0.000	0.000	25.650	0.000	0.000					
1979	1	4	3	0	56.48	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	34.895	0.000	515.372	496.375	998.847	2518.755
	2409.665	3833.332	1742.858	1843.348	1145.716	1036.302	825.716	20.444	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	246.780	17.447	958.533	1675.576	6724.120	6135.442	7048.722	8759.053	5719.057	2486.972
	129.184	0.000	0.000	0.000	0.000	0.000					
1980	1	4	3	0	127.08	0.000	0.000	0.000	0.000	0.000	0.000
	197.856	0.000	197.856	31.514	625.082	427.226	521.769	903.344	2597.881	3704.160	4290.218
	3738.236	6563.053	7713.342	7701.902	4094.748	2073.082	1580.696	327.456	159.428	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	260.885
	625.082	1708.905	2877.867	3689.800	4346.649	6969.248	7760.286	11343.321	13596.222	11141.158	4157.758
	1112.224	436.195	0.000	0.000	38.941	0.000					
1981	1	4	3	0	127.08	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	5.299	10.599	14.541	42.782	108.724	154.700	312.742	358.338
	450.688	545.602	1060.315	1241.733	637.714	302.818	215.344	78.870	28.205	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.299	10.061
	24.613	39.835	236.931	412.858	503.982	636.692	971.332	1650.396	2094.412	1390.323	685.355
	190.354	75.473	0.000	0.000	0.000	0.000					
1982	1	4	3	0	91.78	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	24.886	0.000	328.546	43.122	202.863	557.287	1585.350	869.278
	926.152	1345.255	1221.470	2008.117	1128.658	641.997	136.741	44.692	17.475	5.032	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.209	0.000	29.096
	102.623	39.920	442.944	1193.196	1940.341	1971.903	2377.540	2918.537	2252.714	1828.661	566.036
	419.091	110.787	0.000	0.000	0.000	0.000					
1983	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	43.912	165.137	247.407	367.088	1020.018	1715.425	2842.822	3647.473
	3476.488	3301.649	3060.912	4643.066	4229.710	1137.740	735.821	449.790	64.881	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	20.393	84.769	269.560
	1061.569	1350.783	2080.169	2201.005	4388.296	4022.645	6836.583	5901.799	7087.699	4676.106	1300.412
	396.186	142.642	0.000	0.000	0.000	0.000					
1984	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	32.631	97.892	229.178	236.408	325.627	369.959	569.673	1328.340
	1775.337	1740.033	1547.440	3062.303	1635.041	1404.509	627.224	176.806	25.298	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	66.685	168.482
	293.714	400.137	596.430	760.519	1374.774	2116.568	2997.191	4677.699	5316.577	4694.119	1861.550
	301.851	0.000	0.000	0.000	0.000	0.000					
1985	1	4	3	0	127.08	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	2.989	15.839	103.330	238.384	559.357	531.192	605.844	1490.291
	2030.809	2058.868	3694.619	3111.035	2832.487	1655.595	681.362	176.185	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.989	16.735	8.966
	134.994	327.628	574.765	745.689	1028.635	2307.471	5325.174	5336.196	6305.292	2654.871	896.536
	331.726	66.706	0.000	0.000	0.000	0.000					
1986	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	35.285	32.496	56.564	317.902	494.064	810.430	1425.069	1827.439
	2162.542	2469.396	2173.539	2203.401	1389.945	628.182	387.079	85.347	12.121	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.642
	114.467	298.140	595.463	1519.995	2483.161	3714.314	3509.131	4297.254	2672.789	1361.153	936.321
	394.696	71.085	19.863	0.000	0.000	0.000					
1987	1	4	3	0	176.5	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	28.077	32.720	75.542	238.493	321.462	833.518	1530.834	2950.135
	2330.603	4218.695	4258.030	3938.331	3673.934	2095.398	811.689	591.427	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	140.982

	177.379	249.819	557.568	758.980	3345.156	4763.938	4288.003	5709.554	3956.157	3728.052	843.278
	493.721	37.343	5.002	0.000	0.000	0.000					
1988	1	4	3	0	134.14	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	3.460	17.731	80.829	45.926	243.570	96.744	304.190	714.261	999.777
	2523.393	2094.367	2206.616	2014.405	2461.060	1696.944	822.223	473.125	125.072	21.110	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.770	22.969
	65.405	253.439	130.450	383.261	1050.815	2459.113	2934.398	3182.969	3479.590	2729.951	1551.980
	237.927	323.413	0.000	0.000	0.000	0.000					
1989	1	4	3	0	127.08	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	53.174	88.492	116.308	289.100	372.638	881.412	1513.833	1878.578
	3642.322	3246.403	2851.711	1747.321	1451.045	930.003	524.341	24.538	8.420	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	22.857	140.874	16.190
	198.857	343.503	438.646	1720.645	2983.983	3468.546	4565.652	5343.947	4305.480	2391.239	601.283
	310.756	0.000	6.230	0.000	0.000	0.000					
1990	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	8.864	4.432	26.592	112.955	197.503	1124.477	762.708	2733.743
	3408.024	3979.719	3121.514	2249.299	2550.504	988.332	390.145	176.454	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	39.716	13.296	22.160
	130.526	476.762	865.413	1659.118	2518.488	4321.956	5053.284	5045.810	3552.408	1720.371	1363.853
	100.939	0.000	0.000	0.000	0.000	0.000					
1991	1	4	3	0	155.32	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	132.032	113.271	954.080	602.738	1829.870	3195.848
	4568.224	3884.806	4384.573	4207.931	2604.531	2467.894	706.180	9.774	74.582	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.538
	75.092	336.273	1085.855	2486.687	2889.712	6601.191	8277.912	9176.603	7461.456	4147.401	1276.834
	502.043	74.582	0.000	0.000	3.321	0.000					
1992	1	4	3	0	141.2	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	19.331	0.000	65.605	167.228	413.396	593.861	898.962	1686.336	1954.679	1933.381
	2827.834	3725.351	3291.025	3724.332	3757.101	2063.323	1296.034	55.827	134.573	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.040	15.226	108.965
	225.978	604.399	1410.847	3039.418	3430.809	4193.906	7117.286	7542.803	4968.539	3774.365	1218.769
	5.845	0.000	0.000	0.000	0.000	0.000					
1993	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	1.174	0.000	0.000	145.991	55.140	339.713	1015.904	1258.626	1583.087	1731.309
	1730.824	1129.471	1365.677	554.052	565.490	200.104	1.184	1.184	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.998	1.998	86.438
	280.548	1017.158	1047.291	2009.383	2190.674	1956.893	1933.797	893.195	471.622	185.563	91.737
	0.000	0.000	0.000	0.000	0.000	0.000					
1994	1	4	3	0	105.9	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	25.065	25.065	119.353	173.235	498.026	347.428	999.240	1403.804	1148.810
	1693.197	784.059	1287.478	714.886	581.939	480.321	90.763	59.231	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.759	37.138	290.499
	209.174	450.722	769.290	1102.292	2358.564	1672.643	2080.482	1350.925	1409.134	622.703	255.417
	3.862	0.000	0.000	0.000	0.000	0.000					
1995	1	4	3	0	155.32	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	13.626	21.888	42.826	155.416	184.139	260.684	505.212	510.585	547.770
	837.511	612.709	348.875	195.276	120.347	19.413	41.192	2.565	0.000	1.809	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	6.813	6.813	11.023	45.444	60.663
	166.635	330.332	438.269	642.684	938.887	754.765	465.388	432.425	216.576	77.676	34.031
	0.000	31.708	0.000	0.000	0.000	0.000					
1996	1	4	3	0	105.9	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	11.263	23.895	17.558	46.323	69.688	100.866	143.980	152.860	246.662	253.588
	316.023	382.446	576.702	381.673	210.927	40.580	18.140	3.449	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	1.969	16.569	9.477	20.321	31.888
	122.682	138.799	201.275	244.161	512.928	684.214	513.045	443.938	500.053	168.263	80.697
	0.000	0.000	8.188	0.000	0.000	0.000					
1997	1	4	3	0	120.02	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	1.161	43.012	86.023	161.666	168.856	281.573	561.911	1121.116
	704.254	806.316	955.923	710.574	304.057	252.957	95.198	14.749	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	40.691	40.691	47.718
	333.713	172.561	310.326	929.052	955.761	1403.580	911.236	1101.395	766.225	214.752	62.384
	14.749	0.000	0.000	0.000	0.000	0.000					
1998	1	4	3	0	141.61	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	201.351	9.389	71.792	158.772	203.049	523.069	761.094	831.782
	778.245	685.331	676.433	411.148	463.548	137.832	45.995	0.000	36.865	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15.560	35.388	76.959
	296.725	256.734	553.538	764.909	722.775	934.879	1380.343	585.381	312.343	222.569	78.751
	8.665	0.000	0.000	0.000	0.000	0.000					
1999	1	4	3	0	120.534	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	4.915	12.006	1.779	33.232	58.200	87.069	59.032	125.859	179.031	415.199

	386.455	212.276	507.216	343.535	361.064	201.140	24.138	0.000	0.000	0.000	1.821
	0.000	0.000	0.000	0.000	0.000	0.000	1.088	0.000	0.000	34.497	55.505
	113.264	92.731	198.116	330.745	295.913	500.312	775.089	638.619	523.905	108.118	24.862
	11.499	17.417	0.000	0.000	0.000	0.000					
2000	1	4	3	0	38.602	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	1.481	4.205	4.690	8.643	12.707	16.409	8.126	22.247
	18.609	21.784	14.554	4.205	7.264	1.012	5.065	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.158	0.000	6.556
	3.871	8.643	24.919	15.925	23.617	30.244	40.264	19.303	7.055	2.082	0.593
	1.012	0.000	0.000	0.000	0.000	0.000					
2001	1	4	3	0	57.16	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	4.606	26.627	28.342	44.598	86.517	154.969
	1085.183	213.889	264.800	153.320	976.554	118.618	20.205	0.000	5.386	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	845.704
	23.467	1722.602	3349.163	1767.405	1014.791	569.248	1275.507	379.867	1175.550	50.445	66.011
	0.000	22.930	0.000	0.000	0.000	0.000					
2002	1	4	3	0	133.22	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	4760.725	76.678	382.587	698.354	529.567	610.813
	647.100	1288.210	815.705	714.979	658.795	633.708	139.060	23.450	7.235	7.235	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	64.821	8.564
	202.171	138.602	627.150	901.287	1177.039	1888.291	2010.841	2381.146	546.612	294.483	6.186
	17.677	17.712	0.000	0.000	0.000	0.000					
2003	1	4	3	0	80.888	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	17.774	42.147	67.792	166.407	122.911	210.273	163.433
	171.293	147.393	175.810	189.061	154.536	160.934	55.358	40.396	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	43.628
	63.018	51.325	175.251	172.118	315.236	201.423	279.570	207.985	80.832	79.032	41.444
	27.617	10.878	0.000	0.000	0.000	0.000					
2004	1	4	3	0	141.212	0.000	0.000	0.000	0.000	0.000	0.000
	22.549	0.000	45.255	0.000	4.001	71.317	153.904	149.813	133.328	120.944	163.076
	211.818	187.100	284.776	197.177	329.619	96.333	66.136	71.288	20.118	10.735	7.761
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	34.251
	57.292	66.020	23.867	153.645	418.862	291.695	448.754	243.589	152.704	80.884	67.623
	4.054	11.274	0.000	0.000	0.000	0.000					
2005	1	4	3	0	268.854	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	5.380	18.488	101.538	173.767	390.485	759.734	776.820
	806.680	823.271	680.170	784.293	673.466	222.238	218.663	132.812	92.461	34.972	5.380
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.380
	28.808	108.232	252.587	375.149	545.531	794.508	1020.845	1269.697	848.480	677.878	275.131
	159.960	160.463	53.264	63.990	3.459	0.000					
2006	1	4	3	0	120.974	0.000	0.000	0.000	0.000	0.000	3.720
	8.249	7.845	7.441	28.904	61.633	83.406	82.380	93.861	94.780	93.470	90.799
	1028.732	657.924	869.465	922.558	1007.959	27.059	8.676	29.906	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	8.249	4.125	4.125	14.828	30.286	41.306
	82.516	444.543	140.506	74.676	96.793	671.425	119.801	675.463	339.552	300.103	24.521
	16.786	5.462	5.293	0.000	0.000	0.000					
# 2007 California South non-trawl fleet (n=23)											
1978	1	5	0	0	1.138	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	155.769231		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0				
1979	1	5	0	0	2.38	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	5.102041
	10.204082	5.102041	15.306123	10.204082	5.102041	0	0	0	0	0	0
	0	0	0	0	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	5	0	0	8.14	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	14.423077
	19.23077	128.344231		17.528667	28.547539	1.552795	12.720975	9.615385	4.807692	0	0
	0	0	0	0	0	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	8.416	0	0	0	0	0	0
	0	0	0	0	2.172185	0	4.344371	0	99.14279	39.355556	79.893617
	118.391963		117.853901		39.787234	39.893617	39.355556	0	0	0	0
	0	0	0	0	0	0	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	42.8	0	0	0	0	0	0
	0	0	0	0	35.122195	88.536521	85.652273	88.53637	140.140043		202.02677
	102.894765		90.543284	48.272934	8.788462	28.683644	0	4.267677	0	0	0
	0	0	0	0	0	0	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	30.56	0	0	0	0	14.103093	0
	0	0	0	0	0	242.091683		268.485149		266.77394	
	135.711547		361.897354		292.364077		238.470094		24.000978	50.449512	13.910795
	8.816178	0	0	3.113208	0	0	0	0	0	0	0
	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	25.972	0	0	0	0	0	0
	0	3.707071	0	3.707071	20.750373	46.277146	86.763573	55.235479	69.175557	259.0428	
	204.725494		217.969255		105.381908		9.610526	0	0	0	0
	0	0	0	0	0	0	0	0	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	72.54	0	0	0	0	0	0
	0	0	12.27	7.326733	74.27697	175.021397		329.4444	479.535344		
	466.563555		359.872034		208.215837		365.635163		197.286374		58.407283
	112.627327		0	18.63531	0	0	0	0	0	0	0
	0	0	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	5	0	0	30.592	0	0	0	0	0	0
	2.691589	0	8.737345	13.932535	22.158915	35.070509	97.287122	97.475343	247.187963		93.303613
	83.571667	61.660194	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	5	0	0	17.97	0	0	0	0	0	0
	0	0	5.769231	9.202021	33.750067	46.010101	43.32427	58.124328	48.307573	43.980063	79.789828
	0	27.306593	5.731481	5.731481	0	15.673469	0	0	0	0	0
	0	0	0	0	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	5	0	0	249.868	0	0	0	0	57.448721	
	176.465379		555.044924		679.8155	682.496865		596.829185		780.714735	
	529.549599		503.663751		295.236615		99.649403	129.227127		177.299372	
	58.866318	62.069737	70.536481	15.020164	6.961538	14.461538	6.961538	0	0	0	0
	0	0	0	0	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	5	0	0	146.61	0	0	0	0	0	13.477234
	36.736276	73.577552	79.192808	70.005012	66.162799	111.929037		327.779904		139.084215	
	86.512829	31.826094	52.113691	5.616162	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	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	182.286	0	0	0	11.141304	27.84619	29.099068
	103.777175		197.041855		346.007909		360.516803		314.157782		
	398.863659		364.078038		408.474339		236.289254		359.785115		
	159.917557		115.168451		58.564862	21.801111	20.111111	0	0	0	0
	0	0	0	0	0	0	0	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	96.78	0	0	0	0	7.68	13.88
	56.041667	60.323333	112.081667		281.668744		279.797857		421.692824		
	404.148721		428.122229		377.791066		348.366747		339.113769		
	112.732995		74.809516	126.780701		12.884211	52.669828	2.346939	0	0	0
	0	0	0	0	0	0	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	131.204	0	0	0	0	45.857143	84.062857
	68.574929	251.630323		379.173798		477.618965		459.06708	501.780647		
	478.718823		388.259279		496.245166		494.646526		361.967866		

	323.868918		190.728976		117.457801		10.52381	55.449222	28.252336	0	0
	0	0	0	0	0	0	0	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	123.516	0	0	0	0	0	1
	10	131	221	358	359	268	267	345	185	199	70
	49	18	2	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	0					
1998	1	5	0	0	47.836	0	0	0	0.000	0.000	0.000
	6.909	20.000	10.000	23.855	138.492	190.691	385.066	397.390	82.753	53.969	49.218
	2.360	0.000	0.000	5.520	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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	32.042	0	0	0	0.000	0.000	3.983
	27.440	8.208	27.496	33.131	22.251	14.329	11.247	18.270	19.652	26.005	9.478
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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	8.45	0	0	0	1.387	1.387	0.000
	0.000	5.754	5.037	8.974	5.733	7.326	5.733	0.754	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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	5	0	0	2.276	0	0	0	0.000	0.000	0.000
	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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	29.834	0	0	0	0.000	10.250	37.350
	39.733	61.267	39.850	34.583	26.850	30.750	10.167	0.000	6.100	6.100	0.000
	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0	0	0
	0	0	0	0	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	7.518	0	0	0	0.000	0.000	0.000
	0.000	2.000	1.000	2.000	2.000	2.000	0.000	1.000	0.000	1.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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	23.178	0	0	0	1.000	0.000	19.324
	19.993	34.238	42.565	33.484	13.909	6.414	3.748	0.000	0.000	0.000	0.000
	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0
	0	0	0	0	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 California North non-trawl fleet (n=20)											
1981	1	6	0	0	1.69	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	70.080	140.160	0.000	70.080	70.080	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1982	1	6	0	0	9.24	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	417.046	15.846	987.064	882.483
	1452.501	151.569	235.277	464.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1983	1	6	0	0	2.83	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	7.079	24.845	0.000	14.158	0.000	0.000	17.765	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1984	1	6	0	0	1.14	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	18.535	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1991	1	6	0	0	25.60	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	15.605	25.102	16.096	50.694	74.278	88.011	141.983	138.892	27.645	67.149
	85.826	143.667	120.960	13.909	21.712	0.000	27.818	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1992	1	6	0	0	152.19	0.000	0.000	0.000	0.000	0.000	0.000
	14.640	54.689	140.879	129.079	218.686	305.756	449.891	622.561	419.241	396.772	573.629
	457.581	608.464	625.995	487.455	180.227	121.049	21.797	5.366	1.838	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1993	1	6	0	0	202.66	0.000	0.000	0.000	0.000	39.252	42.253
	143.422	245.319	351.505	385.579	544.492	448.920	460.477	561.082	537.158	553.973	551.546
	538.886	281.341	143.749	162.796	70.734	52.494	7.908	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1994	1	6	0	0	249.58	0.000	0.000	0.000	0.000	0.000	10.455
	58.932	157.765	198.098	343.086	465.128	471.821	681.149	812.397	904.115	863.386	692.537
	494.980	443.115	359.383	444.154	90.914	82.388	2.920	2.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1995	1	6	0	0	168.79	0.000	0.000	0.000	0.000	0.000	4.967
	68.671	115.859	272.873	326.421	393.972	481.528	392.515	303.636	295.934	216.465	203.654
	185.228	181.730	178.553	127.320	25.850	28.690	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1996	1	6	0	0	166.62	0.000	0.000	0.000	3.060	8.074	33.708
	123.337	211.515	370.010	341.345	359.481	406.174	563.921	391.582	519.850	436.825	472.194
	532.126	585.326	267.354	135.712	63.777	28.693	9.564	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1997	1	6	0	0	109.25	0.000	0.000	0.000	0.000	3.961	19.800
	13.860	26.849	77.854	160.787	226.902	320.700	322.333	208.149	207.819	103.785	83.153
	60.349	81.996	84.766	50.031	19.091	2.191	1.600	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1998	1	6	0	0	50.57	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	4.000	9.800	20.560	36.053	62.527	81.003	77.903	44.640	84.160
	53.343	83.170	54.587	35.520	15.110	20.663	5.870	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
1999	1	6	0	0	143.70	0.000	0.000	0.000	0.000	0.000	0.000
	4.708	26.667	36.282	57.677	116.000	144.400	144.248	121.300	77.040	28.400	15.760
	9.540	7.340	3.000	1.200	1.000	1.000	1.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2000	1	6	0	0	36.42	0.000	0.000	0.000	0.000	2.387	0.000
	0.000	1.194	5.194	10.000	12.000	12.922	7.961	26.358	22.613	19.515	31.403
	15.608	8.777	7.010	1.000	0.000	0.000	0.000	0.000	1.194	0.000	1.194
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2001	1	6	0	0	54.08	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	1.000	5.260	7.520	23.560	20.891	16.111	14.800	23.847	35.369	48.937

	36.639	28.111	20.240	6.714	4.160	5.610	2.900	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2002	1	6	0	0	6.04	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	4.000	0.000	7.000	1.000	8.000	1.000	0.000	1.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2003	1	6	0	0	13.55	0.000	0.000	0.000	0.000	1.983	1.983
	0.000	0.000	1.983	12.387	12.387	11.898	17.821	8.983	1.983	3.966	1.983
	0.000	1.983	0.000	1.983	1.983	1.983	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2004	1	6	0	0	74.05	0.000	0.000	0.000	0.000	3.000	1.000
	4.026	4.000	3.000	15.044	18.000	19.000	21.044	15.000	24.000	11.000	7.026
	4.000	7.000	5.000	3.000	1.000	2.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2005	1	6	0	0	46.39	0.000	0.000	0.000	3.000	4.000	1.000
	2.000	8.000	9.000	12.000	14.000	18.000	16.000	12.000	7.000	5.000	5.000
	4.000	2.000	0.000	1.000	2.000	0.000	0.000	0.000	1.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2006	1	6	0	0	33.97	0.000	0.000	0.000	1.000	1.000	1.000
	4.000	5.000	2.000	11.000	21.000	25.000	19.000	19.000	7.000	1.000	3.000
	1.000	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
# 2007 OR-WA non-trawl fleet (n=14)											
1980	1	7	3	0	4.04	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.898	2.694	2.694	0.000	0.000	0.898	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.898	0.000	0.000	0.000	4.491	3.592	0.000	3.592
	0.000	0.000	0.000	0.000	0.000	0.000					
1988	1	7	3	0	21.18	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	89.134	177.891
	344.952	433.709	808.346	573.733	425.603	26.127	198.110	128.361	103.144	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	15.752	57.631	145.933	249.909	266.571	670.514	1027.201	526.473
	103.144	0.000	0.000	0.000	0.000	0.000					
1990	1	7	3	0	7.06	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	25.435
	101.742	76.306	203.483	254.354	228.918	228.918	76.306	25.435	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	50.871	76.306	203.483	152.612	432.401	279.789	127.177
	0.000	0.000	0.000	0.000	0.000	0.000					
1996	1	7	3	0	6.11	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.029	0.000	3.044	4.059
	5.073	2.029	3.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	2.029	1.015	2.029	4.059	1.015	1.015	3.044	2.029	1.015	0.000
	0.000	1.015	0.000	0.000	0.000	0.000					
1997	1	7	3	0	77.66	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	2.632	0.000	8.257	6.637	12.054	44.234	48.590	83.747	63.589
	32.941	81.483	41.605	33.193	36.578	20.011	19.371	5.436	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	2.752	2.752	2.264	4.352	11.633
	22.462	62.896	78.738	102.397	75.465	59.806	69.282	73.443	82.031	59.036	75.930
	21.177	13.467	0.000	13.467	0.000	0.000					
1998	1	7	3	0	54.23	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	20.783	21.124	32.702	43.625	69.784	73.268
	20.062	55.367	7.348	9.580	6.086	25.679	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	4.394	0.000	0.000	0.000	3.846	7.692	16.181

	20.177	38.828	52.952	94.156	107.508	139.738	128.532	105.051	137.777	96.859	41.116
	26.227	0.000	0.000	0.000	0.000	0.000					
1999	1	7	3	0	28.18	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.973	0.000	1.259	7.824	6.785	7.870	7.981	25.272	17.279	15.002
	14.587	5.398	5.464	4.140	7.336	0.000	5.234	0.000	5.234	10.467	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.973	0.000	0.000	4.048
	7.140	4.268	17.289	15.186	27.351	17.902	21.329	13.621	4.314	6.252	2.277
	0.000	5.234	5.234	0.000	5.234	5.234					
2000	1	7	3	0	48.29	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	2.000	3.018	14.935	11.623	7.067	14.001	16.039	12.023	9.145	2.091
	3.041	1.996	1.067	2.015	0.000	0.000	0.000	1.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.022	4.861	5.962
	14.923	12.090	12.086	7.100	7.243	5.097	2.067	1.091	1.996	0.000	0.000
	1.067	0.000	0.000	0.000	0.000	0.000					
2001	1	7	3	0	55.36	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	1.000	6.073	7.251	12.512	14.331	22.977	10.404	16.677	11.022	6.537
	8.662	2.448	2.102	3.568	1.075	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.250	4.253	9.126
	10.417	9.221	5.840	9.948	7.481	5.997	10.801	2.232	0.000	0.000	0.000
	2.157	1.157	0.000	0.000	0.000	0.000					
2002	1	7	3	0	13.45	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.867	0.000	155.510	0.000
	29.200	315.887	335.354	29.200	24.333	160.377	150.643	0.000	4.867	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	4.867	9.733	14.600	4.867	150.643	19.467	14.600	4.867	4.867
	0.000	0.000	0.000	0.000	0.000	0.000					
2003	1	7	3	0	8.73	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	127.509	510.037	255.019
	510.037	382.528	254.764	255.019	127.509	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	127.509	127.509	382.528	255.019	0.000	255.019	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2004	1	7	3	0	17.87	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	68.062	0.000	0.000	0.000	0.000	0.000	145.602	128.770
	315.757	151.569	263.139	286.665	238.217	80.723	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	87.304	0.000	145.602	43.508	141.063	153.324	119.694	41.753	34.031	38.970
	0.000	0.000	0.000	0.000	0.000	0.000					
2005	1	7	3	0	10.62	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	66.273
	44.969	0.000	51.359	66.273	0.000	0.000	59.647	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	38.345	21.302	42.603	79.051	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					
2006	1	7	3	0	7.11	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	583.655	25.560	76.681	626.256	8.520	25.560	8.520	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	17.040	17.040	42.601	34.081	0.000
	0.000	0.000	0.000	0.000	0.000	0.000					

2007 California South recreational fleet (n=24)

1980	1	8	0	0	204.35	0	0	1	9	16	23
	35	47	72	80	64	80	56	36	14	8	3
	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					
1981	1	8	0	0	101.60	0	0	0	1	8	7
	15	19	35	31	33	26	22	8	7	2	3
	4	2	4	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					
1982	1	8	0	0	124.43	0	0	1	0	3	13
	21	28	31	34	24	29	15	17	19	11	5
	4	4	4	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					

1983	1	8	0	0	121.95	0	0	2	5	9	20
	13	27	28	26	32	23	21	17	11	2	2
	2	3	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					
1984	1	8	0	0	147.92	0	0	1	9	28	39
	33	30	29	26	34	26	27	17	2	2	4
	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	0
	0	0	0	0	0	0					
1985	1	8	0	0	273.81	0	0	1	7	27	53
	75	99	96	79	66	65	55	31	17	5	4
	1	4	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	0	0	0	0					
1986	1	8	0	0	254.81	0	1	1	2	10	28
	55	88	110	150	104	73	51	14	9	2	5
	3	3	2	4	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					
1987	1	8	0	0	67.56	0	0	1	2	6	9
	6	11	13	18	21	25	12	2	4	2	3
	8	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	0	0	0	0	0					
1988	1	8	0	0	95.25	0	0	1	1	6	17
	23	22	25	20	13	10	16	15	5	1	1
	1	2	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	0	0	0	0	0
	0	0	0	0	0	0					
1989	1	8	0	0	188.17	0	0	1	4	15	13
	26	56	104	88	49	42	37	27	10	3	7
	3	0	3	5	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					
1993	1	8	0	0	126.12	0	0	1	5	7	15
	37	34	51	27	18	8	1	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					
1994	1	8	0	0	54.35	0	0	0	0	2	3
	6	7	16	16	9	10	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	0	0	0	0	0
	0	0	0	0	0	0					
1995	1	8	0	0	104.91	0	0	1	3	8	18
	21	21	35	43	32	25	26	12	4	1	2
	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					
1996	1	8	0	0	213.91	0	1	4	3	16	30
	30	40	70	111	127	97	67	26	6	6	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	0	0	0					
1997	1	8	0	0	310.43	0	0	0	10	19	25
	43	82	98	165	203	205	154	77	39	30	13
	5	4	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
	0	0	0	0	0	0					
1998	1	8	0	0	209.70	0	0	0	0	9	24
	42	27	42	68	84	77	66	62	36	21	12
	6	3	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	0					
1999	1	8	0	0	228.91	0	0	1	1	3	9
	17	28	53	78	85	95	101	82	51	17	9
	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
	0	0	0	0	0	0					
2000	1	8	0	0	99.12	0	0	0	1	0	3
	6	6	17	36	49	48	39	33	29	17	7
	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	0	0	0	0	0
	0	0	0	0	0	0					
2001	1	8	0	0	73.39	0	0	0	1	3	1
	1	4	5	11	22	24	32	23	12	10	5
	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					
2002	1	8	0	0	50.80	1	0	0	0	2	4
	3	3	9	1	4	15	11	22	11	4	3
	3	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	0	0	0					
2003	1	8	0	0	9.10	0	0	0	1	0	0
	0	0	5	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
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
2004	1	8	0	0	113.42	0	0	1	4	0	5
	4	8	27	30	28	24	9	3	4	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					
2005	1	8	0	0	21.73	0	0	0	0	0	0
	0	1	3	4	7	8	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	0	0	0
	0	0	0	0	0	0					
2006	1	8	0	0	24.24	0	0	0	0	0	2
	1	6	2	4	2	8	7	4	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	0					

2007 California North recreational fleet (n=24)

1980	1	9	0	0	107.09	0	0	0	0	2	3
	12	24	37	49	46	34	22	18	21	20	11
	13	7	9	3	2	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					
1981	1	9	0	0	75.91	6	2	2	2	1	3
	8	9	21	28	43	39	22	14	11	2	3
	2	1	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	0	0	0	0					

1982	1	9	0	0	118.85	0	0	0	0	0	12
	18	42	56	58	56	40	41	21	18	4	3
	3	3	0	2	1	3	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					
1983	1	9	0	0	77.19	0	0	0	1	0	2
	9	20	32	32	24	24	14	17	6	6	1
	1	1	2	0	2	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					
1984	1	9	0	0	105.40	0	0	0	0	3	4
	18	19	18	30	31	26	16	26	14	12	11
	3	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	0	0	0					
1985	1	9	0	0	163.62	0	0	0	1	4	8
	17	31	49	46	57	62	46	34	29	13	11
	2	10	3	5	2	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	0					
1986	1	9	0	0	199.60	0	0	1	0	2	14
	39	73	103	106	96	73	46	28	20	19	13
	9	11	6	7	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					
1987	1	9	0	0	121.72	0	0	0	0	1	8
	17	16	40	27	32	43	47	38	19	24	51
	36	30	9	10	11	7	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					
1988	1	9	0	0	90.26	0	0	0	0	2	3
	12	18	28	26	14	18	12	11	8	12	11
	15	7	8	6	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					
1989	1	9	0	0	30.32	0	0	1	0	1	1
	3	3	7	16	14	15	8	3	1	5	0
	1	1	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					
1993	1	9	0	0	130.51	0	0	0	4	5	12
	26	44	66	52	49	31	18	9	7	8	2
	0	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					
1994	1	9	0	0	131.96	0	0	0	0	4	13
	30	44	66	84	65	40	22	14	6	2	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
	0	0	0	0	0	0					
1995	1	9	0	0	82.88	0	0	0	3	7	20
	31	33	36	31	30	18	9	5	3	0	0
	1	0	1	2	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					
1996	1	9	0	0	147.20	0	0	0	0	4	11
	24	53	65	88	62	40	26	13	13	19	16
	17	6	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					
1997	1	9	0	0	133.73	0	0	1	5	7	28
	56	59	37	35	24	30	44	55	64	47	34
	22	14	14	3	4	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					
1998	1	9	0	0	46.87	0	0	0	1	1	0
	4	6	6	22	14	10	19	20	16	4	7
	6	6	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					
1999	1	9	0	0	109.75	0	0	0	0	0	9
	10	18	29	28	24	18	38	39	57	33	21
	7	8	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
	0	0	0	0	0	0					
2000	1	9	0	0	42.42	0	0	0	0	0	0
	1	4	6	15	2	2	5	12	5	12	12
	4	5	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	0	0	0	0	0					
2001	1	9	0	0	15.90	0	0	0	0	0	0
	0	1	1	2	0	3	2	3	6	1	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					
2002	1	9	0	0	13.35	0	0	0	0	0	2
	1	1	0	2	2	2	2	1	0	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
2003	1	9	0	0	30.24	0	0	0	0	0	0
	0	1	4	3	1	4	8	9	3	3	1
	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	0	0	0	0	0					
2004	1	9	0	0	35.45	0	0	0	0	0	1
	1	2	12	5	11	4	4	3	6	1	1
	0	1	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					
2005	1	9	0	0	20.73	0	0	0	0	0	0
	0	1	0	1	4	7	5	0	3	0	3
	1	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					
2006	1	9	0	0	10.93	0	0	0	0	0	0
	0	1	1	2	1	1	2	2	1	0	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					
# 2007 OR-WA recreational fleet (n=23)											
1980	1	10	0	0	121.29	0	0	0	0	0	
	328.1504039		597.558782		610.9514286		2446.10622		5875.197787		
	3329.646289		4948.273167		5074.900676		2575.317914		1678.769783		
	2955.907527		678.7236824		423.1214634		2844.455689		405.4968427		
	80.20816668		0	0	0	0	0	0	147.526307		0
	0	0	0	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 10 0 0 50.18 0 0 0 0 117.688549
502.0131582 3246.792632 2913.272582 7860.725817 12725.31912
6841.862819 5997.682378 11807.63698 6697.027958 2374.003556
2673.012194 1491.300157 1523.818687 395.638978 0 0
863.2171846 285.775485 0 0 0 0 0 0 0
0 0 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 10 0 0 108.91 0 0 0 0 268.8578971
483.1520862 140.2072405 3227.974591 2769.262849 10440.54535
9676.874221 11703.18003 16723.34727 5210.354968 968.2587613
1540.789364 1874.444309 2115.221868 2034.744482 555.4109315 0
0 0 0 159.0036463 0 0 0 0 0 0
0 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 10 0 0 33.90 0 0 0 0 0
491.9399744 61.16551383 184.9833146 1093.964074 1647.0908 3063.398714
1774.051388 97.20366352 481.5662471 97.20366352 1843.711988
563.0921404 161.1066088 273.0703669 0 181.2546591 0 0
147.6990731 0 0 0 0 0 0 0 0 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 10 0 0 135.64 0 0 0 0 0
330.0311227 946.7096557 2297.646294 3118.932907 5070.596924
4398.525037 4898.987254 3640.055948 3353.701119 1370.554404
933.2577533 971.1793092 489.3916029 353.8373804 113.8037779
59.58932295 242.1124781 55.86245116 0 205.8088908 96.66275609
0 0 0 0 0 0 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 10 0 0 158.58 0 0 0 57.55740042 0
1511.465 2510.830168 3886.974888 6413.075946 4199.75511 6760.287804
9401.850897 9104.653402 7237.968902 4528.731591 4402.164047
2246.93545 4318.812895 729.6205539 3217.808582 172.1165241
790.1322552 0 57.27956183 790.1322552 0 0 0 0
0 0 0 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 10 0 0 72.80 0 0 0 0 103.9245679
83.78531081 1437.027683 1403.790492 2786.59202 2553.757802
2375.591234 1621.556015 975.3961914 1020.097361 215.3114401
534.8829631 1646.401544 2167.891184 374.5262149 1035.646385
249.6841433 124.8420716 0 0 0 0 0 0 0
0 0 0 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 10 0 0 107.22 0 0 155.3185786 275.7672429
881.9218557 979.2894241 3648.684814 4311.403816 6982.337735
4142.742686 5207.436876 5143.446031 3330.618299 2351.544679
1590.567368 812.3628633 1320.389338 522.9872745 2146.580981
401.5495515 591.1991079 423.5670199 0 0 0 0 0
193.0309131 0 0 0 0 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 10 0 0 159.30 525.4874774 0 0 525.4874774
628.878096 2549.582464 5715.182392 10165.7027 12568.5278
18666.61916 11592.98716 12013.27647 5447.11468 3994.65682
1217.579904 1352.908384 1592.307818 1343.349553 1252.193533 0
0 346.0892737 45.47167898 525.4874774 0 0 0 0
0 0 0 0 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 10 0 0 64.22 0 0 0 0 0
224.8409015 559.8862432 3162.727769 4042.15625 7705.794454
4534.859759 4739.198854 3071.283091 2210.015262 1062.980897
1214.839177 1191.964293 664.324081 696.5701124 0 180.0175462

	0	0	226.8885012	0	0	0	0	0	0	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	10	0	0	191.14	0	0	0	0	0
	120.1353979	1162.336046	1917.343549	3770.378049	5501.966416					
	5011.854073	3395.374822	2905.163547	2094.907843	757.1194508					
	420.1350939	668.706784	313.6119453	367.6771169	65.29254079					
	216.2842397	113.1286841	0	0	42.48484849	70.64383562	0			
	84.96969697	0	0	0	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	10	0	0	199.35	0	0	0	0	219.4170364
	502.4533629	1032.281777	2088.753175	2700.567627	4214.363902					
	3900.723771	3303.10353	2236.233557	1129.112827	400.6278448					
	242.9557915	91.58742416	201.8486487	120.7648625	140.1587755	0				
	49.32608696	0	0	0	0	0	68.72	0	0	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	10	0	0	182.25	0	0	0	0	107.6539967
	0	314.604067	1806.634837	2623.209114	6054.456402	3757.736478				
	2825.896799	1604.337605	893.6302461	245.0181818	337.3379585	0				
	229.3571429	0	229.3571429	114.6785714	0	72.74545455	0			
	0	0	0	0	0	0	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	10	0	0	123.37	0	0	0	0	0
	234.4230769	89.06896552	1100.421007	2577.523115	3980.377491					
	2690.014383	3089.308829	2042.286319	1215.629973	410.0770227					
	143.8076923	78.5	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	0	0	0	0	0	0	
1997	1	10	0	0	169.75	0	0	0	37.20731707	0
	540.5059404	1301.359253	2648.154468	8423.818614	4203.338204					
	9861.106653	5482.117362	8688.368134	1837.362763	432.7869333					
	1197.102695	323.7003024	282.8418736	549.5563123	288.7704914					
	36.73651079	0	75.53398058	0	0	0	0	0	0	
	0	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	10	0	0	273.84	0	0	0	0	76.4742268
	793.1413517	2192.276041	5589.897997	10847.03833	7279.171033					
	9017.44332	6803.331773	4163.132868	4798.719129	3622.272345					
	731.5554842	837.9041674	791.3908218	353.0204082	162.4148148	0				
	0	162.4148148	0	0	0	76.4742268	0	0	0	
	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	10	0	0	265.57	0	0	0	112.25	112.25
	274.1303007	1216.471888	3410.908391	6191.820316	6512.580884					
	5236.148204	6262.321993	2574.479191	2466.977664	1176.985111					
	838.6272096	469.9515756	389.2498761	912.2392344	70.17460318					
	64.55980861	0	0	0	0	0	0	0	0	0
	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	10	0	0	152.75	0	0	0	0	0
	140.2708333	786.3815096	2054.777043	3141.604031	5630.211053					
	4404.114665	3311.408439	1924.169271	372.2356034	417.3475916					
	259.1285714	367.3780791	0	212.4439778	18.3	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	0	0
2001	1	10	0	0	92.12	0	0	0	0	0	1360.4
	115.4545455	230.5143745	1198.937507	1332.449208	1893.878029					
	1069.397232	3261.154747	316.995856	236.7781848	16.61538462					
	16.61538462	23	235.997965	0	0	0	0	0	0	
	0	0	0	0	0	0	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 10 0 0 85.25 0 0 0 0 0 0
291.9333333 220.4146794 796.8984632 1281.164623 2417.186895
2047.446112 464.5377886 653.8317965 545.1921569 126.4391892 66
225.9333333 22.5945946 0 0 0 0 0 0 0
0 0 0 0 0 0 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 10 0 0 20.97 0 0 0 0 0 0
0 79.675 146.8161765 135.1965686 93.39313726 219.3544118
64.02990196 60.55980392 3.666666667 1.833333333 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 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 10 0 0 22.31 0 0 0 0 0 0
67.2667547 182.5883164 91.29415822 257.0294712 233.0020677
67.2667547 476.4080241 82.86765651 82.86765651 91.29415822 0
273.8824746 67.2667547 0 0 0 0 0 0 0
0 0 0 0 0 0 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 10 0 0 10.21 0 0 0 0 0 0
0 0 70.90614982 212.7184495 0 70.90614982 226.8181548
70.90614982 70.90614982 99.24143487 70.90614982 0 0
70.90614982 0 0 0 0 0 0 0 0 0
0 0 0 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 At-sea hake fishery (n=4)
2003 1 11 3 0 96.55 0 0 0 0 0 0
0 0 0 0 0 0 2 3 0 16.111111 29.51634
32.738562 20.26634 33.710784 20.873483 14.301587 9.151261 5.722222 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 2.6 14.643791 24.322222 49.410458 52.599673 48.207143 28.317927 13.857143 3
4.634921 0 0 0 0 0
2004 1 11 3 0 118.47 0 0 0 0 0 0
0 0 0 0 0 0 0 0 3.5 0 32.728571
136.17437 135.745798 150.712465 223.222549 133.012465 24.95
112.702941 0 6.25 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 3.5 9.571429 17.828571
133.931513 77.771429 144.62437 15.85 9.25 8.6 0 0 3 0
0 0
2005 1 11 3 0 202.40 0 0 0 0 0 0
0 0 0 0 0 0 0 1.75 5 11.5 27.277778
55.72 55.8 51.67 63.882222 33.888889 22.97 27.498889 10.826667 4.333333 0 2
0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 14.5 48.586667 90.476667 55.525556 32.386667 18.36 9.493333
2 2.333333 0 0 0 1
2006 1 11 3 0 182.29 0 0 0 0 0 3
2 0 0 1 0 3 4 8 9 21 33.095238
43.5 38.833333 40.095238 28.333333 27.3 15.428571 11 4 0 0 0
0 0 0 0 0 0 0 2 0 3 1
3 11.8 3 4 22.633333 53.8 48.345238 46.761905 20.8 5.833333 2
0 0 0 0 0 0
# 2007 NWFSC survey (n=4)
2003 1 12 3 0 79.61 0 43306 57741 72897 0 43190
25363 14357 54765 14357 15747 15786 71294 74632 166245 130017 88970
138216 120031 133437 114197 27694 208718 4550 0 0 0 0
25153 173224 220680 33019 0 54771 39761 14357 39802 0 0
24636 100687 54051 180177 197325 239272 256082 155510 108064 4660 0
0 0 0 0 0 4
2004 1 12 3 0 79.5 0 46225 9781 101655 39123 51157
92780 13115 90261 220272 85706 128292 141709 199472 223960 409937 367860
168530 240944 195117 447365 385664 323417 274293 148496 37124 37124 1
0 78842 33500 32061 75751 51385 168135 142813 127954 120285 143337
170795 278281 55167 152484 243127 269669 405235 429197 755614 253451 133642
122796 0 37124 0 0 5
```

2005	1	12	3	0	99.54	9312	25526	8973	16237	32473	62804
	81477	80227	112847	140374	82628	96844	135024	186567	189341	190581	156303
	322646	354907	258389	192365	150472	0	0	8702	0	0	2
	18624	9312	12393	6197	27978	34827	58313	55054	47607	110161	128571
	91365	166210	171969	180936	258143	383581	550201	653532	226432	57416	36276
	18138	0	0	0	0	6					
2006	1	12	3	0	75.61	0	9256	9256	9256	8621	7697
	0	0	10606	47258	47258	63974	56121	132406	290410	1273628	1358876
	1865188	3615270	3503977	2670924	1502499	2171131	1233554	936980	8888	0	3
	0	0	0	0	8224	26068	7697	7697	0	0	76282
	42775	37284	846074	740597	1822163	2427673	3815830	5786048	4642550	1894456	742727
	0	296574	0	0	0	7					
# 2007 triennnial survey (n=10)											
1983	1	13	3	0	215.16	0	0	3578	3578	13121	14688
	22563	113129	317694	562889	275905	287613	220792	246952	334313	233752	335422
	699948	484401	391119	537382	545882	236888	73064	37180	1813	0	0
	0	0	0	8946	14313	9641	27423	143716	326252	499398	389346
	261883	212402	244898	267583	293468	542581	850132	1241293	789315	540169	155779
	55125	11196	0	0	0	0					
1986	1	13	3	0	215.16	0	3015	1386	2202	20059	7538
	10696	19221	19347	40982	71310	84335	84117	166954	274047	301968	277293
	192250	201573	219700	195734	141261	154333	78156	30502	8970	0	0
	0	0	7148	10128	22063	19363	14420	112850	51652	52758	87857
	96422	164530	167154	335559	336212	284279	344089	370193	307445	312377	125384
	24739	8430	5836	0	0	0					
1989	1	13	3	0	175.77	5678	22712	73814	23116	15040	5678
	20314	69517	56203	107797	103159	75084	94889	94610	142711	162765	102671
	161590	133711	343786	305478	190954	173833	54169	94060	77410	0	0
	22712	0	68136	63175	19125	25160	22807	68265	81616	114142	104050
	81889	127530	137864	221340	196940	221243	304104	560162	523668	512477	86396
	31795	26226	75161	0	0	0					
1992	1	13	3	0	62.49	34885	10902	10966	20773	19820	14781
	30338	38288	31921	40398	42616	51985	106892	101108	107399	146992	69708
	21254	11877	20135	19809	17140	14090	1234	12073	11881	0	0
	34885	13301	25589	50418	28793	22995	16755	9768	11997	34329	26400
	18422	100552	90942	82939	52979	41260	25057	28979	21189	31815	7830
	1479	0	0	0	0	0					
1995	1	17	3	0	84.12	0	0	0	0	2425	6219
	9051	7444	34124	65169	84732	83277	68180	27715	41353	47699	28838
	40874	34870	54909	56214	71852	39778	40100	32907	6853	0	0
	0	0	0	0	0	13408	28080	35758	58054	137785	144116
	78322	72250	69039	25359	47640	47653	100883	120910	187447	124051	34202
	0	0	0	0	0	0					
1998	1	17	3	0	113.54	0	196	22571	196	1570	11689
	9864	7606	4191	21373	16103	40348	59768	79399	82635	70273	52250
	34294	35430	43633	18110	10390	7156	701	2824	0	0	0
	0	3982	7963	4963	1177	8729	11097	2159	1766	10547	24342
	65749	61566	76257	65988	50491	93704	68243	41814	33539	7181	6747
	2105	0	0	0	0	0					
2001	1	17	3	0	100.86	0	0	3606	0	32110	0
	67475	3520	7040	77336	44391	205336	414378	293143	161288	96909	54077
	79501	72585	72892	23599	7090	16502	0	0	0	0	0
	0	0	0	0	22492	0	22492	35200	26012	74040	83963
	262245	311511	186368	156321	90186	65787	79815	40142	36151	13856	3684
	0	0	0	0	0	0					
2004	1	17	3	0	90.84	0	0	4597	0	4040	0
	0	0	0	0	0	0	10782	35686	91136	56932	36869
	60475	55129	84106	59555	94921	41846	22135	0	0	0	0
	0	0	4040	0	0	0	0	0	6603	0	0
	11675	21407	32063	64495	59598	171145	144096	170212	166250	86653	47887
	4230	0	0	0	0	0					

Age data
35 # Number of age bins for data inputs
Lower edge of age bins (first is a minus group, last is a plus group)
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

3 # Number of ageing error types
Vectors of: Average age at true age (to accumulator age)
SD of ageing precision at true age

```
# definition 1 CAP/NWFSC/ODFW
0.5 1.418732 2.33746 3.2562 4.17493 5.09366 6.01239 6.93113 7.84986 8.76859 9.68732 10.6061
 11.5248 12.4435 13.3623 14.281 15.1997 16.1184 17.0372 17.9559 18.8746 19.7933 20.712
 21.6307 22.5494 23.4681 24.3868 25.3055 26.2242 27.1429 28.0616 28.9803 29.899 30.8177
 31.7364 32.6551 33.5738 34.4925 35.4112 36.3299 37.2486
0.0976918 0.0976918 0.195384 0.293075 0.390767 0.488459 0.586151 0.683843 0.781535 0.879226 0.976918 1.07461
 1.1723 1.26999 1.36769 1.46538 1.56307 1.66076 1.75845 1.85614 1.95384 2.0515278 2.1492196
 2.2469114 2.3446032 2.442295 2.5399868 2.6376786 2.7353704 2.8330622 2.930754 3.0284458 3.1261376 3.2238294
 3.3215212 3.419213 3.5169048 3.6145966 3.7122884 3.8099802 3.907672
# definition 2 WDFW
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
0.112926 0.112926 0.225851 0.338777 0.451702 0.564628 0.677553 0.790479 0.903404 1.01633 1.12926 1.24218
 1.35511 1.46803 1.58096 1.69388 1.80681 1.91973 2.03266 2.14559 2.25851 2.371446 2.484372
 2.597298 2.710224 2.82315 2.936076 3.049002 3.161928 3.274854 3.38778 3.500706 3.613632 3.726558
 3.839484 3.95241 4.065336 4.178262 4.291188 4.404114 4.51704
# definition 3 Surface
0.5 1.418732 2.33746 3.33 4.6 5.81 6.95 8.04 9.08 10.07 11.01 11.91
 12.76 13.57 14.34 15.07 15.77 16.43 17.06 17.66 18.24 18.78
 19.1656896 19.64283015 20.0954992 20.52500625 20.9326368
 21.31965835 21.6873264 22.03689045 22.3696 22.68671055 22.9894896
 23.27922265 23.5572192 23.82481875 24.02481875 24.22481875
 24.42481875 24.62481875 24.82481875
0.166883 0.166883 0.333765 0.500648 0.667531 0.834414 1.0013 1.16818 1.33506 1.50194 1.66883 1.83571
 2.00259 2.16948 2.33636 2.50324 2.67012 2.83701 3.00389 3.17077 3.33765 3.504543 3.671426
 3.838309 4.005192 4.172075 4.338958 4.505841 4.672724 4.839607 5.00649 5.173373 5.340256 5.507139
 5.674022 5.840905 6.007788 6.174671 6.341554 6.508437 6.67532

### Age composition data ###
487 # Total number of age observations
# Conditional ages for surveys, marginal for fishing fleets
# Year Season Type Gender Partition ageerr Lbin_lo Lbin_hi Nsamps Data: females then males
# 2007 Southern California trawl fleet age error key 1 (n=8)
1981 1 1 3 0 1 -1 -1 4.83 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 1000.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 500.000 500.000 500.000 0.000 500.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 #
1983 1 1 3 0 1 -1 -1 3.55 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 500.000 0.000 0.000 500.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 500.000 500.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 #
1984 1 1 3 0 1 -1 -1 18.69 0.000 0.000 0.000
 123.718 96.225 94.482 0.000 280.996 500.000 1000.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 500.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 13.746 123.718 68.732 96.225 0.000 513.746 1500.000 0.000 0.000 500.000
 0.000 500.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 500.000 1000.000 1000.000 0.000 0.000 0.000 0.000 0.000
 0.000 #
1985 1 1 3 0 1 -1 -1 18.97 0.000 0.000 0.000
 0.000 0.000 364.773 2026.000 1982.173 890.773 559.273 242.250 182.800 182.800 0.000
 0.000 0.000 0.000 0.000 364.773 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 2000.000 26.000 742.250 91.400 716.667 91.400
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 364.773 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
 364.773 #
2002 1 1 3 0 1 -1 -1 1.83 0.000 0.000 0.000
 0.000 0.000 0.000 1.000 2.000 0.000 1.000 1.000 0.000 0.000 0.000
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
```

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000 #										
2003	1	1	2	0	1	-1	-1	1.28	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000 #										
2004	1	1	2	0	1	-1	-1	1.14	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000 #										
2005	1	1	3	0	1	-1	-1	3.55	0.000	0.000	1.000
	0.000	0.000	0.000	0.000	0.000	1.000	0.000	1.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000 #										

2007 Northern California trawl fleet age key 1 (n=11)

1981	1	2	3	0	1	-1	-1	64.39	0.000	0.000	0.000
	0.000	171.871	155.052	143.855	552.491	960.329	1078.854	476.593	252.977	1164.645	612.456
	614.869	571.300	520.123	14.040	124.939	44.745	329.820	465.292	0.000	71.300	0.000
	11.489	49.480	0.000	0.000	135.129	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	37.002	252.396	64.149	1172.284	1017.173	370.414	604.302	357.478
	930.652	604.664	724.354	427.770	0.000	12.170	0.000	60.526	404.792	0.000	71.300
	0.000	0.000	37.489	0.000	0.000	0.000	0.000	0.000	15.023	0.000	0.000
	26.776										
1982	1	2	3	0	1	-1	-1	79.98	0.000	0.000	0.000
	0.000	0.000	455.671	505.739	809.562	534.882	1664.928	1515.326	1705.311	157.233	895.207
	551.145	0.000	381.290	441.215	11.588	0.000	15.135	0.000	429.253	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	439.254	0.000	0.000	30.154	974.703	137.143	1009.961	1363.132	2457.232	1390.602	821.069
	257.505	147.106	380.196	762.581	221.857	468.665	49.057	887.256	167.180	572.830	721.857
	0.000	0.000	0.000	221.857	0.000	0.000	0.000	0.000	500.000	0.000	0.000
	221.857										
1983	1	2	3	0	1	-1	-1	167.10	0.000	0.000	0.000
	5.747	93.377	219.512	952.225	2093.845	2071.412	562.523	1666.687	225.840	1206.857	921.750
	1972.970	464.367	655.391	211.598	193.744	8.840	457.666	0.000	859.848	283.133	769.938
	0.000	0.000	54.392	250.705	0.000	205.045	0.000	359.848	0.000	364.923	0.000
	0.000	0.000	0.000	303.942	103.889	1867.813	1936.779	2824.357	1371.667	4971.029	1015.804
	905.464	531.908	749.270	1574.260	1477.369	37.216	596.812	902.296	820.007	27.843	564.893
	127.532	323.870	359.848	0.000	52.019	62.040	0.000	0.000	500.000	0.000	205.045
	1400.464										
1984	1	2	3	0	1	-1	-1	109.40	0.000	0.000	0.000
	0.000	0.000	1163.744	740.745	1490.822	1832.411	1163.223	1672.036	1004.852	398.358	1296.562
	399.151	1603.336	137.387	106.831	80.773	201.809	68.850	0.000	147.961	154.250	0.000
	235.778	0.000	199.282	525.262	0.000	24.386	0.000	0.000	229.966	476.896	0.000
	0.000	0.000	0.000	56.725	169.882	567.390	1413.331	878.886	1800.631	1602.013	1773.945
	77.472	0.000	972.600	305.052	414.354	426.362	10.900	143.350	0.000	334.353	432.588
	0.000	500.510	504.399	0.000	142.608	376.596	10.900	166.157	293.260	146.630	158.861
	540.507										
1985	1	2	3	0	1	-1	-1	112.37	0.000	0.000	0.000
	0.000	78.393	208.954	1380.992	1828.328	2118.386	888.288	2023.116	1224.364	815.748	139.485
	190.525	1057.559	633.697	302.630	1089.635	434.647	1384.695	108.774	325.874	293.774	434.647
	347.121	288.030	0.000	190.525	186.804	0.000	0.000	0.000	2.386	576.061	0.000
	0.000	0.000	0.000	24.733	117.263	1527.011	918.644	3339.029	2520.794	2081.283	1501.902
	1062.287	599.978	139.485	415.724	769.725	453.161	0.000	16.760	340.399	347.121	470.495
	1107.642	951.585	190.525	614.351	105.980	0.000	884.767	0.000	0.000	0.000	44.225
	299.298										

1987 1 2 2 0 1 -1 -1 1.14 0.000 0.000 0.000
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2001 1 2 3 0 1 -1 -1 4.86 0.000 0.000 0.000
0.000 0.000 0.000 1.818 1.818 1.818 5.455 5.455 5.455 3.636 3.636
1.818 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
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2002 1 2 3 0 1 -1 -1 14.52 0.000 0.000 0.000
0.000 0.000 0.000 0.000 4.495 7.773 3.795 18.610 8.061 4.495 0.000
3.495 0.000 1.378 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
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0.000 0.000 0.000 0.000 6.448 7.606 7.931 4.031 10.479 10.463 8.984
7.485 1.000 1.300 0.000 1.000 0.000 1.300 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
1.378
2003 1 2 3 0 1 -1 -1 8.66 0.000 0.000 0.000
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2.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
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2004 1 2 3 0 1 -1 -1 9.93 0.000 0.000 0.000
1.000 5.000 5.000 16.600 3.000 0.000 1.000 0.000 16.600 0.000 0.000
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2005 1 2 2 0 1 -1 -1 2.69 0.000 0.000 0.000
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2.000 1.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000
2007 Oregon trawl fleet with age error key 1 (n=25)
1980 1 3 3 0 1 -1 -1 56.48 0 0 0
0 0 0 19.0528035 35.5249684 32.9443299 16.4721649
246.1499061 295.5244271 515.2433836 496.7916307 351.496883
783.8522156 869.629893 199.1663697 604.65023 544.888627 222.542324
521.9129669 517.5869465 163.8310552 0 83.9031889 63.4557014
65.8886598 63.4557014 130.8867253 0 0 0 0 0
0 0 0 0 0 9.5264017 16.4721649 576.1265258
101.5613084 108.5070716 379.0301913 929.2802435 317.9759687
717.0801581 549.3682202 620.605899 1542.466393 567.0034413
1651.308888 1082.508127 537.6195004 326.8049087 1143.928296
678.935447 621.8495312 318.0441385 273.2619326 32.9443299
351.5545607 256.7897677 348.55551 145.5848983 415.0102621 25.8089127
795.7829656
1981 1 3 3 0 1 -1 -1 10.28 0 0 0
0 0 0 0 230.5996252 0 0 1588.750271
982.3003055 606.4499654 606.4499654 375.8503401 230.5996252
375.8503401 606.4499654 0 0 922.3985009 461.1992505 0
230.5996252 230.5996252 0 0 0 0 0 0 0
0 0 230.5996252 0 0 0 0 0 0
0 0 837.0495906 230.5996252 606.4499654 230.5996252
982.3003055 461.1992505 375.8503401 1127.55102 837.0495906

375.8503401 375.8503401 0 1503.401361 982.3003055 375.8503401
230.5996252 0 0 0 0 0 375.8503401 0
230.5996252 0 375.8503401
1983 1 3 3 0 1 -1 -1 204.74 0 0 0
0 213.8485138 243.3152148 1067.225709 2195.062394 2894.850549
3879.902626 3054.129672 2751.510518 3001.940922 2812.473906
2441.258285 1118.251376 575.6970148 963.6910956 1087.080701
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2325.31177 2980.209294 1874.596455 1216.729336 1364.158886
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1019.778152 705.6840087 949.3653908 605.5321124 501.4256925
355.4971152 3867.991233
1984 1 3 3 0 1 -1 -1 134.14 0 0 0
21.3407134 44.6710663 297.879374 678.2147005 1051.86582
1813.324588 2405.419972 2707.951316 1561.479072 989.4581132
1656.514619 1000.457785 680.9618642 312.6764773 509.4572293
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0 0 347.3992369 892.9021116 1054.640438 2274.971563
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2552.088574
1986 1 3 3 0 1 -1 -1 112.96 0 0 0.000
0.000 141.390 374.762 639.799 550.749 555.791 904.234 920.439 1089.095 586.685 276.232
441.690 227.182 328.996 75.733 50.594 77.001 0.000 197.536 175.049 46.174 53.451
119.854 0.000 0.000 2.639 59.479 0.000 82.171 0.000 0.000 177.582 0
0.000 0.000 55.536 207.913 293.942 587.547 1258.664 987.713 1180.242 768.882 798.092
226.574 309.136 88.054 86.103 166.569 90.357 117.364 54.936 33.669 103.977 359.563
71.871 261.398 107.344 0.000 87.705 173.730 46.676 25.331 99.534 22.692 53.451
415.386
1987 1 3 3 0 1 -1 -1 204.74 0 0 0
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587.4100623 550.6967581 370.0044972 633.2049788 613.0190015
261.5396903 231.1729833 335.6470282 82.7398374 163.2075472
538.7717838 155.1239343 114.8929356 187.7091147 75.3204161
59.4299517 0 66.3809524 0 4.9478673 9.8957346 0 0 0
0 32.6597938 355.1718736 822.2707837 4310.453816 5579.246042
4110.59997 5705.398907 2803.372696 1591.154664 1049.066413
760.3714068 397.0783626 120.8915316 463.1759934 671.6757282 0
100.183478 215.3344536 233.5146713 313.2618298 349.1308488
311.5028483 440.9774608 143.0614738 20.586247 190.1887231 4.9478673
55.7746298 2 1.0047847 1089.114668
1988 1 3 3 0 1 -1 -1 56.48 0 0 0
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128.6677076 0 0 147.1396834 163.8364119 39.2740385 0
194.3343316 0 0 92.5309091 105.8524641 0 27.3043872
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1989 1 3 3 0 1 -1 -1 155.32 0 0 0.000
4.272 6.554 125.418 370.491 689.641 1617.320 2116.638 2477.778 1813.231 1254.549 1170.617
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0.000 0.000 0.000 80.033 95.512 45.843 151.757 95.268 79.263 64.362 0
0.000 0.000 0.000 6.554 176.479 623.918 1093.262 1468.296 2886.765 1901.377 1531.155
1438.689 769.437 487.093 410.977 153.255 573.085 217.811 378.429 248.764 80.740 203.560
329.976 198.672 299.446 292.115 437.845 194.784 194.481 207.187 67.041 164.863 77.448
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0 4.4890039 194.6305485 434.1878832 568.0918233 1310.922868
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0 43.9429313 0 0 43.2835821 163.8929727
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2.5494505 413.5840778 463.299608 2033.281096 3041.332409 4515.745669
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1994 1 3 3 0 1 -1 -1 28.24 0 0 0
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71.5470172 71.5470172 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 5.8947368 0
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18.5076453 71.5470172 71.5470172 18.5076453 0 71.5470172
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0 0 0 20.8761597 4.0881764 308.4049602 1099.701488
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0 0 12.3199545 30.8371367 254.4789968
1998 1 3 3 0 1 -1 -1 197.68 0 0 0
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574.0016275
1999 1 3 3 0 1 -1 -1 197.68 0 0 0
8.9997998 88.8401069 188.8186834 727.0406767 1194.616929 921.1139065
1389.452649 1378.858537 1329.705618 1244.841927 867.2759365
582.047559 613.9841124 402.3877177 151.5897581 158.4797559
127.1621067 115.8884342 64.6716394 8.6952288 30.251938 0 67.9441196
0 9.9349675 0 0 0 33.7093596 2.1377551 0 0 0
0 0 26.9993993 107.7781027 231.3046694 603.8382194
1435.065503 1332.680333 1234.177287 1425.468587 1110.012067
700.2616835 1107.749199 448.5023141 433.6291031 184.3832351
169.7782324 176.0854237 239.1292089 156.6873935 50.4805688
116.859356 84.6107629 43.3717184 92.9102603 0 0
82.3711002 33.7093596 0 0 0 3.4626866 219.3529771

2000 1 3 3 0 1 -1 -1 86.83 0 0 0
4.6728972 23.7028846 24.5461283 30.5179174 37.7881862 48.4341615
44.8022124 34.3381988 23.3327972 20.6134137 7.4837927 11.2123894
1.5124378 2.1547838 3.5407051 3.2837116 1.9518543 1.1123596 1.1542339 1 0 0 1
0 0 0 0 0 0 0 0 0 0 0
0 1.9844358 20.0117995 38.9230483 49.5661728 58.8501728
50.7993742 47.8072582 32.0066687 31.9866649 15.8413179
12.6125899 3.898909 6.102536 3.7090959 1.1123596 2.4283455 2.265345 1.0424242 0 0
2.1547838 0 2.1198783 0 0 0 0 0 0 0 0
0
2001 1 3 3 0 1 -1 -1 125.29 0 0 0
0 4.0989127 38.5819067 84.077176 84.1533184 71.3751521 53.9291385
36.7222354 27.5266304 46.6366233 21.5055408 8.2720186 7.0497949
11.1822173 2.495 2.1023434 3.1994854 4.6362736 3.6138751 1.0251955 2.3790643 0 0
0 0 0 0 0 0 0 0 0 0 0
0 1.1219512 8.526474 32.214295 77.6390258 67.7582837 109.3872094
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13.5485967 9.5776245 2.2190933 6.6175561 0.9691418 7.7186303 0 2.967853 0 0
1.42 1.8414828 2.84 0 0 0.8372093 1.217862 0 2.637862 1.42 4.8841418
2002 1 3 3 0 1 -1 -1 191.24 0 0 0
0 16.705409 37.4144876 99.8926612 185.3733681 89.2954486
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29.3122139 8.0518596 26.330153 13.2725849 11.7980229 5.0827386 4.952975 0
5.0983055 0 0 0 0 0 1.1169957 0 1 1.1169957 2.2517085
0 0 0 1 23.679228 49.0298517 123.320601 147.9073487
70.7078824 89.093204 65.5336353 64.750732 46.976769 25.8278094 34.9063427
3.1237071 19.9572325 10.618036 10.7466573 6.2706025 7.4558171 8.2871085 4.1071041 0.999243
0.999243 1.2524655 0 0 0 0 0 3.1078611 1.0116383 1.0116383
15.4313494
2003 1 3 3 0 1 -1 -1 71.36 0 0 0
0 5.516808804 17.17140117 49.53502132 149.4312508 127.4158669
96.97237871 71.11351914 43.13422776 116.7874926 54.98803706
32.07464309 0 55.55615582 4.914365625 5.762683043 42.6347552
0 0 0 0 3.914365625 0 0 3.914365625 0
0 0 0 0 0 0 0 0 0 5.741984528
5.516808804 28.28186241 111.9998934 139.2949807 45.38108938
116.3792515 88.19264837 55.31433478 51.09205013 41.43316169
27.67149041 14.06083183 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
5.762683043
2004 1 3 3 0 1 -1 -1 120.85 0 0 0.000
31.413 31.498 60.282 403.294 325.325 230.441 143.162 162.948 231.261 84.688 75.510
50.124 15.516 52.358 7.423 55.377 0.000 0.000 0.000 0.000 24.324 0.000
0.000 12.730 0.000 0.000 0.000 24.324 0.000 24.324 0.000 11.659 0
0.000 0.000 23.319 118.742 185.863 277.666 203.015 267.756 182.810 56.184 88.833
37.294 62.175 42.433 53.123 55.267 35.224 0.000 0.000 35.224 11.584 0.000
12.730 12.730 0.000 0.000 0.000 0.000 0.000 16.814 12.730 0.000 0.000
14.649
2005 1 3 3 0 1 -1 -1 153.32 0 0 1.768
39.196 35.659 12.093 31.516 138.595 123.710 265.771 153.685 129.120 88.734 90.956
52.181 39.180 35.828 29.431 15.324 22.881 22.165 8.143 0.000 4.399 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0
1.768 30.354 66.014 10.024 24.767 105.551 103.031 246.358 250.983 205.805 103.230
35.504 79.031 28.828 39.483 37.723 22.755 0.000 10.681 20.233 0.000 3.536
0.000 10.134 0.000 0.000 4.773 0.000 0.000 5.847 0.000 0.000 0.000
9.027
2007 Washington trawl fleet with age error key 2 (n=23)
1980 1 4 3 0 2 -1 -1 63.54 0.000 0.000 0.000
197.856 593.568 396.629 1782.537 2489.546 2108.809 1338.983 1203.147 1742.406 979.166 523.004
349.047 550.754 313.489 140.015 158.685 1.833 19.765 40.447 93.676 93.676 0.000
0.000 0.000 0.917 0.000 0.000 0.000 0.000 0.917 0.917 34.681 0.000
0.000 0.000 0.000 407.868 2179.166 2375.189 2605.640 2680.213 1307.968 680.679 1099.193
923.254 969.905 424.226 461.088 208.162 339.534 672.852 262.307 529.635 263.600 23.080
138.003 24.312 45.244 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
21.852
1981 1 4 3 0 2 -1 -1 105.90 0.000 0.000 0.000
0.000 128.193 9.959 10.724 12.287 122.478 74.761 594.275 195.686 45.926 170.838
119.875 134.728 18.468 86.509 5.229 42.607 45.413 3.074 42.659 41.096 0.000
1.512 0.000 1.211 0.000 0.000 0.000 2.506 0.000 0.000 0.000 0.000
0.000 0.000 0.000 25.279 6.387 14.254 61.684 155.147 78.437 71.992 121.150

	131.121	127.297	157.244	139.759	235.427	52.422	47.504	323.773	6.140	190.745	46.190
	2.506	2.423	2.723	4.017	5.363	812.664	50.744	0.000	140.832	4.824	45.920
	375.698										
1983	1	4	3	0	2	-1	-1	56.48	0.000	0.000	0.000
	0.000	47.393	204.351	116.651	376.633	543.503	647.165	786.236	513.667	313.955	571.866
	612.908	372.350	456.148	305.658	144.816	98.026	13.324	114.722	51.957	0.000	60.237
	0.000	3.242	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	47.357	348.393	116.006	602.288	716.108	737.761	708.251	301.112
	626.935	366.265	263.968	243.317	297.650	34.542	193.193	58.379	11.017	13.485	110.841
	76.964	9.635	6.484	53.907	63.479	7.062	56.995	6.423	3.242	53.248	8.791
	250.507										
1984	1	4	3	0	2	-1	-1	35.30	0.000	0.000	0.000
	0.000	0.000	1.763	2.545	2.818	4.640	6.184	10.739	10.565	3.864	4.321
	5.228	6.569	2.269	4.346	1.860	0.626	0.723	1.096	1.860	2.955	0.764
	1.096	1.096	1.428	0.332	0.764	0.332	0.000	0.000	0.764	1.290	0.000
	0.000	0.000	0.000	0.295	2.738	3.719	4.725	5.817	9.012	9.617	10.829
	6.161	8.972	5.959	5.091	4.767	5.779	3.150	0.589	2.449	1.253	1.450
	1.979	3.629	3.407	1.338	0.000	1.860	1.510	0.764	1.018	1.096	2.586
	16.689										
1985	1	4	3	0	2	-1	-1	77.66	0.000	0.000	0.000
	0.000	24.966	77.114	160.980	525.730	876.991	1055.242	1039.556	1143.940	971.531	679.445
	808.435	415.751	872.222	841.102	443.115	255.738	34.561	286.070	30.222	181.618	95.630
	0.000	27.688	190.570	23.349	93.582	13.594	3.407	3.407	23.349	108.796	0.000
	0.000	0.000	0.000	13.746	31.687	298.628	568.105	874.201	911.162	1282.770	1454.375
	914.483	478.458	1288.801	346.835	694.629	319.681	341.640	582.884	97.176	74.795	237.387
	282.908	273.950	119.666	167.058	225.247	128.492	162.235	155.680	76.885	148.458	51.446
	1783.508										
1986	1	4	3	0	2	-1	-1	120.02	0.000	0.000	0.000
	0.000	18.529	408.778	806.492	1723.598	1383.059	2148.497	1304.307	1014.918	822.288	325.707
	449.712	90.307	74.703	18.400	17.600	0.000	26.342	120.097	39.983	0.000	13.617
	32.008	0.000	0.000	74.703	25.212	0.000	0.000	0.000	98.591	215.059	0.000
	0.000	0.000	36.800	183.963	399.326	1417.868	2273.825	1973.574	2032.468	1279.494	1012.664
	517.203	231.766	387.022	330.388	56.983	85.667	214.376	85.947	98.591	236.679	15.508
	29.126	135.406	0.000	30.599	39.983	236.995	112.240	0.000	0.000	98.591	39.983
	528.395										
1987	1	4	3	0	2	-1	-1	35.30	0.000	0.000	0.000
	0.000	9.514	14.482	232.047	591.465	1198.636	464.937	1283.877	566.967	258.992	248.608
	132.230	4.968	117.748	87.805	8.700	31.070	14.482	82.837	0.000	4.968	0.000
	0.000	0.000	0.000	0.000	4.968	8.700	0.000	0.000	0.000	4.968	0.000
	0.000	0.000	0.000	9.514	28.543	330.994	1014.186	928.203	835.810	766.291	422.688
	207.915	107.677	227.922	96.506	8.700	8.700	9.514	121.481	0.000	0.000	121.481
	82.837	92.773	4.968	0.000	0.000	0.000	0.000	0.000	4.968	112.780	0.000
	241.169										
1988	1	4	3	0	2	-1	-1	116.84	0.000	0.000	0.000
	3.460	54.692	144.477	114.149	628.071	1233.436	1497.347	3014.890	1784.404	1085.264	1188.129
	1026.811	643.289	495.689	405.392	297.493	143.862	226.799	0.000	155.249	0.000	7.193
	9.395	125.072	0.000	125.072	0.000	0.000	0.000	18.149	0.000	0.000	0.000
	0.000	0.000	0.000	112.942	180.530	392.496	666.557	769.119	1432.410	2562.971	909.355
	1497.354	816.099	754.660	130.905	858.614	601.765	174.833	335.490	550.310	200.236	167.640
	7.193	101.727	24.992	116.112	162.441	0.918	27.544	9.395	71.329	12.392	0.000
	1575.847										
1989	1	4	3	0	2	-1	-1	55.05	0.000	0.000	0.000
	6.230	1244.059	293.912	594.113	1103.508	552.055	68.305	645.017	651.910	106.366	1413.011
	68.305	50.847	44.284	523.088	38.363	0.000	15.275	31.508	8.420	0.000	0.000
	0.000	4.671	0.000	0.000	0.000	0.000	14.668	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	949.548	222.815	65.124	891.130	391.225	165.293	619.173	474.863
	90.786	1231.735	27.759	29.943	462.358	4.671	500.000	514.668	284.773	0.000	4.671
	0.000	10.603	499.729	0.000	13.091	25.271	437.087	14.668	0.000	0.000	0.000
	25.254										
1990	1	4	3	0	2	-1	-1	59.99	0.000	0.000	0.000
	0.000	144.113	37.798	44.916	231.478	154.412	938.048	233.747	1191.783	728.206	190.805
	586.219	526.559	128.421	512.798	531.691	21.448	12.798	20.486	0.000	0.000	11.206
	0.000	0.000	0.000	0.000	0.000	0.000	10.243	0.000	0.000	98.687	0.000
	0.000	500.000	0.000	17.728	22.160	156.157	1265.852	835.947	1222.395	742.329	166.946
	778.705	203.822	621.793	45.518	21.763	515.419	0.000	0.000	1.343	80.598	1.343
	59.149	0.000	10.243	0.000	0.000	11.520	20.486	10.243	500.000	10.243	10.243
	262.278										
1991	1	4	3	0	2	-1	-1	141.20	0.000	0.000	0.000
	0.000	0.000	108.733	427.936	1266.002	1556.286	2991.128	4253.078	2618.288	2117.950	2867.729
	992.425	750.620	1218.003	1015.890	525.707	1002.853	488.385	324.756	376.611	139.321	95.622

	3.321	45.588	4.992	142.128	0.000	0.000	0.000	0.000	0.000	3.321	0.000
	0.000	0.000	0.000	0.000	61.924	1472.776	1957.819	3038.192	3808.162	4293.543	3812.485
	3256.649	2156.356	1559.364	2307.786	741.689	1013.608	109.686	710.021	423.870	364.805	895.027
	260.072	230.590	0.000	184.908	100.503	184.908	45.588	796.244	274.587	517.603	189.141
	2787.822										
1992	1	4	3	0	2	-1	-1	71.62	0.000	0.000	0.000
	19.331	222.050	230.699	271.872	523.226	304.573	868.709	845.847	1132.027	409.754	745.978
	710.722	119.446	264.023	50.240	35.236	50.240	50.240	4.371	50.240	0.000	0.000
	0.000	0.000	240.214	0.000	0.000	50.240	0.000	0.000	0.000	50.240	0.000
	0.000	0.000	24.121	261.448	258.702	371.445	725.460	1340.597	1389.456	1428.147	231.265
	908.499	615.515	613.302	248.579	603.836	173.861	240.214	4.371	468.045	328.311	227.831
	500.000	55.827	554.611	12.383	50.240	29.649	378.551	0.000	50.240	0.000	505.902
	1358.979										
1993	1	4	3	0	2	-1	-1	106.84	0.000	0.000	0.000
	30.452	79.111	458.197	306.947	674.386	637.764	652.093	546.905	554.960	197.263	64.930
	274.840	211.131	216.108	218.352	262.574	0.000	23.146	307.598	0.000	0.000	12.594
	94.817	23.146	189.635	94.817	0.000	0.000	0.000	94.817	0.000	202.921	0.000
	0.000	0.000	33.759	236.664	221.391	659.123	777.382	2306.465	476.400	564.540	421.125
	350.784	320.239	84.014	182.213	84.285	160.702	24.320	94.817	0.000	11.419	23.146
	94.817	94.817	133.274	0.000	94.817	0.000	0.000	0.000	0.000	0.000	23.146
	288.293										
1996	1	4	3	0	2	-1	-1	9.45	0.000	0.000	0.000
	0.000	0.000	78.838	0.000	7.353	11.029	7.353	7.353	3.676	3.676	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	37.581	0.000	37.581	3.676	0.000	22.059	22.059	7.353	3.676
	0.000	0.000	0.000	0.000	3.676	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	3.676	0.000	0.000	0.000	0.000	0.000
	0.000										
1998	1	4	3	0	2	-1	-1	16.83	0.000	0.000	0.000
	0.000	0.000	89.681	8.740	543.005	555.416	6.555	0.000	48.861	502.185	2.185
	0.000	0.000	0.000	0.000	2.185	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	2.185	2.185	10.925	160.503	149.578	89.681	4.370	6.555	0.000
	72.440	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	344.046										
1999	1	4	3	0	2	-1	-1	2.41	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	500.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	112.960	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	500.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2000	1	4	3	0	2	-1	-1	3.69	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.992	7.992	0.000	103.473
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.992
	0.000	0.000	0.000	0.000	0.000	0.000	15.755	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2001	1	4	3	0	2	-1	-1	4.97	0.000	0.000	0.000
	0.000	0.000	0.000	12.403	0.000	153.281	62.996	0.000	0.000	0.000	22.657
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	153.281	0.000
	12.403	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2002	1	4	3	0	2	-1	-1	21.55	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	82.917	24.553	31.157	37.535	22.820	24.553
	82.917	38.171	51.169	44.858	0.000	40.420	0.000	100.692	0.000	0.000	0.000
	0.000	0.000	38.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	22.634	22.634	0.000	0.000	0.000	0.000
	29.787	42.327	60.168	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	82.917										

2003	1	4	3	0	2	-1	-1	12.79	0.000	0.000	0.000
	0.000	0.000	0.000	25.889	0.000	20.796	0.000	0.000	0.000	0.000	7.824
	25.362	0.000	15.598	0.000	42.394	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2.288	10.184	7.323	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	12.238	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2004	1	4	3	0	2	-1	-1	16.86	0.000	0.000	0.000
	0.000	20.645	0.000	0.000	18.285	36.549	31.851	0.000	96.720	0.000	0.000
	0.773	0.000	25.230	0.000	0.000	7.273	0.000	1.800	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.773	0.000
	0.000	0.000	0.000	0.000	0.769	33.758	35.780	58.815	18.787	0.000	0.000
	0.000	0.000	0.000	0.000	0.773	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	34.531										
2005	1	4	3	0	2	-1	-1	111.69	0.000	0.000	0.000
	0.000	0.000	8.754	15.213	35.013	42.591	52.945	37.835	35.070	25.698	18.751
	16.920	6.730	3.471	12.262	6.775	5.295	4.681	5.422	0.000	1.013	3.331
	4.370	1.043	2.374	0.000	0.000	0.000	0.935	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	1.360	6.366	18.740	62.162	30.532	38.227	32.048	26.756
	14.622	8.440	8.168	4.910	4.943	3.351	2.105	1.013	1.043	2.196	2.037
	3.366	0.000	1.024	0.000	0.777	0.777	2.748	0.000	1.132	1.132	0.000
	5.811										
2006	1	4	3	0	2	-1	-1	70.61	0.000	0.000	1.071
	2.142	9.126	25.193	17.856	24.456	19.332	42.465	8.191	7.241	7.396	1.845
	1.007	4.469	2.309	2.567	2.043	0.920	3.343	0.933	0.000	0.000	0.922
	1.386	2.516	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	3.213	1.071	3.094	26.761	25.072	24.026	17.170	18.265	10.095	11.597
	8.210	6.899	4.870	3.393	4.910	1.391	0.000	2.359	0.920	0.259	3.149
	0.000	0.471	0.922	0.000	0.259	0.000	0.000	0.000	0.000	0.000	0.000
	1.867										
# 2007 OR-WA non-trawl fleet (n=7)											
1997	1	7	3	0	1	-1	-1	3.35	0.000	0.000	0.000
	0.000	0.000	1.004	0.000	0.000	0.000	0.000	0.000	0.000	2.008	0.000
	0.000	0.000	0.000	0.000	0.000	1.004	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	1.004	2.008	1.004	0.000	5.021	2.008	2.008
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
1998	1	7	3	0	1	-1	-1	16.01	0.000	0.000	0.000
	0.000	0.000	4.245	8.489	15.880	19.375	4.245	5.941	9.088	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	2.795	0.000	0.000	0.000	0.000
	2.795	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	3.846	11.538	7.391	27.020	14.678	41.304	9.436	9.440
	11.237	30.813	6.293	2.795	13.333	2.795	0.000	2.795	0.000	9.788	8.384
	2.795	0.000	0.000	2.795	0.000	2.795	0.000	0.000	0.000	0.000	0.000
	2.795										
2001	1	7	3	0	1	-1	-1	10.38	0.000	0.000	0.000
	0.000	3.355	3.084	1.028	3.139	3.084	3.139	4.167	1.084	1.028	0.000
	1.028	1.084	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	2.393	1.143	0.000	4.223	3.139	2.111	1.028	0.000
	2.056	0.000	1.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2002	1	7	3	0	1	-1	-1	2.10	0.000	0.000	0.000
	0.000	0.000	0.000	1.034	0.000	0.000	1.034	0.000	0.000	1.034	0.000
	1.034	1.034	1.034	0.000	0.000	0.000	0.000	0.000	1.034	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	1.034	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2003	1	7	3	0	1	-1	-1	4.93	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	4.000	2.998	1.000
	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	2.000	0.000	1.000	2.000	0.000

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2004	1	7	3	0	1	-1	-1	11.55	0.000	0.000	0.000
	0.000	109.346	0.000	0.000	0.000	0.000	207.528	141.690	231.099	87.017	251.058
	0.000	121.753	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	43.530	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	91.842	54.673	43.530	98.182	0.000	110.610
	0.000	98.182	0.000	0.000	0.000	0.000	0.000	0.000	43.530	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	43.530	0.000	0.000	0.000	0.000	0.000
	0.000										
2005	1	7	3	0	1	-1	-1	8.35	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	7.778	4.278	1.000	0.000	0.000	4.278
	4.278	3.500	3.500	0.000	2.500	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	7.500	8.500
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	4.278	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
# 2007 At-sea hake fishery (n=3)											
2003	1	11	3	0	1	-1	-1	101.73	0.000	0.000	0.000
	0.000	0.000	0.000	7.500	10.167	22.278	15.333	10.833	30.668	18.159	42.359
	25.835	5.857	5.000	0.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	2.333	13.205	26.055	13.433	35.741	50.988	18.961
	25.557	25.356	6.556	0.000	17.500	2.833	3.000	3.000	2.500	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	12.992										
2004	1	11	3	0	1	-1	-1	126.15	0.000	0.000	0.000
	0.000	0.000	0.000	2.000	10.893	12.300	39.943	358.260	17.900	42.643	350.700
	341.067	337.400	48.717	15.700	15.800	3.000	5.500	0.000	7.800	0.000	7.800
	7.800	0.000	0.000	0.000	0.000	0.000	3.600	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	1.000	13.250	15.293	37.443	20.500	26.743	26.800
	13.750	338.400	19.200	42.700	45.800	1.000	0.000	0.000	6.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	7.800	0.000	0.000	0.000	0.000
	6.000										
2005	1	11	3	0	1	-1	-1	209.57	0.000	0.000	0.000
	0.000	0.000	2.000	5.417	80.600	42.217	37.750	45.333	56.967	41.033	31.617
	7.250	18.267	17.200	2.000	2.000	2.667	2.000	0.000	2.000	0.000	2.800
	5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	5.333	9.000	29.633	35.967	31.783	32.550	29.167
	34.650	12.333	7.500	5.667	2.000	4.500	2.000	0.000	3.000	3.000	4.800
	2.000	0.000	2.500	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000
	1.500										
# 2007 NWFSC survey conditionals (n=164)											
2003	1	12	1	0	1	2	2	1.07	0	33683	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	3	3	1.14	0	67365	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	4	4	1.28	0	44026	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	6	6	3.21	0	0	62865
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	7	7	2.14	0	0	25576
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	8	8	1.07	0	0	14570
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	9	9	2.21	0	0	0
	43795	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	10	10	1.07	0	0	0
	0	14570	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	13	13	2.14	0	0	0
	0	0	28349	26320	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	14	14	3.28	0	0	0
	0	6219	52640	0	0	0	0	0	3972	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	15	15	6.77	0	0	0
	0	0	52640	88029	60888	9860	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	16	16	6.49	0	0	0
	0	0	0	32539	5576	56698	18014	0	0	0	5209
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	17	17	5.56	0	0	0
	0	0	0	28349	28349	66982	28349	7040	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	18	18	9.91	0	0	0
	0	0	0	0	0	37940	18368	36737	10769	12149	12869
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	19	19	8.84	0	0	0
	0	0	0	0	3972	0	0	4367	42163	40748	12438
	0	0	5209	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	20	20	9.98	0	0	0
	0	0	0	0	0	0	0	35189	48381	30457	22254
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	21	21	6.77	0	0	0
	0	0	0	0	0	0	0	18319	6219	23771	0
	24538	5525	18319	0	37662	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	22	22	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	5525
	0	0	5525	0	0	0	18319	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	23	23	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	212769	0	18319	0	0	0	0	0	0	0
	6219	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	24	24	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	4550	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	1	1	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	25366

	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	2	2	1.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	101048	0	0	0	0	0	0	0	0	0	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	12	2	0	1	3	3	2.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	302480	0	0	0	0	0	0	0	0	0	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	12	2	0	1	4	4	1.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	33019	0	0	0	0	0	0	0	0	0	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	12	2	0	1	6	6	2.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	11577	43837	0	0	0	0	0	0	0	0	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	12	2	0	1	7	7	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	40189	0	0	0	0	0	0	0	0	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	12	2	0	1	8	8	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	14570	0	0	0	0	0	0	0	0	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	12	2	0	1	9	9	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	40231	0	0	0	0	0	0	0	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	12	2	0	1	12	12	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	12193	0	0	0	0	0	0	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	12	2	0	1	13	13	5.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	80157	3972	28349	3972	0	0	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	12	2	0	1	14	14	7.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	7944	31326	4550	28349	5016	0	0
	6219	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2003	1	12	2	0	1	15	15	9.91	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	11074	113307	7040	32510	26320	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	12	2	0	1	16	16	14.12	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	44388	28239	15384	54887	0	6219	12149
	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	12	2	0	1	17	17	17.68	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	5006	26802	32106	68005	0	40197
	23893	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2003	1	12	2	0	1	18	18	15.75	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	0	0
	0	0	0	0	0	4034	0	29079	21518	18468	45384
	70434	0	22869	5576	0	0	18319	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2003	1	12	2	0	1	19	19	13.26	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	10191	19719	21738	4550
	34351	15592	5576	5525	18319	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2003	1	12	2	0	1	20	20	8.91	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	17674	18319
	17436	23895	22052	0	0	0	0	6238	0	5525	0
	0	0	0	0	0	0	0	0	0	0	0
	5209										
2003	1	12	2	0	1	21	21	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	5209	0
	0	0	0	0	0	0	0	0	0	0	0
	0										

2004	1	12	1	0	1	2	2	2.28	0	46225	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	3	3	1.07	0	9781	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	4	4	2.21	0	0	54185
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	5	5	1.28	0	0	39123
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	6	6	2.28	0	0	38477
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	7	7	1.21	0	0	0
	25222	50444	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	9	9	3.28	0	0	0
	9781	94469	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	10	10	3.56	0	0	0
	0	219774	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	11	11	3.28	0	0	0
	20120	54743	9683	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	12	12	5.77	0	0	0
	20120	103851	20120	61161	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	13	13	3.7	0	0	0
	0	56658	0	123990	34623	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	14	14	4.42	0	0	0
	0	9135	29803	78930	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	15	15	4.49	0	0	0
	0	0	8220	67541	29230	19671	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	16	16	6.63	0	0	0
	0	0	20120	37767	0	19671	201041	172255	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	17	17	7.77	0	0	0
	0	0	0	19671	28519	32595	210014	172255	0	0	0
	0	0	0	0	172255	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	18	18	4.35	0	0	0
	0	0	0	0	0	6505	6077	33978	0	0	28200
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	19	19	10.84	0	0	0
	0	0	0	0	0	15636	18174	28200	180782	34198	11424
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	20	20	8.77	0	0	0
	0	0	0	0	0	0	9559	77186	28200	37949	26544
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	21	21	7.63	0	0	0
	0	0	0	0	0	0	56400	0	0	8615	12516
	17202	0	0	172255	0	186680	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	22	22	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	14425
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	23	23	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	6505
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	24	24	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	172255	14425	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	25	25	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	172255	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	2	2	3.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	68155	25222	0	0	0	0	0	0	0	0	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	12	2	0	1	3	3	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	37348	0	0	0	0	0	0	0	0	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	12	2	0	1	4	4	1.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	75665	0	0	0	0	0	0	0	0	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	12	2	0	1	5	5	2.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	8080	56984	0	0	0	0	0	0	0	0	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	12	2	0	1	6	6	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	8637	0	0	0	0	0	0	0	0	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	12	2	0	1	7	7	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	44404	0	0	0	0	0	0	0	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	12	2	0	1	8	8	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	50443	0	0	0	0	0	0	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	12	2	0	1	9	9	3.7	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	0	0	0	0	0	0	0	0	0
	0	0	29342	185952	0	0	0	0	0	0	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	12	2	0	1	10	10	2.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	9534	173117	0	0	0	0	0	0	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	12	2	0	1	11	11	5.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	25222	44137	109487	0	0	0	0	0	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	12	2	0	1	12	12	6.7	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	0	0	0	0	0	0	0	0	0
	0	0	9135	72746	39791	9559	0	0	172255	0	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	12	2	0	1	13	13	9.05	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	72745	78179	70482	14425	0	0	0	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	12	2	0	1	14	14	3.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	52893	0	6505	0	0	0	0	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	12	2	0	1	15	15	6.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	8848	22962	78683	6505	0	0	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	12	2	0	1	16	16	9.91	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	7809	29594	67542	19671	194098	13425	0
	19671	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	12	2	0	1	17	17	8.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	9067	20120	8848	34705	38373	0	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	12	2	0	1	18	18	8.84	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	9421	19671	49043	0	14425
	19671	42625	179915	0	0	11424	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	12	2	0	1	19	19	4.84	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	6505	0	0	65015
	0	67688	6505	0	0	28200	28200	0	28200	0	0
	0	28200	0	0	0	0	0	0	0	0	0
	0										
2004	1	12	2	0	1	20	20	5.91	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	6924	6505	0
	6924	0	0	178760	0	0	186680	172255	0	0	172255
	0	0	172255	0	0	0	0	0	0	0	0
	364630										
2004	1	12	2	0	1	21	21	4.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	6505	6851	0	6505	0	0	0	0	0	172255	0
	0	0	0	0	0	0	0	28200	0	0	0
	172255										
2004	1	12	2	0	1	22	22	3.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	28200	0	0	0	0	0	0	0	0	11424

	172255	0	0	0	0	0	0	0	0	0	0
	172255										
2004	1	12	2	0	1	23	23	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	11424	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	172255										
2005	1	12	1	0	1	1	1	1.07	9312	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	2	2	2.21	25526	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	3	3	1.07	0	8973	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	4	4	2.14	0	0	48601
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	5	5	1.14	0	0	0
	18220	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	6	6	3.56	0	0	9388
	54660	39491	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	7	7	3.35	0	12193	24386
	9110	0	39491	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	8	8	2.35	0	0	24386
	0	39491	78982	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	9	9	3.56	0	0	60965
	0	9110	78982	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	10	10	3.56	0	0	12193
	60965	0	48601	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	11	11	3.21	0	0	12193
	0	22573	39491	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	12	12	2.28	0	0	0
	0	0	18220	165088	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	13	13	2.28	0	0	0
	0	0	22573	32409	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	14	14	1.07	0	0	0
	0	0	0	10803	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	15	15	6.49	0	0	0
	0	0	0	105117	25213	97249	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	16	16	4.42	0	0	0
	0	0	0	22573	113019	173957	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	17	17	8.7	0	0	0
	0	0	0	22573	109663	115632	7322	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	18	18	10.98	0	0	0
	0	0	0	0	91413	91413	301492	31822	7322	10333	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	19	19	9.84	0	0	0
	0	0	0	0	0	188887	27255	106739	6134	14716	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	20	20	9.63	0	0	0
	0	0	0	0	0	173957	0	14677	8694	25154	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	21	21	8.84	0	0	0
	0	0	0	0	0	0	11843	91413	14840	106467	98735
	17568	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	22	22	5.35	0	0	0
	0	0	0	0	0	0	0	5406	11328	7767	91413
	0	9121	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	25	25	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	8702	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	1	1	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	18624
	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	2	2	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	9312	0	0	0	0	0	0	0	0	0	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	12	2	0	1	3	3	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	18220	0	0	0	0	0	0	0	0	0	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	12	2	0	1	4	4	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	9110	0	0	0	0	0	0	0	0	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	12	2	0	1	5	5	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	9388	18220	0	0	0	0	0	0	0	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	12	2	0	1	6	6	1.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	27330	0	0	0	0	0	0	0	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	12	2	0	1	7	7	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	12193	0	10706	0	0	0	0	0	0	0	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	12	2	0	1	8	8	2.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	24386	9110	9110	0	0	0	0	0	0	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	12	2	0	1	9	9	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	12193	9110	0	0	0	0	0	0	0	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	12	2	0	1	10	10	2.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	36579	0	39491	39491	0	0	0	0	0	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	12	2	0	1	11	11	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	12193	0	0	39491	0	0	0	0	0	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	12	2	0	1	12	12	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	9762	39491	82544	0	0	0	0	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	12	2	0	1	13	13	6.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	4889	28099	122630	0	0	0	0	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	12	2	0	1	14	14	6.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	115373	183510	0	0	0	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	12	2	0	1	15	15	5.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	22573	8320	157866	0	0	0	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	12	2	0	1	16	16	13.19	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	24932	70471	26891	91121	7322	7322
	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	12	2	0	1	17	17	14.61	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	124486	169417	26232	30648	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	12	2	0	1	18	18	11.68	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	13336	31799	39777	205940	281562
	14674	7322	0	7127	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2005	1	12	2	0	1	19	19	11.12	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	8577	91413	39185	8577
	15899	0	98735	124675	0	0	0	0	0	0	0
	10333	0	0	0	0	0	0	0	0	0	0
	0										
2005	1	12	2	0	1	20	20	7.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	13983	22159
	8702	0	0	0	8320	7394	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2005	1	12	2	0	1	21	21	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	8702	0	0	0	8577
	0	0	0	0	0	0	0	0	0	0	0
	0										
2006	1	12	1	0	1	2	2	1.07	0	9256	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	3	3	1.07	0	0	9256
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	4	4	1.07	0	0	0
	9256	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	5	5	1.07	0	0	8621
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	6	6	1.07	0	0	7697
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	9	9	1.07	0	0	0
	10606	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	12	12	1.14	0	0	0
	0	0	41456	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	13	13	2.21	0	0	0
	0	8553	45249	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	14	14	2.21	0	0	0
	0	0	157567	17106	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	15	15	4.35	0	0	0
	0	0	0	39729	0	28289	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	16	16	8.05	0	0	0
	0	0	0	74529	208337	166455	1060633	199023	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	17	17	8.84	0	0	0
	0	0	0	0	69980	157567	181156	427885	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	18	18	8.98	0	0	0
	0	0	0	0	332672	44115	188374	0	0	14701	14701
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	19	19	6.77	0	0	0
	0	0	0	0	0	1038009	209471	540636	1308327	0	1060633
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	20	20	8.05	0	0	0
	0	0	0	0	0	0	0	0	332962	286676	286623
	2076018	1052710	8888	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	21	21	11.05	0	0	0
	0	0	0	0	0	0	0	0	1065319	31058	31401
	14701	8115	1046939	1038009	1038009	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	22	22	4.35	0	0	0
	0	0	0	0	0	0	0	0	0	1038009	329835
	0	0	0	9418	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	23	23	4.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	279736	0	0	0	0	0	0	1038009	14701	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	24	24	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1038009	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	25	25	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	270318
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	1	0	1	26	26	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	8888	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	12	2	0	1	5	5	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	8224	0	0	0	0	0	0	0	0	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	12	2	0	1	6	6	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	18371	7697	0	0	0	0	0	0	0	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	12	2	0	1	7	7	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	7697	0	0	0	0	0	0	0	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	12	2	0	1	8	8	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	7697	0	0	0	0	0	0	0	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	12	2	0	1	11	11	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	12308	41456	0	0	0	0	0	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	12	2	0	1	12	12	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	7417	0	0	0	0	0	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	12	2	0	1	13	13	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	22624	20728	0	0	0	0	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	12	2	0	1	14	14	4.7	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	1122817	1351679	20728	0	0	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	12	2	0	1	15	15	6.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	43352	189609	1465894	0	0	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	12	2	0	1	16	16	10.33	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	225440	293572	111553	175061	0	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	12	2	0	1	17	17	12.26	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	22624	29616	504688	585451	0	1075964
	0	7167	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2006	1	12	2	0	1	18	18	13.17	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	8553	157567	444990	1256154	351957
	53258	1066089	1038009	23254	0	2076018	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2006	1	12	2	0	1	19	19	11.33	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	15917	17106	577949
	292371	1045361	0	10466	14701	1038009	0	1038009	0	0	0
	0	0	270318	0	0	0	0	0	0	0	0
	0										
2006	1	12	2	0	1	20	20	6.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	7130	0	0	0	270318	0	0	293960	0	0
	0	8930	0	1308327	0	0	0	0	0	0	0
	0										
2006	1	12	2	0	1	21	21	3.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1038009	22624	0	270318	0	1038009	0	0	0	1038009	0
	0	0	0	270318	0	0	0	0	0	0	0
	0										
2006	1	12	2	0	1	22	22	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	7804	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	270318										

2007 Triennial survey conditionals (n=217)

1983	1	13	1	0	1	3	3	1.14	68.35	68.35	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	4	4	1.14	0	136.7	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	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	5	5	2.28	0	1071.566	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	6	6	2.21	0	934.8661	68.35
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	7	7	3.35	0	0	137.2792
	1003.216	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	8	8	6.26	0	0	1938.661
	3215.278	68.35	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	9	9	9.92	0	0	205.05
	10639.04	119.23	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	10	10	13.81	0	0	119.23
	25256.28	853.0851	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	11	11	13.69	0	0	0
	8851.196	3270.325	274.4051	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	12	12	15.85	0	0	0
	3267.589	9369.206	477.7368	54.4775	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	13	13	13.59	0	0	0
	68.35	5273.543	618.1973	316.8574	0	54.4775	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	14	14	16.01	0	0	0
	0	1383.82	654.8543	828.5237	70.01429	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	15	15	17.45	0	0	0
	0	68.35	550.0615	929.3401	196.795	0	140.3946	12.32	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	16	16	17.89	0	0	0
	0	0	81.0598	1671.057	333.7599	998.1472	266.9624	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	17	17	14.52	0	0	0
	0	0	0	343.8408	1242.1	806.5965	457.311	128.4152	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	18	18	16.22	0	0	0
	0	0	68.35	90.16302	324.1718	1710.85	1391.807	1020.459	343.8105	0	0
	0	0	0	0	0	0	68.92924	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	19	19	13.52	0	0	0
	0	0	0	128.4152	112.1718	443.0446	1089.583	1217.146	469.8548	581.7685	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	20	20	13.45	0	0	0
	0	0	0	0	0	183.7386	367.176	1227.444	264.4086	395.431	432.1307
	243.4962	994.9313	0	280.35	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	21	21	15.36	0	0	0
	0	0	0	0	0	0	0	671.5023	1241.905	756.8156	1724.974
	1074.298	126.0443	12.32	256.8303	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	22	22	16.29	0	0	0
	0	0	0	0	0	0	0	216.24	687.621	302.9686	318.8861
	1037.639	271.051	254.4594	12.32	151.7807	274.6082	175.1462	111.9137	128.4152	0	68.35
	0	198.6124	0	70.1973	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	23	23	12.75	0	0	0
	0	0	0	0	0	0	0	0	0	68.35	555.8105
	278.1823	57.69429	68.35	376.3055	323.9137	338.0443	54.4775	68.35	91.71552	0	128.4152
	0	68.35	0	0	0	0	0	0	0	68.35	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	24	24	8.12	0	0	0
	0	0	0	0	0	0	0	0	0	0	68.35
	57.69429	0	68.35	0	212	68.35	68.35	151.7807	68.35	0	111.9137
	0	0	160.0655	0	68.35	68.35	0	0	0	68.35	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	25	25	5.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	68.35	212	0	216.24	0	111.9137	0	212	0	0
	0	68.35	0	68.35	0	0	68.35	68.35	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	26	26	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	68.35	0
	0	0	0	0	0	0	0	0	0	0	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	13	2	0	1	4	4	1.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	341.75	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										
1983	1	13	2	0	1	5	5	1.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	546.8	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	0	0
	0										
1983	1	13	2	0	1	6	6	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	119.23	68.35	0	0	0	0	0	0	0	0	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	13	2	0	1	7	7	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	866.5161	137.2792	0	0	0	0	0	0	0	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	13	2	0	1	8	8	6.54	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	2599.548	4424.702	68.35	0	0	0	0	0	0	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	13	2	0	1	9	9	9.01	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	1783.912	12160.72	136.7	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	0	0
	0										
1983	1	13	2	0	1	10	10	13.46	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	21146.27	666.6092	54.4775	68.35	0	0	0	0	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	13	2	0	1	11	11	15.39	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	50.88	12016.17	6404.001	80.67	0	0	0	0	0	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	13	2	0	1	12	12	12.01	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	3910.154	6571.06	328.8826	0	0	0	0	0	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	13	2	0	1	13	13	11.24	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	54.4775	2676.789	643.4669	262.5429	12.32	0	0	0	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	13	2	0	1	14	14	14.66	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	2528.666	752.7975	425.3714	57.69429	101.76	0	0	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	13	2	0	1	15	15	15.87	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	208.0558	1549.219	859.4029	1584.102	122.8275	0	0	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	13	2	0	1	16	16	19.8	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	0	0	0	0	0	0
	0	0	0	0	1142.769	1002.724	1528.884	519.3132	506.8623	212	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	13	2	0	1	17	17	17.22	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	128.4152	280.35	1431.522	2042.251	1088.317	1126.82	216.24
	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	13	2	0	1	18	18	14.69	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	248.6137	996.5949	2889.601	2068.12	956.2608
	1268.925	194.3943	196.7652	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1983	1	13	2	0	1	19	19	22.54	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	494.1973	0	601.4855	767.8779	2585.586
	3146.363	2109.39	2240.413	1280.573	1209.2	692.3563	867.8847	23.36552	503.876	710.9865	277.4352
	0	0	0	0	0	0	0	0	0	180.2637	23.36552
	138.5473										

1983	1	13	2	0	1	20	20	21.61	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	128.4152	428.24	320.5743
	1025.795	2080.831	1261.96	472.9337	805.596	684.1397	925.579	265.1152	385.3137	210.9455	925.579
	647.526	687.621	194.3943	323.9137	816.3572	608.9256	1072.866	186.1094	563.9412	628.4005	198.6124
	906.11772										
1983	1	13	2	0	1	21	21	16.9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	485.9343	1031.431	57.69429	0	624.1605	844.6405	0	967.971	819.7265	813.6653	327.3886
	128.4152	380.5037	91.71552	115.3886	254.4594	111.9137	0	0	269.6943	0	305.5628
	2021.1464										
1983	1	13	2	0	1	22	22	12.75	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	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	57.69429	343.8105	212	0	0	57.69429	0	0	269.6943
	0	0	0	23.36552	343.8105	396.5037	0	0	186.1094	0	0
	1264.83428										
1983	1	13	2	0	1	23	23	4.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	57.69429	57.69429	0	0	0	0	0	0
	463.0405										
1989	1	13	1	0	1	5	5	1.07	0	0	17.19367
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	7	7	1.07	0	0	0
	0	17.19367	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	8	8	2.56	0	0	17.19367
	35.3694	103.162	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	9	9	2.63	0	0	0
	0	228.428	17.19367	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	10	10	4.63	0	0	0
	0	257.4364	0	17.19367	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	11	11	2.63	0	0	0
	0	300.1489	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	12	12	2.28	0	0	0
	0	52.56307	0	0	34.38735	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	13	13	4.56	0	0	0
	0	70.7388	0	62.41367	34.38735	35.3694	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	14	14	2.28	0	0	0
	0	0	0	7.59	0	41.97735	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	15	15	3.28	0	0	0
	0	0	0	0	35.3694	120.3148	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	16	16	3.49	0	0	0
	0	0	0	0	179.3333	164.1313	126.1813	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	17	17	3.35	0	0	0
	0	0	0	0	65.48333	0	0	191.6647	126.1813	37.63	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	18	18	3.21	0	0	0
	0	0	0	0	0	44.41478	0	65.48333	1.39	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	19	19	3.49	0	0	0
	0	0	0	0	0	163.8113	40.76583	333.8944	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	20	20	5.56	0	0	0
	0	0	0	0	0	0	85.18062	166.9472	252.3627	0	0
	1.39	65.48333	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	21	21	2.42	0	0	0
	0	0	0	0	0	0	126.1813	126.1813	126.1813	39.29	0
	0	126.1813	0	126.1813	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	22	22	3.56	0	0	0
	0	0	0	0	0	0	0	0	1.39	0	126.1813
	40.76583	126.1813	0	0	126.1813	0	0	0	0	0	0
	0	0	0	0	0	0	0	126.1813	0	252.3626	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	23	23	6.7	0	0	0
	0	0	0	0	0	0	0	108.0475	0	0	126.1813
	5807.062	40.76583	65.48333	126.1813	0	0	0	0	126.1813	0	0
	126.1813	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	24	24	5.49	0	0	0
	0	0	0	0	0	0	0	0	1.39	0	2883.886
	1.39	2883.886	0	126.1813	0	108.0475	0	108.0475	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	27	27	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	2883.886
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	2	0	1	4	4	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	17.19367	0	0	0	0	0	0	0	0	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	13	2	0	1	5	5	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	34.38735	0	0	0	0	0	0	0	0	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	13	2	0	1	6	6	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	35.3694	0	0	0	0	0	0	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	13	2	0	1	7	7	2.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	86.95042	0	0	0	0	0	0	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	13	2	0	1	8	8	2.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	192.0766	17.19367	0	0	0	0	0	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	13	2	0	1	9	9	2.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	120.3557	35.3694	0	0	0	0	0	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	13	2	0	1	10	10	1.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	247.5858	0	0	0	0	0	0	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	13	2	0	1	11	11	2.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	229.4101	0	0	17.19367	0	0	0	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	13	2	0	1	12	12	2.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	123.3019	0	35.3694	0	0	0	0	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	13	2	0	1	13	13	3.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	35.3694	35.3694	54.82367	34.38735	0	0	0	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	13	2	0	1	14	14	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	37.63	0	0	0	0	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	13	2	0	1	15	15	2.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	44.41478	106.0232	0	0	0	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	13	2	0	1	16	16	5.63	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	65.48333	252.9609	170.5961	85.18062	0	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	13	2	0	1	17	17	6.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	44.41478	0	150.6639	170.5961	378.544
	95.735	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1989	1	13	2	0	1	18	18	9.19	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	44.41478	126.1813	189.6893	373.6975	80.05583
	80.05583	126.1813	65.48333	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1989	1	13	2	0	1	19	19	7.05	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	44.41478	0	298.1675	271.7205
	165.4713	126.1813	39.29	126.1813	0	0	126.1813	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1989	1	13	2	0	1	20	20	5.98	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	39.29	191.6647
	0	165.4713	252.3627	39.29	170.5961	0	83.70478	37.63	0	0	0
	0	0	0	126.1813	0	0	0	0	0	0	0
	0										
1989	1	13	2	0	1	21	21	4.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	65.48333	0	1.39
	0	0	39.29	0	0	0	78.58	0	0	0	0
	65.48333	0	0	0	0	0	0	0	191.6647	0	0
	0										
1989	1	13	2	0	1	22	22	4.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	108.0475	0	0	0
	0	0	0	0	0	0	0	0	0	65.48333	0
	170.59608										
1989	1	13	2	0	1	23	23	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	126.1813	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0										
1992	1	13	1	0	1	5	5	1.07	0	0	6.72
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	7	7	1.07	0	0	0
	46.93345	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	8	8	1.14	0	0	0
	0	46.93345	0	46.93345	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	9	9	1.14	0	0	0
	93.8669	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	10	10	1.21	0	0	0
	93.8669	46.93345	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	11	11	2.21	0	0	0
	0	46.93345	53.65345	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	12	12	2.21	0	0	0
	0	0	46.93345	51.62182	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	13	13	2.35	0	0	0
	93.8669	0	0	93.8669	4.688372	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	14	14	1.42	0	0	0
	0	0	46.93345	93.8669	93.8669	46.93345	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	15	15	2.7	0	0	0
	0	0	0	98.55527	103.2436	93.8669	4.688372	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	16	16	3.7	0	0	0
	0	0	0	98.55527	140.8003	98.55527	0	0	0	0	0
	0	0	0	12.78	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	17	17	3.42	0	0	0
	0	0	0	0	51.62182	56.31019	0	5.12	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	18	18	3.35	0	0	0
	0	0	0	8.96	4.688372	4.688372	46.93345	4.688372	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	19	19	2.42	0	0	0
	0	0	0	0	0	12.78	14.06512	12.78	0	0	0
	0	12.78	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	20	20	5.56	0	0	0
	0	0	0	0	0	0	12.78	22.7	17.55867	4.688372	12.78
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	21	21	2.21	0	0	0
	0	0	0	0	0	0	0	0	12.78	12.78	4.778667
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	22	22	4.91	0	0	0
	0	0	0	0	0	0	4.778667	0	17.46837	22.26837	22.24704
	0	0	25.56	4.8	0	4.778667	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	1	0	1	23	23	2.42	0	0	0
	0	0	0	0	0	0	0	0	12.78	0	12.78

	0	38.34	0	0	0	0	4.8	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	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1992	1	13	1	0	1	24	24	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	4.688372	12.78	4.8	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
	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	13	1	0	1	25	25	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	12.78	0	0	0	8.96	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	13	2	0	1	9	9	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	46.93345	46.93345	0	0	0	0	0	0	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	13	2	0	1	13	13	1.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	46.93345	140.8003	46.93345	0	0	0	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	13	2	0	1	14	14	2.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	46.93345	103.2436	93.8669	0	0	0	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	13	2	0	1	15	15	2.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	51.62182	98.55527	4.688372	0	0	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	13	2	0	1	16	16	2.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	51.62182	0	140.8003	46.93345	0	0	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	13	2	0	1	17	17	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	4.688372	4.688372	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	13	2	0	1	18	18	3.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	4.688372	4.688372	17.46837	22.15674	4.688372	0
	12.78	4.778667	12.78	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1992	1	13	2	0	1	19	19	4.7	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	4.778667	0	12.78	14.24571
	0	0	39.84837	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1992	1	13	2	0	1	20	20	6.05	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	4.8	4.8	0
	17.55867	12.78	0	9.808372	9.376744	17.58	0	0	4.688372	4.8	0
	4.688372	0	0	0	0	4.8	0	0	0	0	0
	0										
1992	1	13	2	0	1	21	21	3.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	12.78	5.12	0	12.78	0	0	0	0	4.8	0	12.78
	0	5.12	0	0	0	0	0	0	0	0	0
	0										
1992	1	13	2	0	1	22	22	3.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	4.778667	5.12	4.8	4.778667	0
	0	0	0	0	0	0	0	0	0	0	0
	14.336001										
1992	1	13	2	0	1	23	23	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	5.12	0	0	0	0	0	0	0	0
	0										
1995	1	17	1	0	1	5	5	1.07	0	0	0
	10.95	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	7	7	1.07	0	12.702	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	8	8	1.07	0	0	0
	87.7344	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	9	9	2.28	0	0	0
	0	282.4432	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	10	10	4.56	0	0	0
	15.05625	350.9376	106.9744	12.702	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	11	11	7.84	0	0	0
	0	223.197	34.29625	53.31978	0	0	21.37778	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	12	12	5.63	0	0	0
	0	0	49.3525	77.05181	12.702	0	12.702	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	13	13	5.91	0	0	0
	0	0	42.8145	128.1946	46.12478	25.404	0	12.702	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	14	14	5.35	0	0	0
	0	0	15.05625	87.7344	0	40.61778	0	12.702	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	15	15	5.49	0	0	0
	0	0	15.05625	0	19.24	15.05625	12.702	61.27941	60.54941	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	16	16	5.56	0	0	0
	0	0	0	0	21.98778	43.48556	60.54941	72.59441	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	17	17	4.28	0	0	0
	0	0	0	0	0	0	0	70.17	0	60.54941	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	18	18	3.21	0	0	0
	0	0	0	0	0	0	0	132.7694	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	19	19	3.21	0	0	0
	0	0	0	0	0	0	0	75.60566	0	19.24	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	20	20	6.63	0	0	0
	0	0	0	0	0	0	0	0	0	149.3494	111.6202
	0	19.24	19.24	0	0	0	0	60.54941	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	21	21	3.42	0	0	0
	0	0	0	0	0	0	60.54941	50.32	0	0	2.44
	50.32	0	100.64	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	22	22	4.35	0	0	0
	0	0	0	0	0	0	0	0	0	0.732	0.7507692
	0	51.13333	0.8133333	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	23	23	3.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0.732
	0	0	50.32	0	0	110.8694	121.0988	60.54941	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	24	24	1.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	60.54941
	0	0	0	0	0	60.54941	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	25	25	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	60.54941	50.32	0	0	0	60.54941	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	2	0	1	6	6	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	19.24	0	0	0	0	0	0	0	0	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	17	2	0	1	7	7	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	34.29625	0	0	0	0	0	0	0	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	17	2	0	1	8	8	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	106.9744	15.05625	0	0	0	0	0	0	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	17	2	0	1	9	9	7.7	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	0	0	0	0	0	0	0	0	0
	0	0	100.4364	164.6944	106.9744	12.702	0	0	0	0	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	17	2	0	1	10	10	4.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	30.1125	87.7344	34.07978	12.702	12.702	0	0	0	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	17	2	0	1	11	11	9.26	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	240.8336	250.1664	36.43403	91.83441	21.37778	0	0	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	17	2	0	1	12	12	6.84	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	166.0177	117.8469	87.7344	24.09	0	0	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	17	2	0	1	13	13	8.84	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	50.525	16.51625	27.10125	53.31978	0	0.73	0	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	17	2	0	1	14	14	5.49	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	15.78625	0	43.48556	0	31.942	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	17	2	0	1	15	15	3.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	61.27941	12.775	60.54941	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	17	2	0	1	16	16	4.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	19.24	0.732	69.56	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	17	2	0	1	17	17	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	19.99077	176.7402	50.32
	0.732	60.54941	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1995	1	17	2	0	1	18	18	6.7	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	62.03018	0
	0.7507692	1.970769	110.8694	0	0	50.32	0	0	0	0	0
	0	0	19.24	0	0	0	0	0	0	0	0
	0										
1995	1	17	2	0	1	19	19	7.84	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	1.482769	0
	2.314872	19.99077	0	121.0988	1.22	50.32	60.54941	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1995	1	17	2	0	1	20	20	2.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	60.54941	0
	0	0	50.32	0	50.32	0	0	100.64	0	0	50.32
	0	0	0	0	0	0	0	0	0	0	0
	0										
1995	1	17	2	0	1	21	21	4.7	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	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	1.501538	0	0	0	0	50.32	0	0	0	0
	121.0988	50.32	0	0	0	50.32	0	60.54941	0	0	0
	51.05										
1995	1	17	2	0	1	22	22	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	60.54941
	0										
2001	1	17	1	0	1	3	3	1.07	0	22.94	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	6	6	1.07	0	0	0
	0	22.94	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	7	7	1.14	0	0	0
	555.8538	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	8	8	1.07	0	0	0
	22.94	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	9	9	1.14	0	0	0
	45.88	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	10	10	3.28	0	0	0
	0	68.82	0	277.9269	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	11	11	5.49	0	0	0
	0	22.94	349.4469	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	12	12	6.56	0	0	0
	0	1.64	45.88	601.7338	0	0	0	22.94	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	13	13	12.54	0	0	0
	0	0	627.3738	950.6008	556.9138	7.438095	22.94	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	14	14	13.4	0	0	0
	0	22.94	24	325.9269	1165.026	0	24	285.365	7.81	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	15	15	12.26	0	0	0
	0	0	0	279.5669	647.6138	858.0702	70.46	47.22941	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	16	16	11.05	0	0	0
	0	0	0	286.425	47.22941	323.8069	32.78751	68.82	7.438095	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	17	17	10.91	0	0	0
	0	0	0	0	0	48.86941	1.06	34.3681	24.58	0	0
	1.64	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	18	18	17.33	0	0	0
	0	22.94	0	0	0	1.06	25.92941	93.4	27.56941	38.56	1.06
	45.88	0	1.64	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	19	19	14.33	0	0	0
	0	0	0	0	0	22.94	0	346.7469	24.58	98.86	75.92
	22.94	45.88	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	20	20	11.98	0	0	0
	0	0	0	0	0	0	22.94	0	56.04	70.16941	0
	30.04	22.94	22.94	0	0	22.94	0	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	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2001	1	17	1	0	1	21	21	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	1.64	22.94	0	22.94	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	22	22	4.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	24.28941
	0	0	22.94	0	7.1	0	7.438095	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	23	23	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	8.52	0	0	7.438095	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	24	24	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	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	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2001	1	17	2	0	1	5	5	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	1.06	0	0	0	0	0	0	0	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	17	2	0	1	7	7	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	22.94	0	0	0	0	0	0	0	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	17	2	0	1	8	8	3.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	24.58	0	0	0	1.06	0	0	0	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	17	2	0	1	9	9	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	300.8669	0	0	0	0	0	0	0	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	17	2	0	1	10	10	4.42	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	308.305	300.8669	0	277.9269	0	0	0	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	17	2	0	1	11	11	3.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	22.94	45.88	1.06	0	0	0	0	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	17	2	0	1	12	12	11.54	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	9.8	48	1436.864	601.7338	856.7208	0	0	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	17	2	0	1	13	13	10.33	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1.64	323.8069	891.3608	287.3769	286.7969	0	0	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	17	2	0	1	14	14	15.19	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	50.7	30.3781	24	555.8538	24.36	0	7.438095
	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	17	2	0	1	15	15	17.26	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	311.005	1.06	372.6763	3.28	54.62	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	17	2	0	1	16	16	17.68	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1.64	0	94.45882	79.61941	58.31941	30.3781	49.16
	1.64	22.94	22.94	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2001	1	17	2	0	1	17	17	15.12	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	22.94	55.33	67.18	38.82751
	24.58	7.81	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2001	1	17	2	0	1	18	18	18.82	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	45.88	0	78.90941	24.58
	65.1181	52.98	45.88	30.04	22.94	45.88	0	0	0	0	0
	0	0	7.438095	0	0	0	0	0	0	0	0
	0										
2001	1	17	2	0	1	19	19	6.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	22.94	22.94
	22.94	22.94	22.94	45.88	7.1	0	22.94	0	0	22.94	1.64
	0	0	0	0	0	0	0	0	0	0	0
	0										
2001	1	17	2	0	1	20	20	6.98	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	53.3181	0	30.3781	22.94	0	1.64	0	22.94	22.94
	0	0	30.3781	0	22.94	22.94	0	0	0	0	0
	1.06										
2001	1	17	2	0	1	21	21	2.35	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	22.94	22.94	0	0	0	0	0	22.94	0	0	0
	30.378095										
2001	1	17	2	0	1	22	22	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	22.94	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	22.94										
2004	1	17	1	0	1	3	3	1.07	0	3.94	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	5	5	1.07	0	0	14.97
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	13	13	1.14	0	0	0
	0	10.4016	0	10.4016	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	14	14	2.28	0	0	0
	0	0	0	25.3716	10.4016	10.4016	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	15	15	4.49	0	0	0
	0	0	14.97	23.64	20.8032	10.4016	14.97	10.4016	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	16	16	6.63	0	0	0
	0	14.97	55.6884	58.1748	14.97	0	7.03	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	17	17	7.56	0	0	0
	0	0	0	14.97	22	58.7784	29.94	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	18	18	9.7	0	0	0
	0	0	0	3.09	14.97	18.06	28.1	26.97	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	19	19	6.56	0	0	0
	0	0	0	0	0	111.3768	70.6584	0	3.09	10.4016	23.96
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	20	20	10.77	0	0	0
	0	0	0	0	0	0	3.09	43.84	6.18	12.08	8.99
	3.09	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	21	21	8.56	0	0	0
	0	0	0	0	0	0	0	3.09	16.5816	14.97	3.94
	3.94	0	55.6884	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	22	22	6.49	0	0	0
	0	0	0	0	0	0	0	0	74.85	0	55.6884
	3.09	8.99	0	0	26.97	14.97	0	0	55.6884	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	23	23	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	55.6884	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	1	0	1	24	24	2.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	55.6884	0	55.6884	0	26.97	0	0	0	26.97
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	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	17	2	0	1	3	3	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	14.97	0	0	0	0	0	0	0	0	0	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	17	2	0	1	9	9	1.07	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	3.09	0	0	0	0	0	0	0	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	17	2	0	1	12	12	2.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	14.97	25.3716	0	0	0	0	0	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	17	2	0	1	13	13	2.14	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	10.4016	14.97	0	0	0	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	17	2	0	1	14	14	4.56	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	13.4916	62.7432	18.06	0	0	0	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	17	2	0	1	15	15	7.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	20.8032	14.97	69.18	41.3116	10.4016	0	0
	8.99	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	16	16	10.77	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	25.3716	33.03	7.03	6.18	14.97	0	0
	55.6884	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	17	17	16.82	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	6.18	52.06	48.2	21.15	52.06	211.5684
	3.09	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	18	18	20.68	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	3.09	36.12	21.15	109.9084	36.12
	54.02	14.97	14.97	0	0	26.97	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	19	19	9.19	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	55.6884	111.3768
	56.91	41.94	26.97	139.5284	97.6284	26.97	0	0	0	26.97	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	20	20	12.33	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	29.94	3.09	0
	18.06	33.03	55.6884	0	29.94	14.97	109.6284	0	26.97	0	0
	53.94	0	0	53.94	0	0	0	0	0	0	0
	0										

2004	1	17	2	0	1	21	21	1.21	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	55.6884	0	0	0	55.6884	55.6884	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
2004	1	17	2	0	1	22	22	4.28	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	74.85	0	0	0	0	14.97	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	14.97	0
	14.97										

2007 WA Trawl age error key 1 (n=25)

1980	1	15	3	0	1	-1	-1	14.12	0.000	0.000	0.000
	0.000	1.138	2.276	2.276	2.276	3.414	7.966	7.966	2.276	1.138	2.276
	1.138	1.138	1.138	1.138	3.414	1.138	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	2.276	5.690	1.138	5.690	6.828	10.242	6.828
	1.138	2.276	0.000	2.276	3.414	5.690	3.414	1.138	0.000	2.276	2.276
	0.000	1.138	1.138	0.000	1.138	1.138	0.000	1.138	0.000	1.138	0.000
	1.138										
1981	1	15	3	0	1	-1	-1	35.30	0.000	0.000	0.000
	0.000	0.000	19.166	68.332	110.669	212.922	397.324	229.214	131.123	58.653	99.620
	21.933	10.967	23.170	68.382	10.967	19.166	5.483	10.967	0.000	0.000	0.000
	5.483	19.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	27.366	0.000
	0.000	0.000	0.000	25.887	5.483	135.102	103.598	176.202	510.172	184.052	208.568
	155.640	154.269	66.987	65.616	152.710	47.578	40.966	23.170	10.967	51.824	5.483
	43.816	0.000	0.000	13.683	65.616	13.683	0.000	13.683	19.166	13.683	0.000
	95.699										
1982	1	15	3	0	1	-1	-1	21.18	0.000	0.000	0.000
	4.269	74.658	41.598	33.650	37.919	33.787	12.807	34.239	30.786	22.474	16.712
	4.495	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	12.443	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	24.886	12.443	83.786	104.403	50.951	58.674	21.433	4.269	29.745
	29.381	35.281	4.269	8.764	4.495	22.474	4.495	4.495	17.979	13.033	21.433
	4.495	12.443	21.433	12.443	0.000	4.495	4.269	4.495	0.000	12.443	4.495
	41.824										
1983	1	15	3	0	1	-1	-1	14.12	0.000	0.000	0.000
	0.000	285.283	285.283	1569.058	1296.316	570.566	815.882	155.183	297.824	232.774	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	142.642	427.925	1141.133	2515.040	1659.190	1153.674	1426.416	570.566	375.416
	297.824	0.000	220.233	285.283	297.824	77.591	77.591	285.283	310.365	142.642	77.591
	155.183	0.000	77.591	0.000	0.000	0.000	0.000	77.591	0.000	0.000	0.000
	840.964										
1984	1	15	3	0	1	-1	-1	21.18	0.000	0.000	0.000
	0.000	0.000	152.652	76.326	129.210	287.883	287.883	287.883	46.863	299.261	58.905
	369.545	123.189	199.515	123.189	0.000	93.726	76.326	129.210	0.000	0.000	0.000
	0.000	76.326	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	311.325	411.735	458.598	493.418	376.251	140.588
	6.021	94.389	64.926	93.726	0.000	105.768	6.021	187.451	6.021	152.652	176.073
	46.863	6.021	58.905	0.000	0.000	0.000	0.000	93.726	0.000	58.905	0.000
	293.219										
1985	1	15	3	0	1	-1	-1	7.06	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	48.931	97.861	391.445	391.445	244.653	146.792	342.514
	195.723	97.861	0.000	97.861	0.000	97.861	0.000	48.931	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	146.792	146.792	391.445	293.584	244.653
	146.792	244.653	244.653	146.792	97.861	0.000	0.000	0.000	48.931	97.861	97.861
	48.931	48.931	48.931	48.931	0.000	0.000	0.000	0.000	0.000	0.000	48.931
	97.861										
1987	1	15	3	0	1	-1	-1	84.72	0.000	0.000	0.000
	0.000	0.000	314.668	181.420	1672.042	2157.026	2323.814	2777.587	2166.543	1851.626	755.256
	1169.988	804.219	505.732	367.263	302.464	72.159	23.770	0.000	37.343	260.564	62.686
	166.382	0.000	0.000	0.000	23.770	0.000	0.000	0.000	0.000	42.346	0.000
	0.000	0.000	0.000	9.874	106.725	427.262	2379.180	2977.990	1680.528	2570.071	2146.587

	1060.484	326.843	199.689	275.267	252.504	257.835	410.780	174.627	336.861	231.434	214.000
	0.000	15.472	30.944	199.689	232.857	198.775	353.972	0.000	132.412	138.105	74.687
	1596.282										
1988	1	15	3	0	1	-1	-1	35.30	0.000	0.000	0.000
	7.962	31.846	39.808	56.960	88.819	214.853	485.450	523.221	664.417	374.519	231.878
	37.671	235.155	227.738	0.000	12.557	73.441	0.000	80.857	0.000	0.000	0.000
	0.000	80.857	80.857	0.000	0.000	0.000	11.556	0.000	11.556	12.557	0.000
	0.000	0.000	0.000	7.962	95.767	129.071	69.517	406.365	667.137	427.669	746.275
	312.735	84.997	246.711	46.225	37.671	73.441	0.000	73.441	24.113	235.155	80.857
	80.857	154.298	103.970	11.556	92.413	161.714	80.857	73.441	12.557	80.857	11.556
	792.499										
1989	1	15	3	0	1	-1	-1	91.78	0.000	0.000	0.000
	125.467	100.465	526.406	1444.355	2215.856	3493.773	2947.182	2161.451	1948.887	978.729	778.550
	362.258	246.616	290.120	0.000	51.073	0.000	214.229	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	218.285	341.862	0.000
	0.000	25.093	54.045	173.713	881.338	2243.636	2521.382	3072.295	4354.315	2677.730	3225.230
	1728.132	953.597	496.604	102.329	384.357	471.094	573.240	92.095	273.182	0.000	92.794
	68.159	0.000	214.229	0.000	107.115	51.073	120.061	102.146	51.073	69.687	206.578
	1359.841										
1990	1	15	3	0	1	-1	-1	77.66	0.000	0.000	0.000
	37.596	0.000	822.504	838.170	1724.910	2403.423	2948.462	3715.324	2325.520	2222.534	750.774
	801.003	198.969	601.608	195.933	135.030	3.035	3.035	127.895	0.000	0.000	0.000
	0.000	0.000	3.035	0.000	211.824	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	5.836	564.907	2546.672	2188.533	2037.928	2493.554	3198.335	3090.009
	1505.896	1066.520	1035.383	561.823	709.498	209.646	212.776	6.071	604.643	344.771	209.741
	0.000	225.316	3.035	6.071	97.434	97.434	3.035	212.776	3.035	30.461	3.035
	1128.254										
1991	1	15	3	0	1	-1	-1	7.06	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	186.491	0.000	559.474	559.474	559.474	932.456
	372.982	0.000	0.000	0.000	0.000	186.491	0.000	186.491	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	186.491	559.474	372.982
	372.982	932.456	745.965	559.474	186.491	0.000	186.491	0.000	186.491	372.982	0.000
	186.491	0.000	186.491	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	186.491										
1992	1	15	3	0	1	-1	-1	84.72	0.000	0.000	0.000
	0.000	385.145	1039.991	892.503	3116.253	1571.725	801.596	1796.922	1846.628	1865.441	1735.802
	2060.908	1863.535	1420.915	402.264	969.284	277.959	0.000	0.000	144.649	144.649	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.574	0.000	0.000
	0.000	0.000	0.000	398.997	110.513	1936.558	2139.602	2865.718	2716.253	3138.851	1752.359
	451.253	570.138	913.504	1644.213	1101.756	1096.679	680.079	21.415	614.964	535.429	478.947
	0.000	0.000	0.000	144.649	334.297	0.000	4.838	340.404	215.706	15.040	0.000
	1211.333										
1993	1	15	3	0	1	-1	-1	32.19	0.000	0.000	0.000
	0.000	41.572	378.135	24.273	813.573	793.459	591.422	893.955	736.212	1284.448	227.523
	0.000	16.138	0.000	0.000	0.000	0.000	0.000	0.000	37.504	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	2.034	6.101	52.613	10.168	772.277	1878.367	881.002	835.084	743.937
	297.304	248.889	0.000	0.000	0.000	0.000	0.000	0.000	37.504	0.000	53.643
	0.000	37.504	0.000	0.000	0.000	0.000	37.504	0.000	16.138	0.000	0.000
	0.000										
1994	1	15	3	0	1	-1	-1	105.90	0.000	0.000	0.000
	11.793	303.052	815.389	1068.324	1207.547	2090.416	1244.078	1171.043	767.828	311.398	222.589
	488.298	204.705	101.889	34.691	49.007	49.007	0.000	18.710	20.141	155.749	0.000
	0.000	1.759	0.000	1.097	0.000	0.000	17.613	54.717	0.000	18.190	0.000
	0.000	0.000	25.065	376.347	785.208	821.024	1975.058	2407.590	1297.573	971.284	1156.390
	524.855	439.259	166.417	139.613	140.949	135.314	38.220	247.029	22.479	139.410	18.710
	0.000	0.000	41.041	139.410	0.000	0.000	139.410	113.371	157.023	6.869	0.000
	191.946										
1995	1	15	3	0	1	-1	-1	155.32	0.000	0.000	0.000
	6.813	89.151	158.557	404.822	651.775	564.748	672.100	820.070	429.091	294.382	144.893
	68.908	23.451	8.749	5.130	12.591	5.977	47.390	0.000	5.130	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.117	0.000	0.000
	0.000	0.000	6.813	157.825	287.799	512.595	824.410	483.796	930.294	671.771	280.718
	110.676	116.835	66.458	71.220	8.632	10.369	12.591	9.948	0.000	0.000	25.387
	4.257	0.000	0.000	0.000	4.058	0.000	0.000	0.000	16.259	0.000	14.929
	32.492										
1996	1	15	3	0	1	-1	-1	98.84	0.000	0.000	0.000
	17.094	56.984	120.955	198.925	254.682	236.982	455.987	492.082	393.291	380.645	79.515
	31.367	140.331	11.698	37.420	8.188	0.000	3.155	3.511	0.000	0.000	0.000

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	20.650	66.958	207.306	264.271	452.880	328.607	397.931	485.390	339.480
	262.084	171.886	51.180	88.719	85.209	8.188	110.703	85.209	41.870	0.000	0.000
	0.000	0.000	0.000	43.338	0.000	33.682	10.477	0.000	0.000	0.000	8.188
	20.953										
1997	1	15	3	0	1	-1	-1	120.02	0.000	0.000	0.000
	42.501	87.323	114.824	273.283	543.503	496.606	809.017	779.741	824.275	724.531	596.595
	172.991	142.488	101.233	126.945	120.775	84.891	115.048	0.000	22.017	49.347	37.900
	0.000	0.000	0.000	34.598	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	43.661	212.569	119.037	603.479	573.911	990.154	943.757	757.181	740.893
	439.659	581.648	260.589	109.790	45.842	184.521	64.877	66.234	76.954	43.669	14.749
	100.299	0.000	56.615	0.000	14.749	0.000	31.636	0.000	0.000	0.000	0.000
	195.584										
1998	1	15	3	0	1	-1	-1	112.96	0.000	0.000	0.000
	5.595	7.553	83.710	364.494	476.123	935.200	728.423	416.294	699.450	442.869	615.200
	271.347	118.811	52.603	159.584	113.465	33.113	77.443	0.000	11.608	0.000	22.757
	0.000	0.000	23.987	11.608	36.865	0.000	0.000	0.000	0.000	11.608	0.000
	0.000	0.000	17.469	54.187	204.535	190.023	854.959	843.092	861.502	717.876	457.856
	439.627	345.411	180.176	208.889	24.514	84.147	126.786	0.000	46.973	60.852	0.000
	42.687	0.000	23.987	48.831	0.000	36.865	0.000	0.000	0.000	0.000	0.000
	125.337										
1999	1	15	3	0	1	-1	-1	105.90	0.000	0.000	0.000
	9.957	55.355	32.538	100.256	146.397	233.871	320.371	302.713	256.557	357.168	217.040
	330.586	198.855	121.465	151.106	49.122	47.882	74.813	0.000	4.977	6.257	0.000
	17.417	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	1.088	2.176	6.003	33.421	246.614	139.806	263.381	433.396	467.628	557.502
	335.087	243.625	287.164	74.749	249.033	59.834	3.370	73.904	46.671	70.862	0.000
	24.862	0.000	2.450	55.516	0.000	17.417	23.673	0.000	0.000	0.000	0.000
	2.527										
2000	1	15	3	0	1	-1	-1	36.64	0.000	0.000	0.000
	0.000	3.212	10.002	8.895	16.260	8.451	10.653	23.115	25.803	11.313	9.077
	6.821	2.596	6.821	2.596	0.000	2.596	0.000	0.000	0.000	0.000	0.000
	0.617	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	4.344	13.603	8.833	23.590	26.293	15.972	23.526	23.964
	12.841	14.564	3.152	4.841	6.821	0.000	2.596	2.596	0.000	0.000	0.617
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.012
	0.617										
2001	1	15	3	0	1	-1	-1	52.26	0.000	0.000	0.000
	1.248	1.248	5.963	24.416	28.733	30.514	21.519	53.550	27.944	27.583	30.326
	19.766	6.180	5.580	7.513	1.510	3.020	0.910	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	2.497	4.751	17.559	19.195	51.598	82.000	53.592	64.353	30.953
	52.942	17.130	14.945	14.920	1.510	1.117	5.438	4.670	5.438	0.000	1.117
	0.000	0.000	0.000	0.000	0.000	0.000	1.117	0.000	0.000	0.000	0.000
	0.000										
2002	1	15	3	0	1	-1	-1	105.56	0.000	0.000	0.000
	0.000	0.000	0.000	29.532	48.568	45.443	20.673	49.737	28.312	46.294	52.844
	55.333	37.873	43.055	32.171	18.309	14.675	4.186	6.038	9.875	4.079	3.960
	2.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.924	0.000	0.000
	0.000	0.000	0.000	0.000	13.388	29.460	77.625	59.585	52.653	78.294	75.888
	33.767	95.232	46.651	19.005	10.053	1.112	13.045	3.423	1.521	0.000	8.842
	0.000	1.112	0.000	0.000	0.000	0.000	0.000	1.112	0.000	0.000	0.000
	19.907										
2003	1	15	3	0	1	-1	-1	56.60	0.000	0.000	0.000
	0.000	3.134	8.169	4.121	24.110	18.518	10.287	14.354	13.282	11.597	5.459
	4.854	5.342	0.000	6.173	2.399	1.083	1.160	1.930	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	3.181	6.188	16.741	21.946	18.779	13.751	9.685
	6.313	7.843	10.364	3.971	3.561	5.720	3.235	0.000	3.774	0.000	0.367
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000										
2004	1	15	3	0	1	-1	-1	126.79	0.000	0.000	11.803
	11.803	42.788	103.303	266.781	193.116	281.273	152.938	143.441	176.494	158.225	82.358
	78.557	55.982	226.019	55.060	26.307	29.505	18.967	35.721	13.685	22.038	4.805
	0.000	7.283	11.803	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	82.353	190.135	341.613	317.556	183.337	170.260	122.757
	297.883	100.273	35.397	31.418	11.300	13.099	8.975	0.000	32.656	0.000	10.306
	5.035	11.803	10.081	0.000	0.000	0.000	0.000	0.000	4.431	5.153	0.000
	33.975										

2005	1	15	3	0	1	-1	-1	109.14	0.000	0.000	0.000
	0.000	1.000	2.000	9.000	68.769	76.644	46.785	27.986	47.013	22.600	37.750
	38.443	46.950	6.000	5.579	6.279	23.050	8.421	0.000	9.150	4.000	1.000
	5.750	3.400	6.500	0.000	0.000	1.000	0.000	1.000	1.000	2.000	0.000
	0.000	0.000	0.000	1.000	2.000	21.173	35.894	20.691	41.863	57.751	53.608
	13.200	28.171	18.050	37.700	16.050	9.000	31.850	21.350	21.050	0.000	2.000
	22.300	11.950	2.000	5.750	7.500	0.000	1.000	1.000	1.000	0.000	0.000
	16.100										

NWFSC marginals for plotting only (n=4)

2003	1	16	3	0	1	-1	-1	1	0	145074	103011
	43795	20789	133629	175237	98785	171480	64731	101652	111504	107125	58295
	24538	218294	29053	18319	37662	0	18319	0	4550	0	0
	6219	0	0	0	0	0	0	0	0	0	25366
	448124	98596	40231	12193	132489	83651	188392	165624	146768	90419	120599
	152333	39487	50497	11101	18319	0	18319	6238	0	10734	0
	0	0	0	0	0	0	0	0	0	0	0
	5209										
2004	1	16	3	0	1	-1	-1	1	0	56006	131785
	75243	589074	87946	389060	92372	94078	501265	483874	208982	80762	99614
	17202	0	0	172255	344510	201105	0	0	0	0	0
	0	0	0	0	0	0	0	172255	0	0	0
	76235	203856	117637	652033	253181	159222	178919	87057	460693	19930	79440
	52771	145364	186420	185265	0	39624	214880	183679	28200	172255	183679
	172255	28200	172255	0	0	0	0	28200	0	0	0
	881395										
2005	1	16	3	0	1	-1	-1	1	34838	21166	192112
	142955	110665	326340	358563	339308	841095	347912	250057	48318	164437	190148
	17568	9121	0	0	0	8702	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	18624
	39725	103849	74476	63252	169145	353799	549669	236684	248543	297078	319620
	39275	7322	98735	131802	8320	7394	8702	0	0	0	8577
	10333	0	0	0	0	0	0	0	0	0	0
	0										
2006	1	16	3	0	1	-1	-1	1	0	9256	25574
	19862	8553	244272	131364	610989	1434435	1639634	1167544	2706608	1370444	1723193
	2090719	1340561	1055827	1047427	1038009	0	0	0	1038009	14701	270318
	0	0	1038009	0	0	8888	0	0	0	0	0
	0	26595	23091	12308	71497	1434961	1873029	2260430	1221419	1273260	2005870
	1383638	2148371	1038009	304038	14701	4422354	0	1045813	293960	1038009	0
	0	8930	270318	1578645	0	0	0	0	0	0	0
	270318										

Triennial marginals for plotting only (n=6)

#1983	1	17	3	0	1	-1	-1	1	1789	27621	80600
	1059623	578322	328239	455316	310005	528206	407144	449496	221668	239010	325851
	340611	110404	63951	91723	47288	76521	63016	32924	35911	0	25245
	0	34643	17757	12483	5752	5285	5914	1882	0	17236	0
	28974	65062	1151279	623300	291965	254776	414736	421507	411595	318627	229723
	346672	348890	254518	123781	140138	125471	78397	66843	129371	84449	116694
	33654	52942	34438	51080	67770	58411	31775	12439	52663	43691	48611
	351654										
#1989	1	17	3	0	1	-1	-1	1	0	0	14750
	9047	391794	5374	71823	240849	253224	174674	312362	216568	66085	40123
	119000	138201	19245	104940	15765	11239	0	11239	13040	0	0
	13040	0	0	0	0	0	0	15765	0	53141	0
	0	17937	0	456863	42011	186880	358492	97395	237381	321245	344866
	175432	146428	239875	63776	90733	0	219836	47245	0	0	0
	58086	0	0	27941	0	0	0	0	128119	12985	0
	33978										
#1992	1	17	3	0	1	-1	-1	1	0	4220	5728
	151991	42311	76086	192645	200244	96084	38175	20818	15026	15986	14965
	6108	6537	2020	9137	6037	974	237	4300	0	0	0
	0	0	0	0	0	0	0	0	0	0	4220
	10234	16394	31408	75863	81925	147870	100347	36390	29768	16729	15134
	23985	23226	9475	13975	5204	1632	271	2158	8780	4947	16996
	815	24158	0	0	0	0	0	0	0	0	0
	0										
#1995	1	17	3	0	1	-1	-1	1	0	0	0
	16624	98129	77798	115218	37344	52032	47063	95381	5527	48649	62711
	21805	29220	27184	6437	13595	28240	11667	14378	6437	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	4469	101537	132293	137491	90822	87870	91782	29427	107383	3989
	76203	115488	32880	23927	26678	23927	32675	37688	0	0	57027
	13267	73671	0	0	0	0	0	0	0	0	0
	0										
#2001	1	17	3	0	1	-1	-1	1	0	3606	0
	141990	302895	433694	804794	432377	182530	282111	298648	170197	94137	38023
	65388	27718	29857	32156	7562	12413	2206	4390	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	3606	0	113833	154619	529211	636973	310154	365015	187195	167463	92678
	71492	41027	42252	31139	20996	17928	8929	4646	0	11013	12465
	9877	9877	16081	0	6098	4646	0	2653	0	0	0
	17319										
#2004	1	17	3	0	1	-1	-1	1	0	4597	4040
	0	12219	20380	69183	64844	57050	81643	55347	56950	29254	60550
	48432	10488	13147	0	16671	10599	6295	0	10376	0	6295
	0	0	0	0	0	0	0	0	0	0	0
	4040	0	6603	7635	32011	68320	81561	95154	56375	83791	74036
	103490	48771	24302	48961	45334	39525	25374	19609	52600	11036	0
	21353	0	0	18025	0	0	0	0	0	3372	0
	14838										

0 # Total number of size-at-age observations
0 # Total number of environmental variables
0 # Total number of environmental observations
999 # End file marker

14. Appendix C: SS2 Control file

```
# control file for 2007 canary assessment
# Morph and area setup
1	# N growth patterns
1	# N sub morphs
1	# N Areas
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 # Area for each fleet
1	# rec dist design
0	# rec interaction
0	# Do migration: 0=no migration, 1=for nareas>1 models
0 0 0	# migration matrix

# Time block setup
13	# Number of time block designs for time varying parameters
1	# Blocks in design 1
1	# Blocks in design 2
1	# Blocks in design 3
1	# Blocks in design 4
2	# Blocks in design 5
2	# Blocks in design 6
2	# Blocks in design 7
2	# Blocks in design 8
3	# Blocks in design 9
3	# Blocks in design 10
3	# Blocks in design 11
3	# Blocks in design 12
2	# Blocks in design 13

1995 2006		# Block Design 1 Trip limits
2000 2006		# Block Design 2 footrope/overfished declaration
2002 2006			# Block Design 3 RCA
2005 2006			# Block Design 4 Flatfish trawl

1995 1999 2000 2006		# Block Design 5 trip limits + footrope
1995 2001 2002 2006		# Block Design 6 trip limits + RCA
2000 2001 2002 2006		# Block Design 7 footrope + RCA
2000 2004 2005 2006		# Block Design 8 footrope + flatfish trawl

2000 2001 2002 2004 2005 2006 # Block Design 9 footrope + RCA + flatfish trawl
1995 1999 2000 2001 2002 2006 # Block Design 10 trip limits + footrope + RCA
1995 1999 2000 2004 2005 2006 # Block Design 11 trip limits + footrope + flatfish trawl
1979 1994 1995 1999 2000 2006 # Block Design 12 roller gear + trip limits + footrope
1979 1999 2000 2006	# Block Design 13 roller gear + footrope/overfished declaration

# Mortality and growth specifications
0.5	# Fraction female at birth
1000	# Ratio of between to within growth morph variance
-1	# Vector of submorph distribution (-1=normal approx)
6	# Last age for M young
14	# First age for M old
1	# Age for growth Lmin
80	# Age for growth Lmax
0.0	# SD constant added to LAA (0.1 mimics v1.xx for compatibility only)
0	# Variability about growth: 0=CV~f(LAA) [mimic v1.xx], 1=CV~f(A), 2=SD~f(LAA), 3=SD~f(A)
1	# maturity option: 1=length logistic, 2=age logistic, 3=read maturity at age for each growth pattern
2	# First age allowed to mature
3	# mg parm offset option: 1=direct assignment, 2=each pat. x gender offset from pat. 1 gender 1, 3=offsets as SS2 V1.xx
with M old and CV old offset from young values
1	# mg parm adjust method 1=do V1.23 approach, 2=use new logistic approach
-50	# Mortality and growth parameter dev phase

# Mortality and growth parameters
# Lo	Hi	Init	Prior	Prior	Prior	Param	Env	Use	Dev	Dev	Dev	Block	block
# bnd	bnd	value	mean	type	SD	phase	var	dev	minyr	maxyr	SD	design	switch
# Females
```

```
0.04	0.08	0.06	0.06	0	50	-50	0	0	0	0	0.5
	0	0	#M1_natM_young
0	0.9	0.45	0.4	-1	50	3	0	0	0	0	0.5
	0	0	#M1_natM_old_as_exponential_offset(rel_young)
2	9	3.8	4	-1	50	2	0	0	0	0	0.5
	0	0	#M1_Lmin
50	70	59.0	60	-1	50	2	0	0	0	0	0.5
	0	0	#M1_Lmax
0.02	0.21	0.14	0.14	-1	50	2	0	0	0	0	0.5
	0	0	#M1_VBK
0.02	0.21	0.14	0.15	-1	50	2	0	0	0	0	0.5
	0	0	#M1_CV-young
-3	3	-1.3	-1.3	-1	50	2	0	0	0	0	0.5
	0	0	#M1_CV-old_as_exponential_offset(rel_young)
# Males
-3	3	0	0	0	50	-50	0	0	0	0	0.5
	0	0	#M2_natM_young_as_exponential_offset(rel_morph_1)
-3	3	0	0	0	50	-50	0	0	0	0	0.5
	0	0	#M2_natM_old_as_exponential_offset(rel_young)
-3	3	0	0	0	50	-50	0	0	0	0	0.5
	0	0	#M2_Lmin_as_exponential_offset
-3	3	-0.12	0	-1	50	2	0	0	0	0	0.5
	0	0	#M2_Lmax_as_exponential_offset
-3	3	0.24	0	-1	50	2	0	0	0	0	0.5
	0	0	#M2_VBK_as_exponential_offset
-3	3	0.04	0	-1	50	2	0	0	0	0	0.5
	0	0	#M2_CV-young_as_exponential_offset(rel_CV-young_for_morph_1)
-3	3	-1.3	0	-1	50	2	0	0	0	0	0.5
	0	0	#M2_CV-old_as_exponential_offset(rel_CV-young)
# Weight-Length and maturity parameters (L in cm, W in kg)
# Lo	Hi	Init	Prior	Prior	Prior	Param	Env	Use	Dev	Dev	Dev
	Block	block
# bnd	bnd	value	mean	type	SD	phase	var	dev	minyr	maxyr	SD
	design	switch
# Females
0	1	1.55E-05 1.55E-05 0	50	-50	0	0	0	0	0.5	0
	0	#Female wt-len-1
2	4	3.03	3.03	0	50	-50	0	0	0	0	0.5
	0	0	#Female wt-len-2
40	41	40.5	40.5	0	50	-50	0	0	0	0	0.5
	0	0	#Female mat-len-1
-3	3	-0.25	-0.25	0	50	-50	0	0	0	0	0.5
	0	0	#Female mat-len-2
-3	3	1.0	1.0	0	50	-50	0	0	0	0	0.5
	0	0	#Female eggs/gm intercept
-1	1	0.0	0.0	0	50	-50	0	0	0	0	0.5
	0	0	#Female eggs/gm slope
# Males
0	1	1.55E-05 1.55E-05 0	50	-50	0	0	0	0	0.5	0
	0	#Female wt-len-1
2	4	3.03	3.03	0	50	-50	0	0	0	0	0.5
	0	0	#Female wt-len-2

# Distribute recruitment among growth pattern x area x season
0	999	1	1	0	50	-50	0	0	0	0	0.5
	0	0	# GP 1
0	999	1	1	0	50	-50	0	0	0	0	0.5
	0	0	# Area 1
0	999	1	1	0	50	-50	0	0	0	0	0.5
	0	0	# Season 1
# Cohort growth (K) deviation parameter
-1	1	1	1	0	50	-50	0	0	1980	1983	0.5
	0	0

0 # Custom environmental linkage setup for mg parameters: 0=Read one line apply all, 1=read one line each parameter
0 # Custom block setup for mg parameters: 0=Read one line apply all, 1=read one line each parameter

# Spawner-recruit parameters
1	# S-R function: 1=B-H w/flat top, 2=Ricker, 3=standard B-H, 4=no steepness or bias adjustment
# Lo	Hi	Init	Prior	Prior	Prior	Param
```

# bnd	bnd	value	mean	type	SD	phase	
7	11	8.5	8.5	-1	50	1	# Ln(R0)
0.21	0.99	0.511	0.4	0	50	-6	# Steepness
0	2	0.5	0.4	0	50	-50	# Sigma R
-5	5	0	0	0	50	-50	# Environmental link coefficient
-5	5	0	0	0	50	-50	# Initial equilibrium offset to virgin
0	2	0	1	0	50	-50	# Autocorrelation placeholder (Future implementation)

0 # index of environmental variable to be used
1 # env target parameter: 1=rec devs, 2=R0, 3=steepness
1 # rec dev type: 0=none, 1=devvector (zero-sum), 2=simple deviations (no sum constraint)
Recruitment residuals
1960 # Start year recruitment residuals
2006 # End year recruitment residuals
-5 # Lower bound
5 # Upper bound
1 # Phase
1900 # first year of full bias correction (linear ramp up from this year minus the plus-age to this year)

Initial F setup by fishing fleet

# Lo	Hi	Init	Prior	P_type	SD	Phase
0	1	0	0.01	0	50	-50 # 1_CA_S_trwl
0	1	0	0.01	0	50	-50 # 2CA_N_trwl
0	1	0	0.01	0	50	-50 # 3OR_trwl
0	1	0	0.01	0	50	-50 # 4WA_trwl
0	1	0	0.01	0	50	-50 # 5CA_S_nontrwl
0	1	0	0.01	0	50	-50 # 6CA_N_nontrwl
0	1	0	0.01	0	50	-50 # 7WAOR_nontrwl
0	1	0	0.01	0	50	-50 # 8CA_S_rec
0	1	0	0.01	0	50	-50 # 9CA_N_rec
0	1	0	0.01	0	50	-50 # 10WAOR_rec
0	1	0	0.01	0	50	-50 # 11atseahake
0	1	0	0.01	0	50	-50 # 12_NWFSC/research

Catchability (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
E=Units: 0=numbers, 1=biomass
F=err_type 0=lognormal, >0=T-dist. DF=input value
A B C D E F
0 0 0 0 1 0 # 1CA_S_trwl
0 0 0 0 1 0 # 2CA_N_trwl
0 0 0 0 1 0 # 3OR_trwl
0 0 0 0 1 0 # 4WA_trwl
0 0 0 0 1 0 # 5CA_S_nontrwl
0 0 0 0 1 0 # 6CA_N_nontrwl
0 0 0 0 1 0 # 7WAOR_nontrwl
0 0 0 0 1 0 # 8CA_S_rec
0 0 0 0 1 0 # 9CA_N_rec
0 0 0 0 1 0 # 10WAOR_rec
0 0 0 0 1 0 # 11atseahake
0 0 0 0 1 0 # 12NWFSC/research
0 0 0 0 1 0 # 13_triennial
0 0 0 0 0 0 # 14_pre_recruit
0 0 0 0 1 0 # 15WA_trwl_mirror
0 0 0 0 1 0 # 16_NWFSC_mirror
0 0 0 0 1 0 # 17_tri_mirror
Catchability (Q) parameters

Selectivity section
Size-based setup
A=Selex option: 1-24
B=Do_retention: 0=no, 1=yes
C=Male offset to female: 0=no, 1=yes, 2=Female offset to male
D=Mirror selex (#)
A B C D
24 0 2 0 # 1CA_S_trwl
24 0 2 0 # 2CA_N_trwl

```
 24  0 2 0  # 3OR_trwl
 24  0 2 0  # 4WA_trwl
 24  0 2 0  # 5CA_S_nontrwl
 24  0 2 0  # 6CA_N_nontrwl
 24  0 2 0  # 7WAOR_nontrwl
 24  0 2 0  # 8CA_S_rec
 24  0 2 0  # 9CA_N_rec
 24  0 2 0  # 10WAOR_rec
 24  0 2 0  # 11atseahake
 24  0 2 0  # 12_NWFSC/research
 24  0 2 0  # 13_triennial
 32  0 0 0  # 14_pre_recruit
 5   0 0 4  # 15WA_trwl_mirror
 5   0 0 12 # 16_NWFSC_mirror
 5   0 0 13 # 17_tri_mirror
# Age-based setup
 10 0 0 0  # 1CA_S_trwl
 10 0 0 0  # 2CA_N_trwl
 10 0 0 0  # 3OR_trwl
 10 0 0 0  # 4WA_trwl
 10 0 0 0  # 5CA_S_nontrwl
 10 0 0 0  # 6CA_N_nontrwl
 10 0 0 0  # 7WAOR_nontrwl
 10 0 0 0  # 8CA_S_rec
 10 0 0 0  # 9CA_N_rec
 10 0 0 0  # 10WAOR_rec
 10 0 0 0  # 11atseahake
 10 0 0 0  # 12_NWFSC/research
 10 0 0 0  # 13_triennial
 10 0 0 0  # 14_pre_recruit
 10 0 0 0  # 15WA_trwl_mirror
 10 0 0 0  # 16_NWFSC_mirror
 10 0 0 0  # 17_tri_mirror
# Selectivity and retention parameters
```

# Lo	Hi	Init	Prior	Prior	Prior	Param	Env	Use	Dev	Dev	Dev
	Block	block									
# bnd	bnd	value	mean	type	SD	phase	var	dev	minyr	maxyr	SD
	design	switch									
# 1CA_S_trwl double normal											
20	60	40	50	-1	50	4	0	0	0	0	0.5
	0	2	# PEAK								
-9.0	4.0	-4	-4	0	50	-50	0	0	0	0	0.5
	0	0	# TOP (logistic)								
0.0	9.0	4.3	4.2	-1	50	5	0	0	0	0	0.5
	0	2	# Asc WIDTH exp								
0.0	9.0	2.5	2.6	-1	50	5	0	0	0	0	0.5
	0	0	# Desc WIDTH exp								
-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT (logistic)								
-5.0	5.0	-1.0	5	-1	50	5	0	0	0	0	0.5
	0	2	# FINAL (logistic)								
# Female offsets											
10	60	40	50	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg								
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage								
# 2CA_N_trwl double normal											
20	60	43	50	-1	50	4	0	0	0	0	0.5
	0	0	# PEAK								
-9.0	4.0	-4	-4	0	50	-50	0	0	0	0	0.5
	0	0	# TOP (logistic)								
0.0	9.0	3.9	2.0	-1	50	5	0	0	0	0	0.5
	0	0	# Asc WIDTH exp								
0.0	9.0	2.7	2.4	-1	50	5	0	0	0	0	0.5
	0	0	# Desc WIDTH exp								

```
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     2.0     5       -1      50      5       0       0       0       0       0.5
        0       0       # FINAL (logistic)
# Female offsets
10      60      45      50      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-3OR_trwl double normal
20      60      50      50      -1      50      4       0       0       0       0       0.5
        12      2       # PEAK
-9.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     4.0     4.0     -1      50      5       0       0       0       0       0.5
        12      2       # Asc WIDTH exp
0.0     9.0     4.0     4.0     0       50      -7      0       0       0       0       0.5
        0       0       # Desc WIDTH exp
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     4.99    5       -1      50      -4      0       0       0       0       0.5
        12      2       # FINAL (logistic)
# Female offsets
10      60      50      44      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-4WA_trwl double normal
20      60      50      50      -1      50      4       0       0       0       0       0.5
        13      2       # PEAK
-4.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     4.5     4.5     -1      50      5       0       0       0       0       0.5
        13      2       # Asc WIDTH exp
0.0     9.0     4.4     4.4     -1      50      5       0       0       0       0       0.5
        0       0       # Desc WIDTH exp
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     -3.3    5       -1      50      5       0       0       0       0       0.5
        13      2       # FINAL (logistic)
# Female offsets
10      60      50      44      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-5CA_S_nontrwl double normal
20      60      34      50      -1      50      4       0       0       0       0       0.5
        2       2       # PEAK
-4.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     4.3     4.1     -1      50      5       0       0       0       0       0.5
        2       2       # Asc WIDTH exp
0.0     9.0     4.3     4.3     -1      50      5       0       0       0       0       0.5
        0       0       # Desc WIDTH exp
```

```
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     -1.8    5       -1      50      5       0       0       0       0       0.5
        2       2       # FINAL (logistic)
# Female offsets
10      60      35      44      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-6CA_N_nontrwl double normal
15      60      40      50      -1      50      4       0       0       0       0       0.5
        10      2       # PEAK
-4.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     4.7     4.2     -1      50      5       0       0       0       0       0.5
        10      2       # Asc WIDTH exp
0.0     9.0     4.0     4.0     0       50      -7      0       0       0       0       0.5
        0       0       # Desc WIDTH exp
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     4.99    0.9     -1      50      -5      0       0       0       0       0.5
        10      2       # FINAL (logistic)
# Female offsets
10      60      40      44      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-7WAOR_nontrwl double normal
15      60      49      50      -1      50      4       0       0       0       0       0.5
        7       2       # PEAK
-4.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     4.7     5.8     -1      50      5       0       0       0       0       0.5
        7       2       # Asc WIDTH exp
0.0     9.0     4.0     4.0     0       50      -7      0       0       0       0       0.5
        0       0       # Desc WIDTH exp
-9.0    5.0     -9.0    -9.0    0       50      -50     0       0       0       0       0.5
        0       0       # INIT (logistic)
-5.0    5.0     4.0     5       -1      50      5       0       0       0       0       0.5
        7       2       # FINAL (logistic)
# Female offsets
10      60      53      44      0       50      -50     0       0       0       0       0.5
        0       0       # female dogleg
-4      0       0       0       0       50      -50     0       0       0       0       0.5
        0       0       # female offset at minage
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at dogleg
-4      0       0       0       0       50      -6      0       0       0       0       0.5
        0       0       # female offset at maxage

#fishery-8CA_S_rec double normal
15      60      30      50      -1      50      4       0       0       0       0       0.5
        8       2       # PEAK
-4.0    4.0     -4      -4      0       50      -50     0       0       0       0       0.5
        0       0       # TOP (logistic)
0.0     9.0     3.9     4.0     -1      50      5       0       0       0       0       0.5
        8       2       # Asc WIDTH exp
0.0     9.0     3.7     3.7     -1      50      5       0       0       0       0       0.5
        0       0       # Desc WIDTH exp
```

```
-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT (logistic)
-5.0	5.0	-3.5	5	-1	50	5	0	0	0	0	0.5
	8	2	# FINAL (logistic)
# Female offsets
10	60	30	44	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage

#fishery-9CA_N_rec double normal
15	60	28	50	-1	50	4	0	0	0	0	0.5
	0	2	# PEAK
-4.0	4.0	-4	-4	0	50	-50	0	0	0	0	0.5
	0	0	# TOP (logistic)
0.0	9.0	3.1	3.1	-1	50	5	0	0	0	0	0.5
	0	2	# Asc WIDTH exp
0.0	9.0	4.4	4.4	-1	50	5	0	0	0	0	0.5
	0	0	# Desc WIDTH exp
-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT (logistic)
-5.0	5.0	-2.3	5	-1	50	5	0	0	0	0	0.5
	0	2	# FINAL (logistic)
# Female offsets
10	60	28	44	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage

#fishery-10WAOR_rec double normal
15	60	31	50	-1	50	4	0	0	0	0	0.5
	2	2	# PEAK
-4.0	4.0	-4	-4	0	50	-50	0	0	0	0	0.5
	0	0	# TOP (logistic)
0.0	9.0	3.2	3.2	-1	50	5	0	0	0	0	0.5
	2	2	# Asc WIDTH exp
0.0	9.0	3.3	2.3	-1	50	5	0	0	0	0	0.5
	0	0	# Desc WIDTH exp
-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT (logistic)
-5.0	5.0	-2.4	5	-1	50	5	0	0	0	0	0.5
	2	2	# FINAL (logistic)
# Female offsets
10	60	31	50	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage

#fishery-11atseahake double normal
15	60	48	50	-1	50	4	0	0	0	0	0.5
	0	0	# PEAK
-4.0	4.0	-4	-4	0	50	-50	0	0	0	0	0.5
	0	0	# TOP (logistic)
0.0	9.0	3.6	3.7	-1	50	5	0	0	0	0	0.5
	0	0	# Asc WIDTH exp
0.0	9.0	4.0	4.0	0	50	-7	0	0	0	0	0.5
	0	0	# Desc WIDTH exp
```

-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT (logistic)								
-5.0	5.0	4.0	5	-1	50	5	0	0	0	0	0.5
	0	0	# FINAL (logistic)								
# Female offsets											
10	60	48	50	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg								
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage								
#survey-12_NWFSC double normal											
20	66	61	50	-1	50	4	0	0	0	0	0.5
	0	0	# PEAK	value							
-4.0	4.0	-4.0	-4	-1	50	4	0	0	0	0	0.5
	0	0	# TOP	logistic							
0.0	9.0	8.8	4.0	-1	50	4	0	0	0	0	0.5
	0	0	# WIDTH up exp								
0.0	9.0	4.0	4.0	0	50	-7	0	0	0	0	0.5
	0	0	# WIDTH dn exp								
-9.0	5.0	-8.0	-9.0	-1	50	4	0	0	0	0	0.5
	0	0	# INIT	logistic							
-5.0	5.0	4.5	5	-1	50	4	0	0	0	0	0.5
	0	0	# FINAL (logistic)								
# Add female offsets											
10	60	55	50	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg								
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage								
#survey-13_triennial double normal											
20	66	64	50	-1	50	4	0	0	0	0	0.5
	0	0	# PEAK	value							
-4.0	4.0	-3.6	-4	-1	50	4	0	0	0	0	0.5
	0	0	# TOP	logistic							
0.0	9.0	7.4	4.0	-1	50	4	0	0	0	0	0.5
	0	0	# WIDTH	exp							
0.0	9.0	4.0	4.0	0	50	-7	0	0	0	0	0.5
	0	0	# WIDTH	exp							
-9.0	5.0	-9.0	-9.0	0	50	-50	0	0	0	0	0.5
	0	0	# INIT	logistic							
-5.0	5.0	4.5	5	-1	50	4	0	0	0	0	0.5
	0	0	# FINAL (logistic)								
# Female offsets											
10	60	55	50	0	50	-50	0	0	0	0	0.5
	0	0	# female dogleg								
-4	0	0	0	0	50	-50	0	0	0	0	0.5
	0	0	# female offset at minage								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at dogleg								
-4	0	0	0	0	50	-6	0	0	0	0	0.5
	0	0	# female offset at maxage								
### Mirrors, leave fixed ###											
#15_Wa trawl mirror for second age key											
-2	0	-1	0	0	50	-50	0	0	0	0	0.5
	0	0	# Min mirror bin								
-2	0	-1	0	0	50	-50	0	0	0	0	0.5
	0	0	# Max mirror bin								
#16_NWFSC mirror for marginal ages											
-2	0	-1	0	0	50	-50	0	0	0	0	0.5
	0	0	# Min mirror bin								
-2	0	-1	0	0	50	-50	0	0	0	0	0.5
	0	0	# Max mirror bin								

#16_triennial mirror for marginal ages
-2 0 -1 0 0 50 -50 0 0 0 0 0.5
0 0 # Min mirror bin
-2 0 -1 0 0 50 -50 0 0 0 0 0.5
0 0 # Max mirror bin
###########################

1 # Selex parm adjust method 1=do V1.23 approach, 2=use new logistic approach
0 # Selex environmental setup: 0=Read one line apply all, 1=read one line each parameter
1 # Selex block setup: 0=Read one line apply all, 1=read one line each parameter

# Lo	Hi	Init	Prior	P_type	SD	Phase
20	60	46	50	-1	50	4 # OR trawl peak 1979-1994
20	60	46	50	-1	50	4 # OR trawl peak 1995-1999
20	60	41	50	-1	50	4 # OR trawl peak 2000-2006
0.0	9.0	4.0	4.0	-1	50	5 # OR trawl ascending width 1979-1994
0.0	9.0	4.0	4.0	-1	50	5 # OR trawl ascending width 1995-1999
0.0	9.0	3.7	3.9	-1	50	5 # OR trawl ascending width 2000-2006
-5.0	12.0	0.2	5	-1	50	5 # OR trawl final 1979-1994
-5.0	9.0	0.2	5	-1	50	5 # OR trawl final 1995-1999
-5.0	9.0	0.15	5	-1	50	5 # OR trawl final 2000-2006
20	60	41	50	-1	50	4 # WA trawl peak 1979-1999
20	60	41	50	-1	50	4 # WA trawl peak 2000-2006
0.0	9.0	3.6	4.6	-1	50	5 # WA trawl ascending width 1979-1999
0.0	9.0	3.6	4.6	-1	50	5 # WA trawl ascending width 2000-2006
-5.0	5.0	4.5	5	-1	50	5 # WA trawl final 1979-1999
-5.0	5.0	4.5	5	-1	50	5 # WA trawl final 2000-2006
20	60	24	50	-1	50	4 # S CA nontrawl peak 2000-2006
0.0	9.0	1.6	1.3	-1	50	5 # S CA nontrawl ascending width 2000-2006
-5.0	5.0	-4.5	5	-1	50	5 # S CA nontrawl final 2000-2006
20	60	33	50	-1	50	4 # N CA nontrawl peak 1995-1999
20	60	41	50	-1	50	4 # N CA nontrawl peak 2000-2001
20	60	33	50	-1	50	4 # N CA nontrawl peak 2002-2006
0.0	9.0	3.5	4.2	-1	50	-4 # N CA nontrawl ascending width 1995-1999
0.0	9.0	4.8	4.2	-1	50	5 # N CA nontrawl ascending width 2000-2001
0.0	9.0	3.9	4.2	-1	50	5 # N CA nontrawl ascending width 2002-2006
-5.0	5.0	0.1	5	-1	50	5 # N CA nontrawl final 1995-1999
-5.0	5.0	-0.3	5	-1	50	5 # N CA nontrawl final 2000-2001
-5.0	5.0	-2.9	5	-1	50	5 # N CA nontrawl final 2002-2006
15	60	33	50	-1	50	4 # OR/WA nontrawl peak 2000-2001
15	60	58	50	-1	50	4 # OR/WA nontrawl peak 2002-2006
0.0	9.0	2.9	5.8	-1	50	5 # OR/WA nontrawl ascending width 2000-2001
0.0	9.0	5.2	5.8	-1	50	5 # OR/WA nontrawl ascending width 2002-2006
-5.0	5.0	-1.6	5	-1	50	5 # OR/WA nontrawl final 2000-2001
-5.0	5.0	4.8	5	-1	50	5 # OR/WA nontrawl final 2002-2006
20	60	31	50	-1	50	4 # S CA rec peak 2000-2001
20	60	30	50	-1	50	4 # S CA rec peak 2002-2006
0.0	9.0	4.0	4.0	-1	50	5 # S CA rec ascending width 2000-2001
0.0	9.0	3.1	4.0	-1	50	5 # S CA rec ascending width 2002-2006
-5.0	5.0	-4.5	5	-1	50	5 # S CA rec final 2000-2001
-5.0	5.0	-4.8	5	-1	50	5 # S CA rec final 2002-2006
20	60	30	50	-1	50	4 # OR/WA rec peak 2000-2006
0.0	9.0	3.2	3.2	-1	50	5 # OR/WA rec ascending width 2000-2006
-5.0	5.0	-3.6	5	-1	50	5 # OR/WA rec final 2000-2006

-50 #_phase_for_selex_parm_devs

Likelihood related quantities
variance/sample size adjustment by fleet
#1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 #
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.035 0.11 0.00 0.00 0.00 # constant added to survey CV
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 # constant added to discard SD
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 # constant added to body weight SD
0.91 1.00 1.00 1.00 0.84 1.00 1.00 0.92 0.92 0.90 1.00 1.00 1.00 1.00 1.00 1.00 1.00 # multiplicative scalar for length comps
1.00 0.98 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 0.36 1.00 1.00 1.00 1.00 1.00 1.00 # multiplicative scalar for agecomps
1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 # multiplicative scalar for length at age obs

30 # DF For discard T-distribution

```
30   #  DF For meanbodywt T-distribution

1             # Max number of lambda phases: read this number of values for each component below
1             # SD offset (CPUE, discard, mean body weight, recruitment devs): 0=omit log(s) term, 1=include
# Lambda values by fleet
0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 # CPUE lambdas
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 # Discard lambdas
1             # Mean body weight data lambda
#1   2    3    4    5    6    7    8    9    10   11   12   13   14   15   16  17  #
0.50 0.50 0.50 0.50 1    1    0.50 1              1    1    0.50 1    1    0    0    0   1   # Length frequency lambdas
0.50 0.50 0.50 0.50 0    0    0.50 0              0    0    0.50 1    1    0    0.50 0   1   # Age frequency lambdas
0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   # Size at age lamdas
1             # Initial F lambda
1             # Recruitment residual lambda
1             # Parameter prior lambda
1             # Parameter deviation lambda
1000          # crashpen lambda
0.9           # max F threshold
999 # end file marker
```

15. Appendix D: SS2 Starter file

Canary_07.dat
Canary_07.ctl
0 # read SS2.PAR: 0=no, 1=yes
1 # output to console: 0=none, 1=most, 2=all
1 # rep file detail: 0=minimum, 1=normal
0 # N bootstrap datafiles to create
25 # last phase to estimate
Canary07_mod # prefix for output string in rep
1 # burn in for mcmc chain
1 # thinning interval for mcmc chain
0.00 # jitter for initial parameter values
0.00 # push initial parameter values away from bounds
-1 # min year for spbio sd_report (neg val = styr-2, virgin state)
-1 # max year for spbio sd_report (neg val = endyr+1)
0.0001 # ending convergence criteria
0 # retro year relative to endyr
1 # 1=keep catches; 0=set catches to nil
0.2 # F ballpark
1999 # F ballpark year
1 # F method: 1=Pope, 2=continuous
5 # summary age for biomass reporting
1 # Forecast_opt: 0=none, 1=use F(spr), 2=use F(msy), 3=use F(btarget), 4=use endyr F
2 # MSY opt: 0=none, 1=F(spr), 2=calc F(msy), 3=F(btarget), 4=endyr F
0 # do Punt-style rebuilder file: 0=no, 1=yes
-1 # first year for which catch could have been set to zero (Ydecl)(-1 to set to 1999)
-1 # year for current age structure (Yinit) (-1 to set to endyear+1)

16. Appendix E: SS2 Forecast file

0.5 # target SPR
1 # total number of forecast years
1 # number of forecast years with SD
1 # emphasis for sigmaR for recruitments occuring prior to endyr+1
1 # fraction of the bias adjustment to use prior to endyr+1
0 # fraction of the bias-correction to use in purely forecast years
0.40 # topend of 40:10 option; set to 0.0 for no 40:10
0.10 # bottomend of 40:10 option
1.0 # OY scalar relative to ABC
2003 # first yr for average fish selex to use in MSY and forecast
2006 # last yr for average fish selex to use in MSY and forecast
1 # for forecast: 1=set relative F from endyr; 2=use relative F read below
0 1 1 1 0 0 1 0 0 1 0 0 # relative F for forecast when using F; seasons; fleets within season
999 # verification read for end of the correct number of relative F reads
1.486 2.144 4.698 14.943 0.024 0.045 2.905 2.639 3.327 5.022 2.350 4.416 # scaled to 44 mt

Agenda Item G.4.a
Attachment 12
September 2007

Canary Rockfish STAR Panel Report

NOAA Western Regional Center
Building 9 Conference Room
7600 Sand Point Way, NE
Seattle, Washington 98115
July 30 – August 3, 2007

Reviewers:

Steve Ralston (panel chair), Scientific and Statistical Committee (SSC) Representative
Patrick Cordue, Center for Independent Experts (CIE, Rapporteur)
Devorah Hart, Northeast Fisheries Science Center (NEFSC)
Jim Ianelli, Alaska Fisheries Science Center (AFSC)
Paul Medley, Center for Independent Experts (CIE)

Advisors:

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Peter Leipzig, Groundfish Advisory Panel (GAP) Representative

Stock Assessment Team:

Ian Stewart, Northwest Fisheries Science Center (NWFSC)

Overview:

The canary rockfish assessment incorporated a variety of data sources into the candidate base model that was presented for review. Those data included landings and discards from trawl and non-trawl fisheries from southern California, northern California, Oregon, Washington, and bycatch in the at-sea whiting fishery. Extensive age and length composition data were also available for most modeled fleets. The principal abundance index used in the model was the triennial shelf trawl survey (1980-2004), although the NWFSC shelf/slope trawl survey (2003-06) was also included. Both surveys collected information on age and length composition. The SWFSC-PWCC/NWFSC coastwide pre-recruit index was evaluated but was initially excluded from the proposed base model.

A number of changes were evident between the last canary rockfish stock assessment conducted in 2005 and the STAT's initial candidate base model, which included:

- Completely revisited age estimation issues (laboratories, bias, and precision)
- Selectivity blocking based *a priori* on management actions (post-1995 only)
- Model-based, not design-based, estimates of survey abundance
- Incorporation of NWFSC shelf/slope survey (indices and compositions)
- Recruitment deviation vector extended back to 1916
- Evaluated effect of pre-recruit survey

Following the STAR Panel review a number of changes were included in the final base model:

- Incorporation of a trawl fishery selectivity block to account for the introduction of roller gear and high-rise nets in 1979
- Recruitment deviation vector starting in 1960
- The pre-recruit survey was included
- sigmaR (σ_r) was set equal to 0.5, based on partial tuning of recruit-deviations
- Due to differences in start dates of the triennial survey and serially correlated residuals in model fit, survey $\boldsymbol{q}$ was estimated separately for 1980-1992 and 1995-2004
- Fix steepness ($\boldsymbol{h}$) using a revised meta-analysis prior (i.e., darkblotched rockfish removed).

Revisions to the model that were completed by the STAT before the STAR panel review had a marked effect on plausible values for steepness, with the age and length compositions favoring high $\boldsymbol{h}$ and the triennial survey favoring low $\boldsymbol{h}$. The Panel and STAT agreed that it was not possible to reliably estimate steepness from the available data. Consequently, steepness was fixed based on a meta-analysis of west coast *Sebastes* that excluded canary rockfish and darkblotched rockfish. Darkblotched rockfish was excluded because the likelihood profile that had been used in developing the prior was considered out of date, i.e., a more recent assessment resulted in a very different view of steepness.

Analyses Requested by the STAR Panel:

Round 1 requests

A: Exploration of triennial survey with regard to seasonal effects and time of day. Produce descriptive plots and/or tables.

Reason: There was a concern that the trend towards earlier start dates for the triennial survey could compromise the time series as an abundance index (e.g., availability and/or vulnerability of canary could vary seasonally).

Response: A plot of the daily distribution of tows within year was presented. It showed that the surveys fell into two blocks: mid July-mid September timing for 1980-1992; and June-mid August timing for 1995-2004. Within the second block there was a trend towards earlier start dates and finish dates with the 2004 survey being the earliest. Plots of catch rates and average catch rates were presented by day of year and time of day. Also, bottom temperature plots were shown.

Discussion/conclusion: The only point of concern was the change in timing of the surveys. However, it was not possible to tell from the data presented whether this was a problem or not. The plot of catch rate by day of year combined over all years showed an increasing trend, but this was because the early surveys covered the "high density" northern strata late in the year. It was suggested that a fixed main-effects GLM could potentially be used to tease out the various effects (year, area, stratum, month or day-of-year).

B: Plots/tables of mean length in the trawl fishery data.

Reason: Some Panelists wanted to see the extent of the changes in the different time series (as a broad indicator of depletion).

Response: Plots were produced for each fishery. Declines in mean length were seen in all of the fisheries up until about 1995, with declines greater in the south than the north.

Discussion/conclusion: Regulations impacting the fisheries after 1995 may have been sufficient to change selectivities to such an extent that trends in mean length after that period would not be indicative of depletion levels. Trends before that period may be indicative of total mortality and it was suggested that Beverton-Holt estimates of Z be produced from the mean length data for each fishery (see Request K).

C: Follow up on the at-sea hake data determining if any other data are available (e.g., mean weight and/or length before 2003).

Reason: Any additional data sources are of interest, if only for qualitative corroboration of model results.

Response: Mean weight data were presented from at-sea sampling of the hake fishery for

1990-2007.

Discussion/conclusion: The mean weight data showed no trend over the period. It appears that the largely mid-water fishery has always caught a few very large canary rockfish.

D: For the base model produce a likelihood profile over $\boldsymbol{R_0}$. Tabulate and graph likelihood components. Also, profile over $\boldsymbol{R_0}$ with steepness = 0.6 (mean of Dorn prior).

Reason: A profile over $\boldsymbol{R_0}$ is often useful for revealing "tensions" in the model, in terms of which data sets are better fitted with high or low biomass.

Response: Plots of likelihood components were produced (standardized so that each component had a minimum of zero).

Discussion/conclusion: As is common with many stock assessments, some tensions in the model were confirmed (from previous profiles on steepness) with survey abundance indices favoring lower $\boldsymbol{R_0}$ than length and age data. The length data showed the strongest preference for higher $\boldsymbol{R_0}$.

E: Explore the relative proportion of tows in juvenile and adult habitat in the NWFSC and Triennial trawl surveys.

Reason: The NWFSC survey catches a higher proportion of small fish than the Triennial survey. It was thought that part of the explanation could be a higher proportion of tows in "juvenile habitat".

Response: A cut-off depth was determined for "juvenile" habitat. Plots of the proportion of tows within depth strata in juvenile and adult habitat were produced for both surveys. Cumulative distributions of tow proportions relative to depth were also displayed.

Discussion/conclusion: The NWFSC survey had a somewhat larger proportion of tows within shallower depths than the Triennial survey. It was concluded that this could be partly, but not wholly, responsible for the larger number of small fish caught in the NWFSC survey.

F: Distribute status report on Canadian stock assessment.

Reason: Additional background material

Response: The report was distributed to Panel members who wanted it.

<u>Round 2 requests</u>

G: Turn off all priors and estimate survey $\boldsymbol{q}$s analytically (median unbiased option).

Reason: Simply a tidying-up exercise (to avoid unnecessary computations).

Response: The changes were made and, as expected, almost identical results were produced.

H: Start a block in 1979 in fishery selectivities to allow for transition to roller gear/high-headline nets (steepness = 0.6).

Reason: Steepness was set to the mean of the Dorn prior (***h*** = 0.6) as there was no other reasonable basis for choosing steepness. A new break-point for selectivities was introduced to allow for known changes in fishing gear (albeit, changes occurred over a number of years).

Response: The increased value for steepness resulted in lower estimated virgin biomass and a substantially higher estimate of current depletion. The extra selectivity block had only a minor effect.

Discussion/conclusion: As expected, the change in steepness produced a large change in estimated depletion. The basis for choosing steepness was further discussed. Concern about the prior was raised by the STAT and, in particular, the inclusion of darkblotched rockfish, for which steepness estimates had recently been substantially revised.

I: Add in the coastwide pre-recruit survey from 2001-2006.

Reason: To explore the effect of including the indices and to raise the issue of whether they should be in the base model.

Response: The indices were included. As expected they had little effect on estimated biomass trajectories, but did alter the estimates of recent recruitment (which could be important in projections).

Discussion/conclusion: Nobody objected strongly to the use of the indices. There was some concern that the time series was too short for the indices to be fully validated against model estimates of recruitment. However, it was noted that the four year NWFSC shelf/slope survey time series was included in the base model without validation. It was also pointed out that if the canary assessment was updated in two years, that if the time series was not included in the base model then it could not be used in the update (when the recruitment indices would contain two more points). However, the converse argument also applies: according to the update rules, the recruitment indices would have to remain in the base model (whether that seemed desirable or not at the time).

J: Try a range of initial sigmaR values (0.4, 0.8, and 1.2) and calculate tuned output values.

Reason: To explore the effect of using different initial values of sigmaR.

Response: The three runs were compared with a sigmaR-tuned model (input sigmaR = 0.3, output = 0.28). Higher input values of sigmaR gave higher output values and resulted in higher estimated virgin biomass and lower estimated depletion.

Discussion/conclusion: Although the alternative start values for sigmaR gave quite different results to the tuned model it was apparent that the tuned result was independent of the initial value of sigmaR. However, Panel members were not convinced that full tuning of sigmaR was appropriate as it tends to underestimate recruitment variability. It was suggested that a better approach was to use a high initial value and then simply fix sigmaR at its output value (i.e., partial tuning). (See Request P.)

K: Calculate Beverton-Holt total mortality (Z) estimates: $Z = K \cdot (L_\infty - l_{bar})/(l_{bar} - l_c)$, where l_c = full selection cutoff (pick by inspection where selectivity = 0.75), l_{bar} = mean length above l_c, K and L_∞ = von Bertalanffy growth parameters. Apply to all fisheries and surveys where there are adequate data.

Reason: Some Panel members were interested in seeing these estimates and using them as a diagnostic (vis-à-vis the plausibility of model estimates of exploitation rates).

Response: Plots of the annual estimates were produced by sex for each fishery at two different values of l_c.

Discussion/conclusion: The estimates varied by sex, fishery, and the value of l_c. The annual estimates generally showed an increasing trend up until about 1995, after which trends varied depending on the fishery. The Panel members who had requested these estimates were satisfied that they were consistent with the SS2 model results.

L: Convert the length frequency data from 2003-2006 for the hake fishery to weights and compare with mean weight plots.

Reason: To check if the weight samples in 2003-2006 were consistent with the length samples which had been included in the model.

Response: The length frequency data were converted to weights and shown to be consistent with the mean weights in those years.

Discussion/conclusion: The consistency of the mean weight and length frequency data raised the issue of whether the model predictions of mean weight for this fleet were consistent with the observed mean weights (see Request V).

M: Produce the "equilibrium yield" figure with a "real fishery" selectivity (rather than an "avoidance fishery"), steepness = 0.35. Also do with steepness = 0.6.

Reason: To see how the reference points for this assessment were affected by the selectivities and steepness used in the calculations.

Response: The plots were produced as requested (showing equilibrium yield vs relative depletion, with estimated depletion and depletion reference points marked). The big impact was from steepness, though the equilibrium estimates of yield were altered somewhat depending on the selectivities used.

Discussion/conclusion: The method of calculating reference points was discussed with particular reference to when and how the selectivities should be chosen for different calculations. The key point was to avoid using estimated selectivities from an "avoidance fishery" in calculations that were pertinent to a "target fishery". The STAT asked if people thought that the plot format was useful to managers and other users of stock assessments. There was general agreement that the plot format was useful.

N: Explore why the length data shows a strong preference for high R_0. (Look at the likelihood components in the existing R_0 profiles).

Reason: It was not clear why the length data should be fitted so much better with high R_0.

Response: Likelihood components were presented for existing profiles on steepness.

Discussion/conclusion: This revealed/confirmed tensions between data sets but also within the length data (with different components pulling in different directions). Profiles on R_0 would have been more revealing perhaps, but this issue was considered low priority.

O: Request a new canary prior for steepness from Martin Dorn.

Reason: The STAT had expressed concern that the existing prior contained a steepness profile for darkblotched rockfish from the 2005 assessment which was very different from that obtained in the 2007 darkblotched assessment.

Response: Martin Dorn supplied a new prior which excluded the 2005 darkblotched rockfish profile (the 2007 darkblotched profile was not available as the assessment was still being finalized). The new prior had a mean of 0.52 (the mean of the old prior was 0.6).

Discussion/conclusion: The removal of darkblotched as the basis for revising the prior was queried as other species which contributed to the canary steepness prior had also been assessed in 2007. However, the only substantial revision had been to darkblotched (Martin Dorn, pers. comm.). It was agreed that the revised prior was preferable to the old prior.

The STAT also produced results for a run which estimated recruitment deviations from 1960 rather than the start of the model. This request was anticipated by the STAT as a similar request for arrowtooth flounder had revealed that the assessment was very sensitive to the year in which recruitment deviations were first estimated. However, the canary results were not sensitive to this choice (for the assumed low value of sigmaR).

<u>Round 3 requests</u>

P: Form a new candidate base model:

- all priors uniform;

- ***q***s estimated analytically with median unbiased option;
- use pre-recruit time series;
- steepness = 0.511 (mean of middle 50% of new Dorn prior);
- recruitment deviations estimated from 1960;
- sigmaR chosen by using an input value of 1.2 and then setting it to the output value;
- re-tune if necessary.

Reason: The above specifications were consistent with the results of previous discussions. The level of sigmaR was not specified as it was thought that the other changes might lead to a somewhat different value than that previously obtained (by the specified method).

Response: The candidate base model was not constructed as requested because of an unexpected result for sigmaR. An input value of 1.2 returned an output value of almost 1 which was considered unrealistic by the STAT. The STAT performed a number of runs at a range of sigmaR values in combination with different start years for estimating recruitment deviations and presented the results graphically. On the basis of these results the STAT tentatively defined the candidate base model with a sigmaR value of 0.5. The candidate base model also included the selectivity break-point in the trawl fisheries at 1979 and in addition included estimation of the selectivity of the smallest length bin in the NWFSC survey.

Discussion/conclusion: The discussion concentrated on the value of sigmaR to use in the base model. The results presented showed that the output value of sigmaR depended on the input value and on the number of recruitment deviations estimated. With all deviations estimated an input of 1.2 produced an output of 0.5, but with deviations estimated from 1960, an input of 1.2 returned an output of almost 1.0. The attempt to get the "data to speak" by specifying a large input sigmaR had produced an unexpected result. From a pragmatic point of view it was decided that the STAT's choice of 0.5 was acceptable, being not too large relative to other values used for rockfish and not too inconsistent with the tuned value of 0.3. There is also some evidence in the literature that tuned values tend to under-estimate sigmaR.

Q: Sensitivity to candidate base model: no recruitment deviations estimated and steepness fixed; also with steepness estimated.

Reason: Given the inability to track cohorts "by eye" in either the length or the age data the issue arose as to whether the estimation of recruitment deviations could be justified in terms of an improved fit (i.e., did the addition of the extra parameters give a sufficient decrease in the total negative log-likelihood).

Response: The total negative log-likelihood for the sensitivity was larger than that of the base model by almost three times the estimated number of recruitment deviations. The estimated value of steepness was about 0.4.

Discussion/conclusion: By "rule of thumb", the estimation of the deviations was justified by the increase in likelihood. It was interesting to note that all of the improvement was in the length data. The age data had almost exactly the same likelihood. The estimate of steepness was not very different from that in the original base model proposed by the STAT, which had relied on likelihood from the Triennial survey. It was noted that there was a clear signal in the data with regard to steepness under the assumption of deterministic recruitment (structural assumptions can impart contrast in likelihood surfaces even in the absence of "real information" in the data).

R: Sensitivities to candidate base model: single ***M*** (no ramping, same for both sexes).

Reason: This was an initial step in the exploration of whether the lack of females in the observed data could be explained by selectivity in the absence of sex-specific mortality (with higher female ***M***).

Response: Two runs were presented with fixed values of ***M*** at 0.06 and 0.07.

Discussion/conclusion: The runs showed substantially degraded fits from the comparative run with ramped female ***M***. However, this was not unexpected and it was noted that sex-specific selectivity would be needed if comparable fits were to be obtained. (See Request X).

S: Sensitivity to candidate base model: split triennial times series into two blocks (1980-92 and 1995-2004.

Reason: A continuing concern about potential changes in availability due to the change in survey timing.

Response: The time series was split as requested and separate ***q***s were estimated (with the same selectivity).

Discussion/conclusion: The bad residual pattern in the fit to the Triennial time series was eliminated with the second segment of the series being fitted almost exactly. The Panel recommended, and the STAT agreed, that the split time-series be adopted as the base model because of the concerns about surveying timing (and the poor residual pattern if the series was not split). The Chair expressed concern about the precedent set by adopting the split in the Triennial time series (with regard to assessments of other stocks which rely on it as an abundance index).

T: Explore potential seasonal effects for the Triennial trawl survey (use a simple fixed main-effects GLM).

Reason: A continuing concern about potential changes in availability due to the change in survey timing.

Response: This was not presented for canary rockfish.

Discussion/conclusion: There was a presentation with regard to arrowtooth flounder which indicated that there were some problems with the balance of the sampling – so that it appeared difficult to get meaningful estimates of seasonal effects. It was agreed that the original GLMM approach used to derive the Triennial biomass indices could perhaps be adapted to include seasonal effects. The arrowtooth-STAT agreed to attempt the desired GLMM analysis for canary as well as arrowtooth. (This was done, but was never formally presented – being somewhat peripheral to the assessment given that the split had already been agreed to for the base model.)

U: Profile over R_0 for candidate base model (or an alternative model if preferred).

Reason: To explore which likelihood components showed contrast across R_0.

Response: Profiles were produced and presented graphically.

Discussion/conclusion: Most contrast was shown by the age data. The indices were fitted better at lower mean recruitment. The length data were fitted better overall by higher mean recruitment (this did not apply to all length times series). Age data were best fitted somewhere in between. Depletion estimates were positively correlated with R_0 as were estimates of M for older females.

V: Candidate base model: compare model predictions of mean weight to observed mean weights in the at-sea whiting fleet.

Reason: It was of interest to see if the model was qualitatively consistent with the additional data.

Response: Predicted mean weights were calculated and graphically compared with the observations.

Discussion/conclusion: The predictions were consistent with the observations showing a slight trend with a decline and then an increase in comparison to the very flat observed mean weights.

W: Candidate base model (or an alternative model if preferred): do the "no fishing" run.

Reason: It is of interest to see what biomass would have been present, using the estimated parameters (in particular, recruitment deviations) in the absence of fishing (i.e., no catches removed).

Response: The run was done and the biomass trajectory was compared with that of the candidate base model. The "no fishing" trajectory was relatively flat.

Discussion/conclusion: There was discussion about how exactly the run was implemented in SS2. Two variations are conceivable. SS2 simply applies the recruitment deviations, as estimated, to the stock recruitment curve in the appropriate years. Compared with the base model, which has removals due to fishing, the deviations are applied to higher biomass. An alternative formulation is to use the estimated number of recruits – in some sense attributing recruitment to purely environmental factors. There was also discussion on the use of such runs to construct alternative “dynamic B_0” reference points (i.e., annual depletion being measured by biomass divided by the un-fished biomass in the same year). No conclusions were agreed upon.

X: Continuation of R: explore different values of ***M*** and alternative selectivities (e.g., sex specific).

Reason: See Request R.

Response: Two different values of ***M*** were tried but there was insufficient time to explore further.

Y: Sensitivity to candidate base model: use full set of conditional age-at-length data.

Reason: The STAT expressed some desire to do this run and some members of the Panel were interested to see the results.

Response: This was not done due to lack of time and some diminishment of the STAT’s desire to see the results. (It is moot whether the addition of a large amount of extra conditional age-at-length data will lead to a better assessment, but it does hugely extend the required runtime.)

Round 4 requests

Candidate base model:

As in request P with:

- sigmaR = 0.5;
- selectivity for NWFSC survey freely estimated on minimum size bin;
- 1979 selectivity split in Oregon and Washington trawl fisheries;
- split triennial time series.

Z: Run the candidate base model estimating recruitment deviations from 1950. Examine standard deviations of estimated recruitment deviations and total likelihood. Compare the 1950 and 1960 runs. Choose a year to start estimating recruitment deviations. The base model is then fully defined.

Reason: This was a final check to make sure that the choice of 1960 was appropriate.

Response: The 1950 run was done and compared to the 1960 run.

Discussion/conclusion: The 1950 run had below average recruitment estimated from 1950-58 and correspondingly higher recruitment estimated from 1990 onwards. The plot of the standard deviations of the recruitment deviations suggested there was “information” about the early recruitment deviations. This may have been an artifact of the zero sum imposed on recruitment deviations. A better fit to the data was perhaps achieved by making the later recruitments larger, given there were sufficient early recruitment deviations to balance the zero sum. However, the early low recruitment may also have been more consistent with the early fishery length frequency data. The STAT chose the original 1960 start and the Panel agreed.

AA: Profile on steepness, being sure to include the means of the lower and upper 25% tails from the new Dorn prior (i.e., low, high steepness values).

Reason: Steepness appeared to be the best candidate as a dimension of uncertainty.

Response: Results were presented for seven runs extending from the low to the high values of steepness.

Discussion/conclusion: The greatest contrast was shown by the length and age data, both of which fitted better at high steepness. The biomass indices showed very little contrast (this was a change for the Triennial survey – splitting the series had reduced the contrast significantly). There was further discussion on whether these data contained any real information on steepness and the relevance of the results to adopting a higher steepness value in the base model (compared to the 2005 assessment). Certainly, these results lend no support to the low value of steepness used in the 2005 assessment (as the only likelihood components with a "preference" favor high steepness).

AB: Sensitivity to base model: completely remove the influence of the stock recruitment relationship. Compare runs, in particular recruitments and asymptotic confidence intervals on spawning biomass. Plot recruitment versus spawning biomass and overlay alternative stock recruitment relationships (base, low, high).

Reason: It was suggested that it would be useful to see what estimated recruitments fitted the data best in the absence of an imposed stock recruitment relationship.

Response: The requested run was done and the results presented as requested. In addition, the recruitment estimates from the base model were also plotted. The freely estimated recruitments followed the same pattern as those in the base model but became increasing large and variable in the later years (from 1980 onwards).

Discussion/conclusion: There was much discussion about the correct interpretation of these results. This option, as currently implemented in SS2, does not produce interpretable reference points or estimates of virgin biomass (the estimated recruitments, in this case, had a mean level which was far larger than the estimate of $\boldsymbol{R_0}$). However, it was argued that it was still possible to interpret the estimated annual recruitments as those which gave the best fit to the data. The plot of recruitment versus spawning biomass gave no support to a Beverton-Holt stock recruit relationship (there was no indication of lower recruitment at lower stock size). There was agreement that there were other model configurations which should at least be considered in sensitivity runs in the future (and not just for canary). Two options were suggested, neither of which would impose a stock recruit relationship: estimation of an initial age structure at the start of the period where data are informative (with no need for a full catch history); or, retaining a full catch history, estimation of recruitment deviations in an internally consistent manner with average recruitment. In both cases, stock recruitment relationships can be derived from model outputs (e.g., if needed for derivation of reference points).

Description of final base model:

The final base model included all data from the original base model with the addition of the pre-recruit survey indices: catch history 1916-2006; fishery age and length data 1968-2004; NWFSC trawl survey 2003-2006; triennial survey 1980-2004; and coast-wide pre-recruit indices 2001-2006.

The final specification included:

- all priors uniform;
- ***q***s estimated analytically with median unbiased option;
- steepness = 0.511 (mean of middle 50% of new Dorn prior);
- recruitment deviations estimated from 1960;
- sigmaR = 0.5 (no tuning)
- estimate the selectivity in the smallest bin size for the NWFSC survey
- include an extra time block for fishery selectivity (break-point 1979)
- split the triennial survey abundance indices (break-point 1995)
- tune CVs and effective sample sizes.

We note here that one panelist was concerned with the decision to split the triennial survey due to the precedent this would set for other assessments. The majority of the panel felt that there were too many uncertainties regarding the seasonal distribution of canary rockfish to treat the survey as a single time series, and thus implicitly assume that the change in timing of the survey does not affect survey catches. The majority of the panel felt the case for splitting the time series was especially compelling given the residual pattern that occurred when no split was made, which closely matched the shift in survey timing. All the panel members agreed that the change in triennial survey timing needs to be considered seriously in all future assessments that use this survey, but that the decision to split the survey for canary rockfish does not necessarily imply that this is the most appropriate action in all cases.

Comments on the Technical Merits and/or Deficiencies of the Assessment:

Technical Merits:

- The preparation of documentation for the panel was excellent, and greatly facilitated the panel's ability to review the assessment.
- The assessment was based on SS2 software, which has been well tested. Using this software increased the confidence of the panel in the analysis and results.
- The method including age observations as conditional on the length was considered a better way to include age data in the model, thereby avoiding *ad hoc* weighting.
- The data have been improved considerably since the last assessment, especially

improvements in the estimation of age data precision and bias.
- The method for defining time blocks for selectivity based on information independent of the data itself improves on the previous *ad hoc* choices.

Technical Deficiencies
- Given the use of conditional age-at-length data it is not clear with this approach how to calculate effective sample size and jointly tune the model/data.
- An *ad hoc* method was used to weight the commercial age and length data.

Explanation of areas of disagreement regarding STAR Panel recommendations:

Areas of disagreement among the members of the STAR Panel:
There were no areas of disagreement among the five panelists.

Areas of disagreement between the STAR Panel and the STAT team:
There were no areas of disagreement between the STAR panel and the STAT team.

Unresolved Problems and Major Areas of Uncertainty:

Without doubt the value of steepness was the major uncertainty in this assessment. The lack of a recent directed fishery combined with the limited amount of survey data made it impossible to reliably estimate this quantity. Moreover, this same lack of recent information implies that estimated rate of rebuilding is primarily controlled by steepness. The Dorn prior suggests that values of steepness between 0.3 and 0.7 are reasonable. Such a range implies great uncertainty regarding the extent of current rebuilding and even greater uncertainty in forecasts. The Dorn prior is based on estimates of steepness in other rockfish assessments, and is sensitive to the inclusion or exclusion of stocks such as darkblotched rockfish. The estimated values of steepness in these other assessments are themselves highly uncertain, and even if they were precisely determined, the hypothesis that steepness in canary rockfish can be inferred by those in other rockfish stocks may be questionable.

Other issues that deserve further consideration include:
- the triennial survey is inefficient for canary; hence, this assessment is really predicated on catches, low natural mortality, and the assumed value of steepness. The survey data and compositional information may not permit reliable estimation of stock status.
- the possibility of a seasonal effect on q from the triennial survey should be evaluated.
- the relationship between the pre-recruit survey and recruitment deviations needs to be verified.
- stock structure and movement is poorly understood.

Concerns Raised by GMT and GAP Representatives During the Meeting:

The GAP and GMT representatives did not object to the discussion and outcome of the STAR panel review but noted the following points:

- there is a need to undertake a comprehensive analysis of all historical catch data and to assemble the information into a reference data set
- streamlined access to NWFSC data sets would be desirable
- greater examination and utilization of logbook data is encouraged

Recommendations for Future Research and Data Collection:

For the next canary rockfish stock assessment

- Assumptions about stock structure and distributional boundaries should be reviewed in light of information on Canadian/Alaskan catches.
- A catch history should be reconstructed using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. As has been previously recommended, the reconstruction needs to be done comprehensively across all rockfish species to ensure efficiency and consistency.
- Evaluate the feasibility of a bi-lateral assessment with Canadian scientists, perhaps through the TSC (Technical Subcommittee of US Canada groundfish working group).
- Investigate the importance of calendar date and other covariates on catch rates from the triennial survey and propose adjustments to account for seasonal and other variation in selectivity/availability.

Generic issues for groundfish assessments

- Establish a meta database of all data relevant to groundfish stock assessment. The database should include enough detail about the nature and quality of the data that a stock assessment author can make a well informed decision on whether it could be useful for their stock assessment.
- Establish accessible online databases for all data relevant to groundfish stock assessment, so that assessment authors can obtain the raw data if required.
- Establish a database for historical groundfish catch histories, "best" guesses and estimates of uncertainty (and processes for updating and revising the database).
- Develop a concise set of documents that provide details of common data sources and methods used for analyzing the data to derive assessment model inputs.
- Develop standard and appropriate methods for modeling age and length data, including choice of distribution, initial variance assumptions, and tuning methods (current methods can and should be improved).
- Routinely produce and present supporting documentation for any derived indices which are included in a stock assessment model (e.g., GLMM derived trawl survey abundance indices).

Acknowledgments:

The STAR panel would like to thank the NWFSC, especially Stacey Miller, for coordinating the meeting and the review of the canary rockfish stock assessment. Ian Stewart is also to be highly commended for his positive attitude, efficiency, and his willingness to endure the week-long

scrutiny by the Panel.

Agenda Item G.4.a
Attachment 13
September 2007

Stock Assessment of the Arrowtooth flounder (*Atheresthes stomias*) Population off the West Coast of the United States in 2007

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August 22, 2007

Executive Summary

Stock

This assessment reports the status of arrowtooth flounder (*Atheresthes stomias*) off the U.S. West Coast. Arrowtooth flounder are primarily found off Washington, Oregon, northern California, and north of the U.S.-Canada border. We assume a single mixed stock, using a model with one area.

Catches

Arrowtooth are commonly caught by trawl fleets off Washington and Oregon, but they are frequently discarded due to low flesh quality. For this reason, the market for arrowtooth has been fairly limited over the last 50 years. We model three components of the arrowtooth fishery:

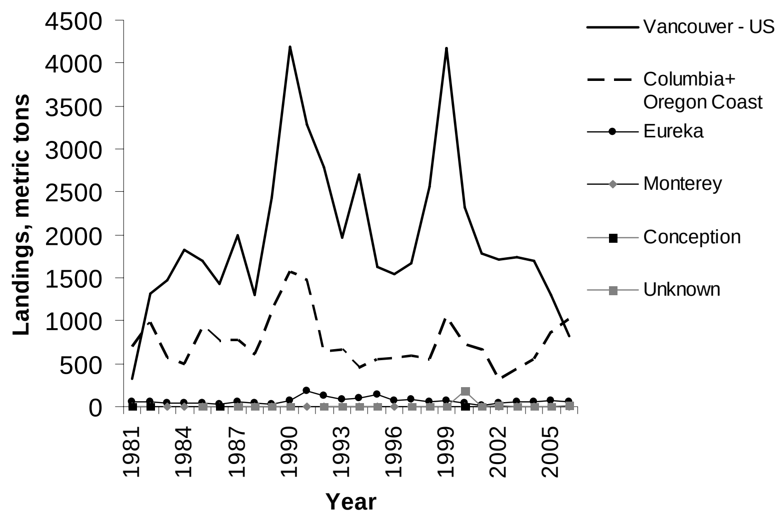
(1) the mink food fishery in the 1950s-70's
(2) a targeted fillet/headed-and-gutted fishery that began around 1981
(3) a "bycatch fleet" that represents West Coast trawl effort with arrowtooth bycatch, but no landings.

We reconstructed landings for the mink food fleet from a variety of historical sources. Landings for the fillet fleet are available from the PacFIN database, with estimates of discard from four observer programs. For the bycatch fleet, we used a simple ratio estimator to predict arrowtooth bycatch from landings of other flatfish. We calculated this ratio from the West Coast Groundfish Observer data for 2001-2006.

Table a. Recent landings of arrowtooth flounder by INPFC area.

	Catch (mt)				
Year	**Vancouver**	**Columbia**	**Eureka**	**Monterey**	**Other**
1996	1545	572	73	1	0
1997	1671	592	79	1	0
1998	2556	555	57	1	0
1999	4174	1045	64	2	1
2000	2326	717	43	0	190
2001	1777	666	20	0	1
2002	1718	317	36	1	13
2003	1746	442	53	5	1
2004	1701	557	61	2	6
2005	1299	865	70	3	2
2006	821	1025	62	2	9

Figure a. Landings of arrowtooth by INPFC area, 1981-2006.



Data and Assessment

This is the first assessment of arrowtooth flounder off the U.S. West Coast since 1993, and the first to use a modern age-structured estimation framework (Stock Synthesis 2).

We modeled both males and females, allowing for different growth between the sexes. We included catch data from 1928-2006. For indices of abundance, we included the NWFSC Shelf-Slope Survey (2003-2006), the NWFSC Slope Survey (1999-2002), the Triennial Shelf Survey (1980-2001), and the AFSC Slope Survey (1997,1999-2001). All but the NWFSC Slope Survey include information on length composition of the catch, as do PacFIN port sampling data (1986-2005). We were able to obtain and incorporate ages (from otolith readings) for a subset of fish from the NWFSC Shelf-Slope Survey and commercial landings from 1986-1991, 1998, and 2003-2005.

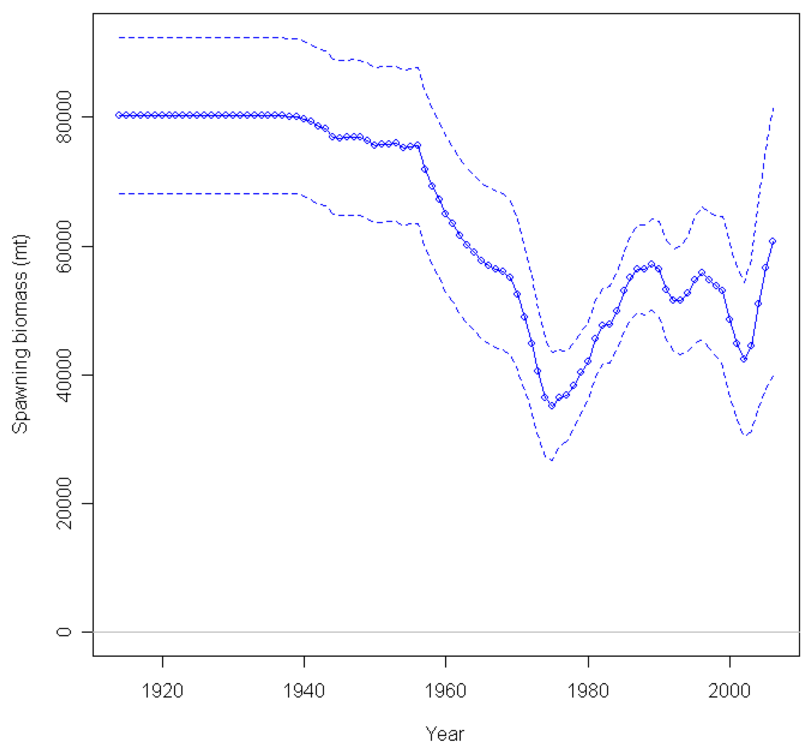
Stock biomass

The base case model shows a period of moderate depletion through the 1950s and 1960s, followed by a rebuilding of the stock beginning in the late 1970's. Recent strong year classes, in particular the 1999 year class, have led to an increase in the stock since the late 1990s. We estimated spawning biomass at the beginning of 2007 to be 63,302 mt (95% CI: 41,027-85,577). This level represents 79% of the estimated unfished spawning biomass (95% CI: 58.1%-99.5%). Total biomass at the start of 2007 was estimated to be 85175 mt.

Table b. Abundance estimates for arrowtooth flounder, 1998-2007

Year	Spawning biomass (mt)	~95% Interval			Relative depletion
1998	53,802	42,819	-	64,785	67.0%
1999	52,962	41,411	-	64,513	65.9%
2000	48,468	36,642	-	60,294	60.3%
2001	44,853	32,986	-	56,720	55.8%
2002	42,330	30,343	-	54,317	52.7%
2003	44,468	31,080	-	57,856	55.4%
2004	51,021	34,823	-	67,219	63.5%
2005	56,486	37,773	-	75,199	70.3%
2006	60,633	39,837	-	81,429	75.5%
2007	63,302	41,027	-	85,577	78.8%

Figure b. Spawning biomass of arrowtooth flounder, 1916-2007. Dashed lines are ~95% confidence intervals.



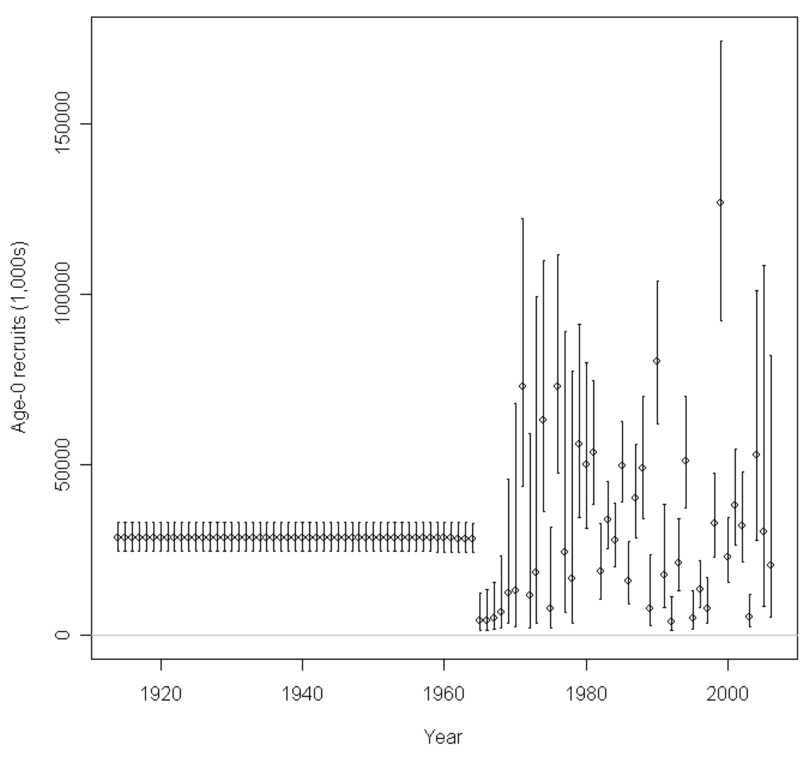
Recruitment

The model predicted that recruitment was low from 1965 to 1970, prior to the availability of age and length data or survey abundance indices. Recent strong year classes, in particular the 1999 year class, have led to an increase in the stock since the late 1990s. Estimated recruitment exceeded 50 million age-0 fish in 1990, 1994, and 1999.

Table c. Estimated recruitment of arrowtooth flounder, 1998-2007.

Year	Age 0 recruits, thousands	~95% Interval		
1998	32,876	22,763	-	47,482
1999	126,750	92,237	-	174,177
2000	22,987	15,281	-	34,578
2001	37,830	26,236	-	54,548
2002	31,901	21,348	-	47,671
2003	5,198	2,256	-	11,974
2004	52,878	27,723	-	100,857
2005	30,337	8,505	-	108,216
2006	20,535	5,147	-	81,934
2007	28,321	7,099	-	113,001

Figure c. Recruitment of age 0 arrowtooth flounder, 1916-2006. Lines are ~95% confidence intervals.



Reference points

We estimated unexploited equilibrium spawning biomass (B0) to be 80,313 mt (95% CI: 68,228-92,398). We estimate that the stock has never fallen below the overfished threshold (i.e. 25% of unfished levels (B0)). The MSY proxy target for flatfish is SPR 40%, which results in an MSY of 5,245mt (4,457 - 6,033) and a spawning stock biomass of 30,780 mt (26,149 - 35,411), or 38% of B0. The MSY proxy target for spawning biomass is SB40% and this target would result in a MSY of 5,148mt. The model estimation of MSY is 5,844mt which results in a spawning stock biomass of 16,593mt or 21% of B0 and a SPR of 0.23.

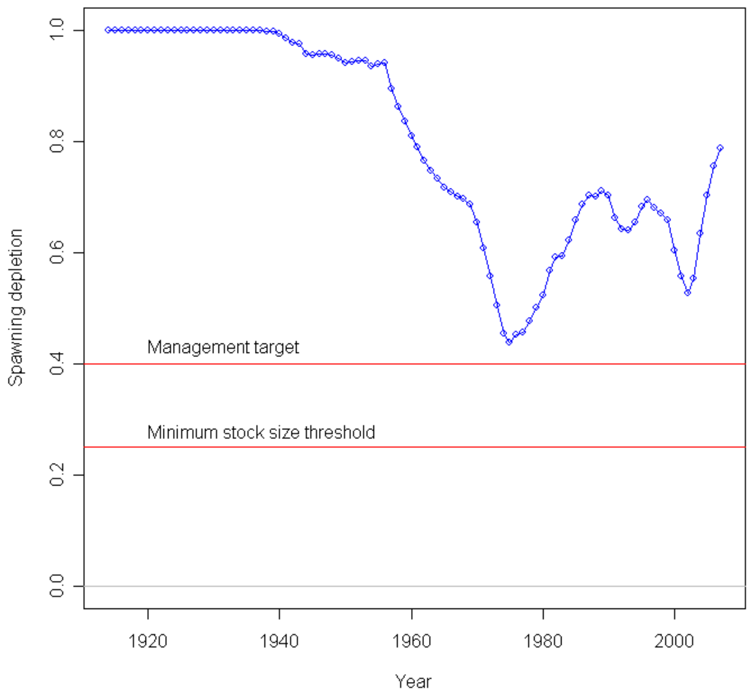
Table d. Reference points

	Point Estimate	Uncertainty in estimates (If Available)
Unfished Spawning Stock Biomass (SB_0) (mt)	80313	6166
Unfished Summary Age 3+ Biomass (mt)	98022	-
Unfished Recruitment (R_0) at age 0	28528	2180
Reference points based on $SB_{40\%}$		
Spawning Stock Biomass (mt) at $SB_{40\%}$	32125	2466
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.42	0.00000004
Exploitation rate resulting in $SB_{40\%}$	11%	-
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	5148	394
Reference points based on SPR proxy for MSY		
Spawning Stock Biomass at SPR (SB_{SPR})(mt)	30780	2363
$SPR_{MSY\text{-}proxy}$	0.40	
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	11.70%	-
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	5245	402
Reference points based on estimated MSY values		
Spawning Stock Biomass at MSY (SB_{MSY}) (mt)	16593	1294
SPR_{MSY}	0.23	0.0023
Exploitation Rate corresponding to SPR_{MSY}	21%	-
MSY (mt)	5844	449

Table e. Summary of trends for 1998-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Landings (mt)	3168	5285	3276	2464	2085	2247	2327	2240	1918	-
Estimated Discards (mt)	916	1293	1247	1155	1233	1165	990	775	489	-
Estimated Total Catch (mt)	4084	6578	4523	3619	3318	3412	3317	3015	2407	-
ABC (mt)	5800	5800	5800	5800	5800	5800	5800	5800	5800	-
OY * (if different from ABC) (mt)	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
SPR	0.62	0.49	0.57	0.61	0.62	0.62	0.64	0.69	0.75	0.73
Exploitation Rate	0.080	0.136	0.100	0.085	0.079	0.082	0.076	0.062	0.044	-
Summary Age 3+ Biomass (B) (mt)	69704	66501	59802	56890	64932	69707	74817	78961	79822	83301
Spawning Stock Biomass (*SB*) (mt)	53802	52962	48468	44853	42330	44468	51021	56486	60633	63302
Uncertainty in Spawning Stock Biomass estimate (SD)	5603	5894	6034	6055	6116	6831	8265	9548	10610	11365
Recruitment at age 0 (x 1000)	32876	126750	22987	37830	31901	5198	52878	30337	20535	28322
Uncertainty in Recruitment estimate (x1000, SD)	6221	20691	4841	7126	6607	2317	17904	21950	16507	22766
Depletion (SB/SB0)	0.67	0.66	0.60	0.56	0.53	0.55	0.64	0.70	0.75	0.79

Figure d. Time series of estimated depletion, 1916-2007.



Exploitation status

The estimated spawning potential ratio is above the proxy target of 40% for flatfish, as well as the estimated MSY level.

Table f. Estimated spawning potential ratio, 1997-2006

Year	Estimated SPR
1997	0.65
1998	0.62
1999	0.49
2000	0.57
2001	0.61
2002	0.62
2003	0.62
2004	0.64
2005	0.69
2006	0.75

Figure e. Estimated spawning potential ratio (SPR).

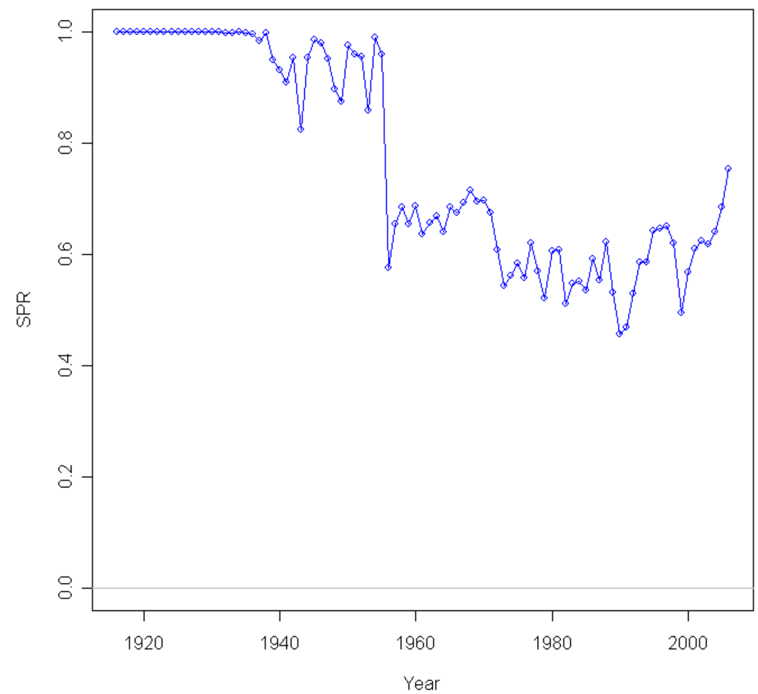
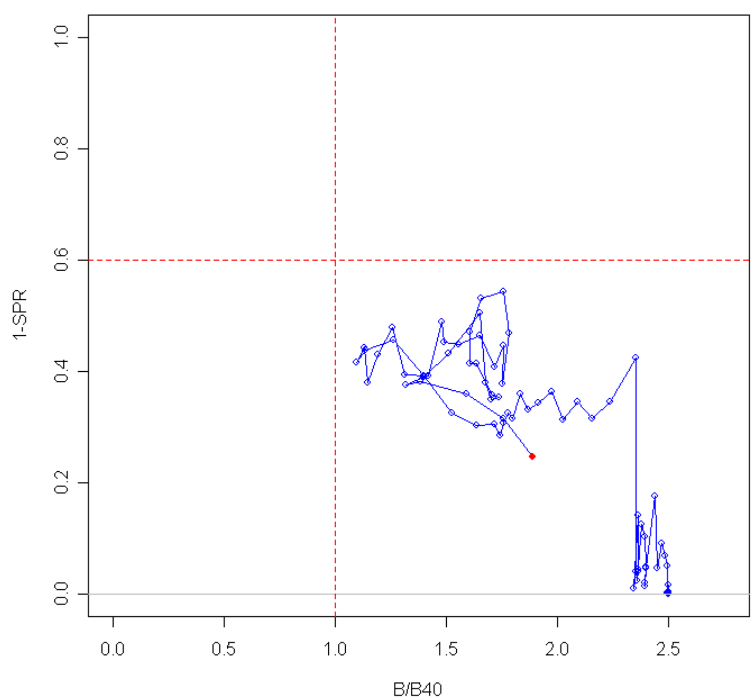


Figure f. Temporal pattern of estimated spawning potential ratio relative to the proxy target of 40% vs. estimated spawning biomass relative to the proxy 40% level.



Management performance

Landings of arrowtooth flounder are currently limited by market and bycatch, and 2006 catches are below the ABC of 5800 mt and MSY_{FSPR} of 5245 mt. Catches exceeded MSY levels in just one year (1999) in the last decade. Our estimates of total catch were based on landings plus discards from both the fillet fishery and bycatch fishery.

Table g. Arrowtooth landings, total catch, and allowable biological catch

Year	Landings (mt)	Estimated total catch (mt)	ABC (mt)
1997	2343	3569	5800
1998	3168	4084	5800
1999	5285	6578	5800
2000	3276	4523	5800
2001	2464	3619	5800
2002	2085	3318	5800
2003	2247	3412	5800
2004	2327	3317	5800
2005	2240	3015	5800
2006	1918	2407	5800

Unresolved problems and major uncertainties

Estimates of historical catch are highly uncertain, particularly for the bycatch fleet (i.e. vessels that don't retain any arrowtooth). To address this, we examined alternative scenarios that included model runs with levels of catch that were either half or twice our best estimate of total catch. This approach suggests that final estimates of depletion are not sensitive to levels of historical catch, but estimates of unfished biomass (B0) are roughly proportional to catches.

We assumed fixed values for natural mortality and steepness of the stock-recruitment relationship. In the base case model, steepness was set at 0.902 based on Dorn's meta-analysis (personal communication). Natural mortality was fixed at 0.166 for females based on Hoenig's method (1983), and 0.274 based on model exploration. Likelihood profiles suggest that the estimates of biomass and depletion are not sensitive to values of steepness. Assumed values of natural mortality have a small effect on estimated depletion, but strongly influence the estimates of absolute biomass.

Forecasts

We generated forecasts of stock size and catch for 2007-2018. Catch for 2007 and 2008 was set equal to the average catch for 2004-2006. Catch for 2009-2018 was fixed at the maximum potential catch removable under the 40:10 harvest control rule, with MSY based on the Council's SPR proxy (F_{SPR}). This forecast estimated that total catch (including discards) could equal 11,267 mt in 2009, falling to 5,804 mt in 2018. Based on West Coast Groundfish Observer estimates of discard rates, landings for 2009 and 2018 would be approximately 8200 and 4100 mt, respectively. Spawning stock biomass would fall from 63,302 mt in 2007 to 34,026 mt in 2018 as a result of fishing and the decline of the large 1999 year class. Depletion would approach target levels, reaching a value of 0.42 in 2018.

Table h. Forecasts of stock size, catch, and depletion for 2007-2018.

Year	Total Catch (mt)	Spawning Biomass	95% CI	Depletion	95% CI
2007	2,913	63,302	41,027 - 85,577	0.79	0.58 - 1.00
2008	2,913	64,214	40,896 - 87,532	0.80	0.58 - 1.02
2009	11,267	65,625	41,066 - 90,184	0.82	0.58 - 1.05
2010	10,112	59,139	37,073 - 81,205	0.74	0.52 - 0.95
2011	9,109	52,993	33,077 - 72,909	0.66	0.46 - 0.86
2012	8,241	47,804	29,517 - 66,091	0.60	0.41 - 0.78
2013	7,518	43,686	26,396 - 60,976	0.54	0.36 - 0.73
2014	6,950	40,517	23,745 - 57,289	0.50	0.32 - 0.69
2015	6,523	38,125	21,597 - 54,653	0.47	0.29 - 0.66
2016	6,207	36,341	19,938 - 52,744	0.45	0.27 - 0.64
2017	5,975	35,015	18,697 - 51,333	0.44	0.25 - 0.62
2018	5,804	34,026	17,785 - 50,267	0.42	0.24 - 0.61

Decision Table

The decision table considers the uncertainty in 'states of nature' regarding natural mortality and past catches. We considered three states of nature: (1) the base model, (2) a high productivity scenario with twice the base historical catch and high natural mortality, and (3) a low productivity scenario with half the base historical catch and low natural mortality. The three options for management action all involved setting 2009-2018 catches equal to the maximum potential catch removable under the 40:10 harvest control rule, with MSY estimated using the SPR proxy. The three management actions differ in that each catch series is based on models that assume alternate states of nature with very different estimates of MSY.

If we calculate our management action (catch) using the base model, but the stock was less productive than assumed, spawning biomass would decline by more than a factor of three by 2011. Complete depletion would occur by 2013 (see Table i, Model A, and the second management action). The decision table gives a timeframe of how rapidly the stock would decline if it truly were as unproductive as in the model with low catch and low natural mortality.

The very high MSY estimated in the productive high historical catch+ high natural mortality model would lead to rapid depletion of the stock, if the true state of nature were actually less productive. However, we feel that given the market and bycatch restraints placed on the arrowtooth fishery, it is unlikely that catches could approach the 40,000-110,000 mt range associated with this scenario.

Table i. Decision table showing the consequences of management actions given three alternate states of nature

			State of Nature					
			Model A **Catch = 1/2x Base Model** **M=0.106 female, 0.214 male**		**Base Model** **M=0.166 female, 0.274 male**		**Model B** **Catch = 2x Base Model** **M=0.246 female, 0.354 male**	
Management action	Year	Total Catch (mt)	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
2009-2018 catch = OY estimated from Model A	2007	1,457	21,680	0.65	63,302	0.79	561,030	0.94
	2008	1,457	22,833	0.68	65,462	0.82	547,141	0.92
	2009	2,668	24,091	0.72	68,087	0.85	542,726	0.91
	2010	2,639	23,875	0.71	68,912	0.86	538,509	0.90
	2011	2,574	23,144	0.69	68,694	0.86	533,054	0.89
	2012	2,476	22,163	0.66	68,155	0.85	531,780	0.89
	2013	2,357	21,095	0.63	67,575	0.84	534,153	0.90
	2014	2,233	20,029	0.60	67,028	0.83	538,438	0.90
	2015	2,115	19,023	0.57	66,559	0.83	543,600	0.91
	2016	2,009	18,107	0.54	66,191	0.82	549,022	0.92
	2017	1,915	17,296	0.52	65,928	0.82	554,317	0.93
	2018	1,834	16,590	0.50	65,765	0.82	559,257	0.94
2009-2018 catch = OY estimated from base model	2007	2,913	21,680	0.65	63,302	0.79	561,030	0.94
	2008	2,913	21,549	0.65	64,214	0.80	545,940	0.92
	2009	11,267	21,488	0.64	65,625	0.82	540,449	0.91
	2010	10,112	13,629	0.41	59,139	0.74	529,402	0.89
	2011	9,109	6,454	0.19	52,993	0.66	518,869	0.87
	2012	8,241	455	0.01	47,804	0.60	514,013	0.86
	2013	7,518	997	0.03	43,686	0.54	514,014	0.86
	2014	6,950	0	0.00	40,517	0.50	516,846	0.87
	2015	6,523	0	0.00	38,125	0.47	521,202	0.87
	2016	6,207	0	0.00	36,341	0.45	526,247	0.88
	2017	5,975	0	0.00	35,015	0.44	531,435	0.89
	2018	5,804	0	0.00	34,026	0.42	536,427	0.90
2009-2018 catch = OY estimated from Model B	2007	5,826	21,680	0.65	63,302	0.79	561,030	0.94
	2008	5,826	18,981	0.57	61,716	0.77	543,536	0.91
	2009	142,422	16,310	0.49	60,707	0.76	535,893	0.90
	2010	110,290	0	0.00	0	0.00	417,209	0.70
	2011	89,743	0	0.00	0	0.00	338,487	0.57
	2012	77,015	0	0.00	0	0.00	291,344	0.49
	2013	69,569	0	0.00	0	0.00	265,174	0.44
	2014	65,551	0	0.00	0	0.00	251,268	0.42
	2015	63,486	0	0.00	0	0.00	243,887	0.41
	2016	62,382	0	0.00	0	0.00	239,682	0.40
	2017	61,559	0	0.00	0	0.00	236,952	0.40
	2018	60,936	0	0.00	0	0.00	235,059	0.39

Introduction

1.1 Life history and ecology

Arrowtooth flounder (*Atheresthes stomias*) are an abundant flatfish commonly found in areas from Northern California through the Bering Sea and in depths from 50 to 800 m. They are members of the family *Pleuronectidae*, the right eyed flounders. Arrowtooth reach sizes of nearly 90 cm and can live to 27 years. Female arrowtooth off Oregon reach 50% maturity at 8 years of age, and males at 4 years (Hosie 1976). Rickey (1995) found that the arrowtooth reach 50% maturity at lengths of 36.8 cm for females and 28 cm for males off Washington, and 44 cm for females and 29 cm for males off Oregon. As a comparison, female length at 50% maturity is 47 cm in the Gulf of Alaska(Turnock, Wilderbuer and Brown 2005) and 38 cm in British Columbia (Fargo and Starr 2001).

Arrowtooth are batch spawners (Rickey 1995). They spawn in the deeper continental shelf waters (>200 m) in the late fall through early spring and appear to move inshore during the summer (Zimmerman and Goddard 1996). Eggs are fertilized externally and are about 2.5 mm in diameter. The larvae spend approximately 4 weeks in the upper 100 m of the water column (Fargo and Starr 2001) and settle to the bottom in the late winter and early spring.

Arrowtooth are piscivorous, but they also eat shrimp, worms, and euphausids (Love 1996). Buckley et al. (1999) analyzed 380 arrowtooth stomachs that were collected in 1989 and 1992 from Oregon and Washington and found that hake (*Merluccius productus*) and unidentified gadids dominate their stomach contents (45 and 22% respectively) followed by herring (19%; *Clupea pallasi*), mesopelagics (0.5%), rex sole (1%; *Glyptocephalus zachirus*), slender sole (*Lyopsetta exilis*) and other small flatfish (3%), other arrowtooth (1.5%), other unidentified flatfish (1%), pandalid shrimp (~3%), and euphausiids (3%). Yang (1995) analyzed 1144 stomachs from arrowtooth collected in the Gulf of Alaska, and found that walleye pollock (*Theragra chalcogramma*) composed 66% of the arrowtooth diet, although arrowtooth smaller than 40 cm primarily feed on capelin (*Mallotus villosus*), herring, and shrimp. Gotshall (1969) examined 425 arrowtooth stomachs from Northern California throughout the 1960s and found that pandalid shrimp made up nearly 40% of the prey by volume, along with other shrimps, crabs, euphausiids, sanddabs (*Citharichthys sordidus*), and slender sole. However, Gotshall's samples were taken directly from shrimp beds, so higher concentrations of shrimp would be expected. It is clear that arrowtooth have a broad diet, consuming most of the common fish and invertebrates found on soft bottom substrate and in the water column.

Predators of juvenile arrowtooth include skates, dogfish, shortspine thornyhead, halibut, coastal sharks, orcas, toothed whales, and harbor seals (Field 2004, Field et al. 2006). Adult arrowtooth are likely to be vulnerable only to the largest of these predators.

1.2 Stock structure

To our knowledge, no tagging, genetic work, or otolith microchemistry studies have been done to estimate arrowtooth movement or population connectivity. It is likely that the stock off the U.S. West Coast is linked to the population off British Columbia and, possibly, to the stock in the Gulf of Alaska. However, in this assessment we assume that the U.S. West Coast population is a unit stock.

1.3 Historical and current fishery

Arrowtooth are commonly caught by trawl fleets off Washington and Oregon, but they are frequently discarded due to low flesh quality. The market for arrowtooth has been fairly limited over the last 50 years, and the arrowtooth fishery differs from those fisheries that target other flatfish. Below, we discuss the three main sources of arrowtooth mortality arising from commercial fishing: 1) the historical mink food fishery, 2) the targeted fillet fishery, and 3) a "bycatch fleet" that represents west coast trawl effort with arrowtooth bycatch, but no landings.

1.4.1 Mink food fishery

Large, unselective flatfish fisheries for mink food operated in Oregon and Washington in the 1950's through 1970's (Hosie 1976). Mink ranching began in 1925 in Oregon, and many mink ranches switched to using fish scrap during the 1940's (Jones and Harry 1960). Between 1945 and 1957, mink production increased from 56,000 to 250,000 animals. Beginning in 1953, with the downturn in the fillet market, an increasing number of vessels targeted a range of flatfish species for use as mink food. In the 1950s, three plants devoted to mink food production were built in Astoria, Newport, and Winchester Bay. During that same period, other processors handled mink food in addition to fillets (Jones and Harry 1960). Between 1953 and 1956, arrowtooth flounder comprised 21-41% of landings for mink food by weight (Jones and Harry 1960). Hosie (1976) reported that arrowtooth were landed as mink food at least through 1974. Landings declined throughout the 1970's. In this assessment we assume that all landings of arrowtooth before 1980 were used by the mink food fishery.

The use of arrowtooth and other groundfish scraps for California's animal food production (for mink and household pets) began in 1952 in Fort Bragg, Oakland, and Fields Landing (Best 1959). Sampling at the Fields Landing plant found that 30% of landings in 1956 and 17% of landings in 1957 were arrowtooth (Best 1959). Hake and sablefish made up most of the other landings used for animal food. Species composition at the other plants are not available, but Best (1959) reported that animal food was derived from bycatch in fisheries targeting other fish for fillet markets.

Landings of arrowtooth as mink food are reported in historical sources, many of which have been used in previous West Coast flatfish assessments (Sampson 2005, Stewart 2005, Lai et al. 2005). Most of the early data sources are in approximate agreement with the NMFS Annual Commercial Landings Database (www.st.nmfs.gov/st1/commercial/landings/annual_landings.html). We used landings from this database for all available years through 1980, supplementing them with earlier time series when necessary.

California landings for 1950-1953 were taken from California Department of Fish and Game (1968), and for 1954-1980 from the NMFS Annual Commercial Landings database (Table 1, Figure 1). We did not use data from Fish and Wildlife Service (1942-1964), which closely agreed with data from the NMFS Annual Commercial Landings database for 1958-1960 but which reported lower landings than the NMFS database for 1961-1964. Oregon catches for 1928-1949 were taken from Cleaver (1951), for 1950-1953 from Smith (1956), and for1956-1970 from PSMFC (1981); no data are available for 1954-1955 (Table 1, Figure 2). Landings for 1971-1980 are from the NMFS Annual Commercial Landings database. We did not use data from Hosie (1976), who reported 1956 landings of 1900 mt, much greater than the 1240 mt for that same year reported in PSMFC (1981) and the 1280 mt reported for 1953 in Smith (1956). Washington landings are from PSMFC (1981) for 1956-1972 and from the NMFS Annual Commercial Landings database for 1972-1980 (Table 1, Figure 3).

Coast-wide landings for mink food peaked in 1956 at 3,700 mt with catches exceeding 1000 mt from 1953 to1967. California landings peaked at under 520mt in 1956. As expected, landings were higher in Oregon and Washington given the distribution of arrowtooth. Oregon landings peaked at 1280 mt in 1943 and 1953. Washington landings reached 1900 mt in 1956 and then declined.

1.4.2 Arrowtooth fillet/headed-and-gutted fishery

A targeted arrowtooth fishery developed in the late 1970s, delivering arrowtooth to Bellingham, WA, and became established in 1980-1981 (K. Bornstein, personal communication). Vessels have been targeting arrowtooth for fillets, but more recently they have entered the headed-and-gutted market. While processors in Warrenton can also handle arrowtooth, the demand and the ability to process them is low coast-wide due to flesh quality. Whenever arrowtooth are landed, they are usually from short trips or from tows at the end of longer trips (M. Larkin and K. Smotherman, personal communication). PacFIN data indicate that most of the catch is in the Vancouver and Columbia INPFC areas (Figure 4) using flatfish bottom trawl gear (Figure 5).

Fluctuating market demand is a key characteristic of this fishery. Over the past 25 years, small numbers of vessels have participated in the arrowtooth fishery whenever there has been a market for it (M. Larkin, personal communication) and when regulations allowed. The West Coast Groundfish Observer data further confirms the sporadic nature of the market. Of all observed groundfish trawl trips that have caught arrowtooth, only 63% retained any arrowtooth catch, 54% retained more than one-third the catch, and 51% retained more than one-half the catch (WCGOP 2006).

Regulations as well as markets have led to fluctuation in fishing effort for arrowtooth. In 2001-2004, an exempted fishing permit (EFP) was issued for seven vessels in a targeted arrowtooth fishery operating off northern Washington. This permit is no longer available (Wallace 2002, Eisenhardt 2005). Bycatch of rockfish also limits fishing opportunity for arrowtooth.

Size-at-retention is likely to vary from 12” to 20” (30-51cm), depending on market conditions and catch size composition (M. Larkin and K. Smotherman, personal communication). Currently, one Bellingham processor is only accepting fish larger than 16” (41cm) for the headed-and-gutted market (K. Bornstein personal communication). Discards are a function of both size and market availability. Observations of discard fraction are shown in Figure 6, and discussed further in *Assessment* below.

In this assessment we assumed that all landings beginning in 1981 are from this targeted arrowtooth fishery (“fillet fishery”), which we expect represents less than one-third of groundfish trips in Oregon and Washington. Of all groundfish bottom trawl trips in the Columbia and Vancouver INPFC areas from 1981-2006, only 20% retained >500 kg of arrowtooth, 33% retained >100kg, and 43% retained any arrowtooth (PacFIN 2007).

1.4.3 *Bycatch trawl fishery*

As discussed above, the majority of bottom trawl trips off Washington, Oregon, and northern California do not land arrowtooth flounder, but many of them are likely to encounter it as bycatch. Observer data (WCGOP 2007) suggest that 37% of arrowtooth catch was discarded from 2001 to 2006, probably due to market availability as well as encounter rates.

It is likely that arrowtooth have been unintentionally caught by West Coast flatfish trawlers since the inception of the trawl fisheries. Harry (1961) reported that the Oregon trawl fishery for flatfish began with a series of exploratory ventures between 1908 and and 1934. These attempts failed, primarily due to a lack of markets. In 1937, two vessels in Oregon began catching fish for the San Francisco market. They were followed by other vessels in Newport and Astoria, using a mix of beam trawl, otter trawl, and paranzella nets. The fishery expanded rapidly during World War II when markets for groundfish increased. Hermann and Harry (1963) reported that arrowtooth made up 6-23% of the catch from 41 trips targeting flatfish (for fillet market) from 1950 to1961 off Oregon.

Since arrowtooth co-occur with other flatfish, we assumed a simple ratio estimator to predict arrowtooth discard in relation to landings of other flatfish. An analysis of the 2001-2006 WCGOP trawl data, excluding hauls that retained arrowtooth, suggests that arrowtooth bycatch is 0.13 times the summed coast-wide landings of English sole, petrale, and Dover sole. To estimate bycatch for 1956-1980 (before PacFIN landings data were available), we applied this multiplier to summed coast-wide trawl landings reported in prior flatfish assessments (Stewart 2005, Lai et al. 2005, Sampson 2005). This time period is prior to the fillet fishery. For 1981-2006, we also calculated arrowtooth bycatch using the same multiplier (0.13) of coast-wide Dover, English, and petrale landings. We applied the multiplier to groundfish trips reported in PacFIN. We excluded all trips with any arrowtooth landings to prevent any possible double-counting of trips in the fillet fishery.

The multiplier (0.13) is comparable to values from other bycatch studies. The Enhanced Data Collection Program in Oregon from 1995 to1999 involved 235 trips and 2172 tows.

Excluding trips with arrowtooth retention, arrowtooth bycatch was 9.6% of the landings of English, petrale, and Dover sole. The Pikitch discard study in Oregon included 138 trips and 409 tows from 1984 to1988. On trips without arrowtooth retention, the arrowtooth bycatch was 16.6 % of the amount of English, petrale, and dover soles that were caught.

There is considerable uncertainty about both discards and landings. Sensitivity analysis done on them is described in the results below.

2. Assessment

2.2 Fishery independent data

Survey biomass indices

This assessment used biomass indices from four surveys: the AFSC-NWFSC Triennial Survey, the AFSC Slope Survey, the NWFSC Slope Survey (1998-2002), and the NWFSC Shelf-Slope Survey (2003-2006). Figure 7 provides a summary of the year and depth coverage of these surveys. Because arrowtooth flounder live on both the continental shelf and slope, all four surveys provide relevant information on this species.

The Triennial Shelf Survey was conducted by the Alaska Fisheries Science Center (AFSC) from 1977 to 2001. The AFSC contracted two Alaska-class trawlers every third year for this survey. In 2004, the NWFSC conducted the Triennial Survey using identical sampling protocols and types of vessels. Details of the methodology are in Dark and Wilkins (1994) and Weinberg et al. (2002). For this analysis we did not include data from 1977 due to the high frequency of tows with insufficient bottom contact.

The AFSC Slope Survey was conducted on a yearly basis by the *R/V Miller Freeman*. Towing speed was 2.3 knots with 30 minutes of bottom contact. Net performance and area swept were monitored using SCANMAR and a bottom contact sensor with GPS. The spatial coverage of the AFSC Slope Survey was highly variable over time. We used data for 1997 and 1999-2001, when the AFSC Slope Survey sampled coast-wide (from the Canadian border to Pt. Conception) and up to depths of 1000 m. The AFSC Slope Survey was terminated in 2001. Details about this survey can be found in Lauth et al. (1998).

The Northwest Fisheries Science Center (NWFSC) conducted a slope-only survey from 1998 to 2002, which originally focused on Dover sole, thornyheads, and sablefish (DTS). For this analysis we did not include data from the 1998 pilot year. Target towing speed was 2.2 knots with 15 minutes bottom contact. GPS navigation, a Simrad ITI net mensuration system, and a bottom contact sensor were used to monitor trawl performance and calculate haul distance and net dimensions (Turk et al. 2001, Keller et al. 2005, 2006a, b). The NWFSC consistently covered depths between 183 m and 1280 m in all years, extending as far south as Point Conception (34.5° N. Lat.). The survey was extended to the southern boundary of the Conception area (32.5° N. Lat.) in 2002, but this is well south of the range of arrowtooth flounder. This survey used a fixed transect design.

Since 2003 the NWFSC has conducted a coast-wide shelf-slope survey. This survey included the depths sampled by the previous NWFSC Slope Survey as well as tows in depths as shallow as 50 m. The shelf-slope survey uses a stratified random block design; other than that the methods are similar to the 1998-2002 slope survey. In this assessment we retained the 2003-2006 shelf-slope survey as an independent time series rather than combining it with the 1998-2002 slope survey. The decision not to combine these surveys was based on (1) concerns over differences in methodology, particularly the fixed transect vs. stratified random designs, and (2) the fact that only the NWFSC Shelf-Slope Survey offers complete and ongoing coverage of the full depth range of arrowtooth.

Each of these four surveys (NWFSC Slope, NWFSC Slope-Shelf, AFSC Slope, and Triennial) was used to develop an index of abundance for arrowtooth flounder. To develop the stratification for these indices, we plotted average catch (kg/ha) and average body weight as functions of depth and latitude for each survey (Figures 8-10). These plots show peak arrowtooth abundance depths at around 155-270 m, with no arrowtooth south of 36° N. Lat. Above 43° N. Lat. both catch rates and fish size increase, with catch rates increasing most dramatically north of 47.5 °. This post-stratification procedure was not meant to reduce catch rate variance but rather to characterize geographic variation in biological features (e.g., average body size and density) of the population.

We based the stratification for each of the surveys on these distributional patterns as well as on the necessity of having sufficient sample sizes within each stratum. For the Triennial Survey and NWFSC Shelf-Slope Survey, latitudinal strata consisting of the INPFC areas were adequate (Vancouver, Columbia, and Eureka+Monterey). Due to the small number of northern hauls in the AFSC and NWFSC Slope Surveys, we shifted the boundary between the northernmost two strata from 47.5 to 46°N. Final post-stratification definitions are shown in Table 2 along with sample sizes and basic statistics of central tendency and dispersion.

A Delta-GLM was applied to each survey to derive indices of population biomass (Table 3 and Figures 11-12). The delta distribution (Aitchison and Brown, 1957) was used to model the survey data because there were many zero catches. This error model is based on the premise that it is possible to treat separately the question of whether a catch rate is zero from the size of the catch given that it is non-zero (Pennington 1983, Stefansson 1996). As such, two separate GLMs were applied to each of the four surveys. The first GLM estimated the probability of a positive haul, assumed to arise from a Bernoulli process, and the data on zero/non-zero hauls were modeled using a binomial error model. The second GLM estimated the positive catch rate for each stratum with an assumed error structure. The gamma error model was selected as the most appropriate among competing models of the exponential family based on the Akaike Information Criterion (AIC) (Akaike 1974), as specified by Dick (2005). Also, in the case where the NWFSC Shelf-Slope Survey uses four vessels chartered at random from the West Coast groundfish trawl fleet, a generalized linear mixed model (GLMM) was applied to account for the extra variance components due to vessel effects. Details of applying the GLMM to the multi-vessel survey can be found in Helser et al. (2004).

To fit the model to the data, a sampling-based Bayesian analysis was conducted to obtain a pseudo-random sample from the joint posterior density of the variance components and other parameters in the mixed model (Tierney 1994; Wolfinger and Kass 2000). Details on the algorithm applied to variance component and mixed models and simulations on its efficiency can be found in Wolfinger and Kass (2000). Bayesian results were also compared to restricted maximum likelihood estimates (REML, Littell et al. 1996; Wolfinger and O'Connell 1993) for parsimony. Model results of the marginal posterior of parameter estimates were evaluated relative to using both a uniform prior density for the variance components and an uninformative reference version of Jeffreys' prior (product of inverse gamma densities). In either case, the resulting marginal posterior distributions are very similar, suggesting that the results are relatively insensitive to choice of priors.

Results of the GLMs are shown in Table 3 and Figures 11-13. Estimates of strata-specific arrowtooth flounder density from the GLMs indicate that densities are higher in the northern deeper strata (Table 3). This is consistent across all four trawl surveys and reflects the empirical pattern in the raw catch rate data. While coefficients of variation (CV) are quite high in some strata, sometimes in excess of 0.7, CVs are quite reasonable on an annual basis, ranging from 0.2 to 0.5. In general, the Delta-GLMs fit the proportion and positive catch data reasonably well. Figure 11 shows a close correspondence along a 1:1 line between the predicted proportion positive and the observed proportion positive based on the binomial error model. Goodness-of-fit for the positive catch rate GLMs was evaluated by plotting the value of the deviance residual (McCulloch and Nelder 1989; p. 39), generated from the appropriate deviance function and inverse link of the linear predictor, as a function of the linear predictors. We also plotted standardized normal Q-Q plots from the NWFSC-AFSC GLMMs, which were the most parameterized. As in the case of traditional linear models, measures of goodness-of-fit are seen as uniformly distributed deviance residuals above and below a zero reference line when plotted against the linear predictors and deviance residuals, which are well approximated by a standard normal distribution (Figure 12).

Additionally, convergence to a stationary distribution was generally achieved from an MCMC sample of 20,000 draws, the first 10,000 of which were discarded and the remaining 10,000 thinned to one draw for every 10^{th} sample. In some cases longer chains were required, up to a maximum of 50,000 draws with correspondingly larger burn-in and thinning intervals. MCMC convergence diagnostics are illustrated in Figure 13 from the NWFSC Shelf-Slope Survey and suggest no evidence of non-convergence. Diagnostic plots for the other surveys are qualitatively similar and are not shown.

Model results are summarized in all cases based on 1,000 MCMC samples and presented in a series of tables that provide medians of the marginal posterior distributions and labeled as "Predicted" quantities. (CVs for each of the predicted values are given relative to the posterior median values).

For each GLM, convergence was obtained using restricted maximum likelihood. Although the sampling-based Bayesian algorithm was used to quantify the marginal posterior median estimates of biomass and their uncertainty, comparison with the maximum likelihood estimator revealed that the two are essentially equal. The Bayesian approach provided an efficient method for propagating uncertainty and integrating the results of both the proportion positive and catch rate GLM analyses. In a purely maximum likelihood approach, this last step would require post-analysis Monte Carlo simulation where biomass is generated as the product of two multi-variate normal distributions using the vector of linear predictors and variance-covariance matrices estimated from the GLMs or GLMMs.

Results of the Delta-GLM applied to the surveys are given in detail in Table 3 and in figures within *Base run results* below. Table 3 provides the predicted proportion positive, the predicted catch rate (given a positive haul), and predicted biomass for each stratum. Overall, the abundance indices show an increase in abundance in recent years in the Triennial Survey (beginning in 1998) and the AFSC Slope Survey (beginning in 1999). NWFSC slope and slope-shelf surveys show little trend in abundance.

Survey length composition

Samples of length frequency data were available from the 2003-2006 NWFSC Shelf-Slope Survey (n=170-219 tows/year), the 1997 and 1999-2001 AFSC Slope Survey (37-43 tows/year), and the 1980-2004 Triennial Shelf Survey (Table 4). The Triennial Shelf Survey for 1980 and 1983 had very low sample sizes of just 15 and 2 tows, respectively, with arrowtooth length information, but later sample sizes ranged from 136 to 321 tows (Table 4). No length composition data were recorded for arrowtooth during the NWFSC Slope Survey (1998-2002). We generated annual length frequencies by sex, using the same stratification as in the GLM (Table 2). Lengths were binned into 35 two-cm bins ranging from 12 to 80 cm. Observed length frequencies were expanded into annual estimates by first expanding each tow's length composition based on the proportion of fish sampled within that tow, and then expanding by swept area of each tow to derive stratum-level estimates. Length frequencies were then summed over strata to yield annual length compositions.

Age composition data

Age-frequency data are from the NWFSC Shelf-Slope Survey (2003-2006) and the PacFIN commercial data (see the *Fishery dependent data* section below). Sample sizes are shown in Table 4. Ages for the NWFSC Shelf-Slope Survey were determined from otoliths by the Cooperative Aging Lab in Newport, Oregon. These were compiled as conditional age-at-length distributions by sex and year. This is akin to entering each row of the age-length key as a separate observation, instead of the sum to the age margin. 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. If the marginal age compositions are used with the length compositions, then there is the problem of double-counting sex-ratio and year-class strength information, as the same fish contribute to total likelihood components that are assumed to be independent. Using conditional age-distributions at length captures just the additional information from the limited age data (compared to the more numerous length observations), thus eliminating double-counting in the total likelihood. The other benefit of using conditional age-composition observations is that, in addition to being able to estimate the basic growth parameters ($L_{age\text{-}1}$, $L_{age\text{-}20}$, K) inside the assessment model, the distribution of lengths at a given age are reliably estimated. This distribution is usually governed by two parameters, the CV of length at some young age and the CV at an older age. This information could only be derived from marginal age-composition observations in the case of very strong and well-separated cohorts that have been accurately aged and measured—rare conditions at best. By fully estimating the growth specifications within the stock assessment model, we were able to include this major source of uncertainty in the assessment results. Therefore, conditional age-at-length compositions were developed for the NWFSC Slope-Shelf Survey age-data and the PacFIN commercial age-data in order to retain objective weighting of the length and age data and to fully include the uncertainty in growth parameters (and thereby avoid potential bias due to external estimation where size-based selectivity is operating).

Age distributions included 30 bins from ages 1 to 30. It is often useful for interpretation purposes to compute the marginal age-compositions and to include these in the assessment model for comparing the 'implied' fit to the margin of the age-length key. Likelihood contributions of marginal age-compositions are turned off so as not to affect model fit in any way. The marginal age-compositions allow for easier visual tracking of strong cohorts and are more familiar to those accustomed to diagnosing model fit based on marginal age-composition data. Age information is still imparted to the model using conditional age-at-length observations.

No within-method comparisons (cross-reads) were available to estimate the standard deviation of aging error. Since age data from the NWFSC slope-shelf survey used current break-and-burn aging methods, we assumed no bias in the data. The standard deviation of aging error was taken from English sole (Stewart 2007).

Fishery dependent data

Commercial landings time series are described above (see *Historical and current fishery*). For the fillet fishery, we expanded the landings data by a time-varying discard fraction to calculate total catch, which we input to the model. Observations of discard proportion for the fillet fishery are available for 1985-1987 from the Pikitch discard study (Pikitch 1998), for 1996-1998 from Oregon's Enhanced Data Collection Program (EDCP), for 2001 from the Bellingham Exempted Fishery Permit data (Wallace 2001), and for 2001-2006 from the West Coast Groundfish Observer Program (WCGOP 2006). For these estimates of discard, we included only trips that retained arrowtooth; other trips were included under the "bycatch" fleet. These observations of discard fraction and the smoothed value we used to represent them are shown in Figure 6.

For the fillet fishery, we used length-composition data for 1986-2006 from PacFIN (2007) commercial landings (Table 4). These data included sex-specific length frequencies at the trip and gear level. We expanded the data to estimate the corresponding statistic from the entire landed catch for each stratum and each year that sampling occurred. The analytic steps are summarized as follows:

1) Extract biological observations by sex, gear type (trawl only) and INPFC region
2) Count lengths in each size bin and for each sex within trip as the "raw" frequency data
3) Expand the raw frequencies from the trip level to account for the landings in each trip
4) Sum frequencies within INPFC area
5) Expand the summed frequencies to account for the total landings
6) Calculate sample sizes (number of samples and number of fish within sample) and normalize to proportions that sum to unity over both sexes within each year.

To complete step 3, it was necessary to derive a multiplicative expansion factor for the observed raw length frequencies of the sample. This expansion factor was calculated for each sample as the ratio of the total landed weight of the species in a trip divided by the total weight of all clusters in the sample from that trip. In cases where there was not an estimated sample weight, a predicted weight of the sample was computed by applying the length-weight relationship used in the assessment to each length in the sample, then summing these weights. Each expansion factor was computed and anomalies created by very small samples (number of fish lengths) from very large landings were avoided by limiting the expansion factor to a maximum of 500. The expanded lengths (N at each length X the expansion factor for the sample) were then summed within each gear and INPFC area and then weighted a second time by the relative proportion of landings for each gear within INPFC areas. Finally, the INPFC-expanded length frequencies were summed over INPFC areas and normalized so that the sum of all lengths and sexes for each gear in a single year was equal to unity.

We also included discard length compositions from the West Coast Groundfish Observer Program for the "bycatch" fleet. These lengths were taken from trips in which arrowtooth were not retained (n=142 trips). Similar to the survey data, we binned length data into 2-cm intervals from 12 to 80 cm.

We have no specific information on length composition of arrowtooth in the mink food fishery.

For the fillet fishery, we included age data available from PacFIN for 1986-1991, 1998, and 2003-2005. Otoliths from 1998 to present were read using current break-and-burn techniques, while the 1986-1991 otoliths were previously surface read. Applying the modern methodology to 99 otoliths from 1989 suggested a slight bias in the surface reads such that break-and-burn age = 0.9506*surface age + 0.5659. We applied this bias adjustment within SS2, treating break-and-burn age as the true age. Since no within-method comparison was available to estimate precision, the standard deviation of aging error was taken from English sole (Stewart 2007).

2.3 History of modeling approaches used for this stock

The only previous assessment for arrowtooth flounder off the U.S. West Coast was conducted in 1993 with catch data for 1981-1992, biological and logbook data from 1986-1992, and survey biomass estimates from 1971-1991 (Rickey 1993). That assessment assumed a unit stock off the U.S. West Coast, from the INPFC Monterey area to U.S. Vancouver. Rickey (1993) used a dynamic pool model to estimate equilibrium yield per recruit. The model assumed asymptotic (logistic) selectivity and constant recruitment. Rickey (1993) varied selectivity and natural mortality parameters to get a range of fishing mortalities at $F_{0.1}$, $F_{35\%,}$ and $F_{45\%}$. Length frequency data from surveys suggested strong recruitment in 1991 and weak recruitment in 1988 and 1990. Survey indices were highly variable (Figure 14). The assessment author suggested that a decline in 1992 abundance may have been due to El Nino's effect on fish behavior and movement rather than a true change in stock abundance. The assessment stated that "it is difficult to draw definite conclusions about the status of coastal arrowtooth flounder given the lack of age data and any absolute estimate of biomass."

To our knowledge, no tagging, genetic work, or otolith microchemistry studies have been done to estimate arrowtooth movement or connectivity of stocks off the U.S. West Coast, Canada, or in the Gulf of Alaska. However, Turnock, Wilderbuer, and Brown (2005) assessed the Gulf of Alaska stock, and Fargo and Starr (2001) assessed the Canadian stock. These assessments may provide useful comparisons.

In the Gulf of Alaska, arrowtooth flounder catch is limited by halibut bycatch caps and market availability. Turnock, Wilderbuer, and Brown (2005) reported 57% retention rates for 2004, although the total fishing mortality rate (F) was 0.01. The authors used an age-structured model to assess Gulf of Alaska arrowtooth. Similar to Stock Synthesis 2 (Methot 2006), their model followed equations from Fournier and Archibald (1982), with parameters estimated using AD Model Builder (Fournier 2002). The authors fixed the parameters for natural mortality, von Bertalanffy growth, and survey catchability. They estimated 2,109,700 mt of arrowtooth in the Gulf of Alaska. Their data included fishery catch, NMFS Triennial Survey and exploratory surveys (including age and length composition), the International Pacific Halibut Commission Trawl Survey, and fishery size compositions. Figure 15 shows the biomass trend from their analysis.

Fargo and Starr (2001) found no trend in biomass in their assessment of the Canadian arrowtooth stock, but there was some evidence of cyclic patterns with abundance peaks in 1989 and 2000 (Figure 16). Catch curve analysis of survey data and port samples using Ricker's methods (1975) showed no change in total mortality rate or age structure between 1980, 1998, and 2000. The authors concluded that arrowtooth catch rates were at or below sustainable levels.

2.4 Model description

This assessment used Stock Synthesis 2.0g (Methot 2007). SS2 is an age-structured model following the methods of Fournier and Archibald (1982). Parameters are estimated using AD Model Builder (Fournier 2002). Table 5 describes the parameterization and assumptions of the model.

In the model we assumed a unit stock for the U.S. West Coast, completely separate from the Canadian stock. We included both sexes, with an accumulator age of 35 years old. We modeled the period from 1916-2006, with the stock beginning at *Bo* (unfished biomass) in 1916. Below we describe the modeling approach for the biology and fisheries.

Growth is modeled separately for each sex following the von Bertalanffy growth function. We estimated length-at-age-30 and *k* using SS2's parameterization of the von Bertalanffy growth function (Figure 17). Although we attempted to estimate the CVs of length at youngest and oldest ages in SS2, we were forced to fix these parameters in the final base model to achieve a better maximum gradient component. We estimated the length-weight parameters external to the SS2 model using data from the 2003-2006 NWFSC Slope-Shelf survey:

$$Weight = a*Length^{b}$$

For females, we estimated $a = 3.785*10^{-6}$ for females, and b= 3.246. For males, we estimated $a = 3.485*10^{-6}$ and $b = 3.256$ (Figure 18).

Female maturity was modeled as a length-based logistic function:

$$Proportion\ Mature = 1/(1+exp(slope*(length-inflection)))$$

We lacked maturity data in this assessment, so we fixed the inflection point at 37.3 cm, estimated by Rickey (1993). We assumed a slope of 0.5, which meant that 5% of 31 cm fish are mature, 50% of 37 cm fish are mature, and 95% of 43cm fish are mature (Figure 19). We did not model male maturity.

We fixed natural mortality at values of 0.166 for females following Hoenig (1983):

$$M = exp(1.44 + -0.982* ln(tmax))$$

where M is natural mortality and tmax is maximum observed age. Maximum observed age from the data used here is 27 years for females. The previous assessment for West Coast arrowtooth (Rickey 1993) used a natural mortality of 0.2 for a female-only model. For males, applying Hoenig's method to the maximum observed age of 19 results in a male natural mortality of 0.234. However, model exploration during the STAR panel led to the discovery that higher male natural mortality improved the model fit to age data. The base model used a fixed male natural mortality of 0.274. The natural mortality rates used here imply that in an unexploited population, approximately 1.6% of male recruits and 8% of female recruits would survive to age 15, and 0.4% of males and 4% of females would live to age 20.

Recruitment was modeled following the Beverton-Holt relationship, with steepness fixed at 0.902. Dorn (personal communication) performed a meta-analysis of West Coast flatfish stocks and suggested a prior mean of 0.902 and standard deviation of 0.082. The analysis was based on a Bayesian hierarchical meta-analysis, which included the 2005 base-case assessment models for Dover sole, petrale sole, English sole, and the northern and southern stocks of starry flounder (Sampson 2005, Lai et al. 2005, Stewart 2005, Ralston 2005). The standard deviation of the recruitment deviations in log-space (σR) was set at 0.8, in agreement with the root mean squared error of the recruitment residuals. We estimated initial recruitment (ln(Ro)) within SS2. We estimated recruitment deviations from the stock recruit curve beginning in 1965. In exploratory model runs for the STAR panel we attempted to estimate recruitment deviations prior to 1965, but found that the asymptotic standard error of the recruit deviations did not fall below σR until approximately 1965.

We modeled three fisheries, as described in section 1.3 above: the mink food fishery, which began in 1928; the fillet fishery in 1981, and the bycatch trawl fleet in 1956. All fisheries have asymptotic length-based selectivity, parameterized as a double normal in SS2.

The mink food fishery lacked length-composition samples and selectivity could not be estimated. We therefore fixed selectivity at the maximum likelihood estimates for the Triennial Shelf Survey. Both the fishery and Triennial Survey operated on the shelf using small-mesh trawl gear. Given the nonselective nature of the mink food fishery, full retention for the fishery was assumed.

For the fillet fishery, we estimated the peak and ascending variance parameters for an asymptotic selectivity function. We also allowed for sex-specific selectivity and assumed full retention for the fillet fishery, adding bycatch to landings (see *Fishery dependent data* above).

Although the bycatch fleet was modeled on a catch time series with full retention, the bycatch fleet is strictly a discard fishery. We estimated the peak and ascending variance parameters of asymptotic selectivity for this fleet. Lacking sex-specific length observations, we did not estimate sex-specific selectivity parameters.

We estimated the peak and ascending variance parameters of asymptotic selectivity for all surveys except for the 1999-2002 NWFSC Slope Survey, which did not have length composition data. For the NWFSC survey, we mirrored the selectivity of the AFSC Slope Survey. All surveys had sex-specific selectivity and a time-invariant catchability. We solved for catchability analytically rather than estimating it as a parameter.

The base case model used weighting factors for the likelihood components (lambdas) equal to one. No parameters used time-varying blocks. All input sample sizes for survey length- and age-composition data were based on the number of tows; for commercial data, the number of trips. We assumed that all surveys and fisheries operated in mid-July.

2.5 Priors

We did not use priors for any parameters.

2.6 Model selection and evaluation

We explored a large number of models with varying levels of complexity, culminating in the base model and sensitivity results presented below. As a guide to this fitting process, we used the likelihood components and overall likelihood as well as visual comparisons of the model fit and residuals.

Some of the salient characteristics in the suite of models that were fitted are higher depletion levels in the early years (1960's and 1970's) and subsequent stock recovery. The early depletion levels are not entirely driven by catches since catch continued to increase through the 1980s. Instead, the early depletion is caused by the fact that the model consistently estimated low recruitment before 1970, with higher recruitment during the recent period of high catch. This pattern persisted even when we (1) removed the constraint that recruitment deviations sum to one, or (2) estimated recruitment deviations for years prior to 1965. Given the lack of age-composition data before 1986 and length and abundance data before 1980, we view the early depletion as uncertain but consistent across models.

Throughout the model-fitting process, attempts to estimate asymptotic selectivity for the fillet fleet consistently led the peak parameter to hit the upper bound (80 cm). Length-composition data for this fleet deteriorated when we fixed the peak of asymptotic selectivity at values of 75 cm or less. Allowing the model to estimate dome-shaped selectivity did not ameliorate this problem, but instead led to the original asymptotic selectivity curve with the peak at the upper bound. We attempted to use an informative prior on the selectivity peak based on the estimated selectivity for the bycatch fleet, but this did not prevent selectivity from hitting the upper bound. The base model fixed selectivity for the fillet fleet at 60 cm.

Most models that we explored easily fitted the NWFSC Slope and NWFSC Shelf-Slope Survey indices. These indices did not show much of a trend. A strong signal from the 1999 year class in the length-composition data was enough to allow the model to track the increase in abundance seen in the AFSC Slope Survey beginning in 1999 and the Triennial Survey beginning in 1998. No models estimated abundance as high as the GLM prediction for 2004 from the Triennial Survey.

The models were able to fit length-composition data for the NWFSC Shelf-Slope Survey, the AFSC Slope Survey, and the fillet fishery in most cases. All of these sources are marked by a strong 1999 year class. Fits to the Triennial data were generally worse than fits to the other surveys. Length-composition fits to the 1980 and 1983 Triennial Survey data were poor due to very low sample sizes (15 and 2 tows, respectively, for length-composition data).

Catchabilities for the surveys were consistently calculated to be quite low, typically ranging from 0.04 to 0.35. In general, the NWFSC Shelf-Slope Survey, which covers the entire depth range of arrowtooth, had the highest catchability. It is possible that the arrowtooth's large size and swimming ability could have resulted in higher levels of escapement from trawl gear than what is usually observed in other flatfish. That could account for the low catchabilities estimated here.

2.7 Base run results

The base case model shows a period of moderate depletion through the 1960's and 1970s, followed by a rebounding of the stock beginning in the late 1970's (Figure 20-22 and Tables 6-8). Estimated stock size has not fallen below the minimum stock-size threshold (Figure 22). The model predicted that recruitment was low in the late 1960's, a period prior to the earliest available length data and survey indices. Recent strong year classes, in particular the 1999 year class, have led to a large stock increase since the late 1990s (Figures 23-25). Recruitment exceeded 50 million age 0 fish in 1990, 1994, and 1999. We estimated spawning biomass at the beginning of 2007 to be 63302 mt (95% CI: 41,027-85,577). This level represents 79% of the estimated unfished spawning biomass (95% CI: 58.1-99.5). Total biomass at the start of 2007 is estimated to be 85,175mt.

For the base case, the total exploitation rate for 2006 is 4.4% (Figure 26) and includes 1918 mt landed by the fillet fishery, 94 mt discarded by the fillet fishery, and 395 mt caught by the discard fleet (Figures 26-27).

Both the NWFSC Shelf-Slope and NWFSC Slope time series contain only four years of data without a pronounced trend (Figures 28-29). The AFSC Slope data (Figures 30) show an increase in abundance between 2000 and 2001, but the model did not capture this trend. The same is true for the Triennial data (Figures 31), which show an increasing biomass trend between 1992 and 2001, and a very strong increase in 2004. The model did not capture the 1989 increase in abundance seen in the Triennial Survey.

Selectivity for fisheries and surveys was modeled assuming an asymptotic selectivity pattern. Since arrowtooth are flatfish that inhabit soft bottom substrate, there may be little justification for assuming dome-shaped selectivity, particularly for surveys that cover all or most of their depth range. Peak selectivity for the surveys and for the discard fleet ranged from 31 cm to 38 cm (Figures 32-39). As described in *Model selection* above, for the fillet fishery we fixed the peak of asymptotic selectivity at 60 cm (Figure 39). We fixed selectivity for the mink food fleet at the maximum likelihood estimates for the Triennial survey, and we mirrored selectivity for the NWFSC Slope Survey to the selectivity for the AFSC Slope Survey. Despite the flexibility to estimate sex-specific selectivity, the model found no difference between sexes for the fillet fleet. For the surveys, the model estimated no difference in selectivity between the sexes at 30 cm, but lower, dome shaped selectivity for males at maximum size.

Length-composition fits were generally best for the fillet fishery fleet and the NWFSC Shelf-Slope Survey, but noisier for the AFSC Slope and Triennial surveys. Generally, for the fillet fishery, the model fitted the modes of the length compositions as well as some of the bimodal structure for recent years (Figures 40-45). Model fits to both male and female arrowtooth length compositions for the fillet fishery showed little residual pattern that would suggest systematic lack of fit. Input sample sizes tuned commensurately to the model expectation of the fit, as shown in Figures 42 and 45. For the bycatch fleet, the model fit 2006 length-composition data (Figures 46-48), matching the strong mode resulting from the 1999 year class.

The model predictions closely matched the NWFSC shelf-slope length compositions, which primarily show evidence of a strong 1999 year class moving through the population (Figures 49-54). The model did not capture the female modes at 60 cm in 2003 and 70 cm in 2006. The model predictions for the Triennial length-composition data were less than observed for ~60cm females in 1995 and 2004. Poor fits in 1980 and 1983 are due to very small sample sizes (Figure 55-60). The model fit to the AFSC Slope Survey (Figures 61-66) missed a 30 cm peak for males and a 30-40 cm peak for females in 1997.

Interpretation of model fits to the conditional age-at-length data can be difficult. Figures 67 and 68 are examples of the conditional age-at-length results. For simplicity, here we show plots of the implied age compositions that would be expected if the model were explicitly fitted to the margin of the whole age composition. The implied model fits are given in Figures 69-76. The model predicted that the age structure in the late 1980s was dominated by the 1980 year class, with the 1985 year class apparent beginning in 1990. The fillet fishery age data support this result. The model managed to catch most of the modes in the data, though in some instances at a lesser magnitude.

The model predicted that the 1999 year class would dominate the age structure for 2003-2005, with some additional peaks due to the 1990 and 1994 age classes. Both the NWFSC Shelf-Slope Survey (Figures 73-76) and fillet fishery exhibited this strong year class. For the fillet fishery, the model did not capture observations of high abundance of age 8 and age13 females in 2004, and predictions are less than the high observations of 15 year olds in 2005 (from the 1990 year class). The strength of the 1994 age class in the fillet fishery data seems to differ by sex and year: strong in males in 2004 but weaker in males in 2003 and females in 2003 and 2004. The model predicted an intermediate abundance between these observations.

In summary, the key aspects of the base model include: (1) current spawning stock biomass of 79% of unfished (0.79**B0*), influenced strongly by large recent recruitments; (2) lower stock abundance in the 1970s (3) high recruitment in recent years, including 1990,1994, and the large 1999 year class; (4) better model fits to composition data from the fillet fishery and the NWFSC Shelf-Slope Survey than to the AFSC slope or Triennial survey, and (5) low levels of current exploitation (4.4%).

2.8 Uncertainty and sensitivity analysis

For the base case above, we have reported uncertainty in parameters and derived quantities based on the asymptotic variance estimates. Particularly since this is a new assessment with uncertain historical catches, we also explored three additional aspects of model behavior and sensitivity:

1) Profiling across fixed values of natural mortality
2) Profiling across fixed values of steepness of the stock-recruit relationship
3) Sensitivity to alternate catch scenarios for the bycatch fleet

Steepness was fixed at 0.902 based on Dorn's meta-analysis (personal communication). Natural mortality was fixed at 0.166 for females based on Hoenig's method (1983), and 0.274 for males based on model exploration during the STAR panel. We tested the assumptions for steepness (h) by fixing it at a range of values from 0.5 to 0.99 and re-estimating the model. The results (Table 9a, Figure 77-80) suggest a fairly flat likelihood surface from h=0.5-0.99, with a slightly better model fit at the highest values. The age composition data exert the greatest influence on this pattern. Steepness does not have a large effect on estimates of B0 or depletion: with a steepness of 0.99, the model predicted 2007 depletion of 0.80 and initial spawning stock biomass of 79639 mt, compared to 0.79 and 80313 mt for the base case.

Similarly, we profiled across male natural mortality (M), ranging from 0.214 to 0.354. This range included the base case value (0.274) and the natural mortality rate used in the Gulf of Alaska assessment (0.35; Turnock, Wilderbuer and Brown 2005). Female natural mortality was set to be 0.108 less than male, as in the base case. The results (Tables 9b and Figures 81-84) suggest slightly better model fit with higher rates of natural mortality. Fits to the male length and age data from the fillet fishery are driving this trend, since that fishery sees very few old, large males. Assumed rates of natural mortality have a strong effect on estimates of B0, which increases five fold when we increase male M from 0.214 to 0.354. Depletion varies less across the range of M, from 0.65 to 0.94.

Due to the high degree of uncertainty in removals of this species, we considered scenarios with catch equal to 2x and ½x the base model's catch (Figure 85). Results from these models are presented in Figure 86 and Table 10. The qualitative pattern for each model is quite similar, as are the estimates of depletion. However, the higher catch scenario increased stock size estimates, with B0 equal to 160,626mt in the 2x scenario vs. 40,155mt in the ½ catch scenario.

To bound the estimates of depletion and stock size, we combined the 2x catch scenario with high natural mortality (0.354 for male and 0.246 for females), and the ½ x catch scenario with low natural mortality (0.214 for male and 0.106 for female) (Table 6). The results suggest that M and catch have a large impact on estimates of absolute stock size, and less of an impact on estimates of depletion. Estimates of depletion and 2007 biomass are 0.65 and 33,402 mt for the low catch/M scenario, and 0.94 and 596,607 mt for high catch/M scenario. Similar to B0, MSY and BMSY also scale strongly with catch and M.

The conclusion that 2007 biomass is well above target level (SB40%) is robust to uncertainties in M and catch.

3. Additional STAR panel recommendations

The STAR panel provided a rigorous review of the model, leading to several major changes to the Pre-STAR base model. These changes are incorporated in the base case model described in *Base run results* above. Table 6 contains a summary of parameter estimates and management quantities estimated for the base case, the Pre-STAR panel model, and models O and P. Many models were explored during the STAR panel and are described in the STAR panel report, but intermediate models O and P, which fall between the Pre-STAR and the final base case model, represent key milestones.

In the Pre-STAR model we estimated recruitment deviations beginning in 1916, and we estimated catchability. Estimates of 2007 depletion were 1.71, with B0 of 79,299 mt. STAR panel members voiced concerns regarding (1) the appropriateness of estimating recruitment deviations so many decades prior to the availability of length and age data in the 1980's; (2) the estimation of catchability (Q) as a parameter when, instead, it could be solved for analytically; and (3) the use of uninformative priors rather than turning off all priors.

In Model O we estimated recruitment deviations beginning in 1970 (about ten years prior to length data available in 1980), used the analytical solution for Q, and used no priors. We also added a relatively small amount (<850mt/year) of catch to the mink food historical removals, equal to ½ the "sole" and "scrapfish" reported by Cleaver (1951) for 1928-1949. Smith (1956) reported that ½ of "mink feed" was arrowtooth. These changes resulted in a large decline in 2007 relative depletion, down to 0.79, with B0 of 62,189 mt (Table 6). Model exploration revealed that the choice of year in which to begin estimating recruitment deviations was responsible for most of this change.

Model P was identical to O, but we estimated split-sex selectivity for the fillet fishery and the three surveys containing length-composition data (NWFSC Shelf-Slope, Triennial, and AFSC Slope Surveys). The STAR panel recommended split-sex selectivity to account for potential differential behavioral and distribution patterns between the sexes, and to attempt to estimate the peak of fillet fleet selectivity, which was consistently hitting the upper bound (80 cm). We hoped that split-sex selectivity could provide an alternative explanation for the NWFSC slope-shelf length-composition data, rather than relying on the high (63 cm) peak selectivity estimated in some earlier models (e.g. the Pre-STAR base). The results from model P (Table 6) did not eliminate the problem with fillet fleet selectivity but did improve model fit to fillet fleet age-composition data and length-composition data from the NWFSC Slope-Shelf and Triennial Surveys.

The final base case model retained the main elements of Model P but incorporated two major simplifications to the fillet fleet: we fixed peak selectivity at 60 cm and assumed full retention for this fleet. Previous models had estimated retention; we simplified the model by adding bycatch (Figure 6) to landings, and inputting this as total catch into SS2.

These changes were based on the STAR panel and STAT team's concerns that (1) we were unable to reliably estimate retention since estimated discard rates were typically half the observed rates, and (2) that estimates of peak selectivity at 80 cm (the upper bound) were unreasonable. Model exploration revealed that 60 cm was a reasonable value for peak selectivity, providing acceptable fits to fillet fleet length compositions. The final setup for the fillet fleet selectivity reflects the need for simplicity in a new assessment and a fishery with fluctuating strategies and markets.

In the final base case we estimated recruitment deviations beginning in 1965, based on plots of the recruitment deviance over time. We also fixed male natural mortality at 0.274 based on likelihood profiling, and left female natural mortality at 0.166 based on Hoenig (1983).

The final base case model showed reasonable fits to fillet fleet length compositions, as a result of the selectivity and retention assumptions for that fleet. Fits to age composition data improved due to the higher rates of male natural mortality (Table 6). Final estimates of depletion are 0.79, relative to 0.67 for Model P, with the start year of the recruitment residuals primarily driving this difference (Table 6). In the final base case, we estimate no difference in selectivity between the sexes for the fillet fleet. For the surveys, we estimate no difference in selectivity at 30 cm, but sex-specific selectivity for sizes greater than 30 cm.

4. Rebuilding parameters

Since this stock is not overfished we have not reported any rebuilding parameters.

5. Reference points (biomass and exploitation rate)

We estimated unexploited equilibrium spawning biomass (B0) to be 80,313 mt (95% CI: 68,228-92,398). We estimate that the stock has never fallen below the overfished threshold (i.e. 25% of unfished levels (B0)). Spawning potential ratio was estimated to be 0.75 in 2006 and 0.73 in 2007.

The MSY proxy target for flatfish is SPR 40%, which results in an MSY of 5,245mt (4,457 - 6,033) and a spawning stock biomass of 30,780 mt (26,149 - 35,411), or 38% of B0. The MSY proxy target for spawning biomass is SB40% and this target would result in an MSY of 5,148mt. The model estimation of MSY is 5,844mt which results in a spawning stock biomass of 16,593mt, or 21% of B0 and a SPR of 0.23.

6. Harvest projections and decision tables

We generated forecasts of stock size and catch for 2007-2018 (Table 11). Catch for 2007 and 2008 was set equal to the average catch for 2004-2006. Catch for 2009-2018 was fixed at the maximum potential catch removable under the 40:10 harvest control rule, with MSY based on the Council's SPR proxy (F_{SPR}). We assumed that 85%

of the catch would derive from the fillet fleet and 15% from the bycatch fishery, based on the average of our estimates from 2004-2006. This forecast estimated that total catch (including discards) could equal 11,267 mt in 2009, falling to 5,804 mt in 2018. Based on West Coast Groundfish Observer estimates of discard rates, these total catches equate to approximately 8200 and 4100 mt of landings for 2009 and 2018, respectively. Spawning stock biomass would fall from 63,302 mt in 2007 to 34,026 mt in 2018 as a result of fishing and the decline in the large 1999 year class. Depletion would approach target levels, to a value of 0.42 in 2018.

The decision table (Table 12) considers the uncertainty in 'states of nature' regarding natural mortality and past catches. The states of nature we consider are the same as those previously presented in Table 6: 1) the base model, 2) a high productivity scenario with high historical catch and high natural mortality, and 3) a low productivity scenario with low historical catch and low natural mortality. As described in *Sensitivity Analyses* above, historical catch and natural mortality strongly affect estimates of depletion, stock size, and MSY. The three options for management action all involve 2009-2018 catches equal to the maximum potential catch removable under the 40:10 harvest control rule, with MSY estimated using the SPR proxy. The three management actions differ, in that each catch series is based on models that assume alternate states of nature, with very different estimates of MSY.

In the decision table, as we move from left to right the columns represent an increasingly productive stock. As we move down the rows of management actions we confront these productivity levels with increasing catch. Full results are shown in the Table 12. It is important to note that if we calculate our management action (MSY harvest) from the base model, but the stock is less productive than assumed, the spawning biomass will decline by more than a factor of three by 2011, with complete depletion by 2013 (see the second management action and the first state of nature in the table). Although the model likelihoods suggest this unproductive state of nature is less probable than the base case (Table 6), the decision table gives a timeframe of how rapidly the stock would decline if it truly were as unproductive as in the low catch, low M model.

The productive high historical catch+ high natural mortality model estimates a very high MSY. Harvesting this amount would lead to rapid depletion of the stock if the true state of nature were actually less productive. However, we feel that given the market and bycatch restraints placed on the arrowtooth fishery, it is unlikely that catches could approach the 40,000-110,000 mt associated with this management scenario.

7. Research needs

We recommend an additional study on length at maturity since the values we used are from Rickey (1993). We also acknowledge that our quantification of aging error is crude: we assumed that break-and burn ages are unbiased, our estimate of bias for surface-read ages is from ninety-nine fish taken from a single year, and our estimate of precision is from English sole. Further comparative aging studies are warranted.

Additional historical research and modeling could reduce the uncertainty in the early catch and bycatch reconstructions. We encourage ongoing efforts to standardize historical landings reconstructions for all West Coast groundfish. For the bycatch fleet, we propose a GLM analysis of observer data that would relate arrowtooth bycatch to latitude, depth, season, and landings of other species.

This assessment should be compared to assessments from the Gulf of Alaska and British Columbia in order to identify different modeling assumptions and solve common problems. Collaboration with Canadian scientists is needed since arrowtooth are likely a trans-boundary stock.

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Figures

Figure 1. California landings for the mink food fishery. NMFS ACL is the NMFS Annual Commercial Landings Database.

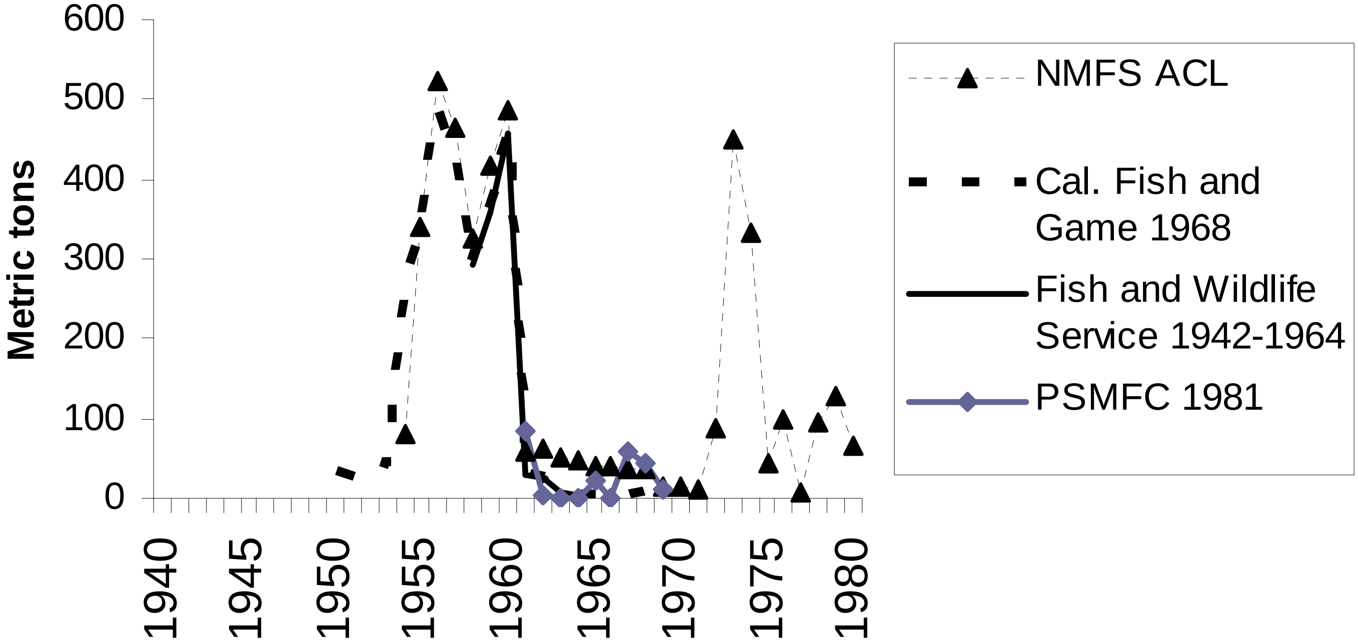


Figure 2. Oregon landings for the mink food fishery. NMFS ACL is the NMFS Annual Commercial Landings Database.

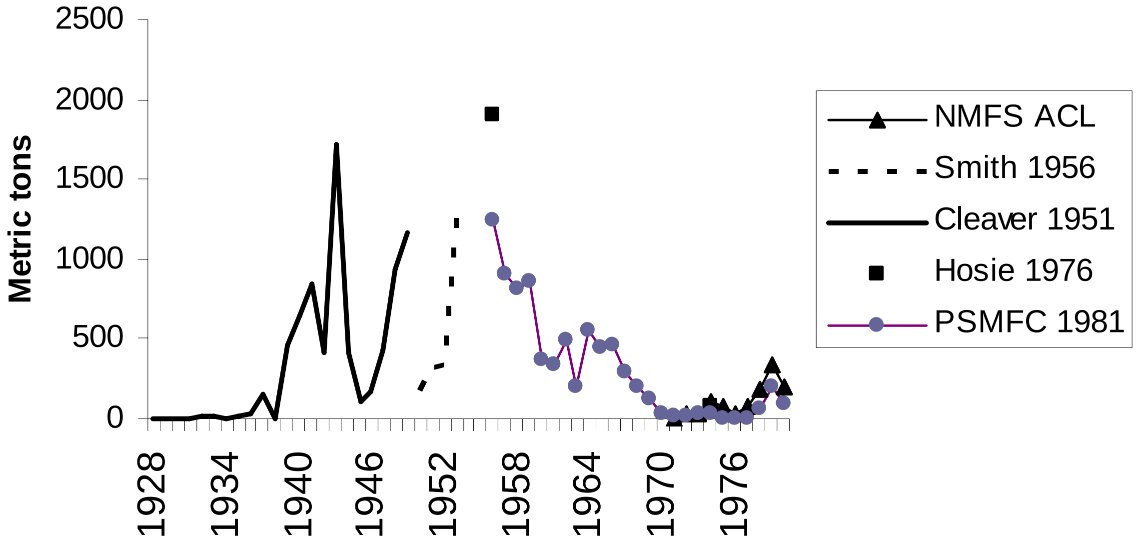


Figure 3. Washington landings for the mink food fishery. NMFS ACL is the NMFS Annual Commercial Landings Database.

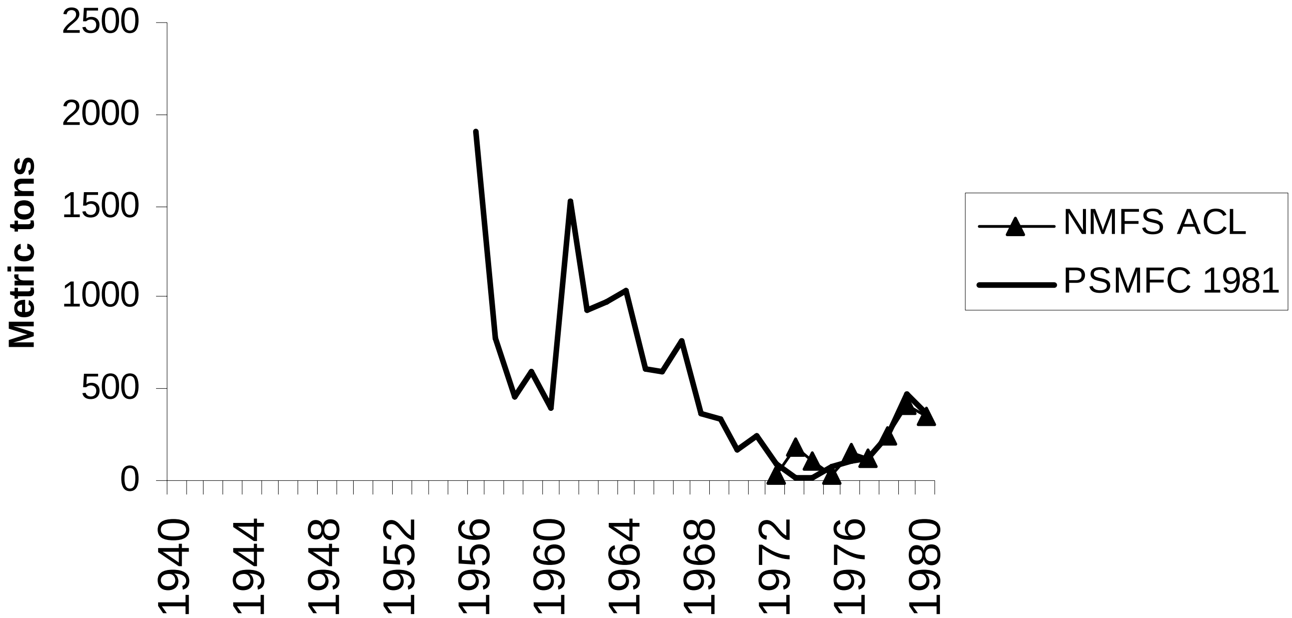


Figure 4. Landings in metric tons, 1981-2006, from the PacFIN database. The Vancouver-US INPFC area is 47° 30’ N to 50° 30’ N, US catch only. The Columbia INPFC area is 43° N to 47° N. The Oregon Coast area was nominally used by WDFW, spans 42° N to 46° 16 N, and landings account for only 0.01% of coastwide catch. The Eureka area spans 40° 30’ N to 43° N. The Monterey area spans 36° N to 40° 30’ N. The Conception area spans 32° 30’ N to 36° N. ‘Unknown’ indicates an unspecified Pacific Council INPFC area.

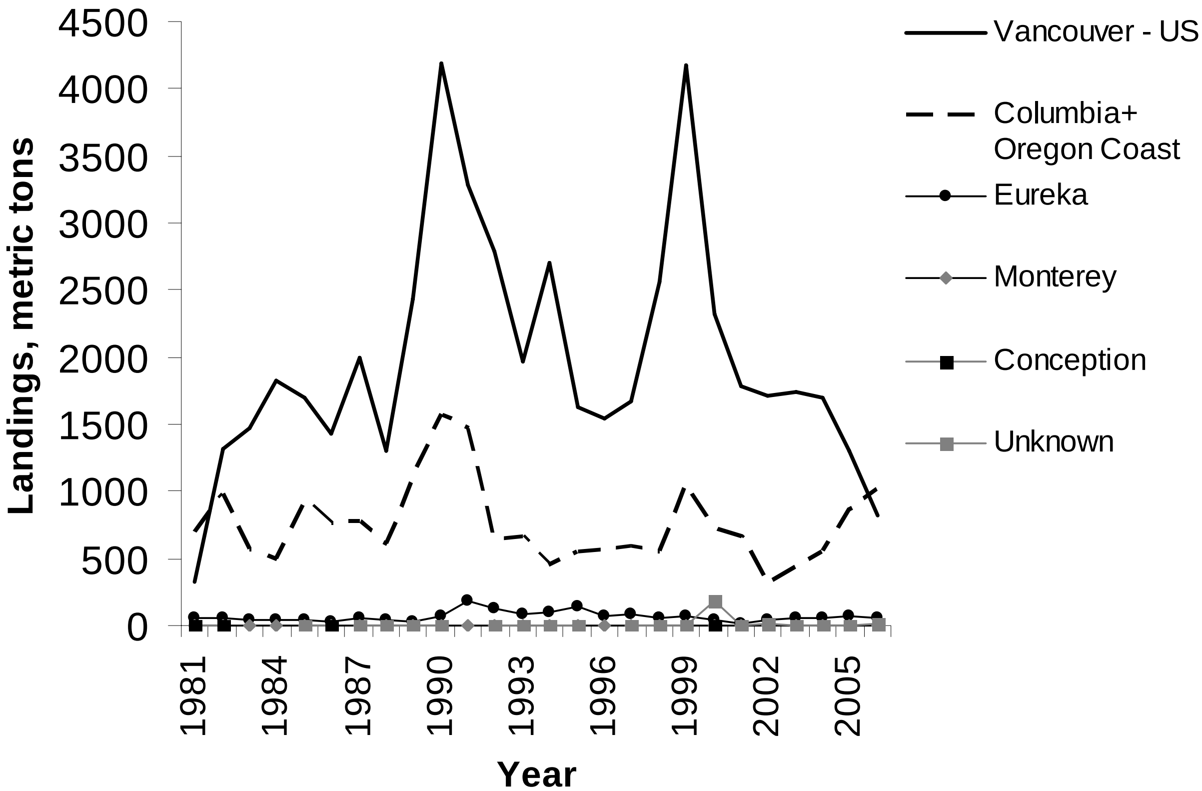


Figure 5. Landings by trawl gear from 1981-2006, from the PacFIN database. Non-trawl landings account for <1%, and are not shown here. Our “other trawl” category includes “bottom trawl”, which accounts for 56% of the total landings in 1981.

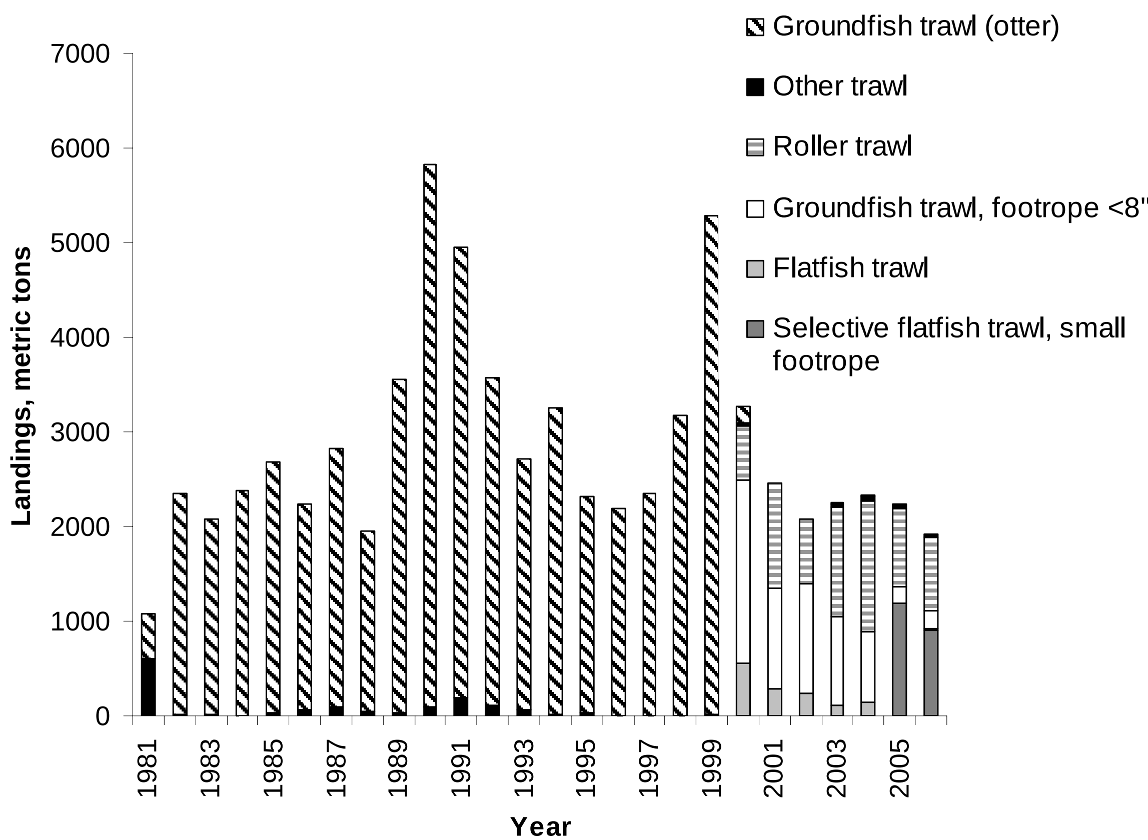


Figure 6. Observed discard fraction from the fillet fleet (points). The line represents values from a loess smoother, used to inflate landings into total catch, which was used as the model input. Trips that did not retain arrowtooth were excluded from these data. “Pikitch” is Pikitch et al. 1998, “EDCP” is the Enhanced Data Collection Program in Oregon, “EFP” is the Exempted Fishing Permit reported in Wallace 2002, and “Observer” is the NMFS West Coast Groundfish Observer Program.

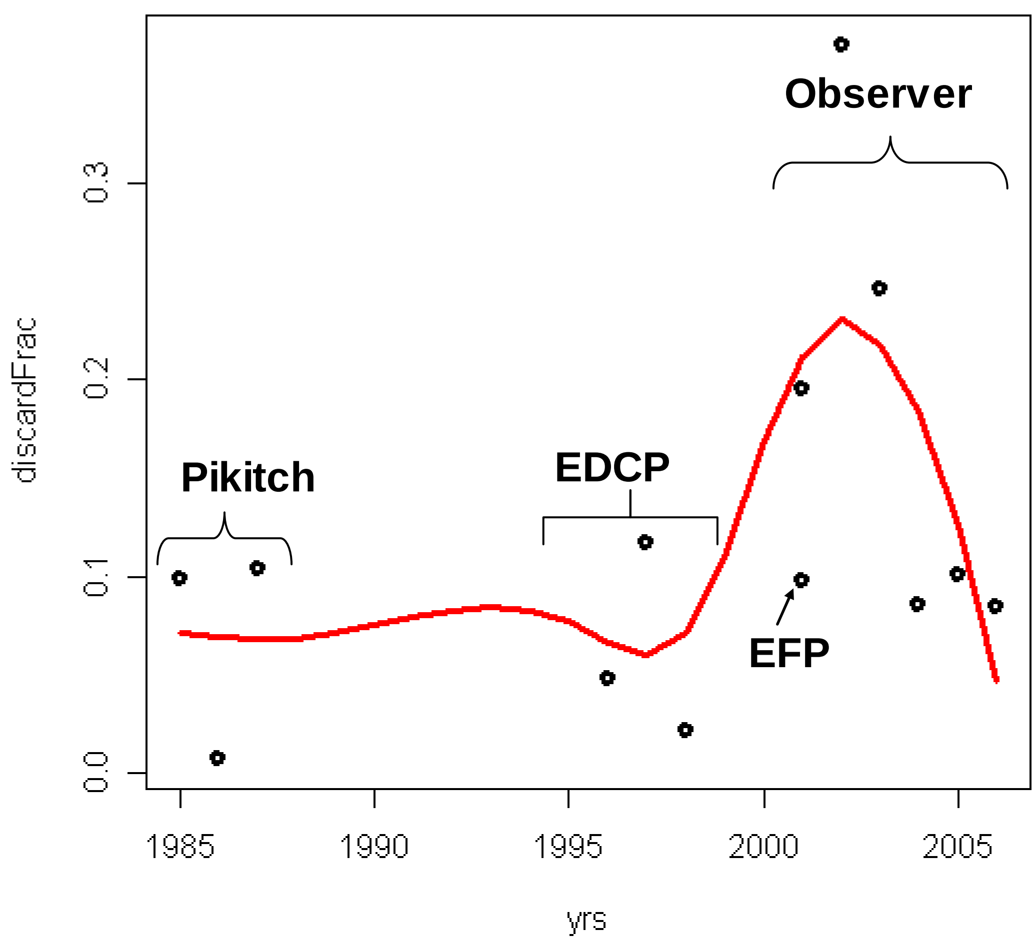


Figure 7. Year and depth coverage of the four surveys used in this analysis. The dashed vertical line in the lower plot is the approximate maximum depth limit of arrowtooth flounder in the surveys, during late spring through early fall.

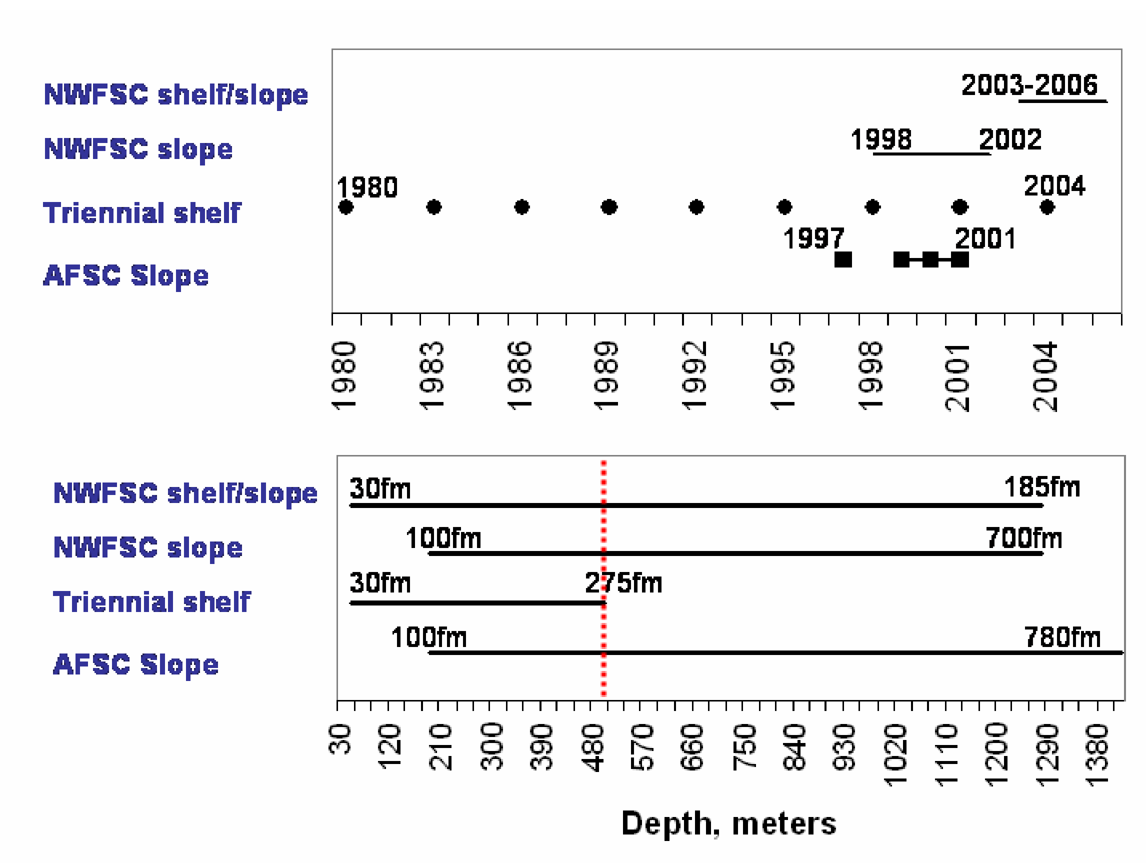


Figure 8. NWFSC Slope/Shelf survey data showing cumulative distribution of catch, by depth and latitude. Dashed lines represent 5% and 95% of cumulative catch.

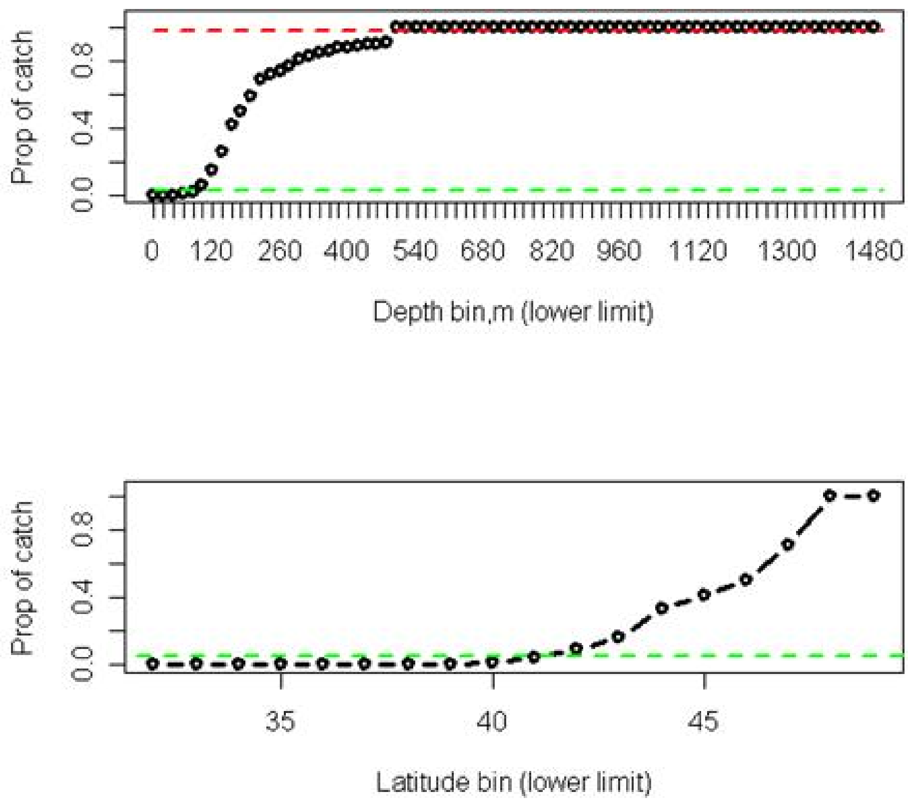


Figure 9. Average arrowtooth catch rate and body size, by depth and latitude. The Triennial Survey (dashed line) and NWFSC Slope/Shelf survey (solid line) are shown. Points represent average values per 20m depth bin or 0.25° latitude bin. Lines are from a loess smoother, weighted by sample size.

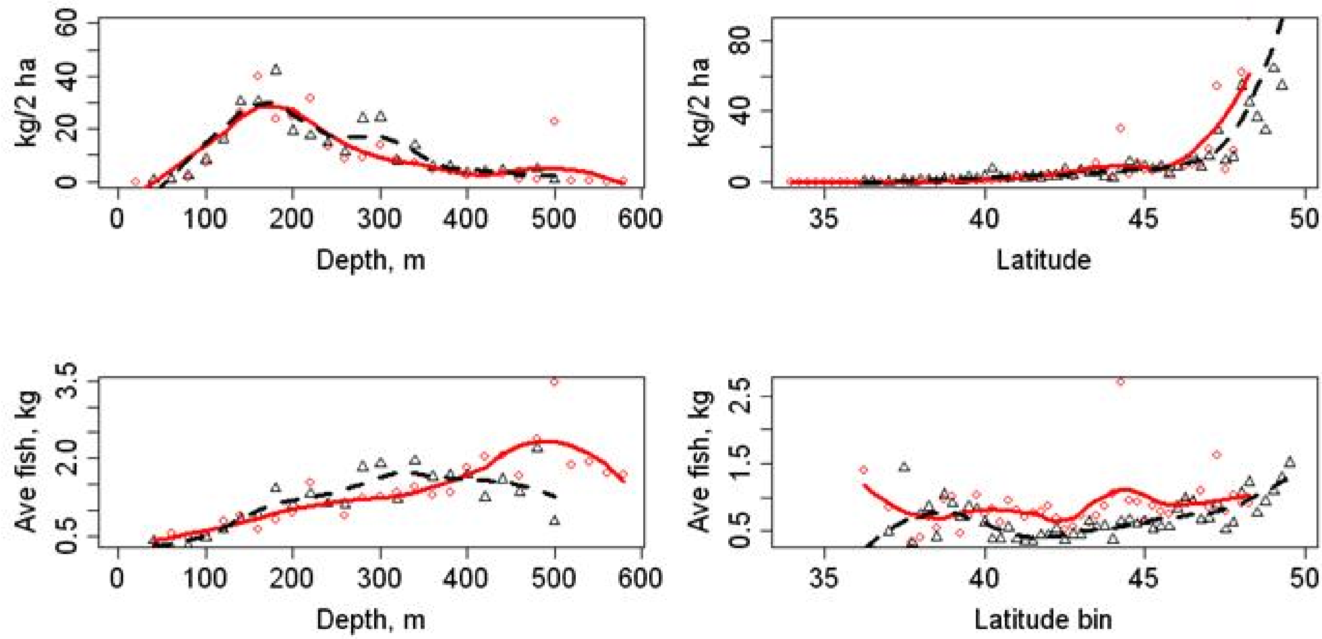


Figure 10. Average arrowtooth catch rate and body size by depth and latitude, for the AFSC Slope Survey, 1997 and 1999-2001. Points represent average values per 20m depth bin or 0.25° latitude bin. Lines are from a loess smoother, weighted by sample size.

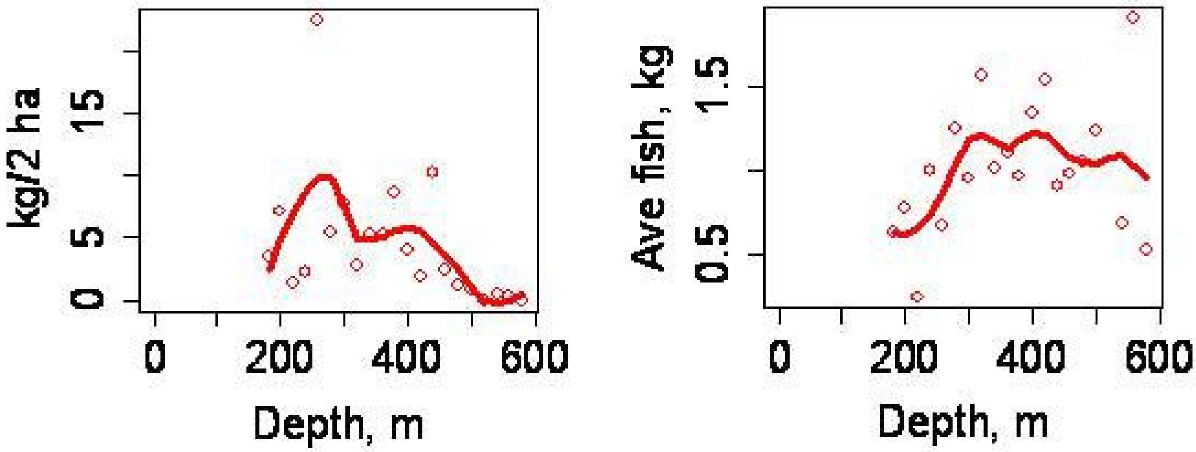


Figure 11. Delta-GLM model fits to NWFSC Shelf/Slope and Triennial Shelf Surveys showing predicted proportion positive vs. observed proportion positive.

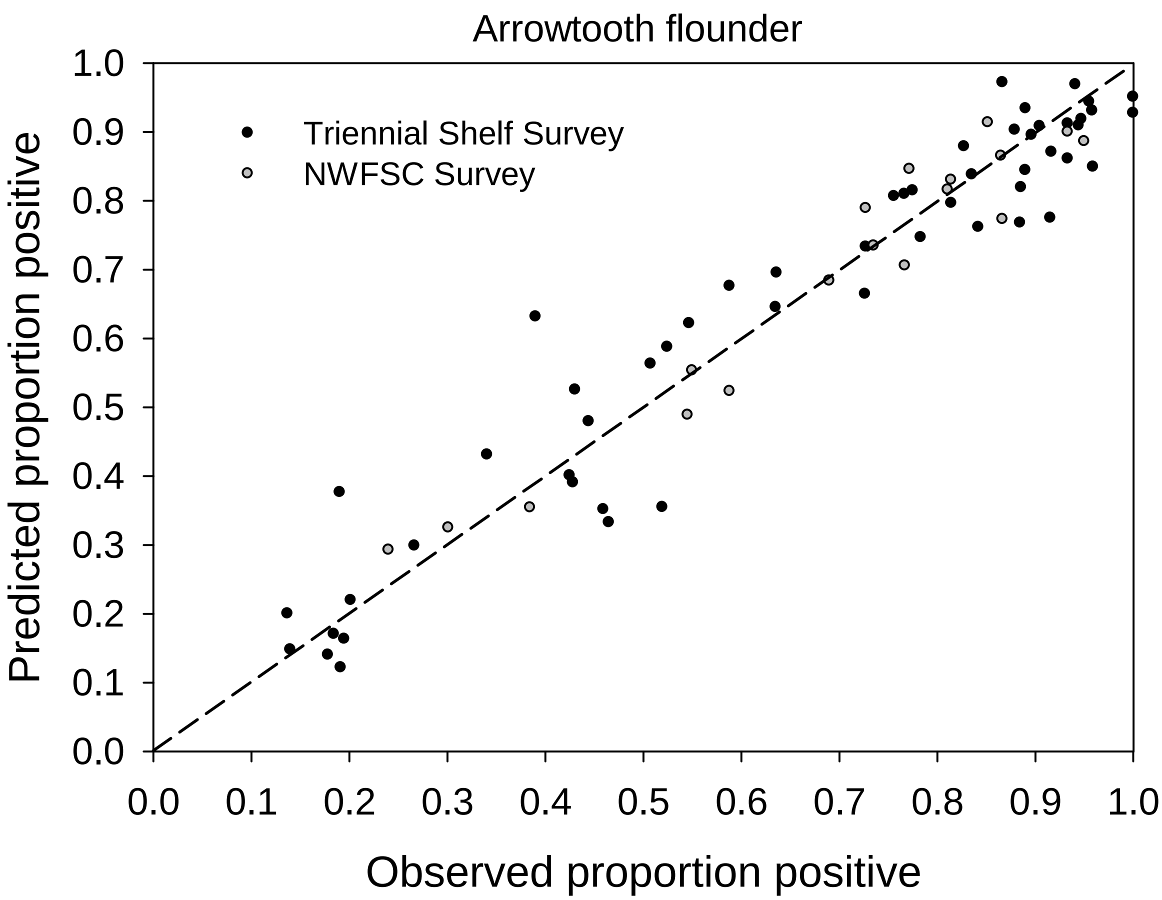


Figure 12. Delta-GLM model diagnostics to positive catch rates models (gamma error models) to NWFSC Shelf/Slope and Triennial Shelf Surveys showing residual deviance.

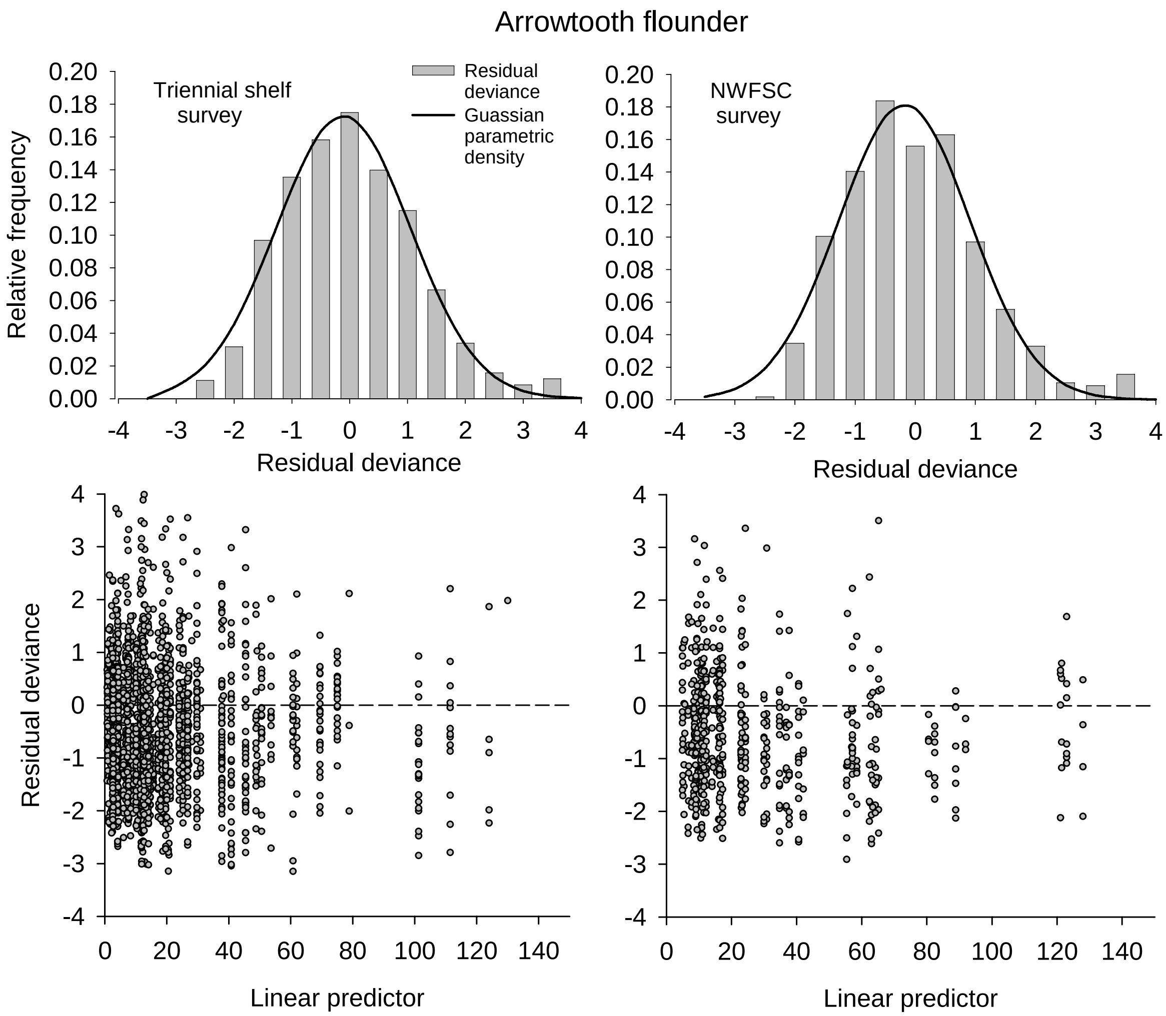


Figure 13. MCMC convergence diagnostics of the Delta-GLM model fit to NWFSC Shelf-Slope Survey data.

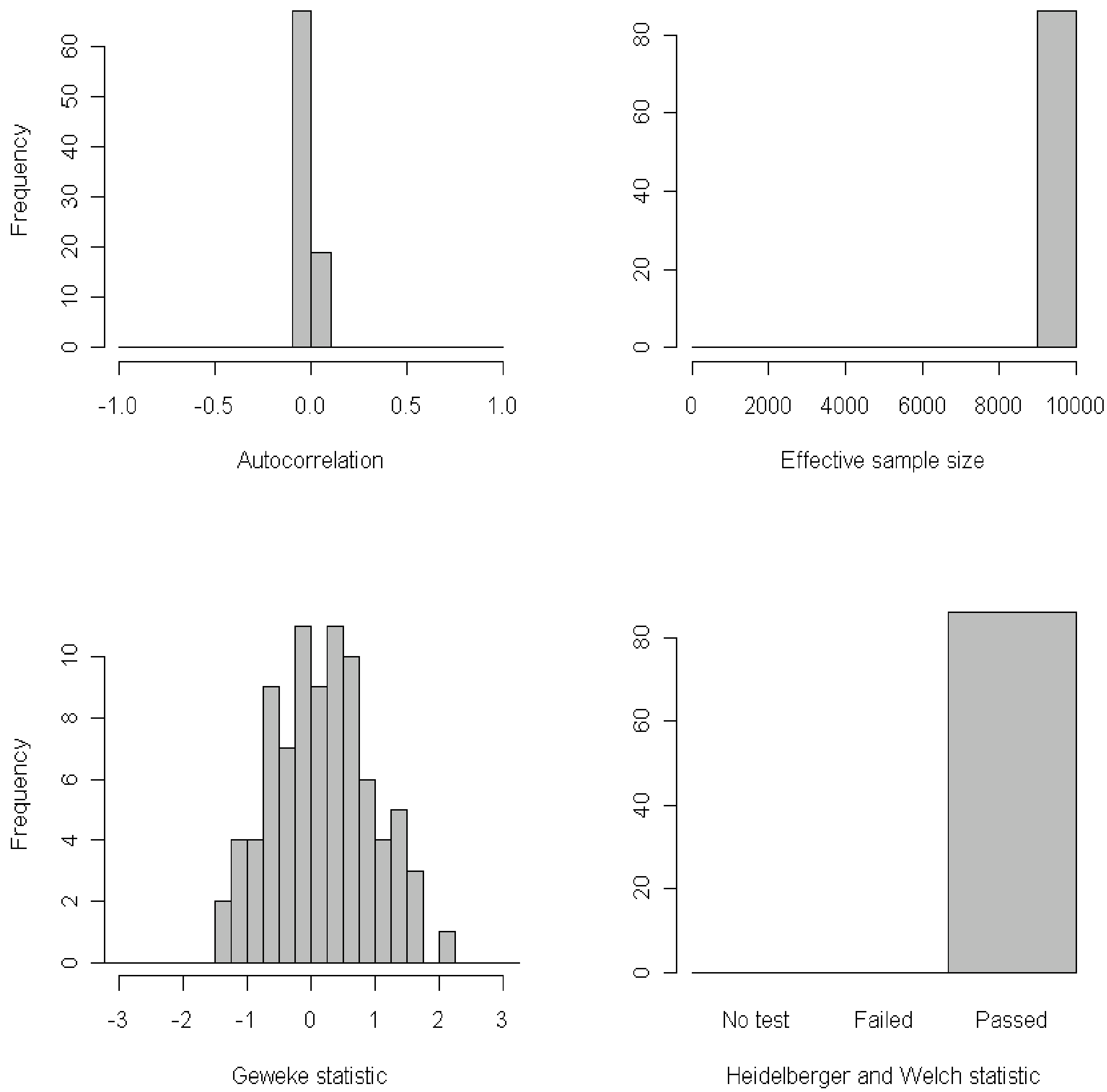


Figure 14. Taken from Rickey (1993): *“Arrowtooth abundance from the 1977-1992 Alaska Fisheries Science Center Triennia Shelf Survey.”*

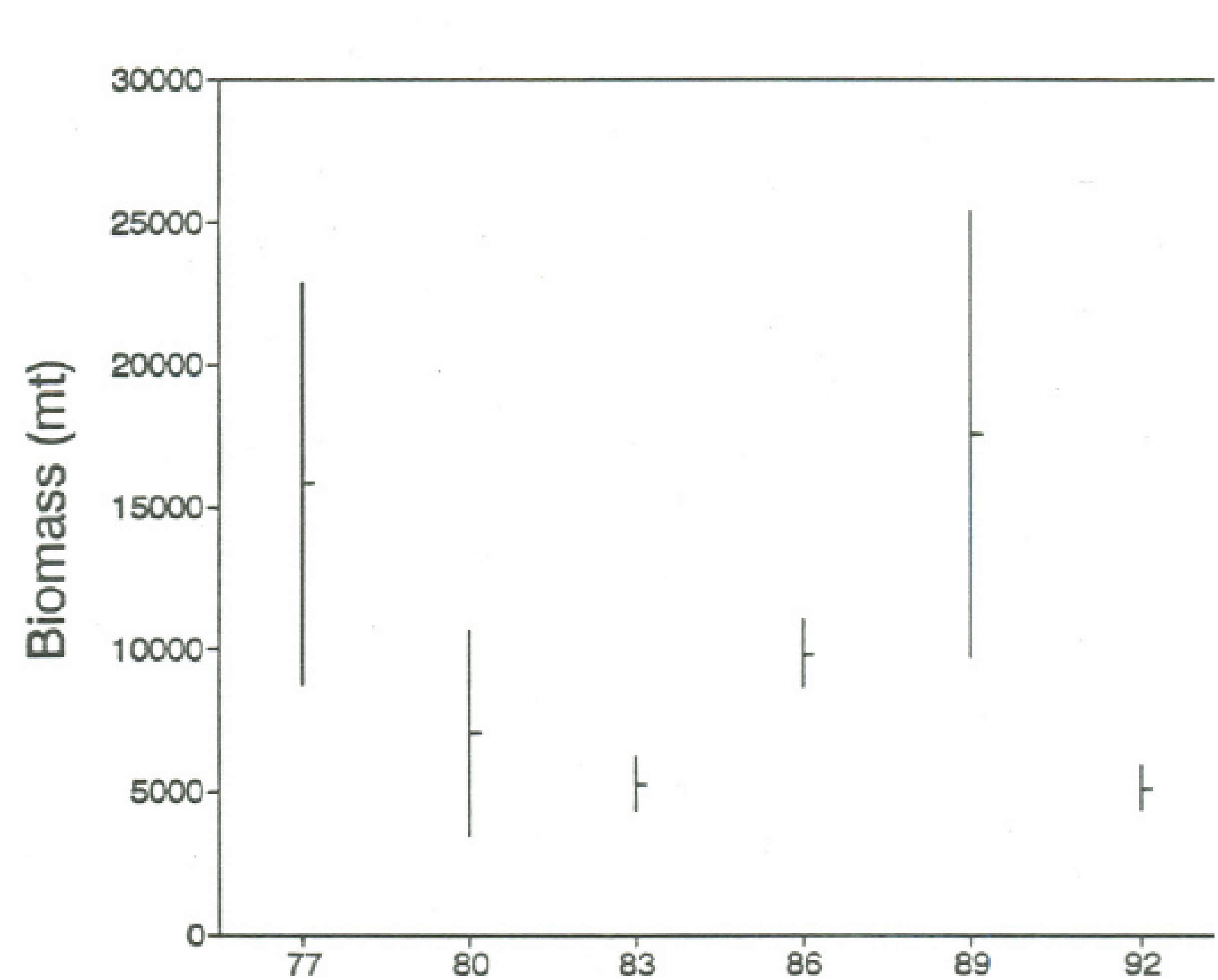


Figure 15. From Turnock, Wilderbuer, and Brown (2005): *"Age 3+ arrowtooth flounder biomass in the Gulf of Alaska (solid line) and female spawning biomass (line with +) from 1961 to 2005. The approximate lognormal 95% confidence intervals shown underestimate the uncertainty because variance in natural mortality and survey Q as well as other fixed parameters are not accounted for."*

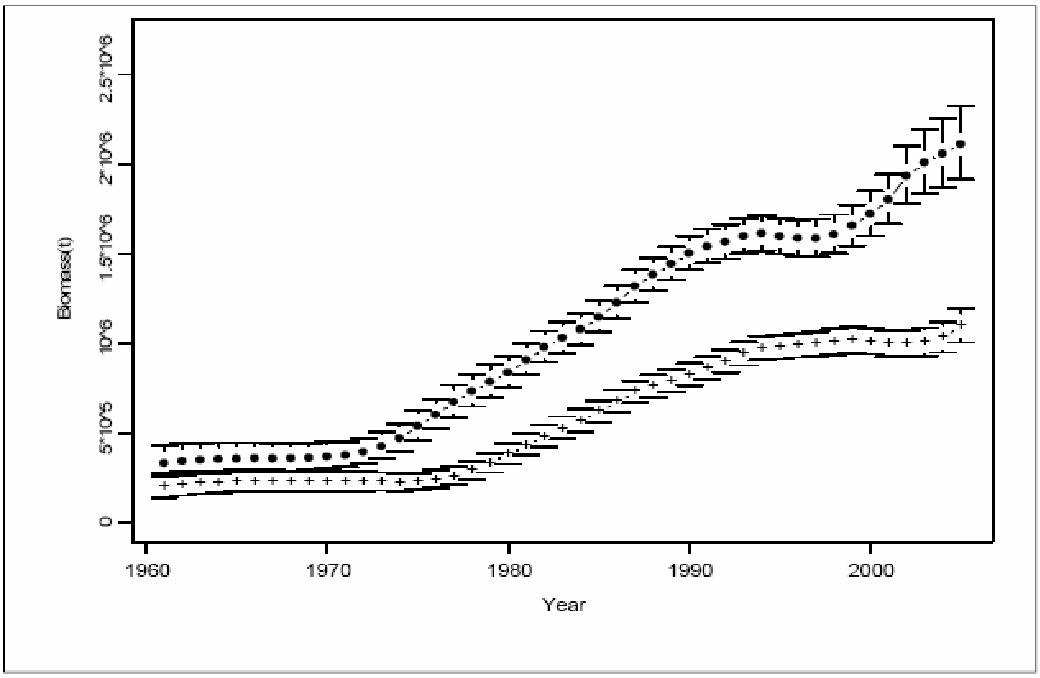


Figure 16. From Fargo and Starr (2001). *"Mean CPUE and 90% confidence interval for arrowtooth flounder from the Hecate Strait multispecies survey, 1984-2000."* Note that this is only a portion of the arrowtooth in British Columbia, and may be a separate stock from areas such as Queen Charlotte Sound and west Vancouver Island.

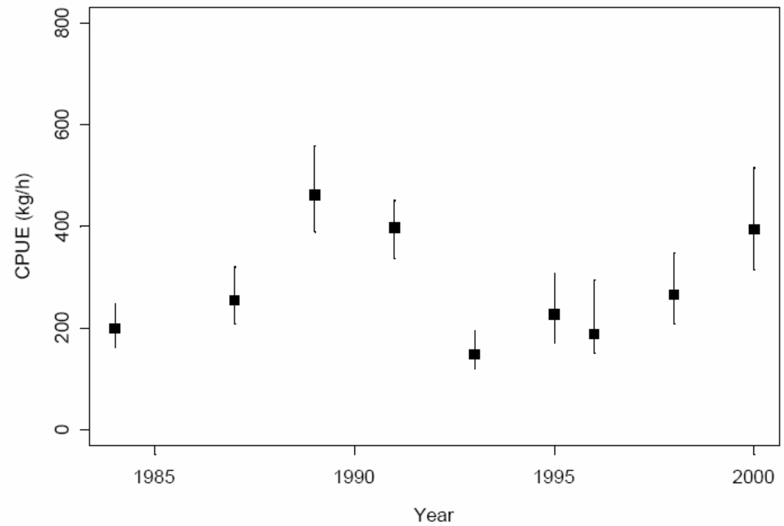


Figure 17. von Bertalanffy growth relationships estimated within SS2 (base case)

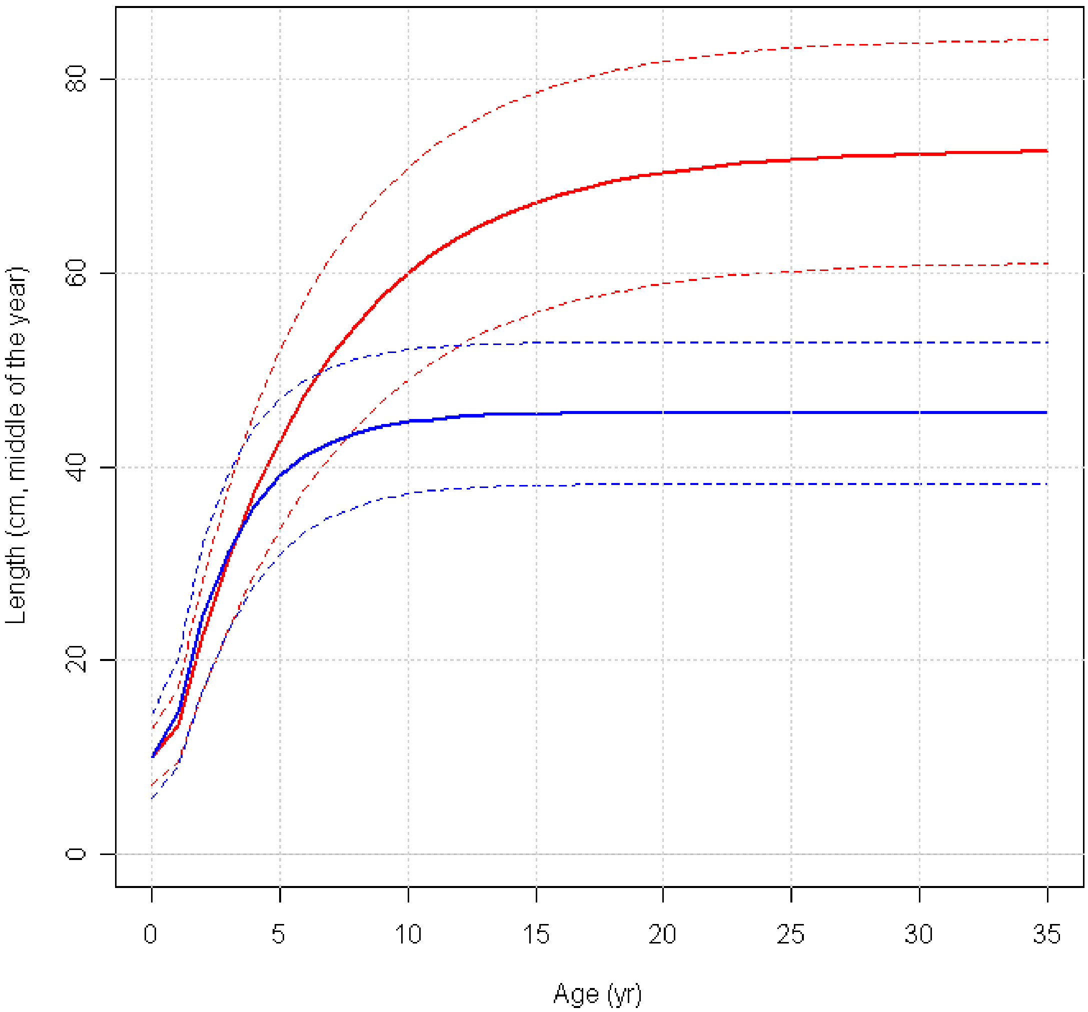


Figure 18. Length weight relationships used as input into SS2.

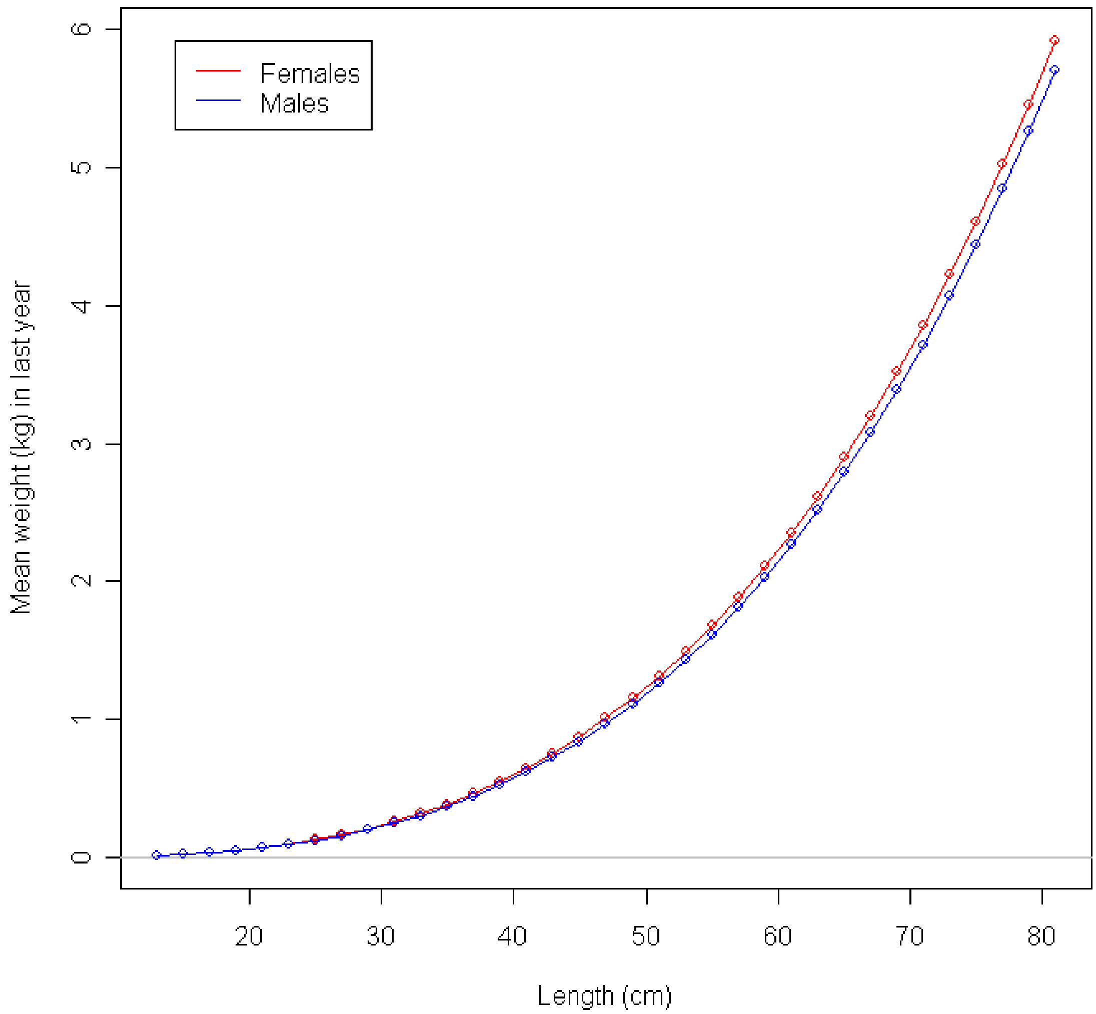


Figure 19. Female maturity relationship (from Rickey 1993).

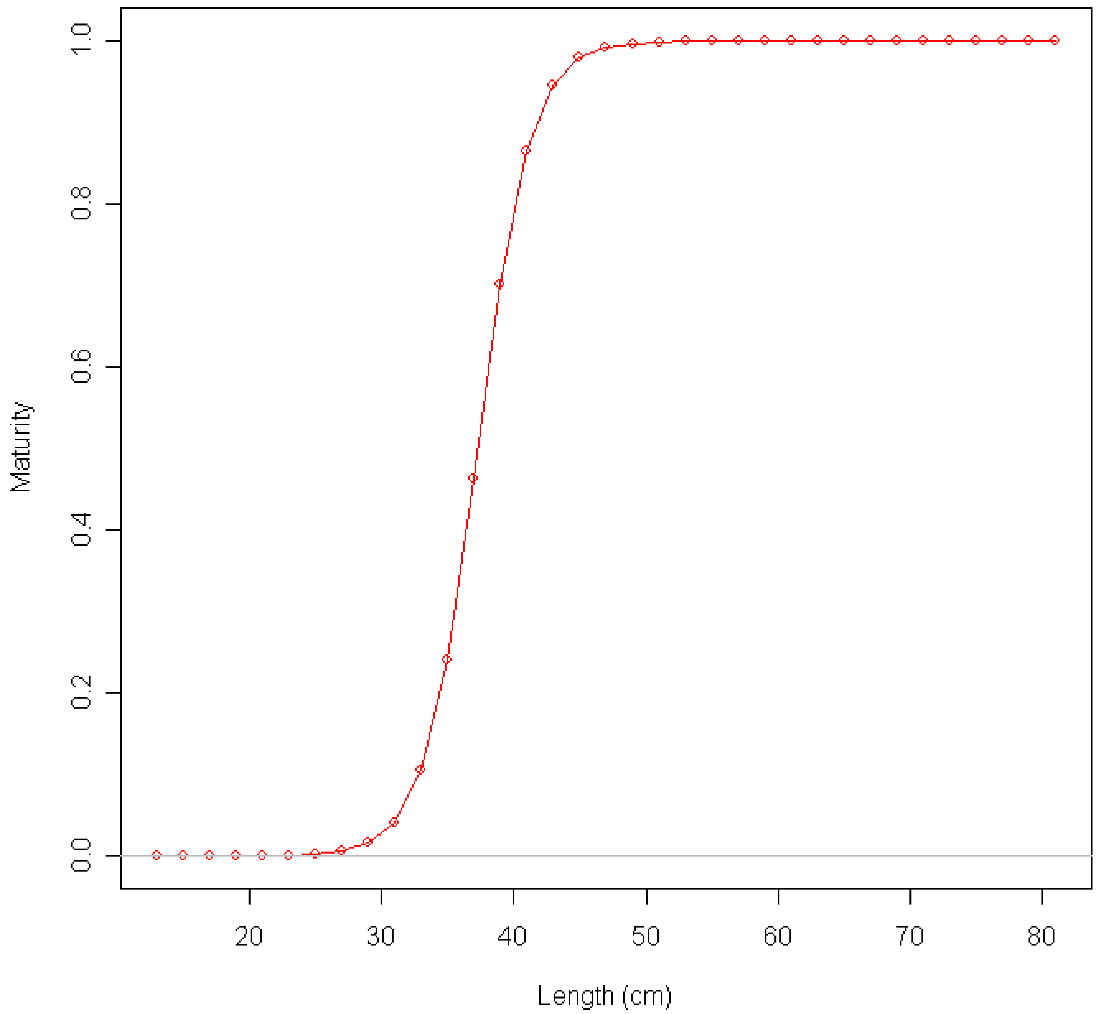


Figure 20. Estimated time series of arrowtooth spawning biomass in the base case model

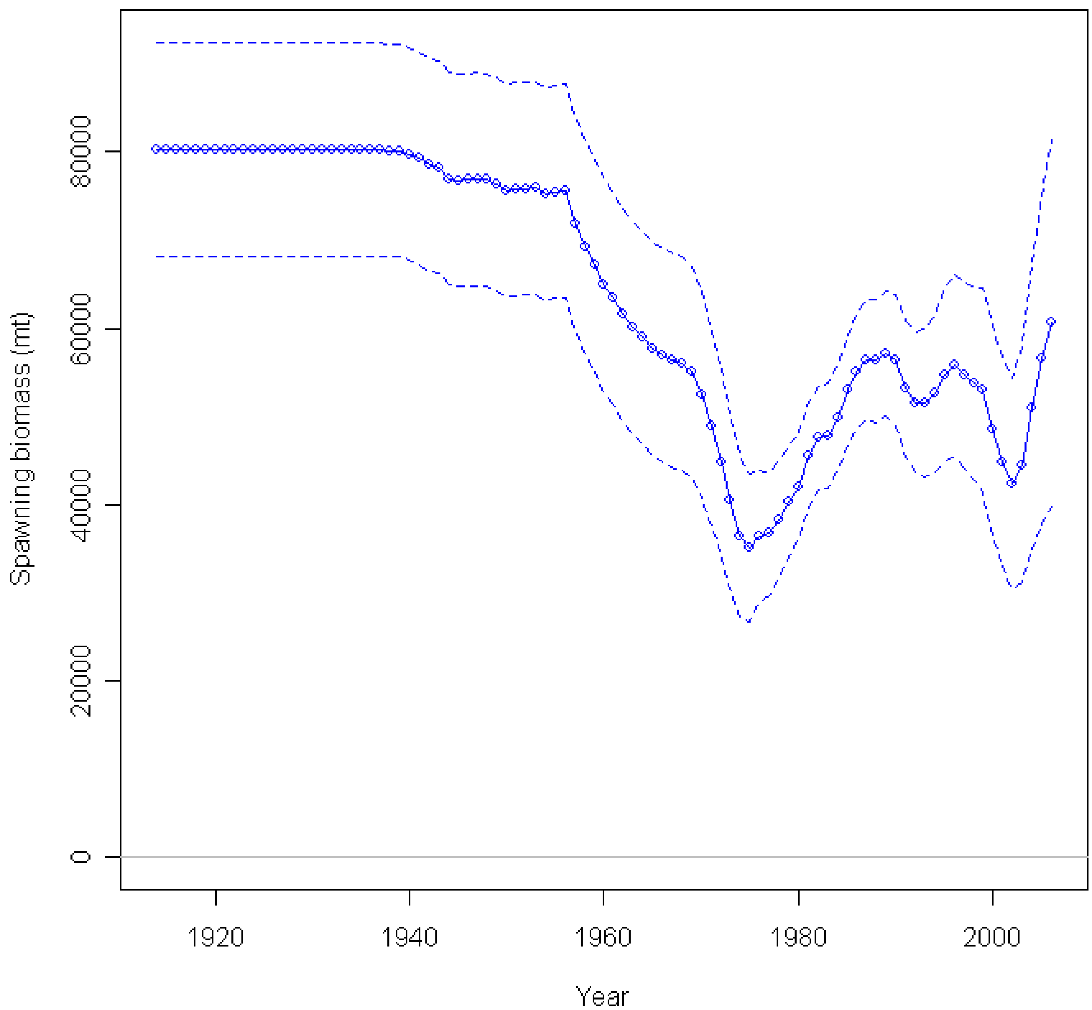


Figure 21. Predicted total arrowtooth biomass time series, base case model.

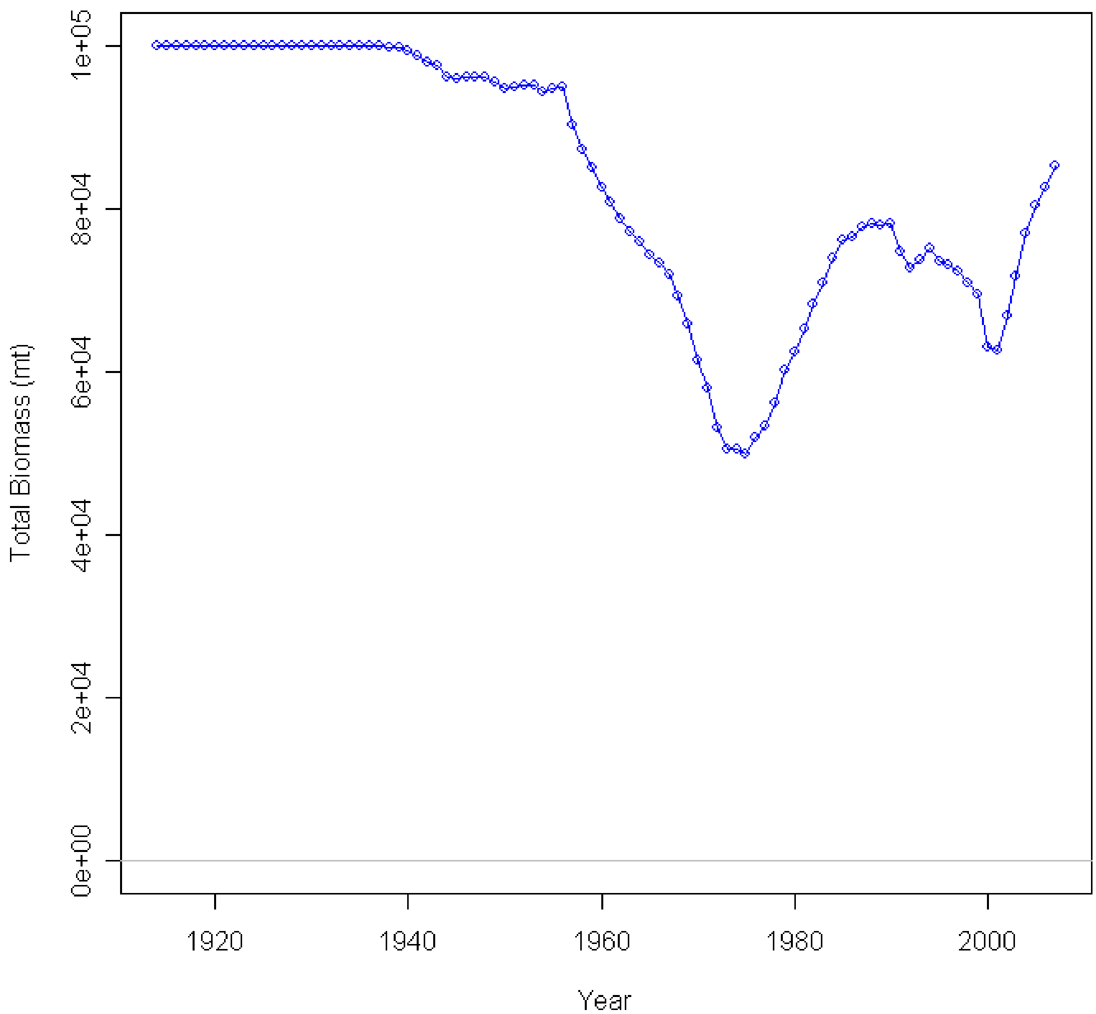


Figure 22. Arrowtooth spawning biomass relative to management targets.

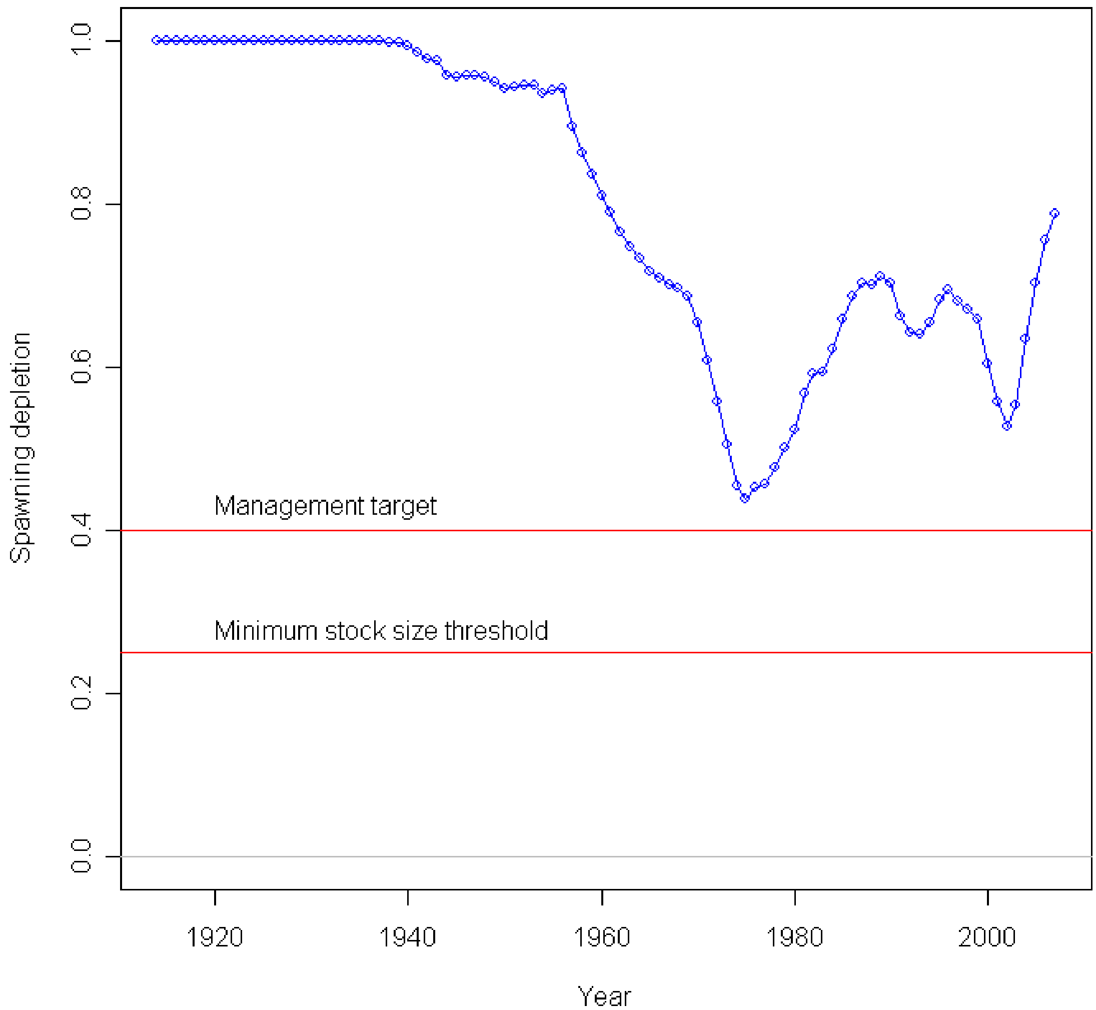


Figure 23. Estimated arrowtooth recruitment and ~95% confidence intervals.

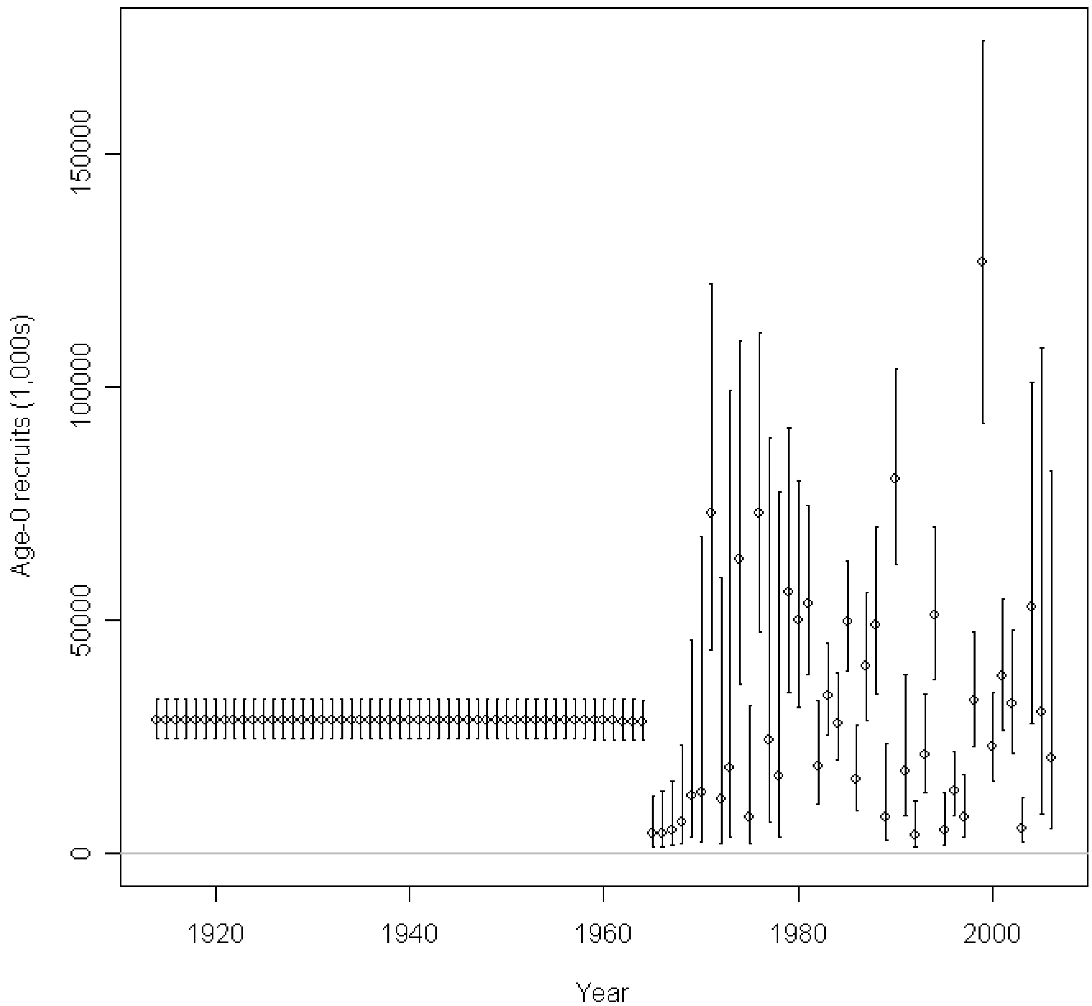


Figure 24. Natural logarithm of recruitment deviations

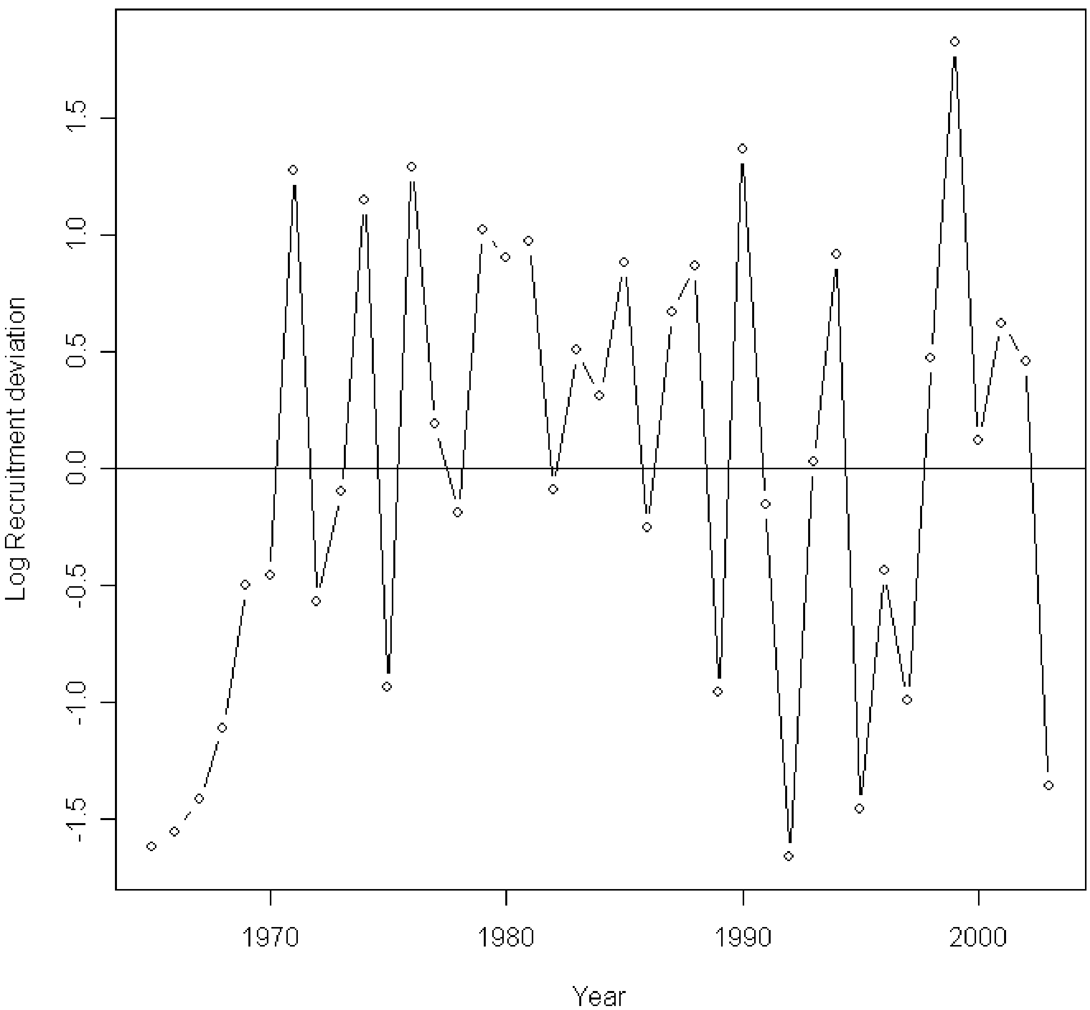


Figure 25. Stock recruitment plot for arrowtooth

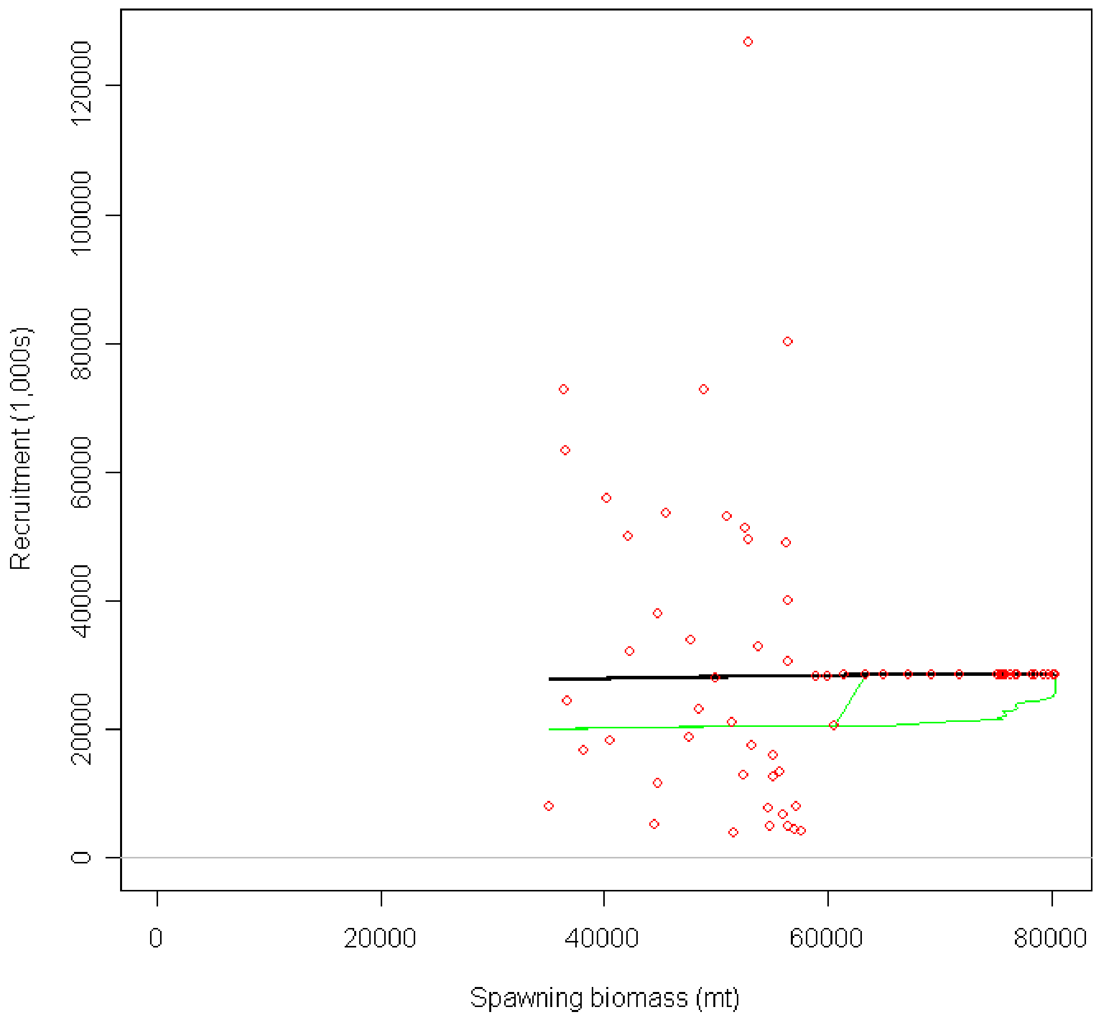


Figure 26. Harvest rate of arrowtooth by the mink food fishery (red line beginning in 1928), the bycatch fleet (green line beginning in 1956), and the fillet fleet (yellow line beginning in 1981).

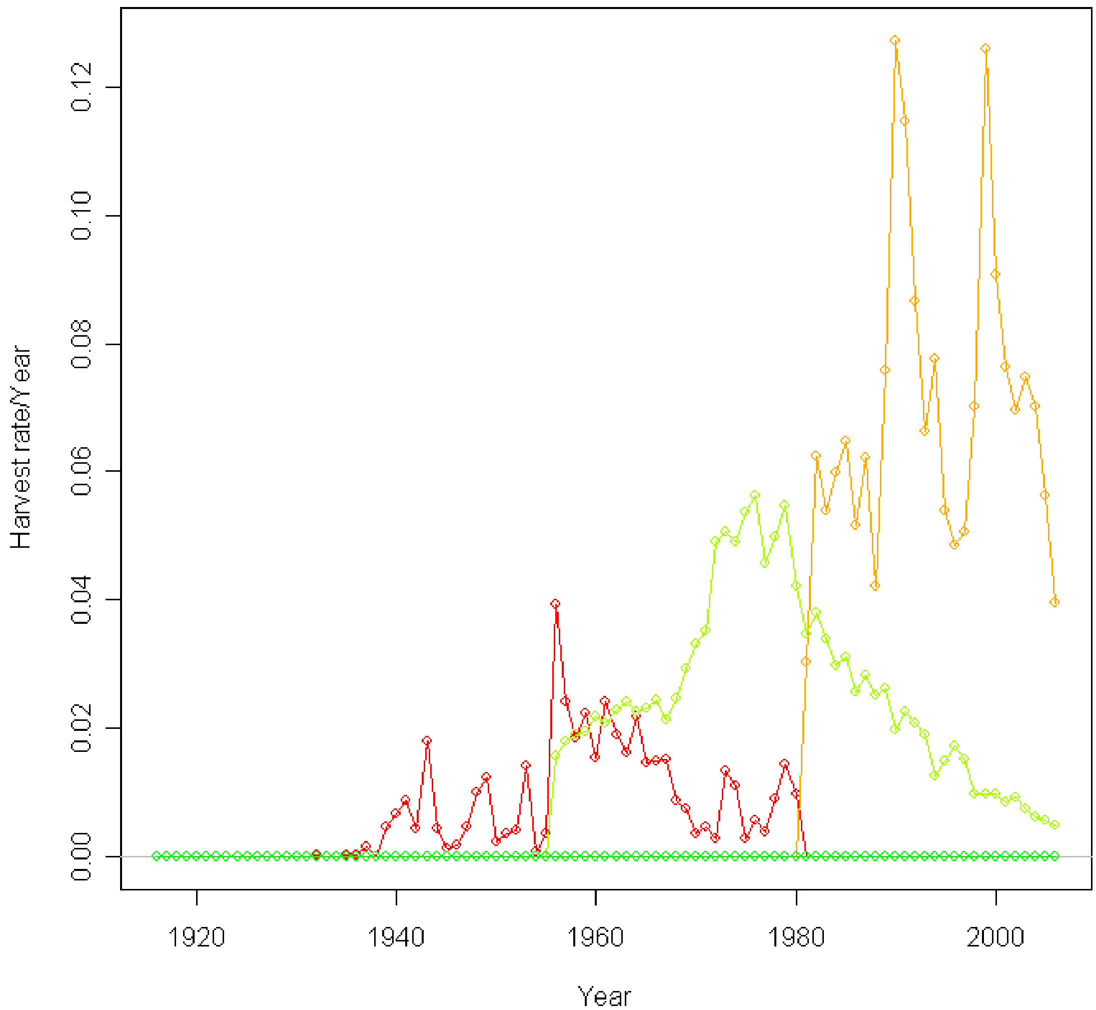


Figure 27. Total catch, in metric tons, of arrowtooth by the mink food fishery (red line beginning in 1928), the bycatch fleet (green line beginning in 1956), and the fillet fleet (yellow line beginning in 1981). The black line is summed catch over all fleets.

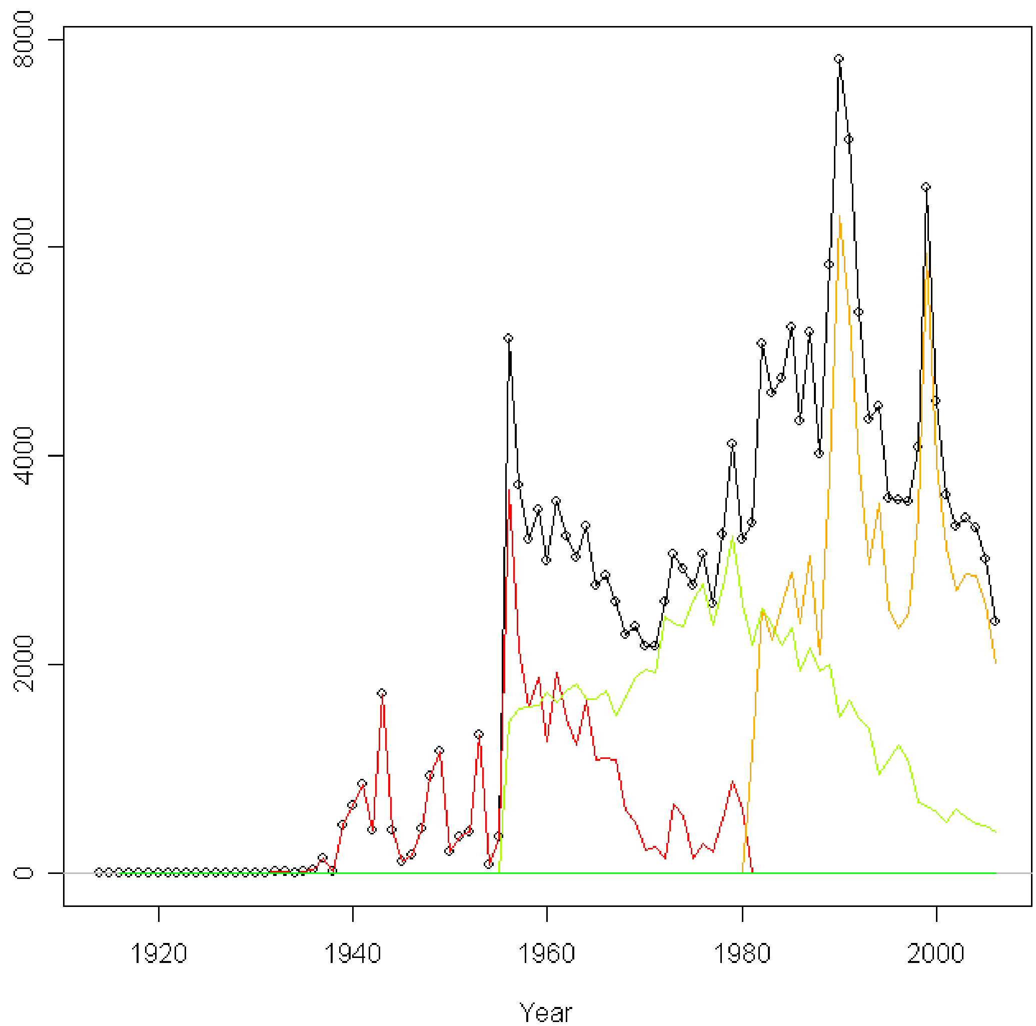


Figure 28. Base model fit to the NWFSC Slope Survey.

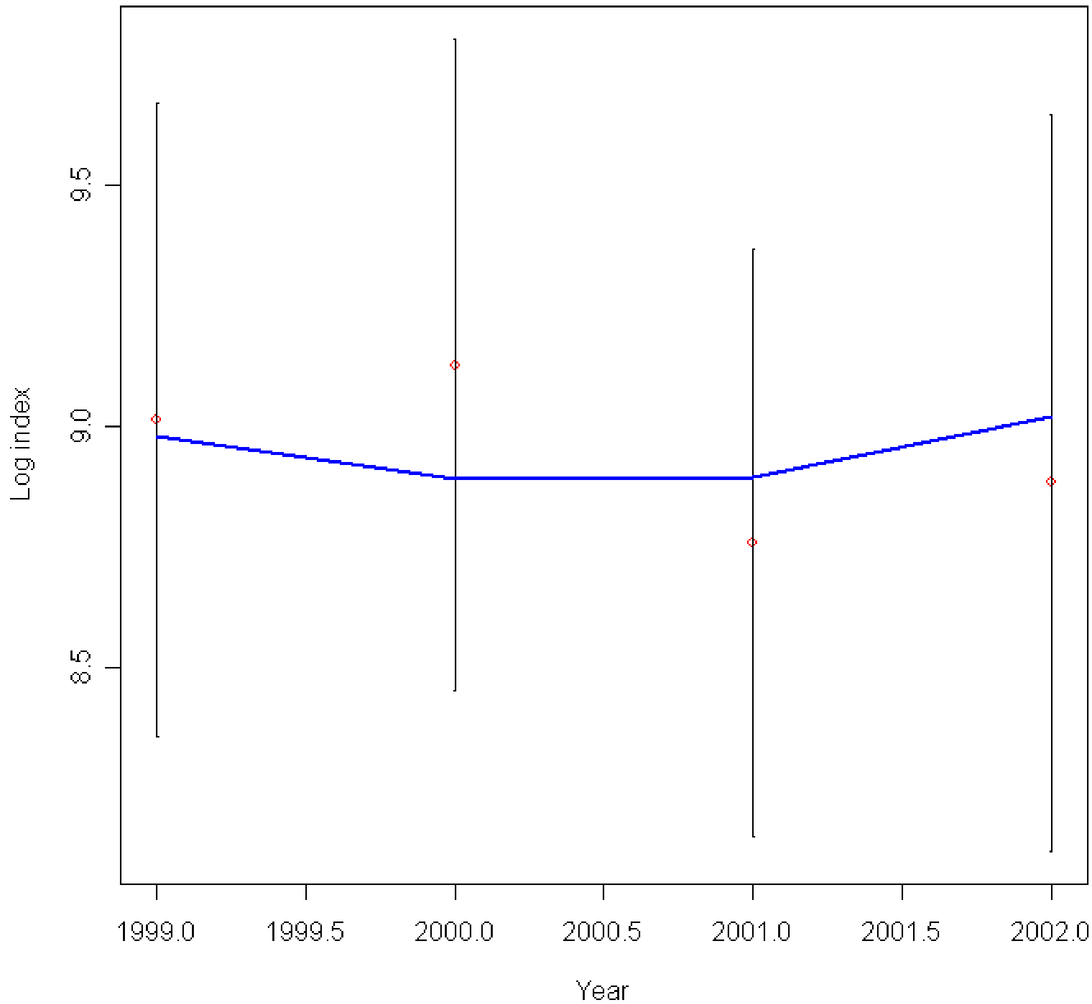
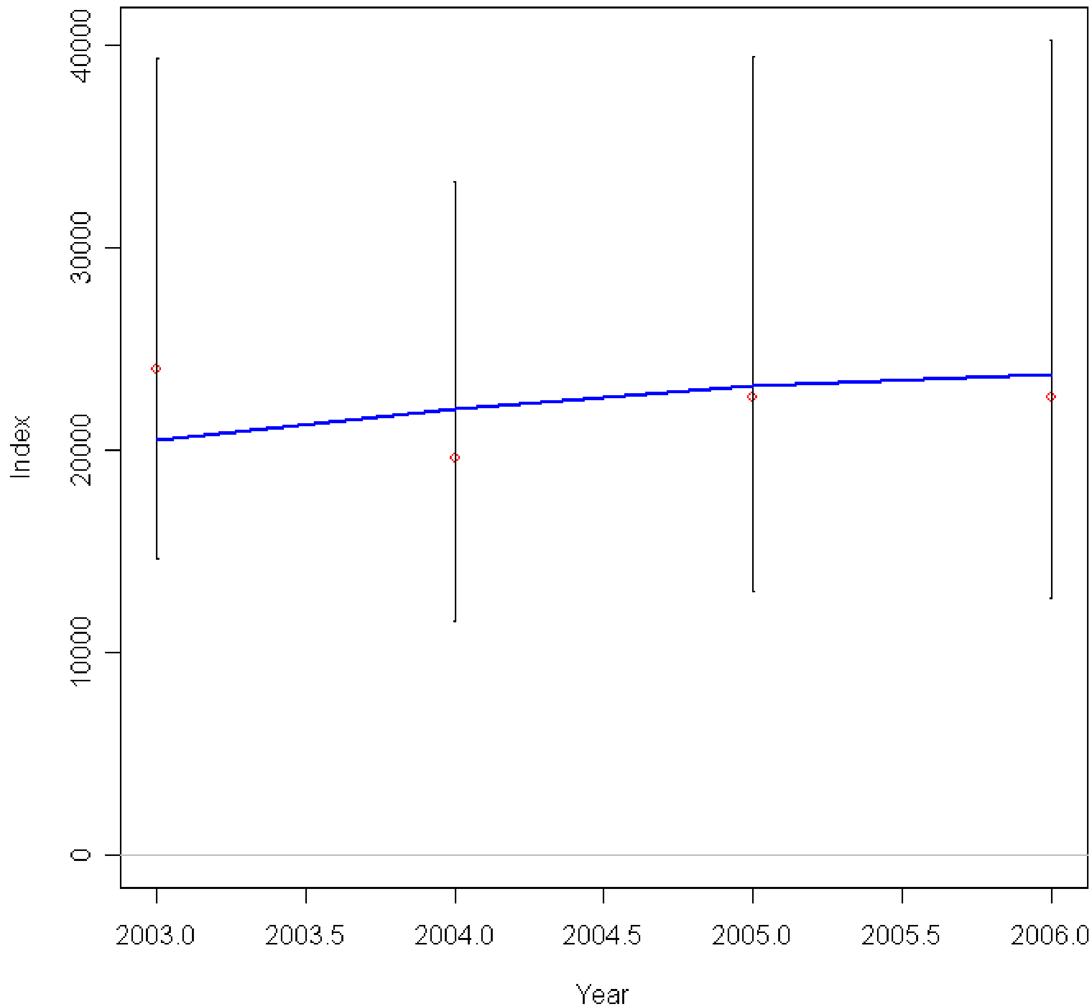


Figure 29. Base case model fits to the NWFSC Slope-Shelf survey



30. Base model fit to the AFSC Slope Survey.

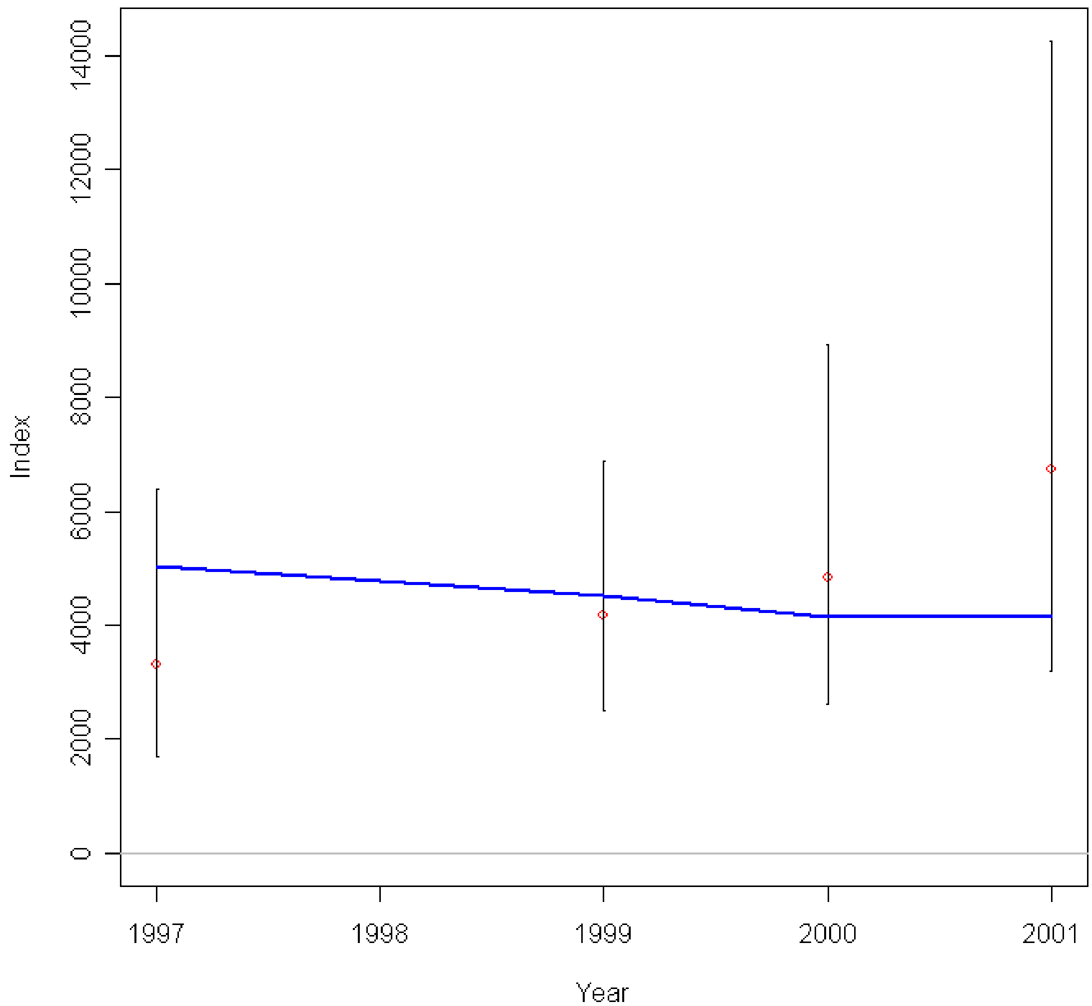


Figure 31. Base case model fit to Triennial Survey data.

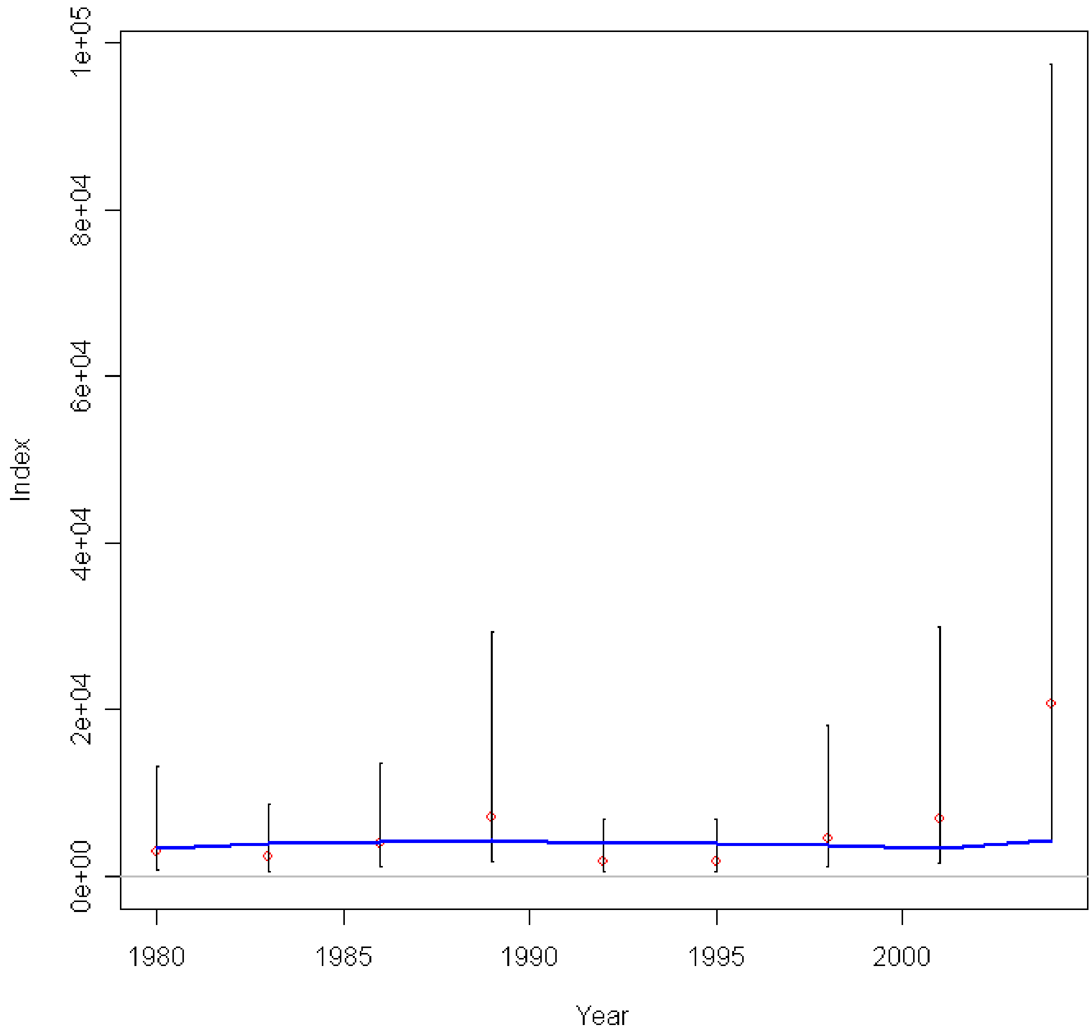


Figure 32. Female selectivity for the Triennial Survey

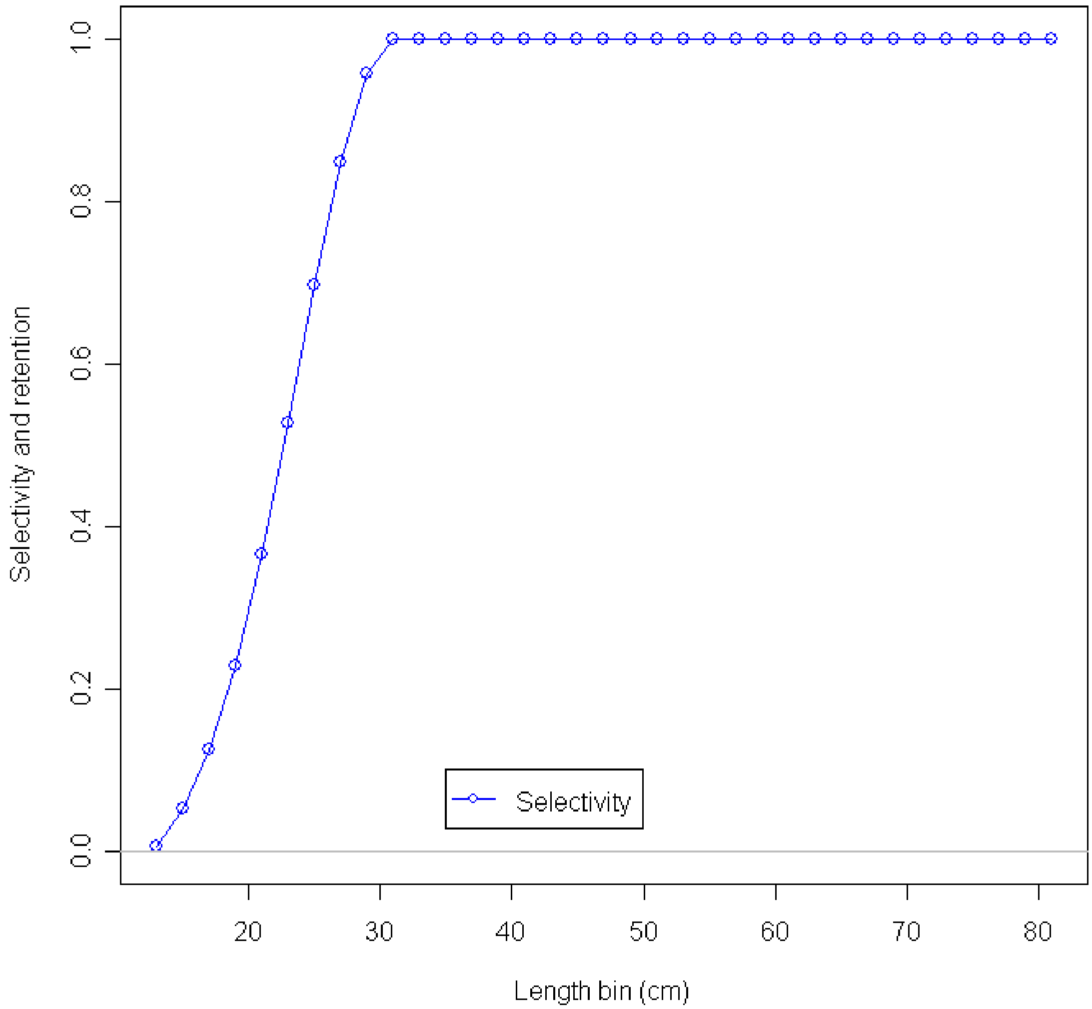


Figure 33. Male selectivity for the Triennial Survey

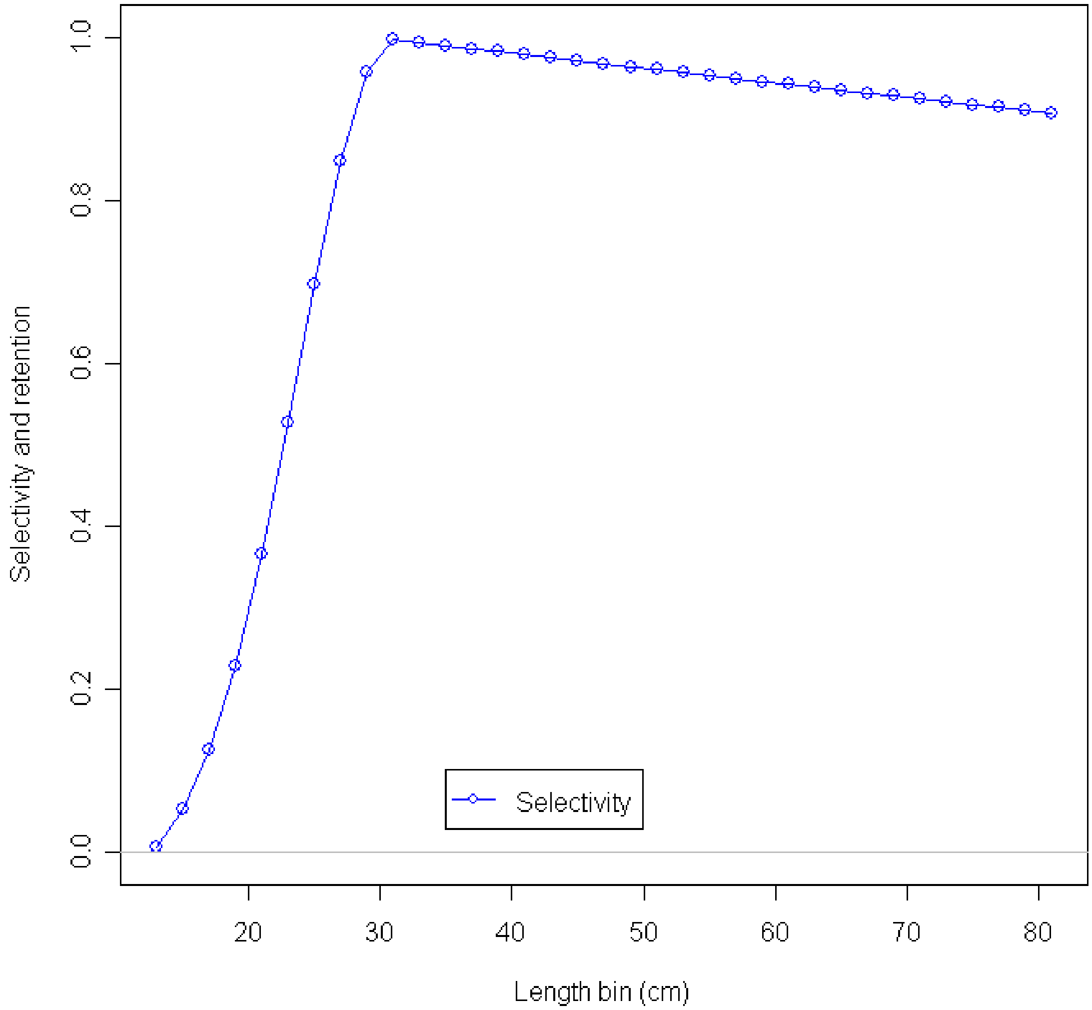


Figure 34. Female selectivity for the AFSC Slope Survey. We also fixed selectivity for the NWFSC Slope Survey at these values.

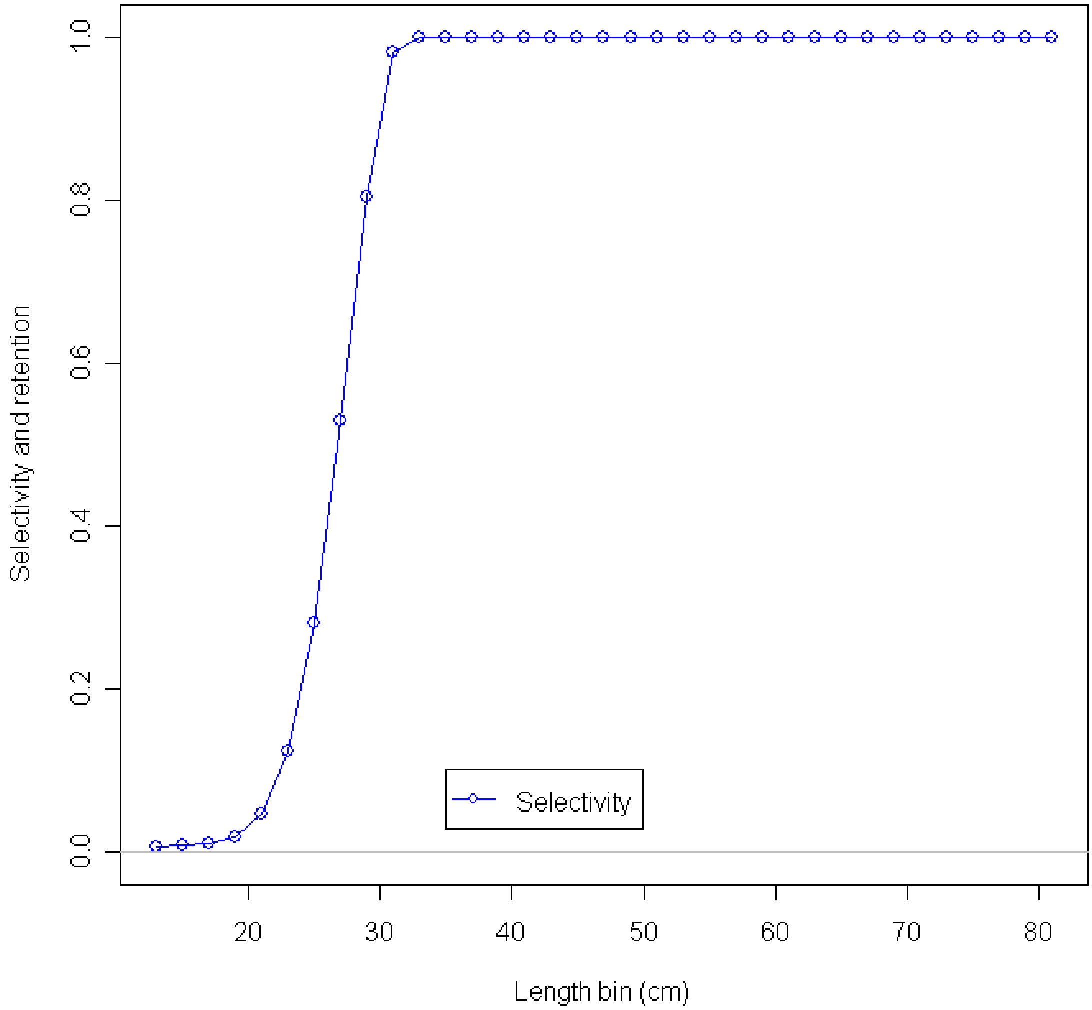


Figure 35. Male selectivity for the AFSC Slope Survey. We also fixed selectivity for the NWFSC Slope Survey at these values.

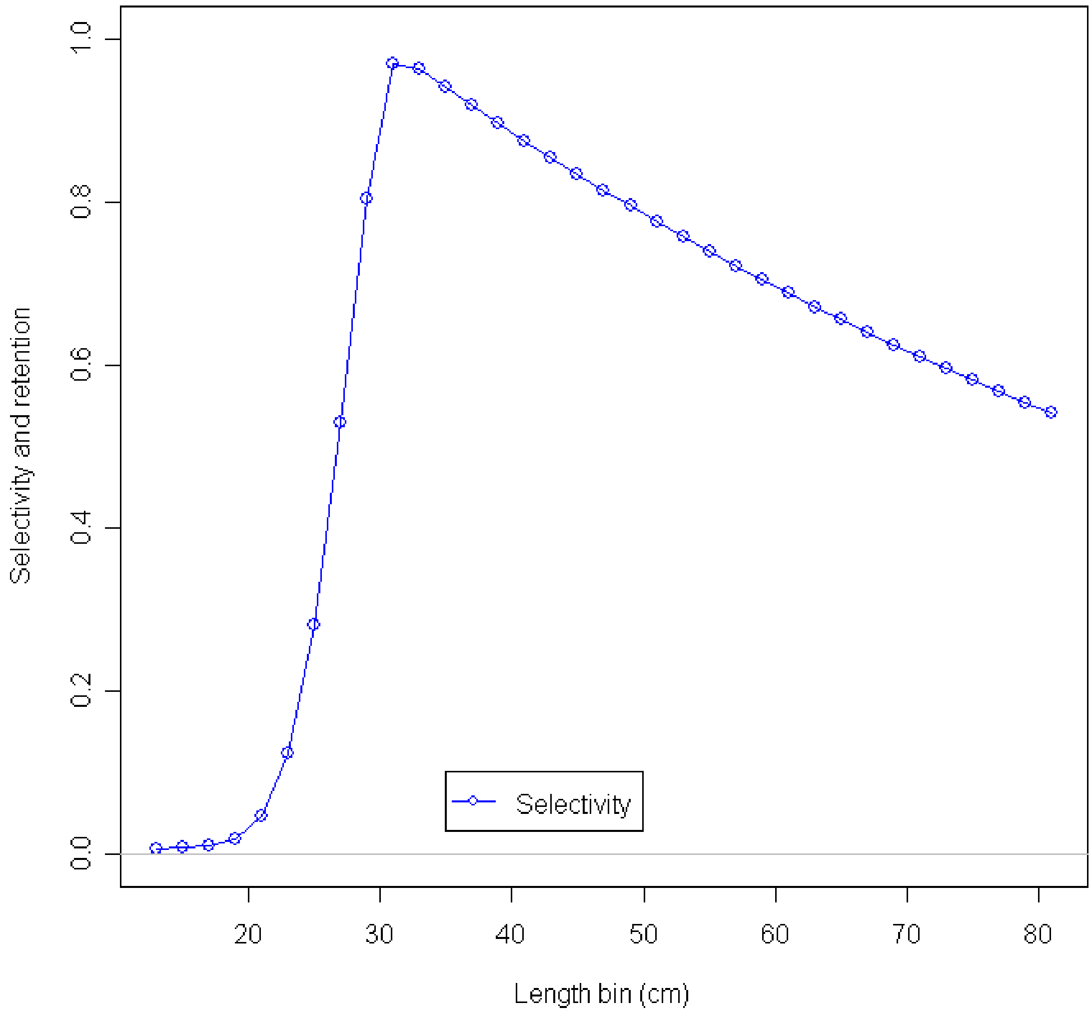


Figure 36. Female selectivity for the NWFSC Slope-Shelf Survey

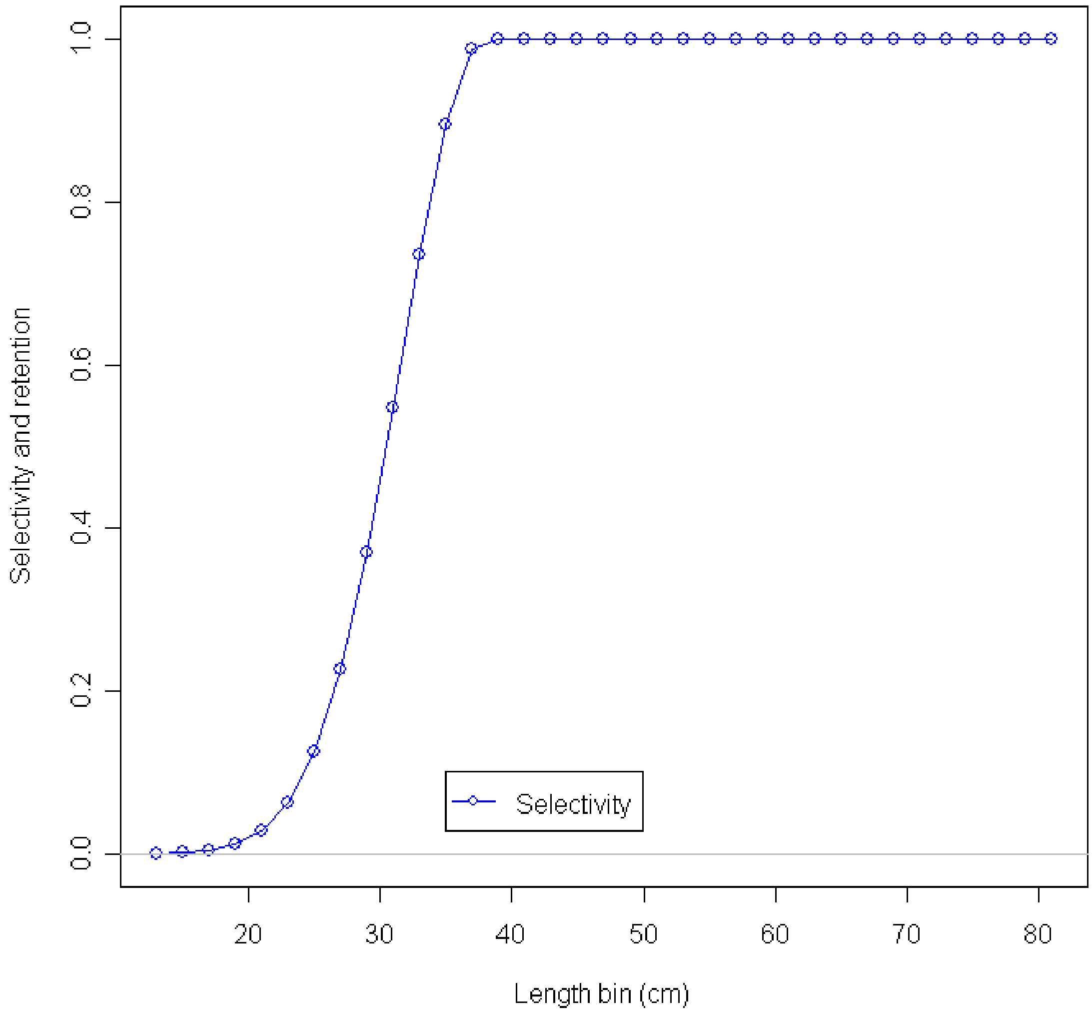


Figure 37. Male selectivity for the NWFSC Slope-Shelf Survey

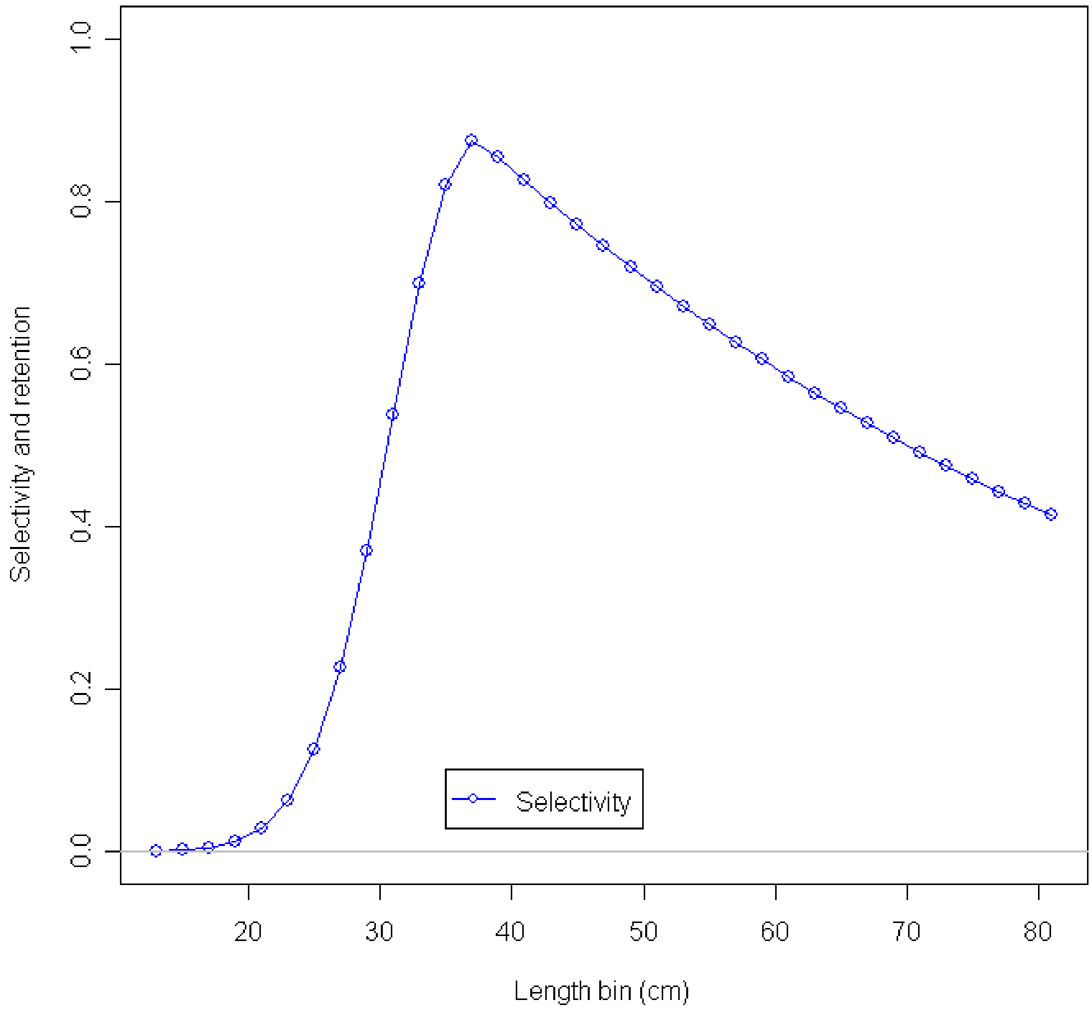


Figure 38. Selectivity for the discard fleet

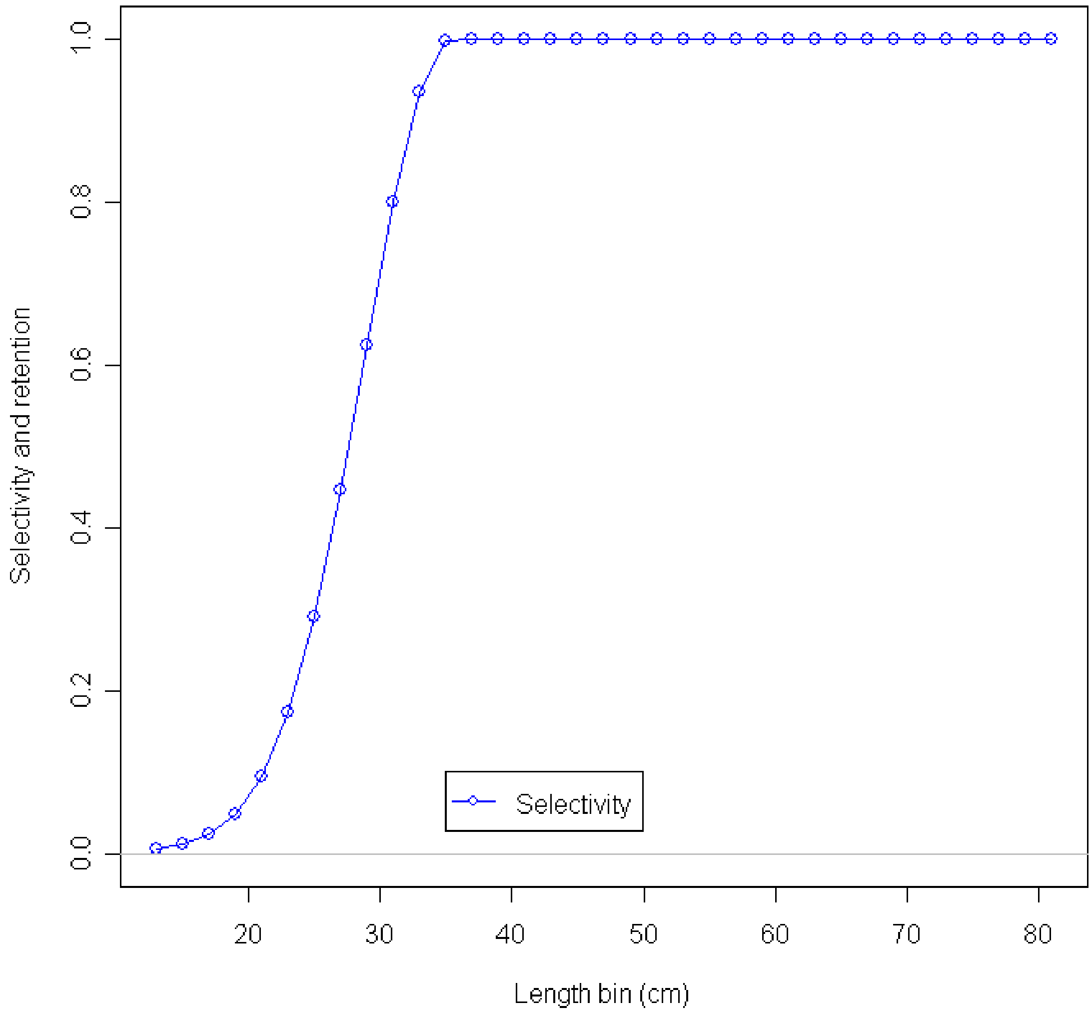


Figure 39. Estimated selectivity for the fillet fleet. The model estimated no difference between the sexes. We assume full retention, since we have added discards to landings.

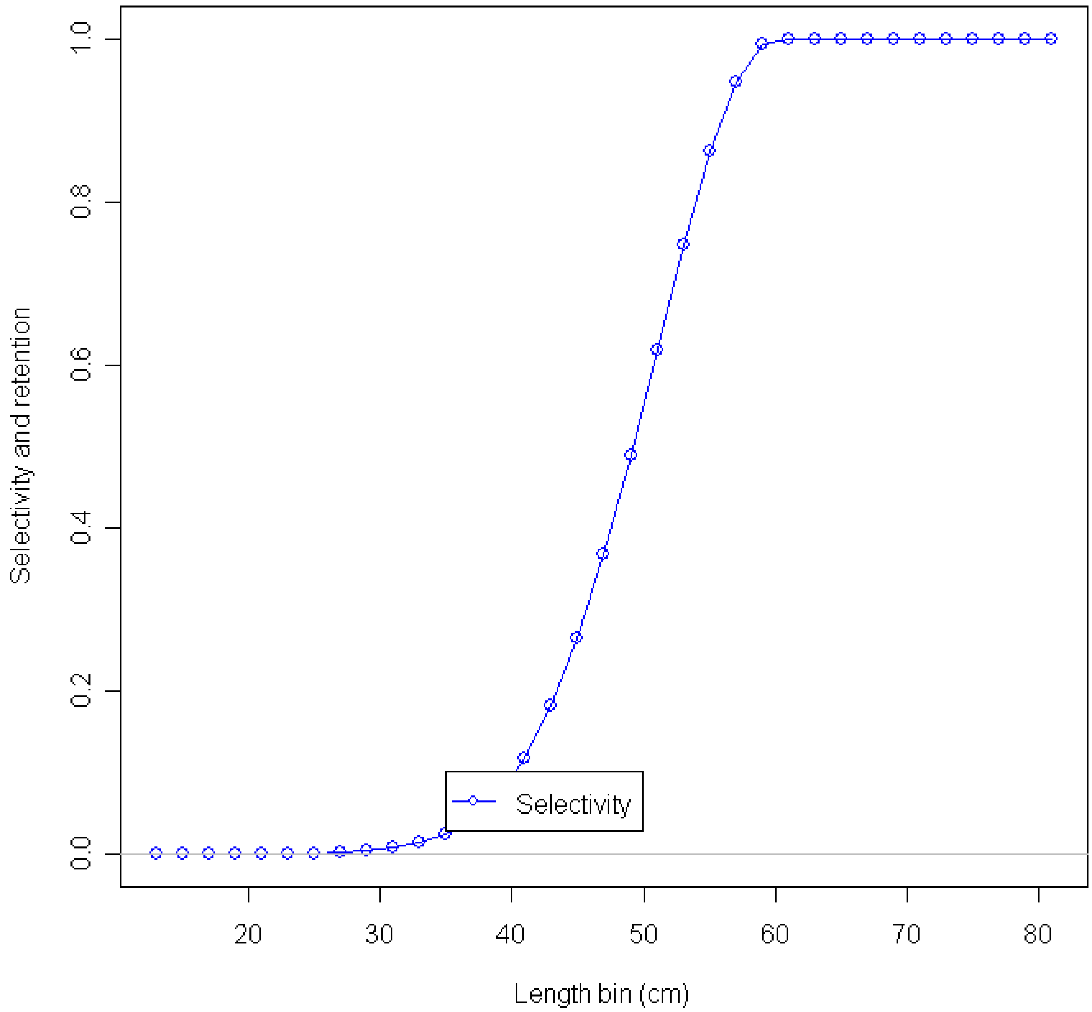


Figure 40. Model fit to fillet fishery female length compositions.

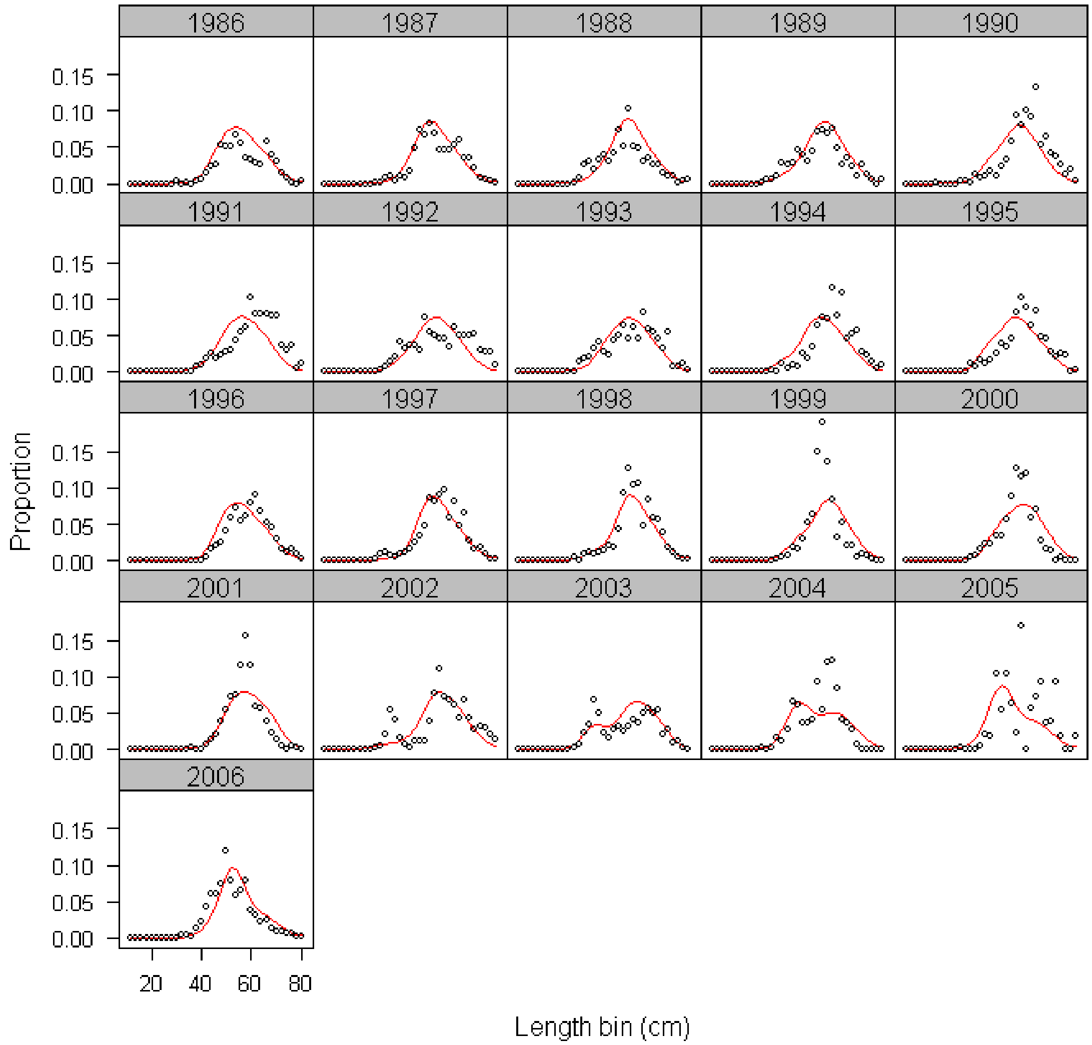


Figure 41. Residuals from model fit to female length compositions for the fillet fishery.

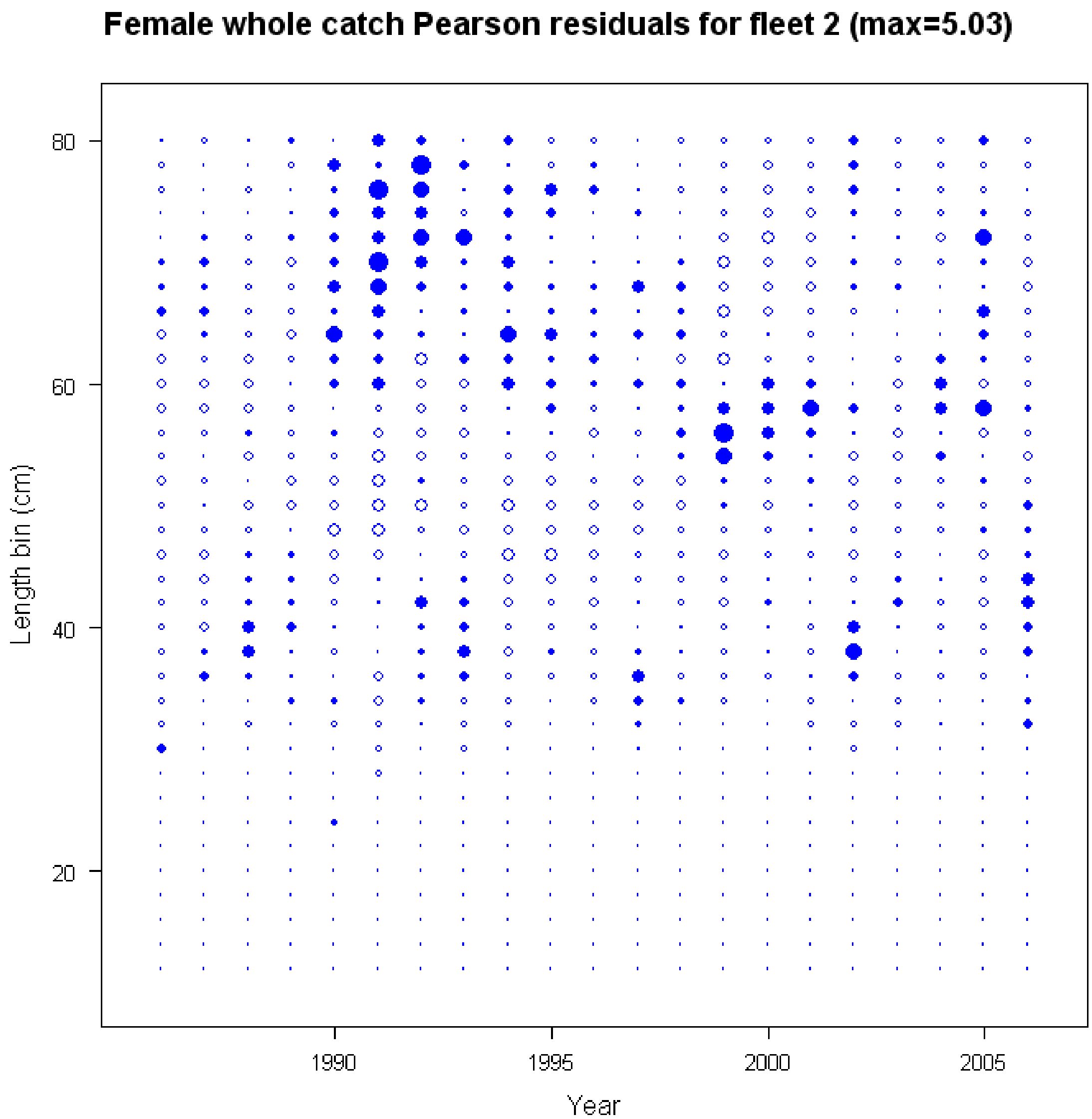


Figure 42. Observed vs. effective sample size for retained female length compositions from the fillet fleet.

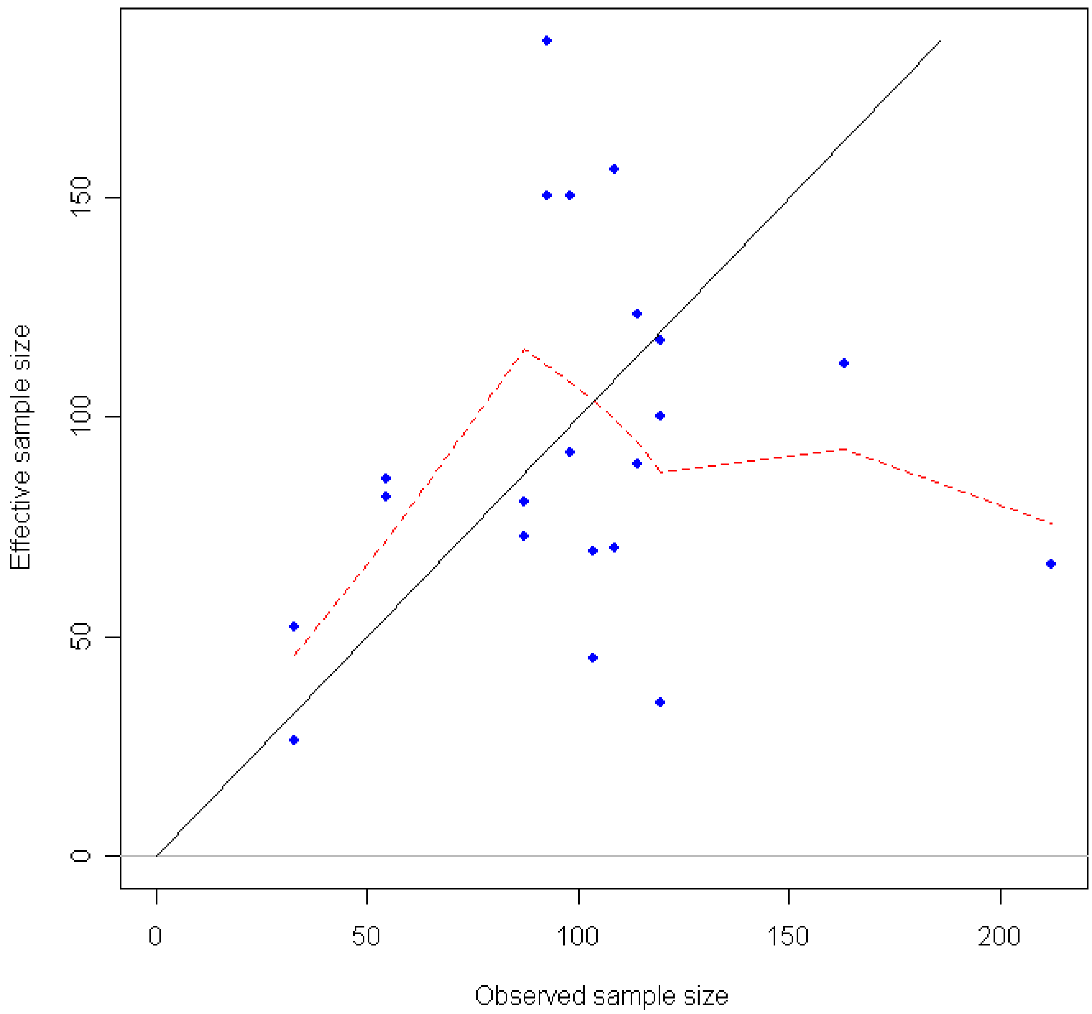


Figure 43. Model fits to length compositions from males in the fillet fishery.

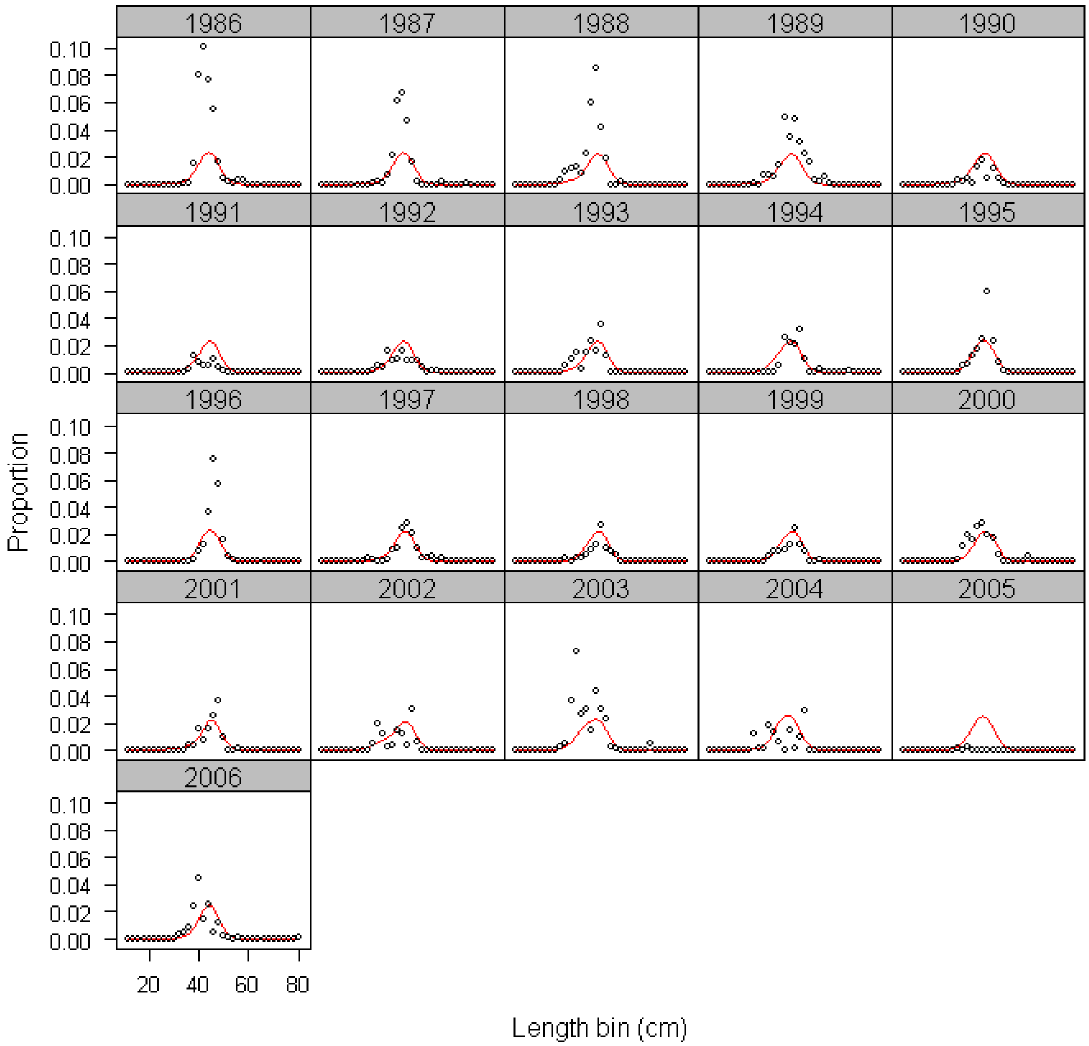


Figure 44. Residuals from model fit to male length compositions from the fillet fishery.

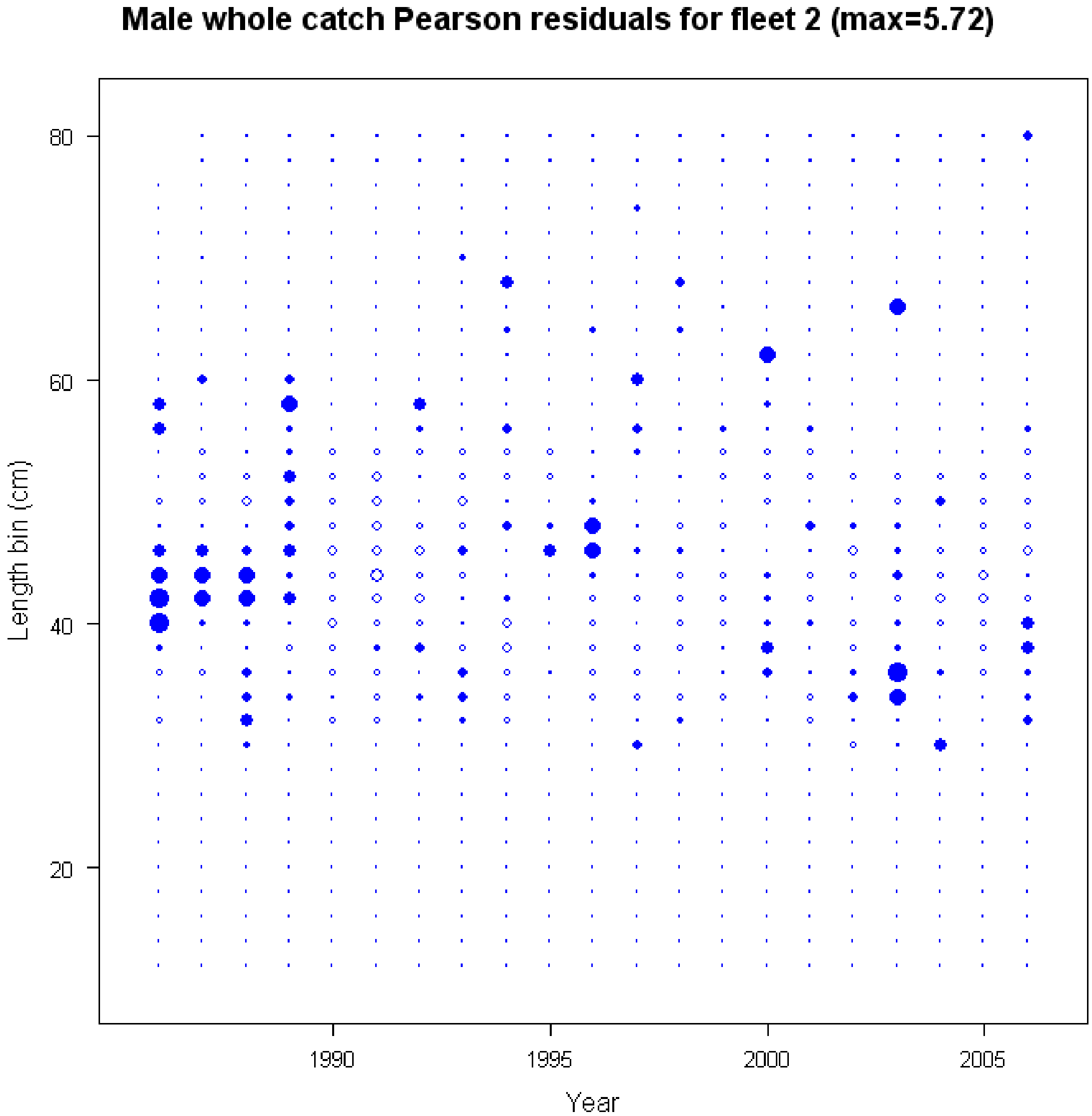


Figure 45. Observed vs. effective sample size for male length compositions from the fillet fishery.

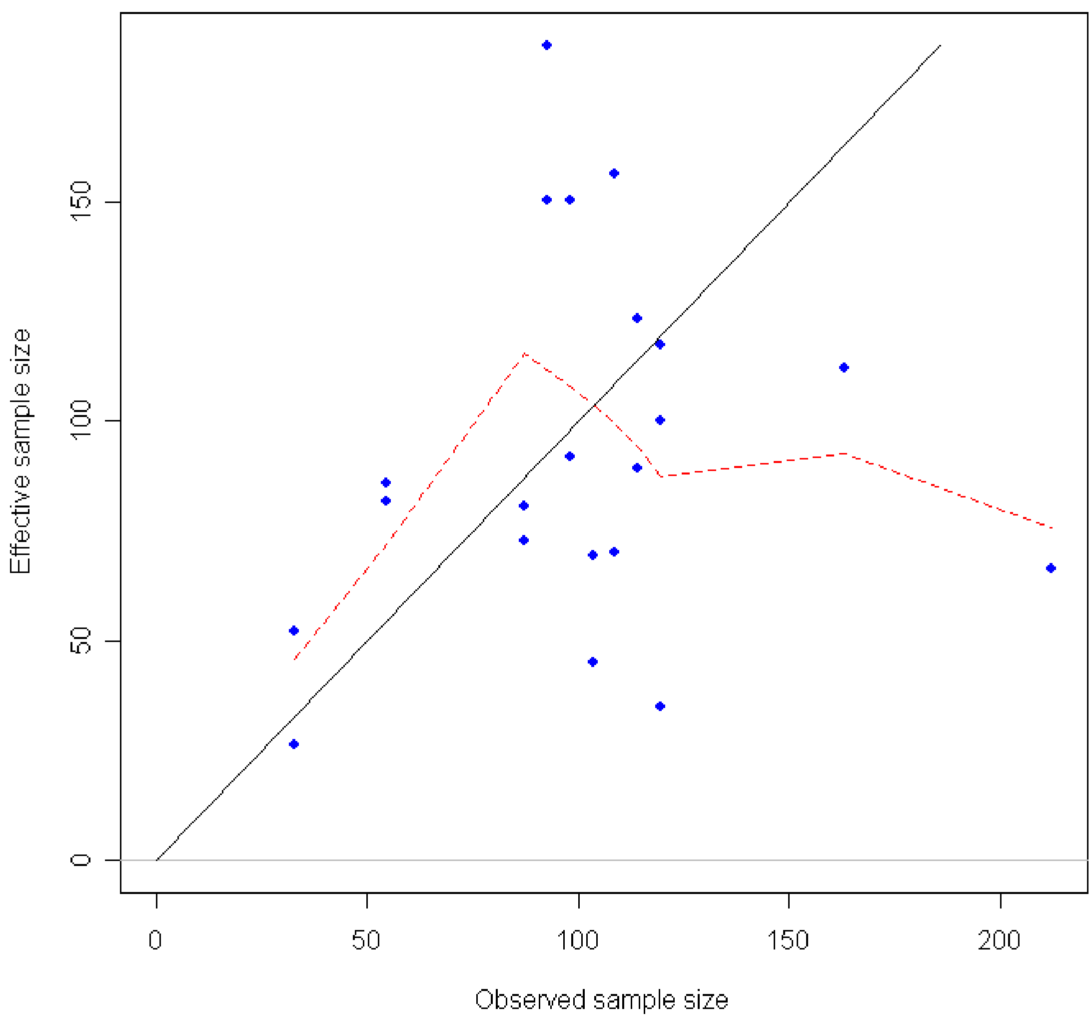


Figure 46. Model fits to combined-sex catch from the bycatch fleet.

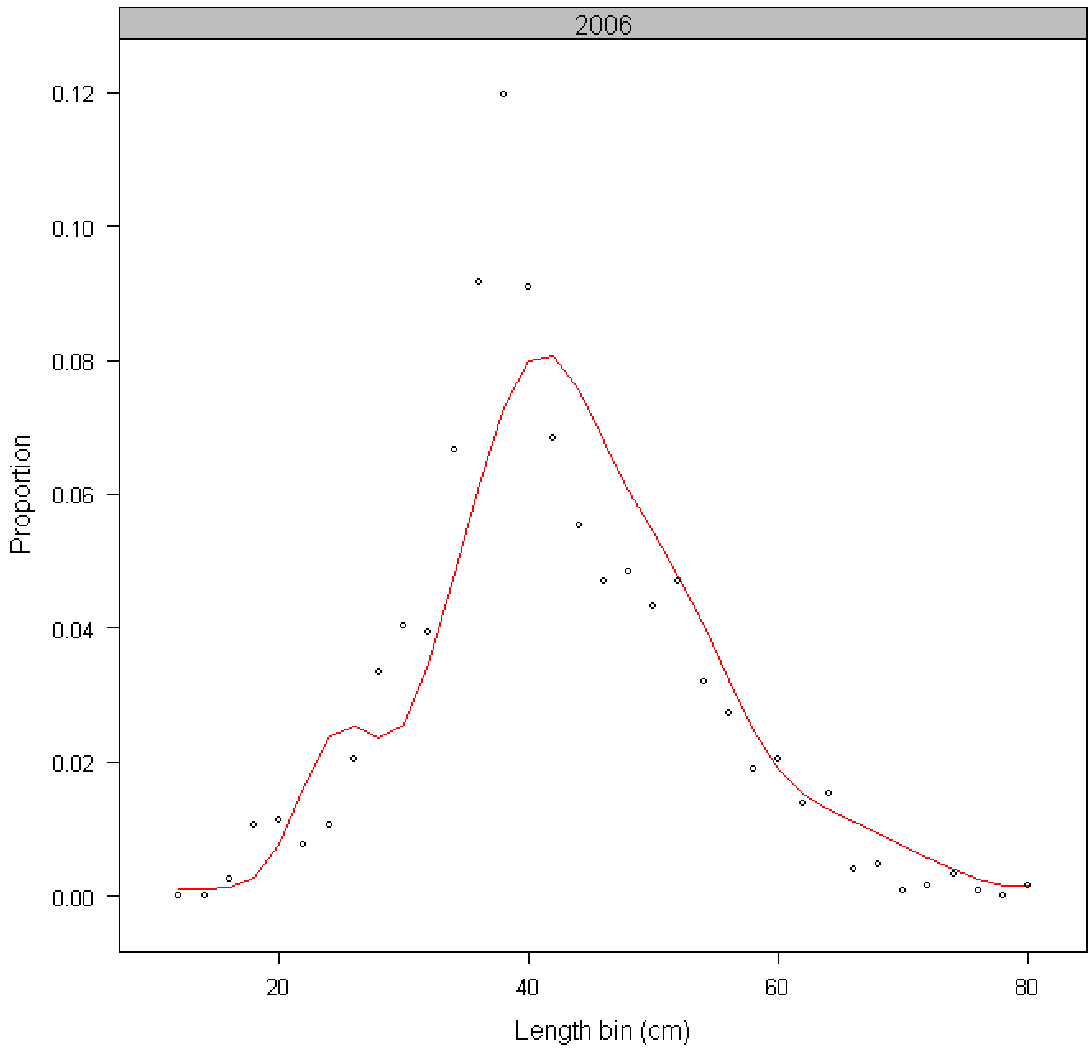


Figure 47. Residuals from model fit to combined-sex length compositions from the bycatch fleet.

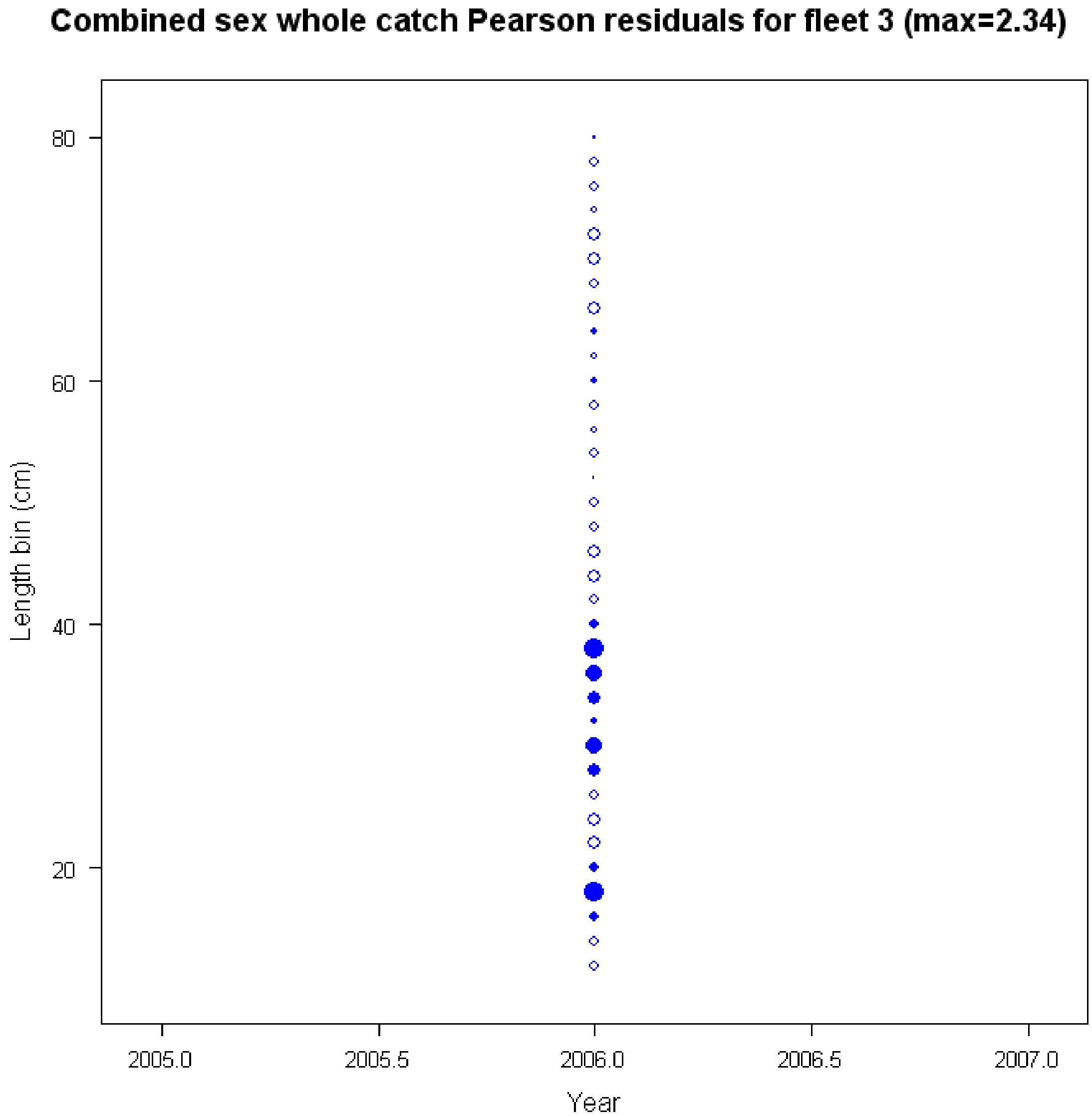


Figure 48. Observed vs. effective sample size for combined-sex length compositions from the bycatch fleet.

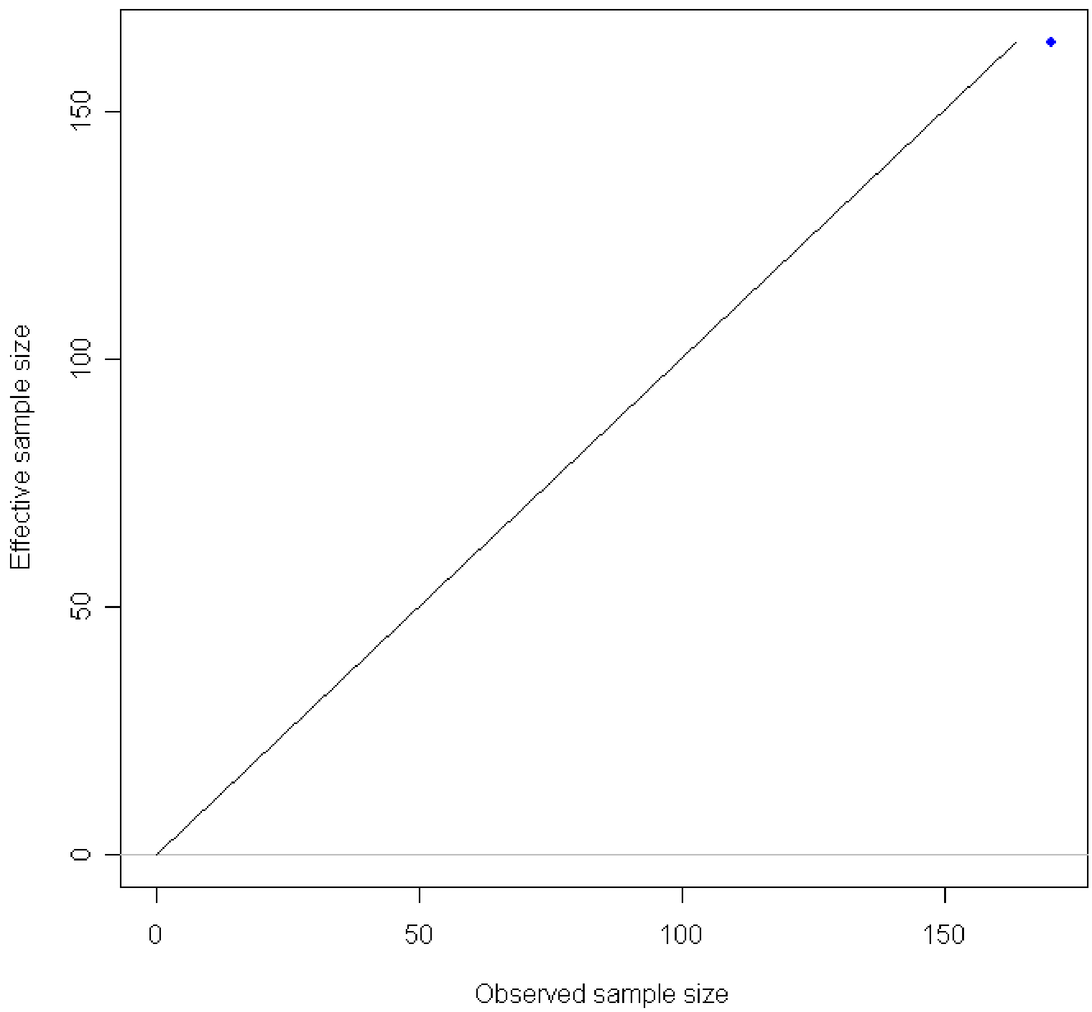


Figure 49. Model fits to female length composition from the NWFSC Slope-Shelf data

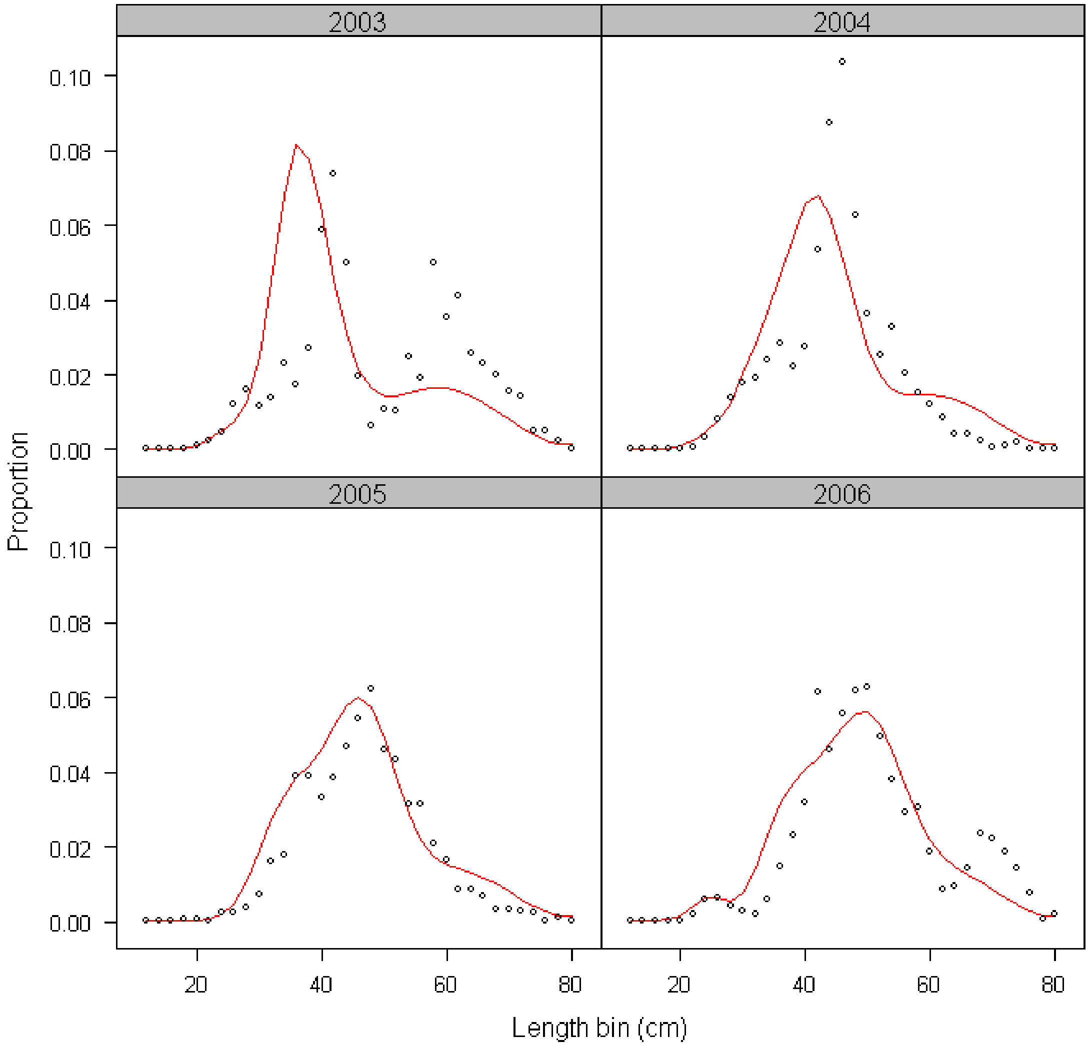
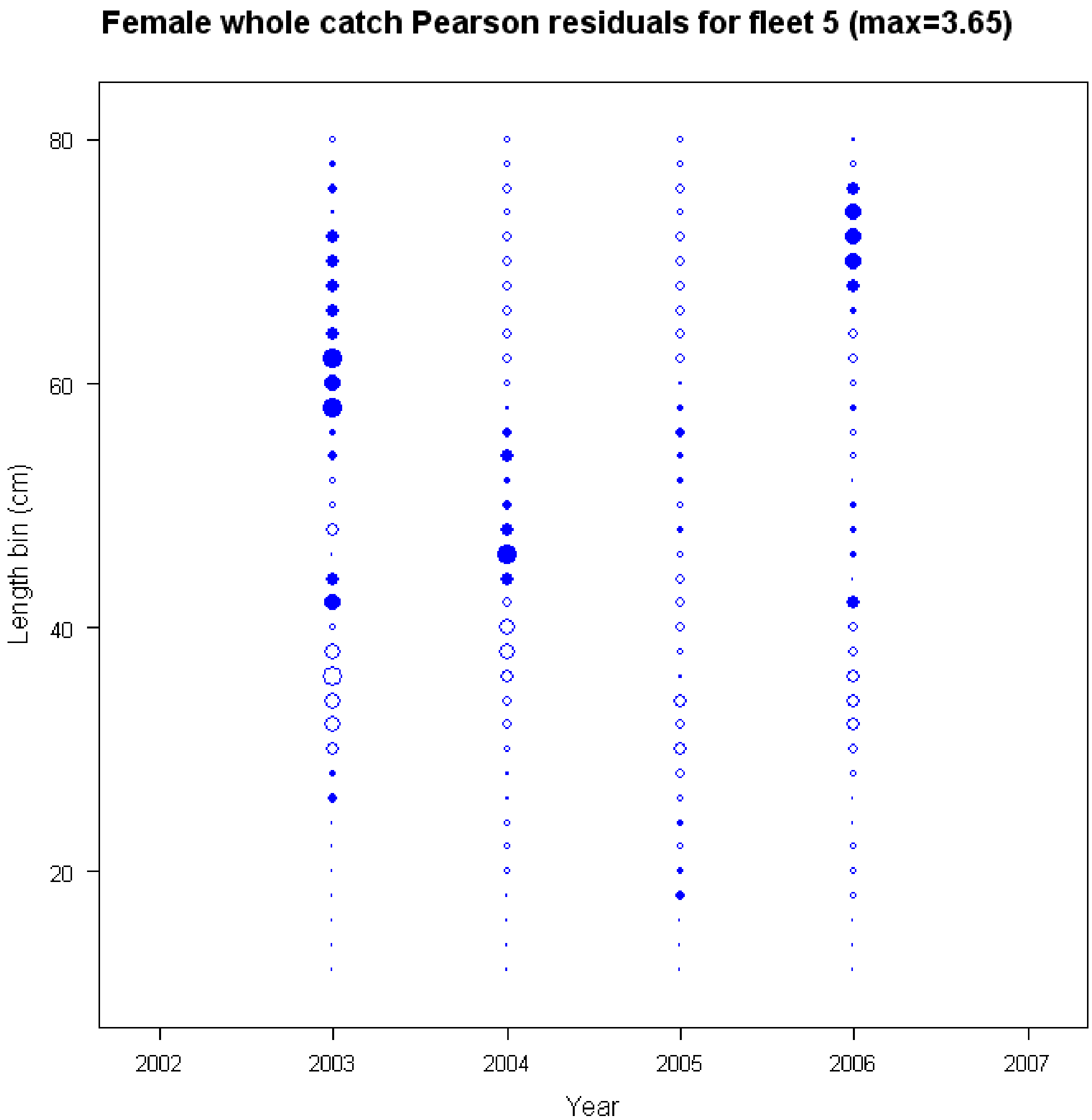


Figure 50. Residuals from model fits to female length composition data from the NWFSC Slope-Shelf survey.



51. Observed vs. effective sample size for model fits to the NWFSC Slope-Shelf female length compositions

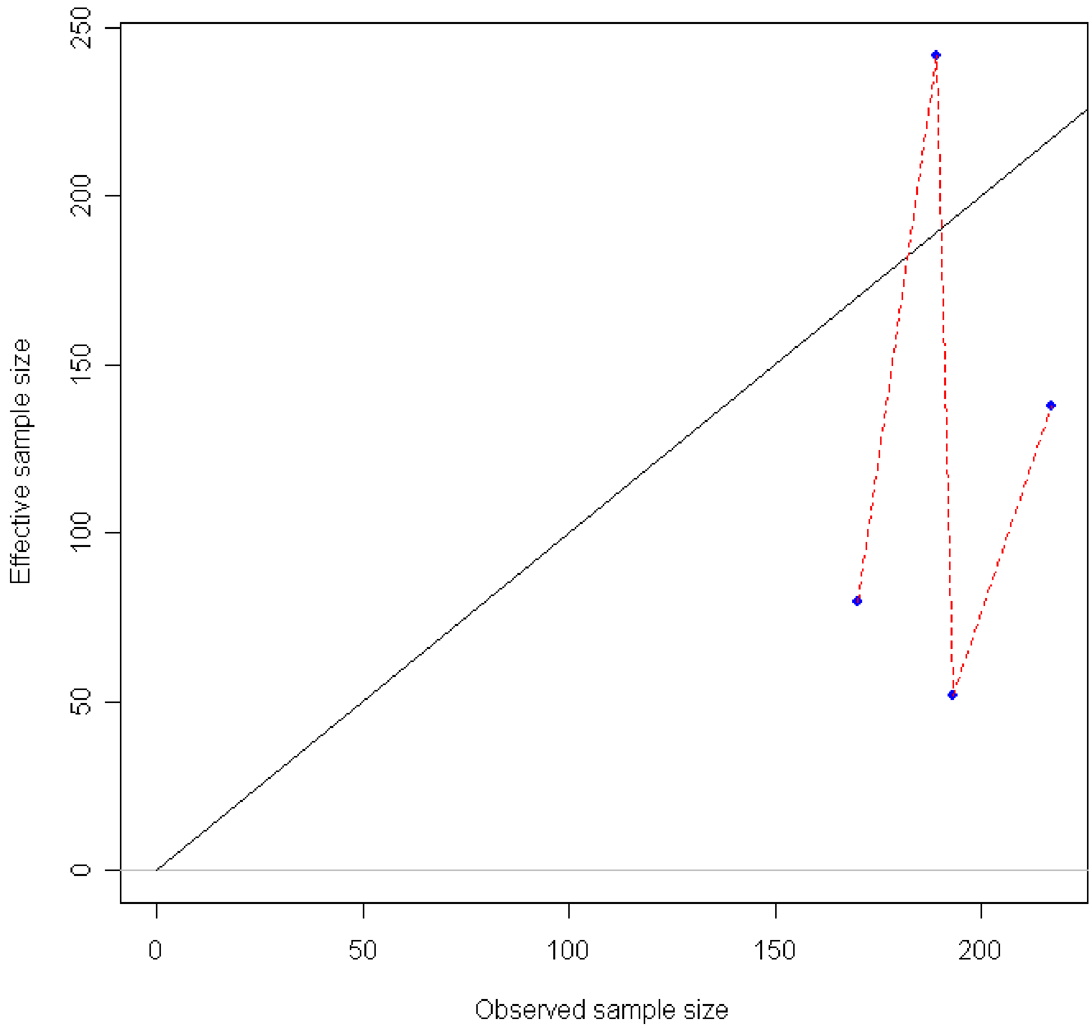


Figure 52. Model fits to the NWFSC Slope-Shelf male length composition data.

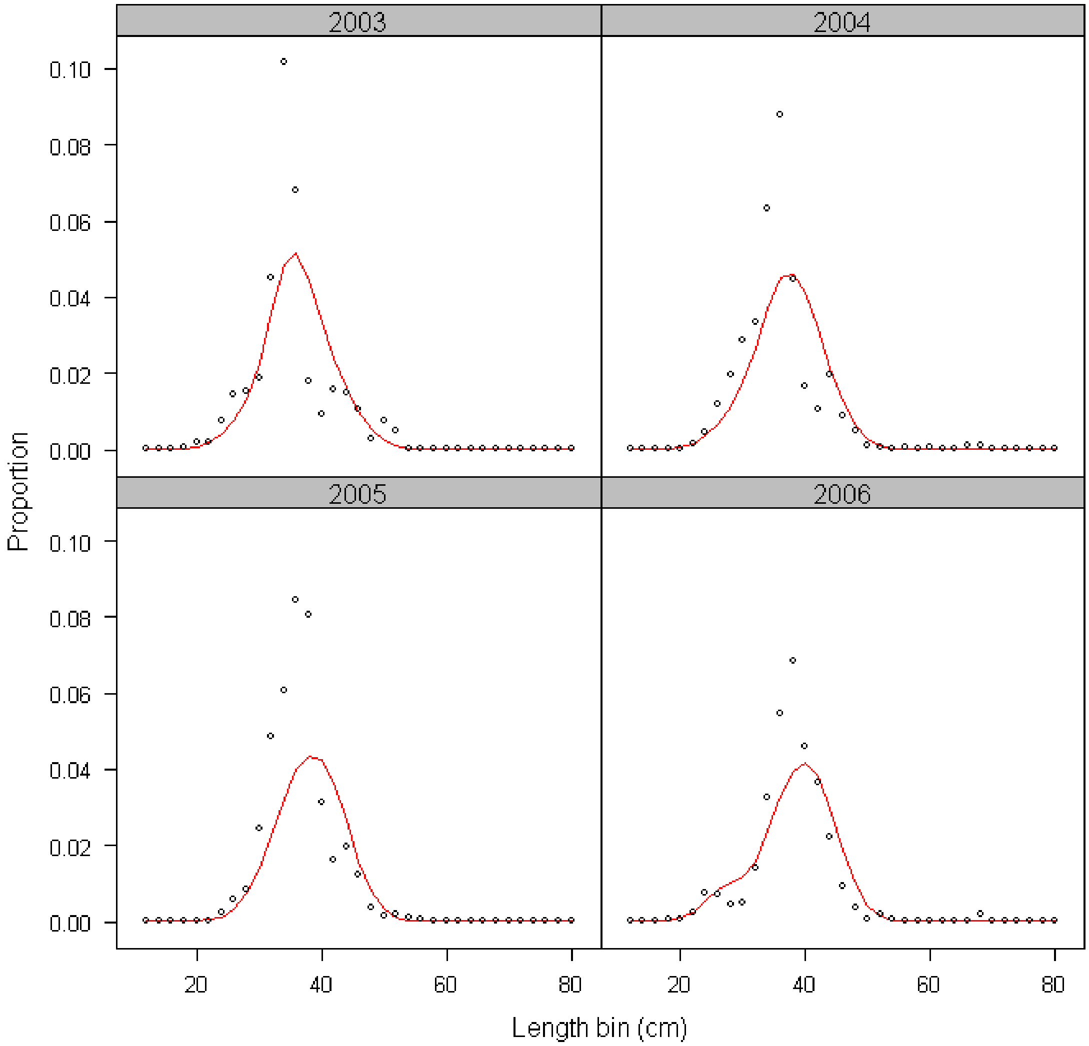


Figure 53. Residuals from the model fit to NWFSC Slope-Shelf male length composition data.

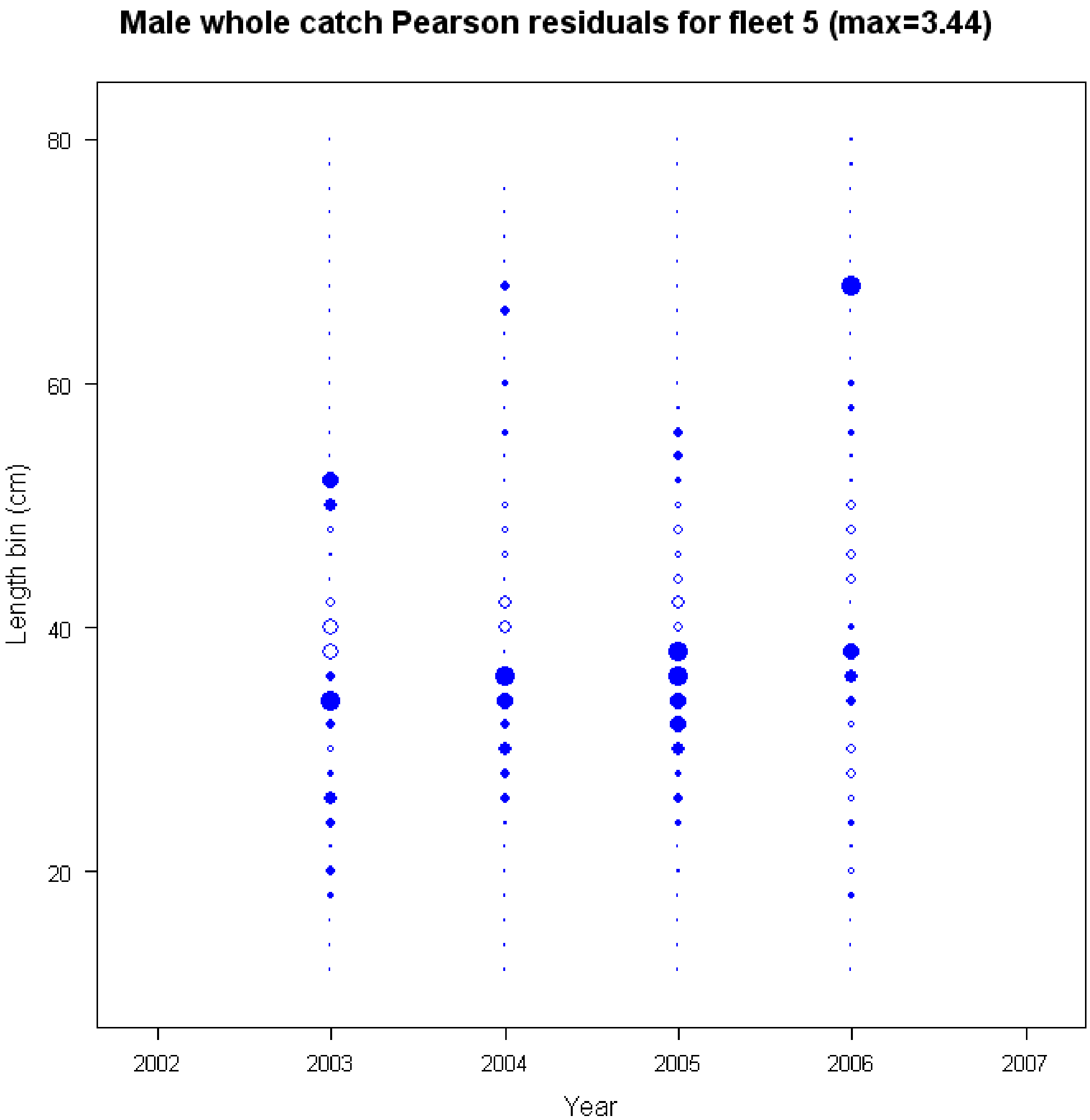


Figure 54. Observed vs. effective sample size for male length composition data from the NWFSC Slope-Shelf Survey.

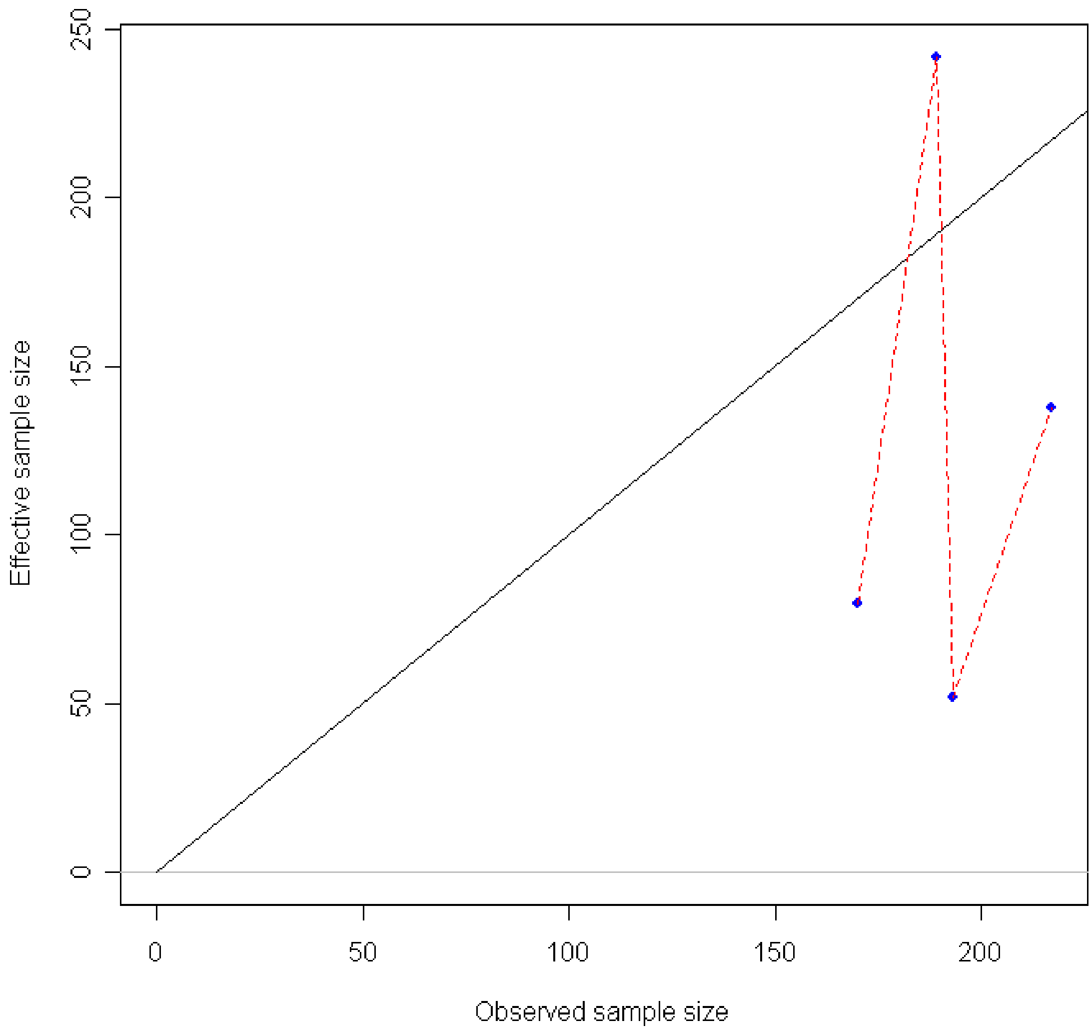


Figure 55. Female length composition and base case model fits, for the Triennial Survey.

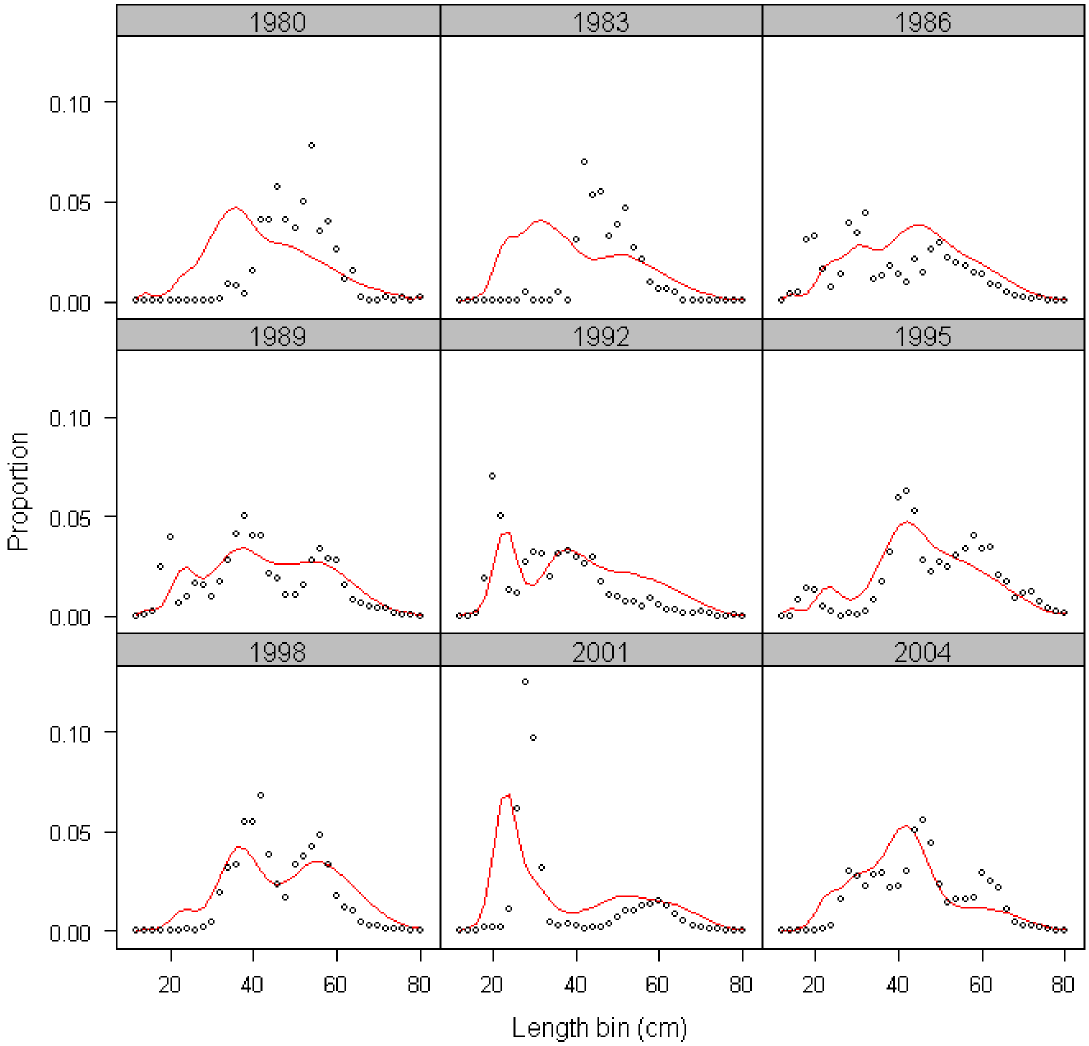


Figure 56. Residuals for base case model fit to female length compositions from the Triennial Survey.

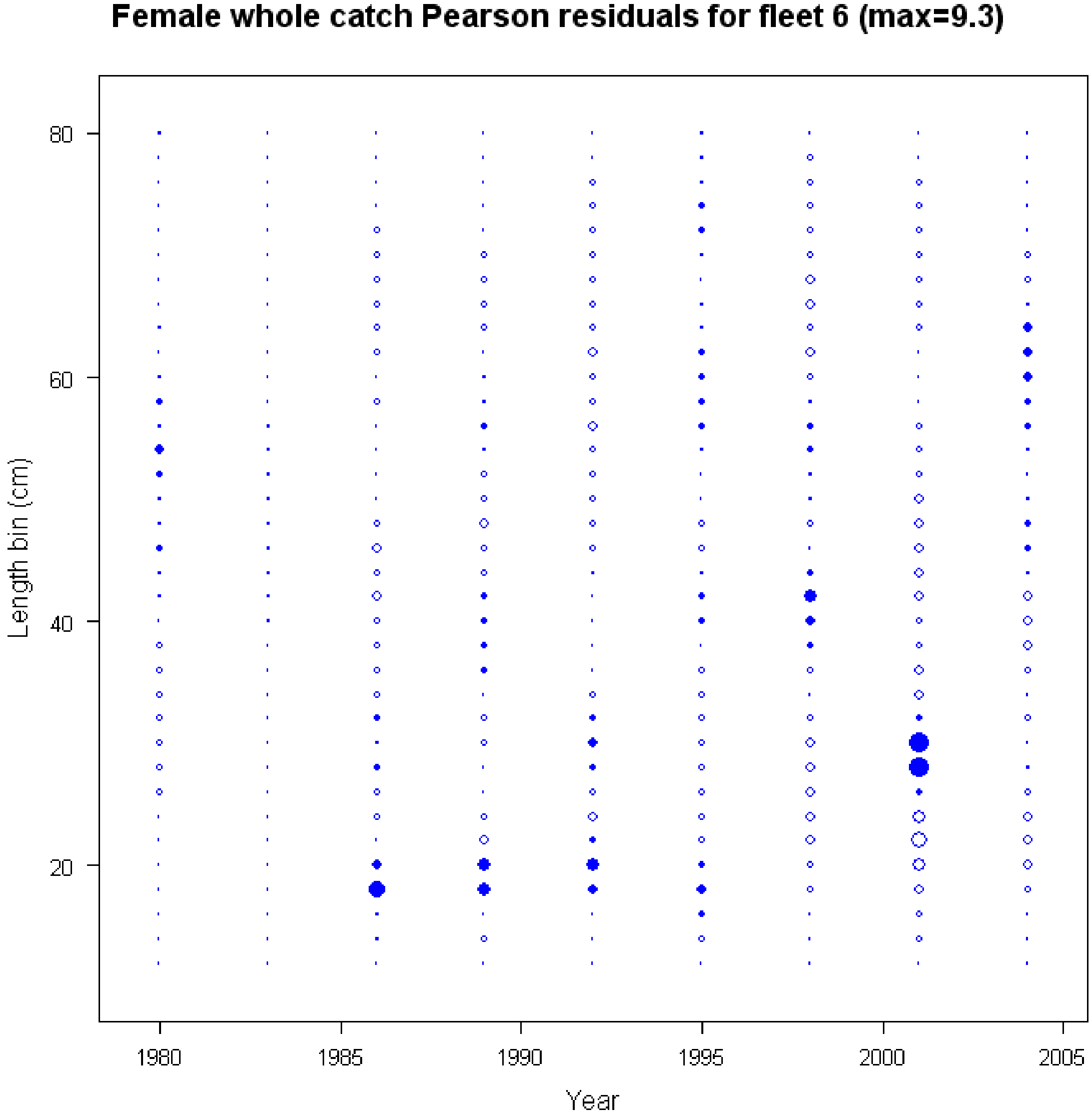


Figure 57. Observed vs. effective sample size for female length compositions from the Triennial Survey.

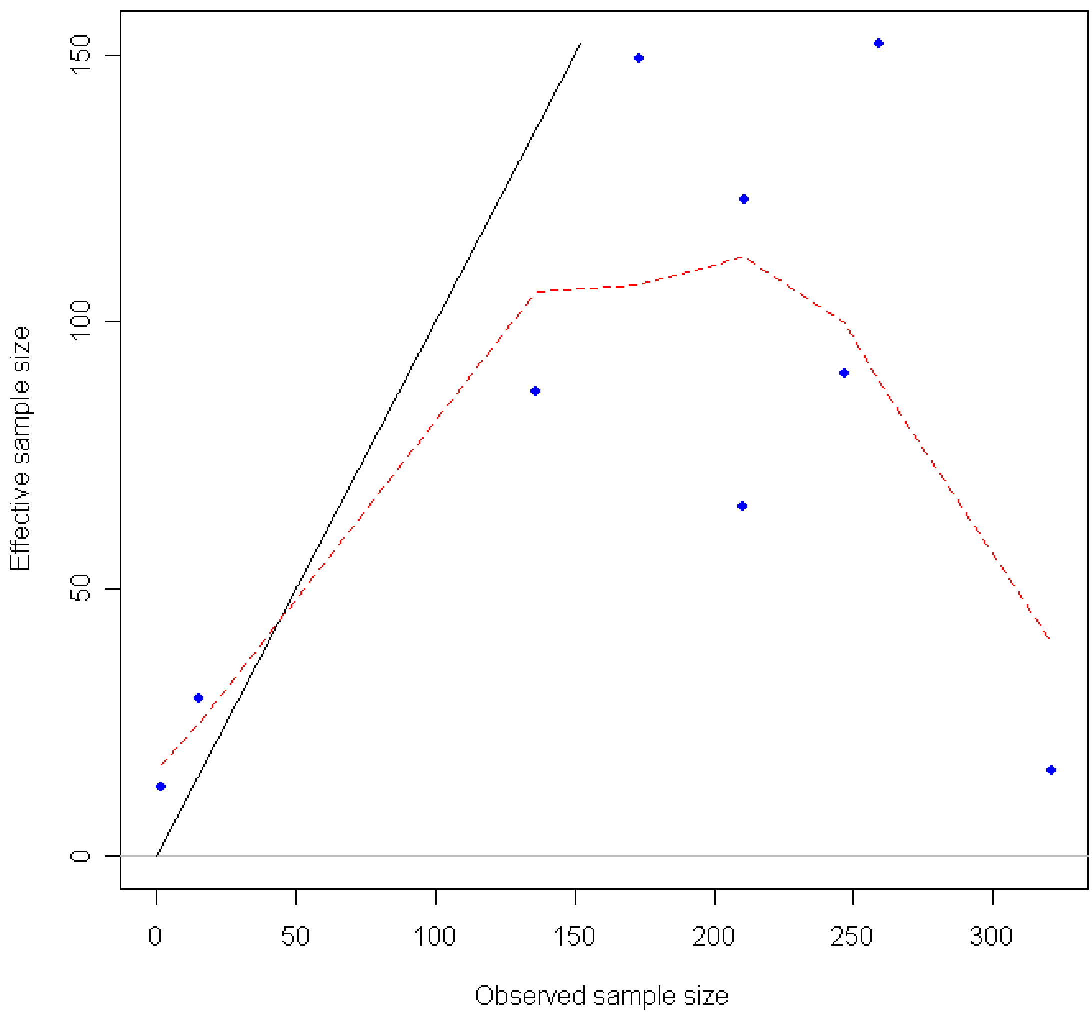


Figure 58. Model fits to male length composition data from the Triennial Survey

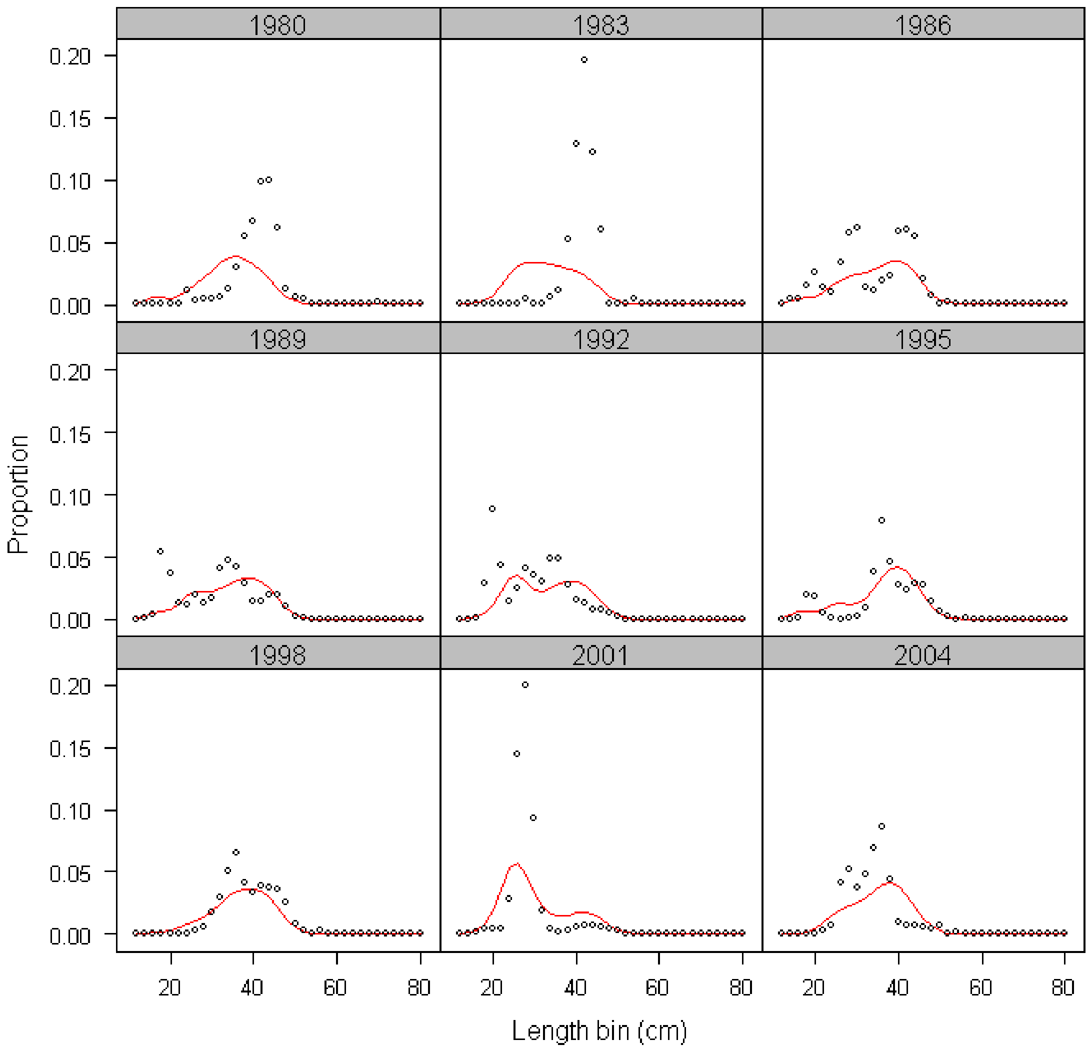


Figure 59. Residual plots for model fit to male length composition data from the Triennial Survey.

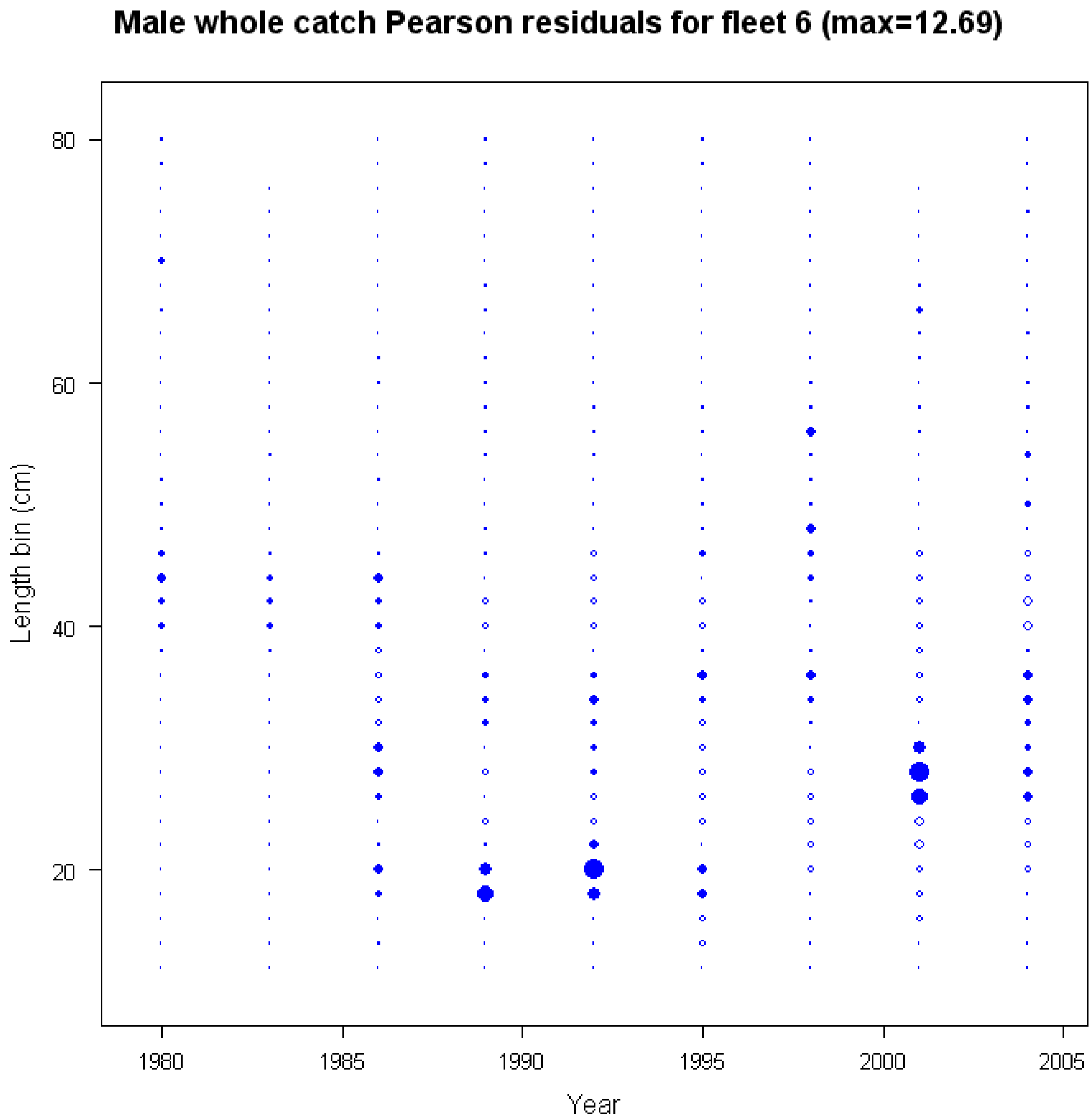


Figure 60. Observed vs. effective sample size for male length compositions from the Triennial Survey.

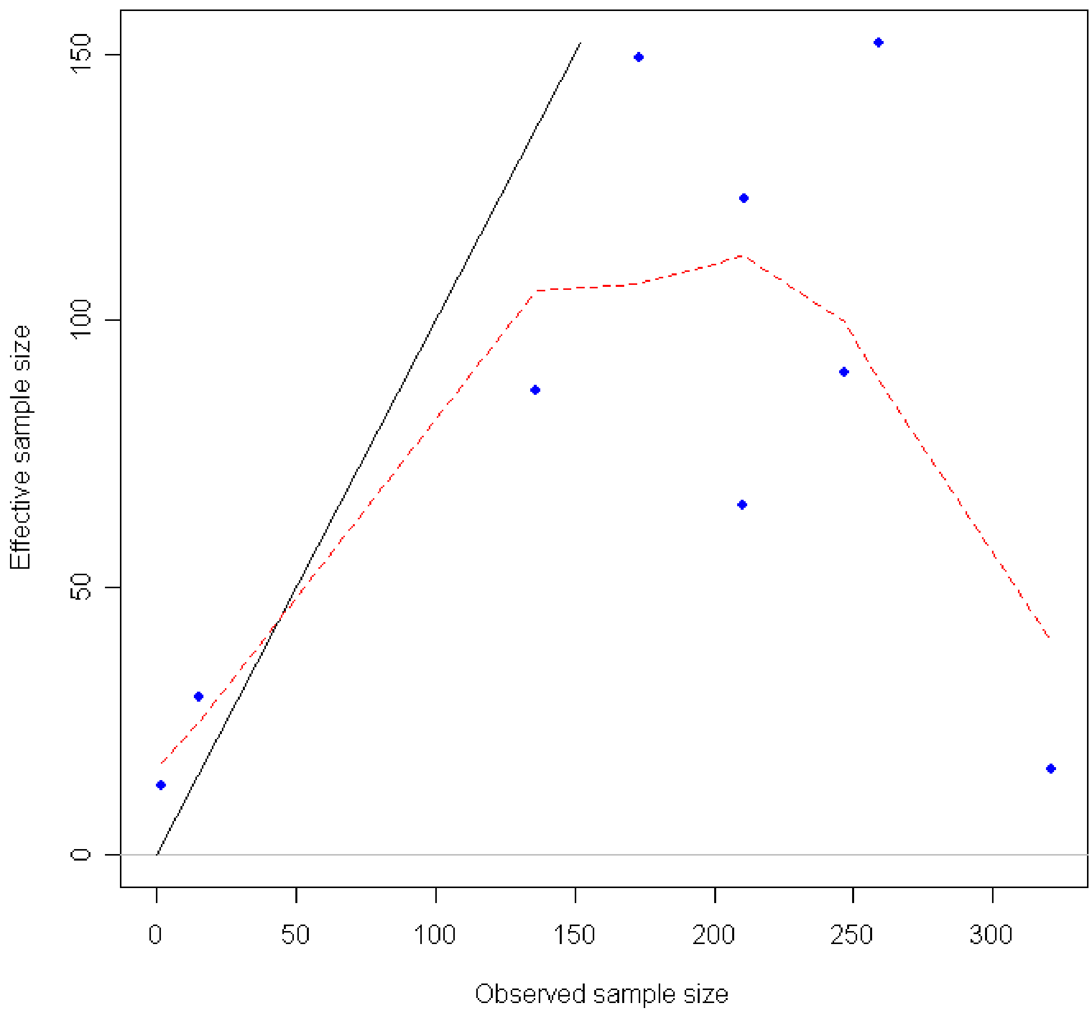


Figure 61. Base model fit to female length compositions from the AFSC Slope Survey.

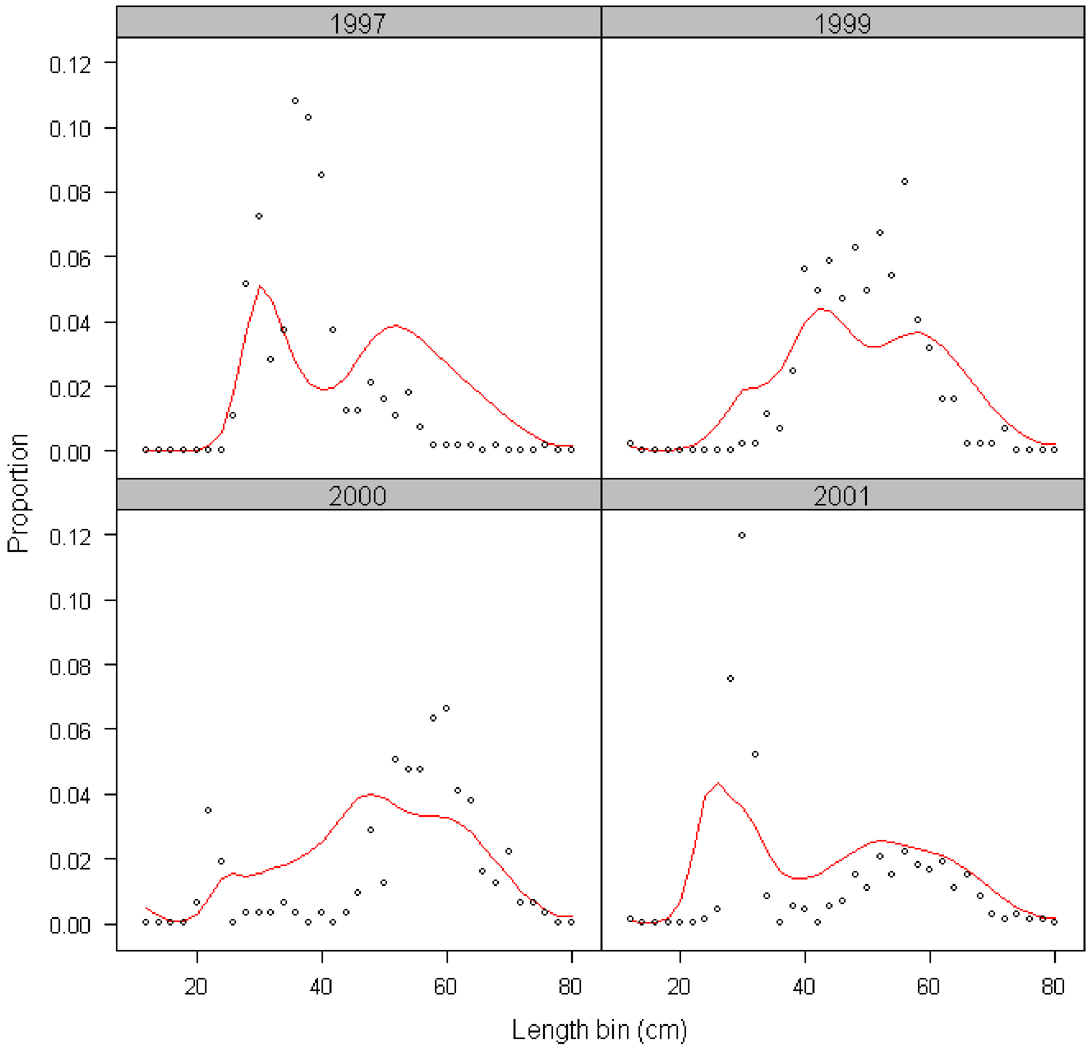


Figure 62. Residuals from base model fits to the AFSC Slope Survey female length compositions.

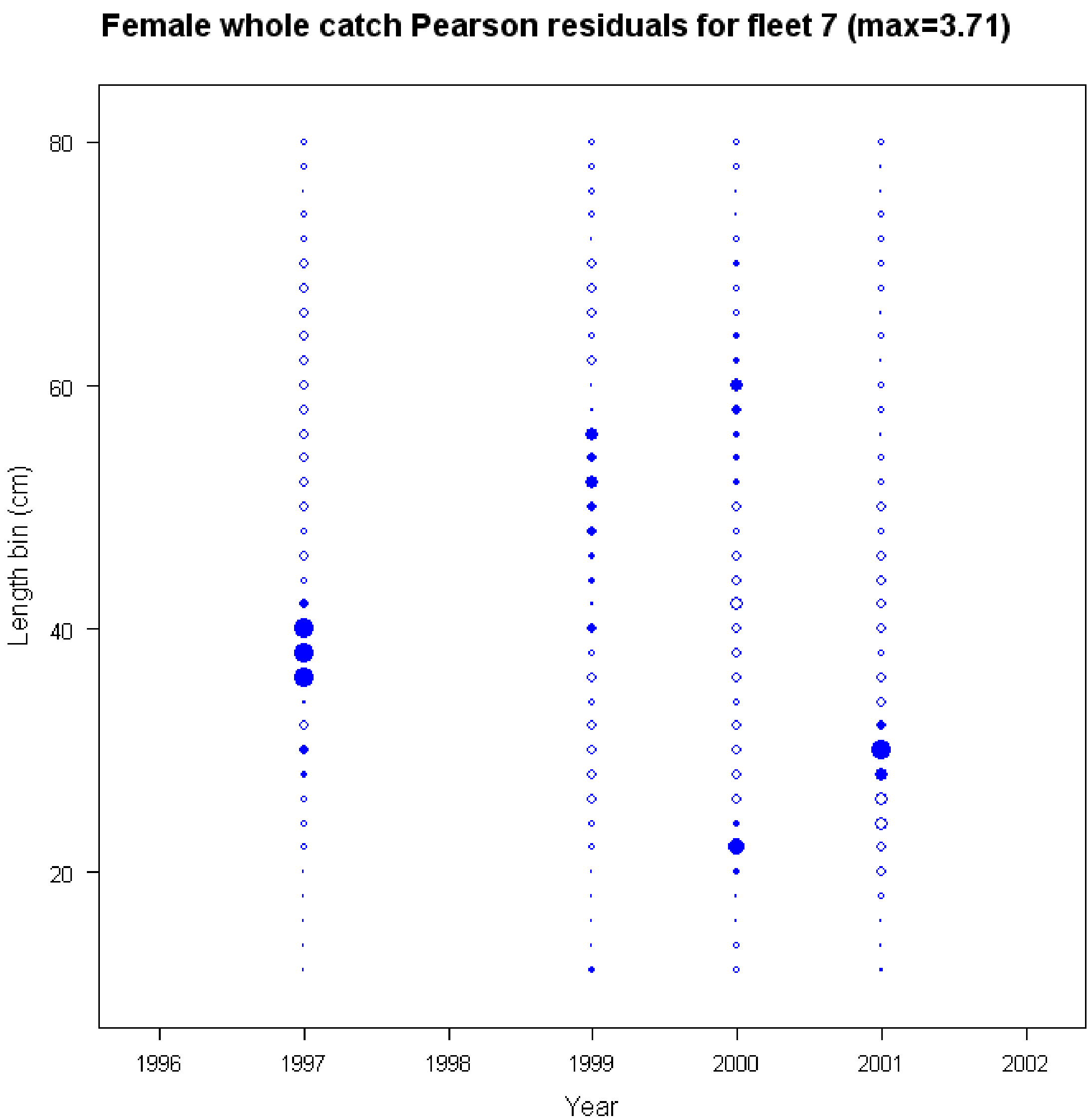


Figure 63. Observed vs. effective sample size for AFSC Slope Survey female length compositions.

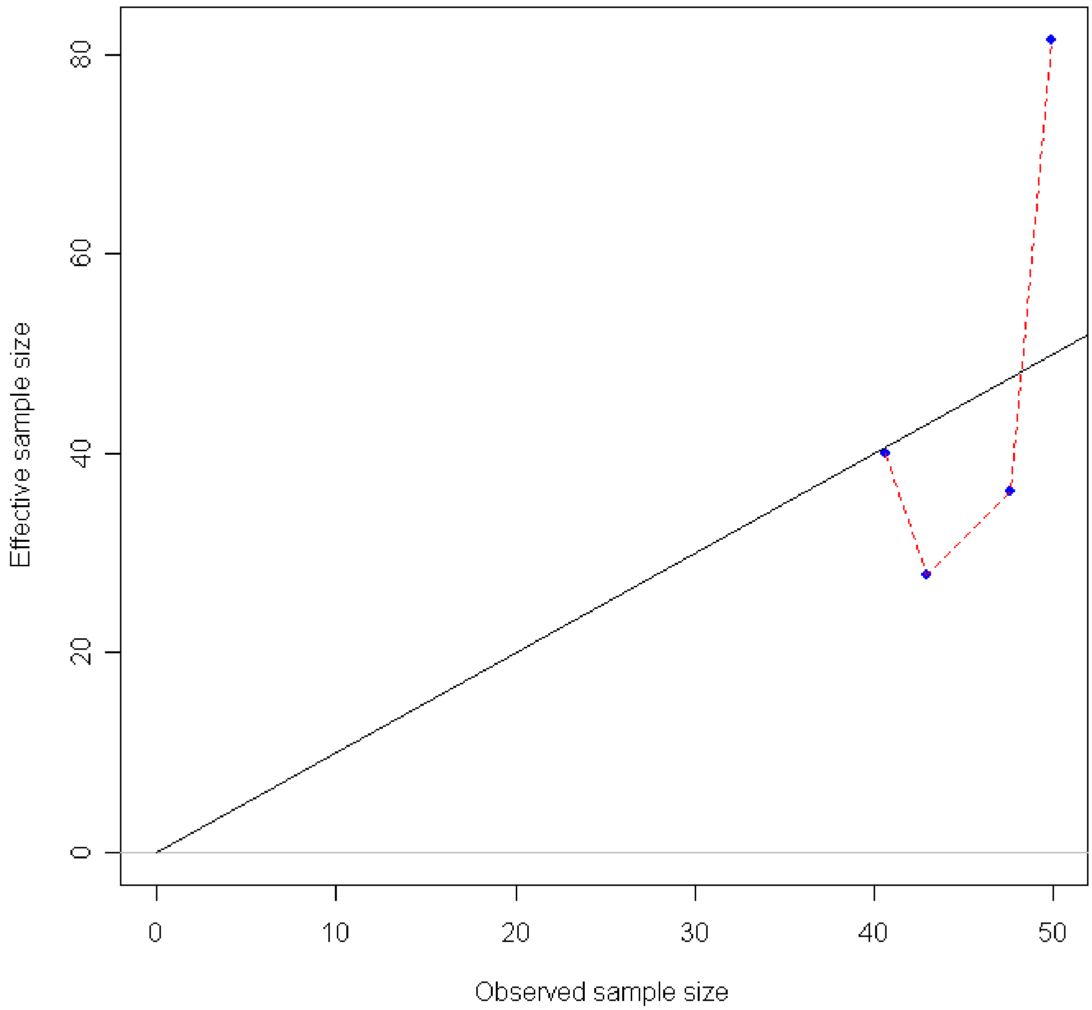


Figure 64. Model fit to AFSC Slope Survey male length compositions.

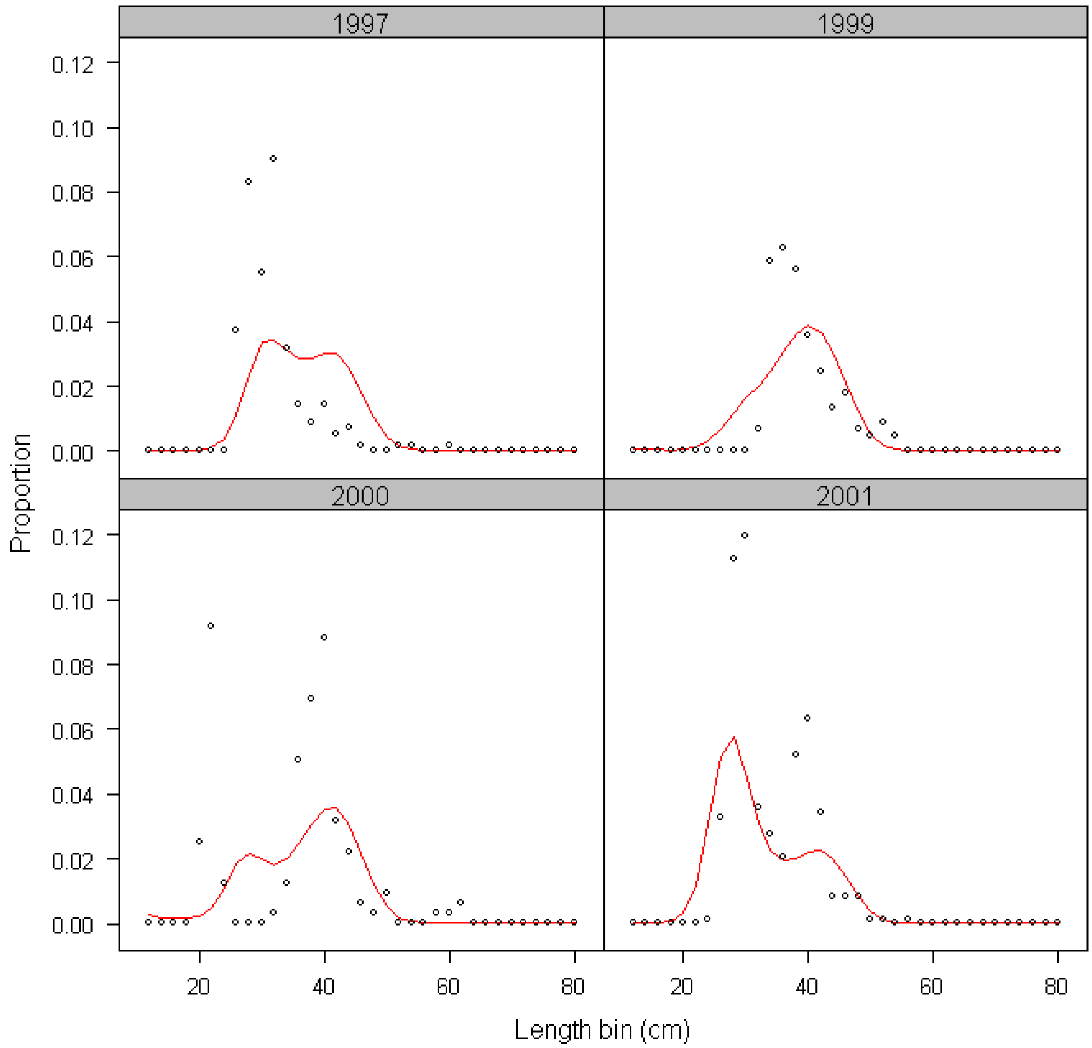


Figure 65. Residuals of the model fit to AFSC Slope Survey male length compositions.

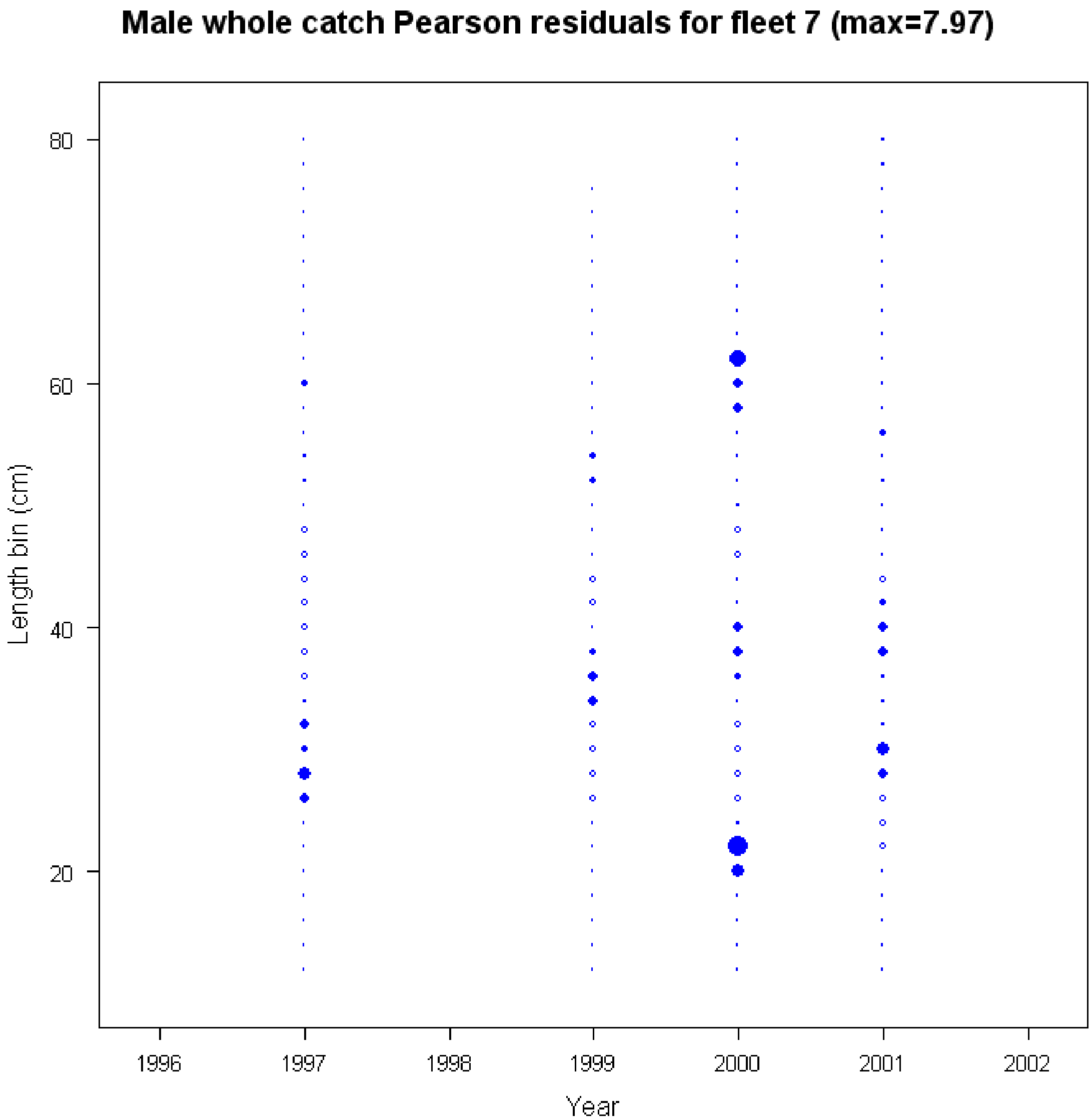


Figure 66. Observed and effective sample size from the model fit to AFSC Slope Survey male length compositions.

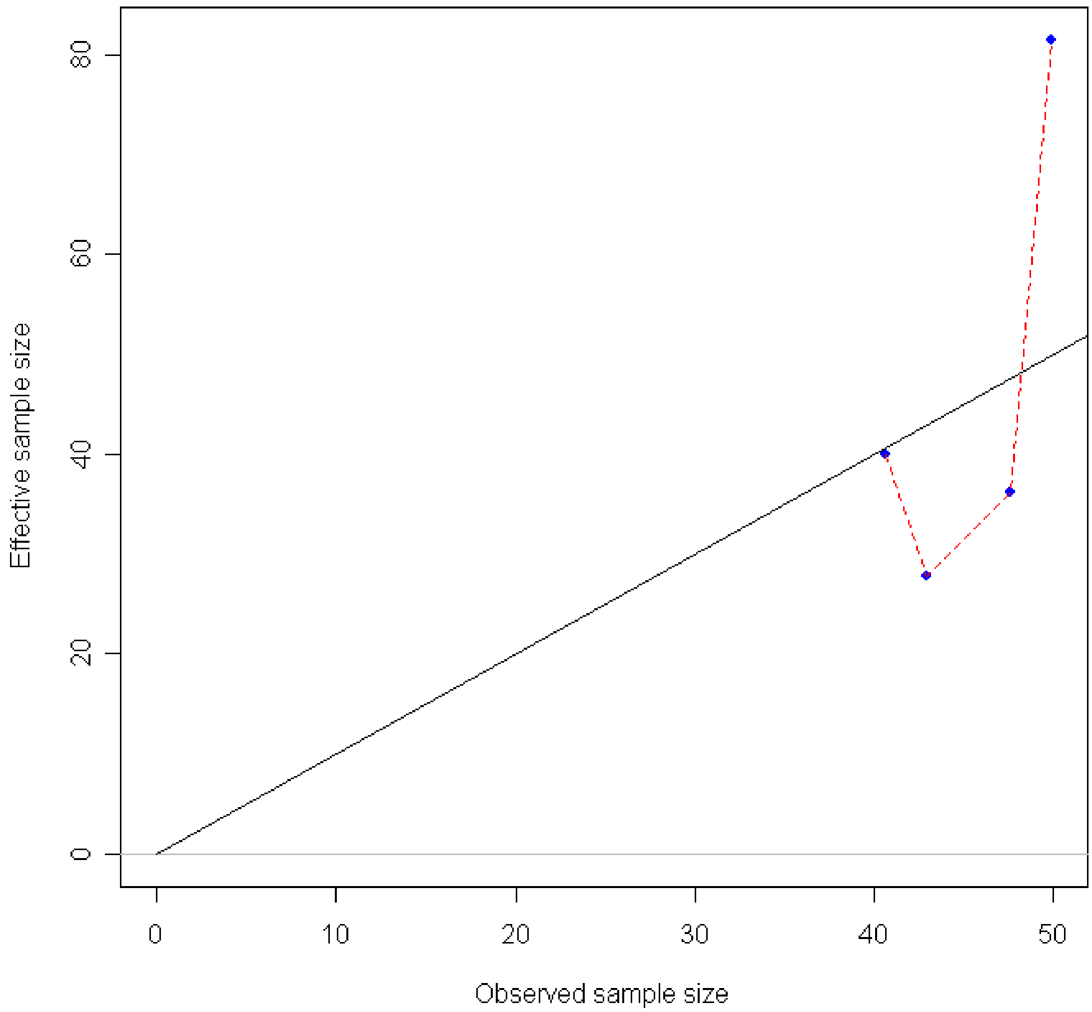


Figure 67. An example of fits to conditional age-at-length, for females retained by the fillet fishery in 1986.

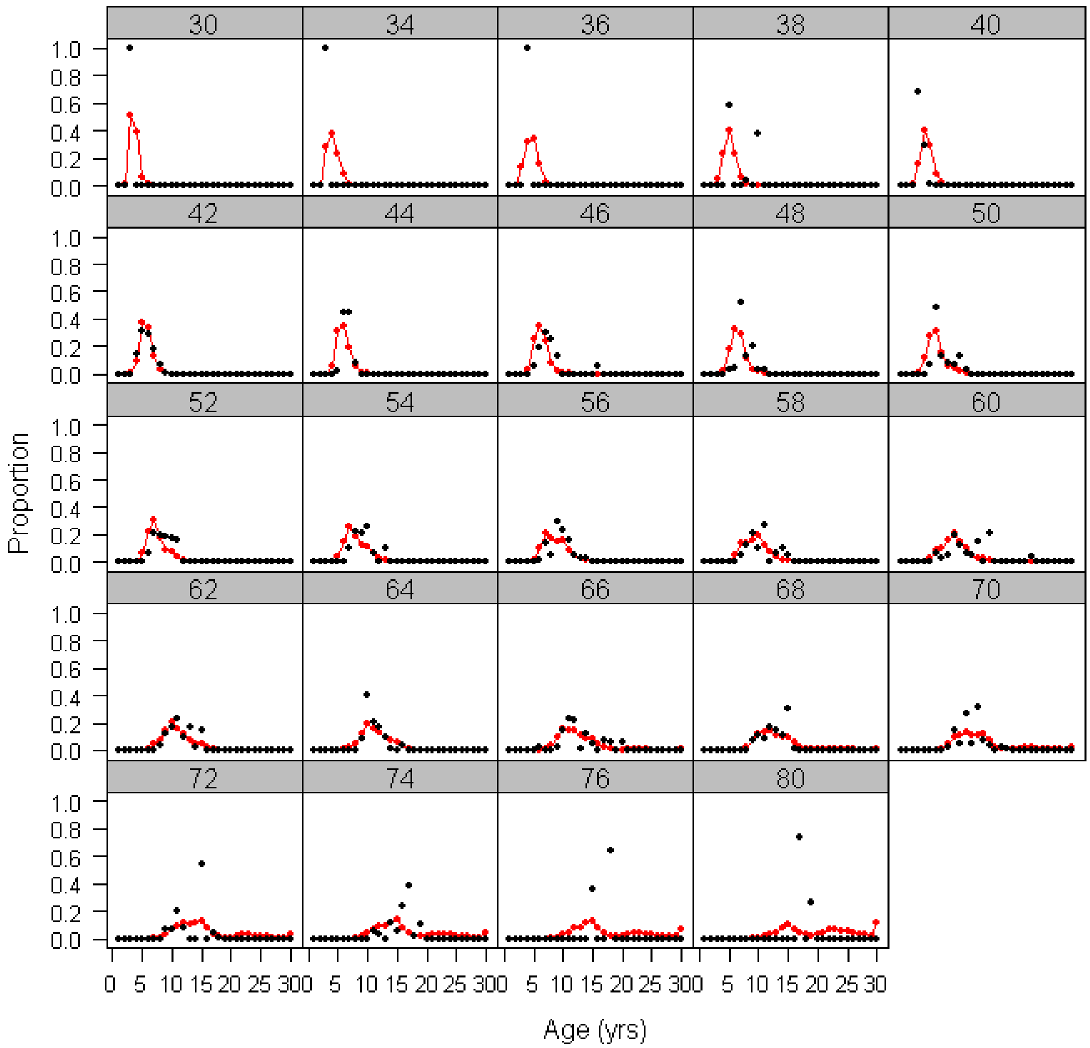


Figure 68. Residuals from model fit to age-at-length data for females retained by the fillet fishery in 1986.

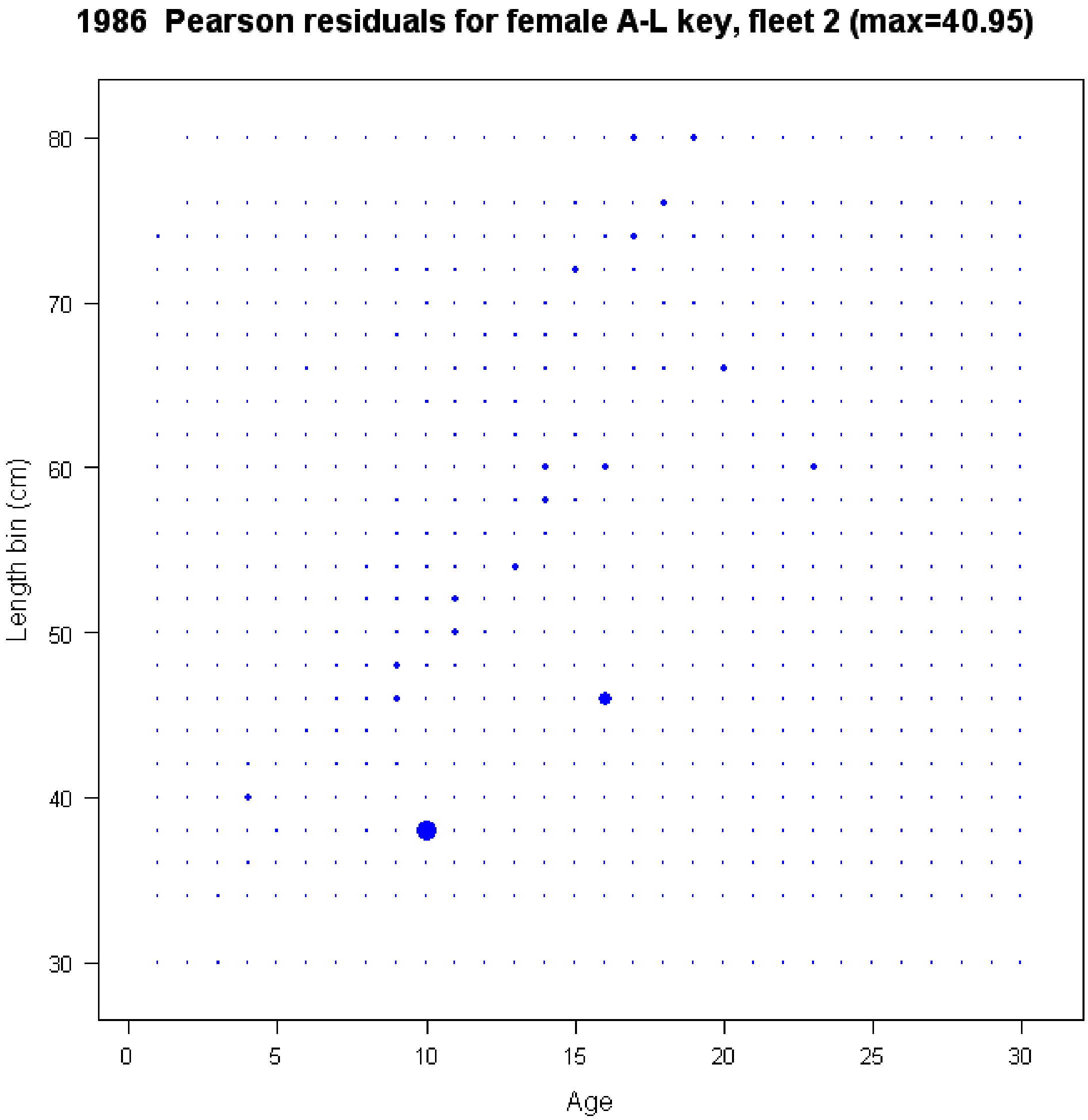


Figure 69. Implied age composition fits for the fillet fishery, for females.

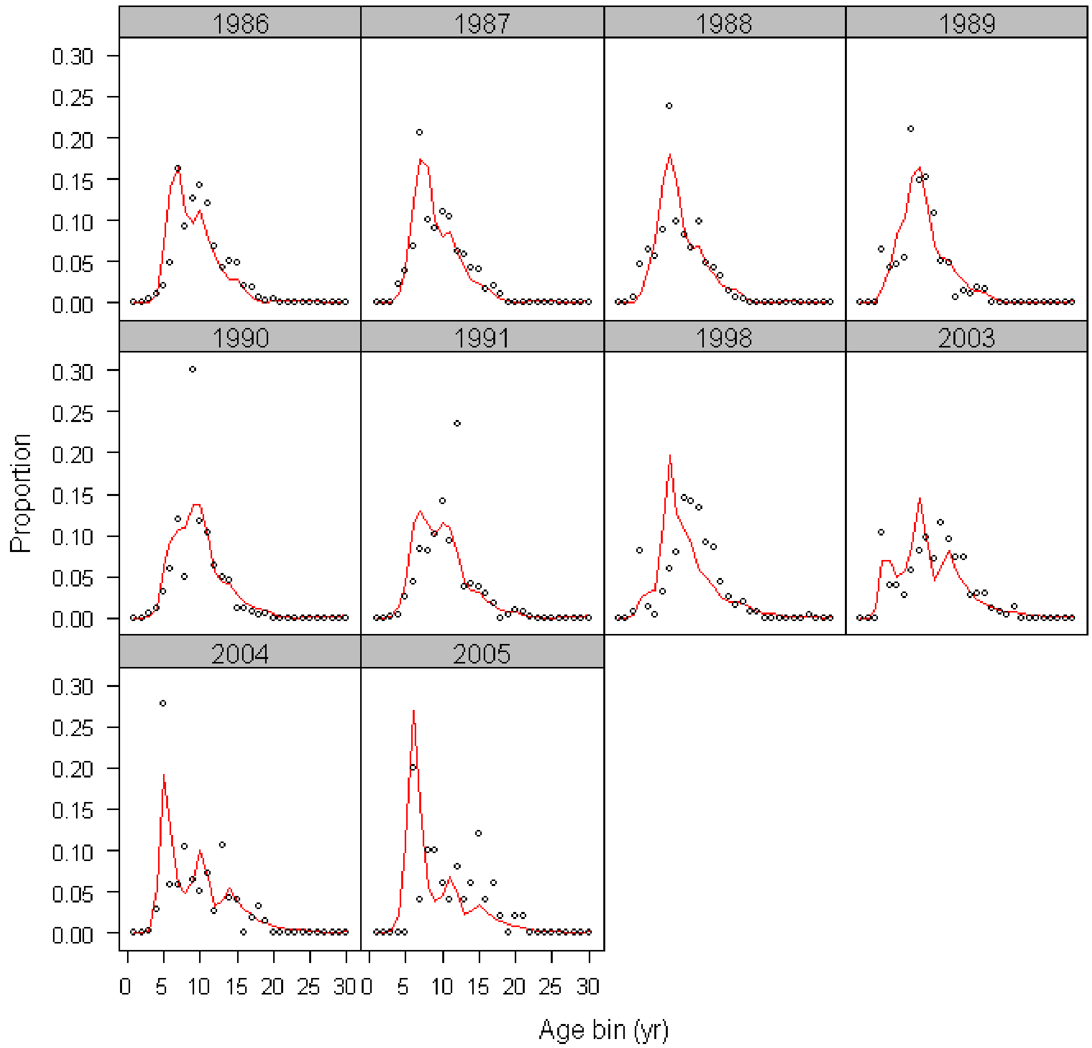


Figure 70. Residuals from the implied age composition fits from the fillet fishery, for females.

Figure 71. Model fit to the implied age compositions for the fillet fishery, for males.

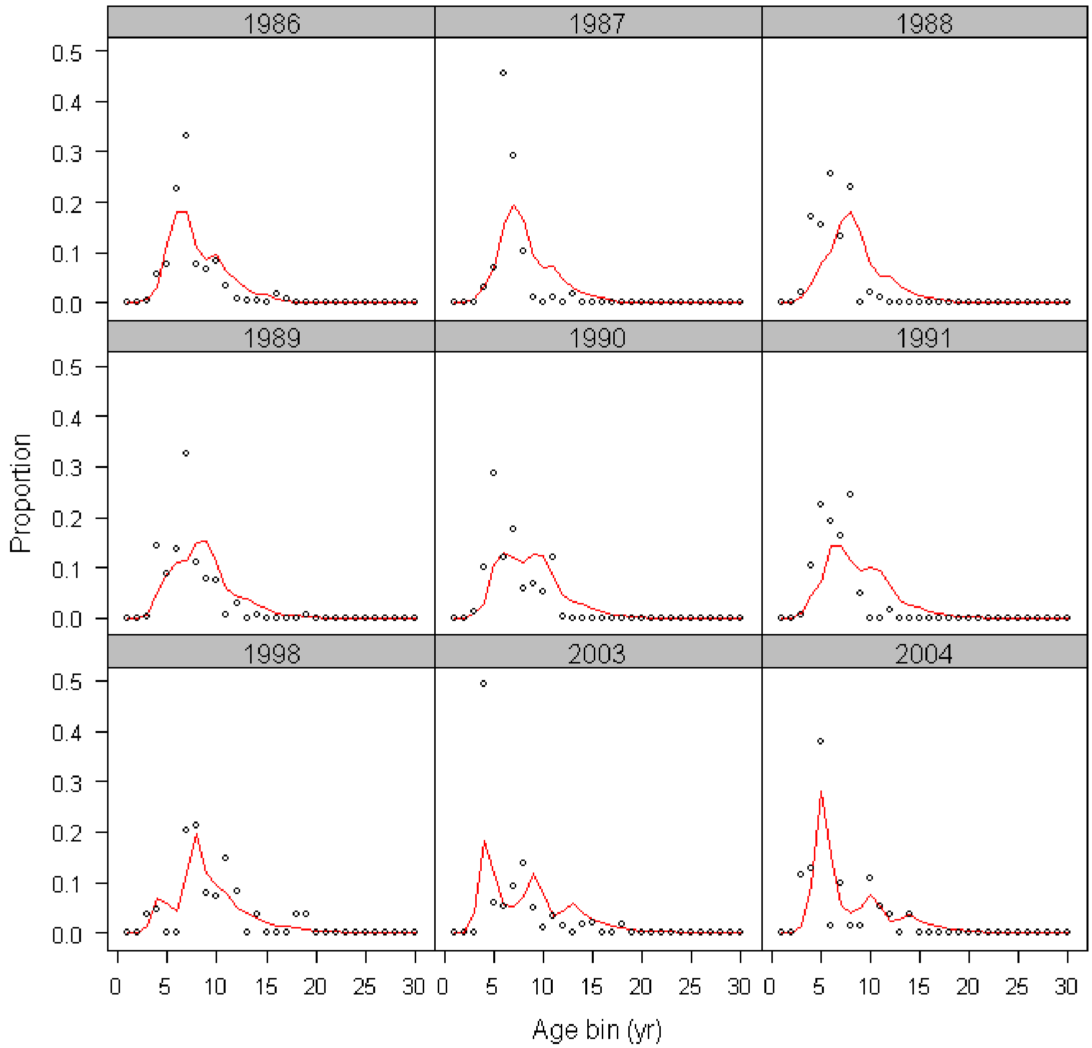


Figure 72. Residuals from implied model fit to age compositions from the fillet fishery, for males.

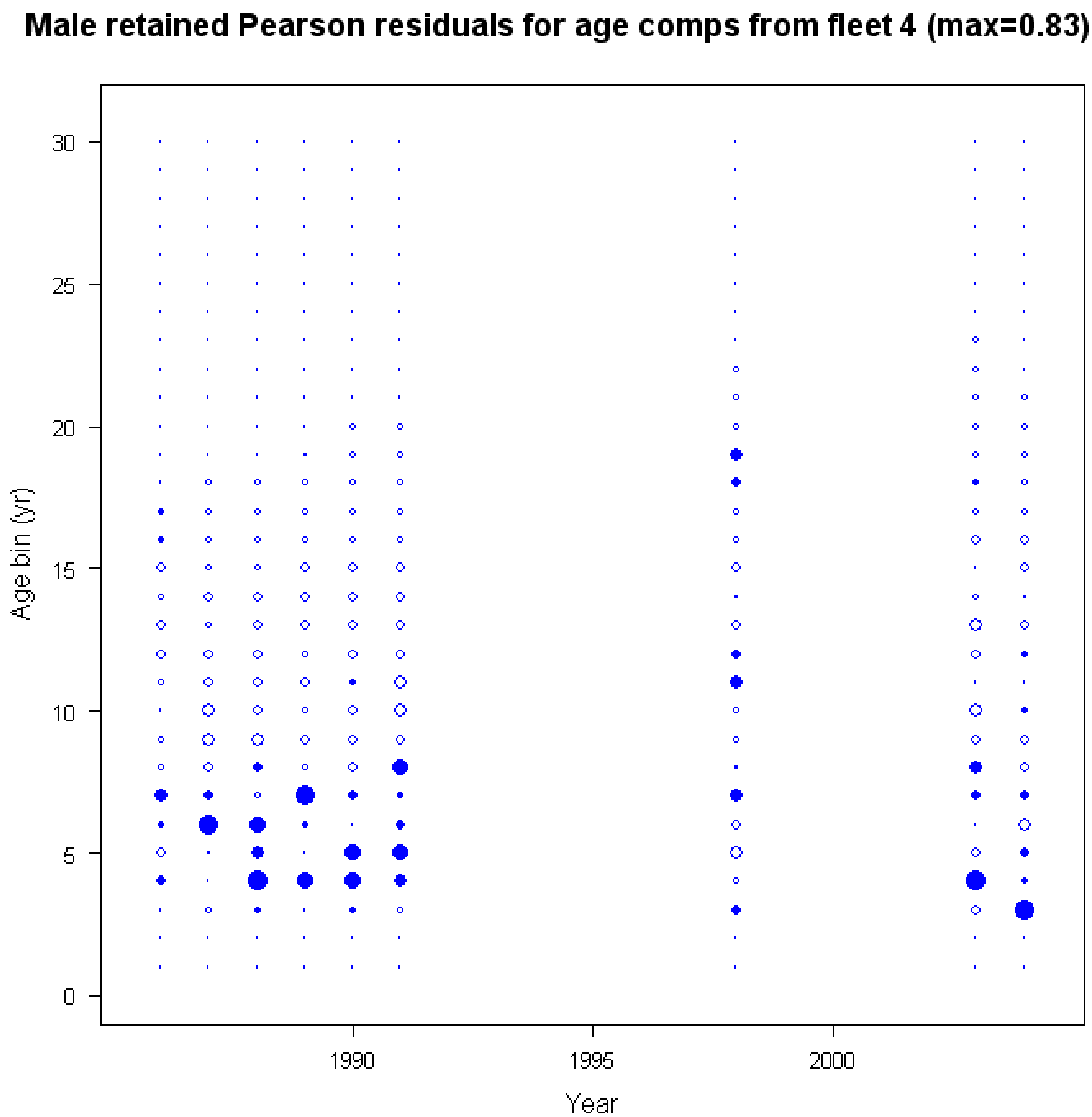


Figure 73. Implied age composition fits to the NWFSC Slope-Shelf data, for females.

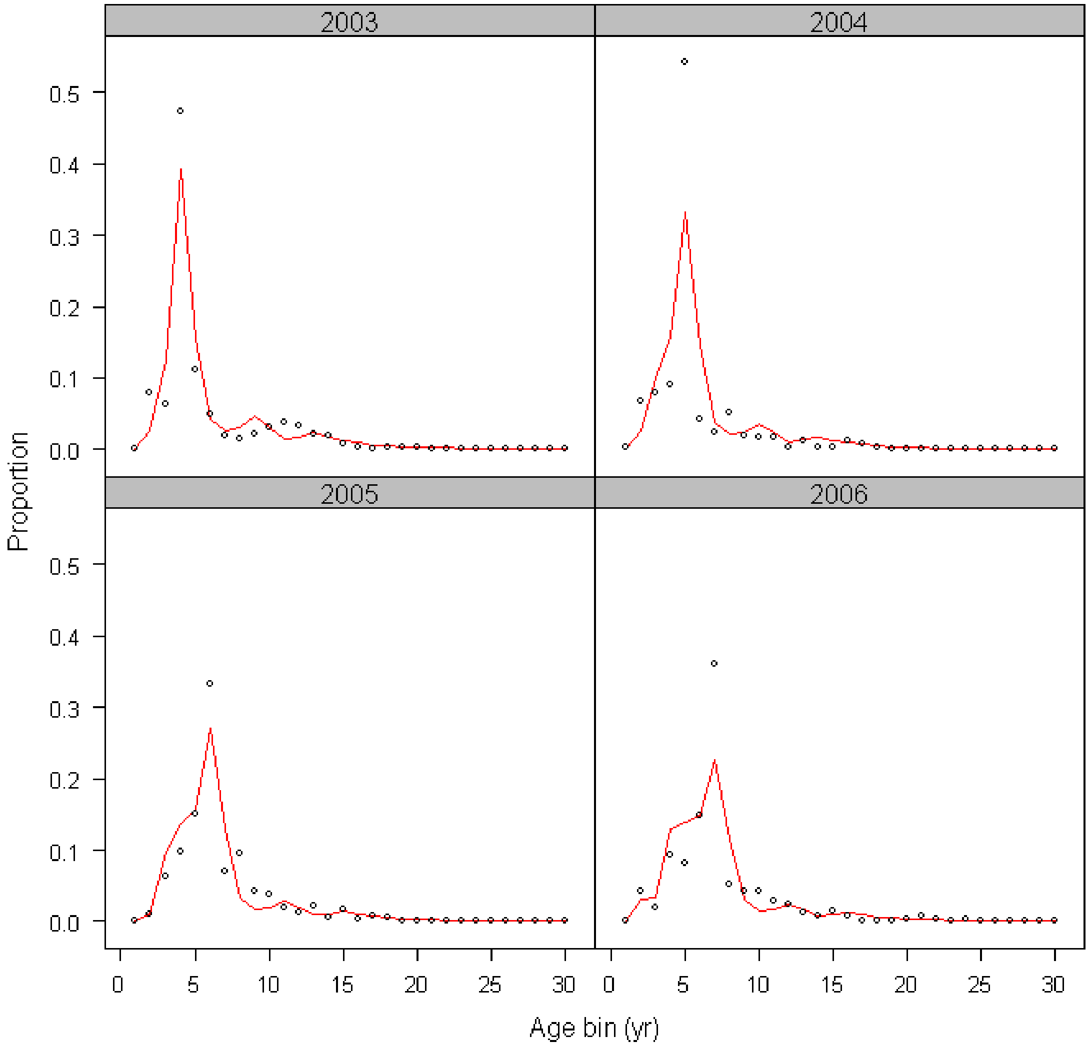


Figure 74. Residuals from implied age composition fits to the NWFSC Slope-Shelf data, for females.

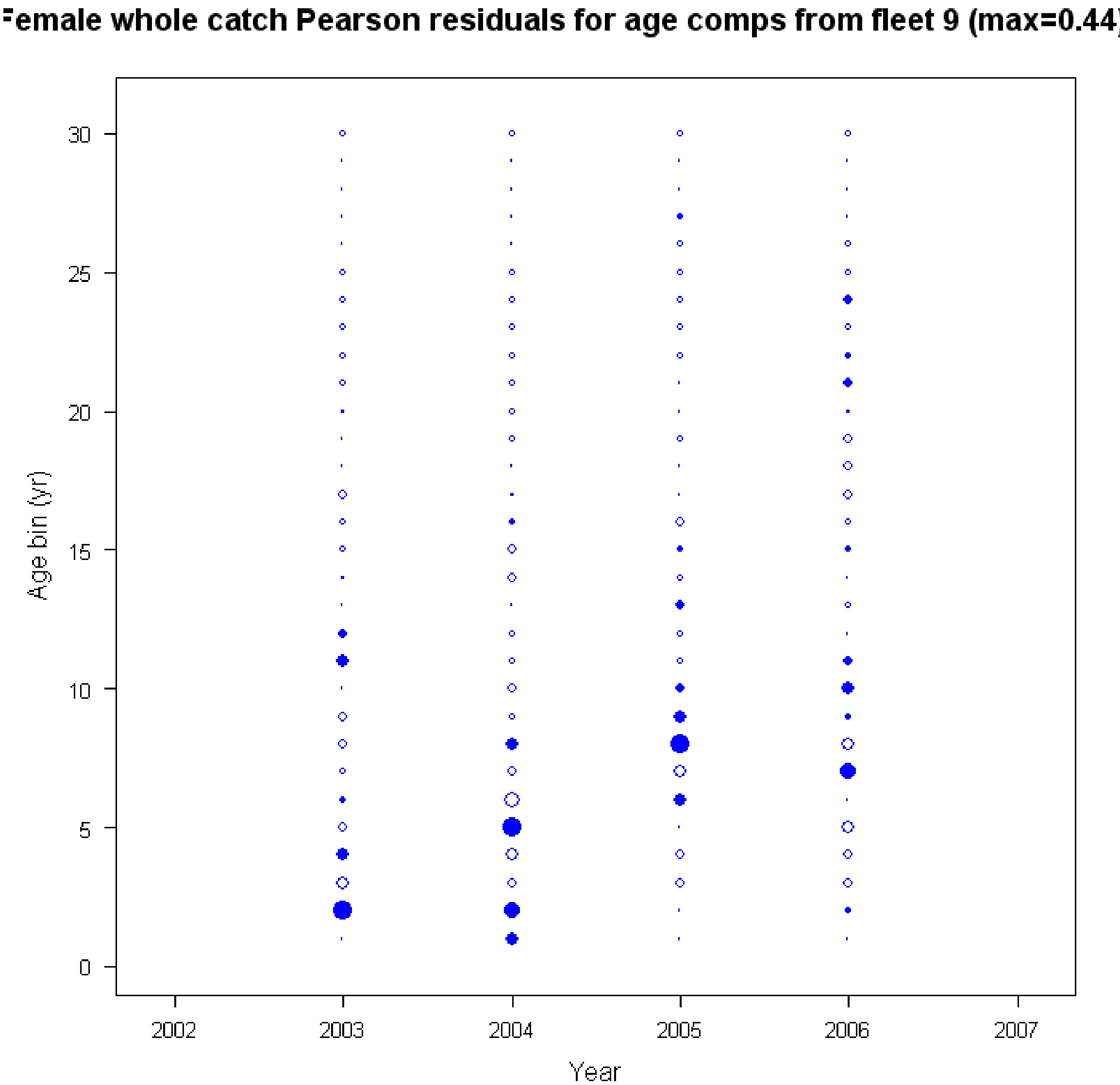


Figure 75. Fits to the implied age composition from the NWFSC Slope-Shelf survey, for males.

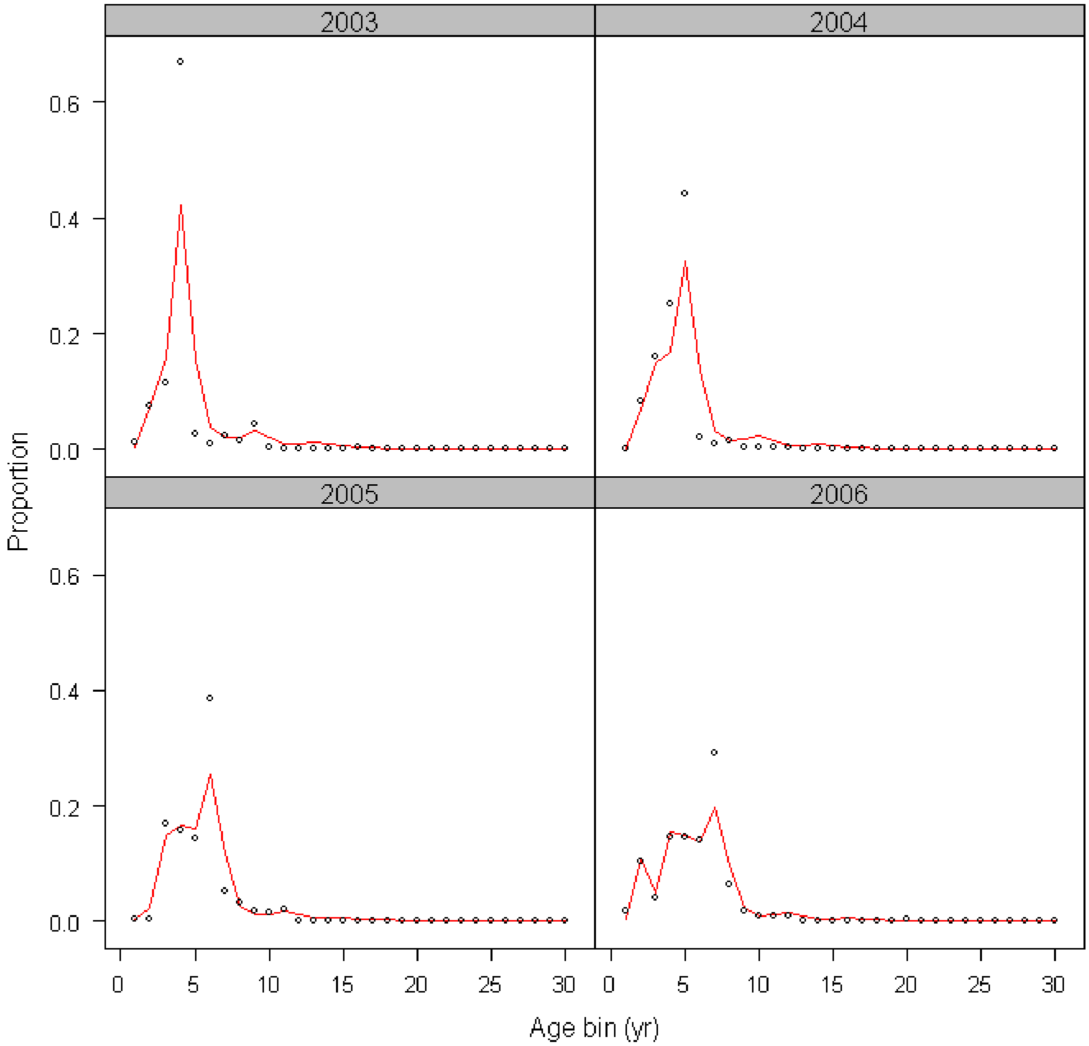


Figure 76. Residuals from fits to the implied age compositions for the NWFSC Slope-Shelf survey, for males.

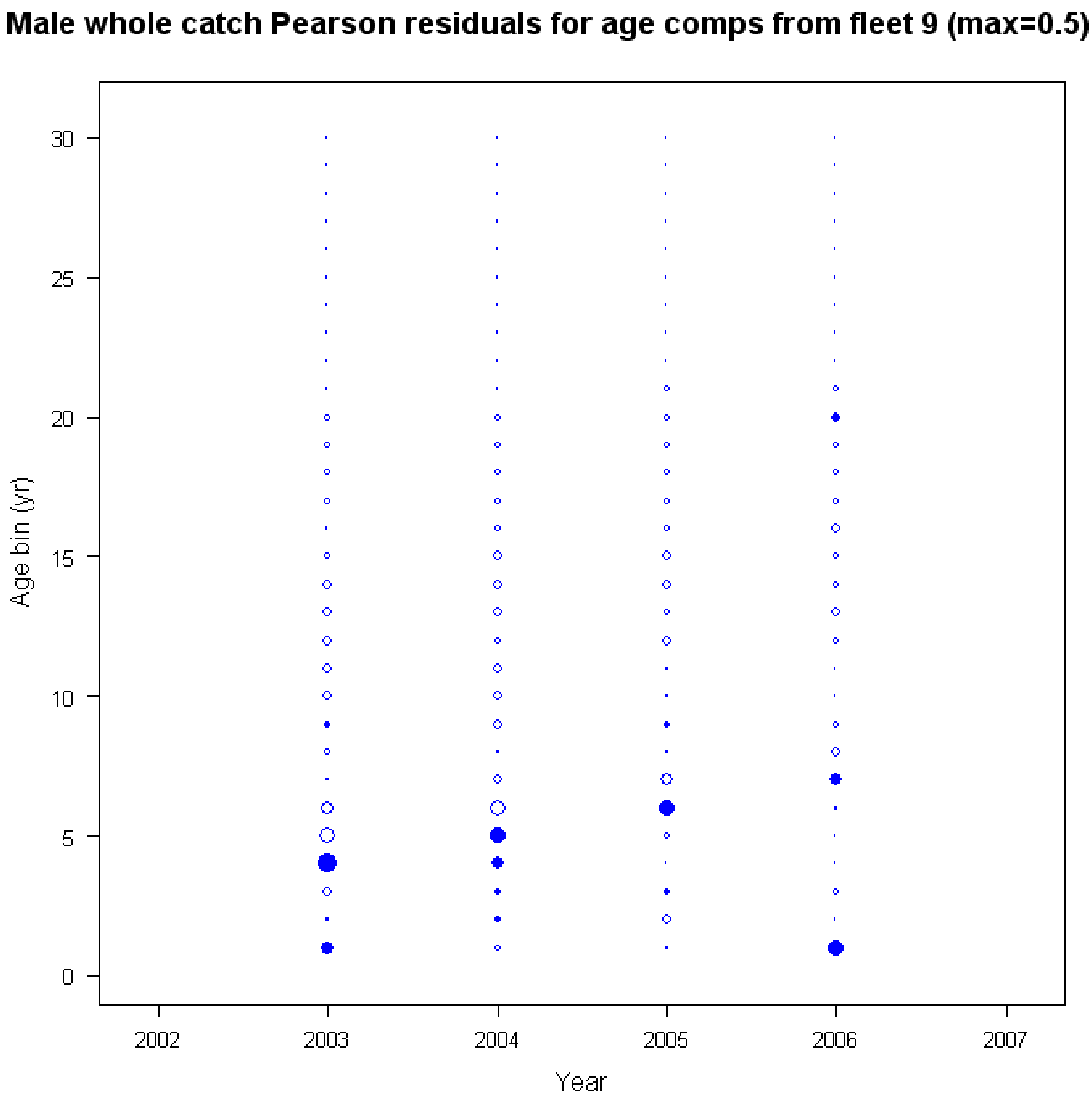


Figure 77. Likelihood profile on steepness, for all data. This is equal to total likelihood, minus the likelihood components for recruitment deviations and forecast recruitment deviations.

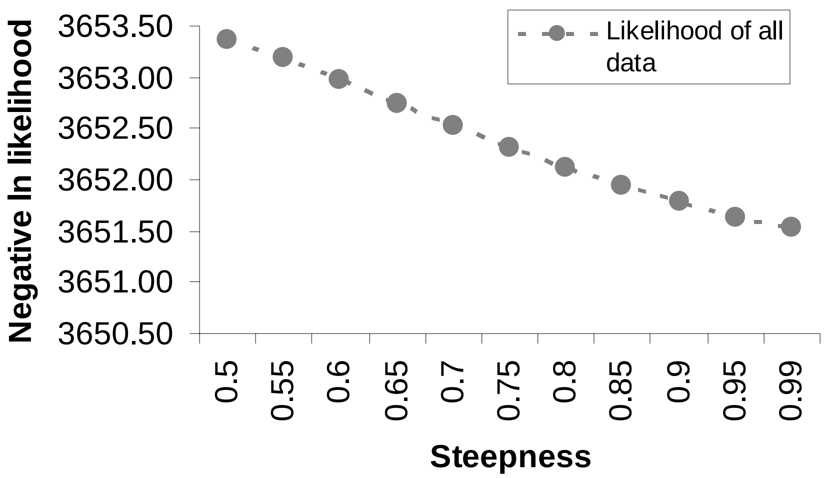


Figure 78. Likelihood profile on steepness, for age composition data only.

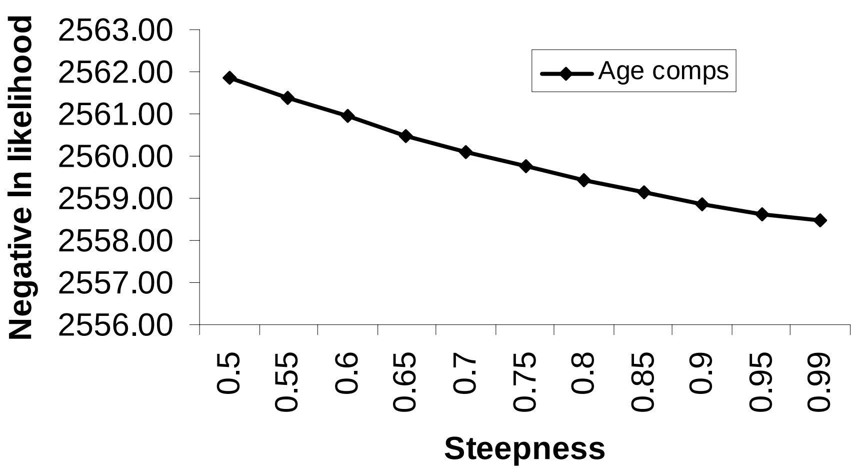


Figure 79. Likelihood profile on steepness, for length composition data only.

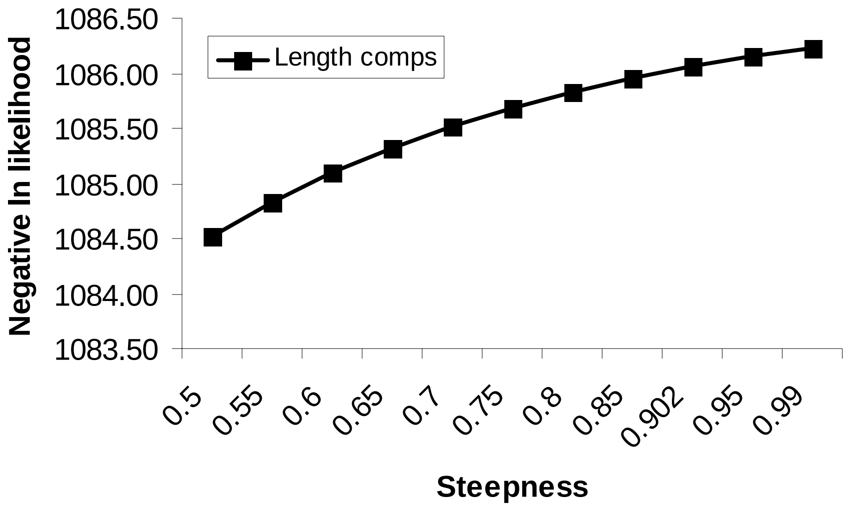


Figure 80. Likelihood profile on steepness, for abundance indices only.

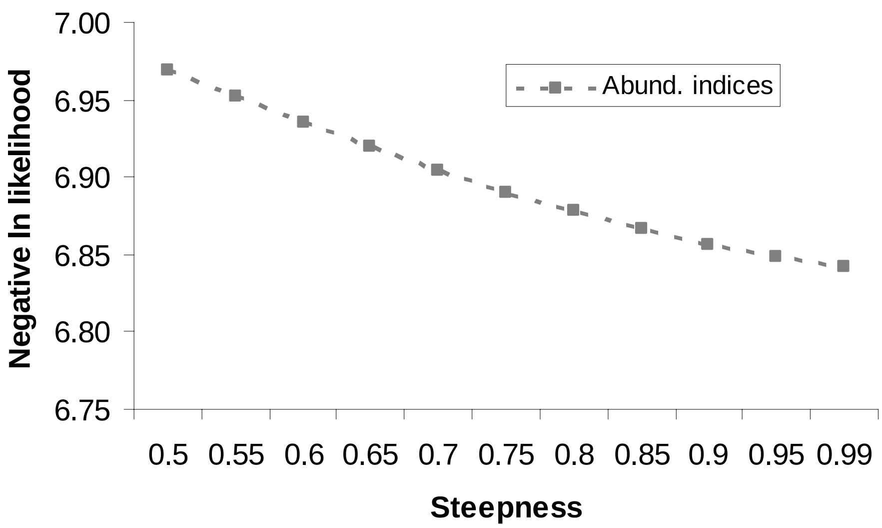


Figure 81. Likelihood profile on male natural mortality (M), for all data components. This is equal to total likelihood minus the likelihood components for recruitment deviations and forecast recruitment deviations. Female natural mortality is male M – 0.108.

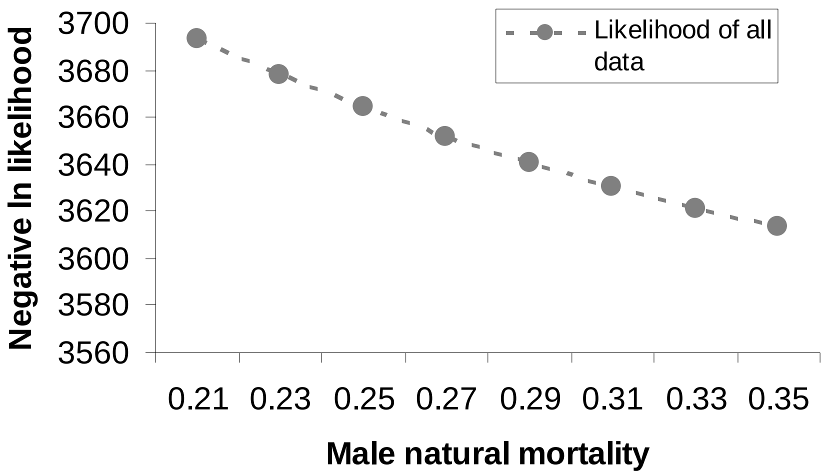


Figure 82. Likelihood profile on male natural mortality (M), for age composition data. Female natural mortality is male M – 0.108.

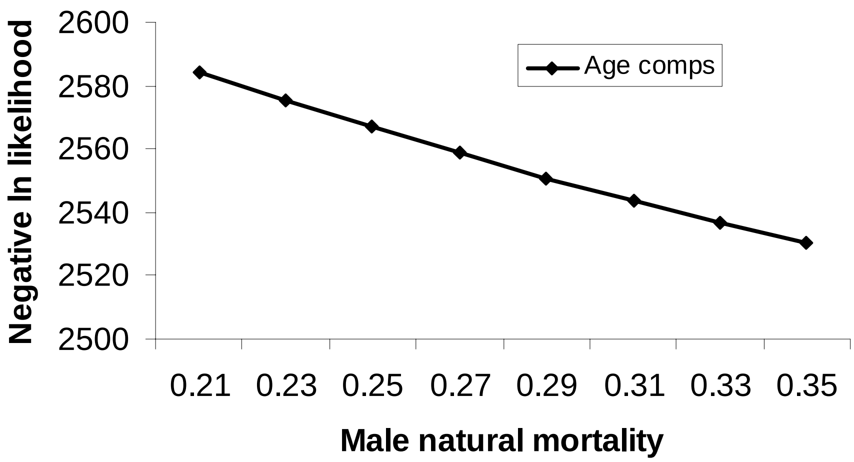


Figure 83. Likelihood profile on male natural mortality (M), for length composition data. Female natural mortality is male M – 0.108.

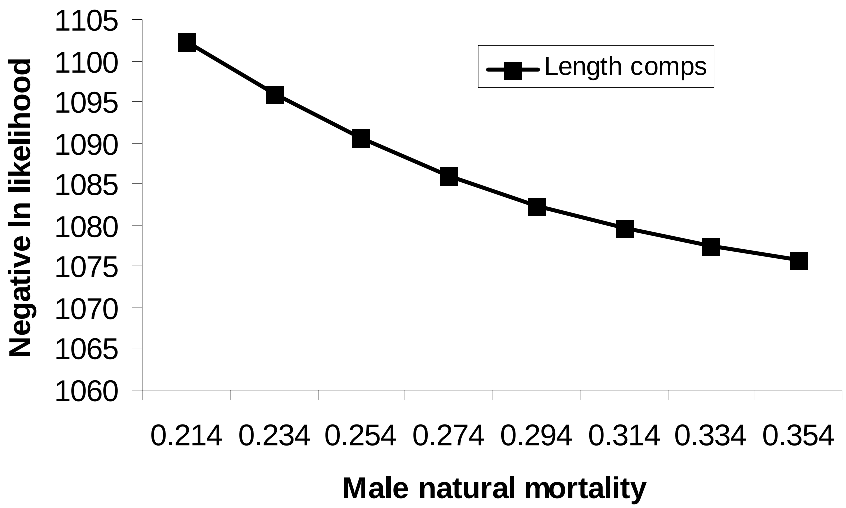


Figure 84. Likelihood profile on male natural mortality (M), for abundance indices. Female natural mortality is male M – 0.108.

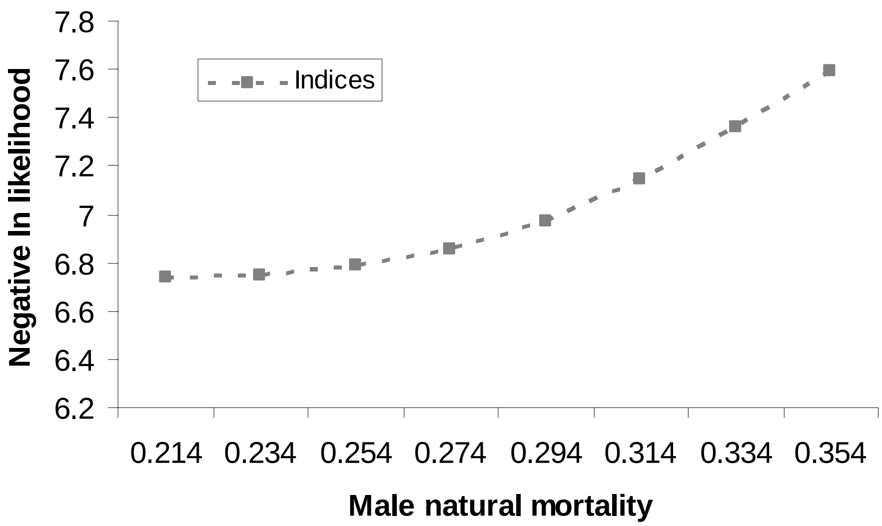


Figure 85. Total catch for all fleets in the base model, and alternate scenarios with 1/2x and 2x base catches.

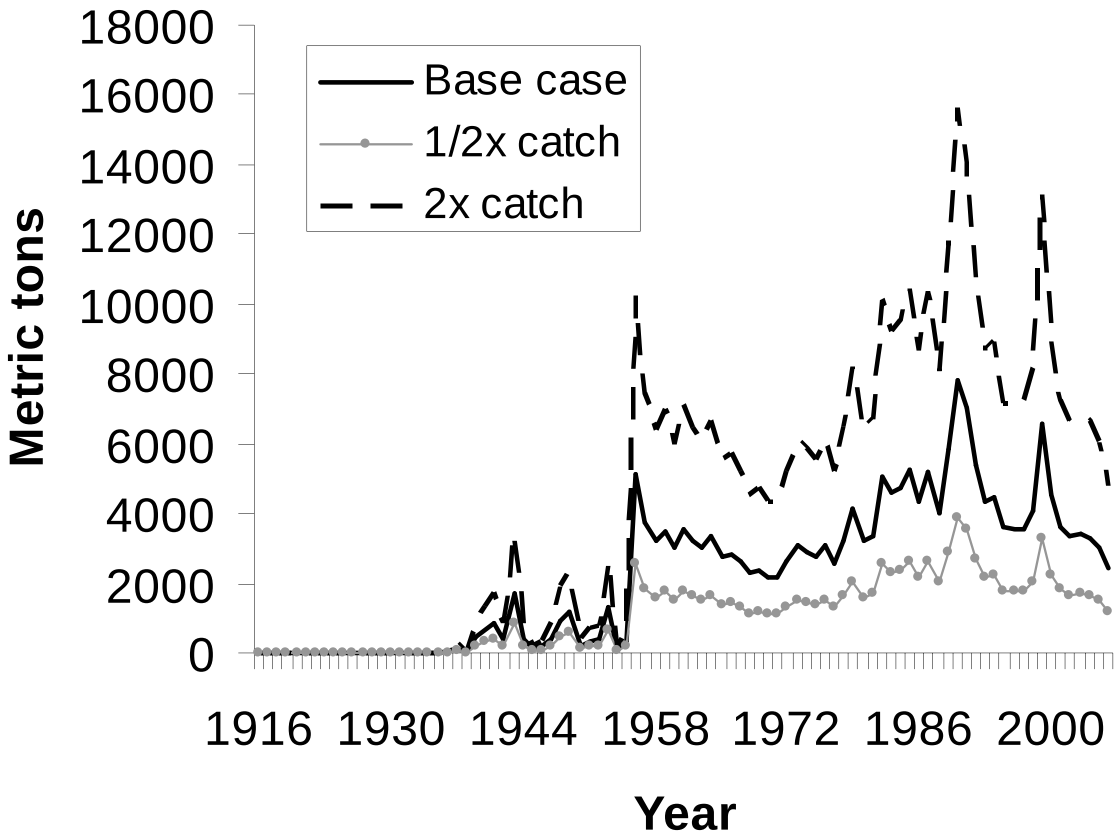


Figure 86. Estimated spawning biomass under three catch scenarios.

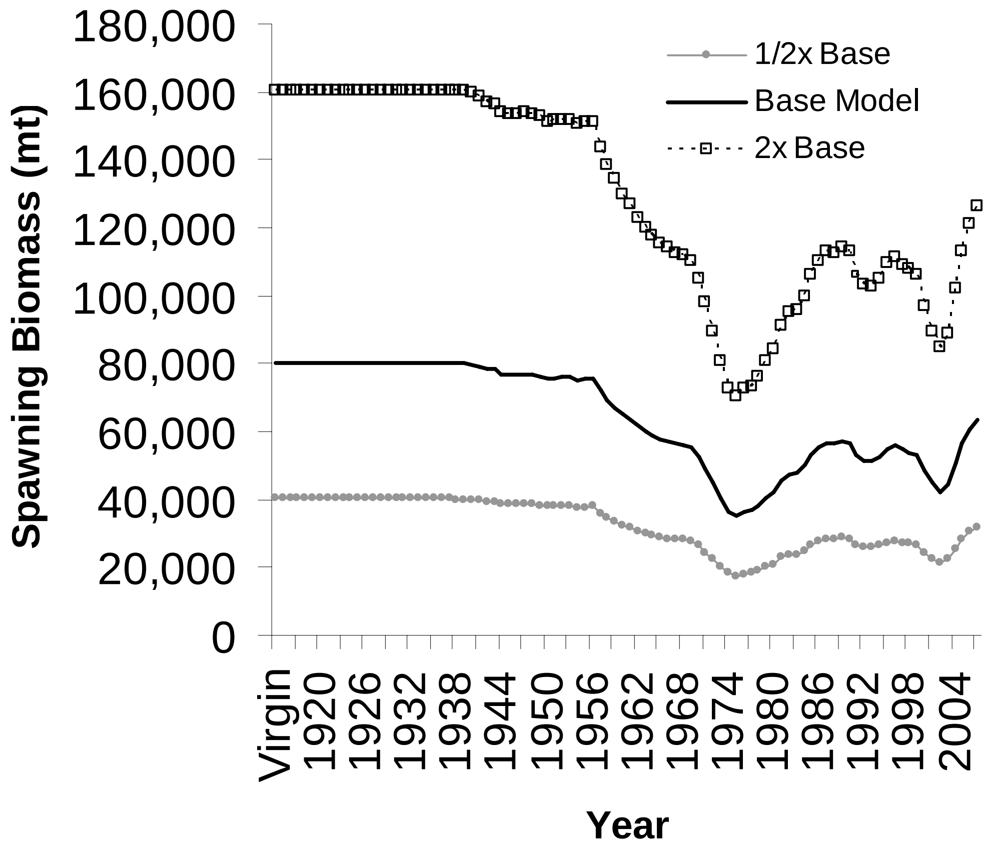


Table 1. Historical landings reconstruction for arrowtooth flounder. Each data source begins with a bold value, and ends the year before the next bold value. Superscripts refer to the data sources listed at the bottom of the table and in the Literature Cited section.

Year	**CA landings, mt**	**OR landings, mt**	**WA landings, mt**	**Coastwide landings, mt**
1916	0	0	0	0
1917	0	0	0	0
1918	0	0	0	0
1919	0	0	0	0
1920	0	0	0	0
1921	0	0	0	0
1922	0	0	0	0
1923	0	0	0	0
1924	0	0	0	0
1925	0	0	0	0
1926	0	0	0	0
1927	0	0	0	0
1928	0	**0.02**[3]	0	0.02
1929	0	6	0	6
1930	0	2	0	2
1931	0	2	0	2
1932	0	12	0	12
1933	0	8	0	8
1934	0	5	0	5
1935	0	10	0	10
1936	0	34	0	34
1937	0	148	0	148
1938	0	7	0	7
1939	0	453	0	453
1940	0	641	0	641
1941	0	846	0	846
1942	0	**412**[4]	0	412
1943	0	1717	0	1717
1944	0	407	0	407
1945	0	113	0	113
1946	0	167	0	167
1947	0	425	0	425
1948	0	936	0	936
1949	0	1165	0	1165
1950	**34**[1]	**168**[5]	0	202
1951	27	318	0	345
1952	51	339	0	390
1953	40	1282	0	1322
1954	**80**[2]	0	0	80
1955	339	0	0	339
1956	523	**1240**[6]	**1911**[8]	3674

1957	463	903	770	2137
1958	325	814	456	1595
1959	416	863	599	1878
1960	485	371	404	1260
1961	60	337	1523	1920
1962	61	489	937	1487
1963	52	200	974	1225
1964	47	558	1044	1649
1965	41	440	603	1085
1966	39	455	602	1096
1967	36	294	758	1088
1968	38	200	360	598
1969	16	127	342	486
1970	16	36	160	212
1971	12	**1**[7]	242	256
1972	87	23	**33**[9]	144
1973	449	33	180	662
1974	333	109	108	549
1975	45	77	23	145
1976	97	32	156	286
1977	6	79	116	202
1978	94	177	244	515
1979	127	339	410	876
1980	65	199	345	609

Data sources:

1 = California Dept. Fish and Game (1968)
2 = NMFS Annual Commercial Landings Database
3 = Cleaver (1951), ½ of "sole" and "scrapfish"
4 = Cleaver (1951), arrowtooth + ½ of "sole" and "scrapfish"
5 = Smith (1956)
6 = PFMFC (1981)
7 = NMFS Annual Commercial Landings Database
8 = PFMFC (1981)
9 = NMFS Annual Commercial Landings Database

Table 2a. Basic data and statistics summary for Arrowtooth flounder caught in the AFSC Triennial Shelf survey.

Number tows with zero and positive catch by year and spatial strata.

	Vancouver				**Columbia**				**Eureka+Monterey**			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0
1980	11	7	12	11	130	56	71	65	47	9	30	8
1983	33	24	29	26	193	98	97	79	84	15	43	20
1986	123	93	49	49	159	101	49	47	82	16	21	4
1989	30	23	24	23	128	93	60	56	124	17	44	15
1992	29	24	18	18	143	112	58	51	119	24	36	16
1995	19	16	18	17	101	53	80	62	100	14	74	34
1998	26	23	15	14	106	58	79	66	103	19	84	36
2001	21	19	17	16	105	93	82	73	102	53	82	32
2004	19	18	15	13	91	81	67	64	80	34	68	40

Mean and CV of catch per kg/4 ha by year and spatial strata (all tows).

	Vancouver				**Columbia**				**Eureka+Monterey**			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1980	3.58	0.53	14.69	0.52	0.65	0.20	5.08	0.21	0.10	0.39	0.22	0.44
1983	2.30	0.28	11.53	0.25	1.02	0.14	2.53	0.18	0.07	0.43	0.48	0.27
1986	7.38	0.16	18.14	0.10	2.01	0.19	4.41	0.14	0.13	0.36	0.05	0.56
1989	3.99	0.28	46.91	0.52	2.18	0.18	5.67	0.13	0.07	0.33	0.46	0.40
1992	2.09	0.22	7.15	0.21	0.80	0.13	2.62	0.15	0.12	0.28	0.91	0.29
1995	3.98	0.33	6.00	0.26	0.97	0.22	3.45	0.35	0.06	0.39	0.93	0.27
1998	22.44	0.60	14.50	0.34	1.53	0.17	2.83	0.16	0.05	0.26	0.46	0.19
2001	12.53	0.18	43.56	0.38	3.69	0.18	4.09	0.18	0.40	0.19	0.39	0.38
2004	27.28	0.34	107.24	0.76	6.38	0.17	11.29	0.19	1.41	0.33	2.84	0.20

Mean and CV catch per kg/2 ha by year and spatial strata (only positive tows).

	Vancouver				**Columbia**				**Eureka+Monterey**			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1980	5.62	0.49	16.03	0.51	1.50	0.18	5.55	0.20	0.51	0.26	0.81	0.34
1983	3.17	0.26	12.86	0.25	2.01	0.12	3.11	0.17	0.41	0.37	1.03	0.21
1986	9.75	0.15	18.14	0.10	3.16	0.18	4.59	0.14	0.68	0.29	0.24	0.36
1989	5.21	0.27	48.95	0.52	3.00	0.17	6.08	0.12	0.49	0.25	1.35	0.34
1992	2.53	0.20	7.15	0.21	1.02	0.13	2.98	0.15	0.57	0.22	2.04	0.23
1995	4.73	0.32	6.36	0.25	1.85	0.20	4.45	0.35	0.42	0.31	2.02	0.24
1998	25.37	0.59	15.54	0.33	2.80	0.15	3.39	0.15	0.28	0.16	1.06	0.14
2001	13.85	0.17	46.28	0.37	4.16	0.17	4.59	0.18	0.76	0.17	0.99	0.36
2004	28.80	0.34	123.73	0.75	7.17	0.17	11.82	0.18	3.31	0.30	4.82	0.18

Table 2b. Basic data and statistics summary for Arrowtooth flounder caught in the combined AFSC Slope survey.

Number tows with zero and positive catch by year and spatial strata.

	46-49°N				43-46°N				36-43°N			
	183-299 m		**300-549 m**		**183-299 m**		**300-549 m**		**183-299 m**		**300-549 m**	
	# tows	# tows	# tows	# tows	# tows	# tows	# tows	# tows	# tows	# tows	# tows	# tows
Year	0 catch	> 0	0 catch	> 0	0 catch	> 0	0 catch	> 0	0 catch	> 0	0 catch	> 0
1997	4	4	5	5	6	6	13	10	11	4	15	5
1999	3	3	9	9	6	6	13	13	12	5	16	6
2000	4	4	7	6	4	3	15	14	12	4	18	2
2001	4	4	7	6	4	4	15	13	12	9	18	3

Mean and CV of catch per kg/2 ha by year and spatial strata (all tows).

	46-49°N				43-46°N				36-43°N			
	183-299 m		**300-549 m**		**183-299 m**		**300-549 m**		**183-299 m**		**300-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1997	28.56	0.46	7.93	0.34	5.82	0.27	2.09	0.21	0.67	0.55	0.79	0.33
1999	42.53	0.38	7.08	0.33	6.71	0.24	2.77	0.16	0.17	0.41	0.34	0.62
2000	21.99	0.54	7.38	0.65	5.01	0.31	1.70	0.32	0.54	0.61	0.12	0.54
2001	23.85	0.72	1.69	0.67	10.98	0.23	1.57	0.28	1.42	0.23	0.21	0.34

Mean and CV catch per kg/2 ha by year and spatial strata (only positive tows).

	46-49°N				43-46°N				36-43°N			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1997	28.56	0.46	10.20	0.32	6.59	0.25	2.93	0.15	1.93	0.48	2.74	0.25
1999	42.53	0.38	7.62	0.32	7.55	0.23	3.29	0.13	0.88	0.19	2.71	0.52
2000	21.99	0.54	9.34	0.64	6.12	0.28	3.49	0.28	1.23	0.58	0.91	0.40
2001	23.85	0.72	4.01	0.63	10.98	0.23	3.05	0.22	2.28	0.18	1.01	0.22

Table 2c. Basic data and statistics summary for Arrowtooth flounder caught in the NWFSC Slope survey.

Number tows with zero and positive catch by year and spatial strata.

	46-49°N				43-46°N				36-43°N			
	183-299 m		300-549 m		183-299 m		300-549 m		183-299 m		300-549 m	
Year	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0
1999	5	5	18	14	17	15	21	15	23	8	52	15
2000	7	7	14	13	19	17	20	16	32	6	48	6
2001	5	5	19	15	11	9	39	19	25	11	47	6
2002	4	4	20	8	15	15	31	16	29	18	59	12

Mean and CV of catch per kg/2 ha by year and spatial strata (all tows).

	46-49°N				43-46°N				36-43°N			
	183-299 m		300-549 m		183-299 m		300-549 m		183-299 m		300-549 m	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1999	28.56	0.46	7.93	0.34	5.82	0.27	2.09	0.21	0.67	0.55	0.79	0.33
2000	42.53	0.38	7.08	0.33	6.71	0.24	2.77	0.16	0.17	0.41	0.34	0.62
2001	21.99	0.54	7.38	0.65	5.01	0.31	1.70	0.32	0.54	0.61	0.12	0.54
2002	23.85	0.72	1.69	0.67	10.98	0.23	1.57	0.28	1.42	0.23	0.21	0.34

Mean and CV catch per kg/2 ha by year and spatial strata (only positive tows).

	46-49°N				43-46°N				36-43°N			
	183-299 m		300-549 m		183-299 m		300-549 m		183-299 m		300-549 m	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1999	28.56	0.46	10.20	0.32	6.59	0.25	2.93	0.15	1.93	0.48	2.74	0.25
2000	42.53	0.38	7.62	0.32	7.55	0.23	3.29	0.13	0.88	0.19	2.71	0.52
2001	21.99	0.54	9.34	0.64	6.12	0.28	3.49	0.28	1.23	0.58	0.91	0.40
2002	23.85	0.72	4.01	0.63	10.98	0.23	3.05	0.22	2.28	0.18	1.01	0.22

Table 2d. Basic data and statistics summary for Arrowtooth flounder caught in the NWFSC slope/shelf survey.

Number tows with zero and positive catch by year and spatial strata.

	Vancouver				Columbia				Eureka+Monterey			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0	# tows 0 catch	# tows > 0
2003	7	30	4	23	9	25	7	45	40	25	36	44
2004	6	16	1	14	17	56	13	44	51	22	14	20
2005	2	13	1	19	31	69	13	57	79	25	25	30
2006	5	14	3	9	32	58	16	69	66	9	32	28

Mean and CV of catch per kg/2 ha by year and spatial strata (all tows).

	Vancouver				Columbia				Eureka+Monterey			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
2003	50.57	0.34	76.35	0.57	11.21	0.19	34.63	0.52	2.06	0.24	5.07	0.22
2004	46.04	0.81	53.80	0.40	8.80	0.17	25.67	0.33	2.23	0.31	6.72	0.22
2005	54.72	0.43	116.86	0.22	11.63	0.17	19.26	0.21	2.28	0.36	6.50	0.30
2006	12.29	0.31	69.49	0.45	6.60	0.22	53.09	0.54	0.34	0.48	9.31	0.26

Mean and CV catch per kg/2 ha by year and spatial strata (only positive tows).

	Vancouver				Columbia				Eureka+Monterey			
	55-155 m		**156-549 m**		**55-155 m**		**156-549 m**		**55-155 m**		**156-549 m**	
Year	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
2003	62.37	0.34	89.63	0.57	15.24	0.16	40.02	0.52	5.37	0.19	9.23	0.20
2004	63.30	0.80	57.65	0.39	11.47	0.16	33.26	0.32	7.39	0.26	11.42	0.18
2005	63.13	0.42	123.01	0.21	16.86	0.14	23.66	0.20	9.48	0.31	11.91	0.26
2006	16.68	0.28	92.64	0.42	10.24	0.20	65.32	0.54	2.85	0.36	19.96	0.23

Table 3a. Triennial shelf survey: Biomass (mt) and associated CVs of Arrowtooth flounder by stratum and year estimated from GLM analysis

	Vancouver				Columbia				Eureka+Monterey						
	55-155 m		156-549 m		55-155 m		156-549 m		55-155 m		156-549 m		Total		
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Biomass	CV	SD ln(Index)
1980	269	0.793	1468	0.661	151	0.364	971	0.328	5	0.724	11	0.749	3001	0.411	0.395
1983	166	0.431	1219	0.443	226	0.362	617	0.321	5	0.559	17	0.485	2274	0.332	0.323
1986	565	0.314	1870	0.382	394	0.342	955	0.328	9	0.537	4	1.150	3830	0.296	0.290
1989	303	0.414	4968	0.468	373	0.331	1317	0.341	7	0.529	25	0.524	7059	0.381	0.368
1992	152	0.416	779	0.517	141	0.330	668	0.332	9	0.446	40	0.535	1828	0.329	0.321
1995	201	0.551	505	0.521	205	0.377	840	0.338	6	0.590	39	0.414	1849	0.315	0.308
1998	1548	0.448	1710	0.601	327	0.350	711	0.326	4	0.499	19	0.404	4431	0.373	0.361
2001	754	0.475	4459	0.547	564	0.328	1002	0.304	14	0.372	19	0.367	6967	0.401	0.386
2004	1983	0.479	14337	0.595	1008	0.329	2887	0.324	55	0.404	98	0.353	20640	0.456	0.434

Table 3b. AFSC slope survey: Biomass (mt) and associated CVs of Arrowtooth flounder by stratum and year estimated from GLM analysis

	46-49°N				43-46°N				36-43°N						
	183-300 m		300-549 m		183-300 m		300-549 m		183-300 m		300-549 m		Total		
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Biomass	CV	SD ln(Index)
1997	1197	0.670	611	0.432	88	0.391	1025	0.290	9	0.588	180	0.597	3295	0.275	0.269
1999	794	0.651	881	0.329	301	0.402	1693	0.261	141	0.475	158	0.521	4164	0.189	0.187
2000	1854	0.523	692	0.410	822	0.654	1160	0.257	29	0.611	49	1.016	4839	0.245	0.242
2001	3612	0.582	504	0.439	666	0.493	1316	0.259	349	0.365	70	0.767	6738	0.320	0.312

Table 3c. NWFSC slope survey: Biomass (mt) and associated CVs of Arrowtooth flounder by stratum and year estimated from GLM analysis

	46-49°N				43-46°N				36-43°N						
	183-300 m		300-549 m		183-300 m		300-549 m		183-300 m		300-549 m		Total		
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Biomass	CV	SD ln(Index)
1999	4281	0.619	996	0.360	1392	0.334	910	0.358	204	0.505	228	0.429	8217	0.345	0.336
2000	5699	0.552	664	0.395	1538	0.331	857	0.350	73	0.594	161	0.648	9208	0.355	0.345
2001	3089	0.598	778	0.396	1224	0.470	884	0.326	95	0.426	48	0.704	6362	0.319	0.311
2002	3233	0.859	348	0.504	2230	0.333	821	0.339	191	0.356	61	0.486	7209	0.405	0.390

Table 3d. NWFSC shelf/slope survey: Biomass (mt) and associated CVs of Arrowtooth flounder by stratum and year estimated from GLM analysis

	Vancouver				Columbia				Eureka+Monterey						
	55-155 m		156-549 m		55-155 m		156-549 m		55-155 m		156-549 m		Total		
Year	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Median	CV	Biomass	CV	SD ln(Index)
2003	3478	0.470	4639	0.559	3820	0.500	9032	0.403	575	0.570	926	0.411	23976	0.256	0.252
2004	3583	0.655	2931	0.835	2753	0.354	7239	0.396	647	0.652	1104	0.636	19571	0.275	0.270
2005	3547	0.862	6483	0.637	4095	0.313	5308	0.342	831	0.576	1063	0.457	22603	0.289	0.283
2006	790	0.723	4219	1.093	2092	0.334	12715	0.321	180	1.189	1409	0.517	22551	0.302	0.295

Table 4. Sample sizes for survey and fishery data

Triennial shelf survey samples

Year	Number hauls	Number lengths
1980	15	827
1983	2	163
1986	136	6457
1989	211	9342
1992	210	5081
1995	173	5255
1998	259	5585
2001	321	11057
2004	247	8664

AFSC slope survey samples

Year	Number hauls	Number lengths
1997	37	562
1999	43	443
2000	35	315
2001	41	724

NWFSC shelf/slope survey

Year	Number hauls	Number Lengths	Number Ages
2003	196	4568	521
2004	178	2776	506
2005	218	3991	863
2006	189	3036	475

Fillet fishery (PacFIN) samples

Year	Sampled trips	Number Lengths	Number Ages
1986	19	950	306
1987	22	1200	368
1988	16	800	277
1989	17	850	312
1990	19	974	324
1991	39	1917	334
1992	30	1499	-
1993	18	900	-
1994	20	1000	-
1995	22	1098	-
1996	18	900	-
1997	17	845	-
1998	20	999	183
1999	22	1098	-
2000	21	1050	-
2001	16	800	-
2002	10	499	-
2003	10	429	106
2004	6	300	95
2005	6	118	16
2006	21	714	-

Table 5. Parameter assumptions and model configuration of Stock Synthesis II (Ver. 2.00G) for Arrowtooth.

Parameter	Number Estimated	Bounds (low,high)
Natural Mortality - Females	-	Fixed at 0.166
Males		Fixed at 0.274
Stock and recruitment		
Ln(Rzero)	1	(5,25)
Steepness	-	Fixed at 0.902
Sigma R (based on 1975-2003 R devs)	-	Fixed at 0.80
Ln(Recruitment deviations): 1965-2005	41	(-10,10)
Catchability		
Ln(q) - NWFSC shelf/slope survey	-	analytical solution
Ln(q) - Triennial shelf survey	-	analytical solution
Ln(q) - AFSC slope survey	-	analytical solution
Ln(q) - NWFSC slope survey	-	analytical solution
Fishery Selectivity --double normal		
(Fillet fleet is sex specific; bycatch fleet is not; mink food fleet fixed at values from Triennial Survey)		
Peak	2	(14,80)
Width (logit trans.)	-	Fixed at 6
Var-ascending (ln)	2	(1,20)
Var-descending (ln)	-	Fixed at 1
Initial (logit trans)	-	Fixed at -10
Final (logit trans.)	-	Fixed at 50
Male offset, point of divergence from female sel.	-	Fixed at 30cm
Ln(male sel. / female sel.) at min length	-	Fixed at 0
Ln(male sel. / female sel.) at point of divergence	1	(-3, 0)
Ln(male sel. / female sel.) at max length	1	(-3, 0)
Survey Selectivity -- double normal)		
NWFSC Slope parameters mirrored from AFSC Slope, all others estimated		
Peak	3	(14,80)
Width (logit trans.)	-	Fixed at 6
Var-ascending (ln)	3	(-1,10)
Var-descending (ln)	-	Fixed at 1
Intial (logit trans)	-	Fixed at -10
Final (logit trans.)	-	Fixed at 50
Male offset, point of divergence from female sel.	-	Fixed at 30cm
Ln(male sel. / female sel.) at min length	-	Fixed at 0
Ln(male sel. / female sel.) at point of divergence	3	(-3, 0)
Ln(male sel. / female sel.) at max length	3	(-3, 0)
Individual growth		
Separate Sex specification :		
Length at age min (age 1) females	-	Fixed at 8cm
Length at age max (age 30) females	1	(40,90)
von Bertalanffy K females	1	(0.05,0.25)
CV youngest age females	-	Fixed at 0.14
CV oldest age females	-	Fixed at 0.08
Length at age min (age 1) males	-	Fixed at 8cm
Length at age max (age 30) males	1	(30,70)
von Bertalanffy K males	1	(0.05,0.5)
CV youngest age males	-	Fixed at 0.21
CV oldest age males	-	Fixed at 0.08

Table 6. Parameter estimates and standard deviations (SD) for the arrowtooth base model, for two scenarios that bracket the uncertainty in catch and natural mortality, and for three earlier models discussed during the STAR panel. A dash ("--") signifies that the parameter was not estimated in that model.

Model Likelihoods	**Base Case**		**Low Catch Low M**		**High Catch High M**		**Pre-STAR Base**		**Model O**		**Model P**	
Likelihood components	**-2 Ln Likelihood**		**-2 Ln Likelihood**		**-2 Ln Likelihood**		**-2 Ln Likelihood**		**-2 Ln Likelihood**		**-2 Ln Likelihood**	
TOTAL	3680.43		3750.41		3633.71		3916.47		3982.43		3947.40	
Survey indices	6.86		6.75		7.59		7.40		9.52		10.34	
length_comps	1086.06		1102.12		1075.75		1244.19		1258.16		1238.04	
age_comps	2558.86		2585.39		2530.34		2552.97		2613.35		2599.88	
discard fraction							58.78		59.89		60.09	
Parameter	**MLE**	**SD**	**MLE**	**SD**	**MLE**	**SD**	**MLE**	**SD**	**MLE**	**SD**	**MLE**	**SD**
Stock and recruitment												
Ln(Rzero)	10.26	0.08	8.46	0.05	13.23	0.48	10.29	0.08	10.04	0.05	9.99	0.05
Catchability (analytical solution)												
Q - NWFSC shelf/slope survey	0.31	-	0.98	-	0.03	-	0.21	0.24	0.37	-	0.49	-
Q - Triennial shelf survey	0.06	-	0.19	-	0.00	-	0.05	0.22	0.07	-	0.08	-
Q - AFSC slope survey	0.07	-	0.25	-	0.01	-	0.05	0.18	0.10	-	0.12	-
Q - NWFSC slope survey	0.13	-	0.44	-	0.01	-	0.08	0.23	0.17	-	0.21	-
Selectivity (double normal):												
NWFSC shelf/slope												
Peak	38.00	1.29	37.50	1.25	38.43	1.28	63.12	5.76	38.80	1.43	38.93	1.27
Var-ascending (ln)	4.40	0.23	4.38	0.24	4.41	0.22	6.60	0.33	4.54	0.24	4.50	0.22
Ln(male sel./ female sel.) at point of divergence	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00
Ln(male sel. / female sel.) at max length	-0.88	0.39	-1.11	0.39	-0.64	0.39	-	-	-	-	-2.25	0.39
Triennial shelf												
Peak	31.15	0.68	30.86	0.90	31.58	0.70	31.86	0.69	31.29	0.65	31.48	0.68
Var-ascending (ln)	4.70	0.18	4.79	0.23	4.61	0.16	4.70	0.16	4.76	0.17	4.75	0.17
Ln(male sel./ female sel.) at point of divergence	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00
Ln(male sel. / female sel.) at max length	-0.10	0.28	-0.47	0.28	0.00	0.00	-	-	-	-	-1.40	0.25
AFSC slope												
Peak	31.82	1.30	31.59	1.26	32.12	1.34	32.34	1.36	31.92	1.32	32.27	1.40
Var-ascending (ln)	3.59	0.37	3.61	0.37	3.58	0.37	3.59	0.37	3.61	0.37	3.63	0.37
Ln(male sel./ female sel.) at point of divergence	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00
Ln(male sel. / female sel.) at max length	-0.62	0.77	-1.01	0.77	-0.19	0.78	-	-	-	-	-2.10	0.78
Fillet Fishery												
Peak (fixed)	60.00	-	60.00	-	60.00	-	77.68	1.48	80.00	0.00	80.00	0.00
Var-ascending (ln)	5.13	0.03	5.16	0.03	5.11	0.03	6.31	0.06	6.44	0.03	6.45	0.03
Ln(male sel./ female sel.) at point of divergence	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00
Ln(male sel. / female sel.) at max length	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-0.28	0.28
Bycatch Fishery												
Peak	35.41	2.48	35.20	2.38	35.69	2.46	36.85	3.86	35.89	2.76	36.11	2.88
Var-ascending (ln)	4.47	0.47	4.51	0.47	4.40	0.45	4.93	0.66	4.64	0.50	4.69	0.51
Fillet fleet retention												
Inflection point	-	-	-	-	-	-	38.31	0.59	38.39	0.58	38.34	0.59
Slope	-	-	-	-	-	-	4.75	0.24	4.72	0.24	4.72	0.24
Individual growth												
Length at age max (age 30) females	72.26	0.41	72.08	0.41	72.28	0.41	70.90	0.41	70.79	0.39	70.86	0.39
von Bertalanffy K females	0.17	0.00	0.17	0.00	0.17	0.00	0.17	0.00	0.18	0.00	0.18	0.00
Length at age max (age 30) males	45.58	0.30	45.51	0.29	45.78	0.30	45.03	0.25	45.20	0.31	45.56	0.32
von Bertalanffy K males	0.39	0.01	0.39	0.01	0.38	0.01	0.39	0.01	0.39	0.01	0.39	0.01
Management quantities												
Bzero	80314	6166	33402	1685	596607	284340	79299	6237	62189	3117	59056	2927
2007 Spawning biomass	63302	11365	21680	3410	561030	323600	135868	22767	49192	5841	40286	5294
2007 Depletion	0.79	0.11	0.65	0.10	0.94	0.11	1.71	0.22	0.79	0.08	0.67	0.07
MSY	5245	402	1434	71	60812	28984	5441	431	4393	221	4173	209
BMSY	30780	2363	12801	646	228650	108970	30387	2390	23834	1195	22633	1122

Table 7. Time series of estimated total biomass, 3+ biomass, spawning biomass, recruitment, and utilization for 1916-2007 from the Arrowtooth ***base model*** *using Stock Synthesis II (Ver. 2.00G). Exploitation rates are calculated as the catch in biomass divided by the vulnerable biomass at the start of the year. Biomass is in metric tons at the start of the year. Recruitment is given in thousands of age-0 fish.*

Year	Total biomass (mt)	3+ Population biomass (mt)	Spawning biomass (mt)	Age 0 Recruits	Depletion % Bzero	Exploitation rate	Year	Total biomass (mt)	3+ Population biomass (mt)	Spawning biomass (mt)	Age 0 Recruits	Depletion % Bzero	Exploitation rate
1916	99,930	98,022	80,314	28,528	100.0%	0.0%	1962	78,772	76,878	61,515	28,294	76.6%	4.2%
1917	99,930	98,022	80,314	28,528	100.0%	0.0%	1963	77,198	75,306	60,050	28,269	74.8%	4.0%
1918	99,930	98,022	80,314	28,528	100.0%	0.0%	1964	75,998	74,108	58,902	28,249	73.3%	4.5%
1919	99,930	98,022	80,314	28,528	100.0%	0.0%	1965	74,239	72,770	57,669	4,038	71.8%	3.8%
1920	99,930	98,022	80,314	28,528	100.0%	0.0%	1966	73,294	72,116	57,003	4,327	71.0%	3.9%
1921	99,930	98,022	80,314	28,528	100.0%	0.0%	1967	71,778	71,489	56,382	4,952	70.2%	3.7%
1922	99,930	98,022	80,314	28,528	100.0%	0.0%	1968	69,220	68,882	55,996	6,737	69.7%	3.3%
1923	99,930	98,022	80,314	28,528	100.0%	0.0%	1969	65,798	65,316	55,104	12,427	68.6%	3.7%
1924	99,930	98,022	80,314	28,528	100.0%	0.0%	1970	61,386	60,759	52,507	12,908	65.4%	3.7%
1925	99,930	98,022	80,314	28,528	100.0%	0.0%	1971	57,873	55,990	48,919	72,809	60.9%	4.0%
1926	99,930	98,022	80,314	28,528	100.0%	0.0%	1972	53,169	51,598	44,833	11,467	55.8%	5.2%
1927	99,930	98,022	80,314	28,528	100.0%	0.0%	1973	50,401	47,228	40,489	18,216	50.4%	6.4%
1928	99,930	98,022	80,314	28,528	100.0%	0.0%	1974	50,394	48,650	36,480	63,146	45.4%	6.0%
1929	99,930	98,022	80,314	28,528	100.0%	0.0%	1975	49,809	48,222	35,129	7,814	43.7%	5.7%
1930	99,925	98,017	80,309	28,528	100.0%	0.0%	1976	51,799	48,086	36,337	72,848	45.2%	6.2%
1931	99,923	98,015	80,308	28,528	100.0%	0.0%	1977	53,303	51,701	36,716	24,287	45.7%	5.0%
1932	99,922	98,014	80,306	28,528	100.0%	0.0%	1978	56,112	52,809	38,218	16,621	47.6%	5.9%
1933	99,910	98,002	80,296	28,528	100.0%	0.0%	1979	60,147	58,070	40,292	55,923	50.2%	6.9%
1934	99,904	97,995	80,290	28,528	100.0%	0.0%	1980	62,379	60,211	42,079	49,907	52.4%	5.2%
1935	99,900	97,992	80,287	28,528	100.0%	0.0%	1981	65,197	61,574	45,578	53,567	56.7%	6.5%
1936	99,892	97,984	80,280	28,528	100.0%	0.0%	1982	68,151	65,311	47,577	18,600	59.2%	10.1%
1937	99,861	97,953	80,254	28,528	99.9%	0.2%	1983	70,902	68,089	47,784	33,847	59.5%	8.8%
1938	99,719	97,811	80,135	28,527	99.8%	0.0%	1984	73,929	72,339	49,910	27,812	62.1%	9.0%
1939	99,722	97,814	80,133	28,527	99.8%	0.5%	1985	76,208	73,749	52,940	49,432	65.9%	9.6%
1940	99,288	97,380	79,770	28,523	99.3%	0.7%	1986	76,450	74,533	55,121	15,832	68.6%	7.7%
1941	98,687	96,780	79,259	28,518	98.7%	0.9%	1987	77,797	75,066	56,448	39,969	70.3%	9.0%
1942	97,914	96,007	78,593	28,511	97.9%	0.4%	1988	78,061	76,136	56,285	48,780	70.1%	6.7%
1943	97,614	95,707	78,305	28,509	97.5%	1.8%	1989	78,026	75,801	57,159	7,858	71.2%	10.2%
1944	96,063	94,157	76,983	28,495	95.9%	0.4%	1990	78,072	74,767	56,396	80,174	70.2%	14.7%
1945	95,883	93,977	76,772	28,493	95.6%	0.1%	1991	74,781	73,204	53,215	17,486	66.3%	13.7%
1946	96,044	94,138	76,849	28,494	95.7%	0.2%	1992	72,758	69,484	51,586	3,868	64.2%	10.7%
1947	96,183	94,278	76,931	28,494	95.8%	0.4%	1993	73,781	72,718	51,479	20,980	64.1%	8.5%
1948	96,088	94,182	76,835	28,493	95.7%	1.0%	1994	75,053	73,766	52,553	51,131	65.4%	9.0%
1949	95,506	93,600	76,343	28,488	95.1%	1.2%	1995	73,568	72,077	54,775	4,749	68.2%	6.9%
1950	94,727	92,822	75,677	28,481	94.2%	0.2%	1996	73,000	70,804	55,758	13,199	69.4%	6.6%
1951	94,942	93,037	75,817	28,483	94.4%	0.4%	1997	72,256	71,786	54,623	7,587	68.0%	6.6%
1952	95,035	93,130	75,869	28,483	94.5%	0.4%	1998	70,859	69,704	53,802	32,876	67.0%	8.0%
1953	95,096	93,191	75,908	28,484	94.5%	1.4%	1999	69,381	66,501	52,962	126,747	65.9%	13.6%
1954	94,244	92,340	75,200	28,476	93.6%	0.1%	2000	62,977	59,802	48,468	22,987	60.3%	10.0%
1955	94,651	92,746	75,512	28,479	94.0%	0.4%	2001	62,559	56,890	44,853	37,831	55.8%	8.5%
1956	94,806	92,902	75,628	28,480	94.2%	5.5%	2002	66,806	64,932	42,330	31,901	52.7%	7.9%
1957	90,253	88,351	71,849	28,437	89.5%	4.2%	2003	71,600	69,707	44,468	5,198	55.4%	8.2%
1958	87,253	85,352	69,246	28,405	86.2%	3.7%	2004	76,987	74,817	51,021	52,878	63.5%	7.6%
1959	84,956	83,056	67,164	28,378	83.6%	4.2%	2005	80,327	78,961	56,486	30,337	70.3%	6.2%
1960	82,558	80,661	64,998	28,347	80.9%	3.7%	2006	82,523	79,822	60,633	20,535	75.5%	4.4%
1961	80,849	78,954	63,396	28,323	78.9%	4.5%	2007	85,175	83,301	63,302	28,322	78.8%	-
							2006 Depletion 5% - 95% Asymptotic Interval					56.3%	94.7%
							2007 Depletion 5% - 95% Asymptotic Interval					58.1%	99.5%

Table 8. Estimates of uncertainty as expressed by asymptotic 95% confidence intervals of spawning biomass and recruitment to age-0 from the Arrowtooth base model. Deviations from log mean recruitment were estimated between 1965-2003 and values given between 2004-2007 represent mean recruitment from the stock recruitment curve.

	Spawning biomass (mt)			Age-0 recruitment (thousands)				Spawning biomass (mt)			Age-0 recruitment (thousands)		
	Asymptotic interval			Asymptotic interval				Asymptotic interval			Asymptotic interval		
Year	MLE	5%	95%	MLE	5%	95%		MLE	5%	95%	MLE	5%	95%
1916	80,313	68,228	92,398	28,528	24,565	33,131	1962	61,515	49,420	73,610	28,294	24,324	32,912
1917	80,313	68,228	92,398	28,528	24,565	33,131	1963	60,050	47,946	72,154	28,269	24,297	32,890
1918	80,313	68,228	92,398	28,528	24,565	33,131	1964	58,902	46,787	71,017	28,249	24,276	32,873
1919	80,313	68,228	92,398	28,528	24,565	33,131	1965	57,669	45,542	69,796	4,038	1,330	12,260
1920	80,313	68,228	92,398	28,528	24,565	33,131	1966	57,003	44,858	69,148	4,327	1,417	13,207
1921	80,313	68,228	92,398	28,528	24,565	33,131	1967	56,382	44,219	68,545	4,952	1,581	15,508
1922	80,313	68,228	92,398	28,528	24,565	33,131	1968	55,996	43,818	68,174	6,737	1,957	23,189
1923	80,313	68,228	92,398	28,528	24,565	33,131	1969	55,104	43,025	67,183	12,427	3,373	45,782
1924	80,313	68,228	92,398	28,528	24,565	33,131	1970	52,507	40,781	64,233	12,908	2,458	67,797
1925	80,313	68,228	92,398	28,528	24,565	33,131	1971	48,919	37,736	60,102	72,809	43,463	121,968
1926	80,313	68,228	92,398	28,528	24,565	33,131	1972	44,833	34,298	55,368	11,467	2,231	58,945
1927	80,313	68,228	92,398	28,528	24,565	33,131	1973	40,489	30,659	50,319	18,216	3,344	99,220
1928	80,313	68,228	92,398	28,528	24,565	33,131	1974	36,480	27,245	45,715	63,146	36,360	109,665
1929	80,313	68,228	92,398	28,528	24,565	33,131	1975	35,129	26,708	43,550	7,814	1,936	31,544
1930	80,309	68,224	92,394	28,528	24,565	33,131	1976	36,337	28,851	43,823	72,848	47,555	111,594
1931	80,308	68,223	92,393	28,528	24,565	33,131	1977	36,716	29,661	43,771	24,287	6,619	89,116
1932	80,306	68,221	92,391	28,528	24,565	33,131	1978	38,218	31,477	44,959	16,621	3,565	77,496
1933	80,296	68,211	92,381	28,528	24,565	33,131	1979	40,292	33,983	46,601	55,923	34,299	91,180
1934	80,290	68,205	92,375	28,528	24,565	33,131	1980	42,079	36,024	48,134	49,907	31,197	79,837
1935	80,287	68,202	92,372	28,528	24,565	33,131	1981	45,577	39,614	51,540	53,567	38,463	74,602
1936	80,280	68,195	92,365	28,528	24,565	33,131	1982	47,577	41,677	53,477	18,600	10,547	32,801
1937	80,254	68,169	92,339	28,528	24,565	33,131	1983	47,784	41,880	53,688	33,847	25,423	45,062
1938	80,135	68,050	92,220	28,527	24,564	33,130	1984	49,910	43,871	55,949	27,812	20,023	38,631
1939	80,133	68,048	92,218	28,527	24,564	33,130	1985	52,940	46,640	59,240	49,432	38,949	62,737
1940	79,769	67,684	91,854	28,523	24,560	33,126	1986	55,121	48,556	61,686	15,832	9,086	27,586
1941	79,259	67,174	91,344	28,518	24,555	33,121	1987	56,448	49,688	63,208	39,969	28,535	55,984
1942	78,593	66,509	90,677	28,511	24,548	33,114	1988	56,285	49,355	63,215	48,780	33,987	70,013
1943	78,305	66,221	90,389	28,508	24,545	33,111	1989	57,159	50,016	64,302	7,858	2,639	23,401
1944	76,983	64,900	89,066	28,495	24,532	33,098	1990	56,396	49,004	63,788	80,174	61,832	103,957
1945	76,771	64,687	88,855	28,493	24,530	33,096	1991	53,215	45,596	60,834	17,486	7,994	38,249
1946	76,849	64,765	88,933	28,493	24,530	33,096	1992	51,586	43,604	59,568	3,868	1,324	11,301
1947	76,931	64,847	89,015	28,494	24,531	33,097	1993	51,479	43,067	59,891	20,980	12,847	34,261
1948	76,835	64,751	88,919	28,493	24,530	33,096	1994	52,553	43,586	61,520	51,131	37,275	70,137
1949	76,342	64,258	88,426	28,488	24,525	33,091	1995	54,775	44,965	64,585	4,749	1,741	12,955
1950	75,677	63,593	87,761	28,481	24,518	33,085	1996	55,758	45,393	66,123	13,198	8,019	21,721
1951	75,817	63,732	87,902	28,482	24,519	33,086	1997	54,623	44,024	65,222	7,587	3,410	16,883
1952	75,869	63,784	87,954	28,483	24,520	33,087	1998	53,802	42,819	64,785	32,876	22,763	47,482
1953	75,908	63,822	87,994	28,483	24,520	33,087	1999	52,962	41,411	64,513	126,750	92,237	174,177
1954	75,200	63,115	87,285	28,476	24,513	33,080	2000	48,468	36,642	60,294	22,987	15,281	34,578
1955	75,512	63,425	87,599	28,479	24,516	33,083	2001	44,853	32,986	56,720	37,830	26,236	54,548
1956	75,628	63,541	87,715	28,480	24,517	33,084	2002	42,330	30,343	54,317	31,901	21,348	47,671
1957	71,849	59,765	83,933	28,437	24,473	33,043	2003	44,468	31,080	57,856	5,198	2,256	11,974
1958	69,246	57,162	81,330	28,405	24,441	33,012	2004	51,021	34,823	67,219	52,878	27,723	100,857
1959	67,164	55,079	79,249	28,377	24,412	32,986	2005	56,486	37,773	75,199	30,337	8,505	108,216
1960	64,997	52,910	77,084	28,347	24,380	32,959	2006	60,633	39,837	81,429	20,535	5,147	81,934
1961	63,396	51,305	75,487	28,323	24,355	32,937	2007	63,302	41,027	85,577	28,321	7,099	113,001

Table 9a. Profile on steepness of the stock recruit relationship. Steepness was 0.902 in the base case.

Steepness	**0.5**	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**	**0.8**	**0.85**	**0.902**	**0.95**	**0.99**
Bo	85405	84561	83786.5	83066	82407	81807	81262.9	80773	80313.5	79930	79639
2007 Depletion	0.72	0.73	0.74	0.75	0.76	0.77	0.77	0.78	0.79	0.79	0.80
Likelihood	3689.01	3687.09	3685.54	3684.28	3683.24	3682.37	3681.63	3680.99	3680.43	3679.97	3679.63
Abund. indices	6.97	6.95	6.94	6.92	6.90	6.89	6.88	6.87	6.86	6.85	6.84
Age comps	2561.88	2561.40	2560.94	2560.50	2560.10	2559.74	2559.42	2559.13	2558.86	2558.63	2558.47
Length comps	1084.51	1084.83	1085.10	1085.32	1085.52	1085.68	1085.82	1085.95	1086.06	1086.15	1086.22
Likelihood of all data	3653.36	3653.18	3652.98	3652.74	3652.52	3652.31	3652.12	3651.95	3651.78	3651.63	3651.53

Table 9b. Profile on natural mortality

Male M	**0.214**	**0.234**	**0.254**	**0.274**	**0.294**	**0.314**	**0.334**	**0.354**
Female M	**0.106**	**0.126**	**0.146**	**0.166**	**0.186**	**0.206**	**0.226**	**0.246**
Bo	66728.4	69058	73530	80313.5	91174.3	110530	152947	298315
2007 Depletion	0.65	0.70	0.74	0.79	0.84	0.88	0.91	0.94
Likelihood	3749.82	3721.52	3698.89	3680.43	3665.27	3652.76	3642.38	3633.71
Abund. indices	6.74	6.75	6.79	6.86	6.97	7.15	7.36	7.59
Age comps	2584.44	2575.41	2567.16	2558.86	2550.89	2543.36	2536.54	2530.34
Length comps	1102.23	1095.93	1090.56	1086.06	1082.36	1079.59	1077.40	1075.75
Likelihood of all data	3693.41	3678.09	3664.51	3651.78	3640.22	3630.10	3621.30	3613.68

Table 10. Spawning biomass and 2007 depletion for base case and scenarios with high and low catch

	1/2x Base	Base Case	2x Base		1/2x Base	Base Case	2x Base
Year		**Spawning Biomass**		**Year**		**Spawning Biomass**	
Virgin	40156	80314	160626	**1961**	31697	63396	126791
Initial	40156	80314	160626	**1962**	30756	61515	123029
1916	40156	80314	160626	**1963**	30024	60050	120099
1917	40156	80314	160626	**1964**	29450	58902	117804
1918	40156	80314	160626	**1965**	28833	57669	115337
1919	40156	80314	160626	**1966**	28501	57003	114005
1920	40156	80314	160626	**1967**	28190	56382	112764
1921	40156	80314	160626	**1968**	27997	55996	111991
1922	40156	80314	160626	**1969**	27551	55104	110208
1923	40156	80314	160626	**1970**	26253	52507	105013
1924	40156	80314	160626	**1971**	24459	48919	97837
1925	40156	80314	160626	**1972**	22416	44833	89666
1926	40156	80314	160626	**1973**	20244	40489	80978
1927	40156	80314	160626	**1974**	18239	36480	72959
1928	40156	80314	160626	**1975**	17564	35129	70257
1929	40156	80314	160626	**1976**	18168	36337	72673
1930	40153	80309	160617	**1977**	18358	36716	73432
1931	40153	80308	160614	**1978**	19109	38218	76436
1932	40152	80306	160611	**1979**	20146	40292	80583
1933	40147	80296	160592	**1980**	21039	42079	84159
1934	40144	80290	160580	**1981**	22789	45578	91155
1935	40142	80287	160573	**1982**	23788	47577	95153
1936	40139	80280	160558	**1983**	23892	47784	95567
1937	40126	80254	160507	**1984**	24955	49910	99818
1938	40067	80135	160269	**1985**	26470	52940	105879
1939	40066	80133	160265	**1986**	27560	55121	110240
1940	39884	79770	159538	**1987**	28224	56448	112895
1941	39628	79259	158517	**1988**	28142	56285	112569
1942	39295	78593	157184	**1989**	28579	57159	114317
1943	39151	78305	156608	**1990**	28197	56396	112790
1944	38491	76983	153965	**1991**	26607	53215	106428
1945	38385	76772	153542	**1992**	25792	51586	103170
1946	38423	76849	153696	**1993**	25739	51479	102957
1947	38464	76931	153861	**1994**	26276	52553	105104
1948	38417	76835	153670	**1995**	27387	54775	109548
1949	38170	76343	152684	**1996**	27878	55758	111514
1950	37837	75677	151353	**1997**	27311	54623	109244
1951	37907	75817	151633	**1998**	26900	53802	107601
1952	37933	75869	151737	**1999**	26480	52962	105922
1953	37953	75908	151814	**2000**	24233	48468	96933
1954	37599	75200	150399	**2001**	22426	44853	89704
1955	37755	75512	151023	**2002**	21164	42330	84659
1956	37813	75628	151255	**2003**	22233	44468	88935
1957	35923	71849	143696	**2004**	25509	51021	102040
1958	34622	69246	138490	**2005**	28242	56486	112970
1959	33581	67164	134328	**2006**	30315	60633	121264
1960	32498	64998	129994	**2007**	31649	63302	126600
				2007 Depletion	**0.79**	**0.79**	**0.79**

Table 11. Forecasts of stock size, catch, and depletion for 2007-2018.

Year	Total Catch (mt)	Spawning Biomass	95% CI	Depletion	95% CI
2007	2,913	63,302	41,027 - 85,577	0.79	0.58 - 1.00
2008	2,913	64,214	40,896 - 87,532	0.80	0.58 - 1.02
2009	11,267	65,625	41,066 - 90,184	0.82	0.58 - 1.05
2010	10,112	59,139	37,073 - 81,205	0.74	0.52 - 0.95
2011	9,109	52,993	33,077 - 72,909	0.66	0.46 - 0.86
2012	8,241	47,804	29,517 - 66,091	0.60	0.41 - 0.78
2013	7,518	43,686	26,396 - 60,976	0.54	0.36 - 0.73
2014	6,950	40,517	23,745 - 57,289	0.50	0.32 - 0.69
2015	6,523	38,125	21,597 - 54,653	0.47	0.29 - 0.66
2016	6,207	36,341	19,938 - 52,744	0.45	0.27 - 0.64
2017	5,975	35,015	18,697 - 51,333	0.44	0.25 - 0.62
2018	5,804	34,026	17,785 - 50,267	0.42	0.24 - 0.61

Table 12. Decision table showing the consequences of management action given a state of nature. States of nature include the base model, a model with low historical catches and low natural mortality, and a model with high historical catches and high natural mortality. These states of nature are bounding cases for depletion and Bo. Management actions consist of harvesting the optimum yield (OY) estimated from models that assume each state of nature.

			State of Nature					
			Model A Catch = 1/2x Base Model M=0.106 female, 0.214 male		**Base Model M=0.166 female, 0.274 male**		**Model B Catch = 2x Base Model M=0.246 female, 0.354 male**	
Management action	Year	Total Catch (mt)	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
2009-2018 catch = OY estimated from Model A	2007	1,457	21,680	0.65	63,302	0.79	561,030	0.94
	2008	1,457	22,833	0.68	65,462	0.82	547,141	0.92
	2009	2,668	24,091	0.72	68,087	0.85	542,726	0.91
	2010	2,639	23,875	0.71	68,912	0.86	538,509	0.90
	2011	2,574	23,144	0.69	68,694	0.86	533,054	0.89
	2012	2,476	22,163	0.66	68,155	0.85	531,780	0.89
	2013	2,357	21,095	0.63	67,575	0.84	534,153	0.90
	2014	2,233	20,029	0.60	67,028	0.83	538,438	0.90
	2015	2,115	19,023	0.57	66,559	0.83	543,600	0.91
	2016	2,009	18,107	0.54	66,191	0.82	549,022	0.92
	2017	1,915	17,296	0.52	65,928	0.82	554,317	0.93
	2018	1,834	16,590	0.50	65,765	0.82	559,257	0.94
2009-2018 catch = OY estimated from base model	2007	2,913	21,680	0.65	63,302	0.79	561,030	0.94
	2008	2,913	21,549	0.65	64,214	0.80	545,940	0.92
	2009	11,267	21,488	0.64	65,625	0.82	540,449	0.91
	2010	10,112	13,629	0.41	59,139	0.74	529,402	0.89
	2011	9,109	6,454	0.19	52,993	0.66	518,869	0.87
	2012	8,241	455	0.01	47,804	0.60	514,013	0.86
	2013	7,518	997	0.03	43,686	0.54	514,014	0.86
	2014	6,950	0	0.00	40,517	0.50	516,846	0.87
	2015	6,523	0	0.00	38,125	0.47	521,202	0.87
	2016	6,207	0	0.00	36,341	0.45	526,247	0.88
	2017	5,975	0	0.00	35,015	0.44	531,435	0.89
	2018	5,804	0	0.00	34,026	0.42	536,427	0.90
2009-2018 catch = OY estimated from Model B	2007	5,826	21,680	0.65	63,302	0.79	561,030	0.94
	2008	5,826	18,981	0.57	61,716	0.77	543,536	0.91
	2009	142,422	16,310	0.49	60,707	0.76	535,893	0.90
	2010	110,290	0	0.00	0	0.00	417,209	0.70
	2011	89,743	0	0.00	0	0.00	338,487	0.57
	2012	77,015	0	0.00	0	0.00	291,344	0.49
	2013	69,569	0	0.00	0	0.00	265,174	0.44
	2014	65,551	0	0.00	0	0.00	251,268	0.42
	2015	63,486	0	0.00	0	0.00	243,887	0.41
	2016	62,382	0	0.00	0	0.00	239,682	0.40
	2017	61,559	0	0.00	0	0.00	236,952	0.40
	2018	60,936	0	0.00	0	0.00	235,059	0.39

Appendix A. Control File for Stock Synthesis 2 Arrowtooth Model

Control file (CTL) for arrowtooth flounder assessent. For SS2 2.0g

Morph and area setup

1 # N growth patterns

1 # N sub morphs

1 # N Areas

1 1 1 1 1 1 1 1 1 # Area for each fleet

1 # rec dist design

0 # rec interaction

0 # Do migration: 0=no migration, 1=for nareas>1 models

0 0 0 # migration matrix

Time block setup

2 # Number of time block designs for time varying parameters

4 # Blocks in design 1

4 # Blocks in design 2

1981 1985 # Block design 1

1986 1990

1991 1995

1996 2006

1961 1970 # Block desin 2

1971 1980

1981 1990

1991 2006

Mortality and growth specifications

0.5 # Fraction female at birth

1000 # Ratio of between to within growth morph variance

-1 # Vector of submorph distribution (-1=normal approx)

0 # Last age for M young

1 # First age for M old

1 # Age for growth Lmin

30 # Age for growth Lmax

0.1 # SD constant added to LAA (0.1 mimics v1.xx for compatibility only)

0 # Variability about growth: 0=CV~f(LAA) [mimic v1.xx], 1=CV~f(A), 2=SD~f(LAA), 3=SD~f(A)

1 # maturity option: 1=length logistic, 2=age logistic, 3=read maturity at age for each growth pattern

1 # First age allowed to mature

1 # mg parm offset option: 1=direct assignment, 2=each pat. x gender offset from pat. 1 gender 1, 3=offsets as SS2 V1.xx with M old and CV old offset from young values

1 # mg parm adjust method 1=do V1.23 approach, 2=use new logistic approach

-50 # Mortality and growth parameter dev phase

0.01	0.8	0.166	0.166	-1	99	-2	0	0	0	0	0.5	0	0	#	female	M, min
0.01	0.8	0.166	0.166	-1	99	-3	0	0	0	0	0.5	0	0	#	female	M, max
5	25	8	10	-1	99	-2	0	0	0	0	0.5	0	0	#	female	Length at
40	90	70.0	76.82	-1	99	2	0	0	0	0	0.5	0	0	#	female	Length at

0.05	0.25	0.18	0.1402	-1	99	2	0	0	0	0	0.5	0	0	# female von B k
0.05	0.25	0.14	0.1	-1	99	-3	0	0	0	0	0.5	0	0	# female CV young
0.05	0.25	0.08	0.1	-1	99	-3	0	0	0	0	0.5	0	0	# female CV old
0.01	0.8	0.274	0.274	-1	99	-2	0	0	0	0	0.5	0	0	# male M, minage
0.01	0.8	0.274	0.274	-1	99	-3	0	0	0	0	0.5	0	0	# male M, maxage
5	25	8	10	-1	99	-2	0	0	0	0	0.5	0	0	# male Length at min age
30	70	45	48.26	-1	99	2	0	0	0	0	0.5	0	0	# male Length max age
0.05	0.50	0.4	0.3123	-1	99	2	0	0	0	0	0.5	0	0	# male von B k
0.05	0.25	0.21	0.1	-1	99	-3	0	0	0	0	0.5	0	0	# male CV young
0.05	0.25	0.08	0.1	-1	99	-3	0	0	0	0	0.5	0	0	# male CV old
0	0.5	3.78538E-06	3.78538E-06	-1	99	-3	0	0	0	0	0.5	0	0	# female LW scale
0	5	3.24547	3.24547	-1	99	-3	0	0	0	0	0.5	0	0	# female LW exponent
0	50	37.3	37.3	-1	99	-3	0	0	0	0	0.5	0	0	#female maturity inflection
-1	1	-0.5	-0.5	-1	99	-3	0	0	0	0	0.5	0	0	#female maturity slope
0	1	1	1	-1	99	-3	0	0	0	0	0.5	0	0	#eggs/kilo intercept
0	1	0	0	-1	99	-3	0	0	0	0	0.5	0	0	#eggs/kilo slope
0	0.5	3.48474E-06	3.48474E-06	-1	99	-3	0	0	0	0	0.5	0	0	#male L-W scale
0	5	3.25607	3.25607	-1	99	-3	0	0	0	0	0.5	0	0	#male L-W exponent
-4	4	0	1	-1	99	-3	0	0	0	0	0.5	0	0	#recruitment by morph
-4	4	0	1	-1	99	-3	0	0	0	0	0.5	0	0	#recruitment by area

-4	4	0	1	-1	99	-3	0	0	0	0	0.5	0	0	#recruitment by season
-1	2	1	1	-1	99	-3	0	0	1980	1983	0.5	0	0	#cohort growh dev

0 # Custom environmental linkage setup for mg parameters: 0=Read one line apply all, 1=read one line each parameter

1 # Custom block setup for mg parameters: 0=Read one line apply all, 1=read one line each parameter

Lo Hi Init Prior P_type SD Phase

Spawner-recruit parameters

1 # S-R function: 1=B-H w/flat top, 2=Ricker, 3=standard B-H, 4=no steepness or bias adjustment

# Lo	Hi	Init	Prior	Prior	Prior	Param	
# bnd	bnd	value	mean	type	SD	phase	
5	25	12.50	13	-1	50	1	# Ln(R0)
0.2	1	0.902	0.902	-1	0.082	-2	# Steepness w/ diffuse prior
0	2	0.8	0	-1	50	-50	# Sigma R
-5	5	0	0	-1	50	-50	# Environmental link coefficient
-5	5	0	0	-1	50	-50	# Initial equilibrium offset to virgin
0	2	0	1	-1	50	-50	# Autocorrelation placeholder (Future implementation)

0 # index of environmental variable to be used

1 # env target parameter: 1=rec devs, 2=R0, 3=steepness

1 # rec dev type: 0=none, 1=devvector (zero-sum), 2=simple deviations (no sum constraint)

Recruitment residuals

1965	# Start year recruitment residuals
2003	# End year recruitment residuals
-10	# Lower bound
10	# Upper bound
1	# Phase
1960	# first year of full bias correction (linear ramp up from this year minus the plus-age to this year)

Initial F setup by fleet

# Lo	Hi	Init	Prior	P_type	SD	Phase	
0	1	0	0.01	-1	50	-50	# Fleet 1: Mink food
0	1	0	0.01	-1	50	-50	# Fleet 2: Fillet fishery
0	1	0	0.01	-1	50	-50	# trawl discard fishery
0	1	0	0.01	-1	50	-50	# Dummy fleet

Catchability (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

E=Units: 0=numbers, 1=biomass

F=err_type 0=lognormal, >0=T-dist. DF=input value

A B C D E F

0 0 0 0 1 0 # Fleet 1: Mink food

0 0 0 0 1 0 # Fleet 2: Fillet fishery

0 0 0 -1 1 0 # fleet 3: trawl discard fleet

0 0 0 -2 1 0 # fleet 4: dummy fleet

0 0 0 0 1 0 # Survey 1: FRAM slope shelf 2003-2006

0 0 0 0 1 0 # Survey 2: Triennial

0 0 0 0 1 0 # Survey 3: AKC slope survey

0 0 0 0 1 0 # Survey 4: FRAM slope shelf 99-02

0 0 0 2 1 0 # Survey 5: ghost of FRAM slope shelf 2003-2006

Catchability (Q) parameters

# Lo	Hi	Init	Prior	P_type	SD	Phase	
-5	0	-0.528	-1	-1	50	-2	# Ln(Q) ghost of FRAM slope/shelf 2002-2006

Selectivity section

Size-based setup

A=Selex option: 1-24

B=Do_retention: 0=no, 1=yes

C=Male offset to female: 0=no, 1=yes

D=Mirror selex (#)

A B C D

24 0 0 0   # Fleet 1: Mink food

24 0 1 0   # Fleet 2: Fillet

24 0 0 0   # Fleet 3: Discard fishery

5 1 0 2   # Fleet 4: dummy fishery

24 0 1 0   # Survey5: FRAM slope shelf 2003-2006

24 0 1 0   # Survey 6: Triennial.

24 0 1 0   # Survey7: AKC slope

5 0 0 7   # Survey 8 FRAM slope survey

5 0 0 5   # Survey 9 ghost of FRAM slope shelf 2003-2006

Age-based setup

10 0 0 0   # Fleet 1: 10 = flat (0 params)

10 0 0 0   # Fleet 2:

10 0 0 0   # Fleet3

10 0 0 0   # Fleet 4

10 0 0 0   # Survey 5 10 = flat (0 params)

10 0 0 0   # Survey 6 10 = flat (0 params)

10 0 0 0   # Survey7

10 0 0 0   # Survey 8

10 0 0 0   # Survey 9

```
# Selectivity and retention parameters
# Lo    Hi      Init     Prior   Prior   Prior   Param   Env   Use   Dev     Dev     Dev   Block    block
# bnd   bnd     value    mean    type    SD      phase   var   dev   minyr   maxyr   SD    design   switch
# Fleet 1  Mink food size based selectivity (using option 24)
 14     46      30.43    29.5    -1      50      -2      0     0     0       0       0     0        0       # peak
 -6.0   6.0     6.0      6.0     -1      50      -50     0     0     0       0       0     0        0       # width
 -1.0   10.0    4.63     4.0     -1      50      -2      0     0     0       0       0     0        0       # var-ascending
 -5.0   9.0     1.0      1.0     -1      50      -50     0     0     0       0       0     0        0       # var-descending
 -10.0  10.0    -10.0    -10.0   -1      50      -50     0     0     0       0       0     0        0       # initial
 0.0    50.0    50.0     50.0    -1      50      -50     0     0     0       0       0     0        0       # final
# Fleet 2 (Fillet fishery) size based selectivity (using option 24)
 14     80      60.0     60.0    -1      50      -4      0     0     0       0       0     0        0       # peak
 -6.0   6.0     6.0      6.0     -1      50      -50     0     0     0       0       0     0        0       # width
 -1.0   10.0    5.17858  4.0     -1      50      4       0     0     0       0       0     0        0       # var-ascending
 -5.0   9.0     1.0      1.0     -1      50      -50     0     0     0       0       0     0        0       # var-descending
 -10.0  10.0    -10.0    -10.0   -1      50      -50     0     0     0       0       0     0        0       # initial
 0.0    50.0    50.0     50.0    -1      50      -4      0     0     0       0       0     0        0       # final
# Fleet 2 (Fillet Fishery) retention parameters
 #23    70      41.0     27      -1      50      4       0     0     0       0       0     0        0       # Inflection
 #0     10      2.5      1.4     -1      50      4       0     0     0       0       0     0        0       # Slope
 #0.8   1       1.0      1       -1      50      -50     0     0     0       0       0     0        0       # Asymptote
 #-10   10      0        0       -1      50      -50     0     0     0       0       0     0        0       # Male offset on inflection
```

Fleet 2 sex offset (Fillet fishery) size based selectivity (using option 24)

14	80	30.0	29.5	-1	50	-4	0	0	0	0	0	0	0	# peak
-3.0	0.0	0.0	6.0	-1	50	-50	0	0	0	0	0	0	0	# width
-3.0	0.0	-.02	4.0	-1	50	4	0	0	0	0	0	0	0	# var-ascending
-3.0	0.0	-.02	1.0	-1	50	4	0	0	0	0	0	0	0	# var-descending

Fleet 3 (discard fishery) size based selectivity (using option 24)

14	80	30	30	-1	50	4	0	0	0	0	0	0	0	# peak
-6.0	4.0	-5.0	-5.0	-1	50	-50	0	0	0	0	0	0	0	# width
-1.0	9.0	5.17858	4.0	-1	50	4	0	0	0	0	0	0	0	# var-ascending
-1.0	9.0	5.0	1.0	-1	50	-3	0	0	0	0	0	0	0	# var-descending
-5.0	9.0	-5.0	-10.0	-1	50	-50	0	0	0	0	0	0	0	# initial
-5.0	9.0	9.0	50.0	-1	50	-2	0	0	0	0	0	0	0	# final

Fleet 3 (Trawl Discard fleet) mirror

# -2	0	-1	44	-1	50	-50	0	0	0	0	0	0	0	# min bin mirror
# -2	0	-1	18	-1	50	-50	0	0	0	0	0	0	0	# max bin mirror

Fleet 4 (ghost of Fleet 2 Fillet fishery)

-2	0	-1	44	-1	50	-50	0	0	0	0	0	0	0	# min bin mirror
-2	0	-1	18	-1	50	-50	0	0	0	0	0	0	0	# max bin mirror

Fleet 4 (ghost of Fillet Fishery) retention parameters

23	70	41.0	27	-1	50	-4	0	0	0	0	0	0	0	# Inflection
0	10	2.5	1.4	-1	50	-4	0	0	0	0	0	0	0	# Slope
0.8	1	1.0	1	-1	50	-50	0	0	0	0	0	0	0	# Asymptote

```
-10     10      0       0       -1      50      -50     0       0       0       0       0       0       0       # Male offset on inflection
# Fleet 5 (FRAM Slope Shelf 2003-2006) size based selectivity (using option 24)
14      70      32.0    29.5    -1      50      4       0       0       0       0       0       0       0       # peak
-6.0    6.0     6.0     6.0     -1      50      -50     0       0       0       0       0       0       0       # width
-1.0    10.0    3.58    4.0     -1      50      4       0       0       0       0       0       0       0       # var-ascending
-5.0    9.0     1.0     1.0     -1      50      -50     0       0       0       0       0       0       0       # var-descending
-10.0   10.0    -10.0   -10.0   -1      50      -50     0       0       0       0       0       0       0       # initial
0.0     50.0    50.0    50.0    -1      50      -4      0       0       0       0       0       0       0       # final
# Fleet 5 sex offset (FRAM Slope Shelf 2003-2006) size based selectivity (using option 24)
14      80      30.0    29.5    -1      50      -4      0       0       0       0       0       0       0       # peak
-3.0    0.0     0.0     6.0     -1      50      -50     0       0       0       0       0       0       0       # width
-3.0    0.0     -.02    4.0     -1      50      4       0       0       0       0       0       0       0       # var-ascending
-3.0    0.0     -.02    1.0     -1      50      4       0       0       0       0       0       0       0       # var-descending
# Fleet 6 Triennial size based selectivity (using option 24)
14      80      30      30      -1      50      4       0       0       0       0       0       0       0       # peak
-6.0    4.0     -5.0    -5.0    -1      50      -50     0       0       0       0       0       0       0       # width
-1.0    9.0     5.17858 4.0     -1      50      4       0       0       0       0       0       0       0       # var-ascending
-1.0    9.0     5.0     1.0     -1      50      -3      0       0       0       0       0       0       0       # var-descending
-5.0    9.0     -5.0    -10.0   -1      50      -50     0       0       0       0       0       0       0       # initial
-5.0    9.0     9.0     50.0    -1      50      -2      0       0       0       0       0       0       0       # final
# Fleet 6 sex offset (Triennial) size based selectivity (using option 24)
14      80      30.0    29.5    -1      50      -4      0       0       0       0       0       0       0       # peak
```

-3.0	0.0	0.0	6.0	-1	50	-50	0	0	0	0	0	0	0	# width
-3.0	0.0	-.02	4.0	-1	50	4	0	0	0	0	0	0	0	# var-ascending
-3.0	0.0	-.02	1.0	-1	50	4	0	0	0	0	0	0	0	# var-descending

Survey 7 AKC slope, size based selectivity (using option 24)

14	80	30	30	-1	50	4	0	0	0	0	0	0	0	# peak
-6.0	4.0	-5.0	-5.0	-1	50	-50	0	0	0	0	0	0	0	# width
-1.0	9.0	5.17858	4.0	-1	50	4	0	0	0	0	0	0	0	# var-ascending
-1.0	9.0	5.0	1.0	-1	50	-3	0	0	0	0	0	0	0	# var-descending
-5.0	9.0	-5.0	-10.0	-1	50	-50	0	0	0	0	0	0	0	# initial
-5.0	9.0	9.0	50.0	-1	50	-2	0	0	0	0	0	0	0	# final

Fleet 7 sex offset (AKC Slope) size based selectivity (using option 24)

14	80	30.0	29.5	-1	50	-4	0	0	0	0	0	0	0	# peak
-3.0	0.0	0.0	6.0	-1	50	-50	0	0	0	0	0	0	0	# width
-3.0	0.0	-.02	4.0	-1	50	4	0	0	0	0	0	0	0	# var-ascending
-3.0	0.0	-.02	1.0	-1	50	4	0	0	0	0	0	0	0	# var-descending

Fleet 8 (FRAM Slope mirrored to AKC slope)

-2	0	-1	44	-1	50	-50	0	0	0	0	0	0	0	# min bin mirror
-2	0	-1	18	-1	50	-50	0	0	0	0	0	0	0	# max bin mirror

Fleet 9 (ghost of fleet 5 FRAM slope shefl 2003-2006 survey)

-2	0	-1	44	-1	50	-50	0	0	0	0	0	0	0	# min bin mirror
-2	0	-1	18	-1	50	-50	0	0	0	0	0	0	0	# max bin mirror

1 # Selex parm adjust method 1=do V1.23 approach, 2=use new logistic approach

0 # Selex environmental setup: 0=Read one line apply all, 1=read one line each parameter

1 # Selex block setup: 0=Read one line apply all, 1=read one line each parameter

Lo Hi Init Prior P_type SD Phase

-50 # Phase for selex parameter deviations

Likelihood related quantities

variance/sample size adjustment by fleet

0 0 0 0 0 0.358 0.07 0 0 # constant added to survey CV

0 0 0 0 0 0 0 0 0 # constant added to discard SD

0 0 0 0 0 0 0 0 0 # constant added to body weight SD

1 5.44 1.2 1 1 1 1.16 1 1 # multiplicative scalar for length comps

1 1 1 1 1 1 1 1 1 # multiplicative scalar for agecomps

1 1 1 1 1 1 1 1 1 # multiplicative scalar for length at age obs

1000 # df discard

1000 # df weight

1 # Max number of lambda phases: read this number of values for each component below

0 # SD offset (CPUE, discard, mean body weight, recruitment devs): 0=omit log(s) term, 1=include

Lambda values by fleet

0 0 0 0 1 1 1 1 0 # CPUE lambdas

0 0 0 0 0 0 0 0 0 # Discard lambdas

0 # Mean body weight data lambda

0 1 1 0 1 1 1 0 0 # Length frequency lambdas

0 1 0 0 1 0 0 0 0 # Age frequency lambdas

0 0 0 0 0 0 0 0 0 #size at age lambda

0 # Initial F lambda

1 # Recruitment residual lambda

1 # Parameter prior lambda

1 # Parameter deviation lambda

10 # crashpen lambda

1.2 # max F threshold

999 # end file marker

Appendix B. Data File for Stock Synthesis 2 Arrowtooth Model

DAT file for Arrowtooth flounder assessement

Global model specifications

1916 # Start year

2006 # End year

1 # Number of seasons/year

12 # Number of months/season(vectory, by season)

1 # Spawning occurs at beginning of season

4 # Number of fishing fleets

5 # Number of surveys

Mink_food_fishery%Fillet_fishery%Trawl_fishery_excluding_arrowtooth_target%GhostOfFillet%FRAMslope_shelf%Triennial%AKC_slope_survey%FRAM_slope_survey%GhostOfFRAMslope_shelf # Fleet names separated by %

Fleet timing (proportion of season)

0.5417 # Mink food fishery (middle of july)

0.5417 # Fillet Fishery

0.5417 # Trawl_fishery_excluding_arrowtooth_target

0.5417 # Dummy fishery

0.5417 # FRAM slope shelf 2003-2006

0.5417 # triennial survey 1980-2004

0.5417 # AKC slope survey

0.5417 # FRAM slope survey 1999-2002

0.5417 # ghost of FRAM shelf slope survey 2003-2006

2	#	Number of genders (1/2)			
35	#	Accumulator age			
###	Catch	section	###		

#Initial equ catch (landings + discard in MT, by fishing fleet)

0	#	mink food fishery
0	#	fillet fishery
0	#	trawl discard fishery
0	#	DUMMY

#Minkfood	Fillet	TrawlDiscard	GhostofFillet	#	Year
0	0	0	0	#	1916
0	0	0	0	#	1917
0	0	0	0	#	1918
0	0	0	0	#	1919
0	0	0	0	#	1920
0	0	0	0	#	1921
0	0	0	0	#	1922
0	0	0	0	#	1923
0	0	0	0	#	1924
0	0	0	0	#	1925
0	0	0	0	#	1926
0	0	0	0	#	1927

0.019	0	0	0	#	1928
5.5877	0	0	0	#	1929
1.75	0	0	0	#	1930
1.78	0	0	0	#	1931
12.39	0	0	0	#	1932
7.82	0	0	0	#	1933
5.18	0	0	0	#	1934
10.36	0	0	0	#	1935
33.7	0	0	0	#	1936
147.8	0	0	0	#	1937
7.45	0	0	0	#	1938
453.18	0	0	0	#	1939
640.54	0	0	0	#	1940
846.25	0	0	0	#	1941
411.863	0	0	0	#	1942
1716.88	0	0	0	#	1943
407.2592	0	0	0	#	1944
113.436	0	0	0	#	1945
166.85	0	0	0	#	1946
425.41	0	0	0	#	1947
936.17	0	0	0	#	1948
1165.5	0	0	0	#	1949

202	0	0	0	#	1950
345	0	0	0	#	1951
390	0	0	0	#	1952
1322	0	0	0	#	1953
80	0	0	0	#	1954
339	0	0	0	#	1955
3674	0	1449	0	#	1956
2137	0	1578	0	#	1957
1595	0	1598	0	#	1958
1878	0	1611	0	#	1959
1260	0	1738	0	#	1960
1920	0	1638	0	#	1961
1487	0	1748	0	#	1962
1225	0	1804	0	#	1963
1649	0	1669	0	#	1964
1085	0	1677	0	#	1965
1096	0	1752	0	#	1966
1088	0	1512	0	#	1967
598	0	1684	0	#	1968
486	0	1873	0	#	1969
212	0	1957	0	#	1970
256	0	1921	0	#	1971

144	0	2460	0	#	1972
662	0	2398	0	#	1973
549	0	2361	0	#	1974
145	0	2613	0	#	1975
286	0	2779	0	#	1976
202	0	2383	0	#	1977
515	0	2735	0	#	1978
876	0	3231	0	#	1979
609	0	2590	0	#	1980
0	1158	2193	0	#	1981
0	2531	2543	0	#	1982
0	2235	2373	0	#	1983
0	2561	2190	0	#	1984
0	2884	2344	0	#	1985
0	2398	1939	0	#	1986
0	3038	2154	0	#	1987
0	2090	1934	0	#	1988
0	3826	2008	0	#	1989
0	6299	1503	0	#	1990
0	5373	1660	0	#	1991
0	3896	1484	0	#	1992
0	2963	1383	0	#	1993

0	3543	939	0	#	1994
0	2515	1079	0	#	1995
0	2347	1223	0	#	1996
0	2493	1076	0	#	1997
0	3413	671	0	#	1998
0	5939	639	0	#	1999
0	3941	582	0	#	2000
0	3124	495	0	#	2001
0	2709	609	0	#	2002
0	2870	542	0	#	2003
0	2852	465	0	#	2004
0	2562	453	0	#	2005
0	2012	395	0	#	2006

Abundance indices

21 # Total number of observations (all fleets)

#FRAM slope 1999-2002 survey series N=4 doubled variance estimates

#Year	Seas	Type	Value	s(log space)
1999	1	8	8217.338721	0.336
2000	1	8	9207.751228	0.345
2001	1	8	6361.744275	0.311
2002	1	8	7209.33129	0.390

AKC slope survey series N=4

#Year	Seas	Type	Value		s(log space)		
1997	1	7	3294.65		0.269		
1999	1	7	4164.47		0.187		
2000	1	7	4839.46		0.242		
2001	1	7	6738.45		0.312		
#	triennial	survey	series	(N=9)			
#Year	Seas	Type	Value		s(log space)		
1980	1	6	3000.51277		0.395		
1983	1	6	2274.083408		0.323		
1986	1	6	3829.542799		0.290		
1989	1	6	7058.615703		0.368		
1992	1	6	1828.467382		0.321		
1995	1	6	1848.889435		0.308		
1998	1	6	4430.744089		0.361		
2001	1	6	6967.007377		0.386		
2004	1	6	20640.23624		0.434		
#	FRAM slope/shelf 2003-2006			triennial	survey	series	N=4
#Year	Seas	Type	Value		s(log space)		
2003	1	5	23976.05642		0.252		
2004	1	5	19570.53597		0.270		
2005	1	5	22602.87529		0.283		
2006	1	5	22551.34203		0.295		

Discard section

Discard observation setup

2 # # Type: 1 = biomass (mt),2 = fraction (D/(D+R)) by weight

0 # # Total number of discard observations all fleets and years

Mean body weight observations

0 # Total number of mean body weight observations

Partition: 1=discarded catch, 2=retained catch, 0=whole catch (R+D)

Year Seas Type Partition Value (kg) CV

-1 # Minimum proportion for compressing tails of observed compositional data

0.0001 # Constant added to expected frequencies

35 # Number of length bins for data inputs

Lower edge of length bins by bin

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 68 70 72 74 76 78
80

39 # Total number of length observations all fleets and years

PacFIN length comps, for Fillet Fishery (2)

#Year Seas Type Gender Partition 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 64 66
68 70 72 74 76 78 80 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 68 70 72 74 76 78 80

1986 1 2 3 0 19 0 0 0 0 0 0 0 0 0 0.322616759
0 0.025307179 0.012272448 0.298357456 0.675884307 1.595683423 2.295722691 2.581804251 5.372000631
5.163591603 5.068094339 6.72840564 5.661255294 3.621801964 3.271065636 2.830514118 2.615472684
5.76127423 4.077296762 3.044514377 1.394015205 0.920584871 0.133014616 0 0.458691577 0 0
0 0 0 0 0 0 0 0 0 0.125568619 0.020771949 1.485799391 8.041438803

10.20326425 7.674716445 5.580874907 1.626333031 0.38378309 0.210266842 0.024443274 0.370880576
0.322616759 0 0 0 0 0 0 0 0 0 0 0

1987 1 2 3 0 22 0 0 0 0 0 0 0 0 0 0
0.04082794 0.161402645 0.878942621 1.059706086 0.315772284 1.146471244 0.776573212 1.77393455
5.000399571 7.325055211 6.702977254 8.39143266 7.00117646 4.771080512 4.558779567 4.688775947
5.452280659 5.91675382 3.643371776 3.537936515 2.268747448 0.890902013 0.486783032 0.27587296
0.042782932 0 0 0 0 0 0 0 0 0 0.059678232 0.197472171
0.116506424 0.653338875 2.147800628 6.20253725 6.798449764 4.68146736 1.67557257 0.16108504
0.007409132 0 0.007409132 0 0.155566452 0 0 0 0 0.02696805 0 0 0
0 0

1988 1 2 3 0 16 0 0 0 0 0 0 0 0 0 0 0
0.153167451 0.726127102 2.601320277 3.136700346 2.024889819 3.374979039 4.065715013 3.177230053
4.225249052 7.434085877 5.055246023 10.24106067 5.103428035 4.98476194 2.975264193 3.5086012 2.626494831
2.671127549 1.422517468 1.005641947 0.969591435 0.053112999 0.25046684 0.503097852 0 0 0
0 0 0 0 0 0 0.312506271 0.949369796 1.133274107 1.27107327 0.85981243
2.204866624 6.065492046 8.578437095 4.237931404 1.884374107 0 0.009398938 0.203586898 0 0
0 0 0 0 0 0 0 0 0 0 0

1989 1 2 3 0 17 0 0 0 0 0 0 0 0 0 0
0.066349481 0.506965102 0.625842727 0.986177827 2.946424791 2.706703683 2.914534887 4.647125198
3.907806278 3.075782745 4.512296533 7.208496566 7.458223093 6.900850872 7.515608016 4.876592374
2.623766566 3.511471685 2.369390897 1.120113926 2.533129133 1.195983426 0.677393669 0.008557149
0.668260811 0 0 0 0 0 0 0 0 0.030575486 0 0.648291935
0.629623584 0.51874709 1.37481249 4.920497436 3.477033055 4.812859306 3.080746973 2.202285456
1.690497145 0.261175534 0.133618873 0.527934044 0.127454158 0 0 0 0 0 0 0
0 0 0

1990 1 2 3 0 19 0 0 0 0 0 0 0.077139143 0 0 0
0 0.427395494 0.275974436 0.206978821 1.247724245 0.902746573 1.110190108 1.629809736 0.937580372
2.444509619 3.211153719 5.806631671 9.497875649 8.018430786 10.10429932 9.096641933 13.17817897
5.445159977 6.518372443 4.156243029 3.658942563 2.5790598 1.188437116 1.869282367 0.252529733 0 0
0 0 0 0 0 0 0 0 0 0.35345183 0.202310425 0.482811548 0.054319557
1.232161044 1.722872977 0.384846355 1.212098494 0.482329685 0.031510455 0 0 0 0 0
0 0 0 0 0 0 0 0 0

1991 1 2 3 0 39 0 0 0 0 0 0 0 0 0 0
0.045810072 0.021473169 0.110356576 0.735089711 1.04815544 1.844604892 2.570694259 1.940707083
2.268237654 2.72566344 3.049630722 4.29332413 5.608405149 6.325676016 10.24680882 8.107200492
8.062021006 7.978898931 7.800357422 7.828386597 3.715440608 2.945646761 3.693295723 0.621665523
1.155825156 0 0 0 0 0 0 0 0 0 0.047128644 0.038873001 0.064893191
0.292289856 1.250033854 0.755574252 0.571823161 0.536512278 1.05301455 0.455424761 0.191057104 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0

1992 1 2 3 0 30 0 0 0 0 0 0 0 0 0 0.036260217
0.149004015 0.426619352 0.802435492 1.558846527 2.028853598 4.081318771 3.207414047 3.65046076
3.739915947 2.948776332 7.589894148 5.580641473 4.973854065 4.596625518 4.744902061 3.417802797

6.109995022 4.989397679 5.194474731 5.172544503 5.353063524 3.118598088 2.834724744 2.895945578
1.023808656 0 0 0 0 0 0 0 0 0 0 0.144051333 0.540750324
0.397089351 1.643086104 0.962612959 0.984006544 1.597399252 0.923824561 0.930713263 0.862267214
0.434864683 0.002472048 0.145040868 0.205643853 0 0 0 0 0 0 0 0 0
0 0

1993 1 2 3 0 18 0 0 0 0 0 0 0 0 0 0 0
0.120541008 1.443109871 2.015751376 2.219839668 3.339645655 4.264215743 2.78564742 2.28240279
4.392902911 5.168225859 6.373804988 4.735481468 6.188322231 4.693123221 8.357412507 5.90378986
5.624048093 4.559861429 3.248561006 5.550348706 0.696954501 0.875549558 1.1876941 0.296542733 0 0
0 0 0 0 0 0 0 0 0.495722747 1.004042965 1.48552686 0.309456996
1.553824386 2.331882905 1.582834396 3.608046686 1.23436517 0 0.015678541 0 0 0 0
0 0 0 0 0.054841647 0 0 0 0 0

1994 1 2 3 0 20 0 0 0 0 0 0 0 0 0 0 0
0 0.218614185 0.002718026 1.143978639 0.564383815 1.006692834 0.791067797 2.510136766 2.022182896
3.455201756 6.394437307 7.592582315 7.418545511 11.67137569 7.752478258 10.99729798 4.655522774
5.328704315 5.667498291 2.874656302 2.340645257 1.500045434 0.571182853 1.067047943 0 0 0
0 0 0 0 0 0 0 0.010818345 0.053899386 0.092532896 0.069331137 0.495015122
2.5829435 2.27495876 2.0726312 3.199947436 0.997631732 0.046404899 0.009459332 0.281339909 0 0
0.001359013 0.048463335 0 0.216267054 0 0 0 0 0 0

1995 1 2 3 0 22 0 0 0 0 0 0 0 0 0 0 0
0.052409197 0.144987733 1.343806504 0.762845874 1.698978538 1.157478853 1.590307847 2.692887857
3.848747616 3.467067798 4.604106466 8.270180435 10.32813244 9.003724736 6.46283848 8.461492752
4.834875262 4.666510292 2.918954364 2.118883319 2.666429946 2.279582179 0.112039025 0.211906224 0
0 0 0 0 0 0 0 0 0 0 0.109408774 0.563591849 0.711441845
1.293739273 1.79248128 2.425403671 6.045998726 2.366200514 0.829434776 0.163125555 0 0 0
0 0 0 0 0 0 0 0 0 0 0

1996 1 2 3 0 18 0 0 0 0 0 0 0 0 0 0
0.065082017 0 0 0.067531574 0.147625401 0.457579074 1.553762716 2.148166462 2.511448937
4.181873696 5.856340714 7.285692066 5.566515889 6.212585576 8.105695085 9.108004214 6.755656137
5.242809344 4.657837532 2.997638581 1.549894062 1.145011279 1.760178744 0.888558084 0.208082505 0
0 0 0 0 0 0 0 0 0 0 0.016599964 0.029553162 0.109138054
0.801220185 1.258282439 3.674179766 7.613812567 5.736442239 1.616967195 0.439852445 0.165300278 0
0 0 0 0.065082017 0 0 0 0 0 0 0 0

1997 1 2 3 0 17 0 0 0 0 0 0 0 0 0 0.11389769
0.34169307 0.941911868 1.298890337 0.7294808 0.460998219 0.966025611 1.087008557 1.709785299 2.6274202445
3.362135486 4.92701694 8.72853692 8.129680029 9.146090592 9.762833553 5.969574696 8.201601417
4.738641084 6.73898347 2.84855068 1.638130852 1.833649295 0.943486698 0.276221123 0.286800832 0
0 0 0 0 0 0 0 0 0.333441753 0.189463731 0 0.033367798 0.117982809
0.875914095 1.040864266 2.440681681 2.838348035 2.091787792 0.948417682 0.284703685 0.26826991
0.385488293 0 0.26826991 0 0 0 0 0 0.073953196 0 0 0

1998 1 2 3 0 20 0 0 0 0 0 0 0 0 0 0
0.013402054 0.432231191 0.157347256 0.869535844 1.283043091 1.074944945 1.130746458 1.472945285
2.146539186 1.865731432 4.307088873 9.356012315 12.85092967 10.53244845 10.68617851 4.803797558

8.473846915 5.925263557 5.687408135 4.009764225 1.91415597 1.081860811 0.450032289 0.314116437
0.184311978 0 0 0 0 0 0 0 0 0 0.021177626 0.325524544 0.062930969
0.317748972 0.298677859 0.551278341 0.868920379 1.210920079 2.764675035 1.053578751 0.742344585
0.515151775 0.064397384 0.044747817 0 0 0 0.044747817 0 0.089495634 0 0 0
0 0 0

1999 1 2 3 0 22 0 0 0 0 0 0 0 0 0 0 0
0 0.039287372 0.182179305 0.511233198 0.762995824 1.849873152 1.748772215 2.927781129 5.203632462
6.374103442 15.13088457 19.02831179 13.74626514 8.380226398 3.12930524 5.243469995 2.116648711
2.054874882 0.54195536 1.019712631 0.713385604 0.370925696 0.012611044 0.079469309 0 0 0
0 0 0 0 0 0 0 0 0 0.404128667 0.75925025 0.813876009 0.896009919
1.260798256 2.446186305 1.265944054 0.793929648 0.085133827 0 0.101174086 0 0 0 0
0.005664518 0 0 0 0 0 0 0

2000 1 2 3 0 21 0 0 0 0 0 0 0 0 0 0 0
0.06132857 0.032148937 0.426121926 0.769317967 1.658592324 2.40525405 2.303230123 3.429839938
3.52300296 5.634090927 8.818620789 12.77707677 11.68281011 12.00510344 6.008881189 7.027155505
2.751297323 1.681604699 1.326868858 0.128662786 0.413768411 0.051768256 0 0 0 0 0
0 0 0 0 0 0 0 0.06132857 0.12265714 1.098766498 1.991544407 1.562565467
2.594075068 2.861995462 1.958050783 1.679720396 0.564199469 0.060232108 0.01199463 0.0733232 0.08531783
0.01199463 0.34568847 0 0 0 0 0 0 0 0 0

2001 1 2 3 0 16 0 0 0 0 0 0 0 0 0 0 0
0 0.243440871 0 0.046270524 0.710795285 1.285302055 2.033338656 3.905218546 5.536519365
7.351671769 7.609607195 11.64427906 15.60933146 11.6832685 6.010674528 5.631727976 3.94052159
2.224883547 1.484714461 0.446787144 0.13088122 0.421910597 0.155193589 0 0 0 0 0
0 0 0 0 0 0 0 0 0.352363936 0.382582961 1.605957304 0.735699904
1.553723726 2.515952732 3.621492705 0.973079361 0 0 0.152809436 0 0 0 0 0
0 0 0 0 0 0 0

2002 1 2 3 0 10 0 0 0 0 0 0 0 0 0 0
0.252961317 0.479153403 2.161650234 5.358220303 4.009750129 1.608266475 0.627540872 0.296041174
1.244645544 1.158404865 1.058944593 3.776518344 7.841454729 11.1345761 7.359777494 6.733550476
6.044573197 4.221991243 6.820533288 4.444778423 2.812538505 3.128968193 3.033572857 2.070440824
1.382578296 0 0 0 0 0 0 0 0 0 0 0.493664514 1.950876603
1.216734895 0.219700998 0.317874091 1.514648527 1.196177422 0.340835557 3.023884942 0.664171571 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0

2003 1 2 3 0 10 0 0 0 0 0 0 0 0 0 0 0
0.282180713 0.738255536 2.195909199 3.437880587 6.926809335 5.064438788 2.213913547 1.573606237
2.693640535 3.13086208 2.586257476 3.178294313 4.182222188 3.644540201 4.995665441 5.78552467
4.974816113 5.513657241 2.173647351 2.705621223 0.929865569 1.195317034 0.220350205 0 0 0
0 0 0 0 0 0 0 0.231839776 0.499794124 3.705258924 7.34754253 2.642499318
3.026651658 1.503611742 4.363467386 3.095933984 2.375579317 0.265451464 0.10902883 0 0 0
0 0 0 0.490065365 0 0 0 0 0 0 0

2004 1 2 3 0 6 0 0 0 0 0 0 0 0 0 0
0.292872789 0.136544996 0.292872789 1.500950647 1.189764144 2.658388144 6.68669405 6.107590601

3.640054772 3.591085707 4.050179227 9.236895378 5.510675258 12.1344797 12.2324418 8.504518285
4.185182962 3.718723539 2.839218625 0.654197792 0.038745028 0 0 0 0 0 0 0
0 0 0 0 0 0 1.24800224 0.136544996 0.194910692 1.806564589 1.338563905
0.576707736 0.038745028 1.426505464 0.156327793 0.997087679 2.877963653 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0

2005 1 2 3 0 6 0 0 0 0 0 0 0 0 0 0 0
0.220558216 0 0 0.066515461 0.441116431 2.062808156 1.842249941 10.53560889 5.580461821
10.44187322 6.377648408 2.23988252 16.9338386 0.062401388 5.659780744 7.368999763 9.211249704
3.684499882 3.942333578 9.211249704 1.842249941 0 0 1.842249941 0 0 0 0 0
0 0 0 0 0 0 0.088537182 0 0.277371049 0.066515461 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

2006 1 2 3 0 21 0 0 0 0 0 0 0 0 0 0
0.405603371 0.405603371 0.276719532 1.427655039 2.279924462 4.18559686 6.090908321 6.048396709
7.361535975 12.00558713 7.944274093 5.891192062 6.52813737 7.835836661 3.889627335 3.110899123
2.239342875 2.554179011 1.33843839 0.924504416 0.862025132 0.631021622 0.597448424 0.150296496
0.103132339 0 0 0 0 0 0 0 0 0 0 0.405603371 0.470769816
0.880846819 2.456256379 4.446417172 1.440208541 2.560936284 0.460461931 1.21141175 0.230230965
0.115115483 0 0.115115483 0 0 0 0 0 0 0 0 0 0 0
0.118739884

47.5_155m FRAM slope/shelf 2003-2006

Season Type Gender Partition 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
68 70 72 74 76 78 80 #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 68 70 72 74 76 78 80

2003 1 5 3 0 193 0.00000 0.00000 0.00000 0.00000 0.00095 0.00239 0.00465 0.01209 0.01610 0.01156 0.01365
0.02297 0.01732 0.02705 0.05888 0.07384 0.05025 0.01941 0.00623 0.01060 0.01042 0.02471 0.01932 0.05023 0.03550 0.04110 0.02587 0.02309
0.01995 0.01546 0.01443 0.00488 0.00519 0.00238 0.00021 0.00000 0.00000 0.00000 0.00057 0.00169 0.00202 0.00734 0.01440 0.01520 0.01891
0.04528 0.10221 0.06835 0.01787 0.00937 0.01562 0.01471 0.01044 0.00287 0.00735 0.00490 0.00021 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000

2004 1 5 3 0 170 0.00000 0.00000 0.00000 0.00000 0.00025 0.00063 0.00334 0.00812 0.01365 0.01778 0.01916
0.02390 0.02848 0.02234 0.02737 0.05362 0.08789 0.10403 0.06307 0.03633 0.02542 0.03300 0.02051 0.01501 0.01195 0.00833 0.00394 0.00432
0.00237 0.00078 0.00109 0.00211 0.00000 0.00000 0.00023 0.00000 0.00000 0.00000 0.00000 0.00022 0.00137 0.00429 0.01194 0.01957 0.02902
0.03351 0.06370 0.08832 0.04510 0.01656 0.01034 0.01963 0.00863 0.00481 0.00112 0.00051 0.00000 0.00039 0.00000 0.00039 0.00000 0.00000
0.00077 0.00077 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000

2005 1 5 3 0 217 0.00000 0.00000 0.00000 0.00057 0.00081 0.00000 0.00244 0.00216 0.00371 0.00714 0.01599
0.01769 0.03922 0.03902 0.03354 0.03870 0.04723 0.05457 0.06250 0.04634 0.04368 0.03159 0.03140 0.02106 0.01646 0.00879 0.00869 0.00667
0.00348 0.00346 0.00268 0.00223 0.00020 0.00094 0.00000 0.00000 0.00000 0.00000 0.00017 0.00028 0.00019 0.00245 0.00595 0.00859 0.02464
0.04868 0.06099 0.08506 0.08093 0.03154 0.01624 0.01987 0.01250 0.00384 0.00148 0.00192 0.00110 0.00054 0.00012 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000

2006	1	5	3	0	189	0.00000	0.00000	0.00000	0.00000	0.00021	0.00202	0.00595	0.00642	0.00431	0.00279	0.00195
0.00586	0.01495	0.02304	0.03215	0.06161	0.04632	0.05574	0.06232	0.06300	0.04970	0.03842	0.02958	0.03063	0.01860	0.00879	0.00963	0.01452
0.02356	0.02239	0.01856	0.01442	0.00783	0.00041	0.00196	0.00000	0.00000	0.00000	0.00067	0.00041	0.00249	0.00763	0.00694	0.00454	0.00516
0.01427	0.03262	0.05496	0.06885	0.04622	0.03678	0.02225	0.00949	0.00354	0.00053	0.00170	0.00038	0.00026	0.00033	0.00037	0.00000	0.00000
0.00000	0.00196	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									
# AKC Triennial Shelf			#Season	Type	Gender	Partition	#Nsamp									
12.00000	14.00000	16.00000	18.00000	20.00000	22.00000	24.00000	26.00000	28.00000	30.00000	32.00000	34.00000	36.00000	38.00000	40.00000	42.00000	44.00000
46.00000	48.00000	50.00000	52.00000	54.00000	56.00000	58.00000	60.00000	62.00000	64.00000	66.00000	68.00000	70.00000	72.00000	74.00000	76.00000	78.00000
80.00000	12.00000	14.00000	16.00000	18.00000	20.00000	22.00000	24.00000	26.00000	28.00000	30.00000	32.00000	34.00000	36.00000	38.00000	40.00000	42.00000
44.00000	46.00000	48.00000	50.00000	52.00000	54.00000	56.00000	58.00000	60.00000	62.00000	64.00000	66.00000	68.00000	70.00000	72.00000	74.00000	76.00000
78.00000	80.00000															
1980	1	6	3	0	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.07458	0.07458	0.09400
0.82989	0.81587	0.34308	1.55078	4.12381	4.09550	5.74692	4.07405	3.69743	4.99590	7.81868	3.50362	4.02737	2.64826	1.13814	1.55120	0.16335
0.00000	0.00000	0.20041	0.00000	0.20041	0.00000	0.22643	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.06648	0.26662	0.48899	0.45240
0.59180	1.25901	2.93299	5.46539	6.75748	9.82460	10.08823	6.23652	1.29973	0.54234	0.47443	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.05830	0.00000	0.20041	0.00000	0.00000	0.00000	0.00000	0.00000									
1983	1	6	3	0	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.47251	0.00000	0.00000
0.00000	0.47251	0.00000	3.08636	7.00713	5.33830	5.51925	3.26731	3.85042	4.68484	2.72445	2.07099	0.94502	0.65346	0.65346	0.47251	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.47251	0.00000
0.00000	0.65346	1.12597	5.22770	12.88829	19.71447	12.23483	5.99176	0.00000	0.00000	0.00000	0.47251	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									
1986	1	6	3	0	136	0.06034	0.39581	0.48353	3.09622	3.24257	1.59127	0.67598	1.36585	3.90444	3.47887	4.43571
1.14397	1.30838	1.80649	1.33514	0.97722	2.07644	1.46898	2.61308	2.91633	2.22331	1.93506	1.75031	1.40909	1.38227	0.88753	0.80749	0.47243
0.30984	0.17033	0.08082	0.18215	0.07319	0.01119	0.00695	0.03017	0.39755	0.43144	1.53021	2.63817	1.43360	0.94094	3.35349	5.79978	6.12526
1.32671	1.10854	1.90055	2.37461	5.91249	6.01531	5.45847	2.11486	0.76647	0.06808	0.17427	0.00000	0.00000	0.00000	0.01667	0.00374	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									
1989	1	6	3	0	211	0.02412	0.06929	0.21711	2.49406	3.93214	0.62384	0.98703	1.62508	1.54089	1.00213	1.73555
2.77009	4.12187	5.01414	4.03221	4.04444	2.15287	1.93604	1.03470	1.10199	1.55902	2.80110	3.41140	2.93127	2.80407	1.56948	0.80145	0.62605
0.47488	0.38922	0.42877	0.15791	0.10565	0.03614	0.00800	0.01112	0.06852	0.32952	5.43043	3.67104	1.34153	1.18009	1.93675	1.34218	1.73591
4.09519	4.79016	4.27136	2.87694	1.46579	1.46457	1.95582	1.95416	1.05223	0.24082	0.07201	0.04102	0.02581	0.02598	0.02158	0.02203	0.00000
0.01022	0.00590	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									
1992	1	6	3	0	210	0.00000	0.00000	0.16014	1.87701	7.06178	5.04729	1.35425	1.17785	2.75460	3.21882	3.12899
1.98295	3.15788	3.28569	2.95474	2.64863	2.99766	1.74117	1.09423	0.97700	0.76040	0.72073	0.48074	0.86916	0.60674	0.32639	0.27876	0.15959
0.18006	0.20734	0.16219	0.01747	0.01758	0.03210	0.00000	0.00000	0.00887	0.09792	2.94816	8.93415	4.40968	1.37963	2.45734	4.11668	3.54654
3.03379	4.90529	4.84985	2.75469	1.52899	1.29020	0.72372	0.75453	0.49070	0.23454	0.00000	0.03937	0.02539	0.03002	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									
1995	1	6	3	0	173	0.00000	0.00000	0.77690	1.41758	1.28133	0.51408	0.20169	0.02797	0.11717	0.09224	0.19920
0.79706	1.72756	3.19873	5.96504	6.28436	5.33020	2.81437	2.25895	2.73798	2.46052	3.04784	3.37417	4.04909	3.38352	3.48706	2.09235	1.71697
0.93572	1.15782	1.19239	0.70409	0.41843	0.26364	0.13070	0.00000	0.00000	0.10059	1.98834	1.89752	0.55901	0.16057	0.01841	0.11543	0.23896

0.95568	3.89615	7.98090	4.59722	2.74044	2.35905	2.96841	2.78511	1.42863	0.70512	0.27242	0.02127	0.06866	0.00431	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

1998	1	6	3	0	259	0.00000	0.00000	0.00000	0.00000	0.00000	0.00363	0.11599	0.05470	0.19746	0.42885	1.92397
3.18608	3.36560	5.50045	5.47059	6.84320	3.81824	2.31725	1.66022	3.30704	3.74003	4.21920	4.84877	3.33572	1.80300	1.18396	1.04780	0.46309
0.30810	0.29664	0.14000	0.14219	0.11171	0.03083	0.03300	0.00000	0.00000	0.00000	0.00000	0.00675	0.03059	0.03058	0.28762	0.56391	1.74332
2.98111	5.09963	6.60912	4.17522	3.40329	3.88119	3.72642	3.63060	2.55179	0.79505	0.24410	0.06118	0.23537	0.02971	0.01854	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

2001	1	6	3	0	321	0.00000	0.00000	0.03095	0.15938	0.19530	0.18273	1.06792	6.19088	12.53765	9.72977	3.15900
0.45063	0.23299	0.35399	0.23620	0.09416	0.19457	0.20564	0.35958	0.65704	0.98476	1.04686	1.27971	1.33720	1.47832	1.25683	0.83937	0.49935
0.30396	0.19017	0.13034	0.07323	0.03362	0.03097	0.01108	0.00000	0.04105	0.10058	0.41252	0.44719	0.46445	2.86074	14.54663	20.06862	9.29763
1.87864	0.47502	0.18902	0.36056	0.53977	0.69196	0.70954	0.50474	0.41199	0.26094	0.06887	0.01631	0.04677	0.01248	0.00000	0.00731	0.00428
0.04412	0.00726	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

2004	1	6	3	0	247	0.00000	0.00899	0.00451	0.01504	0.03385	0.11897	0.29556	1.63119	3.03614	2.72631	2.23426
2.82417	2.90614	2.20873	2.26281	3.02689	5.04882	5.61356	4.38017	2.33424	1.41043	1.59804	1.56744	1.70073	2.91040	2.49104	2.19353	1.12037
0.41792	0.29143	0.24299	0.16224	0.07514	0.03539	0.00598	0.00000	0.00000	0.00000	0.03939	0.01414	0.25094	0.63427	4.19704	5.19071	3.77429
4.76354	6.95080	8.64924	4.47634	0.94391	0.68318	0.72349	0.50052	0.43987	0.66452	0.02557	0.11243	0.00000	0.00576	0.01000	0.00000	0.00832
0.00000	0.00000	0.00000	0.00000	0.00832	0.00000	0.00000	0.00000									

#AKC Slope Survey

#Season	Type	Gender	Partition	#Nsamp	#12

14.00000	16.00000	18.00000	20.00000	22.00000	24.00000	26.00000	28.00000	30.00000	32.00000	34.00000	36.00000	38.00000	40.00000	42.00000	44.00000	46.00000
48.00000	50.00000	52.00000	54.00000	56.00000	58.00000	60.00000	62.00000	64.00000	66.00000	68.00000	70.00000	72.00000	74.00000	76.00000	78.00000	80.00000
12.00000	14.00000	16.00000	18.00000	20.00000	22.00000	24.00000	26.00000	28.00000	30.00000	32.00000	34.00000	36.00000	38.00000	40.00000	42.00000	44.00000
46.00000	48.00000	50.00000	52.00000	54.00000	56.00000	58.00000	60.00000	62.00000	64.00000	66.00000	68.00000	70.00000	72.00000	74.00000	76.00000	78.00000
80.00000																

1997	1	7	3	0	37	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01068	0.05160	0.07295	0.02847
0.03737	0.10854	0.10320	0.08541	0.03737	0.01246	0.01246	0.02135	0.01601	0.01068	0.01779	0.00712	0.00178	0.00178	0.00178	0.00178	0.00000
0.00178	0.00000	0.00000	0.00000	0.00178	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.03737	0.08363	0.05516
0.09075	0.03203	0.01423	0.00890	0.01423	0.00534	0.00712	0.00178	0.00000	0.00000	0.00178	0.00178	0.00000	0.00000	0.00178	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

1999	1	7	3	0	43	0.00226	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00226	0.00226
0.01129	0.00677	0.02483	0.05643	0.04966	0.05869	0.04740	0.06321	0.04966	0.06772	0.05418	0.08352	0.04063	0.03160	0.01580	0.01580	0.00226
0.00226	0.00226	0.00677	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00677	0.05869	0.06321	0.05643	0.03612	0.02483	0.01354	0.01806	0.00677	0.00451	0.00903	0.00451	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

2000	1	7	3	0	35	0.00000	0.00000	0.00000	0.00000	0.00635	0.03492	0.01905	0.00000	0.00317	0.00317	0.00317
0.00635	0.00317	0.00000	0.00317	0.00000	0.00317	0.00952	0.02857	0.01270	0.05079	0.04762	0.04762	0.06349	0.06667	0.04127	0.03810	0.01587
0.01270	0.02222	0.00635	0.00635	0.00317	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02540	0.09206	0.01270	0.00000	0.00000	0.00000

0.00317	0.01270	0.05079	0.06984	0.08889	0.03175	0.02222	0.00635	0.00317	0.00952	0.00000	0.00000	0.00000	0.00317	0.00317	0.00635	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

2001	1	7	3	0	41	0.00138	0.00000	0.00000	0.00000	0.00000	0.00000	0.00138	0.00414	0.07597	0.12017	0.05249
0.00829	0.00000	0.00552	0.00414	0.00000	0.00552	0.00691	0.01519	0.01105	0.02072	0.01519	0.02210	0.01796	0.01657	0.01934	0.01105	0.01519
0.00829	0.00276	0.00138	0.00276	0.00138	0.00138	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00138	0.03315	0.11326	0.12017
0.03591	0.02762	0.02072	0.05249	0.06354	0.03453	0.00829	0.00829	0.00829	0.00138	0.00138	0.00000	0.00138	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000									

Fillet Fishery, from Observer 2006 length comps.

# Year Season		Type	Gender	Partition	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	64	66
68	70	72	74	76	78	80	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	68	70	72	74	76	78	80									

#2006	1	2	0	0	34	0	0	0	0	0	4	4	2	5	24	19
27	24	27	21	18	15	10	10	12	7	2	1	2	5	1	4	2
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									

Trawl Discard Fishery, from Observer 2006 length comps.

#Year Season		Type	Gender	Partition	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	64	66
68	70	72	74	76	78	80	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	68	70	72	74	76	78	80									

2006	1	3	0	0	142	0	0	3	14	15	10	14	27	44	53	52
88	121	158	120	90	73	62	64	57	62	42	36	25	27	18	20	5
6	1	2	4	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	0	0	0	0	0	0									

#

30 # Number of age bins for data inputs

#Lower edge of age bins (first is a minus group, last is a plus group)

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

2 # Number of ageing error types

Vectors of: Average age at true age (to accumulator age)

SD of ageing precision at true age

#Type 1: break and burn.Assume unbiased. SD is from english.

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

0.001 0.001 0.2336773 0.3703697 0.4673546 0.5425818 0.604047 0.6560151 0.7010318 0.7407394 0.7762591 0.8083906 0.8377243 0.8647087 0.8896923 0.9129516 0.9347091
0.9551472 0.9744167 0.9926441 1.0099364 1.0263848 1.0420678 1.0570536 1.0714015 1.0851637 1.098386 1.1111092 1.1233696 1.1351998 1.1466288 1.1466288 1.1466288
1.1466288 1.1466288 1.1466288

Type 2: surface reads. SD is from english, but bias is from 1989 cross reads.

1.04 1.99 2.94 3.89 4.84 5.79 6.74 7.70 8.65 9.60 10.55 11.50 12.45 13.40 14.35 15.30 16.25
17.20 18.15 19.10 20.05 21.00 21.95 22.91 23.86 24.81 25.76 26.71 27.66 28.61 29.56 30.51 31.46 32.41
33.36 34.31

0.001 0.001 0.2336773 0.3703697 0.4673546 0.5425818 0.604047 0.6560151 0.7010318 0.7407394 0.7762591 0.8083906 0.8377243 0.8647087 0.8896923 0.9129516 0.9347091
0.9551472 0.9744167 0.9926441 1.0099364 1.0263848 1.0420678 1.0570536 1.0714015 1.0851637 1.098386 1.1111092 1.1233696 1.1351998 1.1466288 1.1466288
1.1466288 1.1466288 1.1466288 1.1466288

#

538 # 511+27ghost marginals: Total number of age observations

#Pacfin Age-Length Data sorted by year, gender, age-at-length bin observations

#Year Season Type Gender Partition ageerr Lbin_lo Lbin_hi Nsamp Data: females then males

#year	season	fleet	gender	mkt	age err	lbin	lbin	samp	1.0000	2.0000	3.0000	4.0000	5.0000	6.0000	7.0000	8.0000
9.0000	10.0000	11.0000	12.0000	13.0000	14.0000	15.0000	16.0000	17.0000	18.0000	19.0000	20.0000	21.0000	22.0000	23.0000	24.0000	25.0000
26.0000	27.0000	28.0000	29.0000	30.0000	1.0000	2.0000	3.0000	4.0000	5.0000	6.0000	7.0000	8.0000	9.0000	10.0000	11.0000	12.0000
13.0000	14.0000	15.0000	16.0000	17.0000	18.0000	19.0000	20.0000	21.0000	22.0000	23.0000	24.0000	25.0000	26.0000	27.0000	28.0000	29.0000
30.0000																
#year	season	fleet	gender	mkt	age err	lbin	lbin	samp	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	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																
1986	1	2	1	0	2	10	10	1	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	12	12	1	0.00000	0.00000	9.58674	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	13	13	1	0.00000	0.00000	0.00000	37.13927	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	14	14	4	0.00000	0.00000	0.00000	0.00000	9.71770	0.00000	0.00000	0.68607
0.00000	6.27538	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	15	15	4	0.00000	0.00000	0.00000	5.08634	2.13367	0.14118	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	16	16	9	0.00000	0.00000	0.00000	1.89856	4.26269	3.88892	2.42479	0.96401
0.10539	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	1	0	2	17	17	10	0.00000	0.00000	0.00000	0.05866	0.54668	10.09655	10.17388	1.75072
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	18	18	13	0.00000	0.00000	0.00000	0.00000	1.75642	5.65871	8.99809	7.56992
4.07799	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.68280	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	19	19	14	0.00000	0.00000	0.00000	0.00000	2.63363	3.78951	39.99525	9.91450
15.95905	2.10884	2.16429	0.17799	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	20	20	17	0.00000	0.00000	0.00000	0.00000	0.13624	6.17965	44.80127	12.80113
7.43856	6.92366	11.93682	3.17562	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	21	21	15	0.00000	0.00000	0.00000	0.00000	0.00000	5.95353	20.08477	19.76706
18.19696	17.34095	15.25199	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	22	22	16	0.00000	0.00000	0.00000	0.00000	0.20301	0.97665	10.66028	22.88745
21.21307	26.62657	6.94534	0.65901	9.82862	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	23	23	14	0.00000	0.00000	0.00000	0.00000	0.00000	1.08288	13.00091	5.29118
27.67430	22.43278	15.69293	4.60796	2.25067	2.52278	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	24	24	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.17172	11.46037
19.40046	9.69576	25.44485	0.80278	5.65013	9.68609	4.44264	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	1	0	2	25	25	14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.93778	2.65359
5.70068	19.40296	12.88227	6.97575	5.45511	15.04459	0.00000	21.42453	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.52273	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	26	26	14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.12219
12.59166	17.44274	22.72385	9.48046	16.50587	2.04860	15.08462	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	27	27	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8.73770	39.67047	20.19919	16.65202	10.15712	0.71524	0.00000	3.34203	0.52623	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	28	28	15	0.00000	0.00000	0.00000	0.00000	0.00000	2.35255	0.00000	0.00000
2.24105	14.04848	22.73912	22.00447	1.54371	12.05839	4.56603	0.00000	7.06617	5.69001	0.00000	5.69001	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	29	29	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6.80965	11.48636	8.10097	16.60115	14.77589	10.43899	30.70730	0.76554	0.31414	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	30	30	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2.82229	14.97727	4.61194	26.38569	4.96020	31.68310	7.41925	4.00414	0.00000	2.13790	0.99821	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	31	31	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6.45902	6.45902	19.61642	8.27030	0.00000	0.00000	54.47934	0.00000	4.27101	0.44489	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	32	32	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	5.71921	3.52989	0.00000	11.42876	5.71921	24.04682	38.00438	1.57147	9.98026	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	1	0	2	33	33	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	36.42933	0.00000	0.00000	63.57067	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	1	0	2	35	35	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	74.14975	0.00000	25.85025	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	11	11	2	0.00000	0.00000	0.00000	40.93496	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	12	12	3	0.00000	0.00000	0.00000	18.48983	19.31583	7.33162	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	13	13	8	0.00000	0.00000	0.00000	78.10066	9.78206	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	14	14	11	0.00000	0.00000	1.75785	29.18044	38.33694	4.53317	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	15	15	9	0.00000	0.00000	0.00000	9.86302	6.18507	1.17756	11.12919	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	16	16	11	0.00000	0.00000	0.00000	2.44618	11.94606	2.13758	4.53819	0.00000
0.00000	0.00000	3.67415	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	17	17	14	0.00000	0.00000	0.00000	1.41883	6.37472	5.84252	1.48800	0.14484
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	18	18	15	0.00000	0.00000	0.00000	0.00000	4.53735	12.99621	7.06339	0.74417
0.00000	10.13816	0.89533	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	19	19	15	0.00000	0.00000	0.00000	0.00000	0.69681	24.07271	48.36713	3.03378
16.36930	0.46395	0.00000	0.43491	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	20	20	20	0.00000	0.00000	0.00000	0.00000	7.38790	9.92291	38.81172	26.96821
4.35162	1.42712	8.53286	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	21	21	19	0.00000	0.00000	0.00000	0.00000	0.00000	16.27893	32.72465	14.98546
16.06361	13.68530	4.86610	1.28025	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	22	22	20	0.00000	0.00000	0.00000	0.00000	1.15218	8.03723	40.20261	14.52341
20.08965	11.18881	3.47826	0.74819	0.47688	0.00000	0.10278	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	23	23	19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	27.58654	16.88622
7.09513	15.97009	10.82238	11.00035	2.47192	0.00000	0.00000	0.00000	8.04016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	24	24	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	22.19790	15.83504
23.42636	12.95390	16.16714	4.98135	0.16663	3.49857	0.16663	0.60649	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	25	25	17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	8.80952	14.54756
9.96931	11.86277	16.71875	14.90796	5.29569	13.64817	0.65002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	26	26	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.41708
3.56418	11.10570	9.35301	14.00882	28.74954	0.86443	25.49120	2.12572	0.00000	0.00000	0.00000	0.32031	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	27	27	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3.58105	28.64258	31.78933	7.90025	5.39026	4.59571	6.46024	0.78480	10.85577	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	28	28	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.51809
3.69089	15.73402	17.32053	17.60405	16.73911	6.86788	3.35610	1.17556	0.88725	12.46957	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.63695	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	29	29	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	7.09213	9.33479	15.38540	2.18489	34.14696	24.11488	5.24569	0.98930	0.00000	0.32723	0.00000	1.17874	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	30	30	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	9.11556	16.46695	12.36191	12.49521	25.53913	9.11556	11.00750	1.61570	0.40293	0.96018	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	31	31	14	0.00000	0.00000	0.00000	0.00000	11.25932	0.00000	0.00000	0.00000
0.00000	10.59293	12.24390	0.00000	24.71568	1.31903	10.09881	22.27470	4.50771	2.98793	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	32	32	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	92.96301	0.00000	0.00000	0.00000	3.67205	0.00000	0.00000	0.00000	0.00000	3.36494	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	1	0	2	33	33	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	20.99878	0.00000	48.12745	24.56812	6.30565	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	34	34	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.82883	0.00000	86.98132	10.18985	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	1	0	2	35	35	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	12	12	2	0.00000	0.00000	9.29226	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	13	13	3	0.00000	0.00000	5.82783	24.69006	5.82783	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	14	14	6	0.00000	0.00000	6.55973	41.69511	12.41706	3.94755	8.80335	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	15	15	8	0.00000	0.00000	0.00000	18.48063	31.15081	7.38703	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	16	16	8	0.00000	0.00000	0.00000	0.52985	10.36540	2.87013	3.35570	3.12754
3.85180	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	17	17	12	0.00000	0.00000	0.00000	2.99156	7.24341	12.22197	4.85303	1.39549
0.00000	0.00000	1.01919	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	18	18	11	0.00000	0.00000	0.00000	0.00000	8.56086	14.61984	12.61309	6.35838
0.00000	2.79019	2.79019	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	19	19	12	0.00000	0.00000	0.00000	0.00000	0.00000	6.66270	10.83985	41.69873
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	20	20	12	0.00000	0.00000	0.00000	0.00000	0.00000	6.33402	31.21699	62.13867
0.00000	0.31032	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	21	21	14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	22.12697	62.43075
12.68823	1.48491	1.10245	0.16670	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	22	22	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.71127	51.30389
27.59162	7.99290	0.50752	5.31214	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	23	23	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.92920	36.09862
24.34862	15.69638	10.14354	8.78364	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	24	24	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.54026	1.31599
15.61929	29.88225	16.35614	18.80250	0.00000	11.27416	0.00000	6.20942	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	25	25	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.57632
13.17934	32.67753	34.21618	15.16240	2.53007	1.08184	0.00000	0.57632	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	26	26	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	8.82236
0.00000	11.57826	4.15489	29.63567	26.94034	6.72867	12.13980	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	27	27	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	9.27100
9.27100	0.00000	0.00000	43.20872	29.82077	8.07692	0.35158	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	28	28	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	1.05480	22.96131	29.46759	22.32193	22.52670	0.00000	1.66767	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	29	29	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	23.76161	31.50474	4.53246	16.65073	12.61408	9.87793	0.00000	1.05846	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	30	30	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	21.28063	27.48721	1.95299	25.53423	23.74495	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	31	31	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	5.35904	0.00000	55.80302	33.43366	4.23638	0.00000	1.16789	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	32	32	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	24.84783	0.00000	7.20881	0.00000	39.97670	26.74931	0.00000	0.00000	0.00000	0.00000	1.21735	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	1	0	2	33	33	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	50.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	34	34	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	95.32958	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.67042
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	1	0	2	35	35	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	5.38417	0.00000	0.00000	66.17605	5.38417	23.05560	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	11	11	1	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	12	12	4	0.00000	0.00000	0.89490	37.70067	5.81186	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	13	13	7	0.00000	0.00000	0.00000	41.35940	3.41940	5.07089	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	14	14	6	0.00000	0.00000	0.00000	45.45657	20.63222	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	15	15	13	0.00000	0.00000	0.62884	64.64647	10.92450	5.81079	0.00000	0.00000
0.54394	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	1	0	2	16	16	12	0.00000	0.00000	0.00000	5.01761	18.02911	6.09956	4.57735	12.39891
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	17	17	11	0.00000	0.00000	0.00000	11.88875	14.53490	5.45205	0.84734	3.84210
0.14797	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	18	18	14	0.00000	0.00000	0.00000	0.68032	13.57860	21.18422	0.87892	1.78808
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	19	19	11	0.00000	0.00000	0.00000	0.00000	2.83261	21.29896	6.22143	12.92488
13.07475	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	20	20	13	0.00000	0.00000	0.00000	0.00000	0.61158	18.66536	4.53113	6.84203
7.25399	2.87759	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	21	21	14	0.00000	0.00000	0.00000	0.00000	0.00000	3.51858	34.38481	29.17830
17.90386	4.17055	3.74839	0.00000	0.00000	0.00000	0.00000	0.34425	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	22	22	16	0.00000	0.00000	0.00000	0.00000	0.33210	0.00000	15.80886	42.92558
15.72289	8.13483	12.31016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	23	23	16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.67637	40.97548
22.63710	19.48600	11.38573	0.94463	0.99232	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	1	0	2	24	24	14	0.00000	0.00000	0.00000	0.00000	0.04116	0.00000	7.18280	16.61338
16.21061	32.11647	9.18421	4.51734	3.53795	0.00000	3.45857	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	25	25	13	0.00000	0.00000	0.00000	0.08125	0.00000	0.00000	0.38518	22.31307
32.08390	20.51660	18.06043	4.70779	0.17192	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	26	26	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.41142	0.06257	17.92550
22.73645	16.18291	18.56344	14.18700	9.93071	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	27	27	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.11615	30.65049
18.23270	19.93395	28.53833	1.97603	0.55234	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	28	28	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	20.59023
5.46539	24.34812	11.28082	7.77101	11.44565	0.00000	0.00000	9.54939	0.00000	9.54939	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	29	29	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	45.67028	28.46088	2.69176	18.33403	2.94164	1.90142	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	30	30	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.26908
0.00000	6.17551	1.69786	53.42480	29.53365	3.85552	0.00000	0.00000	5.04358	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	31	31	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.24591	10.20466	11.35961	24.87537	0.00000	26.65722	13.32861	0.00000	13.32861	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	1	0	2	32	32	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	3.75626	0.00000	30.23726	2.37876	0.00000	0.00000	30.23726	27.85850	0.00000	5.53196	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	33	33	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	49.32588	0.00000	0.00000	0.00000	0.89882	49.77529	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	34	34	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	1	0	2	35	35	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	50.00000	0.00000	0.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	7	7	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	12	12	2	0.00000	0.00000	52.94095	1.79388	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	13	13	5	0.00000	0.00000	6.08817	40.76642	7.80217	3.04409	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	14	14	7	0.00000	0.00000	0.00000	11.58944	17.52615	0.89045	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1990	1	2	1	0	2	15	15	12	0.00000	0.00000	1.58994	25.96789	58.85415	7.62596	1.79020	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	16	16	11	0.00000	0.00000	0.65538	14.48866	15.14844	4.38173	0.00000	0.00000
7.67563	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	17	17	13	0.00000	0.00000	0.00000	1.31718	20.50099	17.36875	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	18	18	11	0.00000	0.00000	0.00000	0.72010	13.02493	32.77738	14.44482	0.00000
19.87977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	19	19	11	0.00000	0.00000	0.00000	1.06105	3.23628	13.74834	24.46726	0.38354
0.71844	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	20	20	11	0.00000	0.00000	0.00000	0.00000	0.00000	21.61522	32.28342	0.00000
29.13829	0.49704	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	21	21	15	0.00000	0.00000	0.00000	0.00000	1.13454	16.41938	28.88590	34.75051
15.71413	2.12451	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	22	22	18	0.00000	0.00000	0.00000	0.00000	2.81584	13.70323	20.20892	6.76231
24.71551	8.26583	3.33644	11.34057	8.85134	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1990	1	2	1	0	2	23	23	18	0.00000	0.00000	0.00000	0.00000	4.34365	11.87393	22.30093	0.40720
33.40388	13.25047	11.20287	1.88073	0.00000	0.00000	0.00000	1.33635	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	24	24	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.47843	17.28215	5.56643
56.02248	9.62703	4.36020	0.94860	5.41780	0.29689	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	25	25	18	0.00000	0.00000	0.00000	0.00000	0.00000	2.18539	14.06934	8.30029
33.62107	9.47243	19.39087	4.31763	0.96745	7.44330	0.00000	0.23224	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	26	26	18	0.00000	0.00000	0.00000	0.00000	0.00000	1.19620	8.97675	8.03658
24.34399	19.32794	15.34122	16.27920	4.59394	1.64814	0.00000	0.00000	0.25604	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	27	27	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.82607	9.04994	5.81233
35.32364	14.68894	13.90843	4.42873	4.20601	11.75592	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	28	28	17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.10727	3.41209
33.24215	18.12878	13.87759	11.26470	10.02706	4.52557	0.00000	0.00000	1.41478	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	29	29	16	0.00000	0.00000	0.00000	0.00000	3.04075	6.68443	1.05648	0.00000
44.35477	2.15170	16.95368	10.52549	5.46261	6.63901	1.18211	0.00000	0.00000	0.00000	1.94897	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	30	30	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.62017
29.98723	22.66255	0.66460	3.57221	15.14700	4.73153	0.56082	4.47615	9.94619	5.07073	0.00000	0.00000	0.56082	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1990	1	2	1	0	2	31	31	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15.83744	13.10424	11.00014	13.44723	15.02300	2.97044	10.40352	3.46907	0.00000	3.46907	11.27583	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	32	32	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14.73296	22.42670	0.00000	17.72393	8.09786	16.49243	11.16263	4.22249	4.98116	0.15984	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	33	33	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9.16334	31.97239	11.12466	5.80104	22.80905	6.49081	0.00000	12.29184	0.34687	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	34	34	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	14.50135	26.21633	0.00000	0.00000	20.32715	20.32715	18.62802	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	1	0	2	35	35	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	9.30575	0.00000	0.00000	30.54656	0.00000	0.00000	27.30041	0.00000	32.84727	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	12	12	1	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	13	13	2	0.00000	0.00000	0.00000	0.00000	27.89071	0.00000	20.97370	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	14	14	7	0.00000	0.00000	0.00000	2.62465	41.36818	1.62582	0.00000	0.00000
0.00000	2.24119	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1991	1	2	1	0	2	15	15	10	0.00000	0.00000	0.00000	8.83470	29.49810	14.89862	3.49863	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	16	16	12	0.00000	0.00000	0.00000	6.93385	18.41193	15.93378	10.79612	12.14889
0.00000	2.47588	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	17	17	14	0.00000	0.00000	0.00000	0.00000	20.69210	41.99522	17.34413	5.67082
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	18	18	13	0.00000	0.00000	0.00000	0.00000	12.53401	26.20980	9.69609	2.88535
4.77157	1.67603	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	19	19	13	0.00000	0.00000	0.00000	0.00000	0.69282	16.03180	50.09802	13.38202
10.31556	0.00000	0.00000	2.17391	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	20	20	14	0.00000	0.00000	0.00000	0.00000	1.84594	20.32830	37.69054	9.22454
10.40785	0.00000	0.00000	14.42290	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	21	21	14	0.00000	0.00000	0.00000	0.00000	2.01365	6.26637	21.11386	25.28530
35.78425	9.35707	0.17950	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	22	22	14	0.00000	0.00000	0.00000	0.00000	0.00000	15.45604	28.26535	5.74314
8.77303	27.50501	5.58991	7.70801	0.95952	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1991	1	2	1	0	2	23	23	16	0.00000	0.00000	1.20605	0.00000	0.00000	1.33173	7.37923	23.78926
17.14304	13.96607	33.05622	2.12841	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	24	24	15	0.00000	0.00000	0.00000	0.00000	0.00000	1.89995	10.62881	8.32778
9.63203	11.19063	3.16052	36.94167	0.00000	10.27490	7.94371	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	25	25	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	12.46389	6.27953
11.61332	17.56235	12.57360	30.33329	4.44863	3.89898	0.00000	0.35722	0.00000	0.46917	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	26	26	17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	17.13890
14.05103	20.93839	9.82339	32.32361	0.30359	0.30359	0.54966	0.00000	0.00000	0.00000	0.00000	4.56783	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	27	27	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.73487	10.96014
13.55434	26.88630	5.57231	19.41832	7.76420	4.87386	5.42065	1.81502	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	28	28	18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.67103	4.31414
5.76029	12.05613	13.06690	23.47576	10.39458	0.79004	11.34372	10.15570	7.36067	0.00000	0.61103	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	29	29	18	0.00000	0.00000	0.00000	0.00000	0.79302	0.79302	0.07069	0.00000
12.84908	14.71112	15.83078	38.29170	3.30102	10.27629	1.00206	1.68237	0.39884	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	30	30	17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5.30074	21.30428	12.84153	26.13075	2.69101	13.99716	5.10038	2.08814	0.62688	0.00000	0.00000	0.00000	7.11550	2.80363	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1991	1	2	1	0	2	31	31	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2.66141	2.66141	10.66241	51.50251	2.26052	1.13690	4.31890	0.00000	17.10579	0.00000	0.00000	0.00000	7.69014	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	32	32	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	2.53232	0.00000	14.14101	23.59317	7.75935	29.35781	15.29921	7.31712	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	33	33	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	1.59071	45.84381	5.03718	7.83096	2.24851	12.03725	6.85998	0.00000	6.51435	12.03725	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	34	34	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	33.24071	0.00000	0.00000	21.47605	25.70896	19.57429	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	1	0	2	35	35	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	7.99705	0.00000	0.00000	7.99705	0.00000	5.54434	69.04626	9.41530	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	12	12	4	0.00000	0.00000	60.53476	24.12087	15.34437	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	13	13	1	0.00000	0.00000	0.00000	59.16127	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	14	14	5	0.00000	0.00000	0.00000	80.39218	19.60782	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	15	15	5	0.00000	0.00000	0.00000	85.15436	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	16	16	2	0.00000	0.00000	0.00000	66.66667	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	17	17	2	0.00000	0.00000	0.00000	0.00000	4.77793	0.00000	0.00000	20.00850
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	18	18	6	0.00000	0.00000	0.00000	6.74284	6.74284	6.74284	3.25602	11.78415
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	19	19	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	14.37765	28.59101
14.37765	14.37765	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	20	20	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	52.58478	0.00000
0.00000	5.05741	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	21	21	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	11.61443	11.61443
25.86961	27.67267	23.22886	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	22	22	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	9.16770	13.44596
10.26230	36.31284	9.16770	9.16770	4.58385	4.58385	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	23	23	16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	9.77926
21.18212	22.00333	20.14233	12.22407	4.88963	4.88963	2.44481	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	24	24	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9.64056	28.60032	23.36215	19.17095	9.58547	4.82028	4.82028	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	25	25	14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6.37937	21.50998	20.89938	26.26567	16.79938	4.25284	3.89340	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	26	26	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	36.97744	6.34735	25.25483	18.57895	6.42072	6.42072	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	27	27	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6.02057	12.04114	23.22775	28.67649	12.04114	6.02057	5.95177	6.02057	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	28	28	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	5.16408	4.81981	20.16585	25.08745	34.43465	0.00000	5.16408	0.00000	0.00000	5.16408	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	29	29	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	13.78994	27.57989	5.91634	13.05628	20.60613	12.15644	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	1	0	1	30	30	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	10.60191	30.30095	21.20381	9.09714	0.00000	28.79619	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	31	31	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	24.00724	24.00724	0.00000	0.00000	27.97829	24.00724	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	32	32	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	23.74400	0.00000	0.00000	11.87200	10.74441	23.74400	11.87200	9.01180	9.01180	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	34	34	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	1	0	1	35	35	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	13	13	1	0.00000	0.00000	0.00000	0.00000	0.00000	4.68624	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	14	14	2	0.00000	0.00000	0.00000	32.97251	3.00815	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	15	15	2	0.00000	0.00000	0.00000	38.21505	2.39427	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	16	16	2	0.00000	0.00000	0.00000	66.00417	2.71830	0.00000	0.00000	2.71830
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	17	17	3	0.00000	0.00000	0.00000	8.34351	16.30150	2.08588	0.00000	6.92585
0.00000	0.00000	0.00000	0.00000	0.00000	2.08588	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	18	18	4	0.00000	0.00000	0.00000	0.00000	0.00000	26.15700	0.00000	0.00000
0.00000	2.53437	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	19	19	3	0.00000	0.00000	0.00000	0.00000	18.63122	7.03009	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	12.61070	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	20	20	3	0.00000	0.00000	0.00000	0.00000	12.17026	16.47509	0.00000	52.98588
9.18438	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	21	21	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	26.53080	8.50641
19.77828	41.78973	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	22	22	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10.43837	0.00000
13.83192	49.31281	8.41918	4.16579	0.00000	13.83192	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	23	23	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	8.53333	23.84054
0.00000	45.43626	22.18987	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	24	24	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
41.97464	8.69864	0.00000	41.41227	5.29467	0.00000	2.61979	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	25	25	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
41.23919	0.00000	14.83449	15.81109	14.71552	7.41725	0.00000	5.98246	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	26	26	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.77892
0.00000	5.77892	22.16801	31.58659	24.17160	0.00000	4.73704	0.00000	5.77892	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	27	27	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.67541	0.00000
0.00000	9.35082	16.17284	17.87436	21.76739	21.69118	8.46801	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	28	28	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4.05305	0.00000	8.99754	4.05305	13.94203	23.05861	22.93958	4.05305	0.00000	9.88899	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	29	29	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	4.84820	18.53493	18.59773	14.62362	13.74954	7.94822	3.97411	9.77542	0.00000	3.97411	3.97411	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	30	30	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	10.10135	0.00000	0.00000	0.00000	12.52397	12.32309	10.10135	34.74753	10.10135	10.10135	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	31	31	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	4.00677	0.00000	22.14448	0.00000	0.00000	37.89543	0.00000	19.75773	16.19560	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	32	32	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	23.69700	0.00000	0.00000	0.00000	0.00000	0.00000	23.69700	0.00000	0.00000	52.60601	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	1	0	1	33	33	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	18.31577	22.70846	0.00000	0.00000	18.31577	18.31577	0.00000	22.34422	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	1	0	1	34	34	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	11	11	2	0.00000	0.00000	0.00000	59.19054	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	13	13	1	0.00000	0.00000	0.00000	0.00000	8.22319	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	14	14	3	0.00000	0.00000	4.33861	20.14697	31.29045	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	15	15	4	0.00000	0.00000	2.30118	9.15173	54.78551	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	16	16	5	0.00000	0.00000	0.00000	28.54935	60.21421	7.97959	1.62843	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	17	17	6	0.00000	0.00000	0.00000	0.96109	71.05178	0.47681	5.09922	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2004	1	2	1	0	1	18	18	5	0.00000	0.00000	0.00000	0.61701	90.78744	5.52469	0.61701	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	19	19	4	0.00000	0.00000	0.87136	9.31875	67.70698	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	20	20	5	0.00000	0.00000	0.00000	0.00000	35.41240	15.67420	2.55263	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	21	21	6	0.00000	0.00000	0.00000	0.00000	18.00437	0.92216	38.23472	4.60403
9.86202	0.00000	0.00000	0.00000	28.37270	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	22	22	3	0.00000	0.00000	0.00000	0.00000	13.48870	13.48870	13.93398	31.66592
27.42269	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	23	23	4	0.00000	0.00000	0.00000	0.00000	0.00000	44.98312	23.23403	22.49156
7.81780	0.74247	0.73101	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	24	24	6	0.00000	0.00000	0.00000	0.00000	9.79438	0.00000	0.00000	19.90709
19.91208	11.38371	39.00274	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	25	25	5	0.00000	0.00000	0.00000	0.00000	9.82566	0.00000	3.41528	19.65132
0.00000	24.66100	12.96977	9.82566	19.65132	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2004	1	2	1	0	1	26	26	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.46216
0.00000	0.00000	0.00000	14.21969	42.65907	14.21969	28.43938	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	27	27	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	17.45921	27.51360	0.00000	0.00000	0.00000	55.02719	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	28	28	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	23.67493	32.51212	0.00000	43.81295	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	29	29	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	42.59691	0.00000	0.00000	0.00000	0.00000	14.80618	42.59691	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	30	30	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	29.89113	70.10887	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	1	0	1	31	31	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	17	17	1	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	18	18	1	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	19	19	1	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	20	20	1	0.00000	0.00000	0.00000	0.00000	0.00000	50.00000	50.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	40.00000	20.00000	20.00000
20.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	22	22	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	66.66667
33.33333	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	23	23	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	24	24	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	11.11111
22.22222	22.22222	11.11111	22.22222	11.11111	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	26	26	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	33.33333
0.00000	33.33333	0.00000	33.33333	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	27	27	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	25.00000	0.00000	25.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2005	1	2	1	0	1	28	28	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	20.00000	0.00000	20.00000	0.00000	40.00000	0.00000	0.00000	20.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	29	29	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	50.00000	0.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	30	30	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	50.00000	0.00000	50.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	31	31	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	20.00000	20.00000	20.00000	20.00000	0.00000	0.00000	20.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	32	32	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2005	1	2	1	0	1	35	35	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	2	0	2	12	12	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	90.41326	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	2	0	2	13	13	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	40.29229	0.00000	22.56844	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	14	14	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	36.03582	14.04334	33.24169	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	15	15	13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	11.88975	4.18841	37.52281	23.03370	11.42182	1.99967	2.58265	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	16	16	15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.89856	1.96260	7.27118	28.52546	25.84734	0.96401	8.31167	8.58295	3.04184	0.00000
0.00000	0.00000	0.00000	0.00000	0.05002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	17	17	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	7.59945	3.24292	6.41590	37.51837	5.15780	5.78287	8.96975	2.68645	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	18	18	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.25796	2.05415	23.05097	7.58512	8.30323	7.44969	4.07012	3.37170
1.41893	1.41893	0.00000	6.27527	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	19	19	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.10816	7.87644	7.53497	3.86868	0.00000	0.00000	3.86868	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	20	20	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.56831	4.03874	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	3.40474	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1986	1	2	2	0	2	23	23	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.44360	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1986	1	2	2	0	2	24	24	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	8.24521	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	11	11	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	59.06504	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	12	12	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	47.62854	7.23417	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	13	13	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.77059	8.63854	2.70815	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	14	14	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.78790	1.87525	7.04756	12.48088	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	15	15	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	7.41258	49.88465	8.04480	5.12558	1.17756	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	16	16	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.42086	31.77426	17.17319	19.88952	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1987	1	2	2	0	2	17	17	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.63136	5.89695	45.26944	23.82875	3.29339	1.76998	0.00000	3.04124	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	18	18	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.50598	2.51501	31.49272	19.09122	3.68222	0.65948	0.47430	0.00000	0.00000
5.20446	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	19	19	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.95672	0.60470	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	20	20	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.59766	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.11570	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	23	23	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.12720	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	25	25	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.59026	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1987	1	2	2	0	2	30	30	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.91937	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	2	0	2	10	10	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	11	11	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	32.91723	65.83447	1.24830	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	12	12	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	18.58451	72.12323	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	13	13	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	63.65428	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	14	14	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.27986	22.62964	0.33384	0.33384	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	15	15	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	11.76039	9.20501	10.39757	5.86093	5.75763	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	16	16	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	12.12085	16.74489	13.61734	29.56468	0.00000	3.85180	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1988	1	2	2	0	2	17	17	12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.50710	10.25848	30.07963	6.75691	17.67324	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	2	0	2	18	18	11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.62837	7.13751	16.54200	13.36874	11.59083	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	2	0	2	19	19	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.19796	6.50252	6.66270	15.02248	0.00000	0.91053	6.50252	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1988	1	2	2	0	2	22	22	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.58066	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	10	10	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	12	12	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	50.23607	2.67825	2.67825	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	13	13	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.59142	22.95545	12.56832	7.29300	0.00000	5.74212	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	14	14	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.08754	8.16895	2.06695	0.00000	22.58777	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	15	15	5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	14.03793	0.12695	3.28059	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	16	16	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	20.02253	16.28101	7.26831	8.45521	0.00000	0.16309	0.00000	1.68732	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	17	17	9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.02272	12.59657	36.85593	1.75667	6.44754	0.00000	0.00000	1.60745
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	18	18	10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.19869	8.87286	28.32221	1.37420	10.09801	11.02390	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	19	19	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.11367	7.53810	16.66192	9.78193	0.00000	9.55175	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	20	20	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	8.92960	32.93361	16.35921	0.00000	0.99589	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.75126	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	22	22	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.60184	0.00000	0.00000	0.00000
0.00000	1.16374	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	23	23	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.08777	1.81459	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1989	1	2	2	0	2	24	24	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.72314	0.00000	0.00000	4.51734
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.89703	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1989	1	2	2	0	2	25	25	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.67985	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	12	12	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.86456	43.40060	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	13	13	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.58822	12.56099	17.77473	4.51330	0.86191	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	14	14	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.56812	11.32644	44.96315	4.56812	4.56812	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	15	15	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	4.17187	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	16	16	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	7.02025	37.36994	7.02025	6.23971	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	17	17	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10.17094	12.25324	25.82851	1.11224	0.00000	0.00000	11.44814	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1990	1	2	2	0	2	18	18	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10.14191	6.29032	1.55849	0.00000	0.00000	0.00000	0.00000	1.16229
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	19	19	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.97985	15.08751	0.00000	15.08751	19.23022	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	20	20	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.35357	0.00000	0.00000	14.11247	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1990	1	2	2	0	2	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.97103	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	10	10	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	26.44533	73.55467	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	13	13	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	33.72098	5.83026	11.58435	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	14	14	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	7.03859	7.91453	4.19529	10.99725	21.99450	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	15	15	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	15.47674	13.13401	14.65919	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1991	1	2	2	0	2	16	16	6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	12.99044	2.58513	8.67552	0.00000	9.04846	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	17	17	7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.51738	6.02595	5.41280	0.00000	0.00000	0.00000	0.00000	2.34160
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	18	18	8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	19.37820	5.11806	0.84353	8.44368	8.44368	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	19	19	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.13561	1.57702	0.79369	1.79956	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1991	1	2	2	0	2	20	20	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.07992	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	11	11	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	13	13	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	40.83873	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	15	15	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.39922	0.00000	0.00000	0.00000	10.04720	2.39922	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

1998	1	2	2	0	1	16	16	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	33.33333	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	17	17	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	20.00850	55.20507	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	18	18	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	19.77901	13.03616	6.29332	6.29332	6.29332	13.03616
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	19	19	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	6.70957	7.18882	14.37765	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	20	20	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	21.17890	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	21.17890	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	22	22	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.21347	0.00000	0.00000	0.00000	0.00000	1.09460
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	23	23	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	2.44481	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
1998	1	2	2	0	1	29	29	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	6.89497	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	11	11	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	12	12	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	13	13	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	95.31376	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	14	14	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	42.96064	7.53761	13.52109	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	15	15	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	10.76180	7.94982	10.76180	10.76180	16.76119	2.39427	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	16	16	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	19.02960	2.71830	0.00000	0.00000	0.00000
0.00000	0.00000	6.81133	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	17	17	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	18.75129	9.37565	16.30150	14.60230	5.22665	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	18	18	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	13.92591	28.22155	20.27636	6.35045	0.00000	2.53437
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2003	1	2	2	0	1	19	19	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	15.41630	7.03009	0.00000	0.00000	19.64079	7.03009
0.00000	12.61070	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	2	0	1	20	20	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	9.18438	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	2	0	1	21	21	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.39478	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2003	1	2	2	0	1	28	28	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	9.01410	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	10	10	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	100.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	11	11	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	40.80946	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	12	12	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	20.09252	0.00000	79.90748	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	13	13	4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	48.59316	43.18365	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

2004	1	2	2	0	1	14	14	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.75152	38.47245	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	15	15	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	33.76158	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	16	16	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.62843	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	17	17	3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	5.09922	0.00000	13.51935	1.89626	0.00000	0.00000	1.89626	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	18	18	1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	2.45384	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	19	19	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	3.46539	0.00000	0.00000	9.31875
0.00000	9.31875	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																
2004	1	2	2	0	1	20	20	2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	19.74826	0.00000	0.00000	0.00000	0.00000	19.74826	6.86426	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000																

FRAM slope/shelf 2003-2006

# year	season	fleet	gender	mkt	age err	lbin	lbin	samp	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	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																
2003	1	5	1	0	1	7	7	2	0.000000	0.883746	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	8	8	4	0.000000	0.232477	0.029846	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	9	9	14	0.000000	0.364532	0.245694	0.067361	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	10	10	6	0.000000	0.061532	0.081322	0.026381	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	11	11	8	0.000000	0.062451	0.204627	0.049395	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	12	12	6	0.000000	0.000000	0.123222	0.045562	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	13	13	9	0.000000	0.000000	0.000000	0.076371	0.004186	0.020181	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	14	14	16	0.000000	0.000000	0.034641	0.424906	0.025973	0.015774	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	15	15	34	0.000000	0.000000	0.000000	0.538990	0.236437	0.000000	0.029619	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	16	16	43	0.000000	0.031855	0.006543	0.525080	0.136732	0.016389	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	17	17	24	0.000000	0.000000	0.000000	0.527592	0.072192	0.103021	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	18	18	15	0.000000	0.000000	0.000000	0.429362	0.133972	0.034784	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	19	19	5	0.000000	0.000000	0.000000	0.364089	0.101258	0.109883	0.148446	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	20	20	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.040541	0.000000
0.248426	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	21	21	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.214264	0.494190	0.118772
0.000000	0.000000	0.172774	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	22	22	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.229179	0.770821	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	23	23	10	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.523360
0.012959	0.171951	0.269682	0.022048	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	24	24	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.030611	0.091011	0.066984	0.030257	0.000000	0.000000	0.781137	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	25	25	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.434666	0.000000	0.000000	0.489074	0.076260	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	26	26	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.148941	0.820625	0.000000	0.000000	0.000000	0.030434	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	27	27	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.968103	0.031897	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	28	28	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.052995	0.049384	0.897620	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	29	29	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.011105	0.010087	0.978808	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	1	0	1	30	30	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	31	31	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	33	33	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	1	0	1	35	35	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	6	6	1	0.714287	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	7	7	2	0.000000	0.375616	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	8	8	3	0.000000	0.420455	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	9	9	4	0.000000	0.051372	0.124150	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	1	0	1	10	10	11	0.000000	0.267288	0.179152	0.030561	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	11	11	10	0.000000	0.081150	0.052642	0.049386	0.077787	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	12	12	8	0.000000	0.000000	0.092284	0.025486	0.036915	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	13	13	7	0.000000	0.000000	0.036296	0.005755	0.028313	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	14	14	7	0.000000	0.000000	0.031576	0.058102	0.025698	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	15	15	19	0.000000	0.000000	0.000000	0.329919	0.543756	0.040385	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	16	16	21	0.000000	0.013378	0.010650	0.133693	0.703599	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	1	0	1	17	17	36	0.000000	0.000000	0.000000	0.043123	0.797733	0.041921	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	1	0	1	18	18	30	0.000000	0.000000	0.000000	0.035507	0.903472	0.013527	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	1	0	1	19	19	18	0.000000	0.000000	0.000000	0.000000	0.399081	0.089017	0.053465	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2004	1	5	1	0	1	20	20	19	0.000000	0.000000	0.000000	0.016697	0.637742	0.055937	0.031450	0.220098
0.038075	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2004	1	5	1	0	1	21	21	13	0.000000	0.000000	0.000000	0.000000	0.303809	0.000000	0.072687	0.183908
0.264975	0.048840	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2004	1	5	1	0	1	22	22	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	1	0	1	23	23	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005927	0.455840
0.020837	0.455840	0.061556	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2004	1	5	1	0	1	24	24	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.086397
0.000000	0.142117	0.771486	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2004	1	5	1	0	1	25	25	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.141449
0.858551	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2005 1 5 1 0 1 10 10 9 0.000000 0.097958 0.142089 0.046951 0.000000 0.000000 0.000000 0.000000
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2005 1 5 1 0 1 11 11 9 0.000000 0.000000 0.087065 0.027612 0.000000 0.000000 0.000000 0.000000
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2005 1 5 1 0 1 12 12 12 0.000000 0.000000 0.117900 0.086931 0.007277 0.022227 0.000000 0.000000
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2005 1 5 1 0 1 13 13 30 0.000000 0.000000 0.073801 0.038081 0.006470 0.046494 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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2005	1	5	1	0	1	14	14	27	0.000000	0.000000	0.016727	0.127302	0.060944	0.020851	0.000000	0.020985
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	15	15	19	0.000000	0.000000	0.000000	0.288331	0.145392	0.062630	0.007745	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	16	16	34	0.000000	0.000000	0.045416	0.056750	0.323353	0.149397	0.090733	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	17	17	41	0.000000	0.000000	0.000000	0.011992	0.313603	0.229646	0.080666	0.000000
0.000000	0.043652	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	18	18	41	0.000000	0.000000	0.000000	0.018361	0.119883	0.298546	0.067926	0.031425
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	19	19	62	0.000000	0.000000	0.000000	0.000000	0.118492	0.783175	0.062977	0.012963
0.004648	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	20	20	46	0.000000	0.000000	0.000000	0.059927	0.053298	0.299304	0.037049	0.103291
0.004721	0.129610	0.176197	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	21	21	49	0.000000	0.000000	0.000000	0.000000	0.025661	0.377647	0.033004	0.353157
0.041841	0.128804	0.005247	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2005	1	5	1	0	1	22	22	24	0.000000	0.000000	0.000000	0.000000	0.112859	0.033407	0.254332	0.387774
0.099314	0.006438	0.097266	0.004512	0.004099	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	23	23	31	0.000000	0.000000	0.000000	0.000000	0.000000	0.051684	0.148639	0.189092
0.506711	0.040558	0.000000	0.003603	0.056299	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	24	24	13	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.028571
0.169411	0.299129	0.375843	0.018627	0.000000	0.000000	0.000000	0.000000	0.026894	0.081525	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	25	25	9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.125806	0.000000
0.023647	0.135883	0.201179	0.021520	0.491965	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	26	26	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.252737	0.000000	0.000000	0.272868	0.000000	0.000000	0.120608	0.000000	0.353787	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	27	27	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.180634	0.180634	0.000000	0.022381	0.000000	0.265283	0.000000	0.351068	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	28	28	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.008923	0.000000	0.164644	0.013178	0.059278	0.753977	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	29	29	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2005	1	5	1	0	1	30	30	9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.124414	0.000000	0.166118	0.123204	0.000000	0.150698	0.000000	0.000000	0.435566	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	31	31	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.081241	0.000000	0.000000	0.918759	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	32	32	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.039086	0.025173	0.649120	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.286621	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	1	0	1	34	34	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	6	6	1	0.000000	0.104482	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	7	7	2	0.000000	0.128764	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	8	8	1	0.000000	0.173817	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	9	9	5	0.000000	0.518630	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
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2006 1 5 1 0 1 16 16 16 0.000000 0.000000 0.000000 0.061423 0.068264 0.062402 0.056386 0.000000
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0.000000

2006 1 5 1 0 1 17 17 16 0.000000 0.000000 0.020620 0.150911 0.057068 0.051701 0.014764 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000

2006 1 5 1 0 1 18 18 17 0.000000 0.000000 0.000000 0.063860 0.042538 0.115173 0.585480 0.016838
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
0.000000

2006	1	5	1	0	1	19	19	28	0.000000	0.000000	0.000000	0.000000	0.004542	0.112144	0.789933	0.026697
0.000000	0.018457	0.000000	0.028143	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	20	20	21	0.000000	0.000000	0.000000	0.000000	0.000000	0.027099	0.805986	0.161696
0.005219	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	21	21	28	0.000000	0.000000	0.000000	0.000000	0.000000	0.114960	0.275999	0.038585
0.237819	0.269834	0.000000	0.018308	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	22	22	17	0.000000	0.000000	0.000000	0.000000	0.014655	0.101975	0.816881	0.000000
0.032847	0.000000	0.008878	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	23	23	10	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.333142	0.018976
0.000000	0.350613	0.087232	0.000000	0.060698	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	24	24	11	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.539094	0.113347
0.000000	0.079790	0.120620	0.126043	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	25	25	10	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012700	0.066664
0.014135	0.049848	0.155570	0.650302	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	26	26	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.387484	0.000000	0.000000	0.000000	0.121673	0.000000	0.490843	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	1	0	1	27	27	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.306179	0.387642	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.306179	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	28	28	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	29	29	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.097677	0.000000	0.902323	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	30	30	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.989761	0.004954	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005285	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	31	31	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008402	0.984162	0.000000	0.000000	0.000000	0.007436	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	32	32	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	33	33	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	1	0	1	34	34	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	2	0	1	5	5	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	6	6	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	7	7	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.116254	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	8	8	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.169732	0.567945	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	9	9	12	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.310958	0.011455	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	10	10	18	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.067515	0.687440	0.075810	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	11	11	26	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010203	0.143789	0.529534	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	12	12	58	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.036357	0.756795	0.038064	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2003	1	5	2	0	1	13	13	40	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.892038	0.007224	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	14	14	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008952	0.489755	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	15	15	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.100366	0.072489	0.009117	0.012982	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	16	16	13	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.102130	0.014113	0.027986	0.040777	0.011728	0.086667	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	17	17	6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.113258	0.027987	0.155950	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	18	18	6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.150930	0.000000	0.000000	0.000000	0.000000	0.250952	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	19	19	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.223403	0.052921	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2003	1	5	2	0	1	20	20	3	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.053259	0.000000	0.373483	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.284291	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	2	0	1	6	6	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.285713	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	7	7	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.624384	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	8	8	10	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.256909	0.322636	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	9	9	16	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.391433	0.406875	0.026171	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	10	10	17	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.058086	0.397463	0.067451	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	11	11	24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.331200	0.190696	0.217139	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	12	12	43	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.021880	0.167502	0.655933	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	13	13	44	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007918	0.134863	0.786856	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2004	1	5	2	0	1	14	14	32	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014975	0.181631	0.436113	0.251906	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	15	15	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.085940	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	16	16	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.070859	0.006559	0.029678	0.000000	0.000000	0.031583	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	17	17	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.046703	0.000000	0.000000	0.065908	0.000000	0.000000	0.000000	0.004612
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	18	18	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.047495	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	19	19	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012059	0.000000	0.446378	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2004	1	5	2	0	1	21	21	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.125781	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	5	5	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.266078	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2005	1	5	2	0	1	8	8	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.600565	0.000000	0.214820	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	9	9	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.258148	0.030480	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	10	10	14	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.673967	0.039036	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	11	11	28	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.482926	0.287886	0.061164	0.053347	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	12	12	30	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.042971	0.337624	0.173036	0.212035	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	13	13	54	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011281	0.142910	0.234820	0.441067	0.005075	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	14	14	46	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001195	0.078670	0.319848	0.261318	0.092160	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2005	1	5	2	0	1	15	15	12	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003039	0.058082	0.008674	0.104291	0.000000	0.050041	0.271774	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2005 1 5 2 0 1 16 16 13 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.007165 0.014264 0.090162 0.155009 0.000000 0.000000 0.045926 0.021825 0.000000
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2005 1 5 2 0 1 17 17 9 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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2005 1 5 2 0 1 18 18 11 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.224084 0.017794 0.007371 0.066011 0.000000 0.148599 0.000000
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2005 1 5 2 0 1 21 21 4 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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2005 1 5 2 0 1 23 23 1 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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2006 1 5 2 0 1 4 4 1 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
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0.000000

2006	1	5	2	0	1	6	6	0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.062554	0.832964	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	7	7	5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.871236	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	8	8	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.826183	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	9	9	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.448577	0.032793	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	10	10	7	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.204905	0.000000	0.183667	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	11	11	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.025454	0.030265	0.495850	0.448431	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	12	12	11	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.261190	0.191271	0.244122	0.019653	0.089415	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	13	13	24	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.116494	0.212946	0.101981	0.047346	0.199974	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	14	14	33	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.022968	0.310158	0.181636	0.269791	0.047812	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	15	15	45	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.097410	0.239542	0.170015	0.159912	0.011503	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	16	16	18	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.017380	0.003908	0.561872	0.131206	0.015807	0.017931	0.000000	0.003421	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	17	17	20	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.025795	0.000000	0.000000	0.592180	0.012072	0.069479	0.002288	0.003122	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	18	18	8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.142441	0.033669	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	19	19	2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003616	0.002626	0.004379	0.000000	0.000000	0.009462
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	21	21	0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005079	0.039416	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																
2006	1	5	2	0	1	22	22	4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.024764	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	23	23	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.149339	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	24	24	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.021106	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

2006	1	5	2	0	1	25	25	1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.017656	0.000000	0.000000	0.000000	0.033124	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000																

Ghost of FRAM slope shelf survey, age conditionals

#Year	Season	Type	Gender	Partition	ageerr	Lbin_lo	Lbin_hi	Nsamp	#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	#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																

2003	1	9	1	0	1	-1	-1	1	0.00	21.00	17.00	127.00	30.00	13.00	5.00	4.00
6.00	8.00	10.00	9.00	6.00	5.00	2.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

2004	1	9	1	0	1	-1	-1	1	1.00	17.00	20.00	23.00	138.00	11.00	6.00	13.00
5.00	4.00	4.00	1.00	3.00	1.00	1.00	3.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

2005	1	9	1	0	1	-1	-1	1	0.00	6.00	37.00	56.00	87.00	192.00	41.00	55.00
25.00	22.00	11.00	7.00	12.00	3.00	10.00	2.00	4.00	3.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00
0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

2006	1	9	1	0	1	-1	-1	1	0.00	11.00	5.00	24.00	21.00	38.00	92.00	13.00
11.00	11.00	7.00	6.00	3.00	2.00	4.00	2.00	0.00	0.00	0.00	1.00	2.00	1.00	0.00	1.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

2003 1 9 2 0 1 -1 -1 1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 3.00 19.00 29.00 169.00 7.00 2.00 6.00 4.00 11.00 1.00 0.00 0.00
0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

2004 1 9 2 0 1 -1 -1 1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 20.00 39.00 61.00 108.00 5.00 2.00 4.00 1.00 1.00 1.00 1.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

2005 1 9 2 0 1 -1 -1 1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 1.00 1.00 49.00 45.00 41.00 111.00 15.00 9.00 5.00 4.00 6.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

2006 1 9 2 0 1 -1 -1 1 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 4.00 23.00 9.00 32.00 32.00 31.00 64.00 14.00 4.00 2.00 2.00 2.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

Ghost of Fillet fishery

#Year Season Type Gender Part ageerr Lbin_lo Lbin_hi Nsamp 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 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

1986 1 4 1 2 2 -1 -1 1 0.00 0.00 520.63 1055.94 1939.25 4773.52 15701.97 8911.97
12192.75 13715.51 11699.95 6599.39 4174.24 4987.21 4767.23 1943.49 1744.11 759.02 351.38 499.03 0.00 0.00 173.97 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

1987 1 4 1 2 2 -1 -1 1 0.00 0.00 23.39 1611.22 2753.29 4857.05 14504.27 7006.02
6326.26 7822.49 7318.84 4355.51 4104.66 3071.47 2800.67 1230.67 1499.28 699.48 38.42 13.77 30.07 12.62 0.00 0.00 0.00
7.91 30.07 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00

1988	1	4	1	2	2	-1	-1	1	0.00	0.00	592.51	4253.77	5888.98	5072.44	7868.10	21422.12
8771.29	7346.42	5973.46	8859.15	4386.12	3759.43	3020.32	1264.87	697.95	380.97	0.00	0.00	0.00	0.00	15.08	0.00	15.08
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1989	1	4	1	2	2	-1	-1	1	0.00	0.00	26.45	4118.08	2801.54	3023.35	3552.19	13490.61
9530.58	9730.72	7011.59	3197.94	3133.78	497.65	1013.25	718.69	1154.34	1048.03	0.00	69.37	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1990	1	4	1	2	2	-1	-1	1	0.00	0.00	577.20	1223.30	3597.77	6858.78	13447.22	5707.40
34222.89	13360.76	11749.20	7118.65	5630.56	5254.73	1390.60	1374.05	781.86	514.05	653.83	0.00	28.19	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1991	1	4	1	2	2	-1	-1	1	0.00	0.00	68.18	307.32	2424.20	4016.32	7660.79	7378.38
9207.45	12985.62	8630.01	21451.44	3458.61	3833.41	3468.64	2735.79	1701.71	52.73	289.89	876.45	697.01	197.01	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1998	1	4	1	2	1	-1	-1	1	0.00	0.00	285.75	2986.15	485.98	150.00	1194.87	2198.72
2941.97	5321.50	5174.10	4910.89	3360.17	3174.00	1632.33	978.93	600.00	686.13	263.86	263.86	0.00	0.00	0.00	0.00	0.00
0.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
2003	1	4	1	2	1	-1	-1	1	0.00	0.00	0.00	1493.69	562.16	585.58	413.77	831.98
1180.46	1413.17	1041.38	1678.26	1399.16	1074.34	1078.58	395.91	442.93	431.99	164.05	109.37	54.68	188.11	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
2004	1	4	1	2	1	-1	-1	1	0.00	0.00	81.25	1011.31	10202.84	2155.74	2151.78	3787.43
2380.60	1852.57	2667.32	1000.00	3898.42	1554.39	1500.00	0.00	673.79	1173.79	500.00	0.00	0.00	16.51	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
2005	1	4	1	2	1	-1	-1	1	0.00	0.00	0.00	0.00	0.00	3242.67	648.53	1621.33
1621.33	972.80	648.53	1297.07	648.53	972.80	1945.60	648.53	972.80	324.27	0.00	324.27	324.27	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

1986	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	342.63	3146.12	4225.42	12684.98	18312.27	4192.53	3677.35	4689.65	1874.80	413.40
173.97	173.97	0.00	1038.81	509.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1987	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	432.41	966.30	6179.42	3943.42	1382.78	159.09	23.39	166.09	0.00
256.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1988	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	693.84	6106.90	5503.07	9035.67	4675.02	8191.63	0.00	764.49	390.58	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1989	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.89	2061.55	1246.93	1960.97	4696.82	1594.83	1103.55	1099.69	66.68	416.03
0.00	66.68	0.00	0.00	0.00	0.00	69.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1990	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	93.83	758.54	2144.37	902.79	1309.05	430.40	500.00	392.29	892.29	28.42
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1991	1	4	2	2	2	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.90	383.77	826.03	702.89	600.79	899.15	179.97	0.00	0.00	57.91
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																
1998	1	4	2	2	1	-1	-1	1 0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	150.00	185.82	0.00	0.00	812.43	853.86	315.82	290.00	590.00	325.82	0.00
150.00	0.00	0.00	0.00	150.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	1	4	2	2	1	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3348.58	400.88	364.86	630.44	937.37	338.39	67.80	216.48	94.86
0.00	121.62	135.60	0.00	0.00	121.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

2004	1	4	2	2	1	-1	-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	532.50	590.03	1765.06	64.63	460.77	64.63	64.63	500.00	238.42	173.79
0.00	173.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00																

#

0 # Total number of size-at-age observations

0 # Total number of environmental variables

0 # Total number of environmental observations

999 # End file marker

Status of the widow rockfish resource in 2007
An Update

(Draft)

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July 2007

Executive Summary

Stock: This assessment applies to widow rockfish (*Sebastes entomelas*) located in the territorial waters of the U.S., including the Vancouver, Columbia, Eureka, Monterey, and Conception areas designated by the International North Pacific Fishery Commission (INPFC). The stock is assumed to be a single mixed stock and subject to four major fisheries (see figure below).

Catches: The earliest records of foreign landings of widow rockfish were in 1966. U.S. catches of widow rockfish began in 1973, peaking in 1981. Since the 1981 peak there has been a steady decline in the landings of widow rockfish to 55 mt in 2003 and to 281 mt in 2006. Catches were mostly from commercial fisheries. Catches from recreational fisheries ranged from less than 2 mt in 2003 to 375 mt in 1982. The dominant gear type historically has been the midwater trawl. During the early 1990s, bottom trawl catches nearly matched the midwater trawl catches.

Table E1. Recent landings (mt) of widow rockfish by four fisheries from 1990 to 2006.

Year	Vancouver, Columbia	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey, and Conception	Total
1990	2241	3214	2167	2672	10293
1991	1250	2146	1935	1456	6788
1992	1206	1243	2632	1324	6405
1993	1813	1844	3386	1348	8391
1994	1250	1818	2382	1248	6699
1995	1202	1508	2295	1926	6931
1996	1164	1481	2137	1530	6311
1997	1155	1593	2245	1705	6698
1998	757	890	1330	1304	4280
1999	733	1733	796	901	4162
2000	588	2352	16	1141	4097
2001	383	1109	39	504	2035
2002	118	323	3	64	508
2003	23	27	0	5	55
2004	36	42	2	28	109
2005	72	134	1	12	219
2006	92	175	2	12	281

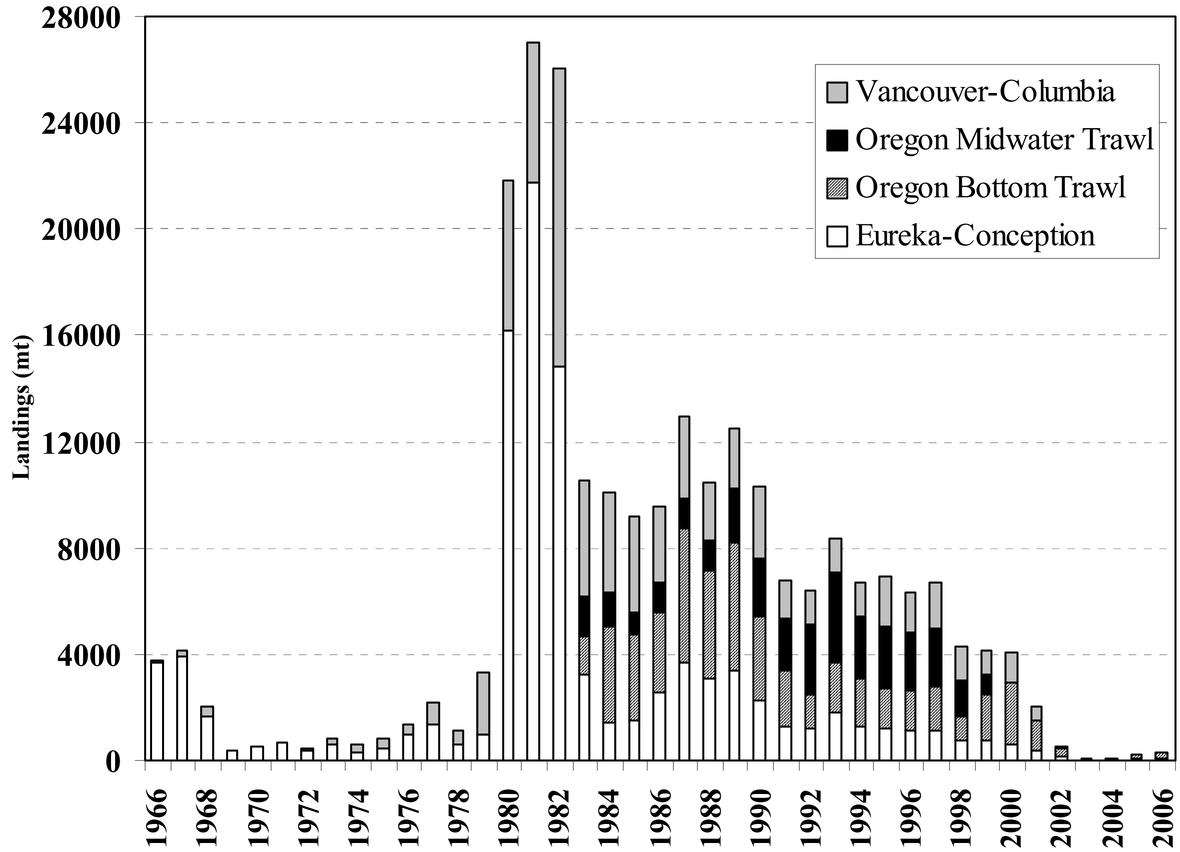


Figure E1. Total landings of widow rockfish from 1966 to 2006

Data and assessment: The last assessment of widow rockfish was conducted in 2005 using an age-based population model (written in ADMB, He et al. 2006). All fishery data, including landings, age composition, and logbook catch rates, were recently downloaded from the PacFIN, CALCOM, and NORPAC databases, or provided by state and federal agencies. Since this assessment is an update assessment, the same assessment model and data compiling procedures were used in this assessment. New data from 2005 and 2006, including catches, age composition, and CPUE time series, were included in this assessment.

Unresolved problems and major uncertainties:

1. The primary source of information on trends in abundance of widow rockfish comes from the Oregon bottom trawl logbook data, which is a questionable source of information for widow rockfish. In addition, no information after 1999 in the Oregon bottom trawl logbook data can be used in the assessment because the catch rates were very low due to trip limits and other management regulations. Based on a recommendation by the 2003 STAR panel, triennial survey indices have been used in this assessment as an additional abundance index.
2. Natural mortality was fixed at 0.15 in previous assessments. The 2005 STAR panel recommended natural mortality to be fixed at 0.125, but the validity of this estimate is still uncertain.

3. There exist uncertainties in estimating stock-recruitment relationships. Similar to other rockfish species in the area, the biomass of widow rockfish has decreased steadily since the early 1980s and recruitment during early 1990s is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment during the period could be due to lower spawning stock biomass, but it could also be due to a lower productivity regime. However, there is evidence that recruitment of many rockfish species since 1999 has been higher than the average of the 1990s. This is also supported by the most recent juvenile survey data and age composition data.
4. The uncertainties in stock-recruitment relationship would lead to greater uncertainties in the rebuilding analysis because it largely depends on how future recruitments are generated.
5. There was considerable discussion about the appropriate use of the Santa Cruz juvenile survey data in the 2003 and 2005 STAR Panel reviews. It was noted that the survey indices are highly variable, that the index has not always identified strong year-classes, and that power transformation of this index has some influences on the results. It has been suggested that the area coverage of the Santa Cruz juvenile survey might not be sufficient to monitor coast-wide distribution of widow rockfish and oceanographic conditions. The Pre-recruit Survey Workshop held in September 2006 suggested using only coast-wide pre-recruit survey indices, which are only available from 2001 to 2006. Since the assessment model uses 3 to 20+ age groups, only pre-recruit data from 2001 to 2003 can be used in the assessment model. It is a very short time series data. Nevertheless, a model run with only 2001-2006 coast-wide pre-recruit survey indices is included for reference (Appendix B).
6. Stock structure issues, in particular the relationship to the Canadian stock, remain an important source of uncertainty.

Reference points: The percentage ratio of spawning output in 2006 to unfished spawning output (B_0) is the population status ("depletion rate"). A depletion rate below 25% indicates an overfished stock, and depletion rates between 25% and 40% indicate a precautionary zone. A depletion rate over 40% is a healthy stock. The following reference points were obtained from the assessment model:

Table E2. Estimated reference points from the assessment.

Quantity	Value
Unfished spawning output (B_0)(millions of eggs)	50746
Current spawning output (B_t) (millions of eggs)	17999
Depletion rate ($100*B_t/B_0$)	35.5
Spawning output at MSY (B_{msy}) (millions of eggs)	20298
Basis for B_{msy}	$B_{40\%\ proxy}$
F_{msy}	0.1210
Basis for F_{msy}	$F_{50\%\ proxy}$

Stock biomass: Stock biomass has shown a steady decline between 1977 and 2001, soon after the fisheries for widow rockfish began. Since 2001, stock biomass has shown an increasing trend. The following table and figure show time series of estimated catches, discards, stock biomass, fishing mortality, and recruitments from the assessment model.

Table E3. Estimated biomass, recruitment, discard, and other annual parameters from the stock assessment from 1990 to 2006.

Year	Total biomass (mt)	Spawning biomass (mt)	Recruitment (*1000)	Landing (mt)	Discard (mt)	Fishing Mortality	Exploitation rate	Depletion (%)
1990	145047	65108	24898	10285	1959	0.1759	0.1572	49.5
1991	133802	60851	16128	6792	1294	0.1258	0.1144	46.9
1992	126355	58084	16102	6409	1221	0.1279	0.1191	45.3
1993	123358	54928	29824	8377	1596	0.1885	0.1708	43.1
1994	123673	50630	45363	6678	1272	0.1666	0.1508	39.8
1995	118715	47835	13939	6911	1316	0.1841	0.1698	37.4
1996	113625	45917	15758	6295	1199	0.1704	0.1566	35.3
1997	108063	45600	13534	6680	1272	0.1639	0.1504	34.6
1998	99972	45148	7470	4281	815	0.1005	0.0942	34.3
1999	94495	44774	7663	4167	794	0.1076	0.0966	34.4
2000	89355	43209	9847	4109	783	0.1182	0.1031	33.8
2001	87514	40888	22504	2038	388	0.0647	0.0574	32.4
2002	88277	39419	18126	508	97	0.0183	0.0158	31.5
2003	105582	39194	66180	55	11	0.002	0.0018	31.3
2004	110688	40131	16045	109	21	0.0035	0.0033	31.5
2005	116042	43017	17236	219	42	0.0067	0.0058	32.8
2006	120132	47478	16393	281	53	0.0065	0.0057	35.5

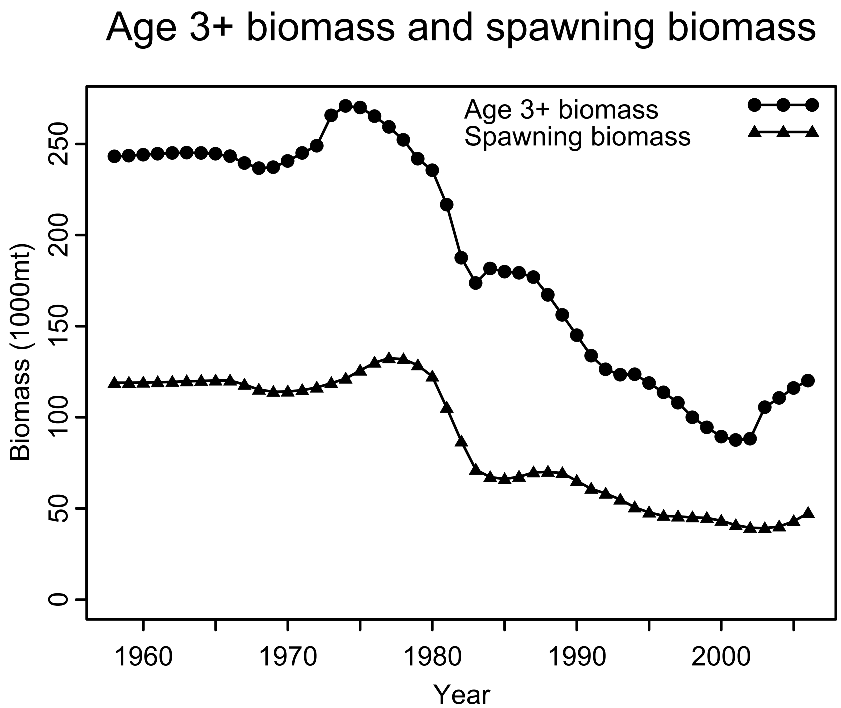


Figure E2. Age 3+ biomass (1000mt) and spawning biomass (1000mt) from 1958 to 2006 estimated from the assessment model.

<u>Recruitment</u>: The model estimated time series of recruitment of age 3 fish from 1958 to 2006. The highest recruitment occurred in 1972. Recruitments remained generally low in the early 1990s as compared to the long-term average, but showed an increasing trend in recent years. Figure E3 shows that recruitment of age 3 in 2003 (born in 2000) is relatively high. This relative strong recruitment class is one of main reasons that the current spawning biomass is higher than that in the 2005 assessment. However, there are uncertainties about how strong this recruitment class really is. One reason is that we have small ageing samples from the most recent years to better measure this recruitment class.

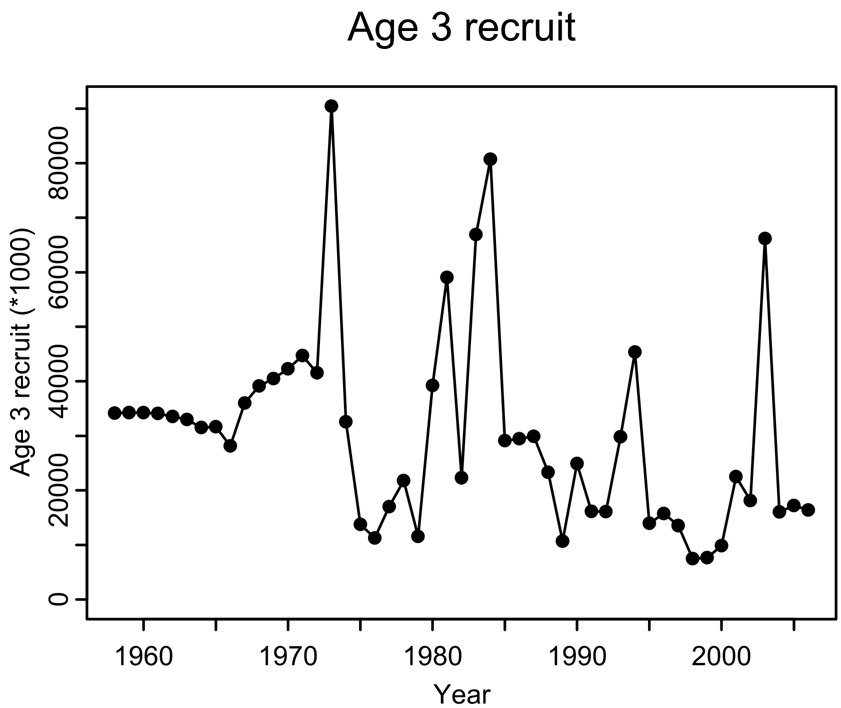


Figure E3. Age 3 recruits (*1000) from 1958 to 2006 estimates from the assessment model.

Exploitation status: The point estimate of the current spawning output is at 35.5% of the unfished level (see table above).

Management Performance: See below.

Table E4. Management performance from 1989 to 2007.

Year	Harvest Guideline	Allowable Biological Catch	Landings
1989	12100	12400	12489
1990	12400	8900	10293
1991	7000	7000	6788
1992	7000	7000	6405
1993	7000	7000	8391
1994	6500	6500	6699
1995	6500	7700	6931
1996	6500	7700	6311
1997	6500	7700	6698
1998	5090	5750	4280
1999	5090	5750	4162
2000	5090	5750	4097
2001	2300	3727	2035
2002	856	3727	508
2003	832	3871	55
2004	284	3460	109
2005	285	3218	219
2006	289	3059	281
2007	368	5334	

Forecasts: The estimated current depletion rate is 35.5% of unfished (virgin) spawning output with 95% confidence level ranged from 22.9% to 48.1%. It is estimated that the population will recover to the target (40% of unfished spawning output) in 2009. Forecasts of future biomass at five constant catch levels (ranged from 500mt to 4000mt each year) are presented in the following tables and figures. They show that the biomass will not fall below the target biomass (40% of unfishing level) if future catches remain at or below 2000mt per year.

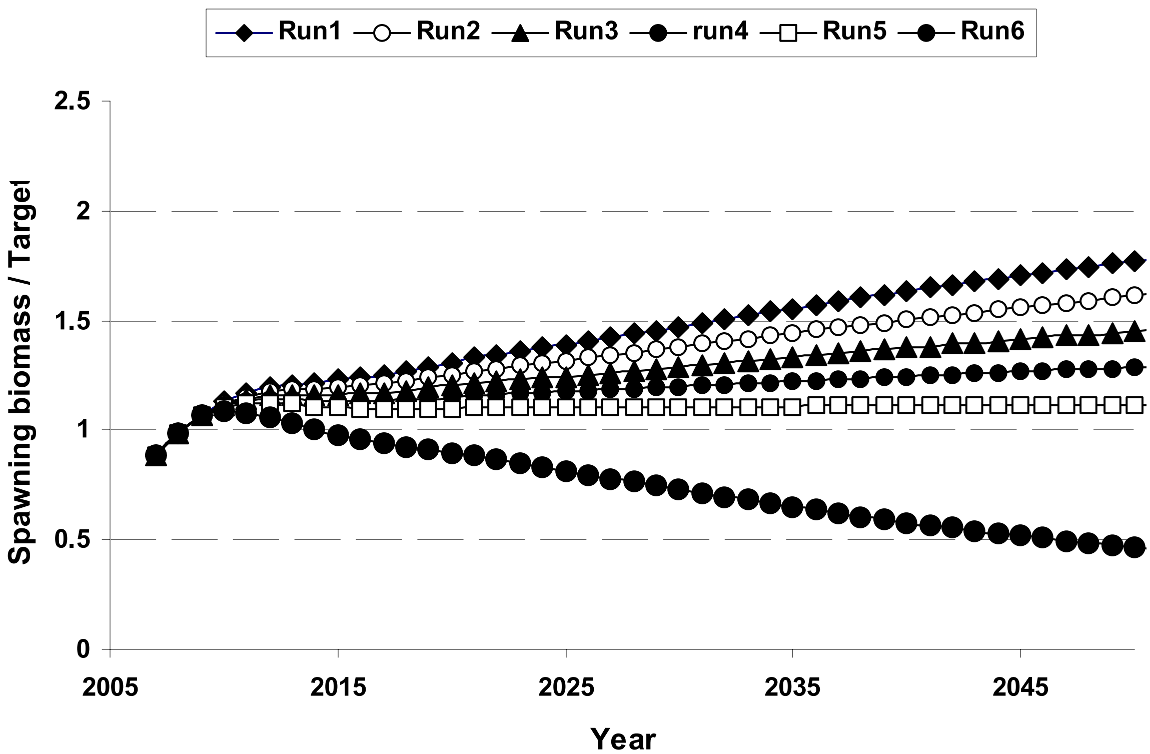
Table E5. Specifications of six rebuilding simulation runs based on different annual catch for future years. Future recruitments are generated using the stock-recruitment relationship estimated in the stock assessment. Maximum fishing mortalities for all future years are set to *Fmsy*.

Run name	Start Year	Catch time series
Run1	2007	368 mt of catch in 2007, and then no catch thereafter
Run2	2007	368 mt of catches in 2007 and 2008, 500 mt thereafter
Run3	2007	368 mt of catches in 2007 and 2008, 1000 mt thereafter
Run4	2007	368 mt of catches in 2007 and 2008, 1500 mt thereafter
Run5	2007	368 mt of catches in 2007 and 2008, 2000 mt thereafter
Run6	2007	368 mt of catches in 2007 and 2008, 4000 mt thereafter

Table E6. Proposed future catches (mt) and estimated exploitable biomass (mt) for six rebuilding runs from 2009 to 2018. The estimated target exploitable biomass is about 26,790 mt, which is roughly corresponding to 40% of virgin spawning output. The population is estimated to recover in 2009. SPR rates and fishing mortalities are average values from 2007 to 2018.

	Run1		Run2		Run3		Run4		Run5		Run6	
Probability of recovery	1.0		1.0		1.0		1.0		1.0		1.0	
Recovery time	2009		2009		2009		2009		2009		2009	
SPR rate	1.000		0.9479		0.8863		0.8356		0.7861		0.6020	
Fishing mortality	0.0000		0.0081		0.0155		0.0232		0.0313		0.0681	
	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass
2009	0	67193	500	66703	1000	66501	1500	66299	2000	66097	4000	61109
2010	0	65869	500	65052	1000	64489	1500	63926	2000	63363	4000	56296
2011	0	63346	500	62275	1000	61420	1500	60565	2000	59710	4000	51885
2012	0	60671	500	59416	1000	58342	1500	57267	2000	56192	4000	48512
2013	0	58624	500	57239	1000	55995	1500	54749	2000	53508	4000	46276
2014	0	57431	500	55937	1000	54554	1500	53173	2000	51809	4000	45039
2015	0	57020	500	55442	1000	53985	1500	52503	2000	51020	4000	44389
2016	0	57275	500	55598	1000	54022	1500	52427	2000	50831	4000	43937
2017	0	57891	500	56093	1000	54400	1500	52690	2000	50962	4000	43381
2018	0	58480	500	56533	1000	54700	1500	52855	2000	50986	4000	42897

Figure E4. Time series of spawning biomass over target for proposed six simulation runs. Note that only Run6 (annual catch of 4000mt) results in the spawning biomass fell below the target level (spawning biomass over target equals to 1).



<u>Recommendations</u>:

1. There are increasingly fewer reliable abundance indices for widow rockfish. Recent management measures have undermined the ability to continue fishery dependent time series of relative abundance from the Oregon bottom trawl fishery and Pacific whiting fishery since 1999. The constant flux of the management regime suggests that there is little likelihood that meaningful CPUE indices can be developed from these fisheries in the future. More analysis should be done to either calibrate or compare triennial survey results with those from the NWFSC Combined survey.
2. Long-term recruitment index is a key datum series in the stock assessment. Continuation of the midwater juvenile trawl survey and recent increases in sampling intensity and spatial coverage will improve estimation confidence and data quality. Comparison and possibly integration of the existing juvenile survey results with a recently initiated survey by the fishing industry (See Report on Pre-recruit Survey Workshop, September 2006) could also broaden the spatial extent of this index. The ability to infer direct and indirect estimates of year class strengths from surveys and other sources, as well as to better understand the relationship between environmental conditions in the California Current

System, should improve short-term forecasts of productivity, biomass levels and allowable catches from stock assessments.

3. Preliminary information from recent bycatch monitoring suggest that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.
4. The utility of hydro-acoustic surveys on widow rockfish abundance should be evaluated in future assessments.
5. Sample sizes for existing age-collection programs (by fishery and survey) should be increased substantially.
6. The age-composition for the triennial survey should be determined by applying year-specific age-length keys to the survey length-frequencies, and included in future assessments as a basis for estimating survey selectivity.

Introduction

Widow rockfish (*Sebastes entomelas*) is an important commercial groundfish species belonging to the scorpionfish family (Scorpaenidae). It ranges from southeastern Alaska to northern Baja California, where it frequents rocky banks at depths of 25-370m (Eschemeyer et al. 1983, Wilkins 1986). In those habitats it feeds on small pelagic crustaceans and fishes, including especially *Sergestes similis*, myctophids, and euphausiids (Adams 1987). There is no evidence that separate genetic stocks of widow rockfish occur along the Pacific coast and the species has been treated as one stock with four separate fisheries (Hightower and Lenarz 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al. 2002).

A midwater trawl fishery for widow rockfish developed rapidly in the late 1970s and increased rapidly in 1980-82 (Gunderson 1984, Fig. 1 and Table 1). Large concentrations of widow rockfish had evidently gone undetected because aggregations of this species form at night and disperse at dawn, an atypical pattern for rockfish. Since the fishery first developed, substantial landings of widow rockfish have been made in all three west-coast states.

Management of the fishery began in 1982 when 75,000 lbs trip limits were introduced in an effort to curb the rapid expansion of the fishery (Tables 2-3). These were reduced to 30,000 lbs in 1983 and the fishery was managed by alteration of trip limits within the fishing season. A 10,500 mt/yr Allowable Biological Catch (ABC) for widow rockfish was instituted in 1983 (Table 3), but no harvest guideline was established. This form of management continued with alterations in ABC and trip limits until 1989 when a 12,100 mt/yr harvest guideline was implemented (Tables 2-3). From 1994-1997 the harvest guideline was changed to 6,500 mt and then reduced to 5090 mt/yr for 1998 to 2000. Based on the 2000 stock assessment and the rebuilding analysis of 2001 and 2003, the harvest guidelines were further reduced to 2,300 mt for 2001, 856 mt for 2002, 832 mt for 2003, 284 mt for 2004 and 2005, and 386 mt for 2006 and 2007 (He et al. 2003a, He et al. 2003b, He et al. 2006a, He at al. 2006b).

This assessment used an age-based population model similar to those used in previous assessments (Ralston and Pearson 1997, Williams et al. 2000, He et al. 2003b, He et al. 2006a). Since this is an update assessment, the model structure and code were same as in the 2005 assessment (He et al. 2006a). The new data from 2005 to 2007, including catches, age compositions, CPUE estimates, and bycatch estimates were added to this update assessment.

Data

Biological information

Growth in length for widow rockfish has been described using von Bertalanffy growth equations in two papers by Lenarz (1987) and Pearson and Hightower (1991). In their analyses it was determined that females attain a larger size compared to males and fish from the northern part of the range tend to be larger at age compared to those in the south. For these reasons we chose to use the sex-specific and area-specific estimates for length-at-age. Furthermore, we chose to use the estimates listed in Pearson and Hightower (1991), shown below and in Figure 2, because they are from a more recent and comprehensive analysis of widow rockfish growth compared to the analysis by Lenarz (1987). In order to match the fisheries, we used the Columbia-Eureka INPFC area border (43^{o} Lat.) to delineate north from south.

Parameter	Females (north)	Males (north)	Females (south)	Males (south)
L_{inf} (cm)	50.54	44.0	47.55	41.5
K	0.14	0.18	0.2	0.25
t_0	-2.68	-2.81	-0.17	-0.28

Sex-specific weight-at-age estimates were computed using the length-at-age estimates above with sex-specific length-weight regressions for widow rockfish developed by Barss and Echeverria (1987) (Figure 2). The length-weight regression equation is $W = \alpha L^{\beta}$, where W is the weight (g) and L is the length (cm). The sex-specific parameter values used in this assessment are listed below:

Parameter	Females	Males
α	0.00545	0.01188
β	3.28781	3.06631

Estimates of maturity and fecundity of female widow rockfish were obtained from Barss and Echeverria (1987) and Boehlert et al. (1982), respectively. Age-specific maturity estimates were taken directly from the literature instead of fitting a parametric model (Figure 3), while age-specific fecundity was computed using the weight-fecundity regression:

$$F = 605.71W - 261830.7 \qquad (1)$$

where F is fecundity (number of eggs) and W is weight (g). The weight-fecundity regression applied to the southern weight-at-age estimates resulted in negative values for ages 3 and 4. The weight-fecundity regression developed by Boehlert et al. (1982) was based on fish captured from Oregon and apparently does not apply to widow rockfish in the south. The maturity estimates shown in Figure 3 indicate a substantial difference in maturity-at-age between the north and south, with the northern fish maturing at an older age. Lacking any other estimate of fecundity for the south, we applied the weight-fecundity regression from the north and modified the estimates for ages 3-5 to approximate an asymptote to 0 (Figure 3).

Landings

All landings for the period 1966-2006 were summarized into four areas (fisheries): (1) Vancouver-Columbia (VC); (2) Oregon mid-water trawl (ORMWT); (3) Oregon bottom trawl (ORBTWL); and (4) Eureka, Monterey, and Conception (EMC). Landings statistics used in this assessment were derived from four sources. First, all commercial landings from 1981 were extracted from the PacFIN database. Second, the very small annual recreational take of widow rockfish was extracted from the Marine Recreational Fishing Statistics Survey (MRFSS) database. Third, all landings from 1966 to 1972, and some landings from 1973 to 1976 were directly taken from a summary table in Rogers (2003), who recently compiled summaries of foreign catches in the period. Fourth, some landing from 1973 to 1976 and all landings from 1977 to 1979 were directly copied from the last assessment (Williams et al. 2000). Summarized landings by year are presented in Table 1 and Figure 1.

As in the last assessments of widow rockfish, the data were pooled over states into INPFC area blocks. These in turn were collapsed into northern and southern areas, representing the U.S. Vancouver and Columbia areas (VC, ORMWT, and ORBTWL) and the Eureka, Monterey, and Conception areas (EMC), respectively. The northern and southern areas are conveniently delineated by the 43^{o} latitude line. Within the southern area, widow rockfish landings were further condensed by summing over gears (i.e., trawl, other commercial, and recreational), providing annual estimates of landings from the southern area fishery. In the northern area, however, landings were partitioned into three separate fisheries; the Oregon midwater trawl fishery, the Oregon bottom trawl fishery, and the remaining catch of widow rockfish, referred to as the Vancouver-Columbia fishery. Because identification of gear types in Oregon (midwater or bottom trawl) did not begin until 1983, all landings in the northern area prior to that time were assigned to the Vancouver-Columbia "trawl" fishery.

It should be noted that there are some differences in the landing statistics between this assessment and that used in the last assessment (He et al. 2006a). First, landings from California waters in early years were corrected by using new catch composition data. These changes, however, are very small (Don Pearson, Personal communication). Second, it was discovered during the June 2007 review meeting that catches in recent years from at-sea processing vessels were not included in the total landings because they were not being reported by state. These landings are relatively small compared to the total landings (Table 1a) and they are now included in total landing estimates. Third, newly estimated bycatches on widow rockfish from 1991 to 2006 were provide by the Northwest Fisheries Science Center and are included in the total landing estimates (Jim Hastie, NMFS Northwest Fisheries Science Center, personal communications). These landings were grouped into either the Vancouver-Columbia fishery or the Oregon mid-water trawl fishery, proportioned by number of hauls observed north or south of latitude of 46 degrees.

Age composition data

Widow rockfish otolith samples collected coastwide since 1989 have been aged at the NMFS Fisheries Ecology Division in Santa Cruz (Tiburon) using the break and burn aging method (Pearson and Hightower 1991). Prior to 1989, the ages of all Vancouver-Columbia fish were obtained by researchers in the State of Washington, who used surface readings. Prior to 1987, Oregon widow rockfish were aged by investigators in Oregon, who used the break and burn aging method. All California fish were aged by Fisheries Ecology Division in Santa Cruz using the break and burn aging technique.

Age validation of widow rockfish was conducted by marginal increment analysis (Lenarz 1987). Hyaline-zone formation, the measure of annual growth, appears to occur between December and April (Pearson 1996). For convenience all widow rockfish are assumed to be born on January 1. Variation in the timing of the hyaline-zone formation occurs between fish from Washington and California, which could affect age determination. Knowledge of the timing variation can be used to avoid mis-ageing and ultimately the variation in hyaline-zone formation is not likely to result in major age discrepancies (Pearson 1996).

Washington provided ageing data from samples collected during commercial market sampling. The data were then expanded using relative catches from US Vancouver and Columbia areas. Oregon provided raw sample data which were expanded using methods described in Sampson and Crone (1997). California age data was extracted and expanded from the CALCOM database (Pearson and Erwin 1997).

In 2005 assessment, new otolith samples from the Eureka-Conception area from 1978 and 1979 were discovered last year. The samples were analyzed and included in the 2005 assessment. For this update assessment, only three sets of age composition data are available. There are age compositions data from US Vancouver and Columbia fisheries in 2005 and 2006, and from Oregon midwater trawl in 2006. The complete sex specific age composition data and sample size information for the four fisheries are presented in Tables 4-8 and Figures 4-7.

Midwater trawl pelagic juvenile survey

Every year since 1983 the Groundfish Analysis Branch at NMFS Fisheries Ecology Division in Santa Cruz/Tiburon Laboratory has conducted a midwater trawl survey, which is designed to assess the reproductive success of rockfish, including widow rockfish. The survey is conducted during May-June, the time of year when the pelagic juvenile stage is most susceptible to capture. Studies have shown that abundance statistics summarized from the survey gauge impending recruitment (Adams 1995; Ralston and Howard 1995; Ralston et al. 1996). Recent efforts to quantify spatial patterns of recruitment variability also suggests that there is substantial synchrony in year class strength over spatial scales on the order of 500-1000 km for widow, as well as chilipepper (*S. goodei*) and yellowtail (*S. flavidus*) rockfish (Field and Ralston 2005). Although much of the spatial variability in year class strength that does exist is associated with major geographic features such as Cape Mendocino and Cape Blanco, these results support the argument that recruitment variability is driven to a large extent by forcing factors operating over large spatial scales.

The survey index is calculated after the raw catch data are adjusted to a common age of 100-days to account for interannual differences in age structure. The abundance data are gathered during three consecutive sweeps of a series of 36 fixed stations that are arrayed over 7 spatial strata that extend from Carmel (36°30'N) to Bodega (38°20'N). As in the previous assessment, the index is calculated using Delta-GLM (Generalized Linear Model) method with lognormal error structure (Pennington 1986, 1996, Stefansson 1996):

$$\log(density) = \mu + Y_i + L_k + \varepsilon \qquad (2)$$

where u is the average $\log(density)$, Y_i is a year effect, L_k is a 'period' (bins of 10-julian days) effect, and ε is a normal error tern with mean zero and variance σ^2. The back-transformed year-specific index, with bias-correction, was then calculated as:

$$Index_i = \exp\left(\mu + Y_i + \bar{L} + \frac{\sigma^2}{2}\right)\pi_i \qquad (3)$$

where $\bar{L}$ is the mean period effect, and π_i is the predicted proportion of positive tows in year i:

$$\pi_i = \frac{\exp(\mu' + y_i' + \bar{L})}{1 + \exp(\mu' + y_i' + \bar{L})} \qquad (4)$$

where μ' is the average, y' is the year effect, and $\bar{L}$ is the average period effect of the logit-transformed probabilities. The coefficient of variation (CV) for each index value was computed from the jack-knife method.

Data from 1983 were deleted from the analysis because of a small total number of datum points. Because no juvenile widow rockfish were caught in 1992, 1996, and 1998, index values for those years were set to one half of the historical low value, and CVs for those years were set to a high value of 2.0. The resulting indices were entered into the model as relative indices of one-year juvenile abundance (Table 9 and Figure 8). The index time series (1984-2006) was then shifted forward three years (1986-2009) to represent the abundance of age-3 widow rockfish, the age of recruitment in the assessment model.

Oregon bottom trawl logbook

Oregon logbook data from 1984 to 1986 were provided by the Oregon Department of Fish and Wildlife, and data from 1987 to 2002 were extracted from the PacFIN database. Catch per unit effort (CPUE) was computed as pounds of fish caught per hour trawled. The data were filtered before the analysis. Only records meeting the following criteria were used in the analysis: (1) the fishing gear code corresponded to bottom trawl or roller gear, (2) hauls were conducted during the months of January, February, or March, and (3) the location of the reported haul fell in the range of 42°30'N to 46°30'N latitude and 124°36'W to 124°54'W longitude. In addition, records associated with any vessel code or spatial unit that had less than 1000 pounds of widow catch over the entire period (1984 to 2002) were also deleted. Data from 2000 to 2002 were not used in the analysis because widow catches in those three years were very low due to trip limits and other management regulations (Tables 2 and 3).

Annual CPUE indices were derived using the Delta-GLM (Generalized Linear Model) method similar to that used for deriving midwater trawl pelagic juvenile survey (see previous section), with an additional factor (vessel) included:

$$\log(CPUE) = \mu + Y_i + V_j + L_k + \varepsilon_{ijkl} \qquad (5)$$

where u is the average $\log(CPUE)$, Y_i is a year effect, V_j is a vessel effect, L_k is a spatial (latitude and longitude) effect, and ε_{ijkl} is a normal error tern with mean zero and variance σ_ε^2. The back-transformed year-specific CPUE, with bias-correction, was then calculated as:

$$CPUE_i = \exp\left(\mu + Y_i + \overline{V} + \overline{L} + \frac{\sigma_\varepsilon^2}{2}\right)\pi_i \qquad (6)$$

where $\overline{V}$ and $\overline{L}$ are mean effects of vessel and spatial unit, respectively, and π_i is binomial coefficient:

$$\pi_i = \frac{\exp(\mu' + y_i' + \overline{V}' + \overline{L}')}{1 + \exp(\mu' + y_i' + \overline{V}' + \overline{L}')} \qquad (7)$$

where μ' is the average, y' is year effect, $\overline{V}'$ is average vessel effect, and $\overline{L}$ is average spatial effect. Derived annual CPUE indices are presented in Table 10 and Figure 9, which are same as in the 2003 assessment.

Pacific whiting bycatch indices

As in the previous assessments (Rogers and Lenarz 1993, Ralston and Pearson 1997, Williams et al. 2002), CPUE indices were computed that measured the incidental catch rate of widow rockfish in the at-sea pacific whiting fishery. Data from the foreign fishery, joint-venture fishery and recent domestic fishery were extracted from the NORPAC database.

Full descriptions on how the CPUE indices were derived are in Appendix A of the 2005 Assessment (He et al. 2006a). Similar Delta-GLM approaches as used for the Oregon bottom trawl logbook is used in the analysis. Annual CPUE indices for the foreign fishery, joint-venture fishery, and domestic fisheries are presented in Table 11 and Figure 10. As recommended by the 2003 STAR Panel, annual CPUE indices from the domestic fishery after 1998 were excluded from the analysis because changes in management measures are expected to have more influence on the CPUE than changes in stock size.

Triennial trawl survey index

The AFSC/NWFSC triennial trawl survey index was not used in the 2003 assessment because of very limited widow catches by the survey and very poor fit of the index in the assessment model (He et al. 2003). The 2003 STAR panel recommended the index be analyzed further and be considered for inclusion in the assessment. Another important reason to include the triennial survey index in the assessment is that the index is likely going to be the only abundance index available in the future because other abundance indices from commercial fisheries will not be suitable for the assessment due to management regulations. The analysis of the triennial survey data uses the similar Delta-GLM method as for other indices, the results are presented in Table 12 and Figure 11, and detailed description of the analysis is in Appendix B of the 2005 assessment (He et al. 2006a).

History of modeling approaches

Previous assessments for widow rockfish have been performed in 1989, 1990, 1993, 1997, 2000, 2003, and 2005 (Hightower and Lenarz 1989, 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al 2000, He et al. 2003, He et al. 2006a). In 1989 the assessment involved the use of cohort analysis and the stock synthesis program (Methot 1998). In 1993 and 1997, the age-based version of the stock synthesis program was used to assess the status of widow rockfish. In 2000 and 2003, the assessment of widow rockfish utilized AD Model Builder (ADMB) software (Otter Research, Ltd. 2001), and applied an age-based analysis of the population with methods very similar to those used in the stock synthesis program. The differences between the ADMB model and stock synthesis are minor. The ADMB model estimates landings with a very low coefficient of variation (0.05), while stock synthesis treats landings in a slightly different manner and the initial age composition estimation process is slightly different in the two models. A full description of the ADMB model follows and should clarify any further differences between this model and the stock synthesis program used in past assessments of widow rockfish.

Model description

General

Since this is an update assessment, this assessment uses the same age-structured population model that was used in the 2005 assessment (He et al. 2005a). Full descriptions of the population dynamics, catch equations, and associated likelihood functions are given in Appendix C of the 2005 assessment. The model is written in a C++ software language extension, AD Model Builder (ADMB) (Otter Research, Ltd. 2001), which utilizes automatic differentiation programming (Greiwank and Corliss 1991; Fournier 1996). The ADMB software allows for more rapid and accurate computation of derivative calculations used in the quasi-

Newton optimization routine (Chong and Zak 1996). Further advantages of this software include the ability to estimate the variance-covariance matrix for all dependent and independent parameters of interest, likelihood profiling, and a Markov chain-Monte Carlo re-sampling algorithm for probability distribution determination.

The population model begins in 1958 and tracks numbers and catches of male and female widow rockfish in age classes 3-20 (age 20 is an age-plus group). In the 2000 assessment, a starting year of 1968 was chosen based on the assumption that the 1965 year class was the earliest recruitment which could be reasonably estimated given a starting year of 1980 for the age composition information. In the 2003 assessment and this assessment, the starting year was extended backward to 1958 because the new landing data from 1966 to 1972 were added. Recruitment estimates prior to 1958 are assumed equal to the 1958 estimate in the model, so that the model is estimating recruitment at age 3 for the years 1958-1999.

The data used in this model include 4 fishery catch-at-age compositions (sum across sexes equal to one), landings in weight for each fishery, NMFS Fisheries Ecology Division's midwater juvenile survey index, Oregon bottom trawl logbook CPUE, three whiting bycatch indices, and triennial survey indices. Predicted catch in each year is scaled to the fishery landings assuming a coefficient of variation of 5%. Double logistic selectivity functions by age were estimated for each fishery.

Natural mortality

Natural mortality (M) is assumed to be constant for all ages and in all years. The initial model allowed the model to estimate a slightly higher natural mortality for males than females based on the observation that there were more old females than males in the age data. The model was presented to the 2003 STAR Panel. It was noted that greater proportions of males at younger ages could be due to differences in selectivity by gender. Allowing for different natural mortality had little impact on model results and the differences in M were small (<0.01). The 2003 STAR Panel considered that until the reason for the difference in age composition has been elucidated, the same natural mortality value should be used for both sexes. Therefore, natural mortality was fixed at 0.15 for the 2003 assessment. The 2005 STAR Panel requested that natural mortality be estimated in the model. After a series of model runs, it was decided natural mortality to be fixed at 0.125 for the assessment model.

Age compositions

The age data are modeled as multinomial random variables, with the year-specific sample sizes set equal to the number of samples collected, rather than the number of fish, which often overstates the confidence of the data (Table 8) (Quinn and Deriso 1999). However, this assessment also examined an iterative-reweighting method to determine the effective sample size in the likelihood functions (details in the Likelihood component weighting section).

Ageing error

The only information available for determination of ageing error was based on two point estimates of percent ageing agreement from the last two assessments (Rogers and Lenarz 1993; Ralston and Pearson 1997). From the previous assessments an estimate of 75% agreement for age 5 fish and 66% agreement for age 20 fish was modeled by assuming a linear relationship of percent agreement with age. These estimates of percent agreement at age were then fit to a set of age-specific normal distributions, which approximated the level of ageing agreement. The resulting matrix of true age versus reader age was then placed in the model

$$A_t = EA_r \qquad (8)$$

where A_t and A_r are n*n matrices for true age and reader age, respectively, n is number of age classes, and E is a n*n matrix for ageing error with the sum across each column equals to one.

Landings

A constant CV of 0.05 is assumed for landing estimates. Year-specific fishing mortalities are computed for each fishery for those years in which there are landings estimates available. Fishing mortalities were zero from 1958 to 1965 since there are no landings estimates for those years.

Fraction of landings in the north

Since there are area specific (north and south) estimates for weight-at-age and maturity, it is necessary to determine the fraction of the population to which each of these area-specific estimates apply. We used the sum of the domestic landings in the Vancouver-Columbia and both Oregon trawl fisheries relative to the total landings as an estimate of the proportion of the population to which the northern weight-at-age and maturity functions could be applied. Foreign landings from 1966 to 1976 from Rogers (2003) were not used in computing the fractions. The annual change in this fraction seemed highly variable and not likely to be indicative of true declines in area abundances. For this reason, the time series of proportions of landings in the north were smoothed using a 7-year moving average (Figure 12). The results from the moving average were then put directly into the model, applying the 1973 value to the earlier years.

Discards

The level of discards of widow rockfish is virtually unknown in most of years. Age compositions in discards and landings can be very different (typically small fish are discarded) and can be important in determining discard rates (Williams et al. 1999). In past assessments a value of 6% of total weight was assumed for years 1958-1982 and 16% of total weight for the years 1983-2002 (Hightower and Lenarz 1990, Williams et al. 2000, He et al. 2003). The same discard rates (16%) were also applied for the years 2003-2004 in this assessment. The 16% estimate of discards is based on a dated study by Pikitch et al. (1988), which indicated most of the discards of widow rockfish were induced by regulations. The earlier 6% estimated is based on an ad hoc adjustment of the 16% by previous assessment authors (Hightower and Lenarz 1990). The 16% assumed value has likely become more uncertain in recent years due changes in regulations. For example, the most recent estimate on discard rate from the 2002 observer data, based on 89mt of widow rockfish catch, was 0.1%, which is much lower than the 16% assumed value.

Midwater juvenile trawl survey

The NMFS Fisheries Ecology Division's midwater trawl juvenile survey is scaled to represent an index of 100 day-old larvae. For inclusion in the model the time series was lagged to correspond with the appropriate year class. Within the model a catchability coefficient is estimated. In past assessments (Williams et al. 2002, He et al. 2006a), a power coefficient was used for the midwater trawl survey. The power transformation was included to account for possible density dependent mortality occurring between 100 days of age and age 3 (the age of recruitment in the model), which likely results in higher variance levels in the survey time series relative to age 3 recruitment time series. However, the 2003 STAR panel argued that using power coefficient might dampen the estimate of recruitment variability. In the 2005 assessment, the power transformation is re-examined (see details in the Model Selection section). Test runs also showed that the results were only slightly different between using the power coefficient of 1.0 and 3.0, which was the default value in the 2003 assessment. In this assessment, the power transformation is used as in the 2005 assessment.

Logbook and bycatch indices

The Oregon bottom trawl logbook indices and whiting bycatch indices are treated as biomass indices and are estimated in the model with a catchability parameter for each index. Because there were no new data since the 2003 assessment, the same Oregon bottom trawl logbook indices from the last assessment are used in this assessment. The whiting bycatch indices are recalculated according to the 2003 STAR panel recommendations, however the results are very similar. Details on the calculations of the whiting bycatch indices using Delta-GLM methods are in the Appendix A of the 2005 Assessment.

Calculation of depletion rate

Depletion rate is calculated as ratio of current spawning output over unfished spawning output. In the 2003 assessment, the depletion rate was calculated as ratio of the 2002 spawning output over the 1958 (first year in the model) spawning output. In this assessment, we calculate depletion rates using the same method as in the 2003 rebuilding analysis (He et al. 2003) and in the 2005 assessment, which used the average of spawning outputs from 1958 to 1982 as unfished spawning output. This same calculation method will also be used for rebuilding analysis in 2005 and this year's (2007) rebuilding analysis.

Likelihood component weighting

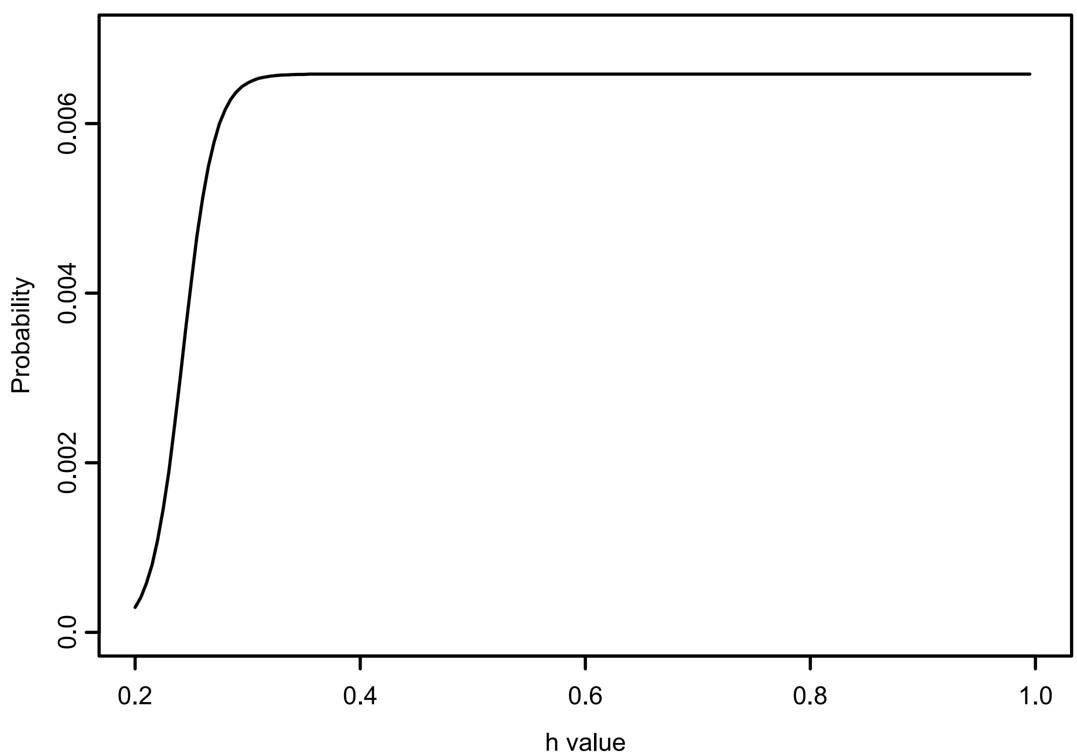
There are nine likelihood components in the model: age-composition data, landings, recruitment residuals, midwater juvenile trawl survey index, four fisheries CPUE indices, and triennial survey indices. Weighting in this assessment model has two levels. First, contribution of each datum point to its likelihood component is weighted by a fixed CV associated with the datum point. Details on how a fixed CV is determined for each component are discussed later. Second, a weighting factors is assumed for each likelihood component and the final likelihood value for each component is multiplied by its weighting factor (Appendix C, He et al. 2006a). In this assessment model, all weighting factor have been set to 1, except for the recruitment residual component and the midwater juvenile survey index component, whose weighting factors are 0.5.

For age composition data, this assessment used the same weighting method as in the 2006 assessment. It examines an iterative-reweighting method to determine the effective sample size in the likelihood functions (McAllister and Ianelli 1997, Maunder, in preparation) for each year in each fishery. Initial sample size for each age composition data is taken directly from real sample sizes of the fishery. After the model is fitted to the data, the observed and predicted proportions at age are used in the following equation to calculate effective sample size (T):

$$T = \frac{\sum_a \hat{p}_a \left(1 - \hat{p}_a\right)}{\sum_a \left(p_a - \hat{p}_a\right)^2} \qquad (9)$$

where $\hat{p}_a$ is the predicted proportion and p_a is the observed proportion at age a. The new sample size is then used in the model and the model is re-run. This process is repeated until the change in effective sample size is less than one percent between two consecutive runs. Because the sample size can differ substantially from year to year in a fishery, a linear regression of effective sample size versus observed sample size is used to obtain predicted effective sample size (MacCall 2003), which is then used in each iteration of the model run.

A prior for the steepness parameter in the stock-recruitment relations is also added in the likelihood functions (He at al. 2006c). The prior is based on a persistence principle that persistence of any species, given its life history and its exposure to recruitment variability, requires a minimum recruitment compensation that enables the species to rebound consistently from very low abundances. The prior curve for widow rockfish-like species has the following form:



A logistic equation that fits well with the curve is used in the likelihood function of the assessment model.

Results

Results of the update assessment model run are presented in Tables 13-14 and Figures 13-27. The resulting time series of total biomass, spawning biomass, spawning output, recruitment, and fishing mortality are presented in Table 13 and Figures 13-16. Estimated parameter values and their standard deviations are presented in Table 14. The fishery-specific selectivity curves are shown in Figure 17. The stock-recruitment relationship is shown in Figure 18. The fits to the landings are shown in Figures 19-20, and the fits to the various indices are shown in Figures 21-26. The fits of the age composition data are shown in Figure 27.

Comparisons between 2005 and 2007 assessments

Comparisons of main model outputs between this assessment and the 2005 base model are presented in Table 15 and Figure 28. Overall, estimated key parameters, such as unfished spawning outputs and recruitment steepness, are very similar. Time series of total biomass from 1958 to present year are also similar (Figure 28). But this assessment indicates that the population recovers quicker in the most recent years (especially in 2003 and 2004) than those estimated in the 2005 base model (Figure 28). The estimated current depletion rate (100**Bt*/*B0*) is 35.5% as compared to the 2005 estimate of 31.09%. There are three reasons that might lead to this quick recovery. First, total catches in the past few years, particularly in 2005 and 2006, have been very low (Table 1 and Table 2). They were lower than the harvest guidelines set by the Council. Second, perhaps more importantly, recruitment classes of the late 1990's (mostly likely the 1999 year class), have entered the spawning biomass which will also be dominating the spawning biomass in the next few years. Third, there are no other data in the most recent years suggest any declining trends of the population.

Rebuilding parameters

Unfished spawning output (B_0) was calculated as an average from the first year (1958) to 1982, which is the same period used in the 2003 and 2005 rebuilding analysis (He et al. 2003a, He et al. 2005b). Other rebuilding parameters were calculated in the same way as in the 2005 assessment. A separate C++ program was written (embedded in the ADMB program) to produce a data file ("rebuild.dat") that can be directly inputted into the rebuilding program written by Punt (2007).

Status of the stock

The percentage ratio of spawning output in 2006 to B_0 is the population status. The point estimate for the population status in 2006 is 35.5% (Table 15). Given that the population was declared as an overfished stock in previous assessments (Williams 2000, He et al. 2003), and the population status is within the precautionary zone (>25% and <40%), rebuilding analysis is needed to determine harvest projections and target fishing mortalities.

Management Recommendations

The stock has declined since fishing began in the later 1970's. The 2003 assessment showed that the spawning output in 2002 was just below 25% of unfished spawning output. This assessment shows that the spawning output in 2006 was within the precautionary zone. Therefore, it is necessary to conduct rebuilding analysis to determine harvest levels and related risks of each harvest levels (He et al. 2003).

Future research

1. There are increasingly fewer reliable abundance indices for widow rockfish. Recent management measures have undermined the ability to continue fishery dependent time series of relative abundance from the Oregon bottom trawl fishery and Pacific whiting fishery since 1999. The constant flux of the management regime suggests that there is little likelihood that meaningful CPUE indices can be developed from these fisheries in the future. The triennial bottom trawl survey may be the only data that can provide abundance indices in the future. More analysis should be done to either calibrate or compare triennial survey results with those from the NWFSC Combined survey.
2. The long-term recruitment index is a key datum series in the stock assessment. Continuation of the midwater juvenile trawl survey and recent increases in sampling intensity and spatial coverage will improve estimation confidence and data quality. Comparison and possibly integration of the existing juvenile survey results with a recently initiated survey by the fishing industry (Vidar Wespestad, pers. comm.) could also broaden the spatial extent of this index. The ability to infer direct and indirect estimates of year class strengths from surveys and other sources, as well as to better understand the relationship between environmental conditions in the California Current System, should improve short-term forecasts of productivity, biomass levels and allowable catches from stock assessments.
3. Preliminary information from recent bycatch monitoring suggests that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.
4. The utility of hydro-acoustic surveys on widow rockfish abundance should be evaluated in future assessments.
5. Sample sizes for existing age-collection programs (by fishery and survey) should be increased substantially.
6. The age-composition for the triennial survey should be determined by applying year-specific age-length keys to the survey length-frequencies, and included in future assessments as a basis for estimating survey selectivity.

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Table 1. U.S. total landings (mt) of widow rockfish by four fisheries from 1966 to 2006.

Year	Vancouver, Columbia	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey, and Conception	Total
1966	3670	0	0	96	3766
1967	3900	0	0	249	4149
1968	1693	0	0	336	2029
1969	356	0	0	21	377
1970	554	0	0	1	555
1971	701	0	0	1	702
1972	410	0	0	13	423
1973	617	0	0	207	824
1974	293	0	0	280	573
1975	454	0	0	358	812
1976	948	0	0	412	1360
1977	1318	0	0	883	2201
1978	605	0	0	502	1107
1979	966	0	0	2326	3292
1980	16190	0	0	5666	21856
1981	21779	0	0	5226	27005
1982	14802	0	0	11261	26063
1983	3222	1452	1488	4402	10564
1984	1450	3568	1334	3719	10072
1985	1537	3185	871	3596	9188
1986	2559	2977	1171	2819	9526
1987	3722	4986	1166	3071	12945
1988	3078	4102	1121	2144	10445
1989	3378	4857	1974	2280	12489
1990	2241	3214	2167	2672	10293
1991	1250	2146	1935	1456	6788
1992	1206	1243	2632	1324	6405
1993	1813	1844	3386	1348	8391
1994	1250	1818	2382	1248	6699
1995	1202	1508	2295	1926	6931
1996	1164	1481	2137	1530	6311
1997	1155	1593	2245	1705	6698
1998	757	890	1330	1304	4280
1999	733	1733	796	901	4162
2000	588	2352	16	1141	4097
2001	383	1109	39	504	2035
2002	118	323	3	64	508
2003	23	27	0	5	55
2004	36	42	2	28	109
2005	72	134	1	12	219
2006	92	175	2	12	281

Table 1a. Annual landing (mt) from at-sea processing (ASP) retrieved from the PacFIN database and bycatch estimates (mt) provided by the Northwest Fisheries Science Center for widow rockfish from 1991 to 2006. These data are included in the catches by fisheries in Table 1.

Year	ASP Catch	Bycatch estimate
1991	150	272
1992	5	348
1993	4	151
1994	27	288
1995	33	195
1996	4	212
1997	3	205
1998	66	259
1999	33	186
2000	77	207
2001	50	173
2002	77	155
2003	13	15
2004	14	21
2005	26	80
2006	67	143

Table 2. Management performance in obtaining the harvest guideline for widow rockfish. Harvest guideline and allowable biological catch (ABC) are taken from Council documents.

Year	Harvest Guideline	Allowable Biological Catch	Landings
1989	12100	12400	12489
1990	12400	8900	10293
1991	7000	7000	6788
1992	7000	7000	6405
1993	7000	7000	8391
1994	6500	6500	6699
1995	6500	7700	6931
1996	6500	7700	6311
1997	6500	7700	6698
1998	5090	5750	4280
1999	5090	5750	4162
2000	5090	5750	4097
2001	2300	3727	2035
2002	856	3727	508
2003	832	3871	55
2004	284	3460	109
2005	285	3218	219
2006	289	3059	281
2007	368	5334	

Table 3. Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
10/13/82	75,000 lb trip limit
1/30/83	30,000 lb trip limit
9/10/83	1,000 lb trip limit
1/1/84	50,000 lb trip limit once per week
5/6/84	40,000 lb trip limit once per week
8/1/84	closed fishery with 1,000 trip limit for incidental catch
9/9/84	closed fishery
1/10/85	30,000 lb trip limit once a week or 60,000 lb trip limit once per two weeks, unlimited trips of less than 3,000 lbs
4/28/85	dropped 60,000 lb biweekly option
7/21/85	3,000 lb trip limit, unlimited number of trips
1/1/86	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
9/28/86	3,000 lb trip limit, unlimited number of trips
1/1/87	30,000 lb trip limit, only one weekly landing greater than 3000 lbs
11/25/87	closed fishery
1/1/88	30,000 lb trip limit, only one weekly landing greater than 3000 lbs, unlimited number of trips less than 3,000 lbs
9/21/88	3,000 lb trip limit, unlimited number of trips
1/1/89	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
4/26/89	10,000 lb trip limit once per week
10/11/89	3,000 lb trip limit with unlimited number of trips
1/1/90	15,000 lb trip limit once per week or 25,000 lb trip limit once per two weeks with only one landing greater than 3,000 lbs each week
12/12/90	closed fishery
1/1/91	10,000 lb trip limit per week or 20,000 lb trip limit every two weeks with only one landing greater than 3,000 lbs per week
9/25/91	3,000 lb trip limit with unlimited number of trips
1/1/92	30,000 lbs cumulative landings every 4 weeks
5/9/92	change from 3" mesh to 4.5" mesh in codend for roller gear north of Point Arena
8/12/92	3,000 lb trip limit with unlimited number of trips
12/2/92	30,000 lb cumulative trip limit per 4 weeks
12/1/93	3,000 lb trip limit with unlimited number of trips
1/1/94	30,000 lb cumulative limit per calendar month
12/1/94	3,000 lb trip limit with unlimited number of trips
1/1/95	30,000 lb cumulative limit per calendar month
4/14/95	45,000 lb cumulative limit per calendar month
9/8/95	4.5" mesh applies to entire net and bottom trawl
1/1/96	70,000 lb cumulative limit per two months
9/1/96	50,000 lb cumulative limit per two months
11/1/96	25,000 lb cumulative limit per two months
1/1/97	70,000 lb cumulative limit per two months
5/1/97	60,000 lb cumulative limit per two months
1/1/98	limited entry: 25,000 lb cumulative per two month period, open access: 12,500 lb cumulative per two month period
5/1/98	limited entry: 30,000 lb cumulative per two month period

Table 3 (continued). Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
7/1/98	open access: 3,000 lb cumulative per month
10/1/98	limited entry: 19,000 cumulative per month
1/1/99	limited entry: cumulative limits: phase 1 - 70,000 lbs per period, phase 2 - 16,000 lbs per period, phase 3 - 30,000 lbs per period. Open access: 2,000 lbs per month
5/1/99	limited entry: decrease phase 2 and phase 3 limits to 11,000 lbs
7/2/99	open access: 8,000 lb cumulative limit per month
10/1/99	limited entry: vessels in Oregon and Washington using 30,000 lb cumulative monthly limit must have midwater trawl gear aboard or a state cumulative limit will be imposed
1/1/00	Widow rockfish classified as a shelf species for regulatory purposes, 30,000 lbs/2 months for limited entry trawl, 3,000 lbs/month for limited entry fixed gear and open access
1/1/01	20,000 lbs/2 months for months of Jan-Apr and Sep-Oct; otherwise 10,000 lbs/2 months for midwater limited entry. 1,000 lbs/months for small footrope limited entry. 3,000 lbs/month for fixed gear limited entry. Open access: north - 3,000 lbs/month, south - 3,000 lbs per month with some monthly closures in some areas.
7/1/01	North - limited entry midwater trawl limits: 1,000 lbs/month
10/1/01	closed fishery for all except midwater, which may land 2,000 lbs/month in north for October, then 25,000 lbs/2 months.
1/1/02	North - limited entry trawl: closed through November to midwater trawl except for small bycatch in whiting fishery, in November 13,000 lbs/2 month with no more than 2 trips, small footrope trawl1000 lbs/month through September, then closed Sept-Oct, then 500 lbs/month Nov-Dec. South - limited entry trawl: midwater closed year round except for a small bycatch in the whiting fishery, small footrope trawl 1,000 lbs/month through July, then closed
1/1/03	North - limited entry trawl: midwater trawl closed through November except for small amount of bycatch in whiting fishery, 12,000 lbs/2 months for Nov-Dec. small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: same as north for midwater and small footrope trawl. South - limited entry fixed gear: closed Mar-Apr, then variable 100 lbs/2 months to 250 lbs/2 months. South - - open access gear: same as limited entry fixed gear.
1/1/04	North - limited entry trawl: midwater trawl closed through November except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting), 12,000 lbs/2 months for Nov-Dec. small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: closed. South - limited entry fixed gear between 40E10' and 34E27' N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27' N lat.: closed Jan-Feb, 2,000 lbs/2 months Mar-Dec. South - - open access gear between 40E10' and 34E27' N lat.: same as limited entry fixed gear. South – open access gear south of 34E27' N lat.: closed Jan-Feb, 500 lbs/2 months Mar-Dec.

Table 3 (continued). Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
1/1/05 (regs. for 2005 and 2006)	North - limited entry trawl: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month. South - limited entry fixed gear between 40E10' and 34E27' N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27' N lat.: 2,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr. South - - open access gear between 40E10' and 34E27' N lat.: same as limited entry fixed gear. South – open access gear south of 34E27' N lat.: 500 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
7/1/05	South - limited entry fixed gear south of 34E27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish/2 months Jul-Dec. South – open access gear south of 34E27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jul-Dec.
10/1/05	North of 38E N lat.: limited entry trawl RCA extended from shoreline to 250 fm; 36E N lat. to 38E N lat.: limited entry trawl RCA extended from shoreline to 200 fm; South of 36E N lat.: limited entry trawl RCA extended from 50 fm to 200 fm.
1/1/06	South - limited entry fixed gear south of 34E27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb. South – open access gear south of 34E27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb.
3/1/06	South - limited entry fixed gear south of 34E27' N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec. South – open access gear south of 34E27' N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec.
10/1/06	Widow bycatch cap in the non-tribal limited entry whiting trawl fishery increased from 200 mt to 220 mt.
1/1/07 (regs. for 2007 and 2008)	North - limited entry trawl: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting; cumulative widow limit of 1,500 lbs/month); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1,000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month. South - limited entry fixed gear between 40E10' and 34E27' N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27' N lat.: 3,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr. South - - open access gear between 40E10' and 34E27' N lat.: same as limited entry fixed gear. South – open access gear south of 34E27' N lat.: 750 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.

4/17/07 Widow bycatch cap in the non-tribal limited entry whiting trawl fishery increased from 200 mt to 220 mt.
North – limited entry trawl: RCA extended to the shore from Cape Alava (48E10' N lat.) to U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.); the shoreward boundary of the trawl RCA is shifted shoreward to 60 fm from April 17 through October 31, 2007 between Leadbetter Point (46°38.17' N. lat.) and the Oregon/Washington border (46°16' N. lat.); shoreward boundary of the trawl RCA shifted shoreward to 75 fm in all other areas through Dec.; the seaward boundary of the trawl RCA is shifted shoreward to 150 fm from the U.S.-Canada Border to Cascade Head (45°03.83' N. lat.) from April 17 through August 31, 2007;, the seaward boundary of the trawl RCA is shifted shoreward to 200 fm between Cascade Head (45°03.83' N. lat.) and 40°10 N. lat. from April 17 through April 30, 2007.

Table 4a. Propotional age composition of males for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2006.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.022	0.020	0.056	0.096	0.111	0.046	0.029	0.012	0.013	0.006	0.004	0.002	0.002	0.001	0.003
1981	0.000	0.007	0.024	0.064	0.046	0.024	0.048	0.088	0.068	0.047	0.026	0.017	0.012	0.005	0.004	0.003	0.003	0.009
1982	0.000	0.008	0.030	0.084	0.031	0.045	0.021	0.021	0.033	0.072	0.045	0.034	0.035	0.021	0.014	0.009	0.005	0.017
1983	0.000	0.008	0.154	0.113	0.028	0.017	0.014	0.013	0.014	0.018	0.020	0.015	0.015	0.009	0.006	0.007	0.006	0.020
1984	0.000	0.003	0.054	0.161	0.083	0.033	0.014	0.004	0.006	0.007	0.008	0.013	0.013	0.011	0.007	0.008	0.008	0.029
1985	0.000	0.008	0.075	0.080	0.125	0.066	0.022	0.009	0.004	0.006	0.005	0.006	0.005	0.003	0.006	0.005	0.003	0.028
1986	0.000	0.007	0.060	0.174	0.075	0.049	0.014	0.006	0.005	0.005	0.003	0.003	0.005	0.006	0.003	0.002	0.002	0.029
1987	0.000	0.006	0.024	0.120	0.194	0.046	0.013	0.009	0.003	0.004	0.006	0.004	0.003	0.004	0.004	0.002	0.002	0.011
1988	0.000	0.000	0.015	0.060	0.137	0.199	0.035	0.013	0.005	0.002	0.001	0.003	0.003	0.001	0.000	0.001	0.001	0.014
1989	0.000	0.003	0.018	0.093	0.095	0.157	0.087	0.009	0.004	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.002	0.008
1990	0.000	0.000	0.025	0.077	0.153	0.068	0.097	0.030	0.011	0.005	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.007
1991	0.000	0.001	0.010	0.062	0.114	0.107	0.074	0.044	0.050	0.010	0.004	0.003	0.002	0.001	0.004	0.001	0.001	0.018
1992	0.000	0.003	0.020	0.031	0.072	0.077	0.082	0.049	0.052	0.029	0.020	0.008	0.005	0.003	0.002	0.000	0.001	0.012
1993	0.000	0.000	0.016	0.058	0.051	0.063	0.057	0.035	0.029	0.031	0.023	0.020	0.012	0.007	0.005	0.004	0.002	0.013
1994	0.000	0.001	0.011	0.041	0.087	0.057	0.045	0.037	0.028	0.023	0.026	0.016	0.013	0.011	0.005	0.004	0.003	0.017
1995	0.001	0.010	0.031	0.056	0.096	0.100	0.064	0.029	0.031	0.019	0.015	0.024	0.010	0.007	0.006	0.007	0.002	0.012
1996	0.001	0.012	0.059	0.112	0.104	0.058	0.033	0.018	0.013	0.010	0.008	0.006	0.008	0.002	0.003	0.003	0.002	0.008
1997	0.000	0.003	0.037	0.149	0.129	0.050	0.015	0.010	0.006	0.007	0.007	0.008	0.001	0.003	0.003	0.001	0.001	0.004
1998	0.000	0.001	0.014	0.043	0.146	0.110	0.040	0.015	0.007	0.009	0.008	0.003	0.002	0.002	0.007	0.001	0.000	0.006
1999	0.000	0.002	0.011	0.041	0.081	0.107	0.082	0.041	0.023	0.010	0.010	0.009	0.005	0.005	0.004	0.005	0.002	0.005
2000	0.000	0.000	0.005	0.058	0.113	0.071	0.073	0.073	0.038	0.013	0.012	0.005	0.002	0.009	0.006	0.003	0.002	0.005
2001	0.000	0.000	0.004	0.051	0.126	0.084	0.062	0.054	0.037	0.039	0.033	0.008	0.017	0.006	0.006	0.006	0.002	0.006
2002	0.000	0.002	0.022	0.027	0.061	0.106	0.068	0.056	0.026	0.027	0.012	0.015	0.002	0.002	0.005	0.002	0.002	0.003
2003	0.000	0.005	0.087	0.115	0.120	0.087	0.024	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.035	0.102	0.044	0.040	0.028	0.010	0.013	0.005	0.003	0.005	0.003	0.002	0.103	0.003	0.000	0.106
2005	0.000	0.008	0.100	0.035	0.110	0.051	0.018	0.022	0.014	0.005	0.003	0.005	0.002	0.003	0.002	0.002	0.002	0.024
2006	0.000	0.013	0.020	0.167	0.070	0.054	0.020	0.015	0.006	0.005	0.007	0.002	0.004	0.002	0.001	0.002	0.003	0.006

Table 4b. Propotional age composition of females for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2006.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.018	0.014	0.026	0.088	0.142	0.085	0.063	0.035	0.018	0.021	0.019	0.005	0.007	0.006	0.013
1981	0.000	0.007	0.017	0.047	0.044	0.020	0.020	0.062	0.078	0.071	0.037	0.028	0.019	0.010	0.005	0.006	0.005	0.027
1982	0.000	0.008	0.018	0.060	0.029	0.042	0.019	0.015	0.015	0.049	0.040	0.040	0.033	0.032	0.017	0.015	0.006	0.037
1983	0.000	0.006	0.153	0.114	0.040	0.021	0.009	0.014	0.013	0.016	0.029	0.023	0.022	0.013	0.010	0.007	0.005	0.028
1984	0.001	0.002	0.044	0.152	0.075	0.026	0.018	0.005	0.006	0.007	0.011	0.017	0.025	0.024	0.020	0.011	0.014	0.081
1985	0.000	0.008	0.071	0.081	0.117	0.058	0.028	0.009	0.007	0.005	0.008	0.005	0.012	0.010	0.011	0.007	0.008	0.099
1986	0.000	0.002	0.053	0.178	0.091	0.070	0.020	0.013	0.004	0.007	0.008	0.006	0.009	0.008	0.008	0.009	0.003	0.061
1987	0.000	0.004	0.014	0.095	0.224	0.057	0.037	0.026	0.009	0.007	0.004	0.002	0.007	0.008	0.005	0.008	0.004	0.035
1988	0.000	0.002	0.007	0.056	0.151	0.206	0.035	0.017	0.012	0.008	0.003	0.000	0.003	0.001	0.000	0.001	0.000	0.007
1989	0.000	0.003	0.007	0.076	0.093	0.184	0.104	0.009	0.010	0.006	0.001	0.001	0.001	0.002	0.000	0.001	0.004	0.020
1990	0.000	0.001	0.028	0.062	0.116	0.078	0.119	0.059	0.012	0.006	0.003	0.003	0.000	0.001	0.002	0.001	0.001	0.029
1991	0.000	0.000	0.004	0.054	0.084	0.099	0.066	0.057	0.054	0.011	0.009	0.005	0.004	0.002	0.001	0.003	0.002	0.040
1992	0.000	0.003	0.023	0.025	0.055	0.091	0.082	0.057	0.069	0.046	0.030	0.012	0.008	0.004	0.001	0.004	0.002	0.024
1993	0.000	0.001	0.008	0.059	0.038	0.068	0.070	0.054	0.050	0.085	0.048	0.030	0.015	0.009	0.003	0.005	0.002	0.029
1994	0.004	0.003	0.013	0.047	0.074	0.068	0.044	0.054	0.041	0.043	0.052	0.035	0.025	0.016	0.013	0.008	0.004	0.031
1995	0.001	0.009	0.032	0.050	0.078	0.082	0.055	0.037	0.023	0.027	0.017	0.021	0.010	0.007	0.011	0.005	0.002	0.014
1996	0.000	0.002	0.068	0.112	0.108	0.064	0.054	0.024	0.014	0.018	0.013	0.011	0.017	0.005	0.004	0.002	0.002	0.019
1997	0.000	0.001	0.029	0.167	0.142	0.053	0.033	0.024	0.017	0.018	0.017	0.010	0.007	0.011	0.005	0.002	0.003	0.029
1998	0.000	0.001	0.012	0.048	0.165	0.153	0.047	0.020	0.023	0.023	0.020	0.021	0.014	0.004	0.011	0.005	0.002	0.017
1999	0.000	0.001	0.012	0.046	0.067	0.127	0.105	0.053	0.033	0.023	0.015	0.013	0.014	0.009	0.006	0.011	0.005	0.018
2000	0.000	0.000	0.002	0.053	0.088	0.097	0.077	0.069	0.046	0.021	0.010	0.009	0.006	0.006	0.006	0.009	0.002	0.007
2001	0.000	0.000	0.002	0.025	0.053	0.090	0.057	0.014	0.031	0.025	0.048	0.035	0.017	0.019	0.004	0.006	0.008	0.023
2002	0.000	0.002	0.026	0.027	0.029	0.111	0.106	0.046	0.048	0.036	0.031	0.027	0.024	0.010	0.002	0.012	0.005	0.022
2003	0.005	0.019	0.144	0.077	0.067	0.082	0.058	0.014	0.038	0.010	0.010	0.010	0.005	0.005	0.000	0.000	0.005	0.005
2004	0.000	0.002	0.031	0.123	0.054	0.061	0.068	0.038	0.031	0.016	0.020	0.012	0.007	0.002	0.002	0.002	0.013	0.016
2005	0.000	0.006	0.101	0.175	0.059	0.056	0.032	0.027	0.016	0.018	0.018	0.014	0.011	0.010	0.010	0.008	0.003	0.030
2006	0.000	0.000	0.040	0.285	0.068	0.082	0.013	0.016	0.017	0.008	0.008	0.008	0.011	0.009	0.007	0.003	0.005	0.021

Table 5a. Propotional age composition of males for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2006. Note that there were no 2003 and 2005 ageing data.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.002	0.019	0.163	0.109	0.010	0.019	0.008	0.007	0.008	0.019	0.023	0.002	0.009	0.003	0.002	0.001	0.013
1985	0.000	0.002	0.065	0.070	0.223	0.065	0.008	0.006	0.003	0.000	0.002	0.005	0.013	0.003	0.002	0.000	0.000	0.010
1986	0.000	0.000	0.006	0.093	0.083	0.196	0.064	0.005	0.006	0.005	0.000	0.000	0.001	0.012	0.004	0.002	0.001	0.007
1987	0.000	0.000	0.014	0.125	0.218	0.074	0.042	0.022	0.002	0.003	0.003	0.000	0.000	0.002	0.004	0.000	0.001	0.003
1988	0.000	0.001	0.014	0.077	0.244	0.129	0.034	0.020	0.008	0.000	0.001	0.000	0.001	0.000	0.003	0.002	0.000	0.003
1989	0.000	0.006	0.019	0.054	0.121	0.199	0.068	0.016	0.010	0.003	0.001	0.001	0.001	0.001	0.002	0.002	0.004	0.006
1990	0.000	0.003	0.028	0.029	0.057	0.099	0.133	0.067	0.032	0.015	0.007	0.004	0.000	0.001	0.000	0.002	0.000	0.004
1991	0.000	0.000	0.008	0.064	0.100	0.107	0.065	0.089	0.039	0.010	0.011	0.003	0.002	0.002	0.001	0.000	0.001	0.009
1992	0.000	0.000	0.036	0.040	0.087	0.083	0.080	0.041	0.086	0.030	0.022	0.014	0.002	0.004	0.000	0.000	0.001	0.013
1993	0.000	0.000	0.016	0.071	0.055	0.081	0.049	0.039	0.034	0.060	0.026	0.018	0.015	0.006	0.000	0.003	0.001	0.010
1994	0.000	0.002	0.009	0.076	0.156	0.080	0.047	0.041	0.012	0.020	0.031	0.000	0.002	0.005	0.000	0.000	0.000	0.009
1995	0.000	0.004	0.017	0.025	0.131	0.095	0.048	0.043	0.032	0.023	0.030	0.007	0.001	0.001	0.000	0.005	0.000	0.001
1996	0.000	0.008	0.073	0.093	0.071	0.065	0.049	0.034	0.014	0.008	0.024	0.009	0.017	0.008	0.003	0.000	0.005	0.005
1997	0.000	0.002	0.031	0.240	0.116	0.043	0.026	0.027	0.016	0.013	0.009	0.003	0.014	0.013	0.000	0.000	0.001	0.002
1998	0.000	0.000	0.012	0.081	0.194	0.112	0.054	0.015	0.025	0.015	0.003	0.007	0.001	0.001	0.009	0.002	0.001	0.004
1999	0.000	0.001	0.025	0.038	0.109	0.181	0.087	0.022	0.005	0.006	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.002
2000	0.000	0.000	0.013	0.054	0.078	0.084	0.119	0.071	0.028	0.021	0.005	0.005	0.006	0.003	0.000	0.001	0.000	0.002
2001	0.000	0.000	0.001	0.018	0.098	0.099	0.120	0.062	0.050	0.042	0.017	0.006	0.002	0.003	0.002	0.002	0.004	0.004
2002	0.000	0.009	0.009	0.044	0.090	0.148	0.118	0.033	0.013	0.009	0.010	0.007	0.000	0.009	0.005	0.000	0.007	0.002
2004	0.000	0.080	0.140	0.203	0.081	0.026	0.015	0.002	0.002	0.002	0.001	0.002	0.001	0.000	0.000	0.001	0.001	0.001
2006	0.000	0.000	0.019	0.206	0.112	0.111	0.017	0.009	0.019	0.007	0.024	0.013	0.008	0.014	0.000	0.000	0.002	0.033

Table 5b. Propotional age composition of females for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2006. Note that there were no 2003 and 2005 ageing data.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.001	0.019	0.166	0.175	0.014	0.031	0.007	0.006	0.004	0.029	0.067	0.018	0.008	0.007	0.006	0.007	0.021
1985	0.000	0.000	0.050	0.067	0.253	0.087	0.011	0.011	0.009	0.000	0.001	0.007	0.018	0.002	0.001	0.001	0.002	0.005
1986	0.000	0.000	0.010	0.122	0.084	0.167	0.073	0.005	0.011	0.005	0.000	0.001	0.004	0.017	0.002	0.002	0.002	0.009
1987	0.000	0.001	0.017	0.113	0.198	0.080	0.038	0.020	0.002	0.005	0.002	0.000	0.001	0.002	0.003	0.001	0.000	0.002
1988	0.001	0.005	0.015	0.077	0.192	0.099	0.026	0.017	0.009	0.004	0.004	0.000	0.001	0.000	0.001	0.004	0.003	0.004
1989	0.000	0.004	0.026	0.036	0.079	0.197	0.086	0.024	0.011	0.006	0.004	0.002	0.000	0.001	0.001	0.002	0.001	0.007
1990	0.000	0.000	0.018	0.034	0.054	0.079	0.151	0.104	0.037	0.022	0.009	0.002	0.002	0.001	0.001	0.000	0.000	0.004
1991	0.000	0.000	0.010	0.062	0.096	0.061	0.069	0.098	0.043	0.014	0.010	0.004	0.003	0.001	0.000	0.000	0.002	0.015
1992	0.000	0.000	0.023	0.030	0.070	0.075	0.042	0.064	0.089	0.031	0.015	0.006	0.001	0.002	0.002	0.002	0.000	0.008
1993	0.000	0.001	0.010	0.068	0.036	0.080	0.065	0.036	0.046	0.067	0.034	0.024	0.020	0.010	0.004	0.005	0.002	0.007
1994	0.000	0.000	0.008	0.049	0.158	0.064	0.056	0.041	0.035	0.025	0.029	0.015	0.021	0.005	0.000	0.000	0.002	0.003
1995	0.000	0.005	0.005	0.031	0.059	0.088	0.089	0.057	0.043	0.039	0.032	0.046	0.013	0.007	0.014	0.001	0.000	0.009
1996	0.000	0.007	0.067	0.059	0.077	0.080	0.049	0.024	0.039	0.016	0.018	0.023	0.018	0.006	0.001	0.001	0.001	0.027
1997	0.000	0.003	0.012	0.170	0.082	0.038	0.038	0.017	0.014	0.012	0.013	0.013	0.007	0.017	0.001	0.002	0.000	0.005
1998	0.000	0.000	0.004	0.037	0.158	0.092	0.048	0.031	0.032	0.015	0.015	0.012	0.004	0.002	0.007	0.001	0.003	0.005
1999	0.000	0.000	0.023	0.036	0.081	0.186	0.093	0.041	0.020	0.008	0.011	0.007	0.001	0.007	0.004	0.001	0.000	0.001
2000	0.000	0.000	0.015	0.046	0.075	0.086	0.081	0.095	0.039	0.024	0.011	0.006	0.007	0.004	0.003	0.002	0.006	0.008
2001	0.000	0.000	0.000	0.013	0.067	0.067	0.071	0.069	0.049	0.060	0.016	0.010	0.008	0.008	0.014	0.008	0.006	0.004
2002	0.000	0.003	0.009	0.018	0.065	0.114	0.091	0.082	0.036	0.033	0.015	0.005	0.009	0.000	0.005	0.000	0.002	0.002
2004	0.005	0.111	0.075	0.152	0.071	0.023	0.006	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.016	0.135	0.028	0.043	0.037	0.014	0.021	0.009	0.024	0.005	0.004	0.008	0.011	0.011	0.011	0.028

Table 6a. Propotional age composition of males for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.002	0.034	0.158	0.115	0.018	0.017	0.004	0.004	0.002	0.021	0.015	0.011	0.009	0.007	0.003	0.001	0.010
1985	0.000	0.003	0.049	0.097	0.195	0.049	0.003	0.005	0.002	0.000	0.001	0.004	0.026	0.000	0.007	0.001	0.000	0.007
1986	0.000	0.002	0.014	0.200	0.081	0.085	0.058	0.003	0.018	0.005	0.002	0.000	0.001	0.018	0.002	0.001	0.003	0.016
1987	0.000	0.000	0.011	0.111	0.204	0.072	0.040	0.016	0.003	0.002	0.007	0.000	0.000	0.006	0.005	0.002	0.000	0.008
1988	0.002	0.011	0.017	0.080	0.208	0.102	0.022	0.011	0.007	0.003	0.000	0.000	0.001	0.000	0.002	0.004	0.001	0.006
1989	0.000	0.009	0.025	0.051	0.094	0.176	0.064	0.027	0.014	0.008	0.000	0.005	0.000	0.000	0.001	0.001	0.006	0.007
1990	0.000	0.004	0.047	0.045	0.056	0.068	0.116	0.058	0.021	0.020	0.010	0.004	0.001	0.003	0.000	0.000	0.000	0.012
1991	0.000	0.000	0.004	0.066	0.100	0.072	0.042	0.078	0.037	0.010	0.012	0.003	0.001	0.004	0.000	0.000	0.001	0.011
1992	0.000	0.000	0.017	0.022	0.084	0.073	0.059	0.034	0.048	0.018	0.029	0.016	0.004	0.004	0.006	0.002	0.003	0.017
1993	0.000	0.000	0.006	0.035	0.035	0.088	0.091	0.047	0.033	0.054	0.035	0.023	0.014	0.004	0.002	0.004	0.000	0.017
1994	0.000	0.003	0.014	0.057	0.107	0.069	0.042	0.017	0.021	0.029	0.024	0.008	0.006	0.005	0.009	0.002	0.000	0.011
1995	0.000	0.003	0.034	0.109	0.074	0.135	0.039	0.044	0.021	0.018	0.007	0.012	0.005	0.005	0.005	0.000	0.000	0.002
1996	0.000	0.002	0.079	0.082	0.059	0.058	0.022	0.017	0.017	0.020	0.016	0.002	0.017	0.005	0.002	0.011	0.001	0.007
1997	0.000	0.006	0.044	0.230	0.118	0.047	0.031	0.021	0.009	0.018	0.007	0.006	0.001	0.006	0.002	0.000	0.000	0.004
1998	0.000	0.000	0.008	0.051	0.183	0.116	0.035	0.022	0.017	0.020	0.006	0.009	0.000	0.002	0.007	0.000	0.003	0.008
1999	0.000	0.004	0.028	0.066	0.118	0.177	0.072	0.027	0.009	0.000	0.000	0.007	0.001	0.000	0.000	0.000	0.007	0.003

Table 6b. Propotional age composition of females for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.000	0.033	0.135	0.188	0.031	0.018	0.013	0.008	0.005	0.014	0.034	0.017	0.009	0.005	0.006	0.003	0.049
1985	0.001	0.000	0.023	0.062	0.199	0.121	0.016	0.007	0.007	0.000	0.001	0.026	0.038	0.006	0.006	0.004	0.004	0.030
1986	0.000	0.001	0.025	0.106	0.062	0.096	0.068	0.007	0.018	0.013	0.000	0.000	0.004	0.044	0.010	0.007	0.005	0.025
1987	0.000	0.002	0.010	0.119	0.167	0.060	0.051	0.030	0.004	0.004	0.002	0.003	0.000	0.005	0.017	0.014	0.003	0.023
1988	0.010	0.014	0.009	0.077	0.172	0.103	0.041	0.027	0.015	0.010	0.005	0.006	0.001	0.002	0.006	0.010	0.003	0.010
1989	0.000	0.001	0.027	0.028	0.068	0.146	0.090	0.038	0.041	0.016	0.006	0.004	0.004	0.004	0.006	0.004	0.010	0.018
1990	0.000	0.000	0.046	0.036	0.037	0.068	0.137	0.107	0.036	0.017	0.009	0.005	0.007	0.002	0.002	0.001	0.001	0.024
1991	0.000	0.000	0.007	0.055	0.060	0.065	0.074	0.109	0.058	0.034	0.034	0.007	0.005	0.005	0.002	0.001	0.003	0.037
1992	0.000	0.000	0.010	0.008	0.082	0.089	0.069	0.058	0.090	0.048	0.032	0.020	0.014	0.005	0.006	0.001	0.003	0.031
1993	0.000	0.000	0.000	0.025	0.025	0.076	0.073	0.044	0.040	0.066	0.043	0.029	0.017	0.021	0.006	0.009	0.006	0.032
1994	0.000	0.002	0.009	0.043	0.100	0.063	0.057	0.063	0.046	0.026	0.065	0.029	0.020	0.012	0.012	0.007	0.006	0.016
1995	0.000	0.005	0.013	0.037	0.109	0.084	0.051	0.039	0.045	0.026	0.017	0.025	0.004	0.002	0.013	0.002	0.000	0.015
1996	0.000	0.007	0.076	0.102	0.082	0.086	0.051	0.028	0.041	0.032	0.008	0.004	0.040	0.000	0.002	0.010	0.003	0.011
1997	0.000	0.008	0.031	0.104	0.094	0.030	0.047	0.031	0.019	0.015	0.008	0.013	0.010	0.016	0.005	0.001	0.005	0.014
1998	0.000	0.000	0.012	0.047	0.141	0.110	0.054	0.024	0.030	0.017	0.026	0.013	0.016	0.003	0.008	0.002	0.001	0.009
1999	0.000	0.000	0.023	0.058	0.068	0.147	0.063	0.042	0.039	0.009	0.012	0.006	0.008	0.002	0.000	0.001	0.001	0.001

Table 7a. Propotional age composition of males for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1978 to 2004.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1978	0.000	0.000	0.000	0.000	0.039	0.062	0.114	0.039	0.047	0.016	0.016	0.000	0.016	0.039	0.000	0.023	0.000	0.055
1979	0.000	0.000	0.000	0.000	0.011	0.012	0.049	0.017	0.020	0.016	0.009	0.017	0.002	0.019	0.011	0.020	0.000	0.048
1980	0.000	0.000	0.002	0.014	0.003	0.007	0.040	0.032	0.051	0.031	0.025	0.029	0.010	0.053	0.004	0.016	0.005	0.060
1981	0.001	0.008	0.010	0.027	0.025	0.028	0.026	0.030	0.043	0.047	0.024	0.033	0.016	0.029	0.012	0.004	0.014	0.025
1982	0.000	0.000	0.044	0.007	0.037	0.033	0.030	0.014	0.043	0.076	0.036	0.030	0.020	0.014	0.017	0.010	0.008	0.032
1983	0.000	0.000	0.023	0.140	0.032	0.033	0.013	0.005	0.008	0.009	0.020	0.020	0.012	0.012	0.005	0.023	0.002	0.027
1984	0.000	0.000	0.022	0.137	0.145	0.028	0.036	0.014	0.014	0.002	0.010	0.030	0.014	0.004	0.005	0.004	0.004	0.030
1985	0.000	0.000	0.009	0.062	0.163	0.145	0.013	0.025	0.011	0.002	0.003	0.010	0.022	0.002	0.005	0.003	0.003	0.027
1986	0.000	0.003	0.042	0.046	0.082	0.124	0.129	0.014	0.022	0.017	0.001	0.001	0.008	0.029	0.006	0.009	0.004	0.038
1987	0.001	0.000	0.055	0.114	0.044	0.060	0.091	0.112	0.020	0.030	0.021	0.003	0.000	0.019	0.015	0.003	0.011	0.026
1988	0.000	0.035	0.000	0.066	0.061	0.090	0.061	0.051	0.034	0.014	0.009	0.008	0.003	0.004	0.006	0.016	0.002	0.016
1989	0.000	0.005	0.109	0.073	0.078	0.119	0.046	0.050	0.020	0.012	0.020	0.016	0.008	0.000	0.000	0.007	0.006	0.009
1990	0.000	0.000	0.045	0.116	0.029	0.047	0.038	0.056	0.030	0.025	0.016	0.023	0.019	0.014	0.004	0.002	0.008	0.006
1991	0.000	0.002	0.015	0.119	0.120	0.049	0.038	0.065	0.022	0.016	0.020	0.012	0.002	0.004	0.004	0.003	0.003	0.017
1992	0.000	0.001	0.011	0.019	0.138	0.095	0.038	0.017	0.044	0.028	0.021	0.019	0.011	0.005	0.016	0.001	0.002	0.023
1993	0.000	0.000	0.085	0.163	0.096	0.078	0.010	0.002	0.009	0.007	0.011	0.001	0.021	0.005	0.002	0.004	0.001	0.033
1994	0.002	0.004	0.007	0.070	0.148	0.110	0.065	0.021	0.024	0.007	0.008	0.005	0.006	0.009	0.001	0.005	0.000	0.005
1995	0.000	0.033	0.039	0.034	0.056	0.197	0.045	0.066	0.058	0.003	0.028	0.007	0.021	0.001	0.004	0.008	0.000	0.003
1996	0.004	0.006	0.046	0.045	0.067	0.114	0.118	0.033	0.027	0.018	0.015	0.003	0.025	0.007	0.002	0.002	0.009	0.013
1997	0.000	0.002	0.008	0.108	0.041	0.051	0.052	0.048	0.050	0.036	0.027	0.023	0.013	0.005	0.004	0.012	0.006	0.012
1998	0.000	0.008	0.082	0.061	0.093	0.069	0.054	0.021	0.045	0.025	0.018	0.018	0.005	0.007	0.009	0.000	0.000	0.013
1999	0.001	0.001	0.019	0.072	0.059	0.101	0.069	0.051	0.027	0.022	0.030	0.016	0.006	0.006	0.006	0.012	0.005	0.031
2000	0.000	0.000	0.004	0.044	0.061	0.116	0.055	0.044	0.027	0.028	0.009	0.000	0.003	0.003	0.008	0.002	0.002	0.002
2001	0.000	0.000	0.000	0.010	0.073	0.012	0.064	0.092	0.035	0.040	0.032	0.030	0.042	0.021	0.004	0.003	0.000	0.007
2002	0.000	0.010	0.002	0.002	0.015	0.035	0.044	0.104	0.029	0.021	0.098	0.032	0.061	0.002	0.030	0.000	0.033	0.036
2003	0.000	0.279	0.013	0.009	0.009	0.035	0.040	0.040	0.000	0.018	0.000	0.004	0.013	0.013	0.000	0.000	0.000	0.004
2004	0.000	0.000	0.023	0.000	0.015	0.031	0.054	0.070	0.039	0.015	0.047	0.023	0.007	0.032	0.039	0.000	0.007	0.007

Table 7b. Propotional age composition of females for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1978 to 2004.

	Age																	
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1978	0.000	0.000	0.000	0.000	0.124	0.206	0.041	0.041	0.018	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.042
1979	0.000	0.000	0.000	0.000	0.029	0.067	0.158	0.062	0.061	0.040	0.075	0.011	0.019	0.036	0.011	0.023	0.030	0.127
1980	0.000	0.000	0.001	0.006	0.004	0.024	0.063	0.098	0.097	0.039	0.051	0.062	0.018	0.013	0.029	0.040	0.007	0.066
1981	0.000	0.003	0.005	0.014	0.036	0.019	0.025	0.055	0.073	0.091	0.027	0.056	0.046	0.039	0.025	0.040	0.011	0.035
1982	0.000	0.000	0.032	0.009	0.035	0.031	0.024	0.008	0.036	0.102	0.051	0.036	0.034	0.032	0.023	0.025	0.017	0.052
1983	0.000	0.010	0.075	0.167	0.047	0.048	0.015	0.009	0.002	0.008	0.037	0.022	0.012	0.028	0.020	0.016	0.026	0.071
1984	0.000	0.000	0.025	0.124	0.113	0.027	0.029	0.012	0.007	0.003	0.020	0.045	0.010	0.011	0.007	0.007	0.010	0.050
1985	0.000	0.000	0.002	0.039	0.153	0.144	0.020	0.039	0.006	0.002	0.003	0.010	0.023	0.002	0.006	0.007	0.009	0.031
1986	0.000	0.001	0.032	0.027	0.073	0.082	0.100	0.007	0.021	0.009	0.005	0.002	0.002	0.028	0.003	0.004	0.004	0.026
1987	0.001	0.000	0.047	0.095	0.021	0.051	0.051	0.055	0.011	0.010	0.004	0.002	0.001	0.004	0.003	0.006	0.001	0.011
1988	0.000	0.086	0.037	0.076	0.072	0.055	0.033	0.037	0.021	0.004	0.014	0.020	0.004	0.007	0.004	0.006	0.009	0.039
1989	0.000	0.003	0.082	0.043	0.042	0.081	0.054	0.038	0.021	0.010	0.008	0.004	0.006	0.006	0.000	0.001	0.001	0.022
1990	0.000	0.003	0.051	0.109	0.056	0.037	0.089	0.071	0.037	0.024	0.010	0.008	0.006	0.001	0.003	0.001	0.002	0.012
1991	0.000	0.007	0.008	0.113	0.128	0.061	0.030	0.033	0.023	0.017	0.013	0.011	0.008	0.008	0.007	0.001	0.002	0.018
1992	0.000	0.000	0.015	0.031	0.108	0.086	0.039	0.030	0.037	0.026	0.026	0.044	0.015	0.000	0.001	0.001	0.006	0.042
1993	0.000	0.004	0.033	0.135	0.124	0.097	0.037	0.004	0.001	0.010	0.008	0.001	0.001	0.001	0.001	0.005	0.005	0.007
1994	0.002	0.002	0.022	0.067	0.161	0.066	0.051	0.020	0.026	0.017	0.015	0.007	0.009	0.008	0.006	0.000	0.002	0.023
1995	0.000	0.008	0.009	0.015	0.050	0.137	0.050	0.068	0.023	0.005	0.008	0.002	0.005	0.008	0.000	0.008	0.000	0.001
1996	0.005	0.007	0.040	0.043	0.042	0.081	0.058	0.050	0.038	0.030	0.011	0.010	0.012	0.003	0.001	0.007	0.005	0.004
1997	0.000	0.001	0.007	0.083	0.038	0.056	0.053	0.042	0.065	0.048	0.030	0.020	0.005	0.021	0.006	0.007	0.005	0.014
1998	0.000	0.002	0.054	0.029	0.076	0.030	0.046	0.045	0.053	0.060	0.028	0.008	0.010	0.006	0.007	0.002	0.003	0.013
1999	0.000	0.002	0.010	0.074	0.046	0.094	0.042	0.047	0.038	0.022	0.021	0.015	0.014	0.014	0.004	0.009	0.002	0.013
2000	0.000	0.000	0.007	0.033	0.099	0.073	0.075	0.057	0.039	0.027	0.059	0.033	0.033	0.021	0.002	0.001	0.024	0.007
2001	0.000	0.000	0.000	0.008	0.060	0.099	0.037	0.065	0.064	0.032	0.038	0.023	0.021	0.001	0.013	0.023	0.034	0.018
2002	0.000	0.010	0.002	0.001	0.031	0.015	0.038	0.112	0.049	0.074	0.004	0.034	0.031	0.033	0.004	0.003	0.000	0.008
2003	0.013	0.412	0.040	0.000	0.000	0.013	0.004	0.022	0.004	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.015	0.016	0.015	0.016	0.038	0.038	0.068	0.060	0.067	0.076	0.015	0.053	0.046	0.031	0.007	0.030

Table 8. Number of samples collected for each year and fishery of age composition data used in the widow rockfish assessment.

	Vancouver-Columbia	Oregon midwater trawl	Oregon bottom trawl	Eureka-Conception
1978				7
1979				11
1980	18			26
1981	31			44
1982	40			149
1983	25			189
1984	22	32	27	169
1985	16	53	23	175
1986	27	56	22	154
1987	36	68	34	135
1988	20	39	33	127
1989	30	65	45	170
1990	41	61	49	155
1991	35	59	78	95
1992	31	43	82	55
1993	36	50	61	22
1994	28	22	63	28
1995	33	30	43	11
1996	27	32	27	35
1997	30	47	40	61
1998	22	41	30	37
1999	29	62	26	31
2000	21	55		17
2001	10	40		7
2002	12	17		14
2003	5			3
2004	20	4		7
2005	11			
2006	10	13		

Table 9. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater trawl pelagic juvenile survey from 1984 to 2006.

Year	Index value	CV
1984	2.854	0.425
1985	20.445	0.411
1986	0.099	0.392
1987	2.421	0.254
1988	2.140	0.256
1989	0.065	0.436
1990	0.075	0.449
1991	0.565	0.335
1992	0.028	2.000
1993	0.372	0.312
1994	0.028	0.491
1995	0.080	0.515
1996	0.028	2.000
1997	0.085	0.451
1998	0.028	2.000
1999	0.082	0.533
2000	0.093	0.366
2001	0.485	0.288
2002	2.971	0.328
2003	0.797	0.291
2004	0.962	0.300
2005	0.028	2.000
2006	0.028	2.000

Table 10. Oregon bottom trawl logbook catch-per-unit-effort index from 1984 to 1999.

Year	CPUE (lbs./hr.)	CV
1984	331.47	0.2121
1985	100.88	0.1875
1986	227.08	0.2928
1987	169.08	0.2730
1988	93.97	0.2897
1989	164.10	0.1749
1990	78.49	0.1348
1991	73.59	0.1275
1992	83.16	0.1179
1993	53.58	0.1314
1994	100.34	0.1128
1995	109.96	0.1387
1996	94.81	0.1357
1997	97.23	0.1502
1998	56.56	0.1718
1999	84.46	0.1684

Table 11. Scaled indices of widow rockfish catches derived from bycatch in three sectors of the Pacific whiting fisheries. Note that index values after 1998 were not used in this assessment.

Year	Index	CV
Foreign		
1977	0.770	0.115
1978	1.205	0.112
1979	0.703	0.119
1980	1.993	0.131
1981	0.728	0.126
1982	0.243	0.247
1984	2.937	0.125
1985	0.407	0.107
1986	1.111	0.103
1987	0.390	0.088
1988	0.513	0.124
Joint venture		
1983	2.889	0.120
1985	0.776	0.117
1986	0.823	0.081
1987	0.320	0.087
1988	0.659	0.077
1989	0.824	0.064
1990	0.710	0.074
Domestic		
1991	1.264	0.125
1992	0.781	0.125
1993	0.801	0.104
1994	1.465	0.068
1995	0.455	0.106
1996	1.018	0.082
1997	0.886	0.077
1998	1.330	0.079

Table 12. Indices of widow rockfish catches derived from triennial surveys from 1977 to 2004. Detailed description of the analysis is in Appendix B.

Year	Index	CV
1977	0.506	0.247
1980	0.382	0.332
1983	0.565	0.289
1986	0.353	0.351
1989	0.390	0.477
1992	0.461	0.364
1995	0.305	0.317
1998	0.692	0.313
2001	0.112	0.350
2004	0.126	0.461

Table 13. Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2006 from the assessment model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1958	34152	243145	119006	47481	0.0000
1959	34221	243566	119023	47481	0.0000
1960	34248	244070	119097	47488	0.0000
1961	34108	244594	119252	47514	0.0000
1962	33555	244999	119483	47576	0.0000
1963	32982	245222	119766	47670	0.0000
1964	31526	244993	120023	47776	0.0000
1965	31650	244611	120198	47875	0.0000
1966	28162	243212	120204	47941	0.0362
1967	35997	239524	117920	47125	0.0409
1968	39154	236741	115239	46127	0.0202
1969	40511	237264	113944	45536	0.0039
1970	42282	240653	114140	45384	0.0057
1971	44704	245021	114905	45410	0.0070
1972	41551	248982	116329	45694	0.0041
1973	90448	265665	118737	46298	0.0074
1974	32579	270818	121270	47013	0.0048
1975	13728	269950	125645	48104	0.0065
1976	11264	265211	130035	49697	0.0101
1977	17009	259292	132416	51534	0.0157
1978	21795	252209	131923	52503	0.0083
1979	11539	241942	128581	52133	0.0258
1980	39262	235543	122405	50269	0.2227
1981	59049	216720	105278	43657	0.3579
1982	22302	187527	86732	35867	0.4336
1983	66907	173672	71221	28812	0.2358
1984	80725	181730	67197	26352	0.2234
1985	29116	179879	66185	25142	0.1883
1986	29471	179346	67421	24840	0.1733
1987	29931	176892	69818	25488	0.1995
1988	23296	167232	70119	25960	0.1531
1989	10683	156146	69371	26185	0.1973
1990	24898	145047	65108	25053	0.1759

Table 13 (continued). Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2006 from the assessment model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1991	16128	133802	60851	23792	0.1258
1992	16102	126355	58084	22929	0.1279
1993	29824	123358	54928	21803	0.1885
1994	45363	123673	50630	20150	0.1666
1995	13939	118715	47835	18887	0.1841
1996	15758	113625	45917	17764	0.1704
1997	13534	108063	45600	17372	0.1639
1998	7470	99972	45148	17280	0.1005
1999	7663	94495	44774	17387	0.1076
2000	9847	89355	43209	17107	0.1182
2001	22504	87514	40888	16444	0.0647
2002	18126	88277	39419	16040	0.0183
2003	66180	105582	39194	15905	0.0020
2004	16045	110688	40131	15963	0.0035
2005	17236	116042	43017	16544	0.0067
2006	16393	120132	47478	17839	0.0065

Table 14. Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Mean recruitment	10.4020	0.1052
Recruitment steepness	0.2904	0.0580
Recruitment deviation in 1958	0.0370	0.4695
Recruitment deviation in 1959	0.0390	0.4693
Recruitment deviation in 1960	0.0399	0.4687
Recruitment deviation in 1961	0.0357	0.4666
Recruitment deviation in 1962	0.0194	0.4621
Recruitment deviation in 1963	0.0021	0.4554
Recruitment deviation in 1964	-0.0434	0.4431
Recruitment deviation in 1965	-0.0403	0.4174
Recruitment deviation in 1966	-0.1582	0.3842
Recruitment deviation in 1967	0.0859	0.3303
Recruitment deviation in 1968	0.1687	0.2861
Recruitment deviation in 1969	0.2019	0.2499
Recruitment deviation in 1970	0.2552	0.2193
Recruitment deviation in 1971	0.3241	0.1930
Recruitment deviation in 1972	0.2589	0.1969
Recruitment deviation in 1973	1.0388	0.1192
Recruitment deviation in 1974	0.0174	0.1713
Recruitment deviation in 1975	-0.8507	0.2064
Recruitment deviation in 1976	-1.0567	0.2013
Recruitment deviation in 1977	-0.6540	0.1673
Recruitment deviation in 1978	-0.4201	0.1405
Recruitment deviation in 1979	-1.0757	0.1658
Recruitment deviation in 1980	0.1272	0.0997
Recruitment deviation in 1981	0.5244	0.0863
Recruitment deviation in 1982	-0.4452	0.1194
Recruitment deviation in 1983	0.6751	0.0761
Recruitment deviation in 1984	0.9494	0.0604
Recruitment deviation in 1985	0.0580	0.0858
Recruitment deviation in 1986	0.2231	0.0875
Recruitment deviation in 1987	0.3038	0.0889
Recruitment deviation in 1988	0.0881	0.0954
Recruitment deviation in 1989	-0.6825	0.1293
Recruitment deviation in 1990	0.1444	0.0922
Recruitment deviation in 1991	-0.3034	0.1070
Recruitment deviation in 1992	-0.3115	0.1120
Recruitment deviation in 1993	0.3378	0.0969
Recruitment deviation in 1994	0.7961	0.0931
Recruitment deviation in 1995	-0.3558	0.1367
Recruitment deviation in 1996	-0.1944	0.1335
Recruitment deviation in 1997	-0.2850	0.1526

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Recruitment deviation in 1998	-0.8279	0.1949
Recruitment deviation in 1999	-0.7532	0.2145
Recruitment deviation in 2000	-0.4845	0.2237
Recruitment deviation in 2001	0.3464	0.1865
Recruitment deviation in 2002	0.1250	0.2549
Recruitment deviation in 2003	1.4333	0.1893
Recruitment deviation in 2004	0.0485	0.3758
Recruitment deviation in 2005	0.1405	0.3946
Recruitment deviation in 2006	0.0974	0.3928
Selectivity parameter 1 for fishery 1	2.5842	0.1439
Selectivity parameter 2 for fishery 1	5.8275	0.0573
Selectivity parameter 3 for fishery 1	0.1506	0.0118
Selectivity parameter 4 for fishery 1	0.0000	0.0011
Selectivity parameter 1 for fishery 2	2.4188	0.1419
Selectivity parameter 2 for fishery 2	6.2552	0.0860
Selectivity parameter 3 for fishery 2	0.2622	0.0288
Selectivity parameter 4 for fishery 2	6.0700	2.9527
Selectivity parameter 1 for fishery 3	2.4544	0.1835
Selectivity parameter 2 for fishery 3	6.0356	0.0920
Selectivity parameter 3 for fishery 3	0.1999	0.0394
Selectivity parameter 4 for fishery 3	8.9373	4.1376
Selectivity parameter 1 for fishery 4	2.3908	0.2937
Selectivity parameter 2 for fishery 4	5.6595	0.1210
Selectivity parameter 3 for fishery 4	0.3247	0.0897
Selectivity parameter 4 for fishery 4	16.9250	1.3464
Average fishing mortality for fishery 1	-4.1735	0.1154
Average fishing mortality for fishery 2	-3.4852	0.1420
Average fishing mortality for fishery 3	-5.1849	0.1411
Average fishing mortality for fishery 4	-5.1393	0.1257
Deviation of fishing mortality for Fishery 1 in 1966	0.8341	0.1188
Deviation of fishing mortality for Fishery 1 in 1967	0.9253	0.1134
Deviation of fishing mortality for Fishery 1 in 1968	0.1159	0.1076
Deviation of fishing mortality for Fishery 1 in 1969	-1.4296	0.1026
Deviation of fishing mortality for Fishery 1 in 1970	-0.9963	0.0965
Deviation of fishing mortality for Fishery 1 in 1971	-0.7886	0.0914
Deviation of fishing mortality for Fishery 1 in 1972	-1.3600	0.0873
Deviation of fishing mortality for Fishery 1 in 1973	-0.9888	0.0841
Deviation of fishing mortality for Fishery 1 in 1974	-1.7729	0.0819
Deviation of fishing mortality for Fishery 1 in 1975	-1.3831	0.0808
Deviation of fishing mortality for Fishery 1 in 1976	-0.7517	0.0802
Deviation of fishing mortality for Fishery 1 in 1977	-0.4497	0.0832
Deviation of fishing mortality for Fishery 1 in 1978	-1.1528	0.0867

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 1 in 1979	-0.5685	0.0899
Deviation of fishing mortality for Fishery 1 in 1980	2.4283	0.0897
Deviation of fishing mortality for Fishery 1 in 1981	2.9761	0.0844
Deviation of fishing mortality for Fishery 1 in 1982	2.8770	0.0760
Deviation of fishing mortality for Fishery 1 in 1983	1.5520	0.0700
Deviation of fishing mortality for Fishery 1 in 1984	0.6385	0.0675
Deviation of fishing mortality for Fishery 1 in 1985	0.6560	0.0654
Deviation of fishing mortality for Fishery 1 in 1986	1.0280	0.0633
Deviation of fishing mortality for Fishery 1 in 1987	1.2309	0.0614
Deviation of fishing mortality for Fishery 1 in 1988	1.0328	0.0594
Deviation of fishing mortality for Fishery 1 in 1989	1.2096	0.0572
Deviation of fishing mortality for Fishery 1 in 1990	0.8926	0.0562
Deviation of fishing mortality for Fishery 1 in 1991	0.3922	0.0564
Deviation of fishing mortality for Fishery 1 in 1992	0.4635	0.0568
Deviation of fishing mortality for Fishery 1 in 1993	0.9632	0.0589
Deviation of fishing mortality for Fishery 1 in 1994	0.6845	0.0628
Deviation of fishing mortality for Fishery 1 in 1995	0.7290	0.0691
Deviation of fishing mortality for Fishery 1 in 1996	0.6775	0.0780
Deviation of fishing mortality for Fishery 1 in 1997	0.5630	0.0879
Deviation of fishing mortality for Fishery 1 in 1998	0.1410	0.0961
Deviation of fishing mortality for Fishery 1 in 1999	0.1709	0.1055
Deviation of fishing mortality for Fishery 1 in 2000	0.0338	0.1171
Deviation of fishing mortality for Fishery 1 in 2001	-0.2940	0.1263
Deviation of fishing mortality for Fishery 1 in 2002	-1.3957	0.1294
Deviation of fishing mortality for Fishery 1 in 2003	-3.0200	0.1295
Deviation of fishing mortality for Fishery 1 in 2004	-2.6359	0.1323
Deviation of fishing mortality for Fishery 1 in 2005	-2.0922	0.1369
Deviation of fishing mortality for Fishery 1 in 2006	-2.1358	0.1492
Deviation of fishing mortality for Fishery 2 in 1983	0.4482	0.1008
Deviation of fishing mortality for Fishery 2 in 1984	1.1761	0.0949
Deviation of fishing mortality for Fishery 2 in 1985	0.9254	0.0911
Deviation of fishing mortality for Fishery 2 in 1986	0.7414	0.0881
Deviation of fishing mortality for Fishery 2 in 1987	1.0368	0.0842
Deviation of fishing mortality for Fishery 2 in 1988	0.7476	0.0808
Deviation of fishing mortality for Fishery 2 in 1989	1.0019	0.0763
Deviation of fishing mortality for Fishery 2 in 1990	0.7067	0.0707
Deviation of fishing mortality for Fishery 2 in 1991	0.3939	0.0666
Deviation of fishing mortality for Fishery 2 in 1992	-0.0379	0.0638
Deviation of fishing mortality for Fishery 2 in 1993	0.4927	0.0600
Deviation of fishing mortality for Fishery 2 in 1994	0.5731	0.0564
Deviation of fishing mortality for Fishery 2 in 1995	0.4876	0.0551
Deviation of fishing mortality for Fishery 2 in 1996	0.4814	0.0566

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 2 in 1997	0.4252	0.0622
Deviation of fishing mortality for Fishery 2 in 1998	-0.2413	0.0701
Deviation of fishing mortality for Fishery 2 in 1999	0.4874	0.0763
Deviation of fishing mortality for Fishery 2 in 2000	0.8902	0.0858
Deviation of fishing mortality for Fishery 2 in 2001	0.2460	0.0940
Deviation of fishing mortality for Fishery 2 in 2002	-0.8840	0.0963
Deviation of fishing mortality for Fishery 2 in 2003	-3.3002	0.0962
Deviation of fishing mortality for Fishery 2 in 2004	-2.9352	0.1000
Deviation of fishing mortality for Fishery 2 in 2005	-1.9247	0.1091
Deviation of fishing mortality for Fishery 2 in 2006	-1.9381	0.1220
Deviation of fishing mortality for Fishery 3 in 1983	1.8054	0.1002
Deviation of fishing mortality for Fishery 3 in 1984	1.6036	0.0937
Deviation of fishing mortality for Fishery 3 in 1985	1.1130	0.0894
Deviation of fishing mortality for Fishery 3 in 1986	1.3007	0.0864
Deviation of fishing mortality for Fishery 3 in 1987	1.1172	0.0829
Deviation of fishing mortality for Fishery 3 in 1988	1.0250	0.0796
Deviation of fishing mortality for Fishery 3 in 1989	1.6588	0.0751
Deviation of fishing mortality for Fishery 3 in 1990	1.8411	0.0696
Deviation of fishing mortality for Fishery 3 in 1991	1.8022	0.0657
Deviation of fishing mortality for Fishery 3 in 1992	2.2061	0.0628
Deviation of fishing mortality for Fishery 3 in 1993	2.5624	0.0591
Deviation of fishing mortality for Fishery 3 in 1994	2.3028	0.0558
Deviation of fishing mortality for Fishery 3 in 1995	2.3585	0.0543
Deviation of fishing mortality for Fishery 3 in 1996	2.2992	0.0556
Deviation of fishing mortality for Fishery 3 in 1997	2.2540	0.0606
Deviation of fishing mortality for Fishery 3 in 1998	1.6951	0.0685
Deviation of fishing mortality for Fishery 3 in 1999	1.2321	0.0748
Deviation of fishing mortality for Fishery 3 in 2000	-2.5819	0.0835
Deviation of fishing mortality for Fishery 3 in 2001	-1.6224	0.0914
Deviation of fishing mortality for Fishery 3 in 2002	-4.0445	0.0935
Deviation of fishing mortality for Fishery 3 in 2003	-6.7855	0.0935
Deviation of fishing mortality for Fishery 3 in 2004	-4.3569	0.0968
Deviation of fishing mortality for Fishery 3 in 2005	-5.8709	0.1043
Deviation of fishing mortality for Fishery 3 in 2006	-4.9150	0.1184
Deviation of fishing mortality for Fishery 4 in 1966	-2.0158	0.1119
Deviation of fishing mortality for Fishery 4 in 1967	-1.0357	0.1084
Deviation of fishing mortality for Fishery 4 in 1968	-0.7126	0.1041
Deviation of fishing mortality for Fishery 4 in 1969	-3.4726	0.0999
Deviation of fishing mortality for Fishery 4 in 1970	-6.5212	0.0950
Deviation of fishing mortality for Fishery 4 in 1971	-6.5381	0.0905
Deviation of fishing mortality for Fishery 4 in 1972	-3.9981	0.0867
Deviation of fishing mortality for Fishery 4 in 1973	-1.2604	0.0838
Deviation of fishing mortality for Fishery 4 in 1974	-0.9923	0.0819
Deviation of fishing mortality for Fishery 4 in 1975	-0.7918	0.0808

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 4 in 1976	-0.73333	0.08035
Deviation of fishing mortality for Fishery 4 in 1977	-0.00135	0.08253
Deviation of fishing mortality for Fishery 4 in 1978	-0.53079	0.08587
Deviation of fishing mortality for Fishery 4 in 1979	1.07210	0.08924
Deviation of fishing mortality for Fishery 4 in 1980	2.10340	0.09002
Deviation of fishing mortality for Fishery 4 in 1981	2.25440	0.08623
Deviation of fishing mortality for Fishery 4 in 1982	3.30730	0.07807
Deviation of fishing mortality for Fishery 4 in 1983	2.62660	0.07249
Deviation of fishing mortality for Fishery 4 in 1984	2.43750	0.06889
Deviation of fishing mortality for Fishery 4 in 1985	2.39460	0.06571
Deviation of fishing mortality for Fishery 4 in 1986	2.04680	0.06454
Deviation of fishing mortality for Fishery 4 in 1987	1.99900	0.06313
Deviation of fishing mortality for Fishery 4 in 1988	1.61680	0.06181
Deviation of fishing mortality for Fishery 4 in 1989	1.72030	0.05972
Deviation of fishing mortality for Fishery 4 in 1990	1.94100	0.05815
Deviation of fishing mortality for Fishery 4 in 1991	1.39170	0.05791
Deviation of fishing mortality for Fishery 4 in 1992	1.36880	0.05798
Deviation of fishing mortality for Fishery 4 in 1993	1.46450	0.05953
Deviation of fishing mortality for Fishery 4 in 1994	1.47800	0.06354
Deviation of fishing mortality for Fishery 4 in 1995	1.99280	0.06933
Deviation of fishing mortality for Fishery 4 in 1996	1.77660	0.07784
Deviation of fishing mortality for Fishery 4 in 1997	1.83310	0.08789
Deviation of fishing mortality for Fishery 4 in 1998	1.57160	0.09766
Deviation of fishing mortality for Fishery 4 in 1999	1.23790	0.10699
Deviation of fishing mortality for Fishery 4 in 2000	1.53400	0.11819
Deviation of fishing mortality for Fishery 4 in 2001	0.78809	0.12695
Deviation of fishing mortality for Fishery 4 in 2002	-1.22780	0.12919
Deviation of fishing mortality for Fishery 4 in 2003	-3.75050	0.12834
Deviation of fishing mortality for Fishery 4 in 2004	-2.08450	0.12926
Deviation of fishing mortality for Fishery 4 in 2005	-3.04910	0.13313
Deviation of fishing mortality for Fishery 4 in 2006	-3.24200	0.14389
Power coefficient for SC Lab index	0.08680	0.08769
Catchbility for SC Lab index	-10.29500	0.25288
Catchbility for Oregon bottom trawl fishery	-6.43600	0.16225
Catchbility for whiting bycatch (foreign)	-11.48100	0.23276
Catchbility for whiting bycatch (joint venture)	-11.27900	0.31769
Catchbility for whiting bycatch (domestic)	-10.81400	0.17976
Catchbility for triennial trawl survey	-12.21600	0.19412

Table 15. Comparisons of key parameters between this assessment (2007 model) and the base model of the 2005 assessment (2005 base model).

Parameter and estimate	2005 base model	2007 model
Number of parameters	198	208
Steepness (*h*)	0.2810	0.2904
Unfished spawning output (B_0) (million of eggs)	49676	50746
Current spawning output (B_t) (million of eggs)	15444	17999
Depletion ($100*B_t/B_0$)	31.09	35.47
Standard deviation of depletion	5.92	6.32

Figure 1. U.S. landings (mt) of widow rockfish by four fisheries from 1966 to 2006. Four fisheries are defined by area and gear type.

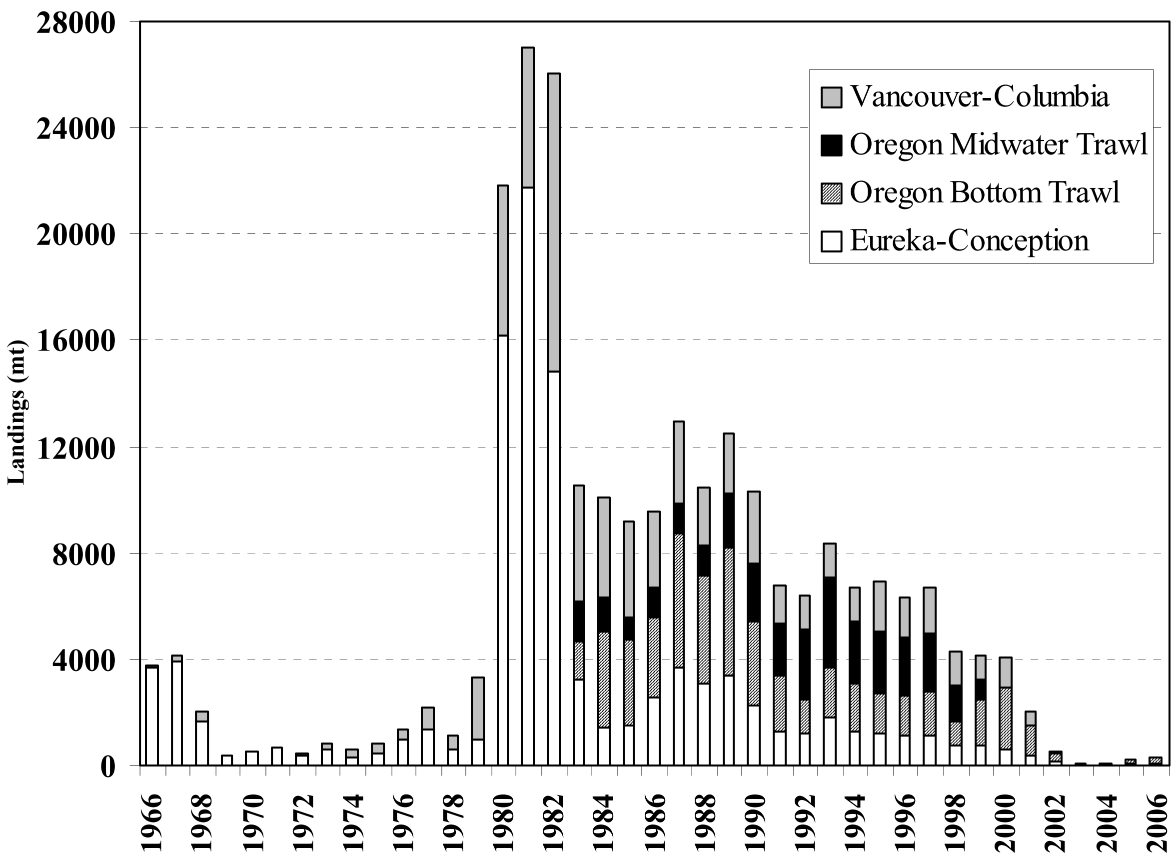
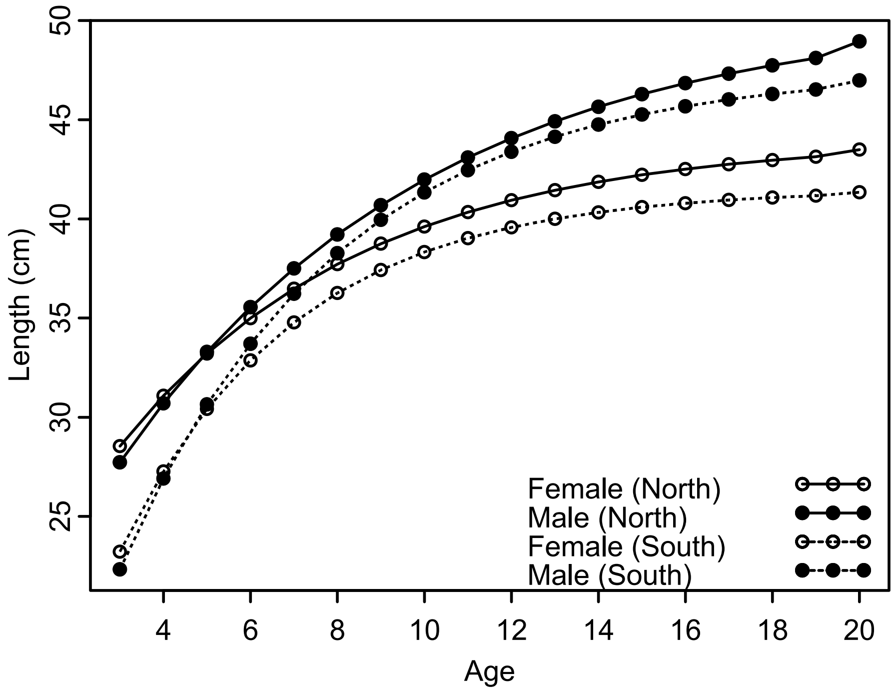


Figure 2. Growth functions for widow rockfish by sex from north and south of 43° latitude used in this assessment.



Weight vs. age

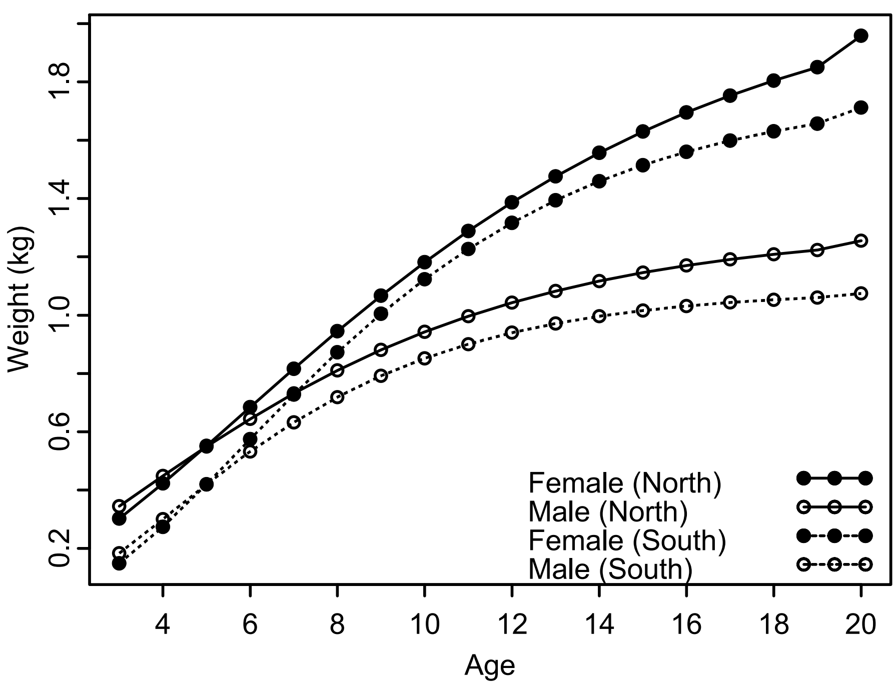


Figure 3. Fecundity and maturity for widow rockfish from north and south of 43° latitude used in this assessment.

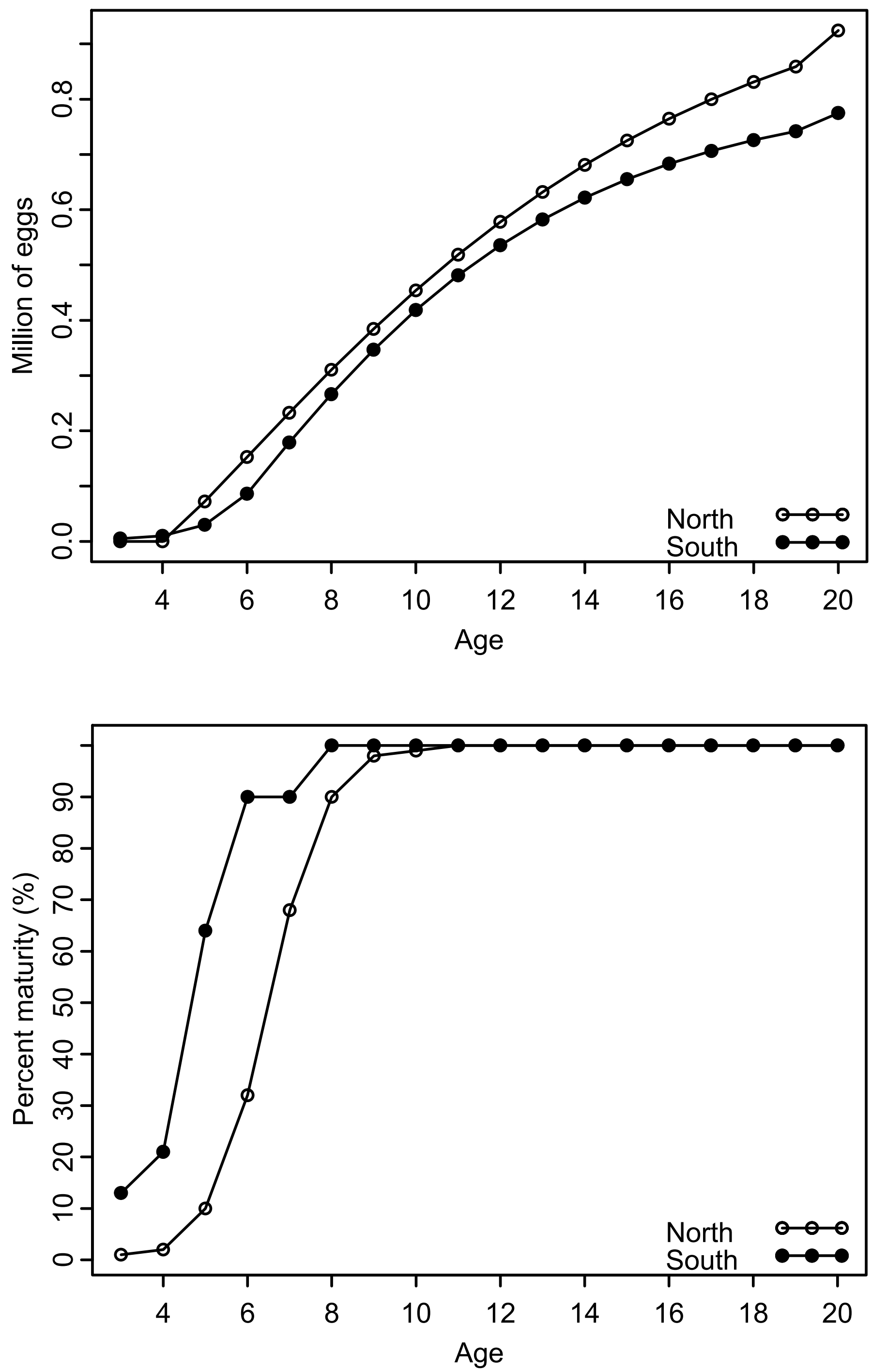


Figure 4. Proportional age composition data for the Vancouver-Columbia combined fishery, by sex and year with the sum across sexes equal to 1.

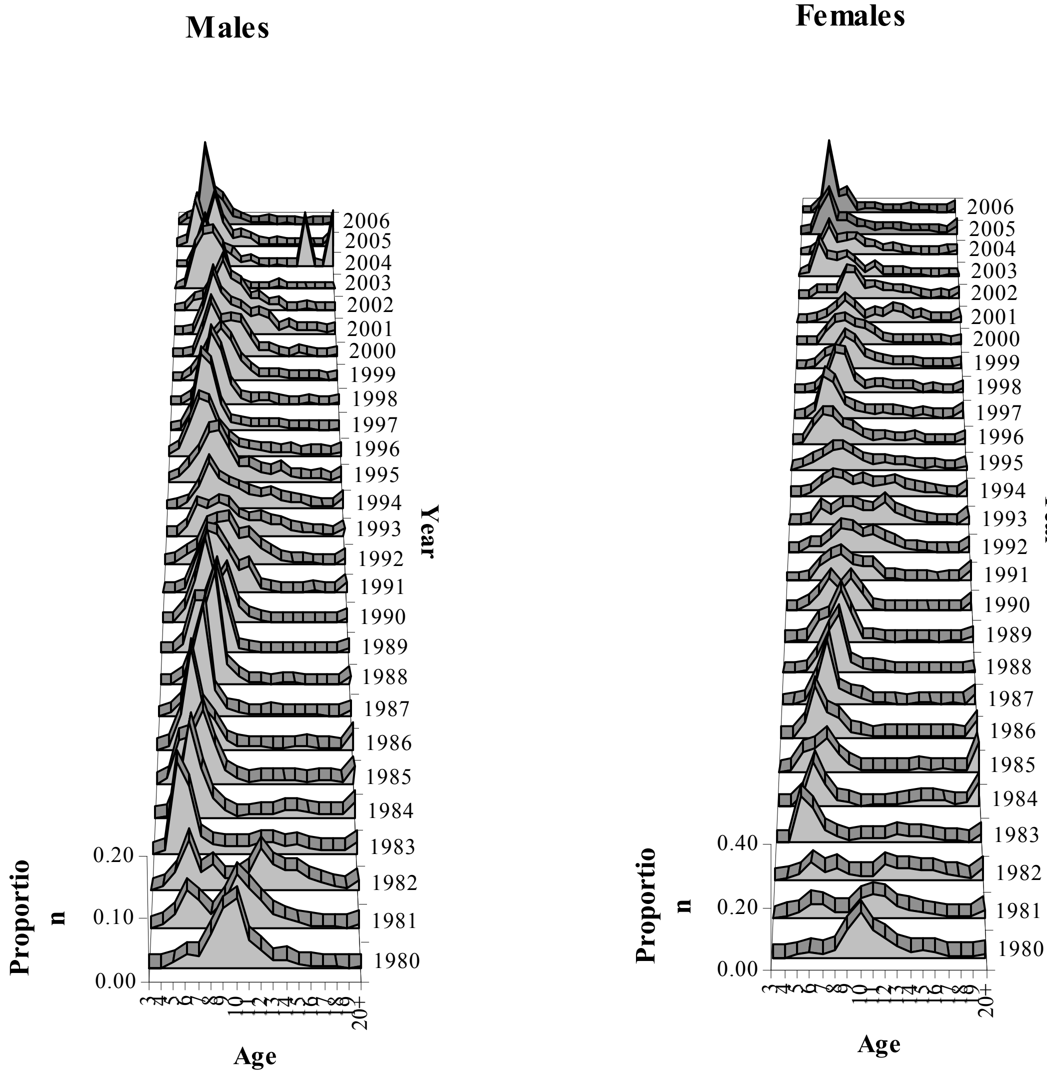


Figure 5. Proportional age composition data for the Oregon midwater trawl fishery, by sex and year with the sum across sexes equal to 1.

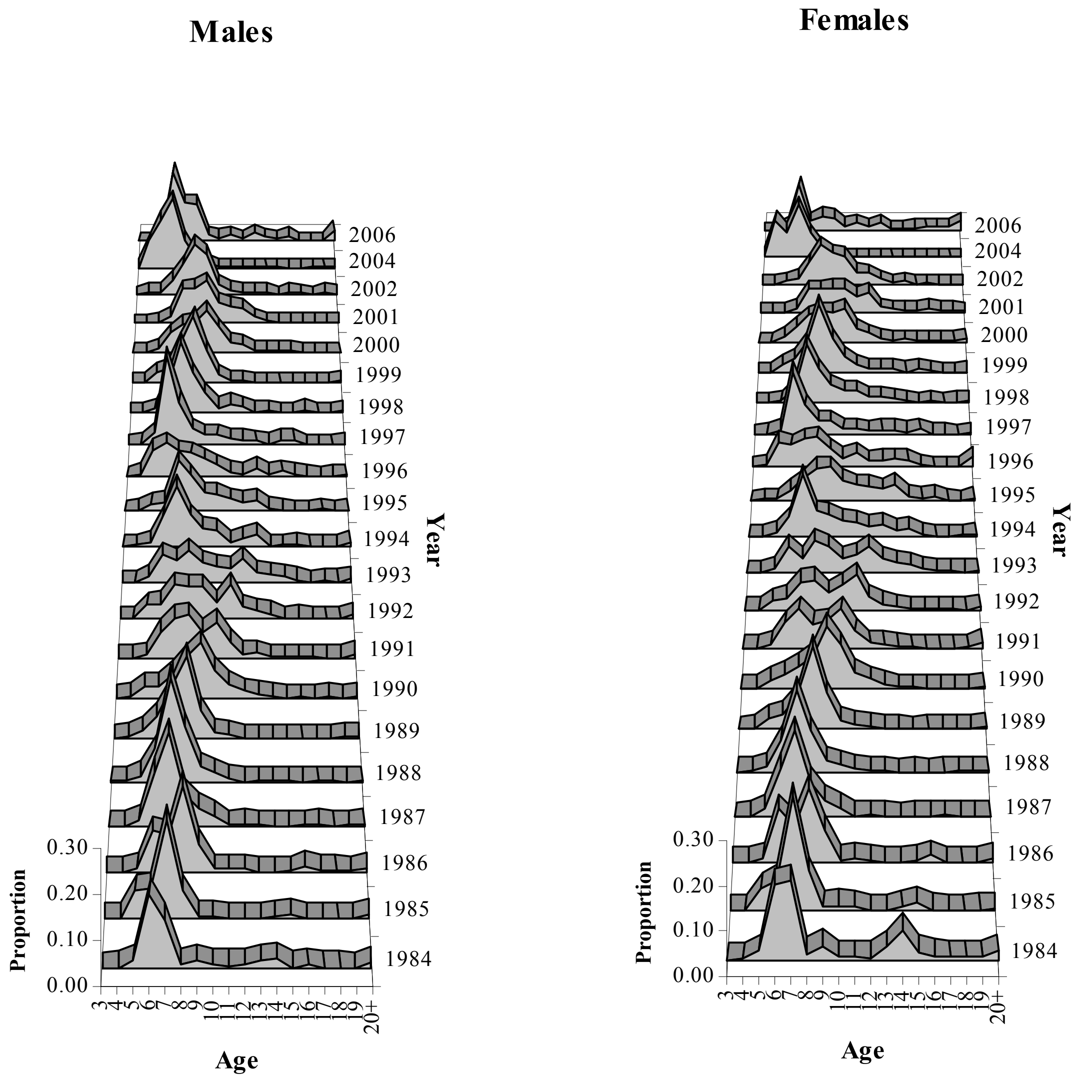
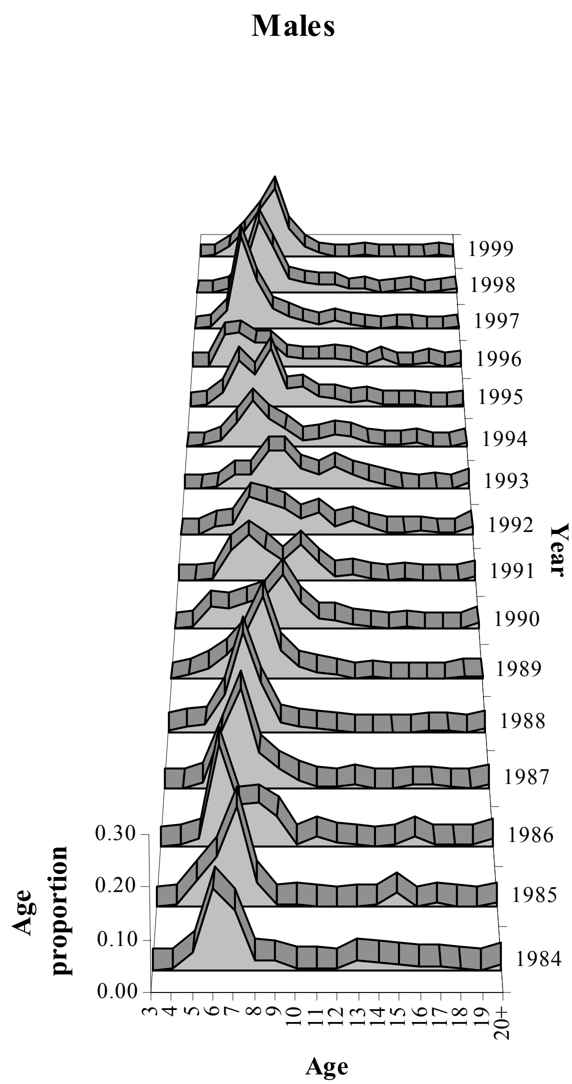


Figure 6. Proportional age composition data for the Oregon bottom trawl fishery, by sex and year with the sum across sexes equal to 1.



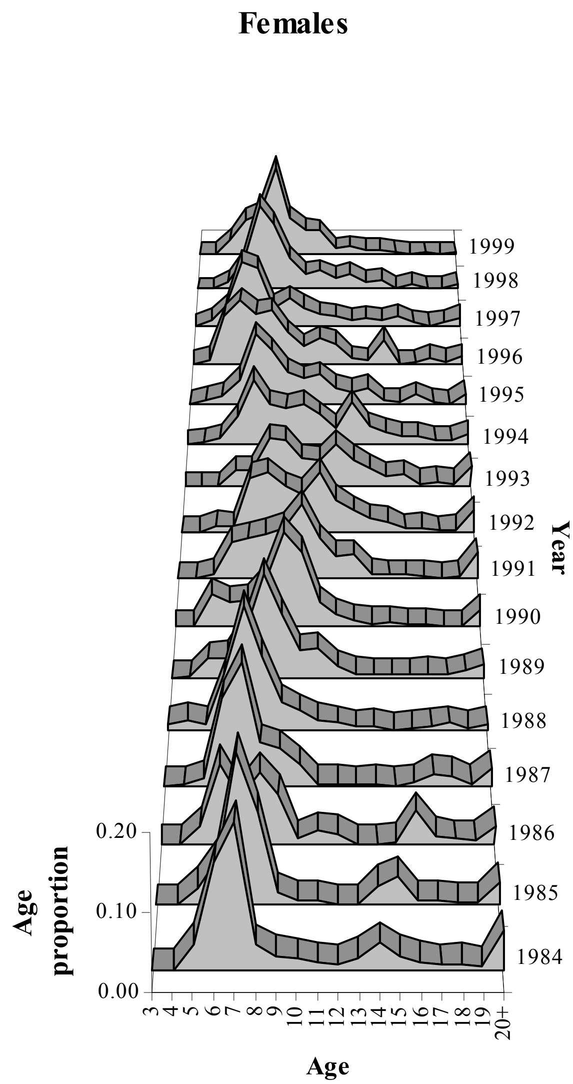


Figure 7. Proportional age composition data for the Eureka-Conception combined fishery, by sex and year with the sum across sexes equal to 1.

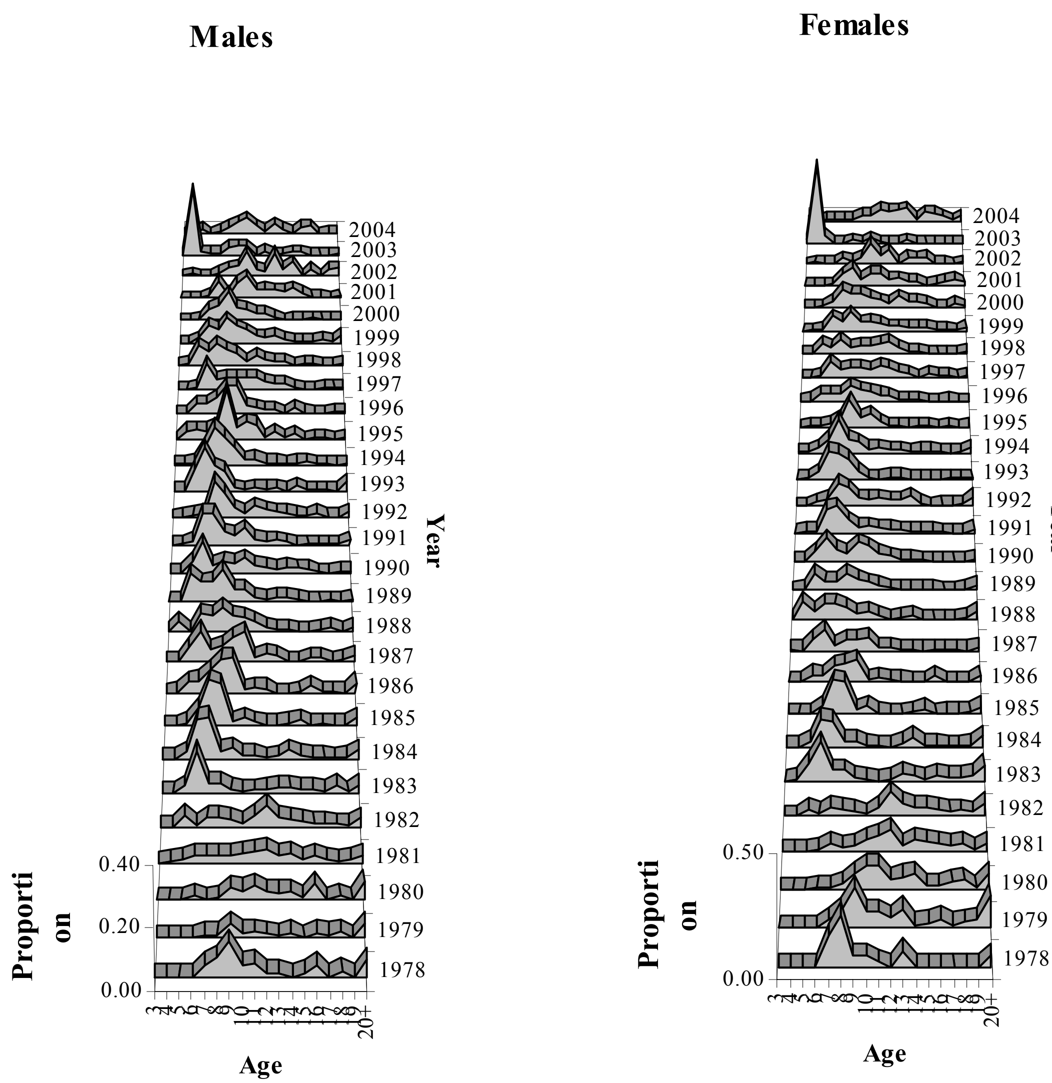


Figure 8. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater juvenile trawl survey from 1984 to 2006.

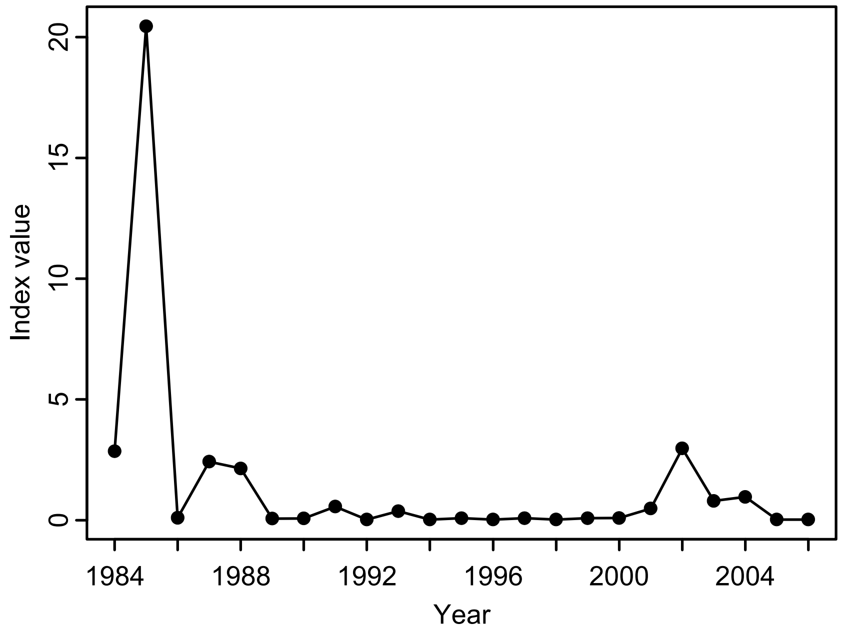


Figure 9. Catch per unit effort of widow rockfish from Oregon bottom trawl fishery from 1984 to 1999.

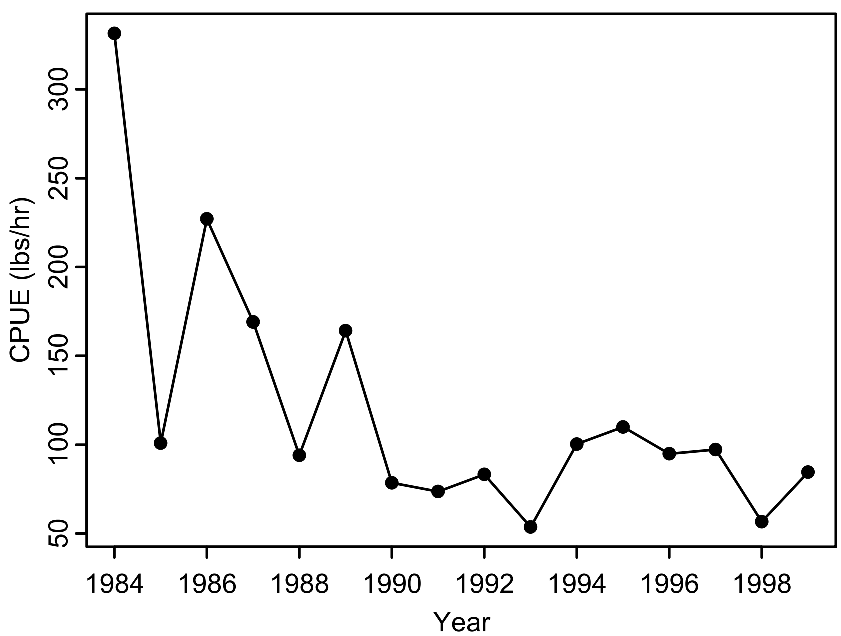


Figure 10. Scaled index values of catch per unit effort of widow rockfish abundance derived from bycatch in the Pacific whiting fisheries.

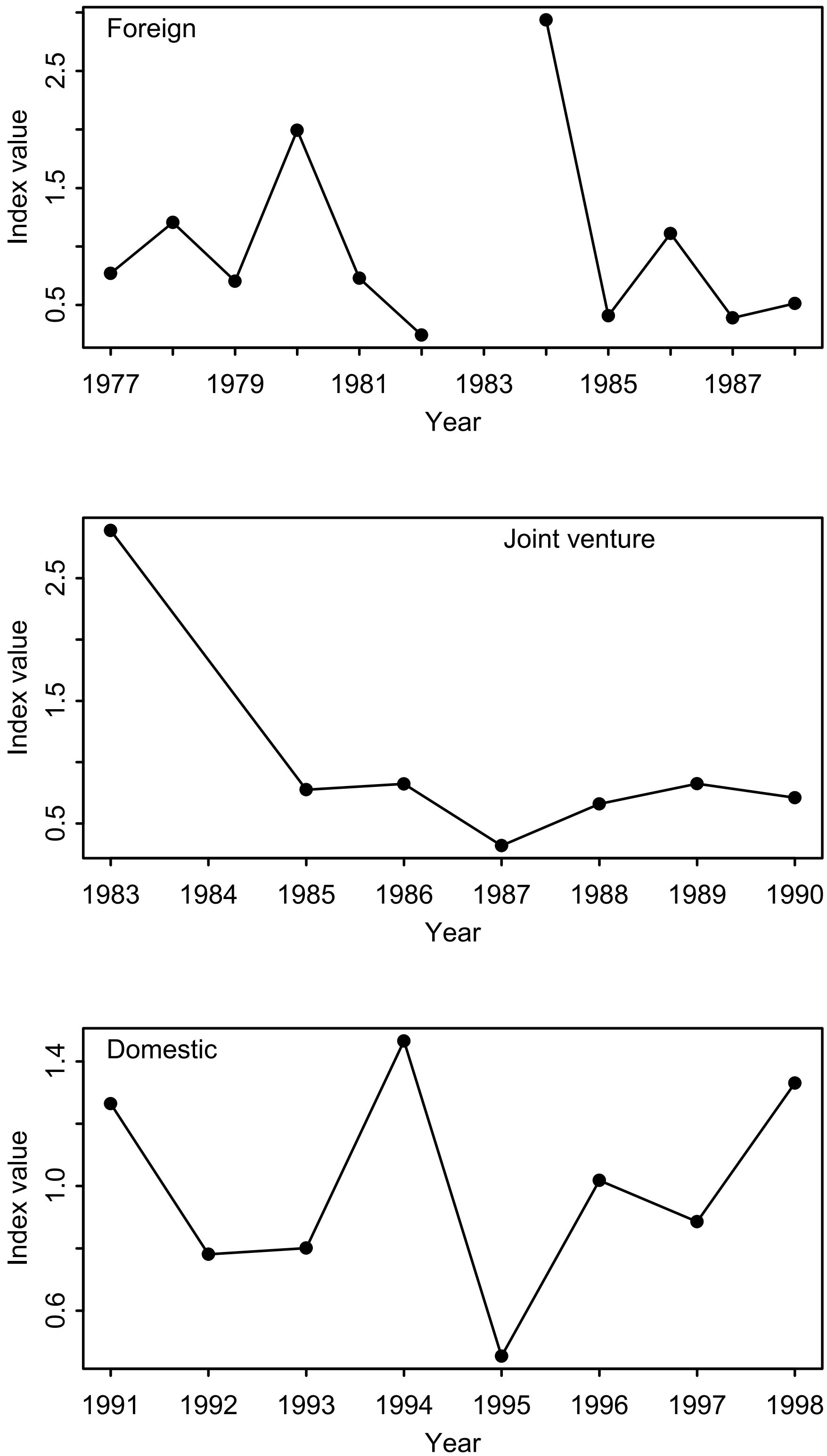


Figure 11. Index values of catch per unit effort of widow rockfish abundance derived from triennial surveys.

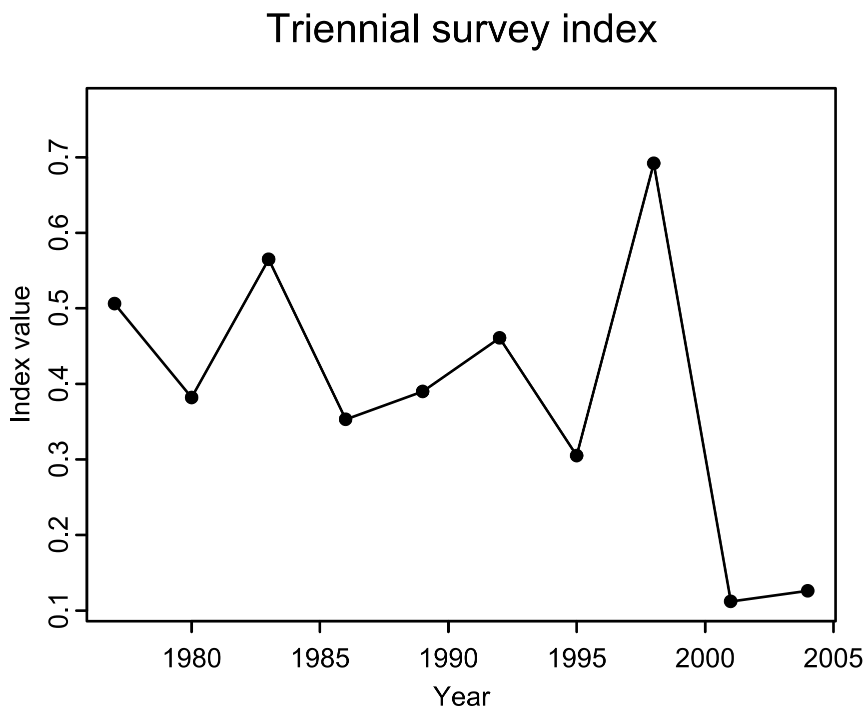


Figure 12. Fraction of landings in the north area, defined as the Vancouver-Columbia and Oregon trawl fisheries, with a 7-year moving average. Note that the fractions before 1977 were fixed at the value computed before the foreign landings (Rogers 2003) were added.

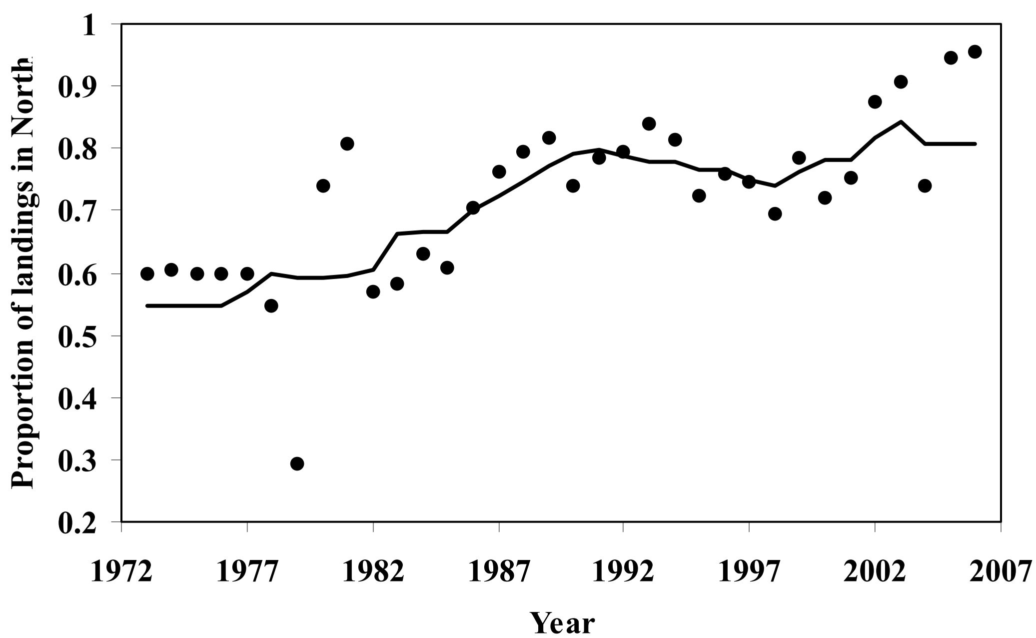


Figure 13. Age 3+ biomass (1000mt) and spawning biomass (1000mt) from 1958 to 2006 estimated from the assessment model.

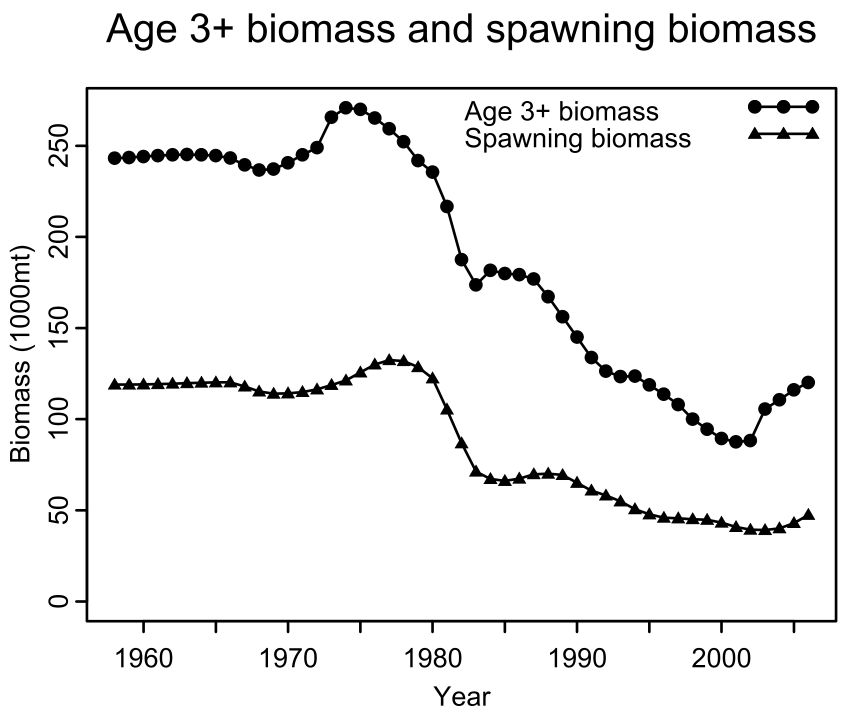


Figure 14. Spawning output (million of eggs) from 1958 to 2006 estimated from the assessment model.

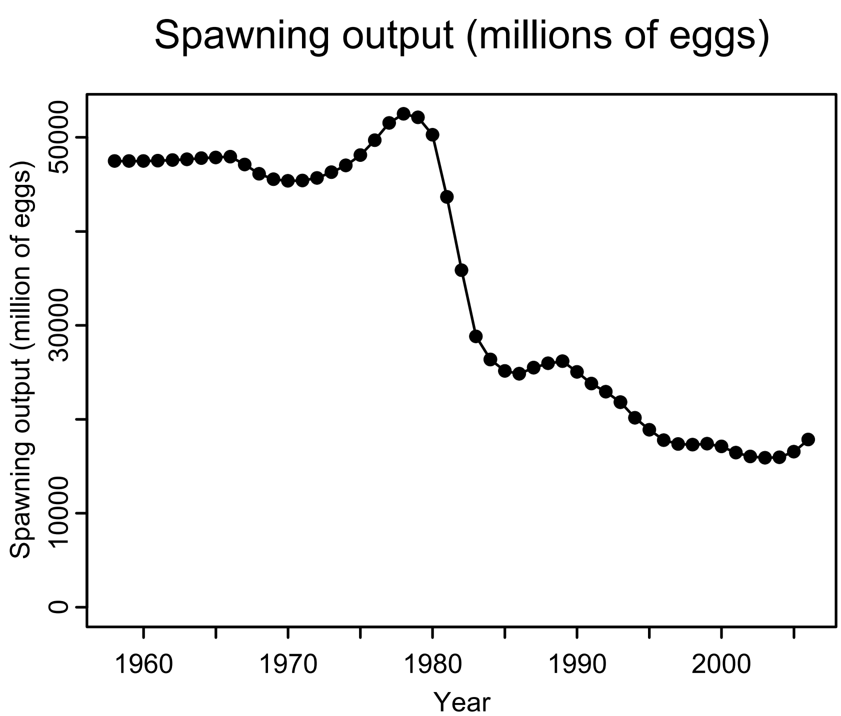


Figure 15. Age 3 recruits (*1000) from 1958 to 2006 estimates from the assessment model.

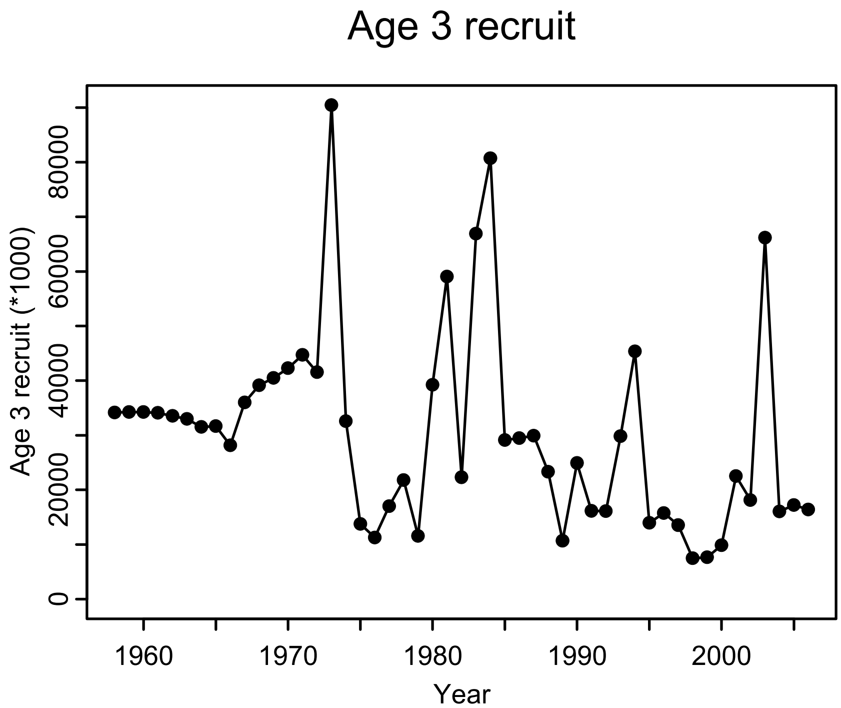


Figure 16. Fishing mortality by four fisheries from 1958 to 2006 estimates from the assessment model.

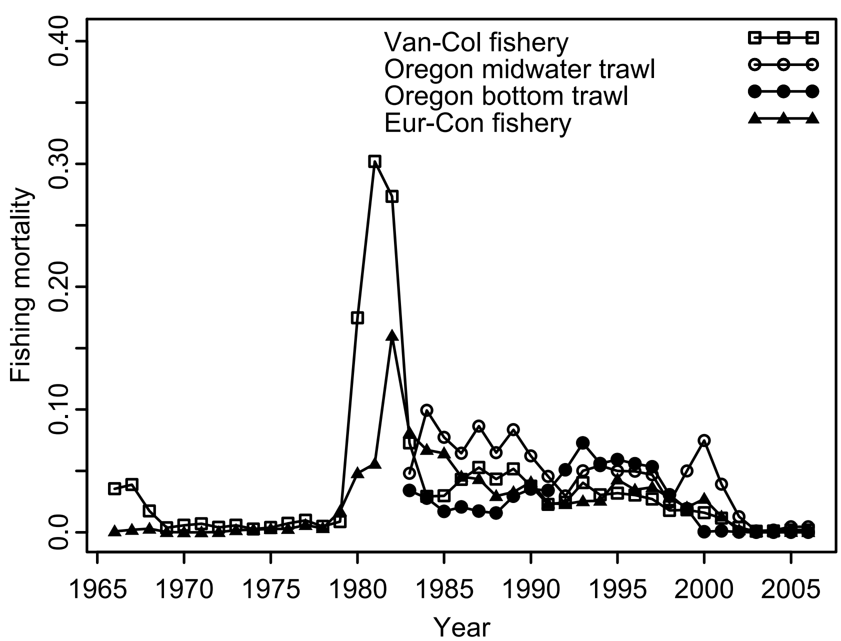


Figure 17. Fishery-specific selectivity estimates from the assessment model.

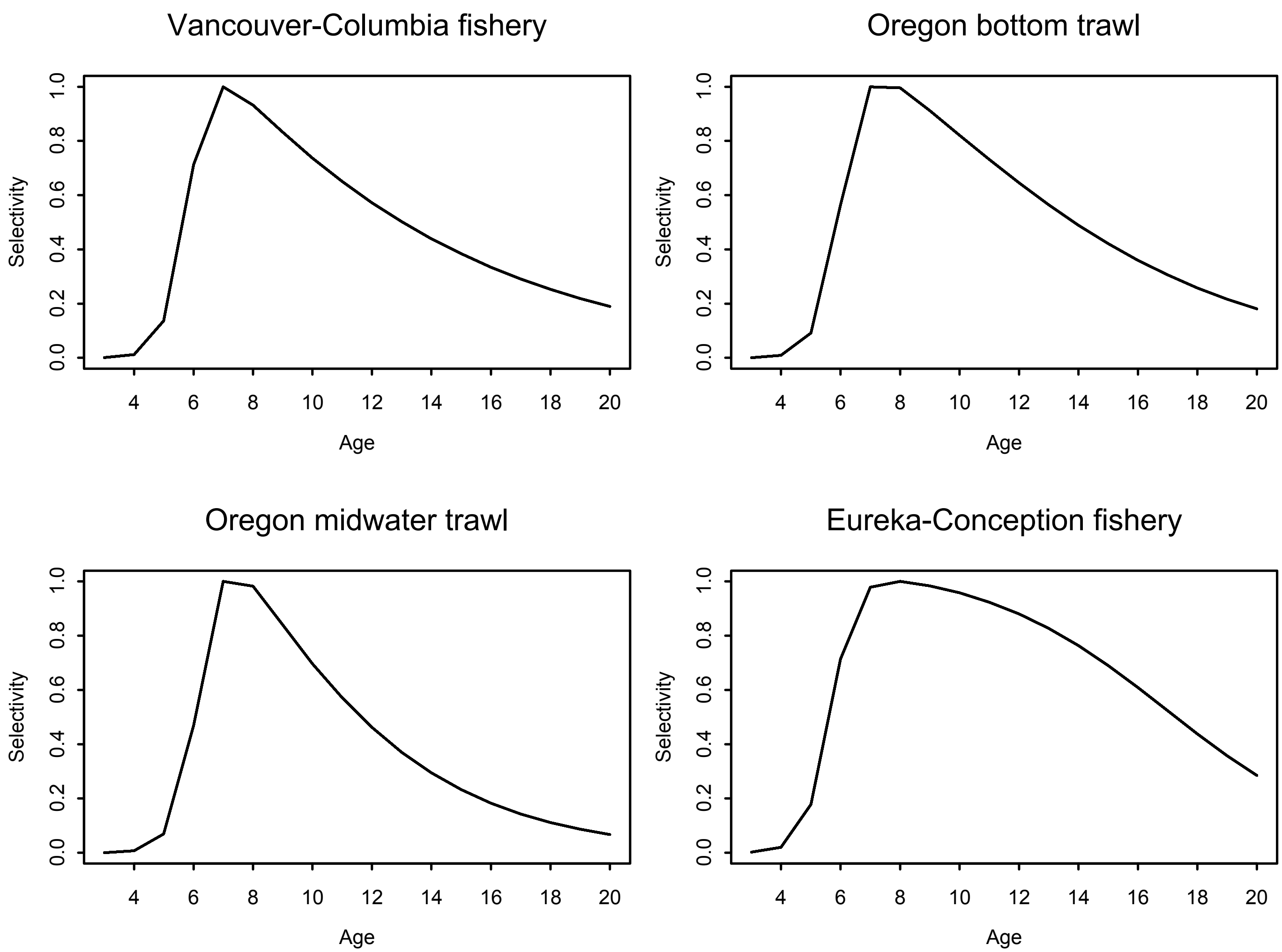


Figure 18. Stock-recruitment relationship from the assessment model. Estimated +Residual = predicted values plus annual recruitment residuals; Estimated = estimated values from stock-recruitment relationship.

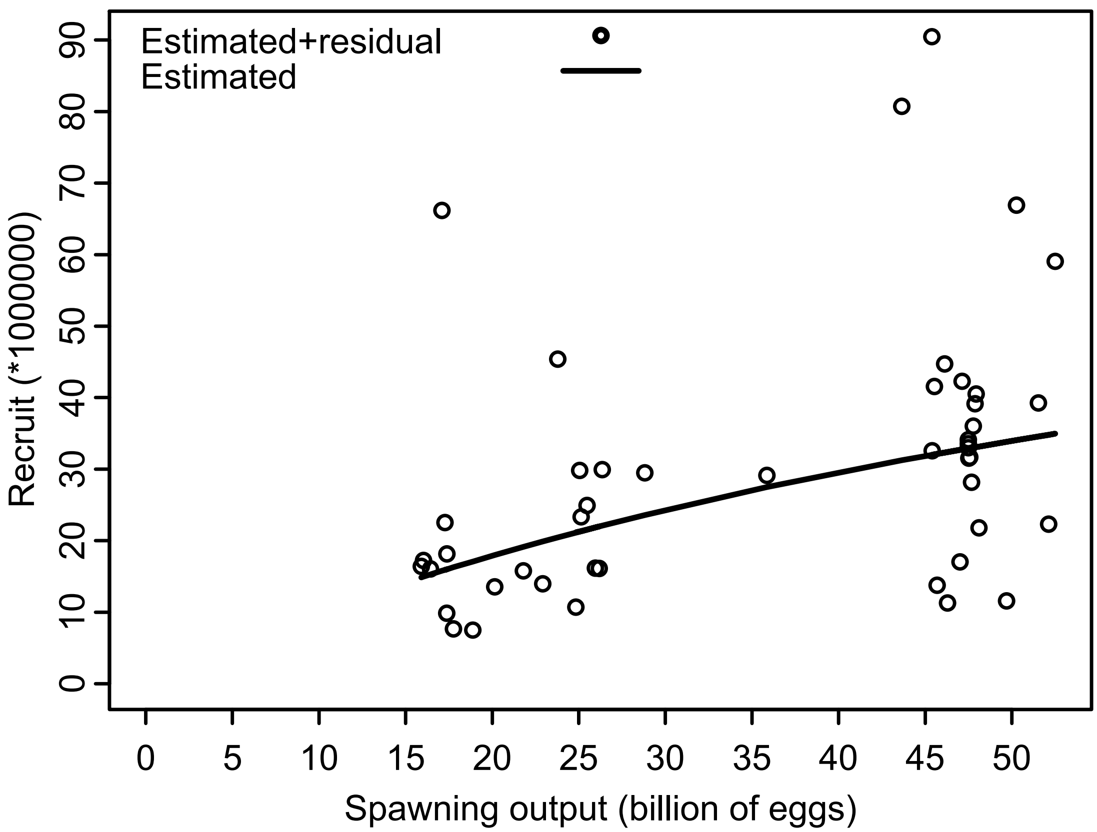
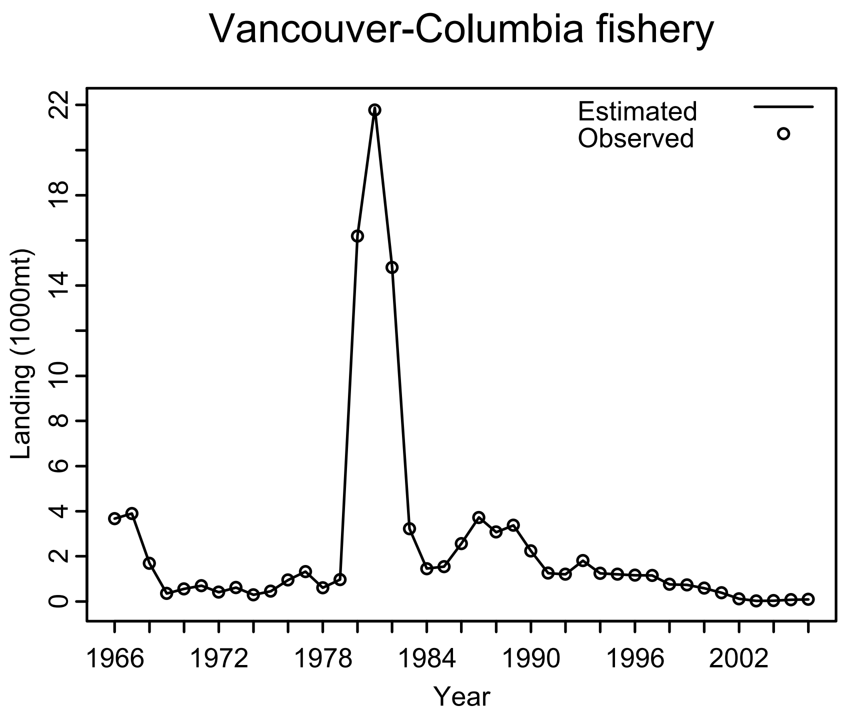


Figure 19. Model fits to the Vancouver-Columbia and Oregon midwater trawl fisheries landings data.



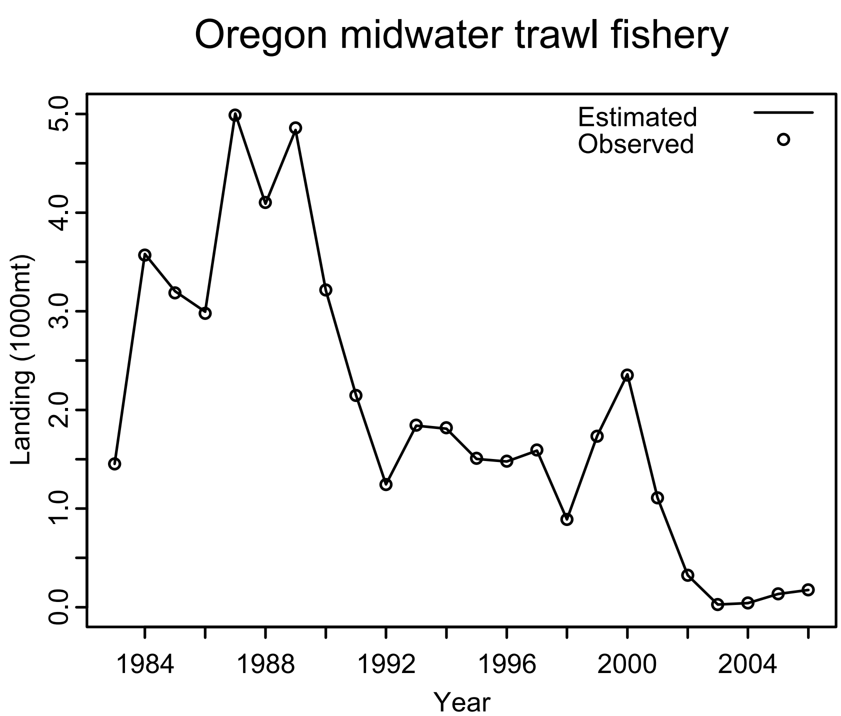
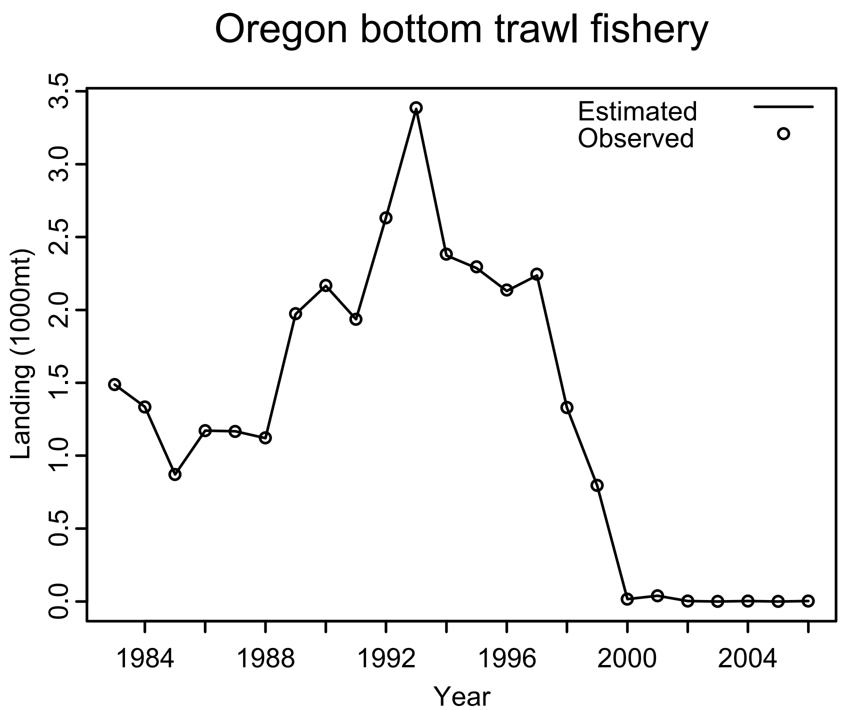


Figure 20. Model fits to the Oregon bottom trawl and Eureka-Conception fisheries landings data.



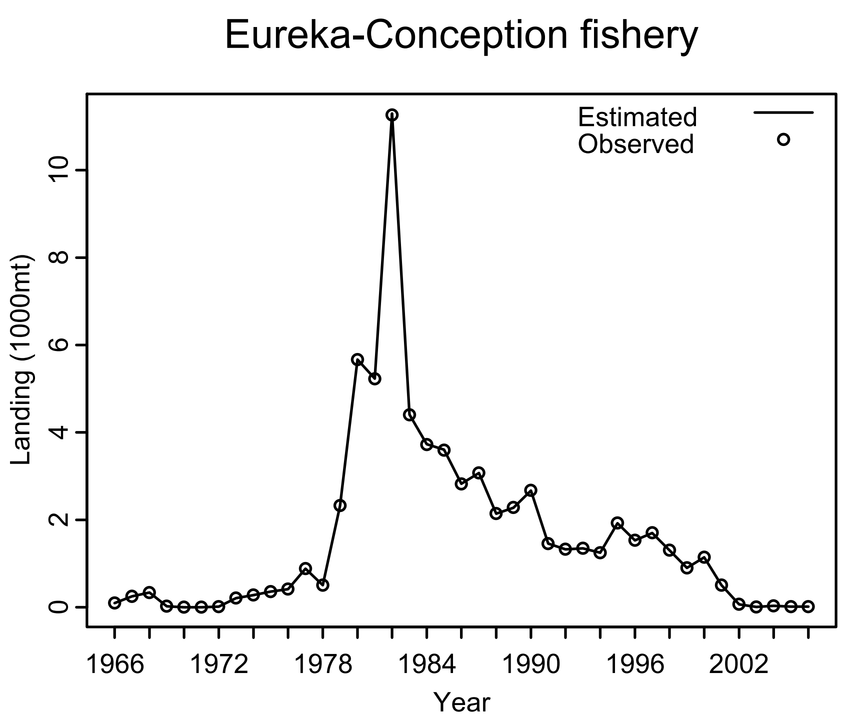


Figure 21. Model fits to the midwater trawl juvenile survey index.

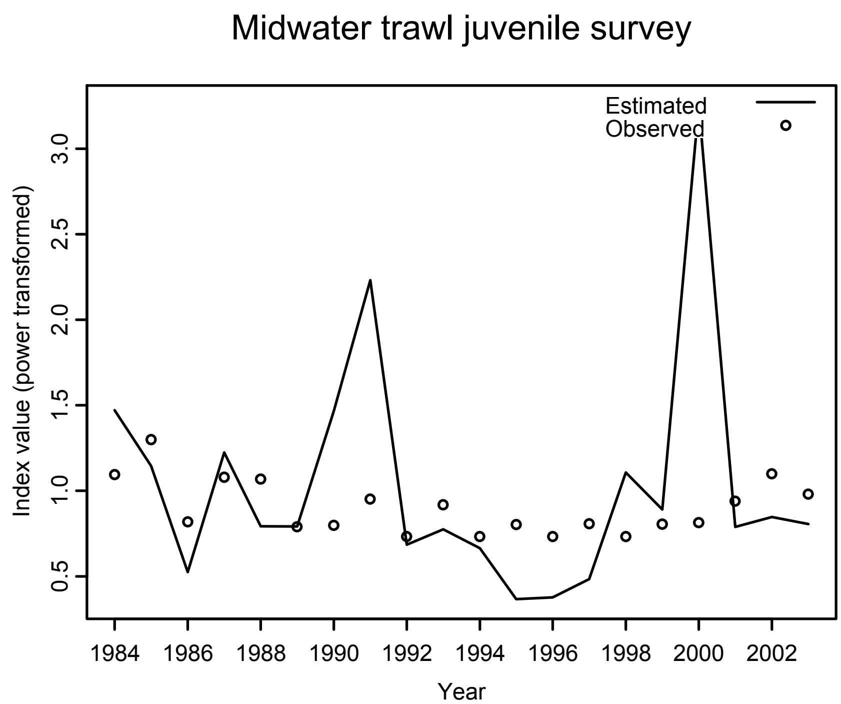


Figure 22. Model fits to the Oregon bottom trawl logbook index.

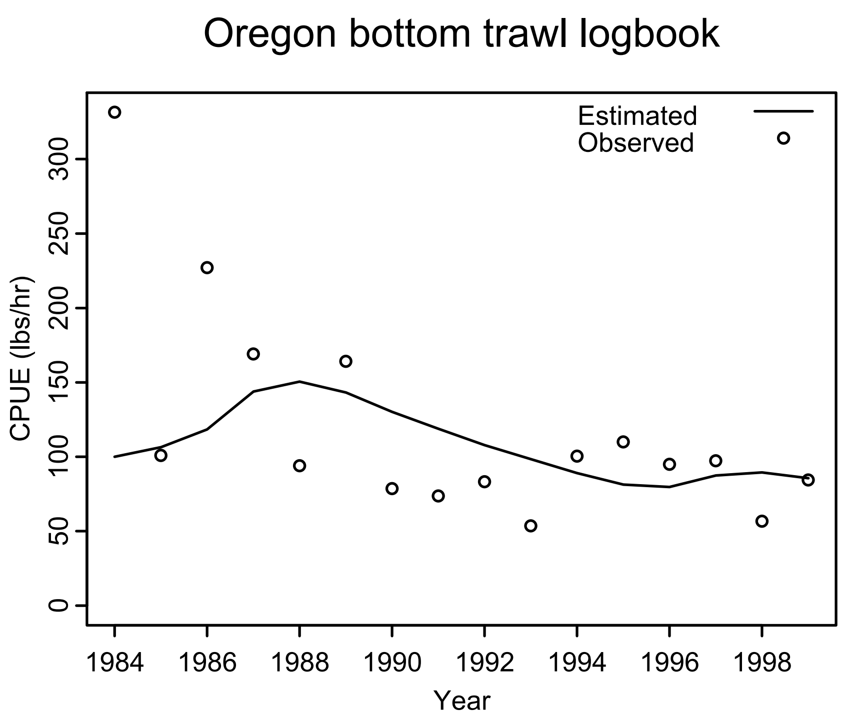


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Figure 23. Model fits to the Pacific whiting foreign fishery bycatch index.

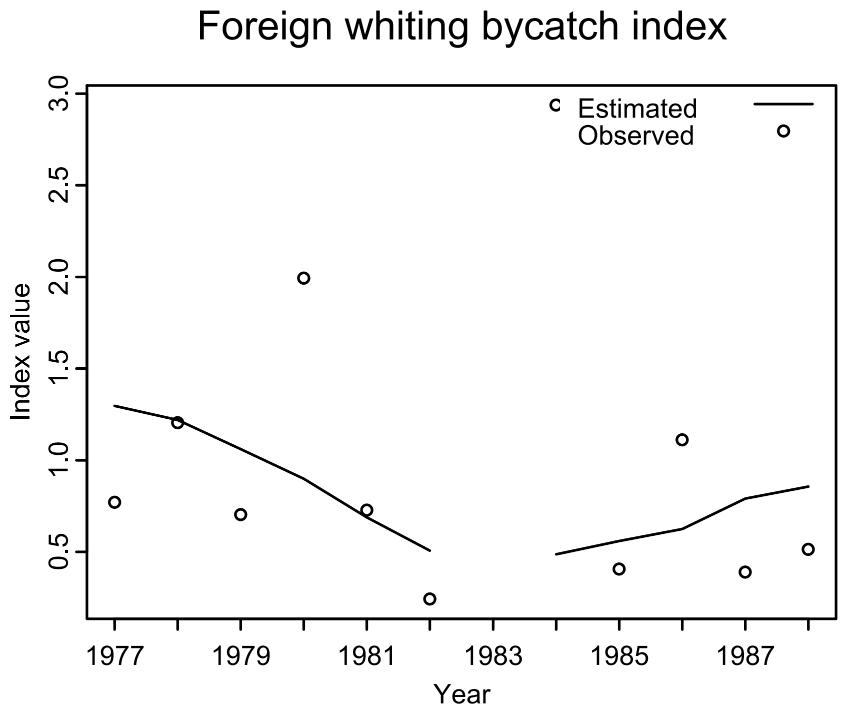
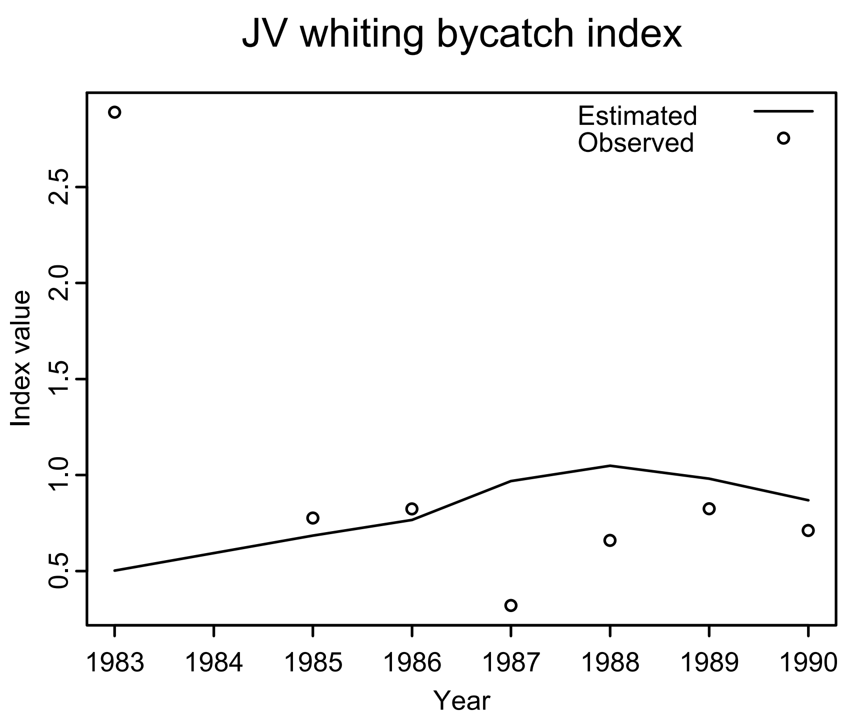


Figure 24. Model fits to the Pacific whiting joint venture (JV) fishery bycatch index.



.

Figure 25. Model fits to the Pacific whiting domestic fishery index.

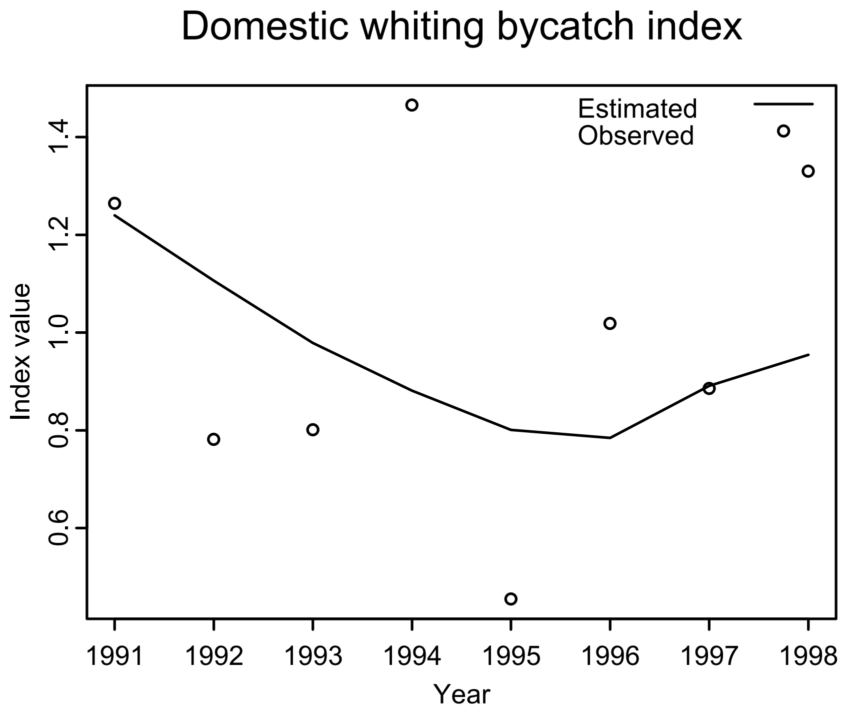


Figure 26. Model fits to triennial survey index.

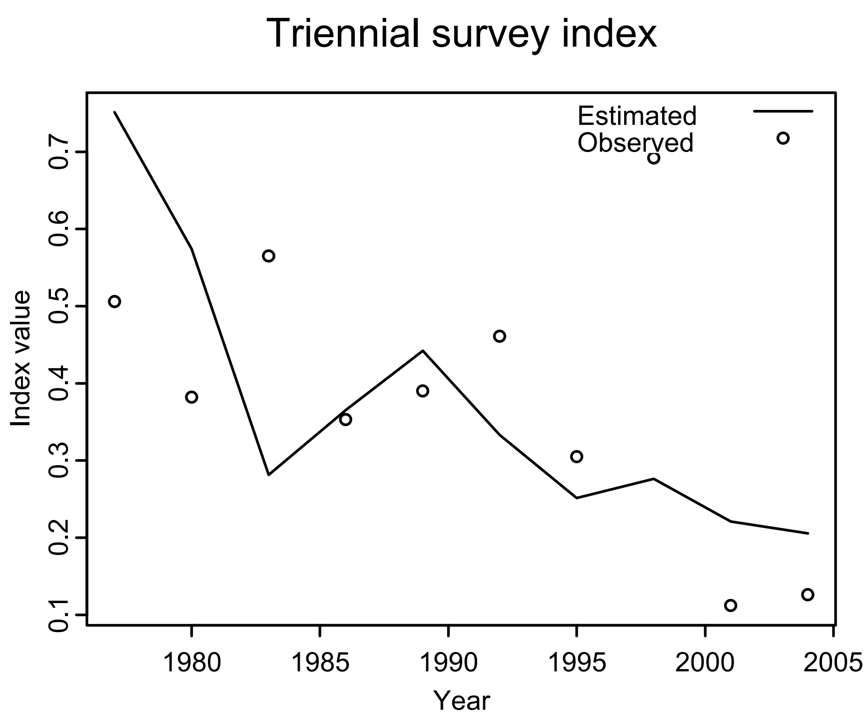
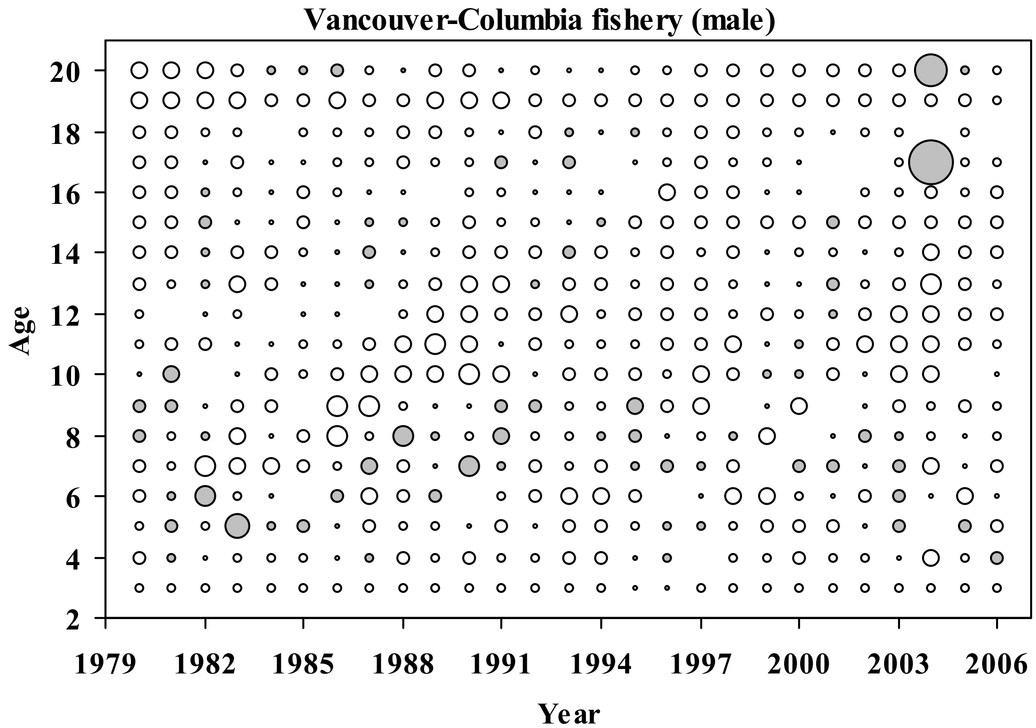


Figure 27a. Age composition residuals for the Vancouver-Columbia fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



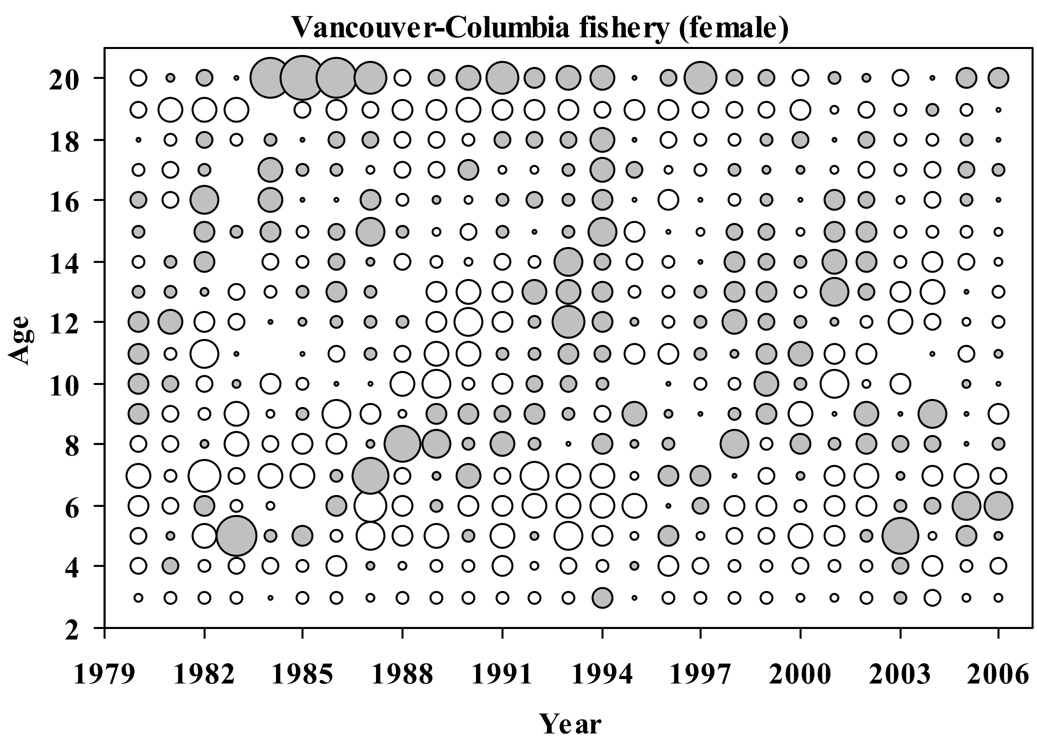
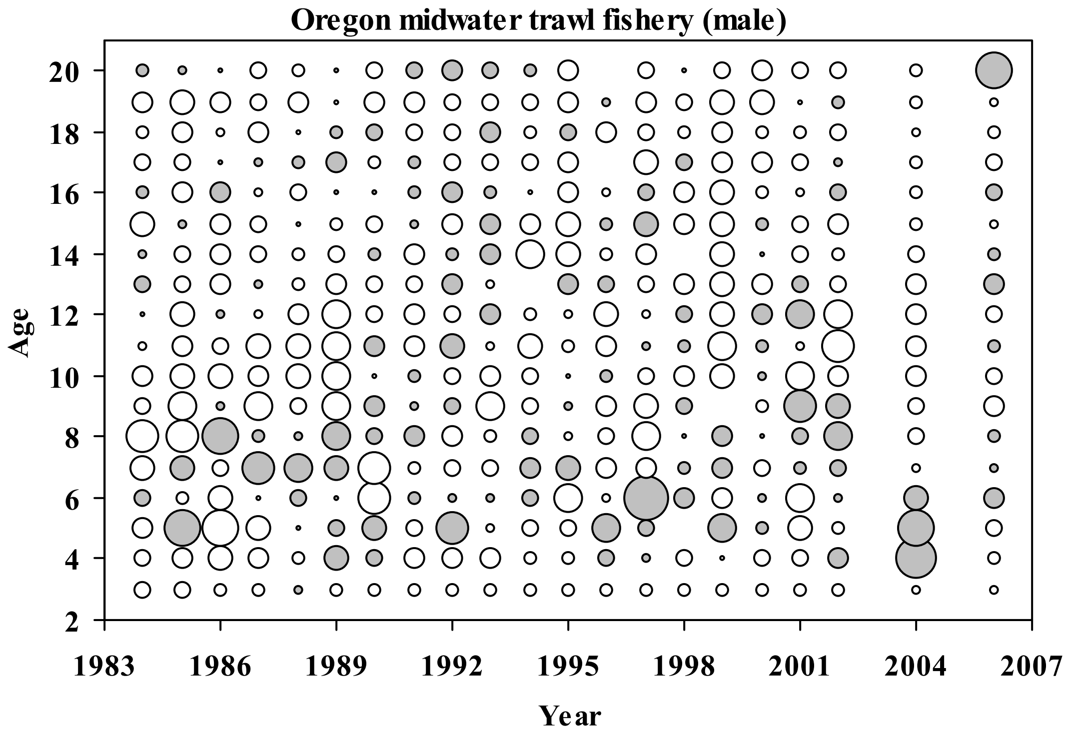


Figure 27b. Age composition residuals for the Oregon midwater trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



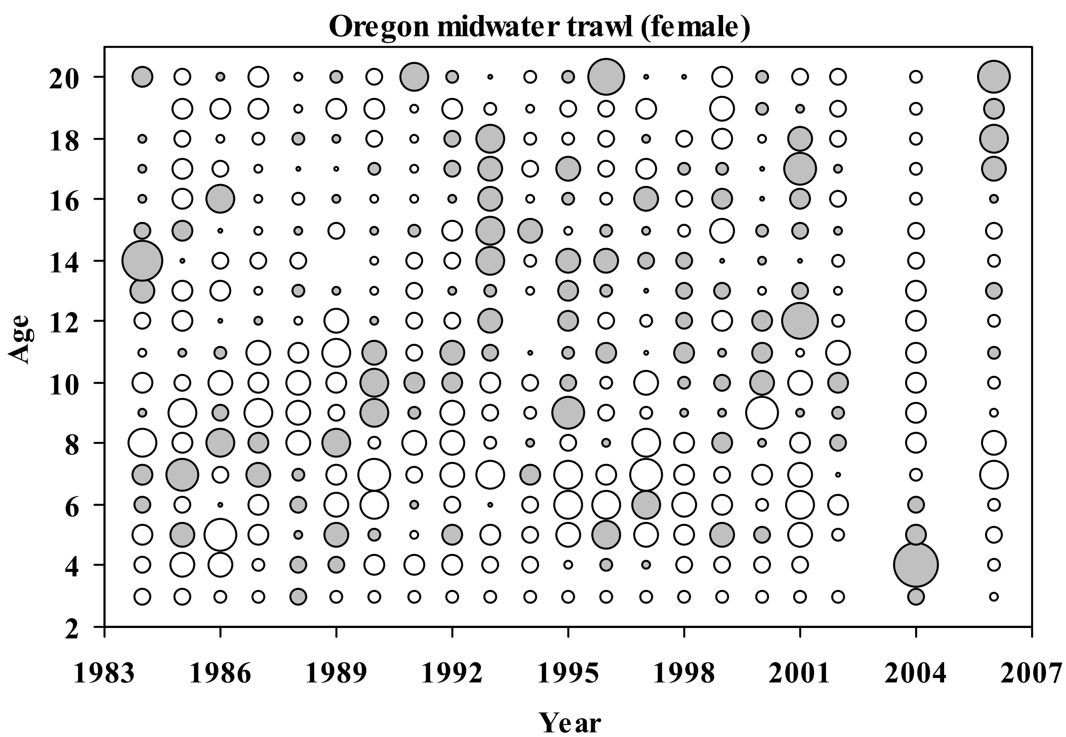
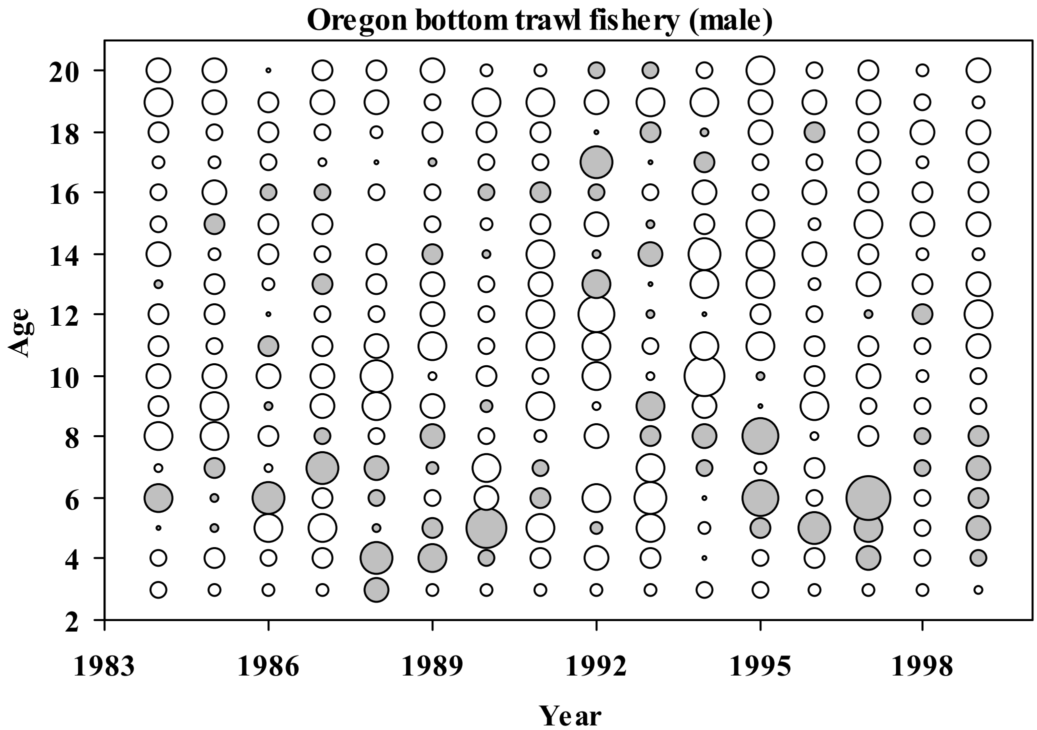


Figure 27c. Age composition residuals for the Oregon bottom trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



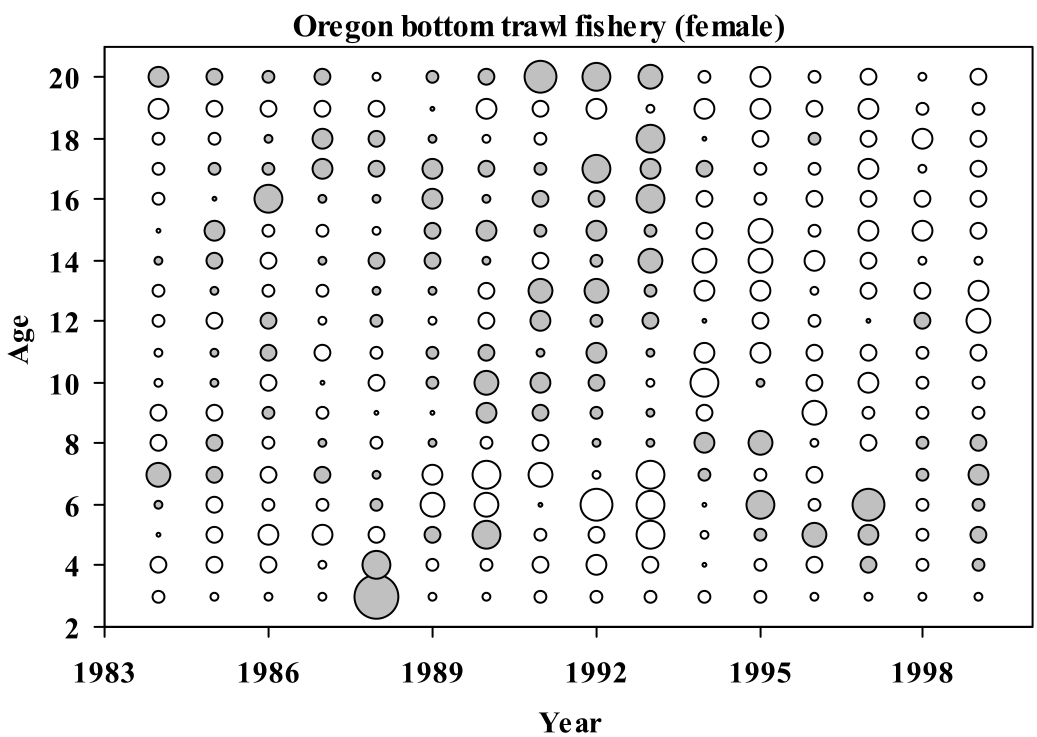
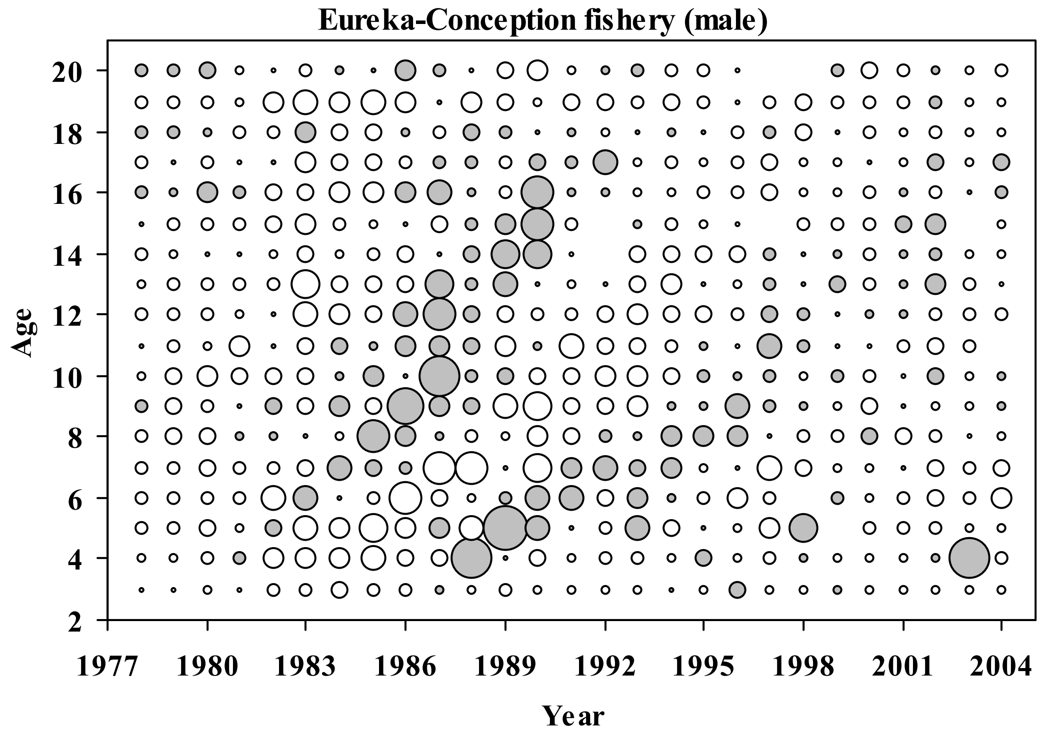


Figure 27d. Age composition residuals for the Eureka-Conception fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



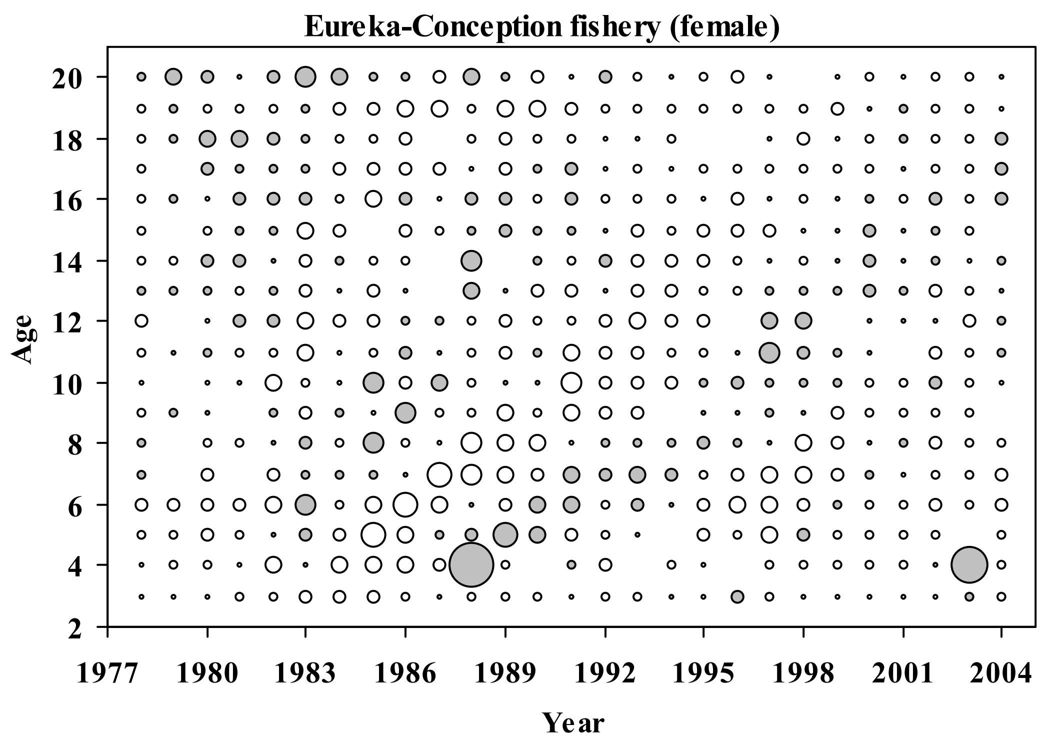
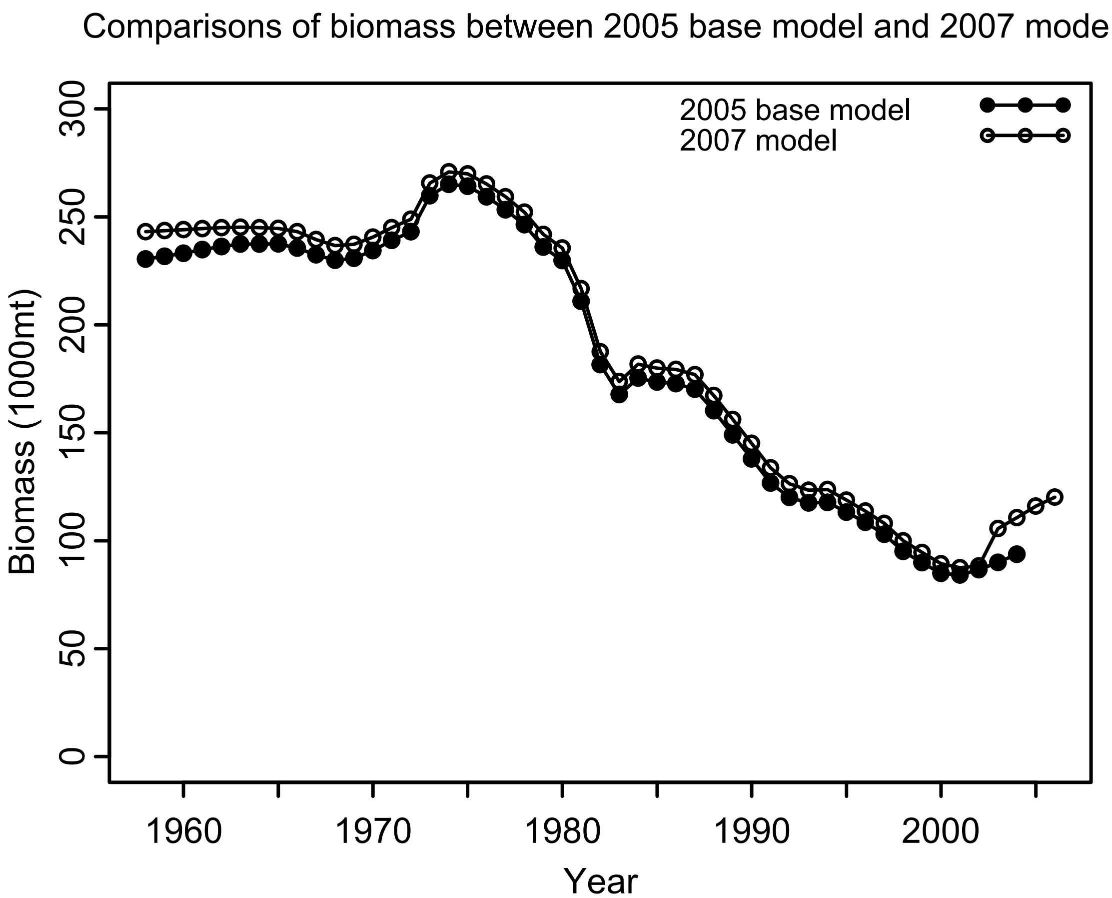


Figure 28. Comparisons of age 3+ biomass between this assessment (2007 model) and the base model of the 2005 assessment (2005 base model).



Appendix A. Input data for widow rockfish stock assessment base model.

```
# ******************************************************************
#  Widow rockfish stock assessment data
#  Xi He
#  National Marine Fisheries Service
#  Southwest Fisheries Science Center
#  Fisheries Ecology Division
#  xi.he@noaa.gov
#  July 2007
#  Filename: wdwmaster.dat
# ******************************************************************

# number of region
2
# number of fishery
4
# number of sex
2
# number of observed indexes
6
# Starting and ending year of the model
1958
2006
49
# Recruitment age and total number of age bins
3
18
# Vector of ages for age bins
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

# number of likelihood components
9

# Natural mortality
0.125 0.125

# Discard rate (D value) by year (landing = catch * (1-D) )
0.06    0.06    0.06    0.06    0.06
0.06    0.06    0.06    0.06    0.06
0.06    0.06    0.06    0.06    0.06
0.06    0.06    0.06    0.06    0.06
0.06    0.06    0.06    0.06    0.06
0.16    0.16    0.16    0.16    0.16
0.16    0.16    0.16    0.16    0.16
0.16    0.16    0.16    0.16    0.16
0.16    0.16    0.16    0.16    0.16
0.16    0.16    0.16    0.16

# Smoothed fraction of total landings in the north\
# fractions from 1968-77 was used in years before 1968, same as in 2000 assessment
# foreign landings from Jean Rogers were not used to compute fractions before 1968
# old data
# 0.548   0.548   0.548   0.548   0.548
# 0.548   0.548   0.548   0.548   0.548
# 0.548   0.548   0.548   0.548   0.548
# 0.548   0.548   0.548   0.548   0.569
# 0.598   0.593   0.592   0.598   0.607
# 0.666   0.670   0.668   0.703   0.726
# 0.746   0.770   0.789   0.795   0.783
# 0.773   0.771   0.755   0.754   0.735
# 0.723   0.738   0.748   0.731   0.731
# 0.731   0.731   0.731   0.731


# new data as computed in 7/12/2007
0.548   0.548   0.548   0.548   0.548
```

```
0.548	0.548	0.548	0.548	0.548
0.548	0.548	0.548	0.548	0.548
0.548	0.548	0.548	0.548	0.569
0.598	0.593	0.591	0.596	0.604
0.663	0.666	0.665	0.700	0.723
0.745	0.771	0.790	0.798	0.787
0.779	0.780	0.767	0.765	0.748
0.740	0.761	0.783	0.782	0.817
0.842	0.806	0.806	0.806


# Biological information
# Growth parameters (Linf,K,t0 for male north, female north, male south, female south)
# age 22 used for wgt of 20+
44.00	50.54	41.50	47.55
0.18	 0.14	 0.25	 0.20
-2.81	-2.68	-0.28	-0.17

# Length weight parameters (b and a for male and female)
0.01188	0.00545
3.06631	3.28781

# proportions of maturity of females
# north
0.01	0.02	0.10	0.32	0.68	0.90	0.98	0.99	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
# south
0.13	0.21	0.64	0.90	0.90	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

# fecundity of females (millions of eggs)
# north
0.0000	0.0000	0.0723	0.1526	0.2325	0.3102	0.3843	0.4540	0.5186
0.5780	0.6322	0.6812	0.7253	0.7648	0.8000	0.8313	0.8590	0.9241
# south
0.0050	0.0100	0.0300	0.0861	0.1788	0.2664	0.3466	0.4184	0.4813
0.5358	0.5824	0.6219	0.6552	0.6831	0.7064	0.7258	0.7419	0.7751

# index values 1968-1999 (-1 = no data)
# NMFS Tiburon/Santa Cruz Lab midwater trawl index
# data copied from Excel file "compare_time_series_with-without_stations.xls" sent by EJ 5-9-2004"
# note that there were no estimates in 1992, 1996, and 1998 because of no positive catches
# 1/2 of historical low estimates (value in 1994) were uesed in those years.
# CVs were set very high.
# only last 2 years data added, proportioan to old data from data sent by EJ 4-28-2004
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
#-1.000000	4.456287 14.319479	0.152868 4.809881
#3.757728	0.206186 0.230129 1.452406 0.067504
#0.878655	0.135008 0.230438 0.067504 0.283063
#0.067504	0.296648 0.287885 1.311048 6.561266
#1.742240	2.379322 0.067504 0.067504
-1.000000	2.853805 20.444666	0.099049 2.421329
2.140435 0.065438 0.075297 0.564927 0.027700
0.372279 0.027699 0.080096 0.027700 0.085343
0.027700 0.081705 0.093390 0.484904 2.971037
0.797075 0.961509 0.027700 0.027700


# Oregon bottom trawl index
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  331.47	100.88	227.08	169.08
```

```
93.97           164.10          78.49           73.59           83.16
53.58           100.34          109.96          94.81           97.23
56.56           84.46           -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000

# Whiting bycatch index - foreign
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000        0.770
1.205            0.703           1.993           0.728           0.243
-1.000000        2.937           0.407           1.111           0.390
0.513           -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000

# Whiting bycatch index - joint venture (JV)
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
2.889           -1.000000        0.776           0.823           0.320
0.659            0.824           0.710          -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000

# Whiting bycatch index - domestic
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       1.2642          0.7812
0.8009          1.4653          0.4546          1.0182          0.8855
1.3301          -1.000000       -1.000000       -1.000000       -1.000000
-1.000000       -1.000000       -1.000000       -1.000000

# Triennual Survey index
# July 7 2005 results from John, base model 1
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      0.506
-1      -1      0.382   -1      -1
0.565   -1      -1      0.353   -1
-1      0.390   -1      -1      0.461
-1      -1      0.305   -1      -1
0.692   -1      -1      0.112   -1
-1      0.126   -1      -1


# cv for each index
# cv for NMFS Tiburon/Santa Cruz Lab midwater trawl index
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.000000         0.424963 0.411120 0.391504 0.253674
0.256064 0.435949 0.448930 0.335098 2.000000
0.311950 0.491489 0.515161 2.000000 0.450671
2.000000 0.533355 0.366159 0.287519 0.328020
0.290935 0.300290 2.000000 2.000000
```

```
# cv for Oregon bottom trawl index
-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    0.2121  0.1875  0.2928  0.2730
0.2897  0.1749  0.1348  0.1275  0.1179
0.1314  0.1128  0.1387  0.1357  0.1502
0.1718  0.1684  -1.0    -1.0    -1.0
-1          -1      -1      -1

# cv for Whiting bycatch index - foreign
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1      0.1153162
0.1118053   0.1186495   0.1311275   0.1257054   0.2466747
-1          0.1253805   0.1074312   0.1026710   0.0880962
0.1243402       -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1

# cv for Whiting bycatch index - joint venture (JV)
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-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
0.12015916      -1      0.11650305      0.08088591      0.08748436
0.07741054      0.06352467      0.07400396      -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1          -1
-1          -1          -1          -1

# cv for Whiting bycatch index - domestic
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-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          0.1251  0.1251
0.1038  0.0685  0.1057  0.0824  0.0767
0.0786      -1          -1          -1          -1
-1          -1          -1          -1

# Triennual Survey CV
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      0.1647139
-1      -1      0.17362109      -1      -1
0.20646497      -1      -1      0.13429315      -1
-1      0.20142058      -1      -1      0.17819659
-1      -1      0.1330084       -1      -1
0.24706085      -1      -1      0.04130032      -1
-1      0.3     -1      -1

# VAL-COL Fishery landings from AllLanding for model.sas
   -1.0    -1.0    -1.0    -1.0    -1.0
   -1.0    -1.0    -1.0  3670.0  3900.0
 1693.0   356.0   554.0   701.0   410.0
  617.0   293.0   454.0   948.0  1318.0
```

```
   605.0     966.0   16190.0   21779.3   14802.4
  3222.4    1450.4    1537.0    2559.1    3721.9
  3078.1    3378.3    2240.7    1250.2    1206.0
  1813.3    1249.6    1201.8    1163.8    1154.9
   757.0     732.6     588.1     383.1     117.9
    22.8      36.4      72.4      91.7

# OR midwater trwal fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
  1452.0    3567.6    3185.0    2976.9    4985.9
  4101.6    4856.9    3213.9    2146.1    1243.4
  1843.6    1818.4    1508.3    1480.6    1593.4
   889.6    1732.7    2351.9    1109.1     323.0
    27.3      41.6     134.3     174.6

# OR bottom trwal fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
  1487.6    1334.2     870.8    1170.7    1166.2
  1121.0    1973.6    2167.1    1935.4    2631.7
  3386.2    2382.5    2295.4    2136.8    2244.7
  1329.7     795.8      16.3      38.9       3.2
     0.2       2.4       0.6       2.0

# EUR-CON fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      96.0     249.0
   336.0      21.0       1.0       1.0      13.0
   207.0     280.0     358.0     412.0     883.0
   502.0    2326.0    5666.0    5225.7   11260.9
  4402.2    3719.5    3595.5    2819.1    3071.0
  2144.0    2279.9    2671.6    1456.4    1324.2
  1348.3    1248.5    1925.7    1530.1    1704.6
  1303.8     900.6    1141.2     504.5      64.1
     5.1      28.5      12.1      12.3

# Age compositions from four fisheries

# VAN-COL Fishery, data copied from "WAAge5.txt"
# number of years of age comps
27
# years of age comps
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
# number of sampled trips, data copied from "nSample_trip.txt"
# next line: real number of trips
# 18  31  40  25  22  16  27  36  20  30  41  35  31  36  28  33  27  30  22  29  21  10  12  5  20  11  10
# next line: fitted effective sample sizes
# 99  171  220  136  120  87  147  198  110  164  225  192  171  198  152  182  147  164  120  158  115  54  66  26  110  61  54
# Dont change formats of next 2 lines (read by effective sample size programs)
# VAN-COL Fishery new sample counts
99  169  221  136  120  87  146  198  110  164  226  192  169  198  152  181  146  164  120  159  115  54  66  26  110  60  54

# male age comps
  0.00000  0.00000  0.00936  0.02151  0.02034  0.05554  0.09555  0.11058  0.04602  0.02920  0.01189  0.01306  0.00585
0.00410  0.00234  0.00234  0.00117  0.00293
  0.00044  0.00661  0.02443  0.06374  0.04552  0.02404  0.04774  0.08777  0.06757  0.04708  0.02576  0.01710  0.01166
0.00533  0.00428  0.00339  0.00289  0.00850
  0.00016  0.00849  0.03050  0.08438  0.03069  0.04496  0.02057  0.02149  0.03265  0.07169  0.04494  0.03431  0.03486
0.02110  0.01407  0.00881  0.00547  0.01688
  0.00000  0.00757  0.15372  0.11349  0.02842  0.01747  0.01426  0.01310  0.01359  0.01836  0.02014  0.01478  0.01532
0.00881  0.00634  0.00669  0.00567  0.01989
```

0.00000 0.00335 0.05370 0.16103 0.08334 0.03342 0.01385 0.00439 0.00560 0.00680 0.00752 0.01293 0.01279
0.01068 0.00680 0.00768 0.00768 0.02856
0.00000 0.00830 0.07482 0.08042 0.12478 0.06645 0.02161 0.00947 0.00356 0.00591 0.00532 0.00605 0.00546
0.00266 0.00591 0.00472 0.00251 0.02834
0.00000 0.00700 0.06018 0.17364 0.07517 0.04895 0.01438 0.00597 0.00529 0.00522 0.00346 0.00312 0.00463
0.00607 0.00322 0.00230 0.00154 0.02948
0.00000 0.00626 0.02405 0.12001 0.19421 0.04619 0.01287 0.00853 0.00284 0.00419 0.00554 0.00421 0.00301
0.00405 0.00375 0.00211 0.00150 0.01125
0.00000 0.00000 0.01486 0.06014 0.13687 0.19886 0.03497 0.01327 0.00455 0.00245 0.00086 0.00262 0.00314
0.00086 0.00017 0.00052 0.00069 0.01404
0.00000 0.00256 0.01760 0.09336 0.09497 0.15702 0.08737 0.00920 0.00372 0.00116 0.00000 0.00128 0.00023
0.00093 0.00023 0.00046 0.00151 0.00846
0.00000 0.00046 0.02508 0.07734 0.15251 0.06807 0.09741 0.02997 0.01148 0.00453 0.00098 0.00046 0.00000
0.00046 0.00051 0.00098 0.00103 0.00747
0.00000 0.00124 0.01005 0.06167 0.11410 0.10725 0.07367 0.04353 0.04959 0.01028 0.00395 0.00290 0.00166
0.00062 0.00405 0.00114 0.00114 0.01829
0.00000 0.00262 0.01954 0.03090 0.07154 0.07726 0.08193 0.04874 0.05152 0.02944 0.01979 0.00793 0.00491
0.00270 0.00172 0.00000 0.00090 0.01162
0.00019 0.00019 0.01642 0.05843 0.05075 0.06302 0.05670 0.03519 0.02906 0.03079 0.02292 0.02033 0.01221
0.00651 0.00533 0.00434 0.00198 0.01338
0.00000 0.00133 0.01058 0.04137 0.08687 0.05705 0.04536 0.03711 0.02812 0.02280 0.02596 0.01647 0.01295
0.01115 0.00493 0.00360 0.00270 0.01747
0.00069 0.01025 0.03094 0.05624 0.09620 0.09981 0.06392 0.02860 0.03060 0.01866 0.01497 0.02361 0.01040
0.00741 0.00614 0.00722 0.00246 0.01198
0.00082 0.01212 0.05914 0.11186 0.10422 0.05756 0.03292 0.01833 0.01345 0.01036 0.00793 0.00635 0.00793
0.00237 0.00316 0.00319 0.00240 0.00793
0.00000 0.00283 0.03676 0.14894 0.12910 0.04963 0.01522 0.00955 0.00624 0.00681 0.00663 0.00814 0.00133
0.00332 0.00265 0.00066 0.00075 0.00398
0.00000 0.00109 0.01427 0.04277 0.14569 0.10966 0.03977 0.01453 0.00714 0.00853 0.00770 0.00331 0.00248
0.00248 0.00661 0.00083 0.00000 0.00579
0.00000 0.00183 0.01104 0.04093 0.08073 0.10702 0.08193 0.04142 0.02262 0.00991 0.00980 0.00915 0.00458
0.00522 0.00366 0.00458 0.00183 0.00522
0.00000 0.00000 0.00459 0.05788 0.11276 0.07104 0.07347 0.07257 0.03842 0.01260 0.01233 0.00525 0.00210
0.00912 0.00630 0.00315 0.00210 0.00525
0.00000 0.00000 0.00412 0.05142 0.12557 0.08423 0.06177 0.05357 0.03715 0.03934 0.03311 0.00831 0.01654
0.00623 0.00619 0.00623 0.00208 0.00623
0.00000 0.00170 0.02215 0.02726 0.06133 0.10562 0.06814 0.05622 0.02555 0.02726 0.01193 0.01533 0.00170
0.00170 0.00511 0.00170 0.00170 0.00341
0.00000 0.00481 0.08654 0.11538 0.12019 0.08654 0.02404 0.00481 0.00000 0.00000 0.00000 0.00481 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.03458 0.10209 0.04446 0.03952 0.02799 0.00988 0.01317 0.00494 0.00329 0.00494 0.00329
0.00165 0.10317 0.00329 0.00000 0.10646
0.00000 0.00802 0.09963 0.03527 0.10971 0.05131 0.01764 0.02245 0.01443 0.00481 0.00321 0.00481 0.00160
0.00321 0.00160 0.00160 0.00160 0.02405
0.00000 0.01321 0.02020 0.16706 0.06996 0.05446 0.02026 0.01484 0.00627 0.00470 0.00706 0.00235 0.00392
0.00235 0.00078 0.00235 0.00314 0.00627

female age comps
0.00000 0.00000 0.00915 0.01848 0.01356 0.02572 0.08794 0.14181 0.08461 0.06275 0.03471 0.01774 0.02125
0.01851 0.00527 0.00702 0.00644 0.01325
0.00000 0.00749 0.01721 0.04658 0.04392 0.02038 0.02043 0.06235 0.07845 0.07129 0.03738 0.02832 0.01854
0.01016 0.00539 0.00578 0.00517 0.02730
0.00031 0.00756 0.01837 0.05959 0.02884 0.04157 0.01882 0.01498 0.01468 0.04925 0.03998 0.04034 0.03274
0.03228 0.01656 0.01511 0.00593 0.03709
0.00000 0.00557 0.15331 0.11397 0.04033 0.02055 0.00918 0.01352 0.01333 0.01629 0.02928 0.02280 0.02159
0.01315 0.01031 0.00688 0.00452 0.02781
0.00106 0.00194 0.04400 0.15202 0.07538 0.02555 0.01816 0.00527 0.00650 0.00701 0.01138 0.01683 0.02513
0.02372 0.02010 0.01089 0.01354 0.08140
0.00000 0.00830 0.07081 0.08146 0.11726 0.05756 0.02751 0.00857 0.00695 0.00532 0.00753 0.00546 0.01239
0.00959 0.01092 0.00722 0.00753 0.09934
0.00000 0.00202 0.05331 0.17762 0.09124 0.06975 0.02015 0.01325 0.00395 0.00697 0.00765 0.00614 0.00888
0.00840 0.00772 0.00916 0.00350 0.06065
0.00015 0.00447 0.01390 0.09509 0.22405 0.05680 0.03697 0.02557 0.00942 0.00674 0.00375 0.00196 0.00706
0.00754 0.00483 0.00752 0.00422 0.03537
0.00000 0.00245 0.00735 0.05615 0.15087 0.20625 0.03527 0.01727 0.01207 0.00820 0.00296 0.00034 0.00262
0.00052 0.00034 0.00086 0.00017 0.00743
0.00000 0.00256 0.00710 0.07590 0.09290 0.18362 0.10439 0.00897 0.00979 0.00582 0.00070 0.00105 0.00105
0.00151 0.00000 0.00093 0.00361 0.02000
0.00000 0.00144 0.02760 0.06204 0.11559 0.07780 0.11935 0.05906 0.01220 0.00551 0.00252 0.00293 0.00046
0.00103 0.00247 0.00098 0.00093 0.02934

0.00000 0.00000 0.00385 0.05429 0.08432 0.09903 0.06562 0.05673 0.05360 0.01080 0.00933 0.00466 0.00414
0.00248 0.00062 0.00300 0.00238 0.04001
0.00000 0.00303 0.02347 0.02534 0.05535 0.09135 0.08186 0.05667 0.06935 0.04588 0.02985 0.01169 0.00785
0.00442 0.00090 0.00360 0.00212 0.02421
0.00000 0.00099 0.00824 0.05949 0.03773 0.06809 0.06964 0.05408 0.04986 0.08460 0.04758 0.02967 0.01536
0.00885 0.00291 0.00452 0.00192 0.02874
0.00353 0.00266 0.01335 0.04676 0.07388 0.06786 0.04380 0.05438 0.04144 0.04327 0.05212 0.03475 0.02463
0.01604 0.01295 0.00759 0.00443 0.03075
0.00069 0.00937 0.03205 0.05033 0.07766 0.08161 0.05547 0.03681 0.02349 0.02722 0.01720 0.02054 0.00967
0.00687 0.01075 0.00476 0.00157 0.01386
0.00000 0.00158 0.06843 0.11211 0.10759 0.06434 0.05369 0.02392 0.01438 0.01825 0.01345 0.01112 0.01743
0.00477 0.00394 0.00158 0.00240 0.01901
0.00000 0.00066 0.02872 0.16724 0.14184 0.05282 0.03318 0.02357 0.01685 0.01799 0.01733 0.01004 0.00729
0.01061 0.00539 0.00199 0.00265 0.02927
0.00000 0.00109 0.01205 0.04774 0.16517 0.15343 0.04665 0.02032 0.02276 0.02306 0.01954 0.02145 0.01427
0.00440 0.01127 0.00466 0.00248 0.01701
0.00000 0.00124 0.01222 0.04600 0.06684 0.12652 0.10482 0.05295 0.03286 0.02284 0.01508 0.01319 0.01438
0.00856 0.00582 0.01131 0.00549 0.01836
0.00000 0.00000 0.00177 0.05344 0.08826 0.09723 0.07692 0.06925 0.04609 0.02138 0.00984 0.00945 0.00630
0.00630 0.00630 0.00945 0.00210 0.00702
0.00000 0.00000 0.00208 0.02465 0.05342 0.09023 0.05742 0.01435 0.03108 0.02488 0.04777 0.03527 0.01661
0.01869 0.00415 0.00619 0.00831 0.02281
0.00000 0.00170 0.02555 0.02726 0.02896 0.11073 0.10562 0.04600 0.04770 0.03578 0.03066 0.02726 0.02385
0.01022 0.00170 0.01193 0.00511 0.02215
0.00481 0.01923 0.14423 0.07692 0.06731 0.08173 0.05769 0.01442 0.03846 0.00962 0.00962 0.00962 0.00481
0.00481 0.00000 0.00000 0.00481 0.00481
0.00000 0.00165 0.03129 0.12349 0.05434 0.06092 0.06751 0.03787 0.03129 0.01647 0.01976 0.01153 0.00659
0.00165 0.00165 0.00165 0.01317 0.01647
0.00000 0.00641 0.10123 0.17475 0.05932 0.05612 0.03207 0.02726 0.01603 0.01764 0.01764 0.01443 0.01122
0.00962 0.00962 0.00802 0.00321 0.03046
0.00000 0.00000 0.04041 0.28515 0.06839 0.08166 0.01327 0.01562 0.01719 0.00784 0.00784 0.00784 0.01092
0.00862 0.00706 0.00314 0.00470 0.02117

OR Midwater Trawl Fishery
note that there are no age samples in 2003 and 2005, so agecomp=(-1) for 2003 & 2005, numbers of trip for 2003 and 2005 are set to (-1)
number of years of age comps
23
years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
next line: real number of trips
32 53 56 68 39 65 61 59 43 50 22 30 32 47 41 62 55 40 17 -1 4 -1 13
next line: fitted effective sample sizes
112 187 199 241 138 229 217 209 153 178 76 107 112 167 144 220 195 142 59 -1 14 -1 45
Dont change formats of next 2 lines (read by effective sample size programs)
OR Midwater Trawl Fishery new sample counts
112 187 198 241 138 229 216 210 153 178 77 107 112 167 144 220 195 142 59 -1 14 -1 45

male age comps
0.000000 0.001697 0.018827 0.162810 0.108622 0.009541 0.018878 0.007612 0.007060 0.007934 0.018659 0.023167
0.002377 0.009381 0.002624 0.002415 0.001036 0.012689
0.000000 0.002160 0.065439 0.069821 0.223067 0.065409 0.007588 0.005755 0.002951 0.000000 0.001683 0.004717
0.012976 0.002557 0.002244 0.000000 0.000000 0.009796
0.000000 0.000000 0.006348 0.092848 0.083102 0.196392 0.064126 0.005321 0.005748 0.005387 0.000000 0.000332
0.001114 0.012367 0.003862 0.002128 0.001175 0.007500
0.000000 0.000000 0.014196 0.125268 0.217513 0.074011 0.041905 0.022240 0.002491 0.003416 0.002991 0.000421
0.000236 0.001845 0.003615 0.000000 0.001370 0.003318
0.000463 0.001134 0.013597 0.076953 0.244116 0.129001 0.033834 0.020208 0.007744 0.000000 0.001440 0.000441
0.000851 0.000000 0.002627 0.002040 0.000000 0.003489
0.000000 0.005576 0.018629 0.054351 0.121196 0.199054 0.068330 0.016187 0.009606 0.002806 0.000780 0.000588
0.000503 0.000680 0.002170 0.002169 0.003530 0.005834
0.000000 0.003259 0.027658 0.029435 0.056774 0.099210 0.133459 0.067073 0.032413 0.015428 0.007388 0.003535
0.000000 0.000956 0.000000 0.001783 0.000000 0.004200
0.000000 0.000000 0.007865 0.064272 0.099804 0.106824 0.065076 0.089038 0.038706 0.009747 0.011371 0.003156
0.002466 0.001678 0.001335 0.000000 0.000553 0.009008
0.000000 0.000000 0.035945 0.039720 0.087052 0.083027 0.080416 0.041211 0.085709 0.030049 0.021923 0.013500
0.002018 0.004160 0.000000 0.000000 0.001193 0.013024
0.000000 0.000000 0.016302 0.070921 0.055203 0.081487 0.049299 0.038564 0.034325 0.059574 0.026062 0.017941
0.014803 0.006404 0.000000 0.003025 0.001142 0.010385

0.000060 0.001656 0.008803 0.075885 0.155556 0.079729 0.046850 0.041458 0.011685 0.019825 0.031305 0.000000
0.001604 0.005385 0.000000 0.000000 0.000000 0.009487
0.000031 0.004062 0.016837 0.024621 0.130919 0.094844 0.048282 0.043438 0.032006 0.022568 0.029549 0.006968
0.001389 0.000584 0.000199 0.005330 0.000099 0.001390
0.000000 0.008243 0.073067 0.092792 0.070761 0.065215 0.049392 0.033786 0.013582 0.008126 0.023971 0.009317
0.017184 0.008103 0.003180 0.000000 0.004503 0.005028
0.000000 0.002472 0.031114 0.240239 0.116098 0.042764 0.026053 0.026697 0.016128 0.013262 0.008786 0.003029
0.013826 0.012758 0.000238 0.000317 0.000627 0.002079
0.000000 0.000000 0.011590 0.081244 0.194209 0.111829 0.054206 0.014576 0.025467 0.014974 0.003056 0.007315
0.000585 0.000827 0.008645 0.002236 0.000510 0.004328
0.000000 0.001307 0.025490 0.038238 0.109048 0.181498 0.087210 0.021738 0.004939 0.005506 0.000349 0.000900
0.001168 0.000127 0.000704 0.000518 0.000027 0.002181
0.000000 0.000000 0.012889 0.053820 0.078489 0.084174 0.118748 0.070706 0.028318 0.021247 0.005465 0.005220
0.006090 0.002900 0.000269 0.001264 0.000008 0.001656
0.000000 0.000000 0.001239 0.018103 0.098269 0.099225 0.120104 0.061746 0.050100 0.042098 0.016837 0.005975
0.002014 0.003145 0.001507 0.001553 0.004036 0.004132
0.000000 0.008723 0.008813 0.043887 0.089952 0.148003 0.117899 0.033222 0.013022 0.008925 0.009604 0.006716
0.000000 0.008839 0.004705 0.000000 0.007456 0.001564
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -
1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.080014 0.140150 0.202790 0.080660 0.026095 0.014545 0.001682 0.002243 0.001682 0.001121 0.001682
0.001121 0.000000 0.000000 0.000561 0.001121 0.000561
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -
1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.000000 0.018510 0.206143 0.112214 0.111277 0.016569 0.009068 0.019236 0.007282 0.023503 0.012957
0.008097 0.014340 0.000000 0.000468 0.001870 0.032592

female age comps
0.000000 0.001232 0.018975 0.165746 0.174835 0.013607 0.031065 0.006897 0.006394 0.004037 0.028644 0.066621
0.017824 0.008463 0.007004 0.005679 0.006654 0.020991
0.000000 0.000000 0.049584 0.066563 0.253371 0.087381 0.010712 0.010895 0.008817 0.000000 0.000539 0.007171
0.017507 0.001968 0.000746 0.001331 0.001956 0.005298
0.000000 0.000000 0.009540 0.122232 0.083948 0.166685 0.072663 0.005029 0.010945 0.004726 0.000000 0.000693
0.004019 0.017453 0.001919 0.002055 0.001795 0.008547
0.000000 0.001290 0.016675 0.112688 0.198001 0.080151 0.038100 0.020477 0.001549 0.004767 0.001785 0.000132
0.000917 0.001633 0.002851 0.001500 0.000435 0.002213
0.000984 0.004680 0.014524 0.076746 0.192350 0.099018 0.025664 0.016977 0.008845 0.004252 0.004467 0.000000
0.001045 0.000000 0.001373 0.004050 0.002694 0.004392
0.000000 0.004348 0.026249 0.036418 0.079465 0.197050 0.086376 0.023765 0.011445 0.005620 0.004468 0.001832
0.000000 0.000745 0.000509 0.001577 0.001323 0.006822
0.000000 0.000000 0.018125 0.033563 0.054101 0.079333 0.150790 0.103895 0.037364 0.021728 0.009049 0.002238
0.001919 0.000577 0.000840 0.000000 0.000000 0.003908
0.000000 0.000000 0.010207 0.061722 0.096026 0.060650 0.068546 0.098079 0.042946 0.013639 0.009989 0.004482
0.003192 0.000781 0.000484 0.000484 0.002413 0.015458
0.000000 0.000000 0.023080 0.029597 0.070216 0.075317 0.042247 0.063636 0.088798 0.031001 0.015295 0.006497
0.001193 0.001984 0.002030 0.002224 0.000000 0.007939
0.000000 0.000619 0.010235 0.067949 0.036055 0.079940 0.065430 0.035775 0.045776 0.067009 0.033835 0.023914
0.020267 0.010147 0.004298 0.005024 0.001773 0.006514
0.000000 0.000060 0.008346 0.048716 0.157869 0.064175 0.055961 0.041445 0.034903 0.024695 0.028568 0.014965
0.020718 0.004541 0.000000 0.000000 0.002325 0.003423
0.000000 0.004768 0.005481 0.030657 0.058610 0.087557 0.088895 0.056843 0.042520 0.038741 0.032444 0.046168
0.012590 0.007441 0.014045 0.001228 0.000153 0.008744
0.000000 0.007131 0.067434 0.059398 0.076746 0.079752 0.049421 0.023895 0.038792 0.016466 0.018451 0.023365
0.018283 0.005841 0.000700 0.000878 0.000572 0.026625
0.000000 0.002580 0.012439 0.169835 0.081572 0.038429 0.037679 0.017000 0.014256 0.011551 0.013032 0.013201
0.006873 0.016518 0.001471 0.002426 0.000000 0.004652
0.000000 0.000037 0.004497 0.036935 0.158466 0.091903 0.047566 0.030986 0.031988 0.014652 0.014922 0.012049
0.003880 0.001903 0.006640 0.000777 0.002699 0.004503
0.000000 0.000166 0.022686 0.036414 0.081014 0.185689 0.092911 0.040511 0.019957 0.008138 0.011300 0.006752
0.000919 0.007343 0.003825 0.000516 0.000007 0.000904
0.000000 0.000000 0.014792 0.045920 0.075338 0.086096 0.081487 0.094960 0.038853 0.024377 0.010573 0.005971
0.006954 0.004270 0.003098 0.001850 0.006177 0.008021
0.000000 0.000000 0.000000 0.012725 0.066942 0.066872 0.071082 0.068574 0.049240 0.060062 0.016389 0.009506
0.008355 0.008059 0.013737 0.008272 0.005784 0.004316
0.000000 0.002825 0.009167 0.017950 0.065404 0.114271 0.090580 0.082117 0.036436 0.033172 0.014684 0.004683
0.009396 0.000044 0.004637 0.000044 0.001564 0.001696
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -
1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.005417 0.110513 0.075197 0.151982 0.070732 0.022576 0.005871 0.000561 0.000561 0.000561 0.000000 0.000000
0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -
1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.000000 0.016244 0.135195 0.027939 0.042968 0.037277 0.014209 0.021045 0.009438 0.023701 0.004646
0.004178 0.008228 0.010520 0.011038 0.011033 0.028216

OR Bottom Trawl Fishery
number of years of age comps
16
years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
next line: real number of trips
27 23 22 34 33 45 49 78 82 61 63 43 27 40 30 26
next line: fitted effective sample sizes
94 81 78 118 116 157 172 273 288 215 222 150 94 139 105 91
Dont change formats of next 2 lines (read by effective sample size programs)
OR Bottom Trawl Fishery new sample counts
94 81 77 118 116 157 172 273 287 215 222 150 94 139 105 91

male age comps
0.000000 0.002000 0.030445 0.189548 0.117081 0.016035 0.015324 0.003114 0.003439 0.001948 0.018194 0.013253
0.009686 0.007799 0.006124 0.002928 0.001011 0.009201
0.000000 0.002502 0.036013 0.074608 0.200140 0.051173 0.001874 0.004660 0.004952 0.000000 0.001042 0.008356
0.028493 0.000000 0.005334 0.003539 0.000143 0.007644
0.000000 0.002454 0.013907 0.200127 0.081379 0.084660 0.058424 0.002879 0.018185 0.005389 0.002106 0.000000
0.001445 0.017611 0.002031 0.001018 0.002843 0.015694
0.000000 0.000000 0.011118 0.109017 0.203522 0.070081 0.039469 0.015803 0.002859 0.002428 0.006852 0.000000
0.000000 0.005938 0.005288 0.001991 0.000000 0.007686
0.001871 0.011031 0.016633 0.079520 0.207515 0.102423 0.021828 0.011340 0.007407 0.003053 0.000490 0.000111
0.001142 0.000177 0.002442 0.003514 0.001270 0.006522
0.000000 0.008833 0.024646 0.049996 0.092063 0.174036 0.067810 0.031354 0.014894 0.008040 0.000000 0.006094
0.000196 0.000020 0.001275 0.000668 0.006091 0.006210
0.000000 0.003583 0.046610 0.044816 0.055997 0.068434 0.115960 0.057955 0.020822 0.019537 0.009585 0.004483
0.001307 0.002656 0.000000 0.000000 0.000000 0.011648
0.000000 0.000147 0.004189 0.070284 0.100833 0.070524 0.042126 0.076314 0.037653 0.009481 0.011792 0.003212
0.001068 0.003579 0.000182 0.000000 0.001193 0.011880
0.000000 0.000210 0.017104 0.021507 0.083738 0.072799 0.059036 0.034356 0.048167 0.017539 0.028795 0.015892
0.004209 0.004150 0.005980 0.001566 0.002672 0.017018
0.000000 0.000000 0.005855 0.035253 0.034549 0.088243 0.091091 0.046518 0.033369 0.054327 0.034564 0.022812
0.013524 0.004287 0.002129 0.003937 0.000464 0.016873
0.000000 0.003066 0.014275 0.056658 0.107092 0.068690 0.042280 0.016704 0.020763 0.028991 0.023737 0.008231
0.006195 0.004521 0.008745 0.002407 0.000000 0.010728
0.000000 0.002979 0.033648 0.108932 0.073740 0.135371 0.039055 0.044337 0.020910 0.017927 0.007067 0.012256
0.004705 0.005004 0.005162 0.000343 0.000000 0.002308
0.000000 0.001546 0.078624 0.082232 0.058865 0.058378 0.022296 0.017354 0.016860 0.020354 0.015502 0.002110
0.016646 0.004691 0.001983 0.010887 0.000918 0.007283
0.000000 0.006259 0.044095 0.229768 0.118118 0.047116 0.031456 0.020552 0.009284 0.017502 0.007340 0.006334
0.000686 0.005679 0.001947 0.000212 0.000000 0.003644
0.000000 0.000000 0.008048 0.051295 0.182533 0.115763 0.034581 0.021837 0.017118 0.020333 0.006225 0.009028
0.000040 0.001808 0.007220 0.000000 0.003032 0.007934
0.000000 0.004410 0.028185 0.065780 0.117624 0.177422 0.072072 0.027160 0.008664 0.000260 0.000000 0.007039
0.001389 0.000369 0.000145 0.000260 0.006664 0.002549

female age comps
0.000000 0.000000 0.029195 0.150224 0.185481 0.027626 0.015787 0.011391 0.007173 0.004612 0.012420 0.029933
0.015032 0.008095 0.004631 0.005248 0.002645 0.043377
0.000442 0.000000 0.019813 0.048296 0.197706 0.126662 0.014812 0.017391 0.011417 0.000077 0.007641 0.022032
0.036411 0.010210 0.013434 0.002712 0.003324 0.037146
0.000000 0.001065 0.024770 0.106380 0.062244 0.095632 0.067643 0.006899 0.017635 0.013058 0.000257 0.000000
0.003719 0.043899 0.009910 0.006981 0.004659 0.025100
0.000000 0.001576 0.010234 0.117399 0.171871 0.063467 0.050337 0.029975 0.003580 0.003687 0.001518 0.003055
0.000272 0.004721 0.016566 0.013579 0.003342 0.022768
0.009606 0.014331 0.009403 0.077325 0.171310 0.103797 0.040625 0.026669 0.015156 0.010274 0.004624 0.005987
0.000830 0.002484 0.006360 0.010148 0.002759 0.010020
0.000000 0.001242 0.025824 0.027018 0.064659 0.144556 0.088917 0.041537 0.039946 0.014916 0.006732 0.006454
0.005084 0.003964 0.005380 0.003800 0.009658 0.018086
0.000000 0.000346 0.045983 0.035820 0.037131 0.067841 0.137383 0.107247 0.036003 0.017221 0.008657 0.004878
0.006605 0.002256 0.002494 0.001175 0.001334 0.024232
0.000000 0.000276 0.008559 0.057365 0.061216 0.065968 0.073102 0.107811 0.057796 0.032714 0.032940 0.007005
0.004608 0.004366 0.002101 0.000526 0.003298 0.035890

0.000000 0.000000 0.009753 0.008144 0.081541 0.088796 0.068771 0.057565 0.089954 0.047986 0.031772 0.019963
0.014438 0.004916 0.006446 0.001441 0.002506 0.031269
0.000000 0.000000 0.000299 0.025279 0.025262 0.075644 0.073311 0.044332 0.040169 0.066328 0.042838 0.028744
0.017316 0.020636 0.005716 0.008841 0.005620 0.031867
0.000000 0.002217 0.008820 0.042980 0.100462 0.063347 0.056897 0.063275 0.046037 0.026311 0.064738 0.028538
0.019849 0.012475 0.012450 0.006566 0.006008 0.015944
0.000000 0.004849 0.012570 0.037066 0.109137 0.084212 0.050834 0.038905 0.045410 0.025559 0.017455 0.024881
0.003947 0.002003 0.013073 0.001605 0.000000 0.014750
0.000097 0.007272 0.076010 0.101629 0.082023 0.086098 0.050735 0.028263 0.040649 0.032268 0.008394 0.004318
0.039893 0.000000 0.001771 0.010131 0.002891 0.011030
0.000000 0.008041 0.030840 0.103883 0.094444 0.030399 0.046719 0.030626 0.019097 0.014813 0.008142 0.013020
0.009741 0.016087 0.004702 0.000592 0.005036 0.013827
0.000000 0.000000 0.011607 0.047322 0.140566 0.110448 0.053762 0.024241 0.030259 0.017303 0.025682 0.013208
0.015729 0.002847 0.008011 0.001866 0.001373 0.008983
0.000000 0.000000 0.023360 0.057678 0.067752 0.146783 0.062621 0.042079 0.039373 0.008637 0.011882 0.006203
0.007617 0.002111 0.000000 0.001389 0.001141 0.001385

EUR-CON Fishery
Note: there are no age data for 2005 and 2006
number of years of age comps
27
years of age comps
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
number of trips sampled
next line: real number of trips
7 11 26 44 149 189 169 175 154 135 127 170 155 95 55 22
28 11 35 61 37 31 17 7 14 3 7
next line: fitted effective sample sizes
5 7 16 26 90 115 103 106 93 81 77 103 94 58 33 14 18 7 21 37 22 19 11 5 8 2 5
Dont change formats of next 2 lines (read by effective sample size programs)
EUR-CON Fishery new sample counts
5 7 16 26 90 115 103 106 93 81 77 103 94 59 33 14 18 7 21 37 22 19 11 5 8 2 5

male age comps
0.000000 0.000000 0.000000 0.000167 0.038794 0.061910 0.113807 0.038798 0.047047 0.016198 0.015682 0.000104
0.015850 0.038590 0.000104 0.022908 0.000376 0.055254
0.000000 0.000000 0.000000 0.000000 0.011438 0.011620 0.048578 0.016812 0.020248 0.015707 0.009403 0.017248
0.001826 0.019215 0.010845 0.019730 0.000012 0.047583
0.000000 0.000000 0.001824 0.014065 0.002924 0.006643 0.039520 0.032312 0.050845 0.031275 0.025393 0.028792
0.009843 0.052786 0.003750 0.016236 0.004651 0.060013
0.000799 0.008361 0.010002 0.027066 0.025037 0.027711 0.025569 0.030219 0.042947 0.046706 0.023835 0.032838
0.015918 0.028874 0.012306 0.004370 0.013545 0.025365
0.000000 0.000106 0.043649 0.007338 0.036963 0.033485 0.030316 0.013544 0.043159 0.076267 0.035984 0.029549
0.019650 0.013771 0.016956 0.010418 0.008094 0.031557
0.000000 0.000086 0.022886 0.140348 0.031918 0.033224 0.012798 0.005381 0.007744 0.009472 0.019691 0.020034
0.012469 0.012446 0.004708 0.023251 0.002119 0.027271
0.000000 0.000000 0.022177 0.136865 0.144882 0.027534 0.035797 0.014452 0.013815 0.001723 0.010158 0.030363
0.014161 0.004130 0.005053 0.003807 0.004250 0.029903
0.000000 0.000227 0.008622 0.062244 0.162794 0.144850 0.012740 0.025432 0.011326 0.002269 0.002575 0.010161
0.021668 0.002268 0.004800 0.003061 0.003256 0.026758
0.000000 0.002672 0.041614 0.045810 0.082096 0.123917 0.129130 0.013757 0.021789 0.017389 0.001018 0.000893
0.008456 0.029102 0.005577 0.008659 0.003709 0.037843
0.001179 0.000152 0.054998 0.114196 0.043553 0.059667 0.090873 0.112021 0.019943 0.029954 0.021102 0.002845
0.000000 0.018666 0.014648 0.002809 0.011094 0.025925
0.000044 0.035380 0.000332 0.065560 0.060575 0.090206 0.060701 0.051129 0.034404 0.014184 0.008844 0.007881
0.003430 0.003586 0.006491 0.016135 0.001500 0.016273
0.000000 0.004922 0.108813 0.072992 0.077959 0.119011 0.046296 0.050071 0.019741 0.011676 0.020419 0.015728
0.008211 0.000000 0.000338 0.007197 0.005816 0.008951
0.000198 0.000005 0.045231 0.116161 0.029490 0.046574 0.037731 0.056019 0.029941 0.024640 0.016278 0.022979
0.019002 0.014258 0.003722 0.002474 0.008377 0.005882
0.000000 0.002436 0.015488 0.119032 0.119577 0.049449 0.037842 0.065086 0.022067 0.016393 0.020120 0.012377
0.001613 0.003541 0.003664 0.002594 0.002776 0.017436
0.000000 0.001110 0.011299 0.018839 0.138318 0.094889 0.037718 0.016739 0.044004 0.027766 0.021343 0.019358
0.011102 0.005458 0.016019 0.001048 0.001845 0.023196
0.000000 0.000000 0.084585 0.163306 0.095533 0.077734 0.009972 0.001732 0.009303 0.006881 0.010719 0.000920
0.020993 0.004707 0.001861 0.004059 0.000628 0.032682
0.001882 0.003574 0.007108 0.070279 0.148029 0.109588 0.064736 0.021235 0.023515 0.006816 0.007885 0.004744
0.006368 0.008510 0.000880 0.004805 0.000299 0.005238

0.000000 0.033490 0.039138 0.033789 0.056445 0.196870 0.044622 0.066035 0.057784 0.003157 0.028233 0.006769
0.020519 0.001013 0.004425 0.008088 0.000051 0.003038
0.003544 0.005653 0.046056 0.045052 0.066636 0.114331 0.117781 0.033128 0.026658 0.018426 0.015394 0.003008
0.024927 0.006853 0.002391 0.002031 0.008824 0.013330
0.000000 0.001634 0.008364 0.108288 0.040725 0.051077 0.052119 0.048417 0.049544 0.035874 0.026884 0.022934
0.012512 0.005025 0.004030 0.012426 0.006304 0.012199
0.000000 0.007713 0.081754 0.060620 0.092682 0.068982 0.053847 0.020544 0.045442 0.025031 0.018261 0.017733
0.005455 0.007462 0.009450 0.000313 0.000000 0.012849
0.000792 0.001303 0.018542 0.072137 0.059251 0.100602 0.069004 0.051386 0.026777 0.022079 0.029557 0.016272
0.006032 0.005804 0.005619 0.012011 0.004983 0.031026
0.000000 0.000000 0.003526 0.043905 0.060881 0.116213 0.055216 0.044377 0.027284 0.028240 0.009386 0.000345
0.002868 0.003058 0.008237 0.002356 0.002153 0.001940
0.000000 0.000172 0.000000 0.010409 0.072637 0.012072 0.064488 0.092402 0.034594 0.039625 0.032375 0.030079
0.041966 0.021130 0.004095 0.003259 0.000000 0.006689
0.000000 0.010264 0.001604 0.001684 0.015276 0.034963 0.043864 0.104166 0.028628 0.020809 0.097590 0.031715
0.060703 0.001604 0.030191 0.000000 0.032557 0.035925
0.000000 0.278761 0.013274 0.008850 0.008850 0.035398 0.039823 0.039823 0.000000 0.017699 0.000000 0.004425
0.013274 0.013274 0.000000 0.000000 0.000000 0.004425
0.000000 0.000000 0.023237 0.000000 0.014953 0.030713 0.053950 0.069711 0.038998 0.014953 0.047282 0.023237
0.007476 0.031522 0.038998 0.000000 0.007476 0.007476

female age comps
0.000000 0.000000 0.000104 0.000000 0.123507 0.205950 0.041377 0.041169 0.018469 0.000000 0.061665 0.000208
0.000104 0.000000 0.000000 0.000208 0.000104 0.041545
0.000000 0.000000 0.000000 0.000000 0.028922 0.067305 0.158389 0.061886 0.061392 0.039940 0.075410 0.011394
0.019222 0.036234 0.011029 0.022589 0.029519 0.126505
0.000000 0.000000 0.000955 0.005649 0.003696 0.024150 0.063373 0.097604 0.097413 0.039497 0.051375 0.061888
0.017530 0.013496 0.029120 0.040354 0.006779 0.066250
0.000000 0.003318 0.004867 0.013777 0.035738 0.019389 0.024915 0.054715 0.072763 0.090769 0.026772 0.055740
0.045834 0.039020 0.025392 0.039669 0.010802 0.035053
0.000000 0.000304 0.032146 0.009081 0.035448 0.031095 0.024213 0.007839 0.036008 0.101644 0.051171 0.036445
0.034257 0.032311 0.023285 0.024933 0.016688 0.052326
0.000000 0.009591 0.075351 0.167412 0.047273 0.048111 0.015052 0.008820 0.002312 0.008036 0.037318 0.021821
0.012045 0.028244 0.019692 0.016134 0.025748 0.071191
0.000000 0.000000 0.025400 0.124378 0.113089 0.026752 0.029462 0.011598 0.007136 0.003342 0.019946 0.045211
0.009560 0.010595 0.006944 0.007132 0.010240 0.050144
0.000000 0.000151 0.001560 0.038649 0.152562 0.144097 0.019940 0.038756 0.006481 0.001962 0.002983 0.010131
0.022748 0.001717 0.006368 0.006675 0.009452 0.030716
0.000000 0.001094 0.032346 0.027042 0.073440 0.081848 0.100382 0.007086 0.021131 0.009354 0.004758 0.001774
0.001549 0.027713 0.003342 0.003768 0.003633 0.026310
0.001179 0.000098 0.047208 0.095361 0.021292 0.050757 0.050894 0.055412 0.011451 0.010172 0.004021 0.002340
0.000793 0.004487 0.002818 0.005991 0.000865 0.011236
0.000140 0.085843 0.037469 0.075957 0.071866 0.055259 0.032502 0.037143 0.021209 0.003896 0.014219 0.019743
0.004235 0.006851 0.003575 0.006002 0.008808 0.038628
0.000000 0.003411 0.081763 0.042605 0.042417 0.081496 0.053703 0.037811 0.021243 0.009702 0.007578 0.003805
0.006337 0.005543 0.000000 0.000650 0.001295 0.022498
0.000005 0.003187 0.050819 0.108911 0.056288 0.036766 0.088722 0.070834 0.037058 0.024351 0.009827 0.008493
0.006215 0.001197 0.003355 0.001205 0.002170 0.011633
0.000226 0.007123 0.008134 0.112901 0.128173 0.060714 0.030229 0.033110 0.023240 0.016982 0.013082 0.010959
0.008170 0.008172 0.006845 0.000731 0.001688 0.018028
0.000000 0.000232 0.015337 0.031121 0.108172 0.086481 0.039057 0.030308 0.037403 0.026187 0.025779 0.043862
0.015023 0.000488 0.001450 0.001391 0.005892 0.041767
0.000000 0.004208 0.033435 0.135163 0.123584 0.096949 0.036693 0.004437 0.001141 0.009519 0.007614 0.001330
0.000782 0.000971 0.001365 0.005160 0.005189 0.006846
0.001882 0.001724 0.022476 0.067422 0.161344 0.066366 0.050772 0.019637 0.025889 0.016917 0.015069 0.006851
0.009371 0.007548 0.006287 0.000228 0.001724 0.023001
0.000000 0.008129 0.009087 0.015496 0.050148 0.136555 0.049764 0.068335 0.023258 0.004577 0.007731 0.002032
0.005057 0.007653 0.000000 0.007704 0.000000 0.001013
0.005316 0.007498 0.039650 0.042831 0.041834 0.081434 0.058032 0.049604 0.037617 0.029501 0.010778 0.009947
0.012242 0.002580 0.001429 0.007214 0.004894 0.003579
0.000076 0.001013 0.007263 0.082973 0.037783 0.055790 0.052979 0.041542 0.064828 0.047760 0.030352 0.020260
0.004756 0.021095 0.006388 0.006955 0.005416 0.014417
0.000000 0.001686 0.053952 0.029427 0.075695 0.029682 0.045987 0.045308 0.052631 0.060361 0.028177 0.007907
0.009615 0.006146 0.006612 0.001982 0.003342 0.013353
0.000193 0.001612 0.010229 0.073635 0.045978 0.093642 0.041606 0.047047 0.038160 0.022148 0.021134 0.015287
0.014316 0.014162 0.003980 0.008607 0.001844 0.013246
0.000000 0.000000 0.006821 0.032812 0.098604 0.073335 0.075038 0.056790 0.039492 0.027416 0.059198 0.032557
0.032994 0.021127 0.002356 0.000562 0.023627 0.007284
0.000000 0.000000 0.000000 0.008190 0.060086 0.098599 0.036981 0.065238 0.063643 0.032407 0.037632 0.022603
0.020863 0.000945 0.012646 0.022527 0.033776 0.017871

```
0.000000  0.010264  0.001604  0.001403  0.031113  0.014715  0.038210  0.111904  0.048715  0.073654  0.004090  0.033960
0.030753  0.033399  0.003769  0.003368  0.000000  0.007538
0.013274  0.411504  0.039823  0.000000  0.000000  0.013274  0.004425  0.022124  0.004425  0.000000  0.000000  0.013274
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
0.000000  0.000000  0.014953  0.015761  0.014953  0.015761  0.038190  0.038190  0.068499  0.059810  0.066882  0.075571
0.014548  0.052738  0.046474  0.030713  0.007476  0.029501

# Ageing Error Matrix
# row is true age, column is observed age (column sums to 1)
0.7620   0.1217   0.0006   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.2315   0.7560   0.1244   0.0006   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0065   0.1217   0.7500   0.1274   0.0007   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0005   0.1244   0.7440   0.1303   0.0008   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0006   0.1274   0.7380   0.1332   0.0009   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0006   0.1303   0.7320   0.1361   0.0010   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0007   0.1332   0.7260   0.1390   0.0011   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0008   0.1361   0.7200   0.1419   0.0012   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0009   0.1390   0.7140   0.1448   0.0014   0.0000   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0010   0.1419   0.7080   0.1476   0.0015   0.0000
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0011   0.1448   0.7020   0.1505   0.0017
         0.0000   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0012   0.1476   0.6960   0.1533
         0.0019   0.0000   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0014   0.1505   0.6900
         0.1561   0.0020   0.0000   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0015   0.1533
         0.6840   0.1590   0.0023   0.0000   0.0000
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0017
         0.1561   0.6780   0.1617   0.0026   0.0007
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0019   0.1590   0.6720   0.1657   0.0313
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0020   0.1617   0.6660   0.3080
0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
         0.0000   0.0000   0.0023   0.1657   0.6600

# UseXHhPrior (0=no, 1=yes)
1
# To replace cv for indices with estimated RMSE (0=no, 1=yes)
1
# RMSE for index data
0.504666  0.461798  0.741004  0.810624  0.338874  0.501206
# Power coefficient Readin value for SC Lab index (PowCoefficientSCLabIndexReadin)
1.0
# Power coefficient to be estimated? (-1=no, 2=yes) (PowCoefficientSCLabIndexEstimated) => this set estimation phase
2
# Include triennial survey index (IncludeTriSurvey)
1

# Rebuilding options: Parameter for rebuilding data output
# end year for B0 calculation
1982
# start year for recruitment resampling
1986
# number of recent years for weighting fecundity, weight, and selectivity
7
# recruitment overidding for rebuilding analysis (1 = yes, 0 = no)
0
# First year of the projection
2007
```

Year declared overfished
2001
Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
3
Year for Tmin Age-structure
2001
Number of simulations
5000

Appendix B. Model run with only 2001-2006 coastwide pre-recruit survey indices

Pre-recruit Survey Workshop, which was held in Santa Cruz, California, from September 13-15, 2006, suggested that using only coastwide pre-recruit survey indices from 2001 to 2006 would be more appropriate for widow rockfish than using the Santa Cruz midwater juvenile survey indices from 1984 to 2006. Main outputs from this model run (named as Coastwide Survey Model) are presented here and are compared with those from the model run using data from all survey data from 1984 to 2006 (2007 main model). In this run, only the Santa Cruz survey indices were changed. All other model settings, including relative weighting of CPUE indices, remained same as in the 2007 main model.

Table B1. Comparisons of assessment results between 2007 Main Model and Coastwide Survey Model.

Parameter and estimate	2007 Main Model	Coastwide Survey Model
Number of parameters	208	208
Steepness (*h*)	0.2865	0.2904
Unfished spawning output (B_0) (million of eggs)	49918	50746
Current spawning output (B_t) (million of eggs)	17448	17999
Depletion (100*B_t/B_0)	34.95	35.47
Standard deviation of depletion	6.39	6.32

The results indicate that parameters and estimates between these two models are very similar. It is important to point out that since the assessment model uses 3 to 20+ age groups, only pre-recruit data from 2001 to 2003 were actually included in the model. That is, only three datum points (2001 to 2003) were used in the model fitting.

Arrowtooth Flounder STAR Panel Report

NOAA Western Regional Center
Building 9 Conference Room
7600 Sand Point Way, NE
Seattle, Washington 98115
July 30 – August 3, 2007

Reviewers:

Steve Ralston (panel chair), Scientific and Statistical Committee (SSC) Representative
Patrick Cordue, Center for Independent Experts (CIE, Rapporteur)
Devorah Hart, Northeast Fisheries Science Center (NEFSC)
Jim Ianelli, Alaska Fisheries Science Center (AFSC)
Paul Medley, Center for Independent Experts (CIE)

Advisors:

Brian Culver, Groundfish Management Team (GMT) Representative
Peter Leipzig, Groundfish Advisory Panel (GAP) Representative

Stock Assessment Team:

Isaac Kaplan, Northwest Fisheries Science Center (NWFSC)
Thomas Helser, Northwest Fisheries Science Center (NWFSC)

Overview:

This assessment represents the first dynamic age-structured analysis for arrowtooth flounder. Data sources for the 2007 candidate model included reconstructed catch histories apportioned among three main fleets, the use of 4 survey indices, and length/age data split by sex for selected surveys and fisheries. All indications from the available data and analyses are that there are no conservation concerns. The stock appears to be well above reference points. Except for a number of concerns detailed below, this assessment is acceptable for use by management.

STAT/STAR changes

Throughout the week, the panels refined the assessment which included: 1) changes to the recruitment deviation start year, 2) treatment of natural mortality, 3) refinements to selectivity/retention assumptions about the fillet fishery.

Analyses Requested by the STAR Panel:

Round 1 requests

A: Include a table of landings, including data sources and estimation methods.

Reason: To evaluate sources and magnitude of catches.

Response: To be included in final report.

Discussion/conclusion: Not applicable.

B: How do different discard rate assumptions affect catches in the bycatch fishery. Are results from Sampson's work on historical catch applicable (i.e., Cleaver, flatfish and rockfish catches to get the scale of catches)?

Reason: This is the first attempt to reconstruct the catch time series and all available sources should be investigated.

Response: These were incorporated for subsequent runs.

Discussion/conclusion: The catch time series is still highly uncertain and future analyses should continue to evaluate this uncertainty.

C: Compute an alternative "bycatch" trend based on the ratio of estimated arrowtooth flounder relative to the flatfish complex:

$$B_y = 0.13 \frac{A_y}{S_y} \frac{\bar{S}_{2001-2006}}{\bar{A}_{2001-2006}}$$

where A_y and S_y are the relative biomass levels of arrowtooth flounder and the flatfish species complex (Dover, Petrale, and English soles) and $\bar{A}_{2001-2006}$ and $\bar{S}_{2001-2006}$ are the mean biomass levels for 2001-2006 for those species/species groups. It may be necessary to run the model several times or, preferably, to use smoothed survey estimates.

Reason: To evaluate the static ratio used in the original analysis and to potentially provide a better approach.

Response: The preliminary runs with this evaluation showed that the constant ratio assumption (arrowtooth flounder to other flatfish) is unlikely to hold.

Discussion/conclusion: This approach should be used unless other more quantitative estimates of historical discard levels become available. However, for current management purposes, this issue appears to be relatively minor.

D: Provide Tables and/or Figures of mean lengths over time by sex and surveys.

Reason: To more easily evaluate changes in mean size of arrowtooth flounder caught in the different surveys.

Response: Figures were provided.

Discussion/conclusion: This provided basic background material needed to evaluate selectivity patterns estimated by the model.

E: Evaluate anomalies from triennial surveys for multiple species.

Reason: This issue spans all species for which the triennial survey is used. The change in the timing of the survey to earlier in the year after 1992 could affect the availability of some species to the survey gear.

Response: Preliminary indications suggest that this is an important issue.

Discussion/conclusion: For arrowtooth flounder, the residual pattern of the fit to the triennial survey was reasonably good and the present application in this assessment was seen as acceptable. The influence of the triennial survey as an index was apparently minor. However, further investigation into this issue is recommended.

F: Evaluate IPHC data for arrowtooth flounder abundance indices, if possible.

Reason: This is a scientific survey that operates well within the range of arrowtooth flounder habitat and should be considered as a potential index in future assessments.

Response: This was pursued.

Discussion/conclusion: The IPHC together with the STAT will investigate the potential utility of this survey for future applications. It may be that the period for which species specific information on arrowtooth flounder from this survey is limited.

G: Run the model with catchability (***q***) set to the analytical, unbiased, median method and turn off all priors.

Reason: The effect of priors should be eliminated and estimation of parameters that can be solved analytically should be avoided.

Response: This was done for subsequent models developed during the week.

Discussion/conclusion: The fact that slightly different answers were obtained in this case indicates that there may have been (and there may still be) a problem with convergence.

H: Do a run with sex-specific selectivities where appropriate data are available (e.g., the fillet fishery and the survey).

Reason: There are residual patterns and sex ratio issues that appear to be a cause of some poor quality residual patterns.

Response: These runs were completed and this aspect was retained for the base model recommendation.

Discussion/conclusion: There remained some problems with the fillet fishery selectivity and the ratio of male:female natural mortality that are addressed in subsequent requests.

I: Evaluate a change in fishery selectivity in 2001.

Reason: This seemed appropriate, based on patterns observed in the length frequency data.

Response: The analysis was completed.

Discussion/conclusion: Little effect was noted.

J: Do a profile over male M, but with female M estimated.

Reason: Due to the constrained selectivity (non-split sex) the original profile was problematic.

Response: This appeared to work appropriately.

Discussion/conclusion: Subsequent requests included this profile with split-sex selectivity options.

K: Do a profile over the length at 50% selectivity for this survey to evaluate this parameter.

Reason: The FRAM slope/shelf survey selectivity is shifted too far to the right (since small arrowtooth flounder are found in shallow regions).

Response: An evaluation with the split-sex selectivity version of the model appeared to rectify this inconsistency.

Discussion/conclusion: This provided further support for the split-sex option on selectivity for the base model configuration.

L: Make a figure of fitted sex ratios by gear type (survey and fishery) obtained from model output and compare to input data.

Reason: Examinations of the length frequency data fits to the model were a cumbersome way to evaluate model predicted sex ratio compared to the observed.

Response: These figures were created.

Discussion/conclusion: The observed variability was quite high compared to model predictions, indicating sampling error was likely quite high. If possible, this type of plot should be included with length frequency figures when sex-specific options are evaluated.

M: Estimate recruitment deviations for the period where data are informative (the alternative method).

Reason: To reduce the number of parameters appropriate to time periods for which data are available to inform the estimates.

Response: The model was very sensitive to this specification.

Discussion/conclusion: As re-requested below, evaluations of 1970 gave very different levels of depletion compared to models with all recruitment deviations were estimated. Further investigations were encouraged with a model that was closer to a final “base” model.

N: Do a run with no fishing, with parameter values fixed from runs with proposed catch histories.

Reason: Since catch history is highly uncertain, the relative impact of different assumptions about catch history can be reasonably evaluated.

Response: This is an output option within SS2.

Discussion/conclusion: This is a second order issue but may help in future evaluations of uncertain catch histories.

Round 2 requests

O: Create a new baseline with the following core specifications: all priors removed, analytical catchabilities, added catch data recommended from B. Culver from Cleaver, and with recruitment deviations starting in 1970. Convergence diagnostics for this model should be evaluated, including bounds checking, checks for derivatives and the maximum gradient.

Reason: After discussions, these features seem most appropriate.

Response: This was done and results guided subsequent discussions.

Discussion/conclusion: see below

P: As in O:, but with split-sex selectivity.

Reason: After discussions, this configuration seems most appropriate.

Response: As in H above,

Discussion/conclusion: See under H above.

Q: Start the vector of recruitment deviations earlier than 1970 for comparisons.

Reason: After discussions, this sensitivity analysis was deemed to be useful.

Response: As in M above,

Discussion/conclusion: See under M above.

R: Do a GLM with seasonal fixed effects for triennial surveys

Reason: There is a concern that the shift in timing for this survey, particularly between the early and later periods, may affect the availability of arrowtooth flounder to the survey.

Response: A GLM was run where average Julian day anomalies (relative to overall mean) were computed and applied as an independent continuous covariate. Estimates of annual coefficients with and without the date covariate were inconclusive.

Discussion/conclusion: The seasonal effect could potentially be tested with the FRAM survey data which occurs over more months in multiple passes (N-S). This was considered a general future research recommendation. For the purposes of the arrowtooth flounder assessment and management outlook, the current treatment (inclusion of the triennial index) is appropriate.

S: Provide year-specific discard ratios for this and other studies (e.g., Pikitch etc).

Reason: As in earlier requests, there are concerns over the catch time series, particularly regarding estimated discard levels.

Response: Provided in a table for panel review.

Discussion/conclusion: The levels of bycatch seemed to be within the ranges evaluated (e.g., under request A).

<u>Round 3 requests</u>

T: Do a full integrated GLMM with seasonal fixed effects for triennial surveys and compare with and without the seasonal effect.

Reason: There is a concern that the shift in timing for this survey, particularly between the early and later periods, may affect the availability of arrowtooth flounder to the survey.

Response: The request was not completed due to difficulty in obtaining the data in an expeditious manner.

Discussion/conclusion: The survey data should be made readily accessible to all stock assessment authors so that timely analyses can be conducted.

U: For a candidate "new" base model, use sex-specific selectivity and remove the retention curve from the fillet fishery. Use the landings and the discard ratios to generate total catch estimates for this fishery. Recruitment deviations are to start in 1970.

Reason: There is a component of discarding that isn't size based and (perhaps) this is causing the selectivity estimates to be unreasonably shifted to larger arrowtooth flounder.

Response: More time will be needed to do this properly (see R: above).

Discussion/conclusion: This is potentially a general issue for many groundfish stocks.

V: For the "new" candidate base model (sex-specific selectivity), evaluate the effect of starting the recruitment deviations vector in 1960, both with and without the "zero sum" option invoked.

Reason: To decide if 1970 is the most appropriate start year for recruitment deviations

Response: Based on the evaluation, the zero sum option had very little effect.

Discussion/conclusion: 1965 appears to be an appropriate compromise between estimating recruitment deviations in each year (dating back to 1916) and a more recent year (e.g., 1970).

W: Conduct profiles over alternative *M* values for one sex, allowing the other to be freely estimated. For both sexes, keep *M* constant with age (no difference between young and old).

Reason: There was little biological rationale provided to suggest that ages 0-4 yrs should have a different *M* than the older ages.

Response: This was done for all subsequent evaluations of "base" models

Discussion/conclusion: The stability of the model apparently changed with this modification. There is some concern that convergence problems may be persisting.

X: Based on sensitivities and profiles, propose a base model.

Reason: To advance the stock assessment for management purposes

Response: The needed evaluations were completed.

Discussion/conclusion: see AB below.

Y: Adjust bycatch ratios based on the new base model. Iterate to see if it changes. Use all available information for discard rates.

Reason: See C above.

Response: See C above.

Discussion/conclusion: See C above.

Z: Do a sensitivity run with the Triennial survey catchability split in 1994 to account for the possible effect of a shift in survey timing.

Reason: The timing of the survey changed and could impact trend information for this survey.

Response: Time was unavailable to complete this during the week of the review.

Discussion/conclusion: This appears to be a relatively minor issue for arrowtooth flounder, but should be considered in future assessments/evaluations. See AC below.

AA: Explore axes of uncertainty, in particular, a profile over alternative values of R_0, perhaps with *M* freely estimated.

Reason: To provide an evaluation of principal axes of uncertainty.

Response: Further work on a base model is needed before this can be appropriately obtained (uncertainty evaluation).

Discussion/conclusion: See AB-AD below.

Round 4 requests

AB: Given the apparent status of the stock and the lack of conservation issues with this stock, a base model recommendation is to retain split-sex selectivity, ignore information on retention rates, start the recruitment deviations in 1965, fix peak selectivity of the fillet fleet to 60cm and estimate natural mortality.

Reason: This appears to be a suitable base model specification for management purposes.

Response: Fixing male natural mortality at 0.274 stabilized the estimation properties and results appear to be reasonable.

Discussion/conclusion: See U above regarding the issues related to retention-rates.

AC: Same as AB, evaluate model sensitivity to the triennial survey index of biomass.

Reason: Since analyses on splitting this survey into two periods of availability were impractical, this will provide some indication on the importance of the survey to this assessment.

Response: There appeared to be very little impact of this survey on key model results.

Discussion/conclusion: This indicates that the constraints on natural mortality combined with catch history and stock-recruitment steepness affect model results most significantly.

AD: Produce alternative scenarios that capture the uncertainty as follows: bracketing uncertainty in M combined with low and high catch histories to pick extreme cases. The bracketing of uncertainty in M should capture approximate lower and upper 25^{th} percentiles of probability estimates.

Reason: This appears to be the main axis of uncertainty.

Response: To be determined.

Discussion/conclusion: Not applicable.

Description of final base model:

The final base model included all data from the pre-STAR base model, with the addition of the

Cleaver (1951) 1928-1949 Oregon catch data for the mink food fleet. The full catch history for the three fleets covered 1928-2006. Commercial length data were available for 1986-2006, with age data for 1986-1991, 1998, and 2001-2005. The model included length data and abundance indices from the NWFSC Slope-Shelf Survey (2003-2006), the Triennial Shelf Survey (1980-2004), and the AFSC Slope Survey (1997, 1999-2001). Survey indices of abundance were also incorporated from the NWFSC Slope Survey (1998-2002), as were ages from the NWFSC Shelf Slope Survey (2003-2006).

The final model specifications included:

- catchabilities (***q***) calculated analytically as median unbiased;
- steepness of 0.902 (from Dorn's meta-analysis);
- recruitment deviations estimated from 1965 on;
- split-sex selectivity;
- full retention for the fillet fleet (i.e. discards incorporated into catches based on observed discard rates, rather than estimating discards within the model);
- selectivity peak parameter for the fillet fleet fixed at 60cm;
- natural mortality fixed at 0.166 for females and 0.274 for males (based on Hoenig 1983 for females and likelihood profiles for males);
- sigmaR=0.8 (tuned);
- tune CVs and effective sample sizes;
- no priors.

Comments on the Technical Merits and/or Deficiencies of the Assessment:

Technical Merits:

- The preparation of documentation for the panel was very good, particularly since this was the first age-structured model developed for arrowtooth flounder.
- The assessment was based on SS2 software, which has been accepted as the standard for west coast groundfish.
- The method of including age observations as conditional on the length was considered a better way to include age data in the model, thereby avoiding *ad hoc* weighting schemes.
- The STAT team was very responsive to the STAR panel's requests.

Technical Deficiencies

- The catch time series is highly uncertain.
- The treatment of the triennial survey should account for the change in the timing of the survey between the early and later parts of that time series.
- Some selectivity parameters appeared to be inestimable.
- There appeared to be some difficulty in obtaining proper convergence of the model.

Explanation of areas of disagreement regarding STAR Panel recommendations:

Areas of disagreement among the members of the STAR Panel:
There were no areas of disagreement among the five panelists.

Areas of disagreement between the STAR Panel and the STAT team:
There were no areas of disagreement between the STAR panel and the STAT team.

Unresolved Problems and Major Areas of Uncertainty:

This section focuses on major uncertainties associated with the arrowtooth flounder assessment.

- Catch histories for arrowtooth flounder are problematic and require further study.
- Recruitment deviation start time—the model was very sensitive to this specification.
- Natural mortality rate is poorly known.
- Selectivity and retention in the fillet fishery is poorly specified.
- The triennial survey appears to have little impact on this assessment. However, it appeared that in some cases (e.g., when natural mortality was estimated), the estimates became unstable (i.e., an unreasonably large stock size resulted). This is cause for concern.

Concerns Raised by GMT and GAP Representatives During the Meeting:

The GAP and GMT representatives did not raise any objections to the discussion and outcome of the arrowtooth flounder STAR panel review, but wished to make note of the following points:

- There is a general need to conduct a comprehensive examination of historical catch data.
- Access to NWFSC trawl survey data is unnecessarily restrictive.
- Trawl logbook data should be examined and utilized to a greater extent.

Recommendations for Future Research and Data Collection:

For the next arrowtooth flounder stock assessment

- The arrowtooth flounder catch history should be reconstructed using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical landings needs to be done comprehensively (i.e., with other species) to ensure efficiency and consistency.
- Evaluate the feasibility of a bi-lateral assessment with Canadian scientists, perhaps through the TSC (Technical Subcommittee of US Canada groundfish working group).
- Investigate the importance of calendar date on catch rates from the triennial survey and propose an adjustment, if needed.

Generic issues for groundfish assessments

- Establish a *meta* database of all data relevant to rockfish stock assessments. The database should include enough detail about the nature and quality of the data that a stock assessment author can make a well informed decision on whether it could be useful for their stock assessment.
- Establish *accessible* online databases for all data relevant to groundfish stock assessments, so that assessment authors can expeditiously obtain the *raw* data if required.
- Establish a database for historical groundfish catch histories, “best” guesses and

estimates of uncertainty (and processes for updating and revising the database).

- Develop a concise set of documents that provide details of common data sources and methods used for analyzing the data to derive assessment model inputs.
- Develop standard and appropriate methods for modeling age and length data, including choice of distribution, initial variance assumptions, and tuning methods (current methods can and should be improved).
- Routinely produce and present supporting documentation for any derived indices which are included in a stock assessment model (e.g., GLMM derived trawl survey abundance indices).

Acknowledgments:

The STAR panel would like to compliment the NWFSC, especially Stacey Miller, for coordinating the meeting and the review of the arrowtooth flounder stock assessment. The STAT team (Isaac Kaplan and Tom Helser) is also commended and thanked for undertaking a wide variety of analyses, all on short notice, which insured the successful completion of the review.

Agenda Item G.4.b
WDFW Report
September 2007

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON NORTHERN BLACK ROCKFISH STOCK ASSESSMENT

After reviewing the final northern black rockfish assessment, and the parameters that were specified and estimated in the model, the Washington Department of Fish and Wildlife (WDFW) has comments on two items: 1) the management structure of black rockfish; and 2) the different models presented in the assessment.

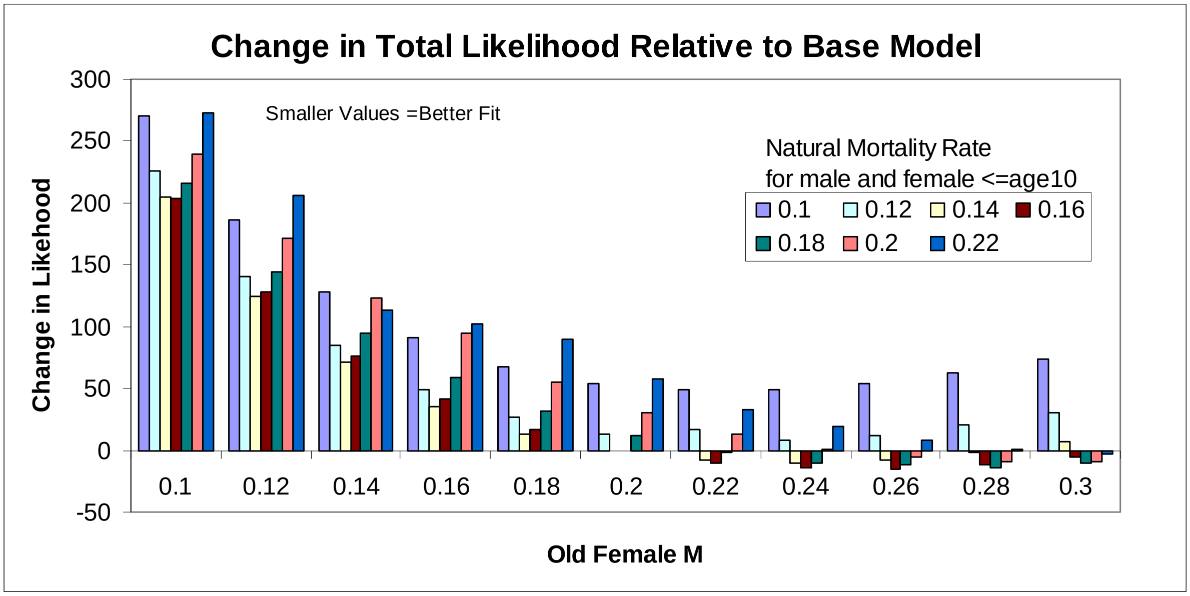
On the management structure, as WDFW has mentioned previously to the Council, a genetic study conducted in 1995-97 reinforced findings from a major tagging study that there are two separate black rockfish stocks, north and south of Cape Falcon, Oregon. The Groundfish Management Team then estimated the amount of the stock located between Cape Falcon and the Oregon/Washington border and, for ease of management, transferred that amount from the northern assessment area to the south. Based on the results of this genetic study and past management practices, WDFW recommends that the Council continue with this approach, specifying separate acceptable biological catches and optimum yields for northern and southern black rockfish stocks.

With regard to the models used for northern black rockfish, they include parameters that the Stock Assessment Team (STAT) specified (i.e., hard-wired) in the model and those that were left unspecified, thus allowing the model to estimate those values. Specified parameters included natural mortality and parameters associated with recruitment (e.g., steepness and sigma R). Unspecified parameters included the coefficient of catchability (q) for the WDFW tagging survey.

In the base model, q is estimated by the model to be 0.8, which suggests that WDFW's tagging survey encounters 80% of the northern black rockfish stock biomass, which is highly unlikely. Beginning in 1998, WDFW implemented a new black rockfish tagging program off the central Washington coast. From a geographic perspective, the area covered by the tagging program represents approximately 36 nm of coastline, or about 22% of the assessed area (see Attachment 1). In addition, tagging activities occur out of Westport and are focused in nearshore areas that are typically < 10-15 fm, in order to reduce the amount of mortalities associated with barotrauma, whereas black rockfish are distributed past 30 fm. Because the tagging area extends along 22% of the assessed area coastline and does not cover the full depth of the black rockfish range, WDFW believes that q is probably closer to the 0.3 specified in the initial STAT (pre-STAR) base model, rather than 0.8 specified in the post-STAR base model.

With regard to the Decision Table, the STAR Panel requested that the STAT Team profile around natural mortality (M) values to capture a reasonable range of uncertainty about stock abundance. For the lower end of this range, they chose values for M that were in the draft southern black rockfish assessment (which has yet to be completed, reviewed, and accepted). However, as it is presented, it appears as if all of the scenarios in the Decision Table are equally likely to represent "possible true states of nature." We believe all scenarios presented are not plausible for northern black rockfish. The age and growth data that we have collected over the past 25 years do not support the low natural mortality scenario, which is why the low M values do not fit the model well (see Figure 1).

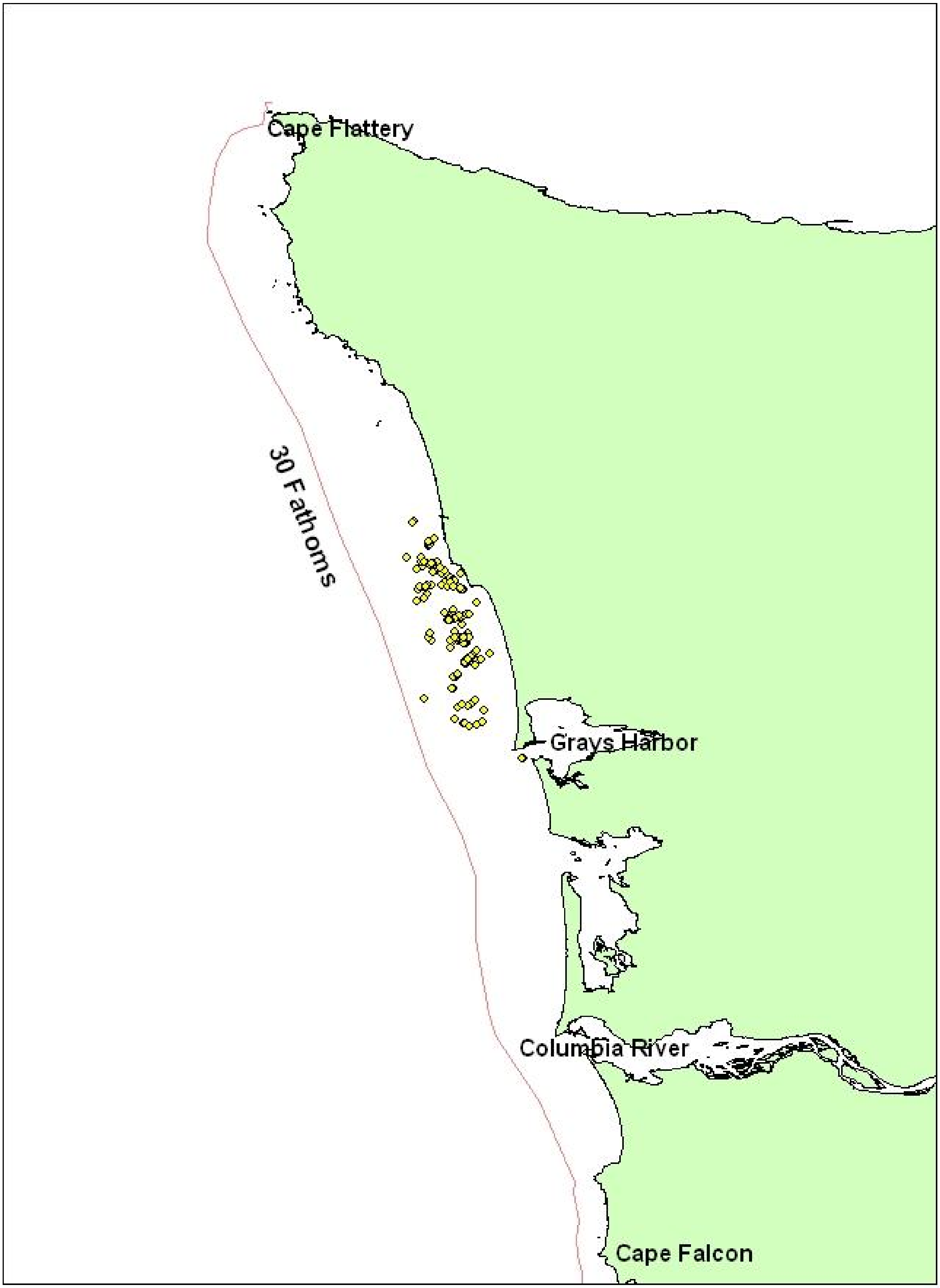
Figure 1.



The "Best Fit" model, however, includes M values that are more consistent with the age and growth data we have collected. In the "Best Fit" model, q is still high—estimated to be 0.62—but is still closer to what we believe occurs in the tagging program.

WDFW would also like to stress that there are potential consequences, which may not be readily apparent, to selecting a harvest yield from an assessment and how that translates into the endorsement of a particular model. As specified in the Terms of Reference (TOR), updates cannot introduce new information; therefore, regardless of which model results are adopted for management by the Council, the parameters for that model then automatically carry forward into future updates, and could potentially influence future full assessments. When the Council selects a harvest yield that it believes is appropriate, that appears to get translated into the Council's endorsement of that particular model and the values of the parameters used in that model. Given this approach, it becomes extremely important that STAT Teams give thorough consideration of the parameters specified and the values used, and that the STAR Panel and Scientific and Statistical Committee pay particular attention to how well those parameters "fit" into the model when structuring their recommendations.

Attachment 1 – WDFW Black Rockfish Tagging Stations, 2003-07.



SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STOCK ASSESSMENTS FOR 2009-2010 GROUNDFISH FISHERIES

The Scientific and Statistical Committee (SSC) reviewed eight stock assessments and the associated Stock Assessment Review (STAR) Panel reports. Six of these were full stock assessments and two were updated assessments. The SSC evaluated each stock assessment in terms of whether it represents the best available science and whether it satisfies the Terms of Reference for Groundfish Stock Assessments. In some cases, the SSC has identified additional information which needs to be included in the assessment reports before they are finalized and included in the Stock Assessment and Fishery Evaluation (SAFE) document. Moreover, all stock assessment reports will be reviewed by STAR Panel Chairs for consistency with the Groundfish Terms of Reference prior to being submitted to the Pacific Fishery Management Council (Council) Staff for inclusion in the SAFE.

The outcomes of the assessments are summarized in terms of relative biomass (the ratio of current to unfished spawning output; also referred to as “depletion”) and, in particular, how current spawning stock biomass relates to the Council’s management target of 40% of unfished spawning output ($0.4B_0$) and its overfished threshold for groundfish species of 25% of unfished spawning stock biomass ($0.25B_0$). An evaluation of whether overfishing has occurred in recent years is also provided for each stock. The SSC identified a base-model, “low” and “high” states of nature, and the resulting decision table for use in Council decision making for each acceptable full stock assessment.

The SSC acknowledges the great amount of work put forth by all the assessment authors and thanks them for their efforts. As a whole, the assessment documents were much more thorough and of higher quality than during the previous cycle and they more closely followed the Terms of Reference. Finally, the SSC notes that convening STAR Panels which consider only two stocks undergoing full assessment reviews was much more manageable and resulted in a more in-depth and rigorous review.

The assessments raised several general issues that require further work, preferably before the next round of assessments. These issues are listed in the SSC statement on off-year science improvements (Agenda Item G.2.c, Supplemental SSC Report).

NORTHERN BLACK ROCKFISH

The SSC reviewed the assessment, the STAR Panel report and a statement by the Washington Department of Fish and Wildlife (WDFW) for black rockfish (*Sebastes melanops*) north of Cape Falcon, Oregon. A presentation of the assessment was provided by Mr. Farron Wallace and Dr. Theresa Tsou (WDFW) and some of the key considerations during the STAR Panel were highlighted by the Panel Chair (Dr. Owen Hamel). The last assessment of this stock was conducted in 1999. The 2007 assessment was based on fitting the estimates of abundance and catch-rates from tagging, along with age- and length-composition data for the trawl fishery, the non-trawl fishery and the sport fishery. Substantial new information has become available since the 1999 assessment, including revised catch data, discard estimates, recent length and age data, and recent tagging information.

During the STAR Panel meeting, the stock assessment team (STAT) and STAR Panel agreed on a base-model. However, following the STAR Panel meeting, and having informed the STAR Panel, the STAT created an alternative base-model in which the natural mortality for mature females (>15 years) was $0.24yr^{-1}$ rather the STAR base-model value of $0.20yr^{-1}$. The STAT noted that this model fitted the data better than the final STAR base-model and the STAR Panel Chair agreed that had this alternative model been provided during the STAR Panel, it would likely have been selected as the base-model given the STAT support for it. The SSC agrees that the alternative base-model should supplant the base-model selected during the STAR Panel. The STAT also provided evidence that the "low" state of nature (mortality for females increasing from 0.12 to 0.16) led to a very poor fit to the data. The SSC recommends that the "low" and "high" states of nature be replaced by scenarios in which female natural mortality increases from 0.12 to 0.18 ("low") and 0.19 to 0.28 ("high"). The change to the "low" and "high" states of nature will necessitate a change to the decision table and the assessment report.

The alternative base-model estimates that the spawning output of black rockfish north of Cape Falcon has been increasing over recent years and is currently above the Council management target of $0.4B_0$ (projected 2007 spawning output 55.2% of B_0). This assessment also indicates that overfishing has not occurred in recent years.

The SSC endorses that the alternative base-model and decision tables based on the revised "low" and "high" states of nature can form the basis for Council decision making. The "low" and "high" states of nature should be considered to be equally likely and half as likely as the alternative base-model. Given the uncertainty associated with the allocation of historical catch to species, and the inability to fully utilize the tagging data in the assessment, the SSC recommends that northern black rockfish again be a full assessment for the next assessment round.

CANARY ROCKFISH

The SSC reviewed the canary rockfish (*Sebaster pinniger*) assessment and STAR Panel report. A presentation was provided by Dr. Ian Stewart of the Northwest Fisheries Science Center (NWFSC). The previous canary rockfish assessment was done in 2005. New data added to the assessment model included NWFSC survey data from 2003 to 2006, and coast-wide pre-recruit indices during 2001-2006. Ageing of both historical and recent otolith samples added substantial new age data to the assessment. Although these new data are not highly influential, they do address issues identified during previous assessment reviews.

In this assessment (and in previous assessments) fishery selectivity was modeled in multi-year time blocks with changes in selectivity allowed between blocks. In contrast to the previous assessment, where blocks were defined arbitrarily to improve model fit, the current assessment defined selectivity blocks according to major management actions. Both the STAT and the STAR Panel considered this to be a more objective and rigorous approach to defining selectivity blocks, and the SSC endorses this decision. A result of this change is that the best overall fit to the data now occurs at a much higher stock size than the previous assessment. In addition, the estimate of steepness, which previously had been precisely estimated at a low value, was now higher and less precisely estimated. However, the data were not entirely consistent. Composition data (length and age data) fit best at high stock size (and high steepness), while the trend from triennial trawl survey fit best at low stock size (and low steepness). Since steepness was no longer reliably estimated by the model, the STAR Panel and STAT agreed that the best approach was to use the meta-analysis of steepness to identify a base model and “high” and “low” states of nature.

These revisions to the model produced a consistent pattern of underestimating the first half of the triennial trawl survey index and overestimating the more recent portion. The STAT and STAR Panel identified a potentially important shift in the seasonal timing of the Triennial trawl survey in 1995, and developed a model with two survey catchability blocks to allow catchability to change as a result of this shift. This model eliminated the pattern in the fit to the survey index, had relatively minor impact on model results, and was adopted by the STAT and STAR Panel as the base model. While the SSC accepted this decision for the current assessment, because of the broader implications to other assessments that use this time series, a high priority should given to further examination of trawl survey data to support the change in catchability (see Agenda Item G.2.c, Supplemental SSC Report).

The base model estimates that spawning stock biomass has been increasing from a minimum of 13% of B_0 in 1994 to 32% of B_0 at the start of 2007. These features represent a significant change from the previous assessment. For example, in the 2005 assessment, spawning stock biomass was estimated to be between 6% and 11% of B_0 at the start of 2005. Fishing mortality rates have been less than 1% since 2001, indicating that overfishing has not occurred since then. The rate of increase is highly dependent on the value of steepness, and moreover the rate of increase is projected to slow as weaker recruitments in recent years begin entering the mature population.

The identification of stock-recruit steepness as the major axis of uncertainty is an important qualitative change from the previous assessment. However, canary rockfish stock-recruit dynamics cannot be fully explored without incorporating Canadian data into the assessment. Joint work with Canada should be considered for the next assessment.

The SSC endorses the decision table with base model and “high” and “low” states of nature as the best available science to provide the basis for Council decision-making. The “low” and “high” states of nature should be considered to be equally likely and half as likely as the alternative base-model. The SSC recommends that canary rockfish be considered for an update in the next assessment cycle unless further examination of trawl survey data do not support the change in triennial trawl survey catchability or progress is possible on a transboundary assessment.

WIDOW ROCKFISH

The widow rockfish (*Sebastes entomelas*) assessment update was initially reviewed by the SSC Groundfish Subcommittee in June 2007. During that review, it was noted that two sources of landings over the 1991-2006 period were not included in the assessment update, namely 1) at-sea processing records and 2) bycatch estimates from observers.

Subsequently, the assessment database was updated to include these data and additional model runs were made. The SSC reviewed the revised runs – presented by Dr. Steve Ralston – and found that none of the key assessment results (including current relative biomass) was affected by inclusion of the additional landings data. Correspondingly, projection results were quite similar. The SSC endorses the use of the assessment results in support of management decisions.

In the next assessment cycle, widow rockfish would benefit from a full stock assessment. Projections indicate that the stock may be approaching its rebuilding target ($0.4B_0$). The Council's ability to classify this stock as "rebuilt" will be greatly enhanced if it is based on a full assessment. The SSC also encourages exploration of the use of the Stock Synthesis 2 (SS2) model in the next widow assessment to better handle the apparent area-specific growth rates and other modeling issues.

BOCACCIO

The SSC reviewed the bocaccio (*Sebastes Paucispinis*) assessment and STAR Panel report. The last full assessment of bocaccio was conducted in 2003 and was subsequently updated in 2005. The 2007 STAR Panel had expected a full assessment for this cycle; however, an update was delivered. The update continued to use the original Stock Synthesis 1 (SS1) model. Conversion to SS2, and exploration of concerns raised by the previous two STAR Panels would have been the main reasons for a full assessment.

The update had the same base model configuration as the original 2003 assessment and the 2005 update, but included: 1) refreshed landings, 2) recent length compositions, and 3) one new point for the California Cooperative Oceanic Fisheries Investigations (CalCOFI) survey. Assessment results indicated that the stock continued to increase. The 1999 year class is still a driving factor, and a larger than average 2003 year class appears to be evident based on updated Recreational Fishery Information Network (RecFIN) length composition data from Southern California. Rebuilding follows the same upward trajectory as was previously projected in 2003; spawning output has doubled since rebuilding started. Depletion in 2005 assessment was estimated at 10.7% in 2005, while depletion in 2007 assessment was estimated to be 13.8% in 2007.

The SSC endorses the bocaccio assessment for use in management; however, the same unresolved problems and major uncertainties remain as in the 2003 assessment. The SSC recommends that the next assessment should be a full assessment and should explore issues recommended by the past three STAR Panels.

COWCOD

The SSC reviewed the assessment and the STAR Panel report for cowcod (*Sebastes levis*) in the Southern California Bight. A presentation of the assessment was provided by Mr. E. J. Dick and the key points of the STAR Panel report by the STAR Panel Chair (Mr. Tom Jagielo). The last full assessment of this stock was conducted in 2005. The 2007 assessment was originally scheduled to be an update. At the update review in June, 2007, a number of technical issues were raised by the STAT and the SSC concluded that it would be appropriate to conduct a full assessment. The STAT was able to provide a full assessment for review at the STAR Panel in mid-July. Given the limited time frame it was not possible for the STAT to fully explore all issues which might have been addressed had cowcod originally been scheduled for a full assessment. This inability to fully explore all of the issues was recognized when the recommendation for a full assessment was made in June.

A number of changes were made from the 2005 assessment in terms of both data and model structure. Gear selectivity, which had been mis-specified in the 2005 assessment, was corrected and revised. The growth curve for cowcod was re-estimated based on corrected data. The commercial and recreational sectors were modeled as separate fisheries. Commercial landings were revised based on a new ratio estimator for historical commercial landings (1900-1968) and port level information from the Southern California Bight. In addition, the California Commercial Cooperative Groundfish Program (CALCOM) (1969-1985) landings estimates had been revised recently, and those changes were incorporated into this assessment. Significant changes were made to the spatial stratification and the model used to develop the Commercial Passenger Fishing Vessel (CPFV) logbook indices. Steepness changed from 0.5 to 0.6 in the base model based upon the expectation of the prior.

The base model agreed upon at the STAR Panel is based upon a stock-recruitment steepness value of 0.6. The “low” and “high” states of nature are based upon steepness values of 0.4 and 0.8 respectively. In addition, the CPFV index was excluded from the “high” state of nature, thus increasing the influence of the visual survey. The base model depletion in 2007 is 4.6% with a slowly increasing trend (~ 0.3% per year). The “low” and “high” states of nature have depletion levels in 2007 of 4.1% and 27.3%, respectively. This assessment supplants the 2005 assessment and the results are not comparable to that assessment due to structural changes identified in June.

The SSC endorses the base model and the decision table based on the “low” and “high” states of nature for Council decision making. However, the “low”, “base”, and “high” states of nature have not been assigned relative probabilities. Given issues with the CPFV index, the historical catch series, and the lack of time to fully address all issues, the SSC recommends that cowcod again be a full assessment for the next round of assessments.

CHILIPEPPER ROCKFISH

The SSC reviewed the assessment and STAR Panel report for chilipepper rockfish (*Sebastes goodei*) in the waters off California and Oregon. A presentation of the assessment was provided by Dr. John Field and the key points of the STAR Panel report summarized by the STAR Panel Chair (Dr. David Sampson). The last full assessment of this stock was conducted in 1998. Substantial new data have been incorporated into this assessment including a revised catch reconstruction back to 1982 and extensive length and age composition data extending back to 1978. The model also included fishery-dependent indices of relative abundance based on trawl log-book and CPFV observer data, and fishery-independent indices based on AFSC triennial shelf and NWFSC shelf/slope bottom trawl surveys. A juvenile index of abundance from the Southwest Fisheries Science Center (SWFSC) Santa Cruz young of the year (YOY) rockfish survey and coastwide YOY rockfish survey was also used.

The current chilipepper rockfish assessment used Stock Synthesis 2 (v2.00c), and represents a substantial improvement over the last assessment. Sexes were modeled separately and selectivity was modeled using a double-normal selectivity curve for the recreational fisheries and catch-per-unit-effort (CPUE) indices. Growth was modeled as time-varying and blocked to correspond to shifts in Pacific decadal oscillation (PDO), which improved model fit. Steepness was fixed at the meta-analysis prior of 0.57 and natural mortality fixed at 0.16 and 0.20 for the females and males, respectively. The 1998 assessment used M of 0.22 and 0.25 for the females and males, respectively. The assessment model fit the age and length compositional data reasonably well, with poorer fits to the survey indices. In general, there were conflicting signals between compositional and survey data, although the strength in the 1999 year class supports the upward trend in triennial survey abundance indices.

The current stock assessment shows similar trends in biomass in comparison to the 1998 assessment. The overall magnitude of biomass is lower primarily due to a lower natural mortality assumed for the current assessment. In general, recruitment strengths are similar for both assessments.

The base model estimates that spawning stock biomass has declined since the early 1900s to a low of 26% of B_0 in 1999, but has subsequently increased to 71% in 2007 due to a very strong 1999 year class. As with many other rockfish, the stock-recruitment value of steepness represents the dominant axis of uncertainty. The “low” and “high” states of nature are based upon steepness values of 0.34 and 0.81, respectively, and represent 25% probability and half as likely as the base case. The base model depletion in 2007 is 71%, with a depletion of 46% and 81% associated with low and high states, respectively.

The SSC endorses the stock assessment and the decision table with base model and “low” and “high” states of nature as the best available science to provide the basis for Council decision-making. The SSC recommends chilipepper rockfish be considered as an update in the next assessment cycle.

DARKBLOTCHED ROCKFISH

The SSC reviewed the darkblotched rockfish (*Sebastes crameri*) stock assessment and STAR Panel report, which was greatly facilitated by a presentation provided by Dr. Owen Hamel. The new assessment supersedes the 2005 assessment and includes the following new sources of data: 1) updated landings from 1980-2004 and new landings estimates for 2005 and 2006, 2) updated 2003 and 2004 discard rate estimates, and a new 2005 estimate, 3) new 2005 and 2006 NWFSC slope trawl survey data, 4) addition of the 2003-2006 NWFSC shelf trawl survey, 5) new GLMM estimates for all surveys, and 6) a variety of conditional age-at-length data that were developed using consistent aging criteria over the 2004-2007 time period. In addition, the new assessment eliminated AFSC slope trawl survey "super-years" and the Pacific Ocean perch survey (1979 and 1985) from the model. Retention curves are now estimated using full length compositions, rather than the average size, of discards. Collectively, these changes represent a substantial advance in the development of the darkblotched model.

The SSC makes note of the fact that the STAR Panel report identified a point of disagreement between the Panel and the STAT regarding the estimation of spawner-recruit steepness (***h***), a parameter that has a major influence on stock productivity. In particular, the STAR Panel preferred to fix this parameter at the median value of a "prior" distribution (i.e., ***h*** = 0.50) that was developed from a meta-analysis of US west coast rockfishes. In contrast, because the prior was developed without any influence from darkblotched rockfish, the STAT preferred to estimate steepness within the assessment model using the prior distribution, which yielded an estimate of ***h*** = 0.60. In this instance the SSC concurs with the STAT's approach because it incorporates what appears to be meaningful information from the current stock assessment into the productivity estimate.

The assessment indicates that stock size in 2007 is currently 22% of the unfished level. In comparison, the last assessment estimated stock size to be 16% in 2005. The stock is rebuilding, with spawning output having increased by 68% over the last five years (i.e., 4,071 to 6,853), much of which has been based on strong 1999 and 2000 year-classes.

The STAT and STAR Panel agreed that natural mortality rate (***M***) represents the major axis of uncertainty in the stock assessment. The base model assumes ***M*** = 0.07, which was bracketed by values of 0.05 and 0.09 as alternative states of nature in a decision table analysis. Those results showed a wide range of potential stock sizes in 2007 (i.e., 2,891 – 15,092) but probabilities were not assigned to any of the states. The SSC notes that because this species is overfished and under rebuilding, results from a rebuilding analysis that will be presented at the October mop-up panel will be more definitive. The SSC endorses the darkblotched rockfish stock assessment as the best available science and recommends that it be used in managing the stock. The SSC recommends that darkblotched rockfish be considered for an update in the next assessment cycle.

ARROWTOOTH FLOUNDER

The SSC reviewed the stock assessment document and STAR Panel report for arrowtooth flounder (*Atheresthes stomias*). Dr. Isaac Kaplan (NWFSC) gave a presentation on the assessment. This stock was previously assessed in 1993 using a dynamic pool model that was based on limited data and did not provide estimates of absolute biomass or depletion. The new assessment, conducted using Stock Synthesis 2, is based on a much more comprehensive base of information, including age and length composition data and biomass indices from several surveys.

Because substantial but unrecorded quantities of arrowtooth flounder are discarded due to limited market opportunities, the catch history of arrowtooth flounder is highly uncertain. The rate of natural mortality, which differs between males and females, was the other major source of uncertainty identified during the STAR Panel review. These two sources define the alternate states of nature for the decision table in the assessment. The more productive state of nature is based on doubling the base-model catch history and has higher rates of natural mortality; the less productive state is based on halving the base-model catch history and has lower rates of natural mortality. The alternate states of nature differ markedly in the optimum yields that the stock could support, from a low of 2,668 mt in 2009 for the low productivity state of nature to over 142,000 mt for the high state of nature. Probabilities were not assigned to the alternate states of nature but the probabilities associated with the high and low states of nature are much lower than 25%. The base model estimates that spawning biomass has always been above the management target and has been increasing in recent years due to an exceptionally strong 1999 year-class. Spawning biomass in the base model is estimated to be 79% of the unexploited level at the start of 2007.

The SSC endorses the base-model and decision table provided in the assessment document and recommends that they can form the basis for Council decision making. The SSC further recommends that the next assessment of this stock should be a full assessment so that there can be fuller exploration of the various sources of uncertainty identified in the assessment and during the STAR review. It is unlikely that status of this stock will need re-evaluation in the next assessment cycle.

PFMC
09/13/07

AMENDMENT 15: PARTICIPATION LIMITATION IN THE PACIFIC WHITING FISHERY

When Congress passed the American Fisheries Act (AFA) in 1998, Congress designated the Pacific Fishery Management Council (Council) to develop conservation and management measures to protect West Coast groundfish fisheries from potential harm caused by the AFA. In September 1999, the Council initiated Amendment 15 to the Pacific Coast Groundfish Fishery Management Plan (FMP) to address this concern. However, because of competing workload and no threatened imminent harm, the Council tabled action on Amendment 15 in 2002.

The Council readdressed Amendment 15 at its September 2006 meeting and voted to move forward expeditiously to complete Amendment 15 for first use in the 2008 fishery with direction to simplify the alternatives brought forward for Council consideration.

As an interim protective mechanism, the Council voted in November 2006 to request that National Marine Fisheries Service (NMFS) enact an emergency rule restricting AFA vessel participation in the whiting fishery without catch history prior to 2006, to be implemented for the 2007 non-tribal season. NMFS did not approve the request. In March 2007, based on concerns of adverse conservation, economic, and safety effects to the 2007 fishery that could result from an unrestricted derby style fishery, the Council broadened its original emergency rule request to prohibit participation in the 2007 non-tribal Pacific whiting fishery by all vessels, including both AFA and non-AFA vessels, without sector-specific history in the fishery prior to January 1, 2007. NMFS implemented the emergency action through temporary rule which became effective May 17, 2007.

At its June meeting, the Council reviewed alternatives to limit participation in the Pacific whiting fishery under Amendment 15 to the Groundfish Fishery Management Plan (FMP) and recommended broadening the scope of the proposed action to address conservation and socioeconomic issues in the non-tribal Pacific whiting fishery by prohibiting sector-specific participation in the fishery by all vessels without historic participation records. The Council's previous range of alternatives focused on potential harm to the whiting fishery by the entry of vessels permitted under the American Fisheries Act (AFA) that have no history in particular sectors. The proposed action alternatives now more closely align with the temporary rule implemented by NMFS in May, which limits participation in this year's whiting fishery.

The Oregon Department of Fish and Wildlife (ODFW) has taken the lead in coordinating the development Amendment 15. In collaboration with an inter-agency workgroup consisting of staff of the Washington Department of Fish and Wildlife, ODFW, and NMFS, ODFW completed a draft Environmental Assessment (EA) (Agenda Item G.5.b., Attachment 1) which provides a description of the proposed action, the purpose and need for such action, and an analysis of the alternatives. Also included for Council review are draft amendatory FMP language (Agenda Item G.5.b, Attachment 2).

The Council is scheduled to take final action on this matter at its September 2007 meeting and hopes to have Amendment 15 implemented in time for the 2008 Pacific whiting fishery. The Council considers this action as an interim step in advance of a possible rationalization of the entire groundfish trawl fishery.

Council Action:

1. Review the draft EA and Adopt a Final Preferred Alternative on Participation Limitation in the Pacific Whiting Fishery.

Reference Materials:

1. Agenda Item G.5.b, Attachment 1: Environmental Assessment of Management Measures to Prevent Harm to the Pacific Whiting Fishery.
2. Agenda Item G.5.b, Attachment 2: Draft Amendment 15 FMP Language.

Agenda Order:

a. Agenda Item Overview — Mike Burner
b. Alternatives Analysis Report — Gway Kirshner
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action:** Adopt Final Preferred Alternative

PFMC
08/24/07

Title of Environmental Review: Environmental Assessment of Management Measures to Prevent Harm to the Pacific Whiting Fishery

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Legal Mandate: Magnuson-Stevens Fishery Conservation and Management Act, 50 CFR Part 660

Location of Proposed Activities: The Exclusive Economic Zone (3-200 nautical miles offshore) of the states of Washington, Oregon, and California

Abstract: This environmental assessment (EA) analyzes the effects of implementing a limited entry program for the three non-tribal sectors of the Pacific whiting fishery (shore-based, catcher/processor, mothership) off the coast of Washington, Oregon, and California. Under current regulations, catcher vessels participating in the shore-based and mothership sectors, or vessels participating in the catcher/processor sectors, must be registered to a groundfish limited entry permit. The limited entry permit program has been in place since 1994 and allows appropriately registered vessels to participate in groundfish fisheries targeting any of the 90+ species in the Pacific Coast Groundfish Fishery Management Plan (FMP). The proposed action, which would be finalized as Amendment 15 to the FMP, would require vessels that wish to participate in the non-tribal whiting fishery to qualify for an additional whiting entry limitation program within the overall groundfish limited entry program. The alternatives considered in this EA share the intent to limit future participation in the Pacific whiting fishery, but vary in the qualifications required to secure that privilege. This EA analyzes the effects that a limited entry program for the Pacific whiting fishery, with qualifications for the three non-tribal sectors, has on the socioeconomic, biological, and physical environments.

TABLE OF CONTENTS

List of acronyms

ABC Allowable Biological Catch
AFA American Fisheries Act
BSAI Bering Sea Aleutian Islands
CFR Code of Federal Regulations
CZMA Coastal Zone Management Act
E.O. Executive Orders
EA Environmental Assessment
EEZ Exclusive Economic Zone
EFH Essential Fish Habitat
EFP Exempted Fishing Permit
EIS Environmental Impact Statement
EMS electronic monitoring system
ESA Endangered Species Act
ESU evolutionarily significant unit
FMP Pacific Coast Groundfish Fishery Management Plan
FR Federal Regulations
H&G head and gut
MMPA Marine Mammal Protection Act
mt metric ton
NEPA National Environmental Policy Act
Nm nautical miles
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
NWR North West Regional
OY Optimum Yield
PacFIN Pacific Fisheries Information Network
POP Pacific Ocean Perch
PRA Paperwork Reduction Act
PWCC Pacific Whiting Conservation Cooperative
RCA Rockfish Conservation Area
RFA Regulatory Flexibility Act
SBA Small Business Administration
SHOP Shorebased Hake Observation Program
USD United State Dollar
WOC Washington, Oregon, and California

1. PURPOSE OF AND NEED FOR THE ACTION

1.1 Introduction

The groundfish fishery in the Exclusive Economic Zone (EEZ), offshore waters between 3 and 200 nautical miles (nm), off the coasts of Washington, Oregon, and California (WOC) is managed under the Pacific Coast Groundfish Fishery Management Plan (FMP). The Pacific Coast Groundfish FMP was prepared by the Pacific Fishery Management Council (Council) under the authority of the Magnuson Fishery Conservation and Management Act (subsequently amended and renamed the Magnuson-Stevens Fishery Conservation and Management Act). The FMP has been in effect since 1982.

Actions taken to amend FMPs or to implement regulations to govern the groundfish fishery must meet the requirements of several Federal laws, regulations, and executive orders. In addition to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), these Federal laws, regulations, and executive orders include: National Environmental Policy Act (NEPA), Regulatory Flexibility Act (RFA), Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), Coastal Zone Management Act (CZMA), Paperwork Reduction Act (PRA), Executive Orders (E.O.) 12866, 12898, 13132, and 13175, and the Migratory Bird Treaty Act.

NEPA regulations require that NEPA analysis documents be combined with other agency documents to reduce duplication and paperwork (40 CFR§§1506.4). Therefore, this EA will ultimately become a combined regulatory document to be used for compliance with not only NEPA, but also E.O. 12866, RFA, and other applicable laws. NEPA, E.O. 12866, and the RFA require a description of the purpose and need for the proposed action as well as a description of alternative actions that may address the problem.

- Chapter One describes the purpose and need of the proposed action.
- Chapter Two describes a reasonable range of alternative management actions that may be taken to meet the proposed need.
- Chapter Three contains a description of the physical, biological, and socioeconomic characteristics of the affected environment.
- Chapter Four examines the physical, biological, and socioeconomic impacts of the alternative management actions.
- Chapter Five outlines the consistency with the fishery management plan and other applicable laws.
- Chapter Six details the regulatory impact review and regulatory flexibility analysis.
- Chapter Seven contains a list of references for this document.

1.1.1 Background

The American Fisheries Act (AFA) of 1998 was designed to strengthen U.S. ownership standards that had been exploited under the Anti-reflagging Act, and to rationalize the Bering Sea and Aleutian Islands (BSAI) walleye pollock fishery (pollock) while protecting non-AFA participants in other fisheries. Management measures required by the AFA include (1) regulations that limit access into the fishing and processing sectors of the BSAI pollock fishery and that allocate pollock to such sectors, (2) regulations governing the formation and operation of fishery cooperatives in the BSAI pollock fishery, (3) regulations to protect other fisheries from spillover effects from the AFA, and (4) regulations governing catch measurement and monitoring in the BSAI pollock fishery. The AFA requires the Council to develop conservation and management measures to protect fisheries under its jurisdiction and the participants in those fisheries from adverse impacts caused by the AFA, or by any fishery cooperatives in the directed pollock fishery. Protection measures can be divided into two basic categories 1) the protection of persons/companies that harvest fish and are not part of the BSAI pollock fleet as defined by the AFA and 2) the protection of non-AFA fish processors. To address the concern of AFA impacts on the Pacific coast groundfish fishery the Council voted to establish a control date of September 16, 1999, and to initiate the development of recommendations to restrict AFA-qualified vessels from participating in the Pacific Coast groundfish fishery if, during a qualifying period between January 1, 1994, and September 16, 1999, the vessel: (1) did not harvest at least 50 metric tons (mt) of Pacific whiting in the mothership sector; (2) did not land at least 50 mt of Pacific whiting in the shorebased sector; or (3) did not land groundfish shore-based in the Pacific Coast groundfish fishery (not including fish landed in the Pacific whiting fishery) (64 FR 66158). This control date provided notice to AFA-permitted vessels that might seek to participate in the Pacific Coast groundfish fisheries that current requirements for accessing the fisheries may change.

At its June 2000 meeting, the Council also set a control date of June 29, 2000, for any limited entry permit on that date owned by an owner of a vessel eligible for benefits under the AFA and registered for use with an AFA-qualified vessel that does not meet minimum participation requirements. The control date was intended to indicate that new requirements may be established in the future, and permit holders may be subject to restrictions similar to restrictions imposed on the vessel (65 FR 55214). The intended effect of this action was to discourage speculative entry or increased effort in the Pacific coast groundfish fisheries by entities eligible for AFA benefits and to provide notice of potential permit restrictions or revocation to purchasers or lessees of limited entry permits owned by AFA-qualified vessel owners and registered for use with AFA-qualified vessels.

In September 2001, the Council reviewed a range of alternatives limiting participation in the West Coast groundfish fisheries and the Pacific whiting fishery under Amendment 15. Analysis in the draft EA identified key issues: qualifying criteria for AFA catcher vessels; whether AFA catcher vessel restrictions would be on vessels, permits held by vessels, or both; qualifying criteria for AFA catcher/processors; qualifying criteria for AFA motherships; and duration of the restrictions. The Council adopted a preferred alternative and directed Council staff to complete public review drafts of the analysis and proposed management measures. However, because of competing workload and no threatened imminent harm, the Council tabled action on Amendment 15 in 2001.

In 2006, changes in the Pacific whiting fishery occurred which led to Council concern about increased participation by both AFA-permitted and non-AFA permitted vessels in the Pacific whiting fishery. A significant increase in the whiting ex-vessel price attracted several new vessels to the fishery, including some AFA-permitted vessels. Since the Alaska pollock fishery was rationalized, some vessels found they could engage in fishing for Pacific whiting off the West Coast in the spring and early summer and then travel to Alaska to take their shares of pollock later in the summer when Alaskan fishing conditions were more favorable. Increased participation in the Pacific whiting fishery contributed to the achievement of the shore-based whiting harvest limits earlier in the year in 2006 than in 2005 which adversely affected processors and fishers.

At the March 2006 Council meeting, the Legislative Committee discussed a request by staff of the U.S. Senate Committee on Commerce, Science, and Transportation for Council input on draft AFA amendatory language. In turn the Council directed Council staff to send a letter to the U.S. Senate Committee recommending that "all AFA qualified vessels (original or replacement) - not just catcher/processor vessels - without West Coast landing history prior to June 29, 2000 [one of two Council approved control dates] be prohibited from participating in the Pacific whiting fishery." At the June 2006 meeting, the Legislative Committee and the Council heard testimony regarding participation by AFA qualified vessels in the shore-based sector of the Pacific whiting fishery. Additional public comments stated that Council recommended restrictions on AFA qualified vessels would not go far enough to protect all sectors of the West Coast Pacific whiting fishery and that sector specific "sideboards" (landing requirements) should be requested and that current efforts to address the issue through federal legislation were unlikely to address all of the Council's concerns. In response, the Council and the Legislative Committee recommended revisiting Amendment 15 to the groundfish FMP as a potential mechanism for protecting West Coast fisheries from adverse impacts caused by the AFA.

In September 2006, the Council recommended that NMFS take emergency action to prevent new entry into the Pacific whiting fishery in 2007. The basis for the Council's recommendation was conservation concerns that could arise from an accelerated race for fish[1] due to new entry of AFA-permitted vessels to the fishery. Members of the Council expressed concern that a race for fish could result in excessive harvest of whiting early in the season, greater bycatch of overfished rockfish and higher levels of incidental catch of endangered and threatened salmon in the early season. The Council also noted its concern that new entry of AFA-permitted vessels could result in early achievement of the U.S. directed harvest whiting quotas, leaving West Coast-based vessels facing no fishing or very limited fishing while the AFA-permitted vessels could return to the rationalized Alaska pollock fisheries, in which they also had an interest. The Council's proposal would only have prohibited AFA-permitted vessels from entry into the Pacific whiting fishery in 2007, and only if they did not have a history of involvement in the fishery prior to 2006. Other non-AFA vessels could still have entered the fishery.

In a letter of January 11, 2007, the Northwest Regional Administrator denied the Council's request for an emergency rule. The letter noted that the Council action was intended to address actual or potential harm to West Coast fisheries from the AFA, however the earlier closure of the whiting shore-based fishery in 2006 (compared to 2005) was due to new participation by both AFA-permitted vessels and non-AFA vessels. While acknowledging that new market conditions were likely to attract additional vessels, the Regional Administrator pointed out that the proposed

[1] The Pacific whiting fishery is managed under a "primary" season structure where vessels harvest Pacific whiting until the sector allocation is reached and the fishery is closed. This is different from most West Coast groundfish fisheries, which are managed under a "trip limit" structure, where catch limits are specified by gear type and species (or species group) and vessels can land catch up to the specified limits. Incidental catch of other groundfish species in the Pacific whiting fishery, however, is managed under the trip limit structure.

action would have denied new entry to a selected category of vessels (i.e., AFA-permitted vessels) but not all vessels. The Regional Administrator noted that the guidelines for the use of emergency rules call for use of notice-and-comment procedures when there are controversial actions with serious economic effects, except under extraordinary circumstances. Therefore, the proposal, as with other allocation decisions, would more appropriately be handled through the Council's full rulemaking process.

The Regional Administrator subsequently advised the Council on February 13, 2007, that if it were to submit a proposal that dealt more broadly with the issue of conservation risks and management problems due to potential new entry of any new vessels into the directed whiting fishery, NMFS would review that proposal on its own merits. NMFS would continue to be concerned if the request based the proposed action on the AFA rather than on the Magnuson-Stevens Act.

At its March 2007 meeting, the Council discussed a schedule of final Council action for Amendment 15 at its June or September 2007 meeting. As an interim protective mechanism, the Council voted to request that NMFS enact an emergency rule for the 2007 non-tribal season to prohibit participation in the 2007 non-tribal Pacific whiting fishery by all vessels without sector-specific history in the fishery prior to January 1, 2007 (72 CFR 27760). In addition to the factors that were presented in the 2006 Council emergency rule request, there were four new pieces of information presented at the March 2007 Council meeting that exacerbated concern for an accelerated race for fish. First, the price for whiting continued to increase to unprecedented levels, ex-vessel prices increased from $77 per ton in 2004 to $137 per ton in 2006 - nearly doubling since 2004, and increasing by over 22% compared to 2005. Industry projections for the 2007 season were that prices would continue to increase to over $176 per ton. Second, the U.S. OY of whiting was reduced by 10% for the 2007 season compared to 2006. Third, because of higher than projected canary rockfish bycatch rates in the non-whiting fishery, the Council took action in March 2007 that placed more severe constraints on the limited entry non-whiting trawl fishery. Vessels that had reduced opportunities due to the expanded rockfish conservations areas, may have had an incentive to join the whiting fishery. Fourth, the quota for Alaskan pollock was reduced in 2007[2]. All of these recent changes increased the likelihood that there could be accelerated race for fish: the first by making entry more lucrative for additional vessels, the second by constraining supply of whiting and leading to more pressure among vessels to quickly capture the more limited supply of whiting, and the third and fourth by increasing the relative attractiveness of entering the whiting fishery this year.

Faced with this information, the Council adopted and submitted a proposal to NMFS to address the anticipated issues in 2007. The Council's proposal was to: (1) prohibit via NMFS emergency action participation in either the shore-based, catcher/processor, and mothership sectors of the fishery by any vessel that had no sector-specific history of participation prior to January 1, 2007; and (2) commit the Council to complete Amendment 15 to the FMP to address concern regarding

[2] Because the midwater trawl fishing gear used in the shore-based whiting fishery is similar to gear used in the Bering Sea/Aleutian Islands pollock fishery, the added equipment cost for participation is minimal for Alaskan pollock vessels. Individuals entering the whiting fishery would need to acquire the necessary West Coast trawl limited entry permit(s); the number of permits needed is directly related to the size of the vessel.

increased participation by AFA vessels for the long term, consistent with the Magnuson-Stevens Act, the AFA, and other applicable law.

The NMFS implemented the Council's request for emergency action on May 14, 2007, prohibiting participation in the 2007 whiting fishery by any vessel that had no history of participation within a specific sector of the whiting fishery during the period between December 31, 1996 and January 1, 2007 (72 FR 27759, May 17, 2007). This action remains in effect until November 13, 2007, unless modified or extended. Emergency actions may be in place for as long as 180 days, and may be extended for a subsequent 180 days, but not longer.

The Council continued to address Amendment 15 during the April 2007 meeting. At this meeting, the Council adopted a purpose and need statement to limit sector-specific participation by AFA-permitted vessels without historical participation, and adopted a range of alternatives. Following the April Council meeting, an inter-agency workgroup led by the Oregon Department of Fish and Wildlife was established composed of staff from that agency, as well as Washington Department of Fish and Wildlife, National Marine Fisheries Service, and the Pacific Fishery Management Council. This workgroup was assigned with conducting analysis of the selected alternatives and completing the EA for Amendment 15.

During the initial planning and analysis, the workgroup identified a need for Council clarification on the purpose and need statement in order to develop and analyze a range of alternatives for Council consideration. During the June 11-15, 2007 Council meeting, the Council refined the previously adopted purpose and need statement, expanding it to prohibit participation by all vessels, regardless of qualification under the AFA. The revised statement and subsequent proposed alternatives, which are presented in this document, were designed to more fully address conservation risks and management problems as a result of new entrants to the Pacific whiting fishery.

1.2 Description of the Proposed Action

The proposed action is to develop conservation and management measures to protect the West Coast non-tribal Pacific whiting fishery and the participants in the fishery from adverse impacts caused by vessels with no sector-specific significant historical participation in the Pacific whiting fishery. The proposed limitations on entry are intended to restrict introduction of additional harvest capital in the fisheries, which could result in an accelerated race for fish. However, the entry limitations alone under the proposed Amendment 15 may be insufficient to reduce the overcapitalization and the "regular" race for fish that currently exist in the Pacific whiting fishery. The proposed Amendment 20 to the Pacific Groundfish Fishery Management Plan, examines the creation and implementation of 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. If the whiting fishery is rationalized under Amendment 20, the proposed action under Amendment 15 would be an interim measure.

1.3 Purpose of and Need for the Action

Overcapacity fosters destructive derby operations (race for fish), aggravates overfishing and bycatch, creates chronic management problems, and undermines the economic performance of the harvesting sector. New entry into all sectors of the directed Pacific whiting fishery is likely given these conditions: increased whiting ex-vessel prices, increased prices for headed and gutted whiting as well as for fillet products, declining whiting OY, limited West Coast trawl opportunities due to overfished species rebuilding measures, and declining pollock quotas. Without action, it is likely that new vessels will enter into the fully capitalized Pacific whiting fishery, which could negatively effect the socioeconomic, biological, and physical environments.

1.4 Relationship to Other Plans and Policies

To encourage consistency among plans the relationship of the alternative actions to existing plans must be examined. Plans and policies that may affect or be affected by the alternative actions are discussed below.

Magnuson-Stevens Act and the Groundfish Fishery Management Plan
The alternative actions are consistent with the national standards and guidelines specified in the Magnuson-Stevens Act and the goals and objectives of the FMP. The alternative actions in the context of the Magnuson-Stevens Act and the Fishery Management Plan are thoroughly discussed in Chapter 5.1.

The proposed actions also relate to other FMP Amendments.

Amendment 10
Amendment 10 will create the regulatory framework for a maximized retention and monitoring program for the Pacific whiting shore-based fishery. Under this amendment, regulations will establish whiting vessel certifications. The alternative actions proposed under Amendment 15 may restrict vessel eligibility for whiting certifications.

Amendment 20
Amendment 20 to the FMP examines the creation and implementation of 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. If the trawl fishery is rationalized under Amendment 20, then the proposed action under Amendment 15 would be an interim measure.

Pacific Fishery Management Council Strategic Plan
The Amendment 15 action alternatives support the Council’s Strategic plan, which addressed the prevention of future overcapacity in the whiting fishery. The plan recommended implementing whiting endorsements with qualification for the endorsement based on landing history since 1994, the start of West Coast limited entry. While action alternatives do not promote an endorsement, a list of vessels eligible to participate in the Pacific whiting fishery would be maintained by the NMFS. Alternatives 1 and 2 contain the 1994 start date for historical participation, which is inline with the Strategic Plan recommendations. The Strategic Plan recommends bringing harvest capacity to a level that is in balance with the economic value of the resource. The plan also recommended limiting capacity while the permanent rationalization program is being developed. As previously mentioned, Amendment 15 would prohibit new

entrants and additional harvest capacity until such a time that the Council can create a permanent capacity reduction program through Amendment 20 or other initiative. If the trawl fishery is rationalized under Amendment 20, then the proposed action under Amendment 15 would be an interim measure. The Strategic Plan also encourages the use of incentives to encourage fishermen to fish in areas or times when bycatch is lower. Reducing competition and slowing the race for fish, under Amendment 15, may provide the opportunity to fish during times and in areas with lower rockfish bycatch.

International Plan of Action for the Management of Fishing Capacity
In 1999 the U.S. and the members of the Food and Agriculture Organization of the United Nations committed to the International Plan of Action for the Management of Fishing Capacity (U.S. Department of Commerce, 2004). The U.S., through NOAA, pledged to have an active role in managing capacity by working with the Councils to reduce overcapacity in fisheries under their jurisdiction. Under the plan of action, states and regional fisheries organizations agree to exercise caution to avoid growth in capacity, which can undermining long-term sustainability objectives. The proposed alternatives under Amendment 15 would prevent new entry and further overcapitalization in the whiting fishery, which is inline with the U.S. commitment to the International Plan of Action for the Management of Fishing Capacity.

1.5 Applicable Federal Permits, Licenses, or Authorizations Needed in Conjunction with Implementing the Proposal

In June 2007, the Council took final action under Amendment 10 to the FMP to adopt a maximized retention and monitoring program for the Pacific whiting shore-based fishery. In addition to a limited entry permit with a trawl endorsement, vessels participating in future shore-based whiting fisheries will be required to apply for and obtain an annual whiting certification, which will serve as a declaration to participate. The alternative actions considered under Amendment 15 are expected to result in NMFS maintaining a list of vessels eligible to participate in the whiting fishery. NMFS expects that it would only issue whiting certificates in the shore-based sector, as called for by the shore-based whiting full retention and monitoring program recommended by the Council in June 2007, to eligible vessels under Amendment 15.

Catcher/processors, motherships, and catcher vessels in the mothership sector may also need to be issued whiting certifications. During the regulatory development process, NMFS will review the Council's recommendations for Amendment 15 in order to determine whether publishing and maintaining a list of eligible vessels is adequate for the amendment's implementation for the catcher/processor and mothership sectors.

Implementing regulations under Amendment 15 would specify the necessary application procedures for the Pacific whiting fishery.

2. ALTERNATIVES

This chapter describes the alternative management actions that could be implemented to prevent increased participation in the non-tribal Pacific whiting fishery by vessels with no sector-specific participation during the qualifying periods. The proposed limitations on entry are intended to restrict introduction of additional harvest capital in the fisheries, which could result in an accelerated race for fish. This action is anticipated to be in effect until the Council recommends and NMFS implements a trawl rationalization program, such as those being considered under Amendment 20 to the groundfish FMP.

For the shore-based and mothership catcher vessel sector, the alternatives proposed by the Council do not seek to restrict or exclude participation of vessels who have participated in the Pacific whiting fishery during the qualifying period. For the catcher/processor and mothership sector, vessels with limited participation (i.e., less than 1,000 mt catching or processing in a single year) in that sector during the qualifying period could be restricted. Preventing further capacity in the Pacific whiting fishery could be accomplished by excluding vessels that do not meet qualifying criteria for sector specific significant participation in the Pacific whiting fishery during the qualifying period.

The primary factors taken into consideration when developing the alternatives were: (1) defining sector-specific significant historical participation by vessels and (2) determining qualifying dates by sector. The Council recommended that any participation during the qualifying period was a sufficient qualifier for the shore-based and at-sea catcher vessel sector. For the catcher/processor and mothership fleet, the Council recommended a tonnage requirement of 1,000 metric tons to represent significant historical participation.

The earliest date for defining the start of participation under the proposed alternatives is January 1, 1994; the year in which the West Coast limited entry trawl permit system began. Limited entry changed the composition of the at-sea processing fleet considerably, increasing the number of motherships, because permits were not required of vessels that only process. No catcher/processors initially qualified for a permit, but later purchased permits necessary to operate in the fishery. An alternative date for the start of the qualifying period is January 1, 1997 for catcher/processors and motherships, which represents the year in which the at-sea allocation was specifically divided into catcher/processor and mothership allocations. Prior to 1997, 60% of the OY was available in open competition between the shore-based and at-sea sectors. The remaining 40% was reserved for the shore-based fishery.

The Council chose two end dates for the qualifying periods in the proposed alternatives. The qualifying period end date of January 1, 2006 reflects the Pacific whiting fishery through the 2005 season, prior to the 22% increase in the ex-vessel value of Pacific whiting and the subsequent increased participation in the shore-based sector by 7 vessels that had not previously participated in that sector of the whiting fishery, and one mothership processor that had not previously participated in the fishery. The qualifying period end date of January 1, 2007 reflects the Pacific whiting fishery through the 2006 season, after improved market conditions and increased participation in the shore-based and mothership sectors by the new entrants.

The proposed alternatives for limiting participation in the Pacific whiting fishery are found in Table 1 and further detailed below.

Table 1 Action Alternatives for Limiting Vessel Participation in the Pacific Whiting Fishery

<table>
<tr><th>Status quo
(No action)</th><th>Alternative 1

(includes participation through the 2005 season)</th><th>Alternative 2

(includes participation through the 2006 season)</th><th>Alternative 3

(2007 E-Rule 72 CFR 27759)</th></tr>
<tr><td rowspan="2">Harvest capacity limited only by the number and availability of limited entry permits with trawl endorsements: Catcher vessels in the shore-based and mothership sectors and catcher/processors must be registerd to a Pacific coast groundish limited entry permit with a trawl endorsement

Processing capacity in the mothership and shore-based sectors are not limited.</td><td>Alternative 1A- All vessels required to have sector specific participation between January 1 1994 & January 1, 2006

Catcher/processor & motherships required to have significant participation a/</td><td>Alternative 2A- All vessels required to have sector specific participation between January 1, 1994 & January 1, 2007

Catcher/processor & motherships required to have significant participation a/</td><td rowspan="2">All vessels required to have sector specific participation between January 1, 1997 & January 1, 2007</td></tr>
<tr><td>Alternative 1B – Shore-based and mothership catcher vessels required to have sector specific participation between January 1 1994 & January 1, 2006

Catcher/processor & mothership Vessels required to have significant sector specific history of participation between January 1, 1997 & January 1, 2006 a/</td><td>Alternative 2B - Shore-based and mothership catcher vessels required to have sector specific participation between January 1, 1994 & January 1, 2007

Catcher/processor & mothership Vessels required to have significant sector history of participation between January 1, 1997 & January 1, 2007 a/</td></tr>
</table>

a/ Significant participation means that at least 1,000 metric tons were processed by a mothership or caught and processed by a catcher/processor in any one qualifying year

For Action Alternatives 1 & 2, significant historical participation is defined as having caught and processed at least 1,000 metric tons in any one qualifying year for catcher/processors; and having received at least 1,000 metric tons of whiting in any one qualifying year for motherships.

2.1 Status Quo (No Action). *Limit participation in the Pacific whiting fishery by using only the current limited entry system*

Under the No Action Alternative, any vessel registered to a West Coast limited entry groundfish permit with a trawl endorsement (176 existing permits) could harvest fish in the shore-based, catcher/processor, and mothership sectors of the Pacific whiting fishery. For new unpermitted vessels to be registered to a limited entry groundfish permit, they would need to purchase trawl endorsement permit(s) adequate to the size of the vessel[3] Under this alternative, increased or decreased participation in the whiting fishery is expected to be driven by whiting allocations, market conditions for whiting products, processor capacity, cost of gear, opportunity in other West Coast groundfish fisheries and other fishing opportunities such as the BSAI pollock fishery. Increased harvest and processing capital in the whiting fishery could result in an accelerated race for fish, which could reduce the per vessel value for the historical participants, may have undesirable consequences on overfished and protected species, and could result in a fishery that is more costly and difficult to manage in an effective manner.

The outcomes and effects of status quo are anticipated to continue until the Council recommends and NMFS implements a trawl rationalization program under Amendment 20 to the FMP, or other program that would reduce capacity in the whiting fishery.

2.2 Alternative 1. *Limit participation through the 2005 season*

Alternative 1 would prohibit participation by vessels that do not have sector-specific history of participation in the Pacific whiting fishery during the qualifying years defined below. This alternative is based on participation in the fishery since license limitation was implemented through the 2005 season. For the at-sea processing sector, a sub option exists with a start date that represents the year in which the at-sea allocation was specifically divided into catcher/processor and mothership allocations. Future adverse harm to the fishery from vessels that joined the fishery in 2006 and any new vessels that may chose to join in the future would be prevented under this alternative.

Alternative 1A
Limit participation to only those vessels with participation records as catcher vessels in the shore-based and at-sea catcher vessel sector during the January 1, 1994 – January 1, 2006 qualification period.

For the catcher/processor and mothership sector only, limit participation to those vessels with significant historical participation during the January 1, 1994 – January 1, 2006 qualification period. Significant historical participation is defined as having caught and processed at least 1,000 metric tons in any one qualifying year for catcher/processors; and having received at least 1,000 metric tons of whiting in any one qualifying year for motherships.

Alternative 1B
Limit participation to only those vessels with participation records as catcher vessels in the shore-based and at-sea catcher vessel sector during the January 1, 1994 – January 1, 2006 qualification period.

For the catcher/processor and mothership sector only, limit participation to only those vessels with significant participation records during the January 1, 1997 – January 1,

[3]Each limited entry permit is endorsed with the length overall or the size of the vessel that initially qualified for the permit. Vessels must combine enough limited entry permits in order to cover the length overall. Only 176 limited entry permits with trawl endorsements are currently available for use in all groundfish fisheries.

2006 qualifying period. Significant historical participation is defined as having caught and processed at least 1,000 metric tons in any one qualifying year for catcher/processors; and having received at least 1,000 metric tons of whiting in any one qualifying year for motherships.

This alternative excludes vessels that entered the fishery for the first time in 2006. The total number of eligible catcher vessels that would be qualified to participate in the Pacific whiting fishery is 68 in the shore-based sector and 64 in the mothership sector, under either Alternative 1A or 1B. For the shore-based sector, of the 68 that qualify based on participation records, 12 vessels are no longer in operation due to the west coast groundfish buyback program. Therefore the effective number of eligible vessels is 56 for the shore-based sector. The effective vessels for this alternative will be referenced hereinafter. The total number of eligible catcher/processors qualified to participate in the Pacific whiting fishery, under Alternative 1A is 11 and 10 under Alternative 1B. The total number of unique motherships qualified to participate in the Pacific whiting fishery, under alternative 1A is 10 and 6 under Alternative 1B. In 2005 there were 29 catcher vessels participating in the shore-based sector and 10 processors. At-sea participation consisted of 6 catcher-processors, 5 motherships, and 18 mothership catcher vessels.

Vessels that purchased limited entry permits with the intent to join the whiting fishery or vessels that purchased equipment necessary to fish for Pacific whiting, but had not previously done so, would be prohibited from future participation under Alternative 1. Vessels that do not meet the participation requirements would need to find other fishing opportunities.

Since the alternatives are sector-specific, vessels that did not qualify for a particular sector would be ineligible to participate in that sector in the future. For example, shore-based vessels that acquired equipment to process at-sea, but had not previously done so, would be prohibited from participating in the catcher/processor sector. Catcher/processors without significant historical participation in the mothership sector would be prohibited from participating from that sector in the future (and vice versa). Catcher vessels with no previous history in shore-based sector would be prohibited from participating from that sector in the future (and vice versa).

Unlike the at-sea processors, participation of Pacific whiting shore-based processing facilities are not restricted under these alternatives. However, Pacific whiting shore-based processing facilities and mothership processors that arranged with catcher vessels that would be excluded under Alternative 1 may experience hardships in contracting with additional catcher vessels in the future.

The outcomes and effects are anticipated to continue until the Council recommends and NMFS implements a trawl rationalization program under Amendment 20 to the FMP or other program that would reduce capacity in the whiting fishery.

2.3 Alternative 2. *Limit participation through the 2006 season*

Alternative 2 would prohibit participation by vessels that do not have sector-specific history of participation in the Pacific whiting fishery during the qualifying years defined below. This alternative is based on participation in the fishery since license limitation was implemented through the 2006 season. For the at-sea processing sector, a sub option exists with a start date that represents the year in which the at-sea allocation was specifically divided into catcher/processor and mothership allocations. Future adverse harm to the fishery from vessels that may chose to join in the future would be prevented under this alternative.

Alternative 2A
Limit participation to only those vessels with participation records as catcher vessels in the shore-based and at-sea catcher vessel sector during the January 1, 1994 – January 1, 2007 qualification period.

For the catcher/processor and mothership sector only, limit participation to those vessels with significant historical participation during the January 1, 1994 – January 1, 2007 qualification period. Significant historical participation is defined as having caught and processed at least 1,000 metric tons in any one qualifying year for catcher/processors; and having received at least 1,000 metric tons of whiting in any one qualifying year for motherships.

Alternative 2B
Limit participation to only those vessels with participation records as catcher vessels in the shore-based and at-sea catcher vessel sector during the January 1, 1994 – January 1, 2007 qualification period.

For the catcher/processor and mothership sector only, limit participation to those vessels with significant historical participation during the January 1, 1997 – January 1, 2007 qualification period. Significant historical participation is defined as having caught and processed at least 1,000 metric tons in any one qualifying year for catcher/processors; and having received at least 1,000 metric tons of whiting in any one qualifying year for motherships.

This alternative includes vessels that entered the fishery during the 2006 season. The total number of unique catcher vessels that would be qualified to participate in the Pacific whiting fishery, under either Alternative 2A or 2B, is 75 in the shore-based sector and 64 in the mothership sector. For the shore-based sector, of the 75 that qualify based on participation records, 12 vessels are no longer in operation due to the west coast groundfish buyback program. Therefore the effective number of eligible vessels is 63 for the shore-based sector. The effective vessels for this alternative will be referenced hereinafter. The total number of unique catcher/processors qualified to participate in the Pacific whiting fishery, under Alternative 2A is 11 and 10 under Alternative 2B. The total number of unique motherships qualified to participate in the Pacific whiting fishery, under Alternative 2A is 11 and 7 under Alternative 2B. In 2006 there were 37 catcher vessels participating in the shore-based sector. At sea participation consisted of 9 catcher-processors, 6 motherships, and 20 mothership catcher vessels.

More vessels are eligible to participate in the Pacific whiting fishery under Alternative 2, compared to Alternative 1. Similar to Alternative 1, vessels that purchased limited entry permits with the intent to join the whiting fishery or vessels that purchased equipment necessary to fish for Pacific whiting, but had not previously done so, would be prohibited from future participation under Alternative 2. Vessels that do not meet the participation requirements would need to find other fishing opportunities.

Like Alternative 1, since the alternatives are sector-specific, vessels that did not qualify for a particular sector would not be eligible to participate in that sector in the future. For example, shore-based vessels that acquired equipment to process at-sea, but had not previously done so, would be prohibited from participating in the catcher/processor sector. Catcher/processors without significant historical participation in the mothership sector would be prohibited from participating from that sector in the future (and vice versa). Catcher vessels with no previous history in shore-based sector would be prohibited from participating from that sector in the future (and vice versa).

Unlike the at-sea processors, participation of Pacific whiting shore-based processing facilities are not restricted under these alternatives. However, Pacific whiting shore-based processing facilities and mothership processors that arranged with catcher vessels that would be excluded under Alternative 2 may experience hardships in contracting with additional vessels in the future.

The outcomes and effects are anticipated to continue until the Council recommends and NMFS implements a trawl rationalization program under Amendment 20 to the FMP or other program that would reduce capacity in the whiting fishery.

2.4 Alternative 3. 2007 Emergency Rule (72 CFR 27759)

Alternative 3 reflects the spirit of the 2007 emergency rule, with participation dates reflecting the first year of the whiting sector allocation (1997) through the 2006 season. Future adverse harm to the fishery from any new vessels that may chose to join in the future would be prevented under this alternative.

The total number of eligible catcher vessels that would be qualified to participate in the Pacific whiting fishery, under Alternative 3 is 65 in the shore-based sector and 39 in the mothership sector. For the shore-based sector, of the 65 that qualify based on participation records, 9 are vessels no longer in operation due to the west coast groundfish buyback program. Therefore the effective number of eligible vessels is 56 for the shore-based sector. The effective vessels for this alternative will be referenced hereinafter. The total number of unique catcher/processors that would qualified to participate in the Pacific whiting fishery, under Alternative 3 is 10. The total number of unique motherships that would be qualified to participate in the Pacific whiting fishery, under Alternative 3 is 7. In 2006 there were 37 catcher vessels participating in the shore-based sector. At sea participation consisted of 9 catcher-processors, 6 motherships, and 20 mothership catcher vessels.

Vessels that participated prior to 1997 and after January 1, 2007, would be excluded under this alternative. Alternative 3 limits participation more than the other action alternatives.

Similar to Alternatives 1 and 2, vessels that purchased limited entry permits with the intent to join the whiting fishery or vessels that purchased equipment necessary to fish for Pacific whiting, but had not previously done so, would be prohibited from future participation under Alternative

3. Vessels that do not meet the participation requirements would need to find other fishing opportunities.

Like Alternatives 1 and 2, since the alternatives are sector-specific, vessels that did not qualify for a particular sector would not be eligible to participate in that sector in the future. For example, shore-based vessels that acquired equipment to process at-sea, but had not previously done so, would be prohibited from participating in the catcher/processor sector. Catcher/processors without historical participation in the mothership sector would be prohibited from participating from that sector in the future (and vice versa). Catcher vessels with no previous history in shore-based sector would be prohibited from participating from that sector in the future (and vice versa).

Unlike the at-sea processors, participation of Pacific whiting shore-based processing facilities are not restricted under these alternatives. However, Pacific whiting shore-based processing facilities and mothership processors that arranged with catcher vessels that would be excluded under Alternative 3 may experience hardships in contracting with enough additional vessels in the future.

The outcomes and effects are anticipated to continue until the Council recommends and NMFS implements a trawl rationalization program under Amendment 20 to the FMP or other program that would reduce capacity in the whiting fishery.

Table 2 summarizes the number of eligible vessels by sector and alternative.

Table 2. Numbers of Eligible Vessels by Sector and Alternative

Vessel Category	Alternative 1A 1/1/94-1/1/06	Alternative 2A 1/1/94-1/1/07	Alternative 3 1/1/97-1/1/07
Shore-based catcher vessels	56 [68][1]	63 [75] [1]	56 [65] [1]
Mothership catcher vessels	64	64	39
Catcher/processor	11	11	10
Mothership	10	11	7
	Alternative 1B 1/1/97-1/1/06	Alternative 2B 1/1/97-1/1/07	
Catcher/processor	10	10	
Mothership	6	7	

[1]Numbers in brackets indicate the actual number of vessels qualified, including those purchased during the buyback program.

2.5 Alternatives Considered but Rejected for Further Analysis

Only restrict participation by AFA-permitted vessels in the whiting fishery

In September 2006, the Council recommended that NMFS take emergency action to prevent new entry into the Pacific whiting fishery in 2007 by AFA-permitted vessels. The Council's proposal would only have prohibited AFA-permitted vessels from entry into the Pacific whiting fishery in 2007, and only if they did not have a history of involvement in the fishery prior to 2006. Other non-AFA vessels could still have entered the fishery.

In a letter of January 11, 2007, the Northwest Regional Administrator denied the Council's request for an emergency rule. The letter noted that the Council action was intended to address actual or potential harm to West Coast fisheries from the AFA; however the earlier closure of the whiting shore-based fishery in 2006 (compared to 2005) was due to new participation by both AFA-permitted vessels and non-AFA vessels. While acknowledging that new market conditions were likely to attract additional vessels, the Regional Administrator pointed out that the proposed action would have denied new entry to a selected category of vessels (i.e., AFA-permitted vessels) but not all vessels. The Regional Administrator noted that the guidelines for the use of emergency rules call for use of notice-and-comment procedures when there are controversial actions with serious economic effects, except under extraordinary circumstances. Therefore, the proposal, as with other allocation decisions, would more appropriately be handled through the Council's full rulemaking process.

As per the Regional Administrator guidelines, the Council submitted the proposed alternatives that deal more broadly with the issue of conservation risks and management problems due to potential new entry of any new vessels into the directed whiting fishery.

Implement Rules under Secretary of Commerce Authority Under the AFA
The Secretary of Commerce has the authority under the AFA to establish regulations and control entry into the Pacific whiting fishery by AFA-permitted vessels. Developing an alternative under the AFA was considered and rejected by the Council at its June 2007 meeting. By rejecting action under the AFA, the Council also rejected participation dates relative to the AFA control dates previously specified by the Council (64 FR 66158 and 65 FR 55214) or the passage of the AFA (1999). The NMFS previously indicated to the Council that the potential problems that would arise with new entry to the Pacific whiting fishery were not limited to the prospect of AFA-permitted vessels entering the fishery. Conservation and management problems were likely to arise with any new entry to the fishery. Further, use of Secretarial authority under the AFA would be more complex and take longer than under the Magnuson-Stevens Act and the rule could likely not be implemented under the AFA in a time frame to be useful in 2008. Therefore, this alternative was rejected without further analysis.

Restrict participation by AFA-permitted vessels in the non-whiting groundfish fisheries
The Council also considered increased participation by AFA-permitted vessels in the non-whiting fishery at the June 2007 Council meeting. The Council stated their desire to implement measures to protect the whiting fishery, from vessels with no previous participation, in time for the 2008 whiting fishery. The Council rejected an expanded action which would restrict AFA-permitted vessel participation in the non-whiting groundfish fishery since it would considerably lengthen the amount of time for the analysis, preventing implementation in time for the 2008 Pacific whiting season.

3. AFFECTED ENVIRONMENT

This chapter describes the Pacific Coast groundfish fishery and the resources that would be affected by the alternative actions. Physical resources are discussed in Chapter 3.1, biological resources are described in Chapter 3.2, and socio-economic resources are described in Chapter 3.3. Other recent NEPA documents prepared for the Pacific Coast groundfish fishery provide detailed information pertaining to the physical, biological and socio-economic environment. These NEPA documents include: the Environmental Impact Statement (EIS) for the FMP, EFH Designation and Minimization of Adverse Impacts; the EIS prepared for the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery; the EA entitled "A Maximized Retention and Monitoring Program for the Pacific Shore-based Fishery"; the EA titled "Catch Accounting Requirements for Pacific Whiting Shore-based Processors/First Receivers Participating in the Shore-based fishery"; and the "Emergency Rule to Implement Measures to Prohibit Entry of New Vessels to the Directed Fishery for Pacific Whiting in the Exclusive Economic Zone Off the West Coast in 2007". Rather than repeat information detailed in the other NEPA documents, the information has been summarized in this document and the reader is referred to the appropriate sections in the other NEPA documents for further detail.

3.1 Physical Characteristics of the Affected Environment

3.1.1 General Characteristics

The coastal ocean off Washington, Oregon, and California is a biogeographic region that is referred to as the Coastal Upwelling Domain (Ware and McFarlane 1989). Coastal upwelling results in high production of phytoplankton from April through September fueled by the nearly continuous supply of nutrients, and a high biomass of copepods, euphausiids and other zooplankton during summer. The Coastal Upwelling Domain is part of the California Current system. The California Current is a broad, slow, meandering current that moves toward the equator. In deep waters offshore of the continental shelf, the currents flow southward all year round; however, over the continental shelf, southward flows occur only in spring, summer, and fall. During winter months, the flow over the shelf reverses, and the water moves northward as the Davidson Current.

Pacific whiting are a California current species that undertake an extended spawning migration during which the adults swim south to spawn in the southern California Bight in fall and winter. Pacific whiting migrate from as far north as Vancouver Island to southern California, a distance of several thousand kilometers. The Pacific whiting fishery has historically occurred during the northern migration of adults. The northern migrating adults and the northward drift of larvae and juveniles takes place at depths where fish take advantage of the poleward undercurrent.

3.1.2 Essential Fish Habitat

The Magnuson Act defines "essential fish habitat" as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Groundfish EFH has been identified by the Pacific Fishery Management Council as all waters from the high tide line (and parts of estuaries) to 3,500 meters (1,914 fathoms) in depth. The physical environment and its relation to Pacific whiting are more fully described in the April 2007 EA titled "Catch Accounting Requirements for Pacific Whiting Shore-based Processors/First Receivers Participating in the Shore-based fishery". In addition, the Pacific Coast Groundfish Fishery Management Plan, EFH Designation and Minimization of Adverse Impacts, contains detailed information on the physical environment. Detailed information on the West Coast marine habitat and physical oceanography is presented in Section 3.2 of the final EFH EIS. A copy of the EFH EIS can be obtained by contacting the Sustainable Fisheries Division, Northwest Region, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115–0070; or viewing the internet posting at www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/NEPA-Documents/index.cfm.

3.2 Biological Characteristics of the Affected Environment

There are over 90 species of groundfish managed under the groundfish FMP. These species include over 60 species of rockfish in the family Scorpaenidae, 7 roundfish species, 12 flatfish species, assorted sharks, skates, and a few miscellaneous bottom-dwelling marine fish species. The groundfish species occur throughout the EEZ and occupy diverse habitats at all stages in their life history. For more in-depth descriptions of species in the affected environment the reader is referred to Section 3.2 of the Emergency Rule to Implement Measures to Prohibit Entry of New Vessels to the Directed Fishery for Pacific Whiting in the Exclusive Economic Zone Off the West Coast in 2007, available online at http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/NEPA-Documents/index.cfm.

3.2.1 Pacific Whiting

Pacific whiting range from Sanak Island in the western Gulf of Alaska to Magdalena Bay, Baja California Sur. They are most abundant in the California Current System (Bailey 1982; Hart 1973; Love 1991; NOAA 1990). In general, Pacific whiting is a very productive species with highly variable recruitment patterns (recruitment-the biomass of fish that mature and enter the fishery each year) and a relatively short life span when compared to most other groundfish species.

In 1987, the Pacific whiting biomass was at a historically high level due to an exceptionally large number of fish that spawned in 1980 and 1984 (fished spawned during a particular year are referred to as year classes). As these large year classes passed through the population and were replaced by moderate sized year classes, the overall size of the Pacific whiting stock declined. The Pacific whiting stock stabilized between 1995 and 1997, but then declined to its lowest level in 2001. The female spawning biomass of Pacific whiting in 2001 was estimated to be less than 20 percent of the unfished biomass. As a result, the stock was believed to be below the overfished threshold ($B_{25\%}$) and was declared overfished on April 15, 2002 (67 FR 18117).

Since 2001, the Pacific whiting stock has increased substantially due to a strong 1999 year class that matured and entered the spawning population. NMFS announced that the Pacific whiting stock was estimated to be above the target rebuilding biomass ($B_{40\%}$) in 2003 and was no longer considered to be an overfished stock. A Pacific whiting stock assessment was prepared in early 2006, and the Pacific whiting biomass was estimated to be between 31 percent and 38 percent of its unfished biomass. In 2006, the U.S. allowable biological catch (ABC) (73.88 percent of the U.S.-Canada coastwide ABC) was 518,294 mt and the U.S. total catch OY with a 40-10 precautionary adjustment was 269,069 mt. In the absence of a strong year class recruiting to the fishery, the Pacific whiting stock is projected to decline to near or below the overfished threshold in the next few years. A 2007 stock Pacific whiting stock assessment, which was available to the Council at its March 2007 meeting shows that the stock biomass is continuing to decline. Whiting is currently considered a precautionary zone stock.

3.2.2 Healthy and Precautionary Zone Stocks

Species that are incidentally taken in the Pacific whiting fishery may be commingled with Pacific whiting or merely in the vicinity of Pacific whiting schools, depending on the relationships between the various species. Major factors affecting bycatch are: area, depth, season, time of day, and environmental conditions. Overall abundance of a particular species is also relevant.

The most common groundfish species taken under the shore-based exempted fishing permit (EFP) fishery between 2002 and 2006 include: yellowtail rockfish (*Sebastes flavidus*), sablefish (*Anoplopoma fimbria*), spiny dogfish (*Squalus acanthias*), chilipepper rockfish (*Sebastes goodie*), and lingcod (*Ophiodon elongatus*). The most common groundfish species taken in the at-sea fishery between 2002 and 2005 include sablefish, thornyhead rockfish (*Sebastolobus altivelis* and *Sebastolobus alascanus*), widow rockfish, and yellowtail rockfish. Yellowtail, chilipepper, thornyheads and lingcod are all considered to be healthy stocks. Sablefish is a precautionary zone species. Spiny dogfish has not been quantitatively assessed.

Yellowtail Rockfish

Of the healthy and precautionary zone stocks, yellowtail rockfish is the most common groundfish species caught with Pacific whiting. Yellowtail rockfish range from San Diego, California, to Kodiak Island, Alaska (Fraidenburg 1980; Gotshall 1981; Lorz, et al. 1983; Love 1991; Miller and Lea 1972; Norton and MacFarlane 1995). The center of yellowtail rockfish abundance is from Oregon to British Columbia (Fraidenburg 1980). Yellowtail rockfish are a common, demersal species abundant over the middle shelf (Carlson and Haight 1972; Fraidenburg 1980; Tagart 1991; Weinberg 1994). Yellowtail rockfish are most common near the bottom, but not on the bottom (Love 1991; Stanley, et al. 1994). Yellowtail rockfish adults are considered semi-pelagic (Stanley, et al. 1994; Stein, et al. 1992) or pelagic, which allows them to range over wider areas than benthic rockfish. Adult yellowtail rockfish occur along steeply sloping shores or above rocky reefs (Love 1991). They can be found above mud with cobble, boulder and rock ridges, and sand habitats; they are not, however, found on mud, mud with boulder, or flat rock (Love 1991; Stein, et al. 1992). Yellowtail rockfish form large (sometimes greater than 1,000 fish) schools and can be found alone or in association with other rockfishes (Love 1991; Rosenthal, et al. 1982; Stein, et al. 1992; Tagart 1991). These schools may persist at the same location for many years.

In the past five years, the yellowtail rockfish catch in the Pacific whiting shore-based fishery has ranged from a low of 41 mt in 2002 with a catch rate of 0.0009 mt of yellowtail rockfish per mt of Pacific whiting to a high of 172 mt in 2005 with a catch rate of 0.0017 mt of yellowtail rockfish per mt of Pacific whiting (Table A1). Yellowtail rockfish catch rates tend to be highest in ports in the north (Westport, Illwaco, and Astoria) than in the south. Catch rates for individual trips between 1999 and 2003 show that the highest interception occurs around Astoria Canyon and south of Cape Flattery (Weidoff and Parker 2004). The mothership sector saw a similar increase in yellowtail interactions; landings were 1.42 mt in 2002 with a catch rate of .00002 and 59.28 mt in 2006 with a catch rate of 0.0011 (Table A1). Catcher processor encountered a range from a low of 1.75 in 2003 at a rate of 0.00004 to 44.74 mt at a rate of 0.0006 in 2005 (Table A1).

Sablefish
Sablefish, or black cod, are distributed in the northeastern Pacific ocean from the southern tip of Baja California, northward to the north-central Bering Sea and in the Northwestern Pacific ocean from Kamchatka, southward to the northeastern coast of Japan. Adults are found as deep as 1,900 m (1,039 fm), but are most abundant between 200 m (109 fm) and 1,000 m (547 fm) (Beamish and McFarlane 1988; Kendall, Jr. and Matarese 1987; Mason, et al. 1983). Adults and large juveniles commonly occur over sand and mud (McFarlane and Beamish 1983b; NOAA 1990) in deep marine waters. They were also reported on hard-packed mud and clay bottoms in the vicinity of submarine canyons (MBC 1987).

Sablefish is a precautionary zone species because the current biomass is below 40 percent but above 25 percent its unfished biomass. A coastwide sablefish stock assessment was prepared in 2005. The coastwide sablefish biomass was estimated to be at 35.2 percent of its unfished biomass in 2005. Projections indicate that the biomass is increasing and will be near 42 percent by 2008.

In the past five years, the sablefish catch in the EFP Pacific whiting shore-based fishery has ranged from a high of 128 mt in 2002 with a catch rate of 0.0028 mt of sablefish per mt of Pacific whiting to a low of 11 mt in 2006 with a catch rate of 0.0001 mt of sablefish per mt of Pacific whiting. The 2000 sablefish stock assessment predicted a strong year class would be entering the fishery in 2001. An analysis of the 2001-2002 sablefish caught in the Pacific whiting shore-based fishery, revealed a large occurrence of 1-2 year olds. In 2003, a moderate catch of 3 year old sablefish was seen. As the sablefish age and move to deeper water, they are less available to the mid-water trawl gear used to catch Pacific whiting.

Spiny dogfish
Spiny dogfish occur in temperate and subarctic latitudes in both the northern and southern hemispheres, ranging from the Bering Sea to Baja California (Allen and Smith 1988). Dogfish tend to migrate in large schools, and can travel long distances, feeding avidly on their journeys (Bannister 1989). The schools, numbering in the hundreds, exhibit north-south coastal movements and onshore-offshore movements. They also make diel migrations from near bottom during the day to near surface at night (NOAA 1990). Survey data indicate that most dogfish inhabit waters up to 350 m (191 fm).

Spiny dogfish has not been quantitatively assessed. In the past five years, the spiny dogfish catch in the EFP Pacific whiting shore-based fishery has ranged from a low of 4 mt in 2003 with a catch rate of 0.0001 mt of spiny dogfish per mt of Pacific whiting to a high of 95 mt in 2005 with a catch rate of 0.0010 mt of spiny dogfish per mt of Pacific whiting.

In the at-sea fishery for the catcher/processor fleet spiny dogfish catch has ranged from a low of 10.01 mt in 2003 with a catch rate of 0.0002 mt of spiny dogfish per mt of Pacific whiting to a high of 331.31 mt in 2004 with a catch rate of 0.0045 mt of spiny dogfish per mt of Pacific whiting. For motherships the range has been between a low of 1.01 mt in 2003 with a catch rate of 0.00003 mt of spiny dogfish per mt of Pacific whiting and a high of 27.93 mt in 2005 with a catch rate of 0.0006 mt of spiny dogfish per mt of Pacific whiting.

Chilipepper Rockfish

Chilipepper rockfish are found from Magdalena Bay, Baja California, Mexico, to as far north as the Northwest Coast of Vancouver Island, British Columbia (Allen 1982; Hart 1988; Miller and Lea 1972). Chilipepper have been taken as deep as 425 m (232 fm), but nearly all in survey catches were taken between 50 m (27 fm) and 350 m (191 fm) (Allen and Smith 1988). Adults and older juveniles usually occur over the shelf and slope; larvae and small juveniles are generally found near the surface. In California, chilipepper are most commonly found associated with deep, high relief rocky areas and along cliff dropoffs (Love, et al. 1990), as well as on sand and mud bottoms (MBC 1987). They are occasionally found over flat, hard substrates (Love, et al. 1990). Chilipepper may travel as far as 45 m (25 fm) off the bottom during the day to feed (Love 1991). Chilipepper rockfish were last assessed in 1998 (Ralston, et al. 1998), at which time the stock was estimated to be at 46 to 61 percent of unfished biomass. Because the biomass is estimated to be above 40 percent of the unfished biomass, chilipepper rockfish is considered to be a healthy stock.

Chilipepper rockfish catch is greatest in California. In the EFP shore-based fishery during 2005, a high of 26 mt of chilipepper rockfish was taken with a catch rate of 0.0003 mt of chilipepper rockfish per mt of Pacific whiting, and a low of 0.52 mt or 0.00001 in 2002 (Table A1). In the mothership sector chilipepper landings were 0.88 mt with a rate of 0.00004 in 2004 (lowest) to 1.92 mt with a rate of 0.00007 in 2002. Catcher/processors had similar low encounters of chilipepper, the lowest in 2003 (0.11 mt or 0.000003) to 2.97 mt with a rate of 0.00008 in 2002 (highest).

Lingcod

Lingcod, a top order predator of the family Hexagrammidae, ranges from Baja California, Mexico, to Kodiak Island in the Gulf of Alaska. Lingcod are demersal at all life stages (Allen and Smith 1988; NOAA 1990; Shaw and Hassler 1989). Adult lingcod prefer two main habitat types: slopes of submerged banks 10 m to 70 m (5 to 38 fm) below the surface with seaweed, kelp, and eelgrass beds and channels with swift currents that flow around rocky reefs (Emmett, et al. 1991; Giorgi and Congleton 1984; NOAA 1990; Shaw and Hassler 1989). Juveniles prefer sandy substrates in estuaries and shallow subtidal zones (Emmett, et al. 1991; Forrester and Thomson 1969; Hart 1988; NOAA 1990). As the juveniles grow they move to deeper waters. Adult lingcod are considered a relatively sedentary species, but there are reports of migrations of greater than 100 km by sexually immature fish (Jagielo 1990; Mathews and LaRiviere 1987; Matthews 1992; Smith, et al. 1990). Mature females live in deeper water than males and move from deep water to shallow water in the winter to spawn (Forrester 1969; Hart 1988; Jagielo 1990; LaRiviere, et al. 1980; Mathews and LaRiviere 1987; Matthews 1992; Smith, et al. 1990). Mature males may live their whole lives associated with a single rock reef, possibly out of fidelity to a prime spawning or feeding area (Allen and Smith 1988; Shaw and Hassler 1989).

A new stock assessment was prepared for lingcod in 2005 and lingcod was determined to be a healthy stock coastwide. However, the stock assessment estimates that the coastwide lingcod stock in 2005 is at 64 percent of its unfished biomass level, with the northern component of the stock (north of Cape Mendocino, CA) at 87 percent of its unfished biomass level and the southern component of the stock at 27 percent of its unfished biomass level.

In the past five years, the lingcod catch in the EFP Pacific whiting shore-based fishery has ranged from a low of 0.22 mt in 2002 with a catch rate of 0.000005 mt of lingcod per mt of Pacific whiting to a high of 6 mt in 2005 and 2006 with catch rates of 0.000060 of lingcod per mt of Pacific whiting. The change in incidental catch rates is consistent with the lingcod biomass increase since 2002.

Lingcod catch for at-sea processing vessels has ranged from .27 mt in 2002 with a catch rate of 0.000004 mt of lingcod per mt of Pacific whiting (overall for both mp and cp) to 3.11 mt in 2006 with catch rates of 0.00005 mt of lingcod per mt of Pacific whiting for the mothership sector and 0.000003 mt of lingcod per mt of Pacific whiting for the catcher/processor sector.

3.2.3 Overfished Species

The Magnuson-Stevens Act requires an FMP to rebuild overfished stocks. The term "overfished" describes a stock whose abundance is below its overfished/rebuilding threshold. Overfished/rebuilding thresholds are generally linked to the same productivity assumptions that determine the ABC levels. In 2007, seven groundfish species continue to be designated as overfished: bocaccio (south of Monterey) (*Sebastes paucispinis*), canary rockfish (*Sebastes pinniger*), cowcod (south of Point Conception) (*Sebastes levis*), darkblotched rockfish (*Sebastes* crameri), Pacific ocean perch (*Sebastes alutus*), widow rockfish (*Sebastes entomelas*), and yelloweye rockfish (*Sebastes ruberrimus*). The most common overfished groundfish species taken in Pacific whiting at-sea and shore-based fishery between 2002 and 2006 have been widow rockfish, darkblotched rockfish, canary rockfish, and POP (Tables 3-5). The Pacific whiting fishery has no impact on overfished cowcod stocks because these stocks are found farther south than where the Pacific whiting fishery has historically occurred. Limited impact on bocaccio rockfish has been reported.

Bycatch limits have been used to constrain the incidental catch of overfished rockfish species in the Pacific whiting fishery (i.e., all sectors) since 2004 (Table 6). If a bycatch limit is reached, all commercial Pacific whiting fisheries are closed for the remainder of the year, regardless of whether or not the Pacific whiting allocations have been reached. While fishery participants have generally demonstrated great sensitivity to the need to avoid rockfish and minimize their bycatch, so that all benefit from the total allowable catch, it is known that even one “disaster” tow can have very severe consequences for all the vessels involved, and disaster tows would be more likely with a race to fish than with a more stable season. The following tables outline historical bycatch limits and catch by sector from 2002-2006.

Table 3. Catch of Overfished Species in the Shore-based Sector, 2002-2006

	YEAR					
SPECIES	2002	2003	2004	2005	2006	Grand Total
Bocaccio rockfish	0.48	0.00	0.01	0.03	0.01	0.05
Canary rockfish	0.43	0.11	1.16	2.24	1.64	5.59
Darkblotched rockfish	0.01	0.26	0.84	5.51	2.27	8.89
Pacific Ocean perch	0.19	0.29	0.40	0.15	0.03	1.06
Yelloweye rockfish	0.00	0.00	0.00	0.01	0.06	0.07
Widow rockfish	5.32	12.54	28.26	77.24	49.51	172.87
Grand Total	5.96	13.20	30.67	85.16	53.46	188.53

Table 4. Catch of Overfished Species in the Mothership Sector, 2002-2006

	YEAR					
SPECIES	2002	2003	2004	2005	2006	Grand Total
Bocaccio rockfish	0.15	0.00	0.09	0.16	0.10	0.50
Canary rockfish	0.81	0.08	4.11	0.70	0.85	6.55
Darkblotched rockfish	0.93	0.10	3.02	5.08	4.24	13.37
Pacific Ocean perch	2.17	0.11	0.10	0.86	1.88	5.12
Yelloweye rockfish	0	0	0	0	0.02	.02
Widow rockfish	20.50	0.69	11.43	35.50	71.80	139.92
Grand Total	24.56	0.98	18.75	42.30	78.87	165.48

Table 5. Catch of Overfished Species in the Catcher-Processor Sector, 2002-2006

	YEAR					
SPECIES	2002	2003	2004	2005	2006	Grand Total
Bocaccio rockfish	0.04	0.06	0.07	0.11	0.01	0.29
Canary rockfish	1.59	0.17	0.48	0.34	0.10	2.68
Darkblotched rockfish	2.19	4.21	4.36	5.95	6.73	23.44
Pacific Ocean perch	1.45	5.04	0.95	0.78	0.75	8.97
Yelloweye rockfish	0.02	0	0	0	0.01	0.03
Widow rockfish	115.10	11.56	8.37	43.14	66.99	245.16
Grand Total	120.37	21.04	14.23	50.32	74.56	280.57

Table 6. Range of bycatch limits (mt) set by the Council for the non-tribal whiting fishery.

	2004	2005	2006	2007[a]
Canary	6.2 – 7.3	4.7	4.0 – 4.7	4.7
Darkblotched	9.5	n/a	25	25
Widow	n/a	200 – 212	200 – 220	220

[a] Year 2007 values represent the numbers currently outlined in the Federal Regulations, which can be modified by the Council during inseason action.

Widow Rockfish

Widow rockfish range from Albatross Bank off Kodiak Island to Todos Santos Bay, Baja California, Mexico (Eschmeyer, et al. 1983; Miller and Lea 1972; NOAA 1990). They occur over hard bottoms along the continental shelf (NOAA 1990) and prefer rocky banks, seamounts, ridges near canyons, headlands, and muddy bottoms near rocks. Large widow rockfish concentrations occur off headlands such as Cape Blanco, Cape Mendocino, Point Reyes, and Point Sur. Adults form dense, irregular, midwater and semi-demersal schools deeper than 100 m (55 fm) at night and disperse during the day (Eschmeyer, et al. 1983; NOAA 1990; Wilkins 1986). All life stages are pelagic, but older juveniles and adults are often associated with the bottom (NOAA 1990). Pelagic larvae and juveniles co-occur with yellowtail rockfish, chilipepper, shortbelly rockfish, and bocaccio larvae and juveniles off Central California (Reilly, et al. 1992).

Similar to other rockfish species, the biomass of widow rockfish has decreased steadily since the early 1980s, and recruitment during early 1990s is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment during the period could be due to lower spawning stock biomass, but it could also be due to environmental conditions. Widow rockfish was declared overfished on January 11, 2001, because the stock was assessed and believed to be below 25 percent of its unfished biomass. A 2005 coastwide stock assessment and rebuilding analysis were completed for widow rockfish. The 2005 stock assessment estimated that the widow rockfish stock was at 31.1 percent of its unfished biomass in 2004. In retrospect, the 2005 stock assessment shows that the widow rockfish biomass may not have declined below the overfished species threshold of 25 percent of its unfished biomass as has been estimated in previous stock assessments.

In 2006, the widow rockfish bycatch limit was 200 mt at the start of the season but was later revised to 220 mt (Table 6). In the past five years, the widow rockfish catch in the Pacific whiting shore-based fishery has ranged from a low of 5 mt in 2002 with a catch rate of 0.0001 mt of widow rockfish per mt of Pacific whiting to a high of 77 mt in 2005 with a catch rate of 0.0008 mt of widow rockfish per mt of Pacific whiting (Table 3). In 2006, the mothership sector encountered the largest amount of widow rockfish in the 5 year period with a catch rate of 0.0013 mt of widow per whiting mt, but in most years the catch was lower than 40 mt (Table 4). The catcher/processor sector encountered the lowest amount of widow rockfish in 2004, 8.34 mt with a catch rate of 0.00011 and a high of 115.50 mt with a catch rate of .0032 mt widow per mt of whiting (Table 5).

Darkblotched Rockfish

Darkblotched rockfish (*Sebastes crameri*) are found from the Bering Sea to near Santa Catalina Island, California at depths of 29-549 m (16-300 fm) (Eschmeyer et al.1983). Commercially important concentrations are found from Northern CA through the Canadian border, on or near the bottom, in depths of approximately 183-366 m (100-200 fm) . This species co-occurs with other slope rockfish, including Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), yellowmouth rockfish (*Sebastes reedi*), and sharpchin rockfish (*Sebastes zacentrus)*.

In 2006, the darkbloched rockfish bycatch limit was 25 mt (Table 6). In the past five years, the darkblotched rockfish catch in the Pacific whiting shore-based fishery has ranged from a low of

0.01 mt in 2003 to a high of 5.51 mt in 2005 (Table 3). The change in incidental catch rates coincides with the darkblotched rockfish biomass increase since 2002. Alternately, the increased catch rates in the 2005 Pacific whiting shore-based fishery may have resulted from increased fishing effort in deeper water to avoid Chinook salmon catch. The at-sea processing sectors tend to fish in deeper waters where darkblotched rockfish are more abundant. The mothership sector maintained low levels of darkblotched rockfish in 2002 and 2003, and in later years their catches have been less than or equal to 5 mt (Table 4). The catcher/processor sector encountered the largest amount of darkblotched rockfish in 2006 (6.73 mt); in earlier years the catchers were less than 6 mt (Table 5).

Canary Rockfish
Canary rockfish range from northern Baja California, Mexico, to southeastern Alaska (Boehlert and Kappenman 1980; Hart 1988; Love 1991; Miller and Geibel 1973; Richardson and Laroche 1979). There is a major population concentration of canary rockfish off Oregon (Richardson and Laroche 1979). Canary rockfish primarily inhabit waters that are 91 m (50 fm) to 183 m (100 fm) deep (Boehlert and Kappenman 1980). In general, they inhabit shallow water when they are young, and deep water as adults (Mason 1995). Adult canary rockfish are associated with pinnacles and sharp drop-offs (Love, et al. 1991) and are most abundant above hard bottoms (Boehlert and Kappenman 1980).

Canary rockfish recruitment has shown a steady decline over the last 50 years. Recent recruitments have generally been low, with 1998 producing the largest estimated year-class of recruitment in the last decade. Canary rockfish was declared overfished on January 4, 2000 (65 FR 221). A canary rockfish stock assessment and rebuilding analysis was prepared in 2005. The results of the stock assessment estimated that the canary rockfish stock was at 9.4 percent of its unfished biomass coastwide in 2005. The 2005 stock assessment estimated that the canary rockfish spawning stock biomass was at its lowest level in 2000, but has been increasing since percent of its unfished biomass in 2000. The result of the 2005 stock assessment estimated that darkblotched rockfish was at 16 percent of its unfished biomass in 2005, and was notably lower in 2000 (8 percent) than had been estimated in the previous stock assessment. However, the stock assessment indicates that the spawning output has more than doubled since 1999. This growth is resulting in rapid rebuilding of the stock due to the strong numbers of fish spawned in 1999 and 2000 that are maturing and entering the fishery. This strong recruitment combined with low exploitation rates in recent years has resulted in more rapid rebuilding than was projected following the 2000 stock assessment.

In 2006, the canary rockfish bycatch limit was initially set at 4.7 mt, but was revised downward to 4.0 mt during the season due to higher than expected canary rockfish research catch (Table 6). Canary catch in the shore-based fishery in the last 5 years has ranged from a low of 0.11 mt to a high of 2.24 mt (Table 3). The mothership sector has maintained low levels of canary bycatch, except in 2004 when 4.11 mt was landed with an associated catch rate of 0.00002 mt canary per mt whiting (Table 4). The majority of this catch, 3.9 mt, occurred in a single tow of fish. Canary catch in the catcher/processor sector was highest in 2002 (1.59 mt catch rate of 0.00004 mt canary per mt whiting) and has been low since (Table 5).

Pacific Ocean Perch
POP are found from La Jolla, California to the western boundary of the Aleutian Archipelago

(Eschmeyer, et al. 1983; Gunderson 1971; Ito, et al. 1986; Miller and Lea 1972), but are common from Oregon northward (Eschmeyer, et al percent 1983). They primarily inhabit waters of the upper continental slope (Dark and Wilkins 1994) and are found along the edge of the continental shelf (Archibald, et al. 1983). POP are found in waters as deep as 825 m, but are usually found in depths of 100 m to 450 m (55 to 246 fm) and along submarine canyons and depressions (NOAA 1990). Throughout their range, POP are generally associated with gravel, rocky, or boulder type substrate (Ito 1986). Larvae and juveniles are pelagic; subadults and adults are benthopelagic (living and feeding on the bottom and in the water column). Adults form large schools 30 m wide, to 80 m deep, and as much as 1,300 m long (NOAA 1990). They also form spawning schools (Gunderson 1971). Juvenile POP form ball-shaped schools near the surface or hide in rocks (NOAA 1990).

POP was formally declared overfished in March 3, 1999, but had been managed as a depleted stock prior to being declared overfished. From 1965 to 1998, POP recruitment was relatively stable and showed recruits per spawning output as an increasing trend over time. However, when compared with the 1950s and 1960s, POP recruitment has been rather poor in recent years, although the 1999 and 2000 year classes (2002 and 2003 recruitment years) appear to be the largest since the early 1970s. A new stock assessment was prepared for POP in 2005 that updates the stock assessment from 2003 for the U.S. waters north of 43° N. lat. Like the 2003 stock assessment, the 2005 stock assessment did not show an obvious increasing trend in recruits per spawning output, nor are the recruitments completely stable. The updated stock assessment estimated the stock to be at 23.4 percent of its unfished biomass in 2005. Despite this, the low exploitation rate (1 percent) since 2000, has allowed the stock to rebuild slowly. Since that time, the POP stock has increased from 20.9 percent of the unfished biomass to 23.4 percent.

In the past five years, the POP catch in the Pacific whiting shore-based fishery has ranged from a low of 0.15 mt in 2006 to a high of 0.40 mt in 2004 (Table 3). Like darkblotched rockfish, POP is a shelf species that is found in deeper waters and is more commonly seen as incidental catch in the at-sea sectors of the Pacific whiting fishery. The mothership sector range of POP bycatch ranged from 0.11 mt (2003) to 2.17 mt (2002) (Table 4). The catcher/processor sector saw a high of POP bycatch in 2003 (5.04 mt, catch rate of 0.0001) and less than one mt in recent years (Table 5).

Yelloweye Rockfish
Yelloweye rockfish range from the Aleutian Islands, Alaska, to northern Baja California, Mexico, and are common from Central California northward to the Gulf of Alaska (Eschmeyer, et al. 1983; Hart 1988; Love 1991; Miller and Lea 1972; O'Connell and Funk 1986). Yelloweye rockfish occur in water from 25 m (14 fm) to 550 m (301 fm) deep with 95 percent of survey catches occurring in waters between 50 m (27 fm) and 400 m (219 fm) (Allen and Smith 1988). Yelloweye rockfish are bottom dwelling, generally solitary, rocky reef fish, found either on or just over reefs (Eschmeyer, et al. 1983; Love 1991; Miller and Lea 1972; O'Connell and Funk 1986). Boulder areas in waters deeper than180 m(98 fm), are the most densely populated habitat type for adult yelloweye rockfish. Juveniles prefer shallow-zone broken-rock habitat (O'Connell and Carlile 1993). Yelloweye rockfish also occur around steep cliffs and offshore pinnacles (Rosenthal, et al. 1982).

Yelloweye rockfish was declared overfished on January 11, 2002. In March 2006, a new stock assessment was prepared for yelloweye rockfish. The results of the coastwide stock assessment estimated that yelloweye rockfish is at 17.7 percent of its unfished biomass coastwide in 2006 and projected that the stock is lagging behind the original rebuilding schedule.

In the past five years, the yelloweye rockfish catch in the Pacific whiting shore-based fishery has ranged from a low of 0 mt in 2002 and 2003 to a high of 0.06 mt in 2006 (Table 3). Yelloweye rockfish is encountered even more infrequently in the at-sea sector, from a low of 0 mt in 2002 to 2005 to a high of 0.03 mt in 2006 (Tables 4-5). Because yelloweye rockfish is less vulnerable to trawl gear than the fixed gears, it is not commonly seen as incidental catch.

Bocaccio

Bocaccio is a common rockfish occurring in coastal waters of the northeastern Pacific from Krozoff and Kodiak Islands in the Gulf of Alaska to central Baja California, Mexico (Hart 1988; Miller and Lea 1972). Historically, bocaccio are most abundant in waters off central and southern California. The population is considered to be two stocks, northern and southern, which are separated by an area of scarcity off northern California and southern Oregon (Macall and He 2002). The northern stock of bocaccio, which is taken in the Pacific whiting fishery, has not been assessed nor has the northern stock been declared overfished like the southern stock. In the past five years, the bocaccio catch in the Pacific whiting fishery for all sectors has remained below 0.5 mt (Tables 3-5).

3.2.4 Non-groundfish Species (state managed or under other FMPs)

Non-groundfish species are also encountered in the Pacific whiting fishery. Species managed under the Coastal Pelagic Species Fishery Management Plan were incidentally taken in the Pacific whiting shore-based fishery between 2000 and 2006, including jack mackerel (*Trachurus symmetricus*), Pacific/chub mackerel (*Scomber japonicus*), and squid. Jack mackerel, Pacific/chub mackerel and Pacific sardine were taken in the at-sea fishery between 2000 and 2006. Like Pacific whiting, mackerel are schooling species that are not associated with the ocean bottom, and that migrate in coastal waters. Historical catches of chub and Jack mackerel in the shore-based and at-sea fisheries are presented in Tables 7 and 8. In addition, walleye pollock (*Theragra chalcogramma*), American shad (*Alosa sapidissima*) and miscellaneous species in smaller numbers including squid, sardine, shark, Pacific cod, flatfish (other than halibut), skates, octopus, sunfish and jellyfish were observed in both the at-sea and shore-based fishery between 2001 and 2006.

Table 7. Landings of Chub and Jack Mackerel in the Shore-based Whiting Fishery, 1994-2006.

YEAR	CHUB MACKEREL (MT)	JACK MACKEREL (MT)	Grand Total
1994	223.28	185.37	408.66
1995	189.34	103.70	293.04
1996	52.31	233.68	285.99
1997	1606.67	372.08	1978.75
1998	534.70	724.55	1259.25
1999	258.17	545.00	803.18
2000	86.01	162.77	248.78
2001	269.22	210.71	479.93
2002	0.01	7.11	7.12
2003	1.70	70.43	72.13
2004	0.79	108.22	109.01
2005	1.39	77.03	78.41
2006	0.05	5.67	5.72
Grand Total	3223.67	2806.30	6029.97

Table 8. Landings of Chub and Jack Mackerel for At-Sea Processing Vessels 1998-2006.

YEAR	CHUB MACKEREL (MT)	JACK MACKEREL (MT)	Grand Total
1998	458.78	229.14	687.92
1999	1.47	53.84	55.31
2000	15.52	52.96	68.48
2001	47.29	107.43	154.72
2002	0.04	6.85	6.89
2003	0.00	12.38	12.38
2004	0.00	58.07	58.07
2005	0.03	4.44	4.47
2006	3.80	10.46	14.26
Grand Total	526.93	535.57	1062.5

3.2.5 Protected Species

Marine species listed as endangered or threatened under the ESA include marine mammals, seabirds, sea turtles, and salmon. Because several Chinook salmon runs are listed under the ESA, the incidental catch of Chinook salmon in the Pacific whiting fishery is a concern. Chinook is the salmon species most likely to be affected by the groundfish fishery because of the spatial/temporal overlap between the Pacific whiting fishery and the distribution of Chinook salmon such that it could result in incidental take of listed salmon. On an annual basis there is some temporal and spatial variation in bycatch that can be accounted for by the behavior and biology of Chinook salmon and Pacific whiting. Bycatch rates tend to be higher closer to shore and earlier in the season (PFMC and NMFS, 2006). A summary of total salmon bycatch in the Pacific whiting fishery, from 1994-2006 is provided in Table 9. Chinook salmon by sector is provided, from 1994-2006 is provided in Table 10.

Table 9. Salmon Bycatch in the Pacific Whiting Fisheries For All Sectors, 1994-2006

Year	Whiting (mt)	Chinook (no)	Chinook rate (no/mt whiting)	Coho (no)	Coho rate (no/mt whiting)	Pink (no)	Pink rate (no/mt whiting)	Chum (no)	Sockeye (no)	Steelhead (no)	Inident	Total Salmon (no)	Total Salmon (rate)
1994	179,073	3,626	0.020	65	0.000	32	0.000	214	0	0		4,335	0.025
1995	102,159	11,579	0.113	1,379	0.014	1,575	0.016	181	6	0		15,249	0.150
1996	127,774	3,152	0.025	64	0.001	0	0.000	178	0	0		1,918	0.015
1997	146,012	3,922	0.027	348	0.002	497	0.003	114	0	0		5,373	0.037
1998	144,961	3,562	0.025	114	0.001	4	0.000	30	0	0		3,681	0.025
1999	141,103	8,888	0.063	117	0.001	496	0.004	465	0	0		9964	0.071
2000	120,906	8,207	0.068	75	0.001	18	0.000	18	2	0	18	8,293	0.073
2001	100,531	3,527	0.035	103	0.001	0	0.000	55	3	0	312	4,000	0.040
2002	84,728	2,697	0.031	169	0.002	0	0.000	76	0	0	4	2,946	0.035
2003	86,610	6,093	0.070	186	0.002	3,774	0.044	20	0	0	192	10,265	0.119
2004	120,590	4,495	0.037	208	0.002	0	0.000	66	0	0	9	4,778	0.040
2005	150,880	7,822	0.052	430	0.003	431	0.003	22	0	0	8	8,713	0.058
2006	134,219	1,192	0.009	28	0.000	0	0.000	87	0	0	0	1,307	0.010

Table 10. Chinook Salmon Bycatch in the Pacific Whiting Fisheries For All Sectors and the Tribal Fisheries 1994-2006

	1995*	1996*	1997*	1998	1999	2000	2001	2002	2003	2004	2005	2006
MOTHERSHIP												
CHINOOK (number of fish)	8487	795	845	966	1687	4421	1721	709	2078	417	2206	1080
WHITING (mt)	40588	44416	50402	50087	47580	46840	35823	26593	26021	24102	48571	55355
RATE: (# chinook/mt whiting)	0.2091	0.0179	0.0168	0.0193	0.0355	0.0944	0.048	0.2269	0.0798	0.0173	0.045	0.01951
CATCHER/PROCESSOR												
CHINOOK (number of fish)	3092	650	553	511	2704	1839	847	970	570	388	1754	112
WHITING (mt)	61571	68359	70771	70365	67679	67815	58628	36341	41214	73175	78890	78864
RATE: (# chinook/mt whiting)	0.0502	0.0095	0.0078	0.0073	0.04	0.0271	0.0144	0.0265	0.0138	0.0053	0.0222	0.00142
TOTAL NONTRIBAL ATSEA												
CHINOOK (number of fish)	11579	1445	1398	1477	4391	6260	2568	1679	2648	805	3960	1192
WHITING (mt)	102159	112775	121173	120452	115259	114655	94451	62934	67235	97277	127461	134219
RATE: (# chinook/mt whiting)	0.1133	0.0128	0.0115	0.0123	0.0381	0.0546	0.0272	0.0267	0.0394	0.0083	0.0311	0.008881
TRIBAL (MOTHERSHIP)												
CHINOOK (number of fish)	na	1707	2524	2085	4497	1947	959	1018	3430	3690	3862	652
WHITING (mt)	na	14999	24839	24509	25844	6251	6080	21793	19375	23313	23419	5545
RATE: (# chinook/mt whiting)	na	0.1138	0.1016	0.0851	0.174	0.3115	0.1577	0.0467	0.177	0.1583	0.1649	0.117583
TOTAL OF ALL ATSEA												
CHINOOK (number of fish)	11579	3152	3922	3562	8888	8207	3527	2697	6078	4495	7822	1844
WHITING (mt)	102159	127774	146012	144961	141103	120906	100531	84727	86610	120590	150880	139764
RATE: (# chinook/mt whiting)	0.1133	0.0247	0.0269	0.0246	0.063	0.0679	0.0351	0.0318	0.0701	0.0373	0.0518	0.013194
TRIBAL SHORE-BASED												
CHINOOK (number of fish)	na	na	na	na	na	na	na	na	9	50	76	1271
WHITING (mt)	na	na	na	na	na	na	na	na	4079	5335	10938	29896
RATE: (# chinook/mt whiting)	na	na	na	na	na	na	na	na	0.0021	0.0094	0.0069	0.042514
SHORE-BASED												
CHINOOK (number of fish)	2954	651	1482	1699	1696	3306	2627	1062	425	4206	4018	839
WHITING (mt)	73397	84680	87499	87627	83388	85563	73326	45276	51061	89670	97378	96619
RATE: (# chinook/mt whiting)	0.0402	0.0077	0.0169	0.0194	0.0203	0.0386	0.0358	0.0235	0.0083	0.0469	0.0413	0.008684

	1995*	1996*	1997*	1998	1999	2000	2001	2002	2003	2004	2005	2006
TOTAL ALL FISHERIES												
CHINOOK (number of fish)	14533	3803	5404	5261	10584	11513	6154	3759	6512	8751	11916	3954
WHITING (mt)	175556	212454	233511	232588	224453	206471	173857	130003	141885	215176	259196	266279
RATE: (# chinook/mt whiting)	0.0828	0.0179	0.0231	0.0226	0.0472	0.0558	0.0354	0.0289	0.0459	0.0409	0.046	0.014849

* NOTE: 1991-1997 is based final inseason data files and may vary from estimates derived from NORPAC data. Shore-based data updated from Nottage and Parker 2005.

2002 shore-based landings does not include 432 mt of whiting or salmon taken in trip limit fishery

2003 shore-based landings does not include 195 mt of whiting or salmon taken in trip limit fishery

2004 shore-based landings does not include 1,644 mt of whiting or salmon taken in trip limit fishery - first year of video monitoring at-sea

2005 shore-based landings does not include 310 mt of whiting or salmon taken in trip limit fishery

2006 does not include 678 mt of whiting that was sorted at sea or associated salmon take

For further information on salmon bycatch as it applied to the entire Pacific whiting fishery, readers are referred to Section 5.1.1 of the EIS for the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery. It is available from the Pacific Management Council at 7700 NE Ambassador Place, Suite 200, Portland, OR 97220-1384; by calling 503-820-2280; or online at http://www.pcouncil.org.

Infrequent encounters with marine mammals have also been documented in the Pacific whiting shore-based fishery. The Pacific Coast groundfish fisheries are considered to have a remote likelihood of, or no known serious injuries or mortalities, to marine mammals.

The biological environment and its relation to the Pacific whiting shore-based fishery were fully described in the April 2007 EA titled "Catch Accounting Requirements for Pacific Whiting Shore-based Processors/First Receivers Participating in the Shore-based fishery" and are not duplicated in this EA. For further biological information including information on the status of the groundfish resources, readers are referred to Section 4.0 of the EIS, prepared for the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery. Copies of the EIS can be obtained from the Council, by writing to 7700 NE Ambassador Place, Suite 200, Portland, OR 97220-1384; or calling 503-820-2280; or viewing the internet posting at http://www.pcouncil.org. Appendix B2 to the final EFH EIS titled: The Pacific Coast Groundfish Fishery Management Plan, EFH Designation and Minimization of Adverse Impacts, also contains detailed information on the life histories of the groundfish species. A copy of the EFH EIS can be obtained by contacting the Sustainable Fisheries Division, Northwest Region, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115–0070; or viewing the internet posting at www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/NEPA-Documents/index.cfm.

3.3 Socioeconomic Characteristics of the Affected Environment

3.3.1 Management Structure of the Pacific Whiting Fishery- Past, Present and Reasonably Foreseeable Future

The Pacific groundfish limited entry program was implemented in 1994. Vessels that did not initially qualify for a permit had to buy or lease one from qualifying vessels to gain access to the fishery. To harvest whiting, all at-sea catcher/processors had to purchase permits. This changed the composition of the at-sea processing fleet considerably, increasing the number of motherships, because permits are not required for vessels that only process fish (PFMC 1998).

Regulations at 50 CFR 660.323(a)(4) divide the commercial OY into separate allocations for the non-tribal catcher/processor, mothership, and shore-based sectors of the Pacific whiting fishery. The catcher/processor sector is comprised of vessels that harvest and process Pacific whiting. The mothership sector is comprised of catcher vessels that harvest Pacific whiting for delivery to mothership processors. Motherships are vessels that process but do not harvest Pacific whiting. The shore-based sector is comprised of vessels that harvest Pacific whiting for delivery to shore-based processors. Each sector receives a portion of the commercial OY, with the catcher/processors getting 34 percent, motherships getting 24 percent, and the shore-based sector getting 42 percent. Prior to the formal three-sector whiting allocation of 1997 (62 FR 27519, May 19, 1997,) 60 percent of the OY was available in open competition between the shore-based and at-sea sectors and the remaining 40 percent was reserved for the shore-based fishery.

Since May 1997, when the U. S. Department of Justice approved allocation of whiting shares among the members of a cooperative, the catcher/processor fishery has operated as a voluntary quota share program where each of the catcher/processor companies has agreed to take a specific share of the harvest. The cooperative arrangement is named the Pacific Whiting Conservation Cooperative (PWCC). The PWCC is comprised of four member companies that operate 10 catcher/processor vessels licensed to participate in the U.S. West Coast Pacific whiting fishery. Since formation of the PWCC, only 6 or 7 of the 10 eligible catcher/processor vessels have participated in the fishery, providing a significant reduction in fishing effort. The PWCC members share real-time information among themselves on vessel bycatch experiences and sponsor scientific research that benefits the West Coast groundfish fishery.

The Pacific whiting fishery is managed under a "primary" season structure where vessels harvest Pacific whiting until the sector allocation is reached and the fishery is closed. This is different from most West Coast groundfish fisheries, which are managed under a "trip limit" structure, where catch limits are specified by gear type and species (or species group) and vessels can land catch up to the specified limits. Incidental catch of other groundfish species in the Pacific whiting fishery, however, is managed under the trip limit structure.

Since 2004, the Council has adopted the ABC/OY of Pacific whiting relative to bycatch projections, in order to promote harvesting of the whiting OY relative to overfished species constraints. Bycatch projections for the non-whiting groundfish fishery are considered first and then bycatch limits for the whiting fishery are proposed based on the projections. To allow the Pacific whiting industry to have the opportunity to harvest the full Pacific whiting OY, the non-tribal commercial fishery is managed with bycatch limits for certain overfished species. To date, bycatch limits have been established for darkblotched, canary, and widow rockfish.

Regulations provide for the automatic closure of the commercial (non-tribal) portion of the Pacific whiting fishery, upon attainment of a bycatch limit. This is different from the bottom trawl fishery where harvest availability of target species is often constrained by the projected catch of overfished species. Under bycatch management for the Pacific whiting fishery, each sector of the fishery remains open for fishing until its sector allocation is reached. However, the entire non-tribal commercial fishery could be closed before the sector allocations are attained if one of the overfished species bycatch limits were reached.

Bycatch projections for the 2007 whiting season were developed using the weighted average approach, similar to the approach used in 2004, 2005, and 2006 to predict mortality of canary, darkblotched, POP, and yelloweye rockfish. The methodology for projecting bycatch for widow rockfish was different as widow rockfish which shows an increasing trend as a result of rebuilding success. Widow projections for 2007 were based on a linear interpolation of the bycatch rate from 2004-2006. Projections for canary, darkblotched, and widow rockfish are used to create the bycatch limits.

A confounding issue for the whiting fishery is what has become known as the rebuilding paradox. As an overfished stock increases in abundance, it becomes more likely some of those fish will be caught, unless fishing effort is reduced. Depending on the particular rebuilding strategies, this could lead to even greater management restrictions in the future.

Management of the salmon and groundfish fisheries has also changed substantially since the early 1990's. Since 1992, new salmon evolutionarily significant units (ESUs) have been listed under the ESA, and several groundfish species that are incidentally taken in the Pacific whiting fishery have been declared overfished. These changes have affected management of the Pacific whiting fishery and were summarized previously in this chapter.

The Council's recently-recommended shore-based whiting full retention and monitoring program would, among other things, establish whiting vessel certifications. The alternative actions proposed under Amendment 15 may restrict vessel eligibility for whiting certifications.

3.3.2 Fishery Harvests and Values

Figures 1 to 3 show annual trends in Pacific whiting harvests, ex-vessel revenues and ex-vessel prices per ton. (Note that for purposes of determining industry revenues, mothership and catcher/processor harvests have been multiplied by whiting shore-based ex-vessel prices) These figures show the recent increase in landings, revenues and ex-vessel prices. As discussed previously, in 2005 and 2006 market conditions for Pacific whiting changed dramatically with prices paid to fishermen increasing from an average price of $0.04 per pound ($88 per ton) in the 1992-2005 period to more than $ 0.062 per pound ($143 per ton) in 2006. Industry projections for 2007 were for prices to increase to $.08 to $.10 per pound ($176 to $220 per ton). Preliminary information for Oregon shore-based landings of whiting indicates an increase from $0.07 in 2006 to $0.08 in 2007, excluding zero or minimal prices for "weighbacks" or fish not in useable or marketable condition (unpublished data Oregon Department of Fish and Wildlife, July 26, 2007).

There is some information indicating at-sea ex-vessel prices are about 15 percent lower than prices for shore-based deliveries (Personal communication with Shannon Davis, The Research Group, August 2007). According to Davis, each catcher vessel has its own contract with a mothership, so there are some differences among contracts. The intuitive reason why at-sea prices may be lower is that costs are lower per delivery, because vessels delivering to motherships and catcher/processors don't have to run to shore between deliveries. Additional research is needed to more precisely identify the price differences between shore-based and at-sea deliveries, and among at-sea deliveries.

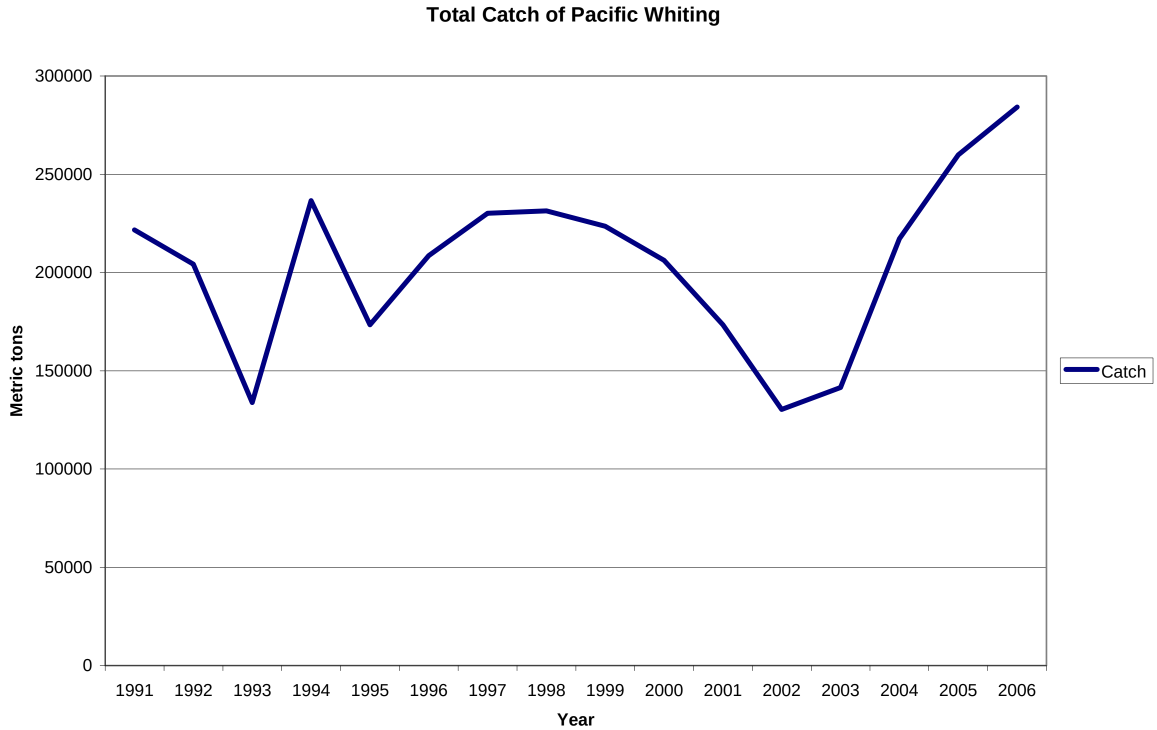


Figure 1. Total catch (mt) of whiting, 1991 - 2006

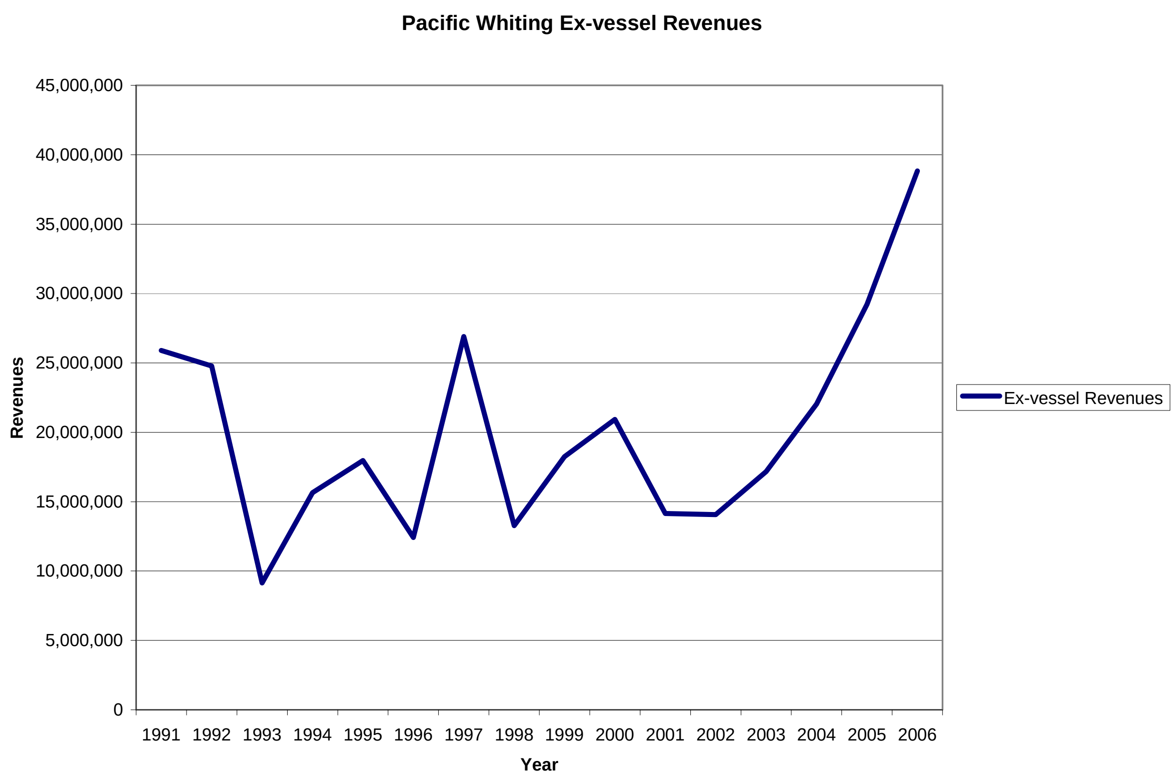


Figure 2. Total ex-vessel revenue from whiting 1991-2006

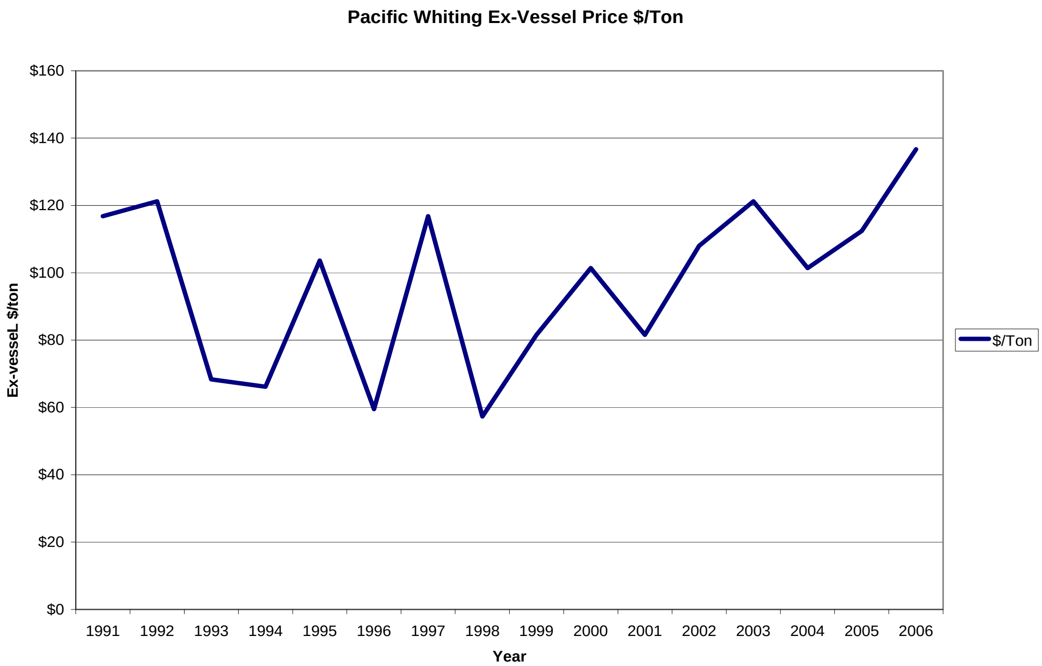


Figure 3. Ex-vessel price per ton for whiting, 1991-2006

3.3.3 Characteristics of Vessels in the Pacific Whiting Fishery

There are two classes of vessels in the at-sea processing sector of the whiting fishery, catcher/processors that harvest and process their own catch, and mothership vessels that process unsorted catch received from smaller catcher vessels. The processing vessels are greater than 250 feet in length, and carry crews of 65-200 people, who mostly work in shifts to keep the factories operating day and night. Some of the processing vessels operate in the Alaskan pollock fisheries, but move south to the Washington, Oregon, California area to fish for whiting between pollock seasons.

Table 11 shows the trends in the number of vessels participating by sector. These trends show changes in the number of catcher/processors, motherships, and mothership catcher vessels participating in the fishery.

Table 11. Number of vessels in the at-sea sector, 1997-2006

Year	Catcher/processors	Motherships	Mothership-Catcher Vessels
1994	9[1]	9[1]	43
1995	9	6	36
1996	10[2]	8[2]	28
1997	10	6	27
1998	7	6	24
1999	6	6	24
2000	8	6	23
2001	7	5	20
2002	5	4	11
2003	6	4	12
2004	6	4	10
2005	6	5	18
2006	9	6	20

[1] In 1994, one vessel participated in both the catcher/processor sector and the mothership sector.
[2] In 1996, two vessels participated in both the catcher/processor sector and the mothership sector.

Table 12 shows the at-sea fishing dates, allocations and landings for 1994 – 2006.

Table 12. Pacific Whiting At-Sea Fishery Allocations, Landings and Fishing Dates 1994-2006

		ALLOCATION		LANDINGS	
Year	Fishing Dates	Catcher-Processor (mt)	Mothership (mt)	Catcher-Processor (mt)	Mothership (mt)
1994	4/15-5/13	60% of harvest guideline (156,000 mt) shared with shore-based in open competition.		87,147	91,926
1995	4/15-5/4	60% of harvest guideline (107,000) shared with shore-based open competition.		61,571	40,588
1996	5/15-6/1	60% of harvest guideline (118,200 mt) shared with shore-based open competition.		63,359	44,416
1997	5/15-6/1 MS 5/15-6/11 CP	70,400	49,700	70,771	50,401
1998	5/15-5/31 MS 5/15-8/7 CP	70,400	49,700	70,365	50,087
1999	5/15-6/2 MS 5/15-6/21 CP	67,800	47,900	67,679	47,580
2000	5/15-6/9 MS 5/15-11/6 CP	67,830	47,880	67,815	46,840
2001	5/15 – 12/31 MS 5/15 – 11/13 CP	58,786	41,496	58,628	41,903
2002	5/15 -6/6 MS 5/15 -10/16 CP	36,353	25,661	36,341	26,593
2003	5/15 – 12/31 MS 5/15 – 10/24 CP	41,208	29,088	41,214	26,021
2004	5/15-10/1 MS 5/15- 11/11 CP	73,270	51,720	73,175	24,102
2005	5/15 – 12/31 MS 5/15-10/18 CP	78,903	55,696	78,147	39,599
2006	5/15-09/29 MS 5/15-11/3 CP	78,903	55,696	78,864	55,355

Table 13 shows the annual shore-based allocation and season dates from 2000 to 2006. During this period the duration of the season has varied from 93 days in 2000 with a moderately high allocation to 30 day in 2003 when the allocation was at one of its lowest points.

Table 13. Pacific Whiting Shore-based Fishery Allocations and Season Dates, 1994-2006

Year	Coastwide Allocation (mt)	Length of Primary Season & Season dates	Early Season Allocation (mt)	Early Season Allocation Reached	Reapport-ioned (mt)
1994	97,000	261 (4/15-12/31)	4,850	No	No
1995	75,776	101 (4/15-7/24)	3,789	No	No
1996	87,001	119 (5/15-9/10)	4,350	No	No
1997	86,900	69 (6/15-8/22)	4,345	Yes (5/27)	No
1998	86,900	121 (6/15-10/13)	4,345	No	No
1999	83,800	91 (6/15-9/13)	4,190	No	No
2000	83,790	93 days (6/15-9/15)	4,190	Yes (6/8)	No
2001	68,418	78 days (6/15-8/21 9/17-9/26)	3,421	No	4,200
2002	44,906	33 days (6/15-7/17)	2,245	No	No
2003	50,904	30 days (6/15-7/14)	2,545	No	No
2004	90,510	61 days (6/15-8/14)	4,526	Yes (5/22)	No
2005	79,469	65 days (6/15-8/18)	4,873	No	No
2006	97,469	49 days (6/15-8/2)	4,873	Yes (5/25)	No

Table 14 shows the recent history of landings, ex-vessel revenues (harvester revenues) and ex-vessel prices for the shorebased whiting fishery.

Table 14. Landings, ex-vessel revenues and ex-vessel prices for the shorebased fishery

Year	Ex-vessel Revenue (millions $)	Percent Change	Landings mt	Landings millions of lbs	Percent Change	Ex-vessel price ($)	Ex-vessel price percent change
2000	8.0		88,842	195.86		0.041	
2001	5.7	-28%	73,411	161.84	-17%	0.035	-13%
2002	4.6	-21%	45,707	100.77	-38%	0.045	27%
2003	5.5	21%	55,333	121.99	-21%	0.045	0%
2004	7.7	40%	96,364	212.44	74%	0.036	-2-%
2005	12.6	64%	109,395	241.17	14%	0.052	44%
2006	17.4	38%	127,167	280.35	16%	0.062	19%

The value of the shore-based sector to the communities in which whiting processing has become an important part of the local economic structure, in some respects replaces or mitigates for lost processing capacity that resulted from cutbacks in other groundfish fishery sectors. A concern is that, with additional entrants, the duration of the fishing season will be further shortened. The shorter the season, the less employment benefit and the less the whiting fishery can mitigate for or replace other lost groundfish fishery activities. Table 15 presents a summary of operational data for the shore-based fishery for 1994 - 2006.

Table 15. Operational Data on Shore-based Whiting Fishery 1994-2006

Year	Start Date	End Date	Duration (days)	# Vessels	# Processors
1994	4/15	12/31	261	33	14
1995	4/15	7/24	101	37	13
1996	5/15	9/10	119	37	13
1997	6/15	8/22	69	41	12
1998	6/15	10/13	121	36	12
1999	6/15	9/13	91	39	14
2000	6/15	9/15	93	36	14
2001[1]	6/15	9/26[1]	78	29	13
2002	6/15	7/17	33	30	8
2003	6/15	7/14	30	33	9
2004	6/15	8/14	61	26	9
2005	6/15	8/18	65	29	10
2006	6/15	8/2	49	37	14

[1]In 2001, the fishery closed on 8/21/01. The Makah tribe then returned 10,000 mt of its allocation to NMFS, which reallocated it to the other fishery sectors. The shore-based component then re-opened from 9/17/01 – 9/26/01.

The short seasons in 2002 and 2003 reflect the low OYs for the U.S. in those years. As the stock improved and as the OY increased, the season duration lengthened as well. However, in 2006, notwithstanding the more favorable allocation to the shore-based fishery, the season was only 49 days, compared to 65 days in 2005. The increase in the number of vessels participating from 29 in 2005 to 37 in 2006, contributed to the shorter season.

The data reported below are based on PacFIN, Shorebased Hake Observation Program (SHOP) and NWR Federal Permits Office data. There are a few discrepancies between these data systems that still need to be explored. These discrepancies mainly affect the counts of vessels in particular years. Two non-AFA vessels were eliminated because they had relatively minor landings compared to the other vessels while one vessel reported by the SHOP in the early years does not show up in the PacFIN fish ticket system. One AFA vessel only had 10,000 pounds of landing in one year and so it was considered a non-participant in that year.

As a result of increases in the commercial OY since 2003 and changes in the market, shorebased landings and revenues have increased per year, as have the number of vessels participating in the fishery. On land, prices have increased dramatically in recent years but so have fuel prices as shown in Table 16.

Table 16. Shorebased Fishery Landings, Revenues, Ex-vessel price, and other data for 2002 - 2006

Year	Landings Million lbs	Revenues Million $	Ex-Vessel Price $/lb	Fuel Price $/gallon	Number Vessels	Revenue/Vessel $1,000
2002	101	4.5	0.045	0.94	28	161
2003	113	5.1	0.046	1.23	31	166
2004	198	6.9	0.035	1.69	25	266
2005	215	11.3	0.053	2.00	29	389
2006	213	13.3	0.060	2.52	35	380

Using 2002 as the baseline, over the years there have been vessels entering and exiting the fishery and these vessels have been from both the AFA and non-AFA fleets. A large percentage of AFA-permitted vessels that fish whiting are associated with mothership operations. The non-AFA fleet was significantly affected by the buyback program, since four of the seven vessels that exited the fishery after the 2003 season were buyback vessels. Because of the high quotas and revenues in the 2005 and 2006 seasons, there were no exits in either fleet -- only entrants. Table 17 shows entry and exit patterns for the period 2002 – 2006.

Table 17. Entry and Exit Patterns in the Shorebased Fisheries, 2002 – 2006

Comparison Years	Total Entrants	Total Departures	AFA Entrants	AFA Departures	Non-AFA Entrants	Non-AFA Departures
2003-2002	6	3	2	0	4	3
2004-2003	4	9	0	2	4	7
2005-2004	3	0	2	0	1	0
2006-2005	6	0	3	0	3	0

During the period 2002-2006, 15 different AFA-permitted vessels participated in shorebased whiting fisheries -- 14 of these vessels fished under Pacific Groundfish permits prior to 1999, and the remaining AFA vessel first entered the Pacific groundfish fishery in 2006.

Data indicates that AFA-permitted vessels have higher per vessel revenues and landings than non-AFA vessels. Although both the AFA and non-AFA fleets expanded by 3 vessels in 2006, the larger capacity of the AFA-permitted vessels took a greater proportion of the shore-based allocation in 2006 than in 2005. In 2005, AFA-permitted vessels landed 51 percent of the shore-based allocation and 58 percent in 2006. Despite the increase in ex-vessel prices, the average non-AFA revenues fell in 2006 compared to 2005. The following tables show the details, first for the combined set of vessels (Table 18), and then for the separated AFA and non-AFA vessels (Table 19).

Table 18. Number, landings and revenues for AFA and non-AFA vessels combined 2002 – 2006

Year	Number of Vessels	Landings per Vessel Million lbs	Revenues per Vessel ($1,000)
2002	28	3.6	161
2003	31	3.7	167
2004	26	7.6	262
2005	29	7.4	391
2006	35	6.1	373

Table 19. Number, landings and revenues for AFA and non-AFA vessels, 2002 – 2006

Year	Number AFA Vessels	Number Non-AFA Vessels	% of Landings AFA	AFA Landings per vessel Million lbs	Non-AFA Landings per vessel Million lbs	AFA Revenues per Vessel ($1,000)	Non-AFA Revenues per Vessel ($1,000)
2002	10	18	43	4.4	3.2	196	142
2003	12	19	47	4.4	3.2	200	146
2004	10	16	49	9.6	6.3	336	216
2005	12	17	51	9.2	6.2	482	327
2006	15	20	58	8.2	4.5	510	271

Table 20 shows the bycatch of overfished rockfish by whiting sector for the period 2003 – 2006.

Table 20. Bycatch limit species, in metric tons, by whiting sector 2003 - 2006

Species	Year	CP (mt)	Mothership (mt)	Shore-based (mt)	Total (mt)
Canary	2003	0.2	0.1	0.1	0.4
	2004	0.5	4.1	0.8	5.4
	2005	0.3	0.7	2.2	3.2
	2006	0.1	0.9	1.6	2.6
Darkblotched	2003	4.2	0.1	0.3	4.6
	2004	4.4	3.0	0.7	8.1
	2005	5.9	5.1	5.3	16.4
	2006	6.7	4.2	2.3	13.2
POP	2003	5.0	0.1	0.3	5.4
	2004	1.0	0.1	0.8	1.8
	2005	0.8	0.9	0.5	2.2
	2006	0.7	1.9	0.0	2.7
Widow	2003	11.6	0.7	9.0	21.2
	2004	8.2	11.4	28.6	48.2
	2005	43.1	35.5	77.2	155.8
	2006	66.9	72.3	49.4	188.5

Vessels participating in the Pacific whiting shore-based fishery are required to have a general limited entry groundfish permit with a trawl endorsement. In 2007, there are approximately 176 limited entry permits with trawl endorsements. These permits may be available to new vessels wishing to participate in the Pacific whiting shore-based fishery, provided the vessel intending to join the fishery is able to find a trawl-endorsed permit that is also endorsed with a vessel length appropriate to the vessel in question (50 CFR 660.334(c).)

The number of catcher vessels participating in the Pacific whiting primary season fishery (EFP and non-EFP vessels) has varied somewhat over the past several years. Though most Pacific whiting shore-based vessels are less than 80 feet in length, the proportion of vessels less than 80 feet has decreased from 68 percent of the fleet in 2002 to 58 percent of the fleet in 2006. Table 21 shows the numbers of vessels by length group that participated in the Pacific whiting shore-based fishery between 2002 and 2006.

In addition to the Pacific whiting primary season, vessels participating in the Pacific whiting shore-based fishery also participate in other West Coast fisheries, specifically the bottom trawl groundfish fishery. Many Pacific whiting shore-based vessels also landed catch in the coastal pelagic and crab fisheries. Catch data shows that Pacific whiting shore-based vessels have landed catch in every other West Coast fishery management group; however revenues from the shrimp, salmon, and highly migratory fisheries may be considered minor compared to revenues from the general groundfish and crab fisheries.

Table 21 also shows the estimated revenues by fishery that vessels actively engaged in the EFP Pacific whiting shore-based fishery received from their participation in the Pacific whiting and other West Coast fisheries between 2002 and 2006. In addition to West Coast fisheries, several whiting vessels also participate in the Alaska groundfish fisheries. Revenues from participation in the Alaska fisheries are not shown here.

Table 21. Number of Active EFP Vessels and Exvessel Revenue by Year, Vessel Length Category, and Species Type, 2002-2006. (PacFIN January 2007)

Year	Vessel Length	No. of EFP Vessels	Pacific Whiting USD	Crab USD	Other Groundfish USD	Other Species USD	Shrimp/ Prawn USD
2002	<70	5	412,086	407,138	715,279	(D)	172,494
	70-74	5	914,620	91,871	397,033	(D)	160,585
	75-79	10	1,403,347	252,184	597,202	(D)	46,746
	80-84	4	770,883	389,005	421,834	2,932	-
	85-89	4	687,231	-	177,398	(D)	-
	>89	2	(D)	(D)	(D)	(D)	(D)
2002 Total		30	4,188,166	1,140,198	2,308,745	4,414	379,824
2003	<70	8	537,890	1,238,027	1,103,348	(D)	279,582
	70-74	4	931,816	237,971	545,605	(D)	98,839
	75-79	11	1,877,797	1,267,603	1,171,440	1,607	36,114
	80-84	3	595,391	794,243	236,531	(D)	-
	85-89	5	856,464	-	54,049	2,085	-
	>89	3	916,421	1,722,694	107,358	7,678	-
2003 Total		34	5,715,780	5,260,538	3,218,331	11,915	414,535
2004	<70	4	808,740	1,673,677	819,442	(D)	-
	70-74	6	2,055,228	726,841	1,640,110	3,835	-
	75-79	6	2,193,020	802,903	968,681	7,262	-
	80-84	4	1,681,745	454,976	840,124	19,092	(D)
	85-89	4	1,151,754	-	60,870	2,673	-
	>89	2	(D)	-	(D)	(D)	-
2004 Total		26	7,890,487	3,658,397	4,329,226	39,682	(D)
2005	<70	4	872,374	894,509	417,607	(D)	-
	70-74	6	2,447,081	189,484	1,389,033	59,131	158,797
	75-79	7	3,256,265	326,055	1,030,668	68,546	44,124
	80-84	4	2,392,754	476,212	426,068	7,538	-
	85-89	4	1,962,455	(D)	122,014	41,843	-
	>89	3	1,801,452	(D)	129,051	15,727	-
2005 Total		28	12,732,381	1,941,264	3,514,441	192,785	202,921
2006	<70	6	1,265,587	2,172,725	744,687	(D)	-
	70-74	7	2,131,813	604,605	1,170,100	(D)	21,632
	75-79	6	2,513,579	601,905	707,860	2,150	-
	80-84	4	1,325,662	699,112	92,375	7,400	-
	85-89	6	3,135,570	(D)	235,788	8,715	-
	>89	4	2,135,240	210,593	250,464	16,373	-
2006 Total		33	12,507,451	4,288,940	3,201,272	37,676	21,632

note: (D) indicates data concealed for disclosure/confidentiality purposes
totals may not reflect confidential cells
vessels with an unknown length were not included in this table

Average gross revenues per vessel have more than doubled since 2002. Gross revenues from Pacific whiting in 2002 were approximately $139,606 per vessel and have increased to $454,728 and $379,014 per vessel in 2005 and 2006 respectively (Table 22). During this same period, the ex-vessel price of Pacific whiting increased from approximately $0.045 per pound in 2002 to$0.062 per pound in 2006 as the demand for Pacific whiting has increased, particularly in the export market for headed and gutted product. With higher OYs in 2005 and 2006 than were available from 2002 to 2004, the average number of pound harvested by each vessel also increased from 2002 to 2006 (Table 23). Assuming that changes in gross revenues are an indicator of changes in net revenues, then the increased interest in participation in the Pacific whiting shore-based fishery in 2007 is likely due to increasing net revenues.

Table 22. Average Per Vessel Revenue of Pacific Whiting and Non-whiting, 2002-2006 (PacFIN January 2007)

Year	Whiting revenue per vessel ($)	Non-whiting revenue per vessel ($)
2002	139,606	127,773
2003	168,111	261,905
2004	303,480	308,480
2005	454,728	207,015
2006	379,014	228,773

Note: values in table are not all encompassing and protect confidentiality

Table 23. Pacific Whiting Shore-based Fishery, Number of Vessels by Weight of Whiting, 2002-2006 (PacFIN January 2007)

Year	Number of Vessels				
	< 2 million lb (907mt)	2-5 million lb (907-2,268 mt)	5-7 million lb (2,268-3,175 mt)	7-9 million lb (3,175-4,082 mt)	> 9 million lb (> 4,082 mt)
2002	7	19	4	1	
2003	7	26	4	1	
2004	3	6	7	7	9
2005	2	7	5	13	7
2006	5	7	8	8	5

In 2006, a shore-based vessel headed and gutted Pacific whiting at sea. The vessel uses a smaller net and tows of short duration to maintain quality. Head and gut machines were used at sea and the product was immediately placed in thick slurry of ice. As a result, the vessel was able to significantly increase its at-sea production of Pacific whiting in 2006. Because fish that are headed and gutted (i.e., leaving the tail on) with no further processing (such as freezing) are not considered to be a final product, the vessel's activities do not qualify as a catcher/processor. The operation which occurred during the primary season for the shore-based sector was allowed to operate within the RCAs without an EFP and electronic monitoring system (EMS). The ex-vessel price of the partially processed catch was approximately four times greater than the price for whiting landed whole in unsorted EFP landings, and approximately double the price when taking the weight conversion from dressed headoff form to round weight into account, i.e., when comparing prices on the basis of a common weight measure.

3.3.4 Processor Characteristics in the Pacific Whiting Fishery

This section presents information on processors, communities, and states where Pacific whiting is landed. Table 24 shows that the highest percentage of Pacific whiting landings occur in Oregon, followed by Washington, and then California. Since 2004, the proportion of overall Pacific whiting landings has decreased in Oregon. Communities receiving landings of Pacific whiting have historically included Westport and Ilwaco, Washington; Astoria, Newport, and Charleston, Oregon; and Eureka, and Crescent City, California.

Table 24. Pacific Whiting Shore-based Landings by State, 2001-2006

State	Year	Number of Landings	Pacific whiting catch (mt)	Percent of Pacific whiting by weight
Oregon	2000	838	68,701	80%
	2001	773	53,422	73%
	2002	454	32168	71%
	2003	514	36,594	71%
	2004	815	59,006	66%
	2005	826	61,460	63%
	2006	748	60,654	63%
California & Washington	2000	266	16,952	20%
	2001	257	19,904	27%
	2002	176	13,147	29%
	2003	186	14,602	29%
	2004	319	30,245	34%
	2005	356	35,918	37%
	2006	387	35,964	37%

Table 25 shows the number of Pacific whiting shore-based processors by state and year, and identifies the processing communities based on EFP data.

Table 25 Pacific Whiting Shore-based Processors and Processing Communities, 2000 – 2006

Year	Number of designated EFP processors	Processing communities
<u>2000</u>-all	**12**	Westport WA, Ilwaco WA, Astoria OR, Newport OR, Charleston OR, Crescent City CA, Eureka CA
Washington	2	
Oregon	7	
California	3	
<u>2001</u>-all	**12**	Westport WA, Ilwaco WA, Astoria OR, Newport OR, Charleston OR, Crescent City CA, Eureka CA
Washington	2	
Oregon	7	
California	3	
<u>2002</u>-all	**8**	Westport WA, Astoria OR, Newport OR, Charleston OR, Eureka CA
Washington	1	
Oregon	6	
California	1	
<u>2003</u>-all	**9**	Westport WA, Ilwaco WA, Astoria OR, Newport OR, Charleston OR, Eureka CA
Washington	2	
Oregon	6	
California	1	
<u>2004</u>-all	**9**	Westport WA, Ilwaco WA, Astoria OR, Newport OR, Charleston OR, Crescent City CA, Eureka CA
Washington	2	
Oregon	5	
California	2	
<u>2005</u>-all	**10**	Westport WA, Ilwaco WA, Warrenton OR, Newport OR, Charleston OR, Crescent City CA, Eureka CA, Moss Landing CA
Washington	2	
Oregon	5	
California	3	
<u>2006-all</u>	**12**	Westport WA, Ilwaco WA, Warrenton OR, Astoria, OR, Newport OR, Charleston OR, Crescent City CA, Eureka CA
Washington	2	
Oregon	8	
California	2	

There has been an increase in the number of shore-based processing facilities entering the whiting fishery whiting since a low in 2002 when the OY was restricted to allow for rebuilding. Based on the concept that a primary processor of Pacific whiting typically processes one million pounds (454 mt) or more, Table 26 shows the entry and exit trends in the Pacific whiting shore-based processing sector on a processor basis. Over the 2000-2006 period there were 17 different processors that processed at least one million pounds (454 mt) in any one year. However there were eight dominant processors who processed more than one million pounds (454 mt) in at least seven of the eight years during this period. Because of entry and exit of processors, the composition of the "other" processor group changes significantly in most years. In 2005, there were no "other" processors. In 2006, five new processors entered the fishery, only one of which had operated before beginning in 2004. The dominant processors typically process 90 to 100 percent of the Pacific whiting.

Table 27 shows the number of processors by state based on PacFIN data which includes tribal landings. In 2006, there were 23 processors that purchased Pacific whiting from fishermen with

10 of these processors purchasing from 4 pounds to 8,000 pounds (3.6 mt) of Pacific whiting. The other 13 processors all processed at least 1 million pounds of Pacific whiting each. During 2006 these 13 processors purchased 280 million pounds (127,000 mt) of whiting worth $17.4 million ex-vessel, and 110 million pounds (49,896 mt) of other fish and shellfish worth $78.5 million.

Table 26. Trends in Number of Processing Plants Consistently Processing Over One Million Pounds of Whiting Per Year, 2000 - 2006

Year	Number of Processors					
	Total	Major Processors	Others	Exit	Enter	Percent of total lbs processed by major processors
2000	12	8	4			75%
2001	10	8	2	2	0	91%
2002	9	8	1	1	0	90%
2003	9	8	1	0	0	90%
2004	9	8	1	1	1	97%
2005	8	8	0	1	1	100%
2006	13	8	5	0	5	92%

Table 27. Shore-based Trawl Landings of Groundfish and Exvessel Revenue, by State and Year, 2000 - 2005. (Pacfin, May 2006)

State		2000	2001	2002	2003	2004	2005
California	Non-whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	9,764 11,859	7,929 9,546	8,026 10,068	7,330 8,618	6,101 7,090	5,760 7,021
	Pacific whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	4,986 765	2,306 171	2,773 274	1,695 166	4,742 641	3,062 338
Oregon	Non-whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	15,952 17,974	12,152 14,687	8,410 10,150	10,499 12,897	10,245 11,833	10,786 12,441
	Pacific whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	68,702 6,081	53,376 4,132	32,305 3,219	36,581 3,642	59,075 4,641	61,463 7,107
Washington	Non-whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	5,593 4,601	4,896 4,319	8,370 4,189	4,258 3,598	3,481 3,148	3,315 3,191
	Pacific whiting Landed Weight (mt) Ex-vessel Revenue (1000's $)	12,156 1,122	17,730 1,439	10,630 1,061	12,934 1,283	25,838 1,993	32,291 3,848

Based on the Small Business Administration (SBA) criteria and a review of Pacific whiting shore-based processing company websites, state employment websites, newspaper articles, personal communications, and “The Research Group” (2006), it appears that the thirteen major Pacific whiting processors can be grouped into nine SBA businesses based on analysis of affiliates. Within these nine SBA businesses, there are three businesses that each generated at least $500 million in sales in 2003 (Seafood Business, May 2004, “Big Brands Head List of Top Suppliers”). One of these three companies reported employing 4,000 people. It is presumed that the other two companies have employment levels much higher than 500 employees. Four of the nine SBA businesses have employment level estimates that range from 100-250 employees, while the remaining two appear to be in the 50-100 employee range (due to missing data, one of these relatively small businesses may have less than 50 employees). In terms of the SBA size standard of 500 or fewer employees for small businesses, there are six “small” businesses that participated in the shorebased Pacific whiting processing sector in 2006.

Annual sales information for these “small” businesses is unavailable, but total ex-vessel revenues (i.e., the values of the fish purchased from fishermen) are available. In 2006, these six businesses purchased approximately $40 million in Pacific whiting and other fish and shellfish from West Coast fishermen. This compares to the $60 million in Pacific whiting and other fish and shellfish purchased by the three large businesses.

The entry and exit of processors can be associated with market trends and the size of the Pacific whiting quotas. Processor consolidation appears to have occurred during the 2002-2004 period. Declines in the Pacific whiting OY in 2002 and 2003 may have caused processors to close their operations, or to consolidate with other operations. However, the increases in OY since 2004 combined with greater market demand, appears to have increased processor interest.

3.3.5 Participation Requirements, Restrictions, Licensing

Participation requirements for harvesters and processors are described in detail in sections 3.3.3 and 3.3.4, respectively. Catcher vessels in the shore-based and mothership sectors and catcher/processors are required to have limited entry permits. Most catcher vessels in the shore-based sector have operated under EFPs since 1991. However, beginning in 2008 the shore-based fishery is expected to operate under federal regulation. The EFPs have routinely required vessels to deliver EFP catch to state designated processors. Like shore-based processors, no federal permits are required of motherships. Shore-based processors must have the appropriate state licenses. Under EFPs, designated shore-based processors have been identified by the states and have maintained signed agreements that specify the standards and procedures they agree to follow when accepting unsorted EFP catch.

In June 2007, the Council took final action under Amendment 10 to the FMP to adopt a maximized retention and monitoring program Pacific whiting shore-based fishery. The Council’s preferred alternative contemplates a maximized retention fishery, where most catch in the shore-based whiting trawl fishery, including that for prohibited species, is to be retained and delivered to shore-based plants. At-sea monitoring to ensure full catch retention would be accomplished using federal- or industry-funded EMS. In addition to a limited entry permit with a trawl endorsement, vessels participating in future shore-based whiting fisheries would need to apply for and obtain an annual whiting endorsement, which will serve as a declaration to participate. EMS providers would also need a NMFS permit to ensure that the equipment and services meet NMFS standards. As with the 2007 EFP, the Council recommended that the vessels continue to pay 100% of the EMS equipment costs while NMFS will continue to provide funding for data analysis and reports. Data quality monitors would be stationed at the processing facility to ensure that the catch is sorted and weighed according to federally-defined standards. Data quality catch monitors will be third-party employees trained to NMFS specifications who would be responsible for observing all unsorted Pacific whiting catch delivered to shore-based plants, verifying fish ticket weights, collecting biological data, and collecting data necessary to determine species composition. In addition, each state may choose to continue using industry samplers or port biologists to meet state biological data collection goals. As is current practice under state law, the Council recommended all catch in excess of limited entry trawl cumulative limits (overages) be reported on state fish tickets and abandoned by the vessel to the state of landing. Each state would continue to be responsible for donating the prohibited species, receiving the value of the processed overage catch, and tracking compliance.

Under the alternative actions, NMFS would maintain a list of vessels eligible to participate in the whiting fishery. Implementing regulations would specify the application procedures.

3.3.6 Market Trends in the Pacific Whiting Fishery

During the 2000-2006 period, there has also been a shift in the major products being produced. When looking at estimates of wholesale production by major product form (surimi, fillets, and headed and gutted), U.S. export statistics show an upward trend in the prices and production of headed and gutted (H&G) Pacific whiting and a downward trend in the production of Pacific whiting surimi. (Export statistics do not isolate Pacific whiting fillets from other species fillets, so exports of Pacific whiting fillets are unknown).

In the early 2000s, the amount of Pacific whiting being processed into surimi for export was far greater than that of H&G products. Simultaneous with the decline in the Pacific whiting OY, one of the three major surimi processors stopped production in 2003 and has yet to return to production. Meanwhile, a new foreign market has spurred the production of H&G products to the extent that in 2006, H&G exports now greatly exceed surimi exports.

The Seafood Trend Newsletter (June 26, 2006) reported the following market trends:

> Is it time to wave the yellow flag in the red-hot Pacific whiting market? While demand remains strong, wholesale prices may be getting out of hand for price-conscious buyers. The West Coast fishery is going gangbusters. Last year, 571.1 million pounds of Pacific whiting was landed, the highest since 1966. Even as landings set a record, value and prices also grew.
>
> And this year looks to continue the upward trend. The OY is the same as last year, the resource remains strong, and landings are good. As of June 19, (2006) the catch for the non-tribal fishery was at 185.7 million pounds out of a commercial allocation of 511.7 million pounds. This allocation is divided among three sectors of the fishery -- 214.9

million pounds to shore-based, 122.8 million pounds to motherships, and 174.0 million pounds to catcher/processors. In addition 77.2 million pounds go to the tribal fishery.

Pacific whiting (Merluccius productus) stocks remain healthy even as the big 1999 year-class dies off. The 2002 and 2004 year classes may keep the fishery going at its current pace. The main constraint on the fishery is the bycatch of several rockfish species, especially POP, canary rockfish, darkblotched rockfish, and widow rockfish.

Demand for Pacific whiting has blossomed over the last couple of years, especially in the export market. Such countries as Russia and Ukraine have taken to H&G Pacific whiting. Last year (2005) exports of Pacific whiting increased nine percent in volume, to 95.7 million pounds, but increased 27 percent in value to $59.3 million, and gained 17 percent on a per pound basis to $0.62/lb., compared to 2004. So far this year (2006), the overall trend has, if anything, accelerated, with export volume and value growing. Through April (2006), 11.4 million pounds of Pacific whiting were exported through West Coast ports, a 73 percent gain over 2005. Value jumped 119 percent to $7 million.

But the seeds of potential problems may be visible in the comparatively slower growth in per-pound value, which gained only 27 percent going from $.48 a year ago to $0.61/lb though April. Giving pause is word that inventory is beginning to pile up in some European markets. Marketers there are advising their American suppliers to sit on their inventory for the time being.

H&G is the place to be, but newer players could be behind the curve. Pushing too much product too quickly could come back to haunt the fishery this fall. If inventory piles up, prices may have to drop to move it, which could have repercussions throughout the Pacific whiting industry.

That's not to say that this will happen because demand is strong, especially in Russia and the Ukraine. Consumers there are moving up from lower-priced fish such as herring to higher quality and higher-priced fish such as Pacific whiting. And with the rapidly developing processing industry demanding more frozen fish, the U.S. is in a good position to satisfy demand.

Another factor in the success of the U.S. in entering export markets for Pacific whiting has been the relative absence of H&G Pacific whiting from Argentina and Peru over the last year or so. The U.S. has taken advantage of the situation and gained a solid foothold in the market.

The strength of the export market has had an impact on the domestic market for Pacific whiting. While the export market is garnering most of the attention and available product, the U.S. market is scrambling for Pacific whiting. This has resulted in higher prices in the U.S. as well as the drying up any spot market. Retailers are purchasing on contract to ensure their supply. Today, West Coast H&G whiting is wholesaling for $0.57-$0.59/lb., up from a more typical $0.45-$0.48 lb. West coast fillets are wholesaling for as much as $0.96/lb., up from $0.72/lb." (Seafood Trend Newsletter, June 26, 2006).

It should be noted that the Seafood Trend's discussion of whiting stock trends turned out not to be completely accurate. According to the Pacific Fisheries Management Council's Groundfish Management Team (Agenda Item E.3.B Supplemental GMT Report, March 2007, page 1):

> Year class trends suggest that the stock is still heavily comprised of the 1999 year class, with near average recruitment from the 2003 and 2004 year classes. There is no indication of another strong year class emerging. As a consequence, the management decisions facing the Council with respect to whiting harvest levels are strikingly similar to those faced in 2006; stock size is projected to continue declining even with greatly reduced harvest rates….

It turns out that the Seafood Trend forecast of slower growth did not come to fruition in 2006. Not only did the annual growth rate in exports from West Coast ports (Seattle, Portland, San Francisco, and Los Angeles) in tonnage increase but so did the per-pound value. Through December 2006, 123 million pounds (55,792 mt) and $88 million worth of H&G products were exported through West Coast ports, an increase almost 30 percent in tonnage and 50 percent in value. The export price increased 16 percent to $0.73 per pound compared to the average export price for 2005. These export growth rates appear to have affected ex-vessel prices as well. Ex-vessel prices increased by 44 percent in 2005 and 19 percent in 2006.

The Seafood Trend Newsletter from April 9, 2007 also noted:

> The market for Pacific whiting has done anything but slow down, especially after the recent decisions on 2007 fishing regulations. In short, supply is down and looks to stay down for the foreseeable future. Export demand is fired up and may leave domestic needs short again.
>
> Pacific whiting—often called hake, especially in Canada—is the major groundfish species off the Lower 48-British Columbia coast. The coastal stock is considered one stock and is managed as such. However, fishing in the U.S. and Canada are managed separately, though a treaty between the two countries specifies shares of the resource. The U.S. gets 73.88% of the ABC and Canada gets 26.12%. The treaty, formulated in 2003 is not yet signed, but the two nations follow its provisions since it prevents over-running the quota and hurting the resource.
>
> There are also small inshore whiting populations (Strait of Georgia, Puget Sound, Gulf of California) but the coastal stock features larger fish, seasonal migration, and average recruitment except for occasional very large year-classes that sustain the population for several years.
>
> At its March meeting, the Pacific Fishery Management Council decided on this year's fishery. It approved an acceptable biological catch of 612,068 metric tons, down 7.5% from last year. The drop came because the huge 1999 year-class had passed its peak. For the last several years, the fishery has depended on this strong year-class to sustain the

fishery. Scientists do not see any major year-class coming along. The 2003 and 2004 year-classes are deemed "average."

With the drop in acceptable biological catch, the annual quota, or optimum yield was set at 328,358 tons, down 10.1% from the 364,842 tons last year. The optimum yield is divided between the U.S. and Canada, with the U.S. getting 242,591 tons and Canada receiving 85,767 tons. The U.S. share is further divided among tribal and non-tribal fishermen, with the tribes at 32,500 tons.

Last year, U.S. fishermen (tribal and non-tribal) landed 266,000 tons of whiting about the same as 2005. B.C. fishermen (foreign, joint venture, and shore-based) landed 94,000 tons, down slightly from the 100,000 tons of the previous year. Total landings last year were 360,000 tons.

Fishing this year started April 1 for the California shore-based fishery. Further north, the shorebased fishery opens June 15. The major U.S. at-sea fishery is set to open May 15.

As for the whiting market, it looks as strong as ever, barely taking a breather from last year's strong finish. Foreign demand for headed and gutted fish is driving the market, and will continue to drive it. The export demand has grown stronger because traditional sources of whiting, including the major producers of Argentina are having resource problems and reduced production. This has made H&G whiting from the U.S. and B.C. a valuable commodity.

Look at U.S. whiting/hake exports for the first month of the year. Export volume went from 2.9 million pounds a year ago to 7 million pounds this past January. More telling, the average price gained 16.9% going from $.65/lb a year ago to $.76/lb this year.

The major export markets for Pacific whiting continue to be Russia and the Ukraine. Russian buyers took 2.9 million pounds in January, up 84% from a year ago. The Ukraine took nearly as much, buying 2.4 million pounds, about seven times as much as January.

Activity is already heating up this year. There are reports that buyers are looking to tie up Canadian production. And U.S. processors are looking at export market again this year.

All this gives U.S. marketers a major case of heartburn. They have no certain source of product, and certainly not in the volumes they need. This continues the trend that began last year when many domestic marketers had a hard time meeting customer needs. But there is no turning back when export demand and prices continue to increase. As well, export markets want H&G, while the U.S. markets want some H&G but also fillets, which are more expensive to produce.

The above analysis addresses price trends for H&G products, but the major industry newletters and magazines do not provide conquerable analysis of whiting fillet and surimi products. These are the major products of the at-sea sectors. The market for such products is strongly influenced by the market for Alaska pollock fillets and surimi. The following was reported in the January 22, 2007 Seafood Trend Newsletter:

> There could be a tug of war this year between the fillet and surimi markets in the Alaska pollock business. Fillets have been on the rise, but surimi may have a trick or two up its sleeve.
>
> With a limited supply of Alaska pollock, how much should go to major pollock products. Despite fluctuations in Alaska pollock stocks, the total allowable catch has remained stable over time thanks to careful management by the North Pacific Fishery Management Council. Each year, fishermen are allowed to catch about 3.5 billion pounds of Alaska pollock in the BSAI and Gulf of Alaska fisheries. This year will be the same with fishermen chasing 3.503 billion pounds, down 4.9 million pounds (or 0.1%) from last year.
>
> The fillet market has continued to gain strength over the last two years. Look at export figures for perspective. Through November 2006, the U.S. exported 189.4 million pounds of pollock fillets, an increase over the previous year. At the same time that export volume was growing, prices also increased, a good indication of market strength. The average price of pollock fillets gained 19% in 2006 over 2005.
>
> For surimi, the opposite situation—exports have fallen and so has average price. Through November, pollock surimi exports totaled 356.1 million pounds, a drop of 12% from the previous year. The per-pound value, however, dropped, albeit by only a penny a pound. Surimi prices are softening, but not by much, suggesting the market is weak but not dead.
>
> The surimi market may strengthen this year, if for no other reason than reduced supplies.

If whiting surimi and fillet prices follow pollock prices, the above analysis indicates that whiting surimi prices in 2007 are likely to stay the same or increase compared to 2006, while fillet prices are likely to continue to increase. It should be noted that the analysis above misstates the percentage reduction in Alaska pollock quotas. According to Seafood.Com (March 13, 2007):

> As a result, the overall TAC for Alaska will see a decline of 7%, with that for the roe season falling by 1% lower by 8%. Industry observers are watching with caution that, in view of the large size of the quota, the difference of even 1% might significantly affect the production of pollock roe, surimi and fillets in this season.

In a recent report done for the Oregon Department of Fish and Wildlife and the Oregon Coastal Zone Management Association, The Research Group (2007) noted the following regarding recent developments in the markets for alternative forms of whiting:

> Ex-processor prices for surimi improved somewhat starting in 2003 due to a weaker U.S. dollar and the decreased supplies to market from downturns in other historical surimi based world fisheries. The expected trend in improved prices is being dampened by increased yield in both the Pacific whiting and the pollock fisheries with the use of

"decanter" technology. There are also other countries, like India, that are starting to produce a lower grade surimi. This will increase the downward pressure on surimi prices. However, in late 2004 the Indian Ocean tsunami destroyed a large part of the fish harvesting and fish processing industry that produced a low quality surimi. This had the effect for raising the expected prices for surimi products in 2005. Because of increased awareness of health aspects of fish consumption and the general decline of wild caught white fish availability in the world, and some collapses of "hake" resources, the prices of all Pacific whiting products have increased.

At the present time, two surimi plants along the West Coast have the capacity to process up to 20 million pounds per week. Except for a couple of years in the early 2000's, an average 150 million pounds of whiting has been delivered onshore annually. The surimi product form's prices are subject to the Alaska pollock surimi market and downturns in the Japanese market have lowered prices in past years. However, surimi price has increased in 2006 and is expected to increase along with other whiting products in 2007. As a consequence, more whiting is being directed to the developing fillet and H&G market. Filleting and H&G processing also require smaller capital investments. Several smaller processors have moved into whiting processing, especially in the Astoria area.

With the use of on-board super-chilling technology, there is an opportunity for an improved headed and gutted product for whiting in the eastern U.S. market and some parts of Europe and Israel.

Tables 28 to 30 present summary information on some key whiting industry market data.

Table 28. Key Pacific Whiting Market Indicators 2000 – 2006 Landings, Ex-vessel Revenues, and Ex-vessel Prices

Year	Ex-vessel Revenue (millions $)	Percent Change	Landings mt	Landings millions of lbs	Percent Change	Ex-vessel price ($)	Ex-vessel price percent change
2000	8.0		88,842	195.86		0.041	
2001	5.7	-28%	73,411	161.84	-17%	0.035	-13%
2002	4.6	-21%	45,707	100.77	-38%	0.045	27%
2003	5.5	21%	55,333	121.99	-21%	0.045	0%
2004	7.7	40%	96,364	212.44	74%	0.036	-2-%
2005	12.6	64%	109,395	241.17	14%	0.052	44%
2006	17.4	38%	127,167	280.35	16%	0.062	19%

Table 29. West Coast Exports of Headed and Gutted Pacific Whiting 2000 - 2006

Year	Export Revenue (millions $)	Percent Change	Exports millions of kg	Exports millions of lbs	Percent Change Export Weight	Export price ($/lb)	Export price percent change
2000	3.7		4.2	9.24		0.400	
2001	14.4	289%	12.9	28.38	207%	0.507	27%

2002	7.5	-48%	6.6	14.52	-49%	0.517	2%
2003	14.9	99%	12.5	27.50	89%	0.542	5%
2004	44.7	200%	38.0	83.60	204%	0.535	-1%
2005	59.2	32%	43.4	95.48	14%	0.620	16%
2006	88.2	49%	55.9	122.98	29%	0.717	16%

Table 30. West Coast Exports of Pacific Whiting Surimi 2000 - 2006

Year	Export Revenue (millions $)	Percent Change	Exports millions of kg	Exports millions of lbs	Percent Change Export Weight	Export price ($/lb)	Export price percent change
2000	18.2		11.4	25.08		0.726	
2001	28.0	54%	17.4	38.28	53%	0.731	1%
2002	16.8	-40%	9.3	20.46	-47%	0.821	12%
2003	10.6	-37%	5.9	12.98	-37%	0.817	-1%
2004	25.6	142%	16.3	35.86	176%	0.714	-13%
2005	28.5	11%	14.5	31.90	-11%	0.893	25%
2006	6.3	78%	3.2	7.04	-78%	0.895	0%

3.3.7 Counties Affected by the Pacific Whiting Shore-based Industry

Counties that are actively involved in the Pacific whiting shore-based industry include Pacific County, Washington; Grays Harbor County, Washington; Clatsop County, Oregon; Lincoln County, Oregon; Coos County, Oregon; Del Norte County, California; and Humboldt County, California. These counties tend to have economies that are based on tourism, natural resources, and government. The largest industries reported by the Bureau of Economic Analysis in counties associated with the Pacific whiting shore-based industry are generally forestry, fishing, and other, manufacturing, government and government enterprise, health care and social assistance, accommodation and food services, and retail trade. Industries falling within the forestry, fishing, and other, and manufacturing sectors are largely made up of timber and fishing industry related business, and timber and seafood processing. Food services, accommodation, and retail trade are largely made up of businesses reliant on the tourism sector.

Readers interested in further information on Counties and communities, are referred to Section 7 of the EIS, prepared by the Pacific Fishery Management Council staff, for the Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery. Copies of the EIS can be obtained from the Pacific Fishery Management Council, by writing to 7700 NE Ambassador Place, Suite 200, Portland, OR 97220-1384; or calling 503 820-2280; or viewing the internet posting at http://www.pcouncil.org.

4. ENVIRONMENTAL CONSEQUENCES

This section examines the environmental consequences that could be expected to result from adoption of the action alternatives. Alternatives 1-3 would prohibit entry of vessels into the fishery with no sector-specific significant historical participation in the Pacific whiting fishery.

4.1 Effects on the Physical Environment

Action Alternatives 1-3 would implement a limited entry program for the non-tribal Pacific whiting fishery in addition to the current West Coast limited entry program. Physical impacts generally associated with fishery management actions are effects resulting from changes in the physical structure of the benthic environment as a result of fishing practices (e.g. gear effects and fish processing discards). Midwater trawl gear is required in the Pacific whiting primary season fishery. At this time, there are no habitat protection areas that prohibit the use of midwater trawl gear in the geographic areas where the Pacific whiting fishery occurs. Because the alternative actions are administrative in nature and are not expected to change current fishing areas or gear used, none of the alternatives to any of the issues detailed in this EA are expected to have notable or measurable effects on the physical environment, either individually or cumulatively.

4.2 Effects on the Biological Environment

Direct effects on the biological environment resulting from fishery management actions primarily include changes in species mortality levels resulting from implementation of the alternatives. Under status quo, ABCs and OYs for Pacific whiting will continue to be set annually and will be based on the best scientific information available and based on the sustainability principles of the Magnuson-Stevens Act or the U.S.-Canada Pacific Whiting Treaty. Allocation of Pacific whiting between the U.S. and Canada and the allocation between commercial sectors will continue as specified in regulations at 50 CFR 660.323 (a)(2), and the allocation to the treaty tribes will continue to be specified at 50 CFR 660.385 (e). Similarly, the ABCs and OY for groundfish stocks taken incidentally with Pacific whiting will be based on the best scientific information available and on the sustainability principles of the Magnuson-Stevens Act. Consistent with the Magnuson-Stevens Act requirements, the ABCs and OYs for overfished species will continue to be based on overfished species rebuilding plans adopted under Amendment 16-4 regulations (71 FR 78638, December 29, 2006). The Pacific whiting fishery will continue as a primary season fishery, as specified in regulations at 50 CRF 660.373, and with the same season dates as have been in place since 1997. Monitoring and maximized retention measures proposed to be implemented in 2008 for the shore-based sector are expected to strengthen the ability to effectively manage the Pacific whiting fishery.

At its April 2007 meeting, the Council expressed its desire to continue managing the Pacific whiting fishery with bycatch limits for the most constraining overfished species. With bycatch limit management, the Pacific whiting industry has the opportunity to harvest the full Pacific whiting OY, provided the bycatch limits are not reached. The bycatch limits used in the Pacific whiting fishery will continue to be based on: the rebuilding OYs for each species; the amount projected to be taken in other fisheries; the more abundant overfished species historical weighted averages or linear interpolation (widow) of incidental catch as reported by observers in the at-sea fisheries; and fish tickets in the shore-based fishery.

Under status quo, the Pacific whiting fishery is being effectively managed to stay within the specific OYs for Pacific whiting and incidental groundfish (healthy, precautionary, and overfished species) stocks as well as Chinook salmon. While the management structure of the fishery is the same under status quo, the absolute number of fish killed would be more than under the action alternatives. The fishery would likely occur earlier in the year, when the yield per fish is lower, meaning that for a ton of catch, there would be more fish caught.

If participation in the fishery were increased under status quo and effort were difficult to manage, indirect biological impacts such as overfishing could result. The impacts on a stock of exceeding an OY depend on how sensitive the stock is to catch level changes. If an allowable harvest level for precautionary zone and healthy groundfish species or species groups is exceeded, the risk to the stock is generally lower than it is for overfished species. If an allowable harvest level of a constraining overfished species was greatly exceeded due to unreported discarding at sea, inaccurate catch accounting, or delayed catch reporting, the risk of exceeding rebuilding-based OYs is increased. The risk to the stock of exceeding the rebuilding based OY is particularly a concern for canary rockfish because it is sensitive to changes in harvest levels. For example, if the 2007 canary rockfish OY were exceeded by 3 mt, it is projected to result in the rebuilding time being extended by 11 years (PFMC and NMFS 2006) There are many variables that affect the time it takes a stock to rebuild; fishing mortality is only one of those variables. However, exceeding the rebuilding based OY could result in an extended rebuilding period for an overfished species.

The consequences of excess harvesting capacity are typically severe biological overfishing (Department of Commerce, 2006). Presumably, effects on protected species correlate with changes in the level of fishing effort. Increased fishing effort could lead to an increase in interactions between fishing vessels and protected species, while a decrease in fishing effort would have the opposite effect (PFMC, 2004). The action alternatives would be more likely to provide additional protection to overfished species of rockfish and to endangered or threatened salmon by prohibiting entry and diminishing the likelihood of an accelerated race for fish as compared to no action. There is likely to be less bycatch of these species than if there were unlimited access to the fishery. The fishery is likely to remain more stable and well paced than under the no action alternative such that bycatch will be controlled as it has been through industry cooperation and efforts to share information so that areas of high bycatch will be avoided. There will be less early season fishing, thus lessening the likelihood of high salmon bycatch. To the extent the alternatives result in lower rockfish bycatch, there will be less likelihood of an early closure of the whiting fishery and a shift of effort from whiting to other groundfish, so that the pressure on these other stocks should not increase above the status quo level.

To the degree that reducing the overall universe of potential whiting fishery participants buffers the fishery against the possibility of exceeding allowable harvest levels for either whiting or non-target species, Alternative 3 could be expected to have the greatest beneficial effect on the biological environment (56 shore-based catcher vessels, 39 mothership catcher vessels, 7 motherships, 10 catcher/processors), followed by Alternative 1 (56 shore-based catcher vessels, 64 mothership catcher vessels, 10 motherships under 1A and 6 motherships under 1B, 11 catcher/processors under 1A and 10 catcher/processors under 1B), followed by Alternative 2 (63 shore-based catcher vessels, 64 mothership catcher vessels, 11 motherships under 2A and 7 motherships under 2B, 11 catcher/processors under 2A and 10 catcher/processors under 2B, followed by status quo, where participation is limited only by the availability of limited entry trawl permits.

4.2.1 Non-groundfish Species (state managed or under other FMPs)

The alternative actions are not expected to affect non-groundfish species in any way.

4.2.2 Protected Species

The alternative actions are expected to minimize the risk of excessive bycatch of salmon in the whiting fishery, by reducing pressure to fish early in the season when salmon bycatch is highest.

Under the Endangered Species Act (ESA), NMFS has completed Section 7 consultations for the West Coast groundfish fisheries, and NMFS has concluded that the fisheries as prosecuted under the Groundfish Fishery Management Plan are not likely to jeopardize the continued existence of any listed species. However, if the whiting fishery were to change in character, with more intensive fishing early in the season, the situation may need to be reevaluated. Salmon bycatch rates are much higher early in the year than later in the year. Additional capacity or associated effort in the fishery may lead to high salmon bycatch rates and additional capacity or effort may also make it difficult for NMFS to react in a timely way to unanticipated conditions in the fishery.

4.3 Effects on the Socioeconomic Environment

4.3.1 Changes in Management Structure of the Fishery

None of the alternatives would revise whiting harvest levels, monitoring procedures, season dates, inseason management processes, or inter-sector allocations. Action Alternatives 1-3 would restrict the universe of potential participants in the fishery, and would require vessels to prove their qualifications from historical catch in order to be allowed to participate in future Pacific whiting seasons. Any changes to the management structure of the fishery would be administrative in nature, as they would require vessel owners to complete applications for participation in the fishery, and would require NMFS to review and approve or disapprove of those applications.

4.3.2 Changes in Fishery Harvests and Values

Since at least the 1990s the National Marine Fisheries Service has recognized that overcapacity is a common problem in many domestic (and international) fisheries (Department of Commerce, 2004). Overcapacity may be defined as that part of the difference between what a fleet could produce if fully utilized under normal operating conditions (during a given period of time, under given stock conditions) and what it actually produces *which results specifically from market failures* (Ward, et al., 2005). Further, Ward et al. note that overcapacity is a structural problem that is not self correcting over time. “Overcapacity occurs in open-access, limited entry, and regulated open-access fisheries because of a specific market failure: when any given boat catches a fish, it does not bear the cost that it imposes on other boats by reducing their opportunities to catch fish." (Ward, 2005).

NMFS has taken recent steps to produce a national plan of action for the management of fishing capacity (U.S. Department of Commerce, 2004). NMFS has also sponsored an analysis of overcapacity in five federally managed fisheries, one of which was the West Coast groundfish fisheries (U.S. Department of Commerce, 2006). The analysis, undertaken by NOAA economists and academic researchers and documented in a NOAA Technical Memorandum, determined the five fisheries all had substantial overcapacity, with the more severe level of overcapacity occurring in the West Coast groundfish fisheries.

In particular, the Pacific whiting fishery was determined to be in overcapacity status (U.S. Department of Commerce, 2006). The report of the analysis concluded that the efficient reduction of overcapacity will likely require a combination of capacity reduction actions. According to the report, this combination of actions could include the use of various management/regulatory strategies, one of which is individual fishing quotas.

Amendment 15 does not contain provisions for individual fishing quotas; however, such provisions are being actively considered through the proposed Amendment 20 to the Groundfish Management Plan. Until a management/regulatory approach, such as Amendment 20 or other fisheries rationalization amendment is adopted, the prevention of additional eligible entrants to the Pacific whiting fishery could be accomplished through the adoption of an alternative to the status quo situation. The alternatives to the status quo proposed for Council consideration represent ways to avoid allowing additional eligibility to enter the Pacific whiting fishery, and thus provide an opportunity for the Council to avoid additional complications prior to adoption of a method for rationalizing the fishery.

In a derby style fishery that is at capacity or overcapacity status, new entry encourages more intensive fishing, or an accelerated race for fish, because participants fear they will not catch a fair share of the available fish if they do not fish early. The race for fish can result in wasteful fishing practices of both target and incidentally caught species. The presence of excess capacity and overcapacity in commercial fisheries causes substantial economic waste in the form of higher than necessary costs of production and reduced net benefits to society (Department of Commerce, 2006).

On May 14, 2007, NMFS adopted a temporary rule to prohibit any vessel from participating in either the mothership, catcher/processor or shore-based delivery sector of the directed Pacific whiting fishery off the West Coast in 2007 if it did not have a history of sector-specific participation in the whiting fishery between January 1, 1997, and January 1, 2007. This rule was intended to prevent serious conservation and management problems that could be caused by new entrants in 2007 and to maintain the status quo while the Council addresses the issue of increased capacity in the whiting fishery through Amendment 15 and capacity reduction through Amendment 20, trawl rationalization. For purposes of section 4.3, we refer to the pre-2007 situation as the status quo.

Under status quo, harvesters have shared information with each other on incidental catch of bycatch limit species and Chinook salmon during the season. The at-sea fleet has used a third party to summarize observer sample data on a daily basis and to provide a summary of all activity to other members of the fleet. In the shore-based sector, fishers have notified SHOP representatives when high bycatch has occurred and SHOP has provided information to the fleet. The exchange of information allows harvesters to understand where the areas of high bycatch may be, so they may choose to voluntarily avoid those areas and help to extend the season with the hope of each sector attaining its allocation. This cooperation may be less likely to continue if a large number of new entrants were allowed into the fishery and fishing were conducted more intensely. If the new entrants consisted of more vessels with higher operational costs, there is a greater likelihood that meeting vessel costs would outweigh the individual's incentive to exchange information. If this were to occur, the fishery may be closed earlier than it otherwise would have, assuming that the loss of bycatch information exchange would result in earlier attainment of bycatch limits.

More fishing capacity exerted earlier in the year is expected to increase the likelihood of early achievement of the Pacific whiting allocations. An early season closure would produce negative economic impacts for the harvesters, processors, and communities involved in whiting operations. If capacity increases, there would be a greater likelihood of more intensive fishing early in the season and achievement of Chinook salmon limits early in the season, as bycatch of this species has historically been higher earlier in the season (PFMC and NMFS, 2006). While some vessels, especially AFA-permitted vessels or vessels receiving benefits from other rationalization programs, would be able to shift to Alaska fisheries, other vessels have less opportunity and may join or increase participation in the bottom trawl fisheries such as nearshore flatfish, deepwater complex, and slope rockfish. Vessels may also join or increase participation in Dungeness crab fishery and the pink shrimp fishery. It should be noted that vessels must have (or be able to acquire) the necessary state permits to participate in either of these fisheries.

Intensive early fishing on whiting will result in early achievement of the harvest limit for the shore-based sector. This means that West Coast-based vessels that do not have access to Alaska fisheries or other stocks may be pushed into alternative West Coast fisheries earlier than normal. In turn, the normal pace of groundfish catches will be accelerated and bimonthly vessel catch limits would likely be achieved earlier in each period. In an accelerated race for fish, there also would be higher risk of exceeding bycatch limits for the established fisheries. At best, there would be short periods in which vessels would be forced to sit idle; at worst, the idle periods would be long, with serious disruption of processing facilities that are already under great economic pressure because of the severe cutbacks in groundfish fisheries the past 10 years.

As described above, achieving any of the bycatch limits will close all whiting fishery sectors. In addition, using bycatch limits helps to prevent the Pacific whiting fishery from affecting the non-whiting other groundfish fisheries. While fishery participants have generally demonstrated great sensitivity to the need to avoid rockfish and minimize their bycatch, so that all benefit from the total allowable catch, the relationships between the bycatch limit species and Pacific whiting are not well understood. Incidental catch tends to occur in rare and sporadic events. In some cases, large occurrences of canary and widow rockfish have been documented in single tows referred to as “disaster tows”. Even one disaster tow can have severe consequences for all commercial whiting vessels and possibly the non-whiting groundfish fisheries.

A confounding issue for the whiting fishery is what has become known as the rebuilding paradox. As an overfished stock increases in abundance, it becomes more likely some of those fish will be caught, unless fishing effort is reduced. Depending on the particular rebuilding strategies, this could lead to even greater management restrictions in the future.

Generally speaking, for all sectors, bycatch of rockfish species occurs at a higher rate in the spring than later in the year (National Marine Fisheries Service Northwest Regional Office, 2007a.). An accelerated race for fish early in the season, due to new entrants or increased capacity by existing participants, is likely to result in greater emphasis on maximizing individual catches of the available whiting as quickly as possible without time or opportunity to refine methods to minimize the catch of bycatch limit species or Chinook salmon. Indeed, if bycatch limits in the whiting fishery are greatly exceeded, there could be pressure to further constrain non-whiting fisheries to ensure that total bycatch does not exceed the levels set by the Council. This could be devastating to the non-whiting groundfish fisheries that have already declined to less than 50-60 percent of historic levels due to fishery controls to rebuild overfished stocks.

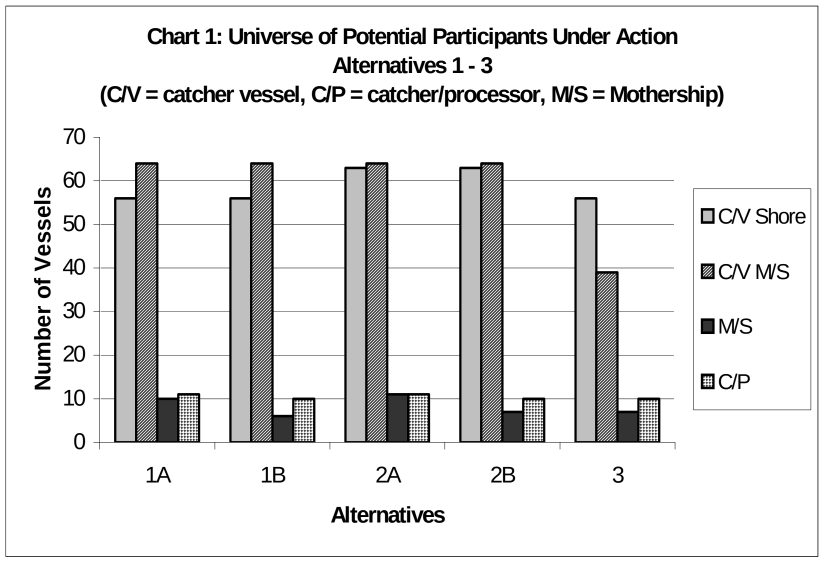
The overcapacity and the associated race for fish are often associated with the potential for increased fishery waste. The yield per fish in usable meat for surimi and the marketability of the fish for direct consumption both improve as the fish recover from spawning in the spring. This is why the cooperative vessels generally focus on fishing later in the season. To the extent new vessels enter the fisheries and promote earlier fishing in all sectors, whiting products will likely be less refined, resulting in less revenue and value from the fishery.

Increased levels of participation by eligible vessels may occur under any of the alternatives; however, the alternatives prohibit addition of new harvest capital through new entrants. Under status quo, the number of new entrants is limited by the number of available limited entry permits with trawl endorsements. In addition, changes in OYs for Pacific whiting and constraining bycatch limits species, market conditions, profitability relative to each vessels operational costs, and other economic factors will drive the number of new vessels that may choose to enter the fishery.

Under status quo, additional harvest capital may also be introduced in the fisheries by existing vessels, which could result in an accelerated race for fish. The harvest capacity on individual vessels may continue to increase if vessels acquire new permits to increase vessel size, or if more efficient harvest gear or equipment becomes available. The proposed Amendment 20 to the Pacific Groundfish Fishery Management Plan examines the creation and implementation of 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. If the whiting fishery is rationalized under Amendment 20, the proposed action under Amendment 15 would be an interim measure. Nothing under status quo limits the entrance of new shore-based processors.

Since 1997, the fishery under status quo has been fairly stable, except for reduced participation from 2002-2004 due to reduced OYs for Pacific whiting and a shift in the marketplace. As in many fisheries, when the fishery is stable, participants often know each other and have a shared interest in maintaining a stable fishery.

The total number of unique catcher vessels that would be qualified to participate in the Pacific whiting fishery, under either Alternative 1A or 1B, is 56 in the shore-based sector and 64 in the mothership sector. This is in contrast to 29 catcher vessels in the 2005 shore-based fishery and 18 catcher vessels in the mothership fishery. The total number of unique catcher/processors that would qualify to participate in the Pacific whiting fishery is 11 under Alternative 1A and 10 under Alternative 1B. This is in contrast to 6 catcher/processors in 2005. The total number of unique motherships that would qualify to participate in the Pacific whiting fishery, is 10 under alternative 1A and 6 under Alternative 1B, in contrast to 5 motherships that participated in 2005.



The total number of unique catcher vessels that would be qualified to participate in the Pacific whiting fishery, under either Alternative 2A or 2B, is 63 in the shore-based sector and 64 in the mothership sector. This is in contrast to 37 catcher vessels in the 2006 shore-based fishery and 20 catcher vessels in the 2006 mothership fishery. The total number of unique catcher/processors that would qualify to participate in the Pacific whiting fishery is 11 under Alternative 2A and 10 under Alternative 2B. This is in contrast to the 9 catcher/processors that participated in 2006. The total number of unique motherships that would qualify to participate in the Pacific whiting fishery is 11 under Alternative 2A and 7 under Alternative 2B, in contrast to 6 motherships that participated in 2006.

The total number of unique catcher vessels that would be qualified to participate in the Pacific whiting fishery, under Alternative 3 is 56 in the shore-based sector and 39 in the mothership sector. The total number of unique catcher/processors that would qualify to participate in the Pacific whiting fishery is 10 under Alternative 3. The total number of unique motherships that would qualify to participate in the Pacific whiting fishery is 7 under Alternative 3. In 2006, there were 37 boats participating in the shore-based sector and 14 processors. At sea participation consisted of 9 catcher/processors, 6 motherships, and 20 mothership catcher vessels.

Under Alternatives 1A, 1B, 2A, 2B, and 3, the number of vessels eligible to enter the fishery is greater than the number that has operated in the fishery in recent years. For the shore-based sector, buyback vessels that qualified under each alternative were easily identified and removed from the set of effective vessels. However, qualifying vessels that no longer hold limited entry permits with a trawl endorsement, vessels that have sunk or are rendered inoperable were not identified.

Vessels that have not been active in the whiting fishery in recent years, but qualify under the proposed alternatives, could choose to re-enter the fishery. These vessels could increase harvest capacity over trends seen in recent years. The decision to participate in the whiting fishery would be based on the available limited entry permits, adequate for the size of the vessel, with trawl endorsements and costs to secure those permits through lease or purchase. Additional factors determining participation include market conditions for whiting products, processor capacity (both shorebased and at-sea), cost of gear, opportunity in other West Coast groundfish fisheries and other fishing opportunities such as the BSAI pollock fishery. The Pacific whiting OY and overfished species constraints may also effect the decision to participate in the fishery. Additionally, vessels that do not have recent history of participation in recent years may speculate on future fishery benefits under Amendment 20 or other potential management programs and re-enter the whiting fishery in an attempt to secure those benefits.

The status quo alternative would likely have adverse impacts on other fisheries, and especially other groundfish fishing sectors. If significant new entry to the whiting fishery were to occur such that there was an accelerated race for fish, then the whiting fishery likely would close early, due to either early achievement of the whiting quota or early achievement of a rockfish bycatch limit. An early closure of the whiting fishery would reduce the harvest and ex-vessel value of the fishery because the yield per fish is lower earlier in the year. It is also important to note that if a rockfish bycatch limit is reached, even if only by one sector, fishing by all sectors of the whiting fishery must cease.

In the case of an early closure of the whiting fishery it should also be expected that some of the fishing effort previously directed at whiting would be shifted to other groundfish fishery sectors, increasing the competition in those already stressed fishery sectors. Further, if rockfish bycatch limits for the whiting fishery were exceeded, then additional limits on groundfish fishery sectors targeting healthy stocks would need to be implemented to ensure that the overall catch and mortality of overfished rockfish stocks would not be grossly exceeded. The Council is committed to taking action to rebuild overfished rockfish stocks to carry out rebuilding plans. The Council will further restrict sectors taking healthy stocks to ensure that overall rockfish limits are not exceeded, which would reduce the harvests and values of the non-whiting groundfish stocks.

Under the action alternatives, fishing effort could increase, but could only increase to a level below that which could occur under the status quo. It is still possible that such an increase in effort could potentially result in early closure for the same reasons as under the status quo; however, the situation would not be exacerbated by additional entrants who might potentially join the fishery under the status quo.

Under alternatives other than the status quo, fishing effort could increase, but could only increase to a level below that which could occur under the status quo. It is still possible that such an increase in effort could result in early closure for the same reasons as under the status quo; however, the situation would not be exacerbated by additional entrants who might join the fishery under the status quo. To the degree that reducing the overall universe of potential whiting fishery participants provides increased access to allowable whiting harvest levels and increases the value of the fishery to participants and fishing communities, Alternative 3 could be expected to have the greatest beneficial effect on the socio-economic environment (56 shore-based catcher vessels, 39 mothership catcher vessels, 7 motherships, 10 catcher/processors), followed by Alternative 1 (56 shore-based catcher vessels, 64 mothership catcher vessels, 10 motherships under 1A and 6 motherships under 1B, 11 catcher/processors under 1A and 10 catcher/processors under 1B), followed by Alternative 2 (63 shore-based catcher vessels, 64 mothership catcher vessels, 11 motherships under 2A and 7 motherships under 2B, 11 catcher/processors under 2A and 10 catcher/processors under 2B, followed by status quo, where participation is limited only by the availability of limited entry trawl permits.

The continued functioning of a whiting cooperative is expected to keep harvesting and bycatch avoidance by the catcher-processor segment relatively efficient under the alternatives compared to the status quo, provided the cooperative is preserved.

It is possible, but unlikely, that substantial increases in OY might lead to a short-run situation where harvesters and processors might not have adequate capacity to take fish when they are schooled and available. As mentioned earlier, according to the recent NMFS document on reducing capacity in U.S. managed fisheries (U.S. Department of Commerce, 2006), the whiting fishery has been judged to be "overcapacity" under expected levels of output. The degree of overcapacity for the whiting fishery estimated in (Department of Commerce, 2006) also suggests that even if vessels age, leave the fishery or are lost at-sea, there would still be adequate capacity to harvest the OY. Additionally, the forecast from the recent whiting stock assessment provides no such indication of an OY larger than current capacity.

4.3.3 Changes in the Economic Situation of Vessels, Processors and the Fishing Communities Associated with the Pacific Whiting Fishery

Every assessment of potential management strategies includes a "no action" baseline against which other alternatives are compared. Under the "no action" alternative, any eligible vessel registered to a limited entry permit with a trawl endorsement could enter one or more sectors of the Pacific whiting fishery in 2008.

As mentioned above in section 4.3.2, the whiting fishery has been estimated to be in an "overcapacity" status by the U.S. Department of Commerce (2006). Given this conclusion, it is not likely that the alternatives to the status quo would do much more than remove the chances a further degree of "overcapacity" would be reached in the whiting fishery compared to the status quo.

Under the status quo that prevailed before 2007, it is likely that the number of vessels participating in each sector would be increased because of increasingly high prices for whiting products and the associated high ex-vessel prices. As each sector is allocated a specific amount of whiting, new entrants to the fishery would cause average revenues per vessel to be reduced and likely raise the total costs of harvesting, as theoretically the catch per unit of effort would also be reduced. If the whiting fishery closed early, whiting vessels would suffer reduced harvests and ex-vessel revenues because the yield per fish is lower earlier in the year. If, as a result of new entrants, bycatch rates increased so as to cause an early closure of the fishery, all sectors could suffer economic losses.

The status quo alternative, since it could adversely affect other fisheries, would have adverse economic effects overall as well. The adverse effects would be felt by West Coast-based fishers who would face increasing competition for catch in the non-whiting sectors; by West Coast-based fishers in the whiting fleet who do not have the ability to relocate to other areas or to shift to other groundfish sectors except at high cost; by fishers in other groundfish fishing sectors who would be faced with greater competition for catches in healthy stocks if there were shifts of effort from whiting to those other stocks; by fishers in any groundfish fishing sectors that would have to be further limited in fishing for healthy stocks because of overages of rockfish bycatch in the whiting fishery; and by coastal and at-seas processors who would have less product to work with and/or a shorter season in which to process whiting, or who would have to pay higher prices to obtain supplies of whiting from the fleet.

Such changes would also exacerbate fishing community problems (both social and economic) arising from declines that have already occurred in other groundfish fishery sectors (e.g., the flatfish trawl fishery and the non-trawl fisheries for groundfish). The magnitude of these impacts cannot be determined with precision due to the inability to predict how fishers and processors will react to different situations, and how prices or costs will change in the future with and without the proposed action. However, all other things being equal, the no action alternative will have adverse economic effects across the shorebased fishing communities compared to the proposed action.

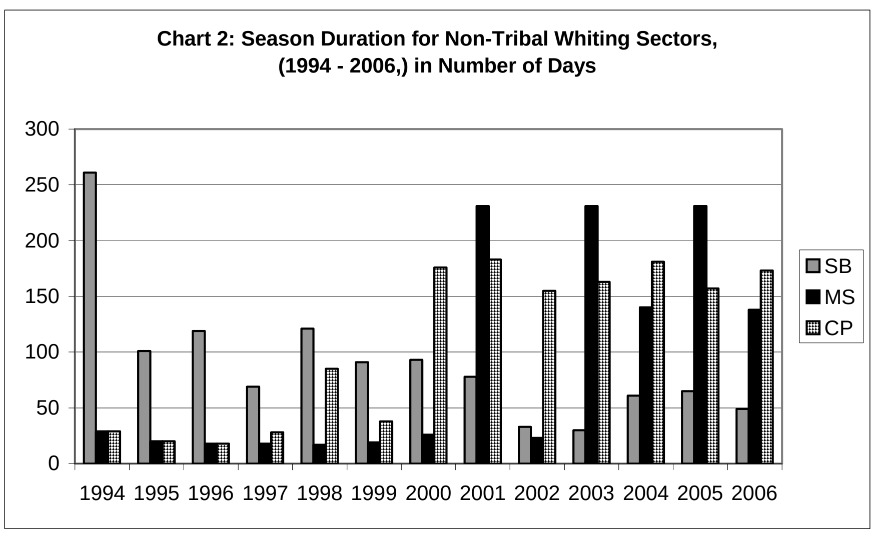
The alternatives, as compared to the status quo, are expected to provide comparative economic benefits to current fishery participants and fishing communities by reducing the potential for an accelerated race for fish, and by reducing the potential for additional disruption to the fishery, other fisheries, and fishing communities from premature season closures. By roughly maintaining the current state of capacity, average revenues per vessel in each sector would not reduced by newly eligible entrants. Similarly, total aggregated fleet fishing costs would probably not increase simply because of new entrants in 2008 and later years. Associated impacts on the shoreside processing sector and on dependent fishing communities would be avoided. Because the whiting fishery is already overcapacity, adoption of alternatives other than the status quo would at least not create further overcapacity from additional new entry to the fishery by vessels looking for short-term gain at the expense of those with a long-standing interest in the fishery. Table 31 summarizes the number of vessels eligible to participate by sector for each of the action alternatives.

Table 31. Summary of Numbers of Eligible Vessels by Sector and Alternative

Vessel Category	Alternative 1A 1/1/94-1/1/06	Alternative 2A 1/1/94-1/1/07	Alternative 3 1/1/97-1/1/07
Shore-based catcher vessels	56 [68][1]	63 [75][1]	56 [65][1]
Mothership catcher vessels	64	64	39
Catcher/processor	11	11	10
Mothership	10	11	7
	Alternative 1B 1/1/97-1/1/06	Alternative 2B 1/1/97-1/1/07	
Catcher/processor	10	10	
Mothership	6	7	

[1]Numbers in brackets indicate the actual number of vessels qualified, including those purchased during the buyback program.

In the context of the proposed action, the fishery sector of greatest concern may be the shore-based sector. This arises from the value of this sector to the communities in which whiting processing has become an important part of the local economic structure, in some respects replacing or mitigating lost processing capacity due to cutbacks in other groundfish fishery sectors. The concern is that, with an accelerated race to fish, the duration of the fishing season will be further shortened. The shorter the season, the less employment benefit and the less the whiting fishery can mitigate for or replace other lost groundfish fishery activities. Tables 12, 13, and 15 as well as Chart 2 present a summary of operational data on whiting fishery from 1994-2006.



To the degree that reducing the overall universe of potential whiting fishery participants increases the economic benefit that the fishery can provide to vessels, processors and fishing communities, Alternative 3 could be expected to have the greatest beneficial effect on the socioeconomic environment (56 shore-based catcher vessels, 39 mothership catcher vessels, 7 motherships, 10 catcher/processors), followed by Alternative 1 (56 shore-based catcher vessels, 64 mothership catcher vessels, 10 motherships under 1A and 6 motherships under 1B, 11 catcher/processors under 1A and 10 catcher/processors under 1B), followed by Alternative 2 (63 shore-based catcher vessels, 64 mothership catcher vessels, 11 motherships under 2A and 7 motherships under 2B, 11 catcher/processors under 2A and 10 catcher/processors under 2B, followed by status quo, where participation is limited only by the availability of limited entry trawl permits.

4.3.4 Changes in Participation Requirements, Restrictions, Licensing

Under the status quo, no changes in participation requirements, restrictions or licensing would occur, other than whiting certification being proposed for the shore-based under Amendment 10. Participation requirements would be specified under Alternatives 1A, 1B, 2A, 2B or 3. Requirements would be in terms of qualifying period dates in the whiting fishery. NMFS would maintain a list of eligible participants. Vessels may be required to provide proof of participation during the qualifying periods. Under Alternatives 1A, 1B, 2A, 2B catcher/processors and motherships may need to show evidence of “significant participation”.

Under any of the action alternatives, costs to NMFS are expected to increase, since the agency would need to implement a historical participation review and whiting certification application process. Some of the costs associated with implementing Amendment 15 may be reimbursed by the whiting certification recipients, in the form of permit fees.

4.3.5 Changes in Revenue and Cost to State and Federal Governments

Revenue to the state governments is primarily determined by the Pacific whiting OY and the availability and successful avoidance of overfished species. As mentioned earlier, under all alternatives, the ABCs and OYs for Pacific whiting will continue to be set annually and will be based on the best scientific information available and based on the sustainability principles of the Magnuson-Stevens Act or the U.S.-Canada Pacific Whiting Treaty. The ABCs and OYs for overfished species will continue to be based on overfished species rebuilding plans adopted under Amendment 16-4 regulations (71 FR 78638, December 29, 2006). The action alternatives will not effect the Pacific whiting OY or bycatch limits and how they relate to government revenue.

Market conditions for whiting are a significant factor in determining cost and revenue to the state and federal governments. Action alternatives are not likely to influence the market and the associated government revenues.

Catch fee revenue from shorebased harvesters and processors accruing to state governments may decline if the status quo situation resumes in 2008, and additional harvesting capacity results in an earlier closure of the fishery than under the alternatives. State income tax revenue from residents of fishing communities are likely to decline if the income of harvesters, processors and their employees declines in response to earlier whiting fishery closures or to the more restrictive fishing regulations that may become necessary if new entrants are permitted. The consequences of excess harvest capacity also include increasingly restrictive management that can be quite costly in terms of the expenditures required to support management and regulation (Department of Commerce, 2006). State and federal government costs of regulation may also increase under the status quo if monitoring and regulatory actions occur earlier and more frequently in both the whiting and non-whiting groundfish fisheries.

To the degree that reducing the overall universe of potential whiting fishery participants positively affects state catch fee revenues from harvesters and processors, Alternative 3 could be expected to have the greatest beneficial effect for state governments (56 shore-based catcher vessels, 39 mothership catcher vessels, 7 motherships, 10 catcher/processors), followed by Alternative 1 (56 shore-based catcher vessels, 64 mothership catcher vessels, 10 motherships under 1A and 6 motherships under 1B, 11 catcher/processors under 1A and 10 catcher/processors under 1B), followed by Alternative 2 (63 shore-based catcher vessels, 64 mothership catcher vessels, 11 motherships under 2A and 7 motherships under 2B, 11 catcher/processors under 2A and 10 catcher/processors under 2B, followed by status quo, where participation is limited only by the availability of limited entry trawl permits. As discussed above in 4.3.4, costs to NMFS associated with implementing a license limitation program would increase under all of the action alternatives; however, NMFS anticipates that these costs would be greatest in the first year of implementation, when vessel qualifications must be reviewed, and would decrease in subsequent years.

4.3.6 Environmental Justice

The proposed alternatives, other than a return to the status quo in 2008, will probably have no significant impacts or implications in terms of environmental justice. As noted in 4.3.3, it is highly likely that not restricting entry to the whiting fishery would result in adverse effects on other fisheries. If so, this could exacerbate problems arising from declines that have already occurred in other groundfish fishery sectors (e.g., flatfish trawl fishery and non-trawl fisheries for groundfish). This would most likely have greater socio-economic effects on fishermen who are less educated and have fewer employment options. There also could be adverse impacts on shorebased processors, whose employees would typically be persons with lower educational levels and lower incomes, and who would also have fewer employment alternatives. Fishing communities that depend on the non-whiting groundfish fisheries and the shore-based whiting fishery would be adversely affected economically and socially as a result of higher unemployment among fishermen, processor employees and dependent secondary employment in the communities.

4.4 Cumulative Effects

Cumulative effects of the alternatives must be considered. Cumulative impacts are those combined effects on quality of human environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-federal agency undertakes such actions (40 CFR 1508.7, 1508.25 (a), and 1508.25 (c)).

Of the past, proposed, and reasonably foreseeable future actions that are expected to also affect these same waters, the most significant is the action to the implementation of Pacific Coast groundfish fishery management measures. Fishing for Pacific whiting occurs in the same waters and affects the same habitats as fishing for other Pacific Coast groundfish species. The effects of the 2007-2008 groundfish specifications and management measures have been described and analyzed by Council staff in an Environmental Impact Statement (PFMC and NMFS, 2006).

Actions considered in this EA for Pacific whiting management are not expected to have effects on the environment that, when considered in combination with groundfish specifications and management measures, measurably alter the effects of the groundfish specifications and management measures. The alternatives are intended to minimize the potential economic and environmental harm to the Pacific whiting fishery from adverse impacts caused by unlimited entry into the fishery. This is consistent with Pacific Coast groundfish fishery management.

Amendment 15, whiting limitation, could be minimal provided it is followed with a subsequent management program to further constrain capacity in the whiting fishery. Amendment 15 is intended to be an interim measure until the Council completes Amendment 20, West Coast trawl rationalization. Therefore, the cumulative effects under Amendment 15, whiting limitation, could be minimized over the long-term, and potentially eliminated if it is replaced with an overall trawl fishery rationalization program.

As discussed above, the Council has recommended implementing a regulatory program to implement a maximized retention and monitoring program for the shore-based whiting sector for 2008 and beyond. Depending on the Council's preferred alternative under Amendment 15, the Council's recommendations for an annual whiting endorsement for participants in the shore-based sector may be somewhat modified. In particular, the maximized retention and monitoring program did not consider limiting participation in the shore-based sector, but instead assumed that whiting endorsements would be issued annually to any applicants. The effects of modifying this program with the preferred alternative from Amendment 15 are expected to be minimal because NMFS anticipates that it could implement both programs simultaneously in order to minimize confusion for the public.

[Insert cumulative effects for the Council preferred alternative]

In the event the status quo alternative is chosen for trawl rationalization, the Council would need to reconsider the harvest capacity in the Pacific whiting fishery relative to resource productivity. In the event trawl rationalization is not completed, the expected cumulative effects of this action are expected to be:

- Non-existent for the physical environment, since the areas fished and gear type used are not expected to change as a result of this action, and since mid-water trawl gear is assumed to have fewer habitat-altering properties than bottom gear.
- Effects on the biological environment resulting from fishery management actions primarily include changes in species mortality levels, while still within the allowable harvest levels, resulting from implementation of the alternatives. Implementation of the action alternatives is expected to have neutral to positive effects on species mortality levels to the extent that bycatch is more likely less than it would be under the no action

alternative. Increased fishing effort could lead to an increase in interactions between fishing vessels and protected species, while a decrease in fishing effort would have the opposite effect (PFMC, 2004). Alternative actions decrease the potential for harvest limit overruns that can result from the difficulty of monitoring catches during short fishing seasons. The action alternatives would be more likely to provide additional protection to overfished species of rockfish and to endangered or threatened salmon by prohibiting entry and diminishing the likelihood of an accelerated race for fish as compared to no action. To the extent the alternatives result in lower rockfish bycatch, there will be less likelihood of an early closure of the whiting fishery and a shift of effort from whiting to other groundfish, so that the pressure on these other stocks will not increase above the status quo level. To the extent that the number of actual participants is lower in the future than it has been in the past, those participants may be more willing to cooperate with each other to minimize bycatch in the whiting fishery. If bycatch amounts or rates decrease as a result of this action, the cumulative effects of this action, in combination with the fishery specifications and management measures, would be expected to be beneficial to bycatch species abundance levels.

- Significant for the socio-economic environment, since, as mentioned above, new entrants could come into the fishery. It should be noted that the action may not reduce the effort of eligible fishery participants while it would certainly reduce the universe of potential participants. The number of actual participants in the fishery in any given year may be more strongly correlated to the whiting OY in that year and to ex-vessel prices for whiting. To the extent that an increase in the number of fishery participants is precluded, this action may provide more stability for fishery participants, and for fishing communities that participate in the whiting fisheries when OYs and prices might produce and attract new entrants to the fishery.

5.0 CONSISTENCY WITH THE FMP AND OTHER APPLICABLE LAWS

5.1 Consistency with the FMP

The socio-economic framework in the FMP requires that proposed management measures and viable alternatives be reviewed and consideration be given to the following criteria: a) how the action is expected to promote achievement of the goals and objectives of the FMP; b) likely impacts on other management measures; c) biological impacts; d) and economic impacts, particularly the cost to the fishing industry; and e) accomplishment of one of a list of criteria defined in Section 6.2.3 of the FMP.

The alternative actions are consistent with goals and objectives of the FMP as discussed below.

Goal 1 Conservation
Objective 1. Maintain an information flow on the status of the fishery and the fishery resource which allows for informed management decisions as the fishery occurs.

The alternative actions will assist in maintaining a more stable whiting fishery compared to that under status quo. Alternative actions will continue the existing data collection burden. Preventing an accelerated race for fish limits the potential for additional difficulties in monitoring the fishery and obtaining quality data on catch, effort, and bycatch. Alternative actions decrease the potential for harvest limit overruns that can result from the difficulty of monitoring catches during short fishing seasons.

Objective 2. Adopt harvest specifications and management measures consistent with resource stewardship responsibilities for each groundfish species or species group. Achieve a level of harvest capacity in the fishery that is appropriate for a sustainable harvest and low discard rates, and which results in a fishery that is diverse, stable, and profitable. This reduced capacity should lead to more effective management for many other fishery problems.

The proposed actions limit capacity in the Pacific whiting fishery by reducing the number of potential fishery participants. These actions would not change harvest specifications or management measures. An accelerated race for fish, like that which would ensue under the no action alternative, does not promote resource stewardship or sustainable fishing. The action alternatives limit competition, which provides a greater opportunity (i.e., time) to reduce unwanted incidental catch and minimize waste, resulting in a fishery that is more stable and profitable. Slowing the race for fish, with the proposed action alternatives, will also limit the number and timing of entrants into other West Coast groundfish fisheries that are also operating under strict overfished species limits. Limiting the overall impacts to overfished species and endangered or threatened species is expected to aid in the success of the rebuilding plans. Further, the alternatives limit disruption to the existing whiting cooperatives that have been successful at minimizing bycatch. Action alternatives promote sustainable harvest by reducing the possibility of harvest limit overruns that can result from the difficulty of monitoring catches during short fishing seasons.

Goal 3 - Utilization.
Objective 9. Develop management measures and policies that foster and encourage full utilization (harvesting and processing), in accordance with conservation goals, of the Pacific Coast groundfish resources by domestic fisheries.

The alternative actions, by limiting entry, promote conditions in the fishery such that focusing fishing effort later in the season is favorable. The yield per fish in usable meat for surimi and the marketability of the fish for direct consumption both improve as the fish recover from spawning in the spring, therefore under the alternative actions there is likely to be more production of whiting products along with revenue and value from the fishery. Action alternatives effectively slow the race for fish, which should improve the handling and processing of whiting, resulting in full utilization of the catch.

Objective 11. Develop management programs that reduce regulations-induced discard and/or which reduce economic incentives to discard fish. Develop management measures that minimize bycatch to the extent practicable and, to the extent that bycatch cannot be avoided, minimize the mortality of such bycatch. Promote and support monitoring programs to improve estimates of total fishing-related mortality and bycatch, as well as those to improve other information necessary to determine the extent to which it is practicable to reduce bycatch and bycatch mortality.

Under the alternative actions there is less likelihood of an accelerated race for fish in which participants may be less likely to avoid areas and times in which rockfish and salmon bycatch would be higher. Therefore, the action alternatives may minimize the interactions of the fishery with non-target species and associated mortality of incidental catch.

Objective 14. When considering alternative management measures to resolve an issue, choose the measure that best accomplishes the change with the least disruption of current domestic fishing practices, marketing procedures, and the environment.

The proposed alternatives are intended, in part, to constrain the universe of potential Pacific whiting fishery participants to those vessels with some historic level of participation in the fishery. By preventing entry of new vessels into the fishery and excessive fleet growth, Amendment 15 ensures continued participation by those vessels with Pacific whiting history, and may minimize future disruption to current domestic fishing practices and marketing procedures.

Furthermore, the Pacific whiting fishery is currently managed under a limited entry system, in addition to the West Coast limited entry program, via the May 2007 emergency rule (72 CFR 27759). Therefore, the least disruption of current fishing practices, marketing procedures, and the environment would occur through the alternative actions. The no action alternative could result in shorter seasons, economic waste, unsafe fishing conditions, and more complicated resource management and conservation efforts.

Objective 15. Avoid unnecessary adverse impacts on small entities.

As with Objective 14, preventing the entry of new vessels into the fishery and excessive fleet growth is expected to minimize potential future adverse impacts to small entities that could result from participating in a greater competitive pool than under status quo.

Objective 16. Consider the importance of groundfish resources to fishing communities, provide for the sustained participation of fishing communities, and minimize adverse economic impacts on fishing communities to the extent practicable.

By preventing new entry to the whiting fishery, the alternatives will minimize adverse impacts on fishing communities to the extent practicable. Action alternatives may enable harvesters and processors to continue to participate at about the current pace, depending on how many eligible vessels decide to participate in future fisheries. Failure to prevent new entry would be expected to reduce the current harvest and processing levels, either due to excessive bycatch of overfished rockfish species or endangered or threatened salmon, or due to the accelerated race to fish that would be more likely to occur under the status quo.

Objective 17. Promote the safety of human life at sea.

The alternative actions are intended to limit the entry and constrain future participation in the Pacific whiting fishery. The accelerated race for fish, or derby fishing, which is often a consequence of overcapacity in a fishery, will be lessened by limiting access. Derby fishing compromises vessel safety at sea, as vessels may fish in unsafe conditions to get as much as possible, as quickly as possible. Under the alternative actions there would be less competition for the available harvest, thus less incentive to fish and take risks in dangerous conditions.

5.2 Magnuson-Stevens Conservation and Management Act

The Magnuson-Stevens Act provides parameters and guidance for Federal fisheries management, requiring that the Councils and NMFS adhere to a broad array of policy ideals. Section 104-297 of the Magnuson-Stevens Act defines the term "optimum", with respect to the yield from the fishery, as the amount of fish which

> (A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;
> (B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and
> (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Action alternatives under Amendment 15 are designed to limit access in the whiting fishery, which should provide the greatest overall benefit to the Nation and considers the relevant economic, social, and ecological factors.

Further Magnuson-Stevens states that Councils can

(6) establish a limited access system for the fishery in order to achieve optimum yield if, in developing such system, the Council and the Secretary take into account--

- (A) present participation in the fishery,
- (B) historical fishing practices in, and dependence on, the fishery,
- (C) the economics of the fishery,
- (D) the capability of fishing vessels used in the fishery to engage in other fisheries,
- (E) the cultural and social framework relevant to the fishery and any affected fishing communities, and
- (F) any other relevant considerations;

Currently, entry into the West Coast groundfish fisheries is governed by a limited entry system and action alternatives would further limit entry into the whiting fishery. The alternatives consider present participation in the fishery (end dates through 2005 and 2006) as well as historical fishing practices in, and dependence on, the fishery, (start dates 1994 or 1997 as well as poundage requirements for catcher/processors and motherships). The EA explores the economics of the fishery and the impacts of the status quo alternative (i.e., participation limited only by the current LE permit). The EA also discusses the capability of fishing vessels used in the fishery to engage in other fisheries, and potential impacts on those fisheries. Finally, the cultural and social framework relevant to the fishery and affected fishing communities are discussed.

Overarching principles for fisheries management are found in the Act's National Standards. The alternative actions consistency with these standards is discussed below.

National Standard 1 requires that conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the U.S. fishing industry.

Alternative action decrease the potential for harvest limit overruns that can result from the difficulty of monitoring catches during short fishing seasons. The alternative actions should help prevent conditions that would risk the rebuilding of overfished rockfish stocks or the biological opinion for endangered or threatened salmon. To the extent that the proposed actions results greater within fleet cooperation, the actions, compared to status quo, have a greater likelihood of allowing the whiting and other groundfish fishing sectors to achieve optimum yields.

National Standard 2 requires the use of the best available scientific information.

None of the alternatives considered under this action are expected to affect the collection or use of scientific information in the management of the Pacific whiting fishery.

National Standard 3 requires, to the extent practicable, that an individual stock of fish be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The Pacific whiting fishery is managed as a stock throughout its range as agreed upon by the U.S. and Canada. The alternative actions would not affect the management of the stock in this regard.

National Standard 4 requires that conservation and management measures not discriminate between residents of different States.

The alternative actions would not discriminate between residents of different States. The prohibition of new entry in the fishery would apply to any and all U.S. vessels.

National Standard 5 addresses efficiency in the utilization of fishery resources.

This action is intended to restrict the universe of potential participants in the whiting fishery. To the extent that the action alternatives can reduce the number of actual annual participants, this action is expected to result in a more efficient utilization of fishery resources.

National Standard 6 requires that conservation and management measures take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

This action affects each of the non-tribal whiting sectors, and would require sector-specific catch history qualifications for future participation in the fishery.

National Standard 7 requires that conservation and management measures minimize costs and avoid unnecessary duplication.

Although this action is seen as an interim measure to be implemented during the development of Amendment 20, it is exclusive from Amendment 20 and from any other action, and none of the alternatives considered mirror action alternatives under development for Amendment 20.

National Standard 8 provides protection to fishing communities by requiring that conservation and management measures be 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.

By requiring vessels to meet historic participation qualifications in order to be permitted to participate in future years' fisheries, this action is intended to ensure that the universe of potential fishery participants is stabilized. The more stable potential universe of fishery participants is expected to maintain historic vessel connections to particular West Coast fishing communities.

Additionally, the alternative actions have less likelihood to result in early closure of the fishery which may lead to periods in which vessels are forced to sit idle and even serious disruption of processing facilities, both of which can mean adverse economic impacts to fishing communities.

National Standard 9 requires that conservation and management measures minimize to the extent practicable, bycatch and minimize the mortality of bycatch.

The alternative actions would serve to reduce bycatch by reducing the pressure for vessels to fish in areas and times when bycatch would be higher.

National Standard 10 Conservation and Management measures shall, to the extent practicable, promote the safety of human life at sea.

The alternative actions promote a stable and well-paced fishery. The accelerated race for fish, or derby fishing, which is often a consequence of overcapacity in a fishery, will be avoided by limiting access. Derby fishing compromises vessel safety at sea, as vessels may fish in unsafe conditions to get their share as quickly as possible. Under the alternative actions there will be less competition for the available harvest, thus less incentive to fish and take risks in dangerous conditions.

5.3 Endangered Species Act

NMFS issued Biological Opinions under the ESA on August 10, 1990, November 26, 1991, August 28, 1992, September 27, 1993, May 14, 1996, and December 15, 1999 pertaining to the effects of the Pacific Coast groundfish FMP fisheries on Chinook salmon (Puget Sound, Snake River spring/summer, Snake River fall, upper Columbia River spring, lower Columbia River, upper Willamette River, Sacramento River winter, Central Valley spring, California coastal), coho salmon (Central California coastal, southern Oregon/northern California coastal), chum salmon (Hood Canal summer, Columbia River), sockeye salmon (Snake River, Ozette Lake), and steelhead (upper, middle and lower Columbia River, Snake River Basin, upper Willamette River, central California coast, California Central Valley, south-central California, northern California, southern California). These biological opinions have concluded that implementation of the FMP for the Pacific Coast groundfish fishery was not expected to jeopardize the continued existence of any endangered or threatened species under the jurisdiction of NMFS, or result in the destruction or adverse modification of critical habitat.

NMFS reinitiated a formal Section 7 consultation under the ESA in 2005 for both the Pacific whiting midwater trawl fishery and the groundfish bottom trawl fishery. The December 19, 1999 Biological Opinion had defined an 11,000 Chinook incidental take threshold for the Pacific whiting fishery. During the 2005 Pacific whiting season, more than 11,000 Chinook were taken, triggering reinitiation. NMFS prepared a Supplemental Biological Opinion dated March 11, 2006, which addressed salmon take in both the Pacific whiting midwater trawl and groundfish bottom trawl fisheries. In that Supplemental Biological Opinion, NMFS concluded that catch rates of salmon in the 2005 Pacific whiting fishery were consistent with expectations considered during prior consultations. Chinook bycatch has averaged about 7,300 fish over the last 15 years and has only occasionally exceeded the reinitiation trigger of 11,000. Since 1999, annual Chinook bycatch has averaged about 8,450 fish. The Chinook ESUs most likely affected by the Pacific whiting fishery have generally improved in status since the 1999 Section 7 consultation.

Although these species remain at risk, as indicated by their ESA listing, NMFS concluded that the higher observed bycatch in 2005 does not require a reconsideration of its prior "no jeopardy" conclusion with respect to the fishery. For the groundfish bottom trawl fishery, NMFS concluded that incidental take in the groundfish fisheries is within the overall limits articulated in the Incidental Take Statement of the 1999 Biological Opinion. The groundfish bottom trawl limit from that opinion was 9,000 fish annually. NMFS will continue to monitor and collect data to analyze take levels. NMFS also reaffirmed its prior determination that implementation of the Groundfish FMP is not likely to jeopardize the continued existence of any of the affected ESUs.

Lower Columbia River coho (70 FR 37160, June 28, 2005) and the Southern Distinct Population Segment (DPS) of green sturgeon (71 FR 17757, April 7, 2006) were recently listed as threatened under the ESA. As a consequence, NMFS has reinitiated its Section 7 consultation on the Council's Groundfish FMP. Green sturgeon have been caught with midwater trawl gear in the commercial non-tribal Pacific whiting fishery, however it is unlikely that the green sturgeon caught were from the ESA-listed southern DPS (south of the Eel River, California, 40/40’ N. lat.), as all documented catches were north of 44/49’ N. lat. After reviewing the available information, NMFS concluded that, in keeping with Section 7(a)(2) of the ESA, allowing the fishery to continue under this action would not result in any irreversible or irretrievable commitment of resources that would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures.

The fishery as managed under proposed alternatives does not affect endangered/threatened species listed under the ESA or their habitat in any way that would alter the conclusions referenced above. The alternative actions would actually increase the probability of reduced salmon bycatch in the fishery as compared to the no action alternative.

5.4 Marine Mammal Protection Act

Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (usually regarded as 60 percent of carrying capacity or maximum population size) can be listed as "depleted". Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Currently, the Stellar sea lion population off the West Coast is listed as threatened under the ESA and the fur seal population is listed as depleted under the MMPA. Incidental takes of these species in the Pacific Coast fisheries are well under their annual Potential Biological Removals. The West Coast groundfish fisheries are considered Category III fisheries, where the annual mortality and serious injury of a stock by the fishery is less than or equal to one percent of the PBR level. The alternative actions are not expected to affect the incidental mortality levels of species protected under the MMPA.

5.5 Coastal Zone Management Act

Section 307(c)(1) of the 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. The proposed action is consistent to the maximum extent practicable with applicable State coastal zone management programs. A copy of this document will be submitted to the State coastal zone agencies in Washington, Oregon and California with a request for consistency determinations.

5.6 Paperwork Reduction Act

Each of the action alternatives contains a collection-of-information requirement needed to verify qualification for future participation in the whiting fishery.

[insert summary of PRA burden]

5.7 Executive Order 12866

This action is not significant under E.O. 12866. This action will not have a cumulative effect on the economy of $100 million or more, nor will it result in a major increase in costs to consumers, industries, government agencies, or geographical regions. No significant adverse impacts are anticipated on competition, employment, investments, productivity, innovation, or competitiveness of U.S.-based enterprises.

5.8 Executive Order 13175

Executive Order 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 U.S. government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary of Commerce recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. At Section 302(b)(5) of the Magnuson-Stevens

Act, a seat on the Council is to be reserved for a representative of an Indian tribe with Federally recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes that 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' usual and accustomed (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. The alternative actions do not alter the treaty allocation of whiting, nor does it affect the prosecution of the tribal fishery.

5.9 Migratory Bird Treaty Act and Executive Order 13186

The Migratory Bird Treaty Act 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 populations of many native bird species. The Act 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 U.S., Canada, Japan, Mexico, and Russia to protect a common migratory bird resource. The Migratory Bird Treaty Act prohibits the directed take of seabirds, but the incidental take of seabirds does occur. The alternative actions are not likely to affect the incidental take of seabirds protected by the Migratory Bird Treaty Act.

Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) is intended to ensure that each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations develops and implements a Memorandum of Understanding (MOU) with the U.S. Fish and Wildlife Service that shall promote the conservation of migratory bird populations. The alternative actions are not likely to have a measurable effect, if any, on migratory bird populations.

5.10 Executive Order 12898 (Environmental Justice) and 13132 (Federalism)

There is no specific guidance on application of E.O. 12898 to fishery management actions. The E.O. states that environmental justice should be part of an agency’s mission “by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.” The alternative actions do not target low income or minority communities; they would affect all populations segments equally. None of the alternative actions would have federalism implications subject to EO 13132.

6.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

In order to comply with Executive Order (EO) 12866 and the Regulatory Flexibility Act (RFA), this document also serves as a Regulatory Impact Review (RIR). The RIR and Initial Regulatory Flexibility Analysis (IRFA) have many aspects in common with each other and with EAs. Much of the information required for the RIR and IRFA analyses has been provided above in the EA.

Table 32 identifies where previous discussions in the EA relevant to the IRFA/RIR may be found in this document.

Table 32 Regulatory Impact Review and Regulatory Flexibility Analysis

RIR Elements of Analysis	Corresponding Sections in EA	IRFA Elements of Analysis	Corresponding Sections in EA
Description of management objectives	1.3	Description of why actions are being considered	1.3
Description of the fishery	1.4, 3.0	Statement of the objectives of and legal basis for actions	1.1, 1.2, 1.3
Statement of the problem	1.3	Description of projected reporting, recordkeeping and other compliance requirements of the proposed action	
Description of each selected alternative	2.0	Identification of all relevant Federal rules	5.0, 6.0
An economic analysis of the expected effects of each selected alternative relative to status quo	4.3		

6.1 Regulatory Impact Review

EO 12866, Regulatory Planning and Review, was signed on September 30, 1993, and established guidelines for promulgating new regulations and reviewing existing regulations. The EO covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. The RIR provides a review of the changes in net economic benefits to society associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the alternative action that could be used to solve the problems.

The RIR analysis and the environmental analysis required by NEPA have many common elements, including a description of the management objectives, description of the fishery, statement of the problem, description of the alternatives and economic analysis, and have, therefore, been combined in this document. See Table 32 above for a reference of where to find the RIR elements in this EA.

The RIR is designed to determine whether the proposed action could be considered a “significant regulatory action” according to E.O. 12866. E.O. 12866 test requirements used to assess whether or not an action would be a “significant regulatory action”, and identifies the expected outcomes of the proposed management alternatives. These tests are whether the action would: 1) have a annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; 2) create a serious inconsistency or otherwise interfere with action taken or planned by another agency; 3) materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or 4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this executive Order.

Based on results of the economic analysis contained in Section 4.3, alternative actions are not expected to be significant under E.O. 12866. This action will not have an annual effect on the economy of $100 million or more, nor will it result in a major increase in costs to consumers, industries, government agencies, or geographical regions. In addition, the alternative action is not expected to: create a serious inconsistency or otherwise interfere with action taken or planned by another agency; materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or raise novel legal or policy issues arising out of legal mandates.

6.2 Initial Regulatory Flexibility Analysis

[To be completed]

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8.0 LIST OF PREPARERS

9.0 AGENCIES CONSULTED

10.0 FINDING OF NO SIGNIFICANT IMPACT

11.0 Appendix

Table A-1. Summary of Rockfish Bycatch by Year and Sector, 1994-2006.

1994

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.20	1.29	0.00	1.49
Other rockfish	23.81	19.06	26.15	69.01
POP	33.02	28.54	10.77	72.33
Thornyheads	0.01	0.20	4.49	4.70
Canary	2.82	2.01	0.00	4.83
Yellowtail	408.90	210.93	255.30	875.12
Widow	191.68	185.49	245.80	622.97
Chilipepper	0.70	5.15	0.00	5.86
Shortbelly	1.08	0.82	0.00	1.91
TOTAL ROCKFISH	662.21	453.50	542.51	1,658.22
Mt whiting	91,925.94	87,146.60	73,512.68	252,585.22
Mt rockfish/mt whiting	0.007203712	0.005203875	0.007379798	0.00656498

1995

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.04	0.34	0.00	0.38
Other rockfish	12.76	78.96	33.35	125.07
POP	30.51	13.28	0.19	43.98
Thornyheads	0.12	5.66	0.01	5.79
Canary	0.18	0.13	0.50	0.81
Yellowtail	708.32	84.60	290.06	1,082.98
Widow	155.28	85.25	236.46	476.99
Chilipepper	0.15	28.02	0.00	28.17
Shortbelly	7.24	2.92	0.00	10.16
TOTAL ROCKFISH	914.60	299.16	560.56	1,774.32
Mt whiting	40,586.00	61,572.00	74,884.51	177,042.51
Mt rockfish/mt whiting	0.022534864	0.004858702	0.007485603	0.01002198

1996

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.11	0.05	0.00	0.16
Other rockfish	14.77	20.73	42.11	77.61
POP	2.32	3.68	20.71	26.71
Thornyheads	0.00	1.93	0.10	2.03
Canary	1.14	0.08	0.67	1.89
Yellowtail	379.36	251.59	519.32	1,150.27
Widow	141.89	124.68	576.06	842.63
Chilipepper	0.00	0.00	0.00	0.00
Shortbelly	0.00	6.15	0.00	6.15
TOTAL ROCKFISH	539.59	408.89	1,158.97	2,107.45
Mt whiting	44,416.70	68,359.40	84,935.07	197,711.17
Mt rockfish/mt whiting	0.012148359	0.005981474	0.01364533	0.01065922

1997

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.15	0.06	0.00	0.21
Other rockfish	12.30	69.30	23.02	104.62
POP	1.46	1.82	6.23	9.51
Thornyheads	0.02	0.44	0.36	0.82
Canary	0.70	1.11	0.95	2.76
Yellowtail	174.04	116.11	226.48	516.63
Widow	133.88	73.33	160.21	367.42
Chilipepper	0.01	0.00	0.00	0.01
Shortbelly	0.28	0.48	0.01	0.77
TOTAL ROCKFISH	322.84	262.65	417.27	1,002.76
Mt whiting	50,402.00	70,771.00	87,143.80	208,316.80
Mt rockfish/mt whiting	0.006405301	0.003711266	0.004788257	0.00481362

1998

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	1.17	0.03	0.00	1.20
Other rockfish	19.79	42.57	45.54	107.90
POP	6.50	14.78	16.66	37.94
Thornyheads	0.01	2.51	0.20	2.72
Canary	2.46	0.25	0.86	3.57
Yellowtail	313.26	63.72	496.41	873.39
Widow	171.84	120.92	360.31	653.07
Chilipepper	0.01	0.00	0.00	0.01
Shortbelly	0.00	0.02	1.28	1.30
TOTAL ROCKFISH	515.04	244.80	921.26	1,681.10
Mt whiting	50,087.10	70,365.00	87,573.35	208,025.45
Mt rockfish/mt whiting	0.010282887	0.003479002	0.010519848	0.00808121

1999

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.07	0.25	0.00	0.32
Other rockfish	14.32	18.83	15.77	48.92
POP	4.44	9.71	1.05	15.20
Thornyheads	0.00	0.02	0.68	0.70
Canary	0.19	1.03	1.89	3.11
Yellowtail	253.26	430.87	475.09	1,159.22
Widow	47.70	101.25	195.18	344.13
Chilipepper	0.54	0.00	0.01	0.55
Shortbelly	0.00	0.00	5.50	5.50
TOTAL ROCKFISH	320.52	561.96	695.16	1,577.64
Mt whiting	47,580.25	67,679.89	83,302.77	198,562.91
Mt rockfish/mt whiting	0.006736408	0.008303205	0.008345039	0.00794531

2000

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	2.20	0.45	0.48	3.13
Other rockfish	29.06	91.28	18.91	139.25
POP	3.03	6.57	0.21	9.81
Thornyheads	0.14	18.93	2.43	21.50
Canary	0.56	0.86	1.09	2.51
Yellowtail	285.54	270.02	190.29	745.85
Widow	150.65	69.97	76.56	297.18
Chilipepper	4.83	0.00	27.67	32.50
Shortbelly	0.00	0.86	2.33	3.19
TOTAL ROCKFISH	476.01	458.94	319.98	1,254.93
Mt whiting	46,840.32	67,814.63	85,756.78	200,411.73
Mt rockfish/mt whiting	0.010162399	0.006767566	0.003731274	0.00626177

2001

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.09	0.21		0.30
Other rockfish	20.48	57.74	5.46	83.68
POP	0.05	19.69		19.74
Thornyheads	0.02	15.19	0.02	15.23
Canary	0.95	0.65	1.39	2.99
Yellowtail	91.82	33.16	101.62	226.60
Widow	29.19	139.71	44.04	212.94
Chilipepper	3.34	0.22	1.03	4.59
Shortbelly	27.28	0.04	0.62	27.94
TOTAL ROCKFISH	173.22	266.61	154.20	594.03
Mt whiting	35,823.00	58,627.62	73,293.52	167,744.14
Mt rockfish/mt whiting	0.004835441	0.004547515	0.002103826	0.00354127

2002

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.15	0.04	0.00	0.19
Other rockfish	1.11	19.44	0.36	20.91
POP	2.17	1.45	0.19	3.81
Thornyheads	0.00	11.91	0.03	11.94
Canary	0.81	1.59	0.43	2.83
Yellowtail	1.42	12.86	41.38	55.66
Widow	20.50	115.10	5.32	140.92
Chilipepper	1.92	2.97	0.52	5.41
Shortbelly	0.10	0.49	0.05	0.64
Darkblotched rockfish	0.93	2.19	0.01	3.13
TOTAL ROCKFISH	29.11	168.04	48.30	245.45
Mt whiting	26,593.29	36,341.41	45,278.79	108,213.49
Mt rockfish/mt whiting	0.001094637	0.004623926	0.001066686	0.00226819

2003

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.00	0.06	0.00	0.06
Other rockfish	0.59	24.15	0.88	25.62
POP	0.11	5.04	0.29	5.44
Thornyheads	0.15	15.50	0.08	15.73
Canary rockfish	0.08	0.17	0.11	0.36
Yellowtail rockfish	0.57	1.75	43.92	46.24
Widow rockfish	0.69	11.56	12.54	24.79
Chilipepper rockfish	1.15	0.11	9.54	10.80
Shortbelly rockfish	0.02	0.48	0.04	0.54
Darkblotched rockfish	0.10	4.21	0.26	4.57
TOTAL ROCKFISH	3.46	63.03	67.66	134.15
Mt whiting	26,021.00	41,214.00	51,099.25	118,334.25
Mt rockfish/mt whiting	0.00013297	0.001529335	0.00132407	0.00113364

2004

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.09	0.07	0.01	0.17
Other rockfish	0.69	25.13	5.76	31.58
POP	0.10	0.95	0.40	1.45
Thornyheads	0.01	5.62	0.39	6.02
Canary rockfish	4.11	0.48	1.16	5.75
Yellowtail rockfish	12.16	6.33	117.63	136.12
Widow rockfish	11.43	8.37	28.26	48.06
Chilipepper rockfish	0.88	1.10	20.60	22.58
Shortbelly rockfish	0.02	0.00	0.01	0.03
Darkblotched rockfish	3.02	4.36	0.84	8.22
TOTAL ROCKFISH	32.51	52.42	175.05	259.98
Mt whiting	24,102.02	73,174.96	89,437.70	186,714.68
Mt rockfish/mt whiting	0.001348712	0.000716309	0.001957278	0.00139238

2005

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.16	0.11	0.03	0.30
POP	0.86	0.78	0.15	1.79
Thornyheads	0.74	6.34	0.29	7.37
Canary rockfish	0.70	0.34	2.24	3.28
Yellowtail rockfish	25.52	47.44	172.69	245.65
Widow rockfish	35.50	43.14	77.24	155.88
Chilipepper rockfish	0.89	0.26	25.85	27.00
Shortbelly rockfish	2.68	0.01	0.00	2.69
Darkblotched rockfish	5.08	5.95	5.51	16.54
Other rockfish	18.81	40.42	5.62	64.85
TOTAL ROCKFISH	90.94	144.79	289.62	525.35
Mt whiting	48,571.23	78,889.57	97,574.52	225,035.32
Mt rockfish/mt whiting	0.001872302	0.00183535	0.002968164	0.00233451

2006

ROCKFISH SPECIES	MOTHERSHIP	CATCHER/PROCESSOR	SHORESIDE	TOTAL
Bocaccio	0.10	0.01	0.01	0.11
POP	1.88	0.75	0.03	2.65
Thornyheads	0.03	0.49	0.08	0.60
Canary rockfish	0.85	0.10	1.64	2.59
Yellowtail rockfish	59.28	3.41	155.88	218.58
Widow rockfish	71.80	66.99	49.51	188.29
Chilipepper rockfish	1.29	2.54	12.65	16.48
Shortbelly rockfish	11.06	0.30	0.28	11.64
Darkblotched rockfish	4.24	6.73	2.27	13.24
Other rockfish	1.37	7.00	4.02	12.39
TOTAL ROCKFISH	151.90	88.30	226.37	466.57
Mt whiting	55,355.21	78,863.88	96,599.70	230,818.79
Mt rockfish/mt whiting	0.002744119	0.001119667	0.002343332	0.00202136

Agenda Item G.5.b
Attachment 2
September 2007

DRAFT

AMENDMENT 15
(VESSEL PARTICIPATION LIMITATION IN THE PACIFIC WHITING FISHERY)

TO THE

PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN

FOR THE CALIFORNIA, OREGON, AND WASHINGTON GROUNDFISH FISHERY

PACIFIC FISHERY MANAGEMENT COUNCIL
7700 NE AMBASSADOR PLACE, SUITE 200
PORTLAND, OR 97220
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JUNE 2007

Preface

This document shows proposed changes to the groundfish fishery management plan (FMP) developed by federal and state staff based on the range of alternatives identified by the Council at its June 2007 meeting for Amendment 15 to the FMP, which would implement a limited entry program for the Pacific Coast whiting fishery. Amendment 15 only affects FMP text in Chapter 11, "Groundfish Limited Entry."

In this document, suggested deletions are marked by ~~strikethrough~~ and insertions by double underline. Notes, for example explaining why the text of a particular sub-section of Chapter 11 may not appear herein, are in ***[boldface italic brackets]***. Readers interested in the substance of those sections of the FMP not provided herein are referred to the Council's FMP website: http://www.pcouncil.org/groundfish/gffmp/fmpthru19.html.

11.0 GROUNDFISH LIMITED ENTRY

All references to fishing activities in these proposals are references to catching activities occurring off the Washington, Oregon, and California coasts unless otherwise noted.

[Note: Sections 11.1 – 11.4 are not proposed to be revised by Amendment 15; therefore, they are not provided here.]

11.5 Limited Entry Program for the Pacific Coast Whiting Fishery

[Note: At its June 2007 meeting, the Council recommended a range of alternatives for implementing a temporary limited entry program for the Pacific Coast whiting fishery, indicating its intent that this program sunset with the implementation of an individual quota or co-operative management program for the whiting fishery. The following proposed amendatory language shows how the FMP might be revised under either of the Action Alternatives (i.e. those alternatives other than status quo.)]

Alternative 1 FMP amendatory language:

Until the implementation of a trawl IQ or cooperative management program in the Pacific whiting fishery, no vessel may participate in the shoreside, mothership, or catcher-processor sector of the Pacific Whiting Fishery unless that vessel meets the following criteria for such vessel in such sector:

> ***Alternative 1A:*** Any vessel that participated in a particular sector in at least one primary whiting season between January 1, 1994 and January 1, 2006.
>
> For catcher vessels participating in the mothership sector, participation in a primary whiting season means that the vessel has made at least one delivery to a mothership whiting processor during the at-sea processing season. For catcher vessels participating in the shore-based sector, participation in a primary whiting season means that a vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.
>
> For catcher/processors vessels, participation in a primary whiting season means that the vessel caught and processed whiting during an at-sea processing season.
>
> For mothership vessels, participation in a primary whiting season means that the vessel received and processed whiting during an at-sea processing season.

Alternative 1B: For catcher vessels participating in either the shore-based or mothership sectors, participation in at least one primary whiting season between January 1, 1994 and January 1, 2006. For catcher vessels participating in the mothership sector, participation in a primary whiting season means that the vessel has made at least one delivery to a mothership whiting processor during the at-sea processing season. For catcher vessels participating in the shore-based sector, participation in a primary whiting season means that a vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.

For catcher/processors vessels, having caught and processed at least 1,000 metric tons (mt) of whiting in any one qualifying year from January 1, 1997 through January 1, 2006.

For mothership vessels, having received at least 1,000 mt of whiting in any one qualifying year from January 1, 1997 through January 1, 2006.

A vessel may qualify for participation in each sector for which it meets the above standards.

Implementing regulations will specify the application procedures. NMFS will maintain a list of vessels or issue a certificate to vessels that qualify for participation in each sector.

Alternative 2 FMP amendatory language:

Until the implementation of a trawl IQ or cooperative management program in the Pacific whiting fishery, no vessel may participate in the shoreside, mothership, or catcher-processor sector of the Pacific Whiting Fishery unless that vessel meets the following criteria for such vessel in such sector:

Alternative 2A: Any vessel that participated in a particular sector in at least one primary whiting season between January 1, 1994 and January 1, 2007.

For catcher vessels participating in the mothership sector, participation in a primary whiting season means that the vessel has made at least one delivery to a mothership whiting processor during the at-sea processing season. For catcher vessels participating in the shore-based sector, participation in a primary whiting season means that a vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.

For catcher/processors vessels, participation in a primary whiting season means that the vessel caught and processed whiting during an at-sea processing season.

For mothership vessels, participation in a primary whiting season means that the vessel received and processed whiting during an at-sea processing season.

Alternative 2B: For catcher vessels participating in either the shore-based or mothership sectors, participation in at least one primary whiting season between January 1, 1994 and January 1, 2007. For catcher vessels participating in the mothership sector, participation in a primary whiting season means that the vessel has made at least one delivery to a mothership whiting processor during the at-sea processing season. For catcher vessels participating in the shore-based sector, participation in a primary whiting season means that a vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.

For catcher/processors vessels, having caught and processed at least 1,000 metric tons (mt) of whiting in any one qualifying year from January 1, 1997 through January 1, 2007.

For mothership vessels, having received at least 1,000 mt of whiting in any one qualifying year from January 1, 1997 through January 1, 2007.

A vessel may qualify for participation in each sector for which it meets the above standards.

Implementing regulations will specify the application procedures.   NMFS will maintain a list of vessels or issue a certificate to vessels that qualify for participation in each sector.

Alternative 3 FMP amendatory language:

Until the implementation of a trawl IQ or cooperative management program in the Pacific whiting fishery, no vessel may participate in the shoreside, mothership, or catcher-processor sector of the Pacific Whiting Fishery unless that vessel meets the following criteria for such vessel in such sector:

Any vessel that participated in a particular sector in at least one primary whiting season between January 1, 1997 and January 1, 2007.

For catcher vessels participating in the mothership sector, participation in a primary whiting season means that the vessel has made at least one delivery to a mothership whiting processor during the at-sea processing season. For catcher vessels participating in the shore-based sector, participation in a primary whiting season means that a vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.

For catcher/processors vessels, participation in a primary whiting season means that the vessel caught and processed whiting during an at-sea processing season.

For mothership vessels, participation in a primary whiting season means that the vessel received and processed whiting during an at-sea processing season.

A vessel may qualify for participation in each sector for which it meets the above standards.

Implementing regulations will specify the application procedures.   NMFS will maintain a list of vessels or issue a certificate to vessels that qualify for participation in each sector.

[Note: Sections 11.5 – 11.7 are proposed to be re-numbered as Sections 11.6 – 11.8, but would otherwise be unchanged by Amendment 15; therefore, they are not provided here.]

Agenda Item G.5.b
Supplemental Attachment 3
September 2007

NMFS REPORT FOR AMENDMENT 15
REQUEST FOR COUNCIL CONSIDERATION OF A REVISION TO FMP LANGUAGE

When the Council adopted Amendment 6 to the FMP in 1991, it determined in Section 4.10, "Permit Renewal Provisions," that 60 days should be allowed for the annual limited entry permit renewal period, "in order to provide permit holders with a sufficient window in which to make their renewal application." Section 11.2.12, paragraph 1 of the FMP, sets this as October 1 through November 30.

The FMP at 11.2.12, paragraph 2., states "*Notice of upcoming renewal periods will be sent by September 1 each year to the most recent address as provided to the permit issuing authority by the permit holder. It shall be the permit holder's responsibility to provide the permit issuing authority with address changes in a timely manner.*" This paragraph is implemented in Federal regulations at 50 CFR 660.335(a)(2), "*Notification to renew limited entry permits will be issued by SFD prior to September 1 each year to the most recent address of the permit owner. The permit owner shall provide SFD with notice of any address change within 15 days of the change.*" This provision has been in place since 1992, although neither Amendment 6 nor the implementing regulations provide any rationale for the choice of the September 1st renewal date.

NMFS requests that the Council consider a revision to the FMP so that 11.2.12, paragraph 2 states that "*Notice of upcoming renewal periods will be sent by* ***September 15*** *each year…*"

NMFS's Fisheries Permits Office (FPO) would prefer to send permit renewal notices by **September 15** for two reasons:

- The Federal fiscal year begins October 1st. When FPO sends permit renewal notices by September 1st, many permit owners diligently renew their permits as quickly as possible, often sending renewals and fees by mid-September. FPO deposits funds received immediately, in keeping with good accounting practices. As a result of this one-month lag between renewal notices and fiscal year start date, each renewal period inevitably includes funds received in two separate fiscal years. Moving the renewal date to September 15th would aid FPO by ensuring that funds received to renew periods for a particular fishing year are credited to the applicable fiscal year.
- September 1st is the start of a two-month cumulative limit period, which means that the week just prior to September 1st is filled with permit transfers by permit owners wishing to move their permits to new boats for the start of the September-October cumulative limit period. This particular cumulative limit period is often active for permit transfers, since it is the last cumulative limit period that also falls within the April – October primary tier sablefish fishing season. Moving the renewal date to September 15th would allow FPO to process last-minute permit transfer requests before sending renewal notification packets to permit owners. This will ensure that all renewal forms reflect the most recent changes to these permits.

Amendment 15 is considering revisions to Chapter 11 of the FMP. Although this issue is not connected to Amendment 15, that amendment does deal with permitting issues and it would be convenient to make this change along with the Amendment 15 revisions to Chapter 11.

Agenda Item G.5.b
Supplemental Attachment 4
September 2007

Amendment 15
Pacific Whiting Limitation
(Agenda Item G.5.b Attachment 1)

Draft environmental assessment prepared by
ODFW, NMFS, WDFW, and PFMC

Background

- The Council began work on Amendment 15 following the passage of the American Fisheries Act (AFA), suspending efforts in 2001.
- March 2006- Legislative Committee
- June 2006- Council heard public comment
- September 2006- Council approved emergency rule limiting AFA participation in the Pacific whiting fishery

Background Cont.

- March 2007- Council approved emergency rule limiting all participation in the Pacific whiting fishery
- April 2007- Council adopted Purpose and Need and range of alternatives
- June 2007- Council refined Purpose and Need and range of alternatives.

Goal of Proposed Action

Restrict introduction of additional harvest and at-sea processing capital in the fisheries, which could result in an accelerated race for fish.

Limitations of Proposed Action

- Entry limitations alone will not stop the current race for fish, but will prevent accelerated race
- Amendment 15 would be an interim measure until Amendment 20 or other consolidation program is implemented

Need for Action

New entry into all harvesting sectors of the directed Pacific whiting fishery and increased processing capacity is likely and has been observed in recent years

Analysis: General Information

- Analysis of shore-based sector conducted by ODFW
- Analysis of at-sea sectors conducted by NMFS
- Numbers differ in analyses conducted in other initiatives (e.g. Amendment 10, 2007 emergency rule, Intersector Allocation, Trawl Rationalization) due to criteria used in querying data

Defining Shore-based Catcher Vessel Participation

A vessel with a limited entry trawl-endorsed permit and using mid-water trawl gear made at least one whiting delivery to a shoreside whiting processor during the primary whiting season.

Defining Catcher Vessel Mothership Participation

A vessel made at least one delivery to a mothership whiting processor during the at-sea processing season.

Defining Catcher/Processor Participation

– Significant participation: A vessel caught and processed whiting at least 1,000 metric tons (mt) of whiting in any one qualifying year

Defining Mothership Vessel Participation

– Significant participation: A vessel received and processed at least 1,000 mt of whiting in any one qualifying year.

Qualifying Start Dates

- 1994 – First year of the West Coast limited entry program
- 1997 – Represents the year in which the at-sea allocation was specifically divided into catcher/processor and mothership allocations.

Qualifying End Dates

- January 1, 2006 reflects the fishery through the 2005 season
- January 1, 2007 reflects the fishery through the 2006 season

Alternatives

Table 1 (page 13)

Status quo (No Action)

- Any vessel with a West Coast limited entry groundfish permit with a trawl endorsement (176 existing permits) could participate
- New un-permitted vessels would need to purchase trawl endorsement permit(s) adequate to the size of the vessel

Alternative 1A

Includes participation through the 2005 season

All vessels required to have sector specific participation between January 1 1994 & January 1, 2006

Catcher/processor & motherships required to have significant participation*

* Significant: For catcher/processors having caught and processed at least 1,000 mt of whiting in any one qualifying year. For motherships, having received at least 1,000 mt of whiting in any one qualifying year.

Alternative 1B

Includes participation through the 2005 season

Shore-based and mothership catcher vessels required to have sector specific participation between January 1 1994 & January 1, 2006

Catcher/processor & mothership vessels required to have significant sector specific history of participation between January 1, 1997 & January 1, 2006*

* Significant: 1,000 mt criteria

Alternative 2A

Includes participation through the 2006 season

All vessels required to have sector specific participation between January 1, 1994 & January 1, 2007

Catcher/processor & motherships required to have significant participation*

* Significant: 1,000 mt criteria

Alternative 2B

Includes participation through the 2006 season

Shore-based and mothership catcher vessels required to have sector specific participation between January 1, 1994 & January 1, 2007

Catcher/processor & mothership vessels required to have significant sector history of participation between January 1, 1997 & January 1, 2007*

* Significant: 1,000 mt criteria

Alternative 3

Includes participation through the 2006 season
2007 E-Rule (72 CFR 27759) criteria

All vessels required to have sector specific participation between January 1, 1997 & January 1, 2007

Note: For catcher/processors and motherships no significant historical criteria required

Alternatives Considered But Rejected

- Only restrict participation by AFA-permitted vessels in the whiting fishery
- Restrict participation by AFA-permitted vessels in the non-whiting groundfish fisheries

Alternative Results

Table 2. Number of eligible vessels by sector and alternative

Vessel Category	Alternative 1A 1/1/94-1/1/06	Alternative 2A 1/1/94-1/1/07	Alternative 3 1/1/97-1/1/07
Shore-based catcher vessels	56	63	56
Mothership catcher vessels	64	64	39
Catcher/processor	11	11	10
Mothership	~~10~~ 7	~~11~~ 8	7
	Alternative 1B 1/1/97-1/1/06	Alternative 2B 1/1/97-1/1/07	
Catcher/processor	10	10	
Mothership	6	7	

Alternative Results Cont.

Modified Table 2. Summary of participation levels by sector and alternatives, compared to recent season participation

	ACTION ALTERNATIVES			RECENT SEASON PARTICIPATION	
Vessel Category	Alternative 1A 1/1/94-1/1/06	Alternative 2A 1/1/94-1/1/07	Alternative 3 1/1/97-1/1/07	2005	2006
Shore-based catcher vessels	56	63	56	29	37
Mothership catcher vessels	64	64	39	18	20
Catcher/processor	11	11	10	6	9
Mothership	~~10~~ 7	~~11~~ 8	7	5	6
	Alternative 1B 1/1/97-1/1/06	Alternative 2B 1/1/97-1/1/07			
Catcher/processor	10	10		6	9
Mothership	6	7		5	6

Consequences of Status quo

Increased harvest and at-sea processing capital could

– reduce the per vessel value for the historical participants,

– have undesirable consequences on overfished and protected species, and

– result in a fishery that is more costly and difficult to manage in an effective manner.

Consequences of Action Alternatives

- Catcher vessels without history may be excluded
- Catcher-processors and motherships without significant participation may be excluded
- Vessels that did not qualify for a particular sector would be ineligible to participate in that sector in the future.
- Hardships in contracting with additional catcher vessels in the future.

Effects

- Physical Environment
- Biological Environment
- Management Structure
- Economic (Changes in Fishery Harvests and Values)

Effects on the Physical Environment

- Actions are administrative in nature (i.e., limiting entry) are not expected to change current fishing areas (i.e., pelagic water) or gear used (i.e., midwater gear).

Effects on the Biological Environment

Direct effects resulting from action may include changes in species mortality levels resulting from implementation of the alternatives.

Biological Effects – Status Quo

- The fishery would likely occur earlier in the year:
  - Smaller fish, more scattered
- Overfishing could result
- Increased interactions between fishing vessels and protected species

Biological Effects – Action Alternatives

- Additional protection to overfished species of rockfish and salmon
- Reduction in bycatch likely
- Increased fishery stability
- Reduced likelihood of high salmon bycatch.
- Less likelihood of an early closure of the whiting fishery

Non-Groundfish Species

The alternative actions are not expected to affect non-groundfish species in any way.

Protected Species

The alternative actions are expected to minimize the risk of excessive bycatch of salmon in the whiting fishery, by reducing pressure to fish early in the season when salmon bycatch is highest.

Changes in Management Structure of the Fishery

None of the alternatives would revise whiting harvest levels, monitoring procedures, season dates, inseason management processes, or inter-sector allocations.

Changes in Fishery Harvests and Values

- Pacific whiting fishery is in overcapacity status (U.S. Department of Commerce, 2006).
- Action alternatives provide an opportunity to avoid additional capacity.

Changes in Fishery Harvests and Values – Status quo

New entry encourages more intensive fishing (i.e., accelerated race for fish)

- greater likelihood of intensive fishing occurring early in the season and resulting in higher bycatch rates (PFMC and NMFS, 2006).
- Can cause substantial economic waste in the form of higher than necessary costs of production and reduced net benefits to society (Department of Commerce, 2006).

Summary of Benefits of Alternatives

To the extent that further limiting entry in the whiting fishery provides biological, economic, and environmental benefits, alternatives with the fewest number of participants likely have the greatest amount of benefit

Modified Table 2. Summary of the likelihood of providing biological or economic benefits and the numbers of eligible vessels by sector and alternative.

Vessel Category	Status Quo	Alternative 1A 1/1/94-1/1/06	Alternative 2A 1/1/94-1/1/07	Alternative 3 1/1/97-1/1/07
Shore-based catcher vessels	Least (Unlimited[1])	Most (56)	Moderate (63)	Most (56)
Mothership catcher vessels	Least (Unlimited[1])	Moderate (64)	Moderate (64)	Most (39)
Catcher/processor	Least (Unlimited[1])	Moderate (11)	Moderate (11)	Most (10)
Mothership	Least (Unlimited[1])	Moderate (7)	Moderate (8)	Moderate (7)
		Alternative 1B 1/1/97-1/1/06	Alternative 2B 1/1/97-1/1/07	
Catcher/processor		Most (10)	Most (10)	
Mothership		Most (6)	Moderate (7)	

[1]Unlimited means that participation limitation is not specified in rule. Participation may realistically be limited by other factors such as infrastructure requirements or permit restrictions.

Council Action

- Council Action: Review the draft EA and adopt a final preferred alternative on participation limitation in the Pacific whiting fishery

End of Presentation

Status quo (No action)	**Alternative 1** **(includes participation through the 2005 season)**	**Alternative 2** **(includes participation through the 2006 season)**	**Alternative 3** **(2007 E-Rule 72 CFR 27759)**
Harvest capacity limited only by the number and availability of limited entry permits with trawl endorsements: Catcher vessels in the shore-based and mothership sectors and catcher/processors must be registered to a Pacific coast groundfish limited entry permit with a trawl endorsement Processing capacity in the mothership and shore-based sectors are not limited.	**Alternative 1A**- All vessels required to have sector specific participation between January 1 1994 & January 1, 2006 Catcher/processor & motherships required to have significant participation a/	**Alternative 2A**- All vessels required to have sector specific participation between January 1, 1994 & January 1, 2007 Catcher/processor & motherships required to have significant participation a/	All vessels required to have sector specific participation between January 1, 1997 & January 1, 2007
	Alternative 1B – Shore-based and mothership catcher vessels required to have sector specific participation between January 1 1994 & January 1, 2006 Catcher/processor & mothership Vessels required to have significant sector specific history of participation between January 1, 1997 & January 1, 2006 a/	**Alternative 2B** - Shore-based and mothership catcher vessels required to have sector specific participation between January 1, 1994 & January 1, 2007 Catcher/processor & mothership Vessels required to have significant sector history of participation between January 1, 1997 & January 1, 2007 a/	

a/ Significant participation means that at least 1,000 metric tons were processed by a mothership or caught and processed by a catcher/processor in any one qualifying year

GROUNDFISH ADVISORY SUBPANEL REPORT ON AMENDMENT 15: PARTICIPATION LIMITATION IN THE PACIFIC WHITING FISHERY

The Groundfish Advisory Subpanel (GAP) discussed at-length the alternatives for limiting entry to the whiting fishery under Amendment 15. A consensus of the GAP recommends that the Council adopt Alternative 2A as a preferred alternative to implement Amendment 15 for the 2008 whiting season. The GAP generally agrees that a chaotic derby fishery with detrimental effects on current participants may occur in 2008 with or without this action and some GAP members have concerns about aspects of Amendment 15 in its current form.

Qualifying vessels versus permits

Some members of the GAP believe strongly that the license limitation program should be based on permits and permit history not vessels. The GAP realizes that basing the program on vessels was appropriate when the goal of Amendment 15 was to prevent American Fisheries Act (AFA)-qualified vessels without prior participation in the whiting fishery from entering. However, continuing to use vessels has many adverse affects. For example, one permit could have qualified several vessels, some of the vessels that qualify are no longer involved with West Coast fisheries, qualifying vessels may have sunk or been scrapped, and permit holders who sold vessels, but retained the permits with whiting history would be excluded. Lastly, using vessels to identify participants is inconsistent with the trawl rationalization program.

Expansion of program to include all vessels in lieu of AFA-qualified vessels without prior participation

Some members of the GAP believe that expanding the program beyond AFA is a mistake. While the GAP hesitantly agreed to limit all vessels for the emergency rule, there is more consternation over the expansion with regards to an interim program. In particular, some of the options allow the AFA catcher vessels that should have been prevented from participating in the fishery to be included, while long-time West Coast trawl vessels are excluded.

Alternatives do not prevent increase in capacity

All alternatives still allow the potential of a significant numbers of catcher vessels to enter the 2008 fishery and some members of the GAP believe that the intent of the action is not being met.

Other potential impacts

The GAP has heard from one small trawl vessel using new and innovative techniques to increase revenue from the whiting they harvest. Amendment 15 could potentially adversely affect these fishermen because their harvesting process includes heading, gutting and tailing their catch. Current definitions classify this operation as processing. These fishermen believe their concerns could be addressed by National Marine Fisheries Service expanding the definition of H & G product. The GAP suggests that NMFS should review this situation and consider revising the H & G definition to address potential impacts to this one vessel.

Interim Measure

The GAP believes the EA language describing the action as an interim measure should be expanded to include verbiage that makes clear that inclusion in the interim measure does not guarantee future participation and/or inclusion in the trawl rationalization program.

PFMC
09/12/07

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON AMENDMENT 15: PARTICIPATION LIMITATION IN THE PACIFIC WHITING FISHERY

The Scientific and Statistical Committee (SSC) reviewed "Environmental Assessment of Management Measures to Prevent Harm to the Pacific Whiting Fishery" (Agenda Item G.5.b, Attachment 1, September 2007).

The following table summarizes information from the Environmental Assessment (EA) regarding limited entry provisions under the status quo, the number of entities qualifying for a whiting endorsement under each alternative to the status quo, and actual participation in 2005 and 2006.

	CatcherProcessrs	Motherships(MS)	MSBoats	ShoreBasedBoats
Status Quo	Coop	No lim entry (LE)	176 LE permits (derby)	
Alt 1a	11	7*	64	56
Alt 1b	10	6		
Alt 2a	11	8*	64	63
Alt 2b	10	7		
Alt 3	10	7	39	56
2005Partcpn	6	5	18	29
2006Partcpn	9	6	20	37
* Corrections to EA conveyed to SSC by G. Kirchner (ODFW).				

Bycatch rates for salmon and overfished rockfish tend to be higher in the spring than later in the season. According to the EA, whiting participation is expected to be higher under the status quo relative to the other alternatives, which could lead to more early season fishing. Potential biological and economic effects associated with this acceleration of fishing activity cited in the EA include: higher salmon and rockfish bycatch, earlier achievement of the shore-based whiting allocation, lower revenue and higher cost per vessel, more pressure on other fisheries once the whiting fishery closes, potentially adverse effects on boats that have few alternatives to whiting, and disruption of processing activity. Little evidence is provided in the EA to substantiate these effects.

Underlying the analysis of biological and economic effects is the assumption that alternatives to the status quo would be more effective than the status quo in preventing acceleration of the derby fishery. The validity of this assumption is not clear in the EA. Specifically, of the 176 catcher boats that hold limited entry permits, only a small number participated in the whiting fishery in 2005-2006 (years of record high revenues and prices). While the alternatives to the status quo would cap whiting participation, the number of mothership and shoreside catcher boats qualifying for a whiting endorsement under each alternative is considerably higher than recent participation and (depending on the alternative) would allow for a doubling or tripling of current participants. In order to demonstrate that the alternatives prevent acceleration of the derby fishery relative to the status quo (as asserted in the EA), it will be important that the EA include a discussion of why participation would increase even more under the status quo than the doubling or tripling allowed under the alternatives.

The focus of the EA on preventing acceleration of the race for fish appears to pertain to the mothership and shoreside sectors (which are derby fisheries). The effects of the alternatives may be quite different for the catcher-processor sector, which is not a derby fishery. The catcher-processor sector operates under the auspices of the Pacific Whiting Conservation Cooperative (PWCC), which engages in coordinated efforts to limit effort and reduce bycatch. Entry of non-PWCC catcher-processors may or may not transform this sector from a rationalized to a derby fishery. The economic implications of the alternatives for this sector should be addressed in the EA.

The objective of Amendment 15 is "to develop conservation and management measures to protect the West Coast non-tribal Pacific whiting fishery and the participants in the fishery from adverse impacts caused by vessels with no sector-specific historical participation in the Pacific whiting fishery. The proposed limitations on entry are intended to restrict introduction of additional harvest capital in the fisheries, which could result in an accelerated race for fish" (p. 9). Relative to this objective, it is not clear that the status quo will result in an accelerated race for fish relative to the other alternatives. It is also not clear why limited entry for motherships is included among the alternatives, at least as it relates to the race for fish; if there are other reasons for such mothership restrictions, they should be documented in the EA. As indicated above, one area where the alternatives may yield changes in economic efficiency relative to the status quo is the catcher-processor sector. Other than that, the fundamental issue addressed by the amendment appears to be one of distributional equity.

PFMC
09/13/07

UNITED CATCHER BOATS
UCB
Washington · Oregon · California · Alaska

September 10, 2007

Mr. Donald Hansen, Chairman
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220

RE: Agenda Item G.5: Amendment 15, Whiting Fishery Participation Limitation

Dear Chairman Hansen,

The members of United Catcher Boats wish to submit the following comments and recommendations to the Pacific Fishery Management Council (PFMC) regarding your final action on Amendment 15. We have reviewed the September 2007 draft of the Amendment 15 Environmental Assessment (EA) and believe the information presented in this analysis will help you make an informed decision on this issue. United Catcher Boats represents the interests of thirteen vessels that participate in the Shoreside and Mothership Pacific Whiting fishery.

1. **Amendment 15 is an Interim Measure** As you are aware, the Council has been developing an amendment package that will establish a quota-based management system for the Whiting and Non-Whiting trawl fisheries off the Pacific Coast (TIQ, Amendment 20). The Purpose and Need Statement for both Amendment 15, as well as the TIQ amendment are very similar as they both seek to address current conservation risks and management problems caused by sector-specific overcapacity which fosters derby operations, aggravating overfishing, bycatch and economic stability. Both specifically seek to protect participants from adverse impacts caused by vessels without sector specific significant historical participation in the whiting fishery. The proposed limits of both are intended to restrict introduction of additional participation which would accelerate the race for fish. However, Amendment 15 only provides one tool to solve the problem, and this is to limit effort. Though this will help, UCB believes that the real solution to the current problems facing participants in the Whiting fishery is through implementation of a trawl rationalization program. We ask that you stipulate that the Amendment 15 regulations sunset upon implementation of a trawl rationalization program and commit to moving forward expeditiously with development and approval of Amendment 20.

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2. **Recommend Alternative 3 for the Catcher Vessels (CVs) that deliver to Motherships; Alternative 2 for the CVs that deliver to Shoreside Processors; and Alternative 3 for Mothership Processors and Catcher Processors.** United Catcher Boats suggests these final alternatives be adopted by the PFMC for the following reasons.

The current Emergency Rule regulation that limits effort into the 2007 Whiting fishery expires after this year. We feel that any permanent, follow-up action by the PFMC should be very similar to the current Emergency Rule regulation in order to incorporate the Council's request for an Emergency Rule as well as the rational for NMFS approval of the Emergency Rule. Alternative 3 is the same as the current Emergency Rule.

Secondly, in review of the Purpose and Need statement of the Amendment 15 EA (pages 9, 10), the theme of this action is to limit new, additional effort into the fishery, not to restrict or exclude current participants. The EA points out that additional, new effort will flow into the fishery due to: recent favorable market conditions, a reduction in the Whiting OY, limited opportunities in the non-whiting trawl fishery, and declining North Pacific Pollock quotas. The reason to limit new effort is because if not constrained, additional participants will lead to overcapacity in the fishery and this overcapacity leads to destructive derby operations and undermines the economic performance of the harvesting sector.

The key phase to consider is "current participants". Previous Council action and record on this issue via recommendations for the Emergency Rule that NMFS implemented in 2007 define current participants as those vessels who participated in the whiting sectors between January 1, 1997 and January 1, 2007. The NMFS did not approve a previously requested Emergency Rule that the PFMC made to the NMFS in September 2006 that would have defined current participants as those vessels that had landings through December 31, 2005. In their January 11, 2007 letter to the PFMC explaining why they did not approve the Council's request, the NMFS provided information about the additional participation in 2006 for the shoreside sector. Of the 39 shoreside whiting exempted fishing permits issued in 2006, 15 were held by AFA-endorsed vessels and of these 15 AFA vessels, four were new participants in the 2006 shoreside whiting fishery. Of the four new AFA vessel participants, only one was newly associated with a Groundfish limited entry permit in 2006. Two of these four vessels used limited entry permits that had very lengthy history in the shoreside whiting fishery. One of the four only participated in 2006 and did not return to the shoreside fishery in 2007.

Shoreside CVs Alternative 3 will allow 56 vessels to be eligible to participate in the shoreside whiting fishery. Alternative 2A will allow 63 vessels, and Alternative 1A will allow 56 vessels to participate. It is important to note that actual participation is much lower than the number of vessels that will be eligible, regardless of which alternative is chosen. Table 15 on page 44 of the EA shows the range of the number of vessels participating in the shoreside whiting fishery over the 1994 – 2006 period is 26 to 41 vessels. In 2006, 37 vessels participated.

We request the Council choose Alternative 2 for the Shoreside CV category because this allows the current participants the ability to continue to participate in the fishery. The last paragraph on page 70 of the EA nicely summarizes why maintaining the current state of capacity is beneficial. Average revenues per vessel would not be reduced by new entrants and associated impacts on the shoreside processing sector and on dependant fishing communities would be avoided. Choosing Alternative 1 for the Shoreside CV sector would disrupt the revenues going to the current vessels participating and will cause impacts to the shore plants dependant on the current fleet that have markets with these plants.

Mothership CVs Comparing the actual number of vessels that have participated verses the number that will qualify to participate under the three alternatives for the Mothership sector shows a very large range. Table 11 on page 41 shows the number of vessels that participated in the Mothership sector from 1994 – 2006. That number has ranged from a high of 43 in 1994 to a low of 10 in 2004, and 20 in 2006. Comparing the number of vessels that participated to the number of vessels that qualify under the three alternatives is alarming. Either Alternative 1A or Alternative 2A allow 64 vessels to participate in the Mothership sector, while Alternative 3 will allow 39 vessels to participate. We feel that allowing three times the current level of effort to participate in the Mothership sector is very destabilizing and goes counter to the Purpose and Need Statement of this amendment. That is why we ask the Council to choose Alternative 3 for the Mothership CV sector.

We ask the Council to continue to work expedisously on the Amendment 20 analysis and take final action on this rationalization program as soon as possible.

Thank you very much for your consideration of our comments.

Sincerely,

Brent Paine
Executive Director

FINAL CONSIDERATION OF INSEASON ADJUSTMENTS
(IF NECESSARY)

Consideration of inseason adjustments to ongoing groundfish fisheries may be a two-step process at this meeting. The Council will meet on Wednesday, September 12, 2007, and consider advisory body and public advice on inseason adjustments under Agenda Item G.3. If the Council elects to make final inseason adjustments under Agenda Item G.3, then this agenda item may be cancelled, or the Council may wish to clarify and/or confirm these decisions. If the Council tasked advisory bodies with further analysis under Agenda Item G.3, the Council task under this agenda item is to consider advisory body advice and public comment on the status of ongoing 2007 groundfish fisheries and recommended inseason adjustments for 2007 groundfish fisheries prior to adopting final changes as necessary.

Council Action:

1. Consider information on the status of ongoing fisheries.
2. Adopt inseason adjustments as necessary.

Reference Materials: None.

Agenda Order:

a. Agenda Item Overview — Merrick Burden
b. Report of the Groundfish Management Team (GMT) — Kelly Ames
c. Agency and Tribal Comments
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Adopt or Confirm Final Adjustments to 2007 Groundfish Fisheries

PFMC
08/16/07

GROUNDFISH MANAGEMENT TEAM (GMT) REPORT ON CONSIDERATION OF FINAL INSEASON ADJUSTMENTS

The Council requested that the GMT further consider inseason adjustments to commercial fisheries. The GMT processed those requests and provides the following considerations and recommendations.

Open Access

Sablefish Daily Trip Limit (DTL) 36°- 40°10' N Lat.

The GMT evaluated this year's sablefish catch attainment relative to the open access (OA) harvest guideline for the area north of 36° N latitude in the QSM report. Current catches are on track and the fishery is projected to attain their full allocation. Providing a modest increase in the bi-monthly DTL limit (i.e., 100 lbs) risks exceeding the open access allocation. The GMT notes the highest sablefish catches occur in periods 4 and 5 and therefore expect sablefish catches to increase over the current period. Although the GAP indicated that this fishery operates at 300 fm at this time of the year, the GMT does not have any data in which to assess bycatch rates. **Therefore, with one of the highest catch periods remaining and the lack of any extra available yelloweye in the scorecard, the GMT does not recommend increasing the DTL bi-monthly limit.**

Limited Entry Non-Whiting Trawl

Based on the most recent catch data, target species catches in the non-whiting trawl fishery are progressing more slowly than anticipated. Under status quo management measures it is anticipated that the catch of all target species will be less than the allowable catch level (see Table 4). Based on this information, as well as the status of other fisheries, the GMT considered inseason adjustments to the non-whiting trawl fishery that would increase catch levels without exceeding the OYs.

Impacts of Re-opening the Shoreward Areas North of Cape Alava and between Humbug Mt and Cape Arago

During the initial inseason session, changes to the California recreational fishery were adopted by the Council which resulted in a revised scorecard (Agenda Item G.3.b Supplemental GMT Report Attachment 2). In this scorecard, the canary balance is 3.4 mt. Based on this information, the GMT explored options that would re-open the areas off Washington and Oregon that were closed to the non-whiting trawl fishery in April. Reopening these areas take an additional 1.7 mt of canary rockfish but are not expected to increase yelloweye impacts. Table 5 reflects the changes in the RCA adjustments. This table shows that those areas closed earlier this year would be open to 75 fathoms starting October 1 through the end of the year.

Trip Limit Adjustments

The GMT analyzed options that would increase opportunities for sablefish, Dover sole, shortspine thornyheads, Other Flatfish, petrale sole in the north, longspine thornyheads in the south, and southern slope rockfish. Table 6 outlines proposed cumulative limit adjustments to the non-whiting trawl fishery. These actions are expected to take 0.3 mt of canary.

Total Canary Impacts from Non-Whiting Trawl Adjustments
The combined analysis shows that if those areas shoreward of the trawl RCA north of Cape Alava and between Humbug Mountain and Cape Arago were re-opened, and if limits to the above mentioned target species were increased, the non-whiting trawl impacts to canary rockfish would be increased from 8.1 metric tons to 10.1 metric tons, leaving 1.4 metric tons available as a remainder in the scorecard (Table 7).

Limited Entry Trawl Whiting
The Council asked the GMT to consider and respond to several questions regarding the potential re-opening of the whiting season. The questions and responses are detailed below.

What amount of canary, widow, and darkblotched mortality could be expected with the 150 fm line?
The GMT discussed methods to estimate the amount of canary rockfish that might be taken if the whiting fishery re-opened deeper than 150 fm to further assist the Council in assessing risk. First, we calculated the amount of canary that would be taken if the sector specific bycatch rates observed in the 2007 fishery thus far were applied to the amount of whiting left in each sector's allocation. This calculation results in an estimated canary catch of 1.68 mt needed to prosecute the remaining 50,055 mt of whiting (Table 1).

Table 1. Estimated canary impacts based on 2007 bycatch rates and remaining whiting allocations. Data from this table was taken from Agenda Item G.2.b (NMFS Preliminary Report #6 – 2007 Whiting Fishery)

Sector	Whiting Catch (mt)	Canary Catch (mt)	Canary Rate	Whiting Allocation (mt)	Whiting Left (mt)	Projected Canary (mt)
Shoreside	67,897	2.01	0.00003	87,398	19,501	0.58
Catcher Proc.	42,330	1.62	0.00004	70,751	28,421	1.09
Mothership	47,809	0.35	0.00001	49,942	2,133	0.02
Total	158,036			208,091	50,055	**1.68**

Since this calculation reflects a fishery that occurred without depth restrictions and includes the accelerated canary bycatch rates that occurred at the end of the shoreside season, the GMT suggests that this estimate might be considered as a high bound estimate for a fishery restricted deeper than 150 fm. If the fishery were limited to depths greater than 150 fm the increase in canary bycatch rates observed during the last week of the 2007 season would diminish since canary encounters are less frequent in deeper waters.
The GMT also notes that shifting all effort outside 150 fm will likely reduce the frequency and magnitude of canary catches, but will not eliminate canary impacts entirely.

In order to estimate potential canary savings from a fishery prosecuted deeper than 150 fm, the GMT examined canary bycatch rates in the 2004-2006 at-sea whiting fishery by depth. Assuming similar rates in the shore-based fishery, canary bycatch rates deeper than 150 fm for the total fishery were 41.1% of the rate for tows conducted in a fishery without a depth restriction. Applying this rate to the 1.68 mt estimated from an all-depth fishery results in an estimated catch of 0.69 mt of canary rockfish in the fishery if the remaining whiting OY is taken.

Additionally, the GMT reviewed the NMFS trawl survey results and found that the occurrence of canary rockfish in the trawl survey drops off substantially at depths deeper than 100 fathoms (as shown in the figure below), though it should be noted that this survey uses bottom trawl gear which has a different interaction with groundfish species than midwater trawl gear.

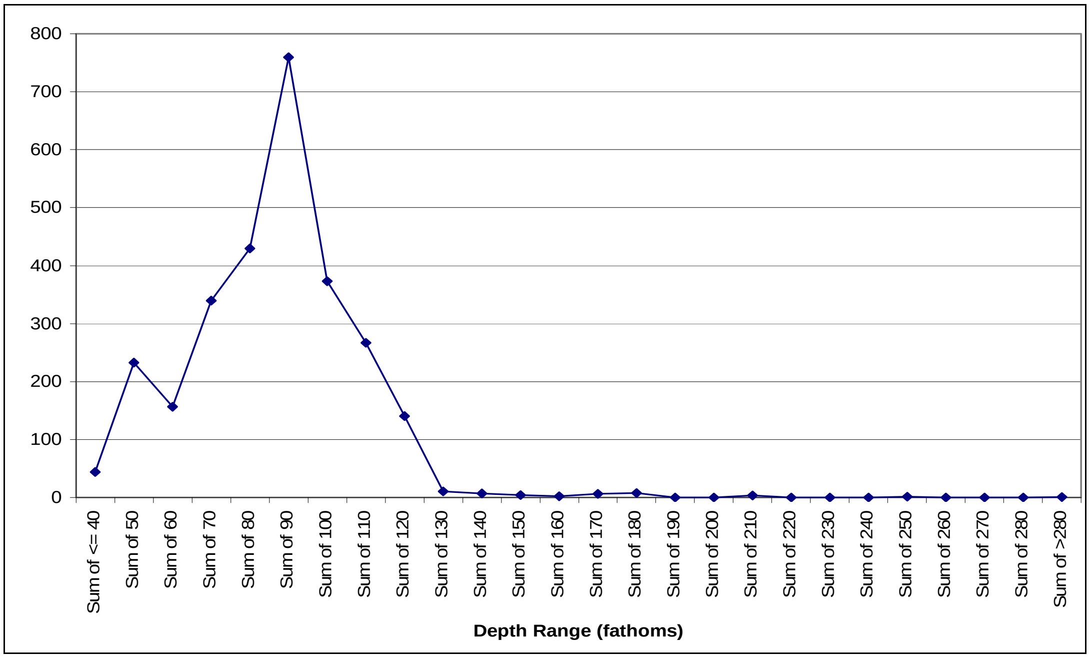


Figure 1. Depth-Based Catch of Canary Rockfish in the NMFS Trawl Survey

The GMT implemented a similar methodology as that used for canary to determine the amount of widow and darkblotched rockfish that might be taken if the whiting fishery re-opened. We calculated the amount of widow and darkblotched that would be taken if the sector specific bycatch rates observed in the 2007 fishery thus far were applied to the amount of whiting left in each sector's allocation without the implementation of a 150 fm restriction. This calculation results in an estimated widow catch of 77.35 mt and an estimated 4.98 mt of darkblotched rockfish needed to prosecute the remaining 50,055 mt of whiting without a 150 fathom restriction (Table 2).

Table 2. Estimated widow and canary impacts based on 2007 bycatch rates and remaining whiting allocations. Data from this table was taken from Agenda Item G.2.b (NMFS Preliminary Report #6 – 2007 Whiting Fishery)

	Whiting Catch (mt)	Widow Catch	Widow Rate	D.Blotch Catch (mt)	D.Blotch Rate	Whiting Allocation (mt)	Whiting Left (mt)	Projected Widow (mt)	Projected D.Blotch (mt)
S.S	67,897	90.27	0.00133	0.8	0.00001	87,398	19,501	25.93	0.23
C.P	42,330	71.74	0.001695	6.73	0.00016	70,751	28,421	48.17	4.52
M.S.	47,809	72.99	0.001527	5.25	0.00011	49,942	2,133	3.26	0.23
Total	158,036					208,091	50,055	**77.35**	**4.98**

The GMT discussed developing a depth-based estimate of widow rockfish that would show the amount of widow expected to be taken if a 150 fathom line were to be implemented. Based on the distribution and variability of the widow rockfish catch in the whiting fishery, the GMT believes that a model of depth related savings (as was done for canary rockfish) was not appropriate and therefore did not pursue that methodology further. However, it may be reasonable to assume the darkblotched catch rate will increase if the fishery operates outside 150 fathoms.

When the Council chose to manage the whiting fishery with bycatch limits, the intent was to close the fishery when the bycatch limit is reached. This methodology was chosen because projecting bycatch estimates can be difficult and could result in premature closure of the fishery. This year, the whiting fishery was closed when the widow bycatch limit of 220 mt was estimated to have been reached. The post-season estimate indicated that the bycatch limit was exceeded by 21.6 mt. If the Council chooses to re-open the whiting fishery and the fishery experiences similar widow rockfish encounters, it may be reasonable to assume the limit could be exceeded by 21.6 mt again. Therefore, the GMT recommends that any Council action take into account the magnitude of potential bycatch limit overages in order to protect against exceeding an OY.

Explore Early and End of Season Bycatch Patterns
Some insight of fishery bycatch trends over time is also documented in the 2007 Environmental Assessment that accompanied the emergency rule to restrict participation in the whiting fishery (Emergency rule to implement measures to prohibit entry of new vessels to the directed fishery for Pacific Whiting in the Exclusive Economic Zone off the West Coast in 2007: Environmental Assessment and Regulatory Impact Review). Bycatch rate trends by fishery and over time are described for widow, and for other rebuilding species and recently rebuilt species ("other species" is primarily canary and darkblotched rockfish, but also includes Pacific Ocean perch, yelloweye, bocaccio, and lingcod). For data collected from the shoreside whiting fleet between 2004 and 2006, widow rockfish bycatch rates are highly variable with a notable trend towards lower bycatch rates late in the season. However, for "other" rebuilding species there is no obvious trend; possibly as declines in the bycatch of shelf rockfish (e.g., canary) are often associated with increased bycatch of slope species (e.g., darkblotched). Similarly, both mothership and catcher-processor sectors show highly variable bycatch rates over time, although both have a tendency towards reduced bycatch rates of both widow and other rebuilding rockfish throughout the course of the season.

The GMT evaluated an early and late season changes in bycatch rates across years. The GMT had difficulty teasing out the early season learning curve from the biological changes related to seasonality in fish aggregations, and therefore the GMT is unable to estimate the effect of the learning curve on bycatch rates. However, by utilizing the 2007 bycatch rates from the entire year in the projected impacts of re-opening the fishery, the learning curve effect is inherently incorporated.

In conclusion, given our best attempts to analyze bycatch trends in the whiting fishery, it is difficult to predict bycatch events and provide the Council with an explicit recommendation for the amount of canary that could be taken in a fall whiting fishery. The GMT recommends that any Council action take into account the magnitude of potential bycatch limit overages in light of the remaining OYs and the current bycatch limit management structure.

Estimate of Undocumented Discard

The Council requested that the GMT revisit and attempt to quantify the undocumented discard identified that the Enforcement Consultants' report (Agenda Item G.3. c, Supplemental EC Report). After further discussion, the GMT again concluded that it was not possible to quantify the bycatch that may have occurred from other potential illegal activity in the 2007 whiting fishery. The general lack of quantitative information available to the team, the ongoing nature of investigations, and the assumptions the team would be required to make in the analysis, make assessing the impact impossible. However, the team notes that there is a likelihood that some undocumented amount of mortality may have occurred for all three bycatch limit species.

What Fisheries Could be Impacted by Canary Overages?

Table 3 outlines the West Coast fisheries that could be impacted by the whiting fishery exceeding the canary bycatch limit.

Table 3. Fisheries that could be impacted by canary overages in the whiting fishery

Fishery	Canary Metric Tons through the end of the year (prior to Final Inseason)	Expected Closure Date
2007 Canary OY	44.0	
Limited Entry Trawl- Non-whiting	8.1	
-Shoreward of RCA		on going
Limited Entry Fixed Gear		
Sablefish	1.1	on going
Non-Sablefish		on going
Open Access: Directed Groundfish		
Sablefish DTL	0.2	
Nearshore (North of 40°10' N. lat.)	1.7	on going
Nearshore (South of 40°10' N. lat.)		on going
Other	1.0	on going
Open Access: Incidental Groundfish		
Pink shrimp	0.1	Close Oct. 31
Ridgeback prawn	0.1	Close Oct. 31
Salmon troll	0.2	Bubble fisheries
Recreational Groundfish		
WA	5.7	on going
OR		on going
CA	10.1	on going

Note: most of the estimated canary impacts have been taken by October 1.

How Soon Could the Whiting Fishery be Closed?

In recent years, the whiting fishery has been closed upon attainment of the whiting sector allocations. The GMT discussed with NMFS staff what methods were used in July 2007 to close the whiting season in a timely manner after reaching the 2007 widow bycatch limit. Upon NMFS receiving catch estimates indicating that the bycatch limit has been reached, they issued a notice that the fleet had 24 hours to stop fishing, (i.e. have gear stowed, and 48 hours to be back in port). NMFS would use similar procedures, as used in July 2007, to issue 24 hour notices to close the whiting fishery if a bycatch limit is estimated to have been reached.

Finally, the GMT comments that the scorecard is an estimate of projected catch. It is likely that the actual catch number will be somewhat different than the point estimate indicated in the scorecard. Therefore, the GMT would like to reiterate that some precaution is warranted in setting management measures because of the inherent uncertainty involved in predicting overfished species mortality.

GMT Recommendations

1. Consider adjustments to the non-whiting trawl fishery RCA boundaries in the area north of Cape Alava and between Humbug Mountain and Arago (Table 5).
2. Adopt trip limit changes to the non-whiting trawl fishery as outlined in Table 6 for implementation as close as possible to October 1.
3. Consider re-opening of the whiting fishery based on the additional GMT analysis presented in this report.

Table 4. Predicted Catch of Select Groundfish in the Non-Whiting Trawl Fishery Under Status Quo Management Measures

		North	South	Total	OY/HG/ Allocation
Rebuilding Species	Canary	7.1	1.0	8.1	
	POP	73.2	-	73.2	
	Drkbltch	191.8	30.3	222.0	
	Widow	1.6	0.0	1.6	
	Bocaccio	-	23.9	23.9	
	Yelloweye	0.4	0.0	0.4	
	Cowcod	-	1.4	1.4	
Target Species	Sablefish	1,769	369	2,138	2,651
	Longspine	651	322	827	2,220
	Shortspine	864	202	853	1,634
	Dover	7,845	1,750	9,595	16,500
	Arrowt'th	3,510	89	3,599	5,800
	Petrale	1,961	395	2,356	2,499
	Other Flat	1,089	422	1,510	4,884
	Slope Rock	131	155	286	1,786

Table 5. Proposed RCA Boundaries for the Non-Whiting Trawl Fishery North of 40°10' N. Lat.

Rockfish Conservation Area North of 40 deg 10 min Lat

	Jan-Feb	March-April	May-June	Jul-Aug	Septembr-Octobr	Nov-Dec
North of Alava			shore-150		shore-200	75-200*
Alava - Leadbetter			75-150		75-200	75-200*
Leadbetter - OR/WA Border			60-150		60-200	75-200*
OR/WA Border - Cascade Head	75-250*	75-250	75-150	75-200		75-200*
Cascade Head - Humbug Mt			75-200			75-200*
Humbug Mt - Cape Arago			shore-200			75-200*
Cape Arago - 40 deg 10 min Lat			75-200			75-200*

Note: a "*" indicates petrale areas

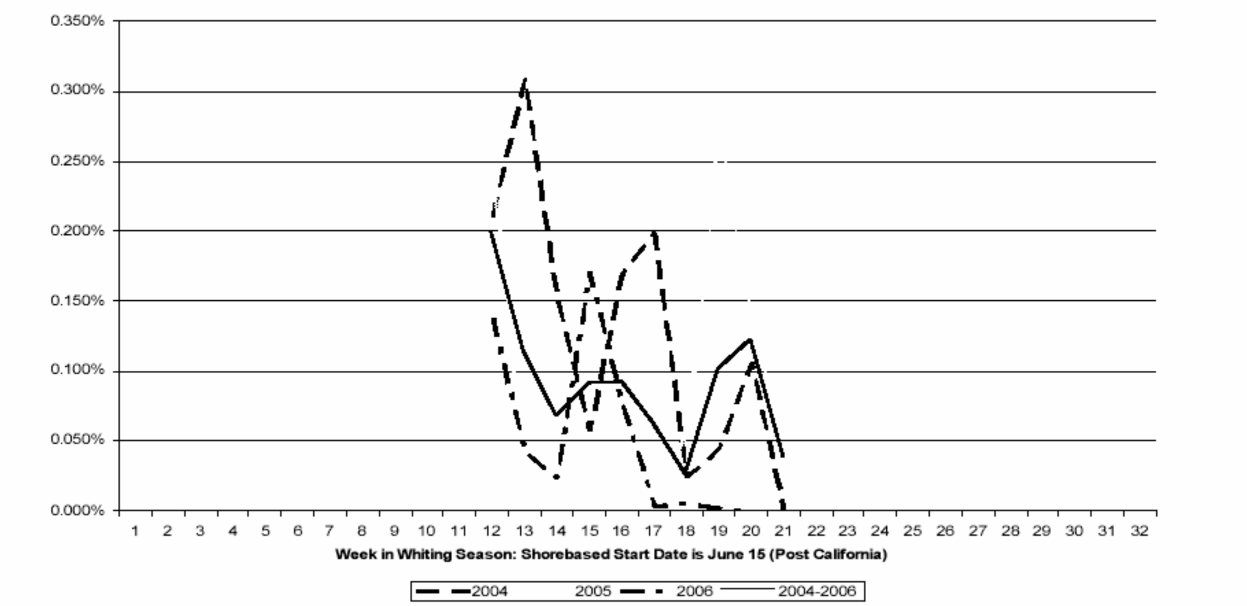
Table 6. Proposed Cumulative Limit Adjustments to the Non-Whiting Trawl Fishery

Area	Period	Shoreward Line	Seaward Line	Sable	Longspine	Shortsp	Dover	Othr Flat	Petrale	Arrowt'th	Slope Rock
N 40 10	1	75	150	13,000	22,000	7,500	80,000	110,000	50,000	100,000	4,000
	2			13,000	22,000	7,500	80,000	110,000	30,000	100,000	4,000
	3			15,000	22,000	10,000	60,000	110,000	20,000		1,500
	4	see attached table		15,000	25,000	10,000	60,000	110,000	20,000	Combined	1,500
	5		200	**22,000**	25,000	**12,000**	**95,000**	**150,000**	20,000	with Other	1,500
	6	75	200*	**22,000**	25,000	**12,000**	**95,000**	**150,000**	**40,000**	Flat	1,500
North Select Flatfish	1	75	150	5,000	3,000	3,000	40,000	90,000	16,000	90,000	4,000
	2			8,000	3,000	3,000	40,000	90,000	25,000	90,000	4,000
	3			5,000	3,000	3,000	38,000	70,000	20,000		1,500
	4	see attached table		5,000	3,000	3,000	38,000	70,000	20,000	Combined	1,500
	5		200	5,000	3,000	3,000	38,000	70,000	15,000	with Other	1,500
	6	75	200*	5,000	3,000	3,000	25,000	30,000	8,000	Flat	1,500
38 to 40 10	1	100	150	14,000	22,000	7,500	70,000	110,000	50,000	10,000	15,000
	2	100	150	14,000	22,000	7,500	70,000	110,000	30,000	10,000	15,000
	3	100	150	14,000	22,000	7,500	70,000	110,000	25,000		15,000
	4	100	150	14,000	22,000	7,500	80,000	110,000	25,000	Combined	10,000
	5	100	150	**22,000**	**25,000**	**13,000**	**95,000**	**150,000**	25,000	with Other	10,000
	6	100	150	**22,000**	**25,000**	**13,000**	**95,000**	**150,000**	50,000	Flat	15,000
S 40 10	1	100	150	14,000	22,000	7,500	70,000	110,000	50,000	10,000	40,000
	2	100	150	14,000	22,000	7,500	70,000	110,000	30,000	10,000	40,000
	3	100	150	14,000	22,000	7,500	70,000	110,000	25,000		40,000
	4	100	150	14,000	22,000	7,500	80,000	110,000	25,000	Combined	40,000
	5	100	150	**22,000**	**25,000**	**13,000**	**95,000**	**150,000**	25,000	with Other	**55,000**
	6	100	150	**22,000**	**25,000**	**13,000**	**95,000**	**150,000**	50,000	Flat	**55,000**

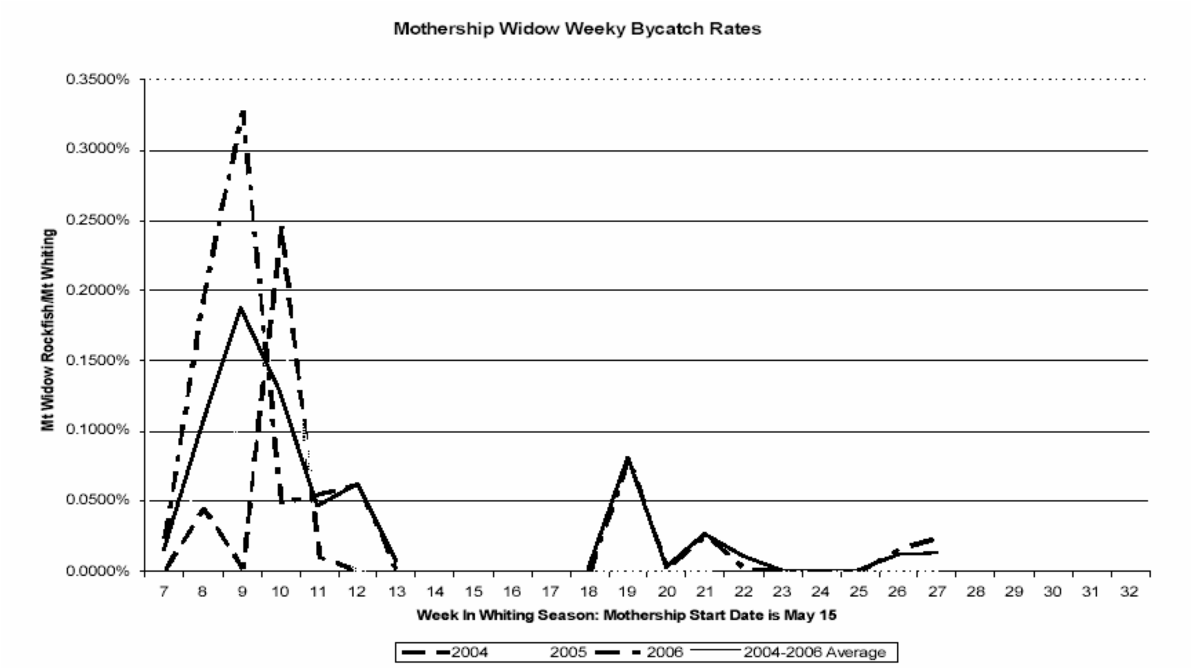
Table 7. Rebuilding species impacts and target species catches under proposed inseason management actions for the non-whiting trawl fishery.

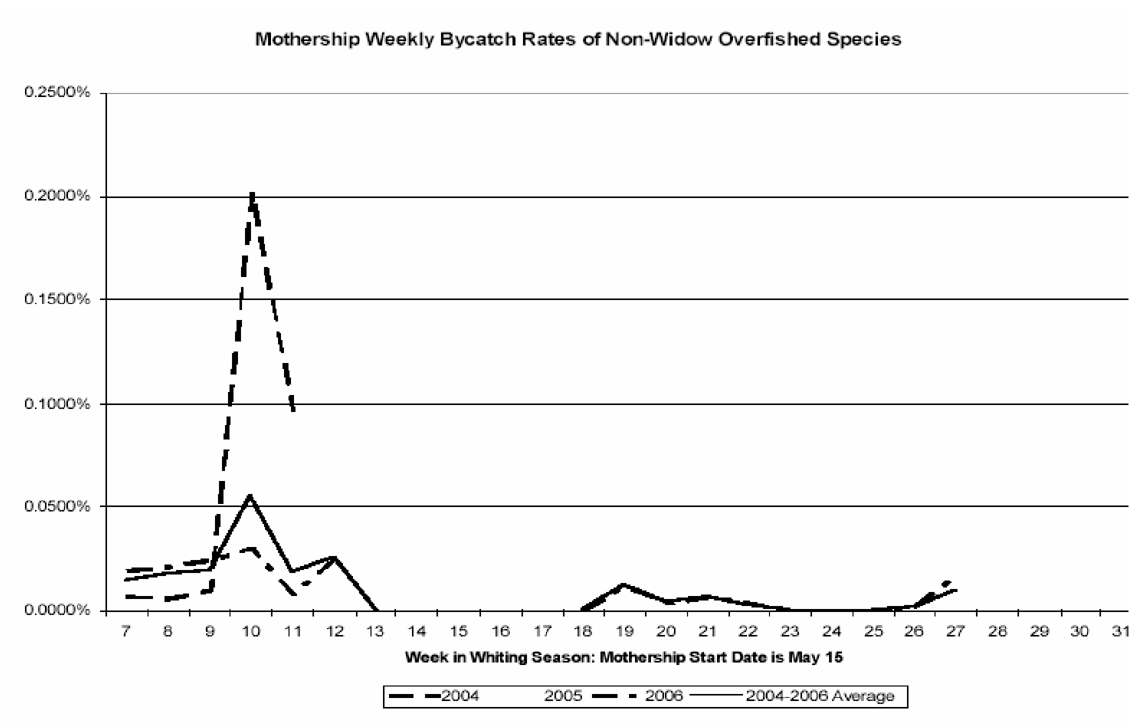
	Species	North	South	Total	Harvest Target
Rebuilding Species	Canary	9.0	1.1	10.1	
	POP	79.6	0.0	79.6	
	Darkblotched	209.7	32.4	242.1	
	Widow	1.7	0.0	1.8	
	Bocaccio	0.0	25.2	25.2	
	Yelloweye	0.4	0.0	0.4	
	Cowcod	0.0	1.4	1.4	
Target Species	Sablefish	2,178	442	2,620	2,651
	Longspine	651	322	973	2,220
	Shortspine	942	266	1,208	1,634
	Dover	8,626	1,890	10,516	16,500
	Arrowtooth	3,510	89	3,599	5,800
	Petrale	2,021	395	2,416	2,499
	Other Flat	1,142	493	1,635	4,884
	Slope Rock	131	156	287	1,786

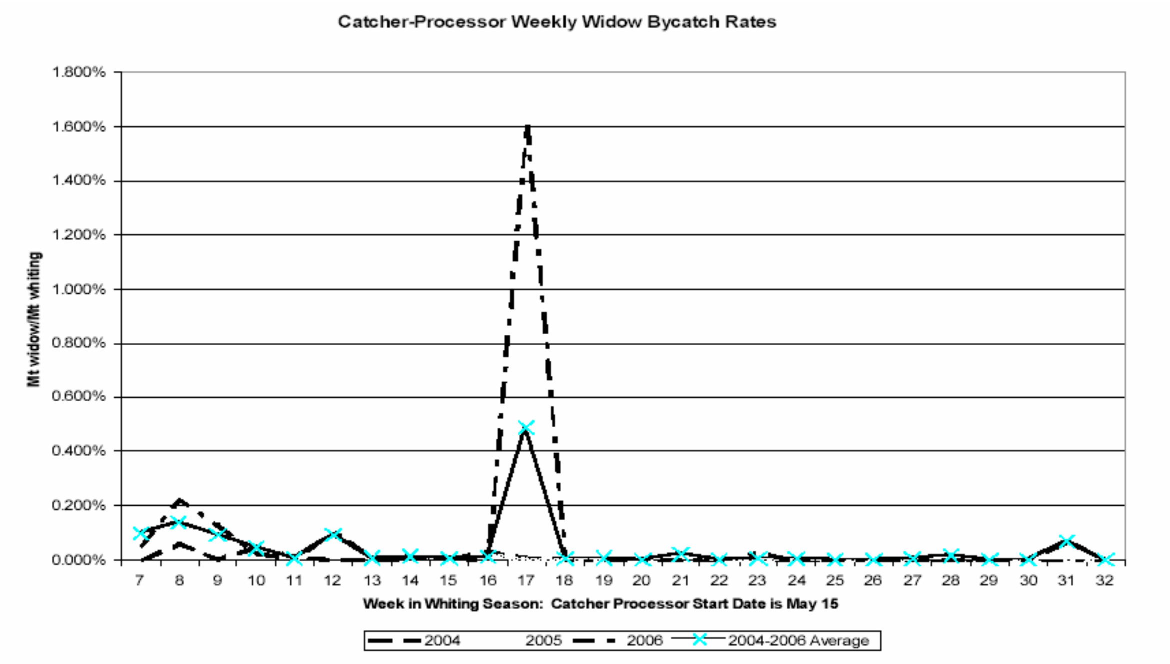
Shorebased Weekly Widow Bycatch Rates

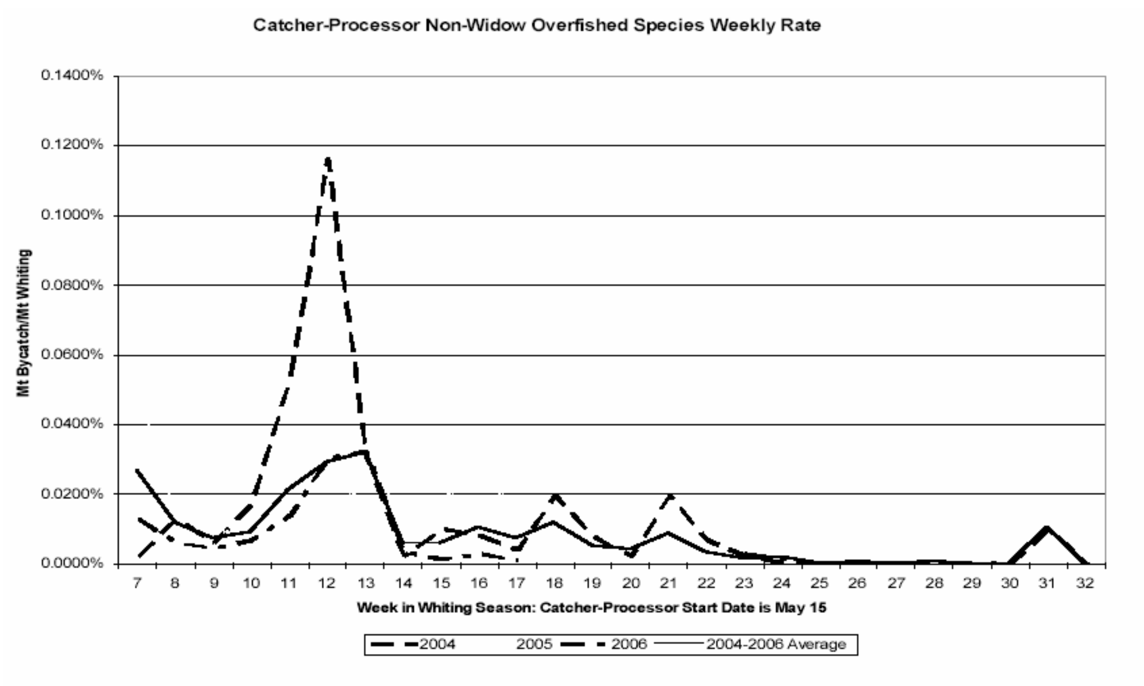


Shorebase Non-Widow Overfished Species Weekly Bycatch Rate


Mothership Widow Weeky Bycatch Rates
0.3500%
0.3000%
0.2500%
0.2000%
0.1500%
0.1000%
0.0500%
0.0000%
Mt Widow Rockfish/Mt Whiting
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
Week In Whiting Season: Mothership Start Date is May 15
2004
2005
2006
2004-2006 Average


Mothership Weekly Bycatch Rates of Non-Widow Overfished Species
0.2500%
0.2000%
0.1500%
0.1000%
0.0500%
0.0000%
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
Week in Whiting Season: Mothership Start Date is May 15
2004
2005
2006
2004-2006 Average


Catcher-Processor Weekly Widow Bycatch Rates
1.800%
1.600%
1.400%
1.200%
1.000%
0.800%
0.600%
0.400%
0.200%
0.000%
Mt widow/Mt whiting
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
Week in Whiting Season: Catcher Processor Start Date is May 15
2004
2005
2006
2004-2006 Average


Catcher-Processor Non-Widow Overfished Species Weekly Rate
0.1400%
0.1200%
0.1000%
0.0800%
0.0600%
0.0400%
0.0200%
0.0000%
Mt Bycatch/Mt Whiting
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
Week in Whiting Season: Catcher-Processor Start Date is May 15
2004
2005
2006
2004-2006 Average

Agenda Item G.6.b
Supplemental GMT Report
September 2007

2007 Projected mortality impacts (mt) of overfished groundfish species Prior to Final Inseason

9/11/07

Fishery	Bocaccio b/	Canary	Cowcod	Dkbl	POP	Widow	Yelloweye
Limited Entry Trawl- Non-whiting	23.9	8.1	1.4	222.0	73.2	1.6	0.4
Limited Entry Trawl- Whiting							
At-sea whiting motherships a/					1.9		0.0
At-sea whiting cat-proc a/		4.0		12.8		241.6	0.0
Shoreside whiting a/					0.0		0.0
Tribal whiting		0.7		0.0	0.6	6.1	0.0
Tribal							
Midwater Trawl		1.8		0.0	0.0	40.0	0.0
Bottom Trawl		0.8		0.0	3.7	0.0	0.0
Troll		0.5		0.0	0.0		0.0
Fixed gear		0.3		0.0	0.0	0.0	2.3
Limited Entry Fixed Gear		1.1		1.3	0.4		2.8
Sablefish	13.4		0.0			0.0	
Non-Sablefish			0.1			0.5	
Open Access: Directed Groundfish		1.0					
Sablefish DTL	0.0	**0.2**		0.2	0.1	0.0	0.3
Nearshore (North of 40°10' N. lat.)	0.0	1.7	0.1	0.0	0.0	0.5	1.5
Nearshore (South of 40°10' N. lat.)	0.0			0.0	0.0		
Other	10.6			0.0	0.0	0.0	0.1
Open Access: Incidental Groundfish							
CA Halibut	0.1	0.0		0.0	0.0		
CA Gillnet c/	0.5			0.0	0.0	0.0	
CA Sheephead c/				0.0	0.0	0.0	0.0
CPS- wetfish c/	0.3						
CPS- squid d/							
Dungeness crab c/	0.0		0.0	0.0	0.0		
HMS b/		0.0	0.0	0.0			
Pacific Halibut c/	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pink shrimp	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Ridgeback prawn	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Salmon troll	0.2	0.8	0.0	0.0	0.0	0.3	0.2
Sea Cucumber	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spot Prawn (trap)							
Recreational Groundfish e/							
WA		5.7					6.0
OR						1.4	
CA	53.2	10.1	0.1			9.0	7.2
Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/							
	2.0	**3.7**	0.2	3.8	3.6	0.9	1.9
TOTAL	104.4	40.6	1.9	240.1	83.5	301.9	22.9
2007 OY	218	44.0	4.0	290	150	368	23
Difference	113.6	3.4	2.1	49.9	66.5	66.1	0.1
Percent of OY	47.9%	92.3%	47.5%	82.8%	55.7%	82.0%	99.4%
Key		= either not applicable; trace amount (<0.01 mt); or not reported in available data					

a/ Non-tribal whiting numbers reflect actual catches through July 26 based on September 7, 2007 NMFS report

b/ South of 40°10' N. lat.

c/ Mortality estimates are not hard numbers; based on the GMT's best professional judgment.

d/ Bycatch amounts by species unavailable, but bocaccio occurred in 0.1% of all port samples and other rockfish in another 0.1% of all port samples (and squid fisheries usually land their whole catch).

e/ Values in scorecard represent projected impacts. However, harvest guidelines for 2007 are as follows: canary in WA and OR combined = 8.2 mt and in CA = 9.0 mt; yelloweye in WA and OR combined = 6.8 mt and in CA = 2.1 mt.

f/ Research projections updated August 2007. Canary and yelloweye updated Sept. 10, 2007. Estimate based on combination of actual 2006 catches and projected 2007 catch.

GROUNDFISH ADVISORY SUBPANEL REPORT ON FINAL CONSIDERATION OF INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) has the following comments and recommendations for final inseason action.

1. A majority of the GAP continues to recommend that the Council reopen the whiting fishery on October 1st. In addition, the GAP recommends increasing the widow bycatch cap to 275 mt for the whiting fishery.

A majority of the GAP believes this recommendation is justified for several reasons, including the economic benefits to coastal communities with minimal biological impacts if the fishery takes place outside 150 fathoms. Twenty-two percent of the shorebased sector's allocation remains and just over 40% of the catcher/processor allocation remains unharvested. Under 5% of the mothership sector allocation remains unharvested. If the whiting fishery is not reopened on October 1st, the unharvested whiting represents $25,000,000 in lost value.

<u>Shoreside fishery</u>

Value
There are 19,501 metric tons of unharvested whiting remaining in the shorebased allocation. At a price of $.08/pound, this results in approximately $3,438,416.00 in exvessel value to coastal fishermen. With a multiplier of 2.5 this results in over $8.5 million dollars to rural coastal communities. The GAP estimates that the ports of Newport and Astoria in Oregon and Ilwaco and Westport in Washington would benefit greatly from the reopening of this fishery. We estimate that up to nine hake processing plants could buy whiting if the season is reopened.

Experience
The GAP also estimates that about 20 vessels may participate if the fishery is reopened. The criticism that fishermen will hug the 150 fathom line or that shoreside fishermen are not experienced with fishing outside 150 fathoms so this may result in increased are unfounded. Whiting fishermen will fish where the whiting are congregating outside 150 fathoms, the fact that the 150 line is in place is immaterial. Many shoreside whiting fishermen also fish in the at-sea mothership fishery as well as the non-whiting limited entry trawl fishery. The bottom line is that they are experienced with fishing outside 150 fathoms.

Costs
We heard testimony that 100% observer coverage in Alaska can run from $15,000 - $20,000 a month per observer. Observers may be unavailable. Two observers for every vessel, as was suggested during testimony yesterday could cost as much as $40,000 per month. We also heard testimony that fuel costs will increase fishing costs outside of 150 fathoms. More fuel will be burned getting to the grounds as well as searching for fish in the offshore fishery. While during the regular season vessels were utilizing $1500 of fuel a day – we estimate that could easily double to $3,000/day. Between observer costs and fuel, it could cost upwards of $4,500/day just to fish. There are also the increased costs of reinstalling the cameras.

Delayed openings
Doling out small amounts of bycatch and revisiting this issue in November is not an acceptable option. The next Council meeting is during the beginning of November. That means that the fishery would likely not open again until December 15th. Stopping and starting the fishery is inefficient. Fishing for whiting in November and December is both dangerous due to weather and futile as well – as generally the fish are no longer on the grounds during this time frame.

Processor Considerations
Several hundred employees are utilized during the hake season. Reopening the fishery allows shorebased processing plants an opportunity to maintain crews through the season until crab begins.

Weather days
October 15th is when the weather out of Newport starts getting rough and dangerous. This runs true up the coast to Westport. Not only is it more dangerous to fish under these conditions it also becomes difficult to find fish – these fish are migratory and scatter following storms.

Catcher/Processor Sector
There are 28,481 mt of unharvested whiting remaining in the catcher/processor allocation. This represents a gross value of approximately $15,000,000. If the fishery reopens the catcher/processor sector anticipates 5 catcher/processor vessels will participate. Combined, those vessels would employ approximately 600 crew. If the fishery is not reopened, approximately $3-4 million in income would be foregone.

The GAP believes that the ability for the agencies to close the fishery when the bycatch cap is projected to be reached is very viable. Beginning in 2007, there was real-time reporting for all sectors and information on catches was reported. Instead of waiting for the bycatch cap to be actually reached it is supposed that the agency would close the fishery on the projection of a bycatch cap being reached. The majority of the GAP believes that the buffers in the scorecard for depleted species associated with the whiting fishery are sufficient to absorb any uncertainty surrounding activities that occurred earlier in the primary season.

A minority of one remains concerned that the catches in the scorecard are reflective of minimum discard estimates and that there is significant uncertainty associated with events that occurred during the primary season and that the impacts on depleted fisheries could be much larger. Given concerns brought up by enforcement, this minority wants to ensure that all discard events are accounted for should the fishery be reopened.

2. The GAP unanimously supports the limited entry non-whiting trawl fishery adjustments presented by the GMT including adjusting the RCA boundaries north of Cape Alava and Humbug Mountain to Cape Arago.

PFMC
09/12/07