# 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 F.1.a, Attachment 1: Federal Register Notices Published Since the Last Council Meeting.
2. Agenda Item F.1.a, Supplemental Attachment 1: Comparison of 2004-2006 Trawl Discard Estimates Obtained Using Retained Tonnage and Trawl Hours as Measure of Effort.
3. Agenda Item F.1.a, Supplemental Attachment 2: Observed and Estimated Total Bycatch of Salmon in the 2005-2006 West Coast Limited-Entry Bottom Trawl Groundfish Fishery.

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
02/25/08

# FEDERAL REGISTER NOTICES

## Groundfish and Halibut Notices
## November 10, 2007 through March 1, 2008

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

**72 FR 64952**. Pacific Coast Groundfish Fishery; Emergency Rule Extension. NMFS is extending the temporary rule to prohibit vessels without sector-specific participation history in the directed Pacific Whiting Fishery off the West Coast - 11/19/07

**72 FR 68097**. Pacific Coast Groundfish Fishery; Biennial Specifications and Management Measures; Inseason Adjustments. This final rule announces inseason changes to management measures in the commercial Pacific Coast Groundfish Fishery - 12/4/07

**72 FR 69162**. Pacific Coast Groundfish Fishery; Vessel Monitoring System; Open Access Fishery. NMFS issues this final rule to require all vessels fishing in the Open Access to provide declaration reports and to activate and use a vessel monitoring system (VMS) transceiver while fishing off Washington, Oregon, and California - 12/7/07

**72 FR 71583**. Pacific Coast Groundfish Fishery; Biennial Specifications and Management Measures; Inseason Adjustments. This final rule announces inseason changes to management measures - effective January 1, 2008 - 12/18/07

**72 FR 72630**. Pacific Coast Groundfish Fishery; Pacific Whiting Allocation. NMFS has determined that 6,000 mt of the 87,398 mt shore-based sectors allocation would not be used by December 31, 2007, therefore, automatic action was taken - 12/21/07

**73 FR 140**. Pacific Halibut Fisheries; Catch Sharing Plan. NMFS proposes to approve and implement changes to the Pacific Halibut Catch Sharing Plan for the International Pacific Halibut Commission's Regulatory Area 2A off Washington, Oregon, and California - 1/2/08

**73 FR 4759.** Pacific Coast Groundfish Fishery; Vessel Monitoring System; Open Access Fishery; Correction. Action: Final rule; Correction - 1/28/08

PFMC
02/19/08

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Sustainable Fisheries Division F/NWR2
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115-0070

MAR 0 3 2008

Don Hansen
Pacific Fishery Management Council
7700 NE Ambassador Place
Portland, OR 97220

Dear Mr. Hansen:

RE: Proposal for a 2008 Pacific Whiting Shoreside Fishery Maximized Retention and Monitoring Exemption Program

NMFS is proposing a 2008 Pacific Whiting Shoreside Fishery Maximized Retention and Monitoring Exemption Program. NMFS Northwest Region and the Pacific Fishery Management Council (Council) are transitioning the Pacific Whiting Shoreside Fishery to a federally managed maximized retention and monitoring program. Although it was expected that the program would be in place at the start of the 2008 fishing season, it will not be possible given the complexity of the rulemaking and unanticipated workload. Therefore, NMFS is proposing a transitional EFP whose purpose would be to investigate the new components of the overall monitoring program before regulatory implementation. The EFP would be in effect until the effective date of the new federal maximized retention and monitoring program.

The proposed maximized retention and monitoring program regulations are intended to create the regulatory structure necessary to effectively manage the Pacific whiting shoreside fishery without EFPs while providing accurate catch data such that the Endangered Species Act and Magnuson-Stevens Fishery Conservation and Management Act requirements for this fishery are adequately met. Under the proposed maximized retention and monitoring program, federal regulations would require Pacific whiting shoreside vessels to dump unsorted catch directly below deck and would allow unsorted catch to be landed, providing that an electronic monitoring system (EMS) is used on all fishing trips to verify retention of catch at sea.

Under the proposed maximized retention and monitoring program, federal regulations would require first receivers to have on shore monitoring conducted by catch monitors. Catch monitors would be third party employees paid for by industry and trained to NMFS standards. The proposed exemption program would include provisions for third party catch monitors from a NMFS specified provider. Like the proposed regulatory program, catch monitors used under the EFP would be trained in techniques that would be used for the verification of fish ticket data and in species identification. Catch monitors would oversee the process of sorting, weighing, and recordkeeping, as well as gathering information on incidentally caught salmon. Catch monitors would verify the accuracy of electronic fish ticket data used to manage the Pacific whiting shoreside fishery such that inaccurate or delayed information does not result in a fishery specification (bycatch limits, species allocations, OYs, and biological opinion thresholds) being exceeded.

Sincerely,

Frank Lockhart
Assistant Regional Administrator

Enclosure

1) **Project Title**: The 2008 Pacific Whiting Shoreside Fishery Maximized Retention and Monitoring Exemption Program

2) **Project coordinator:** NMFS Northwest Region, Sustainable Fisheries Division.
For further information contact: Becky Renko by mail at 7600 Sand Point Way NE, Seattle, WA 98115, by email at becky.renko@noaa.gov, by fax at 206-526-6736, by phone at 206-526-6110.

3) **Purpose of the exemption program and exempted fishing permits (EFP)**

NMFS is in the process of transitioning the Pacific whiting fishery maximized retention and monitoring from a State run program under an EFP to Federal Regulations. The purpose of the exemption program with EFP is to test our initial design for the onshore monitoring in advance of the final rulemaking. The EFP would allow vessels to retain unsorted Pacific whiting catch for efficient prosecution of fishery while assuring that there is adequate monitoring at-sea and verification of electronic fish ticket reports.

4) **Specific regulations from which an exemption is being requested**

The EFP, if issued, would authorize, for limited purposes, the following activities which would otherwise be prohibited:

Under 660.306 (a)(2) it is unlawful for any person to retain any prohibited species. Prohibited species must be returned to the sea as soon as practicable with a minimum of injury when caught and brought on board. An EFP is needed to allow vessels to retain prohibited species until offloading and to require deliveries to processors participating in the program.

Under 660.306 (a)(10) it is unlawful for any person to take, retain, possess or land more than a single cumulative limit of a particular species, per vessel, per applicable cumulative limit period. An EFP is needed to allow vessels and first receivers to take, retain, possess or land more than a single cumulative limit.

Under § 660.306 (a)(7), it is unlawful for any person to fail to sort, prior to the first weighing after offloading, those groundfish species or species groups for which there is a trip limit, size limit, scientific sorting designation, quota, harvest guideline, or OY, if the vessel fished or landed in an area during a time when such trip limit, size limit, scientific sorting designation, quota, harvest guideline, or OY applied. An EFP is needed to allow Pacific whiting shoreside first receivers to use a hopper type scale to derive an accurate total catch weight prior to sorting providing that immediately following weighing of the total catch and prior to processing or transport away from the point of landing, the catch is sorted to the species groups and all incidental catch is accurately weighed and the weight of incidental catch deducted from the total catch weight to derive the weight of target species.

## 5) Catch information

The species (target and incidental) expected to be harvested and/or discarded under the program are similar to those observed in recent years under the State run monitoring program. Please see the attached Pacific whiting shoreside fishery summary from 2006 for the expected catch by species.

Pacific whiting shoreside vessels participating with the EFP would be required to dump unsorted catch directly below deck and would be allowed to land unsorted catch providing an electronic monitoring system (EMS) is used on all fishing trips to verify retention of catch at sea.

Shore monitoring conducted by catch monitors would be required under the EFP. Catch monitors would be third party employees paid for by industry and trained to NMFS standards. The requested EFP would include provisions for third party catch monitors from a NMFS specified provider. Catch monitor duties would include overseeing the sorting, weighing, and recordkeeping process. Catch monitors would also gather information on incidentally caught salmon.

Marine mammal catch will continue to be document on NMFS forms and submitted by the vessels per NMFS reporting requirements for the Pacific Coast Groundfish Fishery. The monitoring program under an EFP could be used to verify that reporting occurred.

## 6) Anticipated number of participants

The estimated number or EFPs that would be issued is as follows:

**Catcher Vessels:** 30-40
**First Receivers:** 12-15

## 7) EFP Terms and conditions for Pacific whiting shoreside vessels

The terms and conditions of EFPs issued to Pacific whiting shoreside vessels would include the following:

Reporting requirements:

- Trawl logbooks must be maintained as required by the applicable state law.
- On each EFP trip "Maximum Retention Fishing Trip" (or "MAX") must be legibly written at the bottom of each logbook page.
- Logbooks must be completed in a timely manner and include:
  - The estimated weight of all species, including, prohibited species.
  - An estimate of the total amount of discarded catch for each species legibly written at the bottom of the logbook page, as well as the accurate location of the haul and reason for discarding.

- If discard occurs as a result of gear malfunction, a description of the event must be recorded.

Maximized Retention requirements

- All catch must be brought on board the vessel and retained until offloading, with some exceptions:
    - Pacific whiting removed from the deck and fishing gear during cleaning may be discarded, provided that the total does not exceed one basket from any single haul, with the maximum dimensions of the basket being 24 inches by 16 inches by 16 inches. All catch in excess of the one basket would need to be placed into the fish hold. Discarding species other than Pacific whiting would be prohibited.
    - Large individual marine organisms, such as marine mammals or fish species longer than 6 ft (1.8 m) in length, could be discarded provided the species and the reason for discarding were properly recorded in the required logbook.
    - All incidentally caught marine mammals would need to be documented in the vessel logbook and reported to the NMFS Office of Protected Resources by submitting a completed Marine Mammal Authorization Program mortality/injury report form.
    - Unavoidable discard of catch would be the result of an event that is beyond the control of the vessel operator or crew. The quantity and all species discarded as a result of an unavoidable discard event would need to be estimated, and the location of the tow, and reason for discarding recorded in the required. Immediately following the event, the vessel would be required to stop fishing and return to port, with notification to NMFS OLE being made prior to arrival in port.
    - Discard that results when more catch is taken than is necessary to fill the hold, is within the control of the vessel operator and would continue to be prohibited.
- All prohibited species incidentally caught in a midwater trawl, and required to be retained under this section, would be abandoned to the State of landing immediately upon offloading.
- All groundfish caught in excess of the trip limits would be abandoned to the State of landing immediately upon offloading.
- No vessel could receive payment for any fish landed in excess of any cumulative trip limits.
- All fish from a delivery must be offloaded at only one first receiver.

EMS requirements

- Owners of vessels participating in the Pacific whiting shoreside fishery, would be required to arrange for EMS services from a NMFS-approved provider and pay all associated costs.
- Vessels required to procure EMS services may also be required to carry an NMFS West Coast Groundfish Observer Program observer.
- The vessel operator would be required to schedule maintenance of EMS equipment.
- Before each haul is retrieved, the vessel operator would be required to check status of EMS control box to confirm that the EMS is functioning properly.
- From 30 minutes before official sunset until 30 minutes after official dawn, each vessel required to have EMS would be required to provide lighting to areas where the trawl nets

and fish are handled and fish hold openings, deck spaces, and the trawl ramp so the activities could be clearly recorded by the EMS cameras:

- When aware that EMS is not functioning properly or the power has been interrupted, the vessel operator would be required to immediately contact the EMS service provider.

Prohibited actions:

- Failure to comply with all EFP requirements.
- Failure to maintain the trawl logbook as required by the State of landing and the EFP.
- Delivery of unsorted whiting catch to first receiver that do not hold EFPs.
- Fish with a vessel that does not have properly installed and functioning EMS equipment.
- Tamper with, disconnect, damage, destroy, alter, or in any way distort, render useless, inoperative, ineffective, or inaccurate any component of the EMS unit.
- Fail to provide notice to NMFS of any interruption in the power supply to the EMS unit or intentionally interrupting the power supply to the EMS unit (failure to provide notice to NMFS OLE will be considered as an intentional interruption);
- Use a gear other than midwater trawl gear.
- Fail to have a valid declaration report for midwater trawl.
- Target a species other than Pacific whiting when the vessel has a declaration for midwater trawl gear in the Pacific whiting fishery.
- Fail to abandon all prohibited species and overage catch to the state of landing
- Fail to bring all catch onboard the vessel and retain that catch until offloading, with the exception of large marine organisms and operational discards.
- Fail to cease fishing and return to port immediately following a discard event of more than one basket of fish.
- Fish for, land, or process fish without observer coverage when a vessel is required to carry an observer under § 660.314(c).

## 8) EFP Terms and conditions for Pacific whiting shoreside first receiver

The terms and conditions of EFPs for Pacific whiting shoreside first receivers would include the following:

Maximized retention requirements

- Procureme catch monitor services from a NMFS approved catch monitor provider and pay all associated costs.
- Catch monitors would be required for all Pacific whiting shoreside fishery deliveries by vessels holding EFPs.
    - Pacific whiting shoreside fishery landings are those landings taken during the primary season by a vessel declared to be using limited entry midwater trawl.
- A catch monitor would be required to be present at the shoreside processing facility each day that Pacific whiting landings are received.
- Catch monitor would be given notification in person, by personal communications radio, or by telephone of planned facility operations, including the receipt of fish, at least 30 minutes and not more than 2 hours prior to the start of the planned operation.

- Catch monitors would be give free and unobstructed access to the catch throughout the sorting process and the weighing process.
- Catch monitors would be given free and unobstructed access to any documentation required by regulation including fish tickets and scale test results.
- Catch monitors would be given free and unobstructed access to a telephone and facsimile during the hours that Pacific whiting is being processed at the facility and 30 minutes after the processing of the last delivery each day.
- The owner or manager of each Pacific whiting shoreside first receiver would be required to provide reasonable assistance to the catch monitors to enable each catch monitor to carry out his or her duties. Reasonable assistance includes, but is not limited to: informing the monitor when bycatch species will be weighed, and providing a secure place to store equipment and gear.
- The owner or manager of each Pacific whiting shoreside first receiver would be required to adhere to all applicable state and federal rules, regulations, or statutes pertaining to safe operation and maintenance of a processing and/or receiving facility.

<u>NMFS-Approved Monitoring plans</u>

- Each Pacific whiting shoreside first receiver would be required to have a NMFS approved monitoring plan before being issued an EFP.
- A monitoring plan would be submitted to NMFS by the owner or manager of a first receiver at least 14 days prior to receiving Pacific whiting shoreside fishery deliveries.
- The catch monitoring plan must include the following information:
    - Name and signature of the person submitting the monitoring plan.
    - Address, telephone number, fax number and email address (if available) of the person submitting the monitoring plan;
    - Name and location of the first receiver;
    - A detailed description on how the first receiver will meet the weighing and sorting requirements including:
        - The sorting locations and the amount of space for sorting catch, the number of personnel assigned to catch sorting and the maximum rate that catch will flow through the sorting area.
        - Personnel skills and training for sorting catch to federal species groups.
        - The process for weighing catch, including large and small volumes of target and incidentally caught species.
        - The scale makes and models being used to weigh catch during the Pacific whiting shoreside fishery, including the most current test date provided by the Department of Weights and Measures for the state of landing and whether or not the scale met the testing criteria either initially or upon retesting.
    - A description of how the catch monitor requirements would be met, including:
        - How the first receiver operates and maintains a safe processing and/or receiving facility.
        - Who would be responsible for notifying the catch monitor of planned facility operations, including the receipt of fish.

        - How the catch monitor would be given access to the catch throughout the sorting process and the weighing process and to any documentation required by regulation including fish tickets and scale test results.
        - The name and contact information for an individual(s) who will be responsible for assuring that the catch monitor obtains the necessary information from the first receiver.
    - A description of when and where prohibited species will be counted.
- NMFS will review and provide approval of the monitoring plans within 14 days of receiving a complete monitoring plan submission. If NMFS disapproves a monitoring plan the first receiver owner or manager may resubmit a revised monitoring plan.

Specifications and management measures

- An allowance would be made to allow Pacific whiting shoreside first receivers that use a hopper type scale to derive an accurate total catch weight prior to sorting. Providing that immediately following weighing of the total catch and prior to processing or transport away from the point of landing, the catch must be sorted to the species groups and all incidental catch (groundfish and non groundfish species) is accurately weighed and the weight of incidental catch deducted from the total catch weight to derive the weight of target species.

Prohibited actions

- Receive for transport or processing, catch from a Pacific whiting shoreside vessel without obtaining verification from vessel personnel that the vessel has an EMS unit
- Process catch without coverage of a catch monitor.
- Fail to sort fish to federal species groups.
- Process, sell, or discard any groundfish received from a Pacific whiting shoreside vessel that has not been accurately weighed on a scale and accounted for on an electronic fish ticket report
- Fail to weigh fish landed from a Pacific whiting shoreside vessel prior to transporting any fish from that landing away from the point of landing.
- Fail to allow the catch monitor unobstructed access to catch sorting, processing, catch counting, catch weighing, or electronic or paper fish tickets.
- Fail to provide reasonable assistance to the catch monitor.
- Forcibly assault, resist, oppose, impede, intimidate, harass, sexually harass, bribe, or interfere with a catch monitor.
- Interfere with or bias the procedure employed by a catch monitor.
- Tamper with, destroy, or discard a catch monitor's equipment, records, photographic film, papers, or personal effects without the express consent of the catch monitor.
- Harass a catch monitor by conduct that: has sexual connotations, has the purpose or effect of interfering with the catch monitors work performance, and/or, otherwise creates an intimidating, hostile, or offensive environment.
- Require, pressure, coerce, or threaten a catch monitor to perform duties normally performed by processor employees.

Agenda Item F.1.b
Supplemental Attachment 1
March 2008

# Comparison of 2004-2006 Trawl Discard Estimates Obtained Using Retained Tonnage and Trawl Hours as Measures of Effort

Prepared by James Hastie[1] and Marlene Bellman[2]
[1]Northwest Fisheries Science Center
[2]Pacific States Marine Fisheries Commission

March 3, 2008

The Northwest Fisheries Science Center (NWFSC) has produced reports documenting total fishing mortality for groundfish for the years 2004-2006, which are available on the NWFSC's website (Hastie 2006, Hastie and Bellman 2006, 2007). A central element of these analyses is the estimation of discard occurring in the non-hake groundfish bottom trawl fishery. This estimation process incorporates data from at-sea observations, logbooks, and fish tickets. During the past year, questions have been raised regarding the methods used to expand amounts of measured or estimated discard on observed vessels into total discard estimates for the groundfish bottom trawl fleet. As part of the Groundfish Science Report at the September 2007 Council meeting, the NWFSC presented a statement addressing several questions relating to the estimation of groundfish bycatch (Supplemental Agenda Item G.1.b). We noted that the use of tow duration as a measure of fleet effort in this expansion process could be expected to yield higher discard estimates for some species and lower estimates for others. This report documents the differences between discard amounts estimated with the method currently used to assess total mortality and estimates derived using an alternative method that utilizes tow duration, for the years 2004-2006.

## *Description of the Alternative Methods*

Depending on the type of species, one of two approaches is currently used to expand amounts of discard in the observed fleet up to the entire fleet. For species that are commonly targeted by trawlers and for which significant percentages of catch are retained in most strata ("target species"), such as sablefish or Dover sole, discard is estimated as a function of retained catch of the individual species or species group. For each stratum delineated by area, season, and depth, the ratio of observed discarded-to-retained catch is assumed to be representative of the propensity for discard in the corresponding logbook stratum. Accordingly, logbook discards are calculated by multiplying these observed ratios by the retained weight of each target species reported in logbooks (Table 1-A, Step 1). Discard amounts estimated at the logbook level are then multiplied by each species' ratio of fish ticket-to-logbook retained weight, to produce total fleet amounts of discard (Table 1-A, Step 2). For other, "bycatch" species, where little or none of the catch is retained in many strata, discard is estimated as a function of the retained catch of all species in a "target group". This group includes all flatfish, sablefish, thornyheads, Pacific cod, skates, and spiny dogfish, in both the northern and southern areas, with the addition of slope rockfish in the southern area. Discard amounts at the logbook level are then multiplied by the ratio of fish-ticket-to-logbook poundage for all target species, combined, as summarized in the table below. Additional details of the current method used to expand observed discard to the fleet level is presented in the most recent report of total mortality (Hastie and Bellman 2007).

**Table 1.--Alternative discard estimation approaches**

| | Target Species (TS) | Bycatch Species |
|---|---|---|
| **A. Current discard estimation process** | | |
| **Step 1** (for each area, season, and depth)<br>Calculate discard ratios, from observer data and fish tickets | Discard lbs (species X) / Retained lbs (species X) | Discard lbs (species Y) / Retained lbs (Σ TS) |
| **Step 2** (estimate discard for logbook records)<br>Multiply discard ratios by retained species weights reported in logbooks | (Step-1 ratio) * (logbook lbs[1] (species X)) | (Step-1 ratio) * (logbook lbs[1] (Σ TS)) |
| **Step 3** (for each state and 2-month period)<br>Calculate fish-ticket-to-logbook ratio of retained catch for each species or group | Fishticket lbs (species X) / Logbook lbs[1] (species X) | Fishticket lbs (Σ TS) / Logbook lbs[1] (Σ TS) |
| **Step 4** (expand discard estimate to entire fleet)<br>Multiply the Step-3 expansion ratio by the weight of discard estimated in Step 2 | (Step-3 ratio) * (Est. logbook discard lbs) | (Step-3 ratio) * (Est. logbook discard lbs) |
| **B. Tow-hour discard estimation process** | | |
| **Step 1** (for each area, season, and depth)<br>Calculate discard ratios, from observer data | Discard lbs (species X) / Number of hours towed | Discard lbs (species Y) / Number of hours towed |
| **Step 2** (estimate discard for logbook records)<br>Multiply discard ratios by the number tow hours reported in logbooks | (Step-1 ratio) * (Logbook tow hours) | (Step-1 ratio) * (Logbook tow hours) |
| **Step 3** (for each state and 2-month period)<br>Calculate fish-ticket-to-logbook ratio of the retained catch of each species or group | Fishticket lbs (species X) / Logbook lbs[1] (species X) | Fishticket lbs (Σ TS) / Logbook lbs[1] (Σ TS) |
| **Step 4** (expand discard estimate to entire fleet)<br>Multiply the Step-3 expansion ratio by the weight of discard estimated in Step 2 | (Step-3 ratio) * (Est. logbook discard lbs) | (Step-3 ratio) * (Est. logbook discard lbs) |

[1] The logbook retained weights used are hail weights that have been adjusted by each state agency to be consistent, at the trip level, with weights recorded on fish tickets.

As an alternative to this approach, we calculated discard ratios for each stratum, by dividing the observed discard weight for each species by the total hours trawled on observed tows (Table 1-B, Step 1). Amounts of discard for the logbook fleet are obtained by multiplying these ratios by the number of tow hours reported in the logbooks for each stratum. Since fish tickets do not capture the number of hours trawled, a different metric must be used to adjust for landings that lack corresponding logbook data. We elected to use the same methods as described above to expand discard estimates from the logbook level to the entire fleet (Table 1-B, Step 2).

*Results*

Table 1 lists the discard amounts estimated using these two approaches for 2006. Discard tonnage is summarized for areas north and south of 40°10' N. lat., and for the entire coast. Table 2 highlights the differences in the 2006 estimates generated using the existing (retained-weight) method and the alternative (tow duration) method. The data in this table are calculated by subtracting the estimated discard using the existing method from the discard generated using the tow-duration method. Consequently, positive values indicate higher amounts using the alternative (tow-duration) method and negative values indicate higher amounts using the existing (retained-weight) method. Each approach yields estimates that are higher for some species and lower for others. Tables 3 and 4 and Tables 5 and 6 provide similar overview of amounts of estimated discard and differences between methods for 2005 and 2004, respectively.

Overall, the differences in amounts of discard estimated using these two approaches vary year to year and between areas. Neither approach yields consistently higher or lower discard amounts across all species. For instance, across all rebuilding species in 2006, estimated discards are 22 mt lower using the tow duration alternative than with the existing approach, however they are 7.7 mt higher in 2004. For all other species combined, discard was estimated to be 2,614 mt higher using the tow duration approach in 2004, but 778 mt lower in 2006.

*References*

Hastie, J. and M. Bellman. 2007. Estimated 2006 discard and total catch of selected groundfish species. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA. Available from http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/totalmortality2006_final.pdf.

Hastie, J. and M. Bellman. 2006. Estimated 2005 discard and total catch of selected groundfish species. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Blvd E, Seattle, WA. Available from http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/totalmortality2005_final.pdf.

Table1.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting[1], commercial limited-entry groundfish trawls targeting groundfish[2] during **2006**, under two alternative estimation methods.

| **Alternative ->** | **1** | | | **2** | | |
|---|---|---|---|---|---|---|
| | **(current estimates)** Status quo stratification (area: season: depth); status quo approach used to expand observer data to logbook and fish ticket levels | | | Status quo stratification (area: season: depth); **Tow duration** used to expand observer data to logbook level; Status quo approach used to expand estimated discard from logbook to fish ticket levels | | |
| | Estimated discard (mt) | | | Estimated discard (mt) | | |
| | North of 40°10' | South of 40°10' | Total | North of 40°10' | South of 40°10' | Total |
| Sablefish | 366.09 | 22.77 | 388.85 | 337.18 | 19.23 | 356.40 |
| Shortspine thornyhead | 95.19 | 26.01 | 121.20 | 99.31 | 22.92 | 122.23 |
| Longspine thornyhead | 77.66 | 13.54 | 91.20 | 84.27 | 11.53 | 95.80 |
| Dover sole | 905.10 | 842.49 | 1,747.6 | 863.47 | 98.74 | 962.21 |
| Petrale sole | 95.25 | 17.29 | 112.55 | 94.63 | 13.97 | 108.60 |
| English sole | 335.00 | 84.92 | 419.92 | 343.46 | 42.03 | 385.49 |
| Arrowtooth flounder | 1,096.5 | 7.07 | 1,103.6 | 649.94 | 7.00 | 656.94 |
| Other Flatfish | 679.51 | 80.68 | 760.19 | 650.66 | 69.44 | 720.10 |
| Blackgill rockfish [3] | na | 26.30 | 26.30 | na | 1.95 | 1.95 |
| Splitnose rockfish [3] | na | 63.84 | 63.84 | na | 629.77 | 629.77 |
| Other slope rockfish | 109.34 | 65.15 | 174.49 | 121.75 | 149.90 | 271.65 |
| Yellowtail rockfish [4] | 8.30 | na | 8.30 | 4.72 | na | 4.72 |
| Chilipepper rockfish [5] | na | 98.86 | 98.86 | na | 67.09 | 67.09 |
| Other shelf rockfish | 31.98 | 17.01 | 48.98 | 32.55 | 11.99 | 44.54 |
| Black rockfish | 2.24 | 0.04 | 2.28 | 2.20 | 0.03 | 2.23 |
| Other nearshore rockfish | 1.90 | 0.00 | 1.90 | 1.88 | 0.00 | 1.88 |
| Pacific hake/whiting | 749.94 | 191.43 | 941.37 | 767.87 | 174.08 | 941.95 |
| Lingcod | 314.50 | 1.08 | 315.59 | 309.46 | 0.85 | 310.32 |
| Pacific cod | 5.77 | 0.00 | 5.77 | 5.27 | 0.00 | 5.27 |
| Spiny dogfish | 506.32 | 74.80 | 581.11 | 493.09 | 76.02 | 569.11 |
| Unspecified skate | 45.19 | 1.66 | 46.84 | 71.88 | 8.27 | 80.16 |
| Big skate | 158.38 | 6.15 | 164.53 | 157.16 | 4.44 | 161.60 |
| Longnose skate | 435.34 | 133.56 | 568.90 | 429.89 | 123.36 | 553.26 |
| Shortbelly rockfish | 0.02 | 0.66 | 0.68 | 0.02 | 0.42 | 0.44 |
| Other groundfish | 600.17 | 147.99 | 748.16 | 603.50 | 108.04 | 711.54 |
| | | | | | | |
| Canary rockfish | 19.14 | 1.12 | 20.26 | 18.70 | 0.78 | 19.49 |
| Widow rockfish | 0.13 | 0.40 | 0.53 | 0.13 | 0.30 | 0.43 |
| Yelloweye rockfish | 0.88 | 0.00 | 0.88 | 0.88 | 0.00 | 0.88 |
| Bocaccio [5] | na | 18.10 | 18.10 | na | 10.25 | 10.25 |
| Cowcod [5] | na | 0.91 | 0.91 | na | 0.70 | 0.70 |
| Pacific ocean perch [6] | 7.73 | na | 7.74 | 7.42 | na | 7.43 |
| Darkblotched rockfish | 90.28 | 0.22 | 90.50 | 77.53 | 0.24 | 77.77 |

[1] Includes only landings containing less than 2 mt of Pacific hake/whiting.
[2] Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.
[3] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.
[4] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.
[5] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.
[6] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 2.--Diffferences in estimated **2006** discards (mt) of major west coast groundfish species under two alternative estimation methods.

| | Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1) | | | | | |
|---|---|---|---|---|---|---|
| | North of 40°10' | | South of 40°10' | | Coastwide | |
| | mt | % | mt | % | mt | % |
| Sablefish | -28.9 | -8% | -3.5 | -16% | -32.4 | -8% |
| Shortspine thornyhead | 4.1 | 4% | -3.1 | -12% | 1.0 | 1% |
| Longspine thornyhead | 6.6 | 9% | -2.0 | -15% | 4.6 | 5% |
| Dover sole | -41.6 | -5% | -743.8 | -88% | -785.4 | -45% |
| Petrale sole | -0.6 | -1% | -3.3 | -19% | -3.9 | -4% |
| English sole | 8.5 | 3% | -42.9 | -51% | -34.4 | -8% |
| Arrowtooth flounder | -446.6 | -41% | -0.1 | -1% | -446.7 | -40% |
| Other Flatfish | -28.9 | -4% | -11.2 | -14% | -40.1 | -5% |
| Blackgill rockfish [3] | na | na | -24.4 | -93% | -24.4 | -93% |
| Splitnose rockfish [3] | na | na | 565.9 | 887% | 565.9 | 887% |
| Other slope rockfish | 12.4 | 11% | 84.8 | 130% | 97.2 | 56% |
| Yellowtail rockfish [4] | -3.6 | -43% | na | na | -3.6 | -43% |
| Chilipepper rockfish [5] | na | na | -31.8 | -32% | -31.8 | -32% |
| Other shelf rockfish | 0.6 | 2% | -5.0 | -30% | -4.4 | -9% |
| Black rockfish | 0.0 | -2% | -0.01 | -19% | -0.05 | -2% |
| Other nearshore rockfish | 0.0 | -1% | 0 | | -0.01 | -1% |
| Pacific hake/whiting | 17.9 | 2% | -17.3 | -9% | 0.6 | 0.1% |
| Lingcod | -5.0 | -2% | -0.2 | -21% | -5.3 | -2% |
| Pacific cod | -0.5 | -9% | 0.0 | | -0.5 | -9% |
| Spiny dogfish | -13.2 | -3% | 1.2 | 2% | -12.0 | -2% |
| Unspecified skate | 26.7 | 59% | 6.6 | 399% | 33.3 | 71% |
| Big skate | -1.2 | -1% | -1.7 | -28% | -2.9 | -2% |
| Longnose skate | -5.4 | -1% | -10.2 | -8% | -15.6 | -2.7% |
| Shortbelly rockfish | -0.001 | -3% | -0.2 | -36% | -0.2 | -35% |
| Other groundfish | 3.3 | 1% | -40.0 | -27% | -36.6 | -5% |
| Sum of differences for species above | -495.5 | | -282.2 | | -777.7 | |
| | | | | | | |
| Canary rockfish | -0.4 | -2% | -0.3 | -30% | -0.8 | -4% |
| Widow rockfish | -0.003 | -2% | -0.1 | -25% | -0.1 | -19% |
| Yelloweye rockfish | -0.003 | -0.4% | 0.0 | | -0.003 | 0% |
| Bocaccio [5] | na | na | -7.9 | -43% | -7.9 | -43% |
| Cowcod [5] | na | na | -0.2 | -24% | -0.2 | -24% |
| Pacific ocean perch [6] | -0.3 | -4% | na | na | -0.3 | -4% |
| Darkblotched rockfish | -12.7 | -14% | 0.0 | 9% | -12.7 | -14% |
| Sum of differences for rebuilding spec. | -13.5 | | -8.5 | | -22.0 | |

**Note: negative** numbers indicate that Alternative 2 results in LOWER discard estimates.

[3] South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

[4] North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

[5] South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

[6] North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.

Table 3.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting[1], commercial limited-entry groundfish trawls targeting groundfish[2] during **2005**, under two alternative estimation methods.

| **Alternative ->** | **1** | | | **2** | | |
|---|---|---|---|---|---|---|
| | **(current estimates)** Status quo stratification (area: season: depth); status quo approach used to expand observer data to logbook and fish ticket levels | | | Status quo stratification (area: season: depth); **Tow duration** used to expand observer data to logbook level; Status quo approach used to expand estimated discard from logbook to fish ticket levels | | |
| | Estimated discard (mt) | | | Estimated discard (mt) | | |
| | North of 40°10' | South of 40°10' | Total | North of 40°10' | South of 40°10' | Total |
| Sablefish | 426.27 | 98.04 | 524.32 | 445.69 | 108.63 | 554.31 |
| Shortspine thornyhead | 93.16 | 40.14 | 133.30 | 96.56 | 44.05 | 140.61 |
| Longspine thornyhead | 63.27 | 28.89 | 92.16 | 65.09 | 33.48 | 98.57 |
| Dover sole | 545.48 | 110.67 | 656.15 | 545.75 | 92.98 | 638.73 |
| Petrale sole | 51.14 | 3.60 | 54.74 | 50.93 | 0.34 | 51.27 |
| English sole | 248.88 | 52.81 | 301.69 | 233.58 | 1.18 | 234.76 |
| Arrowtooth flounder | 1,393.66 | 3.80 | 1,397.5 | 2,046.54 | 8.73 | 2,055.27 |
| Other Flatfish | 589.43 | 141.92 | 731.36 | 606.42 | 24.03 | 630.45 |
| Blackgill rockfish [3] | na | 2.26 | 2.26 | na | 1.37 | 1.37 |
| Splitnose rockfish [3] | na | 143.87 | 143.87 | na | 926.72 | 926.72 |
| Other slope rockfish | 22.34 | 4.67 | 27.01 | 34.59 | 11.94 | 46.53 |
| Yellowtail rockfish [4] | 28.58 | na | 28.58 | 36.65 | na | 36.65 |
| Chilipepper rockfish [5] | na | 51.75 | 51.75 | na | 0.60 | 0.60 |
| Other shelf rockfish | 74.77 | 6.30 | 81.07 | 91.85 | 0.79 | 92.64 |
| Black rockfish | 0.59 | 0.00 | 0.59 | 0.69 | 0 | 0.69 |
| Other nearshore rockfish | 0.06 | 0.22 | 0.28 | 0.07 | 0 | 0.07 |
| Pacific hake/whiting | 612.83 | 209.59 | 822.42 | 633.16 | 127.11 | 760.27 |
| Lingcod | 363.70 | 19.70 | 383.40 | 445.22 | 7.36 | 452.58 |
| Pacific cod | 4.45 | 0 | 4.45 | 6.27 | 0.00 | 6.27 |
| Spiny dogfish | 942.82 | 124.51 | 1,067.3 | 1,114.76 | 144.58 | 1,259.34 |
| Unspecified skate | 134.23 | 3.70 | 137.93 | 163.94 | 4.89 | 168.82 |
| Big skate | 104.95 | 5.59 | 110.54 | 122.44 | 0.09 | 122.53 |
| Longnose skate | 426.39 | 210.68 | 637.07 | 485.36 | 127.82 | 613.19 |
| Shortbelly rockfish | 0.00 | 1.10 | 1.11 | 0.00 | 0.47 | 0.48 |
| Other groundfish | 1,230.69 | 293.52 | 1,524.2 | 402.68 | 30.22 | 432.89 |
| | | | | | | |
| Canary rockfish | 21.50 | 0.05 | 21.56 | 26.59 | 0.01 | 26.60 |
| Widow rockfish | 3.16 | 0.18 | 3.34 | 2.91 | 0.19 | 3.10 |
| Yelloweye rockfish | 0.62 | 0 | 0.62 | 0.73 | 0 | 0.73 |
| Bocaccio [5] | na | 27.71 | 27.71 | na | 10.65 | 10.65 |
| Cowcod [5] | na | 1.43 | 1.43 | na | 0.10 | 0.10 |
| Pacific ocean perch [6] | 10.77 | na | 10.77 | 10.49 | na | 10.49 |
| Darkblotched rockfish | 22.80 | 0.90 | 23.69 | 22.46 | 1.17 | 23.63 |

[1] Includes only landings containing less than 2 mt of Pacific hake/whiting.
[2] Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.
[3] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.
[4] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.
[5] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.
[6] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 4.--Diffferences in estimated **2005** discards (mt) of major west coast groundfish species under two alternative estimation methods.

| | Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1) | | | | | |
|---|---|---|---|---|---|---|
| | North of 40°10' | | South of 40°10' | | Coastwide | |
| | mt | % | mt | % | mt | % |
| Sablefish | 19.4 | 5% | 10.6 | 11% | 30.0 | 6% |
| Shortspine thornyhead | 3.4 | 4% | 3.9 | 10% | 7.3 | 5% |
| Longspine thornyhead | 1.8 | 3% | 4.6 | 16% | 6.4 | 7% |
| Dover sole | 0.3 | 0.0% | -17.7 | -16% | -17.4 | -3% |
| Petrale sole | -0.2 | 0% | -3.3 | -91% | -3.5 | -6% |
| English sole | -15.3 | -6% | -51.6 | -98% | -66.9 | -22% |
| Arrowtooth flounder | 652.9 | 47% | 4.9 | 130% | 657.8 | 47% |
| Other Flatfish | 17.0 | 3% | -117.9 | -83% | -100.9 | -14% |
| Blackgill rockfish [3] | na | na | -0.9 | -40% | -0.9 | -40% |
| Splitnose rockfish [3] | na | na | 782.9 | 544% | 782.9 | 544% |
| Other slope rockfish | 12.2 | 55% | 7.3 | 156% | 19.5 | 72% |
| Yellowtail rockfish [4] | 8.1 | 28% | na | na | 8.1 | 28% |
| Chilipepper rockfish [5] | na | na | -51.1 | -99% | -51.1 | -99% |
| Other shelf rockfish | 17.1 | 23% | -5.5 | -87% | 11.6 | 14% |
| Black rockfish | 0.10 | 16% | 0 | | 0.1 | 16% |
| Other nearshore rockfish | 0.010 | 17% | -0.2 | | -0.2 | -76% |
| Pacific hake/whiting | 20.3 | 3% | -82.5 | -39% | -62.1 | -8% |
| Lingcod | 81.5 | 22% | -12.3 | -63% | 69.2 | 18% |
| Pacific cod | 1.8 | 41% | 0 | | 1.8 | 41% |
| Spiny dogfish | 171.9 | 18% | 20.1 | 16% | 192.0 | 18% |
| Unspecified skate | 29.7 | 22% | 1.2 | 32% | 30.9 | 22% |
| Big skate | 17.5 | 17% | -5.5 | -98% | 12.0 | 11% |
| Longnose skate | 59.0 | 14% | -82.9 | -39% | -23.9 | -4% |
| Shortbelly rockfish | 0.0006 | 29% | -0.6 | -57% | -0.6 | -57% |
| Other groundfish | -828.0 | -67% | -263.3 | -90% | -1,091.3 | -72% |
| Sum of differences for species above | 270.5 | | 140.0 | | 410.6 | |
| | | | | | | |
| Canary rockfish | 5.1 | 24% | -0.05 | -88% | 5.0 | 23% |
| Widow rockfish | -0.3 | -8% | 0.01 | 4% | -0.2 | -7% |
| Yelloweye rockfish | 0.1 | 18% | 0 | | 0.1 | 18% |
| Bocaccio [5] | na | na | -17.1 | -62% | -17.1 | -62% |
| Cowcod [5] | na | na | -1.3 | -93% | -1.3 | -93% |
| Pacific ocean perch [6] | -0.3 | -3% | na | na | -0.3 | -3% |
| Darkblotched rockfish | -0.3 | -1% | 0.3 | 31% | -0.1 | -0.2% |
| Sum of differences for rebuilding spec. | 4.3 | | -18.1 | | -13.8 | |

**Note: negative** numbers indicate that Alternative 2 results in LOWER discard estimates.

[3] South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

[4] North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

[5] South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

[6] North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.

Table 5.--Estimated discard amounts (mt) of major west coast groundfish species from non-whiting[1], commercial limited-entry groundfish trawls targeting groundfish[2] during **2004**, under two alternative estimation methods.

| **Alternative ->** | **1** | | | **2** | | |
|---|---|---|---|---|---|---|
| | **(current estimates)** Status quo stratification (area: season: depth) | | | Status quo stratification (area: season: depth) | | |
| | status quo approach used to expand observer data to logbook and fish ticket levels | | | **Tow duration** used to expand observer data to logbook level; Status quo approach used to expand estimated discard from logbook to fish ticket levels | | |
| | Estimated discard (mt) | | | Estimated discard (mt) | | |
| | North of 40°10' | South of 40°10' | Total | North of 40°10' | South of 40°10' | Total |
| Sablefish | 850.70 | 103.76 | 954.46 | 969.09 | 112.27 | 1,081.36 |
| Shortspine thornyhead | 129.88 | 73.66 | 203.54 | 133.41 | 71.53 | 204.95 |
| Longspine thornyhead | 73.29 | 53.50 | 126.79 | 79.80 | 50.23 | 130.03 |
| Dover sole | 300.79 | 182.70 | 483.49 | 290.81 | 166.31 | 457.12 |
| Petrale sole | 93.27 | 5.13 | 98.39 | 78.80 | 6.18 | 84.98 |
| English sole | 133.55 | 47.79 | 181.33 | 147.13 | 52.30 | 199.43 |
| Arrowtooth flounder | 2,049.0 | 24.30 | 2,073.3 | 809.18 | 12.48 | 821.66 |
| Other Flatfish | 369.70 | 97.53 | 467.23 | 298.97 | 92.61 | 391.58 |
| Blackgill rockfish [3] | na | 1.56 | 1.56 | na | 2.94 | 2.94 |
| Splitnose rockfish [3] | na | 104.83 | 104.83 | na | 3,359.17 | 3,359.17 |
| Other slope rockfish | 38.83 | 5.76 | 44.58 | 74.25 | 7.49 | 81.74 |
| Yellowtail rockfish [4] | 7.94 | na | 7.94 | 6.35 | 0 | 6.35 |
| Chilipepper rockfish [5] | na | 34.87 | 34.87 | na | 51.36 | 51.36 |
| Other shelf rockfish | 25.85 | 10.84 | 36.69 | 29.79 | 14.19 | 43.98 |
| Black rockfish | 0.17 | 0.00 | 0.17 | 0.19 | 0 | 0.19 |
| Other nearshore rockfish | 1.24 | 0.01 | 1.25 | 1.23 | 0.01 | 1.24 |
| Pacific hake/whiting | 2,017.8 | 196.04 | 2,213.8 | 2,118.11 | 233.30 | 2,351.41 |
| Lingcod | 148.75 | 30.55 | 179.30 | 168.94 | 38.62 | 207.56 |
| Pacific cod | 48.97 | 0 | 48.97 | 63.55 | 0 | 63.55 |
| Spiny dogfish | 596.90 | 34.77 | 631.67 | 690.30 | 44.17 | 734.47 |
| Unspecified skate | 279.22 | 61.79 | 341.01 | 316.84 | 70.05 | 386.90 |
| Big skate | 90.15 | 15.42 | 105.57 | 91.43 | 17.46 | 108.90 |
| Longnose skate | 206.23 | 102.42 | 308.65 | 227.23 | 118.89 | 346.12 |
| Shortbelly rockfish | 0.01 | 4.07 | 4.08 | 0.01 | 5.22 | 5.23 |
| Other groundfish | 419.36 | 179.42 | 598.77 | 583.05 | 161.15 | 744.20 |
| | | | | | | |
| Canary rockfish | 5.67 | 0.47 | 6.14 | 6.08 | 0.58 | 6.66 |
| Widow rockfish | 2.69 | 0.54 | 3.24 | 3.35 | 0.70 | 4.05 |
| Yelloweye rockfish | 0.41 | 0 | 0.41 | 0.40 | 0 | 0.40 |
| Bocaccio [5] | na | 4.74 | 4.74 | na | 5.61 | 5.61 |
| Cowcod [5] | na | 0.45 | 0.45 | na | 0.51 | 0.51 |
| Pacific ocean perch [6] | 22.29 | na | 22.29 | 24.63 | na | 24.63 |
| Darkblotched rockfish | 32.85 | 0.81 | 33.66 | 35.68 | 1.05 | 36.74 |

[1] Includes only landings containing less than 2 mt of Pacific hake/whiting.

[2] Includes only landings in which groundfish weight was greater than or equal to the weight of non-groundfish species.

[3] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Slope Rockfish category.

[4] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Shelf Rockfish category.

[5] Amounts in this row are for the area south of 40°10' N. Lat. Northern catch is included in the Other Shelf Rockfish category.

[6] Amounts in this row are for the area north of 40°10' N. Lat. Southern catch is included in the Other Slope Rockfish category.

Table 6.--Diffferences in estimated **2004** discards (mt) of major west coast groundfish species under two alternative estimation methods.

| | Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1) | | | | | |
|---|---|---|---|---|---|---|
| | North of 40°10' | | South of 40°10' | | Coastwide | |
| | mt | % | mt | % | mt | % |
| Sablefish | 118.4 | 14% | 8.5 | 8% | 126.9 | 13% |
| Shortspine thornyhead | 3.5 | 3% | -2.1 | -3% | 1.4 | 1% |
| Longspine thornyhead | 6.5 | 9% | -3.3 | -6% | 3.2 | 3% |
| Dover sole | -10.0 | -3% | -16.4 | -9% | -26.4 | -5% |
| Petrale sole | -14.5 | -16% | 1.1 | 21% | -13.4 | -14% |
| English sole | 13.6 | 10% | 4.5 | 9% | 18.1 | 10% |
| Arrowtooth flounder | -1,239.9 | -61% | -11.8 | -49% | -1,251.7 | -60% |
| Other Flatfish | -70.7 | -19% | -4.9 | -5% | -75.7 | -16% |
| Blackgill rockfish [3] | na | na | 1.4 | 88% | 1.4 | 88% |
| Splitnose rockfish [3] | na | na | 3,254 | 3104% | 3,254 | 3104% |
| Other slope rockfish | 35.4 | 91% | 1.7 | 30% | 37.2 | 83% |
| Yellowtail rockfish [4] | -1.6 | -20% | na | na | -1.6 | -20% |
| Chilipepper rockfish [5] | na | na | 16.5 | 47% | 16.5 | 47% |
| Other shelf rockfish | 3.9 | 15% | 3.4 | 31% | 7.3 | 20% |
| Black rockfish | 0.02 | 9% | 0 | | 0.02 | 9% |
| Other nearshore rockfish | -0.01 | -1% | 0.001 | | -0.01 | -1% |
| Pacific hake/whiting | 100.4 | 5% | 37.3 | 19% | 137.6 | 6.22% |
| Lingcod | 20.2 | 14% | 8.1 | 26% | 28.3 | 16% |
| Pacific cod | 14.57 | 29.76% | 0 | | 14.57 | 29.76% |
| Spiny dogfish | 93.4 | 16% | 9.4 | 27% | 102.8 | 16% |
| Unspecified skate | 37.6 | 13% | 8.3 | 13% | 45.9 | 13% |
| Big skate | 1.3 | 1% | 2.0 | 13% | 3.3 | 3% |
| Longnose skate | 21.0 | 10% | 16.5 | 16% | 37.5 | 12% |
| Shortbelly rockfish | 0.0014 | 14% | 1.2 | 28% | 1.2 | 28% |
| Other groundfish | 163.7 | 39% | -18.3 | -10.2% | 145.4 | 24% |
| Sum of differences for species above | -703.1 | | 3,317.2 | | 2,614.1 | |
| | | | | | | |
| Canary rockfish | 0.4 | 7% | 0.11 | 23% | 0.5 | 8% |
| Widow rockfish | 0.7 | 24% | 0.2 | 29% | 0.8 | 25% |
| Yelloweye rockfish | -0.01 | -2% | 0 | | -0.01 | -2% |
| Bocaccio [5] | na | na | 0.9 | 18% | 0.9 | 18% |
| Cowcod [5] | na | na | 0.1 | 14% | 0.1 | 14% |
| Pacific ocean perch [6] | 2.3 | 10% | na | na | 2.3 | 10% |
| Darkblotched rockfish | 2.8 | 9% | 0.2 | 30% | 3.1 | 9% |
| Sum of differences for rebuilding spec. | 6.2 | | 1.4 | | 7.7 | |

**Note: negative** numbers indicate that Alternative 2 results in LOWER discard estimates.

[3] South of 40°10' N. Lat., only; northern catch is included in the Other Slope Rockfish category.

[4] North of 40°10' N. Lat., only; southern catch is included in the Other Shelf Rockfish category.

[5] South of 40°10' N. Lat., only; northern catch is included in the Other Shelf Rockfish category.

[6] North of 40°10' N. Lat., only; southern catch is included in the Other Slope Rockfish category.

Agenda Item F.1.b
Supplemental Attachment 2
March 2008

**Observed and Estimated Total Bycatch of Salmon in the 2005-2006**
**West Coast Limited-Entry Bottom Trawl Groundfish Fishery**

Marlene Bellman
Pacific States Marine Fisheries Commission

Dr. James Hastie
Fishery Resource Analysis and Monitoring Division
Northwest Fisheries Science Center

March 4, 2008

## Introduction

This report summarizes estimates of salmon species bycatch from the limited-entry (LE) bottom trawl groundfish fleet during the calendar years 2005 and 2006. Data sources for this analysis include onboard observer data, trawl logbook data, and landing receipt data (referred to as fish tickets). Using the catch of salmon species and target groundfish weight from observed trawl tows, in conjunction with logbook and fish ticket target groundfish weight, estimates of the total annual bycatch of salmon in the bottom trawl fishery are developed for geographic regions off the US west coast consistent with salmon management. A previous report was provided of total salmon species bycatch from 2002 through 2004 (Hastie 2005). Salmon included in this analysis are chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), chum (*Oncorhynchus keta*), and a category for unspecified salmon species.

The West Coast Groundfish Observer Program (WCGOP) was established in 2001 by NOAA Fisheries (National Marine Fisheries Service, NMFS) (66 FR 20609). All commercial vessels that catch and retain groundfish in the United States Exclusive Economic Zone (EEZ) from 3-200 miles offshore are required to carry an observer when notified to do so by NMFS or its designated agent. The WCGOP coverage plan, which details program goals, vessel selection, observer coverage, and basic data collection, is available at: http://www.nwfsc.noaa.gov/research/divisions/fram/observer/observersamplingplan.pdf. The LE bottom trawl fleet is one of WCGOP's highest priorities for observer coverage, which was initiated in September 2001. Since then, WCGOP observers have annually monitored 20-30% of groundfish landings (by weight) in the non-hake LE bottom trawl fishery.

Logbook record-keeping for the LE groundfish trawl fishery is a state-mandated requirement in Washington, Oregon, and California. A common-format logbook is used by all three states and completed logbook information is entered into state agency databases. The electronic logbook data are then submitted to a regional database clearinghouse, the Pacific Coast Fisheries

Information Network (PacFIN), maintained by the Pacific States Marine Fisheries Commission (PSMFC).

Landing receipts, known as fish tickets, are completed by fish-buyers in each port for each delivery of fish by a vessel.  Fish tickets are issued to fish-buyers by a state agency and must be returned to the agency for processing.  Washington, Oregon, and California each use slightly different formats for their fish tickets.  Each state also conducts species-composition sampling for numerous “market” categories reported on fish tickets.  Market categories may include several species (e.g. minor shelf rockfish), or may represent individual species where verification of correct species identification is deemed desirable.  The fish ticket and species-composition data are also submitted to the PacFIN database.  The current analysis uses fish ticket data to which species-composition ratios derived from state port sampling have been applied, so that landed weights are as species specific as possible.

**Methods**

Salmon bycatch estimates are derived from WCGOP observer data, fish ticket landings data, and trawl logbook data.  The observer data used in this analysis are included in two data reports for the LE trawl fishery covering calendar years 2005 and 2006 (NWFSC 2006, 2007).  Both of these reports are available at: http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/index.cfm.  Additional details regarding observer program vessel coverage and trawl data collection are found in the WCGOP data reports.  Fish ticket and logbook data for commercial, trawl-endorsed LE vessels using bottom trawl gear are obtained from PacFIN.

The same criteria are applied to data from all three sources (observer, logbook, fish ticket), where appropriate, to ensure that observed bycatch amounts are expanded to the logbook and then fish ticket levels using consistently defined fishing activity.  Records meeting the following criteria were not included in the analysis: 1) research landings; 2) logbook tows lacking a recorded depth or latitude; 3) trips/tows where no groundfish were retained; 4) trips/tows where retained Pacific hake (whiting) was greater than 2 mt or comprised more than half of the total weight of retained groundfish; 5) trips/tows containing more than 100 lb of retained shrimp; and 6) tows/trips in which the landed weight of non-groundfish species was greater than that of groundfish species (see Appendix A. for a list of groundfish species).

The process of estimating salmon bycatch begins with summarizing WCGOP observer data and trawl logbook data according to strata.  Based on review of the amount and distribution of observed and fleet fishing effort, observer data are stratified by area, depth, and season.  Records are separated into four latitudinal regions, three depth zones, and two seasons.  The four latitudinal regions are defined as: US waters north of Cape Falcon, Oregon (45.77° N lat.), Cape Falcon to Cape Blanco, Oregon (42.75° N lat.), Cape Blanco to Cape Mendocino, California (40.16° N lat.), and US waters south of Cape Mendocino (Figure 1).  The average latitude of reported tow set and end location is used to assign each tow to one of these areas.  The depth zones are defined as: depths shallower than 125 fathoms, those between 125 and 250 fathoms, and those deeper than 250 fathoms.  Review of the distribution of observed 2005-2006 trawl tows supported the use of these depth zones, which were also used in the previous report of salmon bycatch (Hastie 2005).  Seasons were defined by pooling data from January-April and

November-December (bi-monthly periods 1, 2, 6) into a winter season, and data from May-October (bi-monthly periods 3, 4, 5) into a summer season. In order to ensure a robust sample size, a few strata were aggregated across season to an annual timeframe. In 2006, data were aggregated to an annual level in depths shallower than 125 fm and between 125 and 250 fathoms in the area from Cape Blanco to Cape Mendocino, and in depths shallower than 125 fm between Cape Falcon and Cape Blanco. In 2005, data were also aggregated to an annual level in depths shallower than 125 fm from Cape Blanco to Cape Mendocino.

Observed numbers of salmon, by species, and the retained weight of groundfish species targeted by the trawl fleet were summed for each year-area-depth-seasonal stratum. A salmon bycatch ratio is then calculated as the number of salmon divided by the weight of retained groundfish "target" species in each stratum. The groundfish "target" species group includes all flatfish, sablefish, thornyheads, Pacific cod, skates, and spiny dogfish, in both the northern and southern areas, with the addition of slope rockfish in the southern area.

The retained catch of groundfish target species is used as a measure of trawl fishing effort for expanding salmon bycatch from observed trips to the entire LE bottom trawl fleet. The retained weight of groundfish target species is summed from the fleet's logbook data for each year-area-depth-seasonal stratum. The logbook retained weight of groundfish target species in each stratum is then multiplied by the observed salmon bycatch ratio for the same stratum, producing an initial estimated of the fleet-wide number of salmon caught.

Because logbooks are not submitted for 100% of trawl trips and some records are missing data elements used in this analysis, logbook data do not capture all groundfish bottom trawl fishing effort. As a result, estimated salmon bycatch numbers must be expanded to include landings that are not reported in logbooks. The landed weight of groundfish target species is summed using fish ticket data for each year, state (of landing), and two month period. An expansion ratio for each year-state-period is then calculated by dividing the fish ticket weight by the logbook weight for combined target species. The initial fleet-wide number of salmon, estimated using observer and logbook data, is then multiplied by the expansion ratio, to produce a final estimate of salmon bycatch.

**Results**

A summary of salmon and groundfish target species catch on observed limited-entry bottom trawl tows during 2005-2006 is provided in Table 1. Only a small percentage of observed tows in this fishery encountered salmon. For those tows that encountered salmon, the major salmon species encountered was chinook. The area north of Cape Falcon accounts for the majority of observed chinook salmon caught in the LE bottom trawl fishery.

The stratification of observer data and fleet-wide logbook target groundfish catch by area, season, and depth is provided in Table 2. No chinook were caught in tows deeper than 250 fathoms. In most cases, higher rates of chinook bycatch were observed in the winter. The highest rate in 2006 was found during the winter in the area south of Cape Mendocino (0.74 chinook per metric ton of target groundfish), and in 2005, during the winter in the area north of

Cape Falcon (0.41 chinook per metric ton of target groundfish). In all other strata, fewer than 0.2 salmon were caught per metric ton of retained target groundfish species.

An overview of the annual numbers of salmon bycatch associated with the LE bottom trawl fishery is provided in Table 3. Fleet-wide estimated bycatch of chinook fell by nearly an order of magnitude from 2005 to 2006. Dramatic reductions were observed in each of the areas north of Cape Mendocino, California. Estimates for both chinook and coho increased modestly from 2005 to 2006 in the area south of Cape Mendocino. For comparison, chinook salmon bycatch in the Pacific hake fishery is also shown.

A summary of the number of tows having specific numbers of observed chinook is presented in Table 4. In most of the year-area strata, the majority of tows with salmon contained only one fish. Only 3 tows were observed in which more than 8 chinook were caught.

**References**

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Table 1.--Summary of salmon and groundfish target species catch on observed limited-entry bottom trawl tows during 2005-2006, by area, species, and year.

| | 2005 | 2006 |
|---|---|---|
| **North of Cape Falcon** | | |
| Number of observed tows | 1,836 | 1,357 |
| number with salmon | 21 | 5 |
| percentage with salmon | 1.1% | 0.4% |
| Total salmon catch in observed tows | | |
| chinook (# of fish) | 115 | 8 |
| coho (# of fish) | 1 | 0 |
| chum (# of fish) | 0 | 0 |
| unspecified (# of fish) | 0 | 0 |
| retained target groundfish (mt) | 2,067 | 1,229 |
| **Cape Falcon - Cape Blanco** | | |
| Number of observed tows | 802 | 697 |
| number with salmon | 15 | 1 |
| percentage with salmon | 1.9% | 0.1% |
| Total salmon catch in observed tows | | |
| chinook (# of fish) | 35 | 1 |
| coho (# of fish) | 0 | 0 |
| chum (# of fish) | 0 | 0 |
| unsp. salmon (# of fish) | 0 | 0 |
| retained target groundfish (mt) | 997 | 914 |
| **Cape Blanco - Cape Mendocino** | | |
| Number of observed tows | 341 | 350 |
| number with salmon | 4 | 1 |
| percentage with salmon | 1.2% | 0.3% |
| Total salmon catch in observed tows | | |
| chinook (# of fish) | 16 | 1 |
| coho (# of fish) | 0 | 0 |
| chum (# of fish) | 0 | 0 |
| unsp. salmon (# of fish) | 0 | 0 |
| retained target groundfish (mt) | 644 | 652 |
| **South of Cape Mendocino** | | |
| Number of observed tows | 613 | 517 |
| number with salmon | 1 | 4 |
| percentage with salmon | 0.2% | 0.8% |
| Total salmon catch in observed tows | | |
| chinook (# of fish) | 1 | 8 |
| coho (# of fish) | 0 | 4 |
| chum (# of fish) | 0 | 0 |
| unsp. salmon (# of fish) | 0 | 0 |
| retained target groundfish (mt) | 689 | 443 |

Table 2.--Estimated numbers and bycatch ratios of chinook salmon caught on observed tows and logbook target species weight from limited-entry groundfish bottom trawl vessels during 2005-2006, by area, season, and depth.

| | | <= 125 fm | | | | | 125.1 - 250 fm | | | | | > 250 fm | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Catch on obs. tows with salmon | | | | | Catch on obs. tows with salmon | | | | | Catch on obs. tows with salmon | | | |
| Area | Season | # of obs. tows | Number of chinook | Target groundfish (mt) | # chinook / mt of groundfish | Logbook mt of target groundfish | # of obs. tows | Number of chinook | Target groundfish (mt) | # chinook / mt of groundfish | Logbook mt of target groundfish | # of obs. tows | Number of chinook | Target groundfish (mt) | # chinook / mt of groundfish | Logbook mt of target groundfish |
| **2005** | | | | | | | | | | | | | | | | |
| North of Cape | winter | 188 | 1 | 132 | 0.008 | 361 | 141 | 114 | 276 | 0.413 | 1079 | 172 | 0 | 380 | 0 | 1148 |
| Falcon | summer | 1183 | 0 | 1138 | 0 | 4335 | 83 | 0 | 81 | 0 | 281 | 69 | 0 | 59 | 0 | 232 |
| | Total | 1371 | 1 | 1271 | 0.001 | 4696 | 224 | 114 | 357 | 0.320 | 1359 | 241 | 0 | 439 | 0 | 1380 |
| Cape Falcon - | winter | 66 | 4 | 45 | 0.089 | 73 | 155 | 28 | 278 | 0.101 | 809 | 126 | 0 | 242 | 0 | 809 |
| Cape Blanco | summer | 273 | 0 | 239 | 0 | 1103 | 74 | 3 | 81 | 0.037 | 296 | 108 | 0 | 112 | 0 | 543 |
| | Total | 339 | 4 | 284 | 0.014 | 1176 | 229 | 31 | 359 | 0.086 | 1105 | 234 | 0 | 354 | 0 | 1352 |
| Cape Blanco - | winter | | | | | | 47 | 14 | 95 | 0.148 | 627 | 78 | 0 | 198 | 0 | 907 |
| Cape Mendocino | summer | | | | | | 21 | 0 | 44 | 0 | 274 | 109 | 0 | 214 | 0 | 823 |
| | Total | 86 | 2 | 93 | 0.021 | 635 | 68 | 14 | 138 | 0.101 | 901 | 187 | 0 | 412 | 0 | 1730 |
| South of Cape | winter | 27 | 0 | 4 | 0 | 78 | 79 | 0 | 119 | 0 | 310 | 121 | 0 | 220 | 0 | 837 |
| Mendocino | summer | 222 | 1 | 88 | 0.011 | 356 | 43 | 0 | 65 | 0 | 238 | 121 | 0 | 193 | 0 | 820 |
| | Total | 249 | 1 | 92 | 0.011 | 434 | 122 | 0 | 183 | 0 | 548 | 242 | 0 | 413 | 0 | 1657 |
| **2006** | | | | | | | | | | | | | | | | |
| North of Cape | winter | 125 | 2 | 49 | 0.041 | 161 | 88 | 5 | 165 | 0.033 | 836 | 94 | 0 | 200 | 0 | 987 |
| Falcon | summer | 933 | 1 | 656 | 0.002 | 3744 | 53 | 0 | 97 | 0 | 457 | 64 | 0 | 62 | 0 | 277 |
| | Total | 1058 | 3 | 705 | 0.004 | 3905 | 141 | 5 | 262 | 0.021 | 1293 | 158 | 0 | 262 | 0 | 1264 |
| Cape Falcon - | winter | | | | | | 150 | 1 | 229 | 0.004 | 1134 | 84 | 0 | 172 | 0 | 846 |
| Cape Blanco | summer | | | | | | 60 | 0 | 78 | 0 | 386 | 121 | 0 | 205 | 0 | 928 |
| | Total | 282 | 0 | 231 | 0 | 1075 | 210 | 1 | 306 | 0.003 | 1520 | 205 | 0 | 377 | 0 | 1775 |
| Cape Blanco - | winter | | | | | | | | | | | 56 | 0 | 127 | 0 | 645 |
| Cape Mendocino | summer | | | | | | | | | | | 134 | 0 | 275 | 0 | 1176 |
| | Total | 70 | 0 | 74 | 0 | 682 | 90 | 1 | 176 | 0.006 | 793 | 190 | 0 | 402 | 0 | 1821 |
| South of Cape | winter | 44 | 7 | 10 | 0.735 | 47 | 23 | 0 | 27 | 0 | 233 | 35 | 0 | 54 | 0 | 457 |
| Mendocino | summer | 200 | 1 | 63 | 0.016 | 274 | 82 | 0 | 78 | 0 | 198 | 133 | 0 | 212 | 0 | 801 |
| | Total | 244 | 8 | 72 | 0.111 | 321 | 105 | 0 | 105 | 0 | 430 | 168 | 0 | 265 | 0 | 1258 |

Note: Winter season includes bi-monthly periods 1, 2, 6 (January-April; November-December); summer season includes bi-monthly periods 3, 4, 5, (May-October).

Table 3.--Estimated total numbers of salmon caught incidentally by the limited-entry groundfish bottom trawl fleet, during 2005-2006, by area, season, and species.

| | Season[1] | Chinook 2005 | Chinook 2006 | Coho 2005 | Coho 2006 |
|---|---|---|---|---|---|
| North of Cape Falcon | winter | 572 | 36 | 5 | 0 |
| | summer | 0 | 6 | 0 | 0 |
| | Total | 572 | 42 | 5 | 0 |
| Cape Falcon - Cape Blanco | winter | 97 | 5 | 0 | 0 |
| | summer | 12 | 0 | 0 | 0 |
| | Total | 108 | 5 | 0 | 0 |
| Total North of Cape Blanco | Total | 680 | 47 | 5 | 0 |
| Cape Blanco - Cape Mendocino | winter | 100 | 4 | 0 | 0 |
| | summer | 15 | 1 | 0 | 0 |
| | Total | 115 | 5 | 0 | 0 |
| South of Cape Mendocino | winter | 0 | 39 | 0 | 0 |
| | summer | 4 | 5 | 0 | 19 |
| | Total | 4 | 44 | 0 | 19 |
| Total South of Cape Blanco | Total | 119 | 49 | 0 | 19 |
| Coastwide | Total | 799 | 96 | 5 | 19 |
| Pacific Hake Trawl Fishery[2] | Total | 11,916 | 3,975 | | |

| | Season[1] | Chum 2005 | Chum 2006 | Unspecified Salmon 2005 | Unspecified Salmon 2006 |
|---|---|---|---|---|---|
| North of Cape Falcon | winter | 0 | 0 | 0 | 0 |
| | summer | 0 | 0 | 0 | 0 |
| | Total | 0 | 0 | 0 | 0 |
| Cape Falcon - Cape Blanco | winter | 0 | 0 | 0 | 0 |
| | summer | 0 | 0 | 0 | 0 |
| | Total | 0 | 0 | 0 | 0 |
| Total North of Cape Blanco | Total | 0 | 0 | 0 | 0 |
| Cape Blanco - Cape Mendocino | winter | 0 | 0 | 0 | 0 |
| | summer | 0 | 0 | 0 | 0 |
| | Total | | | | |
| South of Cape Mendocino | winter | 0 | 0 | 0 | 0 |
| | summer | 0 | 0 | 0 | 0 |
| | Total | | | | |
| Total South of Cape Blanco | Total | 0 | 0 | 0 | 0 |
| Coastwide | Total | 0 | 0 | 0 | 0 |

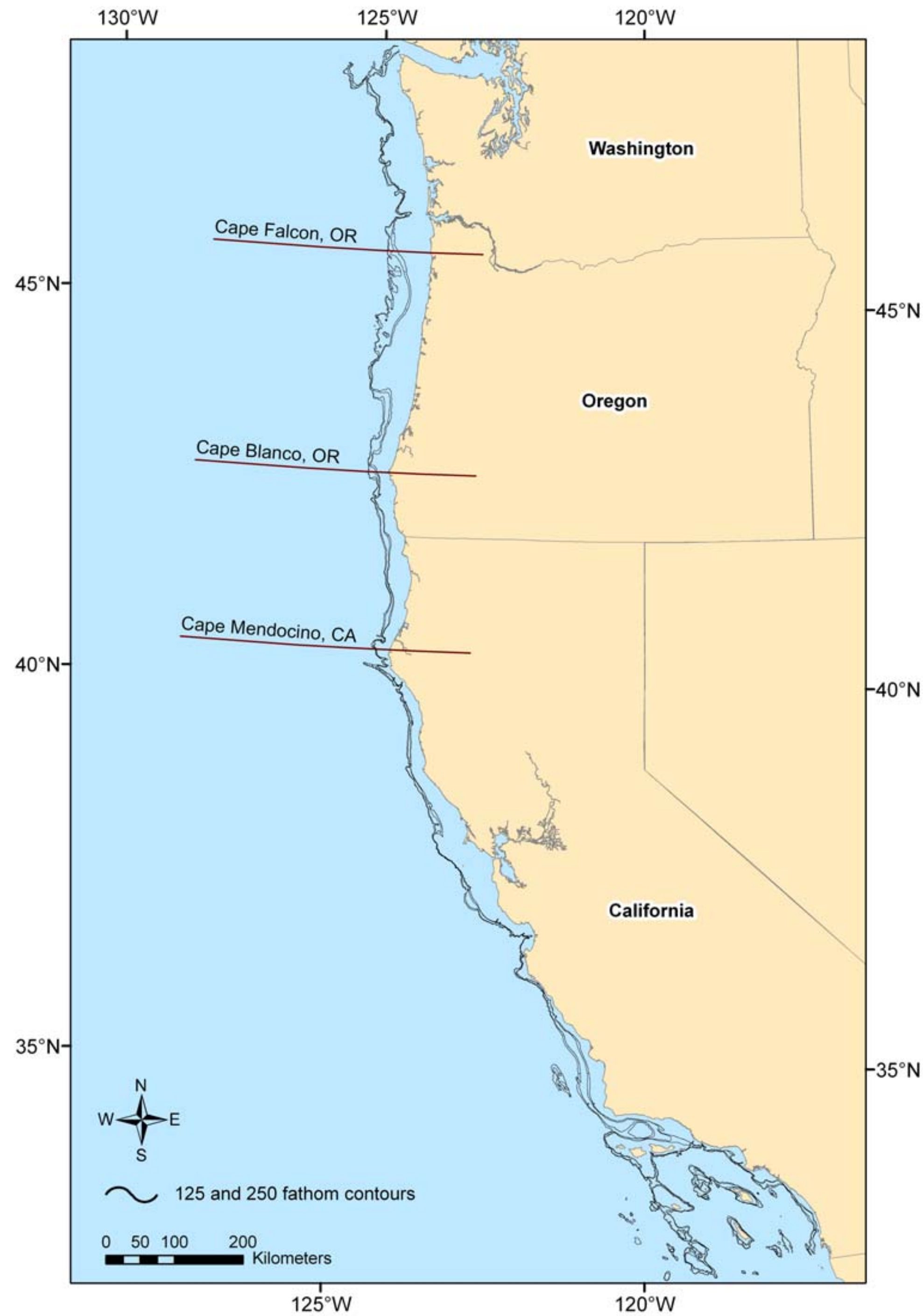
[1]Winter season includes bi-monthly periods 1, 2, 6 (January-April; November-December); summer season includes bi-monthly periods 3, 4, 5, (May-October).

[2]Pacific hake trawl fishery chinook estimates were obtained from summary reports by the Northwest Regional Office for all sectors coastwide (NMFS 2006, 2007).

Table 4.--Tow frequency distribution of the estimated number of chinook per observed tow, by year and area.

| Number of chinook in tow | North of Cape Falcon | | Cape Falcon - Cape Blanco | | Cape Blanco - Cape Mendocino | | South of Cape Mendocino | | Coast-wide | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| None | 1,815 | 1,352 | 787 | 696 | 337 | 349 | 612 | 514 | 3,551 | 2,911 |
| Any | 21 | 5 | 15 | 1 | 4 | 1 | 1 | 3 | 41 | 10 |
| % with any | 1.2% | 0.4% | 1.9% | 0.1% | 1.2% | 0.3% | 0.2% | 0.6% | 1.2% | 0.3% |
| 1 | 5 | 4 | 8 | 1 | 2 | 1 | 1 | 2 | 16 | 8 |
| 2 | 4 | | 3 | | | | | | 7 | 0 |
| 3 | 3 | | 1 | | | | | | 4 | 0 |
| 4 | 3 | 1 | | | | | | | 3 | 1 |
| 5 | 1 | | 1 | | | | | | 2 | 0 |
| 6 | 2 | | 1 | | 1 | | | 1 | 4 | 1 |
| 7 | | | 1 | | | | | | 1 | 0 |
| 8 | | | | | 1 | | | | 1 | 0 |
| 9 | | | | | | | | | 0 | 0 |
| 10 | | | | | | | | | 0 | 0 |
| 11 | | | | | | | | | 0 | 0 |
| 12 | | | | | | | | | 0 | 0 |
| 13 | | | | | | | | | 0 | 0 |
| 14 | | | | | | | | | 0 | 0 |
| 15 | 2 | | | | | | | | 2 | 0 |
| 16 | | | | | | | | | 0 | 0 |
| 17 | | | | | | | | | 0 | 0 |
| 20 | | | | | | | | | 0 | 0 |
| 21 | | | | | | | | | 0 | 0 |
| 22 | | | | | | | | | 0 | 0 |
| 23 | | | | | | | | | 0 | 0 |
| 24 | | | | | | | | | 0 | 0 |
| 25 | | | | | | | | | 0 | 0 |
| 26 | | | | | | | | | 0 | 0 |
| 28 | | | | | | | | | 0 | 0 |
| 30 | | | | | | | | | 0 | 0 |
| 31 | | | | | | | | | 0 | 0 |
| 32 | | | | | | | | | 0 | 0 |
| 33 | | | | | | | | | 0 | 0 |
| 34 | 1 | | | | | | | | 1 | 0 |

Figure 1. Geographic latitudinal regions and depths utilized in salmon bycatch estimation from the limited-entry bottom trawl groundfish fishery.



## Appendix A. Common and scientific names of species included in the Groundfish Fishery Management Plan.

**SHARKS**
Big skate, *Raja binoculata*
California skate, *R. inornata*
Leopard shark, *Triakis semifasciata*
Longnose skate, *R. rhina*
Soupfin shark, *Galeorhinus zyopterus*
Spiny dogfish, *Squalus acanthias*

**RATFISH**
Ratfish, *Hydrolagus colliei*

**MORIDS**
Finescale codling, *Antimora microlepis*

**GRENADIERS**
Pacific rattail, *Coryphaenoides acrolepis*

**ROUNDFISH**
Cabezon, *Scorpaenichthys marmoratus*
Kelp greenling, *Hexagrammos decagrammus*
Lingcod, *Ophiodon elongatus*
Pacific cod, *Gadus macrocephalus*
Pacific whiting, (hake) *Merluccius productus*
Sablefish, *Anoplopoma fimbria*

**FLATFISH**
Arrowtooth flounder, (turbot) *Atheresthes stomias*
Butter sole, *Isopsetta isolepis*
Curlfin sole, *Pleuronichthys decurrens*
Dover sole, *Microstomus pacificus*
English sole, *Parophrys vetulus*
Flathead sole, *Hippoglossoides elassodon*
Pacific sanddab, *Citharichthys sordidus*
Petrale sole, *Eopsetta jordani*
Rex sole, *Glyptocephalus zachirus*
Rock sole, *Lepidopsetta bilineata*
Sand sole, *Psettichthys melanostictus*
Starry flounder, *Platichthys stellatus*

## Appendix A continued. Common and scientific names of species included in the Groundfish Fishery Management Plan.

**ROCKFISH**
(includes all genera and species of the family Scopaenidae, even if not listed, that occur in the Washington, Oregon, and California area)

**Species that are managed with individual Optimum Yields for at least a portion of the Pacific Fishery Management Council area**

Bocaccio, *S. paucispinis*
Canary rockfish, *Sebastes pinniger*
Chilipepper, *S. goodei*
Cowcod, *S. levis*
Darkblotched rockfish, *S. crameri*
Longspine thornyhead, *Sebastolobus altivelis*
Pacific ocean perch, *S. alutus*
Shortbelly rockfish, *S. jordani*
Shortspine thornyhead, *Sebastolobus alascanus*
Splitnose rockfish, *S. diploproa*
Widow rockfish, *S. entomelas*
Yelloweye rockfish, *S. ruberimus*
Yellowtail rockfish, *S. flavidus*

**Minor Rockfish Species**

Minor Nearshore Rockfish

| North of 40°10' N. lat. | South of 40°10' N. lat. |
|---|---|
| Black, *Sebastes melanops* | Black, *Sebastes melanops* |
| Black-and-yellow, *S. chrysolmelas.* | Black-and-yellow, *S. chrysolmelas* |
| Blue, *S. mystinus* | Blue, *S. mystinus* |
| Brown, *S. auriculatus* | Brown, *S. auriculatus* |
| Calico, *S. dalli* | Calico, *S. dalli* |
| China, *S. nebulosus* | California scorpionfish, *Scorpaena guttata* |
| Copper, *S. caurinus* | China, *Sebastes nebulosus* |
| Gopher, *S. carnatus* | Copper, *S. caurinus* |
| Grass, *S. rastrelliger* | Gopher, *S. carnatus* |
| Kelp, *S. atrovirens* | Grass, *S. rastrelliger* |
| Olive, *S. serranoides* | Kelp, *S. atrovirens* |
| Quillback, *S. maliger* | Olive, *S. serranoides* |
| Treefish, *S. serriceps* | Quillback, *S. maliger* |
| | Treefish, *S. serriceps* |

**Appendix A continued. Common and scientific names of species included in the Groundfish Fishery Management Plan.**

| North of 40°10' N. lat. | South of 40°10' N. lat. |
|---|---|
| Minor Shelf Rockfish | |
| Bronzespotted, *S. gilli* | Bronzespotted, *S. gilli* |
| Bocaccio, *S. paucispinis* | Chameleon, *S. phillipsi* |
| Chameleon, *S. phillipsi* | Dwarf-red, *S. rufianus* |
| Chilipepper, *S. goodei* | Flag, *S. rubrivinctus* |
| Cowcod, *S. levis* | Freckled, *S. lentiginosus* |
| Dwarf-red, *S. rufianus* | Greenblotched, *S. rosenblatti* |
| Flag, *S. rubrivinctus* | Greenspotted, *S. chlorostictus* |
| Freckled, *S. lentiginosus* | Greenstriped, *S. elongatus* |
| Greenblotched, *S. rosenblatti* | Halfbanded, *S. semicinctus* |
| Greenspotted, *S. chlorostictus* | Honeycomb, *S. umbrosus* |
| Greenstriped, *S. elongatus* | Mexican, *S. macdonaldi* |
| Halfbanded, *S. semicinctus* | Pink, *S. eos* |
| Honeycomb, *S. umbrosus* | Pinkrose, *S. simulator* |
| Mexican, *S. macdonaldi* | Pygmy, *S. wilsoni* |
| Pink, *S. eos* | Redstriped, *S. proriger* |
| Pinkrose, *S. simulator* | Rosethorn, *S. helvomaculatus* |
| Pygmy, *S. wilsoni.* | Rosy, *S. rosaceus* |
| Redstriped, *S. proriger* | Silvergrey, *S. brevispinus* |
| Rosethorn, *S. helvomaculatus* | Speckled, *S. ovalis* |
| Rosy, *S. rosaceus* | Squarespot, *S. hopkinsi* |
| Silvergrey, *S. brevispinus* | Starry, *S. constellatus* |
| Speckled, *S. ovalis* | Stripetail, *S. saxicola* |
| Squarespot, *S. hopkinsi* | Swordspine, *S. ensifer* |
| Starry, *S. constellatus* | Tiger, *S. nigorcinctus* |
| Stripetail, *S. saxicola* | Vermilion, *S. miniatus* |
| Swordspine, *S. ensifer* | Yelloweye, *S. ruberrimus* |
| Tiger, *S. nigorcinctus* | Yellowtail, *S. flavidus* |
| Vermilion, *S. miniatus* | |
| Yelloweye, *S. ruberrimus* | |
| Minor Slope Rockfish | |
| Aurora, *S. aurora* | Aurora, S. aurora |
| Bank, *S. rufus* | Bank, *S. rufus* |
| Blackgill, *S. melanostomus* | Blackgill, *S. melanostomus* |
| Darkblotched, *S. crameri* | Darkblotched, *S. crameri* |
| Redbanded, *S. babcocki* | Pacific ocean perch (POP), *S. alutus* |
| Rougheye, *S. aleutianus* | Redbanded, *S. babcocki* |
| Sharpchin, *S. zacentrus* | Rougheye, *S. aleutianus* |
| Shortraker, *S. borealis* | Sharpchin, *S. zacentrus* |
| Splitnose, *S. diploproa* | Shortraker, *S. borealis* |
| Yellowmouth, *S. reedi* | Yellowmouth, *S. reedi* |

Agenda Item F.1.b
Supplemental Science Center Activity Report PowerPoint Presentation
March 2008

# Science Center Activity Report

March 12, 2008

Dr. Jim Hastie and Dr. Elizabeth Clarke

# Summary of the Estimated Numbers of Salmon Caught in Groundfish Bottom Trawls, 2005-06

| Area | Chinook 2005 | Chinook 2006 | Coho 2005 | Coho 2006 |
|---|---|---|---|---|
| North of Cape Falcon | 572 | 42 | 5 | 0 |
| Cape Falcon - Cape Blanco | 108 | 5 | 0 | 0 |
| Total: North of Cape Blanco | 680 | 47 | 5 | 0 |
| Cape Blanco - Cape Mendocino | 115 | 5 | 0 | 0 |
| South of Cape Mendocino | 4 | 44 | 0 | 19 |
| Total: South of Cape Blanco | 119 | 49 | 0 | 19 |
| Coastwide Total | 799 | 96 | 5 | 19 |
| Pacific Hake Trawl Fishery[1] | 11,916 | 3,975 | | |

[1] Obtained from summary reports produced by the NMFS Northwest Regional Office

There was no observed catch of Chum or "Unspecified" salmon in either year

# Alternative Methods for Estimating Bottom-Trawl Discards

- NWFSC trawl fleet discard estimates have used retained tonnage to expand observed discard up to all trips with logbook records
  - Retained tonnage is verifiable on fishtickets
- This expansion can also be conducted using tow duration, rather than target tonnage
  - Tow duration is self-reported on some, but not all logbooks
- With either approach, a measure of retained tonnage must be used to expand estimates to include trips with fish tickets but no logbook records
- We have conducted a comparison of discard estimates using these two approaches

# Comparison of Estimated Amounts of Discard Using Alternative Methods of Data Expansion

| | Difference in discards between Alternative 2 (using tow duration) and the status quo method (Alternative 1) | | | | | |
|---|---|---|---|---|---|---|
| | 2004 | | 2005 | | 2006 | |
| | mt | % | mt | % | mt | % |
| **Sum of differences for all non-rebuilding species** | 2,614 | 28% | 411 | 5% | -778 | -9% |
| **Canary rockfish** | 0.5 | 8% | 5.0 | 23% | -0.8 | -4% |
| **Widow rockfish** | 0.8 | 25% | -0.2 | -7% | -0.1 | -19% |
| **Yelloweye rockfish** | -0.01 | -2% | 0.1 | 18% | -0.003 | -0.4% |
| **Darkblotched rockfish** | 3.1 | 9% | -0.1 | 0% | -12.7 | -14% |
| **South of 40°10' only** | | | | | | |
| **Bocaccio** | 0.9 | 18% | -17.1 | -62% | -7.9 | -43% |
| **Cowcod** | 0.1 | 14% | -1.3 | -93% | -0.2 | -24% |
| **North of 40°10' only** | | | | | | |
| **Pacific ocean perch** | 2.3 | 10% | -0.3 | -2.6% | -0.3 | -4% |
| **Sum of differences for all rebuilding species** | 7.7 | 11% | -13.8 | -16% | -22.0 | -16% |

**Note:** negative numbers indicate that Alternative 2 results in LOWER discard estimates.

# STOCK ASSESSMENT PLANNING FOR 2011-2012 MANAGEMENT MEASURES

The Council approved Amendment 17 to the Pacific Coast Groundfish Fishery Management Plan as a means of providing for a biennial management cycle, more opportunity for public input, regulatory efficiencies, and various improvements in the management process. In this process there is a year in which assessments are done to inform decisions for the following biennial management cycle, followed by a year for deciding the new groundfish harvest specifications and management measures. This agenda item concerns planning for new groundfish stock assessments that are anticipated to be done next year, which will be used to decide the harvest specifications and management measures for 2011 and 2012 groundfish fisheries.

Last year 10 full groundfish stock assessments were conducted, peer-reviewed, and ultimately adopted for deciding 2009 and 2010 harvest specifications and management measures (not including Pacific whiting). The Council sponsored a workshop to critically review the recent groundfish stock assessment process and invited the participants to explore improvements to this process. The summary minutes of the December 19, 2007 Groundfish Stock Assessment Review Workshop with recommended assessment process improvements are provided in Agenda Item F.2.a, Attachment 1. One important recommendation was that the Council put forward preliminary decisions on stock assessment planning elements at the March Council meeting and take final action at the June Council meeting.

Dr. Elizabeth Clarke, Division Director at the National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center, will report on possible stock assessments for the next biennial fishery management cycle and recommended criteria for prioritizing these assessments (Agenda Item F.2.b, Attachment 1).

The Scientific and Statistical Committee (SSC) developed a draft Terms of Reference for the Groundfish Stock Assessment and Review Process for 2009-2010 (Agenda Item F.2.c, Supplemental Attachment 1), which specifies how the next assessment process should occur and defines the roles and responsibilities of various entities contributing to this process. Dr. Martin Dorn, the SSC's Groundfish Subcommittee chair, will report on this draft Terms of Reference. Additionally, Dr. Dorn will present a draft Terms of Reference for Rebuilding Analyses (Agenda Item F.2.c, Supplemental Attachment 2) developed by the SSC.

The Council is to consider the input from NMFS, the advisory bodies, and the public; as well as the recommendations of the stock assessment review workshop participants before providing a preliminary decision on 2009-2010 stock assessment priorities by species, type of assessment (full or update), and language for the draft Terms of Reference for both the Groundfish Stock Assessment and Review Process and Groundfish Rebuilding Analyses. There will be a public review opportunity between the March and June Council meetings should the Council decide to take final action on the 2009 and 2010 assessment process matters at the June meeting. The Council is scheduled to make final decisions on agenda item scheduling for future meetings under agenda item B.5.

**Council Action:**

1. **Adopt for Public Review the List of Stocks To Be Assessed in 2009.**
2. **Adopt for Public Review the Preliminary Terms of Reference for the Groundfish Stock Assessment and Review Process For 2009-2010.**
3. **Adopt for Public Review the 2009 Stock Assessment Review Schedule.**
4. **Adopt for Public Review the Preliminary Terms of Reference for Groundfish Rebuilding Analyses.**

Reference Materials:

1. Agenda Item F.2.a, Attachment 1: Draft Summary Minutes of the December 19, 2007 Groundfish Stock Assessment Review Workshop.
2. Agenda Item F.2.b, Attachment 1: Table 1. Possible Schedule for West Coast Groundfish Assessments in 2009 and Beyond.
3. Agenda Item F.2.c, Supplemental Attachment 1: Draft Terms of Reference for the Groundfish Stock Assessment and Review Process for 2009-2010.
4. Agenda Item F.2.c, Supplemental Attachment 2: Draft Terms of Reference for Groundfish Rebuilding Analyses.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. Stock Assessment Options — Elizabeth Clarke
c. Preliminary Stock Assessment Terms of Reference — Martin Dorn
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Adopt for Public Review the List of Stocks to be Assessed, and Preliminary Terms of Reference.

PFMC
02/25/08

DRAFT MINUTES

# Groundfish Stock Assessment Review Workshop

Pacific Fishery Management Council
Sheraton Portland Airport Hotel
Mt. Adams Room
8235 NE Airport Way
Portland, OR 97220
503-281-2500

December 19, 2007

**Participants:**

Dr. André Punt, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA
Dr. Elizabeth Clarke, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Owen Hamel, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Jim Hastie, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Ms. Stacey Miller, National Marine Fisheries Service Northwest Fisheries Science Center, Newport, OR
Mr. Tom Jagielo, Washington Department of Fish and Wildlife, Olympia, WA
Dr. John Field, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Steve Ralston, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Mr. E.J. Dick, National Marine Fisheries Service Southwest Fisheries Science Center, Santa Cruz, CA
Dr. Tom Helser, National Marine Fisheries Service Northwest Fisheries Science Center, Seattle, WA
Dr. Martin Dorn, National Marine Fisheries Service Alaska Fisheries Science Center, Seattle, WA
Ms. Meisha Key, California Department of Fish and Game, Santa Cruz, CA
Dr. David Sampson, Oregon State University, Corvallis, OR
Mr. Rod Moore, West Coast Seafood Processors Association, Portland, OR
Mr. Corey Niles, Washington Department of Fish and Wildlife, Montesano, WA
Mr. Farron Wallace, Washington Department of Fish and Wildlife, Montesano, WA
Dr. Theresa Tsou, Washington Department of Fish and Wildlife, Olympia, WA
Dr. Yong-Woo Lee, Washington Department of Fish and Wildlife, Olympia, WA
Dr. Yuk Wing Cheng, Washington Department of Fish and Wildlife, Olympia, WA
Dr. Donald McIsaac, Pacific Fishery Management Council, Portland. OR
Mr. Mike Burner, Pacific Fishery Management Council, Portland. OR
Mr. John DeVore, Pacific Fishery Management Council, Portland. OR

## *A. Administrative Matters*

1. Roll Call, Introductions, Announcements, etc.

Dr. McIsaac thanked all the participants for attending the workshop and a round of introductions was made. Dr. McIsaac thanked the Scientific and Statistical Committee (SSC) for their continuous resolution of small problems that resulted in a process that was an improvement over the last cycle. Dr. McIsaac expressed appreciation for the coordination and oversight role of the Northwest Fisheries Science Center and particularly the efforts of Ms. Stacey Miller. Although the 2007 process went better than the last process, there are areas for improvement. He asked participants to be frank and share their thoughts and to avoid personal remarks.

2. Opening Remarks and Agenda Overview

Mr. DeVore reviewed the proposed agenda and the materials prepared for today's workshop. Dr. Punt thought it would be useful to include some of the concepts discussed today in the stock assessment processes for the other Council Fishery Management Plans (FMPs). Dr. Punt also noted he has been working on updating the rebuilding forecasting program and will continue to do so over the winter and incorporate any appropriate changes discussed today.

## *B. General Perspectives on the 2007 Stock Assessment Process*

1. Groundfish Management Team (GMT) Perspective

Dr. Field explained the bocaccio assessment issue caught a lot of people by surprise. The Groundfish Management Team, like many others in the process, was expecting a full assessment rather than an updated assessment. He also noted the process for re-constructing groundfish catch histories is of great interest to the GMT.

Dr. Field explained that some assessment results and asymmetric results in decision tables caused some confusion in the GMT when discussing proposed harvest levels. Dr. Helser noted that the decision tables are not often completed during the stock assessment review (STAR) panel meeting. Mr. DeVore said decision tables need to better focus on informing management needs and used the sablefish decision table as an example of a table that was accurate yet did not address sablefish management needs north and south of 36º N latitude. Mr. Moore noted decision tables are very useful to Council members and the Groundfish Advisory Subpanel (GAP) as well and can really hamper the management process to the degree to which they are difficult to locate or decipher. We should not move away from a model where the decision tables are reviewed at a STAR Panel. Mr. Jagielo observed the reauthorized Magnuson-Stevens Act and its call for Annual Catch Limits (ACL) will increase the importance of good decision tables. We are currently working on a two-year cycle, but decision tables project impacts over several two-year cycles. A constant catch scenario in a low state of nature situation will likely look much more dire than would occur over the course of a ten-year period in which the Council is revising management every two years. Dr. Punt recommended improvements for decision tables such as having more than three states of nature and examining the assumption of constant future catches by including the effects of future assessments on catch streams. Dr. Clarke recommended the structure of decision tables should be codified in the Terms of Reference.

There should be more standardization in decision tables to make them less complicated. Mr. Jagielo agreed and added the SSC should decide the structure and elements of decision tables. Mr. Moore was unsure how the required outputs in decision tables could be structured better given our two-year management cycle. He wondered if ten-year projections were appropriate given the uncertainty of data and the biennial management cycle. Mr. DeVore said longer term projections are needed to determine appropriate harvest specifications in the absence of a new assessment.

Mr. DeVore noted that the timing of the mop-up panel and final SSC review of rebuilding analyses made it difficult for the SSC to review and the GMT to interpret the results in time for Council consideration at the November meeting. He recommended advancing the schedule earlier in the year so that assessment reviews are completed by the September Council meeting.

2. GAP Perspective

No GAP members were present at the workshop. The group began the discussion with a review of the written comments submitted by Mr. Pete Leipzig, who represented the GAP at many 2007 STAR panels:

> *1) There were numerous suggestions at panels to have a once and (hopefully) for all, construction of historical data. The past several rounds of assessments have been trying to go back in time with historical catch. Everyone is doing something different and there is a great chance of double counting. A workshop/conference needs to address the issue and someone tasked to do the work of constructing a historical database.*
>
> *2) Ian Stewart produced graphical information which displayed the time shift in the triennial surveys during the Canary review. I think we all were aware that there was some different start and finish times, but the stuff Ian showed was compelling enough that the panel requested the time series be broken into two segments. Running the model with this change alone resulted in an increase of the percent depletion of something like 4%. For overfished species that is huge. I think future assessments should treat this data similarly.*
>
> *3) There needs to be a "bottom-line" for when an assessment will be reviewed or not. There were assessments that had essentially no time series. No surveys and catch was fabricated. Aging was suspect and therefore growth was not known. I think it is important for the STAR panel to "call BS". When all of the important parameters are guesses, then don't move forward.*

Dr. Sampson largely agreed with point number three but felt there needs to be more guidance on what the criteria or tiers for data quality are when dismissing an assessment. Many times removing a data source will have profound effects on the results or even the ability to complete the assessment and the decision cannot be made lightly. Dr. Clarke stated that new requirements under the Magnuson-Stevens Act will put the issue of data-poor stock assessments under greater scrutiny. The national tier system for data quality would be a good model to review and build from. Mr. DeVore noted that the data/modeling workshop would be a good early point in the process for addressing poor data sources.

3. SSC Perspective

Dr. Dorn said the time commitment for SSC members in this process is daunting. There is a general sense that the review process cannot adequately review assessments that are not done in Stock Synthesis 2 (SS2). This limits creativity and perhaps other modeling platforms should be considered. Limiting STAR Panels to two species was very helpful. The better balance between outside independent reviewers and scientists with local expertise and knowledge in STAR panels was also helpful. The SSC was generally pleased with the updated assessment review process and may recommend more updates in the future. The SSC will also look more carefully at the structure and elements of decision tables. In general, the SSC will try to achieve better standardization in assessments. For instance, consistent treatment of steepness, natural mortality, and the use of the pre-recruit index across assessments made the review process go more smoothly this year. The use of two catchability periods for the shelf trawl survey was a new element in the canary rockfish assessment and should be looked at more carefully. Because of the potential implications for other assessment, perhaps the STAR panel should have flagged the potential problem for consideration in future assessments.

The SSC wants to achieve a better balance between reviewers and stock assessment teams (STATs). STAR panel meetings were conducted more as workshops with active participation by both the STAR panel and the STAT, which was exacerbated because some assessments were incomplete. There was also concern of added text and analyses in draft assessment documents produced after STAR panels that were not properly vetted by STAR panel members. Tracking of final assessment documents was not done as thoroughly as should be done. Final versions were sent to Council staff before review by the STAR panel chair.

Mr. Jagielo agreed with Dr. Dorn’s perspectives and emphasized the need for standardization and better separation of the role of STAR panel reviewers and STATs. STAR panels should not impose values for some assessment parameters, but they were attempting to fully evaluate uncertainty. All such imbalance would be rectified with more fully informed assessments delivered on time to STAR panels. Dr. Sampson said it would be bad if STAR panels rejected assessments because the assessments were not quite complete. Sometimes, new issues are uncovered in STAR panel reviews and we need to accommodate such changes.

Mr. Moore provided a historical perspective and said some of these issues between STAR panels and STATs have been brought up since the first STAR panels in 1998. Many changes to the Terms of Reference were made to fix this problem since some past STAR panels have imposed their collective will on STATs. There have been significant improvements but these reoccurring issues are clearly problems that are not easily solved, and rewriting the Terms of Reference may not solve these problems.

Dr. Helser stressed the importance of STAR panel members limiting their actions to a technical review versus providing a professional opinion. In other words, they should review the merits of a STAT treatment of a particular parameter rather than impose their preferred methodologies.

4. Northwest Fisheries Science Center (NWFSC) Perspective

Dr. Clarke recommended a review workshop like this one should be done for evaluating Highly Migratory Species and Coastal Pelagic Species assessment review processes as well. She recommended reviewers think about accountability of their reviews since incomplete or rejected assessments cannot all go to the mop-up STAR panel. It will be important to think about sideboards when preparing STAR panel recommendations. STAR panels should be evaluating critical flaws in assessments and resist the urge to pursue scientific curiosities that may not be significant to the assessment result. This appears to occur when STAR panels act more like workshops in re-structuring assessments. Try not to limit creativity when attempting to standardize assessments. Council staff should be at all STAR panels to ensure continuity and adherence to the Terms of Reference. She agreed with Dr. Dorn to increase the use of updated assessments, which should be strategically decided. We are at the tipping point in workload associated with reviewing full assessments.

Mr. Jagielo thought STAR panels should apply limited criteria for recommending assessments for the mop-up panel. Dr. Clarke thought the SSC should emphasize the need for timely delivery of complete assessments. Dr. Hastie said the workload for preparing assessments for STAR panel reviews is substantial. For instance, the canary assessment was thorough and complete before being delivered to the STAR panel. Nevertheless, the STAR panel had 26 requests for the STAT, most of which did not substantially affect the assessment result. This was exhaustive for the STAT and STAR panel members. He recommended the STAR panel exercise more discipline in their reviews and only requests runs that are critical. Dr. Punt thought a meta-analysis of STAR panel requests would be useful. Explore STAR panel requests to determine which ones were useful in providing important changes to the assessment. Dr. Clarke said the change to limit STAR panels to reviewing two full assessments did allow more thorough review and did turn STAR panels into functional workshops. The SSC should provide the critical advice and request the structure of assessments that go through this process. Give the SSC authority to make more demands of STAR panels.

5. Council Perspective

Dr. McIsaac said the Council generally thought the quality of many of the assessments was better. They did state that late delivery of assessments was a concern and caused some confusion. There is a perception that the SSC extended professional courtesy that contributed to late delivery of their recommendation due to the lateness of the blue rockfish assessment. The Council was concerned about functional independence of STAR panels, which Dr. McIsaac stated he would address later in the meeting. There needs to be better enforcement of the Terms of Reference at STAR panels. He acknowledged that Ms. Miller did a good job reminding STATs about the Terms of Reference and deadlines, but he thought Council staff at STAR panels to enforce the Terms of Reference was a good idea. The Council wants a stronger Terms of Reference that will not limit creativity, but better enforces deadlines. Even with this, there should be a way to allow an exception if someone misses a deadline due to illness or for some other valid reason. There needs to be a limit on the number of assessments that are recommended for the mop-up STAR panel.

Mr. Jagielo asked for clarification on STAR panel member independence on STAR panels. We need to define independence and conflict of interest of STAR panel members in the Terms of Reference.

Mr. Moore shared his perspective. He thought having one Center of Independent Experts (CIE) reviewer at all STAR panels was positive and he thought the public distribution of the CIE report was an improvement. He thought greater discipline in how assessments and STAR panel recommendations are disseminated to the public is needed. He will provide more detailed recommendations on this later in the meeting. He agreed with Dr. Hastie on the need for greater discipline in making STAR panel requests to STATs. Clear scientific advice to the Council is paramount in this process. He brought up the example of rumors emanating from the bocaccio assessment review which confused the public. He also stated the need for more standardized executive summaries and decision tables. However, he acknowledged that there was improvement in how assessment results were provided in executive summaries.

Dr. Punt asked if specific SSC recommendations on base models were helpful and Mr. Moore said yes. The Council needs to know which model was considered the most plausible and most scientifically sound. Dr. McIsaac agreed and said the Council fully respects and needs specific SSC advice. There needs to be a clear line between the SSC delivering scientific advice and not policy recommendations and he thought the SSC has consistently followed a clear delineation between providing scientific versus policy advice.

Mr. Burner stated he thought there should be more consideration of SSC workload when planning the final SSC assessment review since their agendas were overloaded to accommodate assessment reviews.

### *C. Current 2008-2009 Council Schedule of Relevant Activities*

Mr. DeVore displayed a table depicting the proposed Council schedule for groundfish assessment activities in 2008 and 2009. The Council will decide the next suite of assessments as well as the Terms of Reference for assessments and assessment reviews at their March and April meetings next year. Following the same schedule as this cycle, the SSC would review and the Council would adopt recommended assessments during their June, September, and November meetings in 2009.

Further, the Council would decide the Terms of Reference for rebuilding analyses in March and April next year. However, while new National Standard 1 guidelines are still being decided and in the absence of a court ruling on rebuilding plans that are the subject of litigation, Mr. DeVore did not believe these new Terms of Reference could be decided by April of next year. He recommended waiting until 2009 to resolve the Terms of Reference for rebuilding analyses. Rebuilding analyses are developed, reviewed and adopted after the assessments are adopted, which allows more time for deciding that Terms of Reference. The participants agreed with that recommendation.

### *D. Improving the Stock Assessment Process*

1. Pre-Assessment Planning
   a. What Worked and What Didn't in 2007
   b. Recommended Improvements for 2008-2009

Dr. Clarke reviewed the current process for planning the next suite of assessments. She noted that NMFS policy guidance is to conduct assessments every five years to remain up to date. There may be vulnerabilities if the Council does not adhere to the "five year policy". She suspects this may become part of new National Standard 1 guidelines. She displayed a draft assessment planning spreadsheet of assessments considered in the next three assessment cycles (i.e., 2009, 2011, and 2013). Once this plan is more widely vetted, a more complete draft planning list will be provided for the March Council meeting next year. She did not recommend the Council reconsidering the plan after April of next year. For example, a late change of the plan last cycle delayed delivery of the blue rockfish assessment. The Council should be more disciplined in setting the plan. She also recommended the two-meeting planning process be vetted in March and June of next year, not March and April as is currently planned. There needs to be more time to vet the initial plan decided in March. Two more reasons for delaying the final assessment planning decision until June is the April briefing book deadline is three days after the March Council meeting and there may be more agency budget certainty by June, which makes it easier for NMFS scientists to commit to an assessment. Some of the communication problems observed in this past assessment cycle (i.e., learning late that the bocaccio assessment was going to be an update rather than a full assessment as planned) may be averted. When an assessment plan is changed or someone declares an intent to diverge from the planned assessment, then that needs to be clearly communicated to the Council so a contingency plan can be considered. This process should be explicit in the Terms of Reference.

Ms. Key asked how the STAR panel schedule was developed and Ms. Miller said this was done during an SSC meeting in 2006. Dr. Clarke suggested that part of the plan might benefit from a two-meeting process as well. Dr. Hastie said a lot of coordination and thought goes into developing a STAR panel schedule. For instance, if a scientist is tasked with a full and an update assessment, then the full assessment cannot be reviewed prior to June since that time will be needed for conducting the update assessment, which is reviewed by the SSC in June. Scheduling the final assessment plan decision later than June of next year is not recommended because it compromises data collection and scheduling pre-assessment data and modeling workshops.

The process for deciding the priority stocks to be assessed needs to consider richness of data, potential risks to the stock from the current or foreseeable management regime, and a sense of stock trends from a fishery-independent survey. Dr. Dorn observed that the planning process seemed designed to select stocks for full SS2 assessments, and thought that useful but simpler assessments could be done for a greater variety of stocks with local or ecological significance. The group thought that the planning process should give greater consideration to basic assessments for data-poor species and/or an assessment for a complex of species. Dr. Punt thought there should be a test analysis of a relatively data-rich species using simpler assessment methodology to understand whether these assessments can provide acceptable management advice. Some new methodology should be considered since any new species for assessment are likely to be relatively data-poor.

2. Full Stock Assessment Reviews at STAR Panels

    a. What Worked and What Didn't in 2007
    b. Recommended Improvements for 2008-2009

Mr. Patrick Cordue was connected to the workshop through a long distance teleconference line. He offered general comments. He characterized his experience in the 2007 STAR panel process as very positive, professional, and educational. He spoke to the PowerPoint presentation he provided for the workshop which he suggested was the appropriate way to discuss his impressions and recommendations for improvement. In general, he thought STAR panels were under-resourced. More help and resources for STATs to do requested model runs at STAR panels would be helpful. There is also a need for centralized and standardized databases for assessments. Mr. Moore asked for a clarification on that point and Mr. Cordue said many of the assessments used ad hoc data sources to inform the assessment. For example, the cowcod assessment used ad hoc data sources not readily available to the STAT, STAR panel members, or the interested public.

Mr. Cordue reviewed the general structure of assessments provided at STAR panels where most approved assessments were done in SS2 with some Bayesian analysis. He noted it was common that final assessments recommended by STAR panels were drastically altered from the draft assessments originally provided to the panels. He believed having one CIE reviewer at all STAR panels and limiting the review to two full assessments at each STAR panel was a dramatic improvement relative to the 2005 process.

Mr. Cordue then went over procedural problems encountered in the 2007 STAR panel process. There was a problem with the dual role of STAR chairs (i.e., running the meeting and conducting the review), which slowed progress. Also, assigning the rapporteur duties to a reviewer inhibited their review role. The Terms of Reference need to be more explicit on the tasks at STAR panels. There needs to be more SSC feedback to STAR panels when problems are encountered. Additionally, some STAR panel reports were modified and distributed before full STAR panel review, which was problematic. The mop-up panel was also problematic for receiving thorough review. Dr. McIsaac asked for an explanation of the comment that STAR reports were distributed prior to full STAR panel review and Mr. Cordue explained there were instances when STAR panel reports were delivered to the SSC and the Council prior to a final review by STAR panel members.

Mr. Cordue then addressed structural problems with assessments. Often, incomplete assessments were provided to STAR panels with the expectation that the STAR panel was going to recommend changes anyway. This led to STAR panels that became functional workshops. Dr. Sampson asked how assessment reviews in other regions were done with respect to the quality of assessments presented to review panels. Mr. Cordue explained some review processes simply accept or reject assessments without an attempt to overhaul the assessment. In some cases, only limited adjustments are made at these review panels. He recommended consideration of a better intermediate process with more fully developed assessments provided to STAR panels and allowance of some changes to the assessment during the review process.

Other structural problems included dramatic changes to assessments at the final SSC review. Also, assessments using current technologies do not allow the use of full Bayesian methods. Dr. Punt recommended more thorough review of STAR-recommended assessments by STAR panel chairs before they are provided to the SSC and after SSC review before they are finalized and distributed to the public. This final review process should be codified in the Terms of Reference.

Mr. Cordue recommended dedicated chairs at STAR panels to more efficiently run the meetings. He was not sure if detailed minutes are needed for STAR panels. If they are needed, then someone other than a reviewer should take those minutes. He recommended a re-working of mop-up panels. His opinion is full assessments should not be done at mop-up panels, only slight modifications should be considered at mop-up panels. He recommended a working group development of the assessment, with STAR panels simply accepting or rejecting the draft assessment. One possible structure would be to assign STAR panels to develop the assessment as a working group and then use the SSC and CIE reviewers to do the review. Mr. Moore asked if CIE reviewers should be part of the working group at STAR panels and Mr. Cordue thought independent outside help in developing the assessment would be helpful. However, separate CIE reviewers should do the review (i.e., the same CIE reviewer should not help develop and review an assessment). Dr. Clarke asked if it would be acceptable to have the SSC act alone to review the assessment. Dr. Sampson said at times SSC members are part of a STAT and charged with reviewing assessments. We must be careful at maintaining independence. Dr. Clarke asked if one CIE reviewer should be part of the working group charged with developing the assessment and another CIE reviewer charged with reviewing the assessment in cooperation with the SSC. Mr. Cordue agreed that CIE independence of that sort should be designed in the process. Dr. Clarke envisioned a process similar to what is done in Alaska where the STAT solicits members to the working group, usually within the agency, and the Council assigns the review duties to independent experts. Dr. Hastie said it would be difficult to find enough independent experts to develop and review assessments. There may not be enough bodies to do this well and independently. Dr. Punt said drawing the line defining STAT and reviewer independence needs careful consideration. Mr. Jagielo said the working group developing the assessment should not come from within one agency since we benefit from the varied experts in different agencies. Ms. Key thought there should be more collaboration between scientists in the Southwest and Northwest Science Centers. Dr. Hastie said a working group design for developing assessments such as is done in the Southeast Data, Assessment, and Review (SEDAR) process would require an almost continuous assessment development process. Mr. Cordue thought a working group process for developing assessments does not necessarily require public meetings, an email interchange of ideas could be considered. Dr. McIsaac noted Federal Advisory Committee Act (FACA) rules limit how much of the process can be done outside the public arena.

Dr. Ralston asked for clarification on Mr. Cordue's mop-up panel recommendation. Mr. Cordue said his concern was that at various times in this year's mop-up panel, there was an inconsistent number of reviewers working (from 2-5) to critically review the assessment.

Mr. Cordue signed off from the workshop at this point after the participants thanked him for his work at the 2007 STAR panels and his comments today at the workshop.

[Lunch break]

The workshop reconvened to discuss recommendations from the above discussion with Mr. Cordue. Mr. Jagielo said it would cost more and require more resources to change STAR panel roles to that of developing assessments in a working group. Dr. Clarke thought more vetting of assessments at data and modeling workshops prior to developing draft assessments may achieve the same goal. This early collaboration occurs with assessments produced at the NWFSC and those done with Dr. Punt's group at the University of Washington. Dr. Ralston likened Mr. Cordue's recommendation of group collaboration to the process for reviewing scientific journal publications. Editorial review affects the publication, but does not dramatically change the product. He agreed with Mr. Cordue's point that STAR panels have worked more as working groups that have dramatically changed assessments. He thought STAR panels should be doing more pure review work such as editorial review boards do for journal publications. Dr. Dorn thought a few paragraphs in the Terms of Reference could better define the review role of STAR panels and the STAR chairs need to exercise that discipline. More fully vetted assessments might then be provided to STAR panels that will lessen the probability of STAR panels becoming actively involved in developing the assessment model. Dr. Clarke said timely provision of assessments with all the required elements will be critical to effect a disciplined review process. She thought the Terms of Reference should "encourage" STATs to develop assessments with a working group of experts rather than making it a mandate. With future budget uncertainty, a mandate to vet and develop assessments in a workshop environment may not be possible. Dr. McIsaac said the other needed clarification in the Terms of Reference should be to define the STAR panel role as being one of pure review. Mr. Moore added that we should be careful in designing the roles of STATs versus STAR panels. Any Council activity in a data and modeling workshop needs to be a public process given FACA rules. Dr. Sampson said in doing this, there should still be some flexibility to allow improvements in assessments during STAR panel reviews.

We should carefully consider the required elements in assessments drafted for STAR panel reviews. Dr. Clarke said there has been a wide range of completeness and quality of assessments provided to STAR panels. We should define the critical elements required for any assessment provided to STAR panels to ensure at least a minimal level of quality and completeness. Mr. Jagielo questioned whether the STAR panel chair is the appropriate judge on the quality and completeness of a draft assessment. He thought the STAT should at least provide a base model in a draft assessment provided to a STAR panel that they are willing to defend. The group agreed a judgment on the quality and completeness of a draft assessment needs to be done in advance of the STAR panel meeting, highlighting the need to deliver draft assessments at least two weeks in advance of the STAR panel meeting. Dr. Clarke asked who should pass judgment on the quality and completeness of a draft assessment. Dr. McIsaac thought perhaps Council staff and Dr. Ralston recommended this should be the purview of the SSC Groundfish Subcommittee chair.

Many in the group believed there needs to be firm criteria in the Terms of Reference to pass judgment. Ms. Miller said contingency plans should be put in place if a draft assessment is rejected; the mop-up panel should not be the default. Dr. Punt said, if the draft assessment is fundamentally flawed, it should be rejected and not considered during that cycle. Dr. McIsaac said there should be separate recourse if an assessment is short in quality versus being delivered late to the STAR panel. Dr. Clarke thought it possible to write a clear minimal quality standard in the Terms of Reference. It also needs to be made clear whether the recourse is to take up the assessment in the mop-up panel versus deferring it to a future cycle. Dr. Ralston said there are many reasons for an assessment being delivered late or falling short in quality. There were cases where the modeling platform, SS2, was being re-written as a draft assessment was being finalized for a mop-up panel. There should be exemptions from any rule establishing a quality or delivery deadline standard. Dr. Clarke recommended there should be no more than three full assessments recommended for a week-long mop-up panel. Dr. Ralston recommended that review of rebuilding analyses and two full assessments is the limit that should be considered for the mop-up panel. Perhaps the Council should decide which assessments go to the mop-up panel based on management need. Mr. Moore cautioned that may bring an element of politics to the decision. He preferred defining the standards and the recourse if those standards are not met explicitly in the Terms of Reference.

Dr. McIsaac noted another recommendation from Mr. Cordue is that the STAR chair should be dedicated to running the meeting and not to reviewing the assessment. The group did not agree with this and thought loss of the chair in the review process was a waste of resources and talent.

Dr. McIsaac asked how many assessments should be assigned to a STAR panel and how long should that review be. The group thought no more than two full assessments should be assigned to a STAR panel and the panel should plan on four days of work. Dr. Dorn noted some STAR panels worked until late Friday to resolve an assessment. He cautioned the duration limit should be more flexible. Others thought if the assessment was fully developed with a base model and all the required elements, the STAR review could proceed more efficiently.

The group went back to trying to resolve who judges the quality of a draft assessment. Most of the group was comfortable with a committee of Council staff, the NWFSC stock assessment coordinator (Ms. Miller) and the SSC Groundfish Subcommittee as the arbiters.

Dr. McIsaac asked how the group felt about independence criteria for STAR panel members and especially STAR panel chairs. Dr. Clarke said someone who is supervising a STAT member or who has contributed significantly to the assessment should not serve on that STAR panel. She emphasized that any conflict of interest needs to pass a public perception test. Ms. Miller said there are Office of Management and Budget (OMB) guidelines on reviewing influential science, which could serve as a good template. The group generally thought supervisors or persons having a direct or collaborative role in developing an assessment should not review that assessment. The group asked about CIE reviewer conflict of interest guidelines and Dr. Clarke said there are strict CIE guidelines.

3. SSC Reviews of Full Assessments
    a. What Worked and What Didn’t in 2007
    b. Recommended Improvements for 2008-2009

Dr. Dorn remarked that many of the SSC points and concerns for full assessments have already been addressed. He recommended continuing a final SSC review of full assessments after STAR panel review with the STAT lead attending the SSC review. There were cases in 2007 where STATs did not agree with the recommendations of the STAR panel and asked the SSC to resolve these issues. Several STAT teams prepared documents supporting their position, which were then distributed to the SSC. Dr. Dorn expressed concern that this tactic did not allow the STAR panel to develop a rebuttal to the STAT, and that the SSC may have received one-sided information to arbitrate the dispute. Explicit procedures may be needed in the Terms of

Reference to deal with situations where the STAT disagrees with STAR panel report. When asked if the SSC had adequate time to resolve some of these issues, there was a general sense that the SSC was not rushed in their reviews.

Dr. Dorn did recommend a change in process to mandate STAR chair review of post-STAR draft assessments before they go to the SSC and the Council. In some cases, there is not enough time to allow thorough or any review of post-STAR drafts. It was recommended that the review step be accommodated to the extent possible to ensure the STAR panel agrees with the results and advice in the post-STAR draft.

4. SSC Review of Updated Assessments
   a. What Worked and What Didn't in 2007
   b. Recommended Improvements for 2008-2009

Dr. Dorn thought the update review process proceeded smoothly and problems were resolved with little process disruption. One recommended addition to the Terms of Reference is the need for a biomass time series in the executive summary of update assessments.

5. Information Presentation to the Council and Public
   a. What Worked and What Didn't in 2007
   b. Recommended Improvements for 2008-2009

Dr. McIsaac thought the information presentation to the Council and public was relatively positive. Some thought the level of the presentation was too technical, while others did not. One recommended improvement is to characterize the soundness of the science in the assessment. Mr. Moore generally liked the brevity of presentations and the ability for folks to ask STATs and the SSC questions regarding the assessment. He believed, with one exception, the level of technical discussion in these presentations was reasonable. He generally thought the right balance was achieved.

One recommendation is to provide the Council primer on assessments in the briefing book to give laypeople and Council members an advance guide on "assessment speak". Another suggestion is to standardize the presentations (i.e., provide a presentation template). It was also recommended that an explanation of the use of decision tables be provided in any Council primer on groundfish stock assessments.

## *E. Terms of Reference*

1. Review the "Terms of Reference for Groundfish Stock Assessment and Review Process for 2007-2008" and Provide Recommended Edits

Dr. Ralston explained how the Terms of Reference is developed by the SSC. Dr. Hastie recommended a mandate for new reference points in the Terms of Reference addressing biomass projections under proxy harvest rates and conversely, the harvest rate to bring the stock to equilibrium at Bmsy or the proxy thereof. This will allow an understanding of any discrepancy in these two reference points (i.e., B40% target vs. F50% proxy harvest rate outcomes for rockfish). The group returned to the need for more standardized decision tables and decision tables that better inform management risks. Some decision tables ranged harvests across an unreasonably broad range. Mr. Moore also requested adherence to the mandate to provide all critical management reference points in executive summaries. In some cases, some of the updated assessments did not have all the required elements in the executive summary. The group believed projected depletion rates need to be at least one element in decision tables. Dr. Yuk Wing Cheng recommended a process of "data mining" to statistically determine which model parameters should represent the axis of uncertainty in decision tables.

Another recommendation is to capture the time series of regulations in a standard format. One idea is to report annual regulations in an appendix in the specifications environmental analysis. The workshop participants agreed with that idea and recommended incorporation of the regulations in future environmental analyses and/or publications of the Groundfish Stock Assessment and Fishery Evaluation (SAFE) document.

The group thought the Terms of Reference needs to explicitly address how dissenting opinions of STAT members, STAR panel members, and/or CIE reviewers are reported. The best place to address dissenting opinions are within STAR panels. Dr. Punt thought the Terms of Reference needs to set a deadline for when STAT members inform the STAR that they will express a dissenting opinion.

Mr. DeVore said he would capture all the recommendations brought up today for the Terms of Reference in a bullet list in these draft minutes. These will be reviewed by workshop participants to ensure all the recommendations were appropriately captured. Dr. Ralston, Dr. Dorn, and Council staff will develop a draft Terms of Reference with recommended changes from this workshop for Council consideration next March. Ms. Miller said the NWFSC has some specific detailed recommendations for the Terms of Reference that she will forward to the group developing the draft Terms of Reference. Dr. Ralston reminded the group of the biomass time series recommendation for executive summaries of updated assessments. This will be added to the draft Terms of Reference.

The group addressed some of the specific comments made by Mr. Cordue. There was general disagreement that there are no full Bayesian assessments in our process given the limitations of SS2. For instance, recent hake assessments presented Markov Chain Monte Carlo outputs in SS2. Further, there was general disagreement that full Bayesian assessments would be essential in providing management advice.

The group recommended the Terms of Reference not require minutes of STAR panels but a summary report.

2. Review the "Terms of Reference for Groundfish Rebuilding Analyses" and Provide Recommended Edits

This Terms of Reference is out of date. How to generate recruitment in projections is not up to date. Further, the rebuilding run requests of this year that were responsive to last year's Ninth Circuit ruling on rebuilding plans need to be incorporated. There was general thought that this document needs to be developed from scratch. The group was charged with developing this new Terms of Reference in the two-meeting process next year. Drs. Punt and Ralston volunteered to draft the new Terms of Reference.

***F. Other Items?***

Mr. DeVore explained he would send out these draft minutes for review by January 4 and that the minutes would be provided in the March briefing book.

The meeting was adjourned at 5 p.m. after everyone was thanked for attending this workshop.

ADJOURN

PFMC
12/17/07

## Recommendations from the December 2007 Groundfish Stock Assessment Review Workshop

- A standardized structure of stock assessment decision tables should be developed and codified in the Stock Assessment Terms of Reference
- Consider reviewing the national tier system for data quality as a template for judging the quality of assessment data
- Address assessment data quality issues early in the process at pre-assessment data/modeling workshops
- Evaluate the use of two survey catchability periods in assessments using the triennial trawl survey index as was done in the 2007 canary rockfish assessment
- Standardize and separate the roles of stock assessment review (STAR) panel reviewers and stock assessment teams (STATs) in the Stock Assessment Terms of Reference
- Require timely delivery of more fully informed assessments to STAR panels in the Stock Assessment Terms of Reference
- Consider review workshops like this one for evaluating highly migratory species and coastal pelagic species assessment review processes
- Council staff should attend all STAR panels to ensure continuity and adherence to the Stock Assessment Terms of Reference
- Increase the use of updated assessments and strategically decide which assessments are updates
- STAR panels need to exercise more discipline in their reviews and only request model runs that are critical
- Do a meta-analysis of past STAR panel requests to STATs
- The SSC should provide critical advice to STAR panels and STATs and request the structure of assessments that go through the review process
- Limit the number of assessments that are recommended to the mop-up STAR panel to two full assessments (plus review of rebuilding analyses)
- Define independence and conflict of interest of STAR panel members in the Stock Assessment Terms of Reference
- Require more standardized executive summaries of assessments in the Stock Assessment Terms of Reference
- Wait until National Standard 1 guidelines are revised to develop a new Terms of Reference for rebuilding analyses (in 2009?)
- The two-meeting process for deciding the next suite of stock assessments and the next Stock Assessment Terms of Reference should occur in March and June of 2008, not March and April as is currently planned
- Establish an explicit process in the Stock Assessment Terms of Reference to communicate to the Council any divergence from a planned assessment so a contingency plan can be decided
- Final assessment plans need to be decided by June of 2008
- Deciding the priority stocks to be assessed needs to consider richness of data, potential risks to the stock from the current or foreseeable management regime, and a sense of stock trends from a fishery-independent survey
- Consider using a simpler assessment methodology for a greater variety of stocks with local or ecological significance

- Give greater consideration to basic (i.e., simpler) assessments for data-poor species and/or an assessment for a complex of species
- The SSC needs to give more feedback to STAR panels when problems are encountered
- Allow more time for STAR chairs to review post-STAR assessments before they are distributed to the SSC and, after SSC review, before they are finalized and distributed to the public (codify in the Stock Assessment Terms of Reference)
- Define critical elements required for any assessment provided to STAR panels in the Stock Assessment Terms of Reference to ensure at least a minimal level of quality and completeness (i.e., a defined base model and profiling over key population dynamic parameters)
- Judgment on the quality and completeness of a draft assessment needs to be done in advance of the STAR panel meeting, which highlights the importance of providing draft assessments at least two weeks in advance of the STAR panel meeting (however, there should be exemptions from any rule establishing quality or delivery deadline standards)
- A committee of Council staff, the Northwest Fisheries Science Center (NWFSC) stock assessment coordinator and the SSC Groundfish Subcommittee should judge the quality of draft assessments before they are presented to a STAR panel
- Office of Management and Budget (OMB) guidelines on reviewing influential science would be a good template for deciding assessment quality standards
- No more than two full assessments should be reviewed at a STAR panel meeting and four days of work should be planned for STAR panels
- Conflict of interest guidelines for STAR panel members that are codified in the Stock Assessment Terms of Reference should prohibit STAT supervisors and those having a direct or collaborative role in developing the assessment from reviewing the assessment in a STAR panel
- STAT leads should attend the final SSC review of post-STAR panel assessments
- Develop explicit procedures in the Stock Assessment Terms of Reference for resolving conflicts and disagreements between STAR panel members and STATs (include a deadline for informing STAR panel members that STATs intend to provide dissenting opinions)
- Require provision of a biomass time series in assessment executive summaries
- Provide the Council primer on groundfish stock assessments in the briefing book to give laypeople and Council members an advance guide on "assessment speak"
- Explain the use of decision tables in the Council primer on groundfish stock assessments
- Standardize public presentations of assessment results to the public and Council members by providing a presentation template
- Require provision of biomass projections under proxy harvest rates and conversely, the harvest rate to bring the stock to equilibrium at Bmsy or the proxy thereof (codify in the Stock Assessment Terms of Reference)
- The Stock Assessment Terms of Reference should not require minutes from a STAR panel meeting, but a summary report

**Table 1. Possible schedule for west coast groundfish assessments in 2009 and beyond.**
This draft list is provided as a basis to begin discussion of the 2009 groundfish stock assessment cycle and was developed in collaboration with the Southwest Fisheries Science Center.

| | | 2005 Assessment | | Assessment cycle 2007 | | 2009 | | | 2011 | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Species | Full / Upd. | Model | Full | Update | Full | Update | Possible Lead | Full | Update | Full | Update |
| | Number of assessments | | | 10 | 5 | 10 | 6 | | 10 | 8 | 3 | 7 |
| | | | | | | | | | US-Can. treaty process | | | |
| | P. hake (Whiting) | Full (2006) | SS2 | X | | X | | NW | X | | X | |
| Shelf | Bocaccio rockfish | Update | SS1 | | X | X | | SW | | X | | X |
| Shelf | Canary rockfish | Full | SS2 | X | | | X | NW | X | | | X |
| Shelf | Chilipepper rockfish | 1998 | SS1 | X | | | | | | | X | |
| Shelf | Cowcod | Full | SS2 | X | | | X | SW | X | | | X |
| Shelf | Widow rockfish | Full | ADMB | | X | X | | SW | | X | | ? |
| Shelf | Yelloweye rockfish | Full (2006) | SS2 | | X | | X | NW | | X | | X |
| Shelf | Yellowtail rockfish | Update | ADMB | | | | | | X | | | |
| Shelf | Lingcod | Full | SS2 | | | | X | NW | | | | |
| Shelf | Arrowtooth | 1993 | other | X | | | | | | | X | |
| Shelf | English sole | Full | SS2 | | X | | | | | X | | |
| Shelf | Petrale sole | Full | SS2 | | | X | | NW/ODFW? | | | | X |
| Shelf | Longnose skate | Unassessed | | X | | | | | | | | |
| Slope | Pacific ocean perch | Update | ADMB | | X | X | | NW | | X | | X |
| Slope | Darkblotched rockfish | Full | SS2 | X | | | X | NW | | X | ? | ? |
| Slope | Blackgill rockfish | Full | SS2 | | | | | | X | | | |
| Slope | Bank rockfish | 2000 | SS1 | | | X | | NW | | | | |
| Slope | Shortspine thornyhead | Full | SS2 | | | | | | X | | | |
| Slope | Longspine thornyhead | Full | SS2 | | | | | | X | | | |
| Slope | Sablefish | Full | SS2 | X | | | | | X | | | |
| Slope | Dover sole | Full | SS2 | | | | | | X | | | X |
| Nearshore | Black rockfish | 2003/1999 | SS1 | X | | | | | | X | | |
| Nearshore | Cabezon | Full | SS2 | | | | X | NW | | | | |
| Nearshore | Cal. Scorpionfish | Full | SS2 | | | | | | | ? | ? | ? |
| Nearshore | Gopher rockfish | Full | SS2 | | | | | | X | | | |
| Nearshore | Blue rockfish | Unassessed | | X | | | | | | ? | ? | |
| Nearshore | Kelp greenling | Full | SS2 | | | | | | ? | ? | | |
| Nearshore | Starry flounder | Full | SS2 | | | | | | | X | | |
| Currently Unassessed | | | | | | | | | | | | |
| | Spiny Dogfish | | | | | X | | WA | | | | |
| | Minor Slope Complex | To address need for science-based ACLs | | | | X | | NW [+] | | | | |
| | Minor Shelf Complex | | | | | X | | NW [+] | | | | |
| | Minor Nearshore Complex | | | | | X | | SW [+] | | | | |
| | Bronzespotted rockfish | | | | | * | | SW | | | | |
| | Greenspotted rockfish | | | | | * | | SW | | | | |

* May be data reports rather than full assessments

[+] Will require collaboration among assessment groups

# Science Center Discussion Assessment List

March 12, 2008

Dr. Jim Hastie and Dr. Elizabeth Clarke

# Discussion Assessment List (1)

| | Species | Last Full Asmnt. | 2009 | | | 2011 | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Full | Upd. | Poss. Lead | Full | Upd. | Full | Upd. |
| | P. hake (Whiting) | 2008 | X | | NW | X | | X | |
| Shelf | Bocaccio rockfish | 2003 + | X | | SW | | X | | X |
| | Canary rockfish | 2007 | | X | NW | X | | | X |
| | Chilipepper | 2007 | | | | | | X | |
| | Cowcod | 2005 | | X | SW | X | | | X |
| | Widow rockfish | 2005 + | X | | SW | | X | | ? |
| | Yelloweye | 2006 | | X | NW | | X | | X |
| | Yellowtail rockfish | 2000 + | | | | X | | | |
| | Lingcod | 2005 | | X | NW | | | | |
| | Arrowtooth | 2007 | | | | | | X | |
| | English sole | 2005 | | | | | X | | |
| | Petrale sole | 2005 | X | NW/ODFW? | | | | | X |
| | Longnose skate | 2007 | | | | | | | |
| Slope | POP | 2003 + | X | | NW | | X | | X |
| | Darkblotched | 2007 | | X | NW | | X | ? | ? |
| | Blackgill rockfish | 2005 | | | | X | | | |
| | Bank rockfish | 2000 + | X | | NW | | | | |
| | Shortspine | 2005 | | | | X | | | |
| | Longspine | 2005 | | | | X | | | |
| | Sablefish | 2007 | | | | X | | | |
| | Dover sole | 2005 | | | | X | | | X |

# Discussion Assessment List (2)

| | Species | Last Full Asmnt. | 2009 Full | 2009 Upd. | 2009 Poss. Lead | 2011 Full | 2011 Upd. | 2013 Full | 2013 Upd. |
|---|---|---|---|---|---|---|---|---|---|
| Nearshore | Black rockfish | 2007 | | | | | X | | |
| | Cabezon | 2005 | | X | NW | | | | |
| | Cal. Scorpionfish | 2005 | | | | | ? | ? | ? |
| | Gopher rockfish | 2005 | | | | X | | | |
| | Blue rockfish | 2007 | | | | | ? | ? | |
| | Kelp greenling | 2005 | | | | ? | ? | | |
| | Starry flounder | 2005 | | | | | X | | |
| Currently Unassessed | | | | | | | | | |
| | Spiny Dogfish | | X | | WA | | | | |
| | Minor Slope Complex | science-based ACLs | X | | NW [+] | | | | |
| | Minor Shelf Complex | | X | | NW [+] | | | | |
| | Minor Nearshore Complex | | X | | SW [+] | | | | |
| | Bronzespotted rockfish | | * | | SW | | | | |
| | Greenspotted rockfish | | * | | SW | | | | |

Agenda Item F.2.c
Supplemental Attachment 1
March 2008

**GROUNDFISH STOCK ASSESSMENT AND REVIEW PROCESS FOR 2009-2010**

## Introduction

The purpose of this document is to help the Council family and others understand the groundfish stock assessment review process (STAR). Parties involved are the National Marine Fisheries Service (NMFS); state agencies; the Council and its advisors, including the Scientific and Statistical Committee (SSC), the Groundfish Management Team (GMT), the Groundfish Advisory Subpanel (GAP), Council staff; and interested persons. The STAR process is a key element in an overall process designed to make timely use of new fishery and survey data, to analyze and understand these data as completely as possible, to provide opportunity for public comment, and to assure that the results are as accurate and error-free as possible. The STAR process is designed to assist in balancing these somewhat conflicting goals of timeliness, completeness and openness.

## STAR Goals and Objectives

The goals and objectives for the groundfish assessment[1] and review process[1] are to:

a) Ensure that groundfish stock assessments provide the kinds and quality of information required by all members of the Council family.

b) Satisfy the Magnuson-Stevens Sustainable Fisheries Act (SFA) and other legal requirements.

c) Provide a well-defined, Council-oriented process that helps make groundfish stock assessments the "best available" scientific information, and facilitates use of the information by the Council. In this context, "well-defined" means with a detailed calendar, explicit responsibilities for all participants, and specified outcomes and reports.

d) Emphasize external, independent review of groundfish stock assessment work.

e) Increase understanding and acceptance of groundfish stock assessment and review work by all members of the Council family.

f) Identify research needed to improve assessments, reviews, and fishery management in the future.

g) Use assessment and review resources effectively and efficiently.

## Shared Responsibilities

All parties have a stake in assuring adequate technical review of stock assessments. NMFS must determine that the best scientific advice has been used when it approves fishery management recommendations made by the Council. The Council uses advice from the SSC to determine whether the information on which it will base its recommendation is the “best available” scientific advice. Fishery managers and scientists providing technical documents to the Council for use in management need to assure that the work is technically correct. Program reviews, in-depth external reviews, and peer-reviewed scientific publications are used by federal and state agencies to provide quality assurance for the basic scientific methods used to produce stock assessments. However, the time-frame for this sort of review is not suited to the routine examination of assessments that are, generally, the primary basis for a harvest recommendation.

The review of current stock assessments requires a routine, dedicated effort that simultaneously meets the needs of NMFS, the Council, and others. Leadership, in the context of the stock assessment review process for groundfish, means consulting with all interested parties to plan, prepare terms of reference, and develop a calendar of events and a list of deliverables. Coordination means organizing and carrying out review meetings, distributing documents in a

[1] In this document, the term "stock assessment" includes activities, analyses, and management recommendations, beginning with data collection and continuing through to the development of management recommendations by the Groundfish Management Team and information presented to the Council as a basis for management decisions.

[1] In this document, the term "stock assessment" includes activities, analyses, and management recommendations, beginning with data collection and continuing through to the development of management recommendations by the Groundfish Management Team and information presented to the Council as a basis for management decisions.

timely fashion, and making sure that assessments and reviews are completed according to plan. Leadership and coordination involve costs, both monetary and time, which have not been calculated, but are likely substantial.

The Council and NMFS share primary responsibility to create and foster a successful STAR process. The Council will sponsor the process and involve its standing advisory committees, especially the Scientific and Statistical Committee. NMFS will provide a coordinator to oversee and facilitate the process. Together they will consult with all interested parties to plan, prepare terms of reference, and develop a calendar of events and a list of deliverables. NMFS and the Council will share fiscal and logistical responsibilities.

The STAR process is sponsored by the Council because the Federal Advisory Committee Act (FACA) limits the ability of NMFS to establish advisory committees. FACA specifies a procedure for convening advisory committees that provide consensus recommendations to the federal government. The intent of FACA was to limit the number of advisory committees, ensure that advisory committees fairly represent affected parties, and ensure that advisory committee meetings, discussions, and reports are carried out and prepared in full public view. Under FACA, advisory committees must be chartered by the Department of Commerce through a rather cumbersome process. However, the SFA exempts the Council from FACA *per se*, but requires public notice and open meetings similar to those under FACA.

## NMFS Responsibilities

NMFS will work with the Council, other agencies, groups, or interested persons that carry out assessment work to organize Stock Assessment Teams (STAT) and STAR Panels, and make sure that work is carried out in a timely fashion according to the calendar and terms of reference. NMFS will provide a Stock Assessment Coordinator to organize these tasks with assistance from Council staff. To initiate the assessment cycle, NMFS will convene workshops to provide opportunities for assessment scientists and interested parties (e.g., the GMT) to discuss important topics relating to upcoming stock assessments. To promote consistency, representatives from each STAT team are expected to attend these workshops.

The SSC will appoint STAR Panel chairs from among its membership. The NMFS Stock Assessment Coordinator will identify and select other STAR panelists following criteria for reviewer qualifications developed in consultation with the SSC. The public is welcome to nominate qualified reviewers. Selection of STAR panelists should aim for balance between outside expertise and in-depth knowledge of West Coast fisheries, data sets available for those fisheries, and modeling approaches applied to West Coast groundfish species. The bulk of panelists should be experienced stock assessment scientists, i.e., individuals who have done actual stock assessments using current methods. Panelists should be knowledgeable about the specific modeling approaches being reviewed, which in most cases will be statistical age- and/or length-structured assessment models. It is recognized that the pool of qualified reviewers is limited, and that staffing of STAR panels is subject to constraints that may make it difficult to achieve these objectives.

Following any modifications to the stock assessments resulting from STAR panel reviews and prior to SSC review, the Stock Assessment Coordinator will review the Executive Summary for consistency with the Terms of Reference. Inconsistencies will be identified and the authors requested to make appropriate revisions in time for the appropriate SSC and GMT meetings, when an assessment is considered.

Individuals (employed by NMFS, state agencies, or other entities) who conduct groundfish stock assessments or associated technical work are responsible for ensuring that their work is technically sound and complete. Stock assessments must be completed and reviewed in full accordance with the Terms of Reference (Appendices B and C) at the times specified in the calendar (Appendix A).

## STAT Team Responsibilities

The STAT is responsible for conducting a complete and technically sound stock assessment that conforms to accepted standards of quality. The STAT will conduct its work and activities in accordance with the Terms of Reference for Groundfish STAT Teams. The final product of the STAT will be a stock assessment document that follows the outline specified in Appendix B.

## GMT Responsibilities

The GMT is responsible for identifying and evaluating potential management actions based on the best available scientific information. In particular, the GMT makes ABC and OY recommendations to the Council based on estimated stock status, uncertainty about stock status, and socioeconomic and ecological factors. The GMT will use stock assessments, STAR Panel reports, and other information in making their recommendations. The GMT's preliminary ABC recommendation will be developed at a meeting that includes representatives from the SSC, STAT Teams, STAR Panels, and GAP. A GMT representative(s) will be appointed by the chair of the GMT to track each stock assessment, and will serve as advisor to the STAT Team and STAR Panel. The GMT representative will participate in review discussions, but will not serve as a member of the Panel. The GMT representative should be prepared to advise the STAT Team and STAR Panel on changes in fishing regulations that may influence data used in the assessment and the nature of the fishery in the future.

The GMT will not seek revision or additional review of the stock assessments after they have been reviewed by the STAR Panel. The GMT chair will communicate any unresolved issues to the SSC for consideration. Successful separation of scientific (i.e., STAT Team and STAR Panels) from management (i.e., GMT) work depends on stock assessment documents and STAR reviews being completed by the time the GMT meets to discuss preliminary ABC and OY levels. However, the GMT can request additional model projections, based on reviewed model scenarios, in order to develop a full evaluation of potential management actions.

## GAP Responsibilities

The chair of the GAP will appoint a representative to track each stock assessment and attend the STAR Panel meeting. The GAP representative will serve as advisor to the STAT Team and STAR Panel. It is especially important that the GAP representative be included in the STAT team's discussion and review of all the data sources being used in the assessment, prior to development of the stock assessment model. It is the responsibility of the GAP representative to insure that industry concerns about the adequacy of data being used by the STAT Team are expressed at an early stage in the process. The GAP representative will participate in review discussions as an advisor to the STAR Panel, in the same capacity as the GMT advisor.

The GAP representative, along with STAT and SSC representatives, will attend the GMT meeting at which ABC recommendations are made. The GAP representative will also attend subsequent GMT, Council, and other necessary meetings where the assessment is discussed.

The GAP representative may provide appropriate data and advice to the STAR Panel and GMT and will report to the GAP on STAR Panel and GMT meeting proceedings.

## SSC Responsibilities

The Scientific and Statistical Committee (SSC) will participate in the stock assessment review process and will provide the Council and its advisory bodies with technical advice related to the stock assessments and the review process. The SSC will assign one of its members to act as chair of each STAR Panel. Following the Panel meeting, the STAR Panel chair will review the revised stock assessment and STAR Panel report for consistency with the Terms of Reference. This member is not only expected to attend the assigned STAR Panel meeting, but also the GMT meeting at which ABC recommendations are made (should the need arise), and Council meetings when groundfish stock assessment agenda items are discussed (see calendar in Appendix A). Specifically, if requested the STAR Panel chair will present the STAR Panel report to the GMT if it requires assistance in interpreting the results of a stock assessment. In addition, the chair will present the Panel's report at SSC and Council meetings. However, to insure independence in the SSC's review of stock assessments and STAR Panel proceedings, SSC members who served on a STAT Team or STAR Panel for a particular stock assessment are required to recuse themselves when that stock assessment is reviewed by the SSC, except to answer questions or present factual information. Other SSC members will be assigned the roles of discussion lead and rapporteur. The SSC's review constitutes a final independent check of the stock assessment that takes into consideration both the stock assessment and the STAR Panel report.

It is the SSC's responsibility to review and endorse any additional analytical work requested by the GMT after the stock assessment has been reviewed by the STAR Panels. In addition, the SSC will review and advise the GMT and Council on projected ABCs and OYs and, in addition, will serve as arbitrator to resolve disagreements between the STAT Team and the STAR Panel.

## Council Staff Responsibilities

Council Staff will prepare meeting notices and distribute stock assessment documents, stock summaries, meeting minutes, and other appropriate documents. Council Staff will help NMFS and the state agencies in coordinating stock assessment meetings and events. Staff will also publish or maintain file copies of reports from each STAR Panel (containing items specified in the STAR Panel's term of reference), the outline for groundfish stock assessment documents, comments from external reviewers, SSC, GMT, and GAP, letters from the public, and any other relevant information. At a minimum, the stock assessments (STAT Team reports, STAR Panel reports, and stock summaries) should be published and distributed in the Council's annual SAFE document.

## Stock Assessment Priorities

Stock assessments for West Coast groundfish are conducted periodically to assess abundance, trends, and appropriate harvest levels for these species. Assessments use statistical population models to analyze and integrate a variety of survey, fishery and biological data. Due to the large number of groundfish species that have never been assessed, it is the goal of the Council to increase substantially the number of assessed stocks. A constraint on reaching that objective, however, is ~~that a~~the Council's multi-year management regime~~ has recently been adopted~~, which limits assessment activities to odd years only (e.g., 200~~7~~9).

The SSC recommended and the Council adopted in April 2006 a new process to initiate development of criteria for prioritizing stock assessments that may include such factors as: (1) economic importance, (2) overfished status, (3) demographic sensitivity, (4) time elapsed since the last assessment, etc. While this process was not entirely used to recommend stock assessments during the 2007-2008 cycle, it is anticipated for the next assessment cycle and would involve the NMFS stock assessment coordinator, Council staff, GMT, and the GAP to begin scoping these issues.

In establishing stock assessment priorities a number of factors are considered, including:

1. Assessments should take advantage of new information, especially indices of abundance from fishery-independent surveys.

2. Overfished stocks that are under rebuilding plans should be evaluated to ensure that progress towards achieving stock recovery is adequate. ~~Guidelines for assessing adequacy of progress in rebuilding of overfished stocks are currently being developed through a Council-based process, which when complete, will result in a revision to the SSC's Terms of Reference for Groundfish Rebuilding Analyses.~~

3. In general no more than 2 full assessments will be reviewed by a STAR Panel. In exceptional circumstances this number may be exceeded, if the SSC and NMFS Stock Assessment Coordinator conclude that it is advisable, feasible, and/or necessary to do so.

4. The SSC encourages attempts to study previously un-assessed stocks, and recommends that greater consideration be given to simple assessment methods that can be applied to data-poor stocks. These methods typically do not yield the same information as a full assessment, such as the ability to determine stock status relative to biomass reference points. Even so, such reports are still needed to assist ~~but recognizes that often such efforts will not produce a comprehensive understanding of population dynamics. Even so, updates or reports that fall short of a full assessment are still desirable; in order to summarize whatever information exists that may be useful to~~ the Council in making management decisions for these stocks.

5. Any stock assessment that is considered for use in management should be submitted through normal Council channels and reviewed at STAR Panel meetings.

6. The proposed stocks for assessment should be discussed by the Council at least a year in advance to allow sufficient time for assembly of relevant assessment data and for arrangement of STAR panels.

**Terms of Reference for STAR Panels and Their Meetings**

The principal responsibilities of the STAR Panel are to review stock assessment documents, data inputs, analytical models, and to provide complete STAR Panel reports for all reviewed species. Most groundfish stocks are assessed infrequently and each assessment and review should result in useful advice to the Council. The STAR Panel's work includes:

1. reviewing draft stock assessment documents and any other pertinent information (e.g.; previous assessments and STAR Panel reports, if available);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions; and
4. reviewing revised stock assessment documents before they are forwarded to the SSC.

Presuming two full stock assessments are under review, STAR Panels will include a ~~c~~Chair (~~man~~ appointed from the SSC) and at least three ~~at least two~~ other members with experience gained from having personally conducted stock assessments ~~on the U. S. west coast or elsewhere~~. More specifically, of these three other members, one should have a thorough familiarity with west coast groundfish stock assessment practices, data sources, and modeling methods and one should be appointed from the Center for Independent Experts (CIE). In addition, individuals with a supervisory relationship with a STAT Team member are disqualified from serving on the STAR Panel. The same exclusion applies to panelists who contributed significantly to the development of an assessment. The total number of STAR Panel members (including the chair) should be ~~3~~four unless extenuating circumstances preclude this, e.g., ~~such as~~ a large number of stock assessments scheduled for review at ~~the~~ a STAR Panel dictate more reviewers. In addition to Panel members, STAR meetings will include GMT and GAP advisors with responsibilities described in their terms of reference. STAR Panels normally meet for one week.

The STAR Panel Chair is responsible for 1) developing an agenda for the STAR panel meeting, 2) ensuring that STAR Panel members and STAT teams follow the Terms of Reference, 3) participating in the review of the assessment, 4) guiding the STAR Panel and STAT team to mutually agreeable solutions, and 5) coordinating review of final assessment documents.

The STAR Panel, STAT Team, GAP and GMT advisors, and all interested parties are legitimate meeting participants that must be accommodated in discussions. It is the STAR Panel Chair's responsibility to manage discussions and public comment so that work can be completed.

The STAR Panel is responsible for determining if a stock assessment document is sufficiently complete according to Appendix B. It is the Panel's responsibility to identify assessments that cannot be reviewed or completed for any reason. The Panel's decision that an assessment is complete should be made by consensus. If a Panel cannot reach agreement, then the nature of the disagreement must be described in the Panel's report. Moreover, if a stock assessment is deemed to be stable in its approach to data analysis and modeling, the STAR panel should recommend that the assessment be considered as an update during the next stock assessment cycle.

For some species the data will be insufficient to calculate reliable estimates of $F_{MSY}$ (or its proxy), $B_{MSY}$ (or its proxy), ending biomass or unfished biomass, etc. Results of these data-poor assessments typically will not meet the requirements of an assessment according to the Terms of Reference and, in those instances, each STAR Panel should consider what inferences can be drawn from the analysis presented by the STAT Team. The panel should review the reliability and appropriateness of any methods used to draw conclusions about stock status and exploitation potential and either recommend or reject the analysis on the basis of its ability to introduce useful information into the management process.

The STAR Panel's terms of reference solely concern technical aspects of the stock assessment. It is therefore important that the Panel should strive for a risk neutral perspective in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the panel and excluded from the set upon which management advice is to be developed. It is recognized that a broad range of results should be reported to better define the scope of the accepted model results. The STAR Panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty, and the degree to which the probabilities associated with these scenarios are technically sound. The STAR Panel may also provide qualitative comments on the probability of various model results, especially if the Panel does not believe that the probability distributions calculated by the STAT capture all major sources of uncertainty.

Recommendations and requests to the STAT Team for additional or revised analyses must be clear, explicit and in writing. A written summary of discussion on significant technical points and lists of all STAR Panel recommendations and requests to the STAT Team are required in the STAR Panel's report. This should be completed (at least in draft form) prior to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review work that is required.

The primary goal of the STAR Panel is to complete a detailed evaluation of the results of a stock assessment, which puts the Panel in a good position to advance the best available scientific information to the Council[2]. Under ideal circumstances, the STAT Team and STAR Panel should strive to reach a mutual consensus on a single base model, but it is essential that uncertainty in the analysis be captured and transmitted to managers. A useful way of accomplishing this objective is to bracket the base model along what is deemed to be the dominant dimension of uncertainty (e.g., spawner-recruit steepness or $R_0$, natural mortality rate, survey catchability, recent year-class strength, weights on conflicting CPUE series, etc.). Alternative models should show contrast in their management implications, which in practical terms means that that they should result in different estimates of current stock size, stock depletion, and ABC.

Once a base model has been bracketed on either side by alternative model scenarios, which capture the overall degree of uncertainty in the assessment, a 2-way decision table analysis (states-of-nature versus management action) is the preferred way to present the repercussions of uncertainty to management. An attempt should be made to develop alternative model scenarios such that the base model is considered twice as likely as the alternative models, i.e., the ratio of probabilities should be 25:50:25 for the low stock size alternative, the base model, and the high stock size alternative (Fig. 1). Potential methods for assigning probabilities include using the statistical variance of the model estimates of stock size, posterior Monte Carlo simulation, or expert judgment, but other approaches are encouraged as long as they are fully documented. Bracketing of assessment results could be accomplished in a variety of ways, but as a matter of practice the STAR Panel should strive to identify a single preferred base model when possible, so that averaging of extremes doesn't become the *de facto* choice of management.

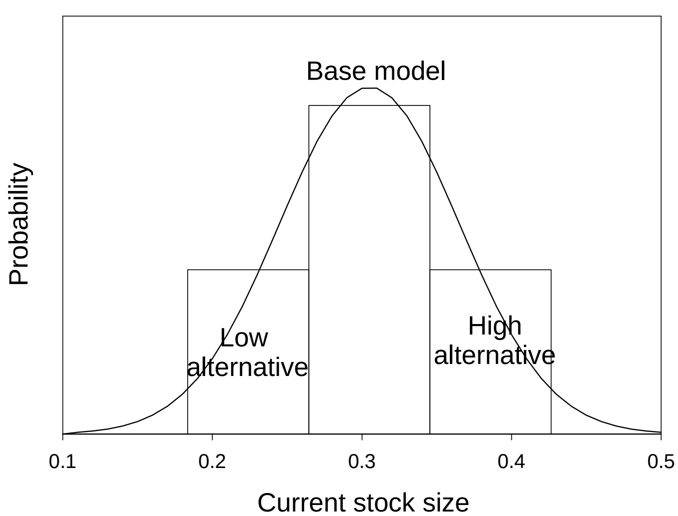



Figure 1. Example of assigning probabilities to alternative models using uncertainty in the estimate of current stock

[2] ~~Nearly all~~Most -groundfish stock assessments conducted for the PFMC have used the Stock Synthesis 2 (SS2) modeling framework, which has been extensively tested and provides model outputs that are compatible with the Council's harvest control rules. Nonetheless, STAT Teams are not required to use SS2. Other valid approaches are available that can be used under appropriate circumstances, especially when model performance issues have been evaluated.

size.

To the extent possible, additional analyses required in the stock assessment should be completed during the STAR Panel meeting. It is the obligation of the STAR Panel C~~c~~hair~~person~~, in consultation with other Panel members, to prioritize requests for additional STAT Team analyses. Moreover, in situations where a STAT team arrives with a well-considered, thorough assessment, it may be that the Panel can conclude its review in less time than has been allotted to the meeting, i.e., early dismissal of a STAT Team is an option for well-constructed assessments. If follow-up work by the STAT Team is required after the review meeting, then it is the Panel's responsibility to track STAT Team progress. In particular, the ~~c~~Chair is responsible for communicating with STAT Teams~~all Panel members~~ (by phone, e-mail, or any convenient means) to determine if the revised stock assessment and documents are complete and ready to be used by managers in the Council family. If stock assessments and reviews are not complete at the end of the STAR Panel meeting, then the work must be completed prior to the GMT meeting where the assessments and preliminary ABC levels are discussed. Any post-STAR drafts of the stock assessment must be reviewed by the STAR Panel (or~~f~~ the Chair if he is delegated that authority by the STAR Panel). Assessments cannot be given to Council staff for distribution unless first endorsed by the STAR Panel chair. Likewise, the final draft that is published in the SAFE document must also be approved by the STAR Panel chair prior to being accepted by Council staff.

~~The STAR Panel, STAT Team, GAP and GMT advisors, and all interested parties are legitimate meeting participants that must be accommodated in discussions. It is the STAR Panel chair's responsibility to manage discussions and public comment so that work can be completed.~~

~~STAT Teams and STAR Panels are likely to disagree on certain technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may also request additional analysis based on an alternative approach. However, t~~The STAR Panel's primary duty is to conduct a peer review of ~~the~~ an assessment that is presented by a STAT Team; they are not workshops. In the course of this review, the Panel may ask for a reasonable number of sensitivity runs, additional details of existing assessments, or similar items from the STAT team. The STAR panels are expected to be judicious in their requests of the STAT teams, recognizing that some issues uncovered during review are best flagged as research priorities, and dealt with more effectively and comprehensively between assessments. The STAR Panel may also request additional analysis based on an alternative approach. However, the STAR Panel is not authorized to conduct an alternative assessment representing its own views that are distinct from those of the STAT Team, nor can it impose an alternative assessment on the Team. Similarly, the Panel should not impose as a requirement their preferred methodologies when such is a matter of professional opinion. Rather, if the Panel finds that an assessment is inadequate, it should document and report that opinion and, in addition, suggest remedial measures that could be taken by the STAT team to rectify whatever perceived shortcomings may exist.

STAT Teams and STAR Panels are required to make a good-faith attempt to resolve any areas of disagreement during the meeting. Occasionally, ~~Where~~ fundamental differences of opinion remain between the STAR Panel and STAT Team that~~, which~~ cannot be resolved by ~~mutual~~ discussion. ~~,~~ In such cases, the STAR Panel must document the areas of disagreement in its report. In exceptional circumstances, the STAT team may choose to submit a supplemental report supporting its view, but in the event that such a step is taken, an opportunity must be given to the STAR panel to prepare a rebuttal. These documents will then be appended to STAR panel report as part of the record of the review meeting. T~~t~~he SSC ~~will review~~ will then review all information pertaining to the dispute, and ~~will~~ issue~~e~~ its ~~own~~ recommendation.

The STAR Panel ~~c~~Chair is expected to attend ~~GMT and~~ Council meetings and GMT meetings (when requested) and where stock assessments and harvest projections are discussed to explain the reviews and provide other technical information and advice. The ~~c~~Chair is responsible for providing the Stock Assessment Coordinator and Council staff with a suitable electronic version of the Panel report.

**Suggested Template for STAR Panel Report**

1. Minutes of the STAR Panel meeting containing
   A. Name and affiliation of STAR Panel members; and
   B. List of analyses requested by the STAR Panel, the rationale for each request, and brief summary of the STAT response to the request.

C. Description of base model and alternative models used to bracket uncertainty.

2. Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies.
3. Explanation of areas of disagreement regarding STAR Panel recommendations:
   A. Among STAR Panel members (including concerns raised by GAP and GMT representatives), and
   B. Between the STAR Panel and STAT Team
4. Unresolved problems and major uncertainties, e.g.; any special issues that complicate scientific assessment, questions about the best model scenario.
5. Management, data, or fishery issues raised by the GMT or GAP representatives during the STAR Panel.
6. Prioritized recommendations for future research and data collection

**Terms of Reference for Groundfish STAT Teams**

The STAT tTeam will carry out its work according to these terms of reference and the calendar for groundfish stock assessments.

All relevant stock assessment workshops should be attended by all STAT team members. The STAT Team shall include in both the STAR Panel draft and final assessment all data sources that include the species being assessed, identify which are used in the assessment, and provide the rationale for data sources that are excluded. The STAT Team is obliged to keep the GAP representative informed of the specific data being used in the stock assessment. The STAT team is expected to initiate contact with the GAP representative at an early stage in the process, and to be prepared to respond to concerns about the data that might be raised. The STAT Team should also contact the GMT representative for information about changes in fishing regulations that may influence data used in the assessment.

STAT teams are strongly encouraged to develop assessments in a collaborative environment, such as by forming working groups, holding pre-assessment workshops, and consulting with other stock assessment scientists. STAT Tteams are also encouraged to also organize independent meetings with industry and interested parties to discuss issues, questions, and data.

Each STAT Team will appoint a representative to coordinate work with the STAR Panel. Barring exceptional circumstances, all STAT team members should attend the STAR Panel meeting.

Each STAT Team conducting a full assessment will appoint a representative who will be available to attend the Council meeting where the SSC is scheduled to review the assessment. In addition, a representative of the STAT Team should be available to attend the GMT and Council meetings where preliminary ABC and OY levels are discussed.

The STAT Team is responsible for preparing three versions of the stock assessment document: 1) a complete "draft" including an executive summary (except for decision tables) for discussion at the stock assessment review meeting; 2) a "revised draft" for distribution to the Council and advisory bodies for discussions about preliminary ABC and OY levels; 3) a "final" version to be published in the SAFE report. Other than changes authorized by the SSC, only editorial and other minor alterations should be made between the "revised draft" and "final" versions. The STAT Team will provide "draft" assessment documents to the Stock Assessment Coordinator, who will distribute them to the STAR Panel, Council, the SSC Groundfish subcommittee, and GMT and GAP representatives at least two weeks prior to the STAR Panel meeting.

Complete, fully-developed assessments are critical to the STAR panel process. Draft assessments will be evaluated for completeness prior to the STAR panel meeting, and assessments that do not satisfy minimum criteria will not be reviewed. The STAR panel chair will make an initial recommendation, which will then be reviewed by the SSC groundfish subcommittee members, council staff, and the groundfish coordinator. A draft assessment will be judged complete if an external reviewer could review the assessment in its present form without additional information. In most cases, this would require 1) a least one candidate model successfully fit to available data, 2) a description of that model, 3) a description of assessment data in sufficient detail to evaluate its merits, and 4) a description the model results in sufficient detail to allow an opinion to be formed of its adequacy.

The STAT Team is responsible for bringing computerized data and working assessment models to the review meeting in a form that can be analyzed on site. STAT Teams should take the initiative in building and selecting candidate models and should have several complete models ready to present to the STAR Panel and be prepared to discuss the merits of each. The STAT team should identify a candidate base model, fully documented in the draft assessment, for STAR panel consideration. Fully developed assessments that are properly documented should require less time to review and approve than poorly constructed, incomplete assessments.

In most cases, the STAT Team should produce a complete draft of the assessment within three weeks of the end of the STAR Panel meeting, including any internal agency review. In any event, the STAT Team must finalize the assessment document before the briefing book deadline for the Council meeting at which the assessment is scheduled for review.

The STAT Team and the STAR Panel may disagree on technical issues regarding an assessment, but a complete stock assessment must include a point-by-point response by the STAT Team to each of the STAR Panel's recommendations. Estimates and projections representing all sides of the disagreement need to be presented to, reviewed by, and commented upon by the SSC.

For stocks that are projected to fall below overfished thresholds, the STAT Team must complete a rebuilding analysis according to the SSC's Terms of Reference for Groundfish Rebuilding Analyses. It is recommended that this analysis be conducted using the rebuilding software developed by Dr. Andre Punt (aepunt@u.washington.edu). The STAT Team is also responsible for preparing a document that summarizes the results of the rebuilding analysis.

Electronic versions of final assessment documents, rebuilding analyses, parameter files, data files, and key output files will be sent by the STAT Teams to the Stock Assessment Coordinator for inclusion in a stock assessment archive. Any tabular data that are inserted into the final documents in and object format should also be submitted in alternative forms (e.g., spreadsheets), which allow selection of individual data elements.

## Terms of Reference for Stock Assessment Updates

The STAR process is designed to provide a comprehensive, independent review of a stock assessment. In other situations a less comprehensive review of assessment results is desirable, particularly in situations where a "model" has already been critically examined and the objective is to simply update the model by incorporating the most recent data. In this context a model refers not only to the population dynamics model *per se*, but to the particular data sources that are used as inputs to the model, the statistical framework for fitting the data, and the analytical treatment of model outputs used in providing management advice, including reference points, the allowable biological catch (ABC) and optimum yield (OY). These terms of reference establish a procedure for a limited but still rigorous review for stock assessment models that fall into this latter category. However, it is recognized that what in theory may seem to be a simple update, may in practice result in a situation that is impossible to resolve in an abbreviated process. In these cases, it may not be possible to update the assessment – rather the assessment may need to be revised in the next full assessment review cycle.

*Qualification*

The Scientific and Statistical Committee (SSC) will determine whether a stock assessment qualifies as an update under these terms of reference. Recommendation by a STAR Panel or the SSC that a full assessment is suitable for an update will be a principal criterion in this determination. To qualify, a stock assessment must carry forward its fundamental structure from a model that was previously reviewed and endorsed by a STAR panel. In practice this means 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 of the various data components, and (g) the analytical treatment of model outputs in determining management reference points, including $F_{msy}$, $B_{msy}$, and $B_0$. A stock assessment update is appropriate in situations where no significant change in these seven factors has occurred, other than extending time series of data elements within particular data components used by the model, e.g., adding information from a recently completed survey and an update of landings. Extending CPUE time series based on fitted models (i.e., GLM models) will require refitting the model and updating all values in the time series. Assessments using updated CPUE time series qualify as updates if the CPUE standardization models follow applicable criteria for assessment models described above. In practice there will always be valid reasons for altering a model, as defined in this broad context, although, in the interests of stability, such changes should be resisted as much as possible. Instead, significant alterations should be addressed in the next subsequent full assessment and review.

*Composition of the Review Panel*

The groundfish subcommittee of the SSC will conduct the review of a stock assessment update. A lead reviewer for each updated assessment will be designated by the chair of the groundfish subcommittee from among its membership, and it will be the lead reviewer's responsibility to ensure the review is completed properly and that a written report of the proceedings is produced. In addition, the groundfish management team (GMT) and the groundfish advisory panel (GAP) will designate one person each to participate in the review.

*Review Format*

All stock assessment updates will be reviewed during a single meeting of the SSC Groundfish Subcommittee scheduled early in the assessment cycle. This meeting may precede or follow a normally scheduled SSC meeting. The review process will be as follows. The STAT team preparing the update will distribute the updated stock assessment to the review panelists at least two weeks prior to the review meeting. In addition, Council staff will provide panelists with a copy of the last stock assessment reviewed under the full STAR process, as well as the previous STAR panel report. Review of stock assessment updates is not expected to require analytical requests or model runs during the meeting, although large or unexpected changes in model results may necessitate some model exploration. The review will focus on two crucial questions: (1) has the assessment complied with the terms of reference for stock assessment updates and (2) are new input data and model results sufficiently consistent with previous data and results that the updated assessment can form the basis of Council decision-making. If either of these criteria is not met, then a full stock assessment will be required.

*STAT Team Deliverables*

Since there will be limited opportunities for revision during the review meeting, it is the STAT team's responsibility to provide the Panel with a completed update at least two weeks prior to the meeting. To streamline the process, the team can reference whatever material it chooses, including that presented in the previous stock assessment (e.g., a description of methods, data sources, stock structure, etc.). However, it is essential that any new information being incorporated into the assessment be presented in enough detail, so that the review panel can determine whether the update satisfactorily meets the Council's requirement to use the best available scientific information. Of particular importance will be a retrospective analysis showing the performance of the model with and without the updated data streams. Likewise, a decision table that highlights the consequences of alternative states of nature would be useful to the Council in adopting annual specifications. Similarly, if any minor changes to the "model" structure are adopted, above and beyond updating specific data streams, a sensitivity analysis to those changes will be required.

In addition to documenting changes in the performance of the model, the STAT Team will be required to present key assessment outputs in tabular form. Specifically, the STAT Team's final update document should include the following:

- Title page and list of preparers
- Executive Summary (see Appendix C)
- Introduction
- Documentation of updated data sources
- Short description of overall model structure
- Complete ~~B~~base-run results, ~~(~~including a ~~largely~~ tabular ~~and graphical~~summary of biomass and recruitment time series~~)~~
- Uncertainty analysis, including retrospective analysis, decision table, etc.

- 10 year harvest projections under the default harvest policy.

*Review Panel Report*

The stock assessment review panel will issue a report that will include the following items:

- Name and affiliation of panelists
- Comments on the technical merits and/or deficiencies of the update
- Explanation of areas of disagreement among panelists and between the panel and STAT team
- Recommendation regarding the adequacy of the updated assessment for use in management

## Appendix A:  2009-2010 Stock Assessment Review Calendar

TO BE DETERMINED

Include deadlines for inclusion of all significant data elements.

Include a post-STAR briefing where STAT teams present their findings to GMT, GAP, and the Council.

Include dates when STAT Teams provide GAP and GMT representatives with stock assessment data.

**Appendix B: Outline for Groundfish Stock Assessment Documents**

This is an outline of items that should be included in stock assessment reports for groundfish managed by the Pacific Fishery Management Council. The outline is a working document meant to provide assessment authors with flexible guidelines about how to organize and communicate their work. All items listed in the outline may not be appropriate or available for each assessment. In the interest of clarity and uniformity of presentation, stock assessment authors and reviewers are encouraged (but not required) to use the same organization and section names as in the outline. It is important that time trends of catch, abundance, harvest rates, recruitment and other key quantities be presented in tabular form to facilitate full understanding and follow-up work.

A. Title page and list of preparers – the names and affiliations of the stock assessment team (STAT) either alphabetically or as first and secondary authors

B. Executive Summary (see attached template and example in Appendices C and D). This also serves as the STAT summary included in the SAFE.

C. Introduction
   1. Scientific name, distribution, the basis for the choice of stock structure, including regional differences in life history or other biological characteristics that should form the basis of management units.
   2. A map depicting the scope of the assessment and identifying boundaries for fisheries or data collection strata.
   3. Description of fisheries for this species off Canada or Alaska, including references to any recent assessments of those stocks.
   4. Important features of life history that affect management (e.g., migration, sexual dimorphism, bathymetric demography)
   5. Important features of current fishery and relevant history of fishery
   6. Management history (e.g., changes in mesh sizes, trip limits, optimum yields)
   7. Management performance – a table or tables comparing acceptable biological catches, optimum yields, landings, and catch (i.e., landings plus discard) for each area and year

D. Assessment
   1. Data
      a. Landings by year and fishery, historical catch estimates, discards (generally specified as a percentage of total catch in weight and in units of mt), catch-at-age, weight-at-age, abundance indices (typically survey and CPUE data), data used to estimate biological parameters (e.g.; growth rates, maturity schedules, and natural mortality) with coefficients of variation (CVs) or variances if available. Include complete tables and figures and date of extraction.
      b. Sample size information for length and age composition data by area, year, gear, market category, etc., including both the number of trips and fish sampled.
      c. All data sources that include the species being assessed, which are used in the assessment, and provide the rationale for data sources that are excluded.
   2. History of modeling approaches used for this stock – changes between current and previous assessment models
      a. Response to STAR Panel recommendations from the most recent previous assessment.
      b. Report of consultations with GAP and GMT representatives regarding the use of various data sources in the stock assessment.
   3. Model description
      a. Complete description of any new modeling approaches.
      b. Definitions of fleets and areas.
      d. Assessment program with last revision date (i.e., date executable program file was compiled).
      e. List and description of all likelihood components in the model.
      f. Constraints on parameters, selectivity assumptions, natural mortality, assumed level of age reader agreement or assumed ageing error (if applicable), and other assumed parameters.
      g. Description of stock-recruitment constraints or components.
      h. Description of how the first year that is included in the model was selected and how the population state at the time is defined (e.g., $B_0$, stable age structure, etc.).
      i. Critical assumptions and consequences of assumption failures.
   4. Model selection and evaluation

a. Evidence of search for balance between model realism and parsimony.
b. Comparison of key model assumptions, include comparisons based on nested models (e.g.; asymptotic vs. domed selectivities, constant vs. time-varying selectivities).
c. Summary of alternate model configurations that were tried but rejected.
d. Likelihood profile for the base-run configuration over one or more key parameters (e.g., M, h, Q) to show consistency among input data sources.
e. Residual analysis (e.g.; residual plots, time series plots of observed and predicted values, or other approaches).
f. Convergence status and convergence criteria for the base-run model.
g. Randomization run results or other evidence of search for global best estimates.
h. Evaluation of model parameters. Do they make sense? Are they credible?
i. Are model results consistent with assessments of the same species in Canada and Alaska? Are parameter estimates (e.g., survey catchability) consistent with estimates for related stocks?

5. Point-by-point response to the STAR Panel recommendations.
6. Base-run(s) results
   a. Table listing all explicit parameters in the stock assessment model used for base runs, their purpose (e.g.; recruitment parameter, selectivity parameter) and whether or not the parameter was actually estimated in the stock assessment model.
   b. Population numbers at age × year × sex (if sex-specific M, growth, or selectivity) (May be provided as a text file)
   c. Time-series of total, summary, and spawning biomass, depletion relative to $B_0$, recruitment and fishing mortality or exploitation rate estimates (table and figures).
   d. Selectivity estimates (if not included elsewhere).
   e. Stock-recruitment relationship.
7. Uncertainty and sensitivity analyses. The best approach for describing uncertainty and the range of probable biomass estimates in groundfish assessments may depend on the situation. Important factors to consider include:
   a. Parameter uncertainty (variance estimation conditioned on a given model, estimation framework, data set choice, and weighting scheme), including likelihood profiles of important assessment parameters (e.g., natural mortality). This also includes expressing uncertainty in derived outputs of the model and estimating CVs by an appropriate methods (e.g., bootstrap, asymptotic methods, Bayesian approaches, or MCMC).
   b. Sensitivity to data set choice and weighting schemes (e.g., emphasis factors), which may also include a consideration of recent patterns in recruitment.
   c. Sensitivity to assumptions about model structure, i.e., model specification uncertainty.
   d. Retrospective analysis, where the model is fitted to a series of shortened input data sets, with the most recent years of input data being dropped.
   e. Historical analysis (plot of actual estimates from current and previous assessments).
   f. Subjective appraisal of the magnitude and sources of uncertainty.
   g. If a range of model runs is used to characterize uncertainty it is important to provide some qualitative or quantitative information about relative probability of each.
   h. If possible, ranges depicting uncertainty should include at least three runs: (a) one judged most probable; (b) at least one that depicts the range of uncertainty in the direction of lower current biomass levels; and (c) one that depicts the range of uncertainty in the direction of higher current biomass levels. The entire range of uncertainty should be carried through stock projections and decision table analyses.

E. <u>Rebuilding analyses</u>

1. Determine $B_0$. The values for spawners are preferably measured as total population egg production, but female spawning biomass is a common proxy.
2. $B_{msy} = 0.4\ B_0$;
3. Mean generation time; and
4. Forward projection using a Monte Carlo re-sampling of recruitments expected to occur as the stock rebuilds, where future recruitments typically are taken from the recent time series of estimated recruitments or recruits per spawner. Alternatively, if a credible stock-recruitment relationship can be estimated, it could be used to project population growth. Either approach can be conducted using the Punt rebuilding software (see above).

F. Reference points (biomass and exploitation rate).

1. Unfished spawning stock biomass, summary age biomass, and recruitment.
2. Spawning stock biomass that produces MSY (provide $B_{40\%}$ proxy).
3. $SPR_{MSY}$ or $F_{MSY}$ (specify which), and the basis for the estimate (based on the $F_{MSY}$ proxy).
4. Exploitation Rate corresponding to $SPR_{MSY}$ or $F_{MSY}$ (if available).
5. Estimate of MSY and the basis for the estimate (based on the $F_{MSY}$ proxy).

G. Harvest projections and decision tables

1. Harvest projections and decision tables (i.e., a matrix of states of nature versus management action) should cover the plausible range of uncertainty about current biomass and the full range of candidate fishing mortality targets used for the stock or requested by the GMT. These should at least include calculation of the ABC based on $F_{MSY}$ (or its proxy) and the OY that is implied under the Council's 40:10 harvest policy. Ideally, the alternatives described in the decision table will be drawn from a probability distribution which describes the pattern of uncertainty regarding the status of the stock and the consequences of alternative future management actions. Where alternatives are not formally associated with a probability distribution, the document needs to present sufficient information to guide assignment of approximate probabilities to each alternative. Decision tables should follow the format of the example Executive Summary for canary rockfish (Appendix 4 of this document) in which the columns represent the states of nature and the rows the management decisions. In most cases, management decisions will represent the sequence of catches obtained by applying the Council 40-10 harvest policy to each state of nature; however other alternatives may be suggested by the GMT as being more relevant to Council decision-making. For example, when recent catches are much less than the OY, there may be more interest in status quo projections.
2. Information presented should include biomass, stock depletion, and yield projections of ABC and OY for ten years into the future, beginning with the first year for which management action could be based upon the assessment.

H. Regional management considerations.

1. Discuss whether a regional management approach make sense for the species from a biological perspective.
2. If there are insufficient data to analyze a regional management approach, what are the research and data needs to answer this question?

I. Research needs (prioritized).

J. Acknowledgments-include STAR Panel members and affiliations as well as names and affiliations of persons who contributed data, advice or information but were not part of the assessment team.

K Literature cited.

L. An appendix with the complete parameter and data in the native code of the stock assessment program.

**Appendix C: Template for Executive Summary Prepared by STAT Teams**

Stock: species/area, including an evaluation of any potential biological basis for regional management

Catches: trends and current levels-include table for last ten years and graph with long term data

Data and assessment: date of last assessment, type of assessment model, data available, new information, and information lacking

Unresolved problems and major uncertainties: any special issues that complicate scientific assessment, questions about the best model scenario, etc.

Reference points: management targets and definition of overfishing, including the harvest rate that brings the stock to equilibrium at $B_{40\%}$ (the $B_{MSY}$ proxy) and the equilibrium stock size that results from fishing at the default harvest rate (the $F_{MSY}$ proxy).

Stock biomass: trends and current levels relative to virgin or historic levels, description of uncertainty-include table for last 10 years and graph with long term estimates

Recruitment: trends and current levels relative to virgin or historic levels-include table for last 10 years and graph with long term estimates

Exploitation status: exploitation rates (i.e., total catch divided by exploitable biomass) – include a table with the last 10 years of data and a graph showing the trend in fishing mortality relative to the target (y-axis) plotted against the trend in biomass relative to the target (x-axis).

Management performance: catches in comparison to ABC and OY values for the most recent 10 years (when available), overfishing levels, actual catch and discard.

Forecasts: ten-year forecasts of catch, summary biomass, spawning biomass, and depletion

Decision table: projected yields (ABC and OY), spawning biomass, and stock depletion levels for each year

Research and data needs: identify information gaps that seriously impede the stock assessment

Rebuilding Projections: principal results from rebuilding analysis if the stock is overfished

Summary Table: as detailed in the attached spreadsheet

Appendix D: Example a Complete Stock Assessment Executive Summary

## 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.

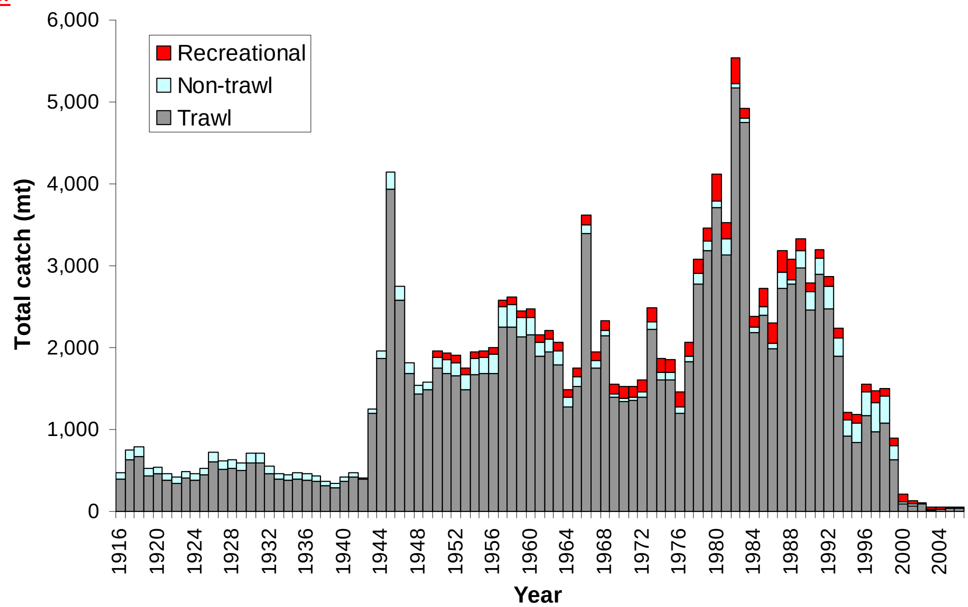



Figure a. Canary rockfish catch history by major source, 1916-2006.

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.

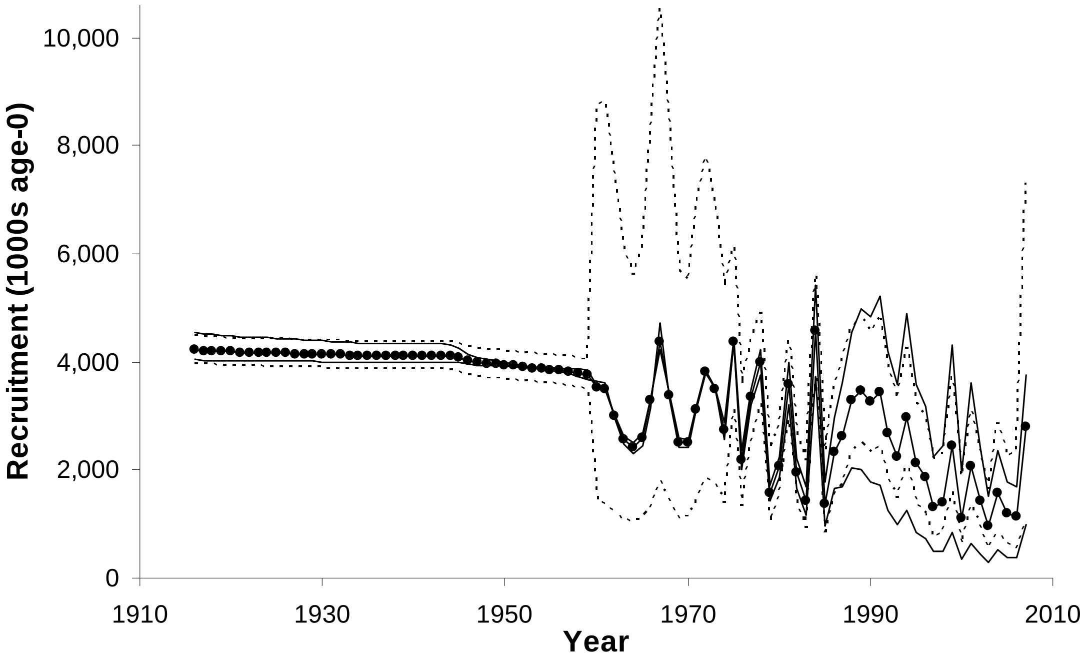



Figure c. Time series of estimated canary rockfish recruitments for the base case model (round points) with approximate asymptotic 95% confidence interval (dashed lines) and alternate states of nature (light lines).

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 |

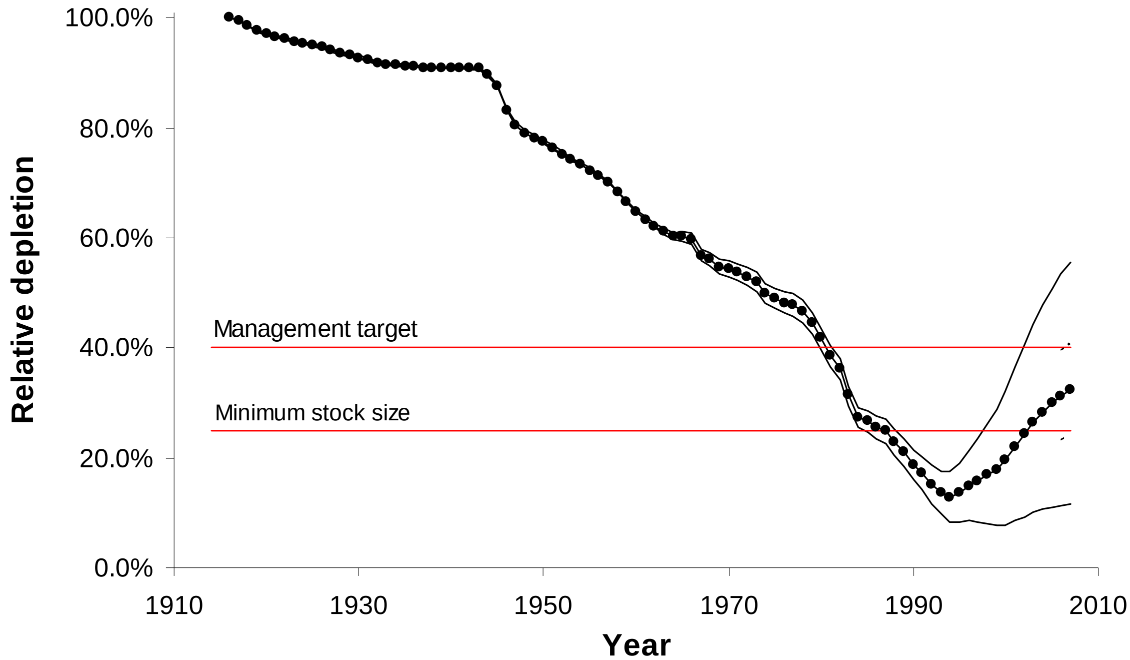



Figure d. Time series of depletion level as estimated in the base case model (round points) with approximate asymptotic 95% confidence interval (2006-2007 only, dashed lines) and alternate states of nature (light lines).

*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 |

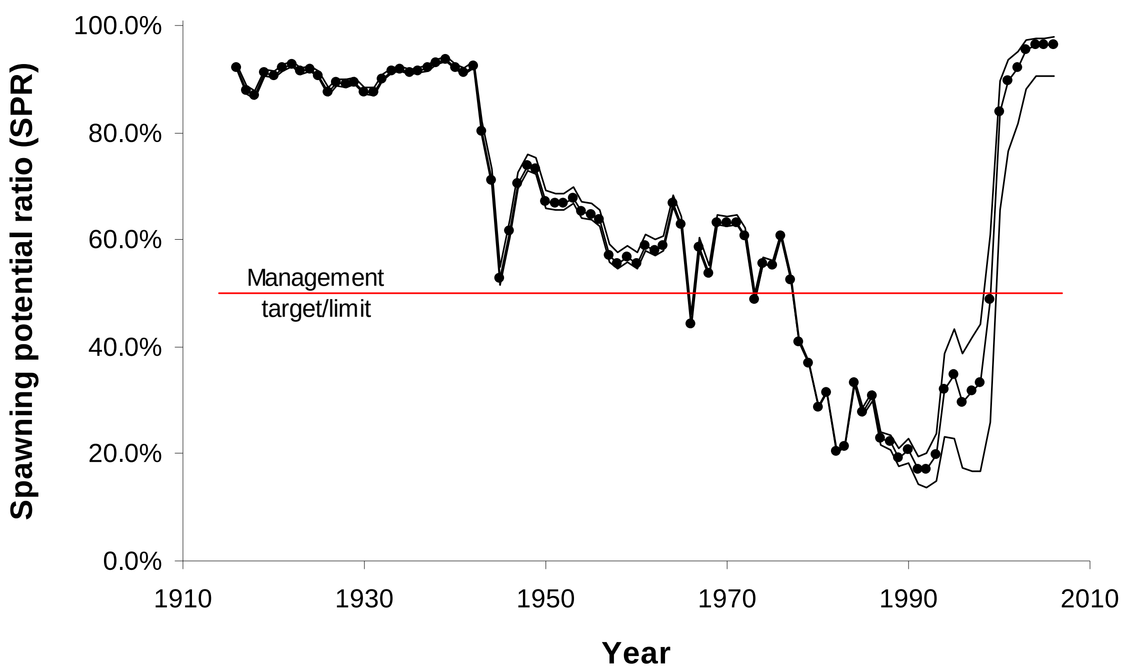



Figure e. Time series of estimated spawning potential ratio (SPR) for the base case model (round points) and alternate states of nature (light lines). Values of SPR below 0.5 reflect harvests in excess of the current overfishing proxy.

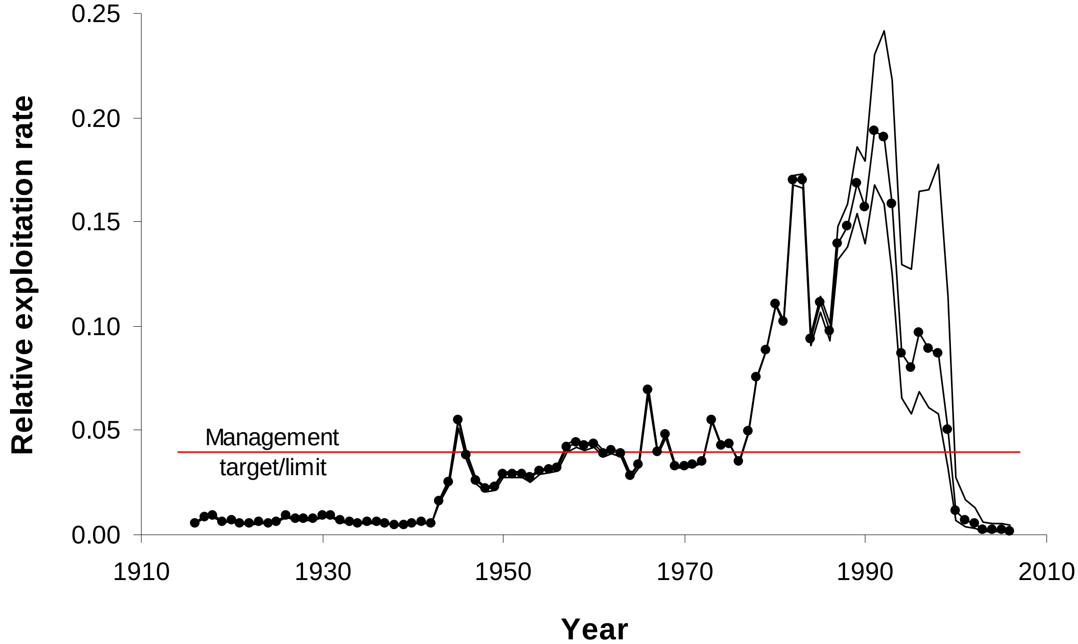



Figure f. Time series of estimated relative exploitation rate (catch/age 5 and older biomass, lower panel) for the base case model (round points) and alternate states of nature (light lines). Values of relative exploitation rate in excess of horizontal line are above the rate corresponding to the overfishing proxy from the base case.

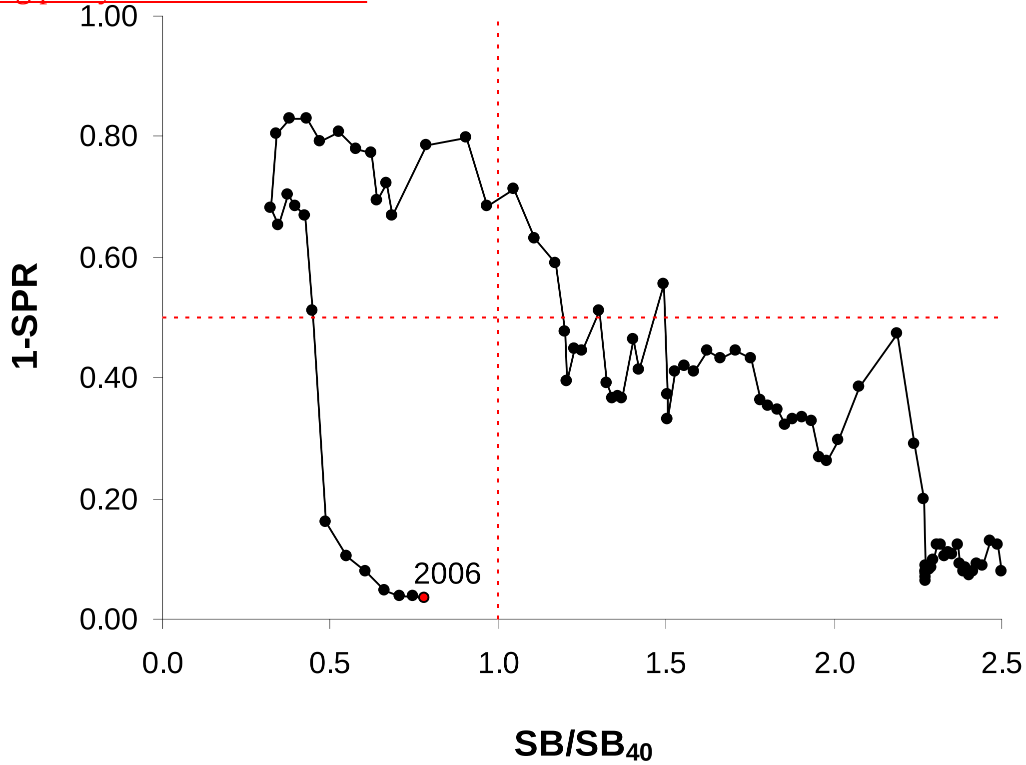



Figure g. Estimated spawning potential ratio relative to the proxy target of 50% vs. estimated spawning biomass relative to the proxy 40% level from the base case model. Higher biomass occurs on the right side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

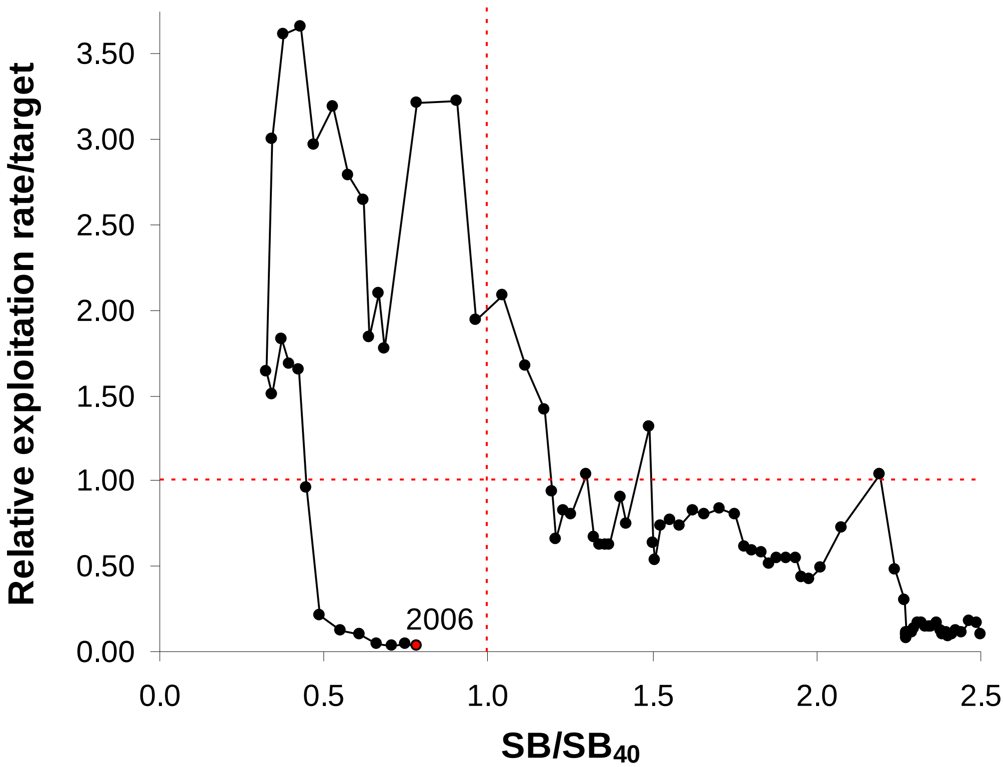



Figure g. Phase plot of estimated fishing intensity vs. relative spawning biomass for the base case model. Fishing intensity is the relative exploitation rate divided by the level corresponding to the overfishing proxy (0.040). Relative spawning biomass is annual spawner abundance divided by the 40% 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 presented in a separate 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- | 4,296- | 4,618- | 5,190- | 5,750- | 6,264- | 6,736- | 7,140- | 7,482- | 7,776- |
| | 6,820 | 7,357 | 8,111 | 9,109 | 10,070 | 10,942 | 11,715 | 12,359 | 12,884 | 13,312 |
| Range of states of nature | 2,761- | 2,610- | 2,644- | 2,918- | 3,184- | 3,417- | 3,628- | 3,795- | 3,918- | 4,009- |
| | 8,241 | 9,073 | 10,144 | 11,477 | 12,779 | 13,985 | 15,076 | 16,019 | 16,825 | 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- | 1,606- | 638- | 1,359- | 905- | 547- | 854- | 627- | 548- | 1,078- |
| | 2,299 | 3,735 | 1,893 | 3,124 | 2,267 | 1,667 | 2,869 | 2,231 | 2,389 | 7,313 |
| Range of states of nature | 484- | 841- | 351- | 643- | 447- | 302- | 520- | 390- | 367- | 991- |
| | 2,453 | 4,318 | 1,938 | 3,613 | 2,383 | 1,515 | 2,373 | 1,771 | 1,699 | 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 |

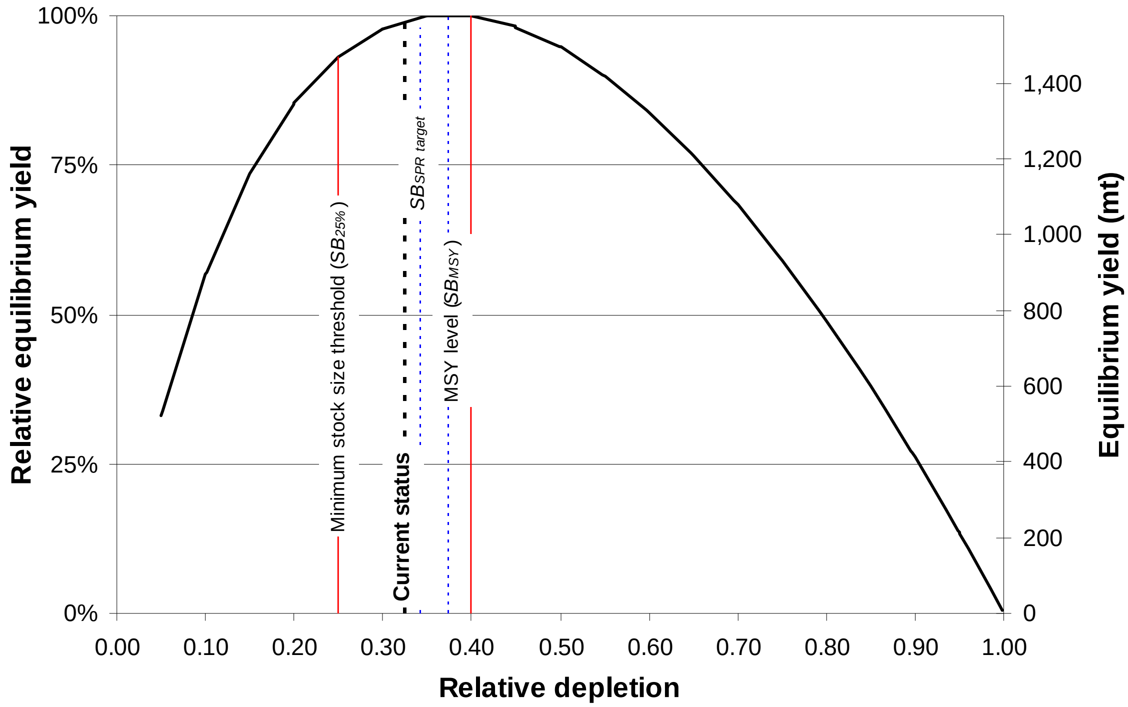



Figure h. Equilibrium yield curve (derived from reference point values reported in table i) for the base case model. Values are based on 1994-1998 fishery selectivity and allocation to better approximate the performance of a targeted fishery rather than a bycatch-only scenario.

Executive Summary

Stock

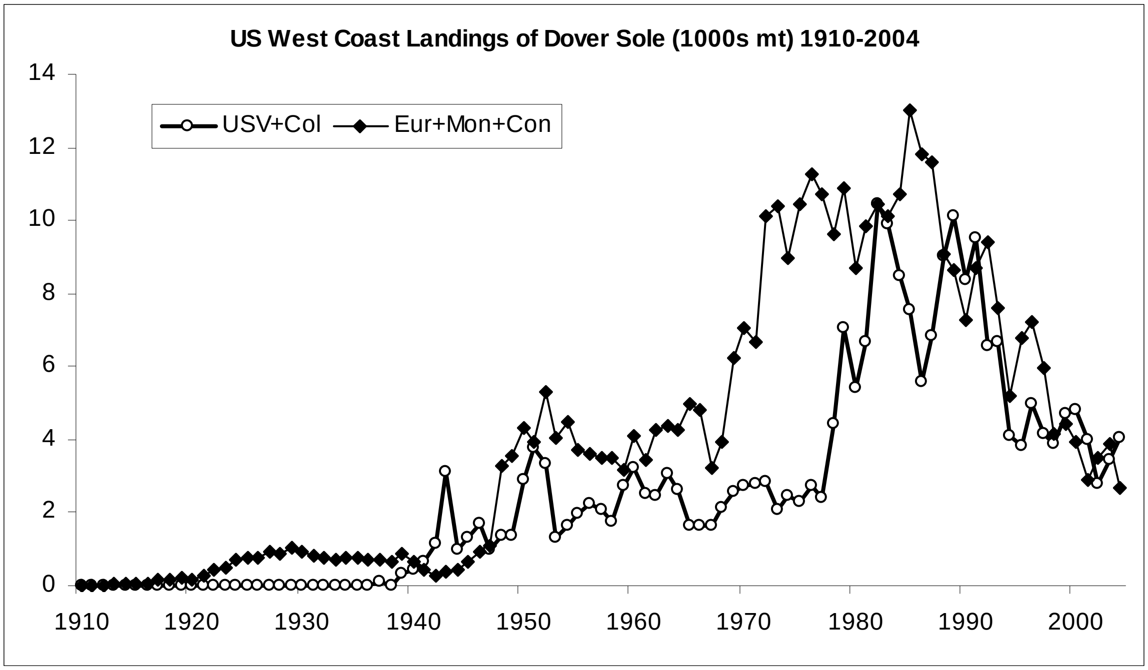
This assessment applies to the Dover sole (*Microstomus pacificus*) that reside in the waters off California, Oregon and Washington in the region bounded by the U.S. borders with Canada and Mexico. This assessment treats these fish as a unit stock. Dover sole are also harvested from the waters off British Columbia and in the Gulf of Alaska.

Catches

Dover sole have been the target of trawl operations along the west coast of North America since World War II and were almost certainly caught prior to the war as incidental take in directed fisheries for English sole and petrale sole. Almost all of the harvests have been taken by groundfish trawl. Annual landings from U.S. waters averaged 6,708 mt during the 1960s, 12,792 mt during the 1970s, 18,383 mt during the 1980s, 12,350 mt during the 1990s, and 7,213 mt since 2000. Discarding of small, unmarketable fish is an important, but poorly documented feature of the fishery.

Recent landings (mt) of Dover sole from Pacific Council waters.

| INPFC Region | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| US Vancouver | 1179.4 | 1459.3 | 995.8 | 897.5 | 1107.4 | 1261.4 | 1455.4 | 765.7 | 838.4 | 979.3 |
| Columbia | 2626.7 | 3514.7 | 3157.9 | 2976.0 | 3611.2 | 3553.1 | 2519.1 | 2030.6 | 2626.9 | 3079.3 |
| Eureka | 2404.9 | 2648.4 | 2113.3 | 2289.0 | 2225.9 | 2003.2 | 1498.9 | 1497.0 | 1955.4 | 1125.7 |
| Monterey | 3252.1 | 3242.0 | 2748.8 | 1276.5 | 1749.6 | 1703.7 | 1294.5 | 1719.4 | 1599.3 | 1245.8 |
| Conception | 1101.9 | 1322.2 | 1108.6 | 571.5 | 443.3 | 238.5 | 121.2 | 288.3 | 352.2 | 312.5 |
| US Total | 10565.1 | 12186.5 | 10124.3 | 8010.4 | 9137.4 | 8759.9 | 6889.2 | 6301.1 | 7372.2 | 6742.6 |




~~Data and Assessment~~
~~The U.S. west coast stock of Dover sole was last assessed in 2001. The current assessment used the new version of the Stock Synthesis program (SS2 version 1.19) and separated the length and age composition data into two fisheries: a northern fishery operating in the US Vancouver and Columbia INPFC regions and a southern fishery operating in the Eureka, Monterey and Conception regions. The period modeled in the assessment extended from 1910 to 2004 with fishing beginning in 1911. Data in the assessment model included fishery length composition data from 1966 to 2004, fishery age composition data from 1981 to 2004, a biomass index derived from trawl logbook catch rates (1978 to 1995), and biomass estimates and length and age composition data from bottom trawl research surveys of the shelf (1980 to 2004) and slope (1992 to 2004). As in previous assessments of Dover sole, retention and discarding were modeled using logistic functions of length.~~

~~Unresolved Problems and Major Uncertainties~~
~~Just before the STAR Panel review, when working up results from the preliminary base model runs with randomized starting parameter values, it became apparent that the likelihood surface was very irregular and that the model often converged to parameter estimates that were not the globally best estimates. During development of the model, while exploring alternative model configurations and fixed parameter values, problems with model convergence lead to the conclusion that small lambda values were needed on the likelihood components for the age composition and mean length-at-age observations. It appears that there are fundamental tensions among some of the different data sources that can be resolved in multiple ways, leading to numerous local extrema on the likelihood surface. After the STAR Panel review experiments were conducted using different sequences of phases in the SS2 control file and some phasing sequences produced much better model convergence. However, none of the sequences that were tried fully solved the problem of convergence to local minima on the negative log-likelihood surface. The size and sex distributions of Dover sole are highly variable by depth and between INPFC areas and have changed over time. It is difficult to determine whether these variations are due to differences in size-related discarding or to differences in selection, related either to gear or to depth of fishing. The size-discards and size-selection effects are confounded in the fishery size-composition data. Only a few observations are available for the size-distributions of discarded fish.~~
~~The West Coast Groundfish Observer Program data indicate considerable latitudinal differences in the pattern of discarding of Dover sole caught in deep water (> 300 fm). In the south (Eureka to Conception) the discarded fish are slightly heavier on average than the retained fish, possibly due to discarding of large "jellied" fish, whereas in the north (US Vancouver and Columbia) the discarded fish are lighter. The pattern in the north is consistent with the assumption that smaller fish are discarded. The current version of Stock Synthesis cannot generate discarded fish that are heavier than the retained fish as was observed in the south.~~

The available Dover sole age composition data do not appear to be very informative. Plots of the age composition data do not show any obvious evidence of strong or weak year classes. This could be due to age-reading error or because Dover sole exhibit considerable variation in length-at-age with depth. In future assessments it might be worthwhile compiling the data into separate fisheries by depth (as attempted in the 2001 assessment), but this approach will be problematic because fishing trips can cover multiple depths and depth data are not always available for Dover sole market samples.
Differences in length-at-age, especially for old fish, were evident in the observed data from the AFSC versus the NWFSC slope surveys. The two surveys used different vessels and tow durations that may have resulted in differing trawl selection characteristics. It is plausible that the shorter NWFSC survey tows (15 versus 30 minutes) resulted in greater escapement of larger fish. Differences in mean length-at-age between the two surveys seemed to be a major source of the tension in the data and almost certainly contributed to the model convergence problem.
The current version of Synthesis does not have any options for selection curves in which peak selection occurs at different lengths for females versus males, and yet this seems to be a distinct feature in the Dover sole length composition data from the trawl surveys and the fisheries.
None of the numerous model configurations that were explored were able to resolve the conflicting signals that were evident in the Dover sole length composition data versus the age composition data versus the mean length-at-age data.
None of the numerous model configurations that were explored were able to fit the unusual bimodal length compositions that were observed in the female Dover sole collected during both slope surveys.

Reference Points
In June 2000 the Pacific Fishery Management Council (PFMC) endorsed the recommendation of the West Coast Groundfish Harvest Policy Workshop that F40% be used as the default target rate of fishing mortality for Council-managed flatfish species. The current assessment uses the F40% default to make harvest projections for Dover sole. Based on the Council's default harvest control rule for groundfish, the stock of Dover sole would be considered to be "overfished" whenever the spawning stock biomass (SB) was less than 25% of the unexploited level, SB(0).
The current assessment estimates that the Dover sole stock can support a maximum sustainable yield (MSY) of about 16,500 tons per year, which is considerably larger than the current OY and coastwide catches in any recent years.

| Reference Points | Value | Units |
|---|---|---|
| Unfished Stock | | |
| Spawning Biomass, SB(0) | 299,054 | mt |
| Spawning Biomass / Recruit | 2.15 | kg / fish |
| Annual Recruitment | 138,970 | 1000s fish |
| F40% Proxy for MSY * | | |
| Spawning Biomass / Recruit | 0.926 | kg / fish |
| Exploitation Rate | 6.72% | |
| MSY | 16,505 | mt |
| SB(MSY) | 117,281 | mt |
| SB(MSY) / SB(0) | 39.2% | |

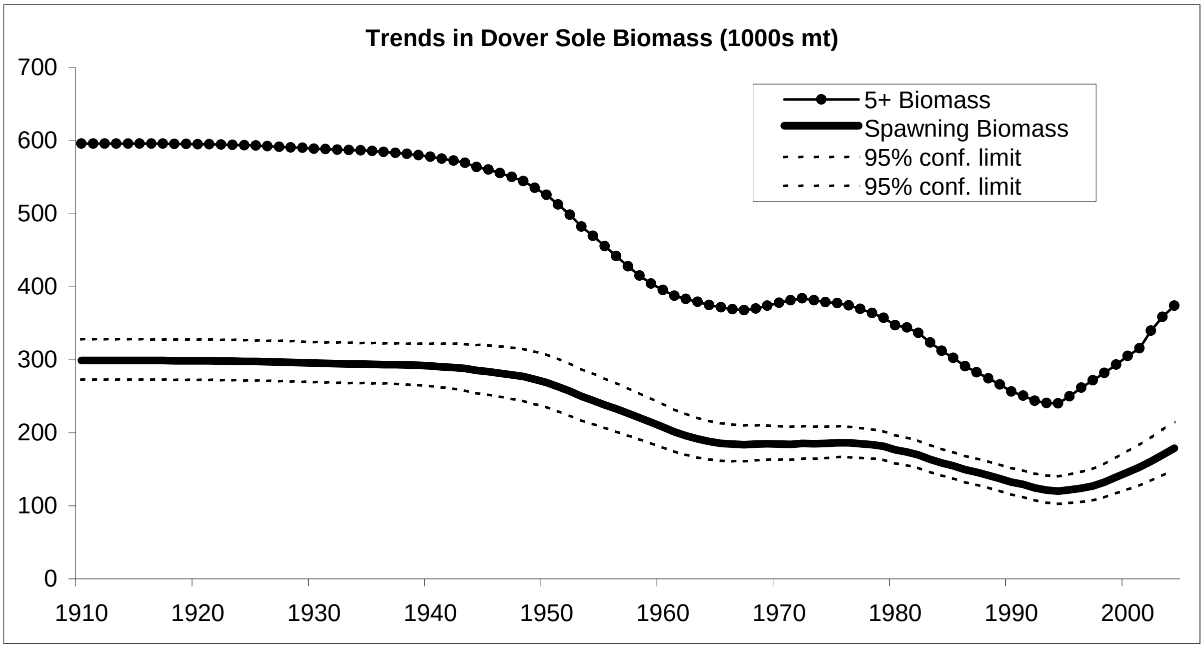
* Based on the current maturity schedule, which differs from the historic schedule.

Stock Biomass
The final base model estimated the unexploited spawning stock biomass to be slightly less than 300,000 mt and spawning biomass at the start of 2005 was estimated to be about 189,000 mt, equivalent to 63% of the unexploited level. Spawning biomass and age 5+ biomass (roughly corresponding to the exploitable biomass) were estimated to have reached their lowest points in the mid-1990s and have been rising steadily since.

Recent trends in Dover sole spawning biomass and depletion.

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ~~Spawning Biomass (1000s mt)~~ | ~~121.8~~ | ~~124.3~~ | ~~127.1~~ | ~~132.3~~ | ~~139.4~~ | ~~146.1~~ | ~~153.1~~ | ~~161.0~~ | ~~169.8~~ | ~~178.8~~ |
| ~~% of Virgin~~ | ~~40.7%~~ | ~~41.5%~~ | ~~42.5%~~ | ~~44.2%~~ | ~~46.6%~~ | ~~48.9%~~ | ~~51.2%~~ | ~~53.8%~~ | ~~56.8%~~ | ~~59.8%~~ |
| ~~Age 5+ Biomass (1000s mt)~~ | ~~250.1~~ | ~~262.0~~ | ~~272.1~~ | ~~282.0~~ | ~~293.2~~ | ~~305.1~~ | ~~316.0~~ | ~~339.8~~ | ~~358.9~~ | ~~374.2~~ |

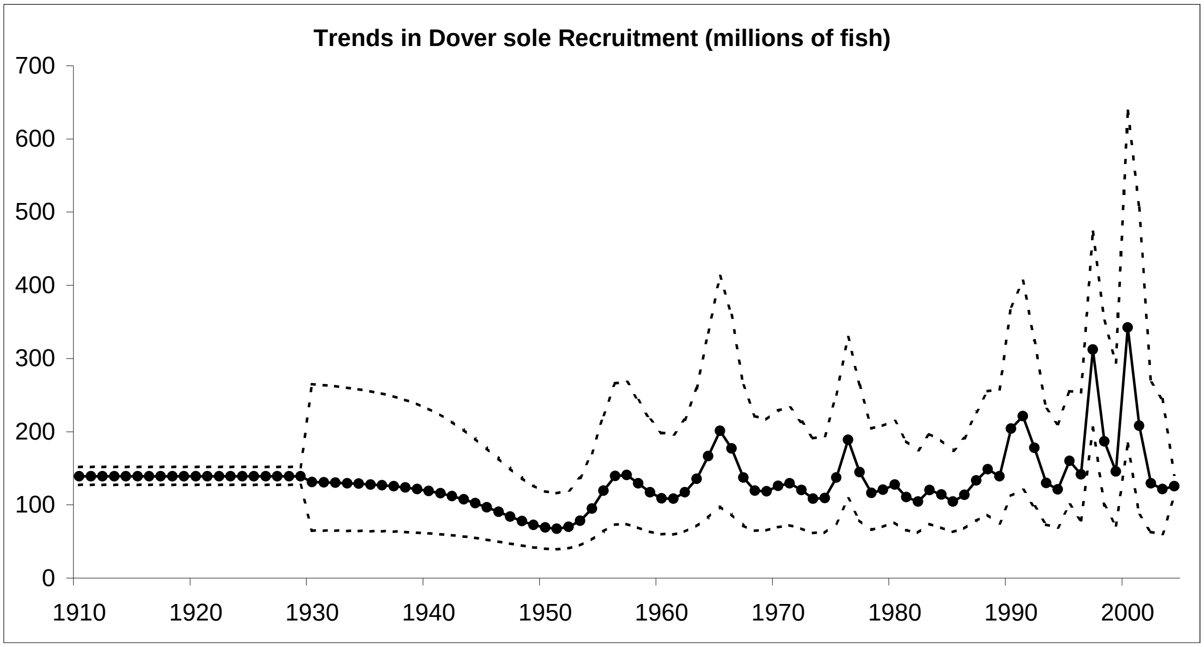


Recruitment

The estimated increases in biomass since the mid-1990s are due primarily to strong year classes in 1990 and 1991, and exceptionally strong year classes in 1997 and 2000.

Recent trends in Dover sole recruitment.

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Recruits (millions) | 159.9 | 141.6 | 312.0 | 186.6 | 145.6 | 342.5 | 208.1 | 129.4 | 121.4 | 125.4 |

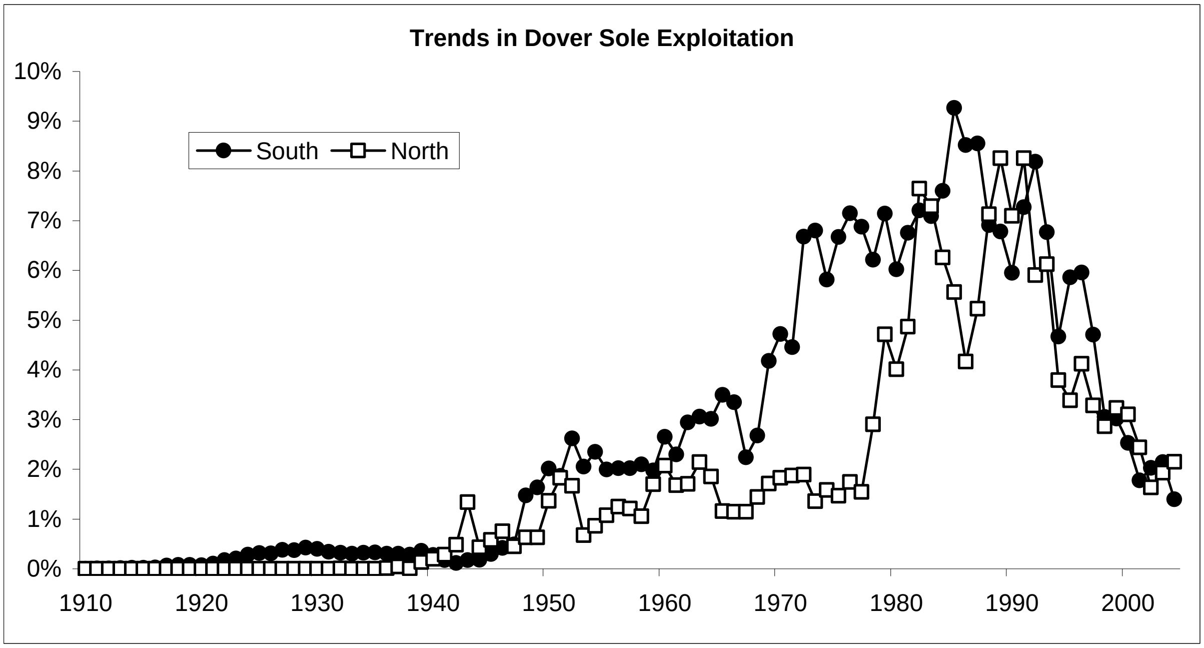



Exploitation Status

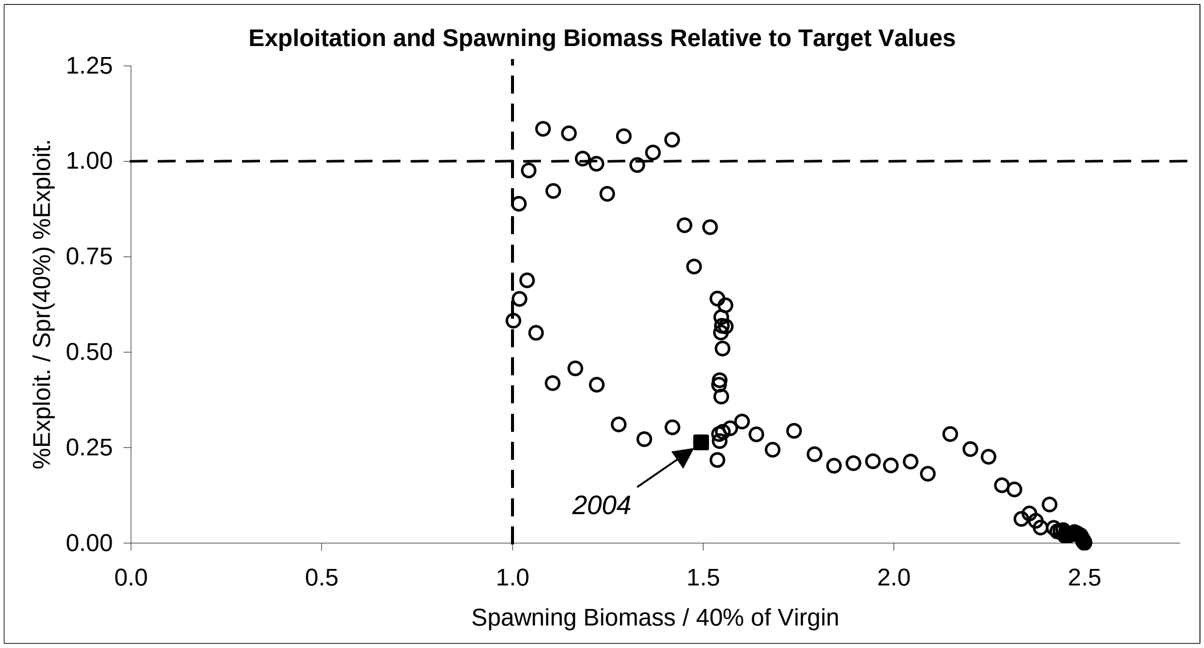
Exploitation of Dover sole was estimated to have reached a peak of 9.3% in 1985 in the southern fishery and a peak of 8.3% in 1991 in the northern fishery. In general, the exploitation rate has been relatively low.

Recent trends in Dover sole exploitation.

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| South | 5.86% | 5.95% | 4.71% | 3.05% | 3.02% | 2.53% | 1.78% | 2.03% | 2.15% | 1.40% |
| North | 3.39% | 4.12% | 3.28% | 2.86% | 3.23% | 3.11% | 2.44% | 1.64% | 1.93% | 2.15% |




Over the stock's history the exploitation rate has been smaller than the F40% target exploitation rate during all but six years and the spawning biomass has been well above 40% of the unexploited level, except during a few years when it approached the 40% level.




Management Performance

Based on the Dover sole landings statistics and the base model's estimates of discards, the coastwide catch of Dover sole was greater than the Acceptable Biological Catch (ABC) or Optimum Yield (OY) limits for three of ten years since 1995.

Management performance: ABCs versus landings and catch (mt).

| - | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| ABC (mt) | | | | | | | | | | - |
| US-Vancouver | 2400 | 1192[a] | 1195[b] | | | | | | | |
| Columbia | 3000 | 3000 | 3000 | 8373 | 8373 | 8373 | | | | |
| Eureka | 2900 | 2900 | 2900 | | | | | | | |
| Monterey | 5000 | 3764[c] | 3764[c] | | | | | | | |
| Conception | 1000 | 1000 | 1000 | 1053 | 1053 | 1053 | | | | |
| Coastwide | 14300 | 11855 | 11859 | 9426 | 9426 | 9426 | 8510 | 8510 | 8510 | 8510 |
| Coastwide OY | | | | | | | 7440 | 7440 | 7440 | 7440 |
| Landings | | | | | | | | | | |
| US-Vancouver | 1179 | 1459 | 996 | 897 | 1107 | 1261 | 1455 | 766 | 838 | 979 |
| Columbia | 2627 | 3515 | 3158 | 2976 | 3611 | 3553 | 2519 | 2031 | 2627 | 3079 |
| Eureka | 2405 | 2648 | 2113 | 2289 | 2226 | 2003 | 1499 | 1497 | 1955 | 1126 |
| Monterey | 3252 | 3242 | 2749 | 1276 | 1750 | 1704 | 1295 | 1719 | 1599 | 1246 |
| Conception | 1102 | 1322 | 1109 | 571 | 443 | 239 | 121 | 288 | 352 | 312 |
| Coastwide | 10565 | 12186 | 10124 | 8010 | 9137 | 8760 | 6889 | 6301 | 7372 | 6743 |
| Catch, including estimated discards | | | | | | | | | | - |
| Coastwide | 11744 | 13043 | 10861 | 8575 | 9738 | 9295 | 7292 | 6675 | 7815 | 7145 |

[a] The ABC was specified as a range of values, 818-1565 mt.
[b] The ABC was specified as a range of values, 820-1570 mt.
[c] The ABC was specified as a range of values, 3164-4363 mt.

Forecasts

Projections of future catches were made based on an F40% rate of fishing mortality and the following assumptions: total catches during 2005 and 2006 would be at the OY levels specified by the Council (total catch each year of 7440 mt); the selection and retention curves operating in the southern and northern fisheries would continue unchanged from the curves estimated for 2004; and the proportion of the catch taken each year by the southern fishery would be 47.2%. Because the projected spawning biomass was greater than 40% of SB(0), no there were no 40:10 harvest control rule adjustments and the OY values were all equivalent to the ABC values.

Forecasts of Optimum Yield catches, biomass, and depletion.

| - | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Catch (mt) | 7440 | 7440 | 30146 | 29960 | 29453 | 28582 | 27433 | 26159 | 24903 | 23757 |
| Spawning Biomass (1000s mt) | 189.0 | 199.9 | 211.4 | 211.4 | 210.0 | 206.8 | 202.2 | 196.5 | 190.4 | 184.2 |
| % of Virgin | 63.2% | 66.8% | 70.7% | 70.7% | 70.2% | 69.2% | 67.6% | 65.7% | 63.7% | 61.6% |

Decision Table

The decision table was developed using a format specified by the STAR Panel. Three alternative states of nature were defined in terms of the natural mortality coefficient: $M = 0.07^{-yr}$ for the pessimistic alternative state of nature and $M = 0.11^{-yr}$ for the optimistic alternative state of nature, with the base model ($M = 0.09^{-yr}$) as the intermediate alternative state of nature. Three alternative management actions were defined in terms of the stream of catches: a low catch series based on the recent average catches, a high catch series based on the projected F40% ABC values derived from the base model, and an intermediate catch series based on twice the recent average catches. The projections in the decision table were made using the same set of assumptions that were used in the harvest forecasts (above).

~~**Decision Table for Dover sole**~~

| Management Action | Year | Landings (mt) South (47.2%) | Landings (mt) North (52.8%) | M = 0.07 Less likely Low Stock Size Sp. Bio. (1000s mt) | M = 0.07 %Virgin | M = 0.09 More likely Base Model Sp. Bio. (1000s mt) | M = 0.09 %Virgin | M = 0.11 Less likely High Stock Size Sp. Bio. (1000s mt) | M = 0.11 %Virgin |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *State of Nature* | | | | | |
| | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% |
| | 2007 | 3402 | 3811 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% |
| | 2008 | 3402 | 3811 | 181.6 | 59.9% | 222.7 | 74.5% | 291.5 | 87.7% |
| **Low Catch** | 2009 | 3402 | 3811 | 190.7 | 62.9% | 233.0 | 77.9% | 303.4 | 91.3% |
| 2000-2004 | 2010 | 3402 | 3811 | 198.7 | 65.6% | 241.8 | 80.9% | 313.2 | 94.2% |
| Average | 2011 | 3402 | 3811 | 205.4 | 67.8% | 248.8 | 83.2% | 320.5 | 96.4% |
| | 2012 | 3402 | 3811 | 210.6 | 69.5% | 254.0 | 84.9% | 325.5 | 97.9% |
| | 2013 | 3402 | 3811 | 214.7 | 70.9% | 257.7 | 86.2% | 328.6 | 98.8% |
| | 2014 | 3402 | 3811 | 217.9 | 71.9% | 260.2 | 87.0% | 330.2 | 99.3% |
| | 2015 | 3402 | 3811 | 220.2 | 72.7% | 261.8 | 87.5% | 330.8 | 99.5% |
| | 2016 | 3402 | 3811 | 222.0 | 73.3% | 262.7 | 87.8% | 330.5 | 99.4% |
| | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% |
| | 2007 | 6803 | 7623 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% |
| | 2008 | 6803 | 7623 | 177.7 | 58.6% | 218.8 | 73.2% | 287.8 | 86.5% |
| **Medium Catch** | 2009 | 6803 | 7623 | 182.7 | 60.3% | 225.2 | 75.3% | 295.8 | 88.9% |
| Double the | 2010 | 6803 | 7623 | 186.4 | 61.5% | 229.9 | 76.9% | 301.6 | 90.7% |
| 2000-2004 | 2011 | 6803 | 7623 | 188.6 | 62.2% | 232.7 | 77.8% | 305.0 | 91.7% |
| Average | 2012 | 6803 | 7623 | 189.4 | 62.5% | 233.8 | 78.2% | 306.2 | 92.1% |
| | 2013 | 6803 | 7623 | 189.1 | 62.4% | 233.5 | 78.1% | 305.7 | 91.9% |
| | 2014 | 6803 | 7623 | 187.9 | 62.0% | 232.2 | 77.7% | 303.9 | 91.4% |
| | 2015 | 6803 | 7623 | 186.2 | 61.4% | 230.2 | 77.0% | 301.3 | 90.6% |
| | 2016 | 6803 | 7623 | 184.0 | 60.7% | 227.7 | 76.1% | 298.2 | 89.7% |
| | 2005 | 3298 | 3718 | 152.2 | 50.2% | 189.0 | 63.2% | 252.0 | 75.8% |
| | 2006 | 3301 | 3719 | 161.7 | 53.4% | 199.9 | 66.8% | 264.9 | 79.7% |
| | 2007 | 13572 | 14950 | 171.7 | 56.7% | 211.4 | 70.7% | 278.3 | 83.7% |
| | 2008 | 13529 | 14913 | 170.1 | 56.1% | 211.4 | 70.7% | 280.4 | 84.3% |
| **High Catch** | 2009 | 13353 | 14716 | 167.1 | 55.2% | 210.0 | 70.2% | 280.8 | 84.5% |
| OY for F40% | 2010 | 13009 | 14318 | 162.6 | 53.7% | 206.8 | 69.2% | 279.2 | 84.0% |
| Including | 2011 | 12523 | 13759 | 156.8 | 51.7% | 202.2 | 67.6% | 275.7 | 82.9% |
| any 40:10 | 2012 | 11959 | 13120 | 150.1 | 49.5% | 196.5 | 65.7% | 270.7 | 81.4% |
| Adjustment | 2013 | 11384 | 12482 | 143.1 | 47.2% | 190.4 | 63.7% | 265.0 | 79.7% |
| | 2014 | 10847 | 11899 | 136.2 | 44.9% | 184.2 | 61.6% | 259.1 | 77.9% |
| | 2015 | 10372 | 11394 | 129.6 | 42.8% | 178.3 | 59.6% | 253.3 | 76.2% |
| | 2016 | 9968 | 10970 | 123.3 | 40.7% | 172.8 | 57.8% | 248.0 | 74.6% |

Research and Data Needs

- The problem of model convergence to local extrema created major difficulties in this assessment because small changes in parameter values did not always produce coherent changes in the model results. Strategies are needed that will help analysts navigate irregular likelihood surfaces. Modification to the phasing used in SS2 seemed to offer a possible solution, but currently there is no theory and little experience to provide guidance on how to set the phasing.
- Data are needed on the length compositions of discarded Dover sole so that the retention function can be estimated more accurately and to help disentangle changes in selection from changes in retention.
- The West Coast Groundfish Observer Program data seemed to indicate large differences in discarding practices between northern and southern fishers, particularly regarding the mean weight of discarded fish compared to the weight of retained fish. These inconsistencies need to be more fully explored so that they can be plausibly modeled.
- In all of the slope surveys the female Dover sole in the Monterey region had a bimodal distribution in length with large numbers of big fish in deep water (500-699 fm). This unusual feature should be more fully explored so that it can be plausibly modeled. Genetic studies or chemical analysis of otoliths might indicate the source of the unusual abundance of these large females, which currently are a source of spawning biomass that is not adequately accounted for by the stock assessment model.
- For Dover sole the CV of length-at-age is not a linear function of length (Fig. 7) but is approximately a linear function of age. The SS2 software should be modified to allow the CV of length-at-age to be interpolated as a function of age instead of length.
- For Dover sole the two sexes seem to have different lengths for peak selection. The SS2 software should be modified to allow greater flexibility in modeling sex differences in selection.

Rebuilding Projections

The stock of Dover sole is estimated to be well above the overfished level. No rebuilding is required.

Regional Management Concerns

There is no genetic evidence to suggest that there are separate biological stocks of Dover sole off the US West Coast. Nor are there any important latitudinal differences in growth or maturity that could result in regional differences in productivity. Further, the current assessment results show that the northern and southern fisheries have similar patterns of selection and have produced very similar rates of exploitation. While there may be legitimate economic and equity reasons for regional apportionments of the Dover sole harvest, there does not appear to be any biological basis for such an apportionment.

**Summary Tables for Dover Sole.**

| - | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Catch (mt) | 11744 | 13043 | 10861 | 8575 | 9738 | 9295 | 7292 | 6675 | 7815 | 7145 | |
| Discards (model predicted) | 1179 | 857 | 737 | 564 | 600 | 535 | 402 | 374 | 443 | 403 | |
| Landings | 10565 | 12186 | 10124 | 8010 | 9137 | 8760 | 6889 | 6301 | 7372 | 6743 | |
| ABC | 14300 | 11855 | 11859 | 9426 | 9426 | 9426 | 8510 | 8510 | 8510 | 8510 | 8510 |
| OY | | | | | | | 7440 | 7440 | 7440 | 7440 | 7440 |
| SPR | 49.7% | 47.1% | 54.3% | 62.9% | 61.3% | 64.1% | 71.3% | 74.5% | 72.2% | 75.1% | |
| Exploitation Rate | 4.30% | 4.62% | 3.70% | 2.81% | 3.07% | 2.79% | 2.09% | 1.83% | 2.04% | 1.77% | |
| Age-5+ Biomass (mt) | 250105 | 261989 | 272062 | 282032 | 293224 | 305080 | 315954 | 339828 | 358927 | 374206 | 402584 |
| Spawning Biomass (mt) | 121839 | 124256 | 127093 | 132275 | 139363 | 146141 | 153056 | 161014 | 169794 | 178801 | 188987 |
| Lower 95% Conf. Limit | 103763 | 105427 | 107295 | 111280 | 117005 | 122359 | 127818 | 134265 | 141438 | 148717 | 157020 |
| Upper 95% Conf. Limit | 143063 | 146447 | 150545 | 157232 | 165994 | 174545 | 183277 | 193092 | 203835 | 214970 | 227462 |
| % of Virgin SB | 40.7% | 41.5% | 42.5% | 44.2% | 46.6% | 48.9% | 51.2% | 53.8% | 56.8% | 59.8% | 63.2% |
| Recruitment (1000s fish) | 159880 | 141640 | 312010 | 186630 | 145560 | 342480 | 208060 | 129370 | 121410 | 125400 | 126120 |
| Lower 95% Conf. Limit | 100168 | 79032 | 205696 | 99057 | 71950 | 183761 | 85596 | 62767 | 60266 | 111330 | 62220 |
| Upper 95% Conf. Limit | 255188 | 253845 | 473272 | 351624 | 294478 | 638288 | 505735 | 266645 | 244588 | 141249 | 255643 |

| | | 95% Conf. Limits | |
|---|---|---|---|
| - | Estimate | Lower | Upper |
| Unfished Spawning Biomass | 299054 | 272724 | 327926 |
| Unfished Age-5+ Biomass | 596145 | | |
| Unfished Recruitment | 138970 | 127149 | 151890 |
| Spawning Biomass at MSY * | 117281 | | |
| Basis for SB(MSY) | F(40%) | | |
| SPR(MSY) | 40% | | |
| Exploitation for SPR(MSY) * | 6.72% | | |
| MSY * | 16504.9 | - | - |

* Based on the current maturity schedule, which differs from the historic schedule.

Appendix E: History of STAR process

In 1995 and earlier years, stock assessments were examined at a very early stage during *ad hoc* stock assessment review meetings (one per year). SSC and GMT members often participated in these meetings and provided additional review of completed stock assessments during regular Council meetings. There were no terms of reference or meeting reports from the *ad hoc* meetings. NMFS provided leadership and coordination by setting up meetings. Each agency or Council paid their own travel costs. Council staff distributed meeting announcements and some background documents. The Council paid for publication of assessments as appendices to the annual Stock Assessment and Fishery Evaluation (SAFE) document.

A key event occurred in July 1995 when NMFS convened an independent, external review of West Coast groundfish assessments.[1] The report concluded that: 1) uncertainties associated with assessment advice were understated; 2) technical review of groundfish assessments should be more structured and involve more outside peers; and 3) the distinction between scientific advice and management decisions was blurred. Work to develop a process to review groundfish stock assessments was aimed at resolving these problems.

For 1996, the groundfish stock assessment review process was expanded to include: 1) terms of reference for the review meeting; 2) an outline for the contents of stock assessments; 3) external anonymous reviews of previous assessments; and 4) a review meeting report.[2] Plans were developed during March and April Council meetings and NMFS convened a week long review meeting in Newport, Oregon where preliminary groundfish stock assessments were discussed. The expanded process itself was reviewed by the Council family at an evaluation meeting at the end of the year. Leadership and planning responsibilities were shared by the SSC Groundfish Subcommittee, NMFS, GMT, GAP, and persons who participated in planning discussions during the March and April Council meetings. There was no formal coordination except for the review meeting terms of reference, organization of the review meeting by NMFS, and as provided by Council staff for publication of documents. Costs were shared as in previous years.

The review process for 1997 was further expanded based on a planning meeting in December 1996.[3] It was agreed that agencies (including NMFS and state agencies) conducting stock assessments were responsible for making sure assessments were technically sound and adequately reviewed. A Council-oriented review process was developed that included agencies, the GMT, GAP, and other interested members of the Council family. The process was jointly funded by the Council and NMFS, with NMFS hosting the Stock Assessment Review (STAR) Panel meetings and paying the travel expenses of the external reviewers, and the Council paying for travel expenses of the GAP representative and non-federal GMT and SSC members.

The process for 1997 included: 1) goals and objectives; 2) three STAR Panels, including external membership; 3) terms of reference for STAR Panels; 4) terms of reference for Stock Assessment (STAT) Teams; 5) a refined outline for stock assessments; 6) external anonymous reviews; 7) a clearer distinction between science and management; and 8) a calendar of events with clear deliverables, dates and well defined responsibilities. For the first time, STAR Panels and STAT Teams were asked to provide

[1] Anon. 1995. West coast groundfish assessments review, August 4, 1995. Pacific Fishery Management Council. Portland, OR.

[2] Brodziak, J., R. Conser, L. Jacobson, T. Jagielo, and G. Sylvia. 1996. Groundfish stock assessment review meeting - June 3-7, 1996 in Newport, Oregon. *In*: Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997. Pacific Fisheries Management Council. Portland, OR.

[3] Meeting Report, Proposals and Plans for Groundfish Stock Assessment and Reviews During 1997 (May 8, 1997). Pacific Fishery Management Council, 2130 SW Fifth Avenue, Suite 224, Portland, OR 97201.

"decision table" analyses of the effects of uncertain management actions and to provide information required by the GMT in choosing harvest strategies. In addition, STAR Panels were asked to prepare "Stock Summaries" that described the essential elements of stock assessment results in a concise, simple format.

At the end of 1997, participants met to discuss events and make recommendations for 1998.[4] Participants concluded that objectives were, to varying degrees, achieved during 1997. A notable shortfall was in "increasing acceptance and understanding by all members of the Council family." The most significant issues seemed to be the nature of the STAR Panels' responsibilities, communicating uncertainty to decision makers, workload, and inexperience in conducting the review process.

In retrospect, there was no formal coordination and leadership except for the terms of reference and the calendar. As in previous years, Council staff coordinated distribution of meeting announcements and distribution of documents. Costs increased substantially due to travel for external experts, increased number of review meetings (three instead of one), and distribution of larger and additional reports. NMFS paid travel and other costs for external members of STAR Panels. Other costs were distributed as in 1996. It was not possible for the Council to copy and distribute all of the stock assessments because of limited funds.

In 1998, the stock assessment process was similar to that in 1997, including the 8 elements listed above. In November, a joint session of the SSC, GMT, and GAP was held to review events in 1998 and make recommendations for 1999. Several topics were discussed, including policy issues related to the 1998 terms of reference and operational issues related to how the terms of reference were implemented in 1998. This meeting produced a list of recommended changes for 1999, including:

•increasing the SSC's involvement in the process;
•clarify/modify the participant roles;
•limit the number of assessments, especially the difficulty caused by the late addition of assessments (e.g., sablefish and shortspine thornyhead in 1998);
•increase the involvement of external participants;
•timeliness in completing and submitting assessments; and
•duration of STAR Panel meetings, and the time required to adequately reviewing assessments.

Accordingly, the terms of reference were amended to include a cut-off date of November by which anyone proposing to present an assessment for review in the following year must notify the stock assessment coordinator. This change will ensure there is adequate time for formation and planning of STAR Panel meetings. The terms of reference were also changed to clarify the SSC's role in the process as "editor" and "arbiter;" the SSC will hear reports from all STAR Panels at its September meeting and will be involved in any unresolved issues between the STAT Teams, STAR Panels, or the GMT. Other issues were raised that had no quick solutions, such as how to incorporate socioeconomic information into the process, and how to present the decision tables to GMT and Council members.

Other than the changes noted above, the 1999 STAR process was similar to 1997 and 1998. As in previous years, a joint meeting of the SSC, GAP, and GMT was convened to review and evaluate the stock assessment process and to recommend modifications for 2000. There were relatively few concerns about the process in 1999, and they centered mainly on the difficulty of recruiting sufficient (external and internal) reviewers. Participants did not recommend departing from the current terms of reference

[4] Jacobson, L.D. (ed.). 1997. Comments, issues and suggestions arising from the groundfish stock assessment and review process during 1997. Report to the Pacific Fishery Management Council (Revised Supplemental Attachment B.9.b, November 1997).

regarding STAR panel composition, although they seemed to regard it more as a goal than a strict requirement. A notable continuing concern was the timeliness of STAT team reports prior to the STAR panel meetings.

Requirements for stock rebuilding analyses and monitoring of rebuilding progress and their relationship to the STAR process were also discussed. The group agreed that the terms of reference should be modified to require additional values (e.g., $B_{msy}$) be tabulated and included in STAT Team report related to an overfished species. There was general agreement that the STAR process should be used to review assessments of overfished species, which are still likely to be on a 3-year cycle. However, the STAR process is not the appropriate process for the "monitoring" reports (required every 2 years), when they are out of phase with the assessment cycle.
Additionally, it was agreed that certain additional values should be consistently tabulated in the STAT team report in order to build a long-term computerized database of key parameters. The group noted that this would not impose additional work for the STAT team, but would simply require these values to be reported consistently.

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The 2000 STAR process was reviewed during a joint meeting of the GAP, GMT, and SSC at the November 2000 meeting. There were relatively few recommendations for improvement to the terms of reference for 2001, although concerns about the long-term future for the STAR process were raised. It was agreed that the future of the STAR process would be evaluated during 2001, but the STAR process in 2001 would proceed similarly to past years. For the 2001 STAR process, participants at the review meeting recommended that greater efforts be made to produce and distribute documents in a timely manner and to assure their completeness and consistency with the terms of reference. In addition, the SSC agreed that its groundfish subcommittee would meet in concert with the GMT during the August 2001 meeting to identify issues, if any, with the assessments or STAR panel reviews that may require additional consideration by the SSC.

At the March 2001 PFMC meeting, the SSC provided recommendations for integrating rebuilding analyses and reviews into the STAR process for 2001.

Agenda Item F.2.c
Supplemental Attachment 2
March 2008

# DRAFT
# SSC Terms of Reference for Groundfish Rebuilding Analysis

## Draft Revised Version
## (xx March 2008)

Note: This version of the Terms of Reference does not include any changes that might be needed owing to the implementation of ACLs, as how ACLs will be implemented is current not known.

# Table of Comments

# 1. Introduction

Amendment 11 to the Groundfish Fishery Management Plan (FMP) established a harvest control rule for determining optimum yields (OY). The 40:10 policy was designed to prevent stocks from falling into an overfished condition. Part of the amendment established a default overfished threshold equal to 25% of the unexploited population size[1] ($B_0$). By definition, groundfish stocks falling below that level are designed to be in an overfished state ($B_{25\%} = 0.25 \times B_0$[2]). To prevent stocks from deteriorating to that point, the policy specified a precautionary threshold equivalent to 40% of $B_0$. the policy requires that OY, when expressed as a fraction of the allowable biological catch (ABC), be progressively reduced at stock sizes less than $B_{40\%}$. Because of this linkage, $B_{40\%}$ has sometimes been interpreted to be a proxy measure of $B_{MSY}$, i.e., the stock biomass that results when a stock is fished at $F_{MSY}$. In fact, theoretical results support the view that a robust biomass-based harvesting strategy would be to simply maintain stock size at about 40% of the unfished level (Clark 1991, 2002). In the absence of a credible estimate of $B_{MSY}$, which can be very difficult to estimate (MacCall and Ralston 2002), $B_{40\%}$ is a suitable proxy to use as a rebuilding target.

Under the Magnuson-Stevens Act (MSA), it is required that rebuilding plans need to be developed for stocks that have been designated to be in an overfished state. Amendment 12 of the Groundfish FMP provided a framework within which rebuilding plans for overfished groundfish resources could be established. Amendment 12 was challenged in Federal District Court and found not to comply with the requirements of the MSA because rebuilding plans did not take the form of an FMP, FMP amendment, or regulation. In response to this finding, the Council developed Amendment 16-1 to the Groundfish FMP which covered three issues, one of which was the form and content of rebuilding plans.

The Council approach to rebuilding depleted groundfish species, as described in rebuilding plans, was re-evaluated and adjusted under Amendment 16-4 in 2006 so they would be consistent with a recent opinion rendered by the Ninth Circuit Court of Appeals in *Natural Resources Defense Council, Inc. and Oceana, Inc.* v. *National Marine Fisheries Service, et al.*, 421 F.3d 872 (9th Cir. 2005), and with National Standard 1 of the MSA. The court affirmed the MSA mandate that rebuilding periods "be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the

[1] The absolute abundance of the mature portion of a stock is loosely referred to here in a variety of ways, including: population size, stock biomass, stock size, spawning stock size, spawning biomass, spawning output; i.e., the language used in this document is sometimes inconsistent and/or imprecise. However, the best fundamental measure of population abundance to use when establishing a relationship with recruitment is spawning output, defined as the total annual output of eggs (or larvae in the case of live-bearing species). Although spawning biomass is often used as a surrogate measure of spawning output, for a variety of reasons a non-linear relationship often exists between these two quantities (Rothschild and Fogarty 1989; Marshall *et al*. 1998). Spawning output should, therefore, be used to measure the size of the mature stock when possible.

[2] Estimates of stock status are typically obtained by fitting statistical models of stock dynamics to survey and fishery data. In recent years, the bulk of stock status determinations have been based on Stock Synthesis II, an age- and size-structured population dynamics model (Methot 2005, 2007). Stock assessment models can be fitted using Maximum Likelihood or Bayesian methods. For both types of estimation methods, a stock is considered to be in an overfished state if the best point estimate of stock size is less than 25% of unfished stock size. This corresponds to the maximum likelihood estimate for estimation methods based on Maximum Likelihood methods, and the maximum of the posterior distribution (MPD) for estimation methods based on Bayesian methods or those in which penalties are added to the likelihood function.

overfished stock of fish within the marine ecosystem" (Section 304(e)). The court opinion also recognized that some harvest of overfished species could be accommodated under rebuilding plans to avoid disastrous economic impacts to west coast fishing communities dependent on groundfish fishing. This harvest can only be incidental and unavoidable in fisheries targeting healthy stocks and, under Amendment 16-4 rebuilding plans, more emphasis was placed on shorter rebuilding times and the trade-off between rebuilding periods and associated socioeconomic effects.

Rebuilding Plans include several components, one of which is a rebuilding analysis. Simply put, a rebuilding analysis involves projecting the status of the overfished resource into the future under a variety of alternative harvest strategies to determine the probability of recovery to $B_{\mathrm{MSY}}$ (or its proxy $B_{40\%}$) within a pre-specified time-frame.

## 2. Overview of the Calculations Involved in a Rebuilding Analysis

This document presents guidelines for conducting a basic groundfish rebuilding analysis that meets the minimum requirements that have been established by the Council's Scientific and Statistical Committee (SSC), those of Amendment 16-1 of the Groundfish FMP, and those arising from the 9th Circuit decision. It also outlines the appropriate documentation that a rebuilding analysis needs to include. These basic calculations and reporting requirements are essential elements in all rebuilding analyses to provide a standard set of base-case computations, which can then be used to compare and standardize rebuilding analyses among stocks. The steps when conducting a rebuilding analysis are:

1. Estimation of $B_0$ (and hence $B_{\mathrm{MSY}}$ or its proxy).
2. Selection of a method to generate future recruitment.
3. Specification of the mean generation time.
4. Calculation of the minimum possible rebuilding time, $T_{\mathrm{MIN}}$.
5. Identification and analysis of alternative harvest strategies and rebuilding times.

The specifications in this document have been implemented in a computer package developed by Dr André Punt (University of Washington). This package can be used to perform rebuilding analyses for routine situations. However, the SSC encourages analysts to explore alternative calculations and projections that may more accurately capture uncertainties in stock rebuilding than the standards identified in this document, and which may better represent stock-specific concerns. In the event of a discrepancy between the generic calculations presented here and a stock-specific result developed by an individual analyst, the SSC groundfish subcommittee will review the issue and recommend which results to use.

The SSC also encourages explicit consideration of uncertainty in projections of stock rebuilding, including comparisons of alternative harvest strategies using decision tables to quantify the impact of model uncertainty (see Section 8 below).

## 3. Estimation of $B_0$

$B_0$ can be estimated from the fit of some form of spawner-recruit model or empirically using the estimates of recruitment from the stock assessment. Most of the recent assessments of west coast groundfish have been based on stock assessments that integrate the estimation of the spawner-recruit model with the estimation of other population dynamic parameters. These stock assessments therefore link the recruitments for the early years of the assessment period with the average recruitment corresponding to $B_0$. Estimates of $B_0$ from empirical methods will not be the same as those estimated as an embedded parameter within an assessment model. As a result, the estimate of $B_0$ from the stock assessment model should be the default for the $B_0$ used in rebuilding analyses when the stock assessment integrates the spawner-recruit model. Justification for the use an empirical estimate of $B_0$ is therefore needed when a direct estimate of $B_0$ is available from a stock assessment model, and the difference in $B_0$ estimates must also be documented. Stock assessment models which integrate the estimation of the spawner-recruit model also provide estimates of $B_{MSY}$. However, at this time, the SSC recommends that these estimates not be used as the target for rebuilding. Rather, the rebuilding target should be taken to be $0.4B_0$ in all cases.

For the purpose of estimating $B_0$ empirically, analysts should select a sequence of years, within which recruitment is believed to be reasonably representative of the natality from an unfished stock. The average recruitment for these years can then be multiplied by the spawning output-per-recruit in an unfished state (which depends on growth, maturity, fecundity and natural mortality) to estimate equilibrium unfished spawning output. In selecting the appropriate sequence of years, analysts have generally utilized years in which stock size was relatively large, in recognition of the paradigm that groundfish recruitment is positively correlated with spawning stock size (Myers and Barrowman 1996). Moreover, due to the temporal history of exploitation in the West Coast groundfish fishery (see Williams 2002), this has typically led to consideration of the early years from an assessment model[3]. Thus, for example, in the case of widow rockfish, the time period within which recruitments were selected when estimating $B_0$ was 1958-62 (He *et al*. 2003).

An alternative view of the recruitment process is that it depends to a much greater degree on the environment than on adult stock size. For example, the decadal-scale regime shift that occurred in 1977 (Trenberth and Hurrell 1994) is known to have strongly affected ecosystem productivity and function in both the California Current and the northeast Pacific Ocean (Roemmich and McGowan 1995; MacCall 1996; Francis *et al*. 1998; Hare *et al*. 1999). With the warming that ensued, west coast rockfish recruitment appears to have been adversely affected (Ainley *et al*. 1993; Ralston and Howard 1995). Thus, if recruitment was environmentally forced, it would be more sensible to use the full time series of recruitments from the stock assessment model to estimate $B_0$. These two explanatory factors are highly confounded for west coast groundfish, i.e., generally high biomass/favourable conditions prior to 1980 and low biomass/unfavourable conditions thereafter. Using all recruitments to estimate $B_0$ will therefore usually result in a lower value of $B_0$ (and hence target spawning output) than when an abbreviated series of recruitments is taken from early in the time series.

There is no incontrovertible evidence to favour one of these two hypotheses over the other. For example, both theoretical and observational considerations support the belief that groundfish recruitment will decline with spawning output (e.g., Myers and Barrowman 1996; Brodziak *et al*.

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[3] Individual recruitments estimated from age-structured stock assessment models do not all exhibit the same precision or accuracy. Recruitments estimated at the very beginning of the modeled time period may suffer from mis-specification of the initial condition of the population (e.g., an assumed equilibrium age structure). Likewise, recruitments estimated at the end of the sequence may be imprecise due to partial recruitment of recent year classes. Thus, it may be advisable to trim the beginning and/or ending years classes to address this problem

2001). On the other hand, recent advances in our understanding of the North Pacific Ocean indicate that profound changes have occurred in the marine ecosystem since the turn of the century (PICES 2005). In fact, a strong argument can be made that the effects of environmental and density-dependent factors on the spawner-recruit relationship are additive (e.g., Jacobson and MacCall 1995), which may allow us to quantitatively determine the relative importance of these two factors in the future.

For each of these two empirical methods of estimating $B_0$, the actual distribution for $B_0$ can be approximated by re-sampling recruitments, from which the probability of observing any particular stock biomass can obtained. This approach was taken in the original bocaccio rebuilding analysis (MacCall 1999), where it was concluded that the first year biomass was unlikely to have occurred if the entire sequence of recruitments were used to determine $B_0$.

# 4. Selection of a Method to Generate Future Recruitment

On can project the population forward once the method for generating future recruitment has been specified, given the current state of the population from the most recent stock assessment (terminal year estimates of numbers at age and their variances) and the rebuilding target. There are several ways of generating future recruitment, but they fundamentally reduce to two basic kinds of approaches. These are: (1) base future recruitments on an empirical evaluation of spawner-recruit estimates and (2) use the results of a fitted spawner-recruit model (e.g., the Beverton-Holt or Ricker curves). To date, rebuilding analyses have been conducted using both approaches and both are acceptable, as long as due consideration is given to the advantages and disadvantages of both. Ideally, reference points (e.g., $B_0$, $B_{\mathrm{MSY}}$ and $F_{\mathrm{MSY}}$) and the results from projections should be compared to better assess the actual extent of uncertainty associated with these quantities.

### 4.1 Fitting a Spawner-Recruit Model

It is possible generate future recruitments by fitting spawner-recruit models to the full time series of spawner-recruit data. SS2-based assessments all assume a structural spawner-recruit model, either estimating or pre-specifying the steepness of the curve[4]. Ideally, the use of spawner-recruit models allows the data (or prior information) to determine the extent of compensation rather than assuming either one of two extremes (constant recruitment or constant recruits/spawner), and is also more internally consistent if the original assessment assumed a particular form of spawner-recruit model. However, this approach can be criticized because stock productivity is constrained to behave in a pre-specified manner according to the particular spawner-recruit model chosen, and there are different models to choose from, including the Beverton-Holt and Ricker formulations. These two models can produce very different reference points, but are seldom distinguishable statistically. Moreover, there are statistical issues when a spawner-recruit model is estimated after the assessment is conducted, including: (1) time-series bias (Walters 1985), (2) the "errors in variables problem" (Walters and Ludwig 1981), and (3) non-homogeneous variance and small sample bias (MacCall and Ralston 2002). Thus, analyses based on a spawner-recruit model should include a discussion of the rationale for the selection of the spawner-recruit model used (e.g. estimated within the assessment model, estimated outside of the model based on

[4] The "steepness" of a spawner-recruit curve is related to the slope at the origin and is a measure of a stock's productive capacity. It typically is expressed as the proportion of virgin recruitment that remains when a stock has been reduced to $B_{20\%}$.

the estimates of spawning output and recruitment), and refer to the estimation problems highlighted above and whether they are likely to be relevant and substantial for the case under consideration. In situations where steepness is based on a spawner-recruit meta-analysis (e.g., Dorn 2002), the reliability of the resulting relationship should be discussed.

### 4.2 Empirical Approaches

There are two ways to use empirical estimates of recruitment from a stock assessment to generate future recruitment, both of which utilize estimates at the tail end of the time series (i.e., the most recent estimates). These two methods have formed the basis of a number of rebuilding analyses that have been accepted by the SSC.

(1) Recent recruitment is standardized to the amount of the spawning output (recruits-per-spawner, $R/S_i$). Annual $R/S_i$ is then randomly re-sampled and multiplied by $S_i$ to obtain year-specific stochastic values of $R_i$.
(2) Recent recruitments are randomly re-sampled to determine the year-specific stochastic values of $R_i$.

Note that use of $R/S_i$ as the basis for projecting the population forward ties recruitment values in a directly proportional manner to spawning output; if spawning output doubles, resulting recruitment will also double, all other things being equal. As the stock rebuilds, this becomes an increasingly untenable assumption because there is no reduction in reproductive success at very high stock sizes, which is to say there is no compensation (i.e., steepness = 0.2). In contrast, re-sampling $R_i$ values, results in errors in the opposite direction. Namely, recruitment does not increase as stock size increases as would be expected of most rebuilding stocks. This type of calculation effectively implies perfect compensation (i.e., steepness = 1). Thus, these two ways of projecting the population forward (using re-sampled $R_i$ or re-sampled $R/S_i$) includes a range of alternatives that is likely to encompass the real world.

In the absence of any other information, rebuilding projections based on re-sampling recruits-per-spawner are generally to be favoured over projections based resampling recruitment because stocks that have declined into an overfished condition are more likely to be unproductive (i.e., low steepness). Note that the implied of lack of compensation in rebuilding projections using this method is not likely to be a serious liability over the long term because it is based on re-sampling recent recruits-per-spawner. The set of $R/S_i$ values used to generate future recruitment will be revised based on a new set of recent recruitments obtained from the latest stock assessment as progress toward rebuilding is evaluated in the future. The $R/S_i$ series will tend to a lower mean value if the stock actually demonstrates a compensatory response during the course of rebuilding. Although projections based on resampling $R/S_i$ represents a logical standard procedure, projections that resample absolute recruitment ($R_i$) would be quite useful in establishing the overall uncertainty in the rebuilding analysis by providing an alternative approach. Moreover, a credible argument that a stock is relatively productive, as evidenced perhaps by observed high recruitment at low spawning output, may serve as a basis for favouring projections that utilize recent absolute recruitments.

## 5. Determination of the Minimum and Maximum Times to Recovery

The minimum time to recovery (denoted $T_{MIN}$) is defined as the median time for a stock to recover to the target stock size, starting from the time when a rebuilding plan was actually implemented (usually the year after the stock was declared overfished) to when the target level is first achieved, assuming no fishing occurs. Next, the mean generation time should be calculated as the mean age of the net maturity function. A complication that can occur in the calculation of mean generation time, as well as $B_0$ (see above), is when growth and/or reproduction have changed over time. In such instances, the parameters governing these biological processes should typically be fixed at their most recent, contemporary, values, as this best reflects the intent of "current environmental conditions" as stated in the NOAA Fisheries National Standard Guidelines. Exceptions may occur if there are good reasons for an alternative specification (e.g., using growth and maturity schedules that are characteristic of a stock that is close to $B_{MSY}$).

Although no longer used directly in Council decision-making for overfished stocks, rebuilding analyses should report the maximum time to recovery (denoted $T_{MAX}$). $T_{MAX}$ is ten years if $T_{MIN}$ is less than 10 years. If $T_{MIN}$ is greater than or equal to 10 years, $T_{MAX}$ is equal to $T_{MIN}$ plus one mean generation. Likewise, rebuilding analyses should report an estimate of the median number of years needed to rebuild to the target stock size if all future fishing mortality is eliminated from the first year for which the Council is making a decision about[5] ($T_{F=0}$). This will typically differ from $T_{MIN}$.

Finally, when a stock rebuilding plan has been implemented for some time and recruitments have been estimated from an assessment, it may be that explicit, year-specific estimates of recruitment are available for the earliest years of the rebuilding time period. In such instances, rebuilding forecasts should be conducted using actual "realized" recruitments for years for which they are available, rather than through re-sampling methods (see above). The manner in which this is achieved will depend on how future recruitments are generated in the rebuilding analysis: (1) use the absolute recruitments if recent recruitments are re-sampled, (2) use the $R / S_i$ values for each year multiplied by the projected $S_i$ if recruits-per-spawner are re-sampled, and (3) use the recruitment deviation for each year if future recruitment is generated from a spawner-recruit model.

## 6. Harvest During Rebuilding

The Council is required to rebuild overfished stocks in a time period that is as short as possible, but can extend this period to take the needs of fishing communities into account. The simplest rebuilding harvest strategy to simulate and implement is a constant harvest rate or "fixed F" policy. All rebuilding analyses should, therefore, consider fixed F strategies. Other strategies are possible, including constant catch and phase-in strategies, in which the catch reductions are phased-in before the OYs transition to a fixed F strategy. In these latter cases, analysts should always assess whether fishing mortality rates exceed $F_{MSY}$ (or its proxy), as this would constitute overfishing.

[5] This year will generally not be the current year, but rather the year following the current two-year cycle.

Analysts should consider a broad range of policy alternatives to give the Council sufficient scope on which to base a decision. The following represent a minimum set of harvest policies that should be reported:

1. The spawning potential ratio[6] listed in the Rebuilding Plan in the FMP (Amendment 16-4 for the stocks that are currently overfished) [only stocks already under rebuilding plans].
2. The spawning potential ratio corresponding to the optimum yields in place for the most current year (or biennium) [only stocks already rebuilding plans].
3. The spawning potential ratio on which the current optimum yields were based [only stock already rebuilding plans; this spawning potential ratio will differ from 2) if the stock assessment has changed substantially since the last assessment].
4. The spawning potential ratio which will rebuild the stock to the target level with 0.5 probability by the $T_{\mathrm{TARGET}}$ specified in the FMP [only stocks already under rebuilding plans].
5. The spawning potential ratio which will rebuild the stock to the target level with 0.5 probability by the $T_{\mathrm{MAX}}$ specified in the FMP [only stocks already under rebuilding plans].
6. The spawning potential ratio which will rebuild the stock to the target level with 0.5 probability by the $T_{\mathrm{MAX}}$ calculated using the most recent biological and fishery information.
7. The ABC and 40:10 control rules.
8. No harvest.
9. Spawning potential ratios which achieve recovery to the target level with 0.5 probability for years between $T_{\mathrm{F=0}}$ and $T_{\mathrm{MAX}}$. These spawning potential ratios should be selected by calculating the median rebuilding times under the most conservative rebuilding strategy (i.e, $T_{\mathrm{F=0}}$) and the most liberal, allowable rebuilding strategy (i.e. $T_{\mathrm{MAX}}$) and then selecting intermediate time intervals in even quartile increments. That is, if $T_{\mathrm{F=0}}$ is 20 years and $T_{\mathrm{MAX}}$ = 60 years, then the intermediate alternatives would have rebuilding times of 30, 40 and 50 years, respectively.

These polices should be implemented within the projection calculations in the year for which the Council is making a decision. For example, for assessments conducted in 2007 (using data up to 2006), the harvest decisions pertain to OYs for 2009 and 2010. In this case, the catches for 2007 and 2008 should be set to the OYs established by the Council for those years.

Many other harvest policies could be implemented by the Council, based on whatever circumstances may mitigate against a constant harvest rate approach. Consequently, analysts should be prepared to respond to requests by the Council for stock-specific projections on an individual case-by-case basis.

# 7. Evaluating Progress Towards Rebuilding

There are, at present, no agreed criteria for assessing the adequacy of the progress towards rebuilding for species that are designated to be in an overfished state and are under a Rebuilding Plan. The SSC currently reviews each stock on a case-by-case basis, considering the following

[6] The Spawning Potential Ratio (SPR) is a measure of the expected spawning output-per-recruit, given a particular fishing mortality rate and the stock's biological characteristics, i.e., there is a direct mapping of SPR to *F* (and *vice versa*). SPR can therefore be converted into a specific fishing mortality rate in order to calculate OYs.

two questions: (1) have cumulative catches during the period of rebuilding exceeded the cumulative OY that was available, and (2) what is the difference between the year in which recovery is predicted to occur under the current SPR ($T_{\text{REBUILD}}$) and the current adopted $T_{\text{TARGET}}$? If the difference between $T_{\text{REBUILD}}$ and $T_{\text{TARGEST}}$ is minor, progress towards rebuilding will be considered to be adequate. In contrast, if the difference between $T_{\text{REBUILD}}$ and $T_{\text{TARGET}}$ is major, it will be necessary to define a new $T_{\text{TARGET}}$. As an initial step in this direction, a new maximum time to rebuild $T_{MAX}^{N}$ will be computed based on the specifications outlined in Section 5. Analysts will be asked to assess whether the currently adopted SPR will readily rebuild the stock before $T_{MAX}^{N}$.

Adequacy of progress will be evaluated when the SSC groundfish subcommittee reviews the draft rebuilding plans. Analysts should provide the information needed to address the two questions. If the SSC agrees that progress is not sufficient, the draft rebuilding analysis documents will need to be updated to include $T_{MAX}^{N}$ and the likelihood that the currently adopted harvest rate (SPR) will rebuild the stock before $T_{MAX}^{N}$.

# 8. Decision Analyses / Considering Uncertainty

The calculation of $T_{\text{MIN}}$ and the evaluation of alternative harvest strategies involves projecting the population ahead taking account of uncertainty about future recruitment. There are several reasons for considering model and parameter uncertainty when conducting a rebuilding analysis. For example, if several assessment model scenarios were considered equally plausible by the assessment authors or, alternatively, one model was preferred by the assessment authors and another was preferred by the STAR Panel.

The uncertainty associated other parameters, such as the rate of natural mortality and the current age-structure of the population, can also be taken into account. This can be achieved in a variety of ways. For example, if the uncertainty relates the parameters within one structural model, this uncertainty can be reflected by basing projections on a number of samples from a distribution which reflects this uncertainty (such as a Bayesian posterior distribution or bootstrap samples). Alternatively, projections can be conducted for each model and the results appropriately weighted when producing the final combined results if the uncertainty pertains to alternative structural models.

A decision table is an appropriate means to express the implications of uncertainty in model structure when an “integrated” approach, as outlined in the previous paragraph, is not adopted. Construction of decision tables when projections are based on a constant harvest hate policy is, however, not entirely straightforward. One way to achieve this is to conduct projections for each alternative model in turn and record the median (or mean) time-trajectory of catches. The decision table is then based on projections with a set of pre-specified time-series of catches. If probabilities were assigned to each alternative model by the assessment authors and STAR Panel, these must be reported with the decision table.

# 9. Documentation

It is important for analysts to document their work so that any rebuilding analysis can be repeated by an independent investigator at some point in the future. Therefore, all stock assessments and rebuilding analyses should include tables containing the specific data elements that are needed to adequately document the analysis. Clear specification of the exact assessment scenario(s) used as the basis for the rebuilding analysis is essential. Therefore, linkages with the most recent stock assessment document should be clearly delineated (e.g., through references to tables or figures). This is important because assessments often include multiple scenarios that usually have important implications with respect to stock rebuilding.

The minimum information that should be presented in a rebuilding analysis is:

- Date on which the analysis was conducted, and specifications for the software used for the analysis (including the version number), along with an example of the program's input file, ideally for the base (most likely) case. Documentation and basis for the number of simulations on which the analyses are based should also be provided. The software and data files on which the rebuilding analyses are based should archived with the stock assessment coordinator.
- Rebuilding parameters. For each alternative model, a table should be produced which lists: (a) the year in which the rebuilding plan commenced, (b) the present year, (c) the first year that the evaluated harvest policy calculates OY, (d) $T_{\mathrm{MIN}}$, (e) mean generation time, (f) $T_{\mathrm{MAX}}$, (g) $T_{\mathrm{F=0}}$, (h) the estimate of $B_0$ and the target recovery level, and (i) the estimate of current stock size.
- Results of harvest policy projections. The following information should be provided for each harvest policy evaluated: (a) the year in which recovery to the target level occurs with 0.5 probability, (b) the SPR for the first year of the projection period, (c) the probably of recovery by the current $T_{\mathrm{TARGET}}$, (d) the probably of recovery by the current $T_{\mathrm{MAX}}$, (e) tables of median time-trajectories (from the present year to $T_{\mathrm{MAX}}$) of: (i) spawning output relative to the target level, (ii) probability of being at or above the target level, (iii) ABC, and (iv) optimum yield. Median time-trajectories of SPR should be provided for the projection based on the 40:10 rule and any phase-in harvest policies that have been specified.
- The information needed to assess progress towards rebuilding (e.g. catches and OYs during the rebuilding period) and any additional information based on the review of adequacy of progress by the SSC (e.g. $T_{MAX}^{N}$ ).
- Median and 95% intervals for: (a) summary / exploitable biomass, (b) spawning output (in absolute terms and relative to the target level), (c) recruitment, (d) catch, (e) landings (if different from catch), (f) ABC, and (g) SPR for the actual harvest strategy selected by the Council.
- The rationale for the approach used to estimate $B_0$ and to generate future recruitment.
- The biological information on which the projections are based (show results for each alternative model):
  - Natural mortality rate by age and sex.
  - Individual weight by age and sex.
  - Maturity by age
  - Fecundity by age
  - Selectivity-at-age by sex (and fleet)
  - Population numbers (by age and sex) for the year the rebuilding plan commenced.
  - Population numbers (by age and sex) for the present year.
  - How fishing mortality was allocated to fleet for rebuilding analyses based on multiple fleets.

Notes:

- Much of the biological information will be stored in the input file for the projection software and doesn't need to be repeated unless there is good reason to do so.
- For cases in which the projections take account of uncertainty about the values for the biological parameters (e.g., using the results from bootstrapping or samples from a Bayesian posterior distribution), some measure of the central tendency of the values (e.g., the mode or median) should be provided and the individual parameter values should be archived with the stock assessment coordinator.
- Rebuilding analyses may be based on selectivity-at-age vectors constructed by combing estimates over fleets. If this is the case, the rebuilding analysis needs to document how the composite selectivity-at-age vector was constructed.

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Agenda Item F.2.d
Supplemental GAP Report
March 2008

# GROUNDFISH ADVISORY SUBPANEL REPORT ON STOCK ASSESSMENT PLANNING FOR 2011-2012 MANAGEMENT MEASURES

The Groundfish Advisory Subpanel (GAP) discussed the list of ten proposed stock assessments slated for 2009. The GAP is supportive of the proposed list with two exceptions:

1. Yelloweye rockfish should be added to the list for a full assessment in 2009.
2. Bank rockfish should be absorbed into the full assessment for the "Minor Slope Complex."

## Yelloweye Rockfish

The GAP believes that it is critical to fully assess yelloweye rockfish in 2009 for several reasons:

- There is a mandate to assess rebuilding progress on overfished species every two years – yelloweye was last fully assessed in 2006 and hence is due for an assessment.
- There will be additional data to inform the assessment in 2009 including both expansions of existing data (IPHC) and new data – WDFW rockfish sampling project.
- There was some indication that a new year class was recruiting into the fishery based on recreational catch data.
- The current status of the yelloweye fishery has the potential to affect every commercial and recreational fishery on the coast. Assessing the rebuilding progress of this stock is very important to the general management of groundfish both for annual management and inseason management processes.

## Bank Rockfish

The GAP believes that Bank rockfish should be absorbed into the "Minor Slope Rockfish" assessment because it is one of the species of that particular complex and because this logical inclusion allows an additional full stock assessment be added to the list (yelloweye).

PFMC
03/11/08

# GROUNDFISH MANAGEMENT TEAM REPORT ON STOCK ASSESSMENT PLANNING FOR THE 2009-2010 FISHING SEASON

The Groundfish Management Team (GMT) heard a presentation from Dr. Jim Hastie on the Northwest and Southwest Fisheries Science Centers' possible schedule for west coast groundfish stock assessments in 2009 and beyond (F.2.b, Attachment 1). In general the GMT agreed with the proposed schedule, but had some suggestions and comments.

With respect to yelloweye rockfish, the GMT noted that it is not scheduled for a full assessment through 2013. This is of concern for a number of reasons. The increasingly restrictive (ramped-down) optimum yield (OY) continues to constrain a number of fisheries. There is both anecdotal and empirical evidence of regional differences in stock abundance and life history characteristics that would be expected from very different levels of historic exploitation. Also, the previous assessment update uncovered problems in the last full assessment that merit further exploration. Only with a full assessment can convergence of state-specific models be explored with the model inputs corrected. These could help account for the apparent higher abundance in the north that the coastwide model misses. Likewise, incorporation of several years of new longline survey, and perhaps remotely operated vehicle (ROV), data as well as creative ways to incorporate other informative data sources could be examined. The GMT recommends this full assessment be given high priority for this cycle.

The GMT is supportive of the proposed full assessment for widow in 2009, as recommended by the Scientific and Statistical Committee, given it is likely approaching rebuilt status. The GMT is also supportive of the proposed full assessment for bocaccio rockfish, as was previously scheduled but not completed in 2007. Rather than updating the most recent cabezon assessment, the GMT recommends expanding the assessment area in 2009. While this species is important both commercially and recreationally along the entire west coast, the first assessment was only for that portion of the stock in California waters. Likewise, recreational opportunities in Oregon are frequently curtailed due to approaching a limit that is based more on historic landings than biological information. Finally, the GMT notes that few data are available to inform full assessments of minor rockfish and other management complexes. For these species, scientific advice on setting Annual Catch Limits (ACLs) will likely be based on methods with fewer data requirements (e.g. spawner per recruit, yield per recruit, or lifetime egg production analyses). The GMT notes this is an active area of research and will become more common as we examine non-assessed species from the groundfish Fishery Management Plan. The GMT looks forward to National Marine Fisheries Service guidance with regard to setting ACLs.

The GMT also discussed issues related to longer term planning for stock assessments, and has several comments. Most importantly, we recommend that more strategic planning for the assessment cycles that will follow 2009 be conducted (perhaps in a forum similar to the workshop held last December), in order to more appropriately coordinate data collection, port sampling, aging and other biological studies. This strategic planning could include a review that would evaluate biological and economic criteria, as well as the availability of data, for unassessed stocks and possibly aid in developing uniform criteria for prioritizing assessments for a given cycle. The GMT also intends to thoroughly review the draft Terms of Reference and make recommendations in time for final action at the June Council meeting.

GMT Recommendations:

1. Conduct full assessments for yelloweye, widow, and bocaccio rockfish in 2009.
2. Conduct a full assessment for cabezon in 2009 to examine stock status beyond California waters.
3. Provide direction on coordinating port sampling, ageing and other data collection efforts for future assessments.

PFMC
3/11/08

# SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON STOCK ASSESSMENT PLANNING FOR 2011-2012 MANAGEMENT MEASURES

The Scientific and Statistical Committee (SSC) reviewed the draft Terms of Reference (TORs) for Groundfish Stock Assessments and Rebuilding Analyses. These documents have been updated by the SSC groundfish sub-committee based on the process used during the 2007 assessment cycle and the recommendations from the December 2007 Groundfish Assessment Review Workshop. The TOR for Rebuilding Analyses do not reflect changes in analyses that may be required to calculate annual catch limits (ACLs) for overfished stocks because the ACL guidance document has not been completed by NOAA Fisheries. Although the SSC has suggestions for how both of these documents should be updated, they are sufficiently complete that they can be made available for Public Review. The SSC groundfish sub-committee will provide updated versions of both documents for adoption at the June Council meeting based on the comments received.

The TORs for Groundfish Stock Assessments were updated to (a) reflect that simple assessment methods can be applied to data-poor stocks and that the results of these methods may not provide the same information as full assessments, but could be used for decision making, (b) expand on the responsibilities of the Stock Assessment Review (STAR) Panel chair and the expectations for STAR Panel members, (c) provide guidelines for how disagreements between a STAR Panel and a Stock Assessment team (STAT) should be documented and handled by the SSC, and (d) identify the requirements for draft assessments and a process to decide whether an assessment is sufficiently complete to warrant review by a STAR Panel.

The SSC has the following suggestions for further modifications to the TOR:

- The introduction should provide the expectations for an assessment; in particular that an assessment should identify and quantify major uncertainties, balance realism and parsimony, and make good use of the available data.
- The document needs to reflect that it takes additional time to review contested assessments and assessments for species that are made up of several stocks.
- The number of STAR Panel members should ideally be n+2 where n is the number of stock assessments being reviewed.
- The description of how requests are made to STAT teams needs to reflect that requests for additional analyses may lead to suggested changes to the base model, and that it would not be unusual for the base model in the draft assessment document to change during a STAR Panel.
- It needs to be clearer that STAR Panel reports are not minutes, but rather summary documents.
- The SSC groundfish sub-committee should consider whether items in Appendix B that are not required of a draft assessment document should be annotated.

The TORs for Rebuilding Analyses have been modified substantially to reflect how rebuilding analyses were conducted in 2007, how progress towards rebuilding was evaluated by the SSC groundfish sub-committee in 2007, and the information provided to the Groundfish Management Team by assessment authors.

The SSC has the following suggestions for further modifications to the TOR:

- The discussion of the benefits of the two empirical methods for generating future recruitment should be deleted or updated to reflect a lower priority for these methods.
- When selecting an empirical method for generating future recruitment, analysts should examine the consistency between historical recruitments and projected recruitments during the period of rebuilding. Projected recruitment should be consistent with historical recruitment between the current stock size and the rebuilding target.

Ms Stacey Miller (Northwest Fisheries Science Center) presented the proposed list of assessments for 2009. The SSC notes that there may be new abundance data for yelloweye rockfish based on underwater visual surveys which might warrant a new full assessment of this species. If such data are available and an assessment lead can be identified, completing a full assessment of yelloweye rockfish should be preferred to a full assessment of Pacific Ocean perch. Pacific Ocean perch is predicted to recover to the $B_{\mathrm{MSY}}$ proxy by 2011 and so a full assessment of Pacific Ocean perch could be delayed until in 2011 when it will be a high priority. Washington Department of Fish and Wildlife will conduct a full assessment of spiny dogfish unless the Council recommends that a full assessment of lingcod be conducted in 2009. Efforts should be made to ensure that research on spiny dogfish population dynamics and life history at the University of Washington can be used in the Council process.

Three of the ten full assessments will be for the minor shelf, slope and nearshore complexes. These assessments will be based on assessment methods for data-poor species, and it is anticipated that all analysts will collaborate extensively. The SSC notes that the standard STAR review process is not likely to be ideal for the assessments of these complexes. Moreover, the SSC notes that although the development of assessments of data-poor species is encouraged, there are at present no control rules for such species. Moreover, there is no process to devise and evaluate the performance of alternative control rules, even though this will be important given the need to develop ACLs and accountability measures for all stocks. The SSC therefore recommends that these assessments be reviewed through a workshop process involving several reviewers, including some from the SSC groundfish sub-committee and the committee of independent experts. Ideally, a first workshop would identify potential analysis methods and control rules, and a second workshop would review the results and evaluate alternative control rules. The SSC notes that California Department of Fish and Game (CDFG) and California Sea Grant are organizing a workshop on assessment and management of data-poor stocks. This workshop may provide a forum for evaluating assessment results and evaluations of harvest control rules for data-poor species, although this would benefit from involvement by the SSC groundfish sub-committee in its planning.

Agenda Item F.2.d
Supplemental WDFW Report
March 2008

# WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON STOCK ASSESSMENT PLANNING FOR 2011-2012 MANAGEMENT MEASURES

In a letter to Dr. Elizabeth Clarke, Northwest Fisheries Science Center (NWFSC), dated July 26, 2006, and a subsequent report to the Council in September 2006, the Washington Department of Fish and Wildlife (WDFW) noted that future yelloweye rockfish assessments were scheduled as "updates" for 2007, 2009, and 2011. At that time, we also explained that we were planning additional research activities for yelloweye in 2007 and 2008 and that we would like the results of those activities considered in a full assessment in 2009.

Specifically: 1) We have partnered with the International Pacific Halibut Commission to add stations to their halibut survey to collect additional yelloweye rockfish data off the northern Washington coast; 2) we began an acoustic tagging program for yelloweye off Westport in 2007, and plan to expand that off the northern coast in 2008; and 3) we plan to conduct a yelloweye survey using a remotely operated vehicle (ROV) in 2008. These surveys would provide additional information regarding yelloweye abundance and distribution and would help ground-truth densities observed in our previous ROV survey in 2002.

There is increasing science that rockfish species, such as yelloweye, have a more discrete population structure than the current coastwide stock assumption, and differences in biological parameters along the coast may demonstrate this. Spatial differences in the stock could be used to support regional management; however, an update assessment would not allow for this consideration.

In addition to the consideration of including the new data sources and potential spatial differences, WDFW also advocates a comprehensive review by NWFSC staff of the data included in the 2006 full assessment. There was considerable uncertainty in the previous full assessment with regard to key parameters. Given that yelloweye rockfish are assessed and studied in Alaska and British Columbia, it may be prudent to review whether the values for the parameters specified in the 2005 assessment still hold.

There was also a discrepancy in the recreational data used as indices of abundance from the different states (e.g., Washington recreational catch-per-unit-of-effort (CPUE) data from halibut trips were excluded whereas Oregon recreational CPUE data from halibut trips were included). It is our understanding that inclusion of certain data would not allow the model to "converge." Recent discussions with NWFSC staff indicate that the cause of this may have been resolved, given that the 2006 assessment was completed with the earliest version of the Stock Synthesis 2 model and there have been several iterations of that model developed since then.

In conclusion, we would strongly recommend that yelloweye rockfish be scheduled for a full assessment in 2009.

PFMC
03/11/08

Agenda Item F.3
Situation Summary
March 2008

# PACIFIC WHITING HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES FOR 2008

The Pacific whiting fishery management process is unlike that for other federally-managed west coast groundfish for 2008 fisheries, for which catch specifications and management measures were adopted by the Council at the June 2006 Council meeting for the two-year period 2007-2008. The Council deferred a decision on setting harvest specifications and management measures for the 2008 Pacific whiting fisheries pending the development and review of a new stock assessment to occur during February 2008. A new Pacific whiting assessment was prepared this winter (Agenda Item F.3.a, Attachment 1) and reviewed by a joint U.S.-Canadian assessment review panel during February 2008 (Agenda Item F.3.a, Attachment 2). Additionally, two other assessment documents were provided to the assessment review panel for consideration (Agenda Item F.3.a, Attachments 3 and 4). The executive summaries of each assessment are included in the briefing book and each assessment in its entirety is found in the CD copy of meeting materials. The Council should consider the advice of the assessment review panel, the Scientific and Statistical Committee (SSC), and other advisors before adopting an assessment for use in management decision-making. The assessment, once approved, will be used to set 2008 Pacific whiting harvest specifications and management measures.

In 2004-2007, this transboundary stock was managed jointly with the Department of Fisheries and Oceans, Canada, in the spirit of a new process described in a treaty that has been signed and ratified by the U.S., but awaits ratification by Canada. The primary tenets of the treaty include a joint U.S.-Canada annual assessment and management process (which will presumably be implemented next year), a research commitment, and a harvest sharing agreement providing 73.88 percent of the coastwide optimum yield (OY) for U.S. fisheries and 26.12 percent for Canadian fisheries.

The Council is tasked with setting an acceptable biological catch (ABC) and OY for Pacific whiting that will be used to manage 2008 fisheries and management measures to properly prosecute the fishery. Considerations for this decision include the stock's current and projected status with respect to the overfished threshold, the international agreement with Canada, and overfished species' bycatch concerns.

**<u>Council Action:</u>**

1. **Adopt the 2008 Pacific whiting stock assessment.**
2. **Adopt a 2008 ABC and OY for Pacific whiting.**
3. **Adopt 2008 management measures for Pacific whiting fisheries.**

Reference Materials:

1. Agenda Item F.3.a, Attachment 1: Executive Summary of Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2008.
2. Agenda Item F.3.a, Attachment 2: Report of the 2008 U.S. / Canada Pacific Hake (Whiting) Stock Assessment Review (STAR) Panel.
3. Agenda Item F.3.a, Attachment 3: Abstract of Canadian Fishery Distribution, Index Analysis, and Virtual Population Analysis of Pacific Hake, 2008.
4. Agenda Item F.3.a, Attachment 4: Executive Summary of Assessment and Management Advice for Pacific Hake in U.S. and Canadian Waters in 2008.

Agenda Order:

a. Agenda Item Overview — John DeVore
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt 2008 Stock Assessment, Allowable Biological Catch, Optimum Yield, and Management Measures

PFMC
02/25/08

# Report of the 2008 U.S. / Canada Pacific Hake (Whiting) Stock Assessment Review (STAR) Panel.

**Review Panelists:**

David Sampson,
Panel chair and representative for the Scientific and Statistical Committee of the Pacific Fishery Management Council (PFMC)

Malcolm Haddon,
Center for Independent Experts

Noel Cadigan,
Fisheries and Oceans, Canada

Dan Waldeck,
Representative for the PFMC Groundfish Advisory Panel

John Wallace,
Representative for the PFMC Groundfish Management Team

## Overview

During 11-14 February 2008, a joint Canada-U.S. Pacific Hake / Whiting Stock Assessment Review (STAR) Panel met in Seattle, Washington, to review three stock assessment documents, by Helser *et al* (2008), Sinclair & Grandin (2008), and Martell (2008). The Panel operated under the U.S. Pacific Fishery Management Council's Terms of Reference for STAR Panels (SSC 2006), but as in previous years, the Panel attempted to adhere to the spirit of the Canada-U.S. Treaty on Pacific Hake / Whiting. As was the case in 2004, 2005, 2006, and 2007 the Panel included a member from Canada and the stock assessment team also included Canadian participants (see *List of Participants*). The revised stock assessments and the STAR Panel review will be forwarded to the Pacific Fishery Management Council and its advisory groups, and to Canadian Department of Fisheries and Oceans (DFO) managers and the PSARC (Pacific Scientific Advice Review Committee) Groundfish Sub-committee.

All members of the stock assessment team (STAT) – Drs. Thomas Helser, Ian Stewart, Owen Hamel, Alan Sinclair, Chris Grandin, and Steve Martell – attended and actively participated in the meeting. Public comment was entertained throughout the four-day meeting, which was held at the Hotel Deca in Seattle. The STAR Panel members were able to receive all draft assessments and supporting materials via an ftp site two weeks prior to the meeting, and this was sufficient time to adequately prepare for the review of the three assessments.

The Panel convened at 08:30 on Monday February 11$^{th}$. Stacey Miller (US National Marine Fisheries Service, NMFS) welcomed the group and then Dr. Elizabeth Clarke (NMFS) briefly reviewed the status of the Pacific Hake / Whiting treaty. The treaty now needs to be ratified by the Canadian parliament and until that occurs the necessary committees cannot be formed. Nevertheless the STAR panel review could continue and would attempt to meet the needs of both parties to the treaty. David Sampson (STAR Panel Chair) then opened the meeting with an overview of the review process including the terms of reference, Panel membership, expected products, and a timeline for completion of the Panel's report. A preliminary meeting between the assessment team groups had occurred and they had all used the same available data in their assessments, although each emphasized different aspects and aggregated the data to different degrees. Tom Helser provided the STAR Panel with a detailed description of the available data inputs. Rebecca Thomas (NMFS) provided a detailed overview of the acoustic survey work. Chris Grandin described the fishery distribution changes in Canadian waters during 2006 and 2007. In addition, John Horne (University of Washington) gave a presentation on a revision of target strengths used in the acoustic survey for Pacific Hake / Whiting. Then the following three stock assessments were presented. Tom Helser (NMFS) presented the Stock Synthesis II (SS2) catch-at-age model (Helser *et al*, 2008), Alan Sinclair (DFO) presented an ADAPT / VPA model (Sinclair & Grandin, 2008), and Steve Martell (University of British Columbia) presented an assessment model that directly estimated parameters of management interest (named TINSS; Martell, 2008).

Based on discussion of the stock assessment documents and related presentations, the Panel requested 24 clarifications, some of which included additional model runs, to help identify the base case, the full range of uncertainty in the stock assessment, and the similarities and differences between the three assessment models. This large number of requests reflected the complexity of reviewing three distinct assessment models contributed from two nations. This iterative process of making additional model runs and discussing the results continued through the end of the day on February 13th. The Panel spent the morning of February 14th reviewing an outline structure of its report; the meeting was adjourned at 14:00. A draft Panel report was distributed by email to all Panel participants for serial development. A draft final Panel report was completed on February 22nd so that it could be included in the "Briefing Book" for PFMC's March meeting.

After careful review of results and diagnostics from the three assessment models (SS2, ADAPT / VPA, and TINSS), the Panel recommended acceptance of a particular scenario from the SS2 model as the base case. This scenario, developed during the review period, estimated the most important parameters more freely and reflected a broad but realistic range of uncertainty in the relative depletion level and productivity of the stock. The base model was developed with careful consideration of knowledge and uncertainty about Pacifc hake stock dynamics, and fisheries and survey's for this stock. Although all three models had the same data streams available for use, the models differed in the amount of data used, the degree of data aggregation, and assumptions on the magnitude of observation error relative to process error. The basic data sets consisted of the following: total catches from the US and Canadian fisheries between 1966 – 2007; length compositions from the US fishery (1975-2007) and the Canadian fishery (1988-2007); conditional age-at-length compositions from the US fishery (1975-2007) and the Canadian fishery (1988-2007); standard age composition data (derived from age-length keys) from the US fishery (1973-1974) and the Canadian fishery (1977-1987); biomass indices, length compositional data, and conditional age-at-length composition data from the joint US-Canadian acoustic / midwater trawl surveys (1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2003, 2005, and 2007); plus biological data relating to pre-recruit abundance, growth, maturity at age and length, and natural mortality.

The SS2 catch-at-age model involved the least degree of data aggregation. Both the ADAPT and TINSS models combined the US and Canadian age compositions and assigned equal weight over all years. A major structural difference between the models was the pattern ascribed to the selectivity for the surveys and commercial fisheries. In the SS2 model, evidence from the US fishery and acoustic survey age-compositions favored "domed selectivity", in which the oldest age-classes were less apparent than intermediate age-classes. Sinclair & Grandin (2008) concluded from a catch curve analysis, an analysis of the ratio of catch-at-age from the fishery and from the survey, and from the VPA that fishery and survey selectivity were asymptotic, meaning that the oldest age-classes were as apparent as intermediate age-classes. The TINSS model assumed that fishery and survey selection were asymptotic and an analysis showed that the estimated steepness parameter (*h*) was not overly sensitive to the assumption.

Responses to the STAR Panel's requests for alternative model runs indicated that all three models provided similar predictions about the resource biomass trajectory when the model assumptions were made to be the same or similar. At the same time the three models made similar predictions for the parameters of management interest (ABC, $F_{40/MSY}$, and depletion), but with differing ranges of uncertainty. The SS2 model that was originally brought to the STAR Panel bracketed uncertainty by using alternative models corresponding to a low and high acoustic survey selectivity at the final-age, but freely estimated the survey catchability. The final SS2 model agreed upon by the STAR and STAT involved more freely estimating the acoustic survey selectivity parameters, as well as acoustic survey catchability and the natural mortality coefficient for ages 14 and 15+. This had the effect of increasing the breath of uncertainty around key management parameters, such that it encompassed the uncertainty expressed by the alternative ADAPT / VPA and TINSS models. From the base case the estimated 2007 spawning stock biomass (SSB) is just below the target level of 0.40 $SSB_0$. A comparison of model outputs is provided in the table below.

| Character | SS2 Base Case | VPA | TINSS |
|---|---|---|---|
| Model Platform | Stock Synthesis 2.0n | ADAPT | AD-Model Builder |
| Ageing error matrix | Yes | No | No |
| Selectivity pattern | Domed | Asymptotic | Asymptotic |
| Fishery composition observation error | Yes | No | Yes but < SS2 |
| Survey composition observation error | Yes | Yes | Yes but < SS2 |
| Length-compositions | Yes | No | No |
| 2007 Depletion | 0.379 (0.22 – 0.54) | 0.280 | 0.519 (0.334 – 0.796) |
| 2008 Catch '000s t | 527 (141 – 942) | 346 (40 - 520) | 446 (182 – 864) |

Table notes: The SS2 estimates for 2007 Depletion and 2008 Catch are the maximum likelihood estimates with approximate 95% confidence limits. The corresponding VPA estimates are from Run 1A and the 2008 catch range values are the catches from this run that will exceed the target exploitation rate with 20% and 80% probability. The corresponding TINSS estimates are from the marginal posterior distributions, with the ranges showing the 95% confidence limits.

There was debate over what would constitute a safe level of catch. Pacific hake / whiting exhibit highly variable episodic recruitment and the fishery during the last 40 years has been driven largely by three large year classes (1980, 1984, and 1999). Questions were raised over whether the Council's 40/10 harvest control rule, by itself, would be sufficient to maintain the stock above the $B_{25}$ level that triggers rebuilding. It was pointed out that: (1) the fishery currently depends on the 1999 cohort, which is declining in abundance and biomass, (2) fishing mortality is increasing and in recent years has been higher than most previous years, and (3) recent catches have been relatively high. These risk factors concerning the fishery are increasing and should be a cause for concern. It is unknown exactly how much risk is involved with the use of the current assessments and harvest control rule with a species such as Pacific hake / whiting. There was general consensus among the STAR panel and STAT that there would be great value in developing and conducting a detailed Management Strategy Evaluation to determine the most robust combination of data collection, applied stock assessment, and harvest control rule that should be applied to achieve sustainable use of the Pacific hake / whiting resource.

In the meantime, the Panel concurred that the stock assessment is suitable for use by the Council and Council advisory bodies for ABC and optimal yield (OY) determination, and for stock projections. However, the risk factors listed above, when coupled with the observation that SSB has been in decline since 2003 (and is now predicted to be below $SSB_{40}$) while ABC has increased substantially over the same period, strongly suggests there may be cause for concern if managers elected to take the full ABC.

The STAR Panel commends the STAT for the quality of the documentation provided for review and their cooperation in performing additional analyses requested during the meeting.

## Analyses requested by the STAR Panel

Monday Questions for the Stock Synthesis Analysts

1. *A major axis of uncertainty is the survey and commercial fishery selectivity. A domed selectivity provides a better fit. Can the specific data (i.e. age+year+fishery), or components where the fit is improved be identified. Rationale: if the improvement in fit is specific to just a small part of the data, as opposed to broadly based, then the improvement in fit may be for the wrong reason.*

Response: The STAT team produced Figure 1 showing the change in negative log-likelihood for the SS2 models with the survey selex[1] = 0.7 and selex = 0.5. The total difference in log-likelihoods between these models was 300 units, indicating that the selex = 0.5 assumption resulted in a substantially better fit overall. A negative in Figure 1 indicates that the selex = 0.7 assumption (less domed) fit the data more poorly than the selex = 0.5 assumption. About 50% of the improvement in fit from the more domed selex=0.5 model was associated with US age-composition data in 1990-1992 and the survey age composition data in 1997; however, 50% of the improvement was broadly distributed. The conclusion from this analysis was that the improvement in fit was not an artifact caused by some other type of model misspecification or unusual data.

[1] "Selex" is the name of the parameter that controls the selection coefficient on the 15+ age-class. A selex value of 1.0 is equivalent to asymptotic selection, where the oldest ages are fully selected.

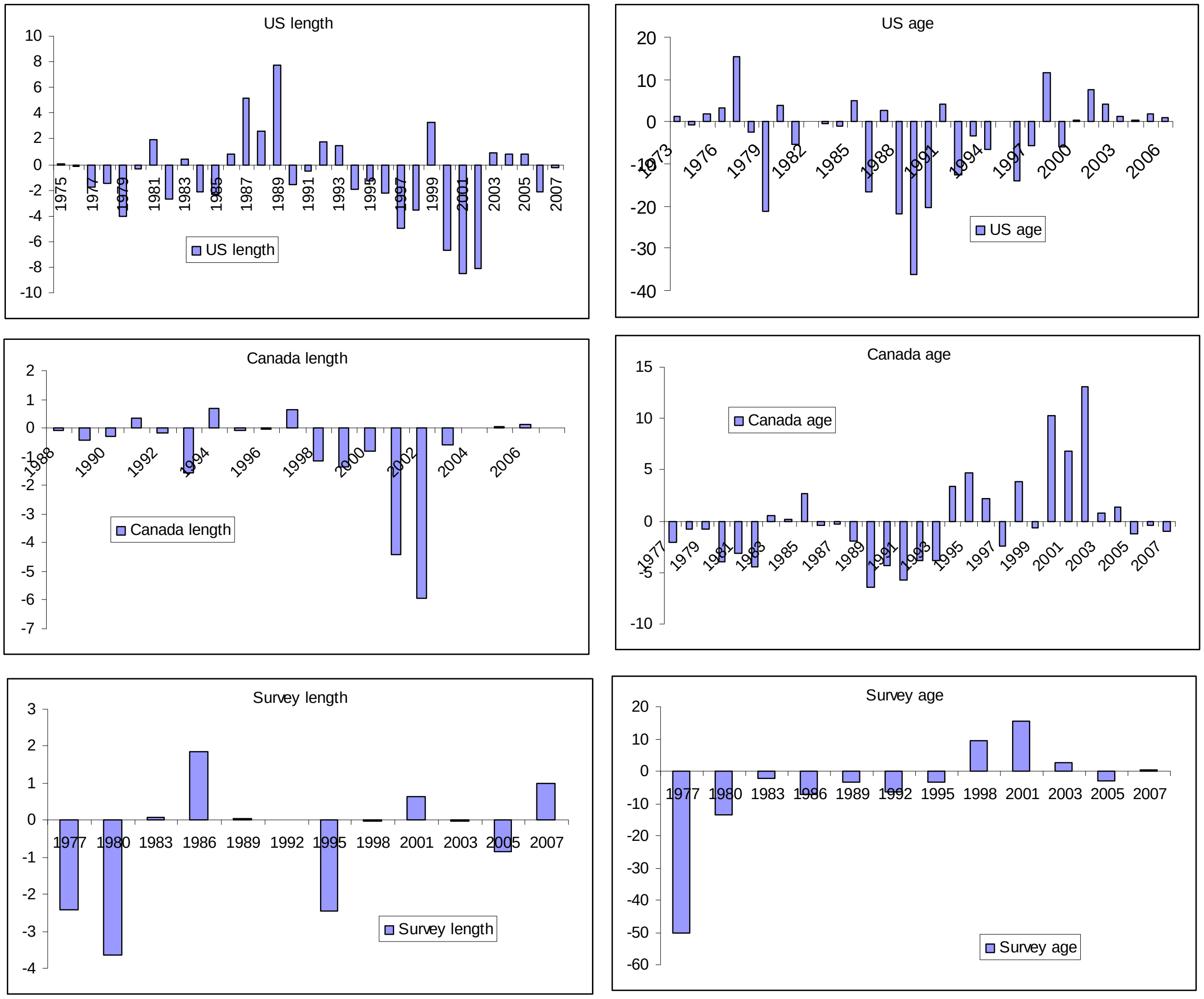


**Figure 1**. Change in negative log-likelihood values by data component between the SS2 models with selex = 0.7 and selex = 0.5.

2. *There is an inconsistency between the Canadian and US fishery age compositions. Are there specific data elements that are responsible for this inconsistency? Rationale: The end-result will be very dependent on the relative weighting applied to the two data sources.*

Response: Evidence for dome-selectivity was broadly distributed throughout the US age composition data (e.g., Figure 1, does not indicate major lack of fit due to the degree of domed-ness in selection), and prior to 1995 in the Canadian age composition data. However, in the period 1995-2003 the Canadian age composition data suggests that fishery had a less domed selectivity. Hence, there is stronger evidenced for domed-selectivity in the US age composition data.

3. *Tabulate discards in non-directed fisheries. Rationale: Demonstrate that the discards are trivial.*

Response: The hake discards in the non-hake fisheries reported by the NMFS Northwest Fisheries Science Center observer program were 822 mt in 2005, and 941 mt in 2006. The amounts are trivial compared to the directed fishery.

4. *Bailey et al. (1982) suggested that the reported foreign catches during1966-1976 were underestimated. Can the potential magnitude be quantified? Rationale: Unaccounted catches could influence assessment results.*

Response: The magnitude of under-reported catch in 1966-1976 was quantified, and an adjusted US catch was derived (see Bailey's US Catch in Figure 2). This was a provisional analysis, and the STAT reported that they would like to explore this as part of future research.

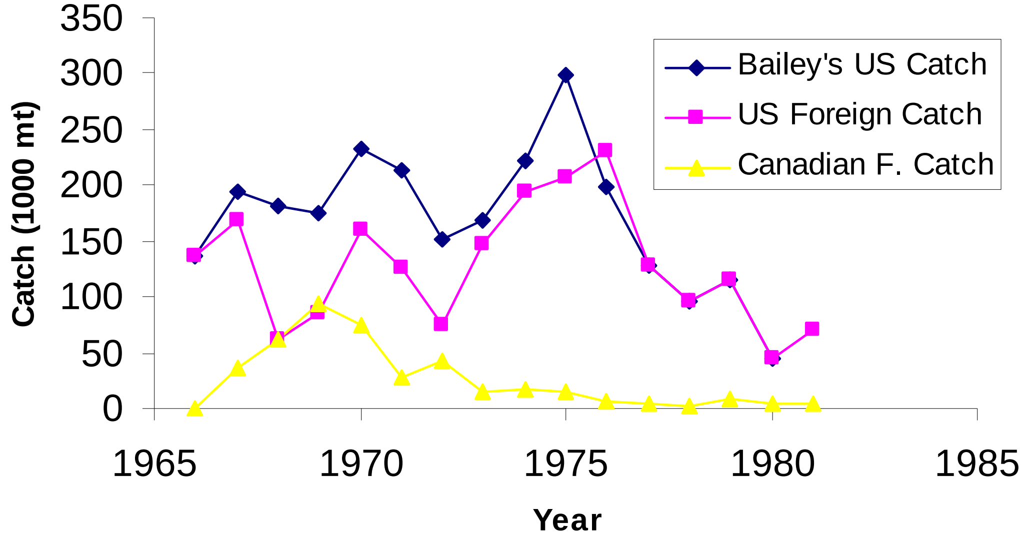


**Figure 2**. Foreign catch from US waters in 1966-1976, adjusted for mis-reporting. Reported catch (US Foreign Catch) and Canadian catch are included for reference.

5. *Tabulate the timing of the acoustic surveys. Rationale: Demonstrate that there have been no significant seasonal changes, which could affect catchability.*

Response: The timing of the surveys is shown in Figure 3. The STAT felt that the duration and changes in the timing of the survey would not have an important effect on the survey catchability.

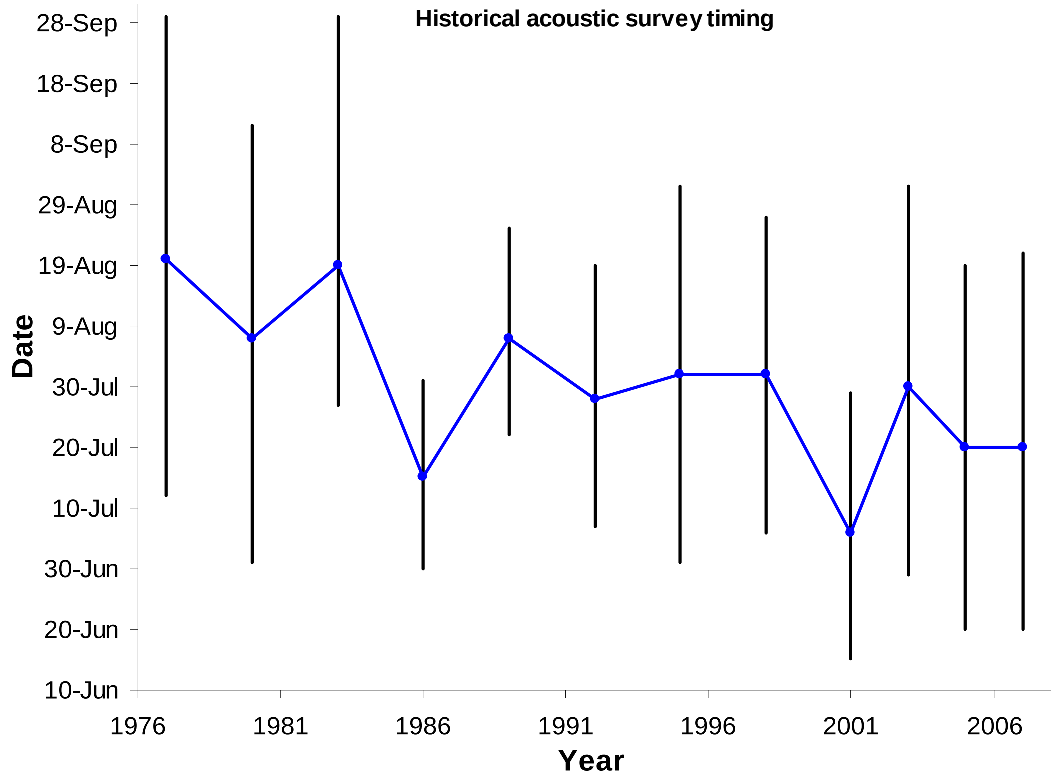


**Figure 3**. The start and end dates of the acoustic surveys, shown as vertical lines. The blue line connects the annual mid-point dates.

6. *Provide evidence for no sex-differences in growth and/or spatial distribution. Rationale: If these differences do occur then they have implications for future model development.*

Response: The STAT presented estimates of growth rates by sex (see Figure 4) and estimates of the proportion of females (Figures 5a,b). The evidence suggests that a model structured as length- and gender-based could produce considerable improvements in fits to the data. This was clearly not possible to do within the time frame of the meeting; however, it is a recommended area for future research.

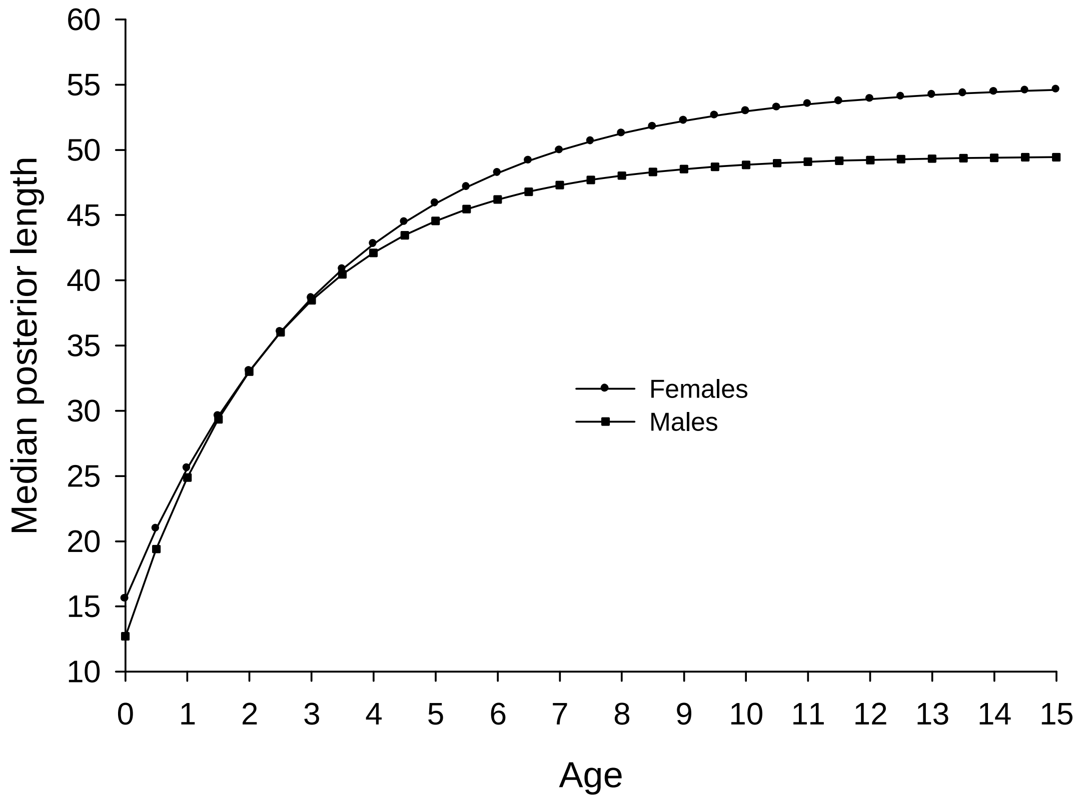


**Figure 4**. Mean growth curves by sex estimated over numerous cohorts from the 1975-2000 cohorts.

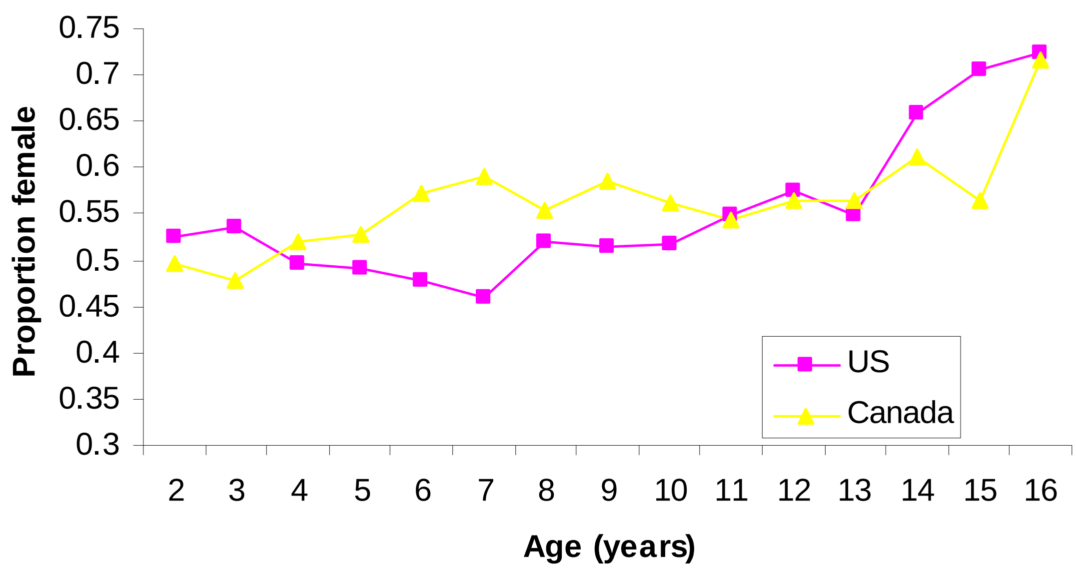


**Figure 5a**. Proportion female by age from commercial fishery samples during 1991-2006.

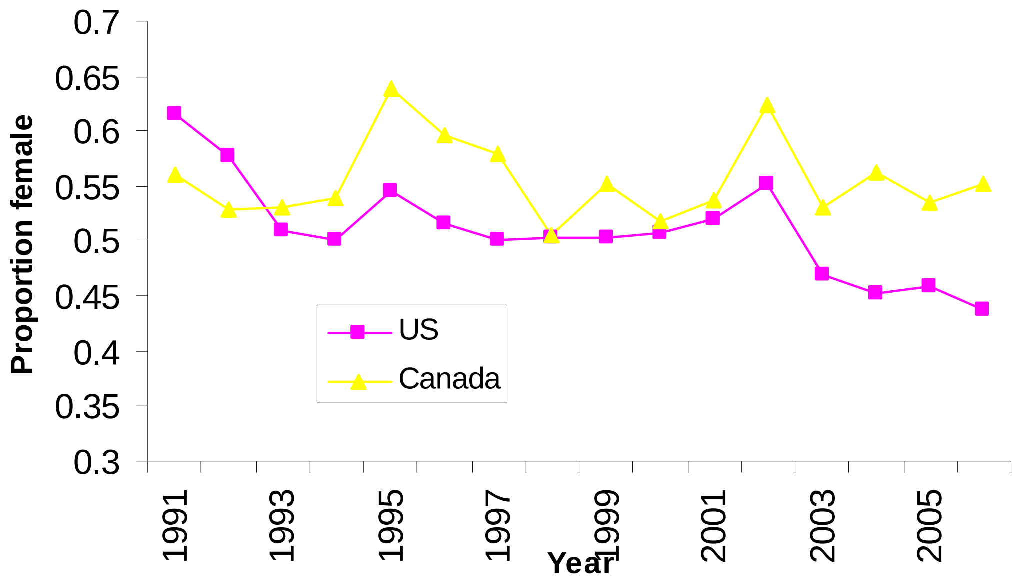


**Figure 5b**. Proportion female (all ages) from commercial fishery samples during 1991-2006.

7. *Provide rationale for age-based selection in the fishery and survey, as opposed to length-based selection. Rationale: real processes affecting catchability would more likely be length-based rather than age-based.*

Response: The STAT reported that this was a useful area for future research. The dominant source of variation in fishery selectivity and survey catchability may actually be length rather than age. However, in many fisheries models selectivity and catchability are commonly modeled as a function of age, and a motivation in designing the SS2 model was to keep it as standard as possible, while at the same time using the observed data more directly for estimation.

Tuesday Morning Questions for ADAPT / VPA and TINSS Analysts

1. *Compare predicted weight-at-age with empirical observations of weight-at-age, by year or cohort. Rationale: Confirm validity of the assumptions about length-weight relationships.*

Response: Text in the document describing the TINSS model implied that it had used empirical estimates of weight-at-age from field samples. In fact, in both the ADAPT / VPA and the TINSS models had used the same data on weight-at-age when referring to biomass estimates. These data were derived from the empirical data on length-at-age using a time-invariant weight-at-length relationship.

2. *Provide a plot of annual fishery selectivity. Rationale: To examine the assumption of annually constant selectivity.*

Response: The VPA provides estimates of fishery selectivity by age for each year of the analysis, and a major contrast between the SS2 versus the VPA and TINSS models was whether selectivity was domed or asymptotic. Estimates of average selectivity through time from Run 1A (Figure 6 and 7), averaged using the same time-blocks as the SS2 model, indicate some variation between each 7-year block, especially the 1984 - 1992 block compared to the other blocks. All the curves were asymptotic and of similar shape.

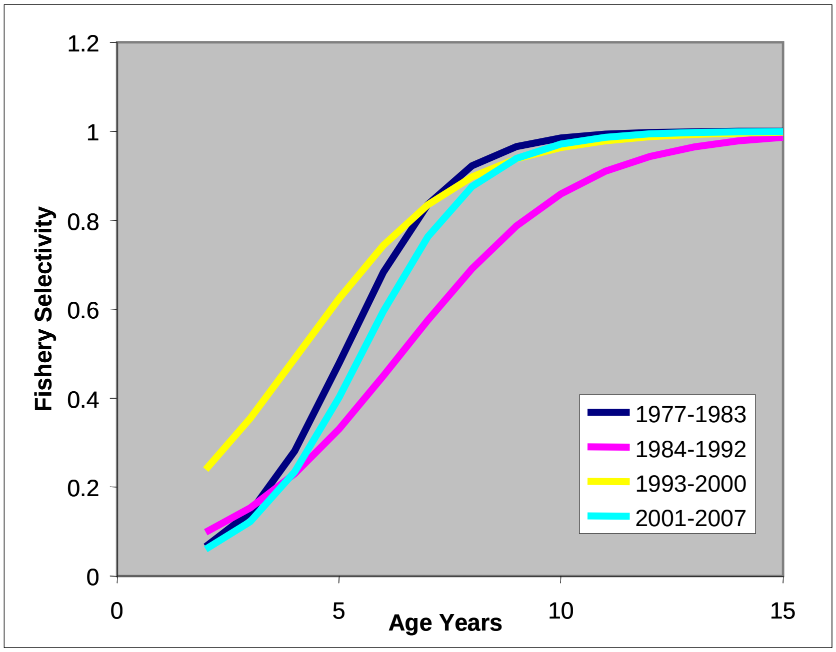


**Figure 6**. The predicted selectivity by age from the VPA analysis (selectivity Run 1A; Sinclair & Grandin, 2008) for four-year blocks.

The fishing mortality rates on the oldest age-classes indicate increased mortality rates in the most recent years.

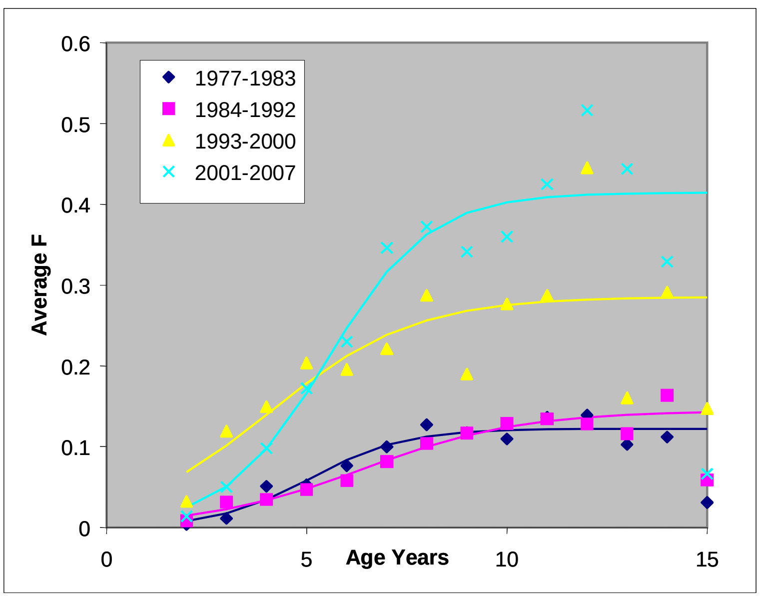


**Figure 7**. Fishing mortality relative to the selectivity in each group of years (*cf* Fig. 6).

3. *Provide plots of the VPA survey catchability. Rationale: To examine the assumption of annually constant and asymptotic selectivity in other models.*

Response: The survey catchability values as implied by the different VPA runs indicate asymptotic patterns (Figure 8). Also, the analyses of residuals of catch-at-age in the VPA assessment report (Sinclair & Grandin, 2008, reproduced below as Fig. 9) indicated that total mortality and survey catchability was relatively constant over ages 7-14 years.

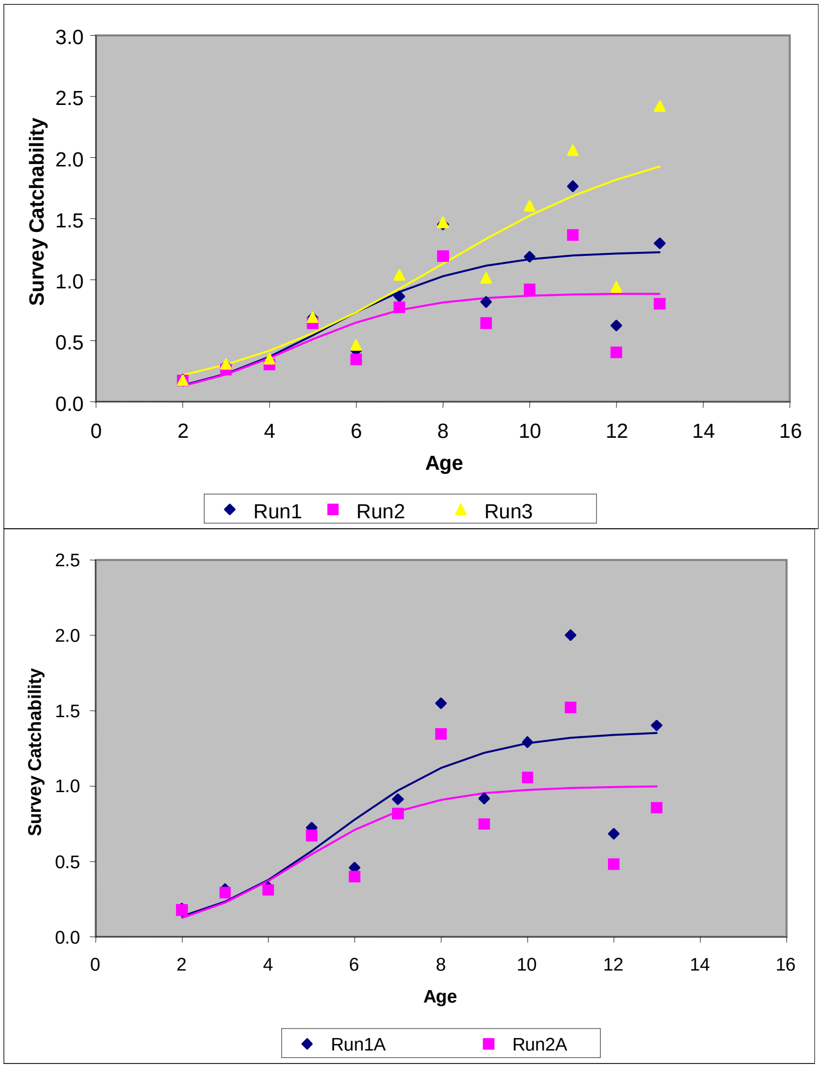


**Figure 8**. The survey catchability-at-age under the VPA analyses with the ADAPT runs 1, 1A, 2, 2A, and 3 (Run 1 $F_T$ = weighted average 7+ fish, Run 2 $F_T$ = Wt Av 4+ fish, and Run 3 $F_T$ = Wt Av 12+ fish. Run 1A $F_T$ = Wt Av 7+ fish and 10 more year parameters, Run 2A $F_T$ = Wt Av 4+ fish and 10 more year parameters).

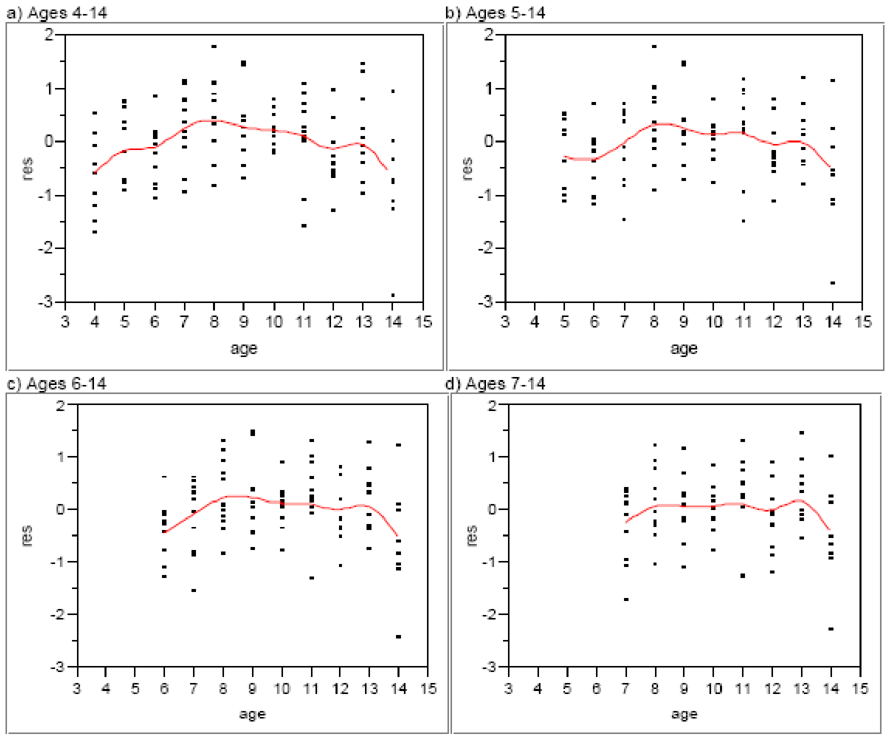


**Figure 9**. Figure 18 in Sinclair and Grandin (2008) showing residual patterns with respect to age from preliminary GLM analyses of total mortality of Pacific hake based on the results of the acoustic survey.

4. *Fmsy prior sensitivity. Shift the prior plus/minus 20%. Rationale: How sensitive is the management advice (e.g. Table 2 and 5) to the prior.*

Response: The posterior probability on the $F_{MSY}$ is effectively coincident with the prior, indicating that the data are not informative for the target fishing mortality rate. Because other parameters are correlated with $F_{MSY}$ the influence of the original prior was explored. In particular, the sensitivity of parameters of management interest were considered. While the changes in $F_{MSY}$ have direct influences on steepness and ABC, the *MSY* appears to be relatively insensitive to the prior on $F_{MSY}$ (Figure 10). Similarly, the predicted depletion level, estimates of *M* (natural mortality), and unfished spawning biomass were insensitive to the influence of $F_{MSY}$ (Figure 11). The $\mathrm{F_{MSY}}$ management target does not appear to be unduly influenced by the prior probability for $\mathrm{F_{MSY}}$.

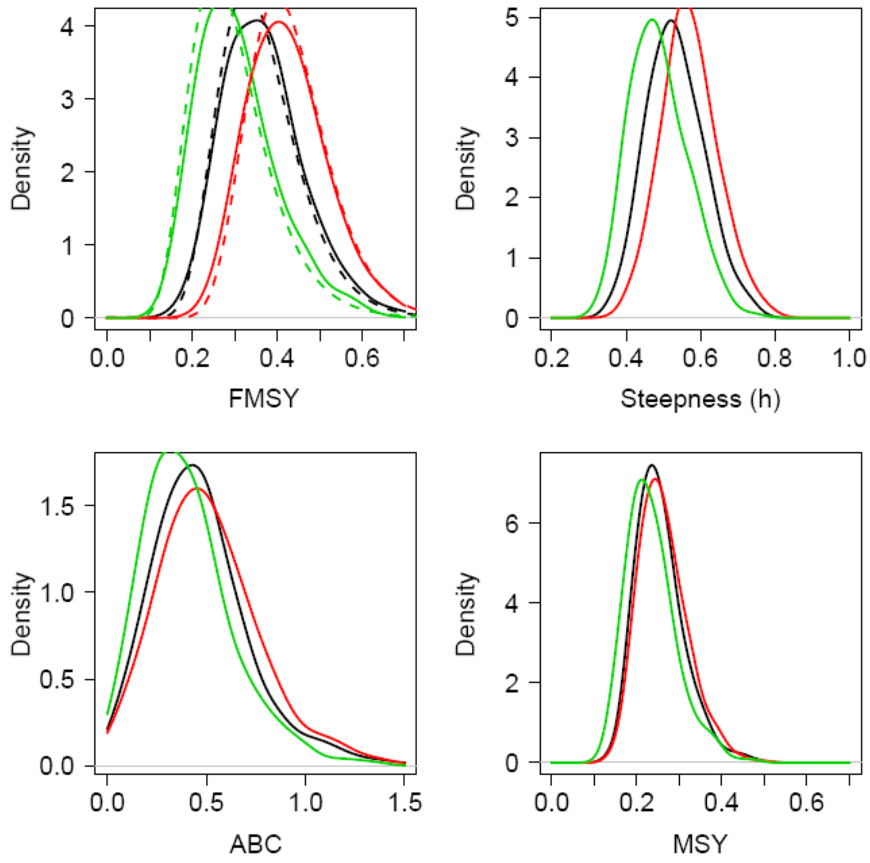


**Figure 10**. Shifted plots of the prior and posterior for $F_{MSY}$ (solid line =prior, dotted line = posterior), with its implications for steepness, the ABC and the MSY. The insensitivity of MSY to the prior imposed on $F_{MSY}$ is apparent.

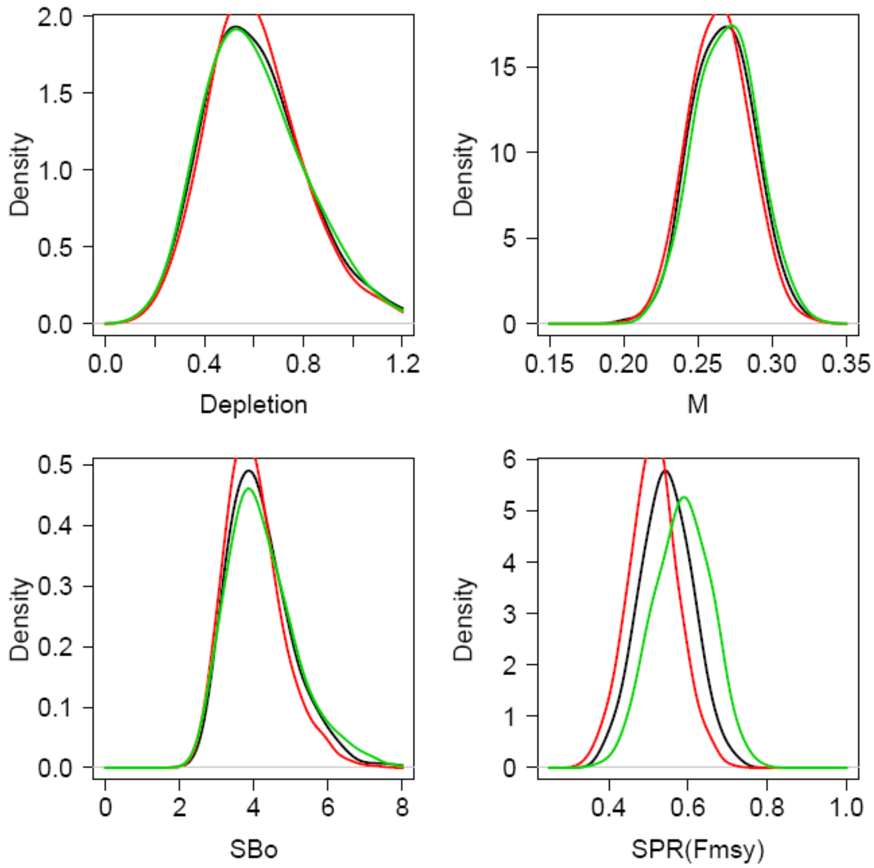


**Figure 11**. The insensitivity of stock depletion levels, natural mortality (*M*), and initial spawning biomass relative to shifts in the prior on $F_{MSY}$ (Fig. 10).

<u>Tuesday Afternoon for the Stock Synthesis Analysts.</u>

1. *What is the impact on values in Table f. in Helser et al. when natural mortality is estimated, with a reasonable prior. Rationale: Fixing natural mortality, and profiling only over selex, may over-state uncertainty in depletion, etc. because of confounding in the effects of selex and natural mortality on population outcomes.*

Response: The top panel of Figure 12 illustrates data from Table 13b in the original SS2 assessment document, which subsumes the original Table f, while the bottom panel indicates how a less informative prior on *M* (natural mortality) alters the profile over the survey selectivity parameter for the oldest fish. The net effect was to compress the lower limits upwards. This question led to the Wednesday afternoon Request 4 (below).

| Derived Parameter | Base model Final selex=0.5 MLE | Asymptotic 95% CI | | Alt. Low Final selex=0.7 MLE | Asymptotic 95% CI | | Alt. High Final selex=0.3 MLE | Asymptotic 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| 2007 Depletion | 0.437 | 0.293 | 0.581 | 0.291 | 0.212 | 0.370 | 0.570 | 0.418 | 0.723 |
| 2008 Depletion | 0.429 | 0.254 | 0.604 | 0.292 | 0.156 | 0.428 | 0.597 | 0.413 | 0.782 |
| MSY | 346,130 | 247,101 | 445,159 | 219,270 | 153,310 | 285,230 | 467,030 | 320,273 | 613,787 |
| $B_{MSY}$ | 637,580 | 359,397 | 915,763 | 434,510 | 248,255 | 620,765 | 917,560 | 504,980 | 1,330,140 |
| $SPR_{MSY}$ | 0.234 | 0.107 | 0.360 | 0.248 | 0.104 | 0.393 | 0.247 | 0.108 | 0.385 |
| 2008 Catch | 401,720 | 190,765 | 612,675 | 111,090 | 22,335 | 199,845 | 750,820 | 411,034 | 1,090,606 |
| Rzero (billions) | 1.210 | 1.010 | 1.410 | 0.787 | 0.700 | 0.874 | 1.674 | 1.376 | 1.971 |
| Bzero (millions, mt) | 1.836 | 1.531 | 2.141 | 1.193 | 1.060 | 1.326 | 2.538 | 2.086 | 2.989 |

| Derived Parameter | Base model Final selex=0.5 MLE | Asymptotic 95% CI | | Alt. Low Final selex=0.7 MLE | Asymptotic 95% CI | | Alt. High Final selex=0.3 MLE | Asymptotic 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| 2007 Depletion | 0.472 | 0.324 | 0.620 | 0.307 | 0.213 | 0.400 | 0.568 | 0.417 | 0.720 |
| 2008 Depletion | 0.485 | 0.302 | 0.668 | 0.271 | 0.147 | 0.395 | 0.603 | 0.417 | 0.789 |
| MSY | 406,060 | 275,863 | 536,257 | 284,320 | 189,227 | 379,413 | 476,520 | 321,950 | 631,090 |
| $B_{MSY}$ | 742,810 | 400,535 | 1,085,085 | 516,020 | 281,878 | 750,162 | 932,550 | 510,464 | 1,354,636 |
| $SPR_{MSY}$ | 0.242 | 0.106 | 0.378 | 0.239 | 0.104 | 0.374 | 0.248 | 0.110 | 0.386 |
| 2008 Catch | 532,400 | 251,160 | 813,640 | 180,080 | 28,264 | 331,896 | 770,080 | 414,399 | 1,125,761 |
| Rzero (billions) | 1.503 | 1.170 | 1.835 | 1.043 | 0.788 | 1.297 | 1.728 | 1.362 | 2.095 |
| Bzero (millions, mt) | 2.086 | 1.692 | 2.480 | 1.461 | 1.188 | 1.734 | 2.567 | 2.088 | 3.047 |

**Figure 12**. The impact on parameters of management interest of estimating natural mortality using a broader prior than originally used in the SS2 modelling. The top panel is the original outputs while the lower panel illustrates the effect of the estimation of *M*.

2. *Explore estimating the initial age-composition in 1966. Rationale: The steady-state assumptions may have implications on model results.*

The SS2 model assumes that the population has an equilibrium age structure in 1966, but the age compositions from the earliest samples indicate that equilibrium was unlikely. This also is expected from the very high variation in recruitment leading to episodic recruitment. In fact, the use of bounded recruitment residuals (forcing a sum to zero) limited the number of years which could include recruitment deviations. 1963 was the earliest year in which recruitment deviations could be successfully imputed (Fig. 13). The additional early recruitment deviations had a relatively minor effect on the subsequent recruitment deviations (Fig. 14) and the spawning stock biomass trajectory (Fig. 15).

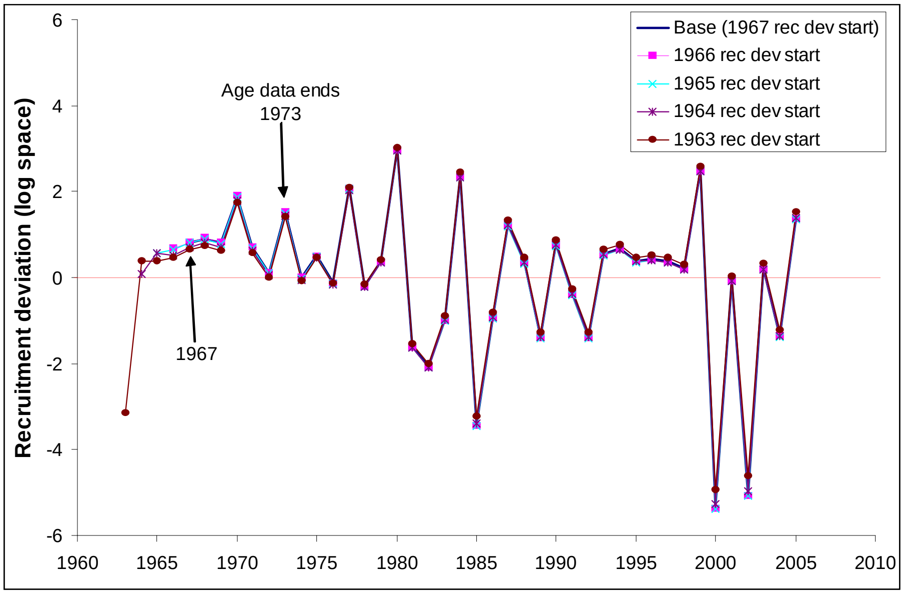


**Figure 13.** The imputation of recruitment deviations to the years prior to available data in an attempt to duplicate the non-equilibrium conditions expected at the start of the fishery.

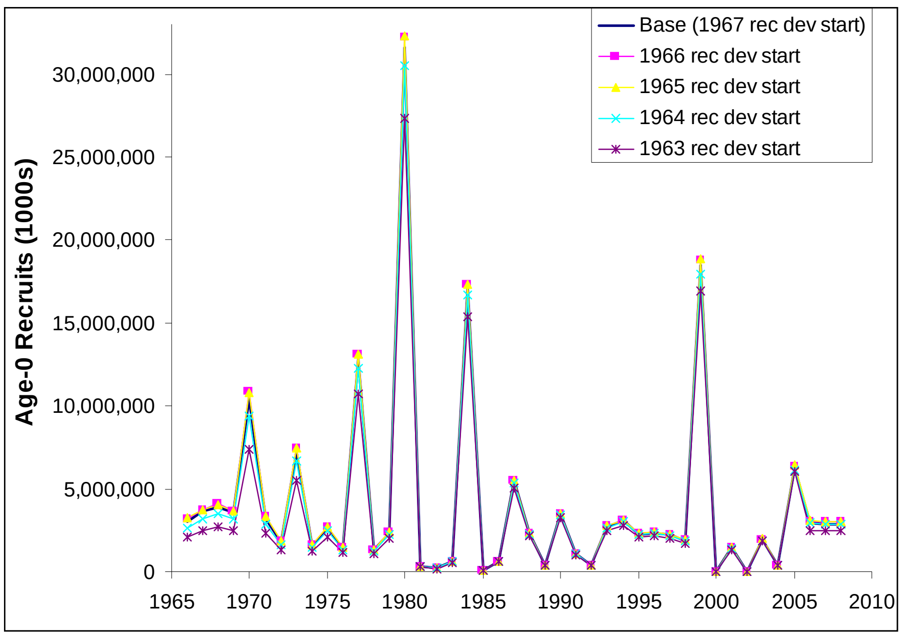


**Figure 14** The impact on the predicted sequence of recruitment deviations of extending the time series of recruitment deviations back before the available data (leading to a non-equilibrium age structure in 1966 – the assumed start of the fishery).

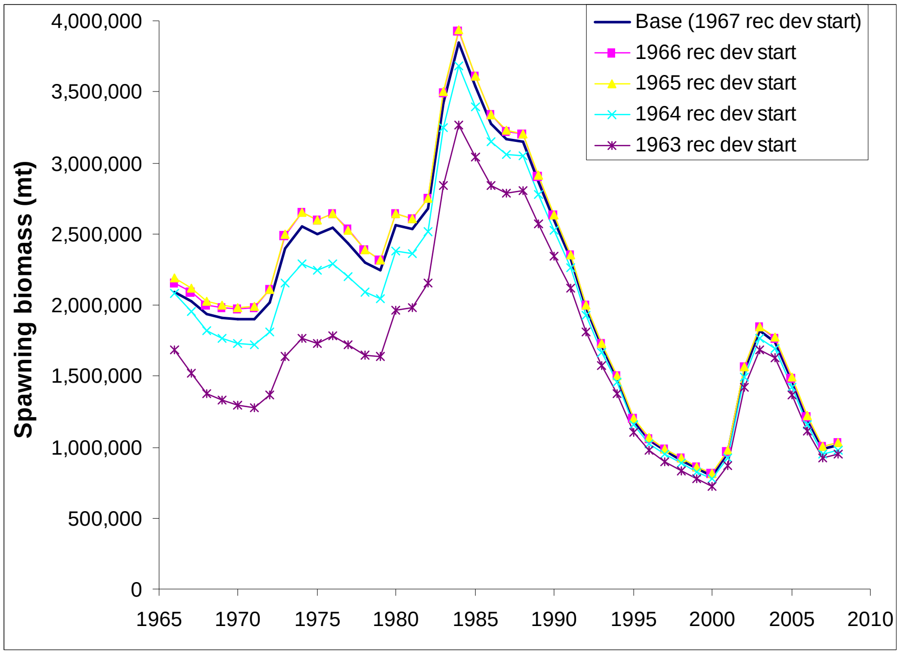


**Figure 15**. The impact on the predicted time series of spawning stock biomass of extending the start of recruitment deviations at the beginning of the time series.

Wednesday Morning for All Analysts

1. *Compute landings divided by age 2+ beginning of year biomass. Rationale: Want a consistent measure of harvest across models.*

The requested estimates of catch divide by age-2+ biomass from the three models (SS2 final base, ADAPT / VPA Run 1A, and TINSS) are shown in the middle panel of Fig. 16. The SS2 and TINSS estimates are very similar. The ADAPT / VPA estimates are generally elevated above the estimates of the other two models, which is consistent with the lower biomass estimated by the ADAPT / VPA model.

2. *Provide comparison of SSB and age-0 recruitment. Rationale: These will illustrate similarities and differences between models.*

The requested estimates of Age-0 recruitment and SSB from the three models (SS2 final base, ADAPT / VPA Run 1A, and TINSS) are shown in the top and bottom panels of Fig. 16. All three models agree on which year-classes are dominant, but the models differ in their estimates of absolute year-class strength. The SS2 and TINSS models have similar spawning biomass trajectories in the early part of the time series but diverge in recent years. The ADAPT / VPA model estimates of spawning biomass are consistently smaller than the estimates from the other two models and are considerably different for the early part of the time-series.

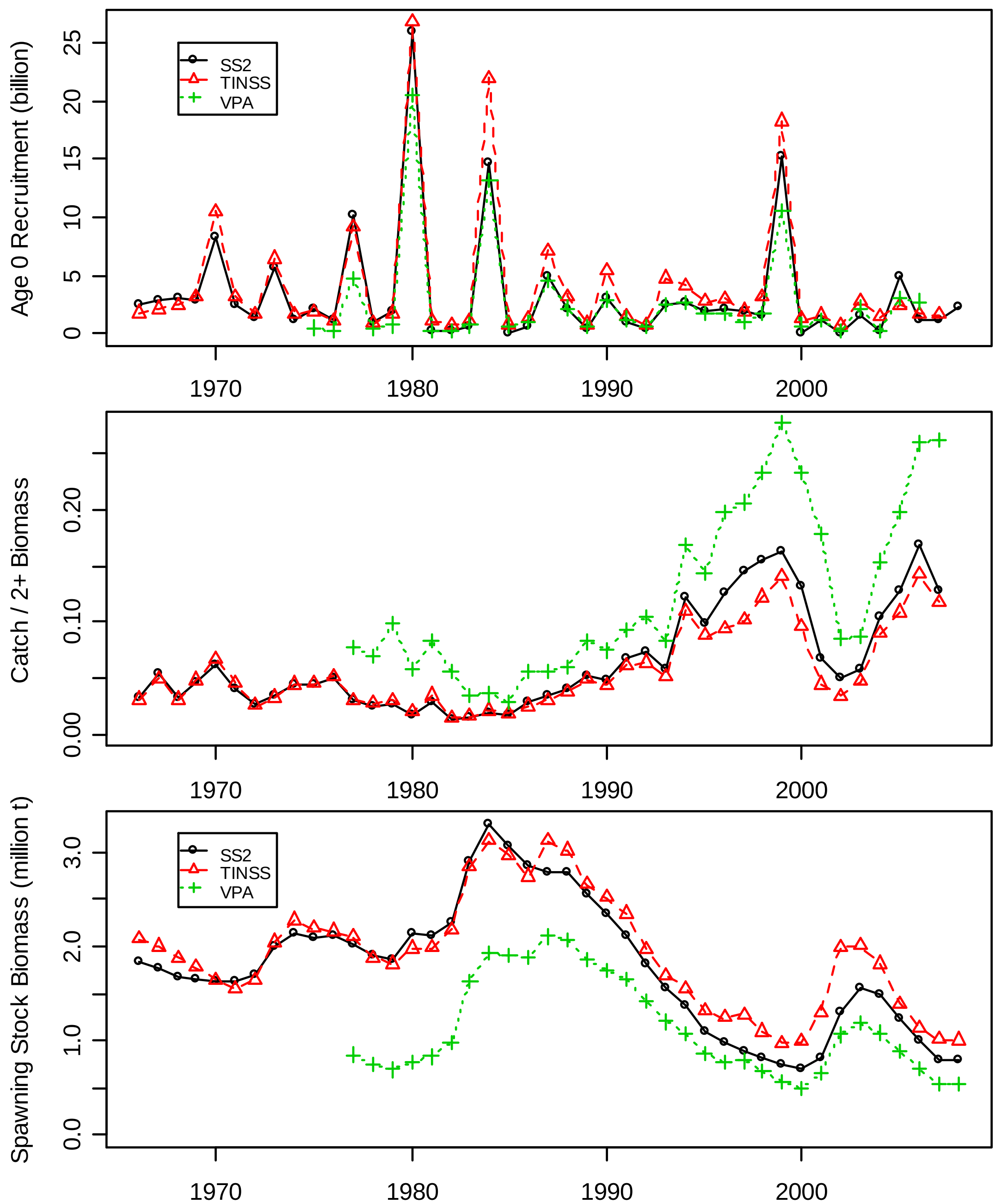


**Figure 16**. Comparison of estimates of Age-0 recruitment, harvest rate (catch / Age-2+ biomass), and spawning stock biomass from the SS2 base-case model, the ADAPT / VPA Run1A model, and the TINSS model.

3. *Provide one-year (2008) catch forecasts based on a $B_o$ calculation using the earliest growth and the 40:10 rule, linear in catch. Use Fmsy and F40% where possible. Rationale: These will illustrate similarities and differences between models.*

The STAT provided the requested information, which is summarized below.

| | SS2 | ADAPT / VPA | TINSS |
|---|---|---|---|
| 40-10 Catch in 2008 | 527,180 | 346,000 | 325,000 |

4. *Provide a comparison across models of retrospective patterns. Rationale: These comparisons will illustrate how the models respond to changes in assessment data.*

The retrospective analyses illustrated the similarities between the models. The general trend in the spawning stock biomass trajectory was approximately repeated for all models. The importance of the survey data is apparent in the shifts in the trajectory that occur following the removal of years of survey data (Fig. 17 to 19).

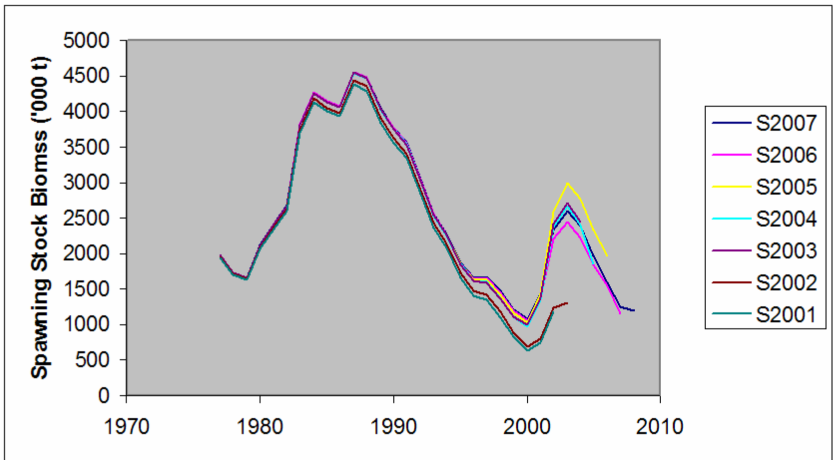


**Figure 17**. The retrospective analysis of Spawning Stock Biomass from the ADAPT / VPA analysis.

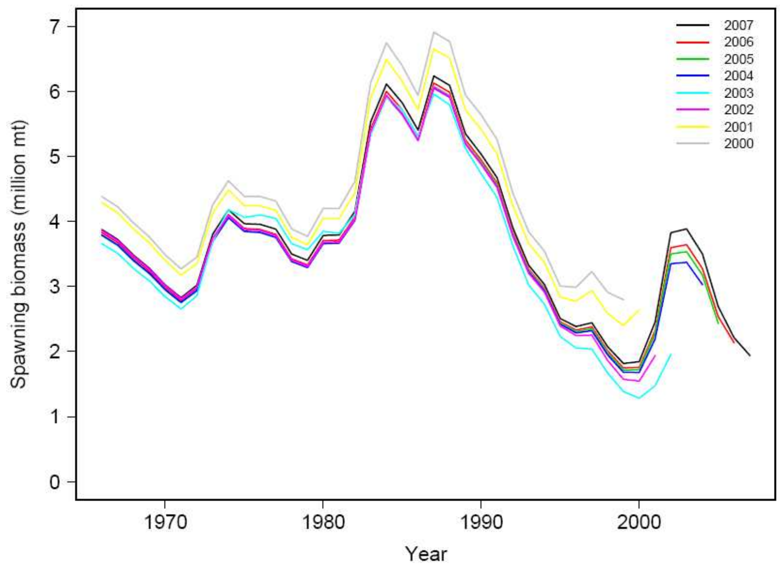


**Figure 18**. The retrospective analysis on Spawning Stock Biomass from the TINSS modelling.

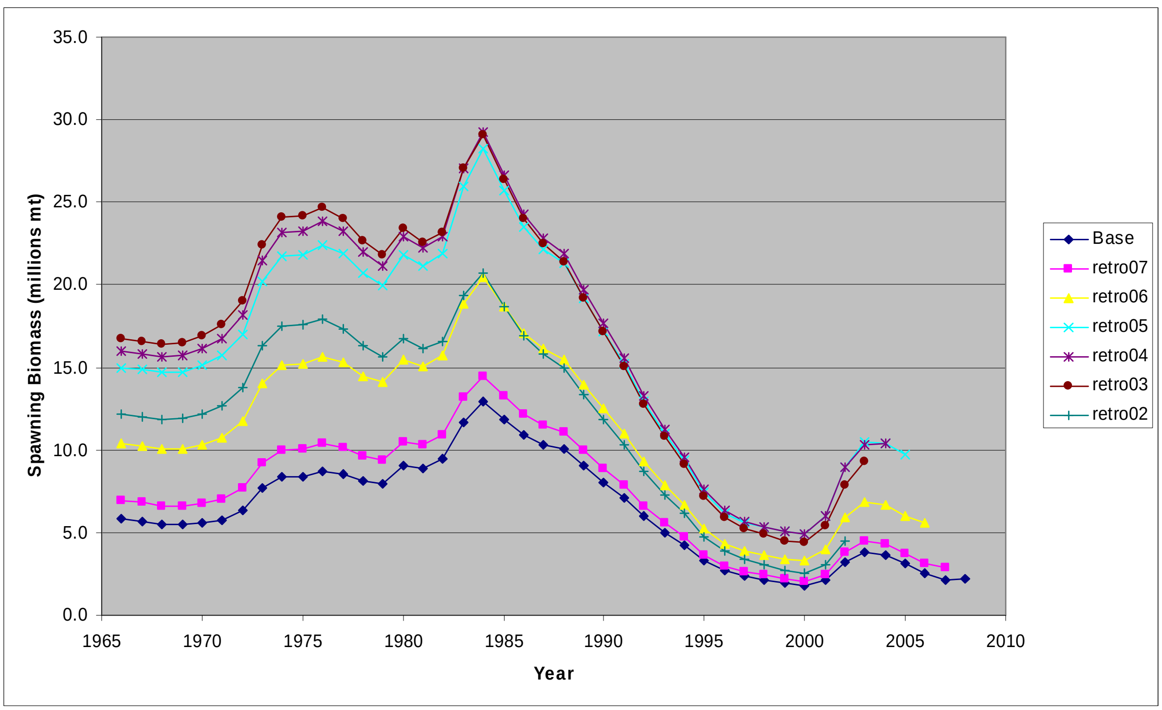


**Figure 19**. The retrospective analysis on Spawning Stock Biomass from the SS2 base-case model.

5. *With respect to Tues Pm request 1, try an age-dependent M. Fix young M at 0.23 and estimate old M. Rationale: The current specification for the SS2 decision table may over-state uncertainty. The new specification may fix this problem.*

The M for young fish was fixed up to age-13 and then allowed to change. Relative to this same summary information from the original assessment model (top panel of Fig. 12), the change in model specification resulted in the desired contraction in the range of values encompassed by the low and high alternatives

| Derived Parameter | Base model Final selex=0.5 MLE | Asymptotic 95% CI | | Alt. Low Final selex=0.7 MLE | Asymptotic 95% CI | | Alt. High Final selex=0.3 MLE | Asymptotic 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| 2007 Depletion | 0.353 | 0.240 | 0.466 | 0.324 | 0.225 | 0.423 | 0.386 | 0.254 | 0.519 |
| 2008 Depletion | 0.357 | 0.217 | 0.497 | 0.322 | 0.197 | 0.447 | 0.398 | 0.237 | 0.559 |
| MSY | 452,320 | 237,151 | 667,489 | 423,950 | 248,467 | 599,433 | 499,660 | 238,568 | 760,752 |
| $B_{MSY}$ | 1,191,500 | 629,294 | 1,753,706 | 1,045,200 | 561,394 | 1,529,006 | 1,350,100 | 704,280 | 1,995,920 |
| $SPR_{MSY}$ | 0.332 | 0.114 | 0.550 | 0.317 | 0.116 | 0.517 | 0.337 | 0.115 | 0.559 |
| 2008 Catch | 463,510 | 154,144 | 772,876 | 370,290 | 127,132 | 613,448 | 591,290 | 170,008 | 1,012,572 |
| Rzero (billions) | 1.858 | 1.532 | 2.185 | 1.682 | 1.430 | 1.933 | 2.083 | 1.612 | 2.553 |
| Bzero (millions, mt) | 2.631 | 2.171 | 3.092 | 2.379 | 2.024 | 2.734 | 2.958 | 2.293 | 3.623 |

**Figure 20**. The effect of adding an age-dependent M to the base model configuration brought to the STAR Review..

6. *In the VPA, compute a "domed-run", with F at age 14 equal to one-half the average F at ages 7-12. Rationale: Explore the reasons for differences between ADAPT and SS2 SSB estimates, which we think is due to domed-selection.*

The effect of using an imposed dome-shaped selectivity on the VPA was to increase the apparent spawning stock biomass (Fig. 21) in such a manner as to make the VPA output much more similar to the spawning stock biomass trajectories from the SS2 and TINSS models (Fig. 22). However, the mean square residual for the asymptotic (flat) selectivity was 0.664 while it was 0.857 for the dome-shaped selectivity, indicating that the quality of the model fit declined when selectivity was dome-shaped.

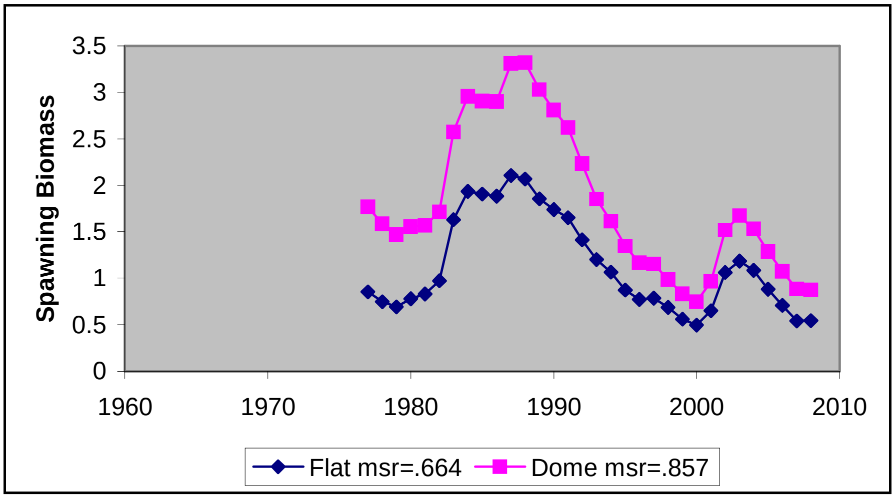


**Figure 21**. The effect of the spawning stock biomass trajectory of forcing the VPA to use a dome-shaped selectivity curve.

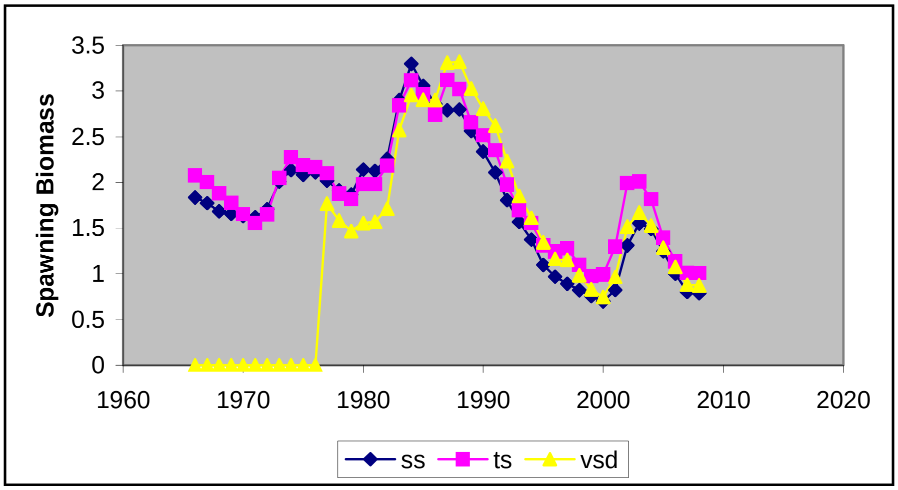


**Figure 22**. The effect of the spawning stock biomass trajectory of forcing the VPA to use a dome shaped selectivity curve. The VPA (vsd) is compared with the SS2 (ss) base-case and TINSS (ts) models.

<u>Wednesday. Afternoon.</u>

1. *With respect to Tues. PM, request 2, plot confidence limits and point estimates for SSB and depletion in 2008 from different recruitment deviation starting points. Rationale: Estimating the initial age distribution may affect uncertainty in the final results.*

The STAT produced a plot (Fig. 23) showing spawning biomass estimates and confidence limits for different recruitment deviation starting years. The plot indicated that uncertainty in the estimates of final biomass was not strongly affected by the assumption of an equilibrium age distribution in 1967.  The STAT did not produce a similar plot for estimated depletion in 2008.

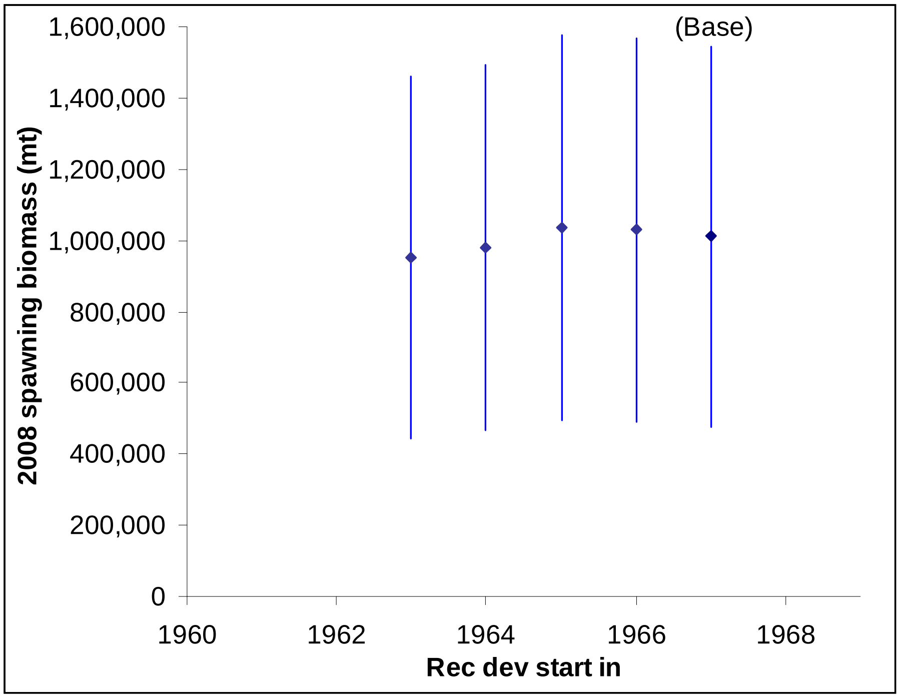


**Figure 23**. The impact on the estimated spawning stock depletion level in 2008 of extending the start of the recruitment deviations back to 1963.

2. *With respect to request 5, Wed. AM, do a run with final selection (selex) estimated. Rationale: If there is sufficient information to do this estimation, then this would provide a more objective basis for assigning probabilities to the SS2 model states of nature in the decision table.*

The overall effect of estimating the final selectivity parameter (selex), along with survey catchability and the natural mortality coefficient for the oldest age-class, was to broaden the uncertainty around the estimated 2008 catch (Fig. 24). Generally, the uncertainty in this final model encompassed the uncertainty expressed in the other SS2 model scenarios and in the ADAPT / VPA and TINSS models. Subject to some additional diagnostic tests, the Panel and STAT were of the opinion that the run "final selex est" would be suitable for use as a base model.

| Derived Parameter | Base model Final selex=0.5 MLE | Asymptotic 95% CI | | Asymptotic selex MLE | Asymptotic 95% CI | | Final selex est MLE | Asymptotic 95% CI | |
|---|---|---|---|---|---|---|---|---|---|
| 2007 Depletion | 0.353 | 0.240 | 0.466 | 0.265 | 0.193 | 0.337 | 0.362 | 0.236 | 0.489 |
| 2008 Depletion | 0.357 | 0.217 | 0.497 | 0.248 | 0.151 | 0.345 | 0.372 | 0.217 | 0.527 |
| MSY | 452,320 | 237,151 | 667,489 | 383,790 | 263,961 | 503,619 | 466,270 | 212,391 | 720,149 |
| $B_{MSY}$ | 1,191,500 | 629,294 | 1,753,706 | 796,640 | 428,101 | 1,165,179 | 1,343,800 | 712,602 | 1,974,998 |
| $SPR_{MSY}$ | 0.332 | 0.114 | 0.550 | 0.277 | 0.108 | 0.445 | 0.352 | 0.121 | 0.582 |
| 2008 Catch | 463,510 | 154,144 | 772,876 | 216,180 | 65,131 | 367,229 | 527,180 | 141,707 | 912,653 |
| Rzero (billions) | 1.858 | 1.532 | 2.185 | 1.403 | 1.254 | 1.552 | 1.728 | 1.362 | 2.095 |
| Bzero (millions, mt) | 2.631 | 2.171 | 3.092 | 1.987 | 1.776 | 2.198 | 2.567 | 2.088 | 3.047 |

**Figure 24**. The effect of altering the assumptions in the SS2 modelling with respect to selectivity (asymptotic versus estimated final selection) given estimation of the survey catchability and natural mortality for the oldest age classes.

3. *For the SS2 base model (to be decided), provide evidence of global convergence. Rationale: to confirm convergence.*

The STAT conducted a series of runs with the proposed SS2 base model in which the initial parameter values were perturbed by random "jitter". Many of the runs failed to converge. Most of those that seemed to have converged did so with the same value of log-likelihood and M for the oldest age-class as the proposed base model (Fig. 25). None of the jittered runs produced a smaller negative log-likelihood value, which suggests that the proposed base model had fully converged to the global maximum likelihood estimates.

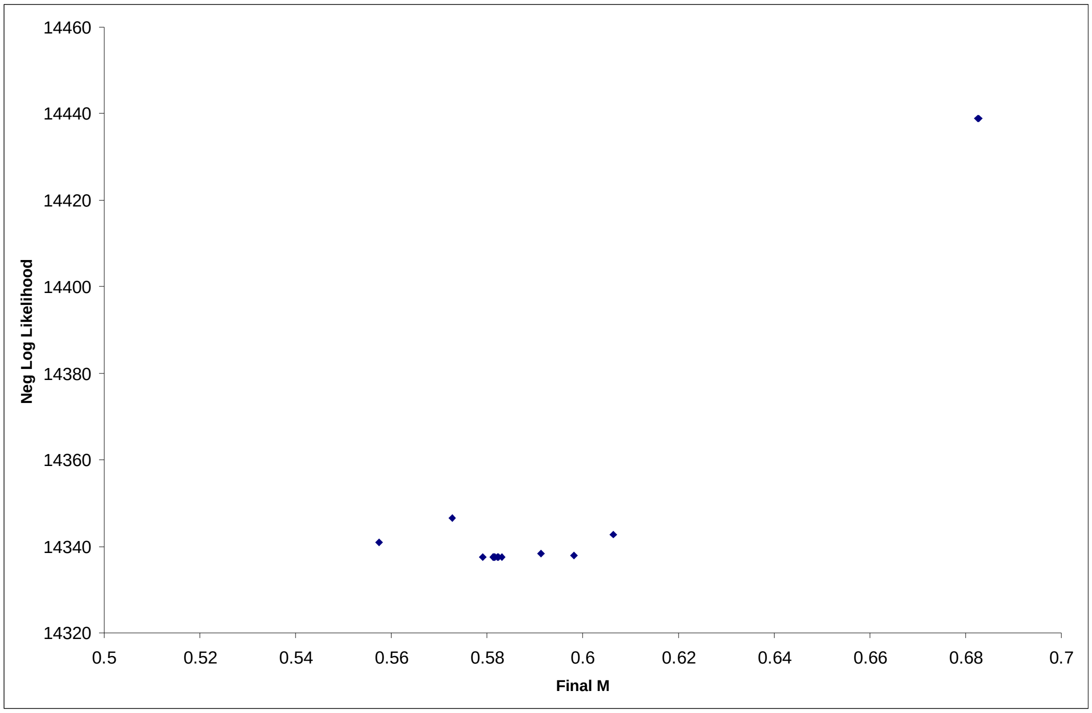


**Figure 25**. Demonstration of global convergence of the SS2 base model using randomly perturbed initial parameter values.

4. *Identify the change in fit in specific data (i.e. age+year+fishery) components, between the "final-selex est" model and the initial base model with M=0.23 and selex=0.5. The fit to the acoustic survey index appears to be worse in the final-selex est model compared to the base model. If time permits, compare final-selex est with the M-estimated (selex=0.5) model. Rationale: Better fits to a single or only a few components is less convincing from a robustness perspective than improvements in fits that are broadly distributed across most data.*

The adopted SS2 base case, where the Age-15+ natural mortality, survey *q*, and selectivity are estimated, improves the fit over the selex = 0.5 model by about 258 negative log-likelihood units (a highly significant change, Fig. 26). Most of that change is a result of changes in the fit to the age composition data. In particular the fit is especially improved with the US fishery age composition data and the acoustic trawl survey age composition data. However, for reasons that are not presently clear, the age composition data for the Canadian fishery declined in their quality of fit. While it is the case that these data tend to be in opposition to each other, it is not clear why this change in the fitting strategy should adversely influence the fit to the Canadian fishery age composition data.

| | selex = .5 | free M selex | difference |
|---|---|---|---|
| LIKELIHOOD | 14595.4 | 14337.6 | -257.8 |
| indices | -6.86409 | -2.60188 | 4.26221 |
| length_comps | 1883.36 | 1892.21 | 8.85 |
| age_comps | 12661.7 | 12400.8 | -260.9 |
| Recruitment | 55.5339 | 43.4585 | -12.0754 |
| | | | |
| us lgt | 1241.1 | 1244.6 | 3.5 |
| can lgt | 533.138 | 530.324 | -2.814 |
| surv lgt | 109.117 | 117.288 | 8.171 |
| us age | 8218.97 | 8070.83 | -148.14 |
| can age | 2757.38 | 2800.46 | 43.08 |
| surv age | 1685.38 | 1529.5 | -155.88 |
| survey | -6.86409 | -2.60188 | 4.26221 |

**Figure 26**. Changes in negative log-likelihood resulting from model configuration changes from the preliminary base case SS2 model in the original assessment document.

5. *For the final-selex est SS2 model, provide estimates of cryptic biomass. Rationale: We want to establish how much of the older spawning biomass is unobserved by the survey.*

Cryptic biomass is predicted to make up a variable amount of the stock at different times in the history of the fisheries (Fig. 27). Once the 1980 and 1984 year classes began to join the exploited stock, the cryptic biomass attained levels of more than 500,000 tonnes. Currently the proportion of cryptic biomass is at a low level, being less than 5%, but this is expected to increase because the 1999 year-class is just entering the cryptic phase (age-9+).

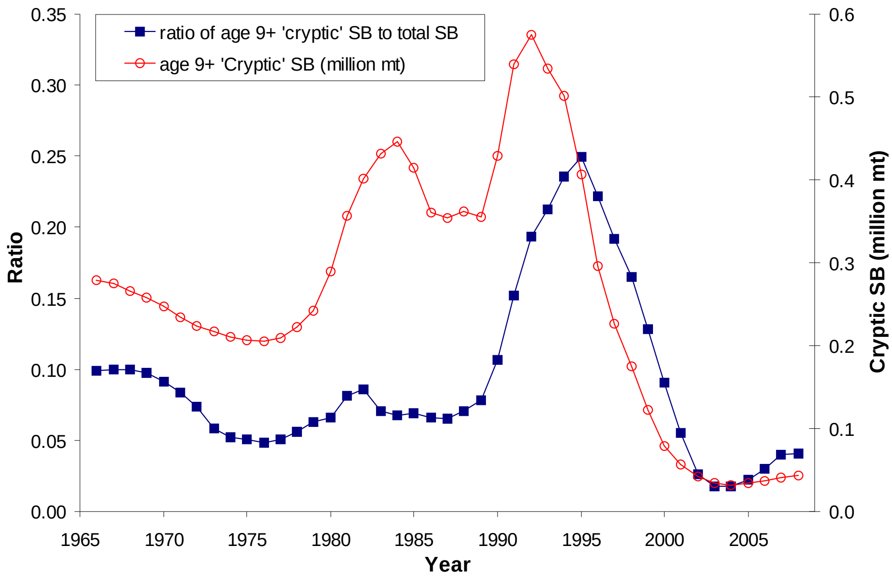


**Figure 27**. The ratio of cryptic biomass (aged 9+) and total biomass expressed as a ratio and as an absolute measure of cryptic biomass. The impact of the 1980 and 1984 year-classes is apparent while the effect of the 1999 year-class has yet to appear.

### Description of base model

Three distinct stock assessment models were brought to the STAR Panel meeting and were carefully reviewed by the Panel. While all three models worked from the same basic set of data, they used different approaches for aggregating the data and made different structural assumptions to model the data. The STAR Panel chose to use the SS2 modeling platform for the base model and decision table because the SS2 model made the most comprehensive use of the available data and provided a more flexible tool for evaluating different plausible sets of assumptions regarding underlying uncertainties in the data (e.g., relative error among different data sources, imprecision in age-readings) and in the model structure (e.g., domed versus asymptotic selection, time-varying selection, age-dependent natural mortality). Further, results from the SS2 model configuration chosen for the base model encompassed the range of results produced by the other model platforms (ADAPT / VPA and TINSS). Requested model runs for the ADAPT / VPA and TINSS models demonstrated that these models were able to produce spawning stock biomass trajectories that were very similar to those produced by the SS2 model.

The SS2 model configuration selected for the base model had the following features.

- A single coastwide stock was assumed and there was no explicit spatial structure.
- There were separate US versus Canadian fisheries, each with its own length-composition and conditional age-at-length composition data and age-based selection curves.
- The joint US-Canada acoustic / midwater trawl survey biomass index was the primary tuning index.

- Age-reading imprecision was incorporated, but there were insufficient data to estimate ageing bias.
- Time-varying growth parameters were estimated.
- A Beverton and Holt recruitment curve was estimated using an assumed beta-prior probability distribution for the steepness parameter and a variability parameter (sigma-R) value of 1.13, with annual recruitment deviations estimated for 1967 to 2005.
- Fishery selection was time-blocked to accommodate apparent targeting of strong year-classes and structural changes in the fisheries (four independent blocks for each of the two fisheries).
- Acoustic survey selection was assumed to be time-invariant.
- The catchability coefficient for the acoustic survey was freely estimated.
- The selection curves for the two fisheries and the acoustic survey were estimated and not forced to be asymptotic.
- The natural mortality coefficient was fixed at $0.23^{-yr}$ for ages 0 to 13, and then was allowed to ramp to higher (or lower) values for age-14 and the age-15+ group.

<u>Alternative models used to bracket uncertainty.</u>

The alternative models for constructing the decision table were derived from the posterior distribution of the base model rather than from alternative model formulations. As previously noted, however, numerous other model configurations were explored during the STAR Panel review, including formulations based on the ADAPT / VPA and TINSS models. The approximate confidence intervals surrounding the SS2 base model estimates generally encompassed the range of values estimated by other reasonable model forms and configurations.

**Technical merits / deficiencies in the assessment**

In past assessments for this stock the catchability coefficient for the acoustic survey (survey-Q) was the major dimension of uncertainty. Past STAR Panels have recommended bracketing uncertainty in decision tables by using one or more fixed values of survey-Q. Discussion during the current STAR Panel review focused primarily on the issue of the form of the selection curves: domed versus asymptotic. The ADAPT / VPA and TINSS models assumed that selection curves for the two fisheries and the survey should all be asymptotic. The SS2 model, in contrast, used a formulation for selection that allowed the data to indicate its preference for domed versus asymptotic selection; that is, SS2 estimated the amount of dome.

The SS2 base model and the ADAPT / VPA and TINSS models made the strong but unverified assumption that the weight-at-length (or age) relationship and the maturity-at-length (or age) relationship have been time-invariant, despite radical changes in stock biomass and cohort strength that could affect these key biological components.

<u>The Stock Synthesis model</u>

- The SS2 model as formulated in the current assessment allowed the STAT to conduct a very full exploration of how key parameters (natural mortality, survey catchability, shape of the selection curves) influenced goodness-of-fit to the data.

- Despite the very flexible modeling structure used, the various likelihood profiles indicated clear tension between the US versus Canadian age-composition data. The reason for this tension is unclear but probably indicates one or more structural problems with the current model formulation. Possible issues include accounting for spatially related stock dynamics, the need to distinguish the genders, and having the selection processes be explicitly length based.
- The STAT explored the effects of assuming an initial equilibrium age-composition and showed that the assumption had little impact on the uncertainty of the estimates of biomass or depletion levels, but this result was very counter-intuitive.

<u>The ADAPT / VPA model</u>

- The ADAPT / VPA model, relative to the other two models, provided the most flexible approach to modeling fishery selection. It did not assume any particular form for selection except at the oldest true age (14) in the model. However, the model was based on the assumption that acoustic survey catchability at ages 13 and 14 were equal.
- The model did not estimate fishing mortality values for the age-15+ fish. As a consequence the issue of reduced selection for the terminal age-class was not investigated.
- Results from a VPA are subject to error due to selection of the so-called terminal fishing mortality coefficients. The influence of this error dissipates as the estimates of stock size propagate to younger ages, but a high cumulative fishing mortality is required to produce rapid dissipation. Because relatively low fishing mortality rates have been applied to the Pacific hake stock, especially prior to 1993, it seems likely that the estimates of abundance and biomass may still be tainted by error from the terminal fishing mortality values.

<u>The TINSS model</u>

- The approach of formulating the model in terms of the management variables MSY and F(MSY) seems very sensible and preferable to having these variables be derived from other less meaningful parameters (e.g., steepness).
- The model provided a simple representation of the dynamic processes that was uncluttered by nuisance parameters.
- The model results presented to the STAR Panel did not provide much evidence that the model's simple structure provided an adequate representation of the available data. For example, residual plots from the model fits to the age-composition data showed evidence of systematic lack of fit to the youngest and oldest ages, consistent with the notion that the fit could be improved by allowing domed selection, but the magnitude of the improvement was not evaluated.

<u>Recommendations for remedies</u>

- The importance of possible structural problems in the SS2 model could be explored by constructing more complex models that incorporate processes based on length, gender, and space. However, overly complex models may not produce reliable results on which to base management decisions.

- The VPA approach is appealing because of its simplicity and transparency, and it provides a useful contrast to integrated analysis approaches such as SS2 and TINSS. Use of alternative VPA derivatives, such as XSA or other approaches, might provide a useful contrast to the ADAPT approach.
- The TINSS model could usefully be expanded to include other processes affecting the dynamics of the stock (e.g., time-varying selection) and the available data (e.g., ageing error). It would useful to include measures such as AIC for formally evaluating model parsimony.
- A full Management Strategy Evaluation would permit the formal evaluation of the relative value of each modeling approach (e.g., SS2, VPA, TINSS) for the production of management advice. The Management Strategy Evaluation approach is internationally accepted as the best way of evaluating the performance of stock assessment methods and their interplay with management decisions.

**Areas of disagreement regarding STAR Panel recommendations**

Among STAR Panel members

There were none

Concerns raised by GAP, GMT, and DFO advisors

There were none

Between the STAR Panel and STAT Team

The analysts responsible for preparing the ADAPT / VPA model disagreed with the STAR Panel's recommendation to use the SS2 model for developing a base model and decision table. Their minority report is included as an appendix.

**Unresolved problems and major uncertainties.**

Data problems and uncertainties

- Although the SS2 model included age-reading imprecision, the age-composition data are assumed to be unbiased, but the validity of this assumption has not been evaluated.
- There continues to be considerable uncertainty regarding the acoustic target strength of Pacific hake. This uncertainty may be consistent with the variability in survey-Q implied by the three models, but this consistency should be established to verify that the models have correctly incorporated the uncertainty associated with the acoustic survey.
- It was disconcerting to learn that the acoustic survey biomass estimates are based on very sparse sampling to establish the species, size and age composition of the acoustic signs. While it is accepted that this is typical of acoustic surveys, it would have been reassuring to have been shown some evidence that a single short tow from a long acoustic transect provides a reliable and unbiased estimate of the species, size, and age composition of identified fish aggregations.

Modeling problems and uncertainties

- The SS2 and TINSS models both estimated the acoustic survey-Q to be less than 1, but the ADAPT / VPA model estimated the survey-Q to be greater than 1 for some older ages. The mechanisms that account for the discrepancies of survey-Q from 1 need to be understood.
- It is unclear what mechanisms are responsible for the apparent domed selection in the fisheries and survey that is implied by the SS2 model.
- Spatial changes in fishery operations have the potential to cause high inter-annual variation in fishery selection. The SS2 model uses four time-blocks to accommodate changes in fishery selection but this may be too rigid a structure. The consequences of imposing an overly rigid selection structure are unknown.
- The issue of an appropriate objective method for iteratively re-weighting observed data remains unresolved. The approach taken to develop the SS2 base model seems reasonable, but we have no basis for presuming that the approach produced a correct balance of the uncertainties among the different data sources.

**Management, data, or fishery issues raised by the GMT, GAP, or DFO advisors.**

Discussions during the STAR Panel review identified several important risk factors that, in the interest of being precautionary, should be taken into consideration when setting catch quotas for 2008. For several years the fishery has been very dependent on the exceptionally strong 1999 year-class; this year-class is now diminishing in biomass. None of the more recent year-classes show evidence of being as strong as the 1999 year-class. Successful recruitment in the future depends on leaving the stock with adequate spawning biomass. Despite catches being constant or even declining, fishing mortality in recent years has been increasing and is now estimated to be at higher levels than it was during most of the history of the fisheries.

The standard decision table developed for the Council does not fully address the Canadian Request for Catch Advice which asked how the expected trajectory of stock biomass would be affected by a range of annual catch quotas. Consequently, the Panel asked the STAT to develop a risk plot with the SS2 base model showing the effect of different levels of catch (Fig. 28, below; Fig. 58 in the SS2 assessment document).

The Canadian Request for Catch Advice also asked for an analysis of appropriate biological reference points for the stock. Specific analyses to address this request were not examined by the STAR Panel.

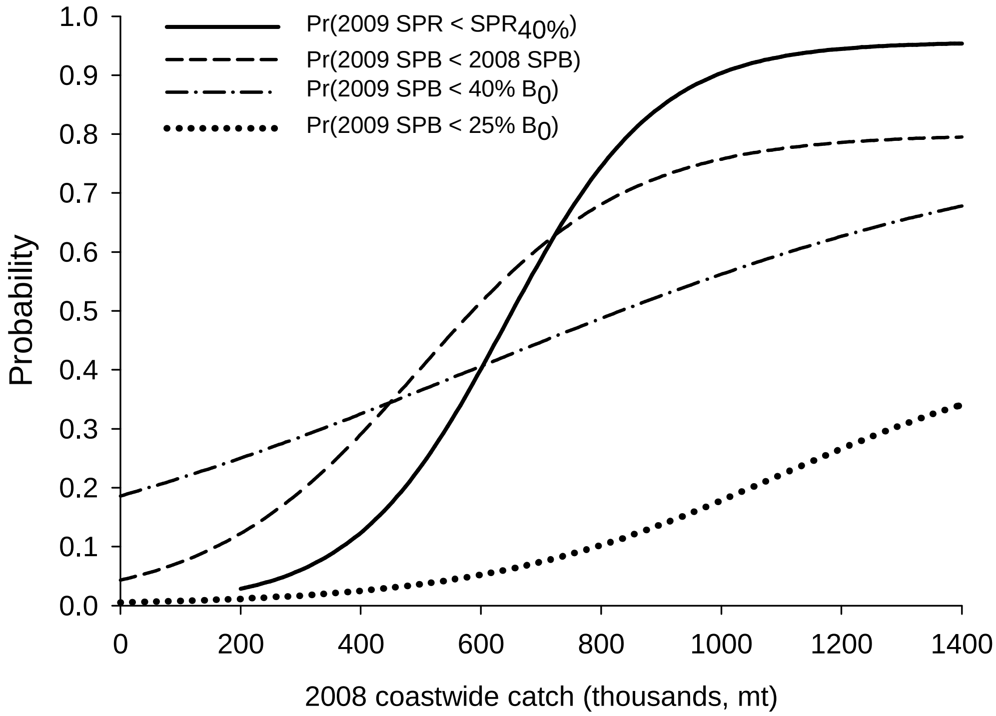


**Figure 58**. Risk profiles showing probability of the 2009 SPR rate being less than target SPR40% and 2009 spawning biomass being less than 25% Bzero for a suite of different coastwide catches in 2008.

**Prioritized recommendations for future research and data collection**

The Panel notes that the 2007 STAR Panel presented a comprehensive review of recommendations from past STAR Panels. Many of these recommendations still apply, but they are not reiterated here. The recommendations below resulted from discussions during the 2008 STAR Panel review and subsequent email exchanges.

1. The Panel recommends that a Management Strategy Evaluation approach be used to evaluate whether the current 40-10 harvest control rule is sufficient to produce the management advice necessary to ensure the sustainable use of the Pacific hake stock with its dramatically episodic recruitment. The 40-10 rule assumes that simply reducing catches in a linear fashion as stock biomass declines will be sufficient to guide the fishery back towards the target spawning biomass level. However, with the fishery being dependent upon a single declining cohort just reducing the catch may achieve the status quo but it rebuilding will not occur without new recruitment.

2. Related to Recommendation 1, the operating model developed for the Management Strategy Evaluation should evaluate how well the different assessment models recapture true population dynamics. At issue is whether a simpler model such as ADAPT / VPA performs better or worse than a more complex model such as SS2.

3. Female Pacific hake grow differently than male Pacific hake and many of the more influential dynamic processes that operate in the fishery are length-based but are currently considered from an age-based perspective (for example selectivity). The Panel recommends

that future assessment models explore the need for including both gender- and length-based selection into the dynamics.

4. The inclusion of ageing error was found to be influential on the model fit in the SS2 model. However, issues with ageing still remain. Further ageing error analyses are required, especially focused on estimating any bias in the ageing. It will be important to conduct a cross-validation of ageing error from the different laboratories conducting the ageing. It is especially important to include otoliths that were read by AFSC staff.
5. In light of current acoustic survey information, re-evaluate treatment / adjustment of pre-1995 acoustic survey data and index values. For example, compare the biomass index implied by the area covered by the pre-1995 surveys with the total biomass from the full area covered by the post-1995 surveys. The difference between these two indices has implications for the magnitude of the survey catchability coefficient prior to 1995.
6. There should be further exploration of geographical variations in fish densities and relationships with average age and the different fisheries, possibly by including spatial structure into future assessment models.
7. There should be exploration of possible environmental effects on recruitment and the acoustic survey.
8. There should be further investigation and resolution of possible under-reporting of foreign catch.

**List of STAR Panelists**

- David Sampson, Panel Chair and Scientific and Statistical Committee representative
- Malcolm Haddon, Panel Reviewer from the Center for Independent Experts
- Noel Cadigan, Panel Review from Fisheries and Oceans Canada
- Jeff Fargo, Advisor from Fisheries and Oceans Canada
- Dan Waldeck, Advisor from the Groundfish Advisory Panel
- John Wallace, Advisor from the Groundfish Management Team

**List of STAT Members**

- Tom Helser, NWFSC / NMFS, lead author of the SS2 assessment
- Ian Stewart, NWFSC / NMFS, co-author of the SS2 assessment
- Owen Hamel, NWFSC / NMFS, co-author of the SS2 assessment
- Alan Sinclair, Fisheries and Oceans Canada, lead author of the ADAPT / VPA assessment
- Chris Grandin, Fisheries and Oceans Canada, co-author of the ADAPT / VPA assessment
- Steve Martell, University of British Columbia, author of the TINSS assessment

**References**

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Martell, S. (2008) Assessment and management advice for Pacific hake in U.S. and Canadian waters in 2008. 47 p.

Sinclair, A.F. and C.J. Grandin (2008) Canadian fishery distribution, Index analysis, and Virtual Population Analysis of Pacific Hake, 2008. 59p.

# Canadian Fishery Distribution, Index Analysis, and Virtual population Analysis of Pacific Hake, 2008

**A. F. Sinclair and C. J. Grandin**
**Fisheries and Oceans Canada**
**Pacific Biological Station**
**Nanaimo, BC, Canada**

**Prepared for the 2008 joint Canada / USA Pacific hake stock assessment meeting in Seattle WA, February 11-14, 2008. This document is for the purposes of the assessment peer review process and represents a work in progress. The original document was amended in response to comments from the review process.**

**Abstract**

The Canadian fishery distribution shifted in 2006 and 2007 with most of the catch taken in Queen Charlotte Sound, well north of the traditional fishing grounds off southwest Vancouver Island. Catch timing suggests hake may have migrated past the traditional location in late spring and returned in early fall. There was very little difference in the size and age distribution of the catches between north and south. The 1999 year-class dominated commercial catches in both years. The 1999 year-class has dominated catch of Pacific hake for several years. These results suggest that the fish caught in the north in 2006 and 2007 were mainly the offshore stock. However, the 2007 hydroacoustic survey caught a large number of age 1 year hake in the Canadian zone. This has not been seen before.

Analysis of the hydroacoustic survey abundance index at age indicated that the 1980, 1984, and 1999 year-classes were the largest year-classes in the population since the acoustic survey began in 1977. Two of the year-classes produced since the 1999 are estimated to be very small (2002 and 2004), the 2000, 2001, and 2003 year-classes were estimated to be below average. The 2005 year-class was estimated to be slightly above average. A qualitative analysis of the acoustic survey results indicated that hake are experienced a consistent rate of total mortality over the age range of 7-14. This supports the idea that recruitment to the acoustic survey is asymptotic An analysis of total mortality rate indicates the adults of the population have a total mortality rate of 0.48. The survey data alone do not indicate temporal patterns in total mortality, however the statistical power to detect such changes is limited. An analysis of relative fishing mortality at age, based on a combined analysis of the survey results and the commercial catch at age, indicates that hake recruit to the acoustic survey before they recruit to the commercial fishery. Secondly, fishing mortality reached an asymptote at age 4 and was consistent at older ages, suggesting that recruitment to the commercial fishery is asymptotic. Relative fishing mortality appeared to increase from the late 1970s to the late 1990s, then there was a decline, followed by an increase from 2003 to 2007.

Several formulations of virtual population analysis were undertaken. The results were in close agreement regarding temporal trends in spawning biomass, recruitment and fishing mortality. The results also suggested that recruitment to both the survey and fishery was asymptotic. However, the scale of estimates and the magnitude of forecast catches was sensitive to the formulations. Two issues of concern were described. The first had to do with how estimates of fishing mortality at age were distributed and the associated estimates of fishery selectivity. The second had to do with high estimates of target fishing mortality (F40%). Catch forecasts are provided consistent with the 40/10 rule. Alternative forecasts at a *status quo* fishing mortality are also provided.

These analyses have revealed several important assessment uncertainties. Management procedure evaluation is an approach that could be used to gain a better understanding of how to assess this stock in the future.

## Introduction

The Pacific hake, also referred to as Pacific whiting (*Merluccius productus*) is a transboundary stock which is jointly managed by Canada and the USA. A treaty dealing with joint management was signed in 2003. The treaty specifies a number of committees and procedures for stock assessment and management. However, these are yet to be fully implemented. In the mean time, scientists from the USA and Canada have endeavored to continue the assessment process "in the spirit of the treaty".

Canadian fishery managers prepared a request for advice on this stock in advance of the 2008 assessment meeting (Appendix 1). The request indicates concern that recent catch advice for the stock was well above the historic maximum catch when the population was dominated by a single year-class which is declining in biomass. The managers asked that alternative assessment methods be considered in order to provide more certainty about projected catches. There has been a recent shift in the location of the fishery in Canadian waters from the traditional area off southwest Vancouver Island to a more northerly location in Queen Charlotte Sound. Managers have asked for additional information about the stock structure of hake that were caught in the northern area.

This working paper addresses the request for advice. There are three main sections. The first provides a description of the recent changes in distribution of the Canadian fishery along with a comparison of the size and age compositions of hake caught in the traditional and new area. The second section presents an analysis of the basic assessment input data "on their own", before they are used in a more complex stock assessment model. This analysis is focused on structural information regarding relative year-class size, mortality rates, and selectivity patterns. The third section presents a virtual population analysis (VPA) of the stock. The "on their own" and VPA analyses used the same input data as were used in the other two stock assessment models presented at this 2008 meeting, SS2 and TINSS.

## Recent Changes in the Canadian Pacific Hake Fishery

The commercial fishery catches for Pacific Hake are monitored by on-board observers or the landings by shoreside observers. Random samples are taken at sea and from the conveyors which carry fish to the processing plants. Lengths and weights are recorded, and otoliths taken for age determination from a subset of the sampled fish. The otolith samples are aged using either break and burn or surface ageing methods. Samples are either age-length or length only but are random and representative of the length and age composition of the population.

The following approach was used to calculate the length and age composition of all Canadian commercial catches based on the collected within strata fleet and year (Gavaris and Gavaris 1983). It begins by applying. The weights of individual samples are then calculated using the allometric equation (1), where $\alpha = 7e-6$ and $\beta = 2.9624$ and equations (2) and (3). An estimate of the number of fish in a sampled catch is produced (equation (4), (6)). This number is multiplied by the ratio of the weight of all catches to the sum of the weight of the sampled catch (equations (5), (7)) to give numbers at length and numbers at age and length respectively. An age-length key is then produced using equation (8). The age-length key is multiplied columnwise by the length frequency to give numbers at length and age (equations (9), (10)).

| | |
|---|---|
| $a$ | age |
| $l$ | length |
| $m$ | sample |
| $fy$ | stratum (fleet and year) |
| | |
| $n$ | number sampled for length |
| $n'$ | number sampled for age and length |
| $N$ | number caught in sampled catches |
| $\dot{N}$ | number caught in all catches |
| $w$ | sample weight |
| $W$ | weight of sampled catches |
| $B_{fy}$ | weight of all catches for fleet $f$ in year $y$. |
| $P_{lfy}$ | length frequency proportion by fleet $f$ and year $y$ |
| $\alpha$ | coefficient of the allometric relationship |
| $\beta$ | exponent of the allometric relationship |
| $\varpi$ | predicted weight of a fish from an allometric relationship |
| $n_{lmfy}$ | number of fish in a length-only sample at length $l$ in sample $m$ taken in fleet $f$ for year $y$. |
| $n'_{almfy}$ | number of fish in a length-age sample at age $a$, length $l$ in sample $m$ in fleet $f$ for year $y$. |

Weight at length $l$

(1) $$\varpi_l = \alpha \, l^{\beta}$$

Weight of sample $m$ in fleet $f$ for year $y$

(2) $$w_{mfy} = \sum_l n_{lmfy} \varpi_l \qquad \text{for a length-only sample}$$

(3) $$w_{mfy} = \sum_l n'_{almfy} \varpi_l \qquad \text{for a length-age sample}$$

Number of fish at length $l$ in sample $m$ in fleet $f$ for year $y$

(4) $$N_{lmfy} = n_{lmfy} \frac{W_{mfy}}{w_{mfy}}$$

Number of fish at length $l$ caught in all catches in fleet $f$ for year $y$

(5) $$\dot{N}_{lfy} = \sum_m N_{lmfy} \frac{B_{fy}}{\sum_m W_{mfy}}$$

Number of fish at age *a* and length *l* in sample *m* in fleet *f* for year *y*

(6) $$N_{almfy} = n'_{almfy} \frac{W_{mfy}}{w_{mfy}}$$

Number of fish at age *a* and length *l* caught in all catches in fleet *f* for year *y*

(7) $$\dot{N}_{alfy} = \sum_m N_{almfy} \frac{B_{fy}}{\sum_m W_{mfy}}$$

Proportions of fish at age *a* given a length of *l* in fleet *f* for year *y*

(8) $$P_{a|lfy} = \frac{\dot{N}_{alfy}}{\sum_l \dot{N}_{alfy}}$$

If only age-length samples were taken

(9) $$\dot{N}_{afy} = \sum_l \dot{N}_{alfy}$$

If both age-length and length only samples were taken. Note, $\dot{N}_{lfy}$ would include age-length samples.

(10) $$\dot{N}_{afy} = \sum_l \dot{N}_{lfy} P_{a|lfy}$$

Changes in the spatial and temporal distribution of catch in the Canadian fisheries

The spatial distribution of hake catches in Canadian waters was analysed by minor statistical areas (Figure 1).The commercial fisheries before 2006 took most of their catch from minor area 23, also known as Big Bank (Figure 2).  Commercial fishing in 2006 and 2007 shifted northward into minor statistical areas 8 and 11, well north of Vancouver Island (Figure 3).  The JV fishery shows a similar pattern.

Cumulative catch trajectories for combined commercial catch reveal that before 2006, almost all catch, ~300,000 t, was taken from area 23, Big Bank (Figure 4).  Fishing typically occurred there at a fairly constant rate from days 140 to 300 of the year (April 20 – November 1).  In 2006 and 2007, however, most of the catch was removed from areas 8 and 11, much further north (Figure 5).  Figure 6 shows cumulative proportion of catch for commercial fisheries prior to 2006, commercial fisheries for 2006 and 2007, and survey catch for 2007.  Southern areas show a major change in the timing of the fishery, it appears that in 2006 and 2007 vessels tried fishing in area 23 around days 110-150, and then moved to the north due to lack of catch.  Areas 8 and 11 show an earlier fishery for 2006 and 2007 and there was another flurry of catch in area 23 in September, implying that the catch for these years was not taken from area 23 until the stock began their migration back southward.

The age-length compositions and distributions of all commercial catches for years prior to 2006 were calculated using the above methods. For these plots, north is considered to be minor areas 1-9, 11, 31, 34, and 35 (see Figure 1). Southern areas include minor areas 20, 21, and 23-27. The fishery was mainly southern-based (Figure 7 and Figure 8) during the years prior to 2006, with catch numbers being an order of magnitude larger in the south; also the northern hake were generally younger and smaller than the southern hake. The northern domestic catch in Figure 3 is mainly located in Goletas Channel (area 11, northeast Vancouver Island), which may suggest either that some of the gulf stock was being caught or that some of the offshore stock missed their southward migratory path (Workman pers. comm.). Gulf hake are generally smaller at age than those in the offshore stock (Mcfarlane and Beamish 1985). The 1999 year class is distinct in both age compositions for 2006 and 2007 with slightly larger fish in the north (Figure 9 and Figure 10).

The acoustic survey has seen a dramatic difference in composition in 2007 (figures 11-14). The northern catch from 1999 to 2006 has been unimodal, at lengths 46-48 cm, or ages 6 and 7 (Figure 11). The 1999-2006 southern catch also has one length mode, 46 cm, and two age modes, 4 and 6 (Figure 12). The 2007 age and length compositions can be seen in and. The acoustic survey age composition was bimodal in the north in 2007, with the majority being age 8, but with a very large age 1 group (Figure 13). The southern age composition in 2007 was dominated by age 1 hake with a small number of age 8 fish (Figure 14). The acoustic survey was fishing in the southern areas before the commercial fisheries took most of their catch (Figure 6), which may explain the difference in age-length compositions between the acoustic survey and commercial fisheries for the southern areas (Figure 10 and Figure 14).

Hallowed 1992 notes that there has been evidence of spawning in more northern waters in the past. The National Marine Fisheries Service has found hake eggs as far north as the coast of Washington state (Hallowed 1992) and Workman (pers. comm.) has found them off the west coast of Vancouver Island. McFarlane is undertaking a comparative DNA/parasite survey in February 2008 to determine if the hake being caught in the north are of the gulf or offshore variety (McFarlane pers. comm.). The gulf stock differs genetically from the offshore stock and lack the parasite *Kudoa paniformis*, which causes offshore hake flesh to rapidly degrade (McFarlane and Beamish, 1985).

**Analyses of the Acoustic Survey and Fishery Catch at Age Data for Pacific Hake "On Their Own"**

Catch advice for Pacific hake has been based on the results of an SS2 stock assessment model for a number of years. Model input includes total catch weight, proportional catch at length and conditional proportions at age given length for the USA and Canadian fisheries (separately), as well as a biomass index, proportional catch at length, and conditional proportions at age given length from an acoustic survey.

Model estimates presented in last year's assessment were highly sensitive to changes in model structure (Helser and Martell 2007). Two catch options were presented that varied only in assumptions regarding survey catchability, one assumed catchability of 1.0, the second used a prior distribution with a mean of 1 and a standard deviation of 0.10. Both model formulations gave spawning stock biomass estimates for the final year of the assessment to be near the lowest previously observed, however the advised catches were 1.6 and 2.4 times the highest catch previously observed. Other trial model runs indicated similar sensitivities. It is not clear why the outputs are so sensitive to relatively minor changes in assumptions.

The SS2 model estimates age-dependent selectivity patterns to the USA and Canadian fisheries as well as to the acoustic survey. The estimated selectivity patterns were strongly dome shaped, with full selection at intermediate ages and a sharply declining selectivity at older ages. If true, this indicates there is a substantial biomass of mature hake somewhere in the system that are not exploited by the fishery and not counted by the acoustic survey. It was suggested that older fish may be close to bottom and not available to the mid-water gear commonly used in the fishery and survey (Helser and Martell 2007). This was supported by a comparison on age composition data from the USA triennial bottom trawl survey and the acoustic survey by. However, the estimated selectivity patterns had a significant effect on catch forecasts and it was not clear if they were real or an artefact of model misspecification. The direction of the bias appears to be toward overoptimistic results, and the consequences on the resource could be devastating.

The intent of this section is to apply simple techniques to the input data to gain insight into population processes such as year-class strength, total mortality, selectivity to the survey and commercial fishery. These estimates may then be compared to assessment model estimates of the same of similar quantities.

Catch at Age by Fleet and Year

These analyses require estimates of catch at age in the commercial fisheries and in the acoustic survey. The required data may be found in the input data file for the SS2 model. There are 3 fleets (*f*), USA commercial fishery, Canada commercial fishery and the acoustic survey. Annual (*y*) catch weights for each commercial fleet and annual acoustic biomass index for each year a survey was conducted are available ($B_{fy}$). We have assumed that the length frequency vectors used as input to the assessment model are representative of the annual length frequency of the fleet specific catch, and that the conditional proportions at age given length used as input to the assessment model are also representative of the fleet specific catch. These data were obtained from the SS2 input file presented at this meeting.

We have length frequencies for each fleet and year, expressed as proportions $P_{lfy}$. There is an allometric equation used to estimate the weight of an individual fish of a given length

$$\overline{w}_l = \alpha l^{\beta}$$

where

where $\alpha = 7e-6$ and $\beta = 2.9624$ are the allometric growth coefficients. The mean weight of fish in a given length frequency can be found as

$$\overline{w}_{fy} = \sum_l \overline{w}_l P_{lfy} \ .$$

We have tables giving conditional proportions at age for a given length for each fleet and year $P_{a|lfy}$. The proportions at age for the fleet and year may be found as

$$P_{afy} = \sum_l P_{lfy} P_{a|lfy} \ .$$

The number of fish in the catch by fleet and year is

$$C_{afy} = \frac{P_{afy} B_{fy}}{\overline{w}_{fy}} \ .$$

I will use a slightly different notation for the acoustic survey index of abundance at age,

$$I_{ay} = C_{afy} \quad where \ \ f = acoustic \ survey \ .$$

The mean length at age is

$$\bar{l}_{af} = \frac{\sum_l P_{lfy} P_{a|lfy} l}{P_{afy}}$$

and the mean weight at age is

$$\overline{w}_{af} = \frac{\sum_l P_{lfy} P_{a|lfy} \overline{w}_l}{P_{afy}} \ .$$

Multiplicative Analysis of the Survey Index

Fish abundance surveys are designed to give a consistent index of population abundance at age through time. In order to be effective, the design must attempt to maintain constant catchability at age over time. Catchability (*q*) is the ratio between the survey index (*I*) and the population abundance (*N*) such that

$$I_{ay} = q_a N_{ay}$$

That survey catchability is lower at younger ages is clear from the fact that the index values for younger ages are often lower than the index for the same cohort at older ages. However, if we follow the index for a cohort at successive ages, the index usually reaches a maximum value then declines at older ages. This decline will be due at least in part to declining cohort numbers due to mortality. This rate of mortality is of primary interest in stock assessment. However, the decline may also reflect declining catchability at older ages, or migration out of the survey area. There are also interannual variations in the survey indices that can be attributed to sampling variability and changes in fish behaviour. To be effective, the design must attempt to minimize these extraneous effects on the index if it is to be useful for stock assessments.

Let's assume that the hydroacoustic survey for hake has been successful in minimizing interannual variations in catchability at age. The following analysis was introduced to AS by John Shepherd at an ICES assessment methods meeting in 1985. It has been used it in many Atlantic cod stock assessments, for example Sinclair et al. 1998. The survey index may be analysed with a separable model

$$\ln I_{ay} = \beta_0 + \beta_1 A + \beta_2 R + \varepsilon_{ay}$$

where *A* is a class variable for age and *R* is a class variable for year-class. $\beta_0$ is a scalar intercept term, $\beta_1$ is a vector for age effects with a length of the number of ages in the index less one, and $\beta_2$ is a vector for year-class effects with a length of the number of year-classes in the index less one. $\varepsilon_{ay}$ is the residual, assumed to normally distributed. A general linear model may be used to estimate the parameters and least square means (LSM) may be estimated to represent the average index value for each age and each year-class, adjusted for all other model effects. The LSM of age can be used as an average catch curve for the index. The LSM value will increase with age as fish recruit to the survey. The declining pattern with respect to age will be affected by total mortality and the availability of older ages to the survey. The slope of the declining limb will increase as total mortality increases, i.e. as the fish recruit to commercial fisheries. If the declining limb becomes linear with respect to age, this indicates a constant total mortality rate, full recruitment to fishing and to the survey. If the slope of the declining limb continues to increase, this may indicate the fish are becoming less available to the survey, i.e. declining catchability with age. The LSM of year-class can be used as an index of relative year-class strength. It should be noted, however, that variations in total mortality during the survey period will be absorbed in the index and while the LSM values may represent averages, they will not reflect changes in conditions throughout the survey time period. Systematic interannual differences may be reflected in model residuals.

Estimates of Total Mortality From Acoustic Survey Results

A modified catch curve analysis can be used to estimates total mortality rates using the acoustic survey results (Sinclair 2001). The model is an analysis of covariance with year-class as a categorical variable and age as a continuous variable.

$$\ln I_{ay} = \beta_0 - Za + \beta_2 R + \varepsilon_{ay}$$

This is a traditional catch curve modified with separate intercepts for individual year-classes. The parameter $Z$ is an estimate of the instantaneous rate of total mortality. To be accurate, the analysis must be performed over a range of ages where total mortality is constant and where the age classes are fully recruited to the survey. Residual patterns vs. age may be examined to select an appropriate age range.

Relative Fishing Mortality at Age and Selectivity

Sinclair 1998 described a method for examining trends in fishing mortality using a relative index obtained from the ratio of catch at age divided by survey estimates of abundance at age. Annual fishing mortality (*F*) at age may be expressed as a separable function of the annual fully recruited fishing mortality ( $F_y$ ) and selectivity at age ( $s_a$ ). Fishing mortality is also the ratio between catch at age and mean population numbers at age (Ricker 1975). The final part of the equation below is obtained by substituting the catchability adjusted survey index for mean population size.

$$F_{ay} = s_a F_y = \frac{C_{ay}}{\overline{N}_{ay}} = \frac{C_{ay} q_a}{I_{ay}}$$

Rearranging, we get

$$\frac{C_{ay}}{I_{ay}} = \frac{s_a}{q_a} F_y$$

This can be expressed as a multiplicative analysis for statistical estimation.

$$\ln\left(\frac{C_{ay}}{I_{ay}}\right) = \beta_0 + \beta_1 A + \beta_2 Y + \varepsilon_{ay}$$

The coefficient vector $\beta_1$ will express the combined effects of catchability and selectivity. Over a range of ages where survey catchability is constant, this vector is an estimate of fishery selectivity. The coefficient vector $\beta_2$ is an estimate of interannual variation in fishing mortality.

Results of Index Analyses

Multiplicative Analysis

The main effects age and year-class were statistically significant in the multiplicative analysis (Table 1) and the assumption of normal distribution of residuals was not violated (Figure 15). Interannual variation in model residuals (Figure 16) indicates that the 1989 and 2001 surveys had anomalously low estimates. The 1986 estimates did not stand out as being anomalously high as was thought in previous assessments. Apart from apparent year effects, there did not appear to be a systematic temporal trend in annual residuals.

The three largest year-class estimates in the time series were the 1980, 1984, and 1999 respectively (Figure 17). The year-class estimates tended to be higher for year-classes from the 1960s and 1970s than for those since 1985. The estimate for the 2005 year-class was relatively large, however this was considerably lower than the 1999 year-class and it was from a single observation in the 2007. The estimates of the 2002 and 2004 year-classes were among the smallest in the time series. There is also only one estimate of the 2004 year-class.

Adult Total Mortality Rate

A number of preliminary analyses were conducted to identify the age range over which the rate of total mortality appeared to be constant. The test was to examine the residual pattern with respect to age and find the age range where there was no pattern. Each analysis used up to age 14 fish, and began with ages 4 – 7 respectively. The results indicated the most favourable pattern was with the analysis for ages 7-14 (Figure 18). The other analyses produced dome-shaped residual patterns.

As with the multiplicative analysis, the main effects are and year-class were statistically significant in the analysis of total mortality for ages 7-14 (Table 2). In this case, however, the independent variable age was a continuous variable. The assumption of normal distribution of residuals was not violated (Figure 19). The interannual distribution of residuals was similar as that for the multiplicative analysis and is not shown here. A test for an interaction between age and year-class was not statistically significant, and we could not reject the hypothesis of constant total mortality rates among year-classes. However, the power of this test was very low due to the low number of estimates for each year-class (between 2 and 4 estimates each), with the lowest least significant difference of 0.40. A second analysis tested for differences in total mortality between the early (1977 – 1992) and later (1995 – 2007) periods of the survey. This also indicated no significant difference. A power test indicated the least significant value given the number of observations was 0.29.

The total mortality estimate for the entire period was $Z = 0.48 \pm 0.09$, about twice M.

Relative Fishing Mortality and Selectivity

The main effects age and year were statistically significant in the analysis of relative fishing mortality at age (Table 3). The assumption of residual normal distribution was not violated (Figure 20).

Estimates of relative fishing mortality at age, retransformed to the arithmetic scale, are shown in Figure 21. The lowest estimate was for age 2 followed by age 3. This is because the relative abundance of these two age groups was consistently higher in the acoustic survey than the commercial catch at age. The relative F estimates for ages 4 and above were relatively consistent. The estimate for age 12 was higher than the others, but this leveraged by a high estimate in 1995. Overall, the pattern of relative f at age indicates similar fishing mortality at ages 4-14, and thus asymptotic selectivity to the commercial fishery.

The trend in relative fishing mortality by year indicates large values in 2001 and 1989 (Figure 22). As noted earlier, the residual distributions for other analyses of the survey data alone suggested the survey estimates for these two years were lower than expected. This would inflate the estimates of relative F. If these two estimates (2001 and 1989) are discounted, the tend indicates an increase in fishing mortality from 1977 to 1998, a subsequent decline, then another increase from 2003 to 2007.

Virtual Population Analysis

Virtual Population Analysis (VPA) is a well recognized age structured stock assessment method widely used throughout the world. Input data include catch at age estimates for a suitably long time period to allow reasonable calibration and an index of population abundance, preferably at age. Catch at age is assumed to be known without error. The leading parameters include a single estimate of population abundance for each year-class in the analysis and a catchability relationship relating the population estimates to the index. The leading population estimates may be at any age within the year-class and the algorithm proceeds to estimate abundance at all younger and older ages within the year-class. It is common practice to begin with population estimates at age in the final year of the analysis and at the oldest age in the analysis, however the choice of which ages to begin with has no effect on the model estimates. Early versions of VPA employed *ad hoc* methods for fitting. Gavaris 1988 introduced ADAPT, a statistically based fitting method. Subsequent enhancements to the software included approximation of the parameter covariance matrix and estimates of parameter bias (Gavaris 1993). Documented software is available at (http://www.mar.dfo-mpo.gc.ca/science/adapt/adapt-e.html). ADAPT uses the Baranov catch equation and not the so called cohort approximation of Pope 1972. There are various options regarding the functional form of the relationship between the population abundance and the index (i.e. catchability). We have assumed that the index is proportional to population abundance and estimate separate catchability for each age. Residual variance is stabilized using a natural log transform. The software also produces risk analysis of a range of catches on forecast fishing mortality, changes in biomass, and terminal biomass relative to specific targets or limits.

Common Formulation

Input Data
- Catch at age 2 – 15+, 1977-2007
  - (note, catch at age 14 = 0 in 2001 and 1985, age 15+ is a plus group)
- Acoustic survey relative abundance at age 2 – 14

Objective Function
- Minimize sum of squared residuals

Parameters
- Acoustic Survey catchability
  - $q_i$, i = 2 to 12, combined 13 and 14
- Terminal N estimates
  - $N_{i,2008}$, i = 3 to 12

Structure Imposed
- Error in catch at age assumed negligible
- M known and 0.23
- Survey assumed to occur on June 30

Summary
- Number of observations to fit 150

Run Formulations

A number of alternative run formulations were used to examine the sensitivity of catch forecasts to structural assumptions. These alternative formulations focused on the number of year-classes that were directly estimated and the rule used to assign fishing mortality to the oldest age group. VPA is notorious for having difficulty directly estimating all year-classes. The "average F" rule is widely used as a way around these difficulties. however, the rule implies an assumption about fishery selectivity in the years it is applied. In Run 1, it was assumed that selectivity was asymptotic with full recruitment at age 7. The oldest age F was estimated as the population numbers weighted mean of ages 7+ in the same year. Run 2 assumed full recruitment occurred at age 4, and in run 3 it was assumed that the F on the oldest age was equal to the weighted mean of the last 2 ages. Note that the catch at age 14 was 0 in 2001 and 1985. Thus, the initial year-class estimates had to be made at age 13, and in run 3 the average F at ages 11 and 12 in the same year was used. In all other cases, the average at ages 12 and 13 were used. Note also that in the case of run 3, selectivity was not constrained to be asymptotic.

W were able to explore an alternative formulation where more year-classes were estimated directly. It was found that the relatively large 1977, 1980, and 1984 year-classes could be estimated directly. In addition, the year-classes beginning at age 14 in 2003 – 2007 could also be estimated. The advantage of this formulation was that it minimized the influence of any assumptions regarding selectivity on the terminal population estimates. Unfortunately, this last formulation was not possible for run 3.

| Run | Additional Parameters | Structural Options | Number of Parameters |
|---|---|---|---|
| 1 | | $F_T$ =wt average 7+ | 22 |
| 1A | $N_{i,2008}$, i = 13-14<br>$N_{y,14}$, y = 1991, 1994, 1998, 2003-2007 | $F_T$ =wt average 7+ | 32 |
| 2 | | $F_T$ =wt average 4+ | 22 |
| 2A | $N_{i,2008}$, i = 13-14<br>$N_{y,14}$, y = 1991, 1994, 1998, 2003-2007 | $F_T$ =wt average 4+ | 32 |
| 3 | | $F_T$ =wt average 12+ | 22 |

Reference Points for Advice

Canada has been a strong proponent of the management principles outlined in the United Nations Fish Stock Agreement (UNFSA - also commonly referred to as UNFA) that it ratified in the fall of 1999. The Agreement came into effect in December 2001, and amongst other things, it requires countries to use the Precautionary Approach (PA) in the management of fisheries. At about the same time, the Privy Council Office (PCO) of the Government of Canada developed the Federal Framework for the precautionary approach to ensure that precaution would be applied consistently across disciplines in the government. The framework became government policy in 2003. Over the last few years, benchmarks have been identified that would be consistent with the approach and that may be applied in fisheries management. A harvest strategy compliant with the PA was described in DFO 2006.

The harvest strategy prescribes three stock status zones divided by two stock status reference points. The Limit Reference Point (LRP) is the stock level below which productivity is sufficiently impaired to cause serious harm to the resource but above the level where the risk of extinction becomes a concern. The zone below the Limit reference point is called the Critical zone. The Upper stock reference point is the stock level threshold below which the removal rate is reduced. The stock status zone above the Limit reference point but below the Upper stock reference is called the Cautious zone. The stock status zone above the Upper stock reference is called the Healthy zone. The harvest strategy also includes a Removal reference designed to scale resource exploitation to stock status. In the healthy zone, the exploitation rate should be moderate and designed to meet social, economic, and biological objectives of management. In the cautious zone, the removal reference declines as status declines and management actions should promote stock rebuilding toward the Healthy Zone.. In the Critical Zone, management actions must promote stock growth. Removals by human activities must be kept at the lowest possible level.

The F-40 percent with a 40/10 adjustment harvest control rule (40/10 rule) that has been used for Pacific hake in past assessment has qualities similar to the Canadian PA compliant harvest strategy. The 40/10 rule specifies a maximum constant harvest rate when the population is above 40% of the unfished equilibrium, a reduction in harvest rate when the population is below this biomass, and essentially a 0 harvest rate when the population is below 10% of the unfished equilibrium. Canadian fisheries managers have requested catch advice using the 40/10 rule. However, they have added the provision "but not restricting the provision of scientific advice on alternate rates necessary to sustain the offshore hake resource", similar to wording the new Hake Treaty.

The following biological reference points relevant to the Canadian PA compliant harvest strategy, were used. Input data for reference point calculations include

- weight at age at the beginning (spawning) and middle of the year (catch) calculated as the means for the period 2003-2007.
- maturity at age was taken from Dorn et al. 1999.
- fishery selectivity at age calculated as a logistic fit to the population number weighted mean fishing mortality at age over the period 2003-2007.

The maximum removal reference was the fishing mortality that gave 40% of the maximum spawning stock biomass per recruit (F40%). A proxy estimate of the unfished equilibrium spawning stock biomass ( $B_0$ ) was the average recruitment multiplied by the maximum spawning stock biomass per recruit, and a proxy for the upper stock reference was 40% of the unfished biomass. The 40-10 adjustment was applied if the 2008 spawning stock biomass was estimated to be below $0.4B_0$. The procedure was

1. Calculate the yield corresponding to F40%
2. Calculate the 2008 depletion as $dep = \frac{B_{2008}}{B_0}$

3. Calculate an adjustment as $\frac{4}{3}\left(\frac{dep-.1}{dep}\right)$
4. Multiply the adjustment by the yield estimated with F40% to get the 40/10 adjusted yield
5. Find the fishing mortality that would give this yield

While the SPR based reference points are widely used, and this framework complies with the PA, we found that our estimates of the target fishing mortality rate (F40%) were very high. An alternative approach was to do the catch forecast at a *status quo* fishing mortality, estimated as the average over the past 5 years. This is suggested as an interim measure to be used until the entire management procedure can be evaluated.

Results of Virtual Population Analysis

Parameter estimates from the 5 model runs are given in Table 7 and Table 8. The goodness of fit, summarized my the mean square residual, indicated that runs 1 and 2 had similar fits and that run 3 was slightly poorer fit. With additional parameters, runs 1A and 2A also had similar mean square residual. We were unable to fit the additional parameter equivalent of Run 3. The population parameter standard errors were quite high, in several cases being of similar magnitude as the estimates. The parameter bias estimates were also relatively high. All of these observations indicate a relatively parameter uncertainty.

Diagnostic plots of observed, predicted, and residual values provided had similar patterns among the various runs. Plots from Runs 1A are shown for illustration. The large 1980, 1984, and 1999 year-classes dominated the observed and predicted survey time series (Figure 24). The spread of residuals by age was consistent, with slightly more spread at older ages (Figure 25). However, this was not sufficient in our opinion to attempt iterative weighting of the age specific observations. There were strong year effects in the model residuals (Figure 26) with the 1989 and 2001 surveys being dominated by negative residuals, and the 1977, 1980, and 1986 surveys dominated by positive residuals.

A retrospective analysis was performed on Run 1 as a check for model stationarity when single year's data are eliminated from the VPA. The last data year in this assessment is 2007. Additional runs were performed with 2006 – 2001 as the last data years. We attempted to maintain the same model formulation for these additional analyses. The number of ages that could be estimated in the terminal year depended upon the proximity of the last survey year to the terminal year. There was information on the 2005 year-class in the 2007 acoustic survey and the 2007 catch at age, and thus the leading parameter for this year-class was age 3 in 2008. However, the youngest year-class for which there was a survey estimate in the 2005 survey was the 2003. Consequently, this was also the youngest year-class that could be estimated as a leading parameter in both the 2006 and 2005 assessments. In addition, this model formulation did not produce a reasonable solution for the analyses ending in 2001 and 2002. The formulation was changed slightly to accommodate this. It should be noted that in these 2 analyses, the 2001 survey provided the most influential points in the VPA calibration. As noted earlier, diagnostics indicated that the 2001 survey estimates appear to be anomalously low. The model formulations are summarized in Table 9.

The retrospective estimates of spawning stock biomass, fishing mortality, and recruitment converged to stable values in the early part of the time series (Figure 27). The estimates for 2003 – 2007 model runs were very similar and did not deviate in any consistent direction. However, the 2002 and 2001 runs gave lower biomass and recruitment estimates, and higher fishing mortality estimates. The 2001 acoustic survey results were the most influential calibration data in these two runs, and previous diagnostic information suggested that these estimates were anomalously low. Overall, the retrospective estimates were remarkably consistent given the overall variability of the acoustic survey results.

The 5 ADAPT runs gave very similar time trend estimates of spawning stock biomass, fishing mortality, and recruitment (Table 10, Figure 28). The temporal correlations in estimates among runs was highest for the recruitment estimates with the 1980, 1984, 1999, and 1977 year-classes being consistently estimated as the four highest in the time series. The trend in spawning stock biomass had an initial increasing trend with the recruitment of the 1980 and 1984 year-classes, reaching a peak in 1987. This was followed by a decline until 2000 as these two large year-classes declined in biomass. There was another period of increase as the 1999 year-class recruited to the spawning population. This peaked in 2003 and there was a decline to 2008. The highest estimates of SSB come from run 2. The difference in annual SSB estimates between runs 1 and 2 were considerably higher than between runs 1A and 2A (Figure 29). It is interesting to note that there was greater variation among the SSB trends during the initial period of the VPA than in the last years. This is unusual since VPA estimates tend to converge in the historical period as the integrated catch becomes the dominant portion of the population estimate. In this case, convergence is limited due to low estimates of fishing mortality in the early period.

The fishery selectivity pattern was estimated from estimates of fishing mortality at age. However, there are two disconcerting patterns apparent in these estimates (Figure 30). The first is that, in all runs, the fishing mortality estimates on the plus group (age 15+) were considerably lower than those at age 14. The second is a diagonal pattern indicating year-class tracking. However, the fishing mortality estimates on the large 1980 and 1977 year-classes were considerably lower than those on adjacent ages in the same years. If real, this means the fishery selectively avoided these large year-classes. Then, the fishing mortality estimates on the 1984 year-class at ages 10 and above were greater than on adjacent ages in the same year. These patterns may also be reflective of ageing errors that have not been accounted for, or possibly changes in natural mortality. At this point, we cannot fully explain these patterns. And, it adds considerable uncertainty to estimates of selectivity.

With the exception of the low fishing mortality estimates on the plus group, the selectivity pattern appears to be asymptotic. The selectivity at age was estimated by fitting a logistic curve to the mean fishing mortality at age for the period 2003-2007. Selectivity curves from the 5 ADAPT runs are shown in Table 11 and Figure 31. The pattern for Run 3 showed a continuous increase across age. This is the run where the selectivity pattern was the least constrained. However, it is highly unlikely that this represents the true selectivity pattern given the growth of Pacific hake making age groups indistinguishable from each other by length after about age 4. As was the case with SSB, the selectivity patterns for runs 1A and 2A were very similar.

These selectivity patterns were used as input for yield per recruit and spawning stock biomass per recruit calculations. The estimated F40% SPR were very high (

Table 12) ranging from 0.55 for Run 2 to 1.02 for Run 1A, or 2.4 to 4.4 times natural mortality. All of these F reference points were above the maximum value in the respective time series. Each run 2008 SSB estimate was below the respective B40 proxy and thus the 40/10 adjustment was applied. Each adjusted forecast fishing mortality was also above the respective time series maxima (Table 13). These high reference fishing mortalities are largely due to the difference between the maturity at age and the selectivity at age. According to these estimates, hake mature well before they recruit to the fishery, thus it takes high fishing mortalities to reduce the spawning stock biomass per recruit to 40% the unfished value.

Yield forecasts with the 40/10 adjustment from the 5 runs ranged from 282,000 t (Run 3) to 472,000 t (Run 2) (Table 13, Figure 32).

Two things about the 40/10 rule catch forecast are counterintuitive. The first is that the reference fishing mortalities are between 1.3 (Run 3) and 1.9 (Run 2A) times higher than the fishing mortality estimate in 2007. The 2007 fishing mortality was the highest in each time series with the exception of Run 2 where it was 90% of the highest. It seems dangerous to advise such a large increase in fishing mortality on a population at the lowest spawning biomass on record. Secondly, the estimated F40% was between 2.4 (Run 2) and 4.4 (Run 1A) times the assumed natural mortality rate. This is well outside the rules of thumb of optimal fishing mortality being close to the rate of natural mortality.

An alternative catch forecast rule is to use the recent average fishing mortality instead of the 40/10 rule. This is an interim measure that could be used until a more satisfactory approach can be found (see discussion below). The advantage of such an approach is that it avoids the large increase in fishing mortality suggested by the 40/10 rule. Catch forecasts using the *status quo* rule ranged from 200,000 t (Run 1A) to 257,000 t (Run 2) (Table 14).

Model Selection

Of the 5 ADAPT model formulations, Run 3 may be the easiest to eliminate as a candidate for providing catch advice. For the same number of parameters, it has the highest mean square residuals. The selectivity pattern indicated by F at age in the most recent period was the least plausible of any examined. Model Run 1 and 1A had slightly lower mean square residuals than their counterparts, Run 2 and 2A. The selectivity pattern from these runs were the closest to the assumption used to estimate F on the oldest age. More year-classes were directly estimated in Run 1A than in Run 1 and thus Run 1A was the least constrained by the oldest age F assumption. Thus, if one had to choose among these 5 model runs, Run 1A seems the best. Population and fishing mortality estimates are given in Table 15 and Table 16.

Estimated trends in recruitment, biomass, and fishing mortality from Run 1A are compared to the catch history in Figure 33. Catches were initially in the 100,000 – 150,000 t range and fishing mortality was relatively low. It is clear that the 1980 and 1984 year-classes were major contributors to the increase in biomass in the early to mid 1980s. Catches increased to around 300,000 t in the late 1980s, and the stock biomass declined as the 1984 year-class passed through the population. Catches remained relatively high and fishing mortality increased. The arrival of the 1999 year-class and a reduction of catches to around 200,000 t in the early 2000s resulted in a decline in fishing mortality and an increase in biomass. This increase was short lived as catches and fishing mortality increased again and biomass has now declined to the lowest in the time series.

The deterministic catch forecast from Run 1A, using the 40/10 adjustment, gives a 2008 catch of 332,000 t. A risk analysis of the 2008 catch forecast considered three performance measures, the probability of the 2008 fishing mortality being above the F40/10, the probability of the spawning stock biomass declining between 2008 and 2009, and the probability of the 2009 spawning stock biomass being below 25% of the unfished equilibrium (Figure 34). Arbitrary levels of probability for risk averse (25%) and risk neutral (50%) decision making are suggested. For the fishing mortality performance measure, the risk averse catch for 2008 is 90,000 t and the risk neutral catch was 265,000 t. For the decline in spawning stock biomass performance measure, the risk averse catch is 350,000 t and the risk neutral catch is 490,000 t. There was a 28% probability that the 2009 spawning stock biomass would be below the overfished level with a catch of 40,000 t. The risk neutral catch for this performance measure was 700,000 t.

**We Need a Management Procedure Evaluation**

Management Procedure Evaluation[1] (MPE) is a process designed to identify the combination of assessment data, analysis method, and decision rule that is robust to uncertainties about how nature works and provides adequate performance in terms of fishery outcomes (Butterworth and Punt 1999, de la Mare 1998). This is a developing field in fisheries research and there is considerable expertise in the Pacific northwest that could be tapped. MPE is likely to be the most efficient way to design and apply effective management of the hake fishery given the uncertainties about nature, the sensitivity of advice to small changes to the assessment method, and the inability to resolve key uncertainties with the available data. The assessment team has also accumulated a good deal knowledge and experience with the issues. There will be three assessment methods used at this meeting, SS2, the Martell model, and VPA, each of which would be reasonable candidates. There are also several alternative decision rules that could be evaluated, in addition to the 40/10 rule, for example the *status quo* rule. Insights into the variability and potential errors in the input data have been discussed. The three methods noted above have used different levels of input data aggregation, and this has also helped understand how this affects results. If there are trade-offs regarding aggregation / model complexity and reality, these should become evident with the MPE simulations. It is difficult at the outset to anticipate what these will be. What is crucial for the MPE is to establish an acceptable reference set of states of nature, a reasonable number of candidate management procedures, and what performance measures will be used in the evaluation developed". The way I see it, MPE is an approach to investigate how priors should be set, as well as many other aspects of the assessment model structure.

[1] The popular term in the literature is "Management Strategy Evaluation". However, I prefer "Procedure" rather than "Strategy" because it implies something broader and better describes the combination of data, assessment model, and decision rule that is being evaluated.

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**Table 1: Analysis of variance summary from a multiplicative analysis of the Pacific hake acoustic survey relative abundance index. The main effects age and year-class (yc) were class variables.**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.846853 |
| RSquare Adj | 0.760708 |
| Root Mean Square Error | 0.817903 |
| Mean of Response | 4.254655 |
| Observations (or Sum Wgts) | 151 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square |
|---|---|---|---|
| Model | 54 | 355.12006 | 6.57630 |
| Error | 96 | 64.22075 | 0.66897 |
| C. Total | 150 | 419.34081 | |

**Effect Tests**

| Source | Nparm | DF | Sum of Squares | F Ratio | Prob > F |
|---|---|---|---|---|---|
| age | 12 | 12 | 151.63701 | 18.8895 | <.0001 |
| yc | 42 | 42 | 177.73619 | 6.3259 | <.0001 |

**Table 2: Analysis of variance summary from an analysis of covariance of the Pacific hake acoustic survey relative abundance index designed to estimate the total mortality rate of adults. The main effect age was a continuous variable and year-class (yc) was a class variable. The analysis included ages 7-14.**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.808786 |
| RSquare Adj | 0.687439 |
| Root Mean Square Error | 0.878915 |
| Mean of Response | 3.676797 |
| Observations (or Sum Wgts) | 86 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square |
|---|---|---|---|
| Model | 33 | 169.90743 | 5.14871 |
| Error | 52 | 40.16959 | 0.77249 |
| C. Total | 85 | 210.07702 | |

**Effect Tests**

| Source | Nparm | DF | Sum of Squares | F Ratio | Prob > F |
|---|---|---|---|---|---|
| age | 1 | 1 | 82.670315 | 107.0177 | <.0001 |
| yc | 32 | 32 | 86.291774 | 3.4908 | <.0001 |

**Table 3: Analysis of variance summary from a multiplicative analysis of relative fishing mortality at age estimates obtained from the Pacific hake acoustic survey abundance index and the commercial catch at age.**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.650864 |
| RSquare Adj | 0.587635 |
| Root Mean Square Error | 0.693662 |
| Mean of Response | -1.93162 |
| Observations (or Sum Wgts) | 151 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square |
|---|---|---|---|
| Model | 23 | 113.91867 | 4.95299 |
| Error | 127 | 61.10812 | 0.48117 |
| C. Total | 150 | 175.02679 | |

**Effect Tests**

| Source | Nparm | DF | Sum of Squares | F Ratio | Prob > F |
|---|---|---|---|---|---|
| age | 12 | 12 | 37.354787 | 6.4695 | <.0001 |
| yr | 11 | 11 | 76.456267 | 14.4453 | <.0001 |

**Table 4: Catch at age (million) of Pacific hake from 1977 to 2007.**

| Catch | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 4.73 | 5.08 | 49.23 | 9.10 | 18.25 | 64.74 | 15.16 | 9.69 | 6.15 | 3.85 | 2.09 | 0.77 | 0.10 | 0.05 |
| 1978 | 0.34 | 7.20 | 8.62 | 44.42 | 8.37 | 18.94 | 38.04 | 8.60 | 5.34 | 3.05 | 1.06 | 0.60 | 0.26 | 0.04 |
| 1979 | 6.32 | 13.54 | 23.08 | 11.64 | 49.96 | 14.63 | 31.77 | 24.77 | 6.74 | 4.05 | 1.62 | 0.92 | 0.53 | 0.35 |
| 1980 | 0.68 | 28.16 | 5.69 | 9.18 | 9.30 | 22.64 | 9.28 | 12.47 | 16.19 | 3.95 | 2.24 | 1.73 | 0.62 | 0.49 |
| 1981 | 19.33 | 5.16 | 85.08 | 4.58 | 11.84 | 11.65 | 32.89 | 11.10 | 11.82 | 17.74 | 3.37 | 1.31 | 1.24 | 0.19 |
| 1982 | 21.94 | 3.35 | 2.61 | 59.25 | 6.13 | 7.76 | 7.48 | 20.40 | 4.30 | 4.67 | 15.76 | 1.36 | 0.84 | 0.50 |
| 1983 | 0.06 | 73.08 | 7.84 | 4.85 | 65.48 | 6.44 | 6.04 | 6.88 | 14.13 | 3.28 | 2.31 | 6.03 | 0.78 | 0.31 |
| 1984 | 0.00 | 2.26 | 132.87 | 9.01 | 18.00 | 47.73 | 6.38 | 4.86 | 3.92 | 8.90 | 1.80 | 2.07 | 4.20 | 0.71 |
| 1985 | 8.64 | 1.00 | 12.78 | 100.68 | 13.58 | 11.37 | 26.33 | 2.71 | 1.58 | 2.46 | 2.34 | 0.44 | 0.00 | 1.61 |
| 1986 | 57.21 | 15.69 | 3.27 | 12.88 | 193.96 | 23.29 | 15.65 | 34.53 | 4.89 | 4.03 | 2.51 | 4.10 | 0.69 | 1.99 |
| 1987 | 0.00 | 111.36 | 6.61 | 1.55 | 6.78 | 209.19 | 13.53 | 6.28 | 36.65 | 1.63 | 0.78 | 1.72 | 4.87 | 1.93 |
| 1988 | 3.01 | 2.59 | 167.74 | 6.04 | 3.49 | 4.84 | 197.55 | 8.67 | 3.16 | 31.37 | 0.55 | 0.68 | 0.27 | 5.65 |
| 1989 | 19.01 | 18.92 | 8.12 | 244.80 | 5.66 | 2.38 | 3.23 | 200.63 | 7.97 | 3.16 | 19.29 | 0.49 | 0.39 | 2.24 |
| 1990 | 7.00 | 92.75 | 11.73 | 2.00 | 176.65 | 2.95 | 1.12 | 0.91 | 140.67 | 1.62 | 0.00 | 13.83 | 0.03 | 1.08 |
| 1991 | 3.16 | 54.61 | 92.66 | 16.52 | 4.88 | 189.60 | 7.09 | 0.64 | 0.77 | 109.47 | 2.59 | 0.00 | 19.76 | 6.21 |
| 1992 | 21.87 | 21.31 | 70.32 | 114.22 | 13.06 | 6.16 | 180.56 | 3.84 | 0.69 | 1.09 | 80.07 | 1.05 | 0.20 | 5.46 |
| 1993 | 1.59 | 83.79 | 12.15 | 54.03 | 65.40 | 5.59 | 2.95 | 105.24 | 2.70 | 0.19 | 0.18 | 37.10 | 0.23 | 2.50 |
| 1994 | 0.26 | 20.19 | 123.11 | 7.51 | 80.03 | 122.64 | 7.42 | 2.63 | 183.38 | 1.24 | 2.61 | 0.20 | 55.33 | 4.44 |
| 1995 | 17.40 | 0.82 | 28.00 | 104.98 | 5.10 | 32.17 | 78.79 | 7.31 | 1.29 | 96.55 | 1.50 | 1.06 | 0.10 | 33.10 |
| 1996 | 101.77 | 85.33 | 6.33 | 50.99 | 105.99 | 5.95 | 32.68 | 64.45 | 3.84 | 1.95 | 96.13 | 0.08 | 0.62 | 22.00 |
| 1997 | 2.68 | 197.07 | 140.54 | 6.88 | 40.84 | 80.14 | 11.32 | 22.71 | 42.21 | 6.94 | 0.83 | 39.50 | 4.04 | 12.92 |
| 1998 | 35.57 | 124.53 | 108.82 | 164.35 | 17.66 | 35.10 | 71.17 | 7.62 | 11.66 | 33.57 | 3.75 | 0.87 | 31.41 | 5.66 |
| 1999 | 57.15 | 134.95 | 115.91 | 125.65 | 76.98 | 16.49 | 29.05 | 31.36 | 6.13 | 10.81 | 19.38 | 4.32 | 5.52 | 18.91 |
| 2000 | 15.40 | 42.51 | 60.47 | 55.80 | 75.25 | 42.46 | 28.49 | 20.82 | 7.31 | 7.23 | 8.34 | 5.05 | 4.13 | 12.88 |
| 2001 | 55.19 | 77.91 | 55.82 | 69.40 | 35.51 | 47.74 | 23.17 | 6.29 | 6.75 | 6.67 | 4.06 | 3.56 | 0.00 | 3.98 |
| 2002 | 0.15 | 147.34 | 53.45 | 32.10 | 21.29 | 15.37 | 19.73 | 11.94 | 2.78 | 2.08 | 3.09 | 0.36 | 1.24 | 2.98 |
| 2003 | 0.54 | 6.13 | 270.92 | 46.19 | 12.38 | 20.19 | 11.85 | 12.31 | 7.03 | 3.30 | 0.97 | 1.91 | 0.31 | 1.10 |
| 2004 | 0.01 | 37.57 | 39.49 | 393.11 | 48.89 | 13.77 | 24.70 | 15.42 | 8.25 | 6.04 | 1.88 | 1.42 | 0.87 | 0.91 |
| 2005 | 7.61 | 2.76 | 43.40 | 32.86 | 406.40 | 52.96 | 14.89 | 18.07 | 13.48 | 5.70 | 4.75 | 1.33 | 0.21 | 1.10 |
| 2006 | 18.35 | 72.35 | 10.25 | 55.30 | 30.28 | 376.16 | 30.45 | 10.55 | 11.37 | 7.62 | 5.32 | 2.91 | 0.96 | 1.42 |
| 2007 | 53.62 | 14.57 | 69.49 | 7.65 | 36.44 | 22.20 | 226.29 | 29.24 | 9.60 | 9.27 | 6.43 | 2.04 | 2.08 | 0.71 |

**Table 5: Catch weight at age for Pacific hake. Age 15+ is a plus group. Values for 2008 are the average for 2003-2007. These weights were assumed to represent mid-year weights at age for the population. Values shown in read were missing and estimated using the means of the closest 2 adjacent values at age. The values for 2008 were the average of 2003-2007.**

| Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 0.354 | 0.454 | 0.533 | 0.605 | 0.700 | 0.748 | 0.853 | 0.944 | 0.974 | 1.070 | 1.168 | 1.218 | 1.274 | 1.653 |
| 1978 | 0.135 | 0.460 | 0.523 | 0.600 | 0.649 | 0.754 | 0.812 | 0.915 | 0.973 | 1.055 | 1.106 | 1.169 | 1.231 | 1.573 |
| 1979 | 0.217 | 0.287 | 0.515 | 0.619 | 0.687 | 0.822 | 0.841 | 0.951 | 1.060 | 1.154 | 1.211 | 1.282 | 1.327 | 1.435 |
| 1980 | 0.279 | 0.407 | 0.487 | 0.624 | 0.684 | 0.796 | 0.850 | 0.877 | 1.010 | 1.066 | 1.184 | 1.163 | 1.233 | 1.196 |
| 1981 | 0.123 | 0.328 | 0.491 | 0.619 | 0.725 | 0.776 | 0.816 | 0.864 | 0.884 | 1.043 | 1.189 | 1.245 | 1.213 | 1.384 |
| 1982 | 0.235 | 0.389 | 0.503 | 0.604 | 0.688 | 0.838 | 0.873 | 0.907 | 0.934 | 1.029 | 1.049 | 1.132 | 1.209 | 1.095 |
| 1983 | 0.264 | 0.355 | 0.428 | 0.563 | 0.631 | 0.742 | 0.827 | 0.855 | 0.883 | 0.969 | 0.994 | 0.941 | 1.155 | 1.094 |
| 1984 | 0.238 | 0.393 | 0.429 | 0.531 | 0.669 | 0.699 | 0.796 | 0.873 | 0.894 | 0.953 | 1.104 | 0.965 | 1.008 | 1.100 |
| 1985 | 0.181 | 0.316 | 0.455 | 0.526 | 0.639 | 0.739 | 0.813 | 0.979 | 0.914 | 1.020 | 1.035 | 1.156 | 1.040 | 1.067 |
| 1986 | 0.273 | 0.314 | 0.426 | 0.537 | 0.562 | 0.633 | 0.724 | 0.821 | 0.921 | 0.992 | 0.989 | 1.102 | 1.047 | 1.086 |
| 1987 | 0.236 | 0.374 | 0.422 | 0.499 | 0.629 | 0.626 | 0.683 | 0.746 | 0.799 | 0.903 | 0.895 | 1.023 | 0.950 | 1.049 |
| 1988 | 0.264 | 0.357 | 0.443 | 0.461 | 0.598 | 0.591 | 0.628 | 0.687 | 0.775 | 0.809 | 0.895 | 0.997 | 0.993 | 1.026 |
| 1989 | 0.226 | 0.317 | 0.367 | 0.502 | 0.531 | 0.617 | 0.656 | 0.670 | 0.717 | 0.789 | 0.896 | 0.860 | 1.052 | 1.030 |
| 1990 | 0.272 | 0.379 | 0.443 | 0.531 | 0.568 | 0.617 | 0.604 | 0.604 | 0.701 | 0.749 | 2.047 | 0.880 | 1.002 | 1.052 |
| 1991 | 0.229 | 0.341 | 0.449 | 0.543 | 0.554 | 0.641 | 0.716 | 0.599 | 0.885 | 0.728 | 0.724 | 0.854 | 0.952 | 1.060 |
| 1992 | 0.248 | 0.338 | 0.458 | 0.525 | 0.581 | 0.598 | 0.638 | 0.638 | 0.612 | 0.679 | 0.698 | 0.851 | 0.716 | 0.931 |
| 1993 | 0.263 | 0.343 | 0.426 | 0.502 | 0.560 | 0.593 | 0.547 | 0.638 | 0.645 | 0.704 | 0.931 | 0.679 | 0.798 | 0.756 |
| 1994 | 0.335 | 0.344 | 0.424 | 0.510 | 0.552 | 0.608 | 0.694 | 0.620 | 0.689 | 0.636 | 0.739 | 0.812 | 0.725 | 0.794 |
| 1995 | 0.114 | 0.515 | 0.484 | 0.511 | 0.625 | 0.623 | 0.679 | 0.706 | 0.713 | 0.724 | 0.661 | 0.892 | 0.711 | 0.772 |
| 1996 | 0.271 | 0.379 | 0.462 | 0.547 | 0.565 | 0.628 | 0.621 | 0.663 | 0.712 | 0.736 | 0.705 | 0.553 | 1.092 | 0.724 |
| 1997 | 0.328 | 0.409 | 0.472 | 0.519 | 0.615 | 0.620 | 0.601 | 0.692 | 0.665 | 0.741 | 0.732 | 0.743 | 0.696 | 0.813 |
| 1998 | 0.235 | 0.350 | 0.458 | 0.497 | 0.518 | 0.587 | 0.598 | 0.619 | 0.637 | 0.651 | 0.775 | 0.638 | 0.735 | 0.734 |
| 1999 | 0.243 | 0.318 | 0.417 | 0.538 | 0.554 | 0.578 | 0.625 | 0.661 | 0.672 | 0.748 | 0.727 | 0.746 | 0.661 | 0.786 |
| 2000 | 0.282 | 0.424 | 0.496 | 0.564 | 0.647 | 0.677 | 0.658 | 0.740 | 0.719 | 0.818 | 0.746 | 0.835 | 0.786 | 0.820 |
| 2001 | 0.289 | 0.454 | 0.599 | 0.608 | 0.681 | 0.778 | 0.780 | 0.806 | 0.854 | 0.832 | 0.831 | 0.901 | 0.863 | 0.962 |
| 2002 | 0.310 | 0.413 | 0.558 | 0.752 | 0.702 | 0.812 | 0.916 | 0.885 | 0.885 | 0.927 | 0.893 | 1.064 | 1.002 | 1.100 |
| 2003 | 0.304 | 0.380 | 0.469 | 0.573 | 0.664 | 0.659 | 0.679 | 0.732 | 0.709 | 0.766 | 0.752 | 0.709 | 0.827 | 0.941 |
| 2004 | 0.241 | 0.419 | 0.489 | 0.550 | 0.625 | 0.709 | 0.691 | 0.713 | 0.758 | 0.765 | 0.742 | 0.880 | 0.928 | 0.836 |
| 2005 | 0.333 | 0.426 | 0.497 | 0.550 | 0.573 | 0.612 | 0.647 | 0.693 | 0.680 | 0.729 | 0.722 | 0.804 | 0.629 | 0.760 |
| 2006 | 0.251 | 0.418 | 0.497 | 0.552 | 0.584 | 0.607 | 0.645 | 0.785 | 0.744 | 0.798 | 0.838 | 0.866 | 0.801 | 0.805 |
| 2007 | 0.241 | 0.408 | 0.512 | 0.580 | 0.619 | 0.639 | 0.641 | 0.698 | 0.781 | 0.743 | 0.777 | 0.796 | 0.805 | 0.863 |
| 2008 | 0.274 | 0.410 | 0.493 | 0.561 | 0.613 | 0.645 | 0.661 | 0.724 | 0.734 | 0.760 | 0.766 | 0.811 | 0.798 | 0.841 |

**Table 6: Pacific hake acoustic survey relative abundance index (million) by age and year.**

| Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977.5 | 141.10 | 117.27 | 611.90 | 72.09 | 124.28 | 1038.47 | 191.44 | 135.47 | 101.97 | 65.21 | 35.95 | 14.74 | 4.47 |
| 1980.5 | 4.91 | 848.64 | 86.62 | 170.99 | 147.84 | 706.22 | 190.08 | 507.74 | 208.72 | 117.31 | 28.08 | 23.84 | 5.64 |
| 1983.5 | 12.06 | 2198.09 | 50.78 | 42.36 | 679.16 | 59.18 | 73.44 | 65.05 | 109.96 | 39.03 | 29.54 | 23.72 | 4.79 |
| 1986.5 | 2532.95 | 81.46 | 32.98 | 141.15 | 2652.29 | 287.84 | 182.12 | 318.03 | 33.16 | 31.11 | 8.37 | 27.51 | 3.70 |
| 1989.5 | 167.87 | 54.34 | 18.27 | 1297.75 | 26.52 | 15.45 | 21.74 | 633.84 | 27.37 | 3.69 | 43.43 | 0.00 | 0.00 |
| 1992.5 | 404.18 | 68.65 | 360.87 | 779.32 | 94.00 | 34.10 | 1522.62 | 50.97 | 26.36 | 13.31 | 549.73 | 26.71 | 0.00 |
| 1995.5 | 966.27 | 119.03 | 36.68 | 606.12 | 31.48 | 109.03 | 434.43 | 8.98 | 0.00 | 461.82 | 1.14 | 20.92 | 0.00 |
| 1998.5 | 327.28 | 480.39 | 366.53 | 457.90 | 37.38 | 106.00 | 247.50 | 39.69 | 22.86 | 152.85 | 3.31 | 13.28 | 123.22 |
| 2001.5 | 1524.17 | 227.43 | 126.46 | 118.39 | 56.21 | 54.33 | 33.14 | 10.85 | 11.31 | 7.52 | 4.54 | 4.31 | 0.00 |
| 2003.5 | 103.77 | 89.19 | 2224.39 | 384.97 | 101.45 | 223.64 | 147.07 | 83.54 | 83.21 | 26.84 | 15.85 | 16.75 | 11.30 |
| 2005.5 | 549.87 | 57.92 | 184.43 | 135.14 | 1275.22 | 140.00 | 47.54 | 66.49 | 37.66 | 29.72 | 12.48 | 6.79 | 0.97 |
| 2007.5 | 646.15 | 43.55 | 185.65 | 21.60 | 83.22 | 54.79 | 617.62 | 65.91 | 31.69 | 31.20 | 16.82 | 14.60 | 6.83 |

**Table 7: ADAPT parameter estimates from Run 1, 2, and 3. The columns give the parameter estimate (Est), the standard error (SE), the bias (Bias), and the bias-corrected estimate (Corr).**

| | Run 1 | msr=0.808 | | | Run 2 | msr=0.819 | | | Run 3 | msr=0.913 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Est | SE | Bias | Corr | Est | SE | Bias | Corr | Est | SE | Bias | Corr |
| N[2008 3] | 3047.4 | 2893.6 | 1393.8 | 1653.7 | 3157.9 | 3015.8 | 1445.0 | 1712.9 | 3105.7 | 3133.8 | 1613.2 | 1492.5 |
| N[2008 4] | 121.9 | 120.5 | 58.9 | 63.0 | 138.0 | 136.7 | 67.7 | 70.3 | 115.4 | 121.6 | 63.1 | 52.3 |
| N[2008 5] | 810.0 | 586.7 | 204.6 | 605.4 | 643.4 | 425.5 | 102.4 | 541.0 | 776.7 | 599.9 | 224.2 | 552.4 |
| N[2008 6] | 42.1 | 33.4 | 12.1 | 30.0 | 46.0 | 36.3 | 13.1 | 32.9 | 40.6 | 34.3 | 13.2 | 27.4 |
| N[2008 7] | 155.1 | 115.8 | 35.3 | 119.8 | 172.4 | 125.0 | 34.4 | 138.0 | 141.4 | 114.5 | 37.7 | 103.7 |
| N[2008 8] | 46.2 | 41.4 | 14.1 | 32.1 | 52.1 | 45.7 | 15.5 | 36.7 | 38.4 | 38.5 | 14.7 | 23.7 |
| N[2008 9] | 472.1 | 263.5 | 38.5 | 433.6 | 720.6 | 436.9 | 46.0 | 674.6 | 474.9 | 442.2 | 149.7 | 325.2 |
| N[2008 10] | 55.9 | 47.8 | 14.0 | 41.9 | 57.0 | 50.1 | 15.8 | 41.2 | 39.4 | 40.9 | 15.3 | 24.1 |
| N[2008 11] | 16.4 | 14.9 | 4.7 | 11.8 | 22.0 | 18.6 | 5.6 | 16.4 | 11.9 | 10.8 | 2.8 | 9.1 |
| N[2008 12] | 17.2 | 15.4 | 4.8 | 12.5 | 17.1 | 15.7 | 5.2 | 11.8 | 10.6 | 10.1 | 2.9 | 7.6 |
| q2 | 0.188 | 0.053 | 0.006 | 0.182 | 0.181 | 0.051 | 0.006 | 0.175 | 0.184 | 0.055 | 0.006 | 0.178 |
| q3 | 0.303 | 0.085 | 0.007 | 0.296 | 0.269 | 0.076 | 0.006 | 0.263 | 0.319 | 0.095 | 0.008 | 0.311 |
| q4 | 0.333 | 0.091 | 0.010 | 0.324 | 0.314 | 0.086 | 0.011 | 0.304 | 0.364 | 0.105 | 0.011 | 0.353 |
| q5 | 0.706 | 0.192 | 0.018 | 0.688 | 0.658 | 0.181 | 0.016 | 0.643 | 0.713 | 0.205 | 0.020 | 0.693 |
| q6 | 0.433 | 0.117 | 0.013 | 0.420 | 0.359 | 0.099 | 0.012 | 0.348 | 0.483 | 0.139 | 0.017 | 0.467 |
| q7 | 0.890 | 0.242 | 0.028 | 0.862 | 0.795 | 0.218 | 0.022 | 0.773 | 1.076 | 0.310 | 0.038 | 1.038 |
| q8 | 1.501 | 0.405 | 0.049 | 1.452 | 1.235 | 0.339 | 0.043 | 1.192 | 1.530 | 0.439 | 0.061 | 1.468 |
| q9 | 0.847 | 0.229 | 0.029 | 0.818 | 0.663 | 0.183 | 0.019 | 0.643 | 1.056 | 0.303 | 0.042 | 1.014 |
| q10 | 1.237 | 0.350 | 0.049 | 1.188 | 0.953 | 0.273 | 0.032 | 0.921 | 1.684 | 0.506 | 0.080 | 1.604 |
| q11 | 1.828 | 0.495 | 0.064 | 1.763 | 1.409 | 0.387 | 0.045 | 1.364 | 2.155 | 0.617 | 0.094 | 2.061 |
| q12 | 0.642 | 0.171 | 0.017 | 0.625 | 0.415 | 0.113 | 0.009 | 0.406 | 0.972 | 0.274 | 0.033 | 0.939 |
| q13-14 | 1.314 | 0.288 | 0.016 | 1.298 | 0.810 | 0.183 | 0.008 | 0.802 | 2.468 | 0.567 | 0.048 | 2.420 |

**Table 8: ADAPT parameter estimates from Run 1A and Run 2A. The columns give the parameter estimate (Est), the standard error (SE), the bias (Bias), and the bias-corrected estimate (Corr).**

| | Run 1A | msr=0.664 | | | Run 2A | msr=0.669 | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Est | SE | Bias | Corr | Est | SE | Bias | Corr |
| N[2008 3] | 3026.5 | 2939.6 | 1518.0 | 1508.5 | 3195.9 | 3115.7 | 1624.8 | 1571.2 |
| N[2008 4] | 117.5 | 119.4 | 64.1 | 53.4 | 127.4 | 129.6 | 70.3 | 57.1 |
| N[2008 5] | 809.6 | 600.4 | 235.8 | 573.8 | 861.9 | 639.1 | 254.0 | 608.0 |
| N[2008 6] | 40.5 | 33.1 | 13.7 | 26.8 | 44.6 | 36.2 | 15.2 | 29.4 |
| N[2008 7] | 150.9 | 116.6 | 43.3 | 107.6 | 170.3 | 128.9 | 48.3 | 122.1 |
| N[2008 8] | 43.8 | 41.0 | 16.9 | 26.9 | 50.6 | 45.9 | 18.8 | 31.8 |
| N[2008 9] | 496.9 | 442.4 | 173.2 | 323.6 | 620.1 | 521.3 | 200.4 | 419.6 |
| N[2008 10] | 47.6 | 45.6 | 19.4 | 28.2 | 50.7 | 48.2 | 20.4 | 30.3 |
| N[2008 11] | 15.8 | 15.1 | 6.3 | 9.5 | 19.3 | 17.5 | 7.2 | 12.1 |
| N[2008 12] | 13.2 | 13.5 | 6.3 | 6.9 | 15.2 | 15.2 | 6.9 | 8.3 |
| N[2008 13] | 10.5 | 10.5 | 4.7 | 5.8 | 13.6 | 12.9 | 5.5 | 8.1 |
| N[2008 14] | 5.8 | 5.6 | 2.5 | 3.3 | 8.8 | 7.7 | 3.3 | 5.6 |
| N[1991 14] | 92.3 | 69.5 | 24.2 | 68.1 | 105.6 | 80.8 | 28.6 | 77.0 |
| N[1994 14] | 466.9 | 306.9 | 105.1 | 361.7 | 352.3 | 252.2 | 83.6 | 268.7 |
| N[1998 14] | 94.8 | 67.7 | 34.6 | 60.2 | 179.3 | 133.5 | 58.7 | 120.5 |
| N[2003 14] | 4.9 | 3.7 | 1.6 | 3.3 | 8.0 | 5.7 | 2.3 | 5.7 |
| N[2004 14] | 3.5 | 3.7 | 1.9 | 1.6 | 6.4 | 6.1 | 2.8 | 3.7 |
| N[2005 14] | 1.4 | 1.2 | 0.6 | 0.9 | 2.8 | 2.2 | 0.9 | 1.8 |
| N[2006 14] | 2.5 | 2.5 | 1.2 | 1.3 | 4.4 | 3.9 | 1.7 | 2.8 |
| N[2007 14] | 6.0 | 4.1 | 1.9 | 4.1 | 9.1 | 6.3 | 2.7 | 6.4 |
| q2 | 0.189 | 0.055 | 0.002 | 0.187 | 0.179 | 0.053 | 0.001 | 0.178 |
| q3 | 0.313 | 0.093 | -0.002 | 0.316 | 0.290 | 0.087 | -0.003 | 0.293 |
| q4 | 0.331 | 0.093 | 0.002 | 0.330 | 0.312 | 0.089 | 0.001 | 0.311 |
| q5 | 0.726 | 0.204 | 0.002 | 0.724 | 0.671 | 0.191 | -0.001 | 0.672 |
| q6 | 0.455 | 0.133 | -0.003 | 0.458 | 0.396 | 0.118 | -0.003 | 0.399 |
| q7 | 0.913 | 0.260 | 0.001 | 0.913 | 0.817 | 0.236 | -0.001 | 0.817 |
| q8 | 1.545 | 0.440 | -0.003 | 1.548 | 1.338 | 0.390 | -0.007 | 1.345 |
| q9 | 0.909 | 0.282 | -0.008 | 0.917 | 0.742 | 0.238 | -0.006 | 0.748 |
| q10 | 1.286 | 0.397 | -0.004 | 1.290 | 1.054 | 0.333 | -0.002 | 1.056 |
| q11 | 1.967 | 0.615 | -0.033 | 2.001 | 1.509 | 0.489 | -0.013 | 1.522 |
| q12 | 0.686 | 0.241 | 0.003 | 0.682 | 0.487 | 0.175 | 0.006 | 0.481 |
| q13-14 | 1.408 | 0.461 | 0.007 | 1.401 | 0.861 | 0.277 | 0.004 | 0.857 |

**Table 9: Summary of retrospective analysis model formulations for run 1.**

| Last Data Year (Y) | Ages Estimated in Y+1 | Mean F Ages in year Y |
|---|---|---|
| 2007 | 3-12 | 7-11 |
| 2006 | 4-12 | 7-11 |
| 2005 | 3-12 | 7-11 |
| 2004 | 4-12 | 7-11 |
| 2003 | 3-12 | 7-11 |
| 2002 | 4-8, 10 | 7, 9 |
| 2001 | 3-11 | 7-10 |

**Table 10: Correlations among time series estimates of spawning stock biomass (SSB), population weighted age 7+ mean fishing mortality (F), and age 2 recruitment (REC) from 5 ADAPT runs.**

| SSB | Run 1 | Run 1 A | Run 2 | Run 2 A | Run 3 |
|---|---|---|---|---|---|
| Run 1 | 1 | 0.989 | 0.992 | 0.977 | 0.927 |
| Run 1 A | 0.989 | 1 | 0.967 | 0.994 | 0.960 |
| Run 2 | 0.992 | 0.967 | 1 | 0.946 | 0.877 |
| Run 2 A | 0.977 | 0.994 | 0.946 | 1 | 0.980 |
| Run 3 | 0.927 | 0.960 | 0.877 | 0.980 | 1 |

| F | Run 1 | Run 1 A | Run 2 | Run 2 A | Run 3 |
|---|---|---|---|---|---|
| Run 1 | 1 | 0.990 | 0.991 | 0.992 | 0.891 |
| Run 1 A | 0.990 | 1 | 0.970 | 0.996 | 0.914 |
| Run 2 | 0.991 | 0.970 | 1 | 0.975 | 0.844 |
| Run 2 A | 0.992 | 0.996 | 0.975 | 1 | 0.924 |
| Run 3 | 0.891 | 0.914 | 0.844 | 0.924 | 1 |

| REC | Run 1 | Run 1 A | Run 2 | Run 2 A | Run 3 |
|---|---|---|---|---|---|
| Run 1 | 1 | 0.985 | 0.999 | 0.990 | 0.974 |
| Run 1 A | 0.985 | 1 | 0.979 | 0.993 | 0.974 |
| Run 2 | 0.999 | 0.979 | 1 | 0.984 | 0.965 |
| Run 2 A | 0.990 | 0.993 | 0.984 | 1 | 0.990 |
| Run 3 | 0.974 | 0.974 | 0.965 | 0.990 | 1 |

**Table 11: Input vectors for reference point estimates. Weight beginning of the year (wboy), weight at age middle of the year (wmoy), and sexual maturity (mat) vectors were the same for each run. The fishery selectivity vectors from each run are shown.**

| Age | wboy | wmoy | mat | sel 1 | sel 1 A | sel 2 | sel 2 A | sel 3 |
|---|---|---|---|---|---|---|---|---|
| 2 | 0.224 | 0.274 | 0.176 | 0.137 | 0.046 | 0.146 | 0.049 | 0.137 |
| 3 | 0.335 | 0.410 | 0.661 | 0.243 | 0.109 | 0.283 | 0.119 | 0.183 |
| 4 | 0.450 | 0.493 | 0.890 | 0.394 | 0.238 | 0.475 | 0.260 | 0.240 |
| 5 | 0.526 | 0.561 | 0.969 | 0.569 | 0.443 | 0.675 | 0.478 | 0.308 |
| 6 | 0.586 | 0.613 | 0.986 | 0.728 | 0.670 | 0.826 | 0.704 | 0.386 |
| 7 | 0.629 | 0.645 | 0.996 | 0.844 | 0.838 | 0.916 | 0.861 | 0.470 |
| 8 | 0.653 | 0.661 | 1.000 | 0.917 | 0.930 | 0.962 | 0.942 | 0.556 |
| 9 | 0.692 | 0.724 | 1.000 | 0.957 | 0.971 | 0.983 | 0.977 | 0.638 |
| 10 | 0.729 | 0.734 | 1.000 | 0.978 | 0.988 | 1.000 | 1.000 | 0.714 |
| 11 | 0.747 | 0.760 | 1.000 | 0.989 | 0.995 | 1.000 | 1.000 | 0.778 |
| 12 | 0.763 | 0.766 | 1.000 | 1.000 | 0.998 | 1.000 | 1.000 | 0.832 |
| 13 | 0.788 | 0.811 | 1.000 | 1.000 | 0.999 | 1.000 | 1.000 | 0.875 |
| 14 | 0.804 | 0.798 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 15 | 0.819 | 0.841 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

**Table 12: Fishing mortality reference points from runs 1, 1A, 2, 2A, and 3. Spawner per recruit at F = 0 was the same for each run, 2.24 kg. Fishing mortality at 40% of SPR0 (F40%), fishing mortality where the slope of the yield per recruit curve is 10% of the slope of the yield per recruit curve at F = 0 (F0.1), average age 2 recruitment (million), and the unfished SSB (B0 proxy).**

| Run | F40% | F0.1 | avg Rec | B0 proxy |
|---|---|---|---|---|
| 1 | 0.63 | 0.47 | 1848 | 4140 |
| 1A | 1.02 | 0.51 | 1726 | 3867 |
| 2 | 0.55 | 0.44 | 2026 | 4538 |
| 2A | 0.94 | 0.50 | 1765 | 3953 |
| 3 | 0.71 | 0.94 | 1810 | 4053 |

**Table 13: Fishing mortality in 2007, forecast fishing mortality in 2008, and catch biomass forecast for 2008 from ADAPT runs following the 40/10 rule.**

| Run | F 2007 | F 2008 | Catch (‘000 t) |
|---|---|---|---|
| 1 | 0.40 | 0.55 | 383 |
| 1A | 0.51 | 0.83 | 346 |
| 2 | 0.29 | 0.50 | 456 |
| 2A | 0.42 | 0.82 | 417 |
| 3 | 0.52 | 0.76 | 312 |

**Table 14: Fishing mortality in 2007, forecast fishing mortality in 2008, and catch biomass forecast for 2008 from ADAPT runs following the *status quo* rule.**

| Run | F 2007 | F 2008 | Catch (‘000 t) |
|---|---|---|---|
| 1 | 0.40 | 0.30 | 232 |
| 1A | 0.51 | 0.38 | 200 |
| 2 | 0.29 | 0.27 | 257 |
| 2A | 0.42 | 0.34 | 213 |
| 3 | 0.52 | 0.38 | 224 |

**Table 15: Beginning of the year estimates of population numbers at age (million), total biomass ('000 t) and spawning stock biomass ('000 t) of Pacific hake from Run 1A.**

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total Biomass | SSB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 98 | 115 | 668 | 108 | 227 | 456 | 80 | 57 | 44 | 27 | 12 | 5 | 1 | 7 | 1906 | 1705 |
| 1978 | 17 | 99 | 103 | 573 | 87 | 183 | 348 | 57 | 39 | 32 | 19 | 7 | 4 | 6 | 1574 | 1495 |
| 1979 | 478 | 29 | 92 | 91 | 491 | 75 | 146 | 283 | 43 | 29 | 25 | 15 | 5 | 7 | 1810 | 1386 |
| 1980 | 76 | 709 | 40 | 74 | 76 | 416 | 57 | 101 | 229 | 30 | 21 | 19 | 12 | 9 | 1870 | 1558 |
| 1981 | 31 | 71 | 836 | 44 | 64 | 62 | 345 | 40 | 72 | 176 | 21 | 15 | 14 | 16 | 1806 | 1662 |
| 1982 | 2474 | 74 | 74 | 769 | 39 | 51 | 47 | 267 | 24 | 52 | 126 | 14 | 11 | 20 | 4040 | 1944 |
| 1983 | 30 | 2967 | 108 | 76 | 660 | 30 | 37 | 33 | 204 | 17 | 40 | 81 | 10 | 23 | 4315 | 3261 |
| 1984 | 27 | 35 | 3162 | 97 | 67 | 525 | 21 | 26 | 21 | 155 | 12 | 29 | 58 | 24 | 4258 | 3870 |
| 1985 | 62 | 28 | 36 | 3001 | 89 | 49 | 442 | 14 | 18 | 15 | 126 | 8 | 21 | 62 | 3972 | 3813 |
| 1986 | 1940 | 83 | 30 | 28 | 2679 | 70 | 33 | 361 | 10 | 14 | 11 | 105 | 6 | 67 | 5437 | 3768 |
| 1987 | 82 | 2095 | 96 | 28 | 20 | 2220 | 44 | 17 | 260 | 4 | 7 | 6 | 76 | 55 | 5008 | 4210 |
| 1988 | 149 | 98 | 2080 | 90 | 26 | 13 | 1748 | 28 | 9 | 179 | 2 | 5 | 3 | 93 | 4523 | 4135 |
| 1989 | 507 | 141 | 97 | 1845 | 77 | 21 | 8 | 1323 | 17 | 5 | 127 | 1 | 4 | 73 | 4247 | 3712 |
| 1990 | 336 | 670 | 139 | 90 | 1544 | 68 | 16 | 4 | 989 | 9 | 4 | 90 | 0 | 61 | 4020 | 3476 |
| 1991 | 77 | 333 | 716 | 139 | 87 | 1291 | 61 | 12 | 3 | 730 | 6 | 3 | 62 | 47 | 3567 | 3302 |
| 1992 | 391 | 90 | 324 | 629 | 119 | 71 | 980 | 45 | 9 | 2 | 509 | 4 | 1 | 63 | 3237 | 2828 |
| 1993 | 180 | 424 | 90 | 283 | 503 | 92 | 53 | 674 | 32 | 7 | 1 | 342 | 2 | 37 | 2719 | 2402 |
| 1994 | 109 | 187 | 412 | 83 | 221 | 397 | 76 | 41 | 495 | 24 | 6 | 1 | 254 | 31 | 2337 | 2131 |
| 1995 | 96 | 133 | 194 | 349 | 76 | 154 | 277 | 62 | 36 | 304 | 18 | 4 | 0 | 199 | 1903 | 1744 |
| 1996 | 362 | 252 | 124 | 182 | 270 | 64 | 112 | 183 | 45 | 30 | 184 | 13 | 3 | 131 | 1954 | 1547 |
| 1997 | 350 | 405 | 375 | 96 | 136 | 181 | 47 | 75 | 106 | 34 | 23 | 87 | 10 | 120 | 2045 | 1572 |
| 1998 | 213 | 296 | 343 | 281 | 78 | 91 | 105 | 31 | 47 | 59 | 24 | 17 | 44 | 71 | 1698 | 1374 |
| 1999 | 118 | 222 | 223 | 264 | 166 | 57 | 54 | 47 | 21 | 32 | 29 | 16 | 12 | 71 | 1331 | 1124 |
| 2000 | 249 | 148 | 208 | 175 | 184 | 112 | 42 | 31 | 22 | 16 | 20 | 13 | 10 | 50 | 1278 | 992 |
| 2001 | 1620 | 314 | 165 | 199 | 147 | 128 | 78 | 21 | 14 | 14 | 8 | 12 | 7 | 43 | 2772 | 1303 |
| 2002 | 117 | 1821 | 316 | 142 | 148 | 117 | 86 | 54 | 15 | 7 | 7 | 4 | 8 | 41 | 2883 | 2128 |
| 2003 | 180 | 115 | 1786 | 255 | 98 | 110 | 83 | 52 | 33 | 9 | 4 | 3 | 3 | 35 | 2765 | 2372 |
| 2004 | 19 | 197 | 112 | 1515 | 190 | 68 | 75 | 54 | 29 | 20 | 5 | 2 | 1 | 25 | 2313 | 2168 |
| 2005 | 409 | 27 | 185 | 89 | 1135 | 129 | 45 | 46 | 34 | 18 | 12 | 2 | 1 | 20 | 2151 | 1765 |
| 2006 | 25 | 406 | 30 | 148 | 61 | 735 | 75 | 29 | 26 | 20 | 11 | 7 | 1 | 13 | 1585 | 1415 |
| 2007 | 338 | 27 | 370 | 23 | 103 | 36 | 411 | 46 | 18 | 14 | 11 | 5 | 3 | 11 | 1415 | 1084 |
| 2008 | 386 | 506 | 24 | 302 | 16 | 68 | 18 | 224 | 21 | 7 | 5 | 5 | 3 | 9 | 1592 | 1090 |

**Table 16: Estimates of fishing mortality at age and year of Pacific hake from ADAPT Run 1A.**

| Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 + | 7+ Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 0.017 | 0.021 | 0.042 | 0.057 | 0.062 | 0.121 | 0.191 | 0.193 | 0.159 | 0.180 | 0.261 | 0.212 | 0.139 | 0.011 | 0.139 |
| 1978 | 0.002 | 0.033 | 0.047 | 0.050 | 0.070 | 0.088 | 0.100 | 0.162 | 0.160 | 0.114 | 0.071 | 0.115 | 0.104 | 0.010 | 0.104 |
| 1979 | 0.002 | 0.107 | 0.146 | 0.085 | 0.076 | 0.173 | 0.215 | 0.090 | 0.191 | 0.181 | 0.084 | 0.084 | 0.143 | 0.073 | 0.143 |
| 1980 | 0.003 | 0.013 | 0.061 | 0.082 | 0.093 | 0.046 | 0.163 | 0.126 | 0.081 | 0.169 | 0.148 | 0.125 | 0.077 | 0.079 | 0.077 |
| 1981 | 0.050 | 0.025 | 0.052 | 0.066 | 0.150 | 0.167 | 0.090 | 0.310 | 0.175 | 0.123 | 0.220 | 0.125 | 0.128 | 0.018 | 0.128 |
| 1982 | 0.002 | 0.011 | 0.016 | 0.048 | 0.123 | 0.143 | 0.159 | 0.076 | 0.195 | 0.100 | 0.158 | 0.133 | 0.114 | 0.032 | 0.114 |
| 1983 | 0.000 | 0.008 | 0.034 | 0.039 | 0.071 | 0.189 | 0.163 | 0.221 | 0.072 | 0.232 | 0.068 | 0.086 | 0.110 | 0.018 | 0.110 |
| 1984 | 0.000 | 0.023 | 0.019 | 0.051 | 0.205 | 0.070 | 0.300 | 0.198 | 0.196 | 0.061 | 0.199 | 0.082 | 0.082 | 0.038 | 0.082 |
| 1985 | 0.022 | 0.011 | 0.183 | 0.018 | 0.104 | 0.199 | 0.052 | 0.207 | 0.094 | 0.187 | 0.021 | 0.070 | 0.000 | 0.031 | 0.064 |
| 1986 | 0.008 | 0.052 | 0.046 | 0.292 | 0.045 | 0.270 | 0.478 | 0.091 | 0.731 | 0.378 | 0.306 | 0.048 | 0.154 | 0.036 | 0.154 |
| 1987 | 0.000 | 0.019 | 0.029 | 0.029 | 0.255 | 0.065 | 0.257 | 0.371 | 0.137 | 0.603 | 0.120 | 0.369 | 0.076 | 0.042 | 0.076 |
| 1988 | 0.005 | 0.009 | 0.037 | 0.034 | 0.085 | 0.302 | 0.082 | 0.269 | 0.334 | 0.171 | 0.439 | 0.149 | 0.094 | 0.069 | 0.094 |
| 1989 | 0.007 | 0.044 | 0.035 | 0.073 | 0.041 | 0.079 | 0.351 | 0.116 | 0.441 | 0.687 | 0.156 | 0.922 | 0.125 | 0.035 | 0.125 |
| 1990 | 0.006 | 0.046 | 0.036 | 0.011 | 0.071 | 0.028 | 0.050 | 0.162 | 0.115 | 0.153 | 0.001 | 0.166 | 0.112 | 0.021 | 0.112 |
| 1991 | 0.009 | 0.057 | 0.062 | 0.067 | 0.035 | 0.104 | 0.090 | 0.038 | 0.207 | 0.127 | 0.404 | 0.000 | 0.389 | 0.165 | 0.117 |
| 1992 | 0.013 | 0.077 | 0.101 | 0.104 | 0.072 | 0.057 | 0.141 | 0.067 | 0.054 | 0.525 | 0.134 | 0.293 | 0.133 | 0.095 | 0.133 |
| 1993 | 0.002 | 0.067 | 0.059 | 0.108 | 0.082 | 0.041 | 0.036 | 0.118 | 0.063 | 0.019 | 0.158 | 0.087 | 0.097 | 0.058 | 0.097 |
| 1994 | 0.001 | 0.037 | 0.136 | 0.048 | 0.238 | 0.225 | 0.072 | 0.042 | 0.319 | 0.038 | 0.407 | 0.274 | 0.187 | 0.134 | 0.235 |
| 1995 | 0.013 | 0.003 | 0.068 | 0.170 | 0.043 | 0.147 | 0.228 | 0.098 | 0.027 | 0.287 | 0.061 | 0.297 | 0.210 | 0.150 | 0.210 |
| 1996 | 0.072 | 0.082 | 0.028 | 0.176 | 0.268 | 0.067 | 0.225 | 0.305 | 0.070 | 0.054 | 0.535 | 0.004 | 0.293 | 0.145 | 0.293 |
| 1997 | 0.003 | 0.200 | 0.194 | 0.040 | 0.215 | 0.345 | 0.182 | 0.250 | 0.348 | 0.180 | 0.030 | 0.457 | 0.313 | 0.121 | 0.313 |
| 1998 | 0.038 | 0.173 | 0.167 | 0.378 | 0.141 | 0.300 | 0.613 | 0.185 | 0.203 | 0.536 | 0.145 | 0.041 | 0.856 | 0.066 | 0.430 |
| 1999 | 0.105 | 0.205 | 0.250 | 0.305 | 0.316 | 0.196 | 0.452 | 0.633 | 0.231 | 0.304 | 0.720 | 0.255 | 0.402 | 0.254 | 0.402 |
| 2000 | 0.015 | 0.109 | 0.138 | 0.189 | 0.313 | 0.298 | 0.628 | 0.718 | 0.302 | 0.483 | 0.421 | 0.428 | 0.428 | 0.238 | 0.428 |
| 2001 | 0.009 | 0.105 | 0.210 | 0.239 | 0.182 | 0.347 | 0.273 | 0.280 | 0.562 | 0.517 | 0.577 | 0.331 | 0.000 | 0.095 | 0.337 |
| 2002 | 0.000 | 0.032 | 0.100 | 0.186 | 0.111 | 0.115 | 0.244 | 0.228 | 0.199 | 0.348 | 0.501 | 0.092 | 0.190 | 0.082 | 0.190 |
| 2003 | 0.001 | 0.021 | 0.078 | 0.121 | 0.104 | 0.150 | 0.126 | 0.244 | 0.210 | 0.397 | 0.279 | 0.701 | 0.111 | 0.035 | 0.178 |
| 2004 | 0.000 | 0.079 | 0.186 | 0.159 | 0.188 | 0.167 | 0.286 | 0.248 | 0.266 | 0.291 | 0.430 | 0.888 | 0.865 | 0.034 | 0.253 |
| 2005 | 0.006 | 0.037 | 0.128 | 0.240 | 0.254 | 0.331 | 0.284 | 0.363 | 0.370 | 0.308 | 0.407 | 0.649 | 0.315 | 0.053 | 0.337 |
| 2006 | 0.178 | 0.077 | 0.195 | 0.245 | 0.377 | 0.408 | 0.334 | 0.346 | 0.426 | 0.384 | 0.547 | 0.489 | 1.661 | 0.090 | 0.404 |
| 2007 | 0.031 | 0.217 | 0.102 | 0.226 | 0.262 | 0.546 | 0.480 | 0.648 | 0.636 | 0.778 | 0.681 | 0.433 | 0.825 | 0.061 | 0.513 |

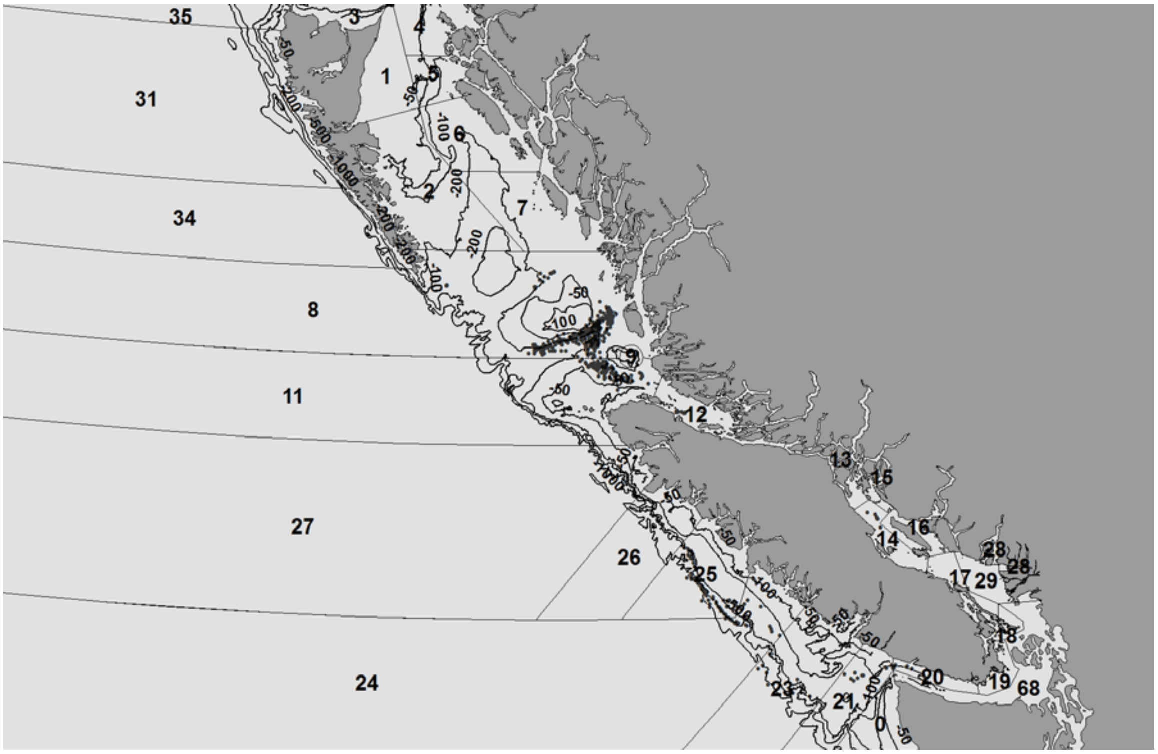



**Figure 1: 2007 commercial catch locations by minor statistical area. Contours show depth in meters.**

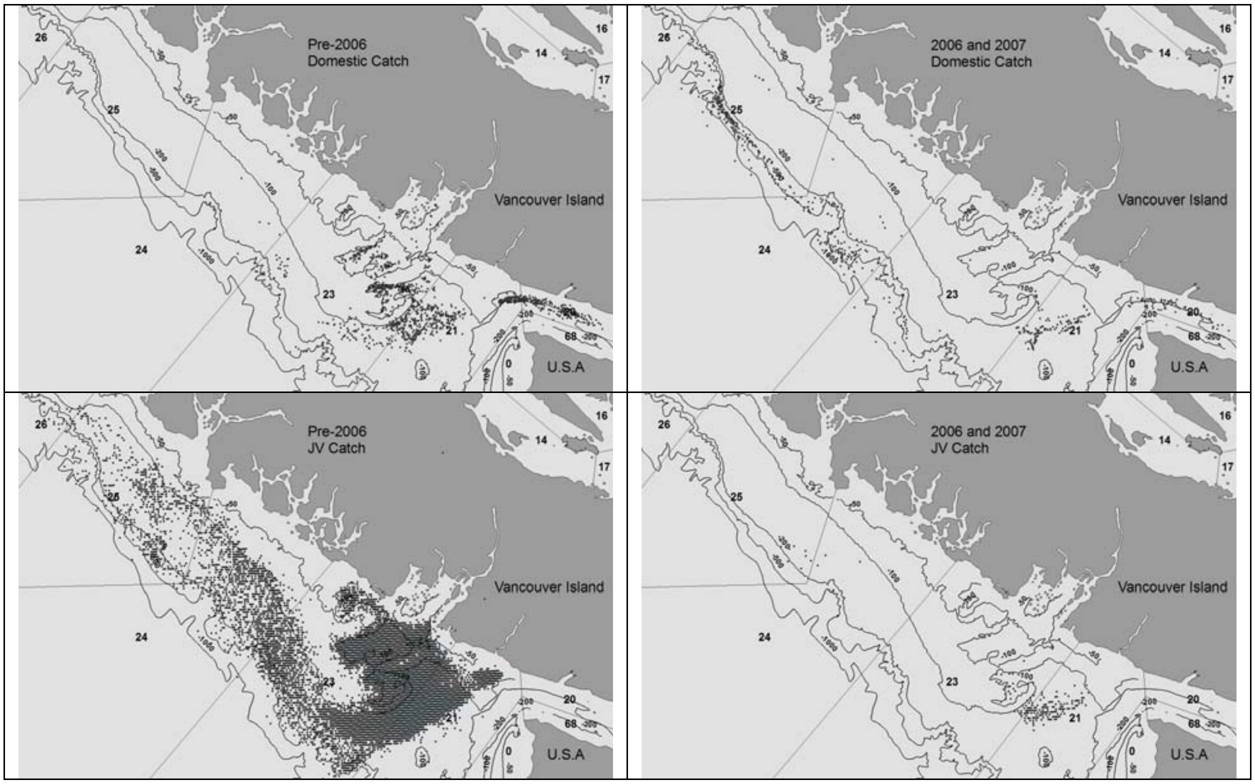



**Figure 2: Southern catch locations by fishery before and after 2006. Contours show depth in meters.**

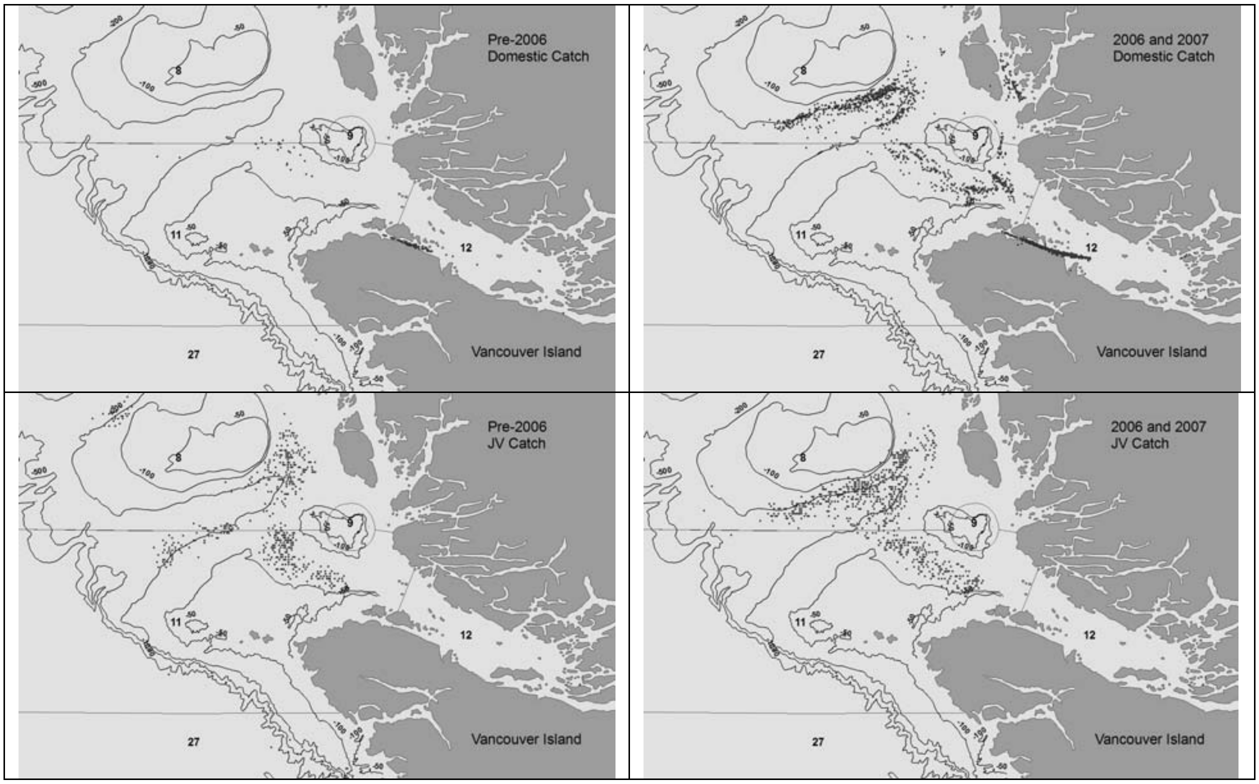



**Figure 3: Northern catch locations by fishery before and after 2006. The catch located north of Vancouver Island in the JV fishery before 2006 was all taken in 2000. Contours show depth in meters.**

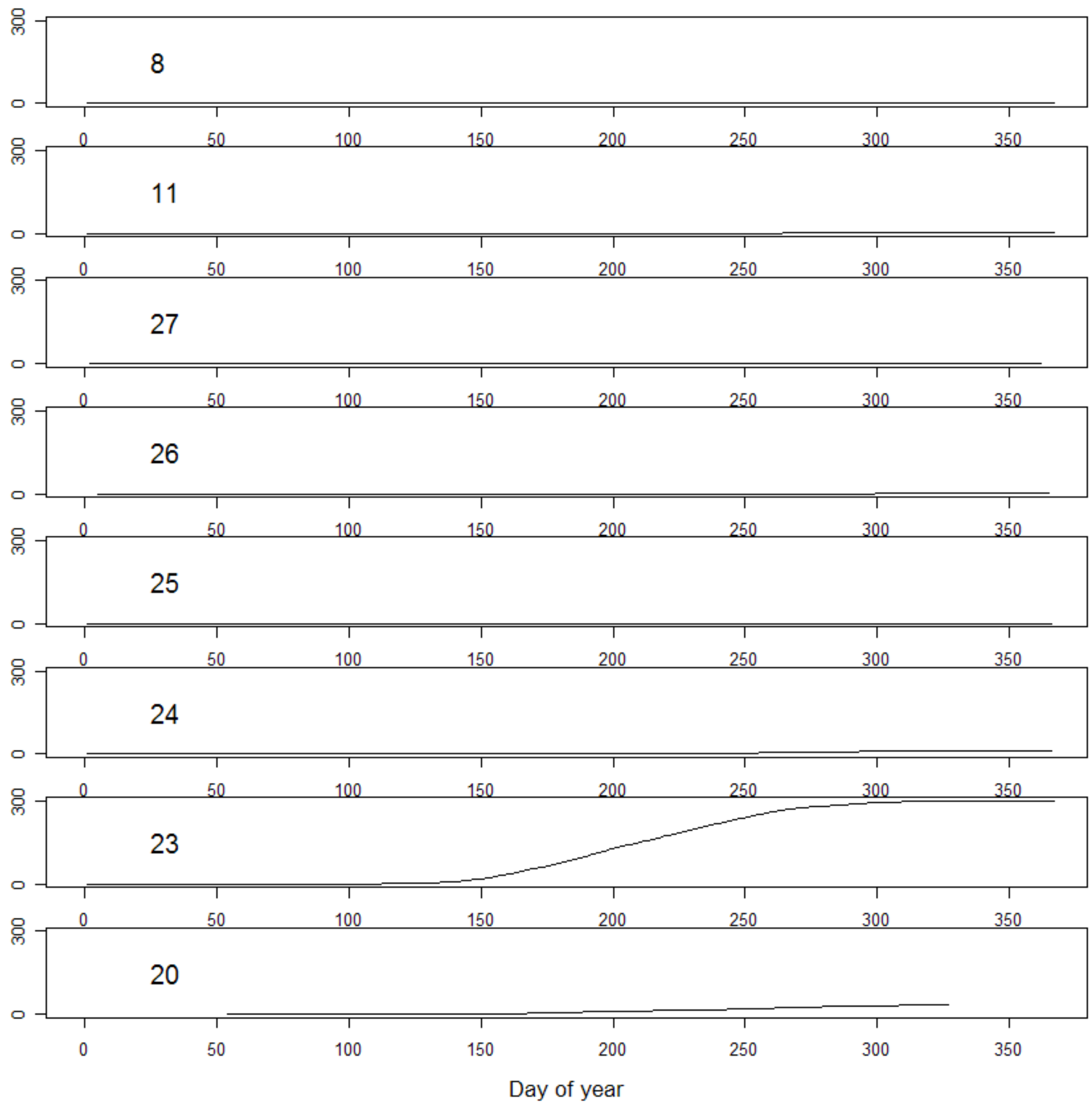



**Figure 4: Cumulative commercial catch by area number, prior to 2006. Area plots are in the same north-south spatial orientation in which they occur. Weight is in thousands of metric tonnes.**

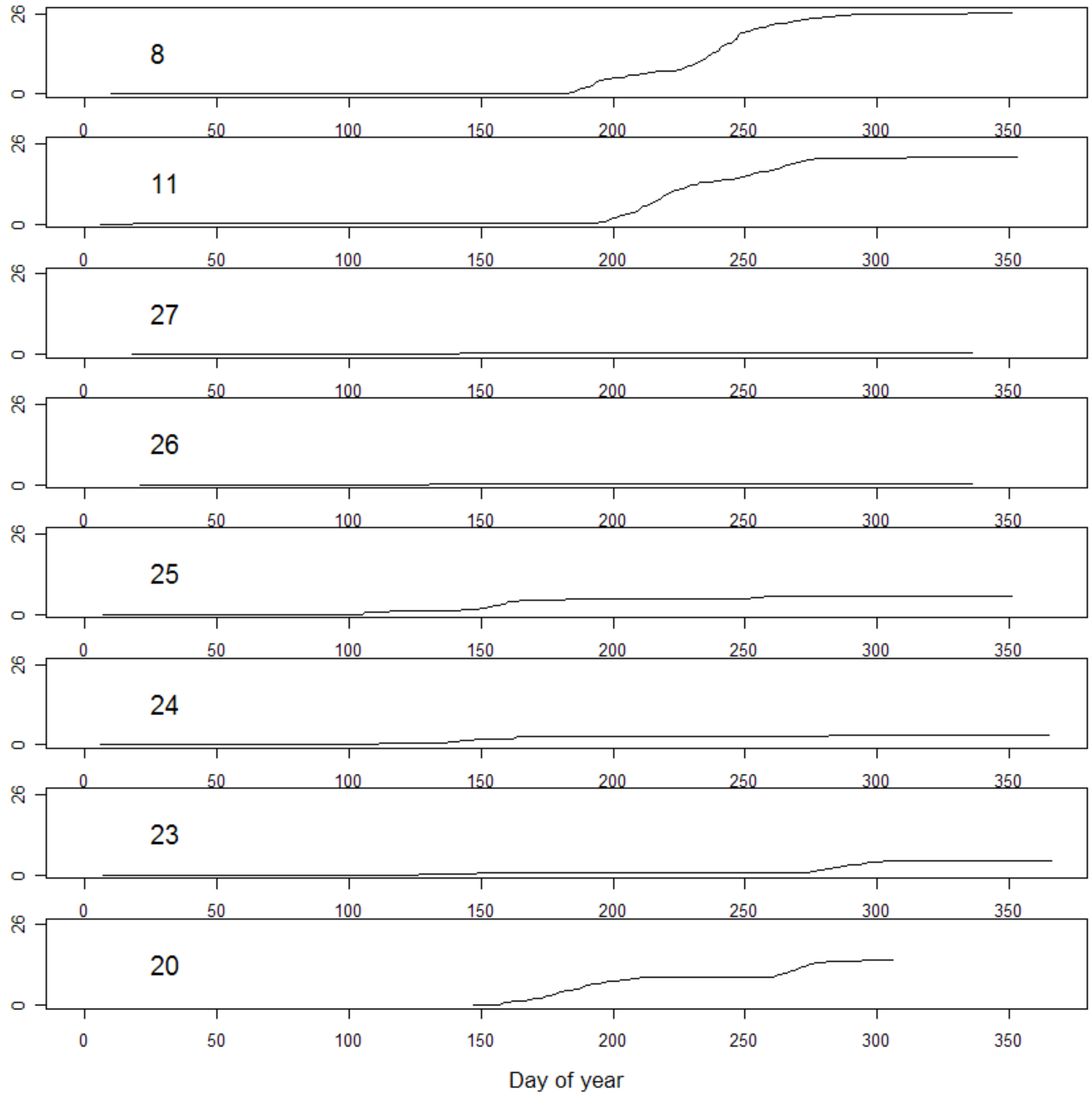



**Figure 5: Cumulative commercial catch by area number, 2006 and 2007. Area plots are in the same north-south spatial orientation in which they occur. Weight is in thousands of metric tonnes.**

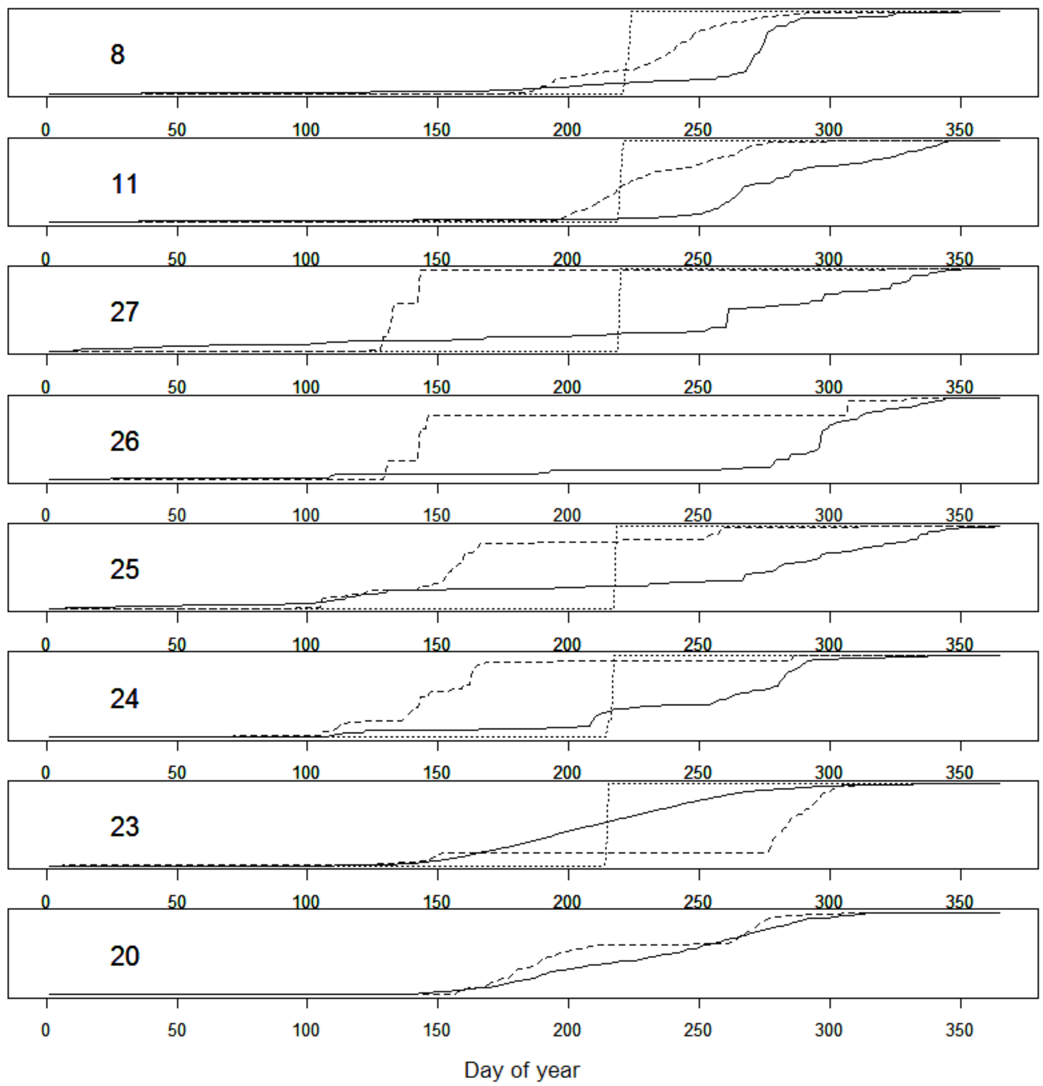



**Figure 6: Cumulative commercial and survey catch proportions by area number. Area plots are in the same north-south spatial orientation in which they occur. Solid lines show commercial fishery catch prior to 2007, dashed lines show 2007 commercial, dotted lines show 2007 acoustic survey.**

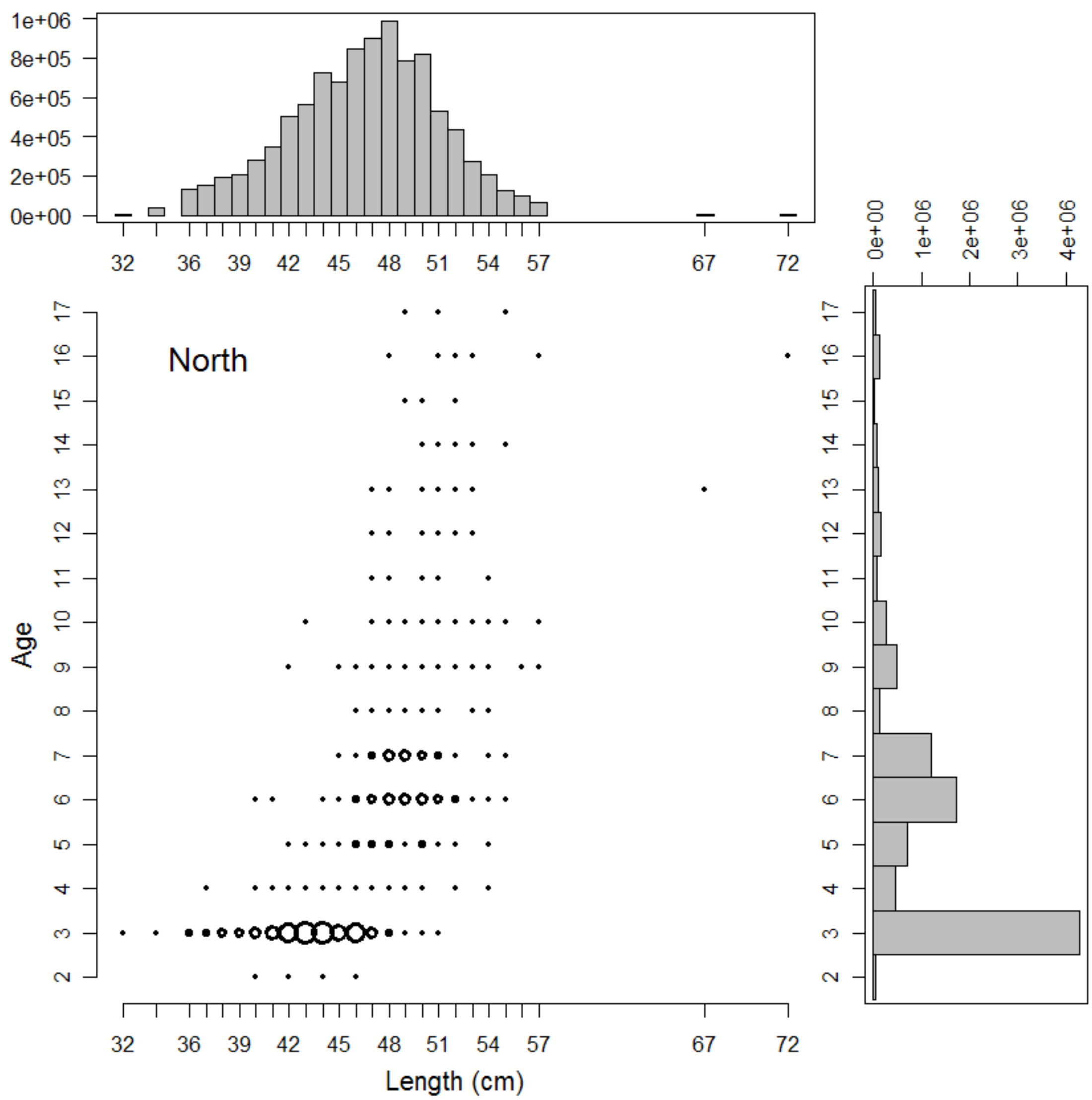



**Figure 7 Aggregated age-length composition for all years prior to 2007, northern area.**

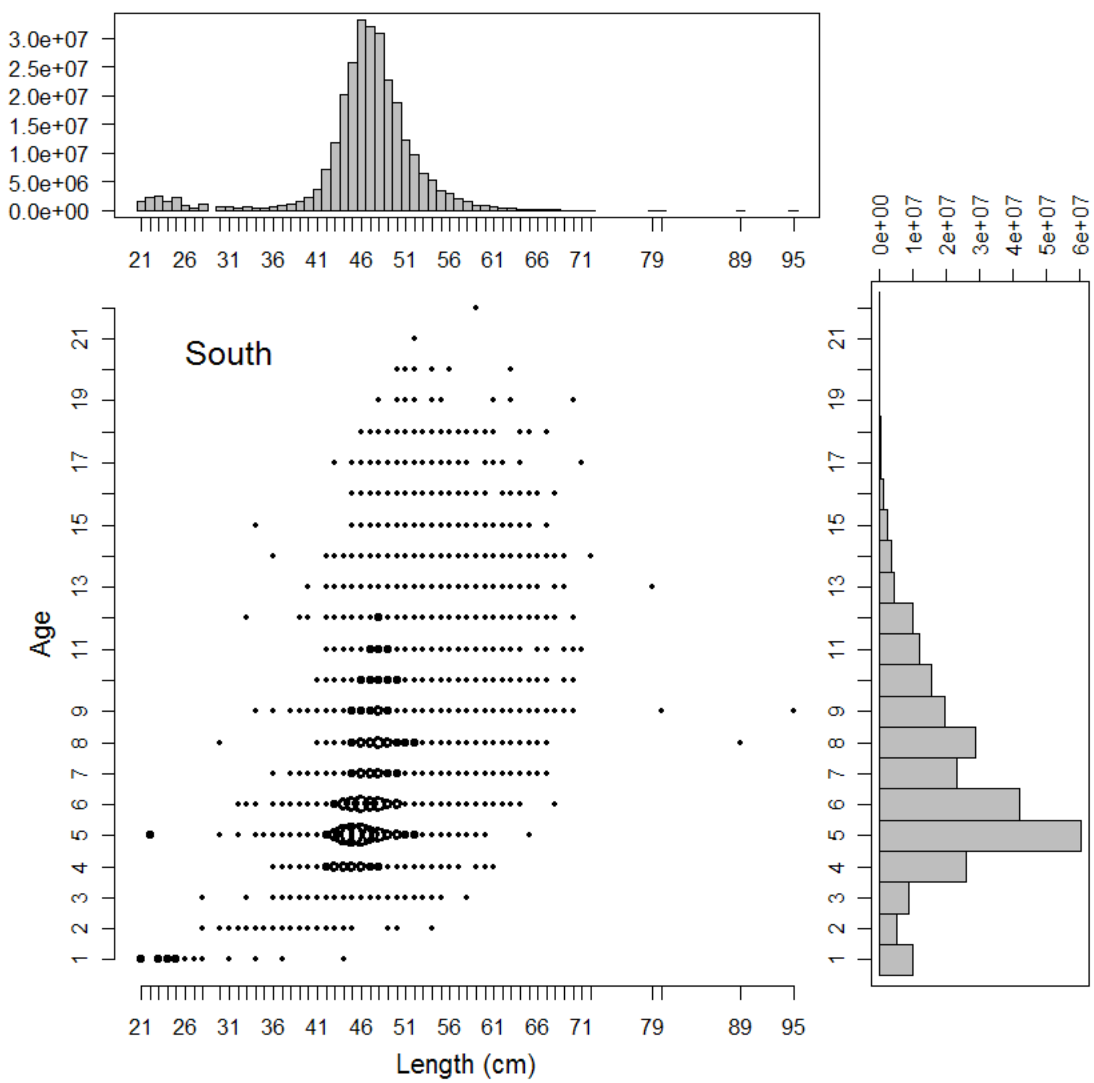



**Figure 8: Aggregated age-length composition for all years prior to 2007, southern area.**

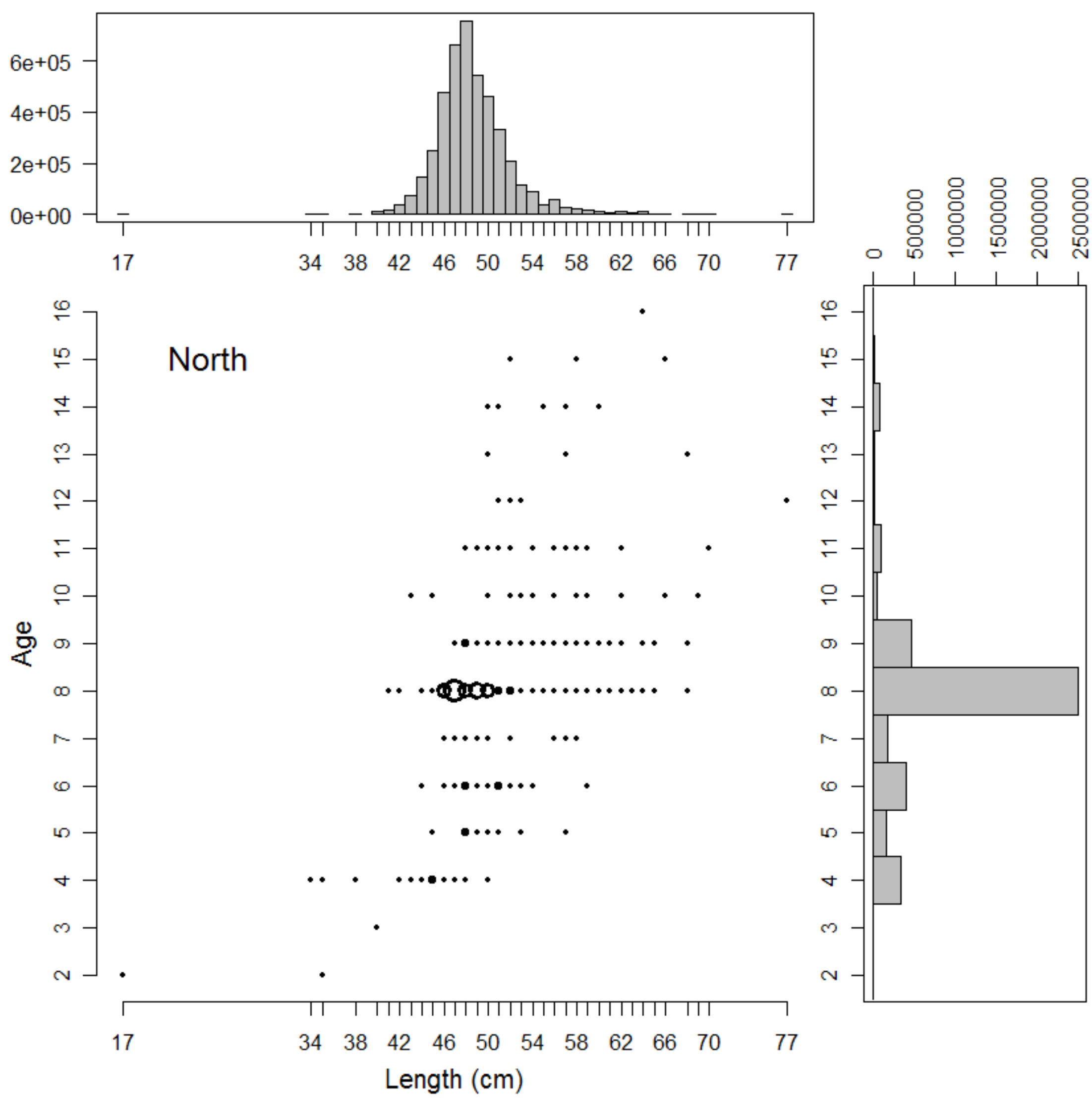



**Figure 9: Age-length composition for 2007 commercial fisheries, northern area.**

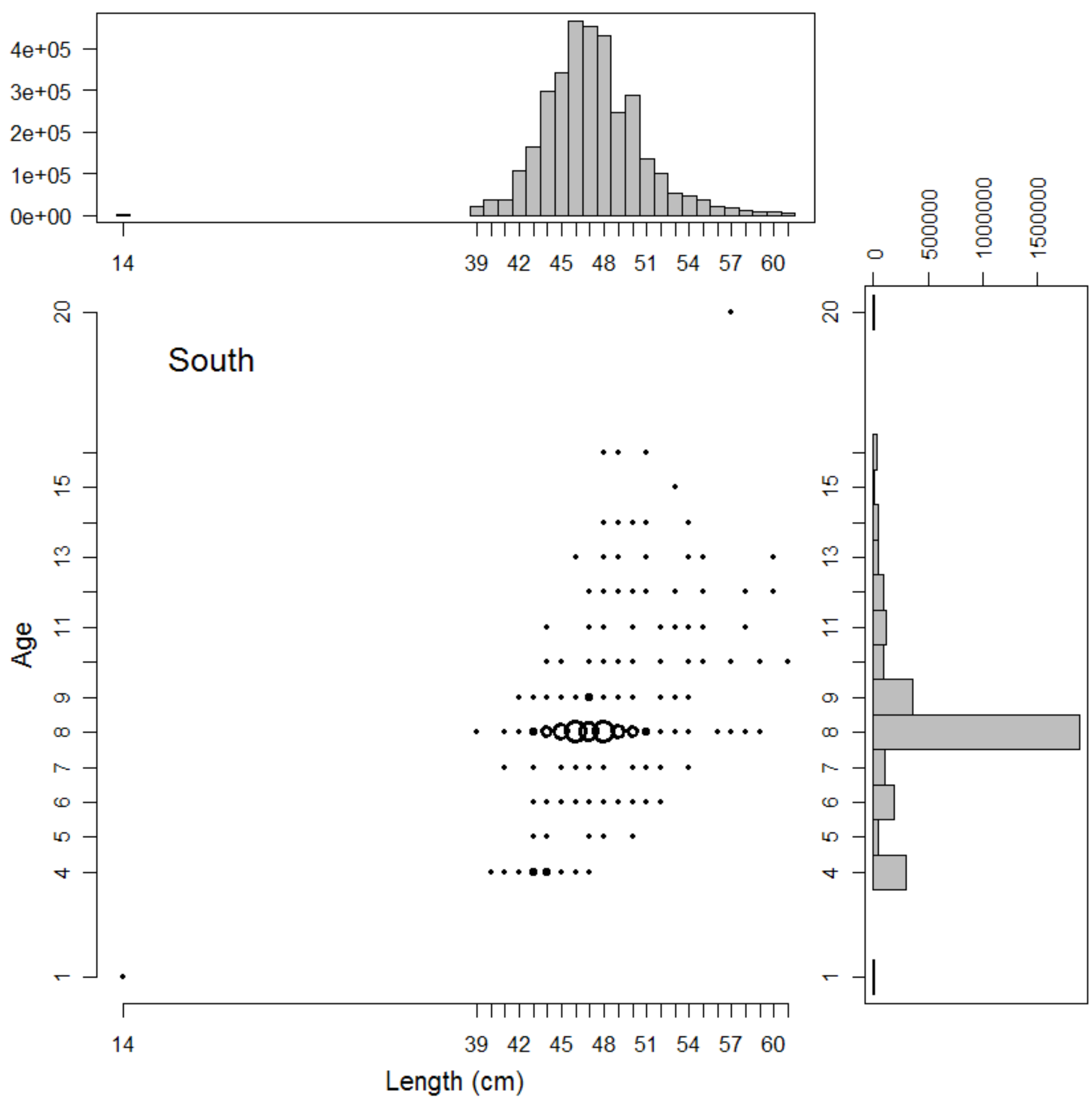



**Figure 10: Age-length composition for 2007 commercial fisheries, southern areas.**

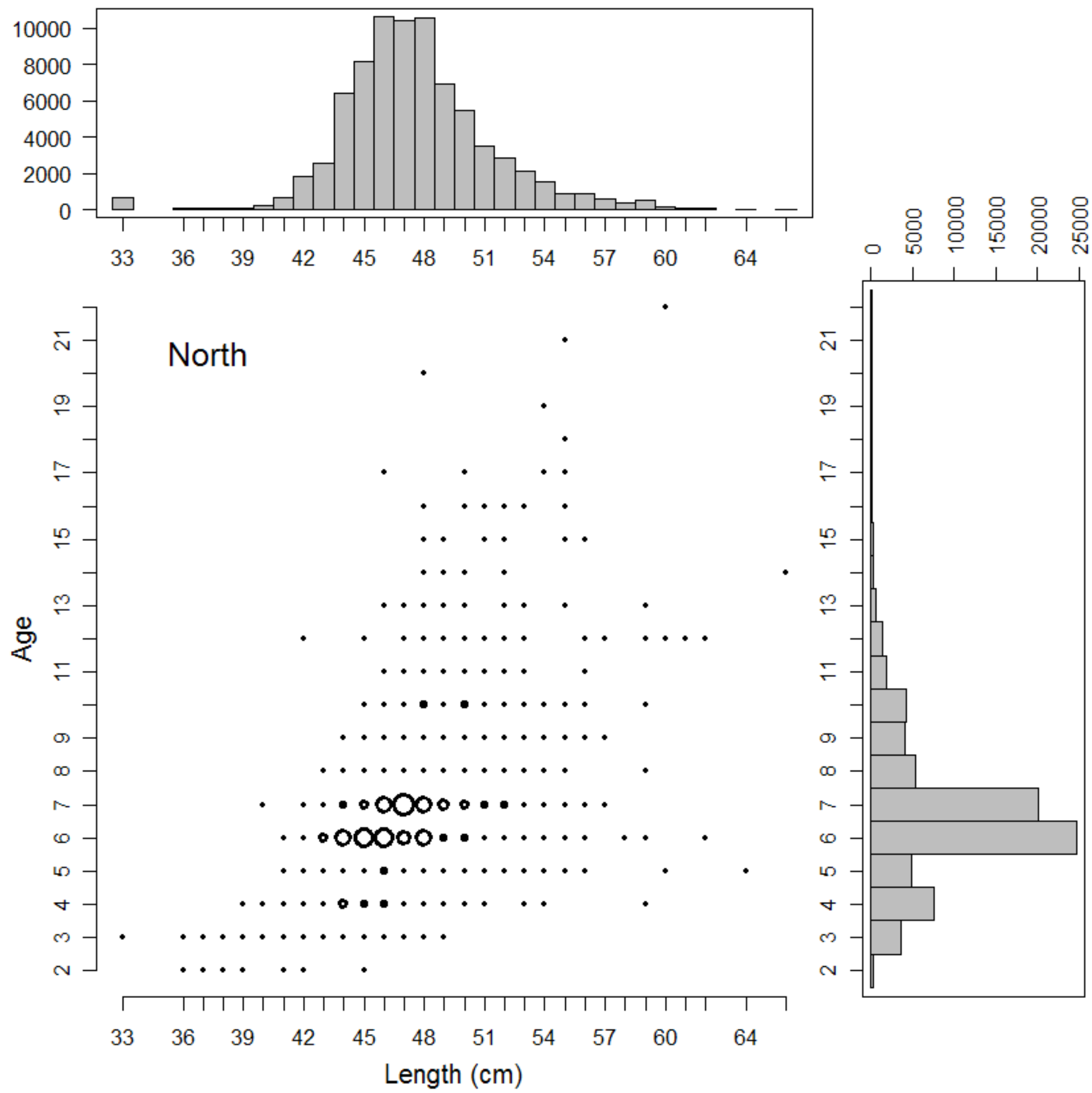



**Figure 11: Age-length composition for acoustic surveys 1999 to 2006, northern areas.**

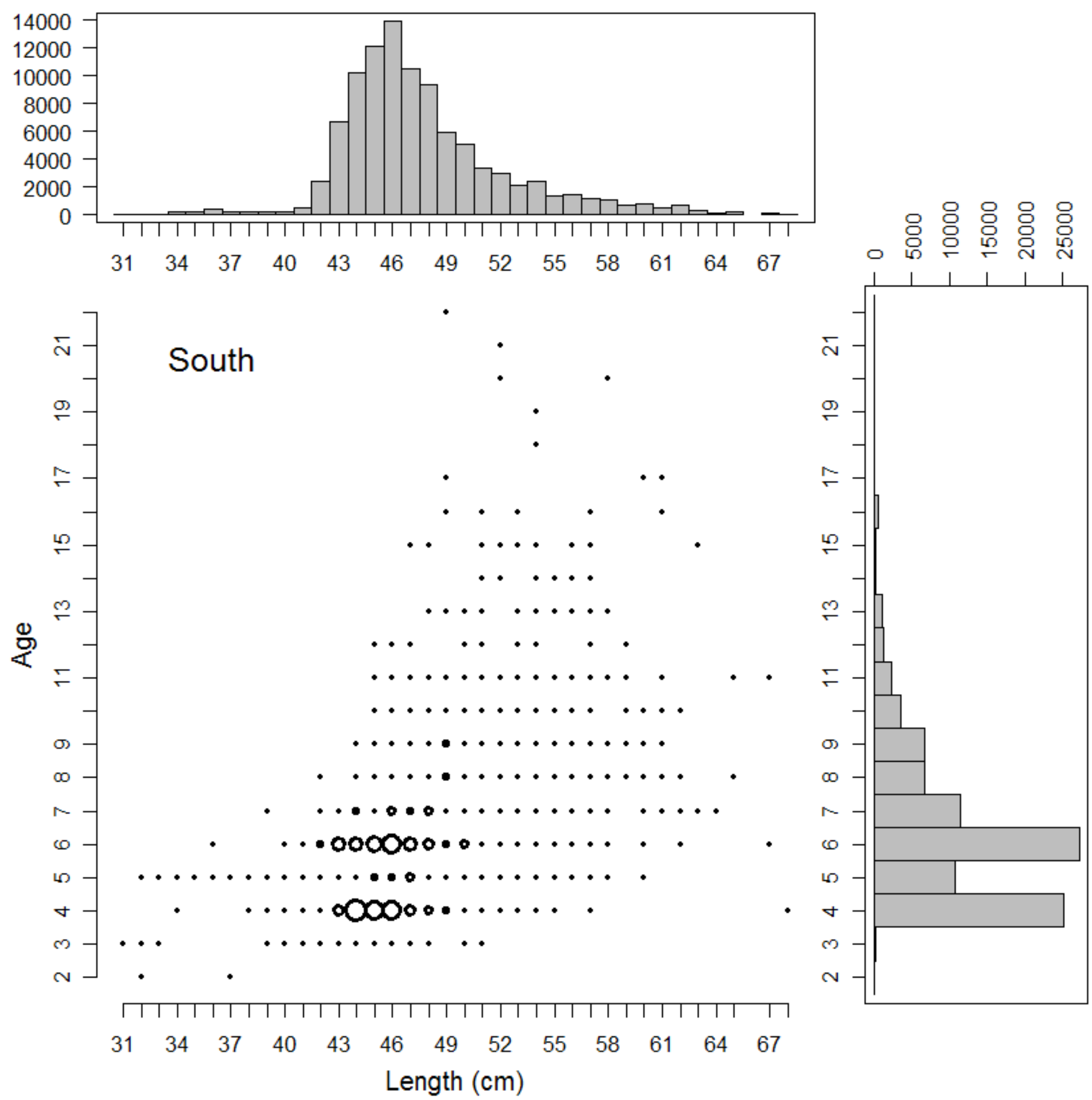



**Figure 12: Age-length composition for acoustic surveys 1999 to 2006, southern areas.**

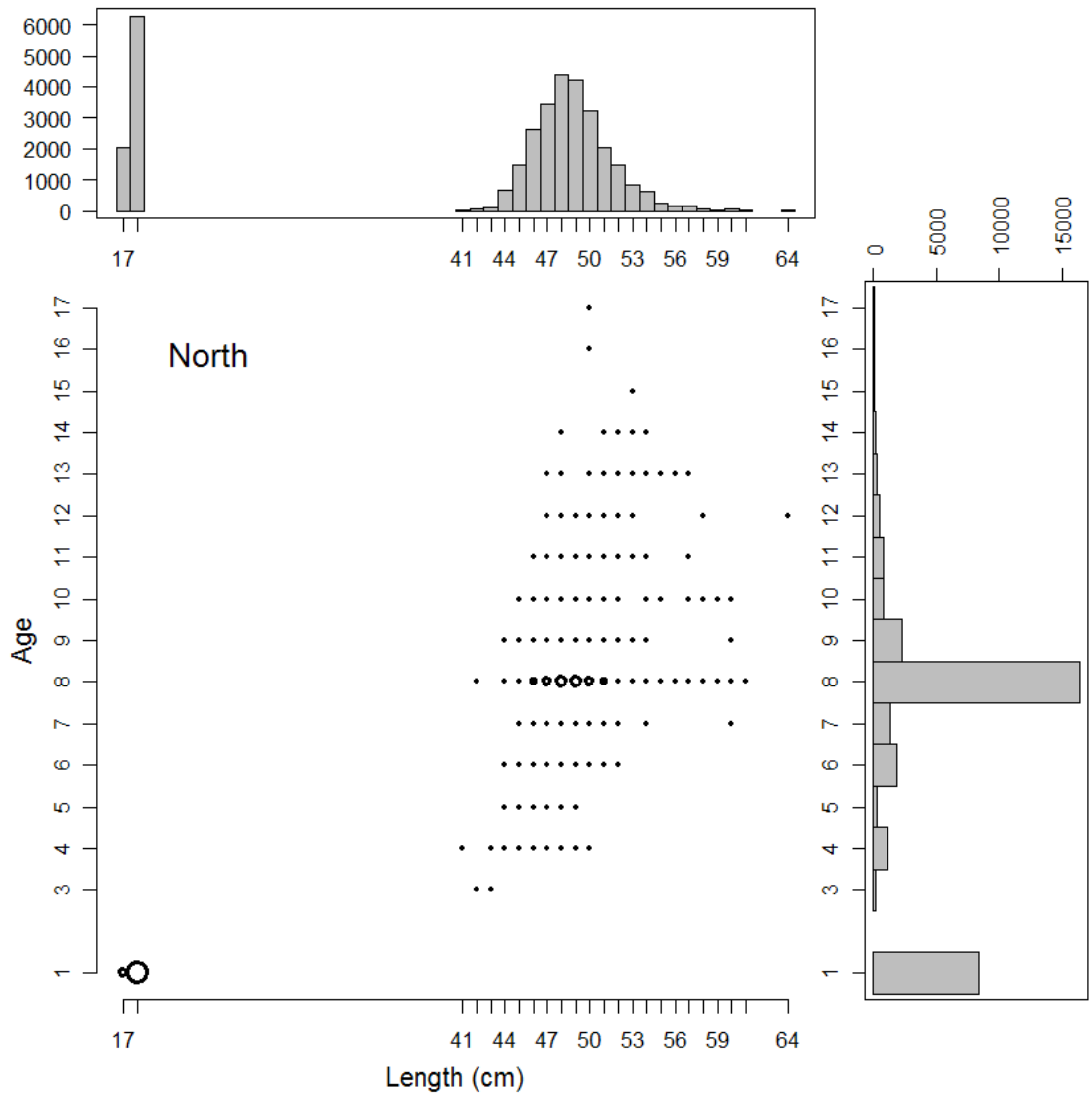



**Figure 13: Age-length composition for the acoustic survey of 2007, northern areas.**

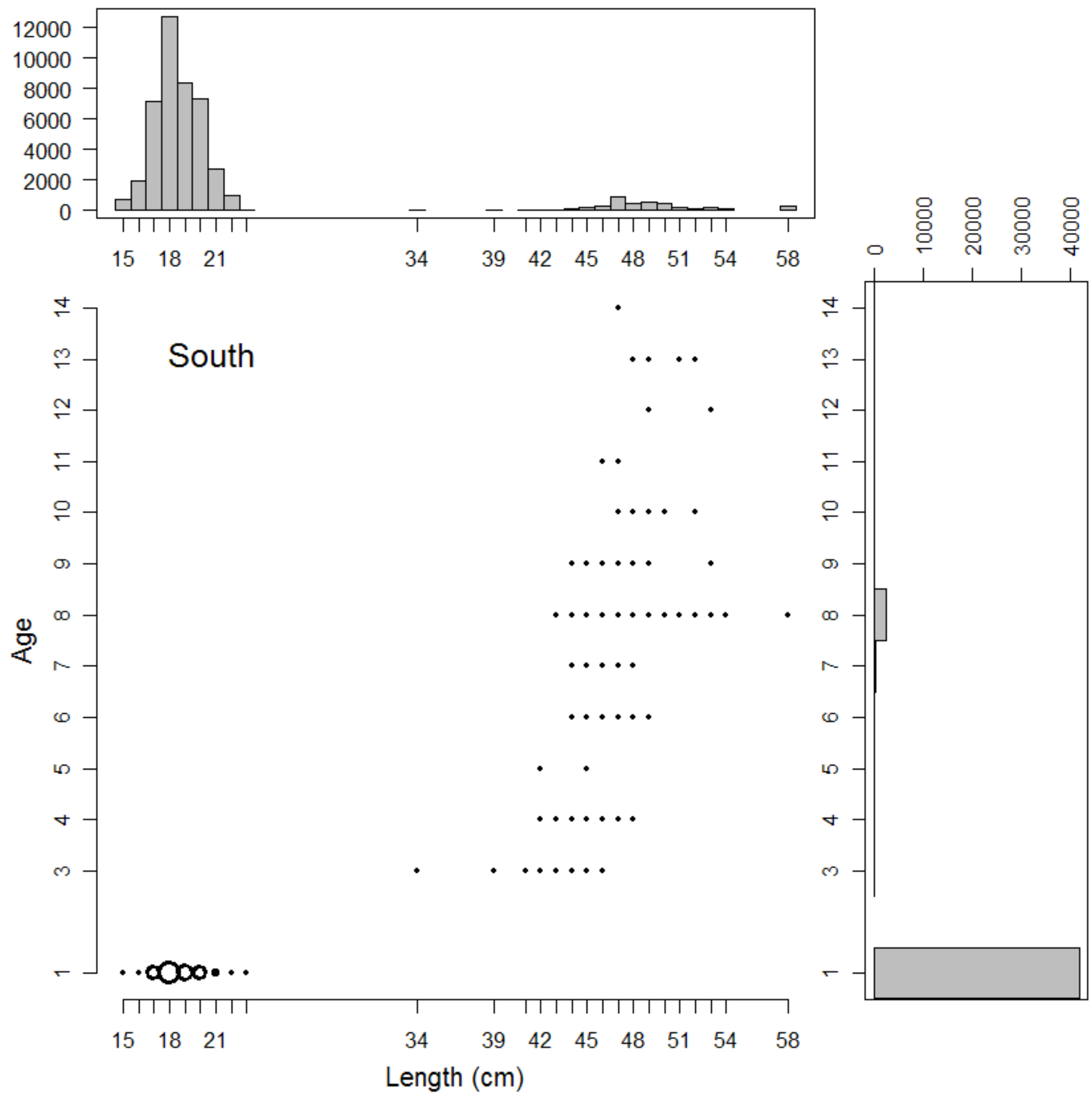



**Figure 14: Age-length composition for the acoustic survey of 2007, southern areas. The 1999 year class is not present.**

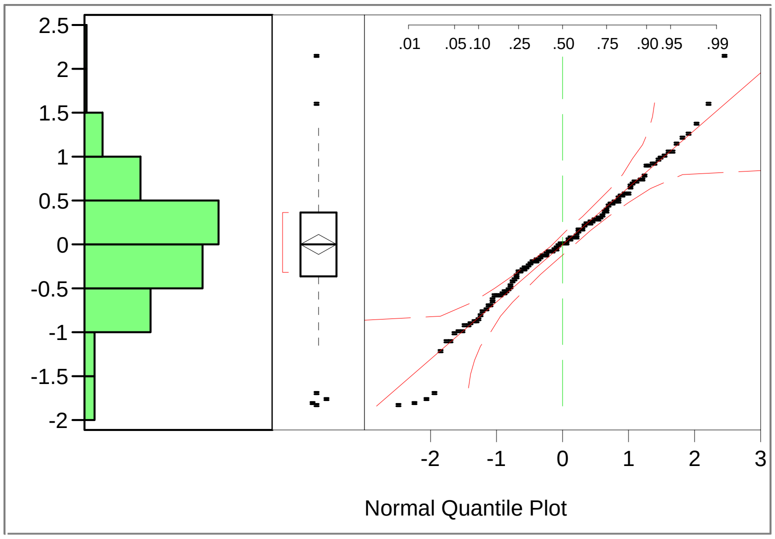



**Figure 15: Residual distribution from a multiplicative analysis of the Pacific hake acoustic survey relative abundance index.**

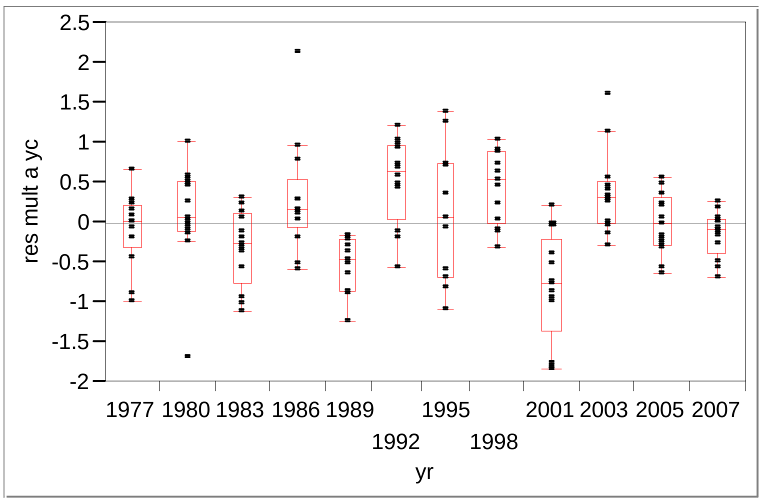
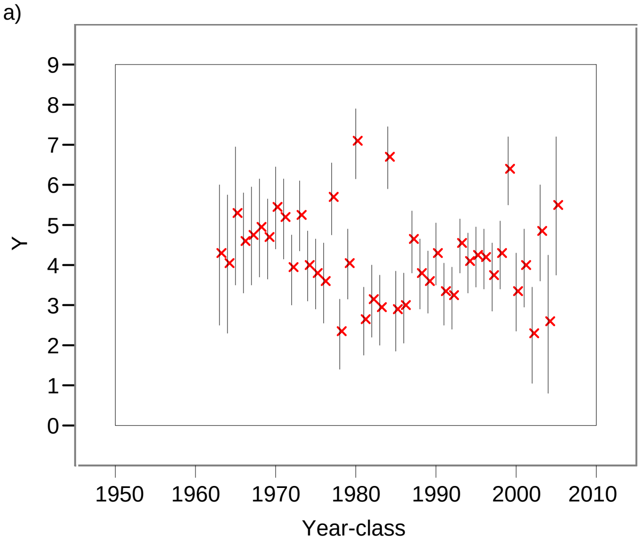



**Figure 16: Annual residuals from a multiplicative analysis of the Pacific hake acoustic survey relative abundance index.**

a)




b)

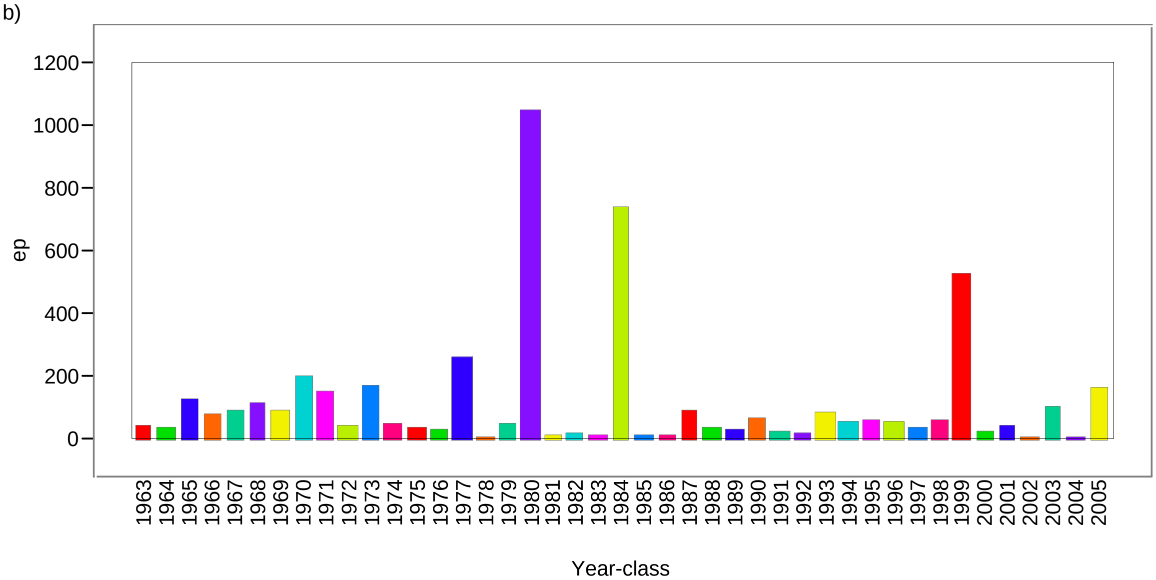



**Figure 17: Relative abundance of year-classes estimated with a multiplicative analysis of the Pacific hake acoustic survey relative abundance index; a) least square mean estimates of ln year-class abundance with 95% confidence intervals, b) estimates converted to the arithmetic scale.**

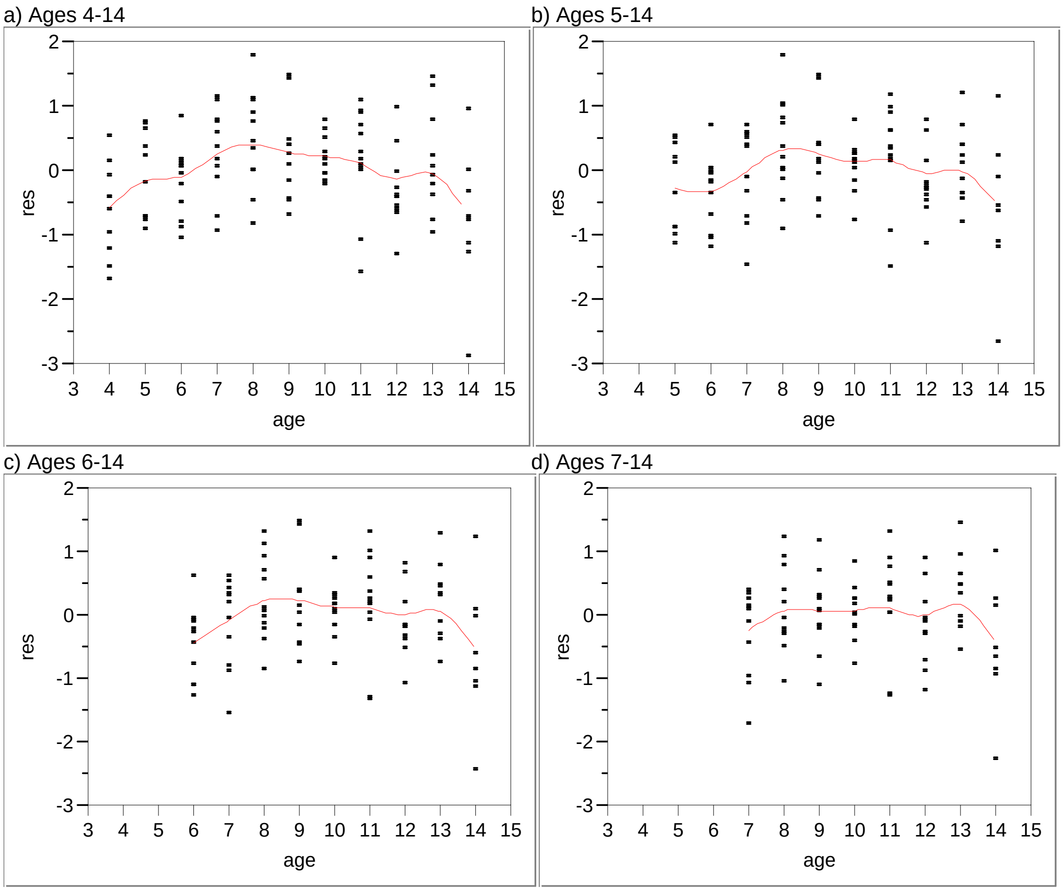



**Figure 18: Residual patterns with respect to age from preliminary analyses of total mortality of Pacific hake based on the results of the acoustic survey. Four analyses were conducted, a) ages 4-14, b) ages 5-14, c) ages 6-14, d) ages 7-14.**

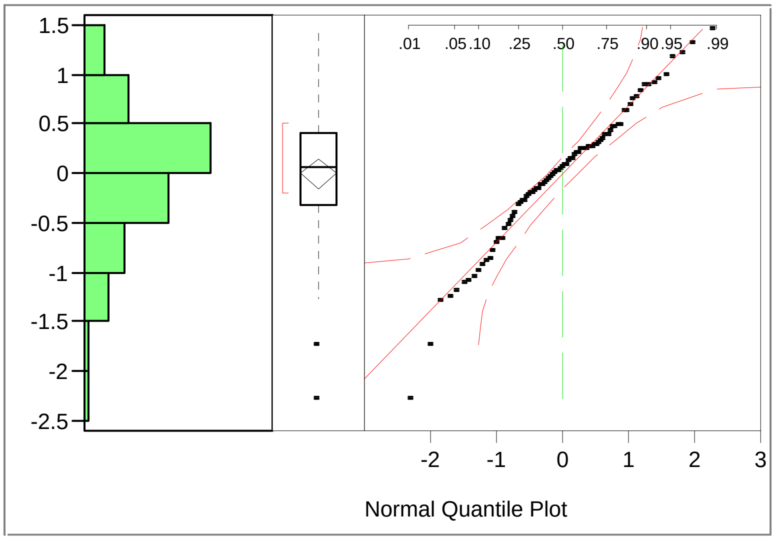



**Figure 19: Residual distribution from an analysis of covariance of the Pacific hake acoustic survey relative abundance index designed to estimate the adult total mortality rate. The analysis included ages 7-14.**

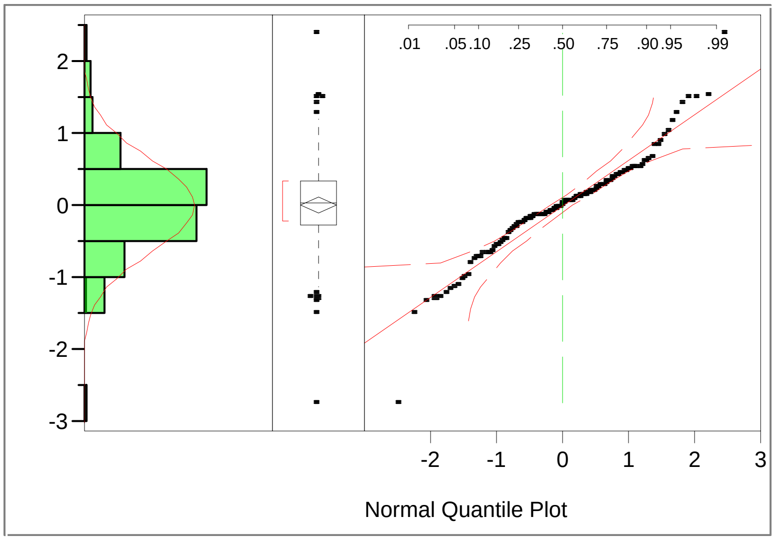



**Figure 20: Residual distribution from a multiplicative analysis of Pacific hake relative fishing mortality at age.**

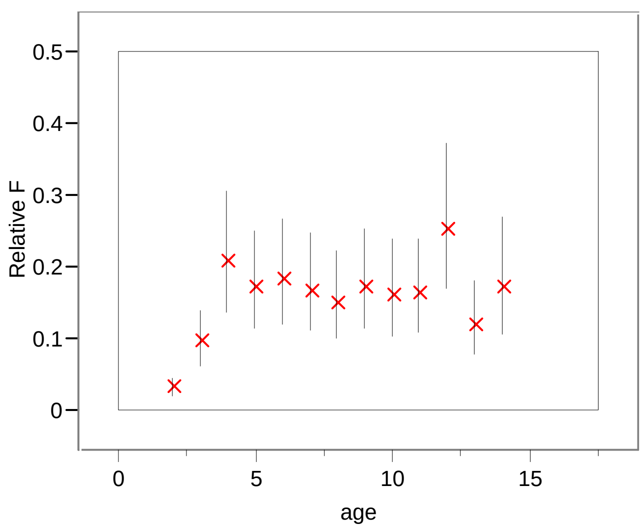



**Figure 21: Parameter estimates for relative fishing mortality at age for Pacific hake.**

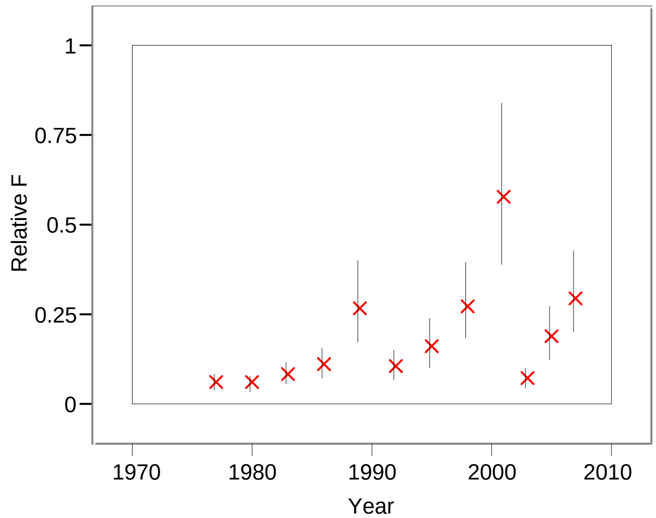



**Figure 22: Parameter estimates for relative fishing mortality by year for Pacific hake.**

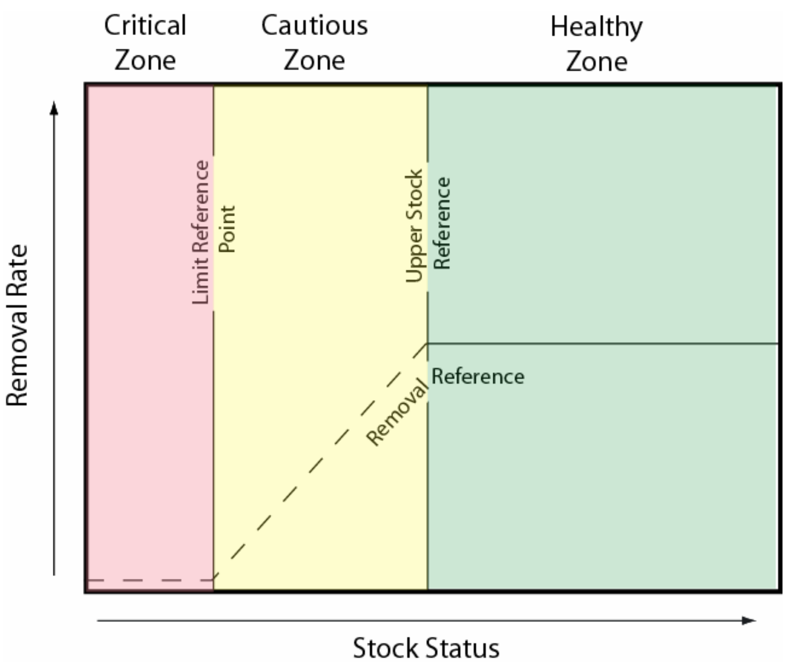



**Figure 23: A harvest strategy consistent with the Precautionary Approach (from DFO 2006)**

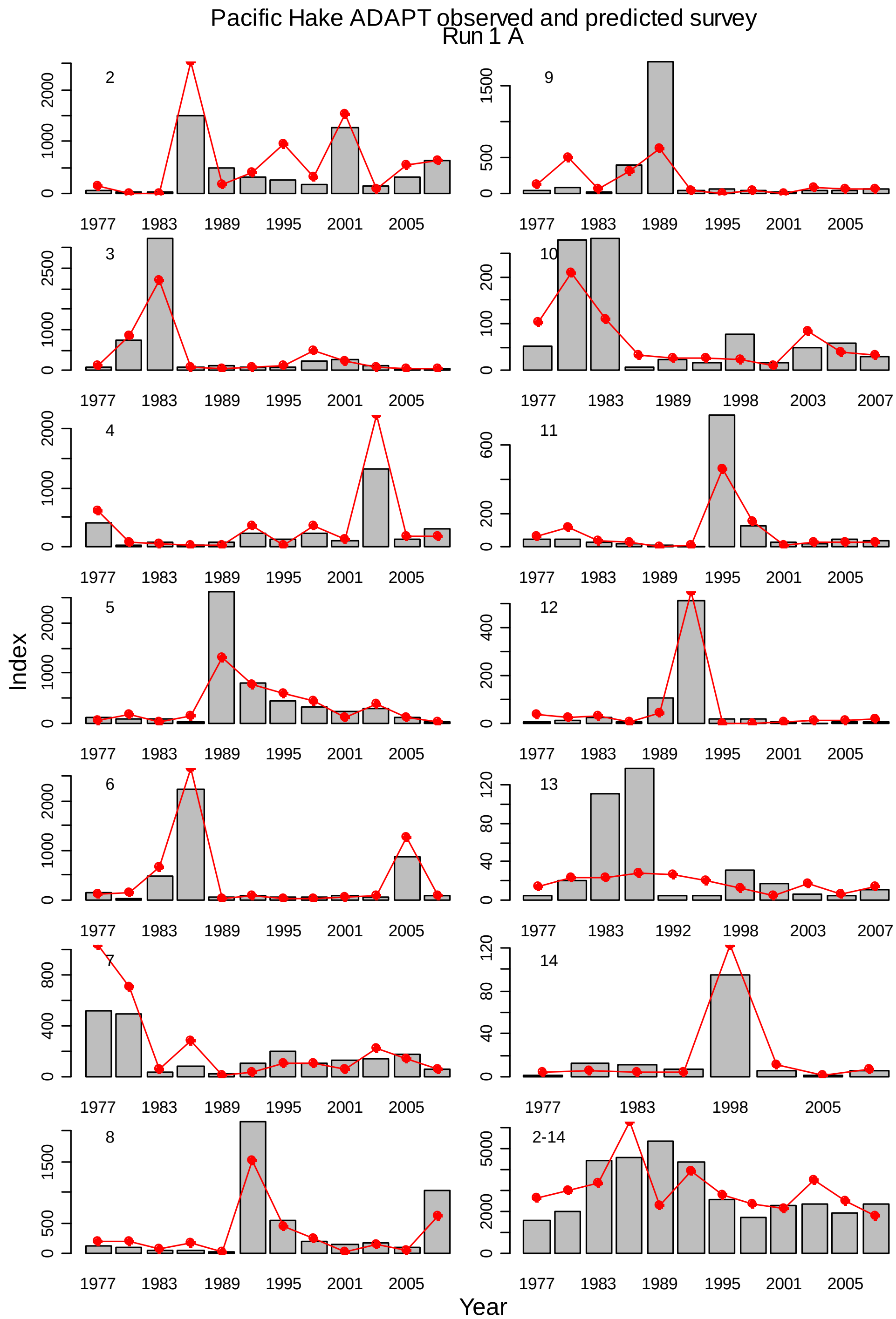



**Figure 24: Observed (points) and predicted (lines) acoustic survey abundance indices at age from Run 1A. Age is indicated in the upper left corner of each plot. The survey catchability adjusted aggregate index is shown in the last plot labeled 2-14.**

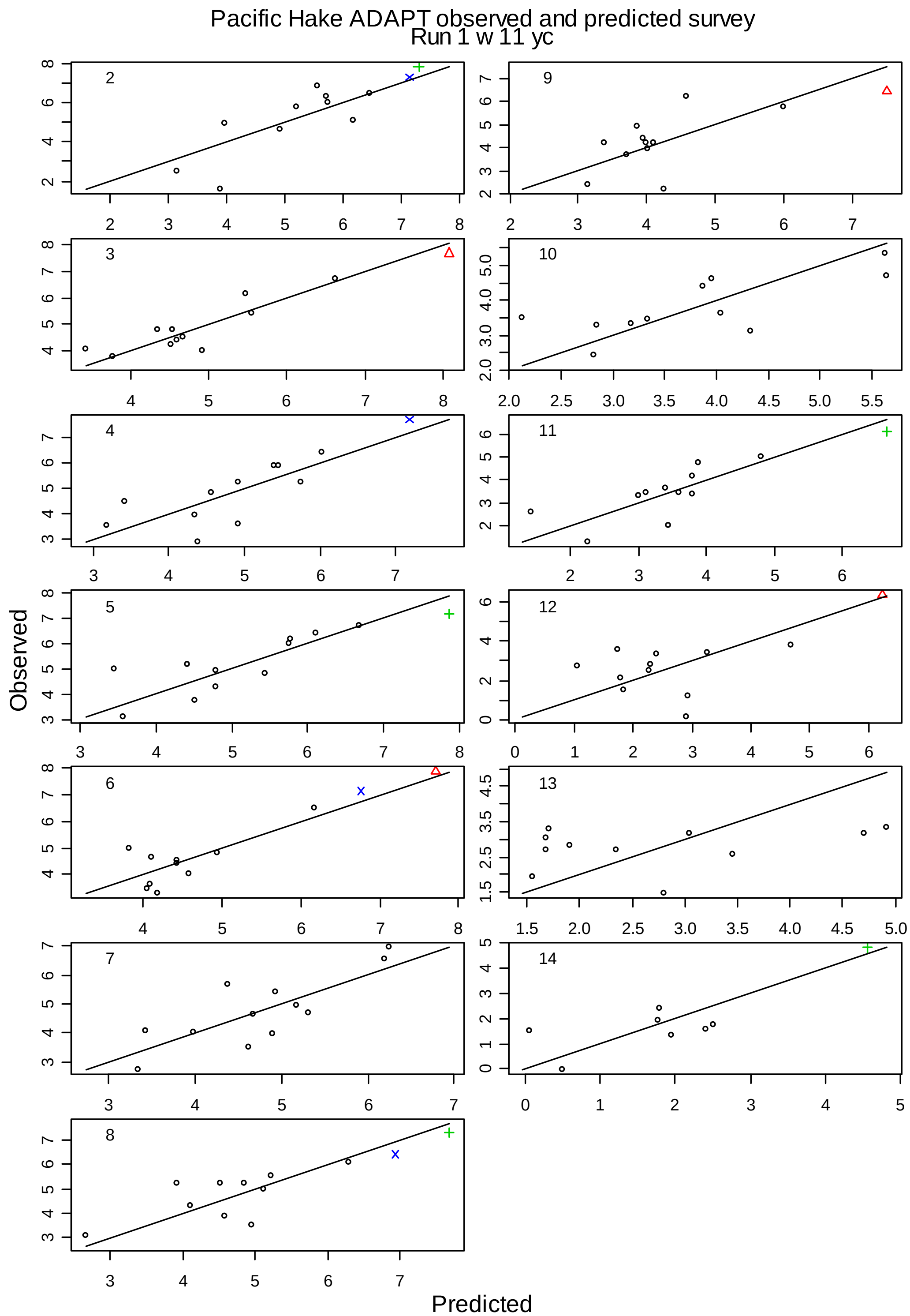



**Figure 25: Calibration plots of observed vs predicted acoustic survey relative abundance indices from Run 1 A. The 1980 (diamond), 1984 (cross) and 1999 (x) year-class values are highlighted. Age is indicated in the upper left corner of each plot.**

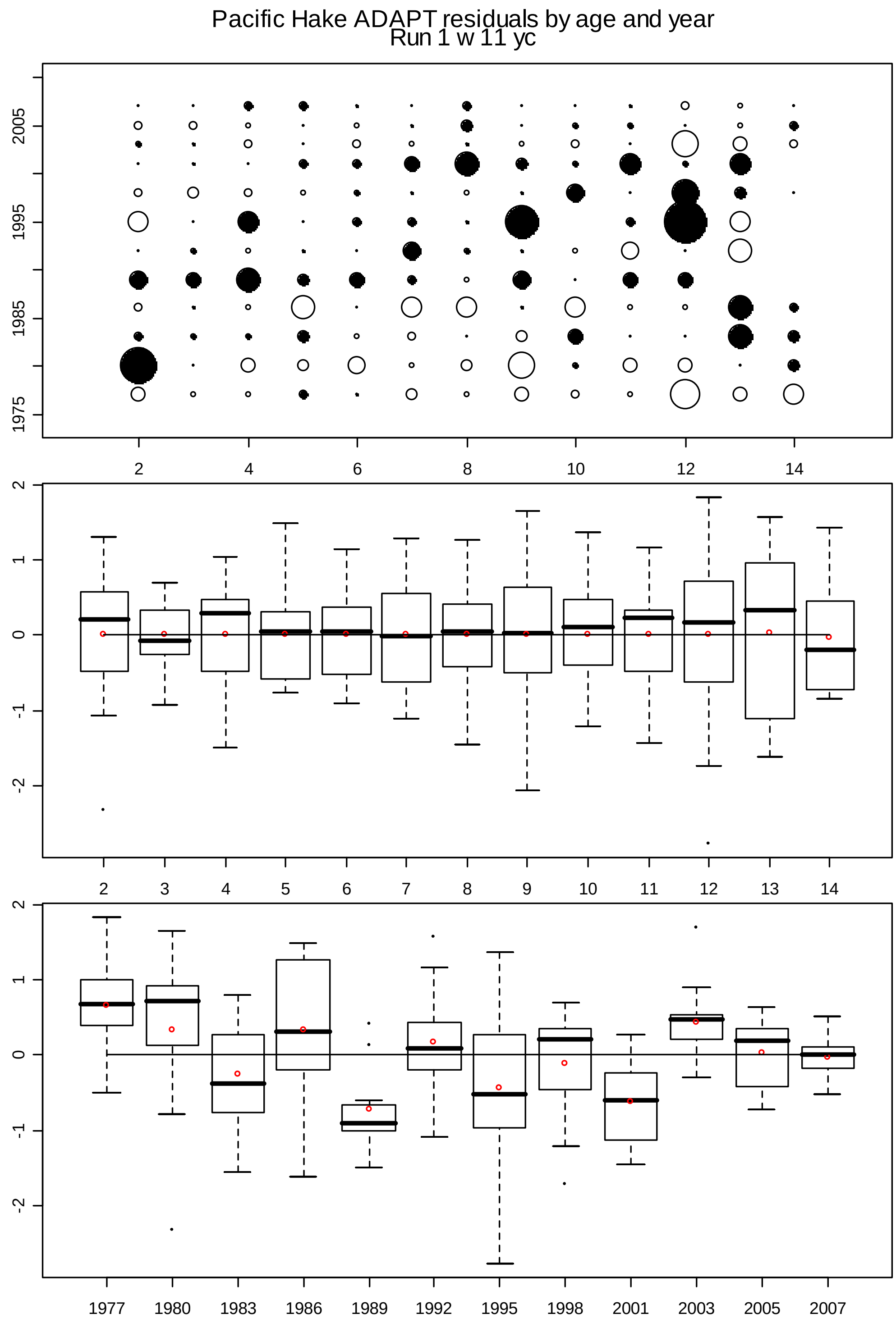



**Figure 26: Residuals from Run 1 A. The upper plot shows residuals by age and year. Solid circles are negative. The area of the circles is proportional to the absolute value of the residual. Box and whisker plots are shown by age and year.**

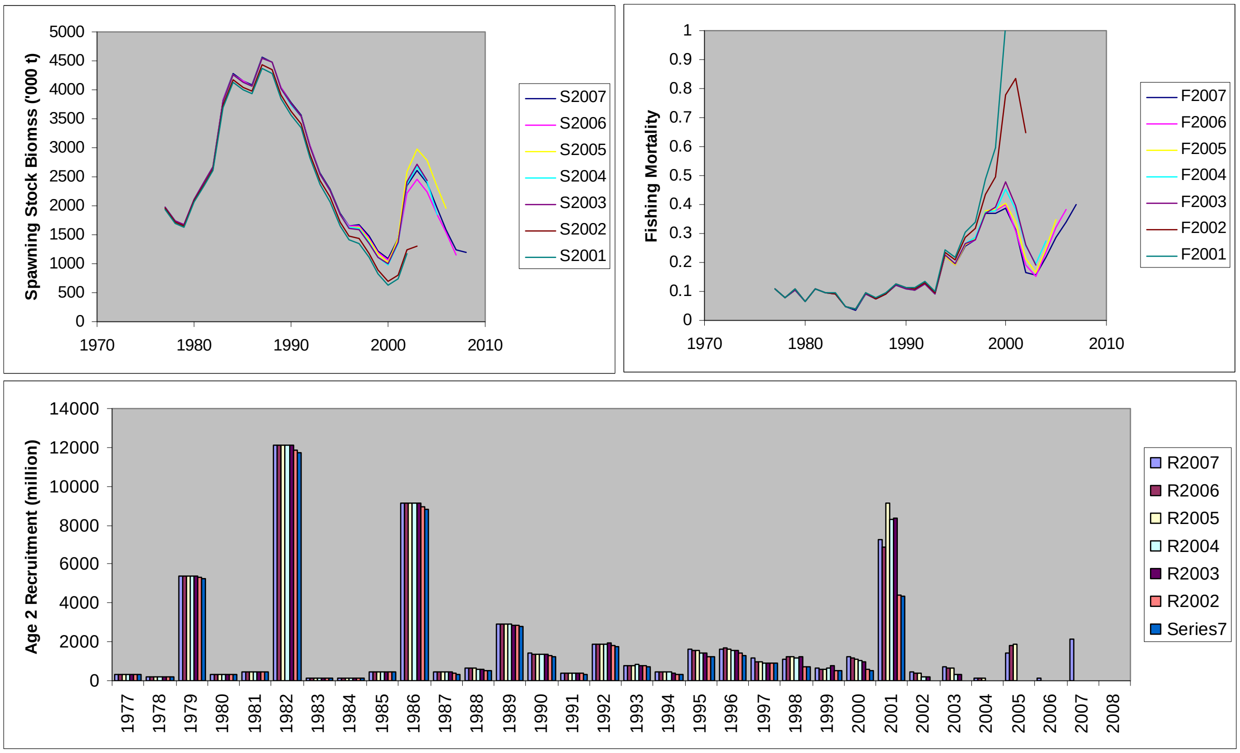



**Figure 27: Retrospective estimates of spawning stock biomass, fishing mortality, and recruitment from VPA run 1.**

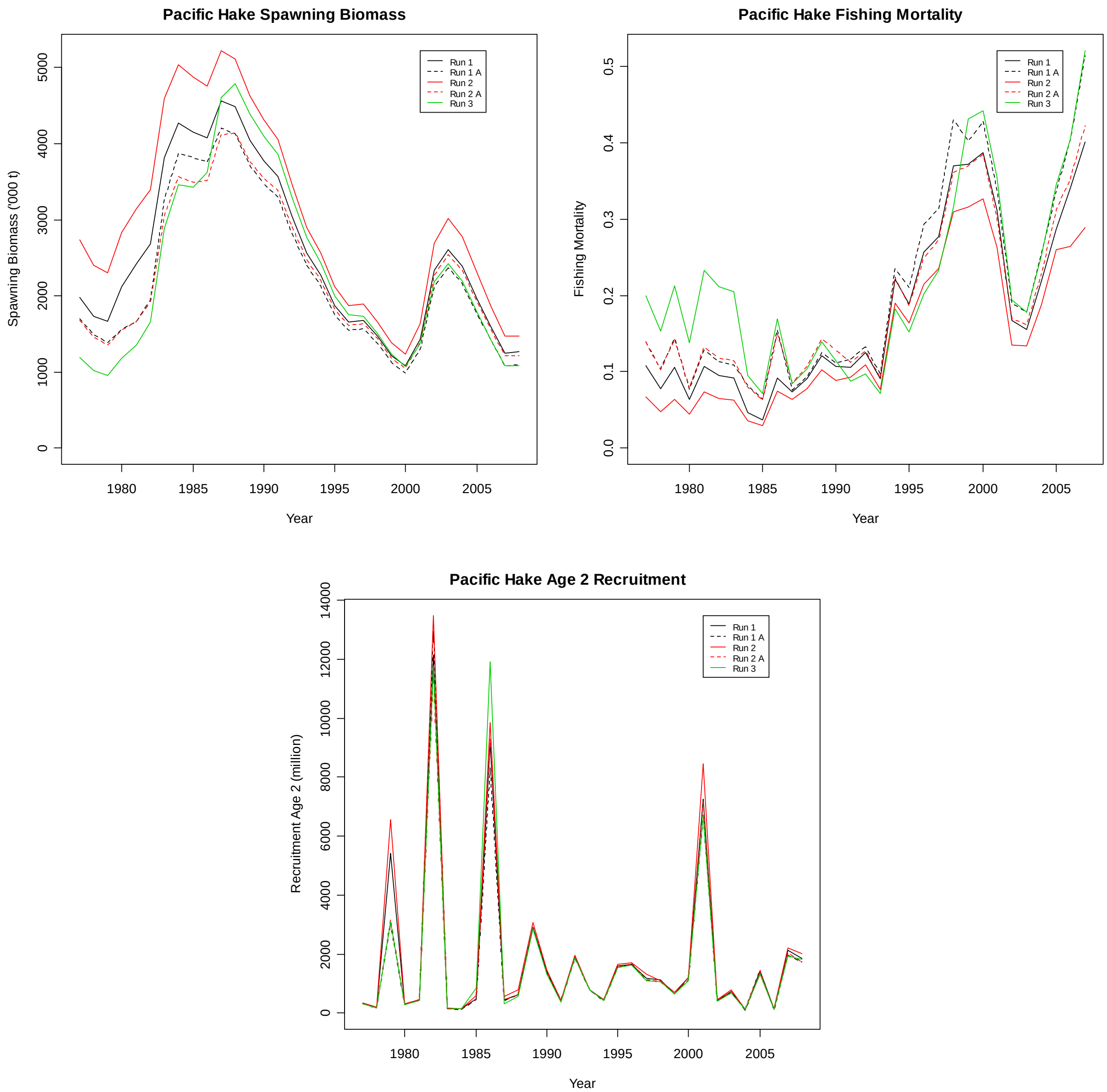



**Figure 28: Trends in spawning stock biomass, population weighted age 7+ mean fishing mortality, and age 2 recruitment estimates from 5 VPA runs.**

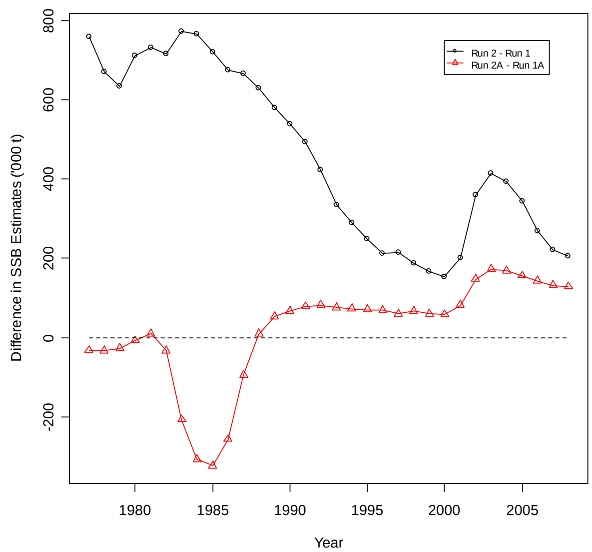



**Figure 29: Annual differences in SSB estimates between ADAPT runs 1 and 2 (circles), and 1A and 2A (triangles).**

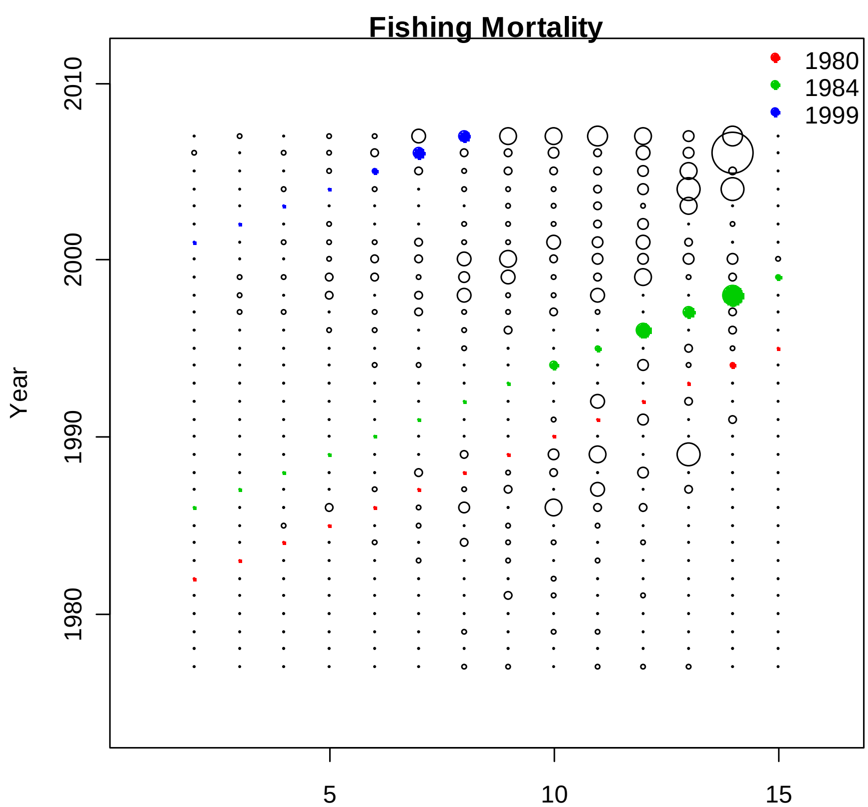



Figure 30: Fishing mortality at age and year from run 1 A. The large 1980, 1984, and 1999 year-classes are highlighted

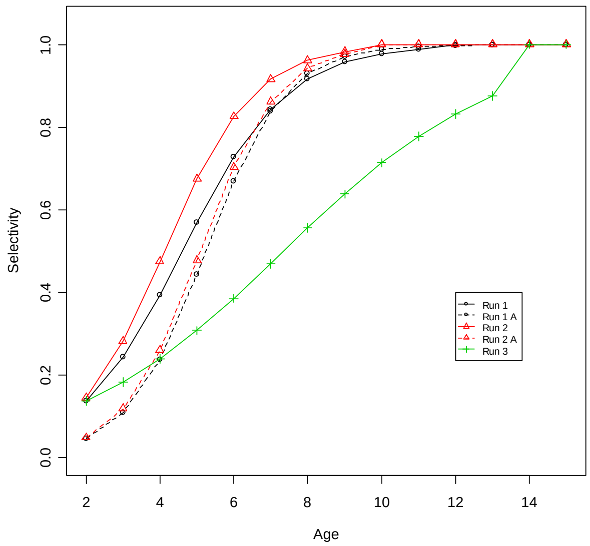



**Figure 31: Selectivity estimates from the 5 ADAPT runs.**

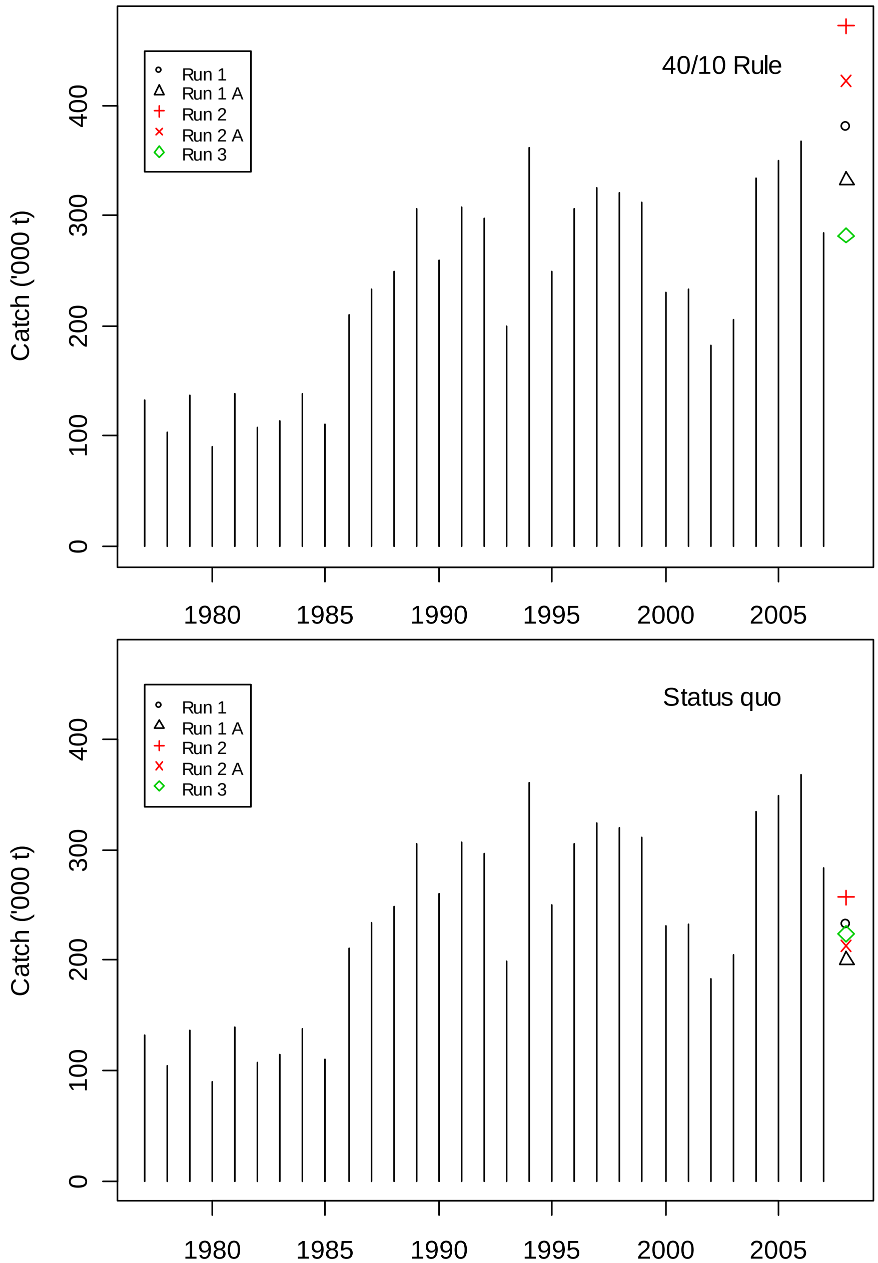



**Figure 32: Annual catches of Pacific hake 1977 – 2007 compared to yield forecasts from the 5 ADAPT runs. The upper panel gives forecasts using the 40/10 rule. The lower panel given forecasts using the *status quo* rule.**

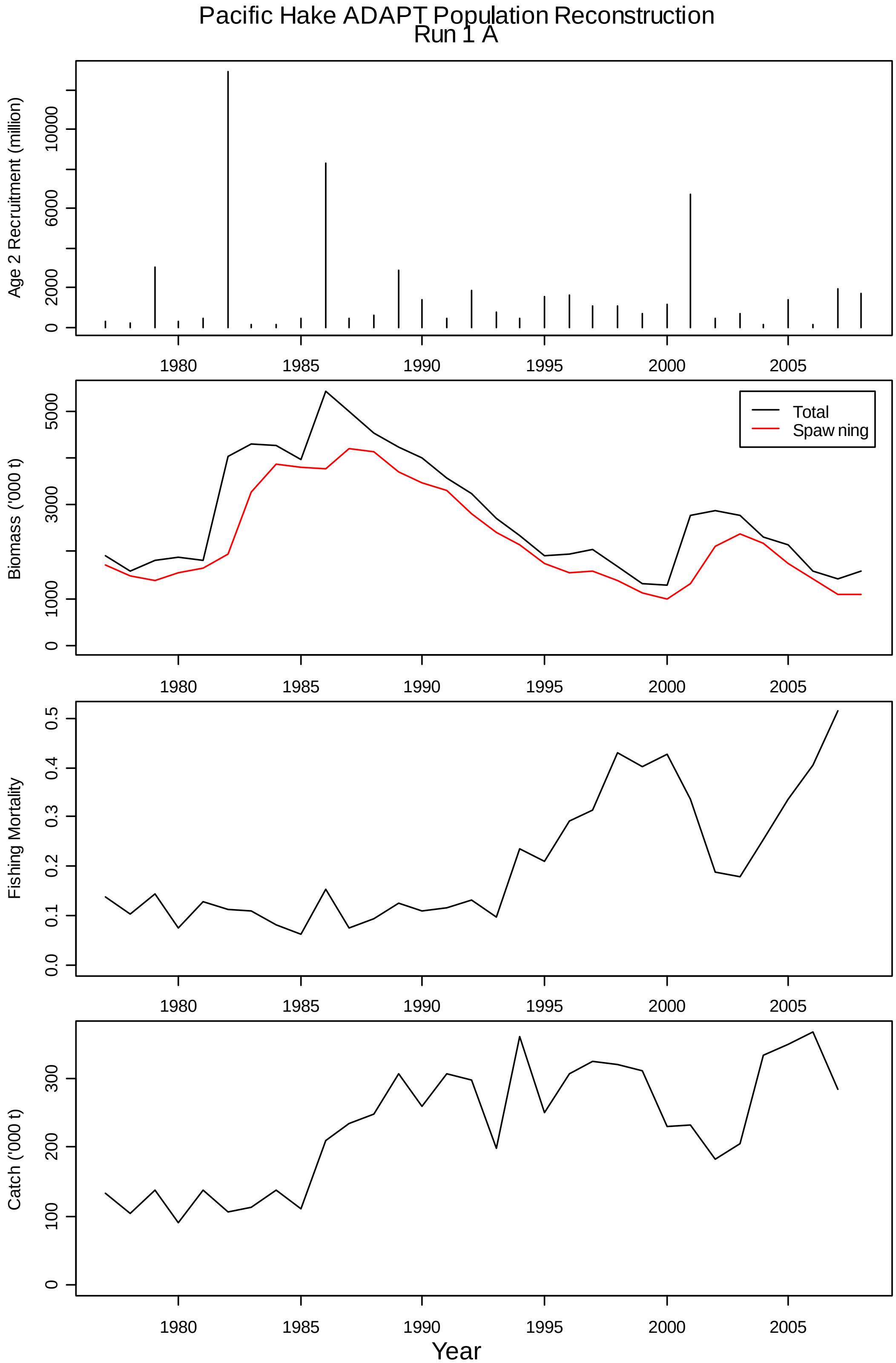



**Figure 33: Recruitment, biomass, fishing mortality, and catch trends for Pacific hake from Run 1 A.**

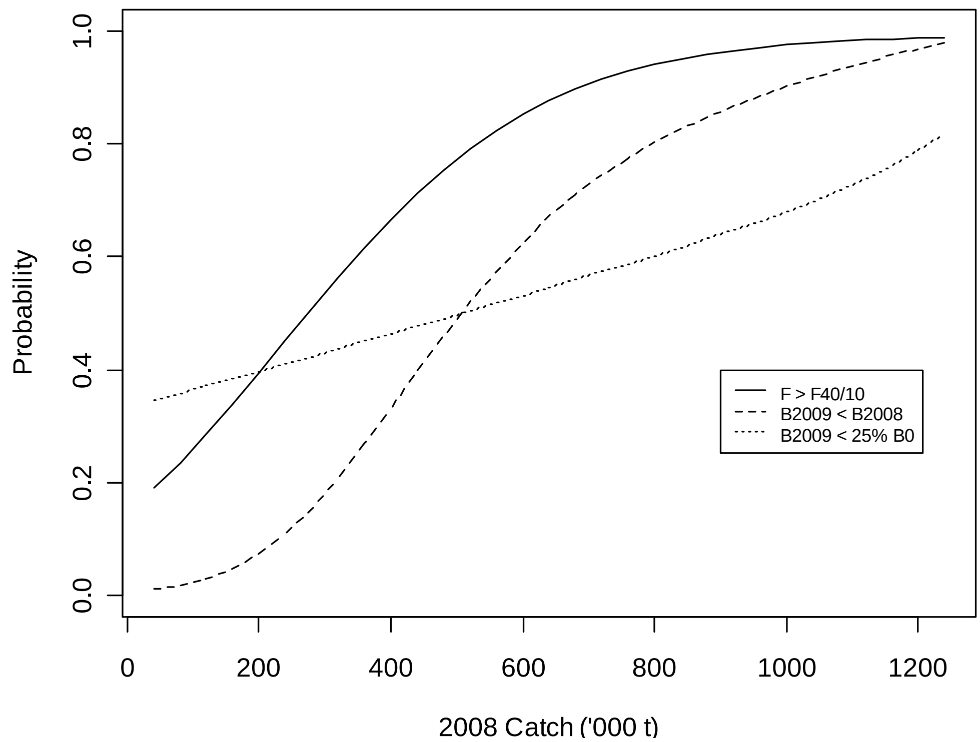



**Figure 34: Risk analysis of the 2008 catch forecast for Pacific hake using the results of Run 1A. Three performance measures are presented, the probability of the 2008 fishing mortality being above F40/10, the probability of the spawning stock biomass declining between 2008 and 2009, and the probability of the 2009 spawning stock biomass being below 25% of the unfished equilibrium.**

Appendix 1: Request for catch advice from Canadian fishery managers.

# Request for Catch Advice

**Date Submitted:**

**Individual or group requesting advice:** DFO Fisheries Management, GTAC

**Proposed Presentation Date:** February, 2008

**Subject of Paper (title if developed):** Assessment of Pacific hake in the offshore area of Western Canada and the USA

**Science Lead Author:** Alan Sinclair

**Resource Management Lead Author:** Barry Ackerman/Gary Logan

**Rationale for request:**
The offshore fishery for Pacific hake is the largest single species fishery in BC. The stock is transboundary between Canada and the USA. A treaty dealing with the joint management of this fishery was signed by Canada and the USA in 2003. While all the committee structures outlined by the treaty have not been established, it has been proposed to proceed with the 2007 assessment as a collaboration between Canadian and USA scientists in the spirit of the treaty.

The Canadian and US combined fisheries on this stock in recent years have been some of the largest ever. Harvest levels in 2006 and 2007 were established considering the spirit of the 2003 treaty, the consideration and subsequent rejection of harvest advice generated thru the joint Canada/US assessment process (SS2 assessment model), and the overall ability of the industries in each country to effectively manage the harvest within established harvest levels.

Concerns with the current model ability to accurately assess the biomass and reconstruct of historic biomass levels exist. It is accepted that the hake biomass fluctuates widely due to the emergence and domination of strong year classes (ie.1980, 1984, 1999) in the stock. The most recent assessment relies heavily on the predominance of 1999 year-class, which is now declining in biomass. Despite uncertainty in the recruitment strength of particularly the 2004 year class, the current model continues to generate harvest ranges 2 to 3 times the current harvest levels. The current models outputs run counter to expectations for the ageing hake biomass with little indication of the emergence and recruitment of a new strong year class. Additionally accurate reconstructions of pre-fishery biomass estimates are intrinsic in the establishment of coast-wide total allowable catch levels. The perceived failure of the model to produce acceptable harvest advice resulted in mangers setting harvest levels at lower than recommended science advice in both 2006 and 2007.

These elements continue to be of concern to Canadian fisheries managers and members of the Canadian fishing industry. Fisheries managers have requested that science further investigate alternative stock assessment methodologies in order to provide more certainty associated with levels of projected catch in 2008 and beyond. This concern is further compounded by a shift in the Canadian fishery in 2006 and 2007 from the traditional area off southwest Vancouver Island (southern area 3C) northward and into southern Queen Charlotte Sound (areas 5AB).

Canada is committed to implementing the Precautionary Approach to fisheries management and meeting obligations set out in the Hake treaty. Harvest strategies are required for all fisheries that include target and limit stock status reference points, and a variable harvest rate which is adjusted according to the productivity of the resource. Catch advice for Pacific hake should reflect this approach respecting the default harvest rate of F-40 percent with a 40/10 adjustment set out within the treaty, but not restricting the provision of scientific advice on alternate rates necessary to sustain the offshore hake resource

**Objective:**
To review surveys, biological sampling, catch records, logbooks, observer reports and fishing practices for Pacific hake and recommend biological reference points for management and provide a basis for management for the 2008/09 fisheries in the offshore areas.

**Question(s) to be addressed:**
(To be developed by initiator)

What is the current biomass and size structure of the offshore Pacific hake stock and how does this relate to historical stock conditions?

What is the expected trajectory of offshore Pacific hake biomass to the end of the 2008/09 fishing season and how will this be affected by a range of annual TACs?

What are appropriate biological reference points for the stock? Include biological considerations and rationale used to form these recommendations.

What is known about the stock structure and origin of Pacific hake recently caught in southern Queen Charlotte Sound?

**Stakeholders Affected:**
GTAC/IHAC

**How Advice May Impact the Development of a Fishing Plan:**
The catch advice will directly affect TAC's set in the IFMP for 2008/09 and beyond.

**Timing Issues Related to When Advice is Necessary:**
Catch advice is required before March 2008

**Approved:**

Science Manager: ________________________________; Date:_______________________

Fisheries/Habitat/Oceans
Manager: ________________________________; Date:_______________________

Agenda Item F.3.a
Attachment 4
March 2008

# Assessment and Management advice for Pacific hake in U.S. and Canadian waters in 2008

Steven Martell
University of British Columbia
Fisheries Centre
2202 Main Mall
Vancouver, BC, Canada

February 19, 2008

First prepared for the 2008 joint Canada/USA Pacific hake stock assessment review meeting in Seattle WA, February 11-14, 2008. Amendments to the original document are in response to peer review comments during the review process.

# Executive summary

This is an alternative assessment model (TINSS) that directly estimates the management variables $C^*$(the maximum sustainable yield) and $F^*$(the fishing mortality rate that produces $C^*$). The model was implemented in the AD Model Builder software and is based on the methods in Martell et al. (in press). The structural assumptions are similar to that of SS2: a Beverton-Holt stock recruitment relationship is assumed, it is assumed that the population was at an unfished state in 1966, and the model is conditioned on historical catch information. The data for TINSS was greatly simplified in comparison to SS2, where catch and catch-age information from U.S. and Canadian fisheries are aggregated into a single fishery and the selectivity curves for this aggregate fishery is asymptotic. I also assume an asymptotic selectivity curve for the fisheries independent acoustic trawl survey. In contrast to previous assessments, the assessment attempts to reduce the amount of prior information on key population parameters that ultimately define the harvest control rule and provide catch advice.

In summary the estimate of spawning stock depletion (male and female) in 2007 is 46% and recent fishing mortality rates are below $F^*$(Table 1). The spawning stock depletion at the start of 2008 is estimated at 43% and the 5% and 95% quantiles for the spawning stock depletion is 0.21 and 0.72, respectively. Estimates of the male and female spawning stock biomass at the start of 2008 range from 0.95 to 4.804 million mt with a median estimate of 2.235 million mt. Recent trends in fishing mortality rates have been increasing owing to the disappearance of the 1999 year class and above average landings in the commercial fisheries. Estimates of fishing mortality in 2007 range from 0.105 to 0.529 with a median value of 0.223.

Catch advice is based on a risk profile using the probability of exceeding the target fishing morality rate ($F^*$), probability of a decline in the 2009 spawning stock biomass and the probability of the spawning stock biomass falling below $SB_{MSY}$, 40% and 25% of the unfished levels (Table 2). Arbitrary levels of probability we defined for risk averse (P=0.25), risk neutral (P=0.5) and risk prone (P=0.75). Based on the risk neutral policy of not exceeding the fishing mortality, a recommended ABC for the 2008 Pacific hake fishery is 364,000 mt; the risk averse policy calls for an ABC of 264,000 mt.

In summary, catch options in excess of 300,000 mt result in a fairly significant probability of overfishing ($P \geq 0.3$), further declines in spawning stock biomass in 2009, and a significant probability of reducing the spawning stock biomass below $\mathrm{SB}_{\mathrm{MSY}}$ ($P \geq 0.4$). Catch options less than 300,000 mt result in a low probability of the spawning stock biomass falling below $\mathrm{SB}_{25}$ level ($P \leq 0.15$).

Table 1: Median estimate and 5% and 95% confidence intervals for the spawning stock biomass (million mt), spawning stock depletion, and fishing mortality rates in 1966 and recent years. These estimates are based on sampling the joint posterior distribution using MCMC, chain length 2,000,000 with systematic samples drawn every 200 iterations.

| | **Spawning stock biomass** | | | **Depletion** | | | **Fishing Mortality** | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | median | 5% | 95% | median | 5% | 95% | median | 5% | 95% |
| 1966 | 5.208 | 3.999 | 7.474 | 1.000 | 1.000 | 1.000 | 0.047 | 0.033 | 0.060 |
| 2003 | 5.027 | 3.342 | 8.509 | 0.968 | 0.725 | 1.310 | 0.146 | 0.078 | 0.253 |
| 2004 | 4.447 | 2.884 | 7.586 | 0.855 | 0.629 | 1.176 | 0.165 | 0.089 | 0.293 |
| 2005 | 3.371 | 2.075 | 5.990 | 0.648 | 0.453 | 0.926 | 0.180 | 0.097 | 0.320 |
| 2006 | 2.756 | 1.567 | 5.202 | 0.529 | 0.340 | 0.806 | 0.236 | 0.121 | 0.461 |
| 2007 | 2.432 | 1.210 | 4.892 | 0.468 | 0.263 | 0.746 | 0.223 | 0.105 | 0.529 |
| 2008 | 2.235 | 0.950 | 4.804 | 0.431 | 0.211 | 0.727 | | | |

Table 2: Decision table for catch advice. The risk level represents the probability of exceeding a specified management target for a given ABC option. The interpretation of this table is as follows; if the management goal is not to exceed the target fishing mortality rate of $F^*$in 2008 with a 0.25 probability, then the ABC option should be set at 0.264 million mt or less. If the management target is prevent further decline in spawning stock biomass with a 0.5 probability then the ABC should be set at 0.122 million mt or less.

| Risk level | $F_{2008} \leq F^*$ | $SB_{2009} \geq SB_{2008}$ | $SB_{2009} \geq SB_{MSY}$ | $SB_{2009} \geq SB_{40}$ | $SB_{2009} \geq SB_{25}$ |
|---|---|---|---|---|---|
| 0.25 | 0.264 | 0.000 | 0.008 | 0.000 | 0.546 |
| 0.50 | 0.364 | 0.122 | 0.464 | 0.285 | 0.866 |
| 0.75 | 0.465 | 0.318 | 0.920 | 0.777 | 1.186 |

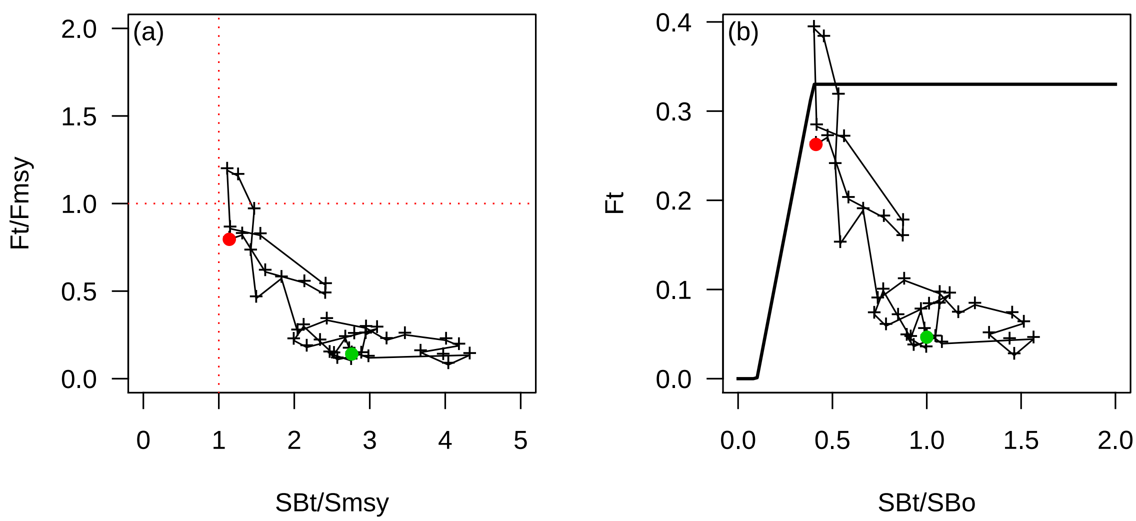



Figure 1: Maximum likelihood estimates of the spawning stock biomass relative to the unfished spawning stock biomass versus the fishing mortality rate relative to $F^*$(a). In panel (b) the inferred harvest control rule (thick line) and the spawning stock biomass depletion levels versus maximum likelihood estimates of historical fishing mortality rates. Green circles indicate the start of the series (1966) and red indicates the end of the series (2007).

# 1 Introduction

Previous assessments of Pacific hake (*Merluccius productus*) have been troubled by the lack of contrast in the acoustic survey data that allow for the estimation of the unfished biomass ($B_o$) and the steepness of the stock recruitment relationship. To cope with the lack of information in the acoustic survey data, the assessments have proceeded by fixing the value ($h$) of steepness for stock recruitment relationship and presented two alternative scenarios for the acoustic survey scaling parameter $q$. Fixing these parameters is necessary due to the lack of contrast in the acoustic survey data; however, it also results in a gross underestimation of the uncertainty in model results and estimates of the reference points used in the determination of Acceptable Biological Catch (ABC).

At present, uncertainty in parameters that define the harvest control rule is only represented by the uncertainty associated with size selectivity parameters in the various commercial fisheries as well as the acoustic survey itself. The parameters that define the underlying production function include the instantaneous natural mortality rate ($M$), the steepness of the stock recruitment relationship ($h$) and a measure of population scale (usually the unfished spawning stock size or $B_o$). In previous assessments, $h$ and $M$ are fixed, and the population scale is determined by the combined effects of selectivity in the acoustic survey and the survey scaler $q$ (which is fixed at two different values). For example for a given value of $q$, estimates of the unfished biomass increase as the acoustic survey selectivity becomes more dome-shaped, and vice-versa.

Historically, management advice is based on the application of the 40-10 harvest control rule. Three critical pieces of information are required to apply the harvest control rule: 1) an estimate of $F_{\text{MSY}}$ and $B_{\text{MSY}}$ which is approximated by $F_{40}$ and $B_{40}$, respectively, 2) an estimate of the current level of depletion in the spawning stock biomass, and 3) a biomass forecast based on historical recruitment or the underlying stock recruitment relationship. Accurate estimates of $F_{\text{MSY}}$ require accurate estimates of $M$, $h$, which are difficult to obtain in many (if not all) fisheries assessments; therefore the a proxy $F_{40}$ (which is the fishing mortality rate that reduces the spawning potential ratio to 40% of its unfished state) is often used to approximate $F_{\text{MSY}}$. This approximation has been shown to achieve nearly 80% of the maximum yield over a wide range of stock recruitment parameters with a variety of stock recruitment models (Clark, 1991, 2002). Similarly, $B_o$ is also difficult to estimate in many cases; therefore the spawner potential ratio (SPR) is used as a measure of depletion. The current level of depletion is determined by comparing the ratio of present day spawning biomass to the estimated unfished spawning biomass. Finally, the forecast is based current levels of depletion and estimates of $h$.

There are a few unresolved problems and inconsistencies in the input data for SS2 or any other age-structured model. First there is a large inconsistency between information in the age-compositions and the acoustic survey biomass index. The age compositions suggest a buildup of biomass through the late 1980s owing to the strong 1980 and 1984 cohorts, yet the biomass index is relatively flat during this time period.

In contrast to previous assessments for Pacific hake, this assessment attempts to reduce the amount of prior information that is used on key population parameters that ultimately defines the harvest control rule and catch advice. To do this, I have implemented a age-structured model that is parameterized from a management oriented perspective, where the leading parameters are $C^*$and $F^*$. The population model is structurally similar to that of SS2, where I assume that the stock is at its unfished state in 1966, recruitment follows a Beverton-Holt stock-recruitment relationship, and the model is conditioned on the historical catch information. The fundamental differences between the two approaches is that I make no prior assumptions about the survey $q$, and no direct prior assumptions about the steepness of the stock recruitment relationship. The model parameterization is such that there is an implied prior for the steepness of the stock recruitment function; however, this prior is very diffuse in comparison to 2008 SS2 implementation. Another fundamental difference is the treatment of the data. In this application, catch data from U.S. and Canadian operations are aggregated into a single fishery, and it is assumed that selectivity curve for the aggregate fishery and the acoustic trawl survey is asymptotic.

# 2 Methods

A summary of the input data and complete technical description of the model is provided in Appendix A and B, respectively. For technical details on the acoustic trawl surveys, please refer to Fleischer et al. (2005). For a more detailed description of the fishery and historical management of the fishery see Helser and Martell (2007) for more details. The purpose of this section is three fold: 1) summarize the modeling approach, 2) provide documentation for informative prior distributions, and 3) provide a technical description on how the reference points and catch advice is formulated.

## 2.1 Modeling approach

The principle difference between the assessment here, and that of last years assessment using Stock Synthesis II (SS2), is that the leading parameters in this model pertain to the management parameters $F^*$(the fishing mortality rate that produced the maximum sustainable yield) and $C^*$(the maximum sustainable yield). Whereas, SS2 estimates the unfished biomass $B_o$ and the steepness of the stock recruitment relationship $h$; these parameters are then transformed into the management variables $F_{40}$ and MSY.

The approach was to fit and age-structured population dynamics model to time series information on relative abundance, proportions-at-age in the commercial fishery, and proportions-at-age from the acoustic trawl survey index using a Bayesian estimation framework. The commercial catch and age-composition information from Canada and the U.S. has been combined to represent a single fishery. The aggregation of the commercial catch data has the potential to create a bias in the predicted-age composition because it assumes that the age-specific fishing mortality rates between the two countries has been relatively consistent over time.

The objective function contains 5 major components: 1) the negative loglikelihood of the relative abundance data, 2) the negative loglikelihood of the catch-at-age proportions in the commercial fishery, 3) the negative loglikelihood of the catch-at-age proportions in the acoustic survey, 4) the prior distributions for model parameters, and 5) two penalty functions that constrain the estimates of steepness to lie between 0 and 1, and prevent exploitation rates exceeding 1. Note that the value of the penalty functions was 0 for all samples from the posterior distribution. The joint posterior distribution is defined by equation (T17.14). This distribution was numerically approximated using the Markov Chain Monte Carlo routines built into AD Model Builder (Otter Research, 1994). Posterior samples were drawn systematically every 400 iterations from a chain of length 2,000,0000 (the first 1000 samples were dropped to allow for sufficient burnin). Convergence was diagnosed using various test provided in the R-package CODA (R Development Core Team, 2006), as well as, running medians and visual inspection of the trace plots. Where possible, we provide comparisons between the maximum likelihood estimates and median estimates from the marginal posterior distributions. Catch advice is based on the samples from the joint posterior distribution (T17.14).

### 2.1.1 Assumptions

There is no prior assumption about the scaling parameter for the acoustic biomass survey ($q$), and the index was treated as a relative abundance index that is directly proportional to the vulnerable biomass as seen by the acoustic survey. It is assumed that the observation errors in the relative abundance index are lognormally distributed. Fishing mortality in the assessment model is conditioned on the observed total catch weight (combined US and Canada catch), and it is assumed that total catch is known and reported without error. Age-composition information is assumed to come from a multinomial distribution where the predicted proportion-at-age is a function of the predicted population age-structure and the age specific vulnerability to the fishing gear. The effective sample size of the age-composition is used a measure of the observation or sampling error variance. Effective sample sizes were determined through a joint process of iterative re-weighting, retrospective analysis, and comparison of the estimated variances and mean squared errors. No aging errors were assumed in this assessment.

Historical observations on mean weight-at-age shows systematic changes, where the average weights-at-age have declined from the mid 1970s and increased again slightly late 1990s (Figure 2). A number of the historical cohorts have a growth trajectories that initially increase from age-2 to age-8 then decline or stay relatively flat (e.g., 1977 cohort in Figure 2). Given these data, there are at least three alternative explanations for the observed decreases in mean weight-at-age: 1) changes in condition factor associated with food availability, 2) intensive size selective fishing mortality with differential fishing mortality rates on faster growing indivuals, and 3) apparent changes in selectiviity over time (e.g., dome-shaped selectivity) where there is a low probability of capturing faster growing fish. All three of these variables are confounded, and it is not possible to capture decreasing weight-at-age using the von Bertalanffy growth model and a fixed allometric relationship between length and weight. As such, the assessment model herein uses the observed mean weight-at-age data from the commercial fishery to scale population numbers to biomass.

The structural assumptions of the model assume that recruitment follows a Beverton-Holt type model and the process error terms are represented by a vector of deviation parameters that are assumed to be lognormally distributed. Both fishing mortality and natural mortality are assumed to occur simultaneously; instantaneous fishing mortality is based on the Baranov catch where the analytical solution for $F_t$ is found using an iterative method. Selectivity, or vulnerability-at-age, to the fishing gear is assumed to be age-specific, time-invariant, and is represented by an asymptotic function (T15.5).

## 2.2 Prior distributions

The underlying production function is defined by three key population parameters ($C^*$, $F^*$, and $M$) and the parameters that define age-specific selectivity ($v_a = f(\hat{a}_h, \hat{\gamma})$). Informative lognormal prior distributions were used for $C^*$, $F^*$, and $M$ where the log means and log standard deviations are given in Table 3. These prior distributions were developed on an *ad hoc* basis and not necessarily derived from meta-analytic work that is the typical source of prior information.

The global scaling parameter in this model is $C^*$; the maximum long-term sustainable yield. Since 1966, the average annual landings removed from this population is 218,963.5 mt, and in the last decade 282,408.7 mt. We assume a rather diffuse prior for $C^*$with mean corresponding to 200,000 mt and a standard deviation of 396,000 mt. This represents a 95% confidence interval of roughly 138,000 mt to 652,000 mt. Assigning a prior density for $C^*$is nearly equivalent to assigning a prior density for the global scaling parameter $q$.

Table 3: Prior distributions for model parameters.

| Parameter | prior density | range | $\mu$ | $\sigma$ | $a$ | $b$ |
|---|---|---|---|---|---|---|
| $C^*$ | lognormal | (0.01-3.0) | 0.2 | 0.396 | | |
| $F^*$ | lognormal | (0.01-0.9) | 0.35 | 0.262 | | |
| $M$ | lognormal | (0.05-0.9) | 0.23 | 0.1 | | |
| $\hat{a}, \bar{a}$ | uniform | (0.0-14.0) | | | | |
| $\hat{\gamma}, \bar{\gamma}$ | uniform | (0.05-5.0) | | | | |
| $\rho$ | beta | (0.01-0.99) | | | 3.5 | 31.5 |
| $\varphi$ | inverse gamma | (0.02-100) | | | 7.5 | 5.78 |

A lognormal prior was assumed for $M$ with a mean corresponding to 0.23 (which is the assumed fixed value in Helser and Martell (2007)) and a standard deviation of 0.1. This roughly corresponds to a 95% confidence interval of 0.19 and 0.28 for $M$, which is lower than the range reported in (Bailey et al., 1982, Table 10).

Uniform prior distributions were assumed for the selectivity parameters for the commercial fishery and the acoustic trawl survey. These parameters are bounded between 0 and 14

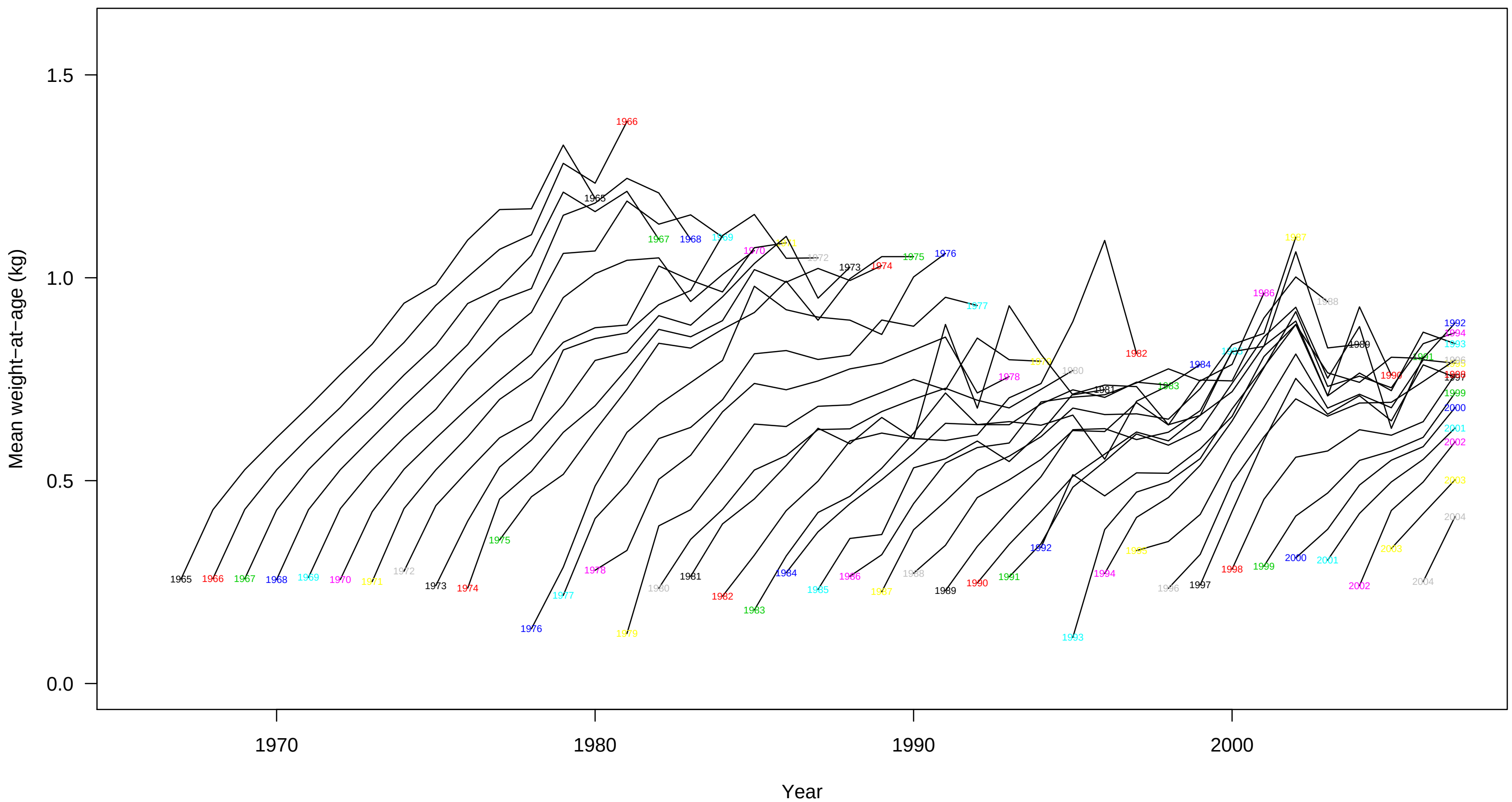



Figure 2: Observed mean weights-at-age by cohort in the commercial catch. Text labels for each line represent the cohort year.

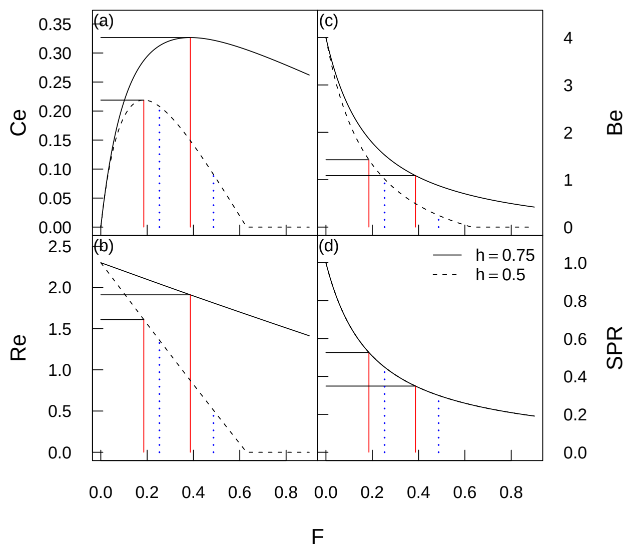



Figure 3: Relationship between equilibrium fishing mortality rate and yield (a), recruitment (b), biomass(c) and spawner per recruit(d) with an assumed value of $h = 0.75$ and $h = 0.5$. The vertical lines in each panel represent estimates of $F^*$(solid lines), $F_{45}$, and $F_{30}$ (dotted lines). Note that the y axis scaling is arbitrary (i.e. $B_o$ was assumed at 4 units of biomass).

years for the age at 50% vulnerability and 0.05 and 5.0 for the standard deviation in age at 50% vulnerability.

In comparison with Helser and Martell (2007), a prior probability for $F^*$is nearly equivalent to a prior probability for steepness $h$. A lognormal prior was assumed for $F^*$, with a mean corresponding to 0.35 and a standard deviation of 0.262 (corresponds to a 95% confidence interval of 0.21 and 0.59). To derive the prior for $F^*$, a steady state age-structured model was developed to calculate spawning potential ratio based on growth parameters from Francis et al. (1982), a natural mortality rate of 0.23, and a logistic selectivity curve ($\hat{a} = 3.13, \hat{\gamma} = 0.8$). Arbitrarily, it was assumed that production is maximized somewhere between SPR=0.3 and SPR=0.45, and the corresponding values for $F_{30}$ and $F_{45}$ were then calculated. Based on the growth-maturity, natural mortality, and assumed selectivity the values correspond to $F_{30} = 0.48$ and $F_{45} = 0.25$, which were then assumed to be the 10th and 90th percentiles for a lognormal distribution. Note that the Spawning potential ratio curve is insensitive to the assumed value of steepness (Figure 3) and that $F_{40}$ is the assumed proxy for $F^*$that is used by the Pacific Fisheries Management Council.

The transition from ($C^*$,$F^*$)$\Rightarrow$($B_o, h$), that is carried out using the algorithm described in Table 15, implies a prior density for the steepness parameter in the stock recruitment relationship. The implied prior density for $h$ used in this assessment is shown in Figure 4. Note that in the Beverton-Holt stock recruitment model, values of $h$ range between 0.2 and 1.0, where 0.2 implies that recruitment is nearly proportional to spawner/egg production, and 1.0 implies that recruitment is the same when spawner/egg production is reduced to 20% of its unfished state. The implied prior for $h$ is sensitive to two key model components: the assumed prior distribution for $F^*$, and the age at which fish recruit to the fishery relative to the age at which fish mature. Larger values of $F^*$imply a more productive stock and higher values of $h$ for given selectivity and maturity schedules. Similarly, if fish recruit to the fishery prior to maturing then the levels of recruitment compensation (or $h$) must increase for a given value of $F^*$. Therefore, a critical piece of information is the maturity-at-age and weight-at-age schedules used to develop the age-specific fecundity relationship.

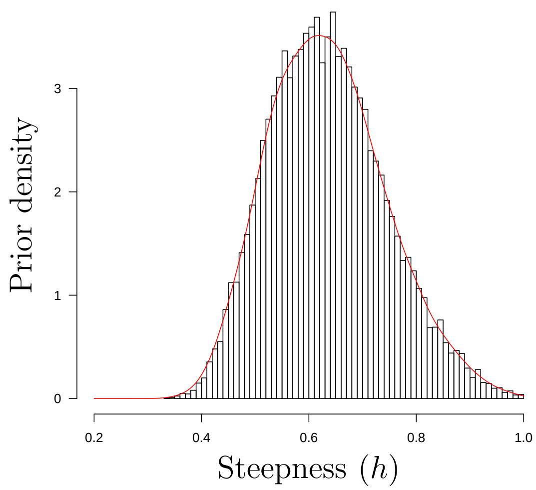



Figure 4: Implied prior for the steepness parameter in the stock recruitment relationship. Note that steepness is derived from the leading parameters $\Theta$; therefore, any assumed prior information for $\Theta$ results in an implied prior for derived quantities such as $h$.

## 2.3 Reference points and catch advice

Catch advice in this model is based on a modified 40:10 harvest control rule, where the modification is to fish at $F^*$, rather than $F_{40}$. Unless otherwise stated, the reference point calculations and catch advice is based on the most recent information about growth (Table 13) and maturity-at-age information from Dorn and Saunders (1997).

The reference points for the harvest control rule are $F^*$and $\text{SB}_{40}$. Recall that $F^*$is the fishing mortality rate that produces the maximum sustainable yield, and this differs from that assumed in the previous assessments where $F_{40}$ was used. $F^*$is estimated as a leading parameter, and $\text{SB}_{40}$is 40% of the unfished spawning biomass ($\text{SB}_\text{o}$). An alternative (but as it turns out, less conservative) harvest rule would be to use $\text{SB}_\text{MSY}$as the reference point in the harvest control rule, where $\text{SB}_\text{MSY}$=$R_e\phi_e$ evaluated at $F^*$and $C^*$.

Catch advice was generated by projecting the stock abundance forward to 2009 by applying catch options between 0 and 750,000 mt tons over 25 equally spaced intervals and then calculating various management objectives for each of the 5,000 samples from the joint posterior distribution. It was assumed in each simulated projection that the total catch option was fully utilized and implemented without error. In the stock projections, age-1 recruits for 2006-2009 were generated using the underlying Beverton-Holt stock recruitment model with annual lognormal recruitment deviates with standard deviation equal to the current estimate of standard deviation in the process errors ($\tau$).

A decision table for catch advice (ABC options) was developed using measures of overfishing (probability that the ABC option will result in a fishing mortality rate that exceeds $F^*$), and four measures of spawning stock depletion. The first measure is the probability that the spawning stock biomass in 2009 will be greater than the spawning stock biomass in 2008, and the second measure is the probability that the spawning stock biomass will be greater than $\text{SB}_{\text{MSY}}$. The third measure is the probability that the spawning stock biomass will be greater than $\text{SB}_{40}$, and the fourth measure is the probability that the spawning stock biomass will remain above $\text{SB}_{25}$. For each sample from the joint posterior distribution the projection model loops over 25 increments of this ABC ranging from 0 to 750,000 mt and then calculates the corresponding fishing mortality rates and levels of spawning stock depletion. We then score the fishing rate and spawning stock depletion on a 0 or 1 scale (0 not overfishing or spawning stock biomass greater than or equal to management target) and fit a binomial (link logit) model versus ABC option to these data. The result is a sigmoid like curve or the cumulative probability of an ABC option versus management objective can be assessed. For specified levels of risk, ABC options for each management objective are then provided in a decision table. This cumulative probability distribution is also compared to the cumulative density function of catch advice produced by the 40/10 harvest control rule.

# 3 Results

Maximum likelihood estimates of the vulnerable biomass, fishing mortality rates, age-1 recruits and historical landings are summarized in Fig. 5. During the late 1960 and 1970s, annual landings averaged 169,000 tons and the corresponding fishing mortalities were less than 0.08 per year. During the 1980s catches increased from 90,000 tons to just over 300,000 tons and the fishing mortality rates during this period averaged less than 0.06 per year. Two exceptionally strong cohorts (1980, 1984) were responsible for a large increase in the vulnerable biomass during this time period. The vulnerable biomass peaked in the mid 1980s declined steadily to a low of 1.46 million tons in 2000. During this time period, there were no significant recruitment events (Fig. 5c), and also during this time period annual landings increased from 110,000 tons in 1985 to nearly 312,000 tons in 1999. The 1999 cohort was an exceptional year class, and the vulnerable biomass nearly doubled from 1.42 millon tons in 2000 to 2.94 million tons in 2004.

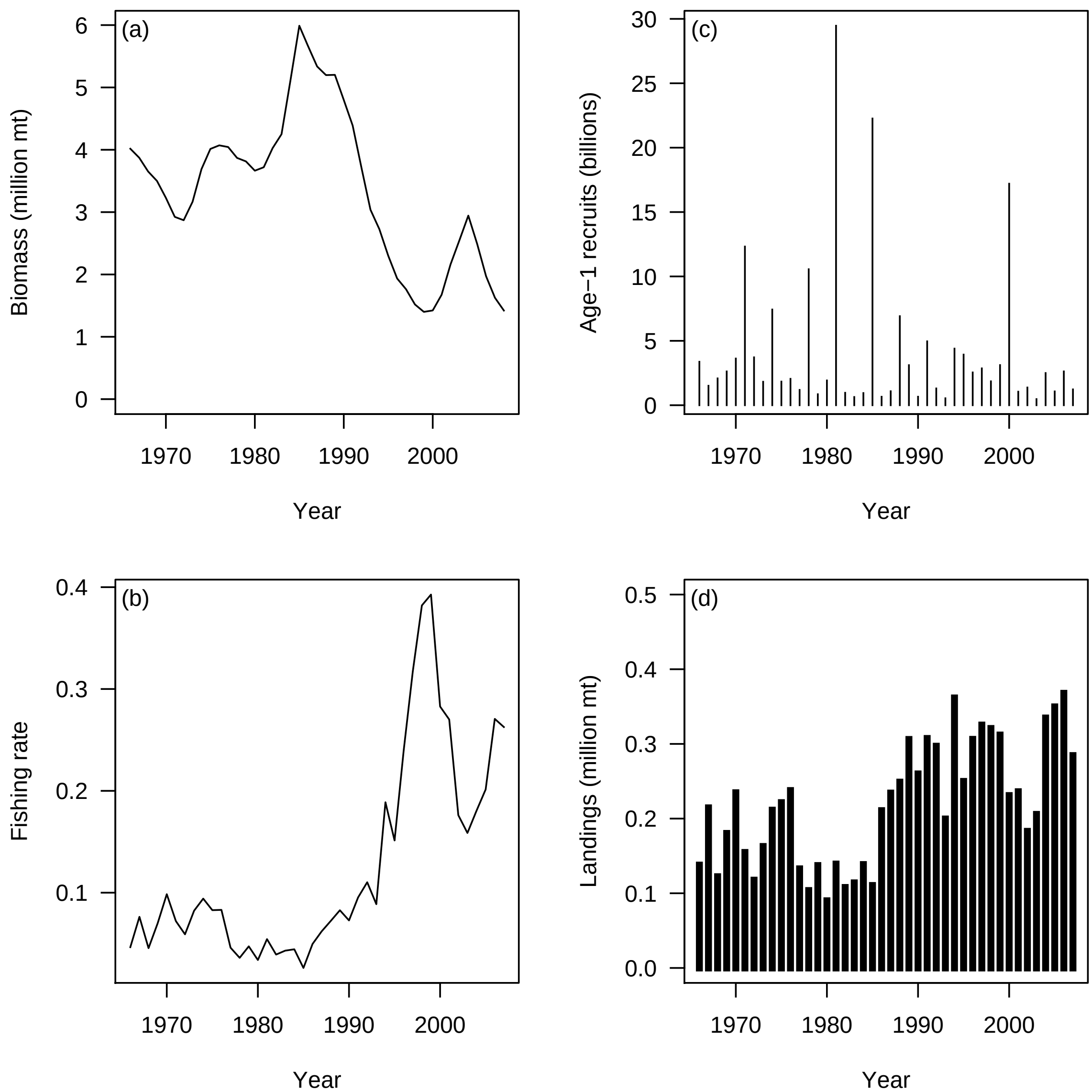



Figure 5: Maximum likelihood estimates of vulnerable biomass (panel a), fishing mortality (b), age-1 recruits (c) and the observed historical landings (d) for U.S. and Canadian fisheries combined.

Table 4: Maximum likelihood estimates of vulnerable biomass ($B_t$), make and female spawning biomass ($SB_t$), , landings ($C_t$ millions mt), instantaneous fishing mortality rates ($F_t$), 2+ and 3+ biomass ($B_{t,2+}$, $B_{t,3+}$), and total catch over 2+ and 3+ biomass ($C_t/B_{t,2+}$, $C_t/B_{t,3+}$), from 1966 to the begining of 2008.

| Year | $B_t$ | $SB_t$ | $SB_t/SB_0$ | $C_t$ | $F_t$ | $B_{t,2+}$ | $B_{t,3+}$ | $C_t/B_{t,2+}$ | $C_t/B_{t,3+}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1966 | 4.02 | 5.08 | 1.00 | 0.14 | 0.05 | 5.96 | 5.30 | 0.02 | 0.03 |
| 1967 | 3.87 | 4.92 | 0.97 | 0.21 | 0.08 | 5.80 | 5.15 | 0.04 | 0.04 |
| 1968 | 3.65 | 4.65 | 0.91 | 0.12 | 0.05 | 5.23 | 4.94 | 0.02 | 0.02 |
| 1969 | 3.50 | 4.31 | 0.85 | 0.18 | 0.07 | 4.82 | 4.41 | 0.04 | 0.04 |
| 1970 | 3.23 | 3.91 | 0.77 | 0.23 | 0.10 | 4.52 | 4.01 | 0.05 | 0.06 |
| 1971 | 2.92 | 3.66 | 0.72 | 0.15 | 0.07 | 4.47 | 3.76 | 0.03 | 0.04 |
| 1972 | 2.87 | 3.98 | 0.78 | 0.12 | 0.06 | 6.27 | 3.89 | 0.02 | 0.03 |
| 1973 | 3.17 | 5.14 | 1.01 | 0.16 | 0.08 | 6.83 | 6.13 | 0.02 | 0.03 |
| 1974 | 3.69 | 5.70 | 1.12 | 0.21 | 0.09 | 6.50 | 6.12 | 0.03 | 0.03 |
| 1975 | 4.01 | 5.41 | 1.07 | 0.22 | 0.08 | 6.75 | 5.40 | 0.03 | 0.04 |
| 1976 | 4.07 | 5.42 | 1.07 | 0.24 | 0.08 | 6.32 | 5.99 | 0.04 | 0.04 |
| 1977 | 4.04 | 5.31 | 1.05 | 0.13 | 0.05 | 6.04 | 5.49 | 0.02 | 0.02 |
| 1978 | 3.87 | 4.73 | 0.93 | 0.10 | 0.04 | 5.03 | 4.91 | 0.02 | 0.02 |
| 1979 | 3.81 | 4.54 | 0.89 | 0.14 | 0.05 | 6.05 | 4.32 | 0.02 | 0.03 |
| 1980 | 3.66 | 5.06 | 1.00 | 0.09 | 0.03 | 6.10 | 5.92 | 0.01 | 0.02 |
| 1981 | 3.72 | 5.02 | 0.99 | 0.14 | 0.05 | 5.29 | 5.11 | 0.03 | 0.03 |
| 1982 | 4.03 | 5.49 | 1.08 | 0.11 | 0.04 | 9.91 | 4.70 | 0.01 | 0.02 |
| 1983 | 4.25 | 7.31 | 1.44 | 0.11 | 0.04 | 9.63 | 9.44 | 0.01 | 0.01 |
| 1984 | 5.11 | 7.95 | 1.57 | 0.14 | 0.04 | 8.48 | 8.37 | 0.02 | 0.02 |
| 1985 | 5.99 | 7.43 | 1.46 | 0.11 | 0.03 | 7.57 | 7.44 | 0.01 | 0.01 |
| 1986 | 5.66 | 6.76 | 1.33 | 0.21 | 0.05 | 10.56 | 5.98 | 0.02 | 0.04 |
| 1987 | 5.34 | 7.69 | 1.51 | 0.23 | 0.06 | 9.49 | 9.38 | 0.02 | 0.02 |
| 1988 | 5.20 | 7.38 | 1.45 | 0.25 | 0.07 | 7.87 | 7.65 | 0.03 | 0.03 |
| 1989 | 5.20 | 6.37 | 1.26 | 0.31 | 0.08 | 7.43 | 6.26 | 0.04 | 0.05 |
| 1990 | 4.80 | 5.93 | 1.17 | 0.26 | 0.07 | 6.99 | 6.36 | 0.04 | 0.04 |
| 1991 | 4.39 | 5.43 | 1.07 | 0.31 | 0.10 | 5.81 | 5.70 | 0.05 | 0.05 |
| 1992 | 3.70 | 4.47 | 0.88 | 0.30 | 0.11 | 5.32 | 4.39 | 0.06 | 0.07 |
| 1993 | 3.04 | 3.76 | 0.74 | 0.20 | 0.09 | 4.33 | 4.07 | 0.05 | 0.05 |
| 1994 | 2.73 | 3.37 | 0.66 | 0.36 | 0.19 | 3.62 | 3.48 | 0.10 | 0.10 |
| 1995 | 2.30 | 2.75 | 0.54 | 0.25 | 0.15 | 3.12 | 2.75 | 0.08 | 0.09 |
| 1996 | 1.94 | 2.62 | 0.52 | 0.31 | 0.24 | 3.61 | 2.81 | 0.08 | 0.11 |
| 1997 | 1.76 | 2.70 | 0.53 | 0.33 | 0.32 | 3.58 | 2.96 | 0.09 | 0.11 |
| 1998 | 1.52 | 2.31 | 0.45 | 0.32 | 0.38 | 2.94 | 2.44 | 0.11 | 0.13 |
| 1999 | 1.40 | 2.04 | 0.40 | 0.31 | 0.39 | 2.52 | 2.19 | 0.12 | 0.14 |
| 2000 | 1.42 | 2.11 | 0.42 | 0.23 | 0.28 | 2.80 | 2.14 | 0.08 | 0.11 |
| 2001 | 1.67 | 2.85 | 0.56 | 0.24 | 0.27 | 6.20 | 2.47 | 0.04 | 0.10 |

Table 4: *(continued)*

| Year | $B_t$ | $SB_t$ | $SB_t/SB_0$ | $C_t$ | $F_t$ | $B_{t,2+}$ | $B_{t,3+}$ | $C_t/B_{t,2+}$ | $C_t/B_{t,3+}$ |
|---|---|---|---|---|---|---|---|---|---|
| 2002 | 2.16 | 4.44 | 0.87 | 0.18 | 0.18 | 6.11 | 5.87 | 0.03 | 0.03 |
| 2003 | 2.55 | 4.43 | 0.87 | 0.21 | 0.16 | 4.99 | 4.68 | 0.04 | 0.04 |
| 2004 | 2.94 | 3.92 | 0.77 | 0.33 | 0.18 | 4.14 | 4.06 | 0.08 | 0.08 |
| 2005 | 2.49 | 2.97 | 0.58 | 0.35 | 0.20 | 3.54 | 2.91 | 0.10 | 0.12 |
| 2006 | 1.97 | 2.41 | 0.47 | 0.37 | 0.27 | 2.79 | 2.58 | 0.13 | 0.14 |
| 2007 | 1.63 | 2.09 | 0.41 | 0.28 | 0.26 | 2.68 | 2.11 | 0.11 | 0.13 |
| 2008 | 1.42 | 1.90 | 0.37 | | | 2.28 | 2.07 | | |

The maximum likelihood estimate of the 2008 spawning stock biomass is 1.90 millon tons, which corresponds to a depletion level of 0.37 (Fig. 6ab, Table 4). This is below the management target of 0.4. In comparison to Helser and Martell (2007), the estimated level of depletion in last years assessment was 0.309. Estimates of female spawning stock biomass in 2007 were nearly identical between this study and last years assessment (female spawning stock biomass is 1.045 and 1.103 million mt, respectively). The difference in the levels of depletion over last years assessment owes to differences in the estimates of the unfished spawning stock biomass. In this study, the maximum likelihood estimate of the unfished female spawning stock biomass is 2.54 million mt, and in last years assessment it was estimated at 3.567 million mt.

A major factor that influences estimates of the 1966 states (assumed to be the unfished state) is the relative weighting of the age-composition data and the assumed variances in the recruitment deviations and observation errors. In this assessment the total variance $\varphi^2$ is estimated and partitioned (via the estimated $\rho$ parameter) into observation and process error components represented by the errors in the relative abundance index and recruitment deviates, respectively. Due to the age-composition information, $\varphi^2$ and $\rho$ are estimable quantities (Deriso et al., 2007); however the assumed variance (or sample sizes) in the age composition information does influence $\varphi^2$ and $\rho$. In short, increasing the assumed weights on the age-composition information tends to increase the biomass peak in the mid 1980s, raises the overall population scaling, and results in greater depletion estimate.

In this assessment we assume a constant age-selectivity curve for both the commercial and acoustic surveys (Fig. 7c). This is markedly different from previous assessments where selectivity is allowed to vary over specified time blocks. In this case, we have dramatically reduced the effective sample sizes in the likelihood (T18.3) on the age-composition information to 35 for the commercial fisheries and 28 for the acoustic surveys. In short, we are willing to accept a lack of fit in the age-composition data in order to place more weight on the trend information in the biomass indices generated from the acoustic trawl surveys. This also allows for visual inspection of patterns in the residuals to determine if alternative selectivity functions (i.e., dome-shaped) would be more appropriate to explain the data, and aid in the justification of time-blocks associated with changes in selectivity (i.e., SS2 implementation).

Reasonable fits were obtained to the age-compositions in the acoustic trawl surveys (Figs.

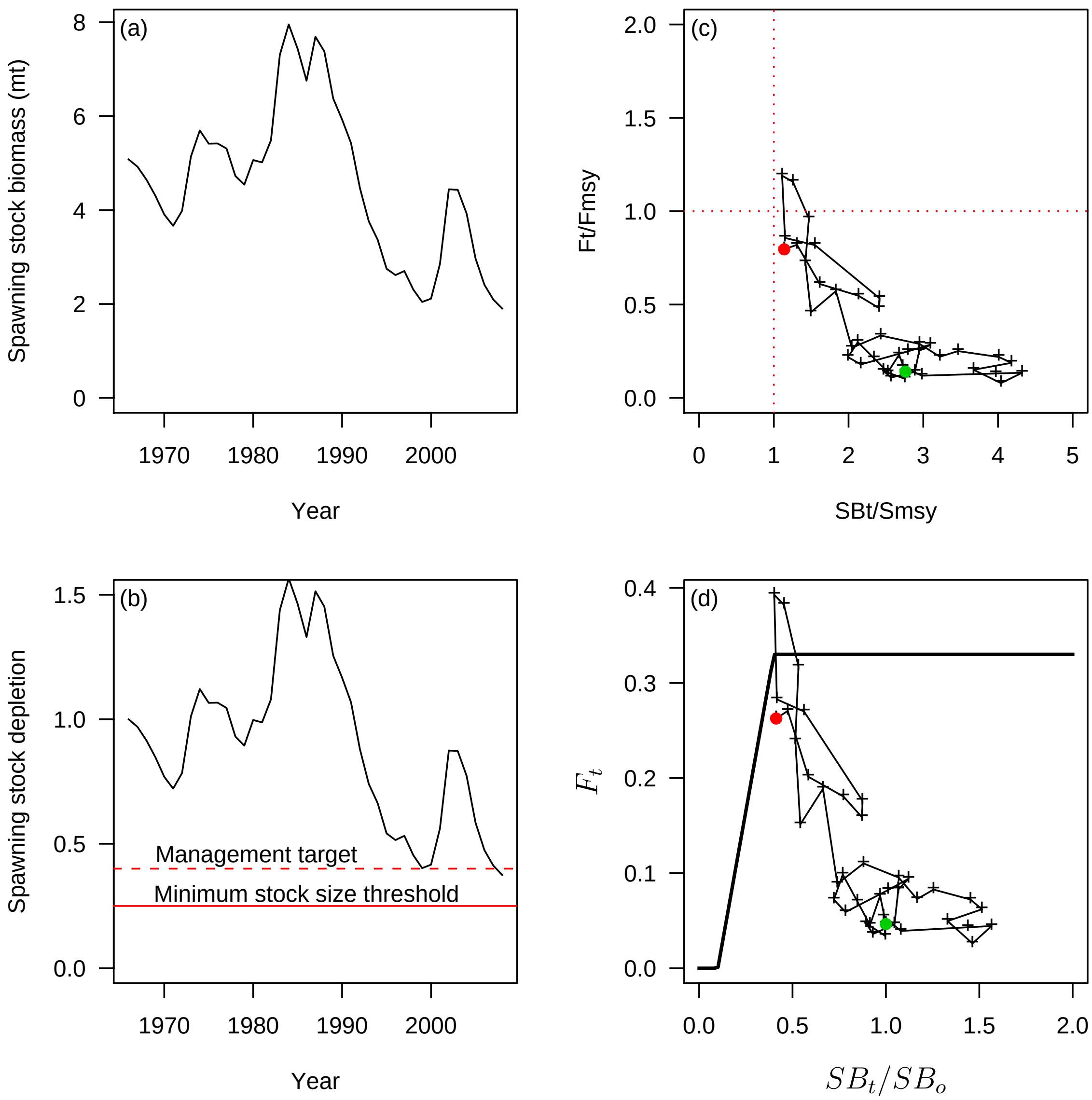



Figure 6: Maximum likelihood estimates of spawning stock biomass (a), spawning biomass depletion (b), the ratio of fishing mortality rates to $C^*$versus the spawning stock biomass to $S_{\mathrm{msy}}$ (c) and the harvest control rule (d). Note that the spawning stock biomass calculations include both male and females.

8-9). The largest residual occurred for the age-2 fish in 2007 and age-7 fish in 1977 (Fig. 9). The model also under-estimates the age-2 fish in 1995 and in 2001, corresponding to the 1993 and 1999 cohorts. The 1999 cohort was above the average long-term recruitment and the 1993 cohort is near the average long-term recruitment. In many years (e.g., 1977, 1980, 1986, and 2007, Fig. 9) there is a pattern in the pearson residuals where the model over-estimate the proportions at ages 2-5 and ages 12-14, and under-estimate the proportions at ages 6-11; this pattern would be better explained with a dome-shaped selectivity curve. But this pattern is not apparent in all years. Also, estimates of the instantaneous natural mortality rate $M$ are substantially higher than the previously assumed values of 0.23. This increase in $M$ better explains the disappearance of older fish in the age-composition information, given that the assumed shaped of the selectivity curves is asymptotic.

In the commercial fishery, we assumed an constant asymptotic selectivity curve and obtained surprisingly good fits to the older age-classes in the commercial catch-age proportions (Figs. 10-11), with the exception of the year 2000 (Fig. 12), and the persistent under-estimate of the proportions-at-age in the plus group. The largest residual variation in the commercial age-composition data occurred in ages 2 and 3. The model tends to under estimate the 1980 and 1984 cohorts at age-2 which would be consistent with a shift to higher selectivity for age-2 fish in 1981 and 1985. The opposite pattern was also observed for the 1999 cohort where the model tended to over-estimate the proportion at age-2. In 1988, there is a positive residual for the 1980 cohort (age-8) that tracks trough to age-12 in 1992. From 1977 to 1979 there is a negative pattern where the residuals from age-12-15; this could be explained by dome-shaped selectivity and or the initialization of the model with a stable age-distribution (with a plus group). In the rest of the time series, there are few exceptions where there are negative residual patterns for ages 10-14 (indicative of a dome-shaped selectivity curve); however, the residuals for the plus group are all negative with exception of the year 2000-2001 when the fish did not show up in the Canadian zone and the fleet operated in the northern portion of the Canadian zone.

Overall, the constant selectivity assumption fits the commercial catch-age data reasonable well (Fig 10). There is a marked pattern in the Pearson residuals that appear to correspond to an aging error pattern (Fig 12) around the strong cohorts (e.g., 1980, 1984 cohorts). Up to age-8, the model tends to over estimate the 1981 cohort and underestimate the 1979 cohort. There are persistent underestimates of the 1985 cohort as well.

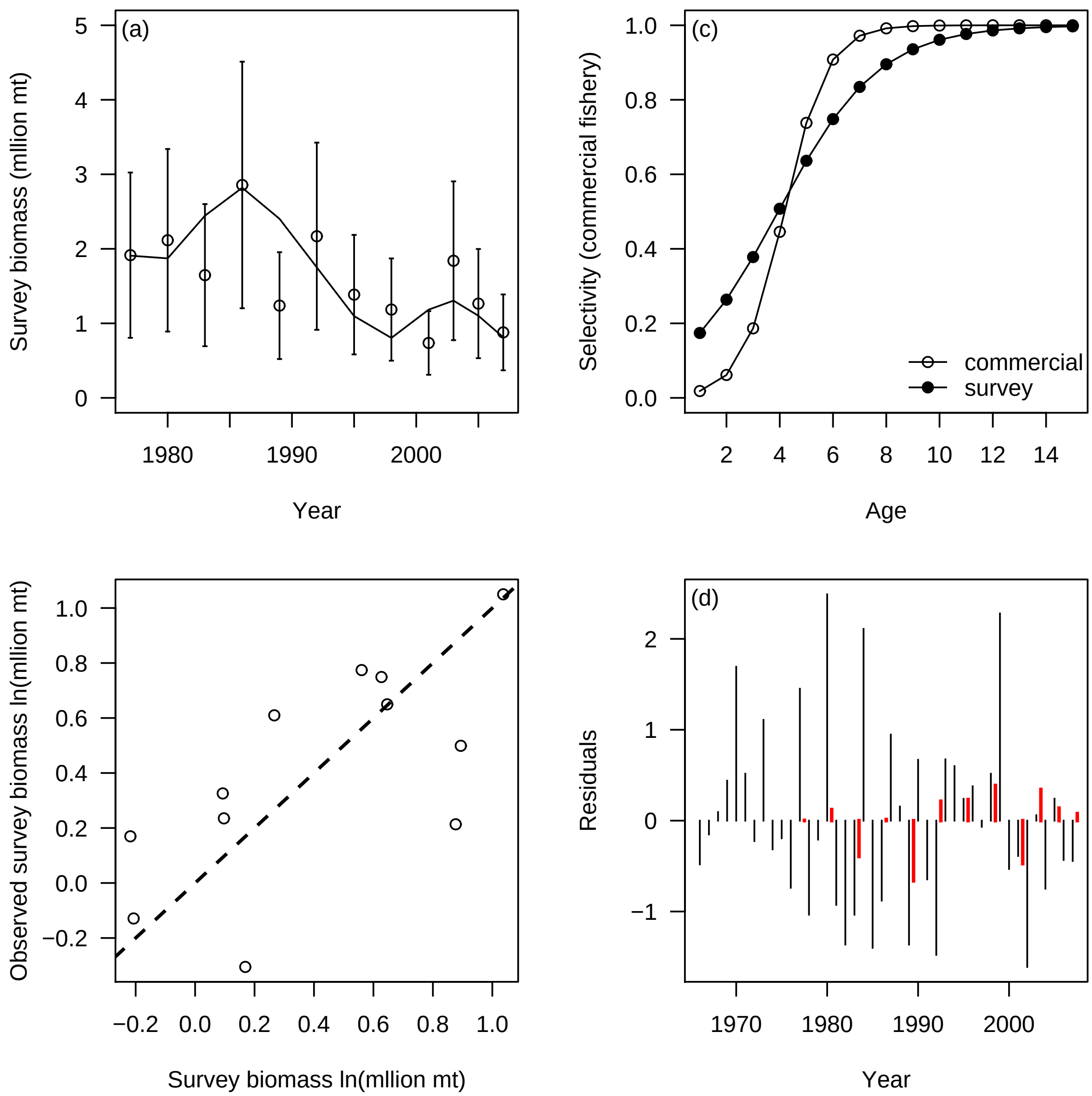



Figure 7: Predicted and observed survey biomass estimates (panel a-b, 1:1 line shown in panel b) based on the maximum likelihood fit to the data. Approximate 95% confidence intervals are shown for the survey points in panel (a) based on the estimated standard deviation in the survey. The estimated selectivity curves for commercial and survey selectivity (c), and the residuals between abundance indices (thick bars in panel d) and recruitemnt deviations (thin bars in panel d).

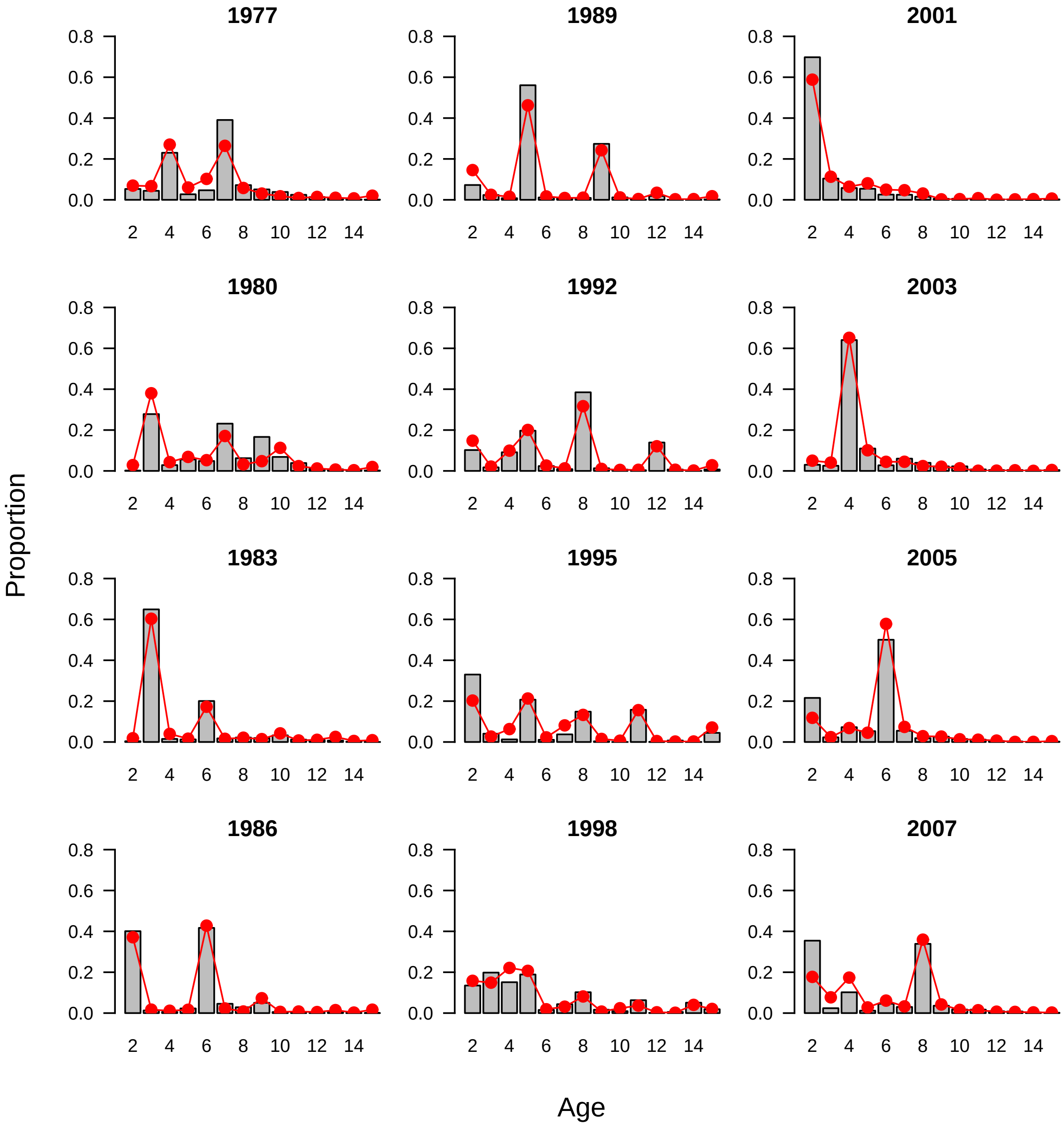



Figure 8: Observed (bars) and predicted (lines) proportions-at-age in the acoustic trawl surveys.

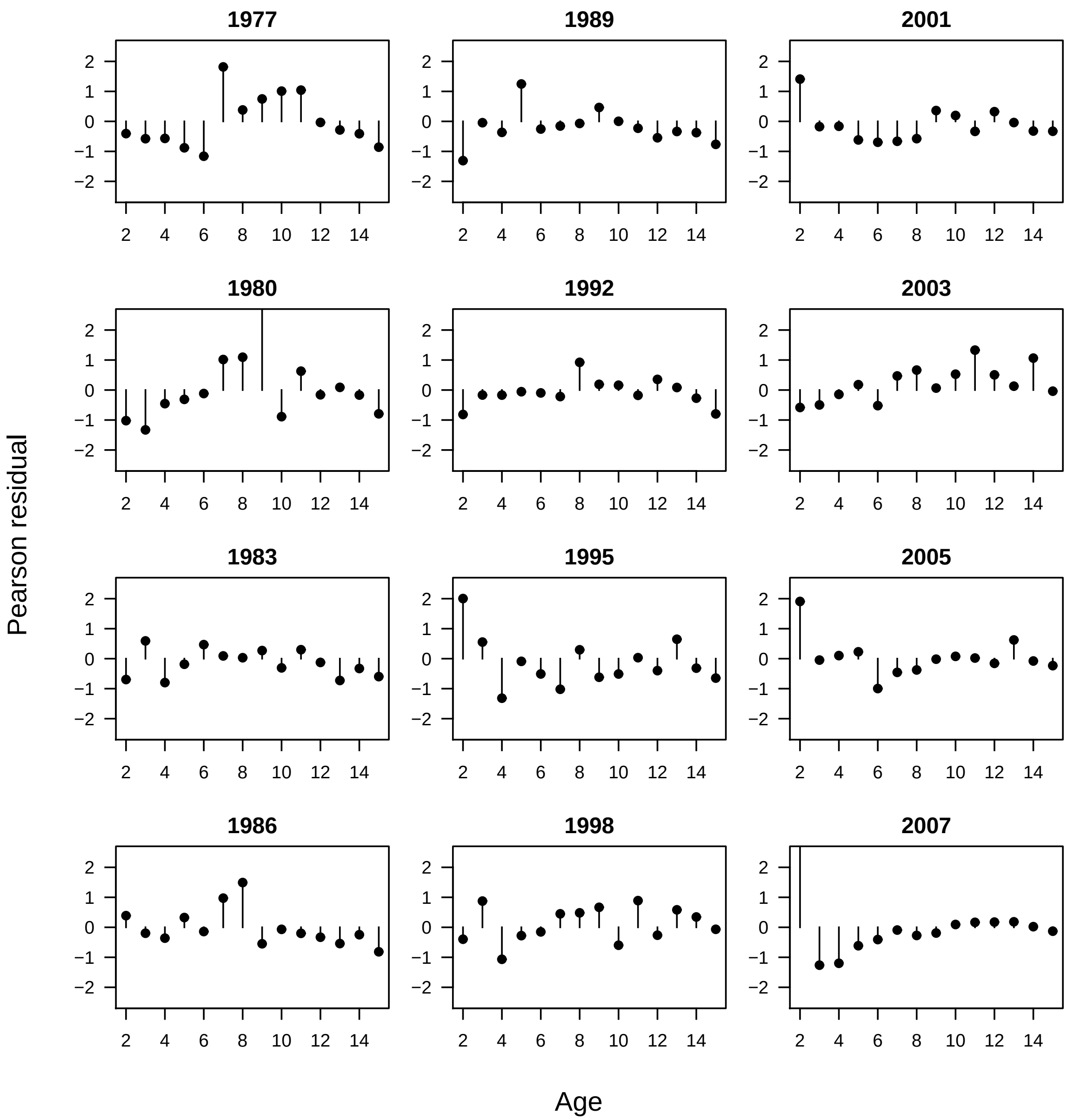



Figure 9: Pearson residuals for the proportions-at-age in the acoustic trawl surveys.

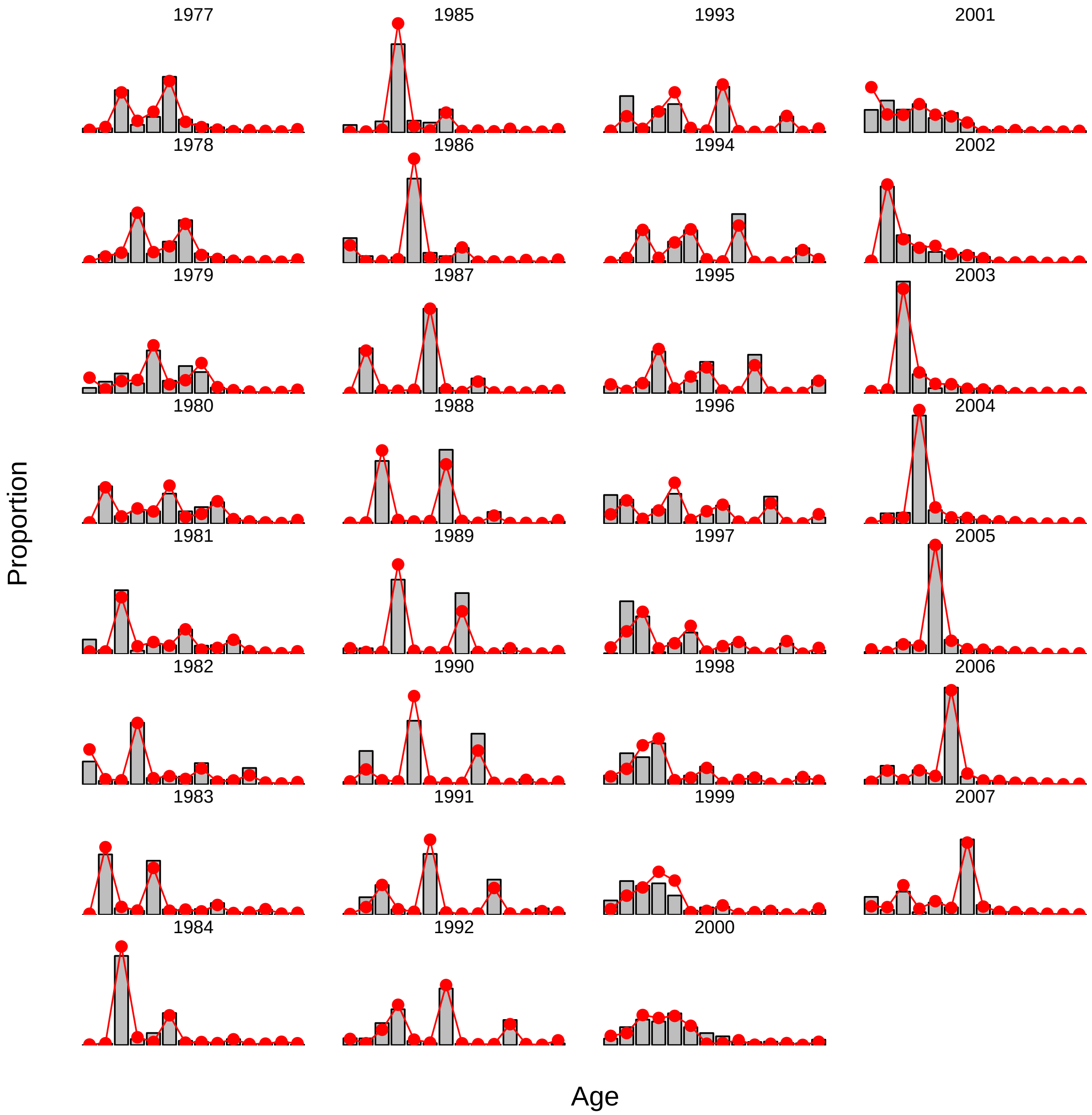



Figure 10: Observed (bars) and predicted (lines) proportions-at-age in the commercial age compositions.

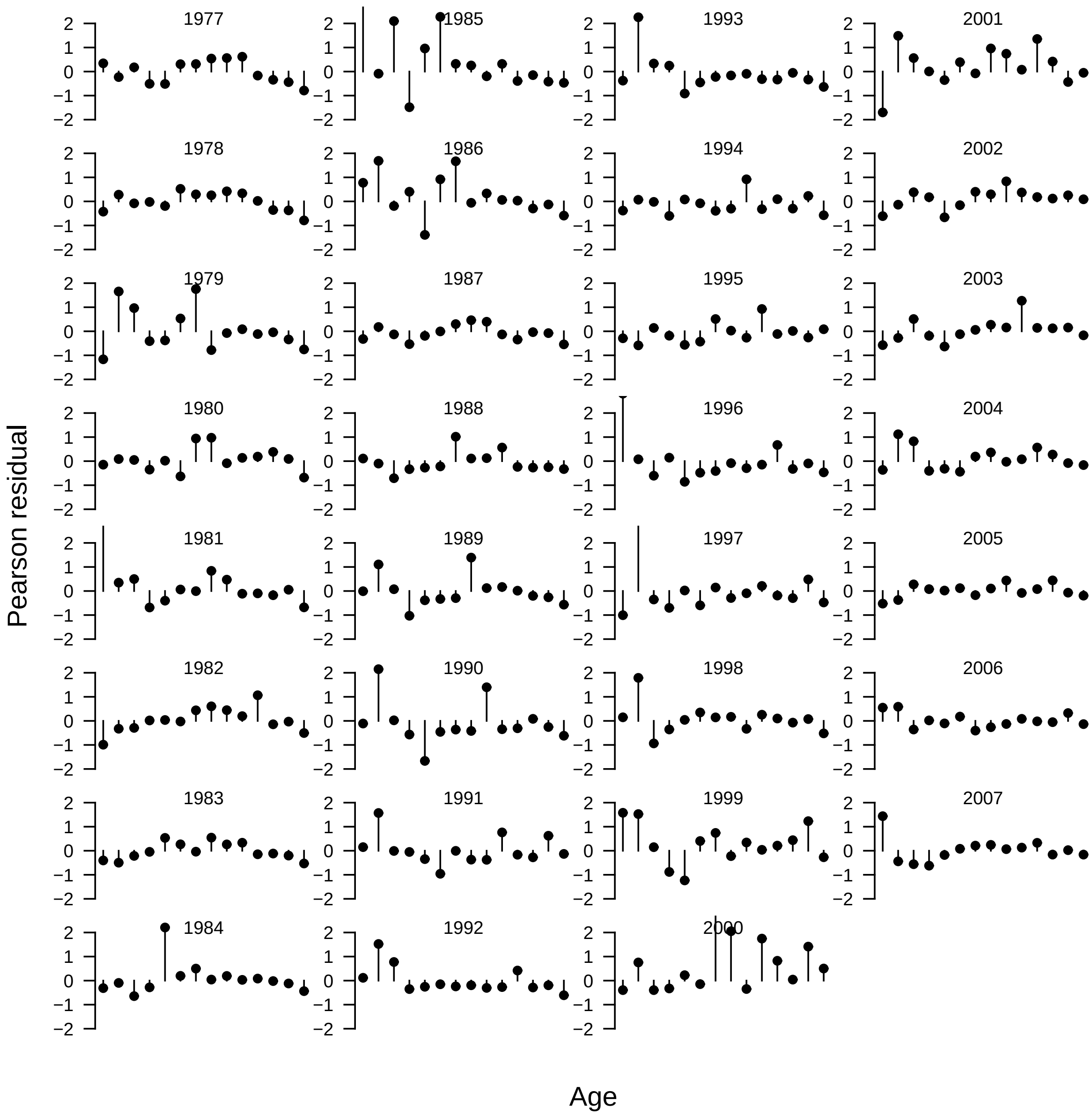



Figure 11: Pearson residuals for the proportions-at-age in the commercial age compositions.

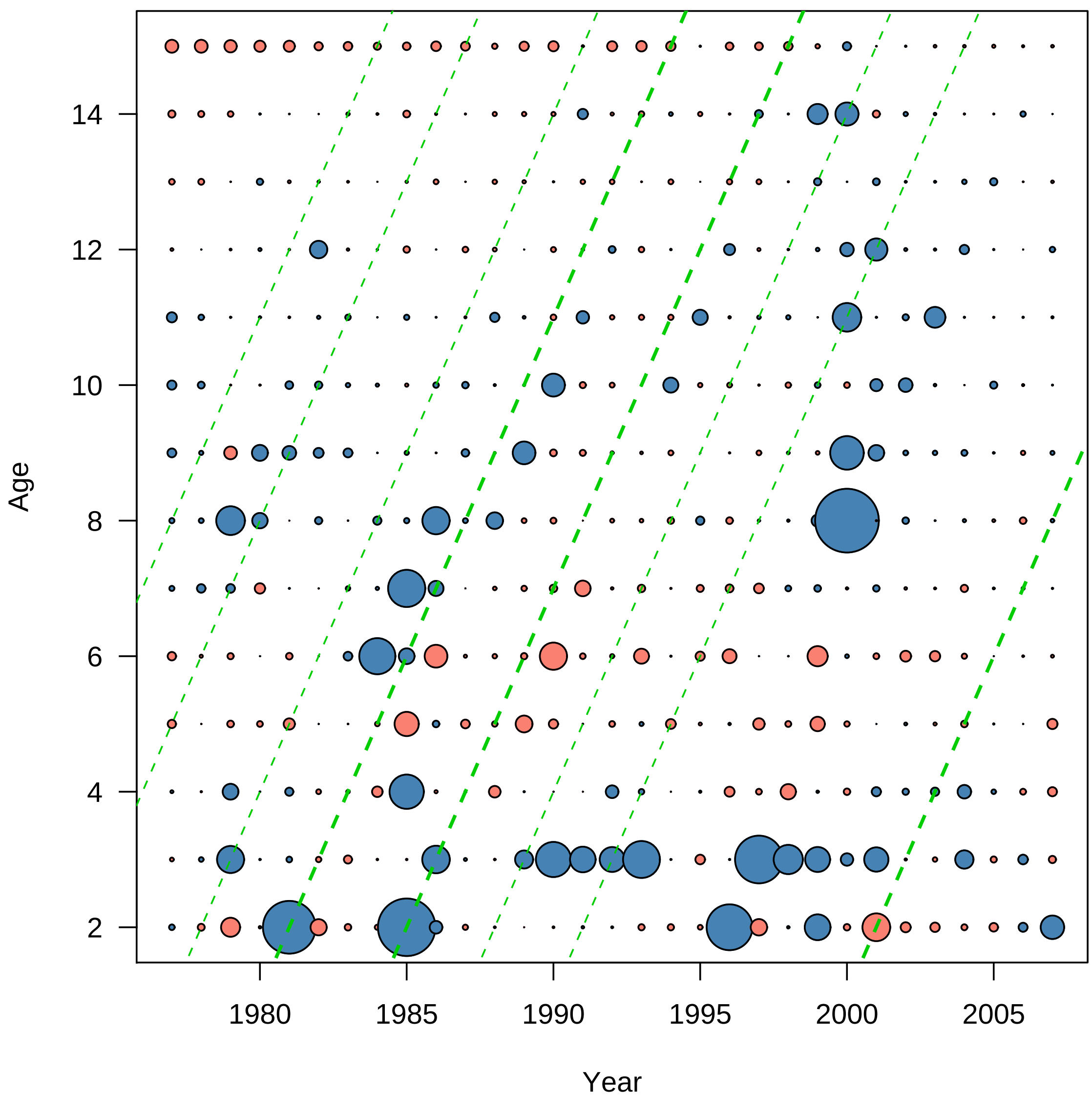



Figure 12: Bubble plots of pearson residuals for the proportions-at-age in the commercial age compositions. Dashed lines follow above average cohorts and the 1980, 1984 and 1999 cohorts are shown in bold dashed lines, positive residuals shown in blue, negative residuals shown in red.

### 3.1 Results from posterior integration

As reported in Martell et al. (in press), there is insufficient trend information, and an apparent contradiction between the age-composition and trend information to reliably estimate overall population scale and productivity parameters (in this case $C^*$and $F^*$, and in previous assessments $B_o$ and $h$). The relative abundance indices are relatively flat, with a slight downward trend between 1986 and 2007. Such one-way trip information is insufficient to resolve parameter confounding between $B_o$ and $h$, yet this information can be surprisingly informative about MSY (Walters and Martell, 2004).

The marginal distribution for $F^*$reflects the assumed prior information for $F^*$(Fig. 13). The median estimate for $C^*$is 0.319 million mt (Table 5), which is greater than the assumed prior mean of 0.2 million mt. Median estimates of $M$=0.289 are also higher than the assumed prior mean of 0.23 (Table 5). Information to estimate $M$ comes from the age-composition information and is positively correlated with the age at 50% vulnerability parameters ($\hat{a}$ and $\bar{a}$) in the selectivity curves. Note that if a dome-shaped selectivity curve was assumed, then estimates of $M$ would likely decrease owing to the disappearance of older animals due to reduced selectivity. The median estimate of the age at 50% recruitment to the commercial and survey gears is 4.0 and 4.6 years respectively (Table 5). Also, note that the uncertainty in the selectivity parameter is large relative to the commercial selectivity parameters. In particular, the standard deviation in the logistic selectivity curve is sufficiently large that a high proportion of age-2 fish are recruited to the survey gear. The median estimate of the variance ratio $\rho$ is 0.120 and the inverse of the total variance $\varphi^{-2}$ is 1.139 which corresponds to coefficients of variation of 0.322 and 0.877 for the observation errors and process errors, respectively (Table 5 and Table 7). There is a slight negative correlation between $\varphi^{-2}$ and $C^*$(as well as between $\varphi^{-2}$ and $M$, Table 7), this illustrates the partial confounding between the age-composition information and the trends in the survey biomass index. As the input sample size for the age-composition is reduced the correlation between $\varphi^{-2}$ and $C^*$is reduced.

Trends in the median estimates of vulnerable biomass and spawning stock biomass are exactly the same as the maximum likelihood estimates; however, in absolute terms the median estimates are slightly higher than the maximum likelihood estimates (Fig. 14a). Thus, uncertainty in biomass estimates is not normally distributed. In comparison to Helser and Martell (2007), uncertainty is much greater in this assessment owing to the large amount of uncertainty admitted in the global scaling parameter ($C^*$) and productivity parameter ($F^*$). Although the survey catchability coefficient ($q$) is not directly comparable with the assumed values in Helser and Martell (2007), the range of uncertainty in this assessment is much larger than the two options explored in previous assessments (Table 7).

Trends in historical recruitment are also comparable with Helser and Martell (2007), and the median estimates are slightly higher than the maximum likelihood estimates (Fig. 15). The overall uncertainty in annual recruitment is also proportional to the overall uncertainty in the global scaling as well as uncertainty in the estimates of $M$. The largest cohorts in the past are the 1980, 1984, and 1999, and the 2005 cohort is estimated to be slightly above the long term median historical recruitment. There is a substantial amount of uncertainty in the estimates of age-1 recruits, and this uncertainty owes to the assumed uncertainty in

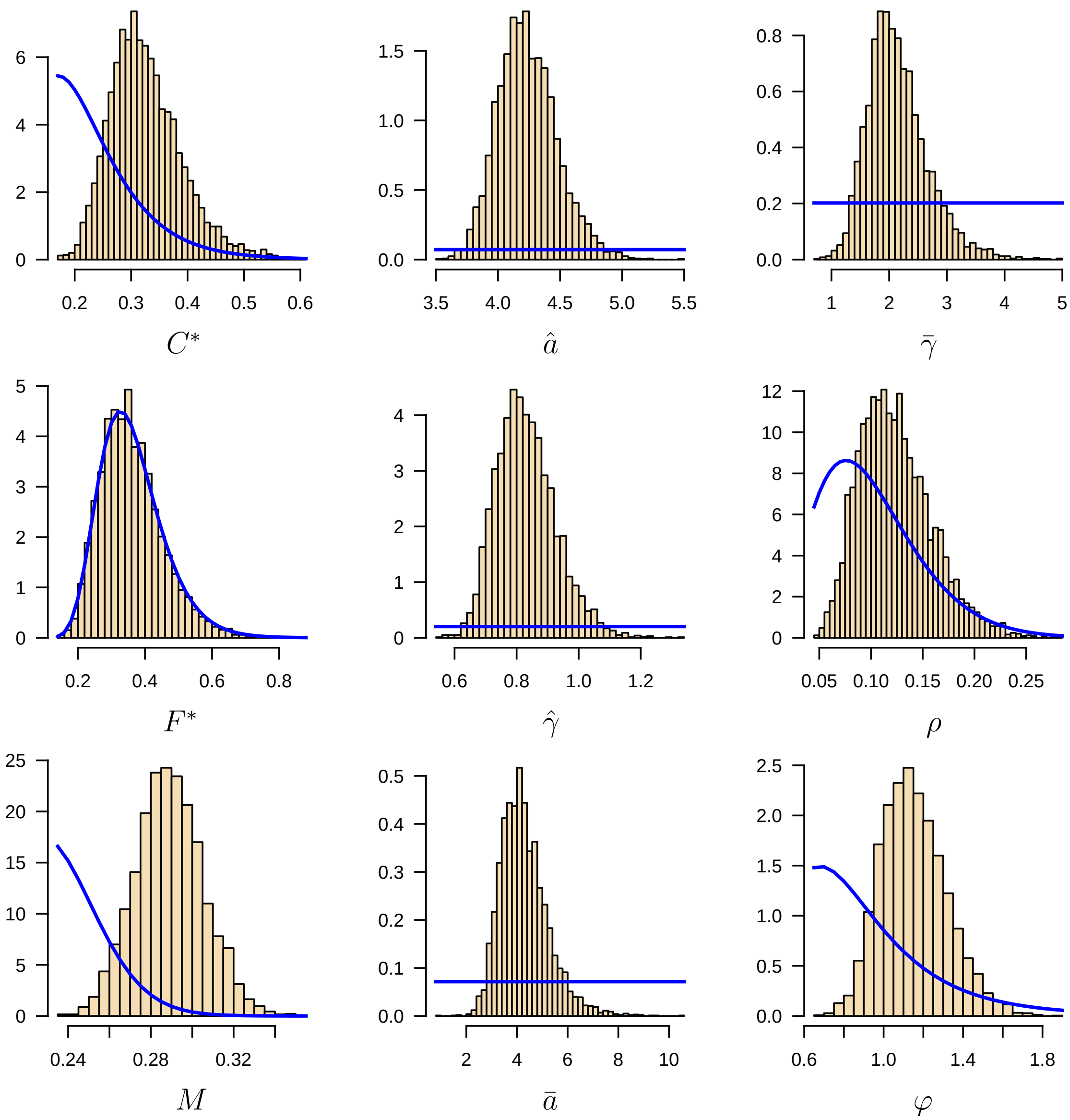



Figure 13: Marginal posterior (histograms) and prior distributions (lines) for key model parameters. Means and variances for the prior distributions are summarized in Table 3.

Table 5: Maximum likeliood estimates (MLE) of model parameters with asymptotic estimates of the standard deviation and median estimates with corresponding 2.5% and 97.5% quantiles from the marginal posterior distributions. Medians and quantiles are based on 5,000 samples from the joint posterior distribution.

| | **MLE** | | **Marginal densities** | | |
|---|---|---|---|---|---|
| | Mean | Std | Median | 2.5% | 97.5% |
| $C^*$ | 0.305 | 0.054 | 0.319 | 0.224 | 0.477 |
| $F^*$ | 0.330 | 0.083 | 0.349 | 0.215 | 0.577 |
| $M$ | 0.283 | 0.016 | 0.289 | 0.258 | 0.322 |
| $\hat{a}$ | 4.174 | 0.217 | 4.219 | 3.812 | 4.759 |
| $\hat{\gamma}$ | 0.798 | 0.081 | 0.821 | 0.665 | 1.038 |
| $\bar{a}$ | 3.942 | 0.743 | 4.154 | 2.798 | 6.532 |
| $\bar{\gamma}$ | 1.890 | 0.408 | 2.075 | 1.311 | 3.399 |
| $\rho$ | 0.119 | 0.034 | 0.120 | 0.067 | 0.204 |
| $\varphi^{-2}$ | 1.366 | 0.191 | 1.139 | 0.860 | 1.503 |

Table 6: Correlation among key model parameters based on 5,000 samples from the posterior distribution.

| | $C^*$ | $F^*$ | $M$ | $\hat{a}$ | $\hat{\gamma}$ | $\bar{a}$ | $\bar{\gamma}$ | $\rho$ | $\varphi^{-2}$ |
|---|---|---|---|---|---|---|---|---|---|
| $C^*$ | 1.000 | | | | | | | | |
| $F^*$ | 0.517 | 1.000 | | | | | | | |
| $M$ | 0.504 | −0.132 | 1.000 | | | | | | |
| $\hat{a}$ | −0.108 | 0.023 | 0.248 | 1.000 | | | | | |
| $\hat{\gamma}$ | −0.124 | 0.012 | 0.097 | 0.857 | 1.000 | | | | |
| $\bar{a}$ | −0.047 | 0.001 | 0.225 | 0.350 | 0.250 | 1.000 | | | |
| $\bar{\gamma}$ | −0.099 | −0.006 | −0.010 | 0.132 | 0.099 | 0.728 | 1.000 | | |
| $\rho$ | −0.043 | 0.000 | 0.024 | 0.015 | −0.012 | 0.027 | 0.049 | 1.000 | |
| $\varphi^{-2}$ | −0.231 | 0.043 | −0.161 | 0.055 | 0.056 | 0.035 | −0.001 | 0.002 | 1 |

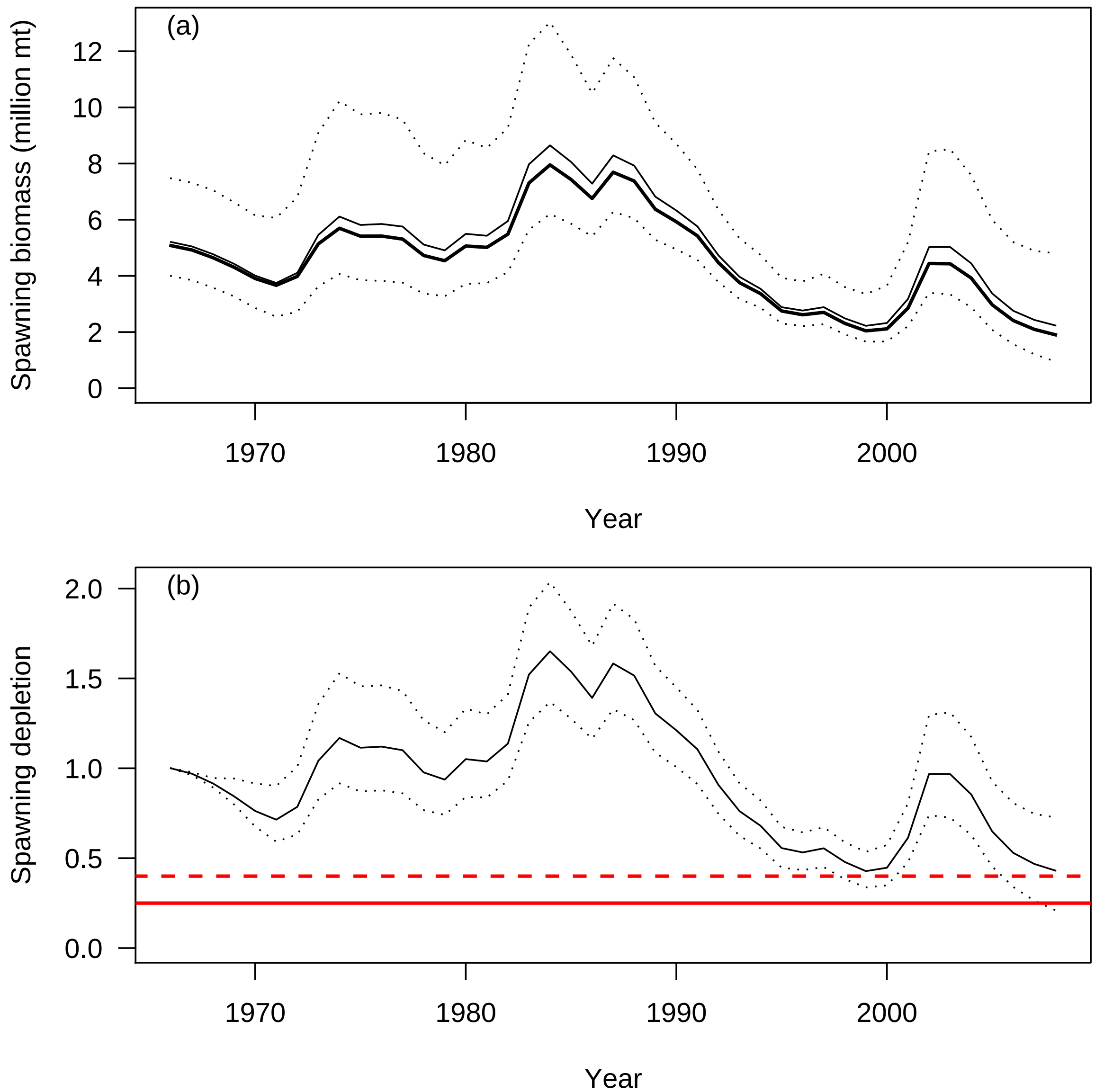



Figure 14: Maximum likelihood estimates (thick line) and median estimates (thin line) of the spawning stock biomass (a) and spawning stock depletion level with 40% and 25% horizontal reference lines (b). The dotted lines represent the 0.025 and 0.975 quantiles based on 5,000 systematic samples from the joint posterior distribution.

Table 7: Modal and median estimates of derived quantities of management interest. Medians and quantiles are based on 5,000 systematic samples from the joint positerior distribution, and the modal estimates correspond to the maximum likelihood estimates.

| Derived quantity & Reference piont | Mode | Median | 2.5% | 97.5% |
|---|---|---|---|---|
| Survey catchability coefficient ($q$) | 0.477 | 0.456 | 0.284 | 0.723 |
| Steepness ($h$) | 0.488 | 0.488 | 0.379 | 0.627 |
| Spawning stock depletion (2008) | 0.375 | 0.431 | 0.211 | 0.727 |
| 2008 ABC from 40/10 rule | 0.325 | 0.424 | 0.072 | 0.984 |
| Unfished total biomass ($B_0$) | 6.363 | 6.496 | 4.856 | 9.619 |
| Unfished 3+ biomass ($B_{0,3+}$) | 5.302 | 5.44 | 4.164 | 7.861 |
| Unfished spawning stock biomass ($SB_0$) | 5.079 | 5.208 | 3.999 | 7.474 |
| Unfished female spawning biomass | 2.539 | 2.604 | 2 | 3.737 |
| Spawning stock biomass at MSY ($SB_{MSY}$) | 1.839 | 1.888 | 1.318 | 2.883 |
| Female spawning biomass at MSY | 0.92 | 0.944 | 0.659 | 1.442 |
| Spawning stock biomass in 2008 (million mt) | 1.903 | 2.235 | 0.95 | 4.804 |
| Female spawning stock biomass in 2008 (million mt) | 0.951 | 1.118 | 0.475 | 2.402 |
| Coefficient of variation in surveys ($\sigma$) | 0.295 | 0.322 | 0.238 | 0.44 |
| Coefficeint of variation in recruitment ($\tau$) | 0.803 | 0.877 | 0.756 | 1.013 |

the instantaneous natural mortality rate ($M$). In comparison to previous assessments the average long-term recruitment is higher; however, both the MLE and median estimates of $M$ are substantially higher than the previously assumed value of 0.23.

Trends in median residual pattern were consistent across all 5,000 samples from the joint posterior distribution (Fig. 16). The 1989 and 2001 acoustic survey biomass estimates are roughly 60% below the predicted biomass. The greatest uncertainty is in the 2007 biomass estimate, and this uncertainty owes to the uncertainty in recent recruitment. The median estimate of the survey catchability coefficient $q$ was 0.456 with a 5% and 95% credible intervals of 0.284 and 0.723, respectively (Table 7). These estimates of $q$ are significantly lower than Helser and Martell (2007); however, in the previous years assessment a dome-shaped selectivity curve for the acoustic survey was assumed and as much as 20% of the older fish were assumed to be “cryptic” biomass.

The median estimate of the spawning stock biomass in 2008 is 2.235 million mt (Table 7) and the modal estimate is 1.903 million mt. More than 20% of 2008 spawning stock biomass it consists of the 1999 cohort (Fig. 17b) and as much as 50% of it consists of the smaller cohorts produced in 2003 and later. Absent any significant recruitment, the spawning stock biomass is expected to decline rapidly as the 1999 cohort ages.

Catch advice based on the 40/10 harvest control rule (ABC in 2008) is highly uncertain, ranging from 72,000 mt to 984,000 mt (Table 7). The modal estimate for the 40/10 rule is 325,000 mt and the median estimate is 424,000 mt. The marginal posterior samples for the

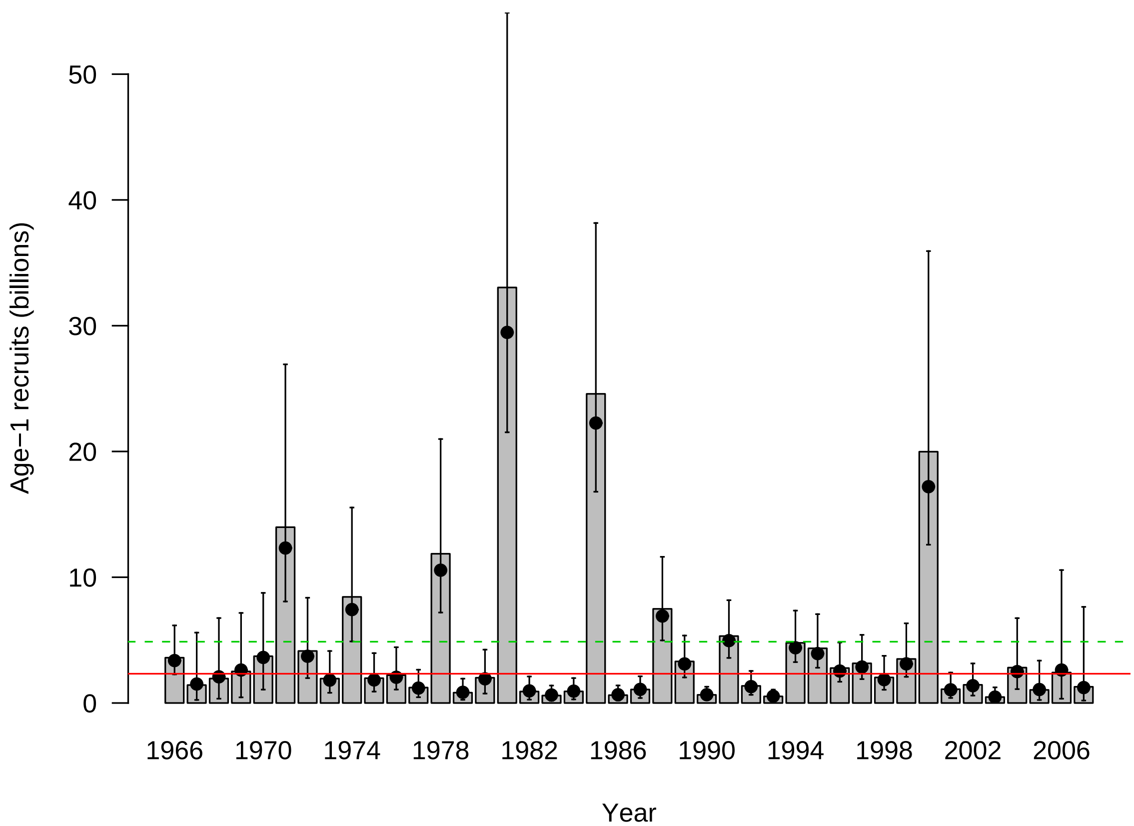



Figure 15: Median (bars) and maximum likelihood (circles) estimates of age-1 recruits, error bars represent the 0.025 and 0.975 quantiles based on 5,000 systematic samples from the joint posterior distribution. Long term average and median recruitment levels are shown as dashed and solid horizontal lines, respectively.

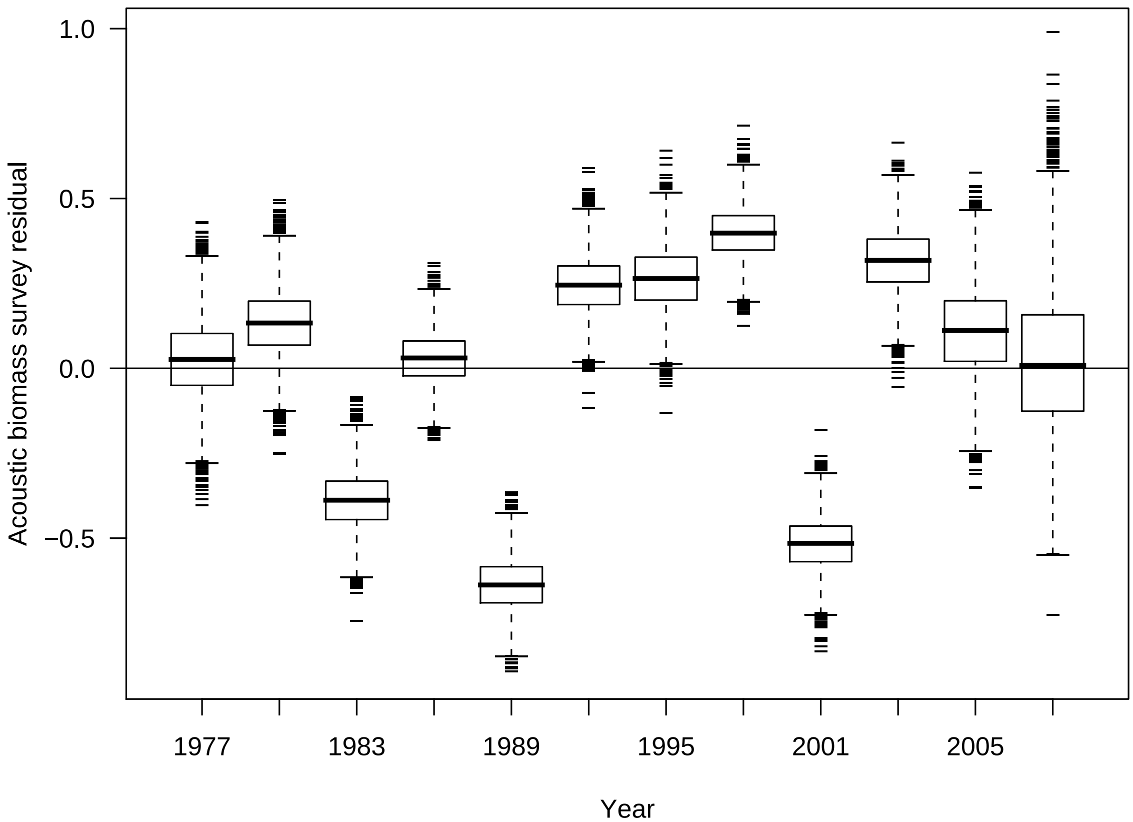



Figure 16: Boxplots of the marginal posteriors for the residuals in the acoustic survey.

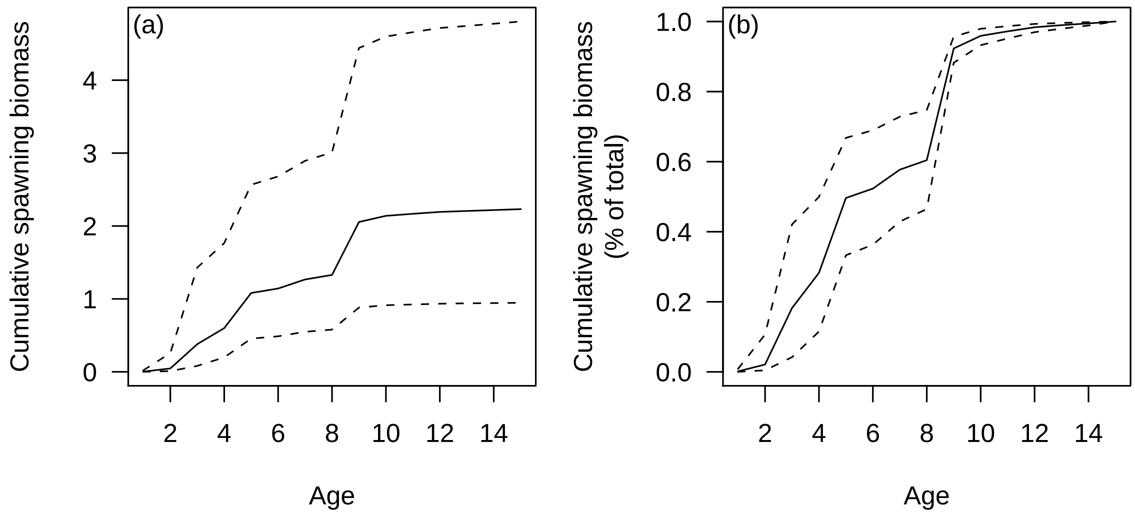



Figure 17: Cumulative spawning stock biomass at-age in 2008. Panel (a) is the cumulative total biomass where the solid line represents the median estimate, and the dashed lines represent the 0.025 and 0.975 quantiles. The cumulative spawning biomass-at-age relative to the total biomass is shown in panel (b).

2008 ABC based on the 40/10 adjustment is highly skewed with a long tail and reflects the huge amount of uncertainty in the 2008 spawning stock biomass estimate.

## 3.2 Risk analysis

Five different criterion were examined in developing risk profiles for various catch options in 2008. The first criterion is the probability of the fishing mortality rate exceeding the estimated value of $F^*$(Fig. 18a). First, let 0.25, 0.5 and 0.75 probabilities represent definitions of risk averse, risk neutral, and risk prone, respectively. The risk averse ABC option for the 2008 fishing season based on achieving the target fishing rate of $F^*$is 264,000 mt (Table 8). The risk neutral and risk prone ABC options are 364,000 and 465,000 mt, respectively. The second criterion is the probability of the spawning stock declining between 2008 and 2009 (Fig. 18b). Under this criterion the risk averse to risk prone ABC options are 0, 122,000 and 318,000 mt, respectively (Table 8 column 3). The third criterion examines the probability that the spawning stock biomass in 2009 will fall below the estimate of $SB_{MSY}$ (Fig 18c). Under this criterion the probability of the spawning stock falling below $SB_{MSY}$ is fairly high with no fishery (P=0.22); the risk neutral and risk prone policies call for ABCs of 464,000 and 920,000 mt (Table 8). The last two criteria criterion examines the probability that the spawning stock will fall below the management target $SB_{40}$ and $SB_{25}$ (Fig 18d). Under

Table 8: Decision table for catch advice. The risk level represents the probability of exceeding a specified management target for a given ABC option. The interpretation of this table is as follows; if the management goal is not to exceed the target fishing mortality rate of $F^{*}$in 2008 with a 0.25 probability, then the ABC option should be set at 0.264 million mt or less. If the management target is prevent further decline in spawning stock biomass with a 0.5 probability then the ABC should be set at 0.122 million mt or less.

| Risk level | $F_{08} \leq F^{*}$ | $SB_{09} \geq SB_{08}$ | $SB_{09} \geq SB_{MSY}$ | $SB_{09} \geq SB_{40}$ | $SB_{09} \geq SB_{25}$ |
|---|---|---|---|---|---|
| 0.05 | 0.095 | 0.000 | 0.000 | 0.000 | 0.008 |
| 0.10 | 0.163 | 0.000 | 0.000 | 0.000 | 0.225 |
| 0.15 | 0.206 | 0.000 | 0.000 | 0.000 | 0.360 |
| 0.20 | 0.238 | 0.000 | 0.000 | 0.000 | 0.462 |
| 0.25 | 0.264 | 0.000 | 0.008 | 0.000 | 0.546 |
| 0.30 | 0.287 | 0.000 | 0.112 | 0.000 | 0.619 |
| 0.35 | 0.308 | 0.011 | 0.207 | 0.008 | 0.685 |
| 0.40 | 0.327 | 0.049 | 0.295 | 0.104 | 0.748 |
| 0.45 | 0.346 | 0.086 | 0.380 | 0.195 | 0.807 |
| 0.50 | 0.364 | 0.122 | 0.464 | 0.285 | 0.866 |
| 0.55 | 0.383 | 0.157 | 0.547 | 0.375 | 0.924 |
| 0.60 | 0.401 | 0.194 | 0.632 | 0.467 | 0.984 |
| 0.65 | 0.421 | 0.232 | 0.721 | 0.562 | 1.046 |
| 0.70 | 0.442 | 0.273 | 0.816 | 0.664 | 1.113 |
| 0.75 | 0.465 | 0.318 | 0.920 | 0.777 | 1.186 |
| 0.80 | 0.491 | 0.370 | 1.039 | 0.906 | 1.270 |
| 0.85 | 0.523 | 0.432 | 1.184 | 1.061 | 1.371 |
| 0.90 | 0.565 | 0.515 | 1.376 | 1.268 | 1.506 |
| 0.95 | 0.633 | 0.649 | 1.686 | 1.603 | 1.724 |

these criterion, the risk averse policy calls for 0 catch and 456,000 mt for the $SB_{40}$ and $SB_{25}$ policies, respectively.

In summary, catch options in excess of 300,000 mt result in a fairly significant probability of overfishing ($P \geq 0.3$), further declines in spawning stock biomass over present levels, and a significant probability of reducing the spawning stock biomass below $SB_{MSY}$ ($P \geq 0.4$). Catch options less than 300,000 mt result in a very low probability of the spawning stock biomass falling below $SB_{25}$ level ($P \leq 0.15$).

# 4 Discussion

Uncertainty in previous assessments of Pacific hake was under-represented due to the use of assumed fixed values for the steepness of the stock recruitment relationship and survey

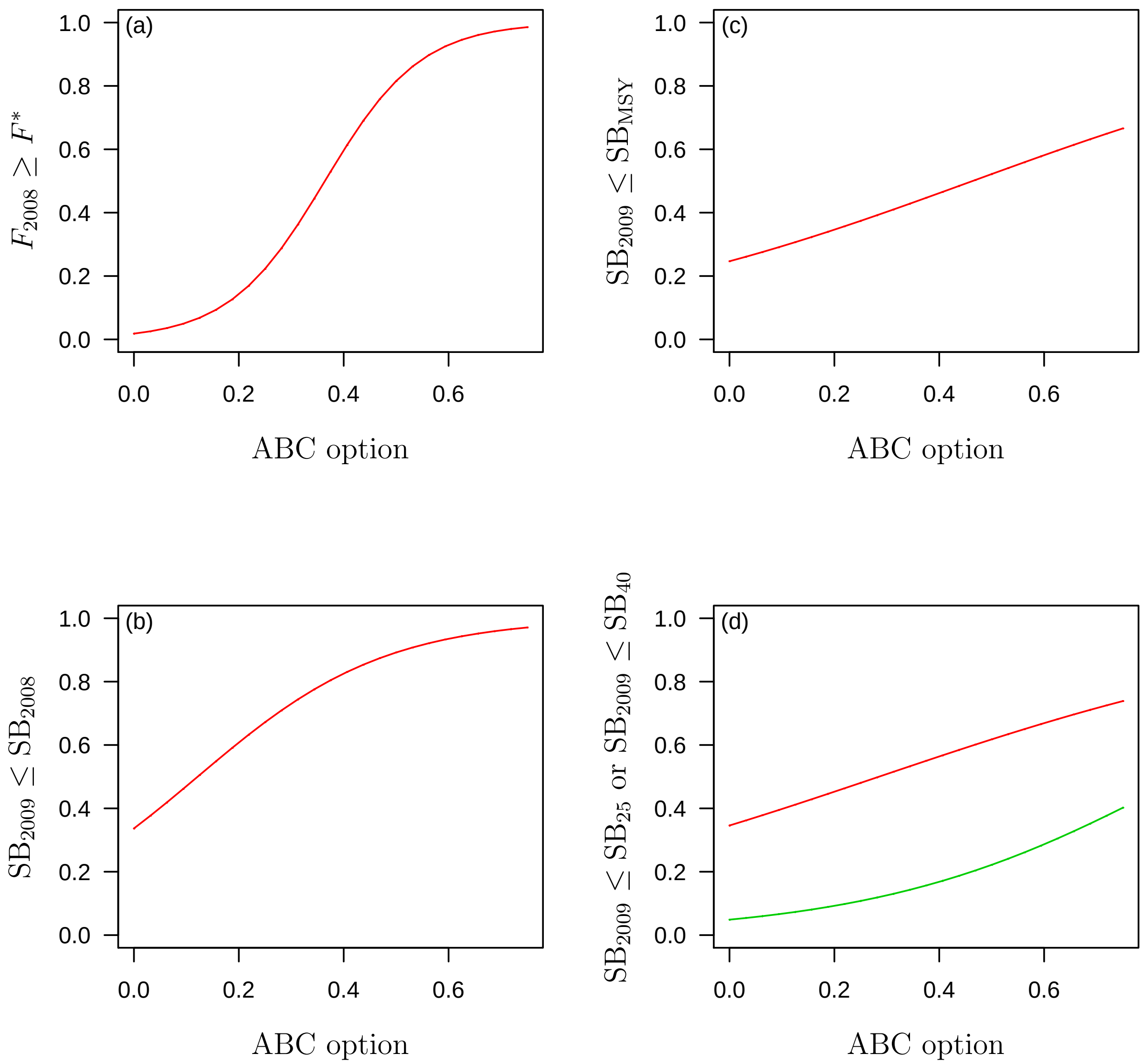



Figure 18: Probability of $F_{2008} > F^*$(panel a) versus ABC option, (b) probability of a decline in spawning biomass ($SB_{2009} < SB_{2008}$) versus ABC option, (c) probability of the $SB_{2009}$ falling below $SB_{msy}$, and (d) probability of $SB_{2009}$ falling below $SB_{25}$ (bottom line) or $SB_{40}$ (top line) .

catchability coefficients. This assessment attempts to integrate over this uncertainty by using less informative prior information for these key parameters. The relative abundance indices alone lack sufficient information to resolve confounding between the global scaling and stock productivity. Addition of the age-composition information further confounds this problem because there appears to be some conflict between expected trends in abundance due to the exceptional 1980 and 1984 cohorts and the downward trend in abundance between the 1986 and 1989 survey points. Previous assessments have omitted the 1986 survey due to pre- and post-survey calibration problems. However, it appears that the 1986 survey point is consistent with trends inferred from the age-composition data, but the 1989 survey point is inconsistent with these trends.

The biggest source of uncertainty in this assessment lies in the relative weighting of the age-composition information. It is clear that there have been changes in selectivities over time for the commercial gears in the two different countries. Evidence for this is not hard to find; for example, interannual variation in northward migration has profound effects of selectivity. Treating the selectivity curves as constant over time (whether or not a logistic or dome-shaped selectivity curve is assumed) will obviously affect estimates of relative cohort strengths, and down weighting these data tends to reduce the amount of recruitment variation as well as affect age-specific estimates of fishing mortality rates. More importantly, the effect on the catch advice varies greatly over a narrow range of effective sample sizes for the age composition (Table 9).

Table 9: Maximum likelihood estimates of Allowable Biological Catch (ABC million mt), $C^*$, $F^*$, steepness ($h$) and instantaneous natural mortality rates $M$ versus assumed effective sample sizes for the age composition data. Note that these results were generated with the model published in Martell et al. (in press).

| Sample N | ABC | $C^*$(million t) | $F^*$ | $h$ | $M$ |
|---|---|---|---|---|---|
| 1 | 0.0526 | 0.146 | 0.329 | 0.374 | 0.305 |
| 5 | 0.0912 | 0.172 | 0.314 | 0.35 | 0.332 |
| 10 | 0.142 | 0.198 | 0.292 | 0.366 | 0.335 |
| 33[1] | 0.305 | 0.243 | 0.271 | 0.436 | 0.295 |
| 40 | 0.326 | 0.246 | 0.269 | 0.437 | 0.293 |
| 50 | 0.648 | 0.424 | 0.364 | 0.663 | 0.291 |

There are at least two approaches for dealing with the weighting of the age-compositions: 1) iterative re-weighting as suggested by McAllister and Ianelli (1997), or 2) retrospective analysis (Vivian Haist, pers comm.). We have examined retrospective bias associated with the assumed effective sample sizes for the age-composition information. In summary, the retrospective biased is greatly reduced when effective sample sizes is less than or equal to 15 for both the commercial and survey age-composition information in this analysis. If additional flexibility was incorporated into the model (e.g., dome shaped–time varying selectivity) we would anticipate that the effective sample sizes would increase markedly.

A final point is that the reference points are highly dependent on the assumed maturity-at-age schedule. This information is outdated and given the marked changes in observed growth the maturity at age information should be updated.

# 5 Acknowledgments

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# A Input data

Table 10: Combined historical landings (mt) for the U.S. and Can. fisheries, mean age of the catch, and survey abundance indices (millions mt) from the acoustic-trawl survey.

| Year | $C_t$ | $\bar{a}$ | $I_t$ | Year | $C_t$ | $\bar{a}$ | $I_t$ |
|---|---|---|---|---|---|---|---|
| 1966 | 137700 | | | 1987 | 234147 | 6.4 | |
| 1967 | 214375 | | | 1988 | 248804 | 6.7 | |
| 1968 | 122180 | | | 1989 | 305916 | 6.8 | 1.238 |
| 1969 | 180131 | | | 1990 | 259792 | 6.8 | |
| 1970 | 234584 | | | 1991 | 307258 | 7.3 | |
| 1971 | 154612 | | | 1992 | 296910 | 7.0 | 2.169 |
| 1972 | 117546 | | | 1993 | 199435 | 6.9 | |
| 1973 | 162639 | | | 1994 | 361529 | 7.8 | |
| 1974 | 211259 | | | 1995 | 249770 | 7.9 | 1.385 |
| 1975 | 221360 | | | 1996 | 306075 | 6.7 | |
| 1976 | 237521 | | | 1997 | 325215 | 6.0 | |
| 1977 | 132693 | 6.3 | 1.915 | 1998 | 320619 | 5.8 | 1.185 |
| 1978 | 103639 | 6.6 | | 1999 | 311855 | 5.4 | |
| 1979 | 137115 | 6.6 | | 2000 | 230820 | 6.2 | |
| 1980 | 89936 | 6.9 | 2.115 | 2001 | 235962 | 5.3 | 0.737 |
| 1981 | 139121 | 6.3 | | 2002 | 182911 | 5.0 | |
| 1982 | 107734 | 6.6 | | 2003 | 205582 | 5.0 | 1.840 |
| 1983 | 113924 | 5.7 | 1.647 | 2004 | 334672 | 5.4 | |
| 1984 | 138441 | 5.8 | | 2005 | 349571 | 6.2 | 1.265 |
| 1985 | 110401 | 5.9 | | 2006 | 367737 | 6.5 | |
| 1986 | 210617 | 6.0 | 2.857 | 2007 | 284358 | 6.7 | 0.879 |

Table 11: Age-composition (reported in percentages) of the combined U.S. and Can. commercial catch from 1977-2007. Age-15 represents a plus group.

| Year | age.2 | age.3 | age.4 | age.5 | age.6 | age.7 | age.8 | age.9 | age.10 | age.11 | age.12 | age.13 | age.14 | age.15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 2.50 | 2.69 | 26.05 | 4.82 | 9.66 | 34.25 | 8.02 | 5.13 | 3.26 | 2.03 | 1.11 | 0.41 | 0.05 | 0.03 |
| 1978 | 0.24 | 4.97 | 5.95 | 30.66 | 5.78 | 13.07 | 26.25 | 5.94 | 3.69 | 2.10 | 0.73 | 0.42 | 0.18 | 0.03 |
| 1979 | 3.33 | 7.13 | 12.15 | 6.13 | 26.31 | 7.71 | 16.73 | 13.04 | 3.55 | 2.13 | 0.85 | 0.49 | 0.28 | 0.19 |
| 1980 | 0.55 | 22.96 | 4.64 | 7.48 | 7.58 | 18.46 | 7.57 | 10.17 | 13.21 | 3.22 | 1.83 | 1.41 | 0.50 | 0.40 |
| 1981 | 8.90 | 2.38 | 39.16 | 2.11 | 5.45 | 5.36 | 15.13 | 5.11 | 5.44 | 8.17 | 1.55 | 0.60 | 0.57 | 0.09 |
| 1982 | 14.03 | 2.14 | 1.67 | 37.90 | 3.92 | 4.96 | 4.78 | 13.05 | 2.75 | 2.99 | 10.08 | 0.87 | 0.54 | 0.32 |
| 1983 | 0.03 | 37.00 | 3.97 | 2.46 | 33.15 | 3.26 | 3.06 | 3.48 | 7.15 | 1.66 | 1.17 | 3.06 | 0.40 | 0.16 |
| 1984 | 0.00 | 0.93 | 54.74 | 3.71 | 7.42 | 19.67 | 2.63 | 2.00 | 1.62 | 3.67 | 0.74 | 0.85 | 1.73 | 0.29 |
| 1985 | 4.66 | 0.54 | 6.89 | 54.27 | 7.32 | 6.13 | 14.19 | 1.46 | 0.85 | 1.33 | 1.26 | 0.23 | 0.00 | 0.87 |
| 1986 | 15.27 | 4.19 | 0.87 | 3.44 | 51.77 | 6.22 | 4.18 | 9.22 | 1.31 | 1.08 | 0.67 | 1.09 | 0.18 | 0.53 |
| 1987 | 0.00 | 27.64 | 1.64 | 0.39 | 1.68 | 51.92 | 3.36 | 1.56 | 9.10 | 0.40 | 0.19 | 0.43 | 1.21 | 0.48 |
| 1988 | 0.69 | 0.59 | 38.51 | 1.39 | 0.80 | 1.11 | 45.35 | 1.99 | 0.72 | 7.20 | 0.13 | 0.16 | 0.06 | 1.30 |
| 1989 | 3.54 | 3.53 | 1.52 | 45.65 | 1.06 | 0.44 | 0.60 | 37.41 | 1.49 | 0.59 | 3.60 | 0.09 | 0.07 | 0.42 |
| 1990 | 1.55 | 20.50 | 2.59 | 0.44 | 39.05 | 0.65 | 0.25 | 0.20 | 31.10 | 0.36 | 0.00 | 3.06 | 0.01 | 0.24 |
| 1991 | 0.62 | 10.75 | 18.24 | 3.25 | 0.96 | 37.33 | 1.40 | 0.13 | 0.15 | 21.55 | 0.51 | 0.00 | 3.89 | 1.22 |
| 1992 | 4.21 | 4.10 | 13.53 | 21.97 | 2.51 | 1.18 | 34.73 | 0.74 | 0.13 | 0.21 | 15.40 | 0.20 | 0.04 | 1.05 |
| 1993 | 0.43 | 22.43 | 3.25 | 14.46 | 17.50 | 1.50 | 0.79 | 28.17 | 0.72 | 0.05 | 0.05 | 9.93 | 0.06 | 0.67 |
| 1994 | 0.04 | 3.30 | 20.15 | 1.23 | 13.10 | 20.07 | 1.21 | 0.43 | 30.01 | 0.20 | 0.43 | 0.03 | 9.06 | 0.73 |
| 1995 | 4.26 | 0.20 | 6.86 | 25.72 | 1.25 | 7.88 | 19.30 | 1.79 | 0.31 | 23.66 | 0.37 | 0.26 | 0.02 | 8.11 |
| 1996 | 17.60 | 14.76 | 1.09 | 8.82 | 18.33 | 1.03 | 5.65 | 11.15 | 0.66 | 0.34 | 16.63 | 0.01 | 0.11 | 3.81 |
| 1997 | 0.44 | 32.38 | 23.09 | 1.13 | 6.71 | 13.17 | 1.86 | 3.73 | 6.94 | 1.14 | 0.14 | 6.49 | 0.66 | 2.12 |
| 1998 | 5.46 | 19.11 | 16.70 | 25.22 | 2.71 | 5.39 | 10.92 | 1.17 | 1.79 | 5.15 | 0.58 | 0.13 | 4.82 | 0.87 |
| 1999 | 8.76 | 20.68 | 17.76 | 19.25 | 11.80 | 2.53 | 4.45 | 4.81 | 0.94 | 1.66 | 2.97 | 0.66 | 0.85 | 2.90 |
| 2000 | 3.99 | 11.01 | 15.66 | 14.45 | 19.49 | 11.00 | 7.38 | 5.39 | 1.89 | 1.87 | 2.16 | 1.31 | 1.07 | 3.34 |
| 2001 | 13.94 | 19.67 | 14.09 | 17.52 | 8.97 | 12.05 | 5.85 | 1.59 | 1.71 | 1.69 | 1.03 | 0.90 | 0.00 | 1.01 |
| 2002 | 0.05 | 46.94 | 17.03 | 10.23 | 6.78 | 4.90 | 6.29 | 3.80 | 0.89 | 0.66 | 0.98 | 0.11 | 0.40 | 0.95 |
| 2003 | 0.14 | 1.55 | 68.57 | 11.69 | 3.13 | 5.11 | 3.00 | 3.11 | 1.78 | 0.83 | 0.24 | 0.48 | 0.08 | 0.28 |
| 2004 | 0.00 | 6.34 | 6.67 | 66.37 | 8.25 | 2.32 | 4.17 | 2.60 | 1.39 | 1.02 | 0.32 | 0.24 | 0.15 | 0.15 |
| 2005 | 1.26 | 0.46 | 7.17 | 5.43 | 67.11 | 8.75 | 2.46 | 2.98 | 2.23 | 0.94 | 0.78 | 0.22 | 0.03 | 0.18 |
| 2006 | 2.90 | 11.42 | 1.62 | 8.73 | 4.78 | 59.40 | 4.81 | 1.67 | 1.80 | 1.20 | 0.84 | 0.46 | 0.15 | 0.22 |
| 2007 | 10.95 | 2.98 | 14.19 | 1.56 | 7.44 | 4.53 | 46.22 | 5.97 | 1.96 | 1.89 | 1.31 | 0.42 | 0.42 | 0.15 |

Table 12: Age-composition (percent) from acoustic surveys from 1977-2007. Note that these data are the conditional age-length data multiplied by the length frequencies and collapsed over the size intervals and represent a summary of the conditional age-length data (age 15 represents a plus group).

| Year | age.2 | age.3 | age.4 | age.5 | age.6 | age.7 | age.8 | age.9 | age.10 | age.11 | age.12 | age.13 | age.14 | age.15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | 5.31 | 4.41 | 23.03 | 2.71 | 4.68 | 39.08 | 7.21 | 5.10 | 3.84 | 2.45 | 1.35 | 0.55 | 0.17 | 0.11 |
| 1980 | 0.16 | 27.80 | 2.84 | 5.60 | 4.84 | 23.14 | 6.23 | 16.63 | 6.84 | 3.84 | 0.92 | 0.78 | 0.18 | 0.20 |
| 1983 | 0.36 | 64.90 | 1.50 | 1.25 | 20.05 | 1.75 | 2.17 | 1.92 | 3.25 | 1.15 | 0.87 | 0.70 | 0.14 | 0.00 |
| 1986 | 40.10 | 1.29 | 0.54 | 2.28 | 41.70 | 4.55 | 2.85 | 5.02 | 0.52 | 0.49 | 0.13 | 0.43 | 0.06 | 0.02 |
| 1989 | 7.25 | 2.35 | 0.79 | 56.08 | 1.15 | 0.67 | 0.94 | 27.39 | 1.18 | 0.16 | 1.87 | 0.00 | 0.00 | 0.17 |
| 1992 | 10.21 | 1.73 | 9.12 | 19.69 | 2.37 | 0.86 | 38.46 | 1.29 | 0.67 | 0.34 | 13.89 | 0.67 | 0.00 | 0.71 |
| 1995 | 33.02 | 4.07 | 1.25 | 20.71 | 1.08 | 3.73 | 14.85 | 0.31 | 0.00 | 15.78 | 0.04 | 0.72 | 0.00 | 4.46 |
| 1998 | 13.50 | 19.82 | 15.12 | 18.89 | 1.54 | 4.37 | 10.21 | 1.64 | 0.94 | 6.31 | 0.14 | 0.55 | 5.08 | 1.89 |
| 2001 | 69.78 | 10.41 | 5.79 | 5.42 | 2.57 | 2.49 | 1.52 | 0.50 | 0.52 | 0.34 | 0.21 | 0.20 | 0.05 | 0.21 |
| 2003 | 3.01 | 2.53 | 64.05 | 10.95 | 2.75 | 6.01 | 3.96 | 2.20 | 2.23 | 0.73 | 0.43 | 0.44 | 0.31 | 0.42 |
| 2005 | 21.57 | 2.27 | 7.24 | 5.30 | 50.03 | 5.49 | 1.86 | 2.61 | 1.48 | 1.17 | 0.49 | 0.27 | 0.04 | 0.19 |
| 2007 | 35.45 | 2.39 | 10.19 | 1.18 | 4.57 | 3.01 | 33.88 | 3.62 | 1.74 | 1.71 | 0.92 | 0.80 | 0.37 | 0.17 |

Table 13: Assumed mean weights-at-age in the commercial catch. Note that the mean weight at age for 2007 was based on the mean weights from the previous 5 years.

| Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1966 | 0.258 | 0.428 | 0.527 | 0.606 | 0.681 | 0.762 | 0.837 | 0.935 | 0.988 | 1.079 | 1.155 | 1.213 | 1.269 | 1.590 |
| 1967 | 0.258 | 0.428 | 0.527 | 0.606 | 0.681 | 0.762 | 0.837 | 0.935 | 0.988 | 1.079 | 1.155 | 1.213 | 1.269 | 1.590 |
| 1968 | 0.259 | 0.428 | 0.527 | 0.606 | 0.681 | 0.762 | 0.837 | 0.935 | 0.988 | 1.079 | 1.155 | 1.213 | 1.269 | 1.590 |
| 1969 | 0.258 | 0.429 | 0.527 | 0.606 | 0.681 | 0.762 | 0.837 | 0.935 | 0.988 | 1.079 | 1.154 | 1.212 | 1.269 | 1.591 |
| 1970 | 0.256 | 0.428 | 0.527 | 0.606 | 0.680 | 0.763 | 0.837 | 0.935 | 0.989 | 1.079 | 1.155 | 1.213 | 1.269 | 1.589 |
| 1971 | 0.261 | 0.428 | 0.527 | 0.606 | 0.682 | 0.762 | 0.838 | 0.936 | 0.988 | 1.079 | 1.156 | 1.213 | 1.269 | 1.591 |
| 1972 | 0.256 | 0.431 | 0.527 | 0.606 | 0.680 | 0.761 | 0.837 | 0.935 | 0.987 | 1.077 | 1.153 | 1.211 | 1.267 | 1.592 |
| 1973 | 0.251 | 0.423 | 0.526 | 0.606 | 0.680 | 0.765 | 0.836 | 0.935 | 0.991 | 1.081 | 1.155 | 1.214 | 1.270 | 1.582 |
| 1974 | 0.277 | 0.431 | 0.528 | 0.606 | 0.685 | 0.760 | 0.841 | 0.937 | 0.987 | 1.079 | 1.159 | 1.215 | 1.271 | 1.600 |
| 1975 | 0.241 | 0.438 | 0.527 | 0.605 | 0.676 | 0.759 | 0.833 | 0.932 | 0.983 | 1.073 | 1.145 | 1.204 | 1.261 | 1.593 |
| 1976 | 0.235 | 0.400 | 0.524 | 0.608 | 0.679 | 0.775 | 0.835 | 0.936 | 1.002 | 1.093 | 1.162 | 1.223 | 1.277 | 1.554 |
| 1977 | 0.354 | 0.455 | 0.533 | 0.605 | 0.700 | 0.748 | 0.853 | 0.944 | 0.974 | 1.070 | 1.168 | 1.218 | 1.275 | 1.653 |
| 1978 | 0.135 | 0.460 | 0.523 | 0.600 | 0.649 | 0.754 | 0.812 | 0.915 | 0.973 | 1.055 | 1.106 | 1.170 | 1.231 | 1.573 |
| 1979 | 0.217 | 0.287 | 0.515 | 0.619 | 0.686 | 0.822 | 0.841 | 0.951 | 1.060 | 1.154 | 1.211 | 1.282 | 1.327 | 1.435 |
| 1980 | 0.279 | 0.407 | 0.487 | 0.624 | 0.684 | 0.796 | 0.850 | 0.877 | 1.010 | 1.066 | 1.184 | 1.163 | 1.233 | 1.196 |
| 1981 | 0.123 | 0.328 | 0.491 | 0.619 | 0.725 | 0.776 | 0.816 | 0.864 | 0.884 | 1.043 | 1.189 | 1.245 | 1.213 | 1.385 |
| 1982 | 0.235 | 0.389 | 0.503 | 0.604 | 0.688 | 0.839 | 0.873 | 0.907 | 0.934 | 1.029 | 1.049 | 1.132 | 1.209 | 1.095 |
| 1983 | 0.264 | 0.355 | 0.428 | 0.563 | 0.631 | 0.742 | 0.827 | 0.855 | 0.883 | 0.969 | 0.994 | 0.941 | 1.155 | 1.095 |
| 1984 | 0.215 | 0.393 | 0.429 | 0.531 | 0.669 | 0.699 | 0.796 | 0.873 | 0.894 | 0.953 | 1.104 | 0.965 | 1.008 | 1.100 |
| 1985 | 0.181 | 0.316 | 0.455 | 0.526 | 0.639 | 0.740 | 0.813 | 0.979 | 0.914 | 1.020 | 1.035 | 1.156 | 1.074 | 1.067 |
| 1986 | 0.273 | 0.314 | 0.426 | 0.537 | 0.562 | 0.633 | 0.724 | 0.821 | 0.921 | 0.992 | 0.989 | 1.102 | 1.048 | 1.086 |
| 1987 | 0.232 | 0.374 | 0.421 | 0.499 | 0.629 | 0.626 | 0.683 | 0.746 | 0.799 | 0.903 | 0.895 | 1.023 | 0.950 | 1.049 |
| 1988 | 0.264 | 0.357 | 0.443 | 0.461 | 0.598 | 0.591 | 0.628 | 0.687 | 0.775 | 0.809 | 0.895 | 0.998 | 0.993 | 1.026 |
| 1989 | 0.226 | 0.317 | 0.367 | 0.502 | 0.531 | 0.617 | 0.656 | 0.670 | 0.717 | 0.789 | 0.896 | 0.860 | 1.052 | 1.030 |
| 1990 | 0.272 | 0.379 | 0.443 | 0.531 | 0.568 | 0.617 | 0.604 | 0.604 | 0.701 | 0.749 | 0.822 | 0.880 | 1.002 | 1.052 |
| 1991 | 0.229 | 0.341 | 0.449 | 0.543 | 0.554 | 0.641 | 0.716 | 0.599 | 0.885 | 0.728 | 0.724 | 0.854 | 0.952 | 1.060 |
| 1992 | 0.248 | 0.338 | 0.458 | 0.525 | 0.582 | 0.598 | 0.638 | 0.638 | 0.612 | 0.679 | 0.698 | 0.851 | 0.716 | 0.931 |
| 1993 | 0.263 | 0.343 | 0.426 | 0.502 | 0.560 | 0.593 | 0.547 | 0.638 | 0.645 | 0.704 | 0.931 | 0.679 | 0.798 | 0.756 |
| 1994 | 0.335 | 0.344 | 0.424 | 0.510 | 0.552 | 0.608 | 0.694 | 0.620 | 0.689 | 0.636 | 0.739 | 0.812 | 0.725 | 0.794 |
| 1995 | 0.114 | 0.515 | 0.484 | 0.511 | 0.625 | 0.623 | 0.679 | 0.706 | 0.713 | 0.724 | 0.661 | 0.892 | 0.711 | 0.771 |
| 1996 | 0.271 | 0.379 | 0.462 | 0.547 | 0.565 | 0.628 | 0.621 | 0.663 | 0.712 | 0.736 | 0.705 | 0.553 | 1.092 | 0.724 |
| 1997 | 0.328 | 0.409 | 0.472 | 0.519 | 0.615 | 0.620 | 0.601 | 0.692 | 0.665 | 0.741 | 0.732 | 0.743 | 0.696 | 0.813 |
| 1998 | 0.234 | 0.350 | 0.458 | 0.497 | 0.518 | 0.587 | 0.598 | 0.619 | 0.637 | 0.651 | 0.775 | 0.638 | 0.735 | 0.734 |
| 1999 | 0.243 | 0.318 | 0.417 | 0.538 | 0.554 | 0.578 | 0.625 | 0.661 | 0.672 | 0.748 | 0.727 | 0.746 | 0.661 | 0.786 |
| 2000 | 0.282 | 0.424 | 0.496 | 0.564 | 0.647 | 0.677 | 0.658 | 0.740 | 0.719 | 0.818 | 0.746 | 0.835 | 0.786 | 0.820 |
| 2001 | 0.289 | 0.454 | 0.599 | 0.608 | 0.681 | 0.778 | 0.780 | 0.806 | 0.854 | 0.832 | 0.831 | 0.901 | 0.863 | 0.962 |
| 2002 | 0.310 | 0.413 | 0.558 | 0.752 | 0.702 | 0.812 | 0.916 | 0.885 | 0.885 | 0.927 | 0.893 | 1.064 | 1.002 | 1.100 |
| 2003 | 0.304 | 0.380 | 0.469 | 0.573 | 0.664 | 0.659 | 0.679 | 0.732 | 0.709 | 0.766 | 0.752 | 0.709 | 0.827 | 0.941 |
| 2004 | 0.241 | 0.419 | 0.489 | 0.550 | 0.625 | 0.709 | 0.691 | 0.713 | 0.757 | 0.765 | 0.742 | 0.880 | 0.928 | 0.836 |
| 2005 | 0.333 | 0.426 | 0.497 | 0.550 | 0.573 | 0.612 | 0.647 | 0.693 | 0.680 | 0.729 | 0.722 | 0.804 | 0.629 | 0.760 |
| 2006 | 0.251 | 0.418 | 0.497 | 0.552 | 0.584 | 0.607 | 0.645 | 0.785 | 0.744 | 0.798 | 0.838 | 0.866 | 0.801 | 0.805 |
| 2007 | 0.288 | 0.411 | 0.502 | 0.596 | 0.629 | 0.680 | 0.716 | 0.762 | 0.755 | 0.797 | 0.789 | 0.865 | 0.838 | 0.888 |

# B Model description and documentation

The stock assessment model used herein consists of 4 major components: 1) a component for initializing the model based on steady-state conditions, 2) a component for updating the state variables, 3) a component that relates the state variables to observations on relative abundance and composition information, and 4) a statistical criterion for evaluating how likely these data are for a given set of model parameters. We have broken the description of the assessment model into these four components and use a series of tables to document model equations. Symbols and their definitions are defined in Table 14; furthermore, we have divided the estimated parameter set into life-history parameters $\Phi$ and population parameters $\Theta$ for clarity.

We have adopted a management oriented approach tho the parameterization of the age-structured model where the leading parameters that define population scale and productivity correspond to MSY (hereafter $C^*$) and Fmsy (hereafter $F^*$). The basic idea here is to change the question to how likely are the data given $C^*$and $F^*$and derive the corresponding $B_o$ and slope of the stock recruitment relationship rather than the traditional approach of estimating these values directly. There are a few statistical advantages of using this approach (i.e., reduced confounding between the leading parameters Schnute and Richards, 1998), but perhaps the biggest advantage is to increase the transparency by which the application of informative priors influence model results (Martell et al., in press).

## B.1 Model initialization

To initialize the model, we must first derive $B_o$ and $\kappa$ from $C^*$and $F^*$as well as other life-history parameters $\Phi$ and the vulnerability schedule. In other words, first we must transform the management parameters $C^*$and $F^*$into population parameters $B_o$ and $\kappa$. This transformation starts with the equilibrium yield equation (e.g. Fig 19a), differentiating this function with respect to $F_e$, setting this equation equal to 0 and solving for $\kappa$ (for the full derivation see Martell et al., in press). Next substitute $\kappa$ back into the equilibrium recruitment equation to obtain estimates of the unfished biomass $B_o$.

An alternative way to envision this transformation is to think about it graphically. For any given model (e.g., a simple production model or a complex age-structure model) we can derive a system of equation that results in the equilibrium yield for any specified equilibrium fishing mortality rate. This same system of equations can also be used to derived equilibrium values of recruitment (e.g., Fig 19b), equilibrium biomass (e.g., Fig 19c) and the spawners per recruit (Fig. 19d). The traditional approach would then differentiate the catch equation with respect to $F_e$, solve this expression for $F_e$ to determine the corresponding value of $F^*$, then substitute the corresponding $F^*$into the catch equation and calculate $C^*$conditional on estimates of $B_o$ and $\kappa$. What differs in the management oriented approach is that we estimate $C^*$and $F^*$directly and then derive $B_o$ and $\kappa$ conditional on the estimates of $C^*$and $F^*$.

The system of equation used to derive $B_o$ and $\kappa$ are laid out in Table 15. The purpose of

Table 14: Description of symbols and indices used in TINSS

| Symbol | Description |
|---|---|
| Indices | |
| $i, j, k, l$ | index for age,year, fleet, and size interval |
| Estimated population parameters ($\Theta$) | |
| $F^*$ | Optimal fishing mortality rate |
| $C^*$ | Maximum sustainable yield |
| $M$ | Instantaneous natural mortality rate |
| $a_{h_k}$ | Age at 50% selectivity |
| $\gamma_k$ | Standard deviation in selectivity |
| Estimated life-history parameters ($\Phi$) | |
| $l_\infty$ | mean asymptotic length |
| $k$ | growth coefficient |
| $t_o$ | age at 0 length |
| $a, b$ | parameters for length-weight relationship |
| $\lambda_1, \lambda_2$ | parameters for standard deviation in length-at-age |
| Derived variables | |
| $B_o$ | unfished steady-state biomass |
| $\kappa$ | recruitment compensation ratio (Goodyear, 1980) |
| $R_e$ | equilibrium age-1 recruitment |
| $\iota_i, \hat{\iota}_i$ | survivorship to age $i$, unfished and fished |
| $\phi_E, \phi_e$ | eggs per recruit, unfished and fished |
| $\phi_B, \phi_b$ | vulnerable biomass per recruit, unfished and fished |
| $\phi_q$ | vulnerable biomass available to the fishery |

laying out the equations in a tabular format is two fold, 1) documentation of the model structure and 2) to provide an algorithm or pseudo code in which to implement the model. First given initial estimates of the life-history parameters $\Phi$ (T15.2), calculate the corresponding age-schedule information (T15.3)–(T15.6). Note that this does not assume that growth or maturity is constant over time, only that some average, or steady state, growth occurred for the cohorts that are used to initialize the numbers-at-age. Next, calculate the survivorship (T15.7) of an individual recruit based on the instantaneous natural mortality rate $M$. These survivorship functions (T15.7) and (T15.8) are used to calculate the per recruit incidence functions for unfished and fished conditions, respectively. An incidence function is the sum of age-specific schedules that express the population units on a per recruit basis. For example the total biomass per recruit is given by (T15.10) and the total unfished biomass is the product $R_o\phi_E$. For notational purposes the prefix $\phi$ denotes an incidence function and the corresponding subscript denotes the type of incidence function (see Table 14 for definitions); we also use upper and lower case subscripts to denote unfished and fished conditions, respectively.

The eggs per recruit for unfished and fished conditions are defined by (T15.9), the biomass

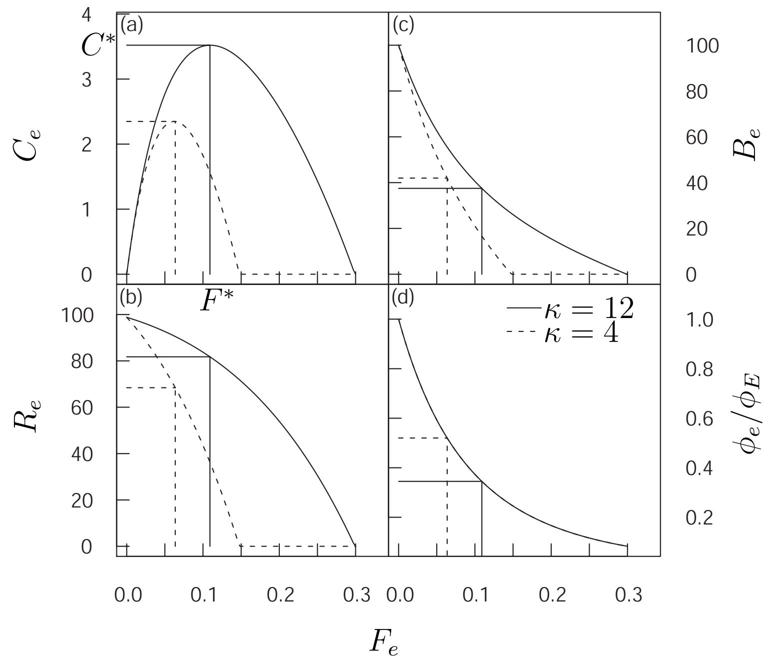


Figure 19: Relationship between equilibrium values for yield (a), recruitment (b), biomass (c) and spawners per recruit (d) versus instantaneous fishing mortality rate for a hypothetical stock with high ($\kappa = 12$) and low ($\kappa = 4$) recruitment compensation parameters.

per recruit by (T15.10), and the vulnerable biomass per recruit available to the fishery is defined by (T15.11). Note that we assume both natural and fishing mortality operate simultaneously and $\phi_q$ represents the Barnov catch equation. To derive $\kappa$, we differentiate

$$C_e = F_e R_e \phi_q \tag{1}$$

with respect to $F_e$ and solve this equation for $\kappa$. Using the chain rule, the derivative of (1) is

$$\frac{\partial C_e}{\partial F_e} = R_e \phi_q + F_e \phi_q \frac{\partial R_e}{\partial F_e} + F_e R_e \frac{\partial \phi_q}{\partial F_e} \tag{2}$$

To derive the recruitment compensation parameter (T15.12) it is necessary to substitute (T15.11) and (T15.13) into (2), set the corresponding expression equal to zero and then solve for $\kappa$. The partial derivatives for (T15.12) are defined in Table 16. Equation (T15.13) is the equilibrium recruits that corresponds to the equilibrium fishing mortality rate $F_e$ and (T15.14) corresponds to the unfished biomass.

### B.1.1 Initialization with multiple fleets

Although the catch data are aggregated into a single fleet for this assessment, the following describes an algorithm for implementing the management oriented approach for multiple fleets that have different age-specific fishing mortality rates. In essence, the algorithm derives F-multipliers for each fleet.

The catch equation (1) considers a single fishery with a unique vulnerability-at-age curve. In the case of multiple fisheries with different vulnerability-at-age curves, it is necessary to allocate the proportion of the total fishing mortality ($F^*$) to each fleet such that the sum of catches from each fleet is equal to $C^*$. For example, consider two separate fishing fleets A and B and assume that fleet A harvest younger fish that fleet B and that the allocation of $C^*$is assigned equally to each fleet. In this case a higher proportion of $F^*$would be assigned to fleet B because this fleet harvest fewer, older fish, in comparison to fleet A which harvest more abundant younger fish. Thus, if some sort of allocation agreement exists between two or more fleets, a multiplier on the fishing mortality rate must be used to allocate the total catch among these fleets. For a given allocation arrangement (e.g., where the fraction of $C^*$assigned to fleet $k$ is denoted as $\Lambda_k$), the equilibrium catch of fleet k can be represented as:

$$\Lambda_k C^* = \tau_k F^* R_e \phi_q^{(k)} \tag{3}$$

where $\tau_k$ is the fleet specific multiplier on $F^*$, $R_e$ is defined in (T15.13), and $\phi_q^{(k)}$ is the fleet specific vulnerable biomass per recruit which is defined as

$$\begin{aligned} \phi_q^{(k)} &= \sum_i \frac{\hat{\iota}_i w_i v_{i,k}}{Z_i} \left(1 - e^{-Z_i}\right), \\ \text{where} \quad Z_i &= M + F^* \sum_k \tau_k v_{i,k}, \\ \hat{\iota}_i &= \begin{cases} 1 & i = 1 \\ \hat{\iota}_{i-1} e^{-Z_{i-1}} & i > 1. \end{cases} \end{aligned} \tag{4}$$

Note that $\tau_k$ appears multiple times in (4) in the $Z_i$ and $\hat{\iota}_i$ terms, as well as the derivation of $R_e$ (see eq. T15.13), and there is no analytical solution for $\tau_k$ (at least that we could find using symbolic math languages). Therefore, $\tau_k$ must be solved for iteratively. Solving (3) for $\tau_k$ results in an update of $\tau_k$:

$$\tau_k = \frac{\Lambda_k C^*}{R_e F^* \phi_q^{(k)}} \tag{5}$$

A simple algorithm to numerically calculate $\tau_k$ proceeds as follows

1. set initial values of the fishing multiplier equal to the allocation proportion: $\tau_k = \Lambda_k$ (Note that if the vulnerability-at-age curves are the same for each fleet, then $\tau_k$ is exactly equal to $\Lambda_k$, i.e., the vulnerable biomass per recruit is the same for all fleets).

2. calculate the age-specific total mortality rates for all fleets combined

$$Z_i = M + F^* \sum_k \tau_k v_{i,k}.$$

3. calculate survivorship ($\hat{\iota}_i$), and per-recruit incidence functions that lead to $R_e$ (eqs. T15.8–T15.13) based on the age-specific total mortality rate in step 2.

4. for each fleet $k$, calculate the vulnerable biomass per-recruit ($\phi_q^{(k)}$) using (4).

5. update $\tau_k$ using (5), and repeat steps 2-5 until estimates of $\tau_k$ converge (Note this take 6-20 iterations depending on how different the vulnerability-at-age curves are for each fleet.

6. Check that the sum catches for each fleet equal $C^*$.

The algorithm outline above is based on the allocation arrangement among the various fleets ($\Lambda_k$) and is not intended to optimize the allocation arrangement based on differences in vulnerability among the various fishing fleets. This is an entirely different policy issue that is not addressed here. If there is no formal allocation arrangement, then historical catch proportions to each fleet could be used as a starting point for values of $\Lambda_k$. Recall, that the approach adopted here is to simple express the population parameters $B_o$ and $\kappa$ as analytical functions of management parameters $C^*$and $F^*$.

## B.2 Updating state variables

Equations used to update the state variables are defined in Table 17. We aggregate the catch data from the CAN and US fisheries into a single catch time series (T17.1) and treat both fisheries as a single fishery with the same selectivity pattern over time. This data simplification reduces the number of estimated parameters but further assumes that the relative mortalities imposed by the two different fisheries has been constant over time. We also aggregate the catch-age samples from the commercial fisheries ($A_{i,j}$) into a single catch age matrix. Catch-age data for the US portion of the fishery are available back to 1976, and age-composition information for the CAN portion of the fishery are available back to 1988. The age-compositions were combined from 1988 to 2006 using a weighted average, where the weights are the proportions landed by each nation. The relative abundance data ($I_j$) corresponds to the abundance index derived from the acoustic surveys, and here we assume these indices are proportional to abundance and estimate the scaling parameter.

Table 15: Steady-state age-structured model assuming unequal vulnerability-at-age, age-specific natural mortality, age-specific fecundity and Beverton-Holt type recruitment.

Parameters

$$\Theta = (C^*, F^*, M, \hat{a}, \hat{\gamma}); \quad C^* > 0; F^* > 0; M > 0 \tag{T15.1}$$

$$\Phi = (l_\infty, k, t_o, a, b, \dot{a}, \dot{\gamma}) \tag{T15.2}$$

Age-schedule information

$$l_i = l_\infty(1 - \exp(-k(a - t_o))) \tag{T15.3}$$

$$w_i = a(l_i)^b \tag{T15.4}$$

$$v_i = (1 + \exp((\hat{a} - a)/\hat{\gamma}))^{-1} \tag{T15.5}$$

$$f_i = w_i(1 + \exp((\dot{a} - a)/\dot{\gamma}))^{-1} \tag{T15.6}$$

Survivorship

$$\iota_i = \begin{cases} 1, & i = 1 \\ \iota_{i-1}e^{-M}, & i > 1 \\ \dfrac{\iota_{i-1}}{1 - e^{-M}}, & i = A \end{cases} \tag{T15.7}$$

$$\hat{\iota}_i = \begin{cases} 1, & i = 1 \\ \hat{\iota}_{i-1}e^{-M-F^*v_{i-1}}, & i > 1 \\ \dfrac{\hat{\iota}_{i-1}}{1 - e^{-M-F^*v_i}}, & i = A \end{cases} \tag{T15.8}$$

Incidence functions

$$\phi_E = \sum_{i=1}^{\infty} \iota_i f_i, \quad \phi_e = \sum_{i=1}^{\infty} \hat{\iota}_i f_i \tag{T15.9}$$

$$\phi_B = \sum_{i=1}^{\infty} \iota_i w_i, \quad \phi_b = \sum_{i=1}^{\infty} \hat{\iota}_i w_i v_i \tag{T15.10}$$

$$\phi_q = \sum_{i=1}^{\infty} \frac{\hat{\iota}_i w_i v_i}{M + F^* v_i} \left(1 - e^{(-M-F^*v_i)}\right) \tag{T15.11}$$

Derived variables

$$\kappa = \frac{\phi_E}{\phi_e} - \frac{F^*\phi_q \dfrac{\phi_E}{\phi_e^2} \dfrac{\partial \phi_e}{\partial F^*}}{\phi_q + F^* \dfrac{\partial \phi_q}{\partial F^*}} \tag{T15.12}$$

$$R_e = \frac{C^*}{F^*\phi_q} \tag{T15.13}$$

$$B_o = \phi_B \frac{R_e(\kappa - 1)}{\kappa - \phi_E/\phi_e} \tag{T15.14}$$

Table 16: Partial derivatives, based on components in Table 15, required for the derivation of $\kappa$ and $B_o$ using the Beverton-Holt recruitment model.

Mortality & Survival

$$Z_i = M + F^* v_i \tag{T16.1}$$

$$S_i = 1 - e^{-Z_i} \tag{T16.2}$$

Partial for survivorship

$$\frac{\partial \hat{\iota}_i}{\partial F^*} = \begin{cases} 0, & i = 1 \\ e^{-Z_{i-1}} \left( \frac{\partial \hat{\iota}_{i-1}}{\partial F^*} - \hat{\iota}_{i-1} v_{i-1} \right), & i > 1 \\ \frac{e^{-Z_{i-1}}}{1 - e^{-Z_i}} \left( \frac{\partial \hat{\iota}_{i-1}}{\partial F^*} - \hat{\iota}_{i-1} v_{i-1} \right) - \hat{\iota}_{i-1} e^{-Z_{i-1}} v_i e^{-Z_i}, & i = A \end{cases} \tag{T16.3}$$

Partials for incidence functions

$$\frac{\partial \phi_e}{\partial F^*} = \sum_{i=1}^{\infty} f_i \frac{\partial \hat{\iota}_i}{\partial F^*} \tag{T16.4}$$

$$\frac{\partial \phi_q}{\partial F^*} = \sum_{i=1}^{\infty} \frac{w_i v_i S_i}{Z_i} \frac{\partial \hat{\iota}_i}{\partial F^*} + \frac{\hat{\iota}_i w_i v_i^2}{Z_i} \left( e^{-Z_i} - \frac{S_i}{Z_i} \right) \tag{T16.5}$$

Partial for recruitment

$$\frac{\partial R_e}{\partial F^*} = \frac{R_o}{\kappa - 1} \frac{\phi_E}{\phi_e^2} \frac{\partial \phi_e}{\partial F^*} \tag{T16.6}$$

Table 17: Statistical catch-age model using the Baranov catch equation and $C^*$ and $F^*$ as leading parameters.

Data

$$C_j = C_j^{\text{US}} + C_j^{\text{CA}} \tag{T17.1}$$

$$I_j, A_{i,j}, Q_{i,j,l} \tag{T17.2}$$

Parameters

$$\Theta = (C^*, F^*, M, \hat{a}, \hat{\gamma}, \bar{a}, \bar{\gamma}, \{\omega_t\}_{t=1}^{T-1}, \rho, \vartheta^2) \tag{T17.3}$$

$$\sigma^2 = \rho\vartheta^2, \quad \tau^2 = (1-\rho)\vartheta^2, \quad \sum_t \omega_t = 0 \tag{T17.4}$$

Unobserved states

$$N_{i,j}, B_j, E_j, F_j \tag{T17.5}$$

Initial states (t=1)

$$N_{i,j} = B_o/\phi_B \iota_i \tag{T17.6}$$

State dynamics (t>1)

$$E_j = \sum_i N_{i,j} f_i \tag{T17.7}$$

$$Z_{i,j} = M + F_j v_i \tag{T17.8}$$

$$\hat{C}_t = \sum_i \frac{N_{i,j} w_i F_j v_i \left(1 - e^{-Z_{i,j}}\right)}{Z_{i,j}} \tag{T17.9}$$

$$F_{j_{i+1}} = \ F_{j_i} - \frac{\hat{C}_j - C_j}{\hat{C}'_j} \tag{T17.10}$$

$$N_{i,j} = \begin{cases} \dfrac{s_o E_{t-1}}{1 + \beta E_{t-1}} \exp(\omega_t - 0.5\tau^2) & a = 1 \\ \\ N_{t-1,a-1} \exp(-Z_{t-1,a-1}) & a > 1 \end{cases} \tag{T17.11}$$

$$B_t = \sum_a N_{t,a} w_a v_a \tag{T17.12}$$

Residuals & predicted observations

$$\epsilon_t = \ln\left(\frac{I_t}{B_t}\right) - \frac{1}{n} \sum_{t \in I_t} \ln\left(\frac{I_t}{B_t}\right) \tag{T17.13}$$

$$\hat{A}_{t,a} = \frac{N_{t,a} \dfrac{F_t v_a}{Z_{t,a}} \left(1 - e^{-Z_{t,a}}\right)}{\sum_a N_{t,a} \dfrac{F_t v_a}{Z_{t,a}} \left(1 - e^{-Z_{t,a}}\right)} \tag{T17.14}$$

Table 18: Likelihoods and priors used in the statistical estimation of $\Theta$ from Table 17.

Negative log-likelihoods

$$\ell(\Theta)_1 = \sum_{t=1}^{T-1} \left[ \ln(\tau) + \frac{\omega_t^2 - 0.5\tau^2}{2\tau^2} \right] \tag{T18.1}$$

$$\ell(\Theta)_2 = \sum_{t \in I_t} \left[ \ln(\sigma) + \frac{\epsilon_t^2}{2\sigma^2} \right] \tag{T18.2}$$

$$\ell(\Theta)_3 = \sum_{t \in A_{t,a}} \sum_{a=2}^{A} \left\{ \ln(\varsigma) + \ln \left[ \exp \left( \frac{-(P_{t,a})^2}{2\varsigma^2} \right) + 0.01 \right] \right\}, \tag{T18.3}$$

$$\text{where} \quad \varsigma = (\hat{A}_{t,a}(1 - \hat{A}_{t,a}) + 0.1/A)n,$$

$$P_{t,a} = (A_{t,a} - \hat{A}_{t,a})$$

$$\ell(\Theta) = \sum_{i=1}^{3} \ell_i \tag{T18.4}$$

Constraints

$$\kappa > 1.0 \tag{T18.5}$$

Posterior distribution

$$P(\Theta) \propto \exp[-\ell(\Theta)] p(C^*) p(F^*) p(M) p(\rho) p(\vartheta^2) \tag{T18.6}$$

# C STAR panel requests

**Request:** Fmsy prior sensitivity. Shift the prior plus/minus 20%. Rationale: How sensitive is the management advice (e.g., Table 2 and 5) to the the prior.

The STAR panel requested a sensitivity analysis about the effect of the assumed prior distribution for $F^*$on the catch advice. To conduct this sensitivity analysis, I performed 3 additional assessments using the alternative prior distributions shown in Fig. 20. Three alternative distributions were explored: two where the same expected variance was assumed but the mean was plus or minus 20% of the assumed value, and a third distribution with the same expected mean but a larger assumed variance.

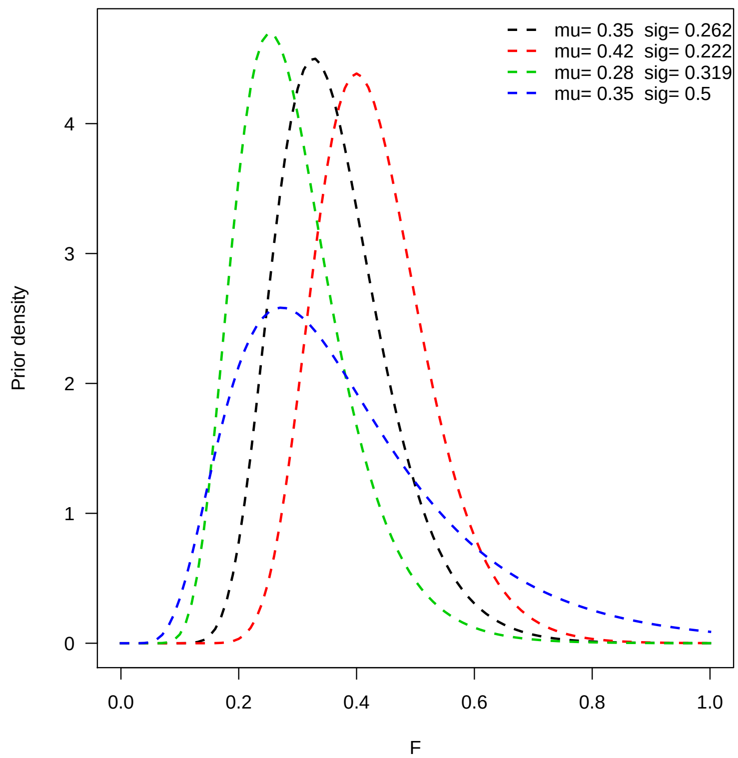


Figure 20: Alternative prior distributions for $F^*$. Note that the black distribution corresponds to the assumed distribution that was used to generate the catch advice.

Due to time constraints, the number of samples from the joint posterior distribution was reduced to 200,000 draws from which 5,000 systematic samples were taken. Overall, there was only minor differences in marginal posterior densities based on this reduced sample size and each run satisfied running median convergence diagnostics (Geweke statistic in the Coda package, R Development Core Team (2006)).

There is insufficient information in the data to resolve $F^*$, and the corresponding marginal posterior distribution for this parameter resembles the assumed prior density (Fig. 21)

The marginal posterior distribution for the catch advice based on the 40/10 control rule is sensitive to the assumed prior for $F^*$; increases in the prior mean for $F^*$result in increases in the median of the marginal posterior distribution for ABC. Estimates of $C^*$are somewhat insensitive to the assumed prior values; increases in the prior mean for $F^*$has very little effect on the marginal posterior mean for $C^*$.

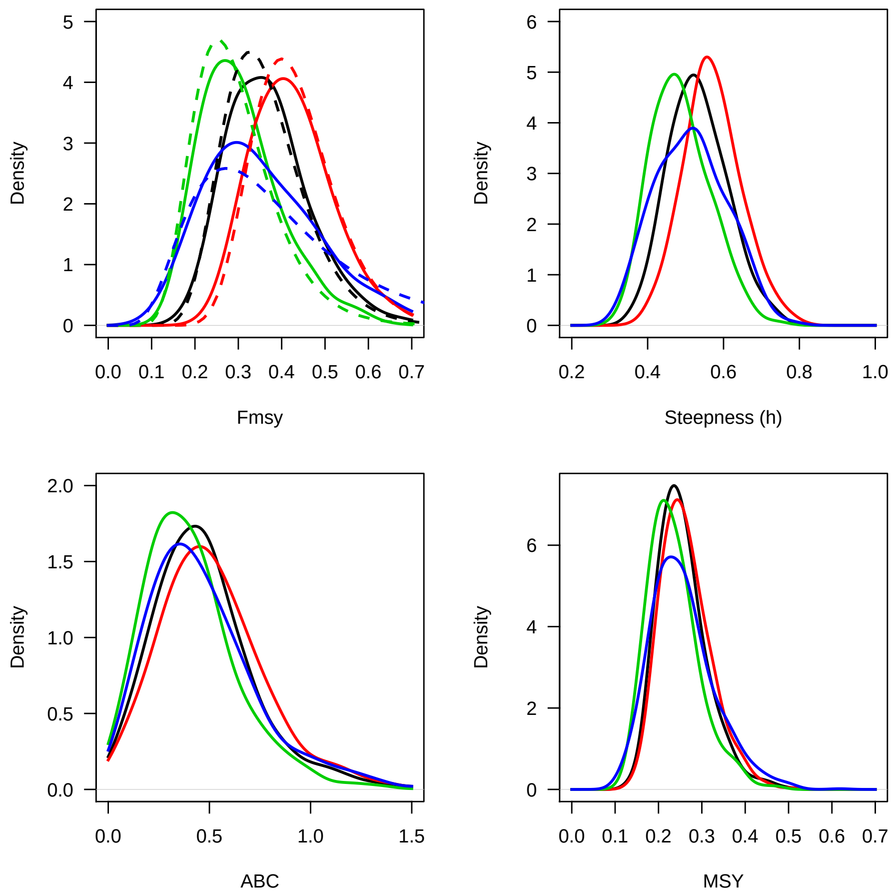


Figure 21: Sensitivity of the marginal posterior distributions for $F^*$, steepness, catch advice, and $C^*$to alternative priors on $F^*$. Note that the priors are shown for $F^*$only (dashed lines in the top left panel).

Estimates of spawning stock depletion are insensitive to alternative prior distributions for $F^*$(Fig. 22). Similarly, the lower bound estimates of the unfished spawning stock biomass is insenstive to the alternative priors for $F^*$. Also, there is little to no sensitivity of $M$ to the alternative priors for $F^*$(Fig. 22). The median estimates of the SPR values associated with $F^*$are sensitive to the assumed prior distributions for $F^*$, where the mode of marginal distributions for $\text{SPR}_{\text{F}_{\text{MSY}}}$ decreases as the mode of the prior distribution for $F^*$increases.

It is not surprising to see that the scaling parameters are insensitive to the rate parameter (i.e., $F^*$and $M$) as the parameterization of this model is designed to reduce the confounding between scale parameters (e.g., unfished biomass) and rate parameters (e.g., steepness).

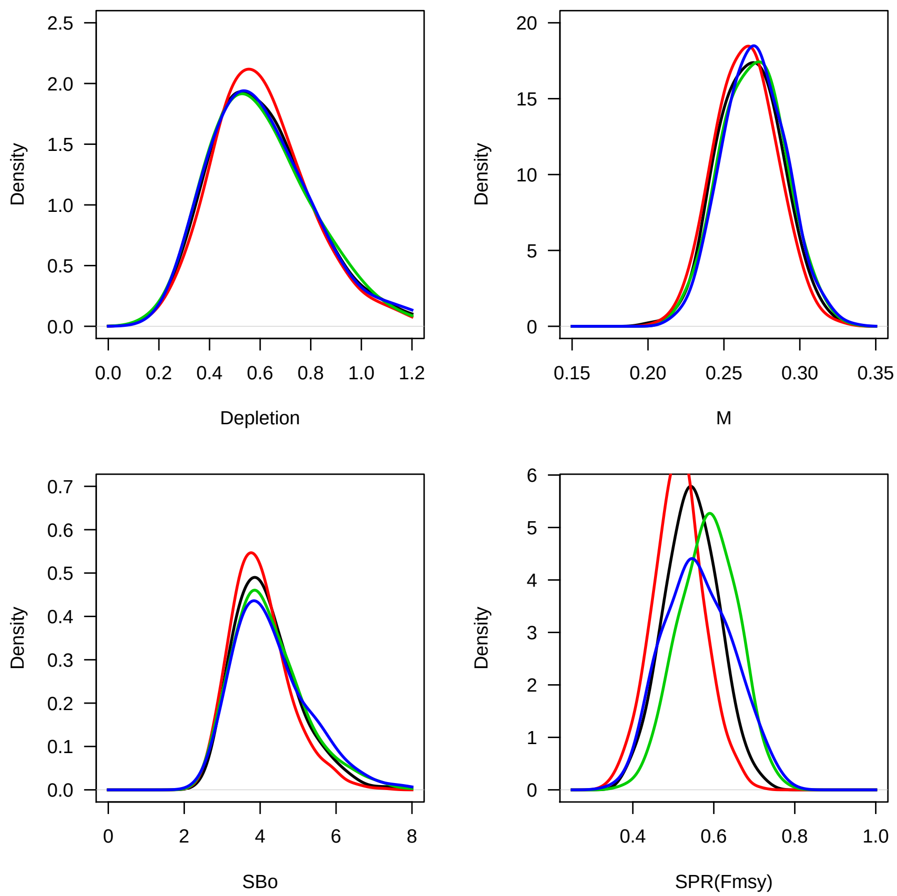


Figure 22: Sensitivity of the depletion estimates, unfished spawning stock biomass (SBo), instantaneous natural mortality rate (M) and the SPR vale at Fmsy to alternative prior assumptions about $F^*$.

Overall, the catch advice is relatively insensitive to alternative prior distributions for $F^*$(Fig. 23) for a given risk level. At most catches vary by 20,000 mt for any given risk level. Note also that the risk of overfishing calculation results in more conservative harvest policies in comparison to the cumulative distribution of catches produced by the 40/10 harvest rule (Fig. 24).

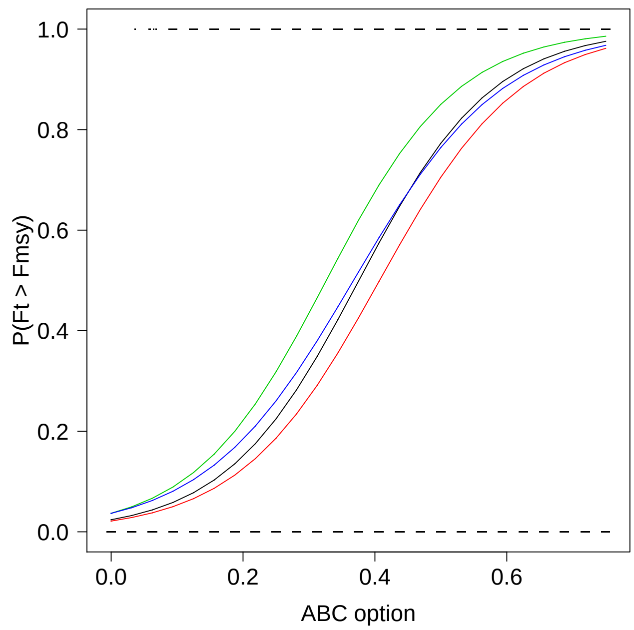


Figure 23: Probability of $F_{2008} \geq F^*$versus ABC option for the 2008 fishery for 4 alternative prior distributions for $F^*$.

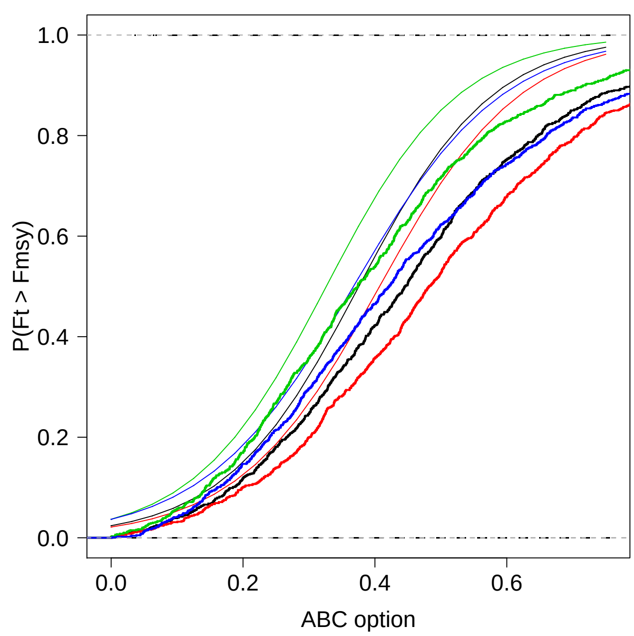


Figure 24: Probability of $F_{2008} \geq F^*$versus ABC option for the 2008 fishery for 4 alternative prior distributions for $F^*$, and the cumulative density functions of the catch advice produced by the 40/10 harvest control rule (thick lines).

# D Retrospective plots

The following retrospective plots were presented at the STAR panel meeting. Note that scale of the age-1 recruits (Fig. 27 is substantially less in comparison to Fig. 15 due to a correction in the likelihood for the recruitment deviations pointed out by Ian Stewart and the STAR panel (the first draft omitted the bias correction term in negative log likelihood for the recruitment deviations). Estimates of age-1 recruits are now higher due to the higher estimates of the instantaneous natural mortality rate $M$.

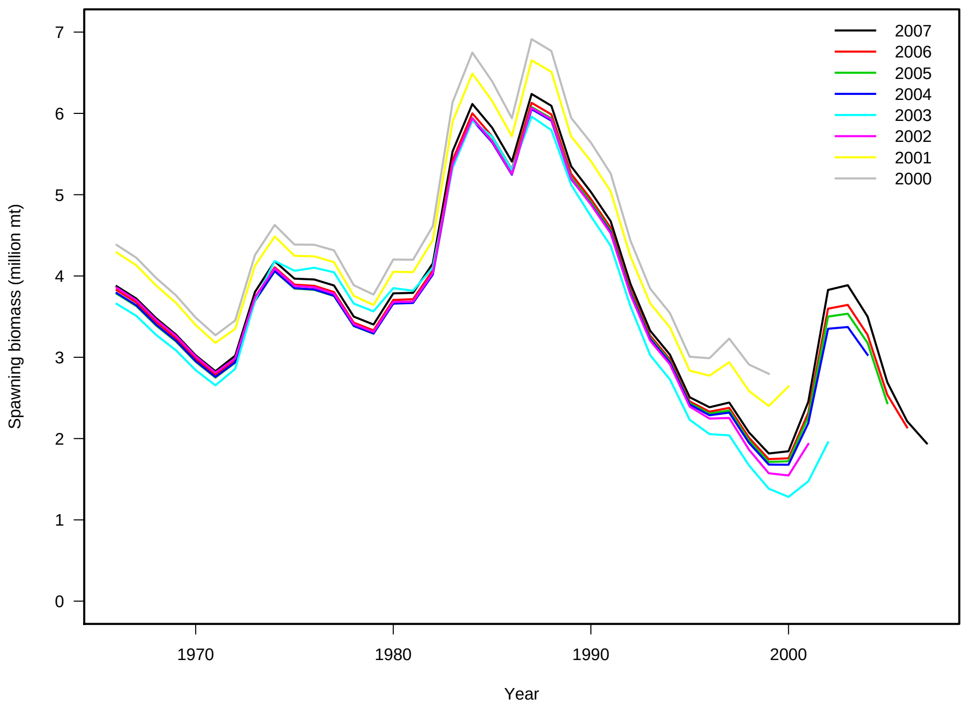


Figure 25: Retrospective pattern in the spawning stock biomass.

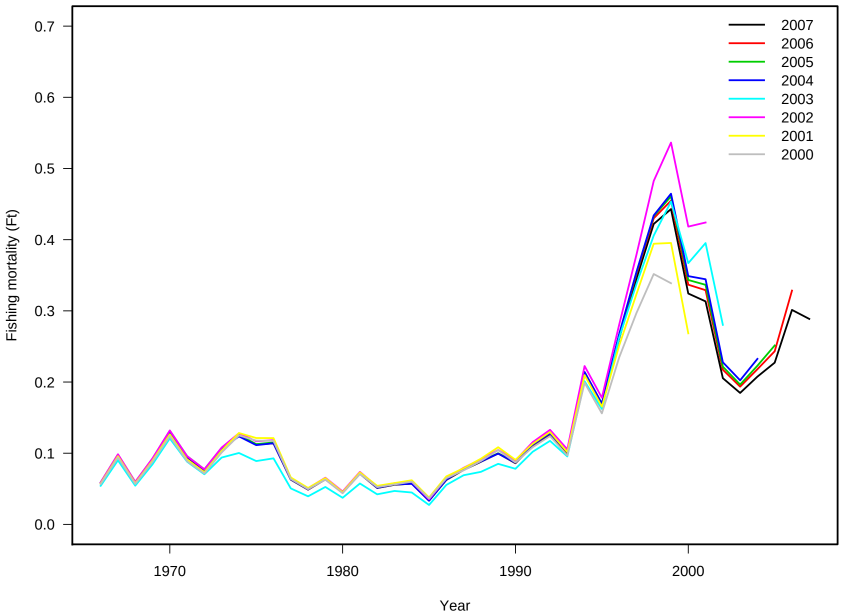


Figure 26: Retrospective pattern in the fishing mortality rates.

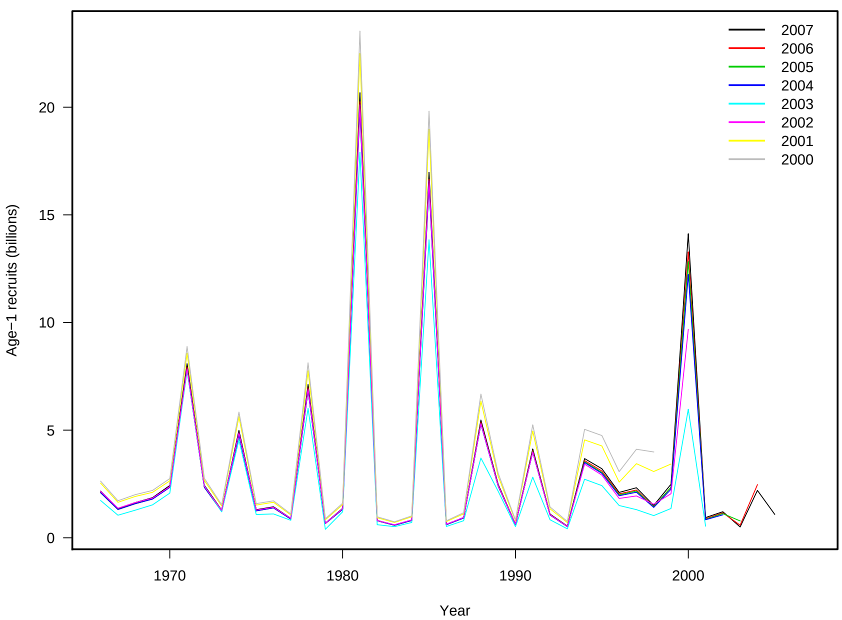


Figure 27: Retrospective pattern in age-1 recruits.

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# Stock Assessment of Pacific Hake (Whiting) in U.S. and Canadian Waters in 2008

T.E. Helser, I.J. Stewart, and O.S. Hamel

*Northwest Fisheries Science Center*
*National Marine Fisheries Service*
*National Oceanic and Atmospheric Administration*
*2725 Montlake Blvd., East*
*Seattle, WA 98112, USA*

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## Executive Summary

### *Stock*

This assessment reports the status of the coastal Pacific hake (*Merluccius productus*) resource off the west coast of the United States and Canada. The coastal stock of Pacific hake is currently the most abundant groundfish population in the California Current system. Smaller populations of hake occur in the major inlets of the north Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California. However, the coastal stock is distinguished from the inshore populations by larger body size, seasonal migratory behavior, and a pattern of low median recruitment punctuated by extremely large year classes. The population is modeled as a single stock, but the United States and Canadian fishing fleets are treated separately in order to capture some of the spatial variability in Pacific hake distribution.

### *Catches*

Coastwide fishery landings from 1966 to 2007 have averaged 219 thousand mt, with a low of 90 thousand mt in 1980 and a peak harvest of 364 thousand mt in 2006. Recent landings have been above the long term average, at approximately 364 and 276 thousand mt in 2006 and 2007, respectively. Catches in both of these years were predominately comprised by fish from the large 1999 year class. The United States has averaged 163 thousand mt, or 74.6% of the total landings over the time series, with Canadian catch averaging 56 thousand mt. The 2006 and 2007 landings had similar distributions, with 74% and 72%, respectively, harvested by the United States fishery. The current model assumes no discarding mortality of Pacific hake.

Table a. Recent commercial fishery landings (1000s mt).

| Year | US at-sea | US shore based | US Tribal | US total | Canadian foreign and JV | Canadian shore based | Canadian total | Total |
|---|---|---|---|---|---|---|---|---|
| 1997 | 121 | 87 | 25 | 233 | 43 | 49 | 92 | 325 |
| 1998 | 120 | 88 | 25 | 233 | 40 | 48 | 88 | 321 |
| 1999 | 115 | 83 | 26 | 225 | 17 | 70 | 87 | 312 |
| 2000 | 116 | 86 | 7 | 208 | 16 | 6 | 22 | 231 |
| 2001 | 102 | 73 | 7 | 182 | 22 | 32 | 54 | 236 |
| 2002 | 63 | 46 | 23 | 132 | 0 | 51 | 51 | 183 |
| 2003 | 67 | 51 | 25 | 143 | 0 | 62 | 62 | 206 |
| 2004 | 90 | 89 | 31 | 210 | 59 | 65 | 124 | 335 |
| 2005 | 150 | 74 | 35 | 260 | 15 | 85 | 100 | 360 |
| 2006 | 138 | 97 | 35 | 266 | 14 | 80 | 94 | 360 |
| 2007 | 107 | 67 | 30 | 204 | 7 | 65 | 72 | 276 |

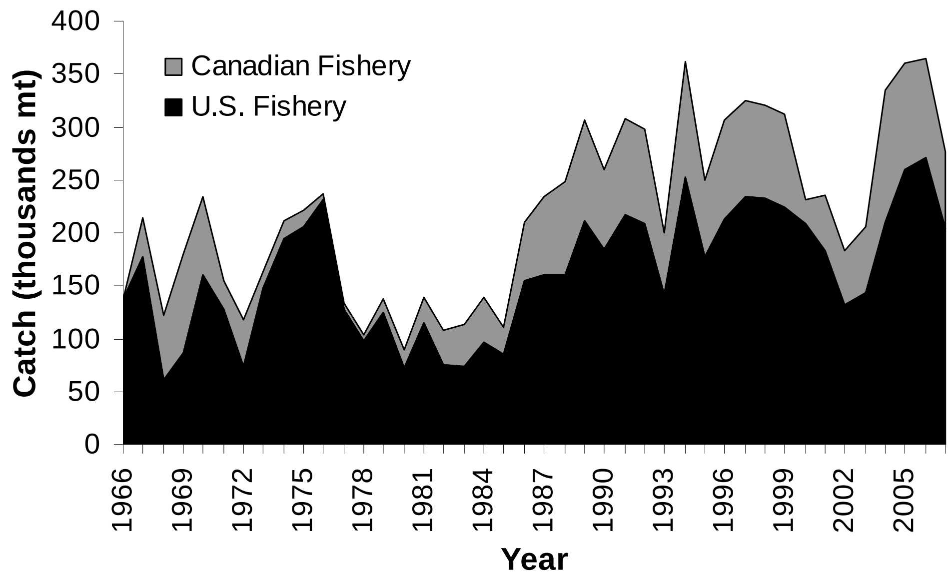


Figure a. Pacific whiting landings (1000s mt) by nation, 1966-2007.

*Data and assessment*

Age-structured assessment models of various forms have been used to assess Pacific hake since the early 1980's, using total fishery catches, fishery age compositions and abundance indices. In 1989, the hake population was modeled using a statistical catch-at-age model (Stock Synthesis) that utilized fishery catch-at-age data and survey estimates of population biomass and age-composition data (Dorn and Methot, 1991). The model was then converted to AD Model Builder (ADMB) in 1999 by Dorn (1999), using the same basic population dynamics equations. This allowed the assessment to take advantage of ADMB's post-convergence routines to calculate standard errors (or likelihood profiles) for any quantity of interest. Beginning in 2001, Helser et al. (2001, 2003, 2004) used the same ADMB modeling platform to assess the hake stock and examine important assessment modifications and assumptions, including the time varying nature of the acoustic survey selectivity and catchability. The acoustic survey catchability coefficient (*q*) has been, and continues to be, one of the major sources of uncertainty in the model. Due to the lengthened acoustic survey biomass trends the assessment model in 2003 was able to freely estimate the acoustic survey *q*. These estimates were substantially below the assumed value of *q*=1.0 from earlier assessments. The 2003 and 2004 assessment presented uncertainty in the final model result as a range of biomass. The lower end of the biomass range was based upon the conventional assumption that the acoustic survey *q* was equal to 1.0, while the higher end of the range represented a *q*=0.6 assumption. In 2005, the coastal hake stock was modeled using the Stock Synthesis modeling framework (SS2 Version 1.21, December, 2006) written by Dr. Richard Methot (Northwest Fisheries Science Center) in AD Model Builder. Conversion of the previous hake model into SS2 was guided by three principles: 1) incorporate less derived data, 2) explicitly model the underlying hake growth dynamics, and 3) achieve parsimony[1] in terms of model complexity. "Incorporating less derived data" entailed fitting

[1] Parsimony is defined as a balance between the number of parameters needed to represent a complex state of nature and data quality/quantity to support accurate and precise estimation of those parameters.

observed data in their most elemental form. For instance, no pre-processing to convert length data to age compositional data was performed. Also, incorporating conditional age-at-length data, through age-length keys for each fishery and survey, allowed explicit estimation of expected growth, dispersion about that expectation, and its temporal variability, all conditioned on selectivity. From 2003 to 2006, assessments have presented two models (which have been assumed to be equally likely) in an attempt to bracket the range of uncertainty in the acoustic survey catchability coefficient, *q*. In this year's assessment, also conducted in SS2, an effort has been made to include the uncertainty in *q*, as well as additional uncertainty regarding the acoustic survey selectivity and the natural mortality rate of older fish within a single model. As a result, a broader range of uncertainty is presented via probability distributions and risk profiles using Markov Chain Monte Carlo simulation. Further refinements include, for the first time, incorporation of an age-reading error matrix.

*Stock biomass*

The base model estimates that the Pacific hake spawning biomass declined rapidly after 1984 (6.45 million mt) to the lowest point in the time series in 2000 (0.88 million mt). This long period of decline was followed by a brief increase to 1.89 million mt in 2003 as the 1999 year class matured. In 2008 (beginning of year), spawning biomass is estimated to be 1.10 million mt and approximately 37.9% of the unfished spawning biomass ($SB_{zero}$). Estimates of uncertainty in relative depletion range from 21.9%-53.9% of unfished biomass, based on asymptotic confidence intervals. It should be pointed out that the 2007 estimates of spawning biomass are lower and depletion level higher compared to last year's assessment result for 2007. The reason is that survey *q* was freely estimated and the assessment incorporated an age-reading error matrix that lowered estimates of $SB_{zero}$ (through a lower reduction in mean log recruitment) and increased the size of the 1999 year class. As such, spawning biomass for the most recent years, while generally lower than predicted in the 2007 assessment, is greater relative to the estimate of $SB_{zero}$ and therefore results in a higher depletion estimate.

Table b. Recent trend in Pacific hake spawning biomass and depletion level from the base and alternative SS2 models.

| Year | Spawning biomass millions mt | ~ 95% Interval | | | Relative Depletion | ~ 95% Interval |
|---|---|---|---|---|---|---|
| 1999 | 0.961 | 0.687 | - | 1.236 | 33.2% | - |
| 2000 | 0.882 | 0.596 | - | 1.169 | 30.5% | - |
| 2001 | 1.048 | 0.677 | - | 1.420 | 36.2% | - |
| 2002 | 1.625 | 1.028 | - | 2.222 | 56.1% | - |
| 2003 | 1.898 | 1.186 | - | 2.611 | 65.5% | - |
| 2004 | 1.827 | 1.113 | - | 2.542 | 63.1% | - |
| 2005 | 1.554 | 0.889 | - | 2.218 | 53.6% | - |
| 2006 | 1.279 | 0.665 | - | 1.892 | 44.1% | |
| 2007 | 1.067 | 0.472 | - | 1.663 | 36.8% | 23.7% - 50.1% |
| 2008 | 1.097 | 0.419 | - | 1.775 | 37.9% | 21.9% - 53.9% |

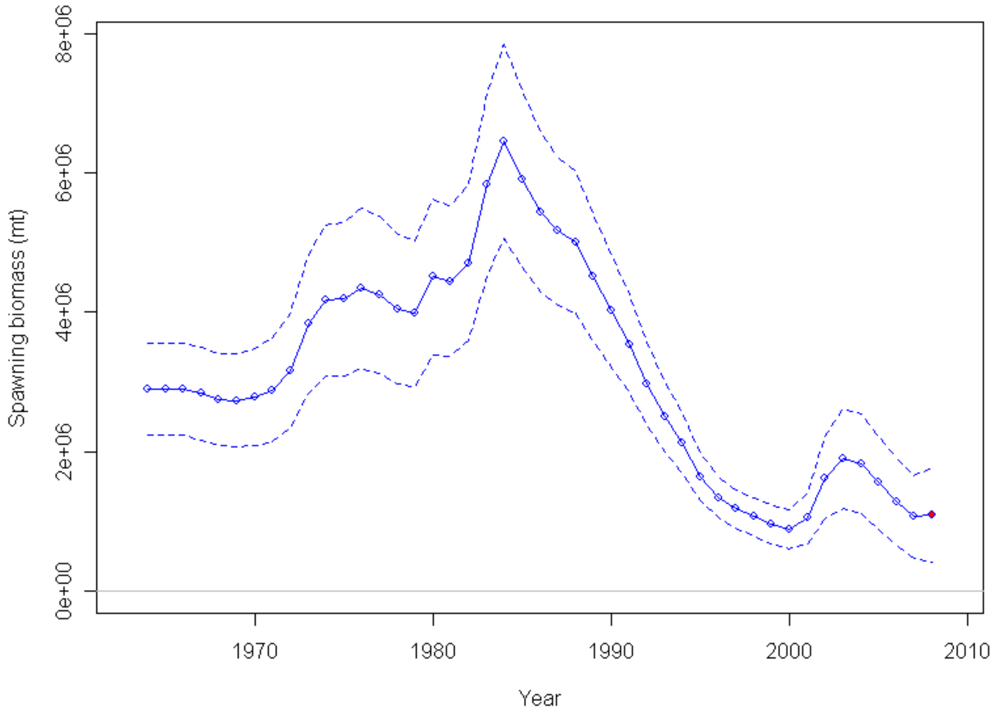


Figure b. Estimated spawning biomass time-series with approximate asymptotic 95% confidence intervals.

*Recruitment*

Estimates of historic Pacific hake recruitment indicate very large year classes in 1980 and 1984, with secondary recruitment events in 1970, 1973 and 1977. The more recent 1999 year class is the most dominant cohort since the late 1980s and has supported fishery catches since 2002. Uncertainty in recruitment can be substantial, especially for recent years, as indicated by the asymptotic 95% confidence intervals. Recruitment to age 0 before 1967 is assumed to be equal to the long-term mean recruitment. Age-0 recruitment in 2005 appears promising but is very uncertain, as it has only been observed in either the fishery or the acoustic survey for one season (2007).

Table c. Recent estimated trend in Pacific hake recruitment.

| Year | Recruitment (billions) | ~ 95% Interval | | |
|---|---|---|---|---|
| 1999 | 18.151 | 12.905 | - | 25.529 |
| 2000 | 0.030 | 0.012 | - | 0.073 |
| 2001 | 1.374 | 0.944 | - | 1.998 |
| 2002 | 0.035 | 0.015 | - | 0.081 |
| 2003 | 1.809 | 1.157 | - | 2.830 |
| 2004 | 0.414 | 0.236 | - | 0.728 |
| 2005 | 6.065 | 3.371 | - | 10.910 |
| 2006 | 3.676 | 0.604 | - | 22.365 |
| 2007 | 3.556 | 0.586 | - | 21.588 |
| 2008 | 3.575 | 0.573 | - | 22.317 |

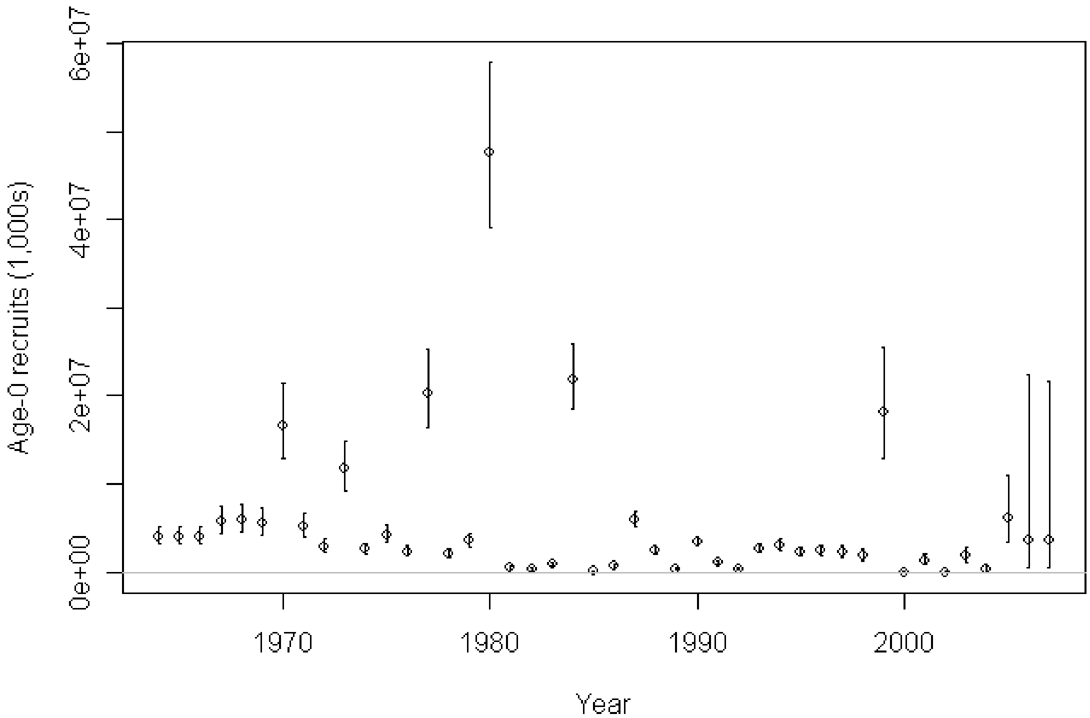


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Figure c. Estimated recruitment time-series with approximate asymptotic 95% confidence intervals.

*Reference points*

Two types of reference points are reported in this assessment: those based on the assumed population parameters at the beginning of the modeled time period and those based on the most recent time period in a ‘forward projection’ mode of calculation. This distinction is important since temporal variability in growth and other parameters can result in different biological reference point calculations across alternative chronological periods. All strictly biological reference points (e.g., unexploited spawning biomass) are calculated based on the unexploited conditions at the start of the model, whereas management quantities (MSY, $SB_{msy}$, etc.) are based on the current growth and maturity schedules and are marked throughout this document with an asterisk (*).

Unexploited equilibrium Pacific hake spawning biomass ($SB_{zero}$) is estimated to be 2.89 million mt (~ 95% confidence interval: 1.556 – 2.50 million mt), with a mean expected recruitment of 4.06 billion age-0 hake (~ 95% confidence interval: 3.23 – 5.11). Associated management reference points for target and critical biomass levels based on $SB_{40\%}$ proxy are 1.16 million mt (B40%) and 0.72 million mt (B25%), respectively. The MSY-proxy harvest amount (F40%) under the base model is estimated to be 470,910* mt (~ 95% confidence interval: 253,115 - 688,705 mt). The spawning stock biomass that produces the MSY-proxy catch amount under the base model was estimated to be 0.81 million* mt (confidence interval is 0.42 - 1.90 millions mt)* <u>given current life history parameters</u>.

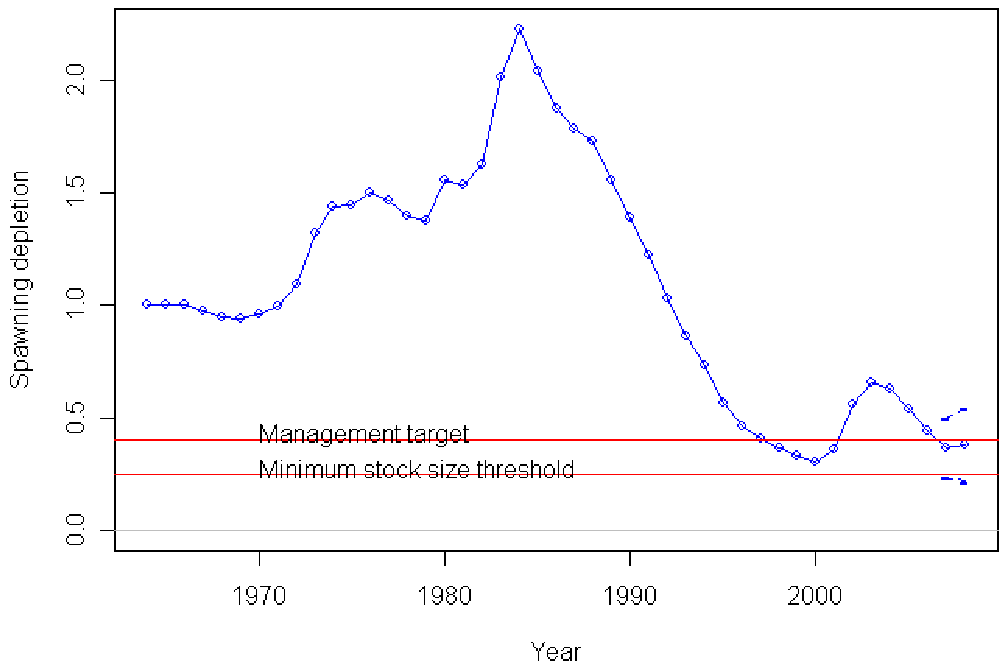


Figure d. Time series of estimated depletion, 1966-2008.

*Exploitation status*

The estimated spawning potential ratio (SPR) for Pacific hake has been above the proxy target of 40% for the history of this fishery. In terms of its exploitation status, Pacific hake are presently just below target biomass level (40% unfished biomass) and above the target SPR rate (40%). The full exploitation history is portrayed graphically below, plotting for each year the calculated SPR and spawning biomass level (B) relative to their corresponding targets, F40% and B40%, respectively.

Table d. Recent trend in spawning potential ratio (SPR).

| | Base Model | |
|---|---|---|
| | Estimated | ~ 95% |
| Year | SPR | Interval |
| 1998 | 0.474 | - |
| 1999 | 0.456 | - |
| 2000 | 0.512 | - |
| 2001 | 0.527 | - |
| 2002 | 0.707 | - |
| 2003 | 0.736 | - |
| 2004 | 0.646 | - |
| 2005 | 0.580 | - |
| 2006 | 0.497 | - |
| 2007 | 0.485 | |

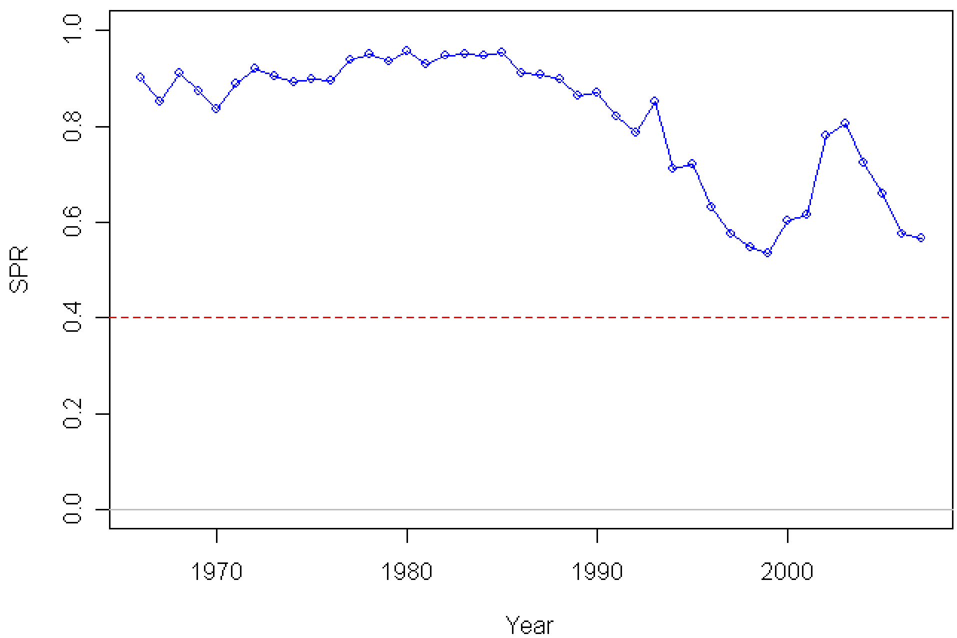


Figure e. Time series of estimated spawning potential.

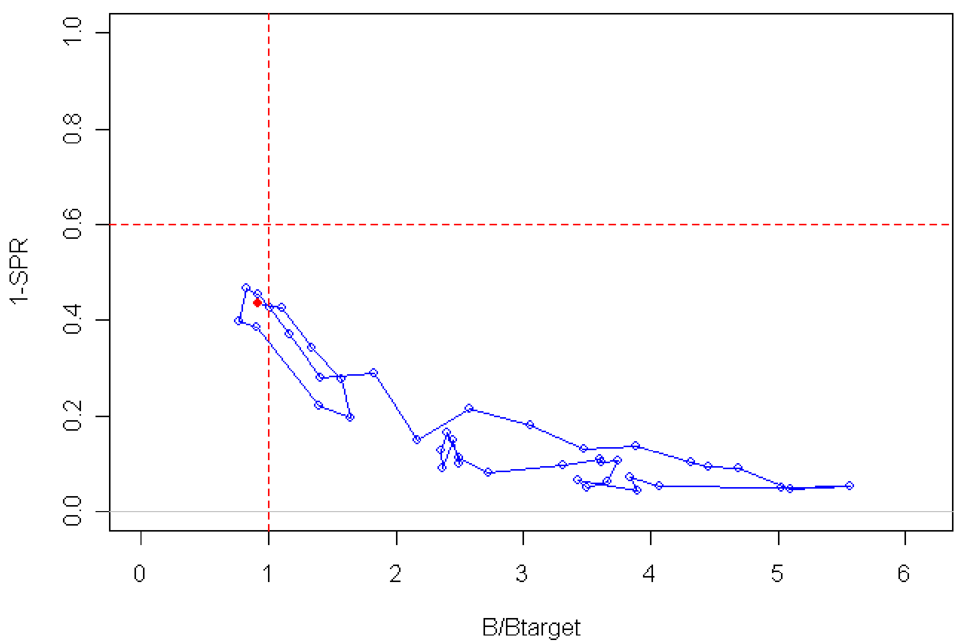


Figure f. Temporal pattern of estimated spawning potential ratio relative to the proxy target of 40% vs estimated spawning biomass relative to the proxy 40% level .

*Management performance*

Since implementation of the Magnuson Fisheries Conservation and Management Act in the U.S. and the declaration of a 200 mile fishery conservation zone in Canada in the late 1970's, annual quotas have been the primary management tool used to limit the catch of Pacific hake in both zones by foreign and domestic fisheries. The scientists from both countries have collaborated through the Technical Subcommittee of the Canada-US Groundfish Committee (TSC), and there has been informal agreement on the adoption of an annual fishing policy. During the 1990s, however, disagreement between the U.S. and Canada on the division of the acceptable biological catch (ABC) between the two countries led to quota overruns; 1991-1992 quotas summed to 128% of the ABC and quota overruns have averaged 114% from 1991-1999. Since 2000, total catches have been below coastwide ABCs. A recent treaty between the United States and Canada (2003), which awaits final signature, establishes U.S. and Canadian shares of the coastwide allowable biological catch at 73.88% and 26.12%, respectively.

Table e. Recent trend in Pacific hake management performance.

| Year | Total landings (mt) | Coastwide (U.S. + Canada) OY (mt) | Coastwide (U.S. + Canada) ABC (mt) |
|---|---|---|---|
| 1997 | 325,215 | 290,000 | 290,000 |
| 1998 | 320,619 | 290,000 | 290,000 |
| 1999 | 311,855 | 290,000 | 290,000 |
| 2000 | 230,819 | 290,000 | 290,000 |
| 2001 | 235,962 | 238,000 | 238,000 |
| 2002 | 182,883 | 162,000 | 208,000 |
| 2003 | 205,582 | 228,000 | 235,000 |
| 2004 | 334,721 | 501,073 | 514,441 |
| 2005 | 360,306 | 364,197 | 531,124 |
| 2006 | 359,901 | 364,842 | 661,680 |
| 2007 | 276,084 | 328,358 | 612,068 |

*Unresolved problems and major uncertainties*

The acoustic survey catchability, *q,* and selectivity remains uncertain and the model results are quite sensitive to assumed values. This is largely driven by an inconsistency in the acoustic survey biomass time series and age compositions. Age-composition data suggest a large build up of stock biomass in the mid-1980s, however the acoustic survey biomass time series is relatively flat since 1977. Efforts have been made in this assessment to integrate both the uncertainty in the acoustic survey's *q* and selectivity pattern.

*Forecasts*

Stochastic forecasts are generated assuming the maximum potential catch would be removed under 40:10 control rule for both the base and alternative models. Projections are based on relative F's corresponding to a coastwide catch allocation of 73.88% and 26.12% to the U.S. and Canada, respectively, with application of the 40-10 harvest control rule.

Table f. Three year stochastic projections of potential Pacific hake landings, spawning biomass and depletion assuming full coastwide catch is taken under the 40:10 rule. Three year catch streams are given for three arbitrary catches of 250,000, 300,000 (approximately status quo) and 400,000 mt. In addition, catch streams of the average 2008-2010 coastwide catches corresponding to the 0-25th, 25-75th and 75-100th percentile of the marginal posterior distribution of 2008 spawning depletion are also given.

| Percentile[1] | | | Spawning Biomass (millions, mt) [2] | | | | | Spawning Depletion (% unfished) [2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | Forecast | Coastwide | Posterior Interval | | | | | Posterior Interval | | | | |
| depletion | Year | Catch (mt) | 5th | 25th | 50th | 75th | 95th | 5th | 25th | 50th | 75th | 95th |
| | 2008 | 414,193 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 25% | 2009 | 432,862 | 0.757 | 1.062 | 1.430 | 1.885 | 3.424 | 0.278 | 0.368 | 0.470 | 0.571 | 0.891 |
| | 2010 | 522,299 | 0.670 | 1.083 | 1.609 | 2.250 | 4.369 | 0.244 | 0.372 | 0.512 | 0.673 | 1.236 |
| | 2011 | - | 0.571 | 1.111 | 1.740 | 2.608 | 5.204 | 0.210 | 0.377 | 0.546 | 0.789 | 1.570 |
| | 2008 | 656,604 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 50% | 2009 | 675,032 | 0.765 | 1.009 | 1.321 | 1.720 | 3.199 | 0.281 | 0.349 | 0.427 | 0.517 | 0.814 |
| | 2010 | 751,936 | 0.712 | 0.994 | 1.365 | 1.895 | 3.631 | 0.257 | 0.339 | 0.432 | 0.578 | 1.049 |
| | 2011 | - | 0.685 | 1.005 | 1.417 | 2.056 | 3.878 | 0.240 | 0.337 | 0.451 | 0.631 | 1.192 |
| | 2008 | 1,092,911 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 75% | 2009 | 1,341,489 | 0.455 | 0.763 | 1.129 | 1.592 | 3.132 | 0.169 | 0.262 | 0.369 | 0.482 | 0.803 |
| | 2010 | 1,502,207 | 0.103 | 0.423 | 0.926 | 1.574 | 3.683 | 0.037 | 0.148 | 0.298 | 0.469 | 1.046 |
| | 2011 | - | 0.019 | 0.270 | 0.716 | 1.562 | 4.187 | 0.006 | 0.092 | 0.230 | 0.477 | 1.238 |
| | 2008 | 250,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 250,000 | 0.951 | 1.299 | 1.748 | 2.727 | 9.203 | 0.351 | 0.446 | 0.557 | 0.718 | 1.102 |
| | 2010 | 250,000 | 1.050 | 1.536 | 2.122 | 3.511 | 10.202 | 0.380 | 0.516 | 0.670 | 0.897 | 1.397 |
| | 2011 | - | 1.164 | 1.780 | 2.485 | 4.201 | 10.813 | 0.412 | 0.593 | 0.778 | 1.037 | 1.793 |
| | 2008 | 300,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 300,000 | 0.807 | 1.112 | 1.481 | 1.935 | 3.473 | 0.297 | 0.385 | 0.485 | 0.586 | 0.907 |
| | 2010 | 300,000 | 0.776 | 1.189 | 1.715 | 2.355 | 4.476 | 0.283 | 0.410 | 0.543 | 0.710 | 1.259 |
| | 2011 | - | 0.765 | 1.308 | 1.936 | 2.801 | 5.401 | 0.280 | 0.441 | 0.609 | 0.854 | 1.634 |
| | 2008 | 400,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 400,000 | 0.763 | 1.068 | 1.436 | 1.891 | 3.430 | 0.280 | 0.370 | 0.471 | 0.573 | 0.893 |
| | 2010 | 400,000 | 0.690 | 1.104 | 1.629 | 2.271 | 4.390 | 0.251 | 0.379 | 0.518 | 0.680 | 1.241 |
| | 2011 | - | 0.644 | 1.184 | 1.814 | 2.681 | 5.277 | 0.235 | 0.401 | 0.569 | 0.812 | 1.591 |

[1] Coastwide catches for 2008-2010 represent the average from slicing the marginal posterior distribution of 2008 spawning depletion in 25th, 50th and 75t

[2] Posterior intervals are based on 1,000,000 draws from MCMC simulation.

*Research and data needs*

1) Evaluate the quantity and quality of biological data prior to 1988 from the Canadian fishery for use in developing length and conditional age at length compositions.
2) Evaluate whether modeling the distinct at-sea and shore based fisheries in the U.S. and Canada explain some lack of fit in the compositional data.
3) Evaluate a sex specific model and use of split-sex selectivity for both the U.S. and Canadian fishery and survey data.
4) Compare spatial distributions of hake across all years and between bottom trawl and acoustic surveys to estimate changes in catchability/availability across years. The two primary issues are related to the changing spatial distribution of the survey as well as the environmental factors that may be responsible for changes in the spatial distribution of hake and their influences on survey catchability and selectivity.
5) Initiate analysis of the acoustic survey data to determine variance estimates for application in the assessment model. The analysis would provide a first cut to define the appropriate CV for the weighting of the acoustic data and should incorporate uncertainties in spatial variability, sampling variability and target strength variability.
6) Develop an informed prior for the acoustic q. This could be done either with empirical experiments (particularly in off-years for the survey) or in a workshop format with technical experts. There is also the potential to explore putting the target strength estimation in the model directly. This prior should be used in the model when estimating the q parameter.
7) Review the acoustic data to assess whether there are spatial trends in the acoustic survey indices that are not being captured by the model. The analysis should include investigation of the migration (expansion/contraction) of the stock in relation to variation in environmental factors. This would account for potential lack of availability of older animals and how it affects the selectivity function.
8) Investigate aspects of the life history characteristics for Pacific hake and their possible effects on the interrelationship of growth rates and maturity at age. This should include additional data collection of maturity states and fecundity, as current information is limited.
9) Additional cross and double reads of otoliths prior to 2001 should be performed to determine the age-reading error properties of production ages.
10) Additional in situ measurements of target strength for hake are needed, particularly during daytime hours and at varying depths.

Table g. Summary of recent trends in Pacific hake exploitation and stock levels; all values reported at the beginning of the year.

| Base Model | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Landings (1000s mt) | 320.6 | 311.9 | 230.8 | 236.0 | 182.9 | 205.6 | 334.7 | 360.3 | 359.9 | 276.1 | NA |
| ABC (1000s mt) | 290 | 290 | 290 | 238 | 208 | 235 | 514 | 531 | 661 | 612 | 555 |
| OY (1000s mt) | | | | | | | | | | | |
| SPR* | 0.548 | 0.536 | 0.601 | 0.616 | 0.779 | 0.805 | 0.723 | 0.657 | 0.573 | 0.566 | NA |
| Total biomass (millions mt) | 2.29 | 2.08 | 1.90 | 1.80 | 4.42 | 4.18 | 3.89 | 3.15 | 2.69 | 2.05 | 2.49 |
| Spawning biomass (millions mt) | 1.06 | 0.96 | 0.88 | 1.05 | 1.62 | 1.90 | 1.83 | 1.55 | 1.28 | 1.07 | 1.10 |
| ~95% interval | 0.794-1.336 | 0.687-1.236 | 0.596-1.169 | 0.677-1.42 | 1.028-2.222 | 1.186-2.611 | 1.113-2.542 | 0.889-2.218 | 0.665-1.892 | 0.472-1.663 | 0.419-1.775 |
| Recruitment (billions) | 1.898 | 18.151 | 0.030 | 1.374 | 0.035 | 1.809 | 0.414 | 6.065 | 3.676 | 3.556 | 3.575 |
| ~95% interval | 1.377-2.616 | 12.905-25.529 | 0.012-0.073 | 0.944-1.998 | 0.015-0.081 | 1.157-2.83 | 0.236-0.728 | 3.371-10.91 | 0.604-22.365 | 0.586-21.588 | 0.573-14.359 |
| Depletion | 36.8% | 33.2% | 30.5% | 36.2% | 56.1% | 65.5% | 63.1% | 53.6% | 44.1% | 36.8% | 37.9% |
| ~95% interval | - | - | - | - | - | - | - | - | - | 23.7% - 50.1% | 21.9% - 53.9% |

Table h. Summary of Pacific hake reference points. Quantities based on the current growth and maturity schedules and are marked with an asterisk (*) and are not comparable to those based on unfished conditions. The symmetric approximation of the 95% confidence interval included zero for some quantities, the lower limit is therefore rounded up and in italics.

| Quantity | Estimate | ~95% Confidence interval |
|---|---|---|
| Unfished spawning stock biomass ($SB_0$, millions mt) | 2.89 | 1.56 - 2.50 |
| Unfished 3+ biomass (millions, mt) | 5.99 | NA |
| Unfished recruitment ($R_0$, billions) | 4.06 | 3.23 - 5.11 |
| ***Reference points based on $SB_{40\%}$*** | | |
| *MSY* Proxy Spawning Stock Biomass ($SB_{40\%}$ millions mt) | 1.17 | 0.89 - 1.43 |
| SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$) | 0.53 | 0.43 - 0.33 |
| Exploitation rate resulting in $SB_{40\%}$ | 0.16 | NA |
| Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt) | 416,150 | 232,245 - 600,055 |
| ***Reference points based on SPR proxy for MSY*** | | |
| Spawning Stock Biomass at SPR ($SB_{SPR}$)(millions mt) | 0.81 | 0.42 - 1.9 |
| $SPR_{MSY\text{-}proxy}$ | 0.40 | NA |
| Exploitation rate corresponding to SPR | 0.25 | NA |
| Yield with $SPR_{MSY\text{-}proxy}$ at $SB_{SPR}$ (mt) | 470,910 | 253,115 - 688,705 |
| ***Reference points based on estimated MSY values*** | | |
| Spawning Stock Biomass at *MSY* ($SB_{MSY}$) (millions mt) | 0.68 | 0.34 - 1.01 |
| $SPR_{MSY}$ | 0.35 | 0.11 - 0.59 |
| Exploitation Rate corresponding to $SPR_{MSY}$ | 0.26 | NA |
| *MSY* (mt) | 476,750 | 209,073 - 744,427 |

## INTRODUCTION

The Joint US-Canada treaty on Pacific Hake was formally ratified by the United States as part of the reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act. As of this writing the treaty has not been officially ratified by the Canadian Parliament. Under this treaty Pacific hake (a.k.a. Pacific whiting) stock assessments are to be prepared by the Hake Technical Working Group comprised of U.S. and Canadian scientists and reviewed by a Scientific Review Group (SRG), with memberships as appointed by both parties to the agreement. While these entities have not been formally established by either nation, the current assessment was cooperatively prepared by an ad hoc Technical Committee. The US and Canadian scientist met three times for the purposes of data exchange and discussion of major issues and modeling activity in preparation for the final review. As background, separate Canadian and U.S. assessments were submitted to each nation's assessment review process prior to 1997. In the past, this practice has resulted in differing yield options being forwarded to each country's managers for this single, yet shared trans-boundary fish stock. Multiple interpretations of Pacific hake status made it difficult to coordinate overall management policy. To address this problem, the working group agreed in 1997 to present scientific advice in a single collaborative assessment agreement officially formalized in 2003. To further advance the coordination of scientific advice on Pacific hake, this report was submitted to the Pacific Council's Stock Assessment review process for technical review in fulfillment of the agreement and to satisfy management responsibilities of both the U.S. Pacific Fisheries Management Council (PFMC). The Review Group meeting was held in Seattle, WA at the Northwest Fisheries Science Center, during Feb 11-14, 2008.

### Stock Structure and Life History

Pacific hake (*Merluccius productus*), also referred to as Pacific whiting, is a codlike species distributed along the west coast of North America generally ranging from $25^0$ N. to $51^0$ N. latitude. It is among about a dozen other species of hakes from the genus, *Merluccidae*, which are distributed worldwide in both hemispheres of the Atlantic and Pacific Oceans and collectively constitute nearly two million mt of catch annually (Alheit and Pitcher 1995). The coastal stock of Pacific hake is currently the most abundant groundfish population in the California Current system. Smaller populations of this species occur in the major inlets of the North Pacific Ocean, including the Strait of Georgia, Puget Sound, and the Gulf of California. Electrophoretic studies indicate that Strait of Georgia and the Puget Sound populations are genetically distinct from the coastal population (Utter 1971). Genetic differences have also been found between the coastal population and hake off the west coast of Baja California (Vrooman and Paloma 1977). The coastal stock is distinguished from the inshore populations by larger body size, seasonal migratory behavior, and a pattern of low median recruitment punctuated by extremely large year classes.

The coastal stock of Pacific hake typically ranges from the waters off southern California to Queen Charlotte Sound. Distributions of eggs, larvae, and infrequent observations of spawning aggregations indicate that Pacific hake spawning occurs off south-central California during January-March. Due to the difficulty of locating major offshore spawning concentrations, details of spawning behavior of hake remains poorly understood (Saunders and McFarlane 1997). In spring, adult Pacific hake migrate onshore and to the north to feed along the continental shelf and slope from northern California to Vancouver Island. In summer, Pacific hake form extensive midwater aggregations in association with the continental shelf break, with highest densities located over bottom depths of 200-300 m (Dorn 1991, 1992). Pacific hake feed on euphausiids, pandalid shrimp, and pelagic schooling fish (such as eulachon and Pacific herring) (Livingston and Bailey 1985). Larger Pacific hake become increasingly piscivorous, and Pacific herring are commonly a large component of hake diet off Vancouver Island. Although Pacific hake are cannibalistic, the geographic separation of juveniles and adults usually prevents cannibalism from being an important factor in their population dynamics (Buckley and Livingston 1997).

Older (age 5+), larger, and predominantly female hake exhibit the greatest northern migration each season. During El Niño events, a larger proportion of the stock migrates into Canadian waters, apparently due to intensified northward transport during the period of active migration (Dorn 1995, Agostini et al. 2006)). Range extensions to the north also occur during El Niño conditions, as evidenced by reports of hake from southeast Alaska during these warm water years. Throughout the warm period experienced in 1990s, there have been changes in typical patterns of hake distribution: Spawning activity has been recorded north of California, and frequent reports of unusual numbers of juveniles from Oregon to British Columbia suggest that juvenile settlement patterns have also shifted northwards in the late 1990s (Benson et al. 2002, Phillips et al. 2007). Because of this shift, juveniles may be subjected to increased predation from cannibalism and to increased vulnerability to fishing mortality. Subsequently, La Nina conditions apparently caused a southward shift in the center of the stock's distribution and a smaller portion of the population was found in Canadian waters in the 2001 survey.

**Fisheries**

The fishery for the coastal population of Pacific hake occurs primarily during April-November along the coasts of northern California, Oregon, Washington, and British Columbia. The fishery is conducted almost exclusively with midwater trawls. Most fishing activity occurs over bottom depths of 100-500 m, and offshore extensions of fishing activity have occurred in recent years to prevent bycatch of depleted rockfish and salmon. The history of the coastal hake fishery is characterized by rapid changes brought about by the development of foreign fisheries in 1966, joint-venture fisheries in the early 1980's, and domestic fisheries in 1990's (Fig. 1).

Large-scale harvesting of Pacific hake in the U.S. zone began in 1966 when factory trawlers from the former Soviet Union began targeting Pacific hake. During the mid 1970's, factory trawlers from Poland, Federal Republic of Germany, the former German Democratic Republic and Bulgaria also participated in the fishery. During 1966-1979, the catch in U.S. waters averaged 137,000 t per year (Table 1). A joint-venture fishery was initiated in 1978 between two U.S. trawlers and Soviet factory trawlers acting as mother ships (the practice where the catch from several boats is brought back to the larger, slower ship for processing and storage until the return to land). By 1982, the joint-venture catch surpassed the foreign catch. In the late 1980's, joint-ventures involved fishing companies from Poland, Japan, former Soviet Union, Republic of Korea and the People's Republic of China. In 1989, the U.S. fleet capacity had grown to a level sufficient to harvest the entire quota, and no foreign fishing was allowed. In contrast, Canada allocates a portion of the Pacific hake catch to joint-venture operations once shore-side capacity is filled.

Historically, the foreign and joint-venture fisheries produced fillets and headed and gutted products. In 1989, Japanese mother ships began producing surimi from Pacific hake, using a newly developed process to inhibit myxozoan-induced proteolysis. In 1990, domestic catcher-processors and mother ships entered the Pacific hake fishery in the U.S. zone. Previously, these vessels had engaged primarily in Alaskan pollock fisheries. The development of surimi production techniques for walleye pollock was expanded to include Pacific hake as a viable alternative. In 1991, the joint-venture fishery for Pacific hake ended because of the increased level of participation by domestic catcher-processors and mother ships, and the growth of shore-based processing capacity. Shore-based processors of Pacific hake had been constrained historically by a limited domestic market for Pacific hake fillets and headed and gutted products. The construction of surimi plants in Newport and Astoria, Oregon led to a rapid expansion of shore-based landings in the U.S. fishery in the early 1990's.

The sectors involved in the Pacific hake fishery in Canada exhibits a similar pattern, although phasing out of the foreign and joint-venture fisheries has lagged a few years relative to the U.S. Since 1968, more Pacific hake have been landed than any other species in the groundfish fishery on Canada's west coast (Table 1). Prior to 1977, the fishing vessels from the former Soviet Union caught the majority of Pacific hake in the Canadian zone, with Poland and Japan accounting for much smaller landings. Since declaration of the 200-mile extended fishing zone in 1977, the Canadian fishery has been divided into shore-based, joint-venture, and foreign fisheries. In 1990, the foreign fishery was phased out, but the demand of Canadian shore-based processors remained below the available yield, thus the joint-venture fishery continued through 2002. Poland is the only country that participated in the 1998 joint-venture fishery. The majority of the shore-based landings of the coastal hake stock is processed into surimi, fillets, or mince by processing plants at Ucluelet, Port Alberni, and Delta, British Columbia. Small deliveries were made in 1998 to plants in Washington and Oregon. Although significant aggregations of hake are found as far north as Queen Charlotte Sound, in most years the fishery has been concentrated below 49° N latitude off the south coast of Vancouver Island, where there are sufficient quantities of fish in proximity to processing plants.

**Management of Pacific hake**

Since implementation of the Magnuson-Stevens Fishery Conservation and Management Act in the U.S. and the declaration of a 200-mile fishery conservation zone in Canada in the late 1970's, annual harvest quotas have been the primary management tool used to limit the catch of Pacific hake. Scientists from both countries have historically collaborated through the Technical Subcommittee of the Canada-U.S. Groundfish Committee (TSC), and there have been informal agreements on the adoption of annual fishing policies. During the 1990s, however, disagreements between the U.S. and Canada on the allotment of the acceptable biological catch (ABC) between U.S. and Canadian fisheries led to quota overruns; 1991-1992 quotas summed to 128% of the ABC, while the 1993-1999 combined quotas were 107% of the ABC on average. The 2002 and 2003 fishing year were somewhat different from years past in that the ABC of

Pacific hake was utilized at an average of 87%. In the Pacific hake agreement between the United States and Canada, 73.88% and 26.12%, respectively, of the coastwide allowable biological catch are to be allocated between the two countries. Furthermore, the agreement establishes a Joint Technical Committee to exchange data and conduct stock assessments, which will be reviewed by a Scientific Review Group.

*United States*

Prior to 1989, catches in the U.S. zone were substantially below the harvest guideline, but since 1989 have caught up to the harvest guideline with exceptions in 2000, 2001 and 2003 when 90%, 96% and 96% of the quota were taken, respectively. The total U.S. catch has not significantly exceeded the harvest guideline for the U.S. zone, indicating that in-season management procedures have been effective.

In the U.S. zone, participants in the directed fishery are required to use pelagic trawls with a codend mesh that is at least 7.5 cm (3 inches). Regulations also restrict the area and season of fishing to reduce the bycatch of Chinook salmon, and several depleted rockfish stocks. More recently, yields in the U.S. zone have been restricted to levels below optimum yields due to widow rockfish bycatch in the Pacific hake fishery. At-sea processing and night fishing (midnight to one hour after official sunrise) are prohibited south of 42° N latitude. Fishing is prohibited in the Klamath and Columbia River Conservation zones, and a trip limit of 10,000 pounds is established for Pacific hake caught inside the 100-fathom contour in the Eureka INPFC area. During 1992-95, the U.S. fishery opened on April 15, however in 1996 the opening date was advanced to May 15. Shore-based fishing is allowed after April 1 south of 42° N. latitude, but is limited to 5% of the shore-based allocation being taken prior to the opening of the main shore-based fishery. The main shore-based fishery opens on June 15. Prior to 1997, at-sea processing was prohibited by regulation when 60 percent of the harvest guideline was reached. The current allocation agreement, effective since 1997, divides the U.S. non-tribal harvest guideline among factory trawlers (34%), vessels delivering to at-sea processors (24%), and vessels delivering to shore-based processing plants (42%).

Shortly after the 1997 allocation agreement was approved by the PFMC, fishing companies with factory trawler permits established the Pacific Whiting Conservation Cooperative (PWCC). The primary role of the PWCC is to allocate the factor trawler quota among its members. Anticipated benefits of the PWCC include more efficient allocation of resources by fishing companies, improvements in processing efficiency and product quality, and a reduction in waste and bycatch rates relative to the former “derby” fishery in which all vessels competed for a fleet-wide quota. The PWCC also initiated recruitment research to support hake stock assessment. As part of this effort, PWCC sponsored a juvenile recruit survey in the summer of 1998 and 2001, which since 2002 has become an ongoing collaboration with NMFS.

**Overview of Recent Fishery and Management**

United States

The coastwide acceptable biological catch (ABC) for 2004 was estimated to be 514,441 mt based on the $F_{msy}$ proxy harvest rate of F40% applied to the model in which acoustic survey catchability (q) was assumed to be 1.0 (Helser et al. 2004). This was the largest ABC in recent years and reflected substantial increases in biomass (above 40% unfished biomass) due to the presence of the strong 1999 year-class. The final commercial U.S. optimum yield (OY) was set at 250,000 mt due to constraints imposed by bycatch of canary and widow rockfish in the hake fishery. The Makah tribe was allocated 32,500 mt in 2004. For the 2005 fishing season, the coastwide OY was estimated to be 364,197 mt, with 269,069 mt apportioned to the U.S. fishery. The 2005 OY was nearly 100% utilized. The coastwide 2006 ABC was estimated to be 661,680 mt (based on the q=1.0 model assumption), with a coastwide OY set at 364,842 mt. The U.S. fishery OY of 269,069 mt was fully utilized. For the 2007 fishing season the PFMC adopted the 612,068 mt ABC and coastwide OY of 328,358 mt. The coastwide OY, which was considerably below the ABC was based on bycatch considerations. The 2007 U.S. OY for hake was 242,591 metric tons (mt). The Makah tribe was allocated 32,500 mt, the commercial fishery 208,091 mt, and research 2,000 mt. The shoreside sector has been allocated 87,398 mt while the catcher/processor and mothership fishery received 70,751 mt and 49,942 mt respectively.

The at-sea sector's distribution of catch in 2004 ranged slightly stronger northward with roughly 50% of the catch occurring north and south of Newport, Oregon (Fig. 2). The total at-sea sector harvested approximately 43% (90,200 mt) of the total U.S. catch of 210,400 mt. In 2005, at sea catches extended from south of Cape Blanco to Cape Flattery, with nearly even distribution north and south of Newport.

The shore-based sector harvested 46% (96,200 mt) of the total U.S. catch of 210,400 mt in 2004. As in previous years, the dominate ports were Newport (38,800 mt) followed by Westport (30,000 mt) and Astoria (16,000 mt). The 2005 shore-based fishery began on June 15 and ended on August 18, and utilized approximately 94% of the commercial optimum yield of 97,469 mt.

Since 1996, the Makah Indian Tribe has conducted a separate fishery in its "usual and accustomed fishing area." During the 2004 and 2005 fishing season, the distribution of Pacific hake provided favorable conditions to support the fishery in the Makah tribal fishing area, where the Makahs harvested approximately 95% (31,000 mt) of the Tribal allocation and 15% of total US catch in 2004. The 2005 Makah fishery, which began on May 1 and ended on August 15, utilized 35,000 mt, (100% of the 35,000 mt allocation).

The primary 2007 hake/whiting fishery began on June 15, however the fishery was closed to all fishing sectors on July 26, 2007 because at sea observer data indicated that the bycatch limit (220 mt) of widow rockfish had been exceeded in the non-tribal whiting fisheries. On November 28, 2007 6,000 mt of the 87,398 mt shore-based sectors was reapportioned to the catcher/processor sector and fishing continued in the early fall. The U.S. havested 84% of the 242,519 OY allocation.

Canada

DFO managers allow a 15% discrepancy between the quota and total catch. The quota may be exceeded by up to 15% in any given year, which is then deducted from the quota for the subsequent year. Conversely, if less than the quota is taken, up to 15% can be carried over into the next year. For instance, the overage in 1998 (Table 2) is due to carry-over from 1997 when 9% of the quota was not taken. During 1999-2001 the PSARC groundfish subcommittee recommended to DFO managers yields based on F40% (40-10) option and Canadian managers adopted allowable catches prescribed at 30% of the coastwide ABC (Table 14; Dorn et al. 1999).

The all-nation catch in Canadian waters was 53,585 mt in 2001, up from only 22,401 mt in 2000 (Table 1). In 2000, the shore-based landings in the Canadian zone hit a record low since 1990 due to a decrease in availability. Catches in 2001 increased substantially over those of 2000 for both the Joint Venture and shore-based sectors over catches in 2000, but were still below recommended TAC. Total Canadian catches in 2002 and 2003 were 50,769 mt and 62,090 mt, respectively, and were harvested exclusively by the shore-side sector; constituting nearly 87% of the total allocation of that country. In 2004, the allowable catch in Canada was 26.14% of the coastwide ABC, approximately 134,000 mt. Catches were nearly split equally between the shore-based and joint venture sectors, totaling 124,000 mt. Canadian Pacific hake catches were fully utilized in the 2005 fishing season with 85,284 mt and 15,178 mt taken by the Domestic and Joint Venture fisheries, respectively. In 2006, the Joint Venture and Domestic fisheries harvested 13,700 mt and 80,000 mt, respectively. During the 2007 fishing Season, Canadian fisheries harvested 85% of the 85,373 mt national allocation with Joint Venture and Domestic sectors catching 7,000 mt and 65,000 mt, respectively.

## ASSESSMENT

### Modeling Approaches

Age-structured assessment models have been used to assess Pacific hake since the early 1980's. Modeling approaches have evolved as new analytical techniques have been developed. Initially, a cohort analysis tuned to fishery CPUE was used (Francis et al. 1982). Later, the cohort analysis was tuned to NMFS triennial acoustic survey estimates of absolute abundance at age (Francis and Hollowed 1985, Hollowed et al. 1988a). Since 1989, a stock synthesis model that utilizes fishery catch-at-age data and acoustic survey estimates of population biomass and age composition has been the primary assessment method (Dorn and Methot, 1991). Dorn et al. (1999) converted the age-structured stock synthesis Pacific hake model to an age-structured model using AD model builder (Fournier 1996). AD model builder's post-convergence routines permit calculation of standard errors (or likelihood profiles) for any quantity of interest, allowing for a unified approach to the treatment of uncertainty in estimation and forward projection. Since 2001, Helser et al. (2001, 2003, 2004) have used the same ADMB modeling platform to assess the hake stock and examine important modifications and assumptions, including the time varying nature of the acoustic survey selectivity and catchability. The acoustic survey catchability coefficient ($q$) has been, and continues to be, one of the major sources of uncertainty in the model. Due to the lengthened acoustic survey biomass trends the assessment model was able to freely estimate the acoustic survey $q$. These estimates were substantially below the assumed value of $q$=1.0 from earlier assessments. The 2003 and 2004 assessment presented uncertainty in the final model result as a range of biomass. The lower end of the biomass range was based upon the conventional assumption that the acoustic survey $q$ was equal to 1.0, while the higher end of the range represented a $q$=0.6 assumption.

In 2006, the hake population model was migrated to the Stock Synthesis modeling framework (SS2 Version 1.21, December, 2006) which was written by Dr. Richard Methot (Northwest Fisheries Science Center) in AD Model Builder (Helser et al. 2006). Conversion of the previous hake model into SS2 was guided by three principles: 1) the incorporation of less derived data, 2) explicit modeling of the underlying hake growth dynamics, and 3) achieving parsimony[2] in terms on model complexity. "Incorporating less derived data" entailed fitting observed data in their most elemental form. For instance, no pre-processing to convert length composition data to age composition data was performed. Also, the incorporation of conditional age-at-length data, through age-length keys for each fishery and survey, allowed explicit estimation of expected growth and dispersion and temporal variability about that expectation, all conditioned on selectivity. The primary goal was to achieve model parsimony without loss of performance in maximum likelihood estimation, and was assessed through a combination of diagnostics, convergence criteria and comparative analysis with MCMC integration. The current assessment implements the hake model in the newest version of SS2 (Ver. 2.00n). The model is updated with fishery data through 2007 and includes estimates of hake biomass and age-length compositions from the recently completed 2007 U.S.-Canada acoustic survey. The model also includes an aging error matrix using nearly 1,000 cross-read otoliths collected since 2001. Efforts have also been made to incorporate uncertainty in acoustic survey catchability coefficient $q$, the acoustic survey selectivity and natural Mortality, M, on ages 13-15+ though numerical integration using Markov Chain Monte Carlo simulation.

**Data Sources**

The data used in the stock assessment model included:

- Total catch from the U.S. and Canadian fisheries (1966-2007).
- Length compositions from the U.S. fishery (1975-2007) and Canadian fishery (1988-2007).
- Age compositions from the U.S. fishery (1973-1974) and Canadian fishery (1977-1987). These are the traditional age compositional data generated by applying

[2] Parsimony is a balance between the number of parameters needed to represent a complex state of nature and data quality/quantity to support accurate and precise estimation of those parameters.

fishery length compositions to an age-length key. Use of this approached was necessary to fill in gaps for those years in which biological samples could not be re-acquired from standard procedures.

- Conditional age-at-length compositions from the U.S. fishery (1975-2007) and Canadian fishery (1988-2007).

- Biomass indices, length compositions and conditional age-at-length composition data from the Joint US-Canadian acoustic/midwater trawl surveys (1977, 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2003, 2005, and 2007). It should be noted that this year's assessment re-incorporates the 1986 acoustic survey biomass estimate and compositional data that which was previously removed upon recommendation by 2004 STAR review (the STAT argued that this was one of the few survey biomass estimates that provided contrast in the time series).

- NWFSC-PWCC midwater juvenile hake and rockfish surveys (2001-2006). A coastwide index of hake recruitment was generated based on data from both the SWFSC and NWFSC-PWCC surveys to account for recent northerly extension of hake recruitment along the coast.

- CalCOFI larval hake production index, 1951-2006. The data source was explored as a potential index of hake spawning stock biomass.

- Aging error matrix based on 1,000 cross-read otoliths

As in the previous hake model, the U.S. and Canadian fisheries were modeled separately. The model also used biological parameters to estimate spawning and population biomass to obtain predictions of fishery and survey biomass from the parameters estimated by the model. These parameters were:

- Proportion mature at length (not estimated in model).

- Population allometric growth relationship, as estimated from the acoustic survey (not estimated in model).

- Initial estimates of growth including CVs of length at age for the youngest and oldest fish (estimated in model).

- Natural mortality (*M,* not estimated in model).

*Total catch*

Table 1 lists the catch of Pacific hake for 1966-2007 by nation and fishery. Catches in U.S. waters for 1966-1980 are from Bailey et al. (1982). Prior to 1977, the at-sea catch was reported by foreign nationals without independent verification by observers. Bailey et al. (1982) suggest that the catch from 1968 to 1976 may have been under-reported because the apparent catch per vessel-day for the foreign feet increased after observers were placed on foreign vessels in the late 1970's. For 1981-2007, the shore-based landings are from Pacific Fishery Information Network (PacFIN). Foreign and joint-venture catches for 1981-1990 and domestic at-sea catches for 1991-2007 are estimated by the NWFSC's At-Sea Hake Observer Program.

At-sea discards are included in the foreign, joint-venture, at-sea domestic catches in the U.S. zone. Discards have been recently estimated for the shore-based fishery but are nominal relative to the total fishery catch. The majority of vessels in the U.S. shore-based fishery operate under experimental fishing permits that require them to retain all catch and bycatch for sampling by plant observers. Canadian joint-venture catches are monitored by at-sea observers, which are placed on all processing vessels. Observers use volume/density methods to estimate total catch. Domestic Canadian landings are recorded by dockside monitors using total catch weights provided by processing plants. Catch data from Canadian JV and domestic fisheries were provided by Greg Workman (DFO, Pacific Biological Station, Nanaimo, B.C.).

*Fishery-dependent Data*

Since the SS2 model uses length compositions and conditional age-at-length compositions, a complete reconstruction of these data inputs was required. Biological information from the U.S. at-sea commercial Pacific hake fishery was extracted from the NORPAC database management system maintained at the Alaska Fisheries Science Center. A query of length, weight and age information yielded biological samples from the Foreign and Joint Venture fisheries from 1975-1990, and from the domestic at sea fishery from 1991-2007. Specifically these data included sex-specific length and age data collected at the haul level by observers, where random samples of fish lengths from a known sampled haul weight and otoliths are then collected on a length-stratified basis. Detailed sampling information including the numbers of hauls sampled, lengths collected, and otoliths aged in the Foreign, JV and domestic at-sea fisheries are presented in Table 2.

Biological samples from the U.S. shore-based fishery were collected by port samplers from ports with substantial landings of Pacific hake: primarily Newport, Astoria, Crescent City, and Westport, from 1991-2007. Port samplers routinely take one sample per offload or trip in the port consisting of 100 randomly selected fish for individual length and weight, and 20 random samples per offload for otolith extraction and subsequent aging. It should be noted that the sampling unit here is the trip rather than the haul as in the case of the at-sea fishery. Since detailed haul-level information is not recorded on trip landings documentation in the shore-based fishery, and hauls sampled in the at-sea fishery can not be aggregated to a comparable trip level, there is no least common denominator for aggregating at-sea and shore-based fishery samples. As a result, samples sizes were simply summed over hauls and trips for U.S. fishery length- and age-compositions, however each fishery was weighted according to the proportion of its catch.

The Canadian domestic shore-based fishery is subject to 10% observer coverage. On observed trips, an otolith sample is taken from the first haul of the trip with associated length information, followed by length samples on subsequent hauls. For unobserved trips, port samplers obtain biological data from the landed catch. Observed domestic haul-level information is then aggregated to the trip level to be consistent with the unobserved trips that are sampled in ports. Sampled weight of the catch from which biological information is collected must be inferred from year-specific length-weight relationships. Canadian domestic fishery biological samples were only available from 1996-2007, and detailed sampling information is presented in Table 3.

For the Canadian at-sea Joint Venture fishery, an observer aboard the factory ship records the codend weight for each codend transferred from companion catcher boats. However, length samples are only collected every second day of fishing operations, and an otolith sample is only collected once a week. Length and age samples are taken randomly from a given codend. Since sample weight from which biological information is taken is not recorded, sample weight must be inferred from a weight-length relationship applied to all lengths taken and summed over haul. Length and age information was only available from the Joint Venture fishery from 1988-2007. As in the case with the U.S. at-sea fishery, the basic sampling unit in the Canadian Joint Venture fishery is assumed to be a haul. Detailed sampling information for the Canadian Joint Venture fishery is also presented in Table 3.

The length and age data were analyzed based on the sampling protocols used to collect them, and expanded to estimate the corresponding statistic from entire landed catch by fishery and each year that sampling occurred. In general, the analytic steps can be summarized as follows:

1) Count lengths (or ages) in each size (or age) bin (1 cm/year) for each haul in the at-sea fishery and for each trip in the shore-based fishery, generating "raw" frequency data.
2) Expand the raw frequencies from the haul or trip level to account for the catch weight sampled in each trip.
3) Expand the summed frequencies by fishery sector to account for the total landings.
4) Calculate sample sizes (number of samples and number of fish within sample) and normalize to proportions that sum to unity within each year.

To complete step (2), 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 corresponding to the ratio of the total catch weight in a haul or trip divided by the total sampled weight from which biological samples were taken within the haul or trip. In cases where there was not an estimated sample weight (more common in the Canadian domestic shore-based trips), a predicted weight of the sample was computed by applying a year-specific length-weight relationship to each length in the sample, then summing these weights. Anomalies that could emerge when very small numbers of fish lengths are collected from very large landings were avoided by constraining expansion factors to not exceed the $95^{th}$ percentile of all expansion factors calculated for each year and fishery. The expanded lengths (N at each length times the expansion factor for the sample) were then summed within each fishery sector, and then weighted a second time by the relative proportion of catches by fishery within each year and nation. Finally, the year-specific length frequencies were summed over fishery sector and normalized so that the sum of all lengths in a single year and nation was equal to unity.

Tables 4 and 5 provide a detailed sampling summary, by fishery and nation, including the number of unique samples (hauls in the JV fishery and trips in the domestic fishery) by year and other sampling metrics of the relative efficiency of sample effort. Ultimately, the total sample size (# samples) by year is the multinomial sample size included in the stock assessment model. In both the U.S. and Canada, at-sea biological samples are collected at the haul level while shore-based samples are collected at the trip level. Tables 4 and 5 provide comparisons of sampling levels relative to the total sector catches in each country. In recent U.S. fisheries, between 9% and 16% of all shore-based catch has been sampled, compared to 40% to 60% of the at-sea catch. In both cases, fraction sampled has increased over time. Between 2000 and 2007, a sample was taken, on average, once per 575 mt of hake caught in the shore-based fishery, compared to once per 45 mt of catch in the at-sea fishery. Sample sizes for conditional age-at-length compositions for the U.S. and Canadian fisheries are given in Tables 6 and 7, respectively.

U.S. fishery length and implied age compositions representing fish caught in both the at-sea and shore-based fisheries are shown in Figures 3-4 and Figure 5-6, respectively. Implied age compositions represent the proportions at age from collapsing the conditional age at length compositions over the length margin (appropriately weighted). It should be noted that there are some differences in the length compositions between the at sea and shore-based domestic fisheries, suggesting that future attempts should be made to model them separately. In general, the composite U.S. fishery length and age compositions confirm the well known pattern of year-class strengths, including the dominant 1980 and 1984 and secondary 1970, 1977 and 1999 year classes moving through the size structure (Figure 4). The most recent length and age compositional data from the 2007 U.S. fishery also indicate the presence of a 2003 and 2005 year class. These relationships suggest that the sizes of hake, which are vulnerable to the U.S. fishery, have changed over time, possibly due to growth, selectivity or both. This is particularly evident with the appearance of larger fish before 1990 and a shift to smaller fish between 1995 and 2000. These features are explored in the population dynamics model.

As with the U.S. fleet sectors, differences in length compositions between the Canadian Joint-venture and domestic fleets among some of the years warrant exploration of fitting the fisheries separately. This, however, was not done in this assessment due to time limitations. The composite Canadian fishery length compositions (Figures 7 and 8) and age compositions (Figures 9 and 10) indicate that the Canadian fleets exploit larger and presumably older hake. A particularly interesting feature of these length compositions is that the Canadian fleet prosecuted a seemingly fast growing 1994 year class of hake in 1995 (age 1), 1996 (age 2) and subsequent years. It is unclear whether this is due to size- vs. age-based selectivity; however, it is well known that larger (and older) hake migrate further northward annually (Dorn, 1995). In recent year the 1999 year class has dominated the catch of the Canadian fleets. As in the U.S. fishery, Canadian length compositions show some temporal pattern in the range of fish exploited by the fishery (Figure 8).

U.S. and Canadian fishery conditional age-at-length compositions constitute the bulk of compositional data in this assessment and provide information on recruitment strength, growth and growth variability. As such the model is actually fitting the conditional age-at-length compositions, but fits are shown to the "implied" age compositions (fits are simply collapsed in the margin of proportions at age) for convenience. Since age-composition data used in the old hake assessment extended further back in time than the conditional age-at-length data generated here, the older data were also included in the assessment model to augment information on recruitment earlier in the time series (U.S. fishery = 1973-1974, Canadian fishery=1977-1987).

*Triennial Shelf Trawl Survey*

The Alaska Fisheries Science Center has conducted a triennial bottom trawl survey along the west coast of North America between 1977-2001 (Wilkins et al. 1998). In 2003, the Northwest Fisheries Science Center took responsibility for the triennial bottom trawl survey. Despite similar seasonal timing of the two surveys, the 2003 survey differed in size/horsepower of the chartered fishing vessels and bottom trawl gear used. For this reason, the continuity of the shelf survey remains to be evaluated. In addition, the presence of significant densities of hake both offshore and to the north of the area covered by the trawl survey limits the usefulness of this survey to assess the hake population. Moreover, bottom trawl used in the survey is limited in its effectiveness at catching mid-water schooling hake. For these reasons the triennial shelf trawl survey is presently not used in the assessment. However, age composition data from this survey is used, in conjunction with age composition data from the acoustic survey, to evaluate the selectivity pattern associated with the acoustic survey external to the SS2 model. Results of this analysis are described below.

*Acoustic Survey (Biomass, length and age composition*)

Integrated acoustic and trawl surveys are used to assess the distribution, abundance and biology of coastal Pacific hake, *Merluccius productus*, along the west coasts of the United States and Canada (Fleischer et al. 2005). The Pacific Biological Station (PBS) of the Canadian Department of Fisheries and Oceans (DFO) has conducted annual surveys along the Canadian west coast since 1990. From 1977-2001, surveys in U.S. waters were conducted triennially by Alaska Fisheries Science Center (AFSC). The triennial surveys in 1995, 1998, and 2001 were carried out jointly by AFSC and PBS. Following 2001, the responsibility for the U.S. portion of the survey was transferred to the Fishery Resource Analysis and Monitoring (FRAM) Division of NOAA’s Northwest Fisheries Science Center (NWFSC). Following the transfer, the survey was scheduled on a biennial basis, with joint acoustic surveys conducted by FRAM and PBS in 2003, 2005 and 2007.

The 2007 survey was conducted jointly by U.S. and Canadian science teams aboard the NOAA vessel *Miller Freeman* from 20 June to 19 August, spanning the continental slope and shelf areas the length of the West Coast from south of Monterey California (35.7º N) to the Dixon Entrance area (54.8º N). A total of 96 line transects, generally oriented east-west and spaced at 10 or 20 nm intervals, were completed (Figure 11). During the 2007 acoustic survey, aggregations of coastal Pacific hake were detected as far south as 37º N (Monterey Bay) and extending nearly continuously to the furthest northerly area surveyed at Dixon Entrance. Areas of prominent concentrations of hake included the waters off Point Arena (ca. 39º N) and north of Cape Mendocino, California (ca. 41º N), in the area south of Heceta Bank, Oregon (ca. 44º N). North of the U.S. border, hake which are typically present in the acoustic survey off Vancouver Island, were relatively sparse during the 2007 acoustic survey. Diffuse concentrations were found north of Vancouver Island within waters of the Queen Charlotte Sound (ca. 51º N) and north to Dixon Strait. Mid-water and bottom trawls, deployed to verify size and species composition and collect biological information (i.e., age composition, sex), found that smaller individuals - age-2 fish - were prevalent in the southern portion of their range, but the coastal Pacific hake stock continued to be dominated by representatives of the 1999 year-class (age 8) throughout most of their range, except for the occurrence of numbers of larger Pacific hake in the north.

Pacific hake distribution can be highly variable based on backscatter information from the acoustic survey such and northward migration patterns have been proposed to be related to the strength of subsurface flow of the California Current (Agostini et al. 2006) and upwelling conditions (Benson et al. 2002). Distributions of hake backscatter plotted for each acoustic survey since 1995 illustrate the variable spatial patterns (Figure 12). The 1998 acoustic survey stands out and shows an extremely northward occurrence that is thought to be tied to the strong 1997-1998 El Nino. In contrast, the distribution of hake during the 2001 survey was very compressed into the lower latitudes off the coast of Oregon and Northern California.

As with the fishery data, acoustic survey length and conditional age compositions were used to reconstruct the age structure of the hake population. In general, biological samples taken by midwater trawls were post-stratified based on geographic proximity and similarity in size composition. Estimates of numbers (or biomass) of hake at length (or age) for individual cells were summed for each transect to derive a coast-wide estimate. Details of this procedure can be found in Fleischer et al. (2005). Each sample was given equal weight without regard to the total catch weight. The composite length frequency was then used for characterizing the hake distribution along each particular transect and was the basis for predicting the expected backscattering cross section for Pacific hake based on the fish size-target strength relationship $TS_{db} = 20\log L - 68$ (Traynor 1996.). New target strength work (Henderson and Horne 2007), based on in situ and ex situ measurements, suggests a regression intercept of 4-6 dB lower than that of Traynor. A lower intercept to the TS-to-length regression suggests that an individual hake reflects 2.5-4 times less acoustic energy, implying considerably more biomass than that of Traynor's equation. Both estimates of the TS-to-length regression use night time in situ measurements and hake may have different behavior characteristics than during the daytime. The acoustic survey is conducted during the daytime. The current biomass estimates continue to be based on that of the Traynor's TS-to-length regression, which has been used historically to interpret the acoustic survey data. More careful and accurate *in situ* measurements on hake TS need to be collected *during daytime* when the survey acoustic data are collected, in addition to the investigation of , the depth dependence of the hake TS.  In either case, uncertainty in the TS regression represents another source of uncertainty that is not accounted for in the survey biomass estimates.

Acoustic survey sampling information including the number of hauls, numbers of length taken and hake aged are provided in Tables 8 and 9.  The 2007 acoustic survey size composition shows a dominant peak at 48 cm indicating the persistence of the 1999 year class in the population, and a secondary peak around 33 cm suggests the potential of a 2005 year class (Figures 13-14).  Age compositions shown in Figure 15-16 confirm the strong 1999 year class and the presents of a 2005 year class.  Size and age compositions from the previous acoustic surveys also confirm the dominant 1980 and 1984 year classes present in the mid-1980s to early 1990s.  Proportions at age are given in Figures 15 and 16, and conditional age-at-length proportions are shown in Figure 17.

Based on estimates from the acoustic survey, Pacific hake biomass declined by 31% from 1.8 million mt in 2003 to 1.26 million mt in 2005 (Table 10).  The 2007 biomass estimate of 879,000 mt declined another 30% from 2005.   In general, acoustic survey estimates of biomass indicate that the hake population has varied with little trend from the time of the first survey in 1977 to the most recent in 2007 (Figure 14).  Estimates of variability have been calculated since the 2003 survey based on the Jolly-Hampton estimator (1989) with CVs on the order of 25%. This takes spatial variability of the acoustic backscatter into account but leaves other sources of observation error, including sampling variability (haul to haul variation in size/age) and target strength, unaccounted for.  Error bars shown around point estimates of biomass are not estimated but rather assumed based on reliability of the survey in a given year and are used as input in SS2 (CV=0.5 1977-1989, CV=0.25 1992-2005.

Considerable discussion on assessment uncertainty continues to center on the acoustic survey in both the catchability coefficient, $q$, and the asymptotic vs. dome-shaped selectivity. Dome-shaped selectivity implies a greater proportion of older hake in the population than observed in the survey.  Reasons for dome-shaped selectivity could be due to a number of factors including net avoidance of older hake and differential distribution of older fish near the bottom or at deeper depths.  This was further investigated by comparing the numbers at age in both the acoustic and bottom trawl surveys between 1977-2001, in which data spatially and temporally overlapped.  The sum of at age of hake taken from mid-water and near-bottom hauls in the acoustic survey and from bottom hauls in the triennial bottom trawl survey was assumed to be representative of the underlying population age structure, and was compared with those numbers at age taken from hauls in the acoustic survey.  Results indicate empirical support of an acoustic survey selectivity that is dome-shaped (Figures 19 and 20).  A comparison of the ratio of acoustic survey numbers at age to the sum of the acoustic and triennial bottom trawl survey numbers at age (normalized to have a peak of unit), indicate that only 2 out of the nine years have asymptotic-like selectivity patterns. The remaining nine years show curves that peak at about ages 5-7, decline between 0.2-0.9 at ages 11-13, and further decline between <0.1-0.7 at ages 14-15+.  For ages 14-15+ , the mean is about 0.5 (when normalized) for all years.  The weight of evidence suggests dome-shaped selectivity, although the results are not definitive.

The acoustic survey catchability coefficient, *q*, has historically been quite uncertain. This parameter globally scales population biomass higher if *q* is lower and lower if *q* is higher. Early assessments that used the acoustic survey in age-structure assessments (Dorn et al. 1999) asserted *q*=1.0 and treat the parameter as a fixed quantity (In fact ABCs and OYs until 2003 have been predicated upon that assumption). Helser et al. (2004) conducted a likelihood profile over the value of *q* as well as estimated it freely in the model, and found values of *q* in the range of 0.38 to 0.6, depending on model structure. In general, the best fit to the data is achieved when *q* is estimated to be low; however, low *q*'s for an acoustic survey has been met with some resistance. Since 2005 assessments have presented two models with differing *q*'s in order to bracket the range of uncertainty in the acoustic survey catchability coefficient, *q*. As discussed below, this assessment attempts to integrate out the uncertainty in *q* while incorporating uncertainty in the shape of the acoustic survey selectivity curve.

*Aging Error*

With the transfer of the task to age Pacific hake to the Northwest Fisheries Science Center in 2001, an effort was made to cross-calibrate age reader agreement. Cross-calibration was performed on a total of 900 otoliths collected between 2001-2007 and exchanged between the Cooperative Aging Project (Northwest Fisheries Science Center, NWFSC) and Department of Fisheries and Oceans (DFO). Overall agreement between NWFSC and DFO was 50%, and for ages assigned that were aged within one and two years, the agreement was 76% and 86%, respectively. As expected, agreement among all three labs, NWFSC, DFO and AFSC, was greater for younger fish than for older fish. The results of the cross-calibration were somewhat better than the 2001 comparisons between NWFSC and DFO but poorer than the1998 comparisons between AFSC and DFO. It should be noted that agreement between two age readers at NWFSC was 77%, with 88% agreement on aging within one year. Agreement between NWFSC readers for ages 3-4 and ages 5-7 was 82% and 40%, respectively, with similar results obtained between the NWFSC and DFO labs. When there was no age agreement between the three labs, the NWFSC tended to assign older ages to samples than DFO. Additional comparisons are needed to further calibrate ageing criteria between agencies.

Age-reading error was quantified for use in the stock assessment model according to the maximum likelihood method of Punt et al. (In Press). This method estimates bias and precision of the observed age from the "true" age assuming unbias sample in the observed data. There were insufficient samples to estimate bias; however, precision was estimated and quantified as the standard deviation of observed age from true age. Figure 19 shows the relationship of the standard deviation as a function of true age and suggests that aging imprecision increases as a nonlinear function of true age. This age error matrix (CAP + DFO) was applied to the model for 2001-2007. A similar relationship was estimated, with similar results, for individual age reads by AFSC, based on a large sample of calibration reads between "testers" and production readers. Since 20% of all pre-2001 samples read by AFSC were based on "resolved age" (consensus obtained between a production reader and "tester"), we assumed an aging error twice as precise as that obtained from the recent otolith cross reads (Figure 21). Further research is needed to derive an imprecision matrix based on the statistical properties of production resolved ages.

*Pre-recruit surveys*

NOAA's Southwest Fisheries Science Center (SWFSC) has conducted annual surveys since 1983 to estimate the relative abundance of pelagic juvenile rockfish off central California coast (36.50°–38.33°N). The survey was designed to measure the annual relative abundance of pelagic juvenile rockfishes (*Sebastes* spp.), but also captured YOY Pacific hake (Sakuma et al. 2006). Standardized 15 min midwater trawls with the headrope set at a depth of 30 m were conducted at a series of standard stations with a 9.5 mm mesh liner. The survey was expanded substantially in 2004 to cover a much larger spatial area (i.e., from San Diego to Point Delgada: 32.75°–40.00° N). Since 1999, the NWFSC and Pacific Whiting Conservation Cooperative (PWCC), in coordination with the SWFSC Rockfish survey have conducted an expanded survey to improve targeting of juvenile hake and rockfish. The NWFSC-PWCC pre-recruit survey uses a midwater trawl with an 86' headrope and ½" codend with a 1/4" liner to obtain samples of juvenile hake and rockfish (identical to that used in the SWFSC Juvenile Rockfish Survey). Trawling was done at night with the head rope at 30 m at a speed of 2.7 kt. Some trawls were made before dusk to compare day/night differences in catch. Trawl tows of 15 minutes duration at target depth were conducted along transects at 30 nm intervals along the coast. Stations were located along each transect from 50 m to 700 m bottom depth seaward with hauls taken from bottom depths of 50, 100, 200, 300, and 500 m at each transect. Since 2001, side-by-side comparisons were made between the vessels used for the NWFSC-PWCC and SWFSC survey.

In an effort to obtain a more comprehensive coastwide survey of hake recruitment, a Delta-GLM was applied to catch data from both the SCL and PWCC-NWFSC midwater trawl data. The Delta-GLM approach is a type of mixture distribution analysis which models zero and non-zero information from catch data separately (Pennington 1983, Stefansson 1996). Specifically a logistic regression, which assumes a binomial error model, is used to model the proportion positive, while a lognormal error model is used to model the non-zero catches given a positive catch. The forms of the binomial and lognormal GLMs are:

$$p_i = \log\left[\frac{\pi_{ij}}{(1-\pi_{ij})}\right] = m + \tau_i + S_j + l_k + (S \cdot l_{jk})$$

$$c_i = g(\mu_{ij}) = m + \tau_i + S_j + l_k + (S \cdot l_{jk})$$

where: $m$ is the model intercept, $\tau$ is the year effect, $S$ is the survey effect, $l$ is the latitude (seven discrete 1 degree latitude bins) effect. The survey effect accounts for potential differences between the NWFSC-PWCC survey and SWFSC survey catch data while the latitudinal effect attempts to capture changes in relative abundance of young-of-year hake. In particular, between 2001 and 2004, peak relative abundance shifted from approximately 38 to 42 degrees latitude.

An index of abundance is obtained by taking the product of the inverse link of the year effects for each GLM. Variances were obtained using a numerical procedure in which a Monte Carlo approach (based on 10,000 replicates) was used by taking replicate draws from multivariate normal distributions of the MLE estimates of the mean parameter vector and the variance-covariance matrices.

Trends in the coastwide index and associated 95% intervals are shown in Figure 22 and Table 11a. While the coastwide index does include SWFSC data, the trends in hake recruitment between the coastwide and SWFSC index are comparable for the years of overlap, from 2001 to 2006. Specifically, both indices show large values in 2004 compared to the surrounding years, followed by very low values in 2005 and 2006. Given the brevity of the coastwide time series it is difficult to judge how the magnitude of the values taken from 2001 to 2006 compare on a historical basis. Details of the data used for this analysis are given in Table 11b.

*CalCOFI Ichthyoplankton Survey*

Pacific hake larvae have been routinely collected in the CalCOFI survey (Lo 2007). The survey, which began in 1949, was conducted annually until 1966 and then triennially until 1984. Survey coverage was generally restricted to between San Diego and Point Conception. Beginning in 1985, the survey was resumed annually and coverage, in some years, extended northwards to San Francisco. Lo (2007) has developed a time series of hake larval production, which may be useful for indexing spawning stock biomass. However, recent northward extension of pre-recruit densities suggested by Phillips et al. (2007) may indicated that hake spawn in areas to the north of the CalCOFI survey area. Despite this limitation, we investigated the usefulness of this survey to index the spawning stock biomass of the hake population.

Figure 23 shows a plot of the natural logarithm of hake spawning stock biomass (Helser and Martell. 2007) to the natural logarithm of the daily hake larval production index (Lo 2007) for data between 1966 and 2007. The plot shows a generally positive correlation (r = 0.53) between the larval production index and spawning stock biomass; however, the variability is quite large. Although coefficients of variation vary considerably over the time series, the average, CV=0.52, was assumed constant for modeling. The daily larval production was assumed to index the spawning stock biomass at the beginning of each year and the catchability coefficient, $q$, was estimated both as a linear and nonlinear function (power term on the proportionality) of spawning biomass. Model results given in Figure 23 show the fit to the observed larval production index and illustrate that the larval production index as a measure of spawning biomass has little influence on the fit. While the input CV is 0.52, the resulting root mean square error (RMSE, measure of error between the expected value and observed index) calculated from this index is 2.00. nearly 3*x* higher than the acoustic survey biomass index (RMSE=0.59). The larval production index may be of limited utility as an index of spawning biomass since the model would simply ignore it, due to the large variance, in favor of the other data sources such as the acoustic survey biomass, which are relatively more precise. Therefore, further efforts to include the larval production index in the model were not conducted. However, virgin spawning biomass, external to the SS2 model, was derived as a "ball park" estimate based on a predictive relationship between spawning biomass and larval production index (Figure 23). For this exercise, an estimate of unfished spawning biomass ($SB_{zero}$) was obtained by taking the bias-corrected, back-transformed predicted spawning biomass, based on the average larval production index between 1951-1965, a period prior to heavy exploitation. Unfished spawning biomass was estimated to be roughly 2.0 million mt. This estimate is highly uncertain given the prediction intervals (0.54 million mt - 3.8 million mt), but it does provide a check for results from the SS2 model.

## Biological Parameters

### *Growth*

There is considerable variability in the length-at-age data collected during the acoustic surveys since 1977. The process governing variation in growth may include effects from size-selective fishing, changes in size selectivity over time, and variation in growth rates over time. In order to explore alternative specifications for hake growth within SS2, we fit alternative growth models to the length-at-age data collected in the acoustic surveys (assuming size-selectivity in the acoustic surveys has been constant over time). The first of these models was a simple time-varying growth model, where the growth coefficient (k) was allowed to vary over time. This assumed that all extant cohorts are subject to time varying changes in the metabolic rates (presumably associated with changes in available food). This version of the growth model was implemented in the current assessment in Stock Synthesis 2 (SS2). The second growth model assumed that growth is density-dependent. That is, the density of each cohort determines the overall growth rate and each cohort has its own asymptotic length. The third model was similar to the second model; however, in this case we assumed the growth coefficient (k) to be cohort specific. Details of this analysis are given in Helser et al. (2006).

Temporal variability in hake growth is shown in Figures 24 and 25 in terms of observed lengths at age from the acoustic survey from 1977-2005. Of the three alternative growth models, the model with cohort specific $l_2$ (asymptotic size, SS2 parameterization of the von Bertalanffy growth model) values explains more of the variation in the length-age data than the time varying k model and cohort k model (Figure 24). In particular, cohort based L2 begins relatively high (> 55 cm) prior to 1980 (Figure 24) and then appears to decline rapidly as the very large 1980 and 1984 year class grow. Expected size at age, based on the cohort based L2 parameter, is above the expected size for the other models in the 1977, 1980, and 1983 survey data. Likewise, cohort based k declines rapidly between the mid 1970s and mid 1980s (Figure 24). It should be noted that these cohort-based models do not assume the cumulative affects of size-selective fisheries. A similar exploratory growth analysis was conducted on other sources of age data including the acoustic survey (1977-2007), AFSC triennial bottom trawl survey (1977-2003), and the U.S. at sea hake fishery (1973-2006). In particular, a hierarchical von Bertalanffy growth model was fit separately to each data source which treated cohort as a random linear effect with the growth coefficients, $L_\infty$ and $k$. The scale parameter, $t_0$, was estimated as the mean fixed effect. Markov Chain Monte Carlo simulation in WinBUGs (Bayesian inference Using Gibbs Sampling, Thomas et al. 1992; Spiegelhalter et al. 1999) was used to estimate the marginal posterior density of the cohort specific $L_\infty$ and *k* parameters, which were plotted sequentially by cohort (Figure 25). The results illustrate striking consistency in the change in $L_\infty$ and *k* parameters over time (by cohort) from each data source and confirm the observations described above.

A final analysis was conducted, using the same hierarchical model, to investigate differences in sex specific growth of hake. A plot of the bivariate posterior density of 1,000 MCMC samples of $L_\infty$ and *k* reveal that female hake grow to a significantly larger asymptotic size ($L_\infty$) but at as slower rate (*k* ) than males (Figure 26). While the present model does not model hake by sex, future work should consider a separate sex model that may account for differential fishery selectivity by sex. To properly represent the cumulative effects of size-selective fisheries in this approach, the cohort-based growth model should be integrated into the assessment model itself. This would provide a fruitful area of research for improving SS2. In this case it would not be necessary to use the conditional MLE for the numbers at age; this information could be provided from the stock assessment model itself. Since this feature is not currently implemented in SS2, blocks were created aggregating various years in which it was anticipated the cohort affects on growth would be manifested (See *Model Selection and Evaluation* below).

*Size/Age at Maturity*

The fraction mature by size was estimated using data from Dorn and Saunders (1997) with a logistic regression. These data consisted of 782 individual ovary collections based on visual maturity determinations by observers. The highest variability in the percentage of each length bin that was mature within an age group occurred at ages 3 and 4, with virtually all age-one fish immature and age 4+ hake mature. Within ages 3 and 4, the proportion of mature hake increased with larger sizes such that only 25% were mature at 31 cm while 100% were mature at 41 cm. Maturity in hake probably varies both as a function of length and age, however, for the purposes of parameterizing SS2 the logistic regression model was fit as a function of length. Maturity proportions by length are shown in Figure 27. Less then 10% of the fish smaller than 32 cm are mature, while 100% maturity is achieved by 45 cm.

*Natural mortality*

The natural mortality currently used for Pacific hake stock assessment and population modeling is 0.23. This estimate was obtained by tracking the decline in abundance of a year class from one triennial acoustic survey to the next (Dorn et. al 1994). Pacific hake longevity data, natural mortality rates reported for Merluciids in general, and previously published estimates of Pacific hake natural mortality indicate that natural morality rates in the range 0.20-0.30 could be considered plausible for Pacific hake (Dorn 1996). We also considered Hoenig's (1983) method for estimating natural mortality (M) , assuming a maximum age of 22 (attributing a single observation at age 25 to ageing error or anomaly), The relationship between maximum age and M was recalculated using data available in Hoenig (1982) and assuming a log-log relationship (Hoenig, 1983),while forcing the exponent on maximum age to be -1. The recalculation was done so that uncertainty about the relationship could be evaluated, and the exponent was forced to -1 because theoretically, given any proportional survival, the age at which that proportion is reached is inversely related to M (when free the exponent is estimated , to be -1.03). The median value of M via this method was 0.193. Two measures of uncertainty about the regression at the point estimate were calculated. The standard error, which one would use assuming that all error about the regression is due to observation error (and no bias occurred) and the standard deviation, which one would use assuming that the variation about the regression line was entirely due to actual variation in the relationship (and no bias occurred). The truth is undoubtedly somewhere in between these two extremes (while not addressing the bias question). The value of the standard error in log space was 0.094, translating to a standard error in normal space of about 0.02. The value of the standard deviation in log space was 0.571, translating to a standard deviation in normal space of about 0.1. Thus Hoenig's method suggests that a prior distribution for M with mean of about 0.2 and standard deviation between 0.02 and 0.1 would be appropriate if it were possible to accurately estimate M from the data, all other parameters and priors were correctly specified, and all correlation structure was accounted for (note that SS2 does not currently allow for priors in log-normal space). The fixed value of M which is used in the current model (0.23) is about two standard errors from Hoenig's point estimate (0.193), while still being far less than the model estimate when M is free constrained by either of the above priors (> 0.30 in all three cases).

**Model description**

This assessment used the Stock Synthesis modeling framework written by Dr. Richard Methot at the NWFSC (SS2 Version 2.00n, Methot 1989). The Stock Synthesis application provides a general framework for the modeling fish stocks that permits the modeling of population dynamics to vary in complexity, in response to the quantity and quality of available data. In this regard, both complex and simple models were explored as part of this assessment. The Pacific hake population is assumed to be a single coastwide stock along the Pacific coast of the United States and Canada. As in the previous model, sexes are combined in the current model in representing the underlying dynamics and in all data sources where this was possible: growth and fishery and survey size/age compositions. The accumulator age for the internal dynamics of the population was set at 15 years, well beyond the expectation of asymptotic growth. The length structure ranged from 20 cm to 70 cm. The years explicitly modeled were 1966-2007 (last year of available data). Initial population conditions were assumed to be in equilibrium prior to the first year of the model. No initial fishing mortality was estimated and the spawning biomass was assumed equal to Bzero in 1966, preceding the advent of the distant water fleets during the mid-to-late 1960s. The level of hake removals prior to 1966 is unknown, but there were no directed commercial fisheries for hake until the arrival of foreign fleets in the mid to late 1960s.

The following narrative of the model structure is accompanied by the detailed parameter specifications and assumptions found in Table 12. The assessment model includes two national fisheries: US and Canadian trawl fisheries. Arguably, the U.S. at-sea and shore-based fisheries, as well as the Canadian JV and domestic fisheries could be modeled separately for reasons mentioned above. However, in this assessment each nation's fleets were combined and implicitly assumed to have the same selectivity patterns. The selectivity curves for the acoustic survey and the U.S. and Canadian fisheries were assumed to be dome-shaped and modeled as a function of age using the double logistic function (option 19 in SS2). These fishery selectivity curves were also allowed to vary over time to account for temporal changes in fishery operations (distant water fleets, domestic fleets, etc.) and shifts in selectivity as the fishery focused exploitation on abundant cohorts.

The wealth of conditional age-at-length data from the commercial fleets and acoustic survey provided a great deal of flexibility in modeling potential changes in growth curves over time. The comparative analysis used a 'random walk' approach to growth, but it was felt that this approach might be over-parameterized since empirical examination of the growth parameters outside the model suggested a pattern of discrete changes between multi-year periods. Preserving some degree of temporal variability was clearly warranted, since specifying growth as time-invariant resulted in a decline of roughly 1,000 likelihood units in the objective function, relative to the random-walk structure. Through an iterative process of gradually increasing the size of adjacent-year blocks and examining residuals, a block structure was developed that sacrificed little in the value of the objective function and seemed consistent with empirical observations. Two blocks were used for the L2 parameter, 1966-1983 and 1984-2007, which allowed the model to account for the larger asymptotic fish size and the general prevalence of larger observed during the early period. Three blocks were used to partition the growth parameter k: 1966-1980, 1981-1986, and 1987-2007. The middle period was intended to allow the model accommodate the slightly smaller body size of age 4-6 year old fish during those years. The temporal structure of hake growth in terms of the expected size at age is (Figure 24) characterized as an early period from 1966 to the early 1980s where expected maximum size (i.e., L2) is high relative to the subsequent period from the mid 1980s to 2007, with a decline in growth rates (i.e., smaller expected size at age for ages 4-6) during the early-to-mid 1980s. In the most recent block, 1987-2007, growth returns to near baseline rates but the expected maximum size is lower.

In modeling temporal changes in fishery selectivity, we employed the same approach and developed a block structure that seemed consistent with the empirical data. In particular, both the U.S. and Canadian fisheries consisted of four discrete temporal blocks. For the U.S. fishery, separate selectivity functions (for both the ascending and descending limb) were estimated for the periods: 1966-1983, 1984-1992, 1993-2000, and 2001-2007. Selectivity functions for the Canadian fishery (ascending limb only allowed to vary through time) were estimated for the periods: 1966-1994, 1995-2000, 2001-2002, and 2003-2007.

For the base case model, as well as the previous models, instantaneous natural mortality (M) is assumed to be time-independent and equal to 0.23 $y^{-1}$, and allowed to increase on ages 13-15+. A prior distribution was used on the offset parameter as specified in Table 12. We also conducted a profile likelihood over values of M. The stock-recruitment function was a Beverton-Holt parameterization, with the log of mean unexploited recruitment estimated. When freely estimated, the steepness parameter is close to the upper limit of 1.0, thus implying that recruitment is independent of the level of spawning biomass. However, for this assessment a beta prior for steepness was developed based on the median (0.79), 20th (0.67) and 80th (0.87) percentiles from Myers et al. (1999) meta-analysis of the family Gadidae. Year-specific recruitment deviations were initially estimated from 1967-2007 but revised based upon inspection of the standard deviation of the deviations. This structure was based upon inspection of year-specific standard deviations relative to the input value of $sigma_R$.

The constraint and bias correction standard deviation, $sigma_R$, is treated as a fixed quantity in SS2. Typically, the value is derived through an iterative process of adjusting the input value corresponding to the minimal difference between the root mean squared error (RMSE) of the predicted recruitment deviations and the input value. This ensures that the approximate bias-correction term will be appropriately and internally consistent for predicted recruitments estimated in the model and projected forward in time. Initial model runs began with the value used in the 2007 hake model: $sigma_R = 1.13$. In addition, input sample sizes were iterated by examining the relationship between effective sample size estimated in the model and the observed input sample sizes.

Maturity of Pacific hake was assumed to have a logistic functional form, increasing sigmoidally to an asymptote as a function of size (Figure 28). Fecundity (spawning output) was assumed to be a function only of mass and equivalent in form to the maturity-at-length relationship (Figure 28). Individual growth was modeled for combined sexes and based on the von Bertalanffy growth function. All von Bertalanffy growth parameters, including the growth coefficient k, length at minimum age, length at maximum age (15 years old), CVs of size at age, as well as time blocks describing changes in some parameters, were estimated within the model. The explicit temporal parameterization is shown in Table 12.

Multinomial sample sizes for the length composition and conditional age at length data used in this assessment are based on the number of hauls or trips sampled for the commercial at sea and shore-based fisheries, respectively, and the number of tows in the research surveys. Sample sizes for conditional age-at-length data were taken from the number of fish aged. Standard deviations from the survey indices were not adjusted, as the RMSE from preliminary model runs were consistent with the mean of the input standard deviations. The base case model employed equal emphasis factors (lambdas=1.0) for each likelihood component.

## Modeling Results

### *Model Transition*

This assessment transitioned to the newest version of Stock Synthesis (SS2 ver.2.00n) and therefore, a comparison was performed to evaluate differences in model results, if any, from the last assessment (Helser and Martell 2007) in SS2 ver.1.23e using the exact same model structure and data through 2006. The model structure employs temporal variation in growth and fishery selectivity as described earlier, but the reader is directed to Helser and Martell (2007) for specific details. Figure 29 shows estimated trends in spawning biomass and relative depletion from 1966 to 2007. Ver.2.00n of SS2 resulted in slightly lower initial spawning biomass prior to

1984 than compared to ver.1.23e, but both have very similar trends in stock biomass overall. Unfished spawning biomass dropped from 3.56 to 3.21 million mt. A detailed comparison of model output shows slightly lower estimates of mean size at ages 0-3 which are attributable to the new way in which SS2 extrapolates means size as a linear function below the first age specified for growth estimation in the model. Despite the slight differences in spawning biomass between versions, the relative depletion is nearly identical at roughly 32% of unfished biomass in 2007. These results were satisfactory as to warrant a version update of the model.

The model using SS2 ver.2.00n was then updated with data from the 2007 fishery and 2007 acoustic survey. Again, the trend in spawning biomass and relative depletion were quite similar, except that unfished spawning biomass in 1966 was lower (2.97 million mt) and 2007 relative depletion dropped from 32% to 25% (Figure 29). The difference in relative depletion was attributable to the fact that recruitment in 2004, which was predicted by the coast-wide pre-recruit index to be larger than any from 2001-2006 (see Figure 22), did not in fact materialize based on the newest 2007 fishery and acoustic survey data (evident as age 3 hake in the 2007 acoustic survey). This weaker than expected year class translated into less biomass and therefore lower relative depletion. However, recruitment in 2005, which was predicted to be the second lowest between 2001-2006 based on the coast-wide pre-recruit index, appears to be a considerably larger than average based on the 2007 fishery and acoustic survey data (Figure 15). The resulting RMSE for the pre-recruit survey has more than doubled (SE=1.45) since the last assessment and calls into question the utility of the index to reliably predict recruitments that are not well informed by other data in the model.

The final series of model runs focused on comparison of the double normal selectivity curve for the acoustic survey and the double logistic form used in the last assessment, implementation of the aging error matrix (imprecision but not bias), and tuning the input to output sample variances. The purpose of using an age-reading error matrix (imprecision matrix) is to generate the model's expectation of cohort sizes so that there is some probability of assigning an age other than the true age in order to better match the observed age-composition data. Implementing the aging error matrix did in fact improve the model fits to the age-composition data. As a result, the expected the cohort sizes were sharpened, with large year-classes increasing in size and smaller year classes being reduced. The effect on the model result was a reduction in the estimate of logRzero, which translated into a lower estimate of Bzero (from approximately 3 million mt to 2.4 million mt), and increase in 2008 relative depletion from 25% to 31% with an increase in the strength of the 1999 year class (Figure 29). Transitioning to the double normal curve for acoustic survey selectivity gave results nearly identical to those obtained with the double logistic curve. The model including ageing error and the double-normal selectivity specification, which is generally consistent with the model structure and assumptions from the 2007 assessment (i.e. $q$ = 1.0), served as the basis for additional model selection and evaluation.

*Model selection and evaluation*

As previously mentioned, acoustic survey catchability, *q,* and selectivity have been viewed as the principal axes of uncertainty in the hake assessment for a number of years. We explored this uncertainty by conducting likelihood profiles for five different values of the final (age-15) acoustic survey selectivity (final selex = 0.2, 0.4, 0.6, 0.8, 1.0) within five acoustic survey catchability values (*q* = 0.2, 0.4, 0.6, 0.8, 1.0) within five different values of natural mortality (M = 0.21, 0.22, 0.23, 0.24, 0.25). The final selectivity (final selex) defines the degree of curvature in the descending limb of the selectivity curve. Figure 30 illustrates the results of this analysis and shows the response surface of differences in total log likelihood, as well as corresponding estimates of Bzero and 2008 relative depletion, as a function of M, acoustic survey final selectivity and survey catchability. Figure 31 shows the difference in likelihood of the individual data components (size and age compositions) for M=0.23 and Figure 32 shows the difference in likelihood of the acoustic survey biomass index for all values of M profiled against.

The relative difference in total log likelihood (smaller differences imply better fit to the data) changes far more dramatically with changes in final acoustic survey selectivity than with changes in survey catchability; dropping by as much as 400 likelihood units from a curve which is asymptotic to one which is highly dome-shaped. This pattern is consistent over all values of survey catchability included in the profile, suggesting that better model fits are achieved when the selectivity curve is dome-shaped no matter which value of survey q is used. In contrast, the difference in total log likelihood changes very little as a function of survey catchability when profiled against lower values of final selectivity, but suggest better model fits to higher values of q when selectivity is assumed asymptotic. Finally, the response surface of difference in total log likelihood is conserved over the profiled values of natural mortality, but does suggest better model fit with a higher value of M.

While the likelihood profiles suggest that model results are more sensitive to the shape of the selectivity curve than to survey *q* in terms of differences in total likelihood, estimates of Bzero and 2008 relative depletion appears to be sensitive to final selectivity, and perhaps even more so to survey *q*. Using results with M=0.23 to illustrate, Bzero ranges from over 3.5 million mt at low *q* and dome-shaped selectivity to less than 1.0 million mt at high values of *q* and asymptotic selectivity. Correspondingly, relative depletion in 2008 ranges from nearly 80%-100% of unfished biomass at low values of survey *q* to less than 30% under high values of *q*.

These results point to some degree of confounding between survey selectivity, q and M, however, all the individual data components (except perhaps those of the Canadian age compositions) suggest better model fits to a dome-shaped selectivity pattern and lower or intermediate values of survey *q*. Nevertheless, uncertainty regarding the true values of both survey *q* and final selectivity propagates substantial uncertainty upon our understanding of Bzero and the level of depletion.

In the present assessment we attempt to capture the uncertainty associated with the acoustic survey selectivity while at the same time allowing for uncertainty in the survey catchability coefficient, *q*. We initially proposed a base model with two alternatives where the model is fit using the double normal curve (pattern 20) for the acoustic survey selectivity that specifies a range of curvature for the descending limb; final selectivity at age 15+ equals 0.3, 0.5 and 0.7. The two parameters that defined the shape of the ascending limb of the curve were freely estimated as was the acoustic survey catchability coefficient, *q*, for each descending limb selectivity pattern. During the STAR review, February 11-12, 2008, the review panel expressed concern that this approach overstated the uncertainty in model results (95% of 2008 depletion from the two extreme models ranged from 17.5% to 78.2%). As such an alternative model formulation was proposed in which the acoustic survey selectivity curve (both ascending and descending portions) and survey catchability coefficient, *q,* are freely estimated, and that M on older ages, 13-15+, is also estimated with a mildly informative prior ($M_{13\text{-}15+}$ ~ N(0.0.8), Table 12). The STAT agreed with this approach as a better means of quantifying uncertainty and to fully integrate model results using Markov Chain Monte Carlo simulation, described later under

***Model Uncertainty***.

The acoustic survey selectivity was estimated freely but was time invariant. The estimated selectivity curves are shown in Figure 34 with parameter estimates and asymptotic standard deviations in Table 13. The shapes of the selectivity curves for both the U.S. and Canadian fisheries appear to be quite reasonable, even with the apparent temporal shifts in the curves. The U.S. fishery selectivity curves show substantial temporal variation in both the ascending and descending limbs. As might be expected, U.S. fishery selectivity increased on the younger aged fish (ages 3 and 4) as the dominant 1980 and 1984 year classes became vulnerable to exploitation during the mid 1980s to early 1990s. As these cohorts grew into the older age structure and persisted in the fishable stock U.S. fishery selectivity increased on the older ages, seen as an increase in the descending curve in 1993-2006. Canadian fishery selectivity curves also show variability through time (it should be noted that Canadian fishery selectivity curves on older fish were assumed to be the same throughout). As is the case with the U.S., changes in ascending-limb selectivity appear to be associated with availability of a specific year class and its exploitation by the Canadian fleets, which can be observed in the exploitation of the 1994 year class during1995-2000.

Model fits to size-composition data are shown as predicted length frequency distributions, effective vs. observed sample sizes, and Pearson residual plots, and are illustrated separately for the U.S. fishery (Figures 35-37), Canadian fishery (Figures 38-40) and acoustic survey (Figures 41-43). In general, model fits to the U.S. fishery length-frequency distributions show reasonable predictions given the observed data (Figure 35). Predictions seem to be consistent with the observed length compositions in terms of hitting the modes of the distribution and range of sizes exploited. Comparison of observed and calculated effective sample sizes for U.S. fishery length frequencies show no clear relationship, but generally indicate that model fits are as good as expected given the input sample sizes and length frequency data (Figure 66). It should be noted that the input samples sizes shown in Figure 36 for the U.S. length and length-at-age compositions have already been iteratively tuned to 0.3 and 0.5, respectively, of their original input sizes. Some lack of fit does appear to be evident in the U.S. fishery length compositions, but this is generally restricted to the largest sizes, especially in the earlier years (Figure 37).

The model fit the Canadian fishery length composition data slightly less well than the U.S. fishery, but this might not be surprising given the fewer years of data (Figure 38). Predicted length distributions were on the mode for most years with the exception of 2000, 2001, and 2002, suggesting a pool of larger hake was exploited during those years than predicted by the model. The model was also not able to accommodate well the catches of smaller hake in 1995-1998. This suggests that hake spawned in Canadian waters in 1994 and were exploited by the Canadian fleet as young fish. Benson et al. (2002) confirm this pattern of spawning in Canadian waters. This pattern has not been observed in the Canadian fishery during any other period. Despite the lack of fit created by these anomalies, overall the model fit these data as well as expected given the observed data and input sample sizes (Figure 39). Canadian size- or age-composition data did not require iterative re-scaling of input sample sizes. Pearson residuals of length compositions data also illustrate the apparent lack of fit in the mid-1990s and early 2000s (Figure 40).

Predicted lengths for the acoustic survey were also generally on the modes with the observed size compositions. But in a number of years (1980, 1995, and 2005) the model was unable to effectively reproduce the observed bi-modal structure (Figure 41). Comparison of effective vs. input sample sizes suggest that the model fit these data as well as expected, given the observed data and input sample sizes (Figure 42). Figure 33 illustrates model lack of fit, consistent with the model's inability to reproduce the bi-modal structure of the observed size compositions. The 1999 year class in 2007 is fully selected and thus the model fits the modal structure of the size composition well. In contrast, the 2005 year class, evident as 31 cm fish in the 2007 size compositions, is not fit particularly well as these fish are not fully selected to the survey, and the model appears to be splitting the difference in an attempt to fit both a 2003 and 2005 year class.

Given the assumption of age-based selectivity for the fisheries and the volume of conditional age-at-length data, the model generally fits the age data better than the length-composition data. Fits to the implied age compositions and Pearson residual plots are illustrated separately for the U.S. fishery (Figures 44-45), Canadian fishery (Figures 46-47) and acoustic survey (Figures 48-49). Results indicate that the model fit the data as well as expected, given the data and sample sizes (Figure 36, Figure 39, and Figure 42). As with the U.S. fishery length compositions, the U.S. fishery age-composition sample sizes were iterated to 30% of the original input sample sizes. The Canadian and acoustic survey conditional age-at-length compositions were unmodified. The model fit the U.S. fishery age composition (implied) data relatively well, particularly for the series of years that were dominated by the large 1980, 1984, and 1999 year classes. For instance, throughout the early 1980s and 1990s the predicted fits match the age structure of the population as the dominant 1980 and 1984 year class moved through the population (Figure 44). Similarly, the model fits to the observed age compositions since 2003 are particularly good during the time period in which the U.S. fishery has exploited the 1999 year class. During the mid-1990s to early 2000s, when the age compositions lacked any strong year class, the model fits are not as good. However, Pearson residuals for the U.S. fishery do not appear to present any pathologic patterns (Figure 45). Model fits to the Canadian fishery age composition data (Figure 46) show similar patterns and quality as those for the U.S. fishery. In general, the predicted age compositions matched the observed data relatively well during those years when the compositions were dominated by the 1980, 1984 and 1999 year classes. As with the U.S. fishery, Pearson residuals for the Canadian age composition data do not show any evident patterns (Figure 47). Model predictions of the acoustic survey age compositions again show a similar pattern to that illustrated for the U.S. and Canadian fisheries, although fits appear slightly worse (Figure 48). In particular, the model over-estimates the observed size of the 1999 year class between 2001 and 2005 and slightly over estimates the observed strength of the 2005 year class in 2007. Acoustic survey Pearson residuals for the age composition data are shown in Figure 49 and a pattern of negative (under fit) residuals are evident in 2001 and 2003.

The model's fit to the acoustic survey biomass time series seems reasonable given the error structure assumed for the index (Figure 50). Biomass estimates since 1992 are assumed to have less error (CV=0.25) than pre-1992 (CV=0.5) data. During all survey years, the predicted biomasses are within asymptotic 95% confidence intervals, with model fits generally better to the post-1992 survey indices. Prior to 1992, the predicted survey biomass is above the observed data, which is not unexpected given the assumed variance and the influence of other data (compositional data) informing the level of biomass during the mid 1980s. The predicted vs. observed acoustic biomass estimates generally show a linear pattern, and calculated RMSE was approximately 0.58.

*Assessment Model Results*

The predicted time series of hake recruitments, as well as recruitment uncertainty, recruitment deviations from the S-R curve, and yearly estimates of variability are shown in Figure 51. The model estimated very large year classes in 1980 and 1984, with secondary recruitment events in 1970, 1973 and 1977. The 1999 year class was the single most dominate cohort since the late 1980s, and is estimated to be the second largest since 1966. Evidence of an above-average 2005 year class is also present in the data, however its magnitude is subject to greater uncertainty than estimates for most year classes, due to the limited opportunities for observing it. Uncertainty in recruitment can be substantial as shown by asymptotic 95% confidence intervals (Figure 51). Based on the assumption of log-normal error about the mean log recruitment, uncertainty increases with the magnitude of recruitment. Recruitment to age 0 before 1967 is assumed to be equal to mean recruitment, while recruitment from 1967 to 2005 is estimated from the data. Age-0 recruitment in 2005 is predicted to be slightly above average as informed by both the U.S. fishery data and acoustic survey age compositions. This year class was previously predicted to be weak, based on the 2005 coast-wide pre-recruit survey. Furthermore, the 2004 year class that was predicted by the coast-wide pre-recruit survey to be much stronger than indicated in the current assessment. Model results indicate that the coast-wide pre-recruit survey has no better predictive capability (RMSE=1.5) than average recruitment (assumed RMSE=1.13) generated from the S-R curve. The calculated RMSE of recruitment has increased over estimates from last year's assessment, principally due to the increased variability introduced by addition of age-reading error. Except for the actual magnitude of estimated recruitments, the patterns in recruitment deviations and uncertainty are qualitatively the same under the base and alternative models.

Summary of Pacific hake population time trends in 3+ biomass, recruitment, spawning biomass, relative depletion, spawning potential ratio (SPR) and fishery performance are shown in Figures 52-54 for the base. Summary Pacific hake biomass (age 3+) under unfished conditions (< 1966) was estimated to be 5.9 million mt (Table 14). Summary biomass increased briefly during the mid-1970s, as the 1970 and 1973 year classes recruited, then declined briefly until 1980 (Figure 52, Table 14). Summary biomass increased again to the highest level in the time series in 1983 as the very large 1977 and 1980 classes entered the population (Figure 52, Table 14). The hake population then experienced a long period of decline as fishing increased and few large recruitment events occurred between 1985 and 2001. Summary biomass increased by more than 150% between 2001 and 2002 due to recruitment of the 1999 year class, but has subsequently declined in the face of generally poor recruitments since.

Pacific hake spawning biomass trend is similar to that for summary biomass (Figure 53, Table 14). Spawning biomass in 1966 (unfished conditions) was estimated to be 2.89 million mt. It is worthy to note that this estimate is quite close to the 2.0 million mt estimate generated from the CalCOFI larval production index. Spawning biomass declined rapidly after peaking in 1984 (6.5 million mt) to the lowest point in the time series in 2000 (882 thousand mt), followed subsequently by a brief increase to 1.0 million mt in 2003. In 2008 (beginning of the year), spawning biomass is estimated to be 1.1 million mt, and is at 37.9 % (~95% CI range from 21.9% to 53.9%; Figure 53, Table 14) of the unfished level. Approximate asymptotic intervals about the MLE for spawning biomass and recruitment for the entire times series are given in Table 15.

*Reference points (biomass and exploitation rate)*

Because of temporal changes in growth, there are two types of reference points reported in this assessment: those based on the assumed population parameters at the beginning of the modeled time period and those based on the most recent time period in a 'forward projection' mode of calculation. All strictly biological reference points (e.g., unexploited spawning biomass) are calculated based on the unexploited conditions at the start of the model, whereas management quantities (MSY, $SB_{msy}$, etc.) are based on the current growth and maturity schedules and are marked throughout this document with an asterisk (*).

Given the current life history parameters and long term exploitation patterns, the fishing mortality that reduces the spawning potential of the stock to 40% of the unfished level is referred to as F40%, which is the default Pacific Fishery Management Council proxy for $F_{MSY}$ for Pacific hake. Similarly, the proxy for $B_{MSY}$ is spawning biomass corresponding to 40% of the unfished stock size (B40%). Unexploited equilibrium Pacific hake spawning biomass ($SB_{zero}$) from the base model was estimated to be 2.9 million mt (~ 95% confidence interval: 2.23 – 3.56 million mt), with a mean expected recruitment of 4.06 billion age-0 hake (~ 95% confidence interval:

3.23 – 5.11). Associated management reference points for target and critical biomass levels for the base model based on $SB_{40\%}$ proxy are 1.16 million mt (B40%) and 0.72 million mt (B25%), respectively. The MSY-proxy harvest amount (F40%) under the base model was estimated to be 470,910* mt (~ 95% confidence interval: 253,115 - 688,705 mt). The spawning stock biomass that produces the MSY-proxy catch amount under the base model was estimated to be 0.81 million* mt (confidence interval is 0.42 - 1.90)* million mt given current life history parameters.

The full exploitation history under the base and alternative models is portrayed graphically in Figure 54, which plot for each year the calculated spawning potential ratio (1-SPR) and spawning biomass level (B) relative to their corresponding targets, F40% and B40%, respectively. As indicated in Figure 54, the estimated spawning potential ratio for Pacific hake has generally been above both the 40% proxy target MSY and $B_{MSY}$ level in all but one of the assessed years. During the last decade both target reference points have gradually declined as stock biomass decreased under moderately high removals. While SPR has been above proxy target of 40% for Pacific hake, the biomass relative to the B40 reference target dropped briefly below the target in recent years.

*Harvest projections*

Stochastic forecasts were generated assuming the maximum potential catch would be removed under the 40:10 harvest control rule. Projections were based on the relative F contribution from the U.S. and Canadian fishery commensurate with the 73.88% and 26.12% coast wide national catch allocation to the U.S. and Canada, respectively, as specified in the Treaty. Table 16 presents 3-year stochastic projections using catch streams which correspond to the 2008-2010 average catches by slicing the marginal posterior density of 2008 spawning depletion at the 25th, 50th and 75th percentiles. The results of the MCMC posterior sample were combined with the forecasted 2008-2010 catch streams and results summarized as posterior intervals of spawning biomass and spawning depletion. Spawning biomass is expected to increase slightly or stay relatively constant over the next three years if coastwide catches are taken consistent with the 25% and 50% of 2008 spawning depletion. In the extreme case where coastwide catches are taken from the upper 75% percentile of 2008 spawning depletion forecasted spawning biomass will decline from 1.3 million mt in 2008 to 716,000 mt in 2010, and spawning depletion will decline to greater than a 50% probability of being less than the minimum spawning threshold of 25% unfished. Alternative coastwide constant catch scenarios of 250,000, 300,000 (roughly status quo) and 400,000 mt for 2008-2010 are also presented in Table 16. In each case, spawning stock biomass and relative spawning depletion is projected to increase.

*Uncertainty and reliability*

Uncertainty in current stock size and other state variables were explored using a Markov Chain Monte Carlo (MCMC) simulation in AD model builder. Although MCMC has been used mostly in Bayesian applications, it can also be used to obtain likelihood-based confidence regions (Punt and Hilborn 1997). It has the advantage of producing the true marginal likelihood (or marginal distributions) of the parameter, rather than the conditional mode, as with the likelihood profile. For the base case, low and high alternative models, we ran the MCMC routine in ADMB drawing 1,000,000 samples in which one in every 1000$^{th}$ sample was saved to reduce autocorrelation in the chain sequence. Results of the MCMC simulation were evaluated for nonconvergence to the target posterior distribution as prescribed in Gelman et al. (2004). The final samples from the MCMC were used to develop the probability distributions of the marginal posterior of management quantities and were compared to MLE asymptotic estimates of uncertainty.

Convergence diagnostics of selected parameters from the MCMC simulation provided no evidence for lack of convergence in the base model, in either the primary estimated parameters (Figure 55) or derived quantities such as spawning stock biomass and recruitment (Figure 56). In nearly all cases, parameter autocorrelation was less than +/- 0.15. Furthermore, most of the primary parameters or derived variables have a Geweke statistic of less than +/- 1.96 indicating stationarity of the parameter mean. Finally, parameters passed the Heidelberger-Welch statistic test. If this test is passed, the retained sample is deemed to estimate the posterior mean with acceptable precision, while failure implies that a longer MCMC run is needed to increase the accuracy of the posterior estimates for the given variable. Based on the above diagnostic tests the retained MCMC sample appears acceptable for use in characterizing the uncertainty (distribution) of state variables.

Results of the Markov Chain Monte Carlo simulation show the uncertainty in 2008 female spawning biomass and relative spawning depletion (Figure 57). Based on MCMC results there is 50% probability that 2008 spawning biomass is 1.3 million mt, with a corresponding 50% probability that relative spawning depletion is 42.6%. There is less than a .5% probability that 2009 spawning depletion is below minimum biomass threshold of 25% Bzero and a 35% probability of being below 40% Bzero. It should be noted that the MPD (median posterior density) from MCMC simulation of 2008 spawning biomass (1.3 million mt) is slightly greater than the MLE (1.1 million mt) and that MPD relative spawning depletion in 2008 is 42.6% compared to the MLE of 37.9%. This is largely due to the non-symmetric nature of the posterior distributions of state variables from MCMC integration.

A risk analysis was conducted to evaluate the outcomes associated with a range of 2008-2010 catch scenarios. Performance measures included the probability that 2009 SPR is less than the $SPR_{40\%}$ target, the probability of spawning stock biomass declining between 2008 and 2009, and the probability that 2009 spawning stock biomass is below the target and threshold spawning biomass level of 40% and 25% unfished, respectively. Arbitrary 2008-2010 catch streams ranging from 200,000 to 1,400,000 mt were used to forecast stock outcomes and MCMC implemented to calculate risk and posterior intervals. Results or the risk analysis are shown in Figure 58, and show that with respect to the fishing rate target there is a 50% probability that the 2009 SPR will be below the SPR40% target with a catch of 647,000 mt, and a 25% probability with a coastwide catch of 512,000 mt. The probability of 2009 spawning biomass falling into the precautionary zone, less than 40% unfished, remains relatively low (less than 40%) for a range of coastwide catch below 550,000 mt.

Finally a retrospective analysis was conducted by systematically removing the terminal years' data sequentially for six years and re-running the model. Results of this analysis show trends in spawning stock biomass, recruitment to age-0 and spawning depletion in Figure 59. Little to mild retrospective bias is seen when comparing the model results in terms of spawning depletion, which suggests that addition of data year after year may revise the overall scale of biomass (through changes in recruitment) in concert with virgin and ending year biomass levels. Overall recruitment strength seems to be generally revised downward through time by sequentially adding new data. The parameters which affect population scale, most notably acoustic survey catchability *q*, are shown in Figure 60 and illustrate how these estimates are retrospectively revised.

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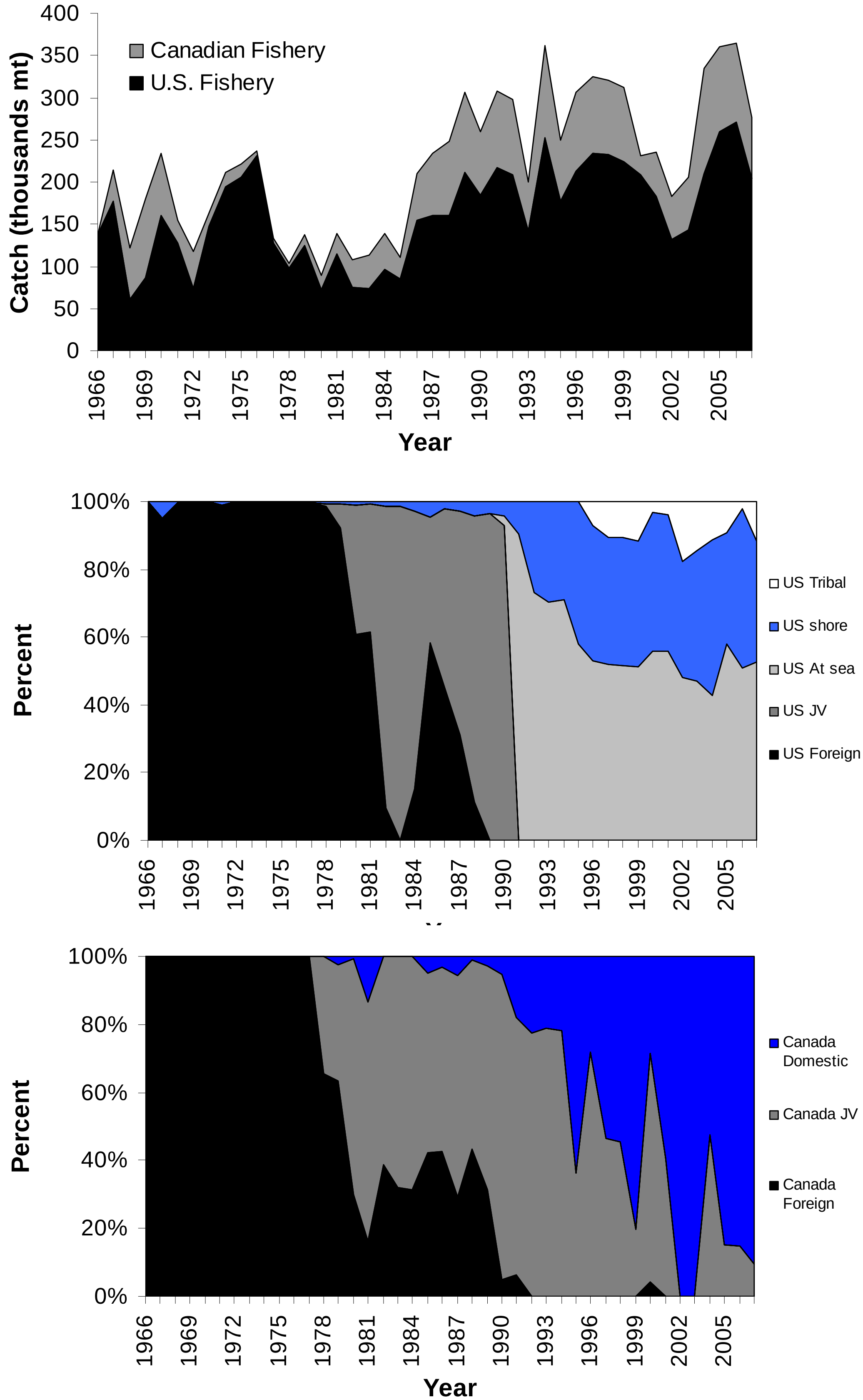



Figure 1. Pacific hake catches by fishery and national fishing sector, 1966-2007.

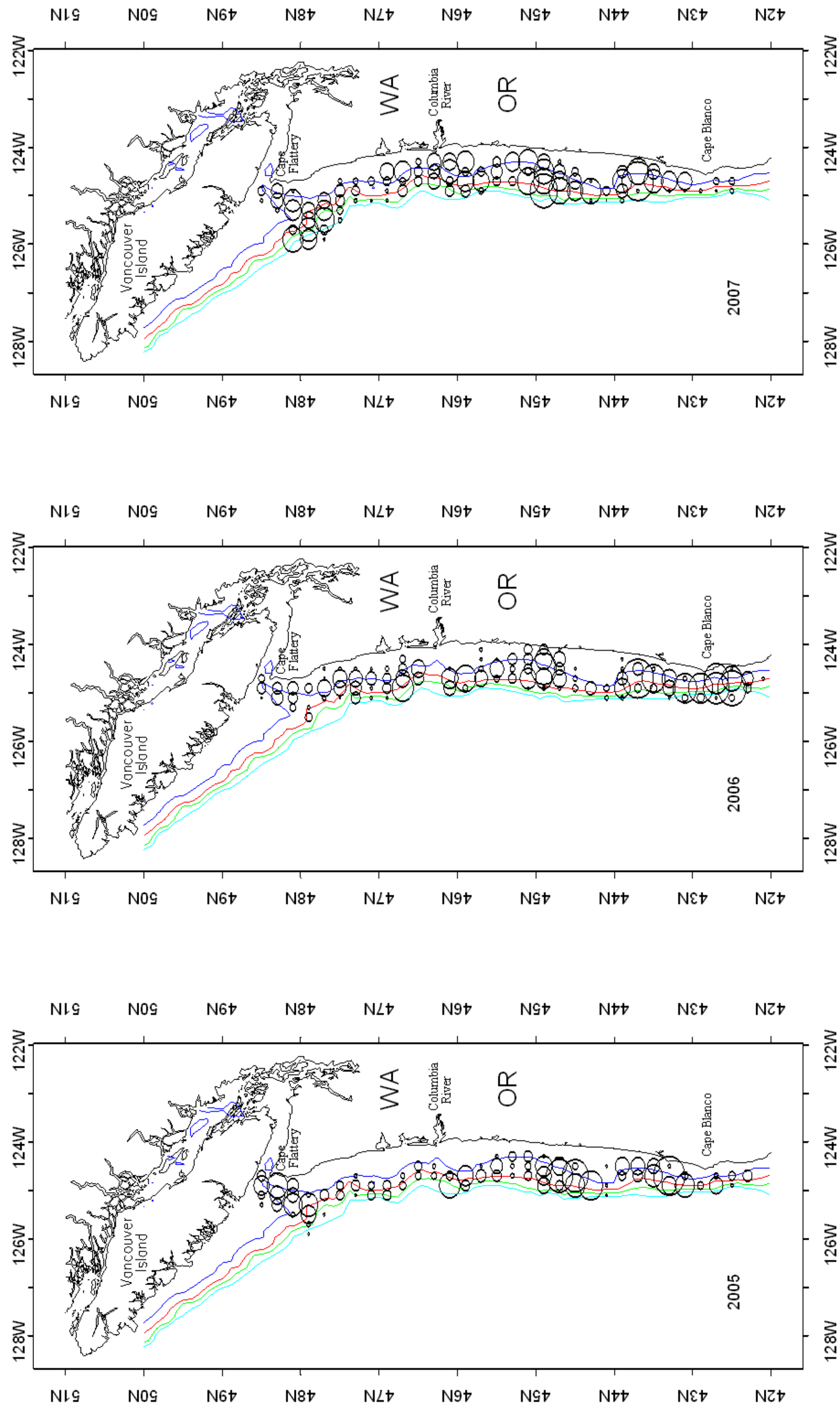



Figure 2. Distribution of at sea Pacific hake catches off the coast of the U.S. in 2005 (bottom), 2006 (middle) and 2007 (top).

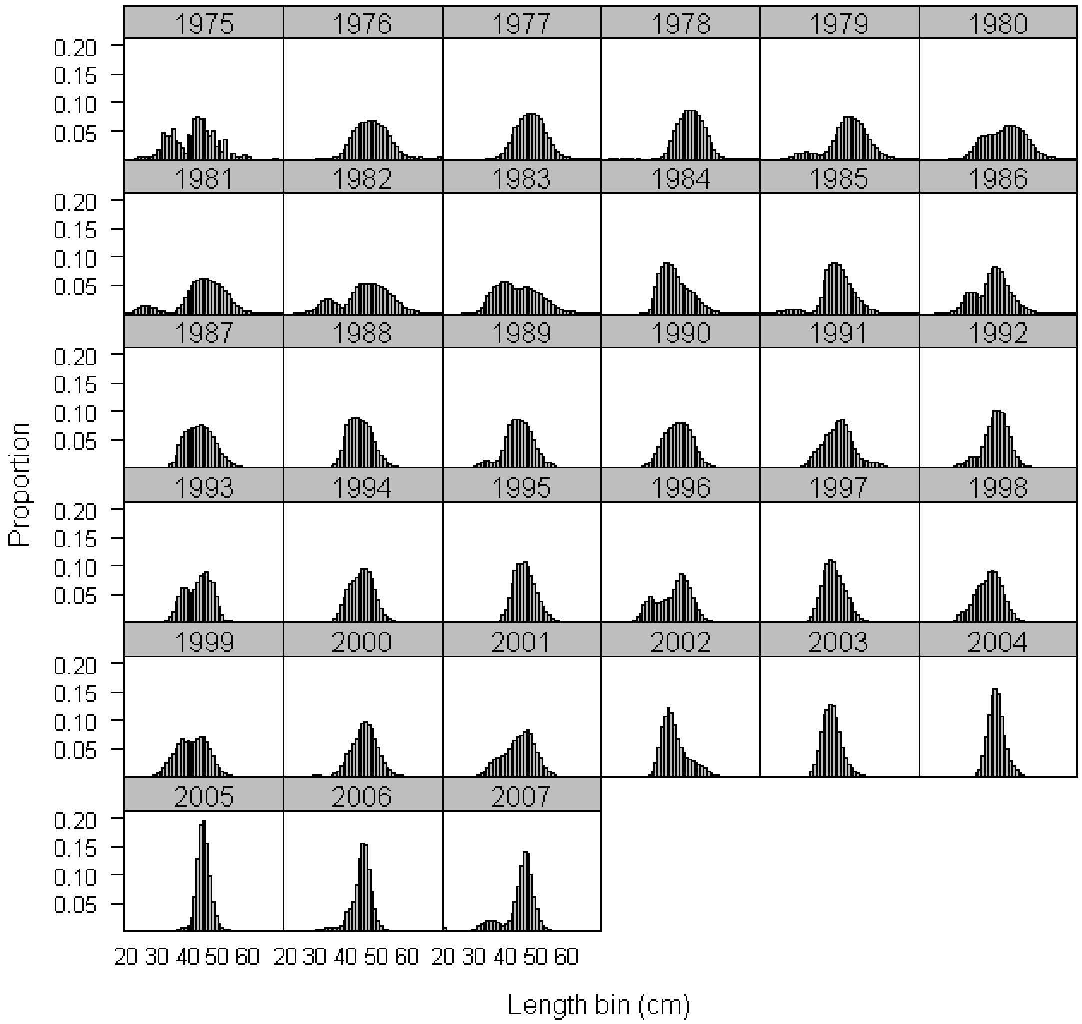



Figure 3. Plot of composite U.S. fishery size compositions of Pacific hake from fisheries operating off the west coast of the U.S., 1975-2007.

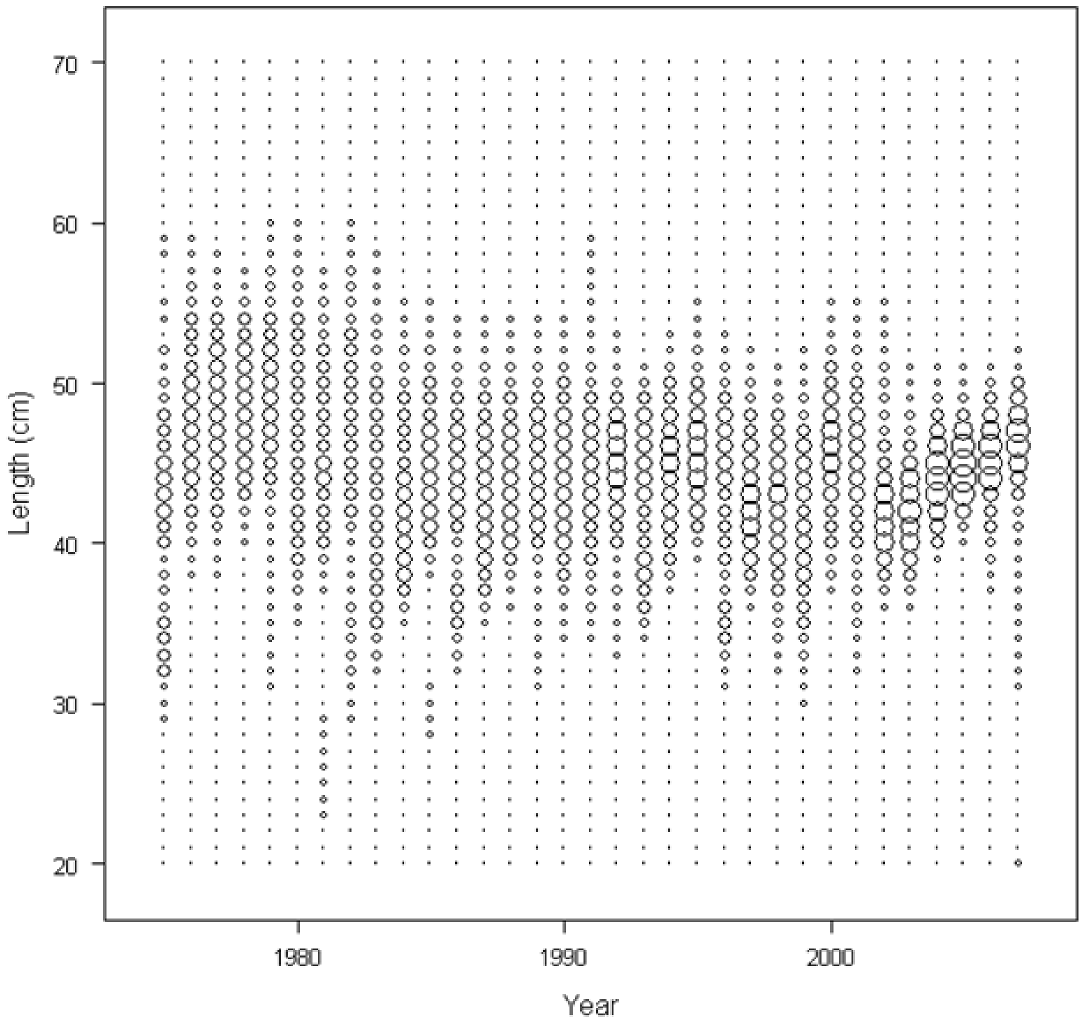



Figure 4. Composite U.S. fishery size compositions of Pacific hake from all fisheries operating off the west coast of the U.S., 1975-2007. Diameter of circles are proportional by year.

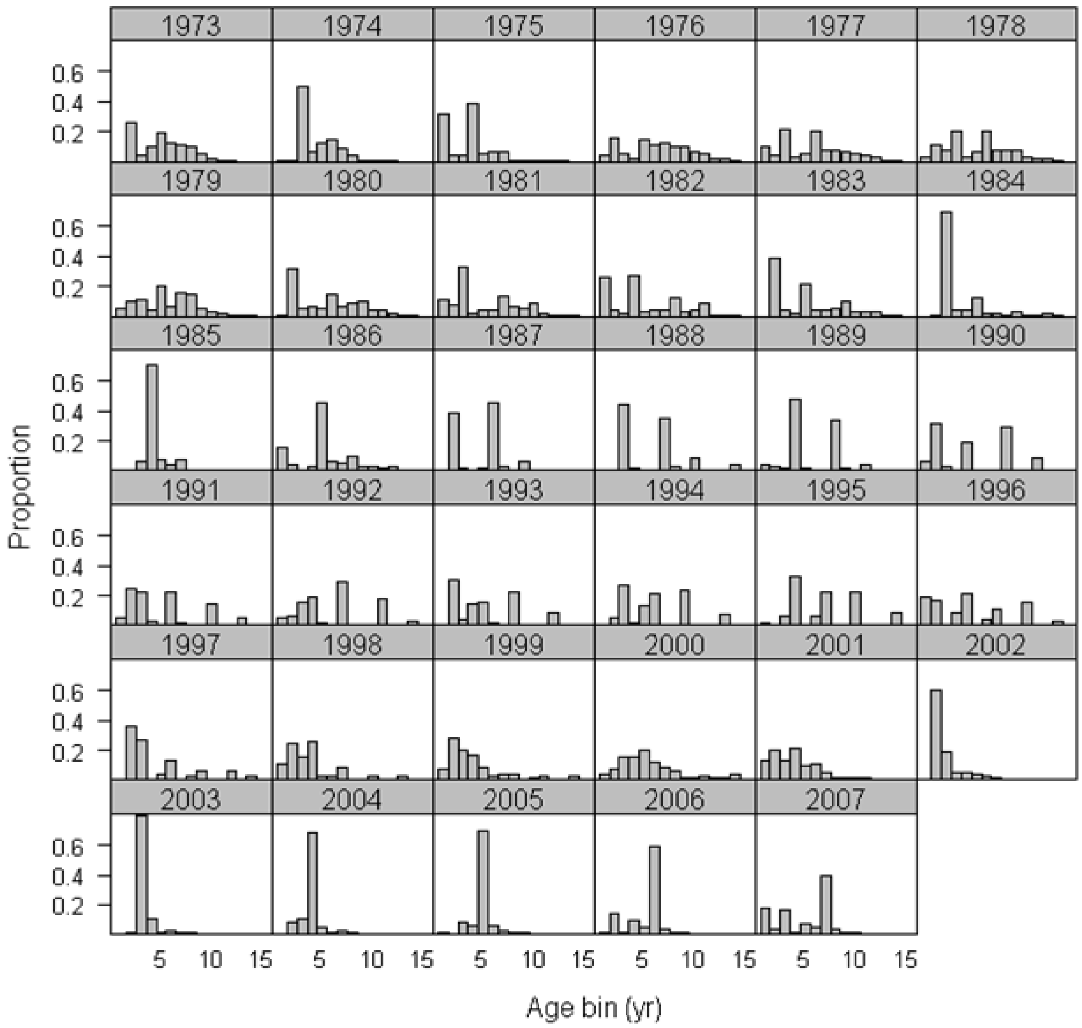



Figure 5. Plot of composite U.S. fishery age compositions of Pacific hake from fisheries operating off the west coast of the U.S., 1973-2007.

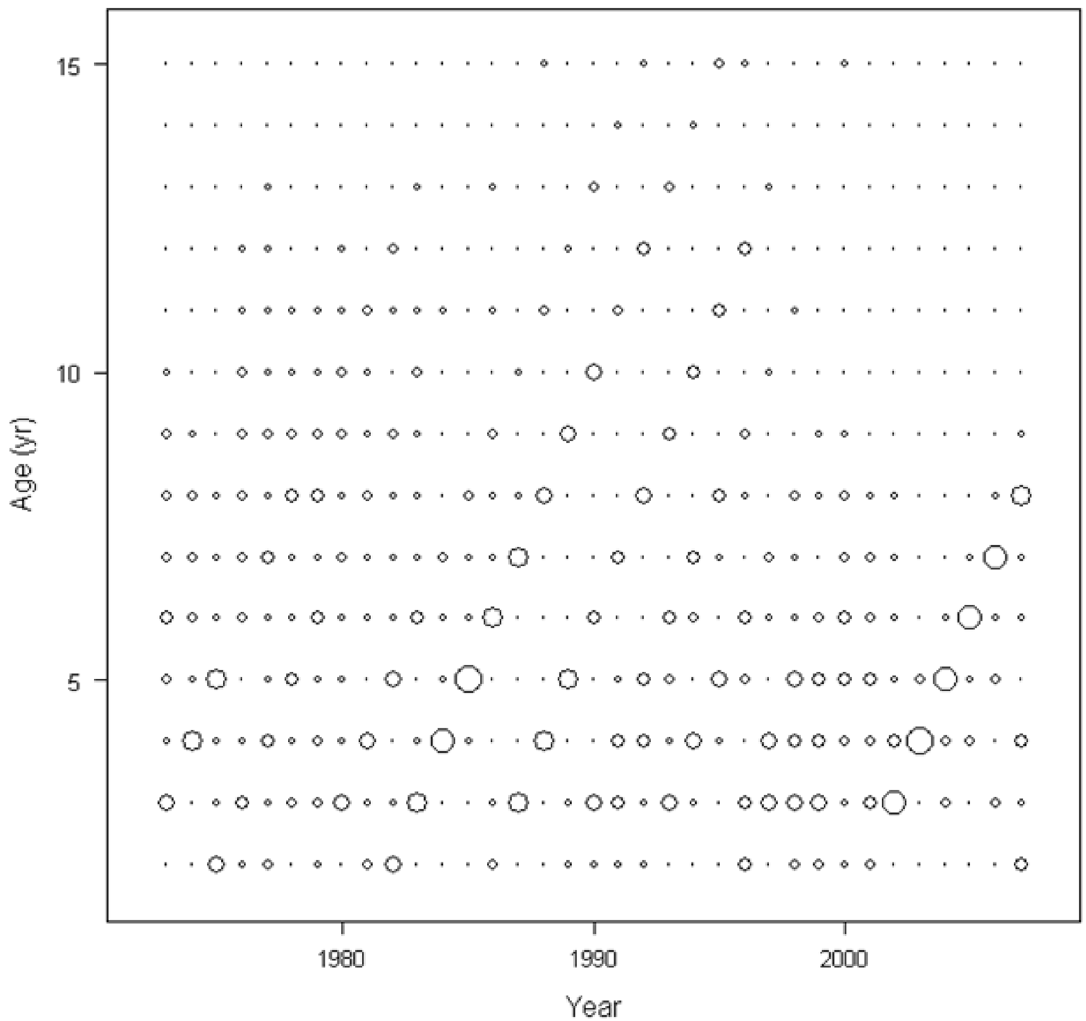



Figure 6. Age compositions of Pacific hake from the U.S. fishery, 1973-2007. Diameter of circles are proportional by year.

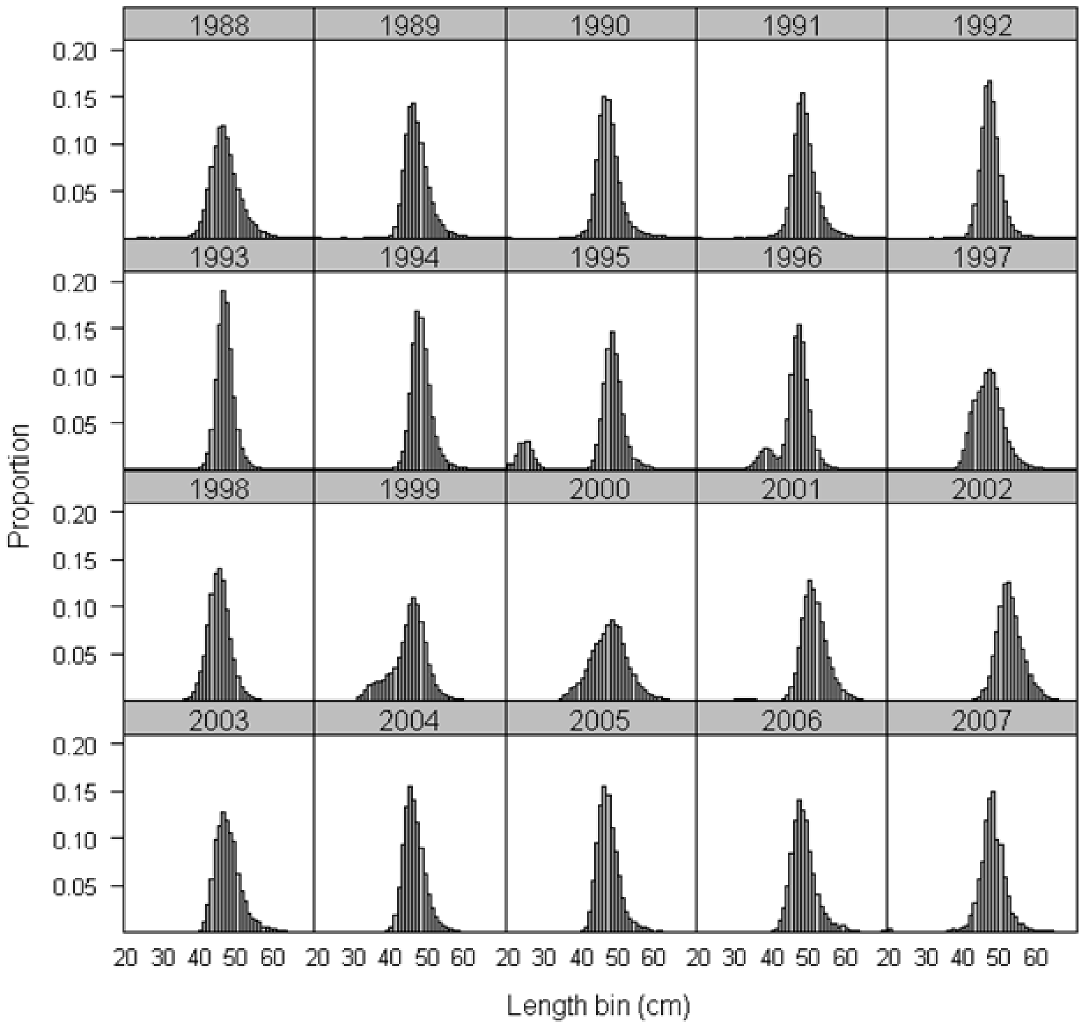



Figure 7. Plot of composite Canadian fishery size compositions of Pacific hake from fisheries operating off the west coast of the U.S., 1975-2007.

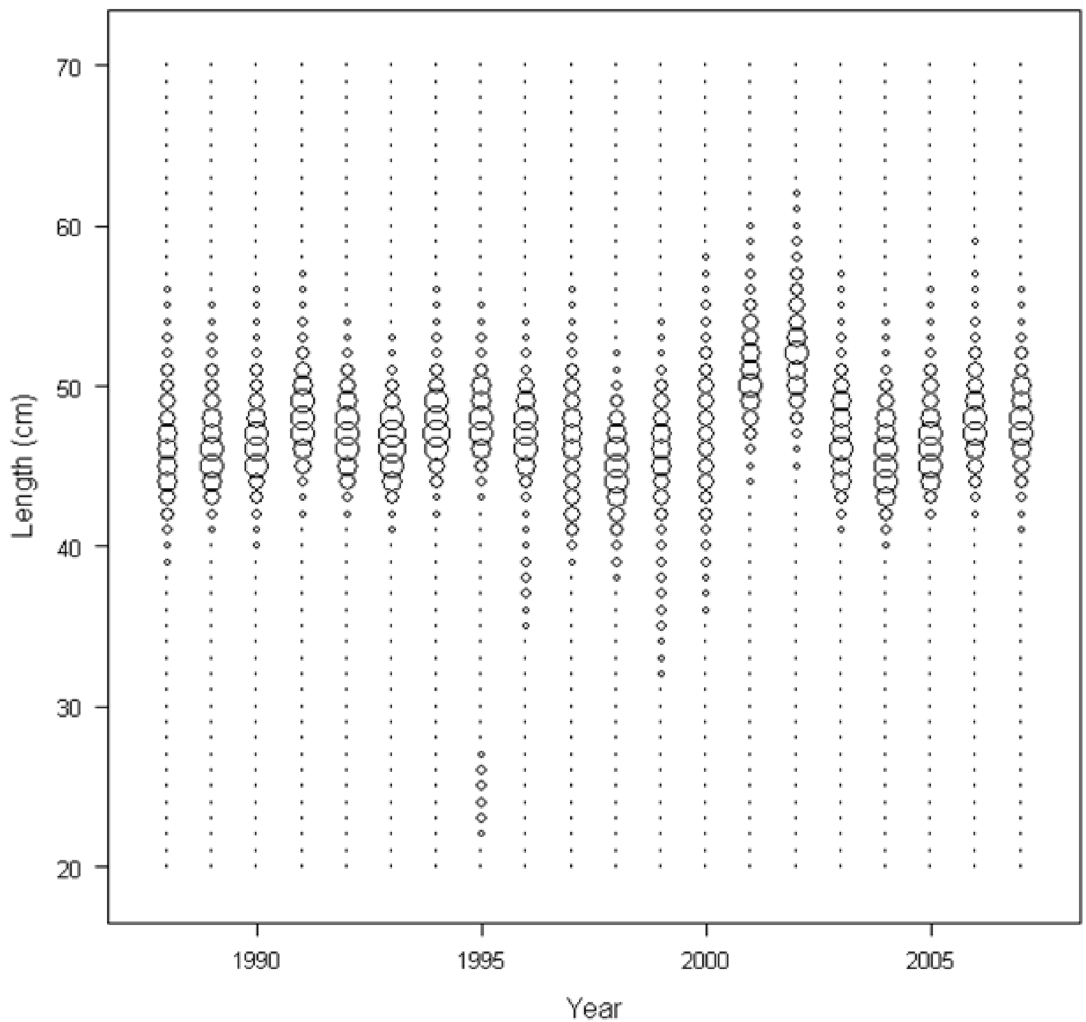



Figure 8. Size compositions of Pacific hake from the Canadian fishery, 1988-2007. Diameter of circles are proportional by year.

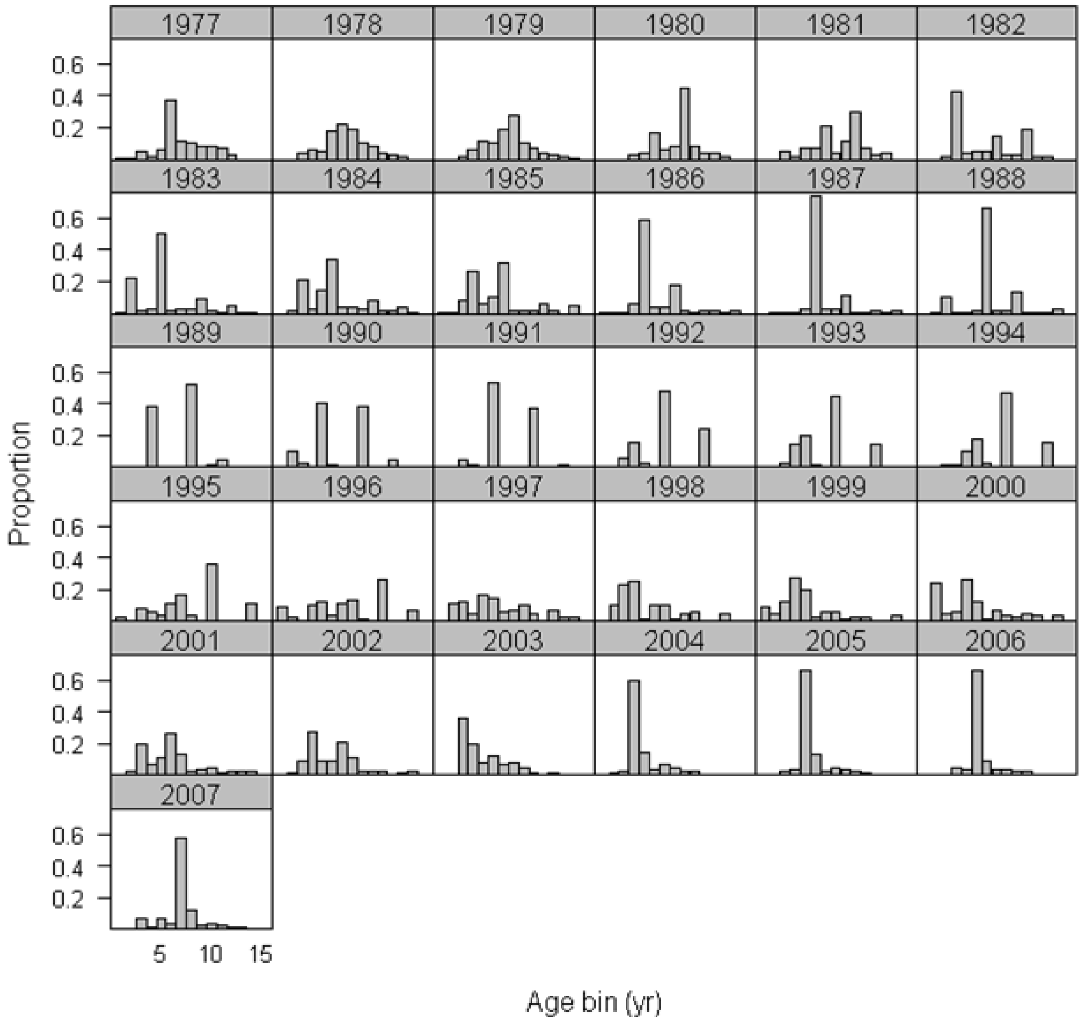



Figure 9. Plot of composite Canadian fishery age compositions of Pacific hake from fisheries operating off the west coast of the Canada., 1977-2007.

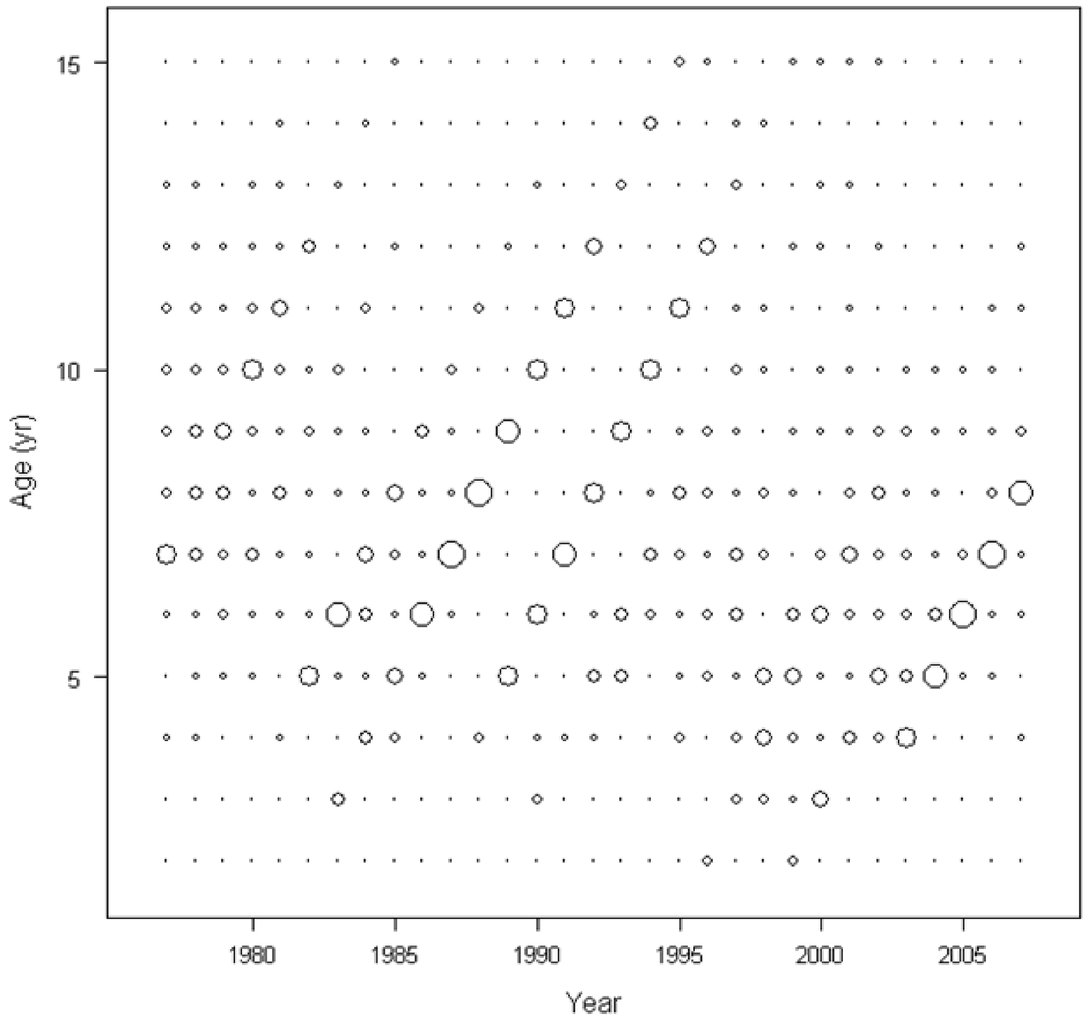



Figure 10. Age compositions of Pacific hake from the Canadian fishery, 1977-2007. Diameter of circles are proportional by year.

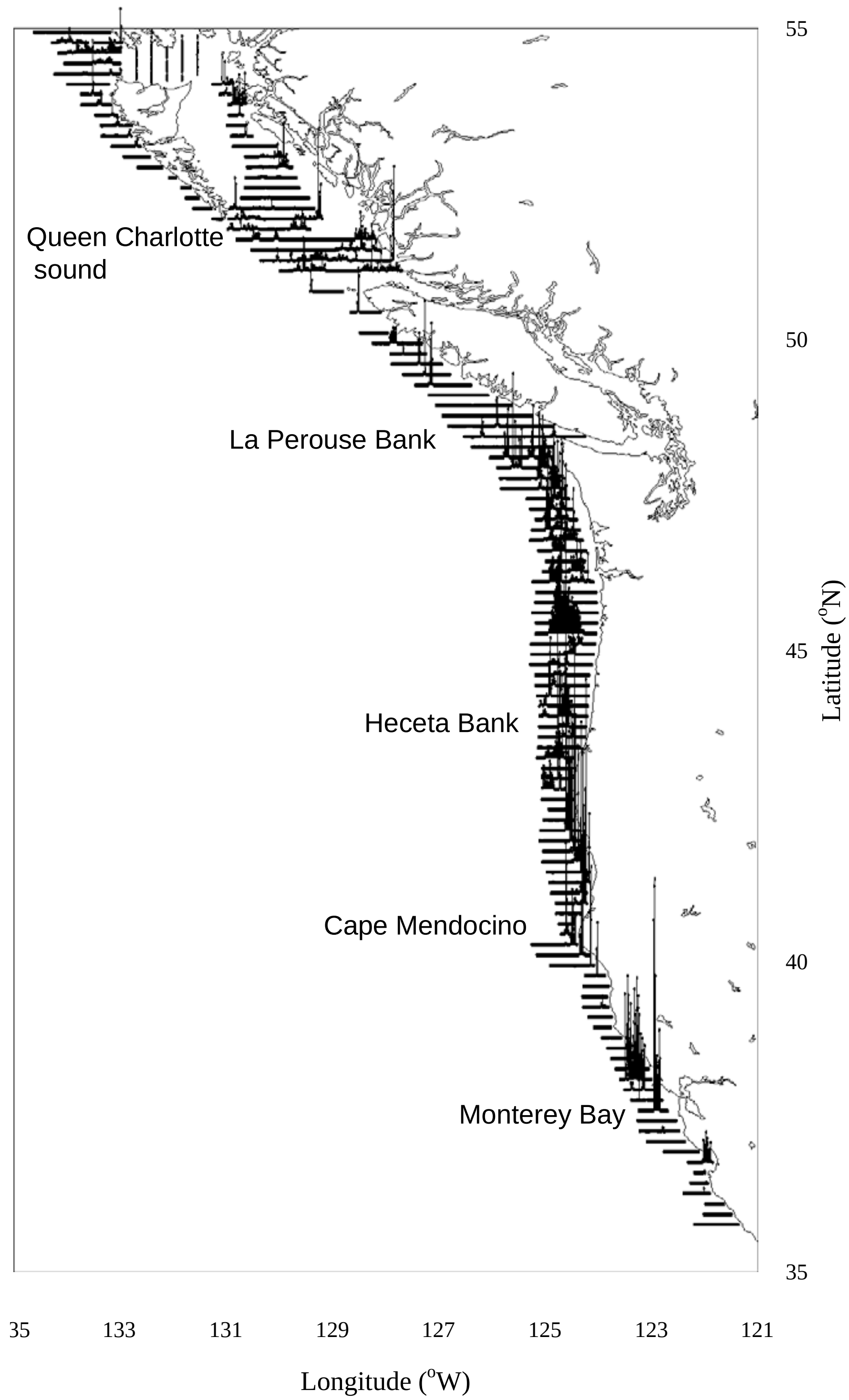



Figure 11. Line transects and occurrence of acoustic area backscattering attributable to Pacific hake in the 2007 joint US-Canada acoustic survey. Diameter of circles is proportional to measured backscatter levels.

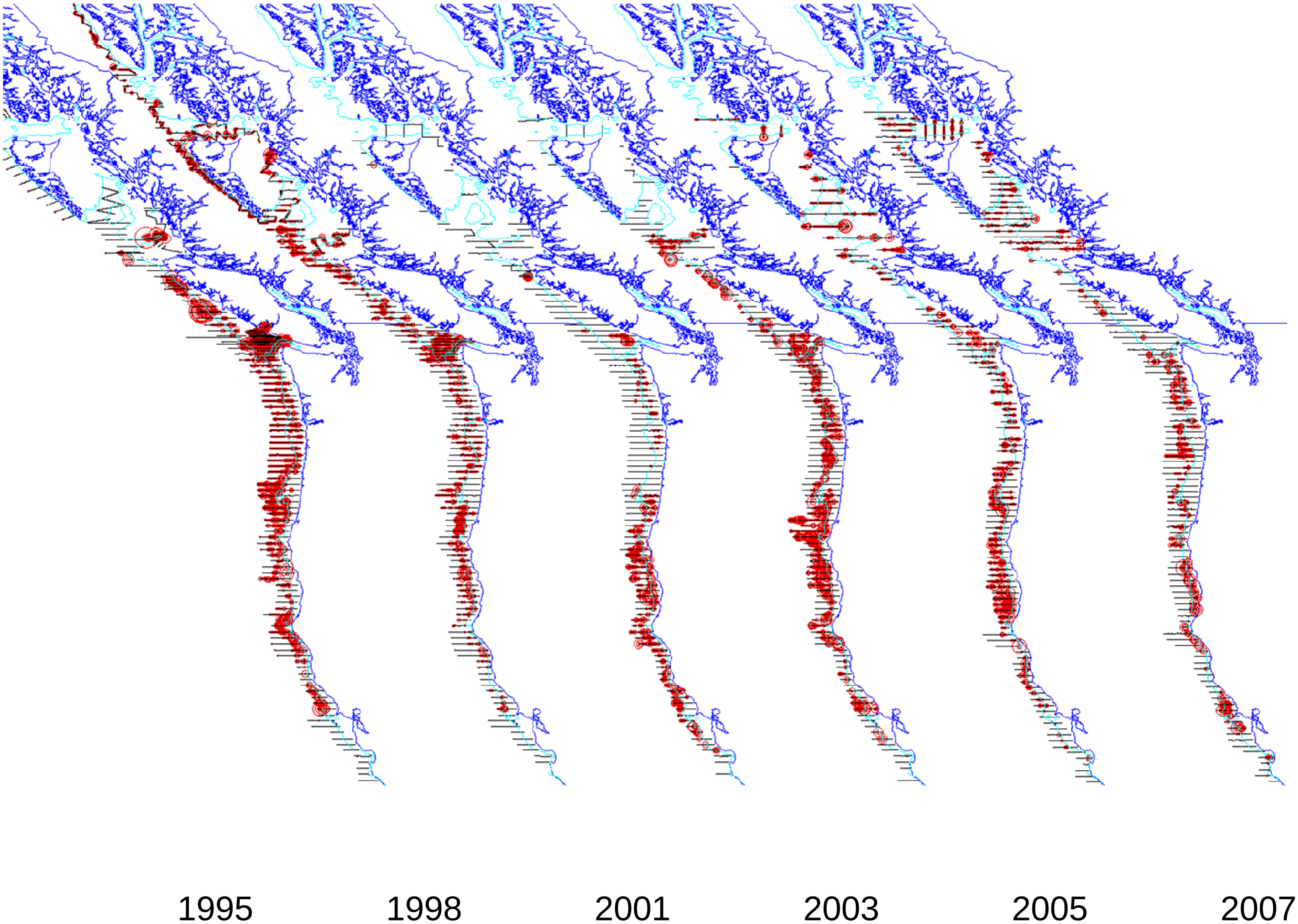



Figure 12. Occurrence of acoustic area backscattering attributable to Pacific hake in the last six (1995-2007) joint US-Canada acoustic surveys. Diameter of circles is proportional to measured backscatter levels.

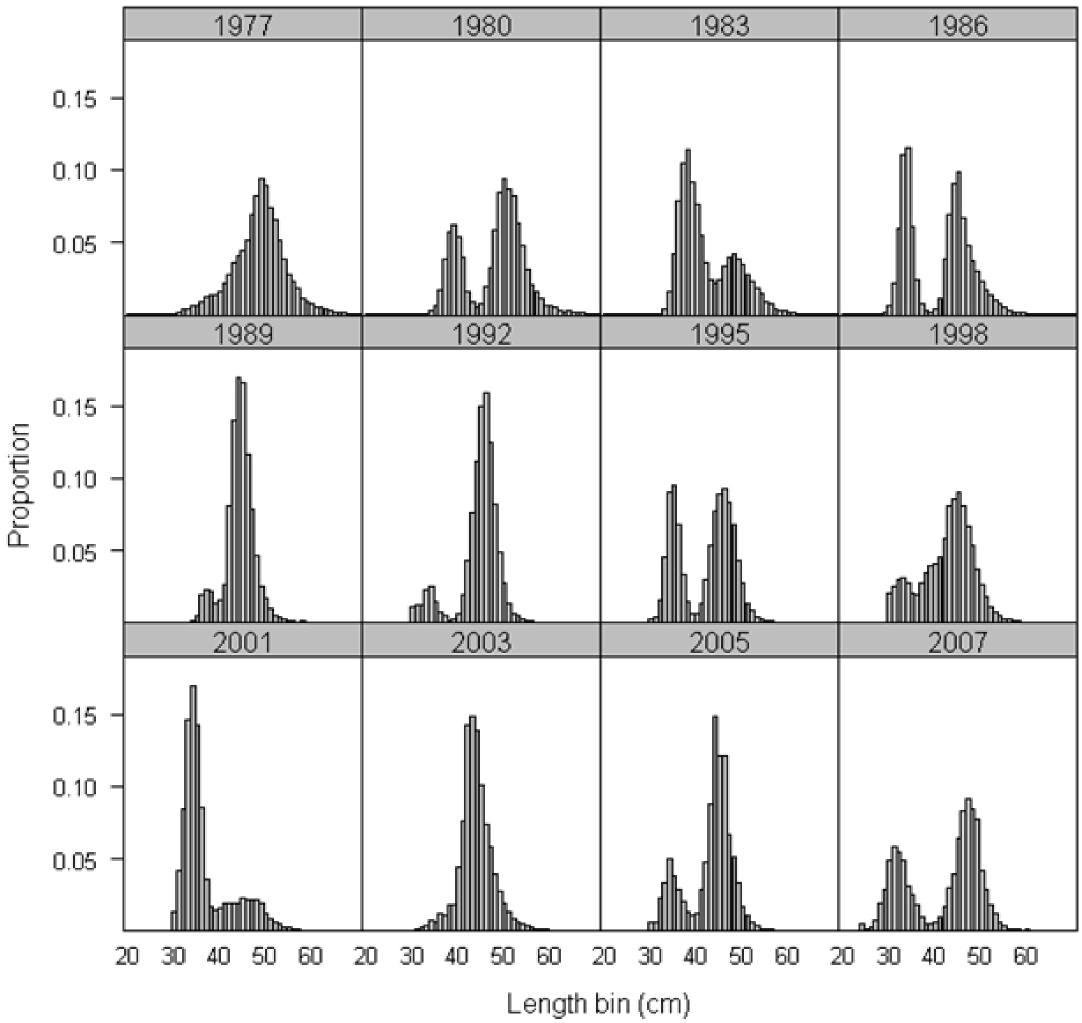



Figure 13. Plot of acoustic survey size compositions of coastal Pacific hake off the west coast of the U.S. and Canada, 1975-2007.

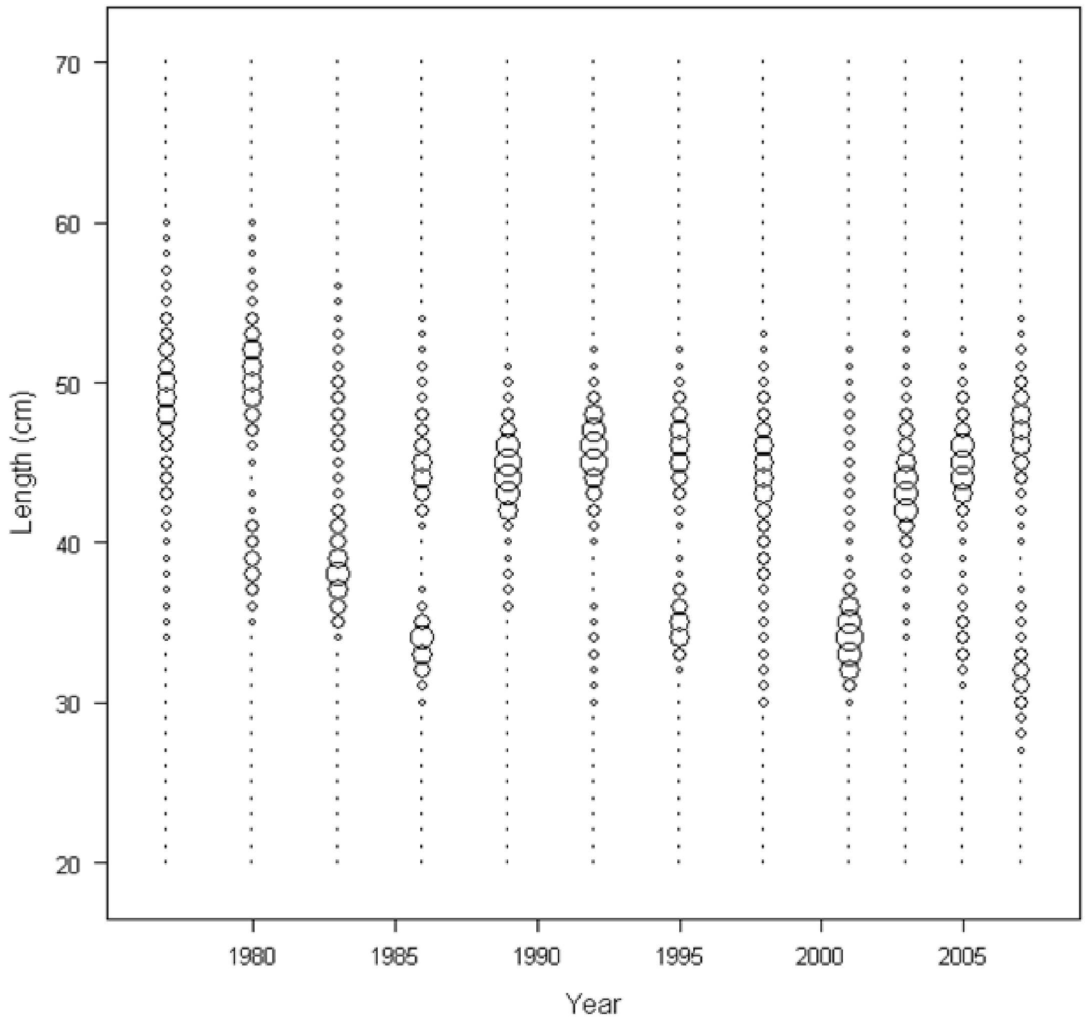



Figure 14. Length compositions of Pacific hake from the joint U.S.-Canada acoustic surveys off the west coast of the U.S. and Canada, 1977-2007. Diameter of circles are proportional by year.

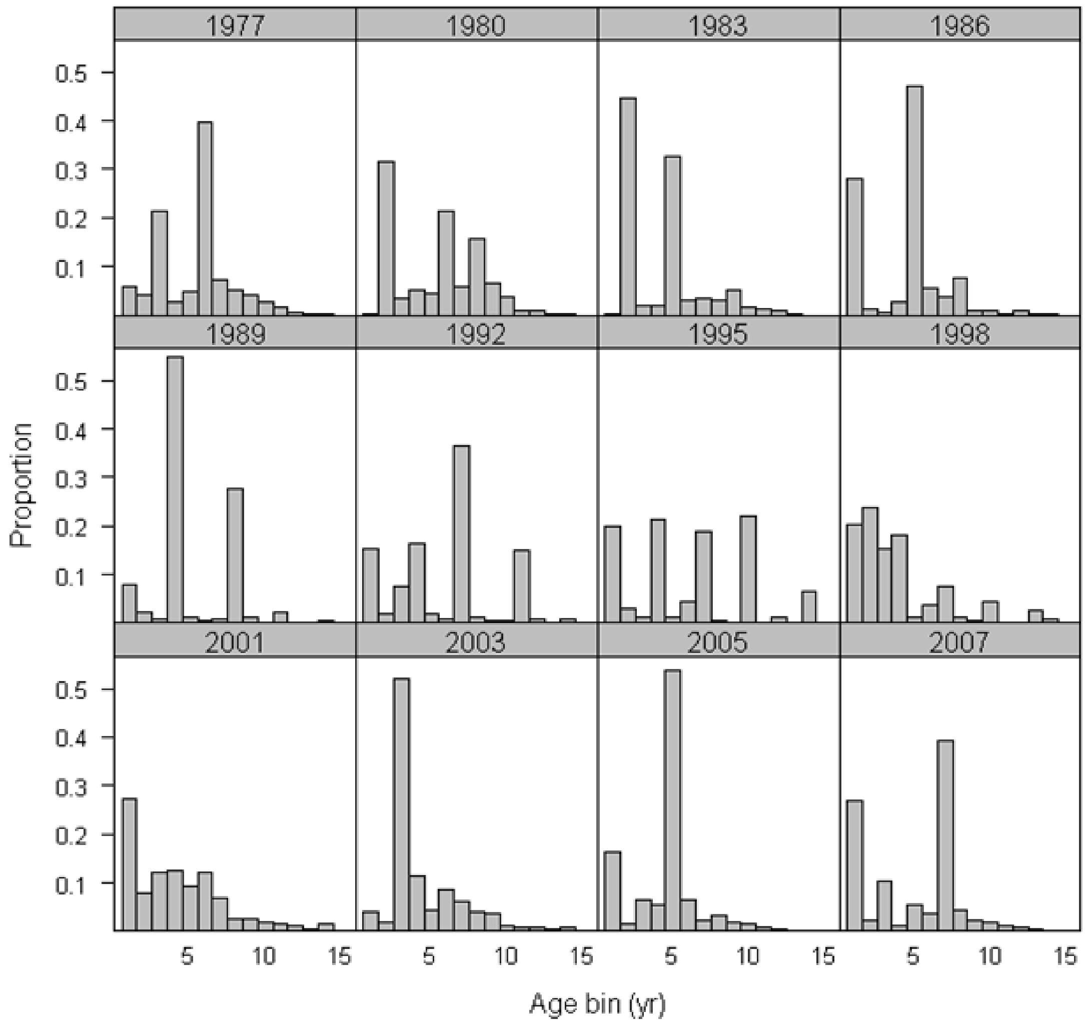



Figure 15. Plot of acoustic survey age compositions of Pacific hake off the west coast of the U.S and Canada., 1977-2007.

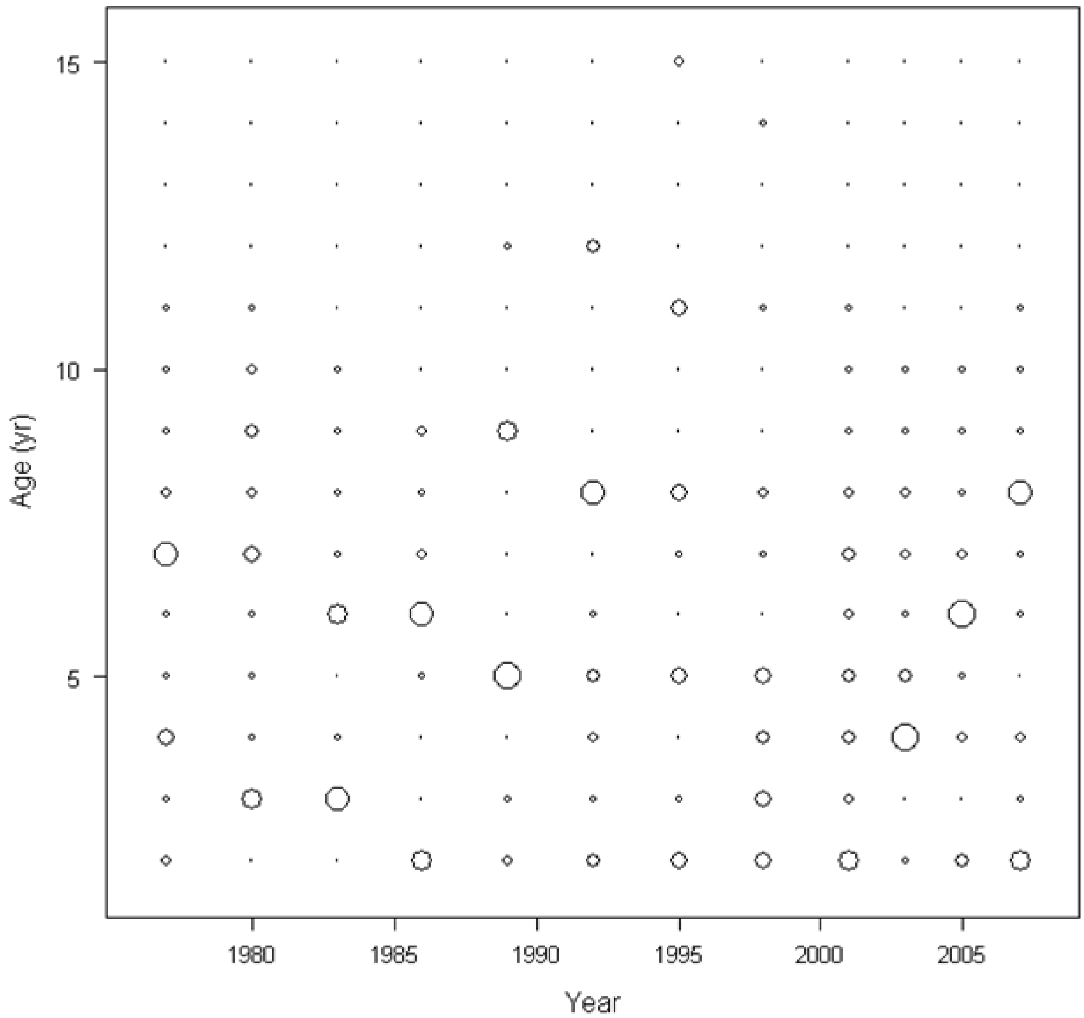



Figure 16. Age compositions of Pacific hake from the joint U.S.-Canada acoustic surveys off the west coast of the U.S. and Canada, 1977-2007. Diameter of circles are proportional by year.

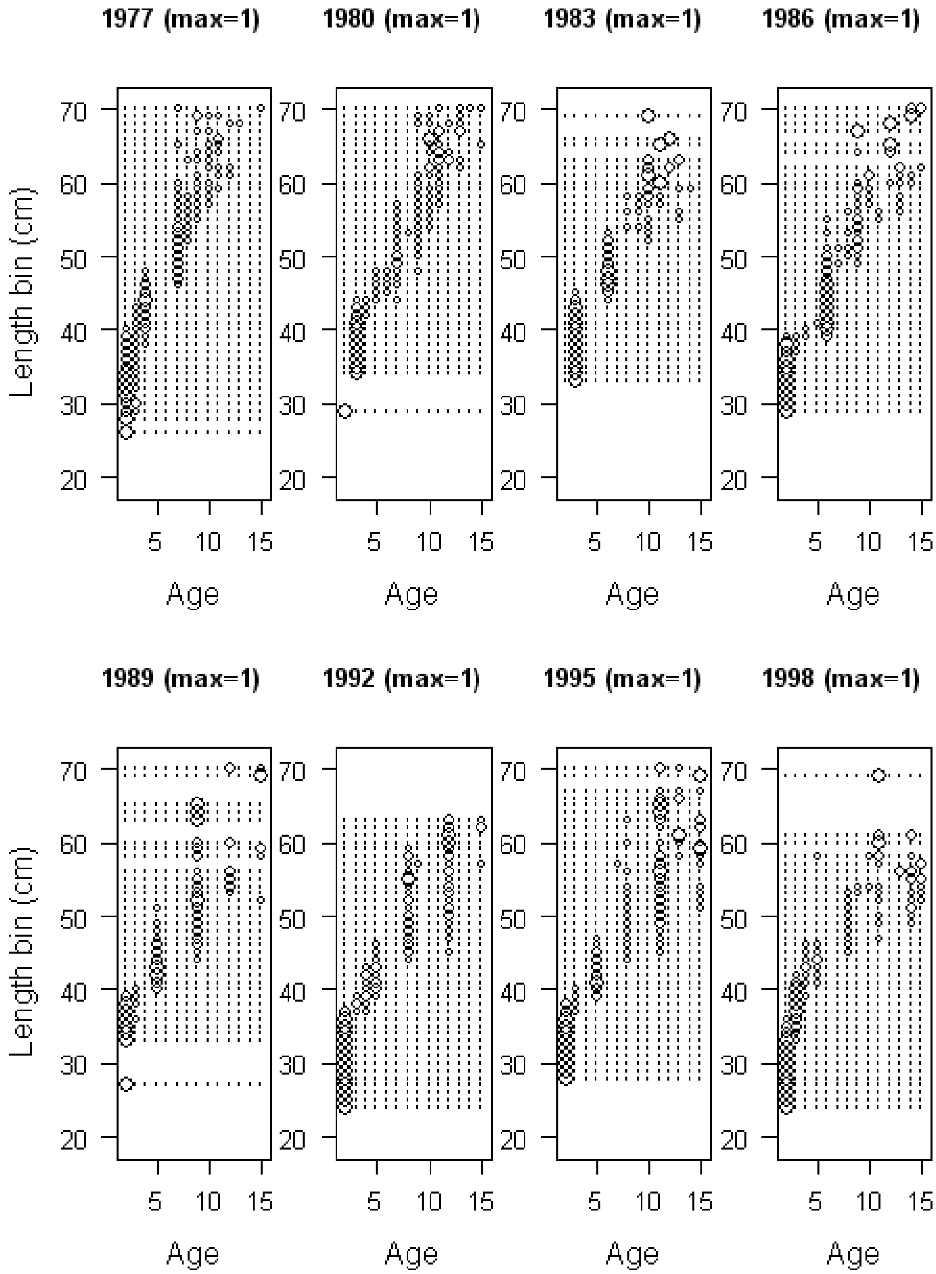



Figure 17. Conditional age at length compositions from the acoustic survey, 1977-2007. Diameter of circles are proportional by year.

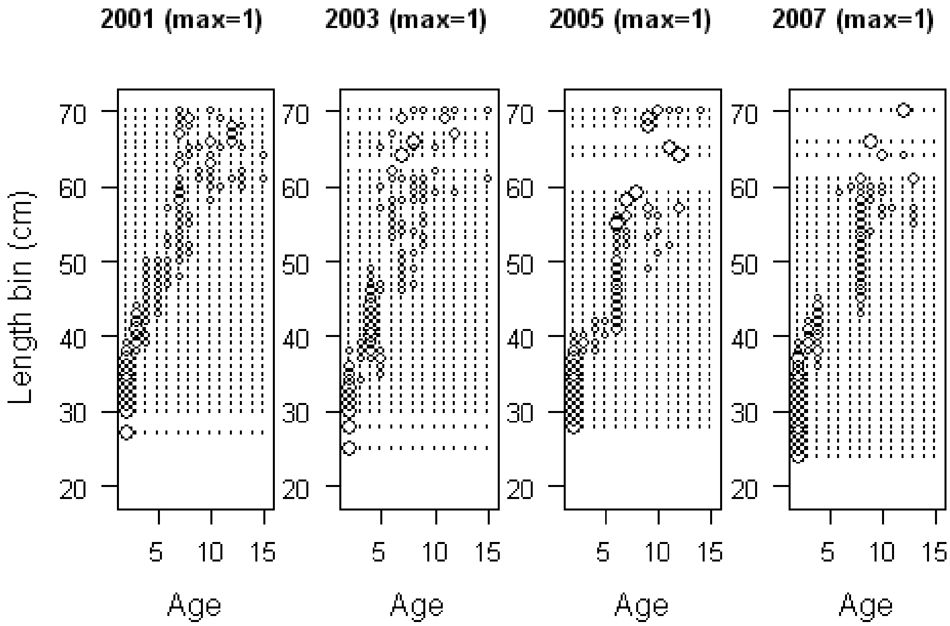



Figure 17 continued. Conditional age at length compositions from the acoustic survey, 1977-2007. Diameter of circles are proportional by year.

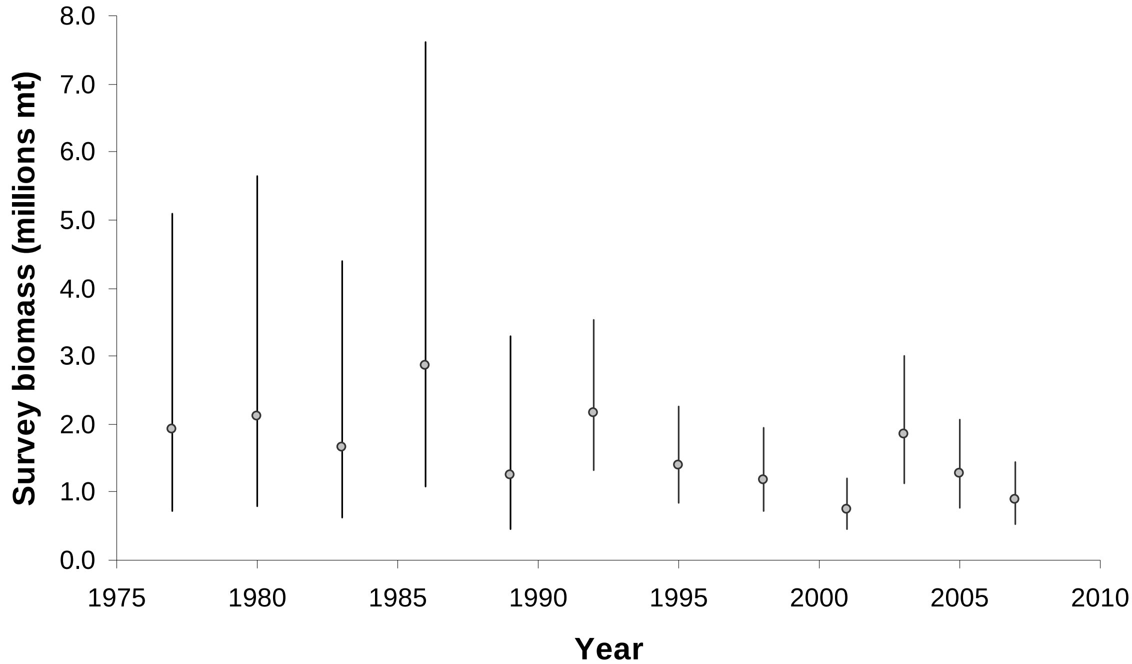



Figure 18. Time series of acoustic survey age 2+ biomass estimates, 1977-2007. Confidence intervals are based on assumed CV=0.5 1977-1989 and CV=.25 1992-2007.

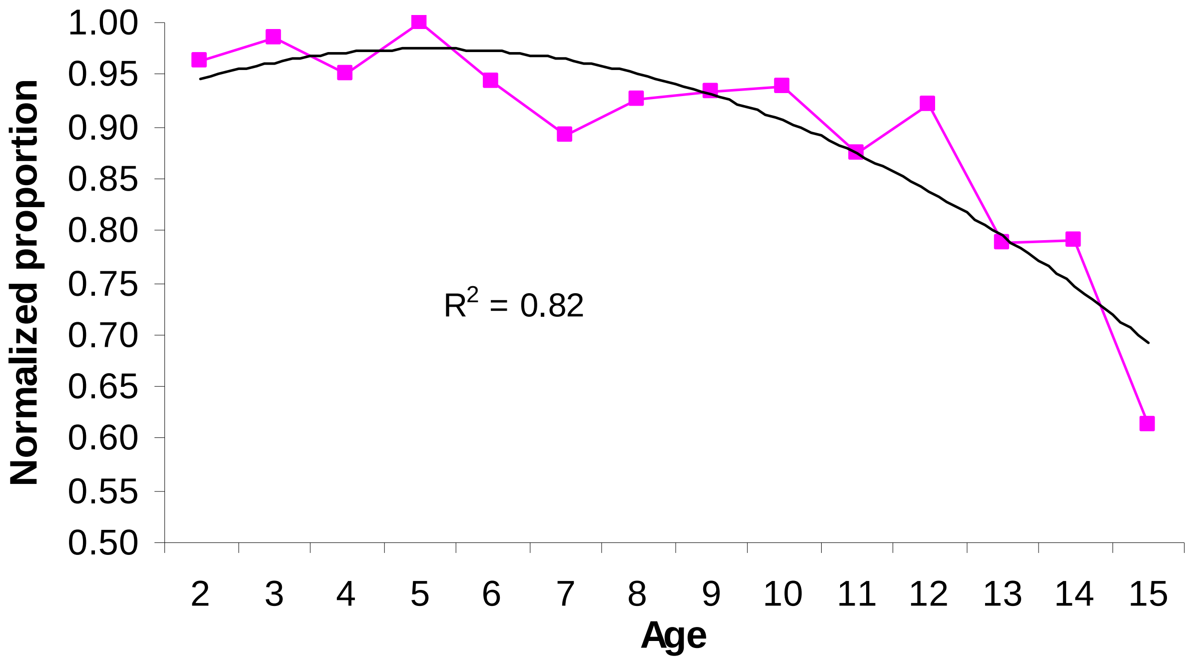



Figure 19. Plot of normalized (divided by maximum value) average (1977-2001) ratio of expanded acoustic survey numbers at age to the sum of acoustic survey and triennial bottom trawl survey expanded numbers at age. This analysis was conducted to explore empirical evidence for dome-shaped selectivity in the acoustic survey.

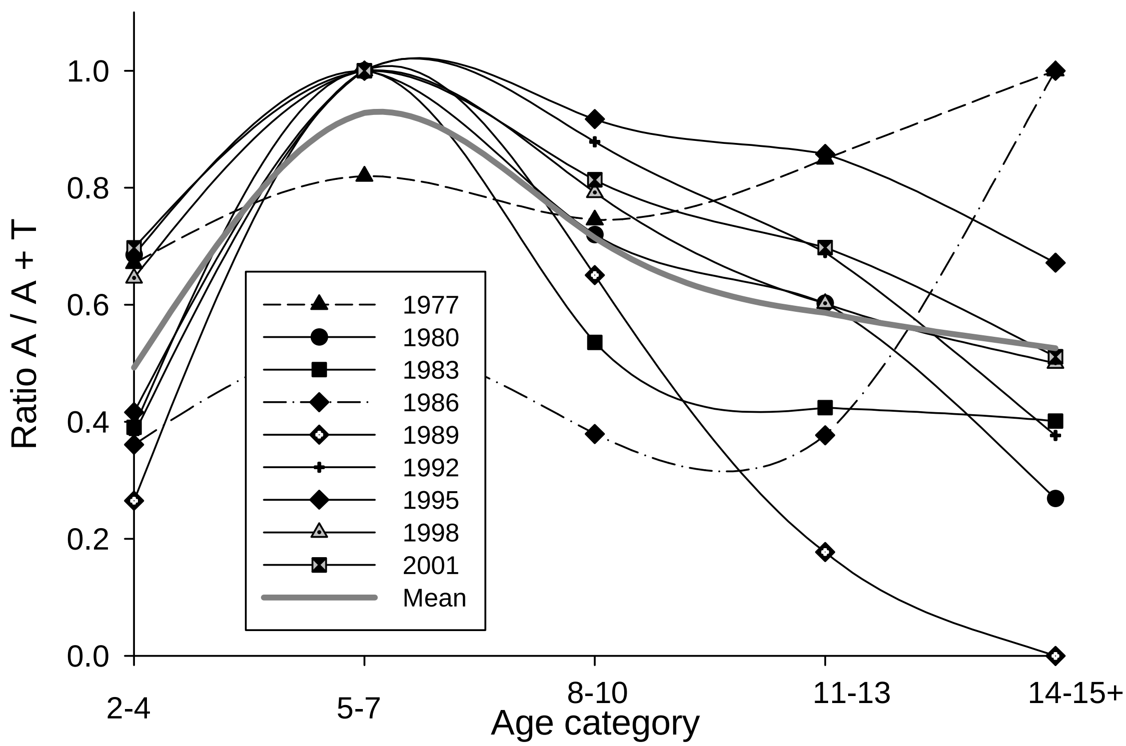
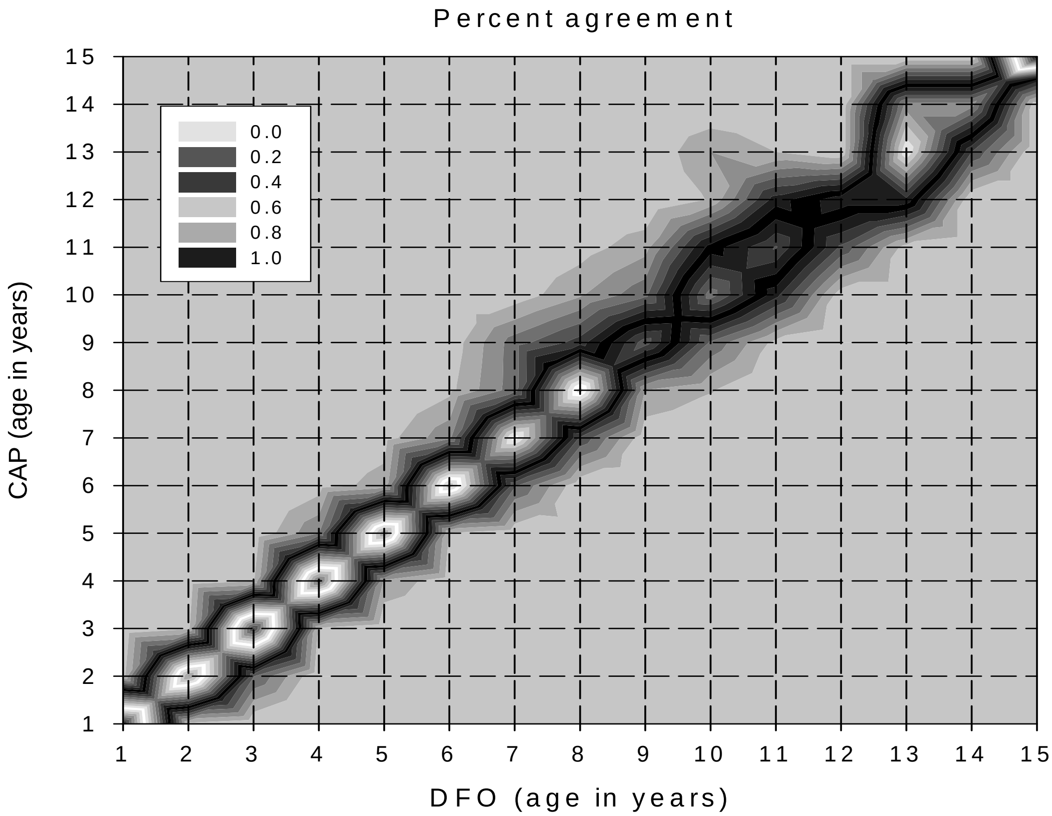



Figure 20. Plot of normalized (divided by maximum value) ratio of acoustic survey numbers at age to the sum of acoustic survey and triennial bottom trawl survey numbers at age. Numbers at age are based on aged samples taken from all hauls during that survey year and not based on expanded numbers at age. This analysis was conducted to explore empirical evidence for dome-shaped selectivity in the acoustic survey.



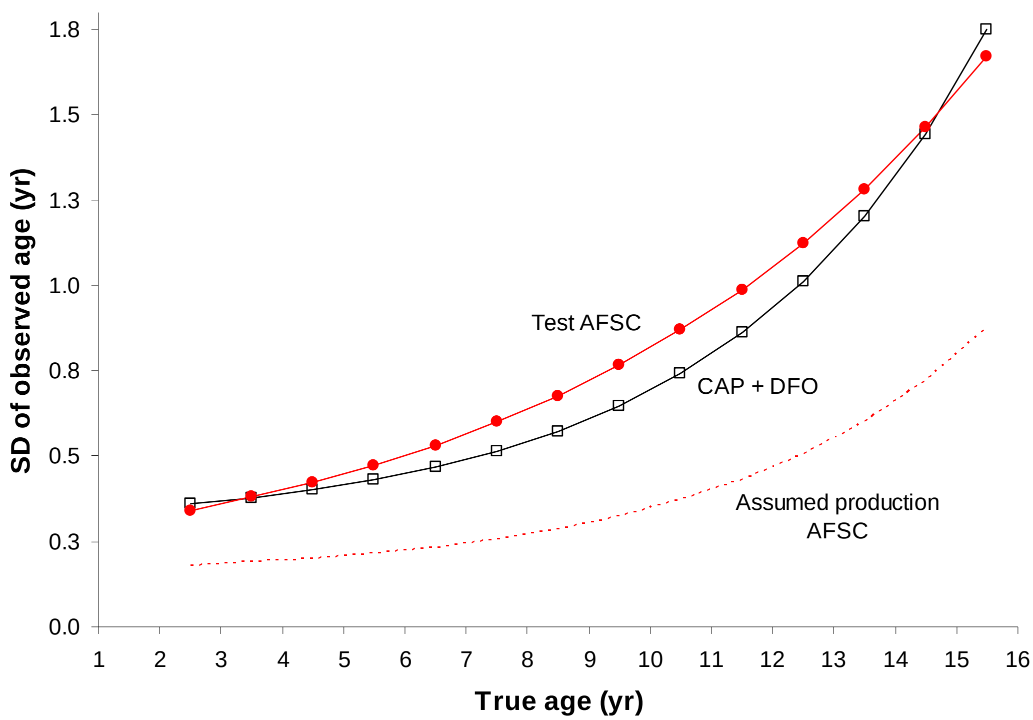
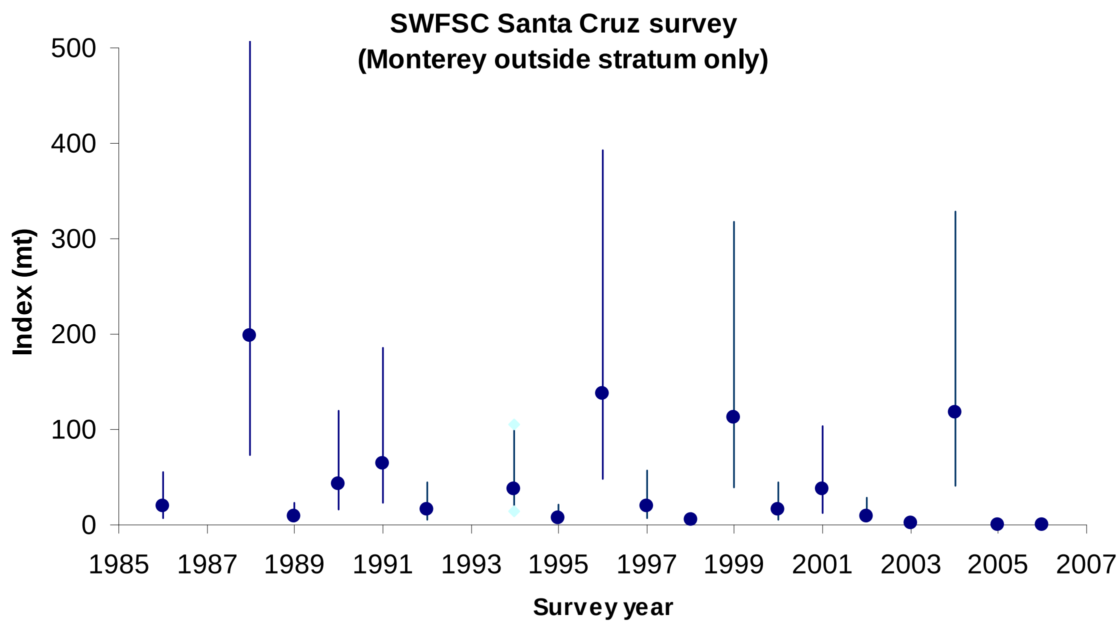




Figure 21. Comparison of 990 ototliths collected between 2001-2007 and cross-read between the Cooperative Aging Program (US) and the Canadian Department of Fisheries and Oceans. The bottom figure shows the estimated standard deviation of observed age as a function of true age.



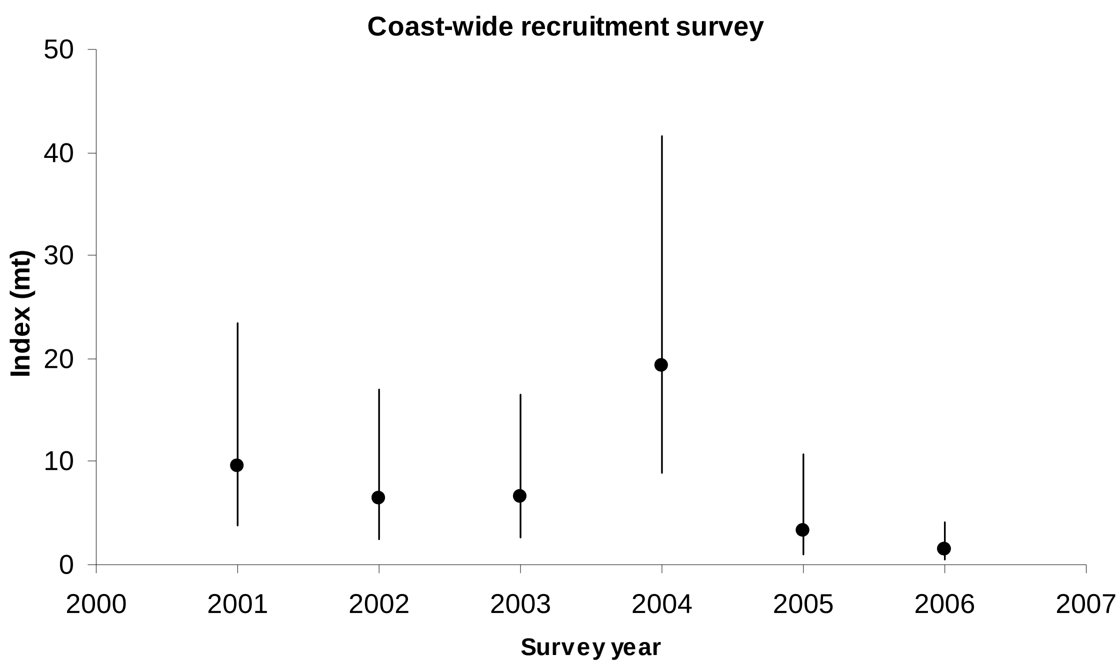
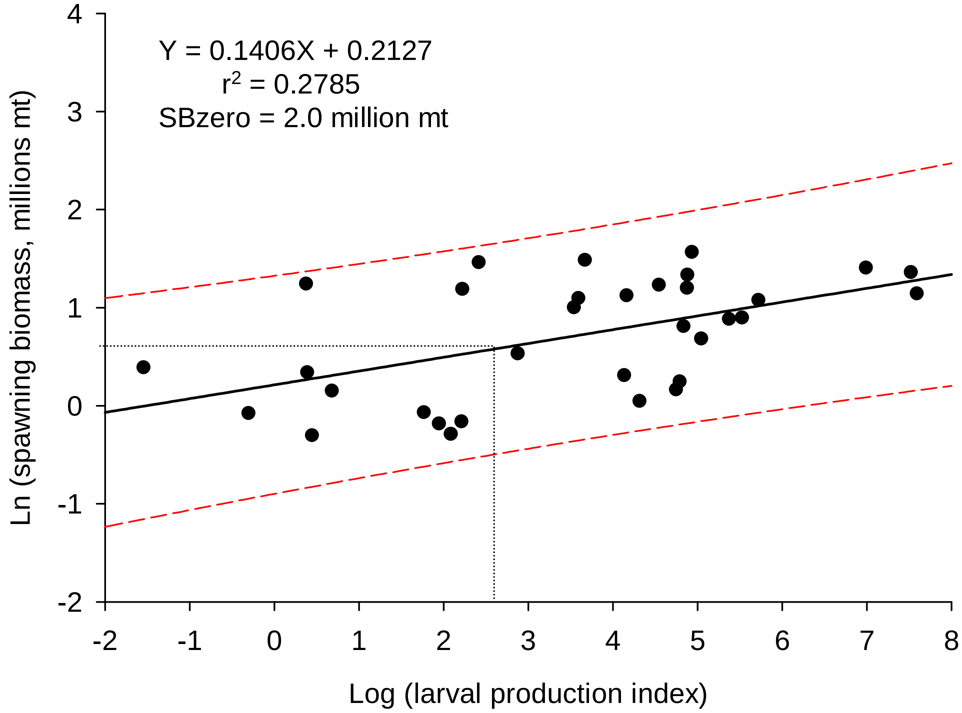




Figure 22. A) Plot of time series of the South West Fisheries Science Center Santa Cruz pre-recruit survey (Monterey outside stratum only) for young-of-year Pacific hake. Estimates and error bars are taken from back-transformed (bias corrected) year effects from GLM. B) Coast-wide Pacific hake pre-recruit survey indices based on data collected from SWFSC Santa Cruz and the joint PWCC-NMFS surveys. Estimates and error bars are obtained from a Monte Carlo simulation of a Delta-GLM analysis.



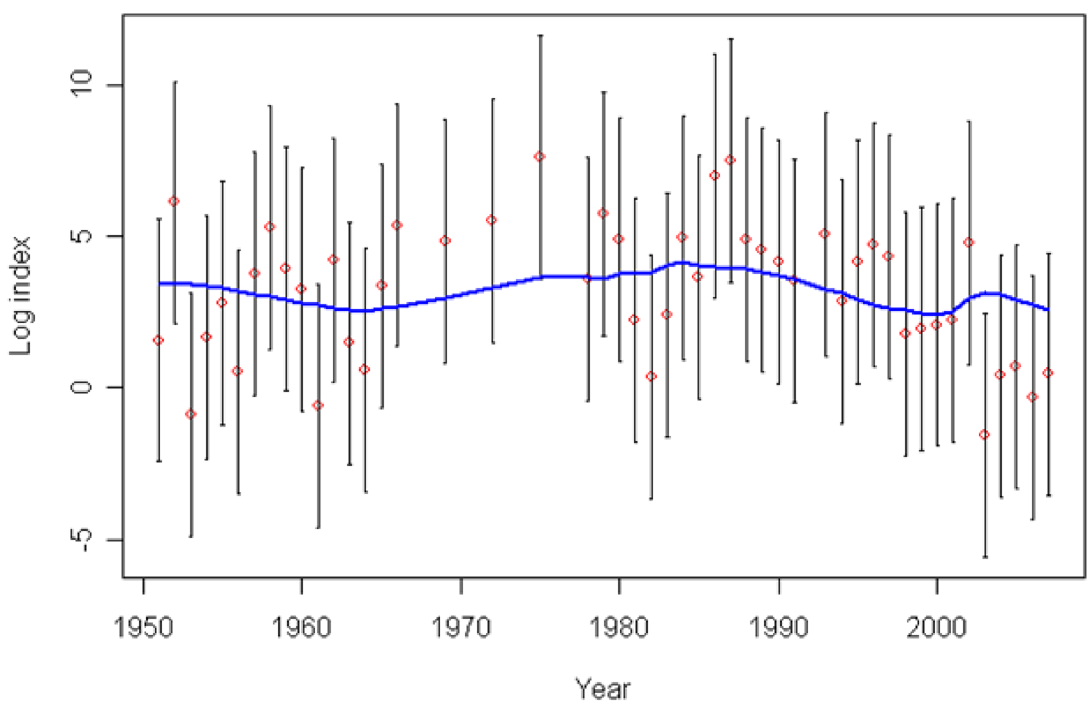




Figure 23. Top) Relationship of natural log of the daily hake larval production index (as a measure of hake spawning biomass, Lo et al. 2007) and the natural log of female spawning stock biomass as estimated from the 2007 hake assessment (Helser et al. 2007). Solid line is the expectation of a non-functional regression line and dotted lines represent prediction intervals about the regression. Bottom) Fits of SS2 model expected larval production index to observed larval production index. An estimate of unfished spawning biomass (SBzero) was obtained by taking the bias corrected back transformed predicted spawning biomass based on the average larval production index between 1951-1965.

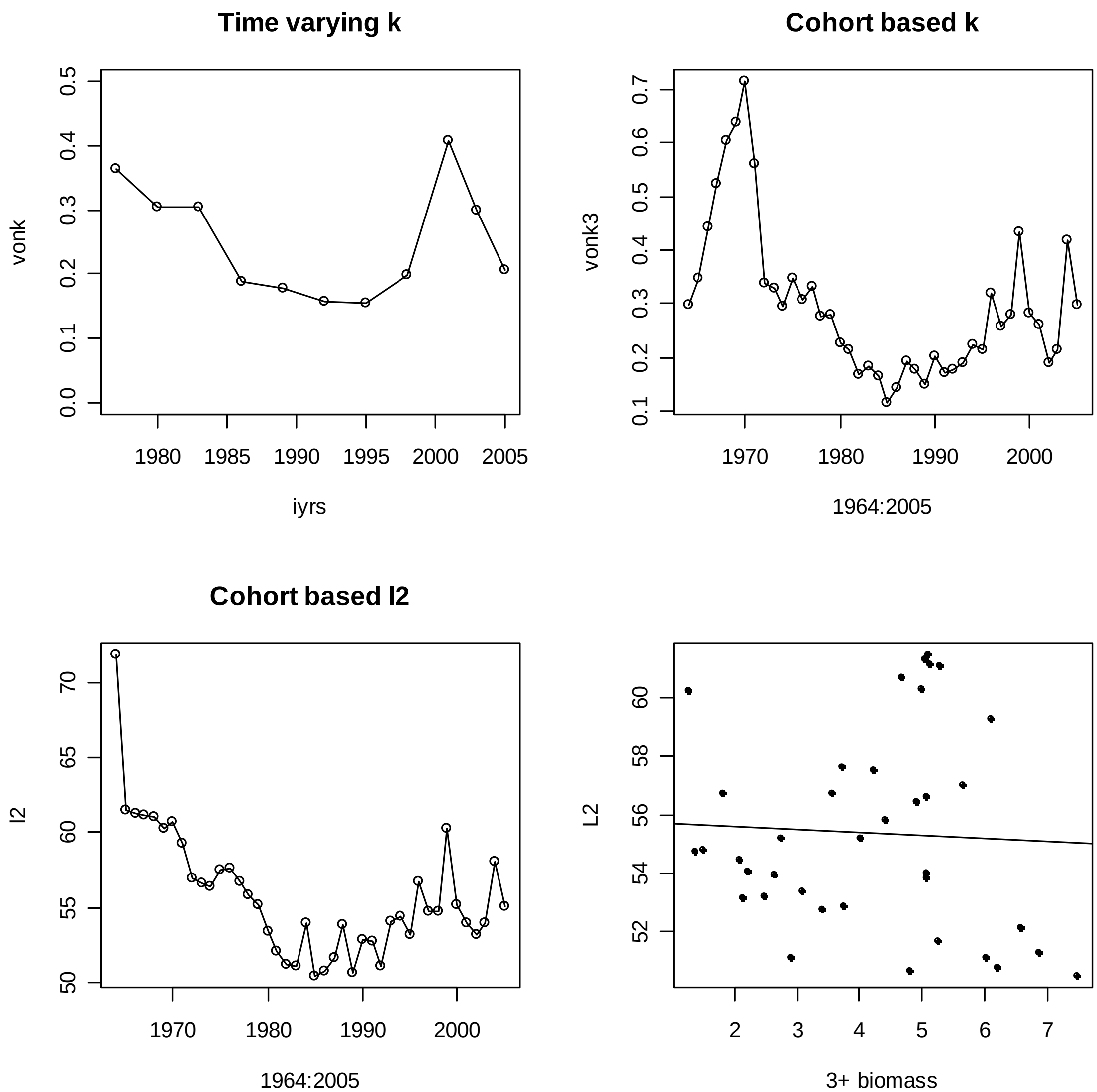



Figure 24. Time varying and cohort based fits of the von Bertalanffy growth model to Pacific hake age data from the acoustic survey, 1977-2005.

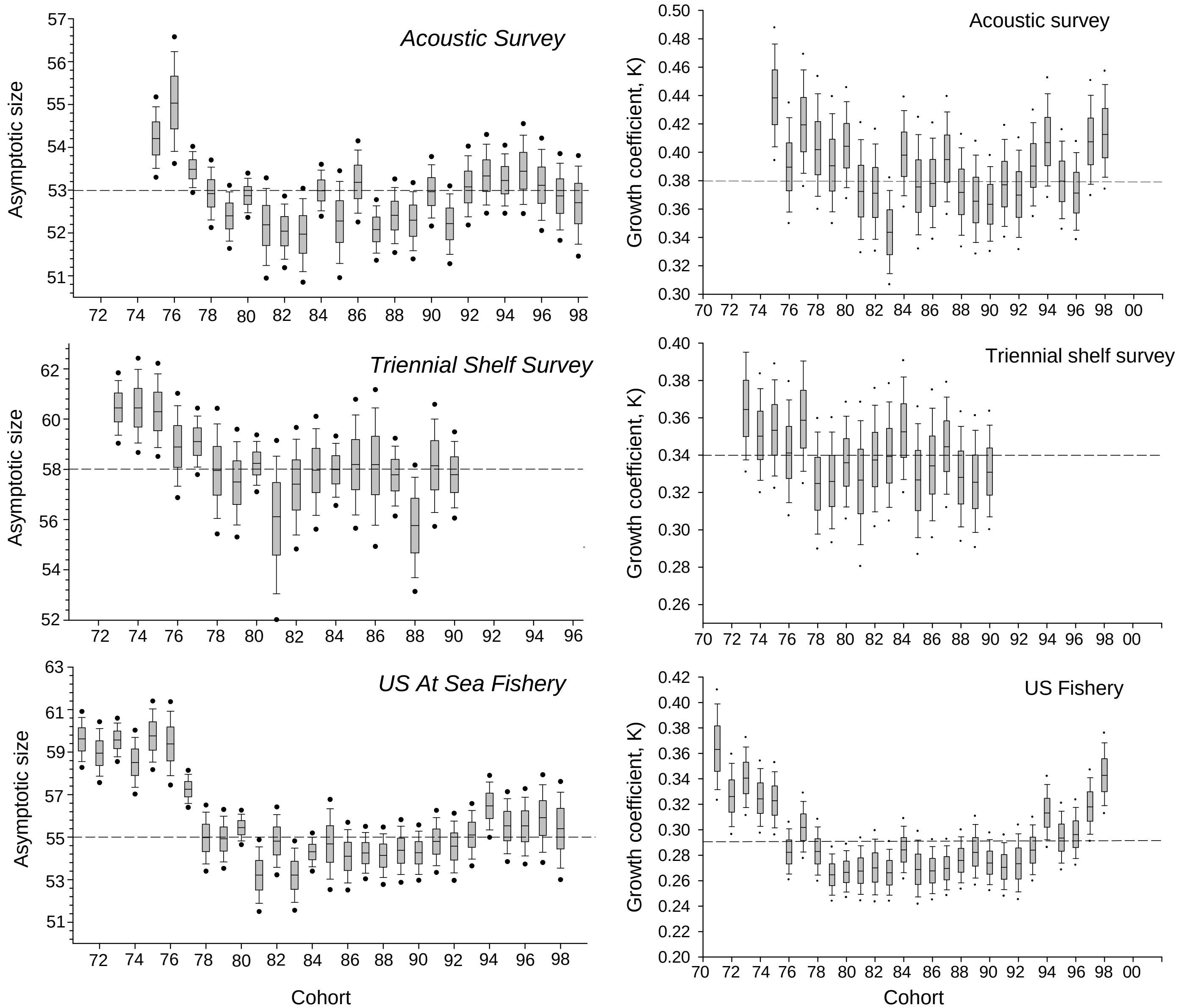



Figure 25. Results of a hierarchical von Bertalanffy growth model fit to three difference sources of Pacific hake growth data. A von Bertalanffy growth model was fit to each of the three data sources with age at length data combined and cohort treated as a random variable. The results show an early consistent decline in asymptotic size and instantaneous growth coefficient, k, in the early 1980s. Box whisker plots show the marginal posterior density of growth parameters, Lmax and K, for each cohort and the dotted line gives the overall mean parameter estimate.

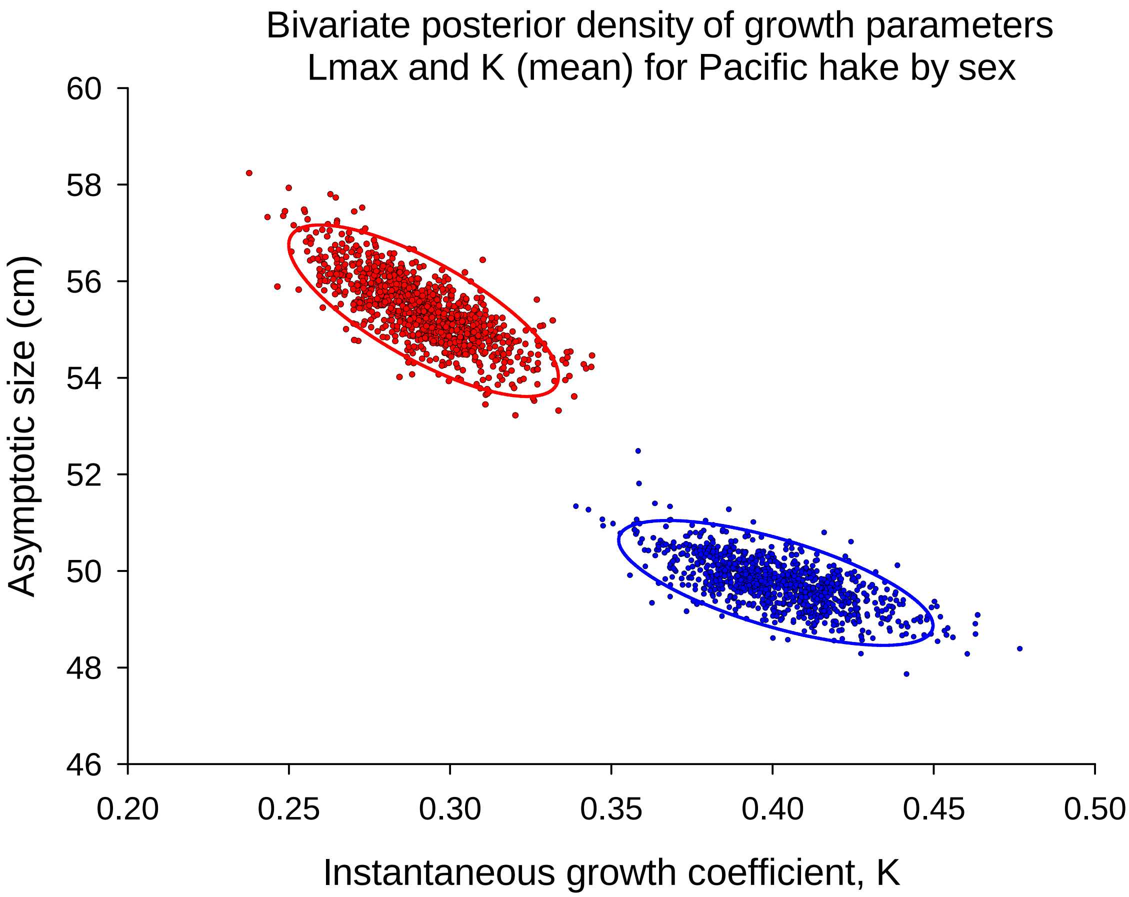



Figure 26. Results of a hierarchical von Bertalanffy growth model fit to Pacific hake growth data from the acoustic survey (all years, 1977-2007). A von Bertalanffy growth model was fit separately to each sex and cohort treated as a random variable. The results show that female pacific hake achieve a significantly larger size the males, but also growth at a slower rate. The dots show the bivariate distribution of Lmax and K from a sample of 1,000 draws from the joint posterior density and the solid ellipses give the 95% posterior interval.

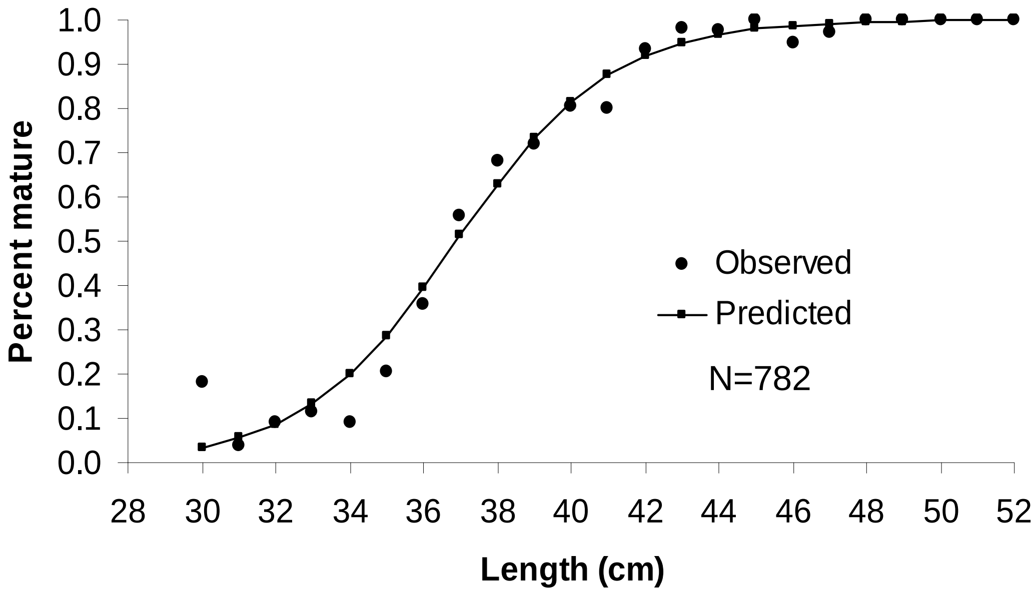



Figure 27. Observed and predicted fraction of Pacific hake mature at length.

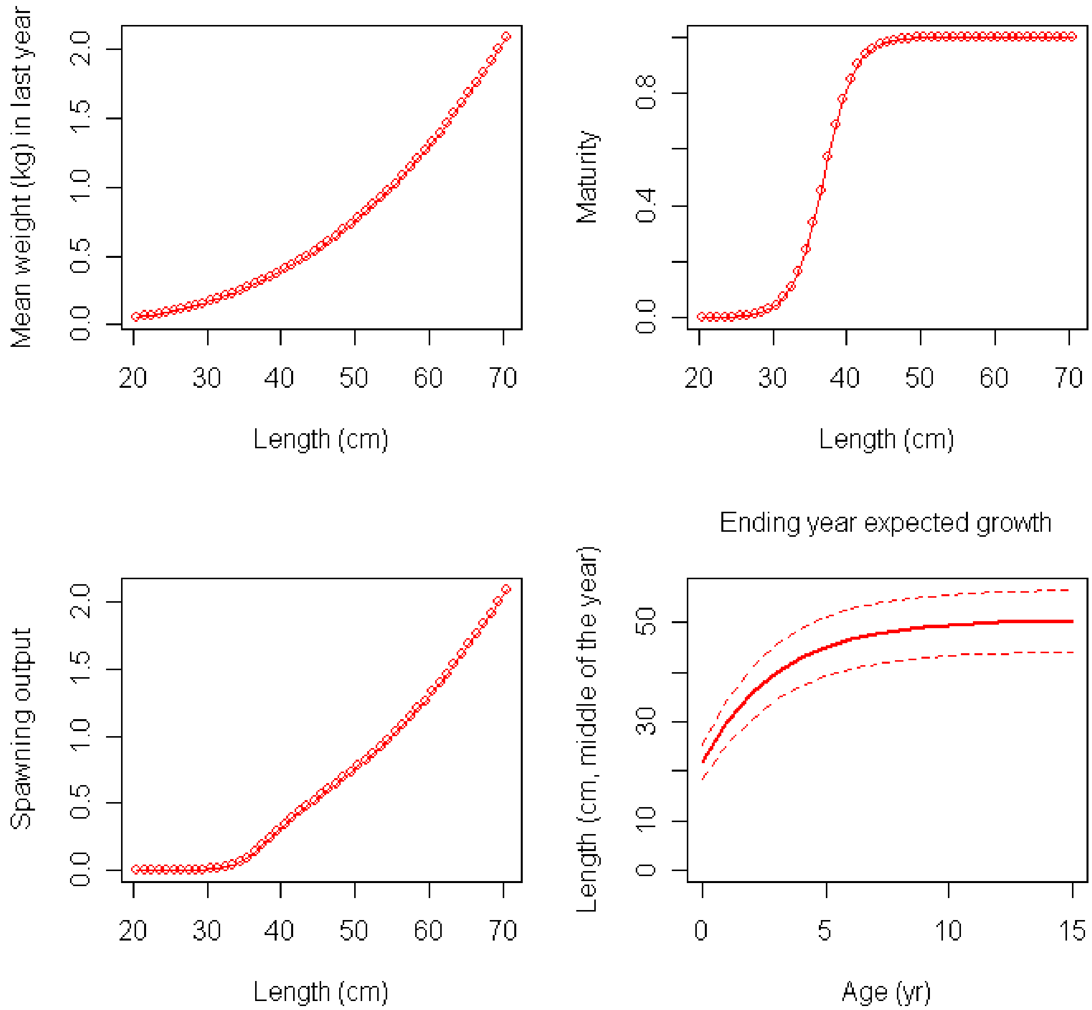



Figure 28. Biological parameters (functional forms) assumed in the hake model.

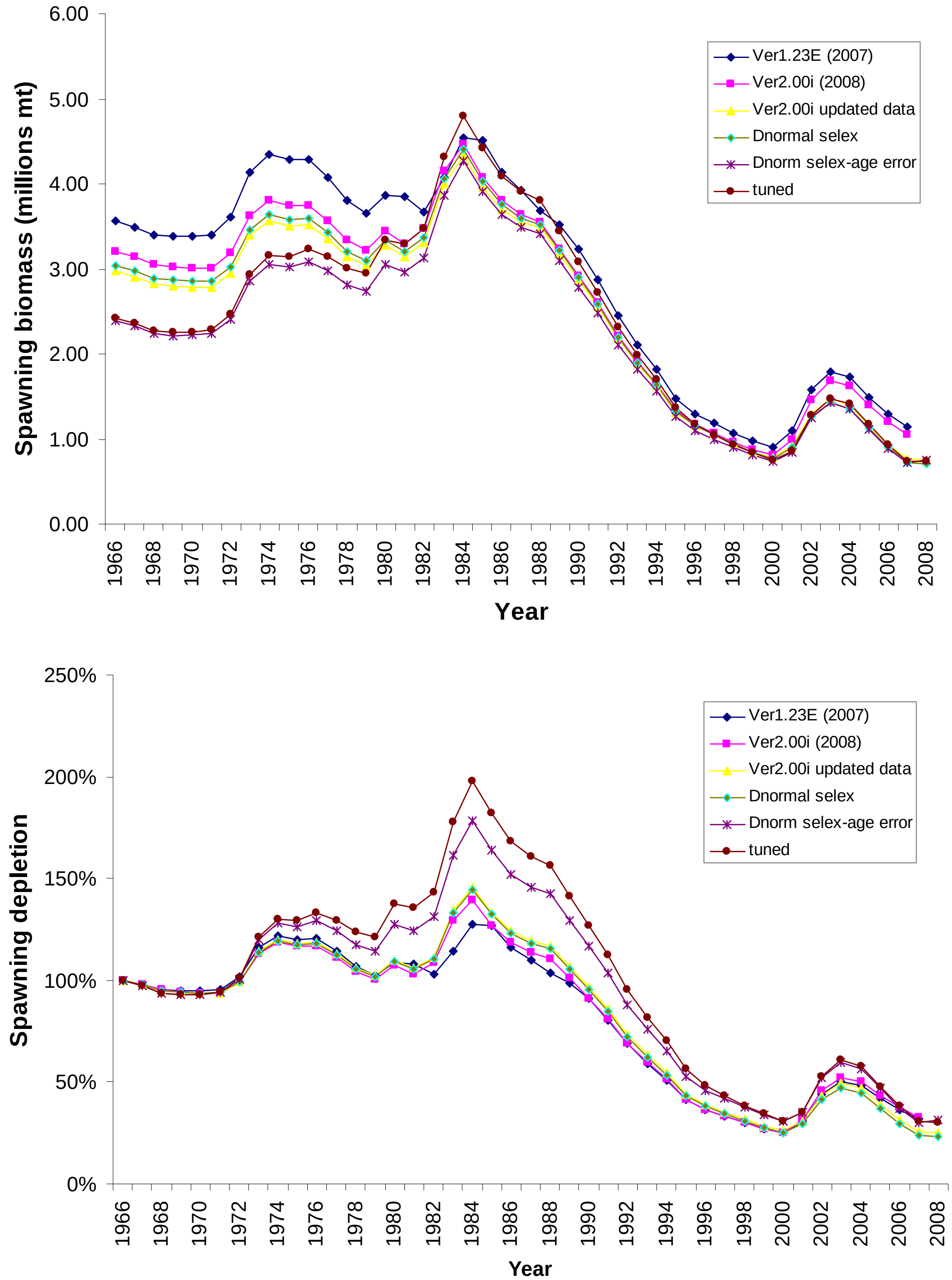



Figure 29. Time series of spawning biomass and depletion (% unfished biomass) from comparative assessment model results between the 2007 (Helser et. al. 2006) and the present assessment. The trends represent the sequence of changes made to the previous assessment including: 1) transition to the newest version of SS2 (Version 2.00n) with the same model structure and data through 2006, 2) SS2 (version 2.00n) with inclusion of updated fishery and acoustic survey data through 2007, 3) same as (2) but with implementation of the double normal selectivity function for the acoustic survey, 4) same as (3) but with implementation of aging error matrix, and 5) same as (4) with the model tuned.

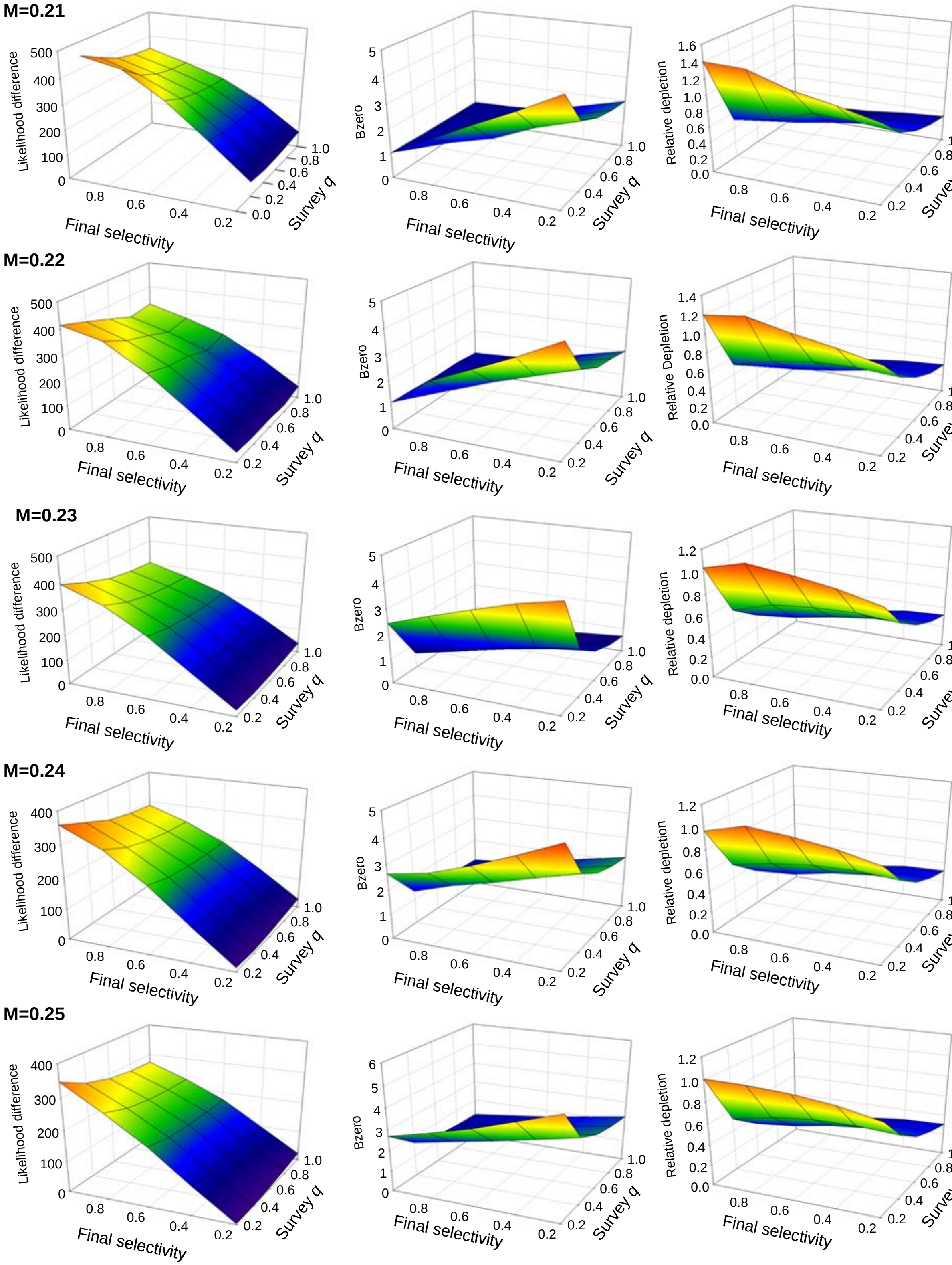



Figure 30. Results of profiling over 5 values of the acoustic survey selectivity at age 15 (0.2 to 1.0) within 5 values of the acoustic survey catchability, q (0.2 to 1.0), and within 5 values of natural mortality (0.21 to 0.25 by 0.01). The rows in the figure from top to bottom give the results for M=0.21, 0.22, 0.23, 0.24, and 0.25.

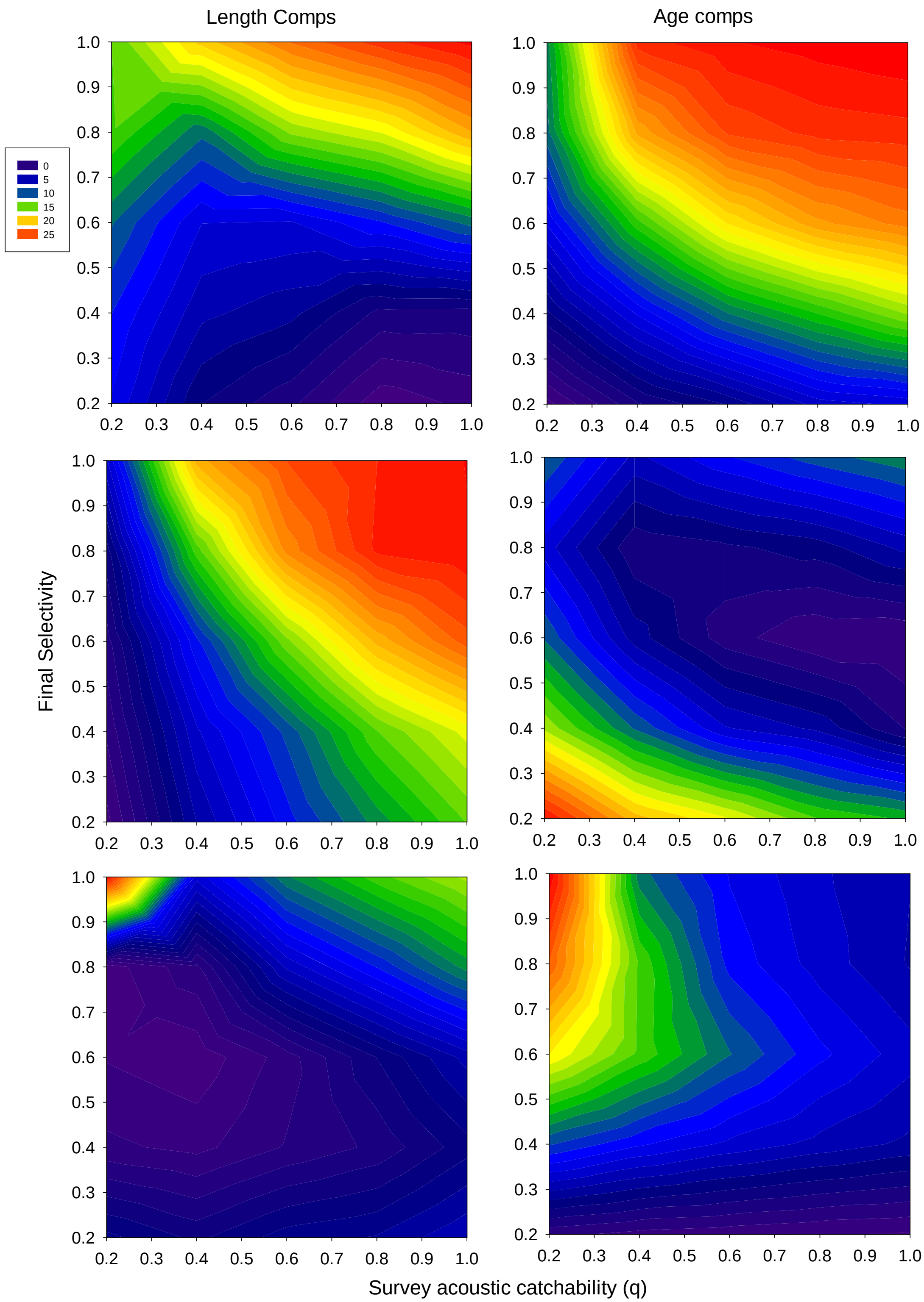



Figure 31. Contour plots showing changes in individual likelihood components for the US fishery (top row), Canadian fishery (middle row) and Acoustic survey (bottom row) length and age compositions as a function of final acoustic survey electivity at age 15 (0.2 to 1.0) and acoustic survey catchability, q (0.2 to 1.0). These results are shown for the M=0.23 run.

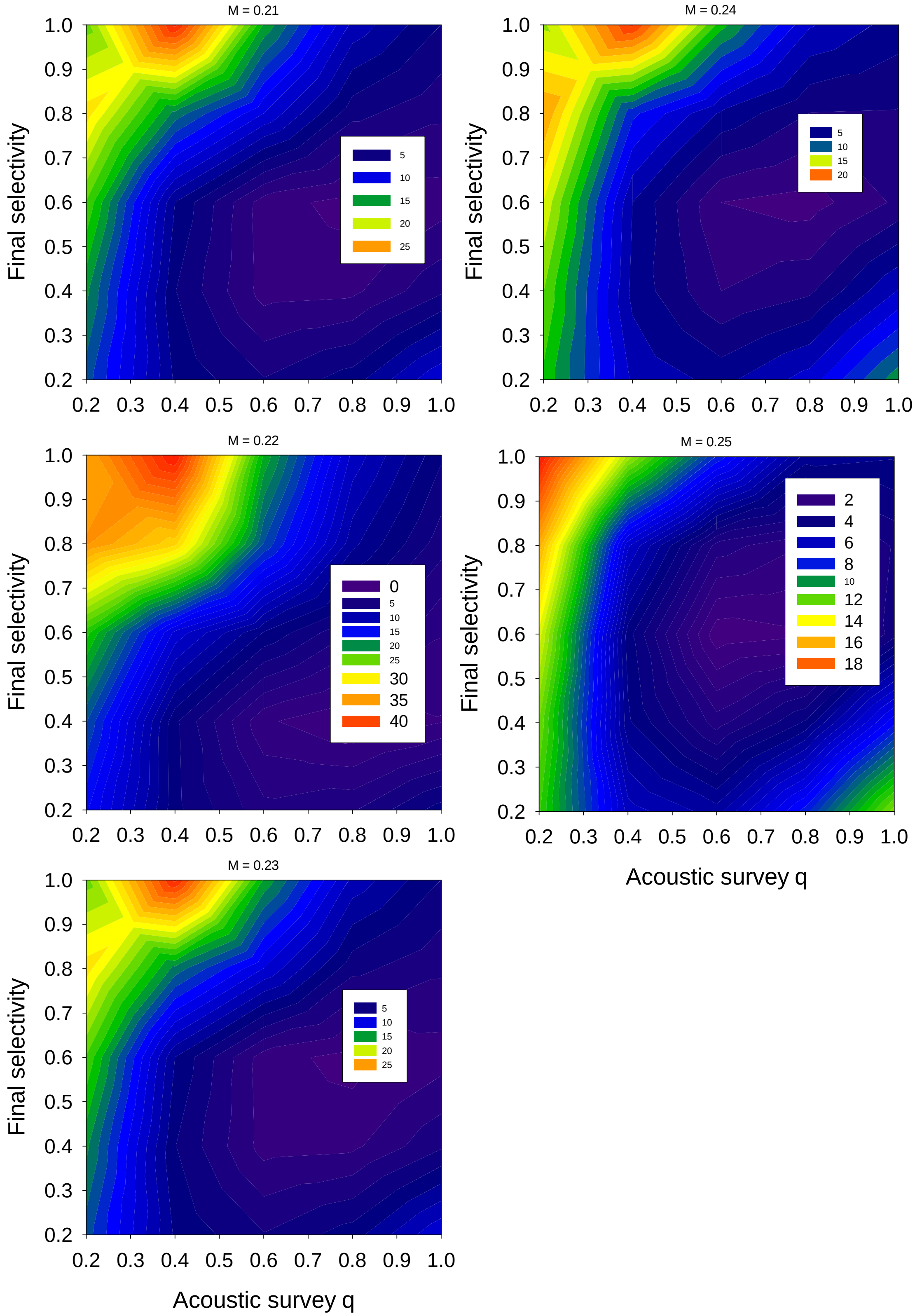



Figure 32. Contour plots showing changes in individual likelihood components for the Acoustic survey biomass index as a function of final acoustic survey electivity at age 15 (0.2 to 1.0) and acoustic survey catchability, q (0.2 to 1.0) and five different values of natural mortality.

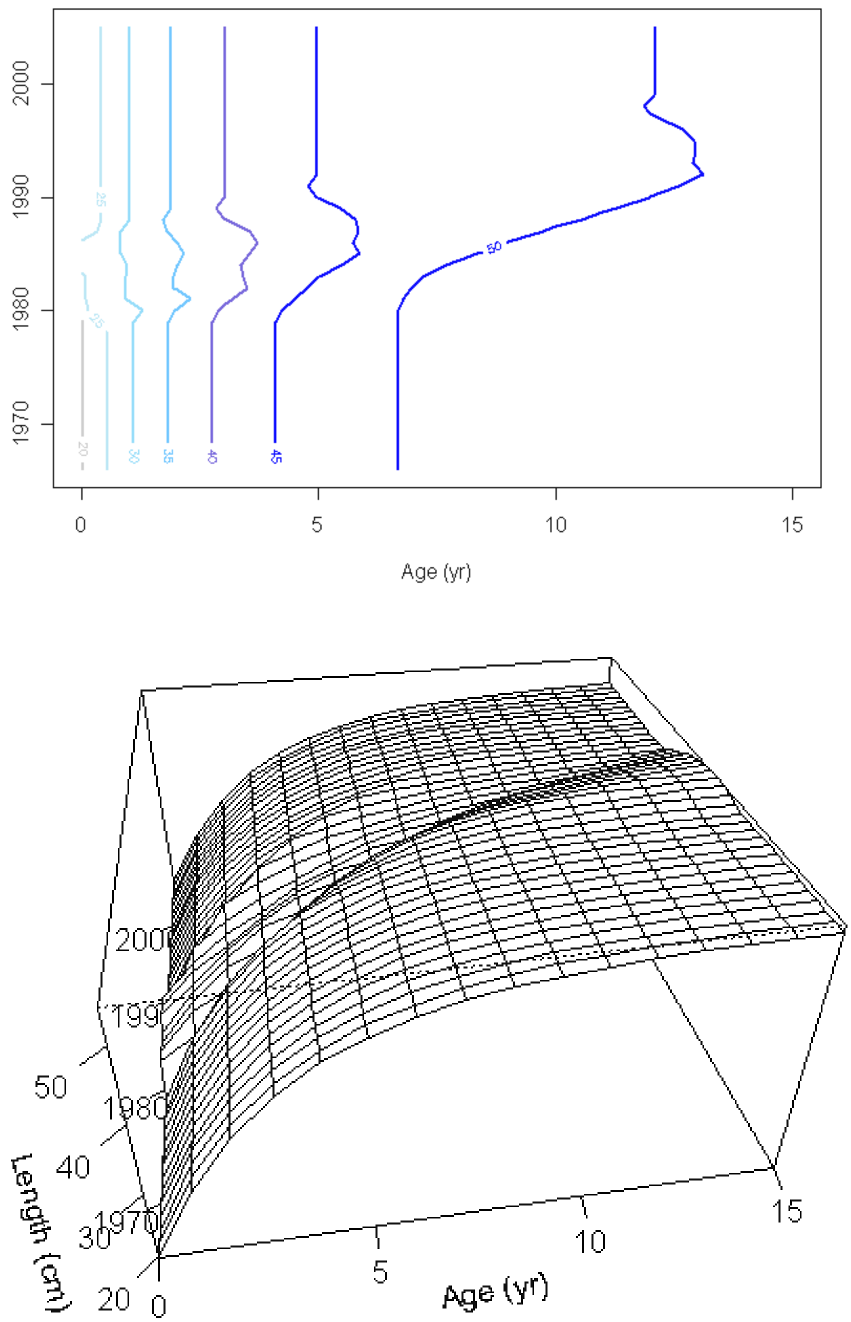



Figure 33. Time varying trajectory of growth in size at age estimated for Pacific hake.

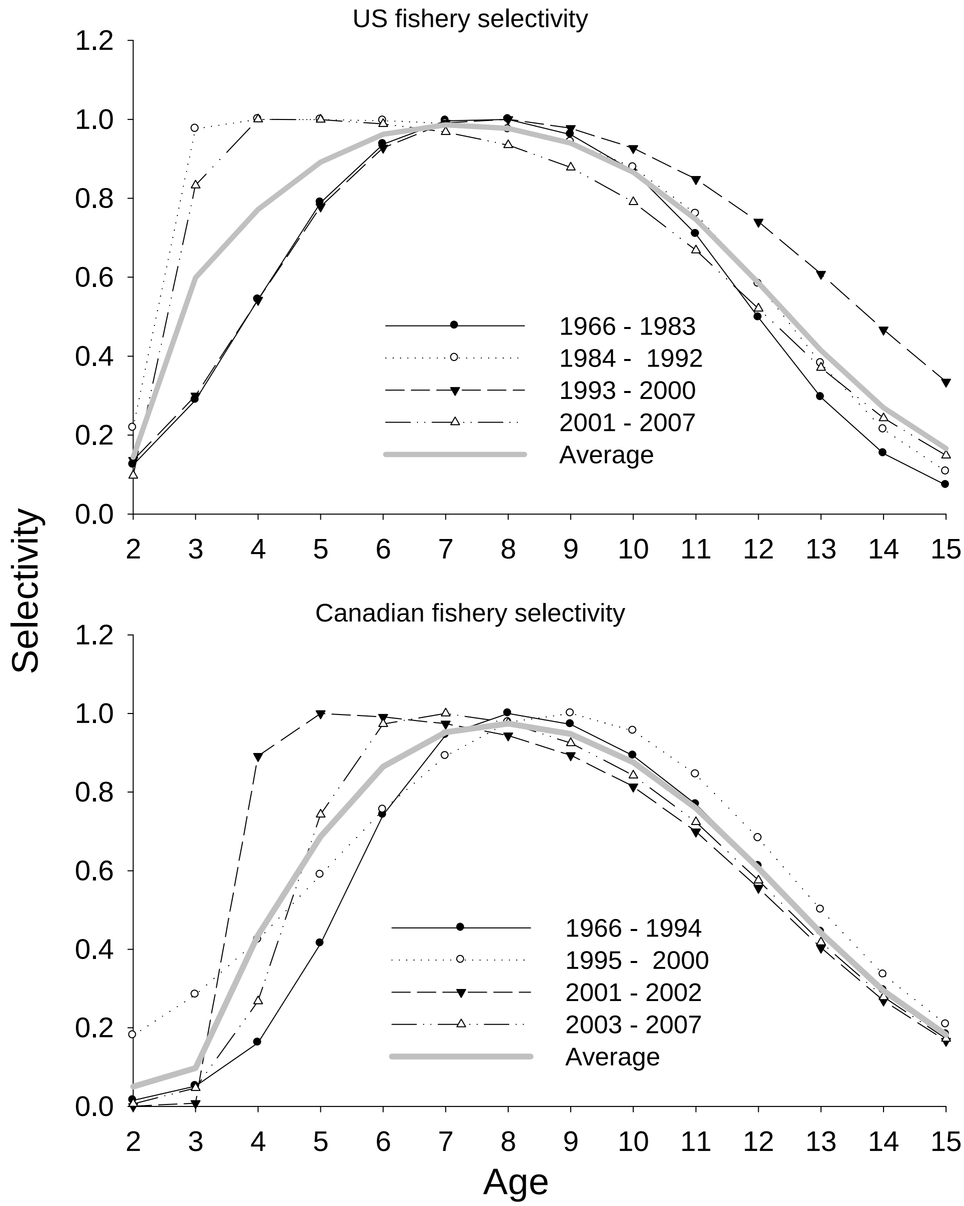



Figure 34. Estimated selectivity curves for different time blocks in the U.S. fishery, Canadian fishery and acoustic survey. Selectivity in the acoustic survey was assumed to be time-invariant with the final selectivity at age 15 fixed at 0.5. The ascending limb was freely estimated.

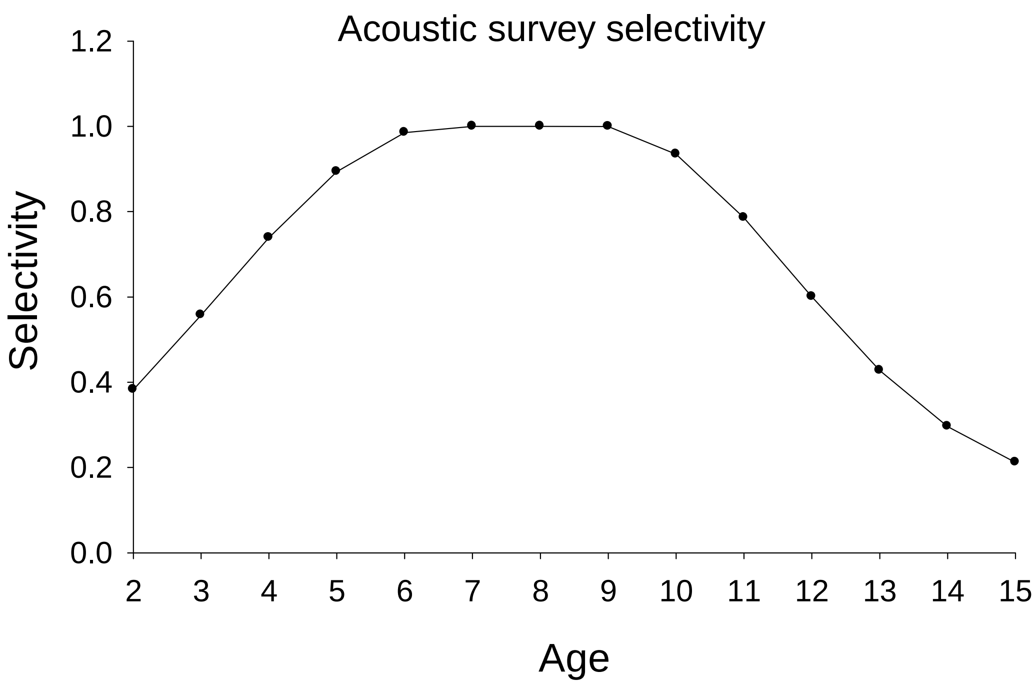



Figure 34. Continued.  Estimated selectivity curve for the acoustic survey selectivity (assumed to be time invariant).

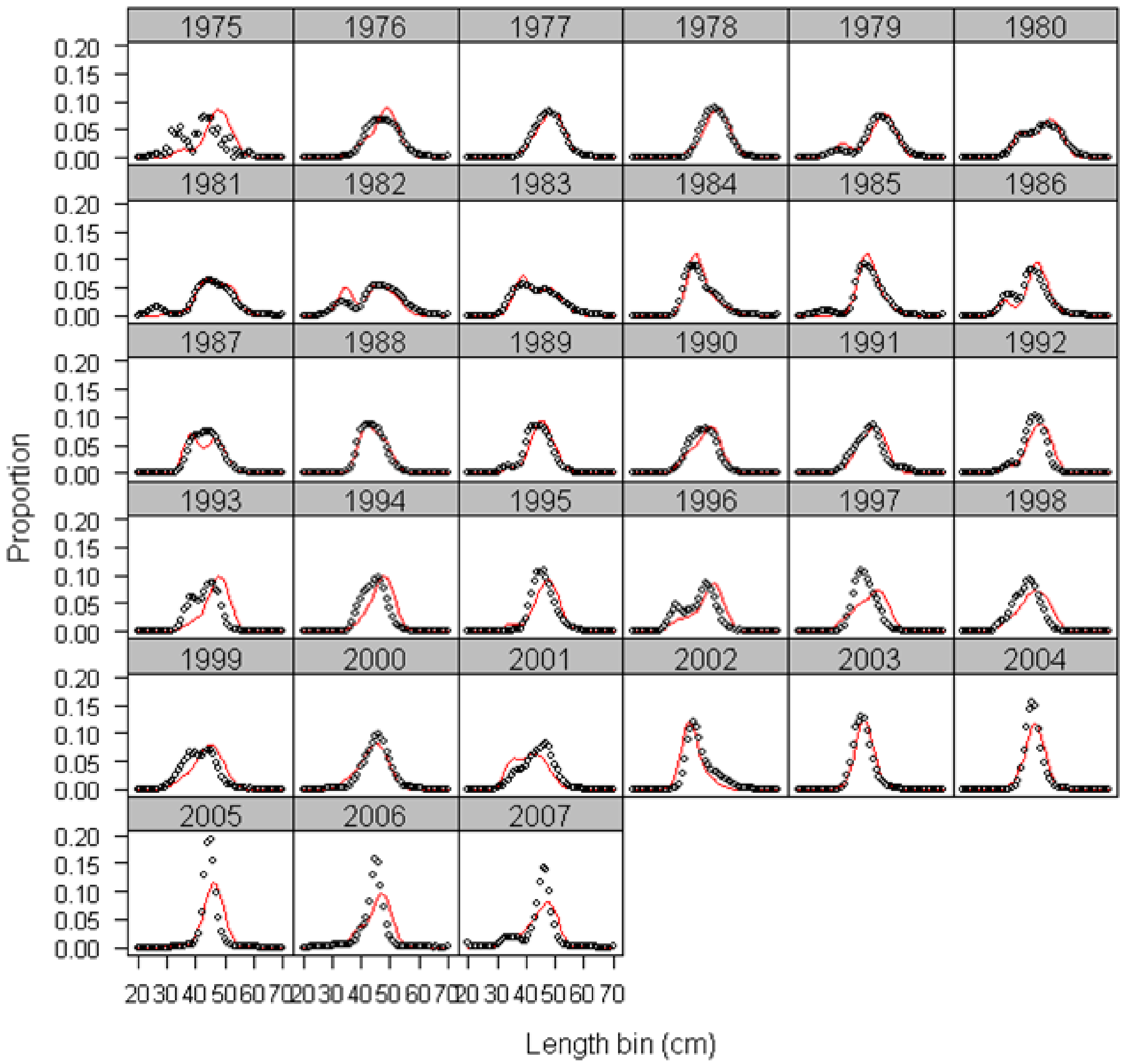



Figure 35. Predicted fits to the observed U.S. fishery length composition data.

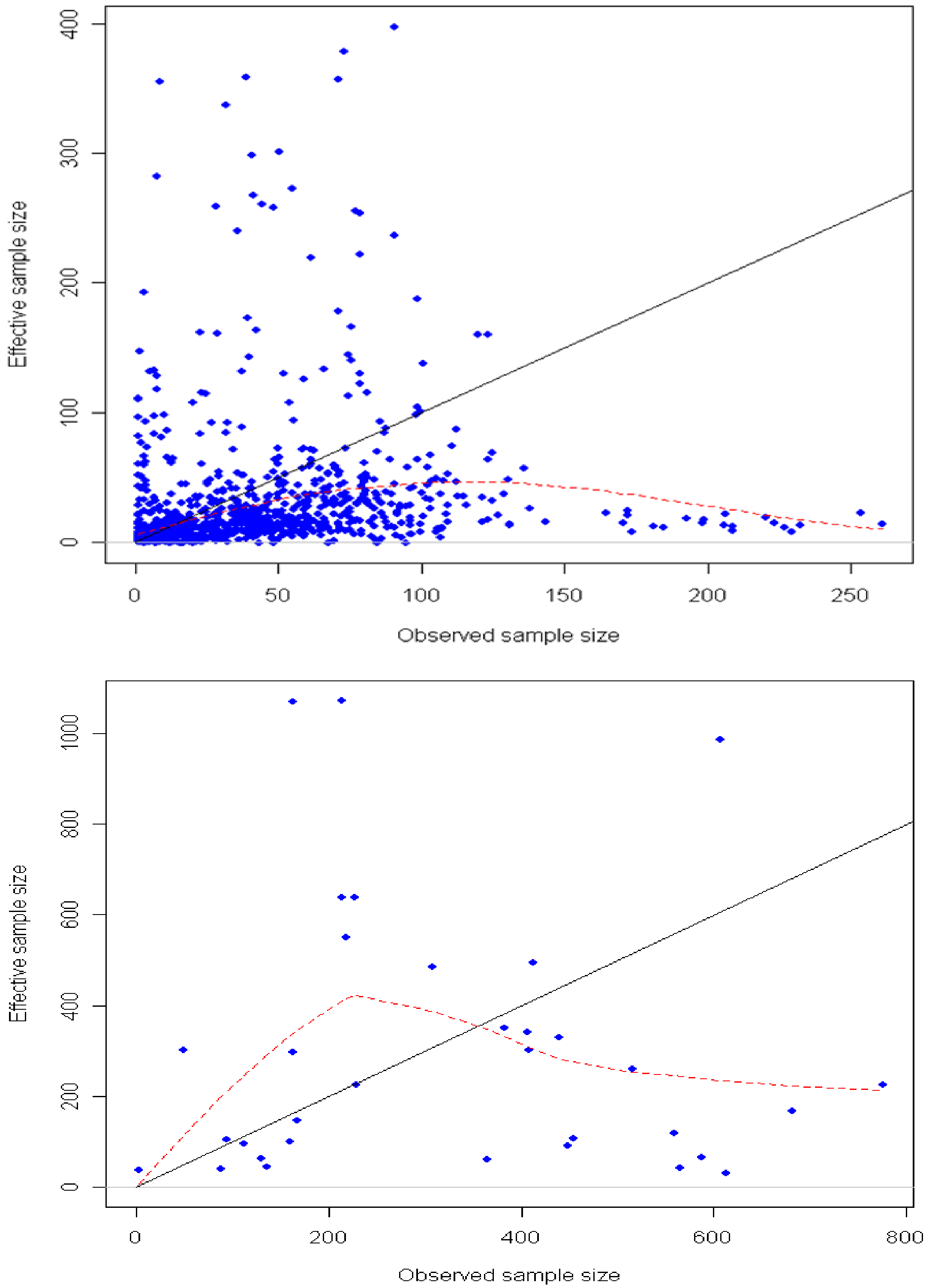



Figure 36. Plot of effective vs. observed input sample sizes for the U.S. fishery conditional age at length compositions (top) and length compositions (bottom).

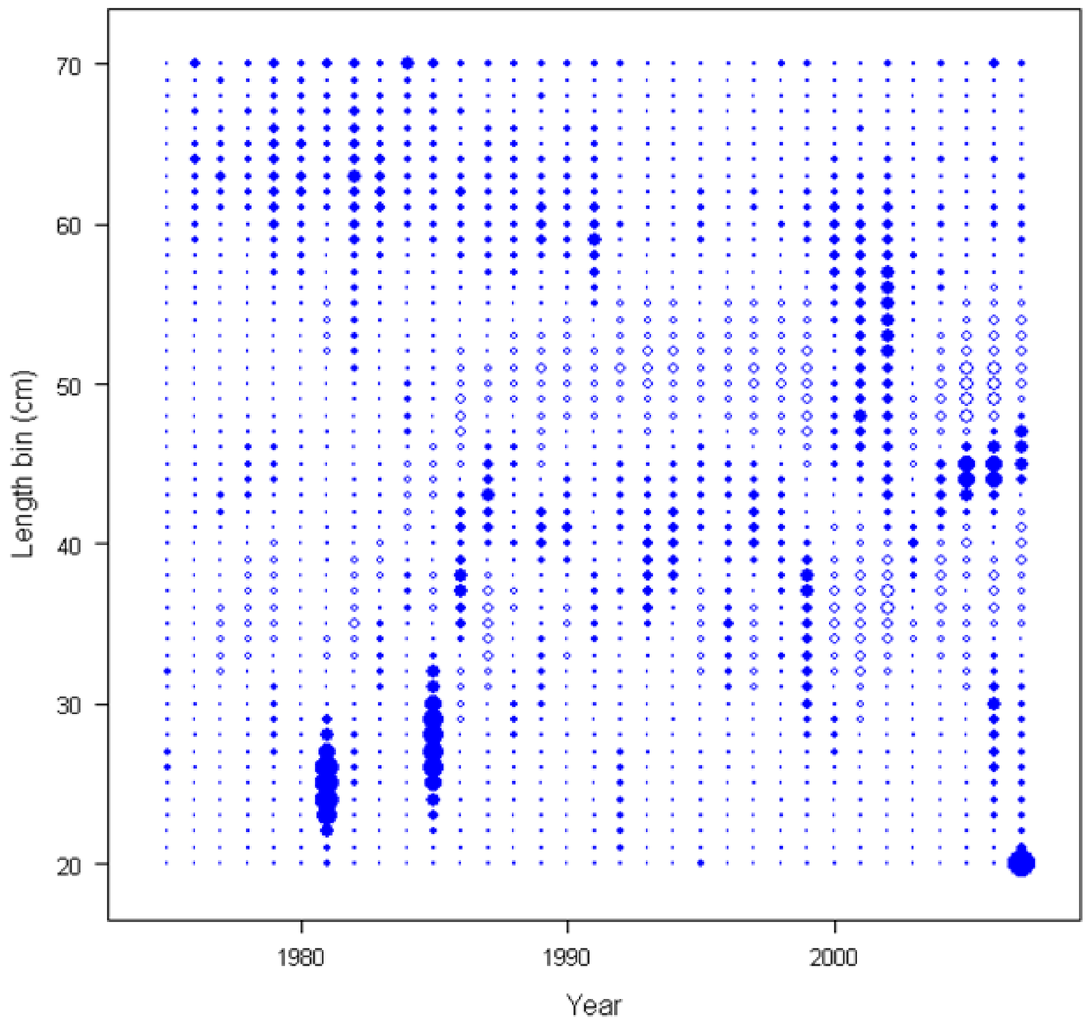



Figure 37. Pearson residuals of model fits to the U.S. fishery length composition data

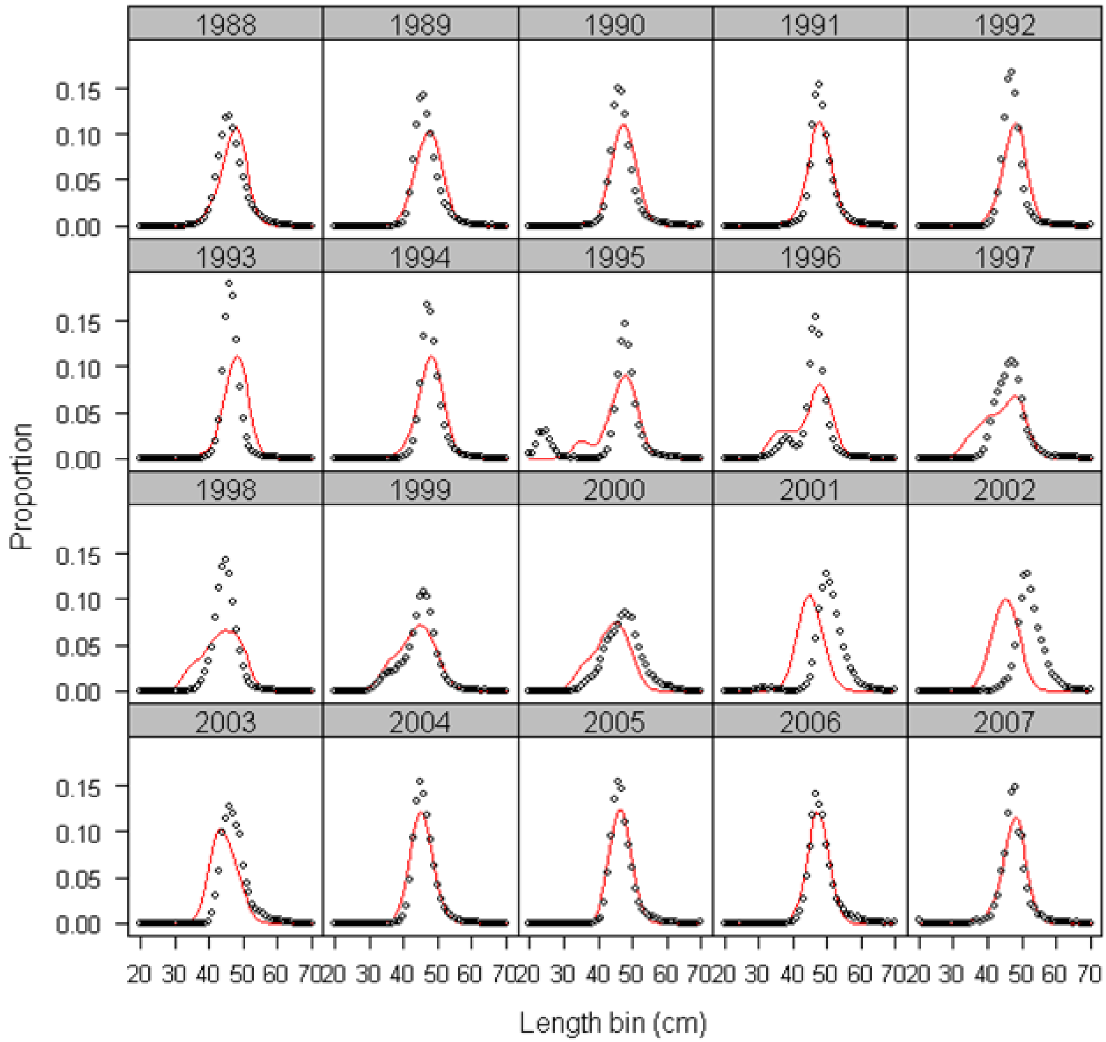



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Figure 38. Predicted fits to the observed Canadian fishery length composition data.

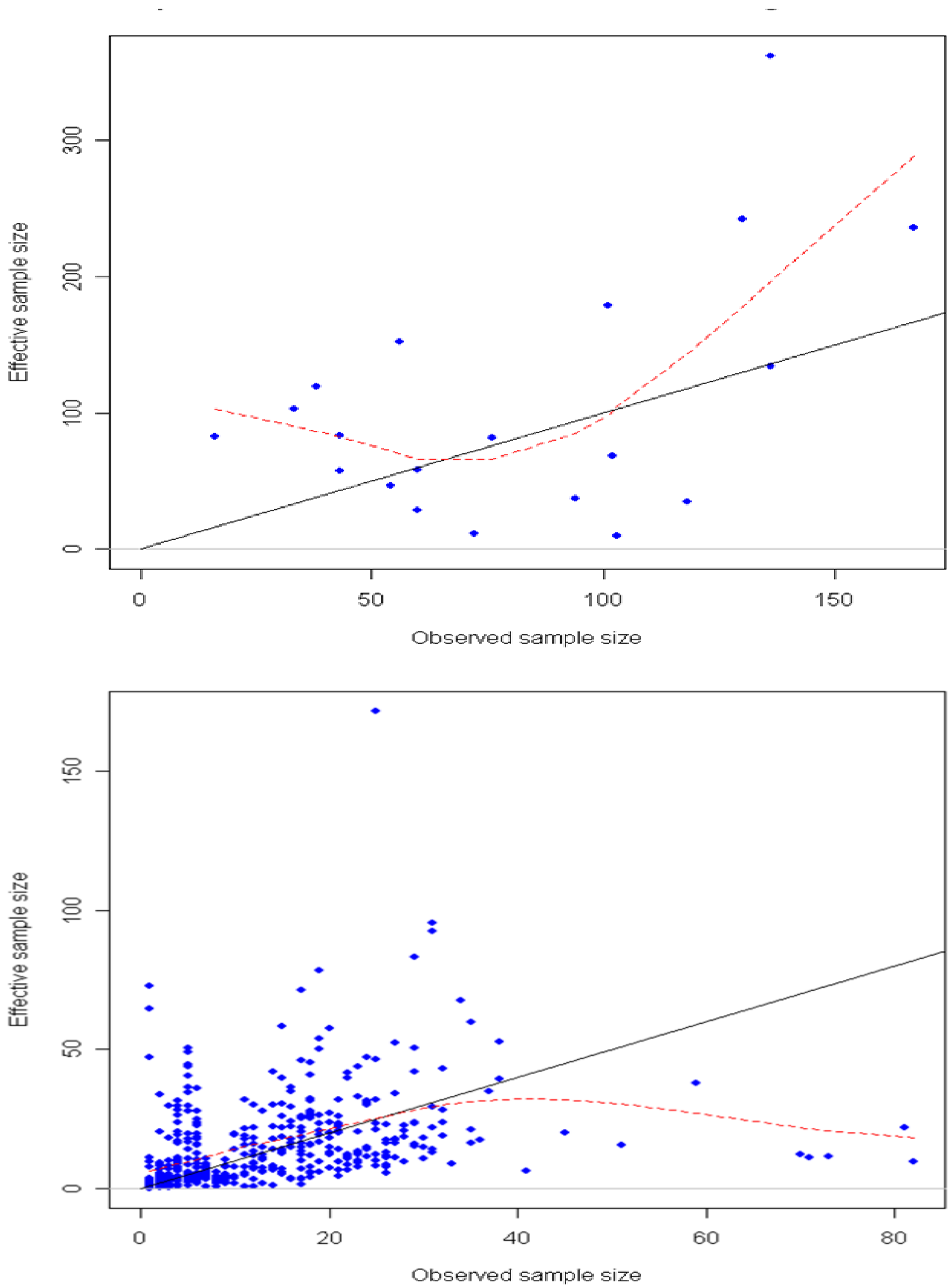



Figure 39. Plot of effective vs. observed input sample sizes for the Canadian fishery conditional age at length compositions (top) and length compositions (bottom).

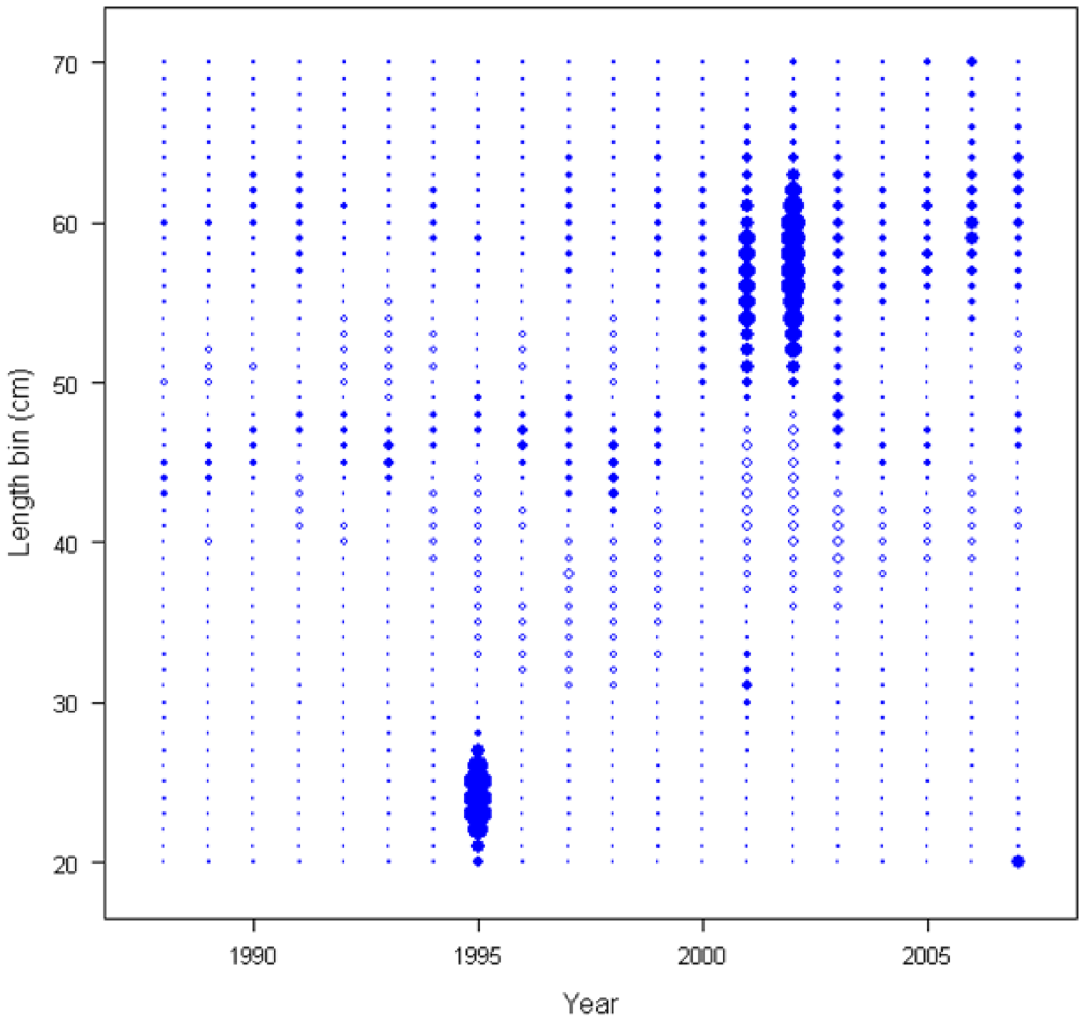



Figure 40. Pearson residuals of model fits to the Canadian length composition data.

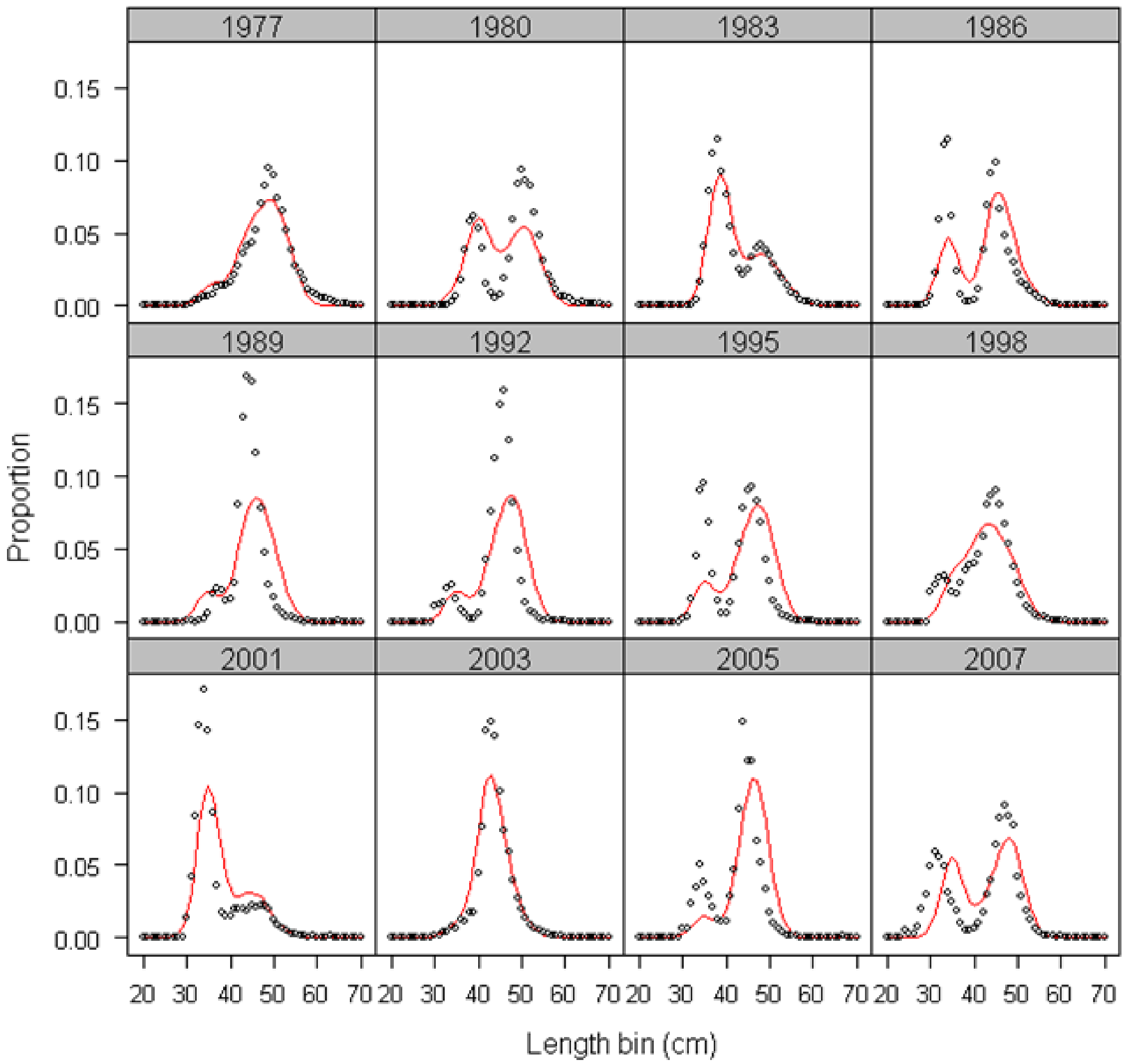



Figure 41. Predicted fits to the observed acoustic survey length composition data.

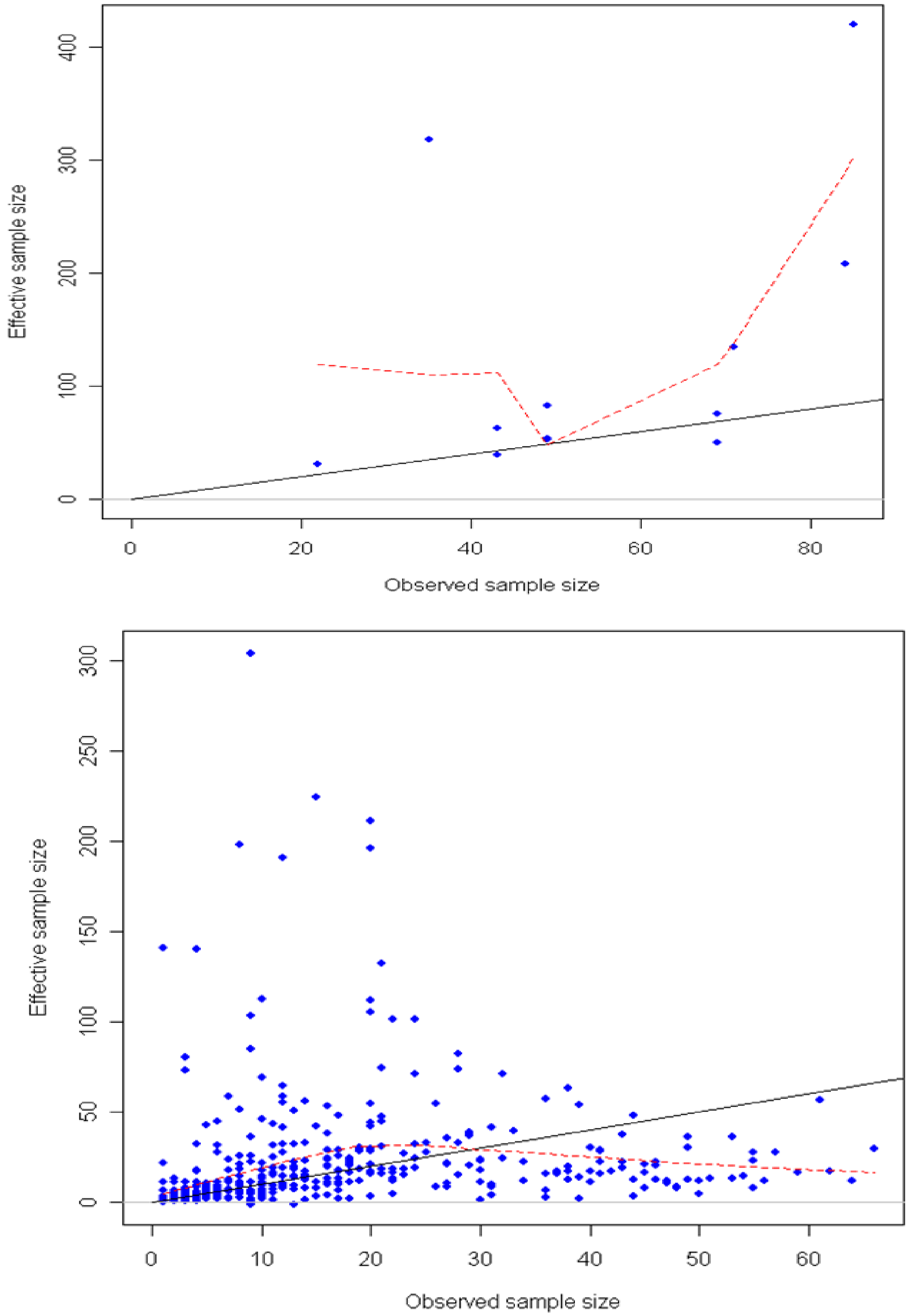



Figure 42. Plot of effective vs. observed input sample sizes for the acoustic survey conditional age at length compositions (top) and length compositions (bottom).

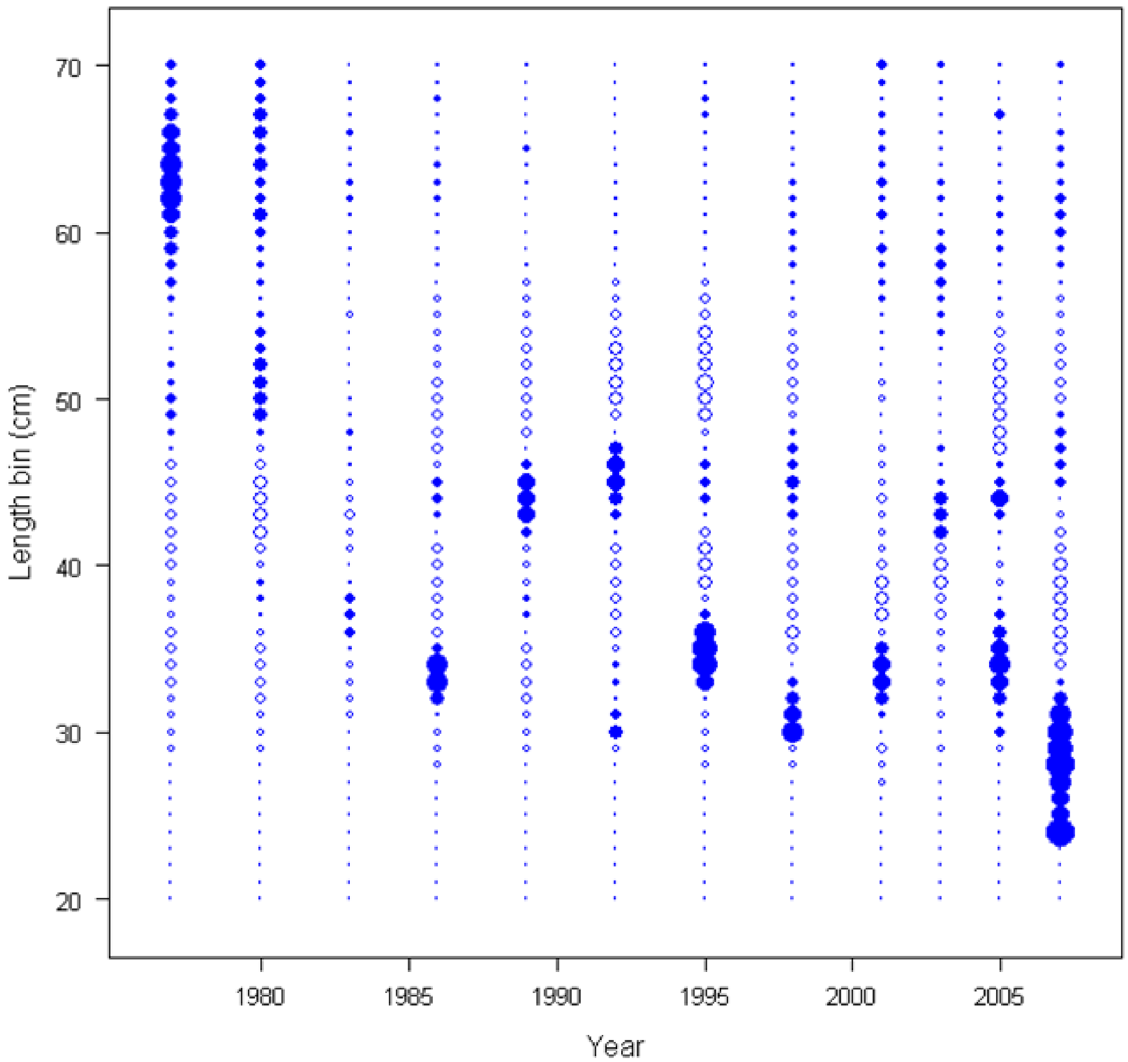



Figure 43. Pearson residuals of model fits to the acoustic survey length composition data.

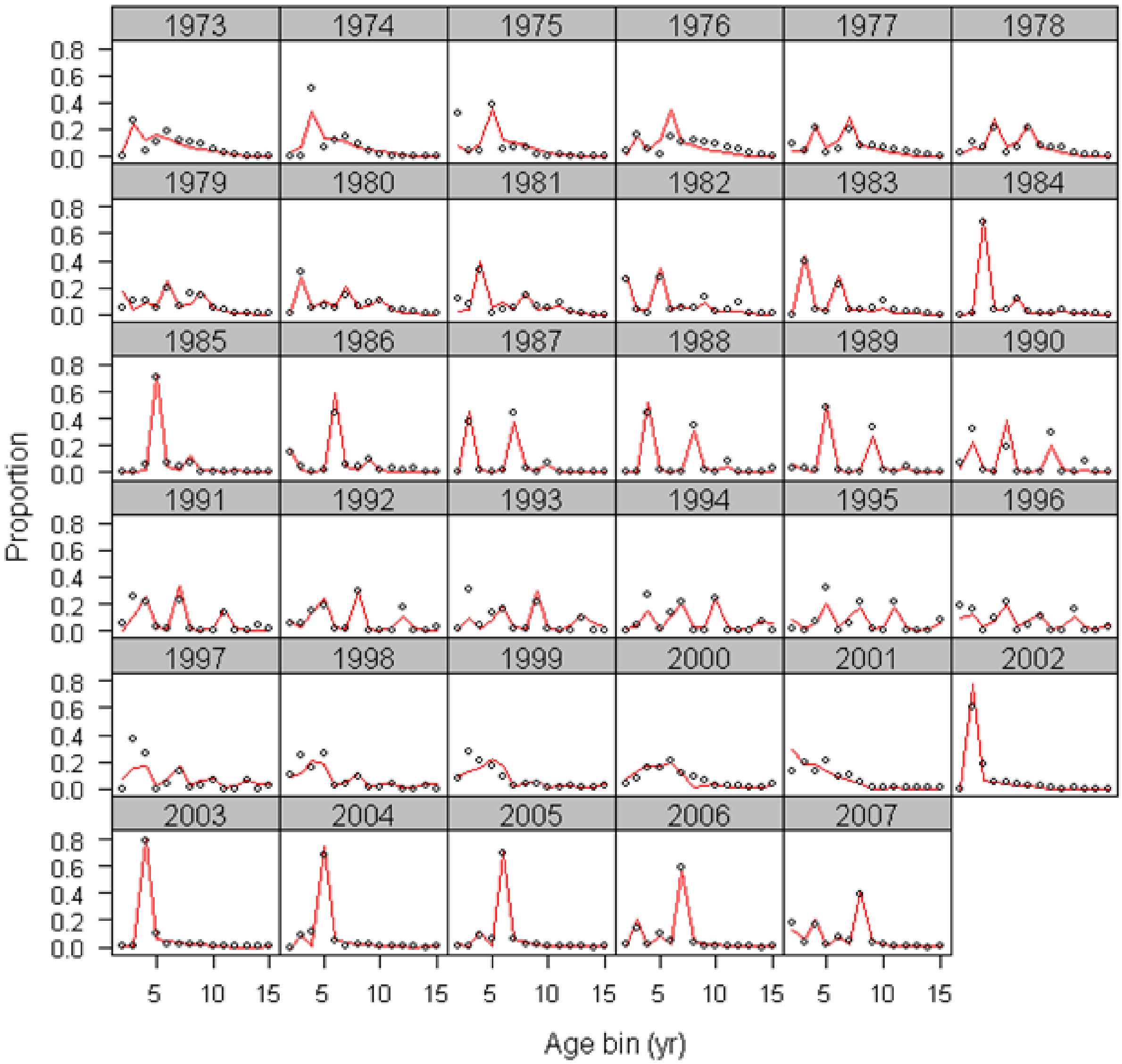



Figure 44. Predicted (implied) fits to the observed U.S. fishery age composition data.

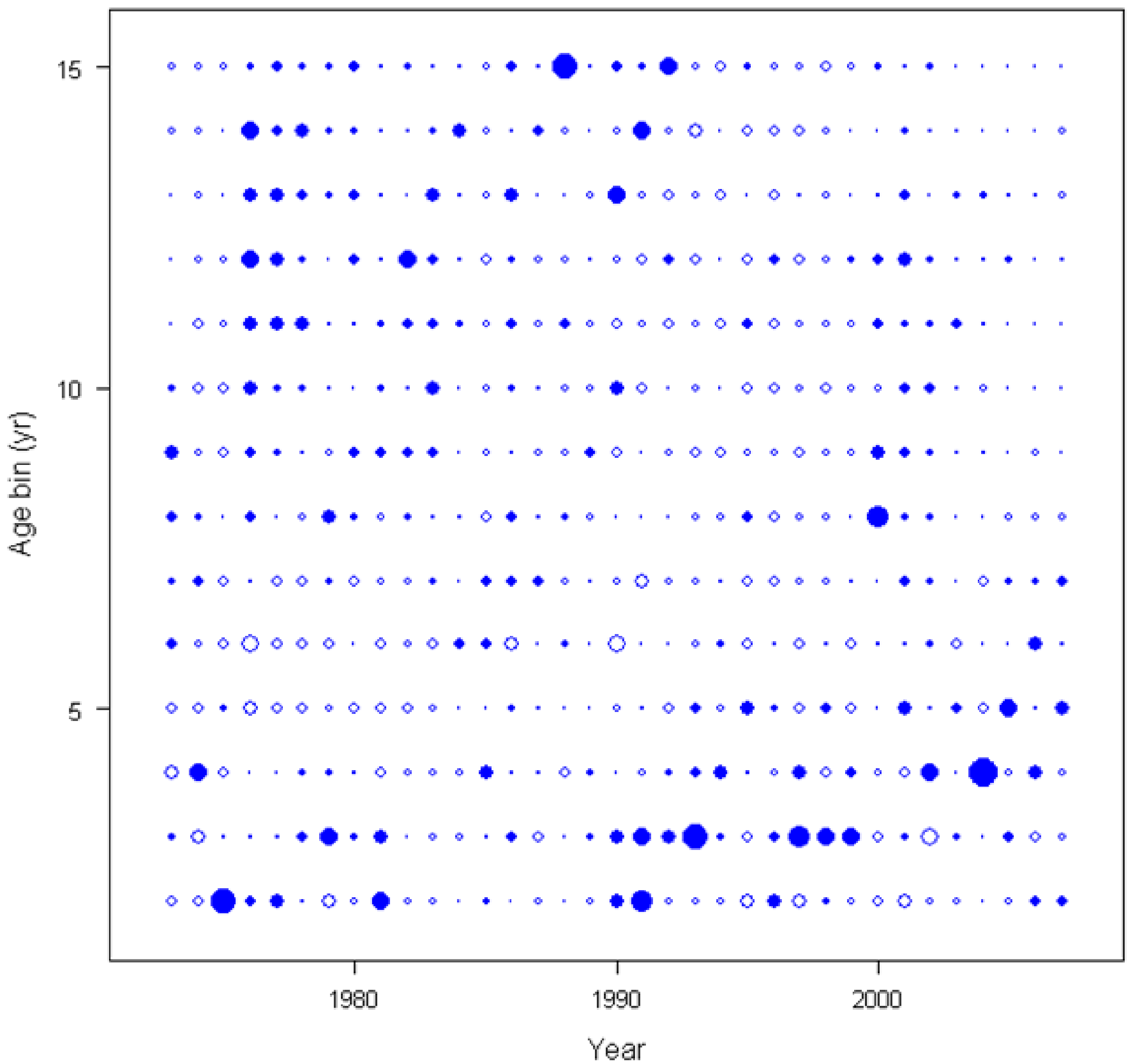



Figure 45. Pearson residuals of model fits to the acoustic survey age composition data.

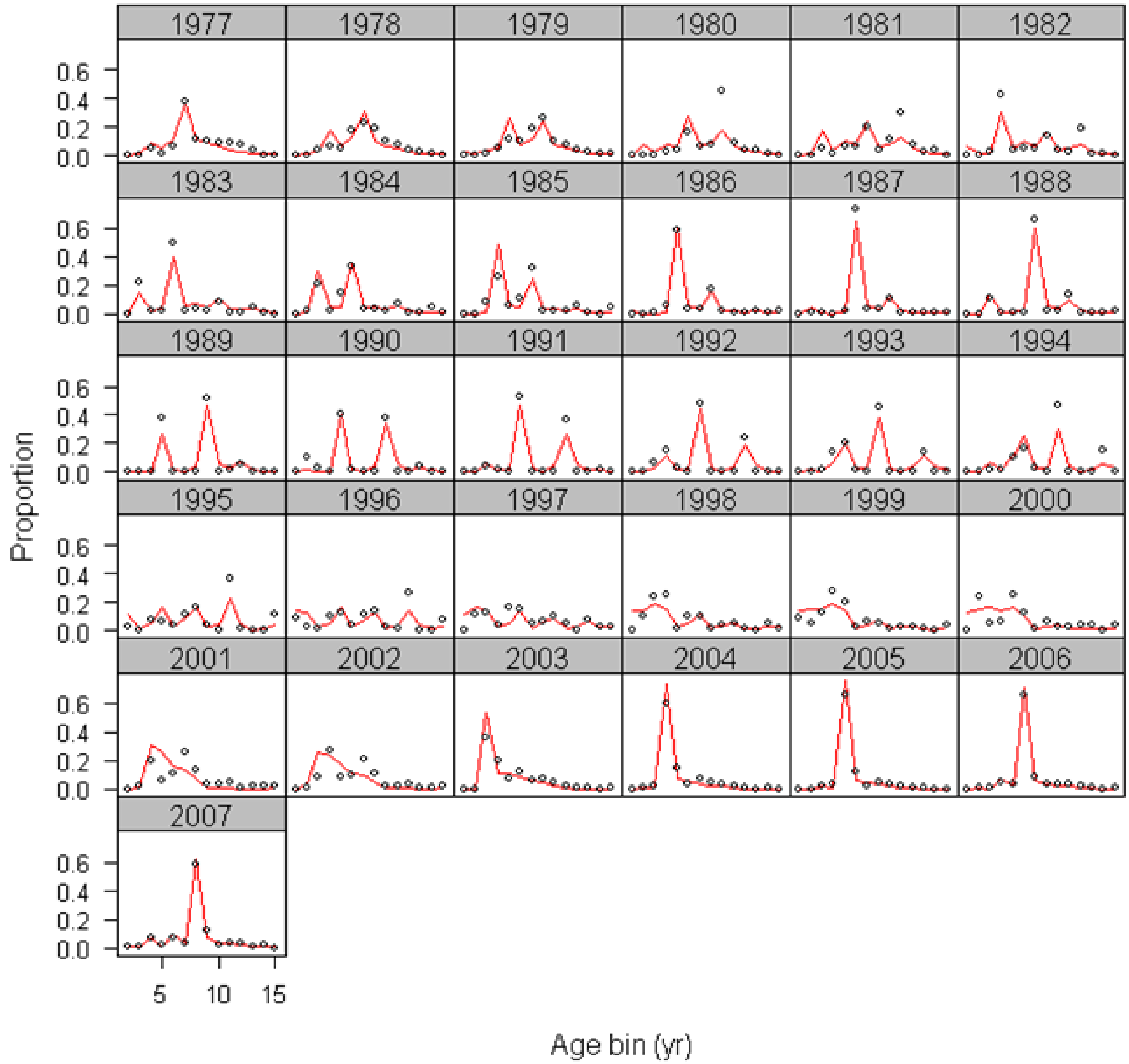



Figure 46. Predicted fits (implied) to the observed Canadian fishery age composition data.

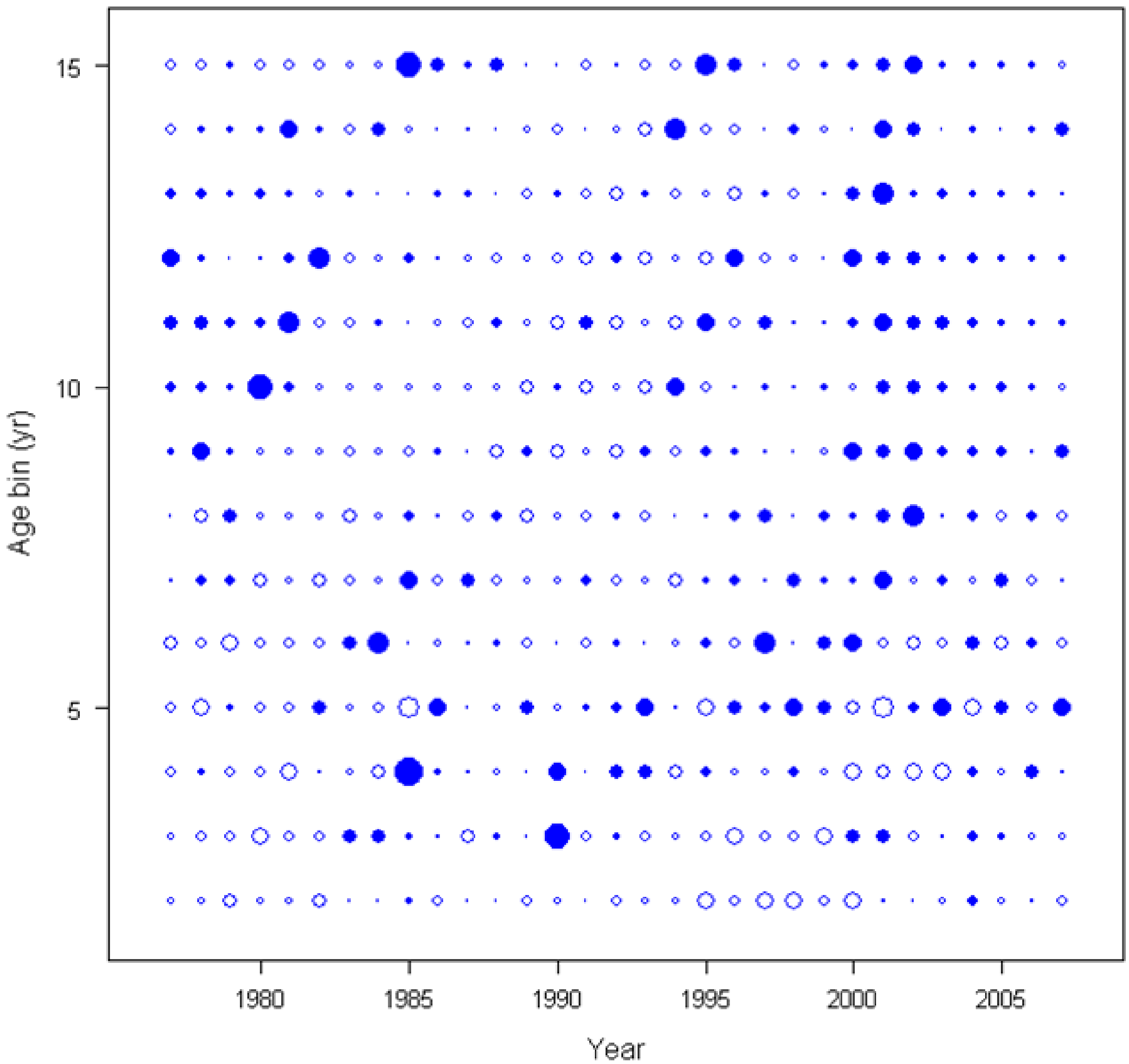



Figure 47. Pearson residuals of model fits to the Canadian fishery age composition data.

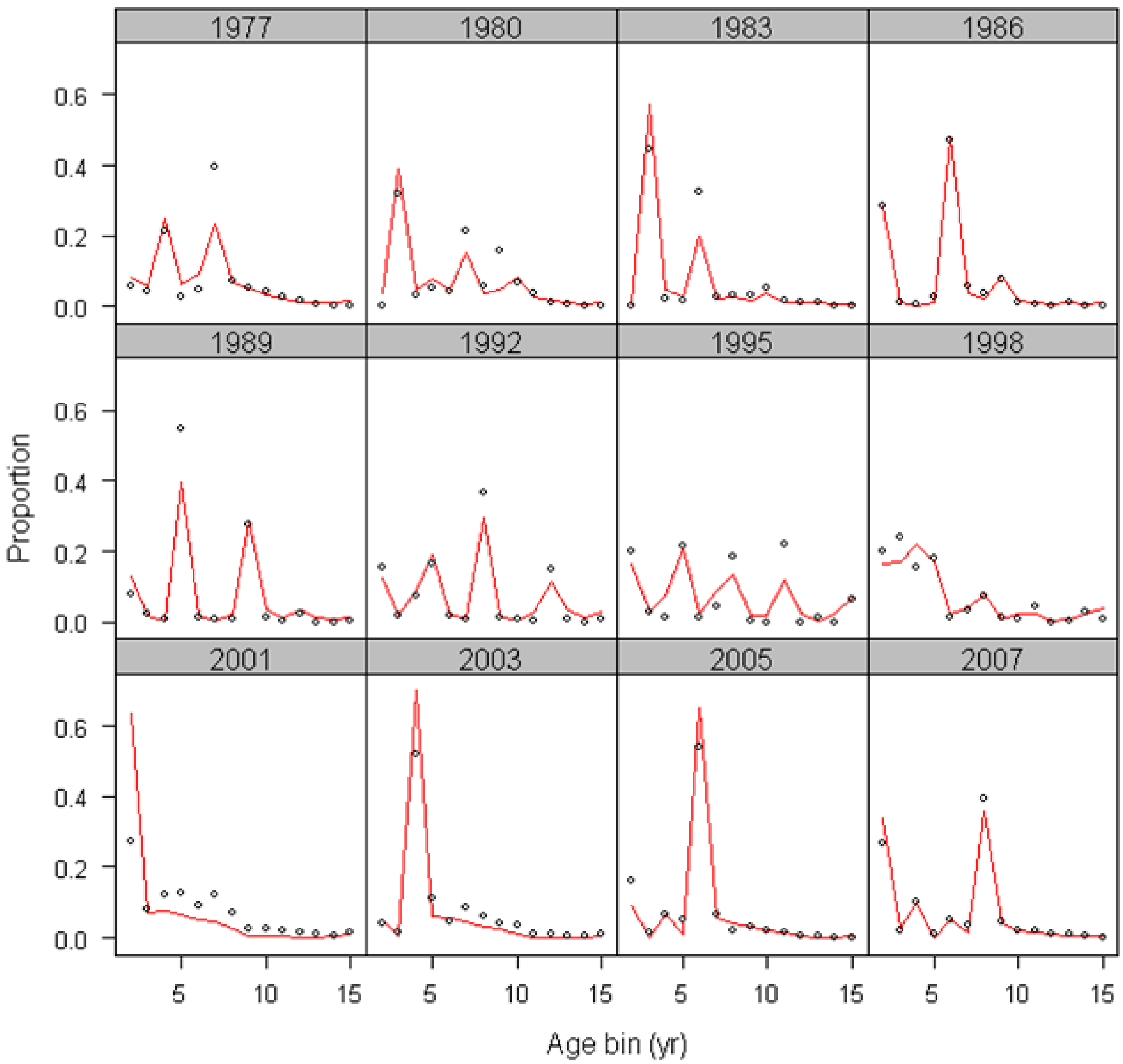



Figure 48. Predicted (implied) fits to the observed acoustic survey age composition data.

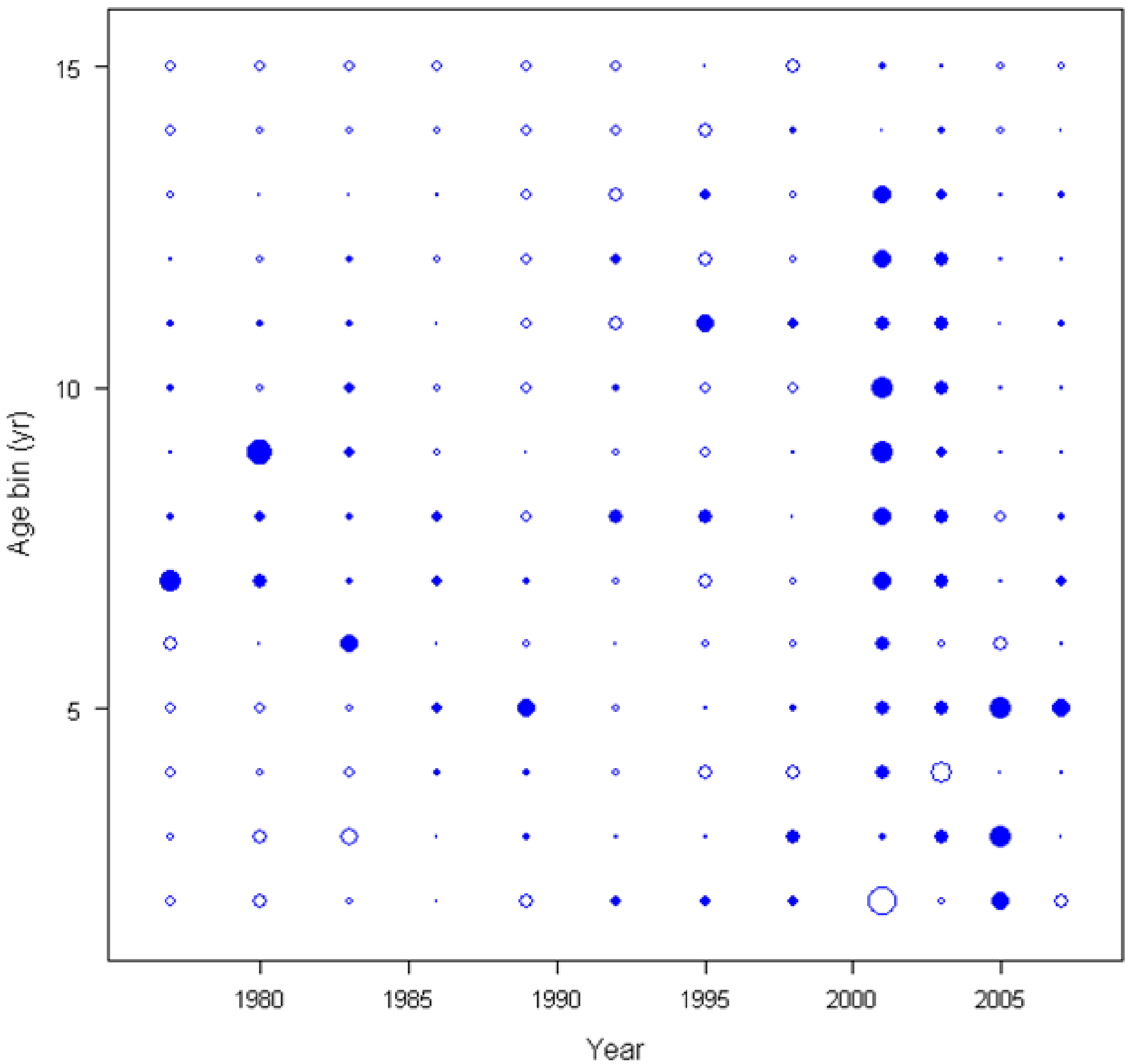



Figure 49. Pearson residuals of model fits to the acoustic survey age composition data.

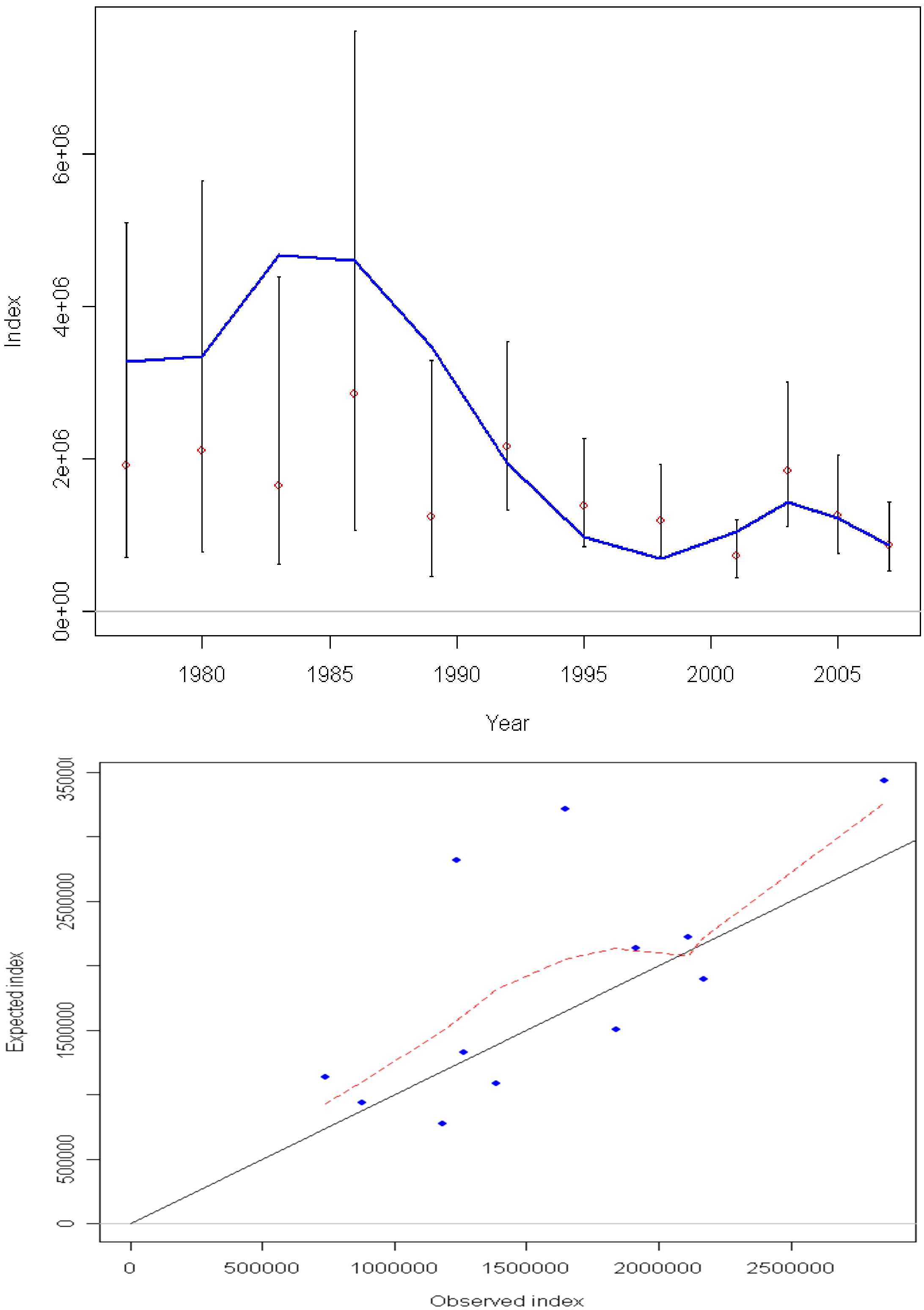



Figure 50. Predicted fit of acoustic survey biomass to the observed time series.

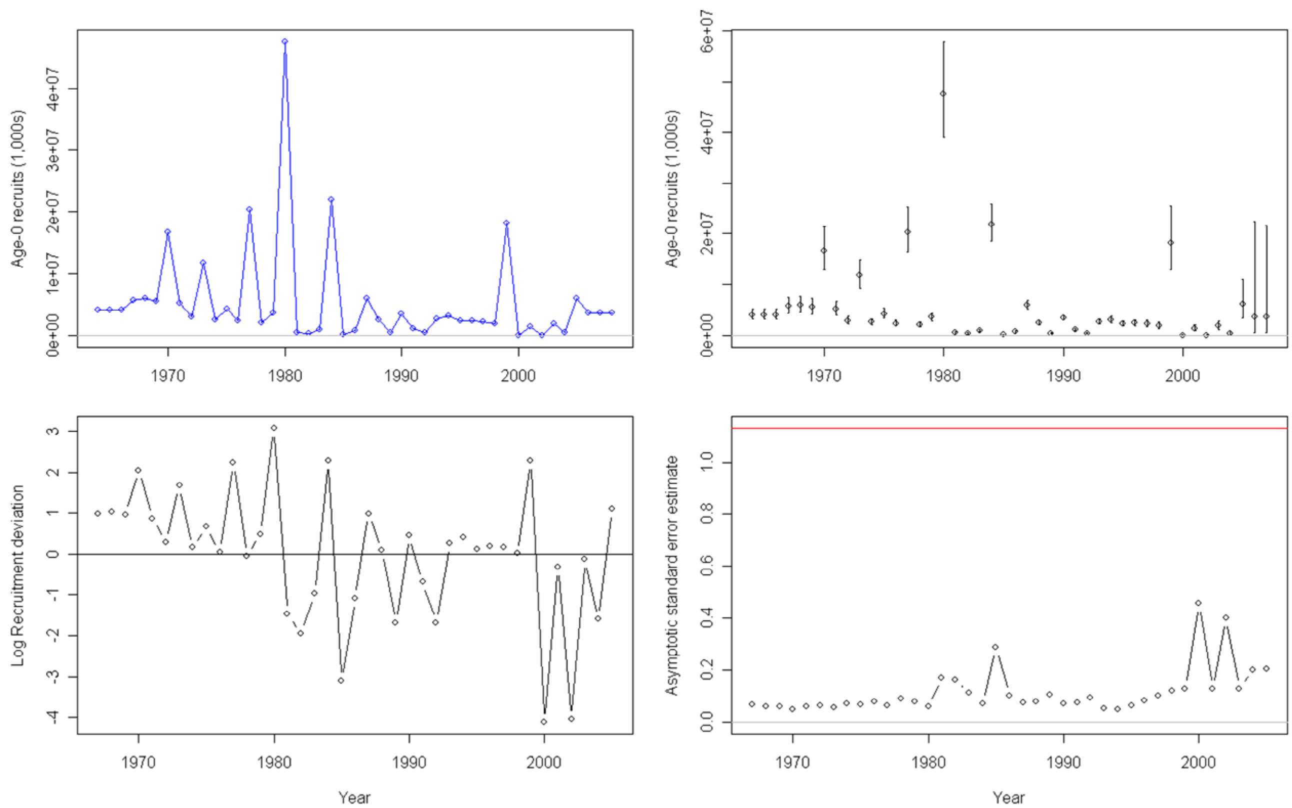



Figure 51. Estimates of Pacific hake recruitment (A), recruitment variability (B), recruitment deviations (C), and asymptotic standard errors (D). Recruitments were estimated from 1967-2005, but 2006-2007 were taken from the S-R curve.

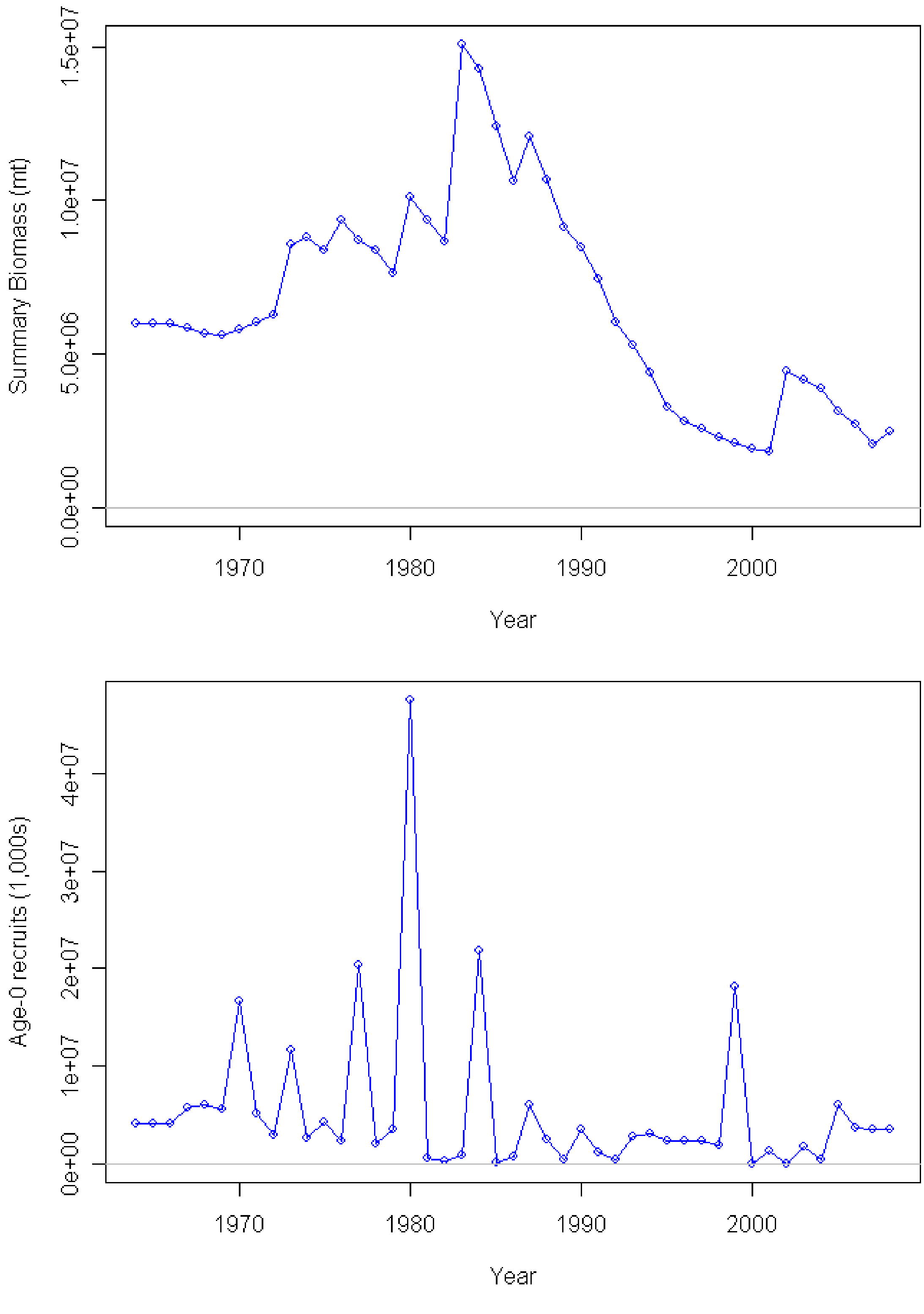



Figure 52. Estimated time series of Pacific hake summary biomass (age 3+) and recruitment from the base SS2 model.

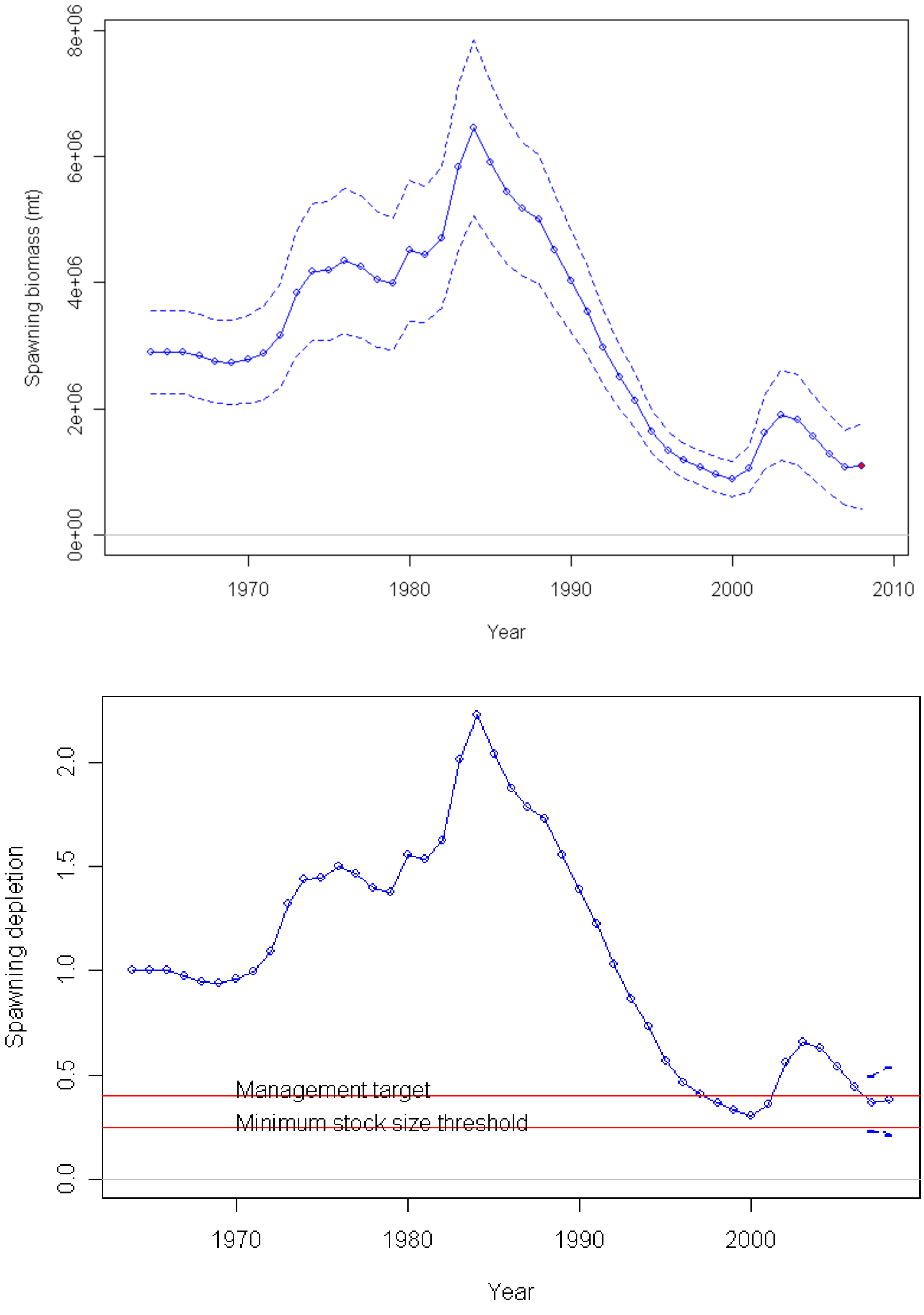



Figure 53. Estimated time series of Pacific hake spawning biomass (along with asymptotic 95% confidence intervals and spawning depletion (fraction of unfished spawning biomass).

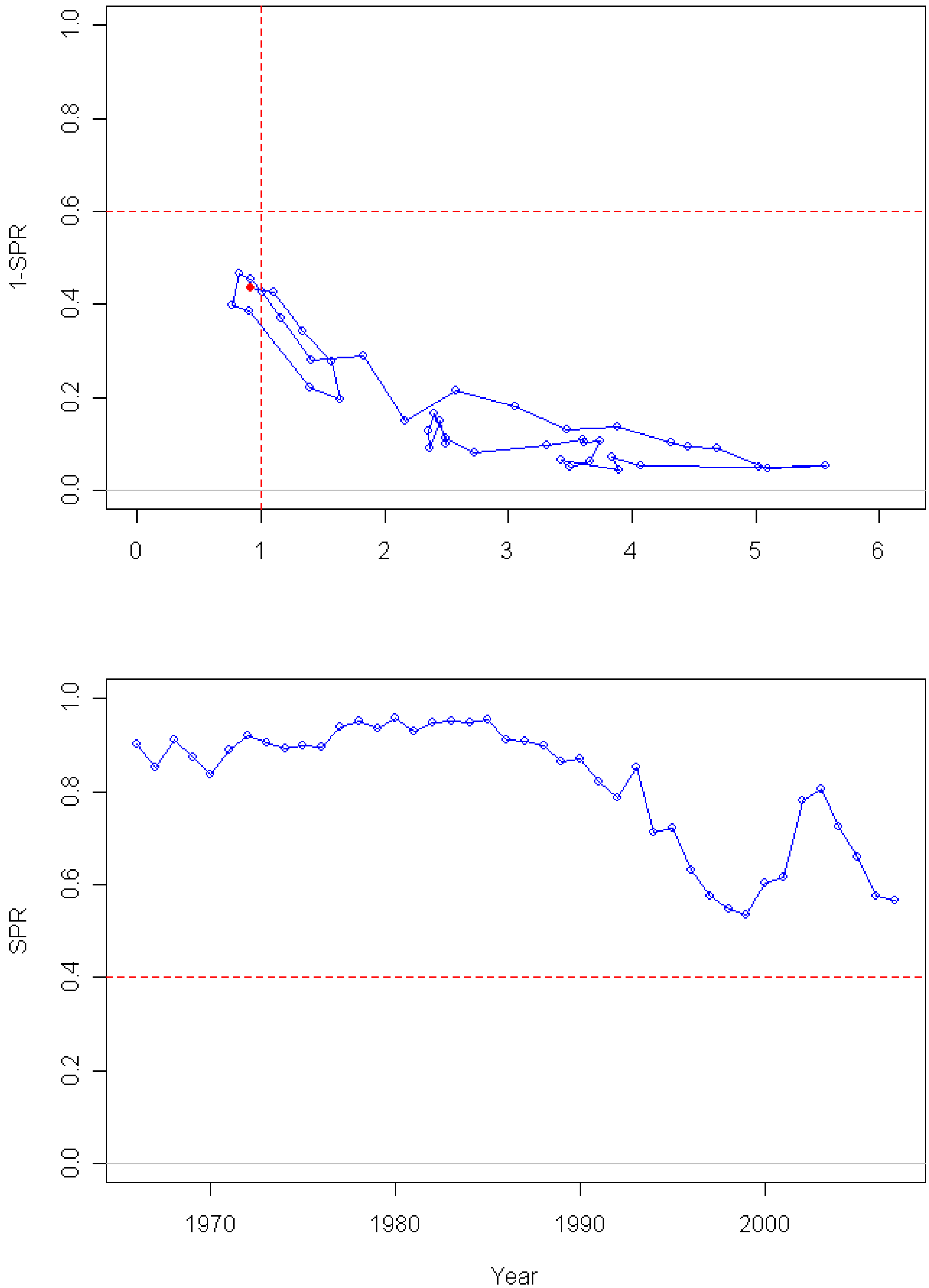



Figure 54. Estimated time series of Pacific hake spawning potential ratio (SPR) and fishery performance relative to reference point targets from the base SS2 model. Current (2007) performance relative to targets is shown as solid dot.

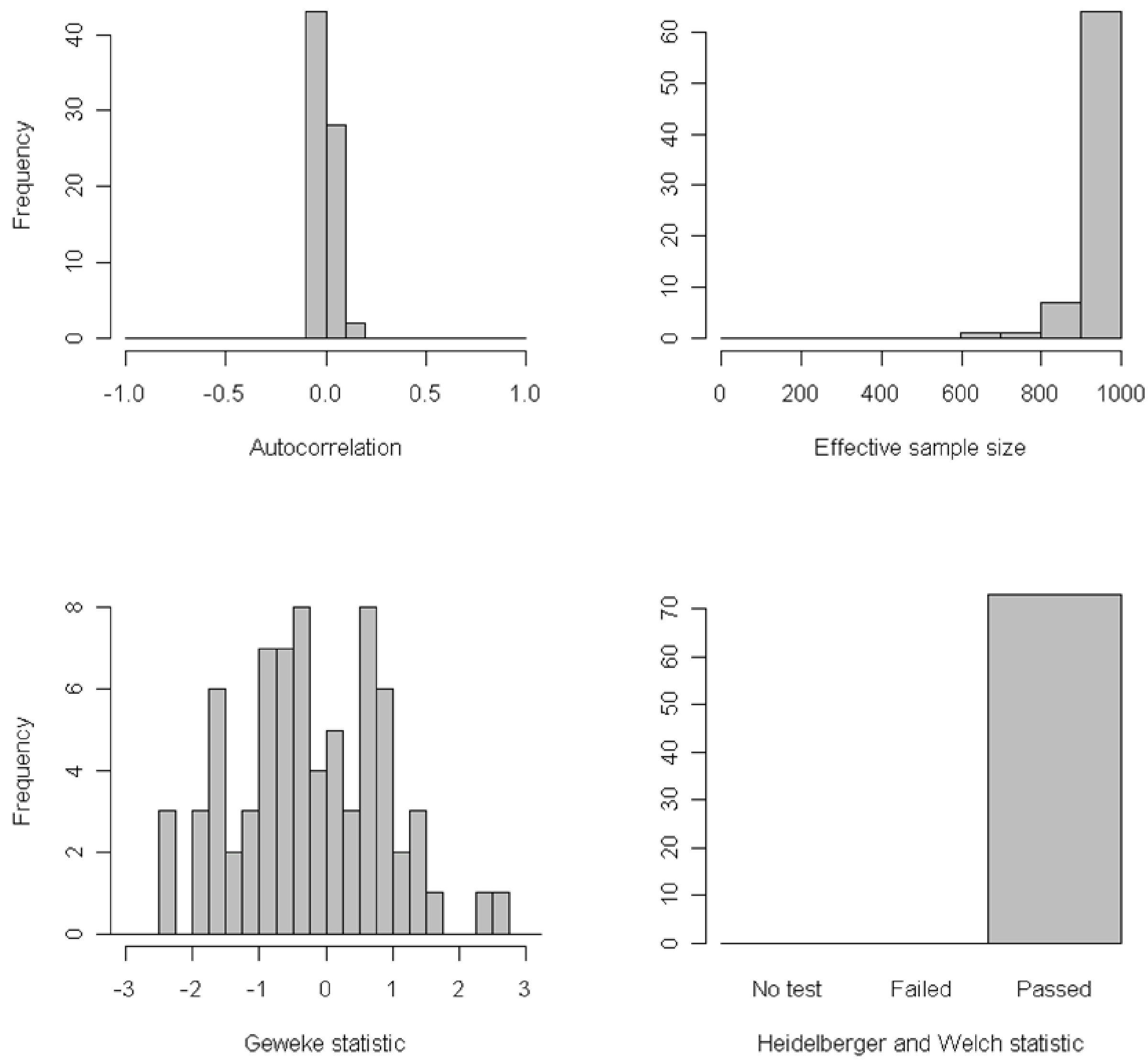



Figure 55. Summary of convergence criteria for all estimated model parameters from the base model.

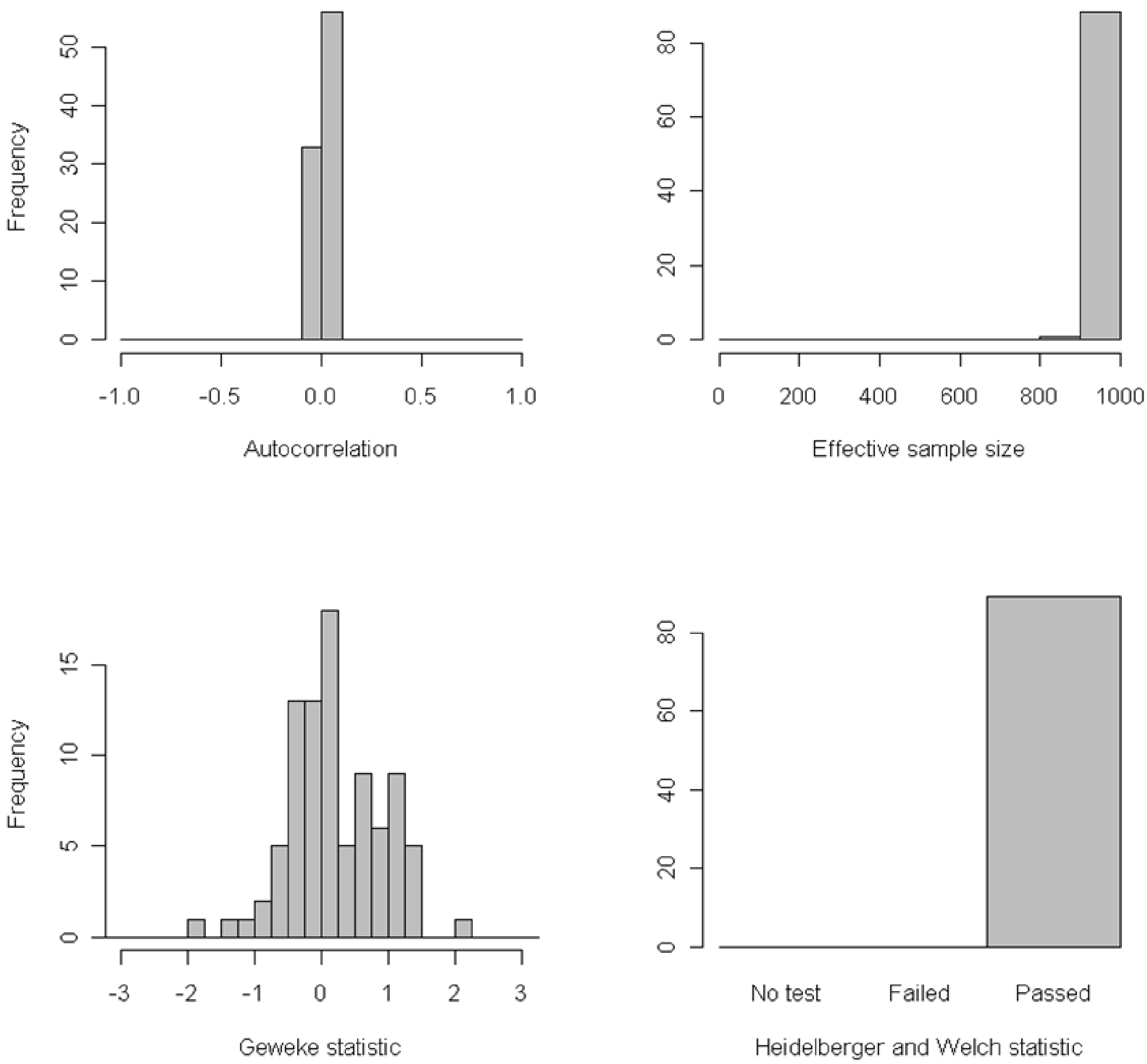



Figure 56. Summary of convergence criteria for the derived variables such as spawning biomass and recruitment time-series'.

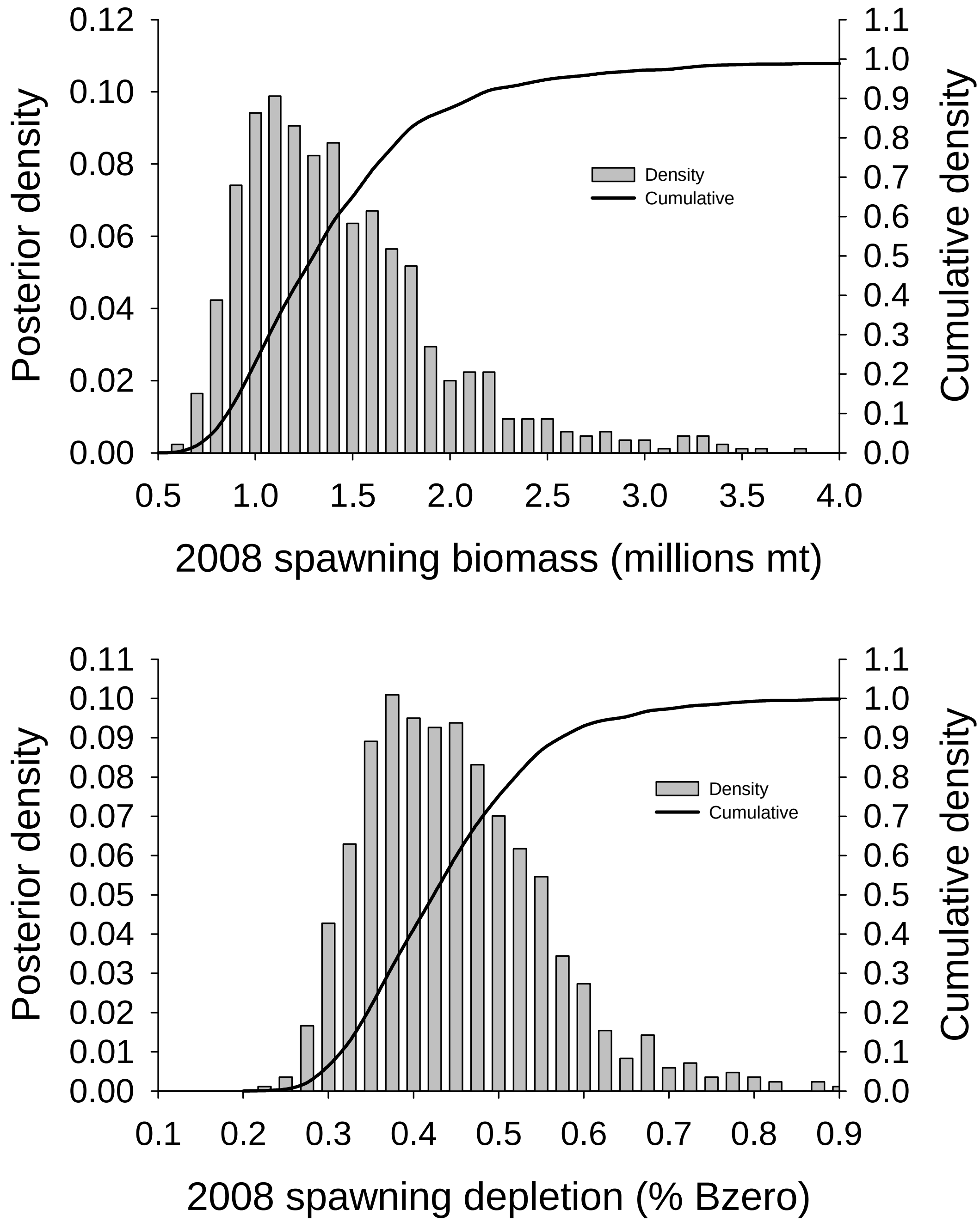



Figure 57. Uncertainty in 2008 female spawning biomass and relative depletion generated from 1,000,000 Markov Chain Monte Carlo simulations of the joint posterior distribution. Note that the MPD is slightly larger then the MLE.

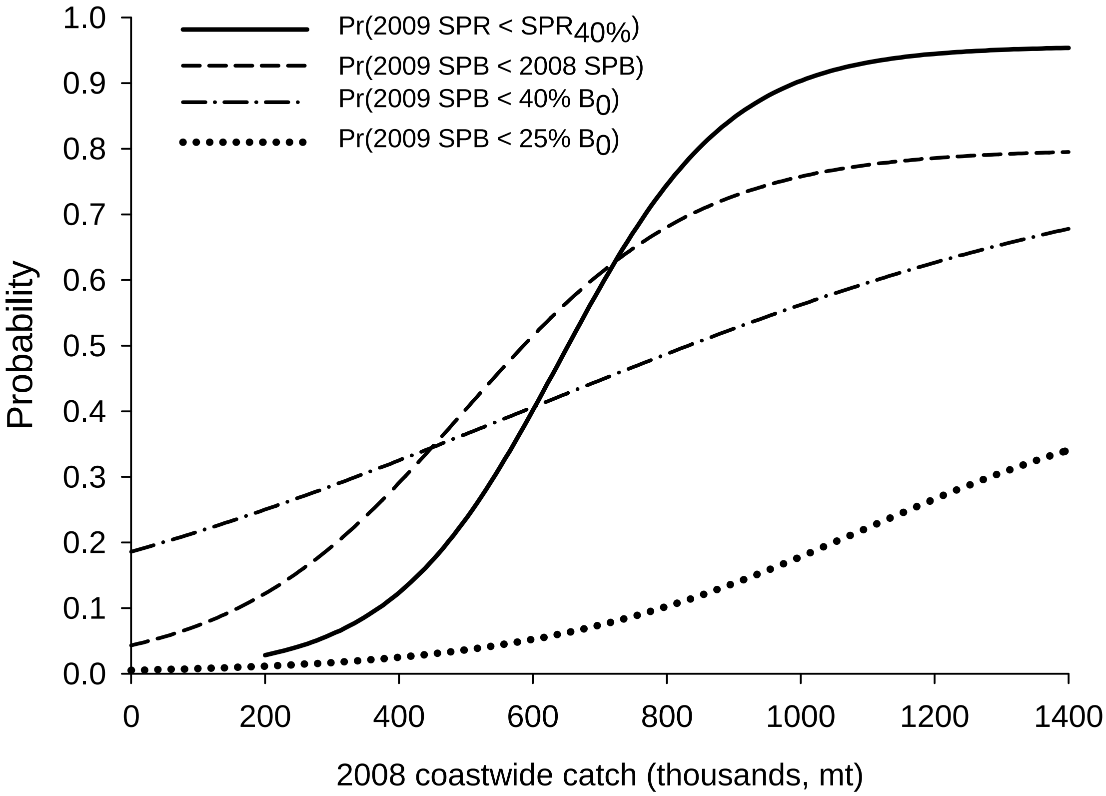



Figure 58. Risk profiles showing probability of the 2009 SPR rate being less than target SPR40% and 2009 spawning biomass being less than 25% Bzero for a suite of different coastwide catches in 2008.

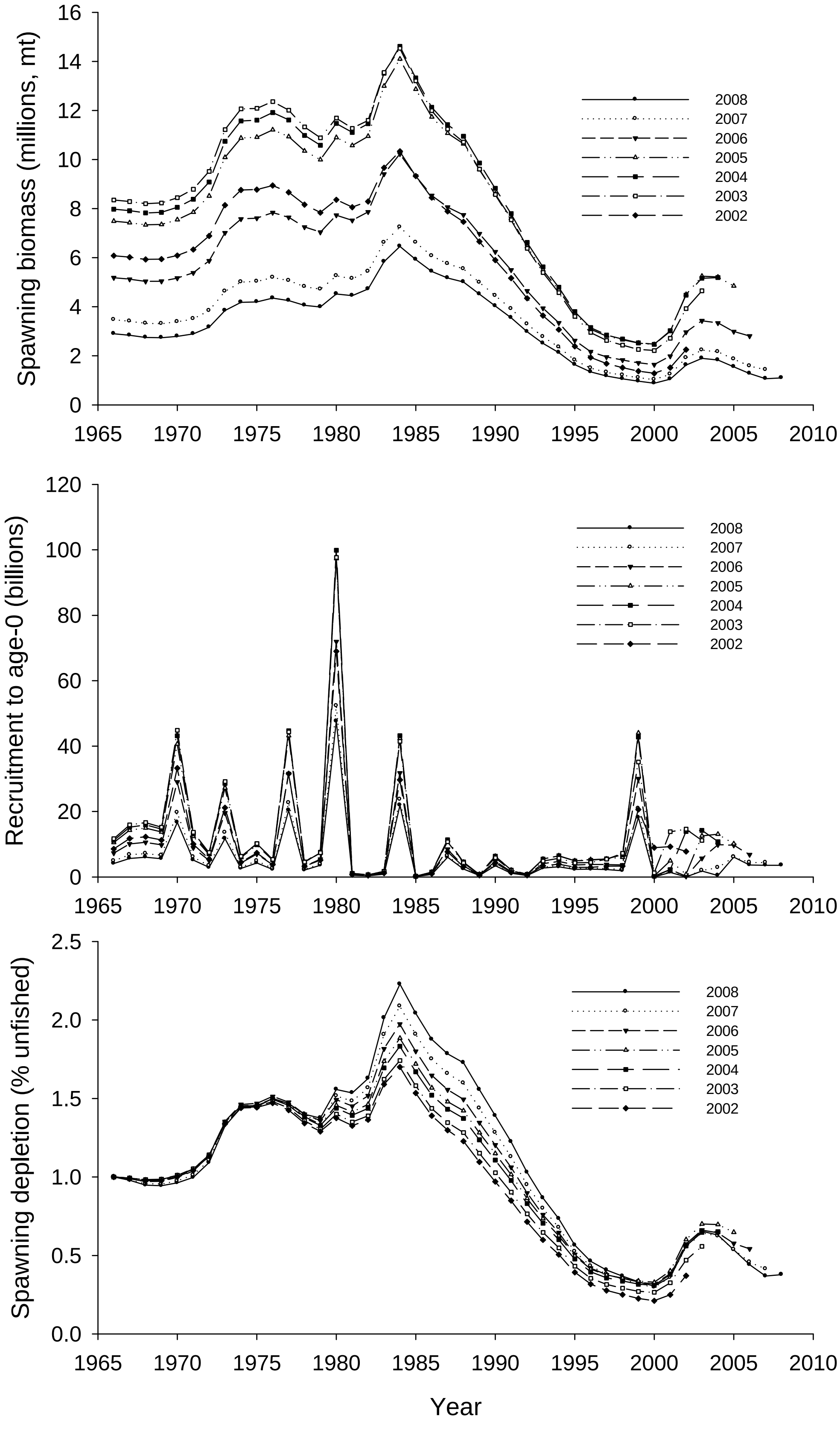



Figure 59. Retrospective analysis of the hake model showing spawning biomass, recruitment to age-0 and spawning depletion.

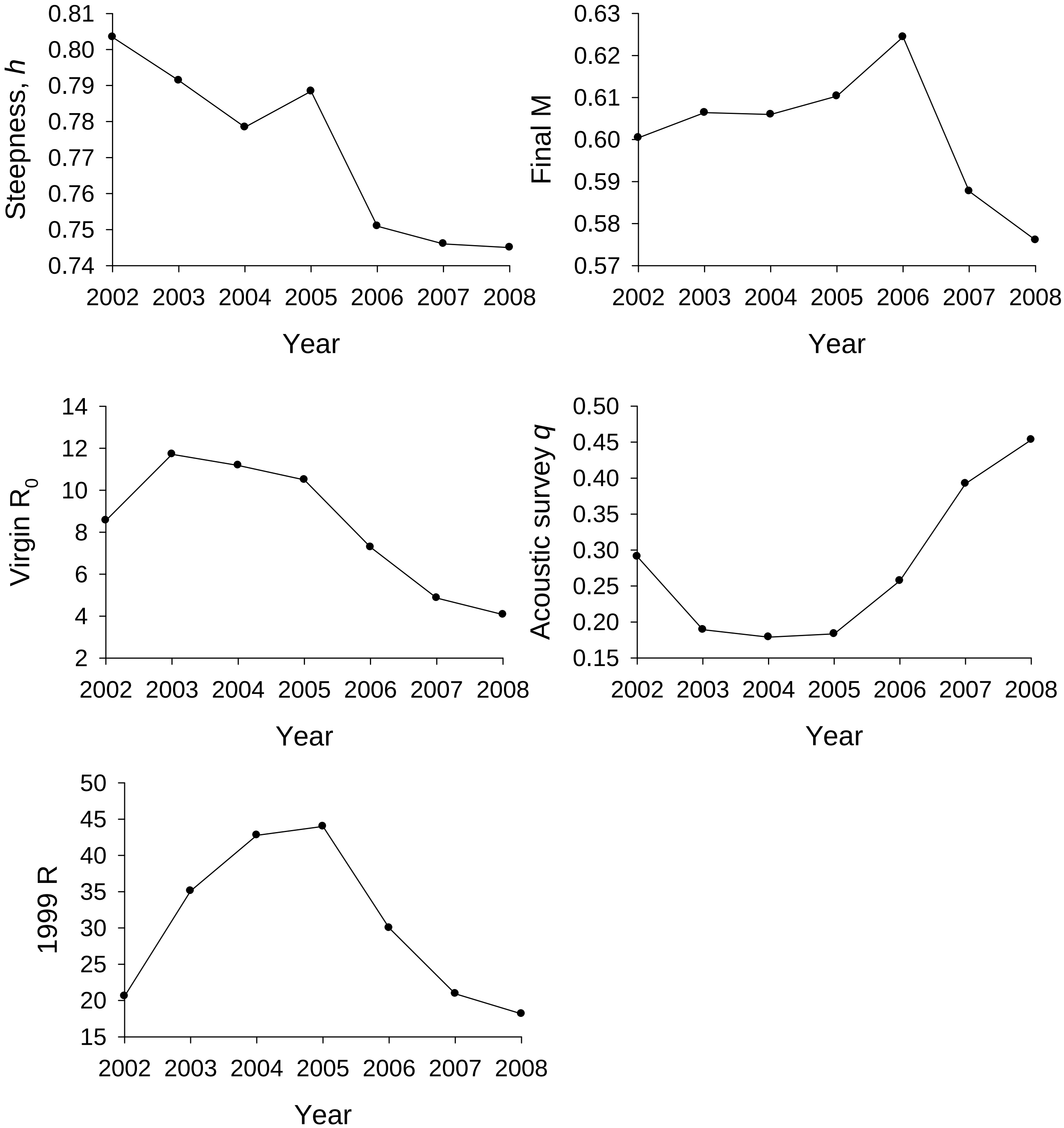



Figure 60. Retrospective analysis of the hake model showing changes in selected estimated parameters when years are sequentially removed from analysis.

Table 1. Annual catches of Pacific hake (1,000 t) in U.S. and Canadian management zones by foreign, joint venture (JV), domestic at-sea, domestic shore-based, and tribal fisheries, 1966-2007.

| | U.S. | | | | | | Canada | | | | U.S. and |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Domestic | | | | | | | | Canada |
| Year | Foreign | JV | At-sea | Shore | Tribal | Total | Foreign | JV | Shore | Total | total |
| 1966 | 137.000 | 0.000 | 0.000 | 0.000 | 0.000 | 137.000 | 0.700 | 0.000 | 0.000 | 0.700 | 137.700 |
| 1967 | 168.699 | 0.000 | 0.000 | 8.963 | 0.000 | 177.662 | 36.713 | 0.000 | 0.000 | 36.713 | 214.375 |
| 1968 | 60.660 | 0.000 | 0.000 | 0.159 | 0.000 | 60.819 | 61.361 | 0.000 | 0.000 | 61.361 | 122.180 |
| 1969 | 86.187 | 0.000 | 0.000 | 0.093 | 0.000 | 86.280 | 93.851 | 0.000 | 0.000 | 93.851 | 180.131 |
| 1970 | 159.509 | 0.000 | 0.000 | 0.066 | 0.000 | 159.575 | 75.009 | 0.000 | 0.000 | 75.009 | 234.584 |
| 1971 | 126.485 | 0.000 | 0.000 | 1.428 | 0.000 | 127.913 | 26.699 | 0.000 | 0.000 | 26.699 | 154.612 |
| 1972 | 74.093 | 0.000 | 0.000 | 0.040 | 0.000 | 74.133 | 43.413 | 0.000 | 0.000 | 43.413 | 117.546 |
| 1973 | 147.441 | 0.000 | 0.000 | 0.072 | 0.000 | 147.513 | 15.125 | 0.000 | 0.001 | 15.126 | 162.639 |
| 1974 | 194.108 | 0.000 | 0.000 | 0.001 | 0.000 | 194.109 | 17.146 | 0.000 | 0.004 | 17.150 | 211.259 |
| 1975 | 205.654 | 0.000 | 0.000 | 0.002 | 0.000 | 205.656 | 15.704 | 0.000 | 0.000 | 15.704 | 221.360 |
| 1976 | 231.331 | 0.000 | 0.000 | 0.218 | 0.000 | 231.549 | 5.972 | 0.000 | 0.000 | 5.972 | 237.521 |
| 1977 | 127.013 | 0.000 | 0.000 | 0.489 | 0.000 | 127.502 | 5.191 | 0.000 | 0.000 | 5.191 | 132.693 |
| 1978 | 96.827 | 0.856 | 0.000 | 0.689 | 0.000 | 98.372 | 3.453 | 1.814 | 0.000 | 5.267 | 103.639 |
| 1979 | 114.909 | 8.834 | 0.000 | 0.937 | 0.000 | 124.680 | 7.900 | 4.233 | 0.302 | 12.435 | 137.115 |
| 1980 | 44.023 | 27.537 | 0.000 | 0.792 | 0.000 | 72.352 | 5.273 | 12.214 | 0.097 | 17.584 | 89.936 |
| 1981 | 70.365 | 43.556 | 0.000 | 0.839 | 0.000 | 114.760 | 3.919 | 17.159 | 3.283 | 24.361 | 139.121 |
| 1982 | 7.089 | 67.464 | 0.000 | 1.024 | 0.000 | 75.577 | 12.479 | 19.676 | 0.002 | 32.157 | 107.734 |
| 1983 | 0.000 | 72.100 | 0.000 | 1.050 | 0.000 | 73.150 | 13.117 | 27.657 | 0.000 | 40.774 | 113.924 |
| 1984 | 14.722 | 78.889 | 0.000 | 2.721 | 0.000 | 96.332 | 13.203 | 28.906 | 0.000 | 42.109 | 138.441 |
| 1985 | 49.853 | 31.692 | 0.000 | 3.894 | 0.000 | 85.439 | 10.533 | 13.237 | 1.192 | 24.962 | 110.401 |
| 1986 | 69.861 | 81.640 | 0.000 | 3.463 | 0.000 | 154.964 | 23.743 | 30.136 | 1.774 | 55.653 | 210.617 |
| 1987 | 49.656 | 105.997 | 0.000 | 4.795 | 0.000 | 160.448 | 21.453 | 48.076 | 4.170 | 73.699 | 234.147 |
| 1988 | 18.041 | 135.781 | 0.000 | 6.876 | 0.000 | 160.698 | 38.084 | 49.243 | 0.830 | 88.157 | 248.855 |
| 1989 | 0.000 | 203.578 | 0.000 | 7.418 | 0.000 | 210.996 | 29.753 | 62.618 | 2.563 | 94.934 | 305.930 |
| 1990 | 0.000 | 170.972 | 4.713 | 8.115 | 0.000 | 183.800 | 3.814 | 68.313 | 4.022 | 76.149 | 259.949 |
| 1991 | 0.000 | 0.000 | 196.905 | 20.600 | 0.000 | 217.505 | 5.605 | 68.133 | 16.178 | 89.916 | 307.421 |
| 1992 | 0.000 | 0.000 | 152.449 | 56.127 | 0.000 | 208.576 | 0.000 | 68.779 | 20.048 | 88.827 | 297.403 |
| 1993 | 0.000 | 0.000 | 99.103 | 42.119 | 0.000 | 141.222 | 0.000 | 46.422 | 12.355 | 58.777 | 199.999 |
| 1994 | 0.000 | 0.000 | 179.073 | 73.656 | 0.000 | 252.729 | 0.000 | 85.162 | 23.782 | 108.944 | 361.673 |
| 1995 | 0.000 | 0.000 | 102.624 | 74.965 | 0.000 | 177.589 | 0.000 | 26.191 | 46.193 | 72.384 | 249.973 |
| 1996 | 0.000 | 0.000 | 112.776 | 85.127 | 14.999 | 212.902 | 0.000 | 66.779 | 26.395 | 93.174 | 306.076 |
| 1997 | 0.000 | 0.000 | 121.173 | 87.410 | 24.840 | 233.423 | 0.000 | 42.565 | 49.227 | 91.792 | 325.215 |
| 1998 | 0.000 | 0.000 | 120.452 | 87.856 | 24.509 | 232.817 | 0.000 | 39.728 | 48.074 | 87.802 | 320.619 |
| 1999 | 0.000 | 0.000 | 115.259 | 83.419 | 25.844 | 224.522 | 0.000 | 17.201 | 70.132 | 87.333 | 311.855 |
| 2000 | 0.000 | 0.000 | 116.090 | 85.828 | 6.500 | 208.418 | 0.960 | 15.059 | 6.382 | 22.401 | 230.819 |
| 2001 | 0.000 | 0.000 | 102.129 | 73.474 | 6.774 | 182.377 | 0.000 | 21.650 | 31.935 | 53.585 | 235.962 |
| 2002 | 0.000 | 0.000 | 63.258 | 45.708 | 23.148 | 132.114 | 0.000 | 0.000 | 50.769 | 50.769 | 182.883 |
| 2003 | 0.000 | 0.000 | 67.473 | 51.256 | 24.763 | 143.492 | 0.000 | 0.000 | 62.090 | 62.090 | 205.582 |
| 2004 | 0.000 | 0.000 | 90.258 | 89.381 | 30.845 | 210.484 | 0.000 | 58.892 | 65.345 | 124.237 | 334.721 |
| 2005 | 0.000 | 0.000 | 150.400 | 74.147 | 35.297 | 259.844 | 0.000 | 15.178 | 85.284 | 100.462 | 360.306 |
| 2006 | 0.000 | 0.000 | 137.564 | 97.230 | 35.469 | 270.263 | 0.000 | 13.751 | 80.011 | 93.762 | 364.025 |
| 2007 | 0.000 | 0.000 | 107.489 | 66.640 | 29.850 | 203.979 | 0.000 | 6.780 | 65.325 | 72.105 | 276.084 |
| Average 1966-2007 | | | | | | 163.179 | | | | 55.797 | 218.977 |

Table 2. U.S. fishery sampling information by sector showing the number of hauls (or trips), number of lengths and number of ages taken by year. Sample sizes shown are the number of hauls or trips where length samples were taken.

| U.S. At-sea fishery length samples | | | | U.S. Shore-based fishery | | | |
|---|---|---|---|---|---|---|---|
| Year | No. Hauls | No. Lengths | No. Aged | Year | No. Trips | No. Lengths | No. Aged |
| 1973 | - | - | - | 1973 | - | - | - |
| 1974 | - | - | - | 1974 | - | - | - |
| 1975 | 13 | 486 | 332 | 1975 | - | - | - |
| 1976 | 249 | 48,433 | 4,077 | 1976 | - | - | - |
| 1977 | 1,071 | 140,338 | 7,693 | 1977 | - | - | - |
| 1978 | 1,135 | 122,531 | 5,926 | 1978 | - | - | - |
| 1979 | 1,539 | 170,951 | 3,132 | 1979 | - | - | - |
| 1980 | 811 | 101,528 | 4,442 | 1980 | - | - | - |
| 1981 | 1,093 | 135,333 | 4,273 | 1981 | - | - | - |
| 1982 | 1,142 | 169,525 | 4,601 | 1982 | - | - | - |
| 1983 | 1,069 | 163,992 | 3,219 | 1983 | - | - | - |
| 1984 | 2,035 | 237,004 | 3,300 | 1984 | - | - | - |
| 1985 | 2,061 | 259,583 | 2,450 | 1985 | - | - | - |
| 1986 | 3,878 | 467,932 | 3,136 | 1986 | - | - | - |
| 1987 | 3,406 | 428,732 | 3,185 | 1987 | - | - | - |
| 1988 | 3,035 | 412,277 | 3,214 | 1988 | - | - | - |
| 1989 | 2,581 | 354,890 | 3,041 | 1989 | - | - | - |
| 1990 | 2,039 | 260,998 | 3,112 | 1990 | - | - | - |
| 1991 | 800 | 94,685 | 1,333 | 1991 | 17 | 1,273 | 934 |
| 1992 | 787 | 72,294 | 2,175 | 1992 | 49 | 3,152 | 1,062 |
| 1993 | 406 | 31,887 | 1,196 | 1993 | 36 | 1,919 | 845 |
| 1994 | 569 | 41,143 | 1,775 | 1994 | 80 | 4,939 | 1,457 |
| 1995 | 413 | 29,035 | 690 | 1995 | 57 | 3,388 | 1,441 |
| 1996 | 510 | 32,133 | 1,333 | 1996 | 47 | 3,330 | 1,123 |
| 1997 | 614 | 47,863 | 1,147 | 1997 | 67 | 4,272 | 1,759 |
| 1998 | 740 | 47,511 | 1,158 | 1998 | 63 | 3,979 | 2,021 |
| 1999 | 2,176 | 49,192 | 1,047 | 1999 | 92 | 4,280 | 1,452 |
| 2000 | 2,118 | 48,153 | 1,257 | 2000 | 81 | 2,490 | 1,314 |
| 2001 | 2,133 | 48,426 | 2,111 | 2001 | 106 | 4,290 | 1,983 |
| 2002 | 1,727 | 39,485 | 1,695 | 2002 | 94 | 3,890 | 1,582 |
| 2003 | 1,814 | 37,772 | 1,761 | 2003 | 101 | 3,866 | 1,561 |
| 2004 | 2,668 | 57,014 | 1,875 | 2004 | 129 | 7,170 | 1,440 |
| 2005 | 2,956 | 62,944 | 2,451 | 2005 | 108 | 6,166 | 1,160 |
| 2006 | 2,824 | 58,094 | 2,058 | 2006 | 156 | 8,974 | 1,547 |
| 2007 | 2,810 | 57,817 | 2,058 | 2006 | 126 | 7,035 | 1,398 |

Table 3. Canadian fishery sampling information by sector showing the number of hauls (or trips), number of lengths and number of ages taken by year. Sample sizes shown are the number of hauls or trips where length samples were taken.

| | Canadian JV fishery samples | | | | Canadian shore-based fishery samples | | |
|---|---|---|---|---|---|---|---|
| Year | No. Hauls | No. Lengths | No. Aged | Year | No. Trips | No. Lengths | No. Aged |
| 1988 | 231 | 75,767 | 1,557 | 1988 | - | - | - |
| 1989 | 261 | 56,202 | 1,353 | 1989 | - | - | - |
| 1990 | 171 | 33,312 | 1,024 | 1990 | - | - | - |
| 1991 | 632 | 97,205 | 1,057 | 1991 | - | - | - |
| 1992 | 429 | 60,391 | 1,786 | 1992 | - | - | - |
| 1993 | 500 | 70,522 | 1,228 | 1993 | - | - | - |
| 1994 | 875 | 122,871 | 2,196 | 1994 | - | - | - |
| 1995 | 183 | 20,552 | 1,747 | 1995 | - | - | - |
| 1996 | 813 | 99,228 | 1,526 | 1996 | 6 | 449 | 0 |
| 1997 | 414 | 16,957 | 1,430 | 1997 | 302 | 42,296 | 150 |
| 1998 | 468 | 45,117 | 1,113 | 1998 | 238 | 29,850 | 454 |
| 1999 | 66 | 8,663 | 812 | 1999 | 314 | 42,119 | 1,568 |
| 2000 | 375 | 45,946 | 1,536 | 2000 | 19 | 2,151 | 0 |
| 2001 | 284 | 26,817 | 1,424 | 2001 | 121 | 14,937 | 111 |
| 2002 | - | - | - | 2002 | 186 | 13,611 | 1,831 |
| 2003 | - | - | - | 2003 | 345 | 24,898 | 1,386 |
| 2004 | 595 | 60,025 | 1,102 | 2004 | 124 | 7,716 | 1,581 |
| 2005 | 58 | 5,206 | 292 | 2005 | 240 | 17,252 | 1,415 |
| 2006 | 98 | 9,417 | 334 | 2007 | 203 | 15,576 | 1,170 |
| 2007 | 47 | 4,050 | 0 | 2007 | 120 | 8,991 | 965 |

Table 4. U.S. fishery sampling summary by sector showing number of samples, total sampled weight, total fishery weight, and sampling intensity given as the percent of total catch weight sampled and catch weight per sample taken.

| | U.S. At-sea sampling (foreign, JV, domestic) | | | | | U.S. Shore-based fishery sampling | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. Hauls | Sampled weight (mt) | Total fishery landings (mt) | % total weight Sampled | Weight (mt) per sample | No. Trips | Sampled weight (mt) | Total fishery landings (mt) | % total weight Sampled | Weight (mt) per sample |
| 1975 | 13 | 47 | 205,654 | 0.02% | 15,820 | - | - | - | - | - |
| 1976 | 249 | 4,165 | 231,331 | 1.80% | 929 | - | - | - | - | - |
| 1977 | 1,071 | 4,239 | 127,013 | 3.34% | 119 | - | - | - | - | - |
| 1978 | 1,135 | 4,769 | 97,683 | 4.88% | 86 | - | - | - | - | - |
| 1979 | 1,539 | 6,797 | 123,743 | 5.49% | 80 | - | - | - | - | - |
| 1980 | 811 | 10,074 | 71,560 | 14.08% | 88 | - | - | - | - | - |
| 1981 | 1,093 | 9,846 | 113,921 | 8.64% | 104 | - | - | - | - | - |
| 1982 | 1,142 | 23,956 | 74,553 | 32.13% | 65 | - | - | - | - | - |
| 1983 | 1,069 | 27,110 | 72,100 | 37.60% | 67 | - | - | - | - | - |
| 1984 | 2,035 | 13,603 | 93,611 | 14.53% | 46 | - | - | - | - | - |
| 1985 | 2,061 | 11,842 | 81,545 | 14.52% | 40 | - | - | - | - | - |
| 1986 | 3,878 | 24,602 | 151,501 | 16.24% | 39 | - | - | - | - | - |
| 1987 | 3,406 | 22,349 | 155,653 | 14.36% | 46 | - | - | - | - | - |
| 1988 | 3,035 | 21,499 | 153,822 | 13.98% | 51 | - | - | - | - | - |
| 1989 | 2,581 | 20,560 | 203,578 | 10.10% | 79 | - | - | - | - | - |
| 1990 | 2,039 | 16,264 | 175,685 | 9.26% | 86 | - | - | - | - | - |
| 1991 | 800 | 15,833 | 196,905 | 8.04% | 246 | 17 | 683 | 20,600 | 3.32% | 1,212 |
| 1992 | 787 | 17,781 | 152,449 | 11.66% | 194 | 49 | 1,964 | 56,127 | 3.50% | 1,145 |
| 1993 | 406 | 11,306 | 99,103 | 11.41% | 244 | 36 | 1,619 | 42,119 | 3.84% | 1,170 |
| 1994 | 569 | 13,959 | 179,073 | 7.80% | 315 | 80 | 4,461 | 73,656 | 6.06% | 921 |
| 1995 | 413 | 9,833 | 102,624 | 9.58% | 248 | 57 | 3,224 | 74,965 | 4.30% | 1,315 |
| 1996 | 510 | 13,813 | 112,776 | 12.25% | 221 | 47 | 3,036 | 85,127 | 3.57% | 1,811 |
| 1997 | 614 | 17,264 | 121,173 | 14.25% | 197 | 67 | 4,670 | 87,410 | 5.34% | 1,305 |
| 1998 | 740 | 17,370 | 120,452 | 14.42% | 163 | 63 | 4,231 | 87,856 | 4.82% | 1,395 |
| 1999 | 2,176 | 47,541 | 115,259 | 41.25% | 53 | 92 | 6,740 | 83,419 | 8.08% | 907 |
| 2000 | 2,118 | 48,482 | 116,090 | 41.76% | 55 | 81 | 7,735 | 85,828 | 9.01% | 1,060 |
| 2001 | 2,133 | 43,459 | 102,129 | 42.55% | 48 | 106 | 8,524 | 73,474 | 11.60% | 693 |
| 2002 | 1,727 | 37,252 | 63,258 | 58.89% | 37 | 94 | 7,089 | 45,708 | 15.51% | 486 |
| 2003 | 1,814 | 38,067 | 67,473 | 56.42% | 37 | 101 | 7,676 | 55,335 | 13.87% | 548 |
| 2004 | 2,668 | 53,411 | 90,258 | 59.18% | 34 | 129 | 10,918 | 96,229 | 11.35% | 746 |
| 2005 | 2,956 | 66,356 | 150,400 | 44.12% | 51 | 108 | 8,997 | 85,914 | 10.47% | 796 |
| 2006 | 2,824 | 60,435 | 97,403 | 62.05% | 34 | 156 | 13,646 | 115,980 | 11.77% | 743 |
| 2007 | 2,810 | 64,230 | 107,489 | 59.75% | 38 | 126 | 12,231 | 72,663 | 16.83% | 577 |

Table 5. Canadian fishery sampling summary by sector showing number of samples, total sampled weight, total fishery weight, and sampling intensity given as the percent of total catch weight sampled and catch weight per sample taken.

| | Canadian JV fishery sampling | | | | | Canadian Shore-based fishery sampling | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. Hauls | Sampled weight (mt) | Total fishery landings (mt) | % total weight Sampled | Weight (mt) per sample | No. Trips | Sampled weight (mt) | Total fishery landings (mt) | % total weight Sampled | Weight (mt) per sample |
| 1988 | 231 | 4,184 | 49,243 | 8.50% | 213 | - | - | - | - | - |
| 1989 | 261 | 4,679 | 62,618 | 7.47% | 240 | - | - | - | - | - |
| 1990 | 171 | 3,396 | 68,313 | 4.97% | 399 | - | - | - | - | - |
| 1991 | 632 | 13,054 | 68,133 | 19.16% | 108 | - | - | - | - | - |
| 1992 | 429 | 8,901 | 68,779 | 12.94% | 160 | - | - | - | - | - |
| 1993 | 500 | 8,929 | 46,422 | 19.23% | 93 | - | - | - | - | - |
| 1994 | 875 | 15,387 | 85,162 | 18.07% | 97 | - | - | - | - | - |
| 1995 | 183 | 3,770 | 26,191 | 14.39% | 143 | - | - | - | - | - |
| 1996 | 813 | 14,863 | 66,779 | 22.26% | 82 | 6 | 21,297 | 26,395 | 80.69% | 4399 |
| 1997 | 414 | 8,325 | 42,565 | 19.56% | 103 | 302 | 44,802 | 49,227 | 91.01% | 163 |
| 1998 | 468 | 9,638 | 39,728 | 24.26% | 85 | 238 | 45,982 | 48,074 | 95.65% | 202 |
| 1999 | 66 | 1,970 | 17,201 | 11.45% | 261 | 314 | 66,700 | 70,132 | 95.11% | 223 |
| 2000 | 375 | 6,557 | 15,059 | 43.54% | 40 | 19 | 5,791 | 6,382 | 90.74% | 336 |
| 2001 | 284 | 6,072 | 21,650 | 28.05% | 76 | 121 | 30,852 | 31,935 | 96.61% | 264 |
| 2002 | - | - | - | - | - | 186 | 49,189 | 50,769 | 96.89% | 273 |
| 2003 | - | - | - | - | - | 345 | 61,110 | 62,090 | 98.42% | 180 |
| 2004 | 595 | 14,620 | 58,892 | 24.83% | 99 | 124 | 58,624 | 65,345 | 89.71% | 527 |
| 2005 | 58 | 1,630 | 15,178 | 10.74% | 262 | 240 | 67,242 | 85,284 | 78.84% | 355 |
| 2006 | 126 | 2,702 | 13,715 | 19.70% | 109 | 203 | 14,555 | 80,011 | 18.19% | 394 |
| 2007 | 47 | 1,043 | 6,780 | 15.38% | 144 | 122 | 4,049 | 65,325 | 6.20% | 535 |

Table 6. U.S. fishery sample sizes for conditional age at length. Sample size shown by year and length bin represent the sum of the total number of hauls (in the at-sea fishery) and trips (in the shore-based fishery) contributing age information to each 1 cm length category.

| | Year samples were taken | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
| 20 | | | 1 | | 1 | 1 | 5 | | | | | | | | |
| 21 | | | 1 | 2 | | 3 | 9 | | | | | | | | |
| 22 | | 1 | | 2 | | 2 | 13 | | | | | | | | |
| 23 | 1 | 1 | | 4 | | 1 | 23 | | | | | | | | |
| 24 | 1 | 1 | | 4 | | 2 | 25 | 2 | | | | 1 | | | |
| 25 | 1 | 3 | | 10 | 1 | 1 | 29 | 5 | | | | | | | |
| 26 | 2 | 1 | | 10 | 2 | | 40 | 11 | 1 | | 1 | | | 1 | |
| 27 | 2 | 4 | | 9 | 2 | 1 | 34 | 9 | | 1 | | | | | |
| 28 | 1 | 5 | | 14 | 4 | 1 | 22 | 12 | | | 1 | | | | |
| 29 | 3 | 4 | | 7 | 10 | 1 | 21 | 18 | 6 | | 2 | 1 | | 1 | 2 |
| 30 | 5 | 4 | | 4 | 21 | 1 | 16 | 37 | 10 | | 1 | 5 | | | 3 |
| 31 | 3 | 6 | 2 | 2 | 27 | | 12 | 38 | 11 | 3 | 3 | 8 | | 1 | 9 |
| 32 | 5 | 8 | | | 30 | 3 | 6 | 52 | 23 | 1 | 3 | 19 | | 2 | 15 |
| 33 | 2 | 9 | 4 | | 46 | 4 | 9 | 62 | 23 | 2 | 3 | 22 | 3 | 2 | 15 |
| 34 | 4 | 10 | 5 | | 33 | 9 | 12 | 66 | 35 | 6 | 2 | 49 | 6 | 3 | 8 |
| 35 | 4 | 7 | 12 | | 24 | 19 | 16 | 62 | 39 | 12 | 1 | 41 | 16 | 3 | 10 |
| 36 | 5 | 13 | 28 | 3 | 17 | 38 | 28 | 55 | 51 | 25 | 1 | 42 | 29 | 3 | 13 |
| 37 | 5 | 23 | 56 | 7 | 19 | 66 | 49 | 59 | 55 | 41 | 2 | 40 | 60 | 15 | 9 |
| 38 | 3 | 26 | 71 | 17 | 12 | 74 | 59 | 48 | 62 | 72 | 7 | 39 | 79 | 56 | 17 |
| 39 | 2 | 45 | 99 | 51 | 11 | 84 | 78 | 50 | 58 | 112 | 16 | 36 | 88 | 101 | 40 |
| 40 | 6 | 58 | 114 | 88 | 17 | 89 | 94 | 62 | 62 | 121 | 43 | 51 | 97 | 129 | 79 |
| 41 | 10 | 53 | 146 | 129 | 25 | 83 | 84 | 66 | 69 | 135 | 78 | 85 | 104 | 141 | 120 |
| 42 | 9 | 55 | 141 | 176 | 36 | 93 | 85 | 86 | 77 | 125 | 107 | 114 | 112 | 141 | 129 |
| 43 | 9 | 56 | 160 | 171 | 44 | 88 | 88 | 94 | 72 | 112 | 121 | 119 | 121 | 145 | 125 |
| 44 | 10 | 54 | 160 | 158 | 65 | 100 | 101 | 99 | 69 | 93 | 124 | 110 | 117 | 153 | 127 |
| 45 | 8 | 47 | 147 | 165 | 72 | 111 | 101 | 100 | 69 | 82 | 115 | 113 | 113 | 152 | 125 |
| 46 | 9 | 47 | 142 | 148 | 74 | 114 | 107 | 99 | 75 | 83 | 101 | 105 | 106 | 150 | 130 |
| 47 | 7 | 39 | 132 | 144 | 84 | 96 | 114 | 103 | 74 | 74 | 79 | 100 | 102 | 137 | 133 |
| 48 | 10 | 42 | 128 | 154 | 83 | 90 | 122 | 111 | 70 | 67 | 63 | 83 | 92 | 123 | 118 |
| 49 | 8 | 44 | 136 | 143 | 76 | 85 | 122 | 116 | 69 | 66 | 58 | 67 | 83 | 81 | 98 |
| 50 | 4 | 57 | 123 | 147 | 83 | 90 | 105 | 101 | 71 | 50 | 52 | 77 | 59 | 68 | 74 |
| 51 | 5 | 62 | 135 | 156 | 89 | 87 | 113 | 112 | 59 | 49 | 25 | 59 | 40 | 45 | 49 |
| 52 | 6 | 60 | 140 | 184 | 85 | 92 | 107 | 100 | 66 | 43 | 24 | 51 | 31 | 34 | 40 |
| 53 | | 69 | 146 | 178 | 86 | 94 | 116 | 106 | 66 | 28 | 17 | 52 | 18 | 22 | 35 |
| 54 | 2 | 64 | 147 | 186 | 78 | 105 | 96 | 104 | 61 | 20 | 15 | 44 | 14 | 15 | 27 |
| 55 | 4 | 58 | 161 | 176 | 70 | 102 | 80 | 86 | 57 | 11 | 11 | 27 | 8 | 14 | 14 |
| 56 | | 67 | 139 | 156 | 66 | 102 | 65 | 85 | 44 | 5 | 3 | 31 | 5 | 8 | 15 |
| 57 | 1 | 65 | 131 | 115 | 58 | 102 | 56 | 81 | 32 | 5 | 4 | 24 | 5 | 13 | 8 |
| 58 | 1 | 62 | 94 | 103 | 41 | 88 | 39 | 48 | 32 | 4 | 3 | 11 | 3 | 11 | 8 |
| 59 | 2 | 57 | 95 | 60 | 47 | 52 | 34 | 53 | 17 | 7 | | 11 | 2 | 4 | 7 |
| 60 | 1 | 56 | 73 | 60 | 22 | 60 | 36 | 37 | 22 | 2 | 1 | 7 | 5 | 6 | 3 |
| 61 | | 48 | 60 | 45 | 26 | 39 | 30 | 28 | 15 | | 1 | 8 | 3 | 5 | 6 |
| 62 | | 45 | 52 | 41 | 16 | 27 | 20 | 17 | 9 | 4 | | 7 | 6 | 1 | |
| 63 | | 30 | 46 | 27 | 12 | 25 | 20 | 21 | 12 | 4 | | 3 | 1 | | 3 |
| 64 | | 36 | 42 | 26 | 8 | 26 | 16 | 21 | 6 | 2 | | 6 | 2 | 4 | 1 |
| 65 | | 33 | 23 | 18 | 13 | 19 | 8 | 18 | 6 | 1 | | 5 | 3 | 3 | 1 |
| 66 | | 33 | 17 | 14 | 11 | 12 | 10 | 9 | 4 | | | 6 | 1 | 4 | 2 |
| 67 | | 33 | 15 | 18 | 6 | 11 | 10 | 10 | 4 | 1 | | 4 | 2 | | |
| 68 | 1 | 28 | 18 | 13 | 8 | 9 | 5 | 6 | 5 | 2 | 1 | 3 | 3 | 2 | 4 |
| 69 | 1 | 25 | 17 | 10 | 4 | 7 | 7 | 6 | 1 | 3 | | 4 | 1 | 3 | |
| 70 | | 71 | 62 | 60 | 16 | 14 | 15 | 14 | 12 | 9 | | 25 | 5 | 12 | 4 |

Table 6. continued.

| | Year samples were taken | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| 20 | | 2 | | | | 1 | | | | | | | | | | | 1 | 4 |
| 21 | | 2 | | | | | | | | | | | | | | | 1 | |
| 22 | | 1 | | | | | | | | | | | | | | | 1 | 1 |
| 23 | | 1 | | | | | | | | | | | | | | | 2 | 1 |
| 24 | | | | | | | | | | | | | | | | | 4 | |
| 25 | | | | | | | | | | | | | | | | | 6 | |
| 26 | | | | | | | | | | | | | | | | | 7 | 1 |
| 27 | | | 1 | | | | | | | | | 1 | | | | | 11 | 3 |
| 28 | 2 | | 2 | | | | | | | | 2 | | | | | | 11 | 6 |
| 29 | 6 | | 5 | | | | | | | 2 | 2 | | | | | | 10 | 8 |
| 30 | 5 | 1 | 6 | | 1 | | 1 | | | 8 | 3 | 6 | | | | | 9 | 11 |
| 31 | 15 | 2 | 8 | 4 | | | 6 | | | 8 | 3 | 7 | 1 | | 1 | | 7 | 17 |
| 32 | 22 | 5 | 5 | 1 | | 1 | 9 | | 2 | 9 | 2 | 15 | | | | | 14 | 39 |
| 33 | 24 | 13 | 3 | 5 | 1 | | 17 | | 4 | 19 | 1 | 19 | | | | 1 | 28 | 41 |
| 34 | 45 | 23 | 4 | 5 | | 1 | 23 | 1 | 1 | 29 | 2 | 28 | 1 | | | 2 | 51 | 41 |
| 35 | 51 | 32 | 3 | 17 | 3 | | 30 | 1 | 5 | 41 | 2 | 32 | 2 | | | 4 | 96 | 57 |
| 36 | 76 | 33 | 6 | 31 | 9 | | 30 | 7 | 13 | 38 | 6 | 50 | 11 | 2 | | | 107 | 45 |
| 37 | 84 | 39 | 22 | 42 | 19 | 2 | 23 | 16 | 17 | 41 | 18 | 55 | 19 | 2 | 1 | 2 | 128 | 49 |
| 38 | 94 | 37 | 23 | 45 | 42 | 4 | 27 | 32 | 30 | 54 | 16 | 61 | 45 | 6 | 7 | 3 | 187 | 60 |
| 39 | 98 | 46 | 58 | 49 | 64 | 2 | 33 | 47 | 36 | 60 | 24 | 56 | 80 | 25 | 23 | 6 | 275 | 42 |
| 40 | 104 | 50 | 66 | 44 | 70 | 6 | 38 | 59 | 50 | 53 | 36 | 61 | 113 | 61 | 45 | 25 | 298 | 46 |
| 41 | 95 | 55 | 78 | 38 | 66 | 18 | 35 | 77 | 56 | 59 | 43 | 97 | 128 | 133 | 90 | 49 | 328 | 72 |
| 42 | 96 | 59 | 84 | 50 | 73 | 31 | 36 | 83 | 73 | 49 | 56 | 100 | 117 | 199 | 133 | 125 | 248 | 126 |
| 43 | 93 | 58 | 82 | 57 | 81 | 33 | 50 | 84 | 97 | 77 | 85 | 100 | 100 | 227 | 216 | 242 | 187 | 155 |
| 44 | 91 | 54 | 81 | 64 | 99 | 38 | 65 | 70 | 102 | 70 | 86 | 112 | 85 | 203 | 227 | 309 | 112 | 235 |
| 45 | 82 | 53 | 81 | 65 | 99 | 37 | 73 | 71 | 90 | 84 | 89 | 121 | 63 | 156 | 225 | 318 | 72 | 319 |
| 46 | 88 | 53 | 81 | 63 | 98 | 36 | 74 | 57 | 77 | 63 | 106 | 136 | 53 | 106 | 177 | 267 | 45 | 332 |
| 47 | 82 | 47 | 84 | 58 | 95 | 39 | 72 | 53 | 51 | 63 | 120 | 136 | 61 | 67 | 105 | 199 | 18 | 315 |
| 48 | 84 | 48 | 84 | 62 | 90 | 38 | 64 | 41 | 43 | 47 | 100 | 153 | 65 | 49 | 79 | 114 | 8 | 259 |
| 49 | 73 | 44 | 82 | 46 | 91 | 37 | 59 | 28 | 25 | 31 | 95 | 118 | 74 | 33 | 39 | 72 | 2 | 173 |
| 50 | 72 | 36 | 73 | 30 | 63 | 33 | 47 | 27 | 17 | 17 | 75 | 86 | 76 | 33 | 26 | 46 | 8 | 124 |
| 51 | 74 | 18 | 59 | 22 | 34 | 25 | 30 | 21 | 7 | 13 | 55 | 59 | 68 | 17 | 8 | 31 | 3 | 74 |
| 52 | 58 | 9 | 39 | 9 | 25 | 23 | 29 | 11 | 3 | 9 | 34 | 50 | 55 | 15 | 12 | 9 | 6 | 53 |
| 53 | 43 | 6 | 35 | 4 | 15 | 13 | 10 | 11 | 3 | 6 | 17 | 37 | 48 | 5 | 5 | 11 | 4 | 31 |
| 54 | 34 | 6 | 26 | 7 | 13 | 10 | 12 | 5 | 2 | 3 | 17 | 34 | 38 | 7 | 3 | 6 | 1 | 19 |
| 55 | 20 | 7 | 20 | 6 | 8 | 8 | 7 | 1 | 4 | | 9 | 10 | 27 | 4 | 2 | 3 | 2 | 14 |
| 56 | 15 | 2 | 15 | 1 | 4 | 6 | 4 | 3 | 1 | | 12 | 8 | 17 | 3 | 2 | 4 | 1 | 9 |
| 57 | 14 | 3 | 15 | 2 | 5 | 4 | 1 | 1 | | 3 | 4 | 11 | 13 | | 2 | 3 | 1 | 16 |
| 58 | 14 | 2 | 9 | | 6 | 6 | 3 | 1 | 1 | 2 | 3 | 1 | 7 | | 2 | 1 | 2 | 4 |
| 59 | 11 | 3 | 9 | 1 | 2 | 3 | 3 | 1 | 1 | | 5 | 2 | 4 | 1 | 1 | 2 | 1 | 6 |
| 60 | 14 | | 7 | | 3 | 1 | 1 | 1 | | 1 | 4 | 4 | 4 | | 2 | | 3 | 6 |
| 61 | 15 | 3 | 5 | 2 | 1 | 1 | 2 | 1 | | 2 | 2 | 1 | 2 | | | 1 | 2 | 2 |
| 62 | 9 | 3 | 5 | | 1 | 2 | 2 | | 1 | 1 | 4 | | 3 | | 1 | | 5 | 1 |
| 63 | 9 | 3 | 2 | | 1 | 1 | 1 | 1 | | | 1 | | 1 | | | | | 5 |
| 64 | 8 | | 3 | | 1 | | 1 | | | | | | 2 | | | | | 1 |
| 65 | 8 | 2 | 2 | | 2 | | 1 | | 1 | | 2 | 1 | 1 | 1 | | | | 1 |
| 66 | 8 | 5 | 2 | | | | | 1 | | | | | 1 | | | 1 | | 1 |
| 67 | 6 | 2 | | | 1 | | 1 | | | | | | | | 1 | | | |
| 68 | 6 | 2 | 2 | | 1 | | | | | | | | | | | 1 | | |
| 69 | 7 | 1 | | 1 | 1 | | | | | | | | | | | | | |
| 70 | 20 | 8 | 6 | 1 | 3 | 1 | 2 | 2 | | | | | 1 | | | | | 4 |

Table 7. Canadian fishery sample sizes for conditional age at length. Sample size shown by year and length bin represent the sum of the total number of hauls (in the joint venture fishery) and trips (in the shore-based domestic fishery) contributing age information to each 1 cm length category.

| | Year samples were taken | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| 20 | | | | | | | | | | | 1 | | | | | | | | | 1 |
| 21 | | | | | | | | | | | | 1 | | | | | | | | |
| 22 | | | | | | | | | | | | 1 | | | | | | | | |
| 23 | | | | | | | | 1 | | | | 2 | | | | | | | | |
| 24 | | | | | | | | 2 | | | | | | | | | | | | |
| 25 | | | | | | | | 2 | | | | | | | | | | | | |
| 26 | | | | | | | | 1 | | | | 2 | | | | | | | | |
| 27 | | | | | | | | 1 | | | | | | | | | | | | |
| 28 | | | | | | | | 1 | | | 1 | | | | | | | | | |
| 29 | | | | | | | | | | | | 1 | | | | | 1 | | | |
| 30 | | | | | | | | | | | | 1 | | | | | 1 | | | |
| 31 | | | | | | | | | 2 | | | 3 | 1 | 1 | | | | | | |
| 32 | | | | | | | | | 2 | | | 5 | | | | 2 | 1 | | | |
| 33 | | | | | | | 1 | 1 | 3 | | | 10 | | | | 2 | 1 | | | |
| 34 | | | | | | 1 | | | 3 | | 1 | 7 | 1 | | | | 2 | | | 1 |
| 35 | 1 | | | | | | 1 | | 4 | | | 10 | 3 | | | | 1 | | | 2 |
| 36 | | | | | | 1 | 1 | | 8 | | 4 | 16 | 4 | | | 1 | 1 | | | |
| 37 | 1 | | | | 1 | | 1 | | 9 | | 8 | 17 | 5 | | 1 | | 2 | | | |
| 38 | 1 | | 2 | | 1 | | | | 12 | 1 | 10 | 19 | 6 | | | | 2 | 2 | | 1 |
| 39 | 3 | | 3 | 1 | 2 | | | | 7 | 7 | 17 | 26 | 5 | | | | 3 | | 1 | 1 |
| 40 | 4 | 2 | 3 | 1 | 3 | 5 | | | 8 | 10 | 18 | 27 | 9 | | | 1 | 11 | 1 | 2 | 4 |
| 41 | 4 | 5 | 4 | 1 | 9 | 10 | 6 | 1 | 6 | 17 | 19 | 30 | 13 | 1 | | 3 | 20 | 3 | 5 | 7 |
| 42 | 4 | 6 | 5 | 3 | 15 | 14 | 10 | 6 | 14 | 21 | 25 | 35 | 14 | 3 | | 11 | 26 | 12 | 13 | 13 |
| 43 | 5 | 6 | 6 | 6 | 22 | 17 | 20 | 11 | 15 | 22 | 24 | 36 | 14 | 4 | 8 | 14 | 31 | 17 | 16 | 15 |
| 44 | 5 | 6 | 4 | 14 | 27 | 17 | 24 | 18 | 22 | 22 | 25 | 35 | 17 | 6 | 3 | 14 | 32 | 19 | 41 | 19 |
| 45 | 5 | 6 | 4 | 16 | 29 | 18 | 28 | 21 | 24 | 23 | 25 | 37 | 16 | 11 | 5 | 15 | 32 | 20 | 51 | 24 |
| 46 | 5 | 6 | 4 | 16 | 29 | 18 | 29 | 21 | 24 | 23 | 25 | 38 | 18 | 15 | 11 | 15 | 32 | 20 | 73 | 26 |
| 47 | 5 | 6 | 4 | 16 | 29 | 18 | 30 | 21 | 24 | 23 | 25 | 38 | 19 | 18 | 15 | 15 | 32 | 20 | 82 | 29 |
| 48 | 5 | 6 | 4 | 16 | 29 | 18 | 31 | 21 | 24 | 23 | 23 | 34 | 19 | 20 | 22 | 15 | 31 | 19 | 81 | 30 |
| 49 | 5 | 6 | 4 | 16 | 29 | 18 | 30 | 21 | 23 | 22 | 21 | 35 | 19 | 20 | 24 | 15 | 31 | 17 | 71 | 33 |
| 50 | 5 | 6 | 5 | 16 | 27 | 17 | 28 | 21 | 23 | 22 | 22 | 31 | 20 | 20 | 25 | 15 | 31 | 12 | 70 | 31 |
| 51 | 5 | 6 | 5 | 16 | 28 | 13 | 28 | 21 | 22 | 18 | 17 | 27 | 18 | 20 | 26 | 13 | 27 | 12 | 59 | 23 |
| 52 | 5 | 6 | 6 | 13 | 16 | 12 | 27 | 17 | 17 | 18 | 8 | 22 | 16 | 20 | 26 | 13 | 18 | 2 | 45 | 23 |
| 53 | 5 | 6 | 4 | 13 | 15 | 4 | 23 | 17 | 11 | 14 | 8 | 14 | 17 | 19 | 26 | 11 | 17 | 5 | 24 | 17 |
| 54 | 5 | 4 | 5 | 8 | 12 | 5 | 18 | 14 | 12 | 9 | 6 | 11 | 15 | 18 | 26 | 11 | 13 | 7 | 26 | 21 |
| 55 | 4 | 5 | 3 | 4 | 7 | 1 | 21 | 11 | 4 | 5 | 2 | 9 | 9 | 19 | 26 | 9 | 11 | 6 | 10 | 10 |
| 56 | 4 | 4 | 4 | 8 | 4 | | 12 | 7 | 7 | 2 | 2 | 6 | 10 | 17 | 25 | 7 | 5 | 4 | 12 | 12 |
| 57 | 4 | 4 | 4 | 3 | 4 | | 9 | 5 | 7 | 3 | 3 | 2 | 6 | 17 | 25 | 6 | 7 | 2 | 6 | 9 |
| 58 | 4 | 3 | 3 | 5 | 4 | 5 | 6 | 9 | 6 | | 2 | 4 | 6 | 17 | 21 | 8 | 3 | 2 | 6 | 12 |
| 59 | 3 | 2 | 4 | 3 | 1 | | 8 | 6 | 1 | 1 | 1 | 4 | 8 | 12 | 13 | 5 | 1 | 1 | 7 | 8 |
| 60 | 3 | 2 | 3 | 2 | 3 | | 6 | 4 | 4 | 1 | | 1 | 4 | 9 | 18 | 5 | 5 | | 7 | 6 |
| 61 | 2 | 1 | 2 | 2 | | | 5 | 4 | 4 | | | 1 | 4 | 7 | 12 | 3 | 2 | 1 | 6 | 2 |
| 62 | 1 | 3 | 4 | 2 | 1 | | 3 | 1 | 1 | | | 1 | | 4 | 12 | 1 | 1 | | | 4 |
| 63 | 1 | 3 | 4 | | 2 | | 2 | 2 | | | 1 | | 2 | 2 | 7 | 1 | 2 | | 1 | 2 |
| 64 | 1 | 2 | 2 | 1 | | | 3 | 3 | | 1 | | 1 | 1 | 2 | 2 | 1 | | 1 | 2 | 3 |
| 65 | 1 | 1 | 2 | | | | 5 | 1 | 2 | | | | | 3 | 1 | 1 | 1 | 1 | 2 | 2 |
| 66 | | 1 | 1 | 1 | | | 1 | 1 | 1 | | | 2 | 1 | 1 | 2 | | 1 | | 1 | 2 |
| 67 | | 2 | 2 | | | | | 1 | | | | | 1 | 2 | 1 | | | | | |
| 68 | | | | 1 | | | | | 1 | 1 | | | | | 1 | 1 | 1 | | | 3 |
| 69 | | | 1 | 1 | | | | 1 | | | | | | | | | 1 | | | 1 |
| 70 | 1 | 4 | 1 | 1 | 1 | | 2 | 1 | | | | | 1 | | | | | | 1 | 2 |

Table 8. Acoustic survey sampling information showing the number of hauls, number of lengths measured and number of aged by year.

| Year | No. hauls | No. lengths | No. aged |
|---|---|---|---|
| 1977 | 85 | 11,695 | 4,262 |
| 1980 | 49 | 8,296 | 2,952 |
| 1983 | 35 | 8,614 | 1,327 |
| 1986 | 43 | 12,702 | 2,074 |
| 1989 | 22 | 5,606 | 1,730 |
| 1992 | 43 | 15,852 | 2,184 |
| 1995 | 69 | 22,896 | 2,118 |
| 1998 | 84 | 33,347 | 2,417 |
| 2001 | 49 | 16,442 | 2,536 |
| 2003 | 71 | 19,357 | 3,007 |
| 2005 | 49 | 13,644 | 1,905 |
| 2007 | 130 | 15,756 | 2,915 |

Table 9. Acoustic survey sample sizes for conditional age at length. Sample sizes shown by year and length bin represent the sum of the total number of hauls contributing age information to each 1 cm length category.

| | Number hauls by length and year | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length | 1977 | 1980 | 1983 | 1986 | 1989 | 1992 | 1995 | 1998 | 2001 | 2003 | 2005 | 2007 |
| 24 | | | | | | 2 | | 1 | | | | 3 |
| 25 | | | | | | 2 | | 3 | | 1 | | 2 |
| 26 | 1 | | | | | 2 | | 2 | | | | 4 |
| 27 | | | | | 1 | 4 | | 4 | 2 | | | 7 |
| 28 | 1 | | | | | 2 | 2 | 10 | | 1 | 1 | 8 |
| 29 | 1 | 1 | | 2 | | 5 | 1 | 13 | | | 1 | 15 |
| 30 | 1 | | | 3 | | 7 | 2 | 16 | 3 | 2 | 4 | 17 |
| 31 | 2 | | | 6 | | 7 | 4 | 20 | 8 | 2 | 6 | 18 |
| 32 | 3 | | | 8 | | 8 | 9 | 23 | 14 | 4 | 7 | 17 |
| 33 | 4 | | 2 | 8 | 1 | 8 | 13 | 23 | 17 | 4 | 10 | 20 |
| 34 | 3 | 4 | 4 | 9 | 3 | 8 | 15 | 31 | 20 | 8 | 8 | 20 |
| 35 | 9 | 7 | 3 | 9 | 4 | 7 | 21 | 31 | 20 | 8 | 10 | 16 |
| 36 | 14 | 9 | 5 | 11 | 6 | 6 | 20 | 30 | 20 | 8 | 9 | 15 |
| 37 | 16 | 10 | 7 | 8 | 8 | 6 | 17 | 36 | 17 | 9 | 10 | 13 |
| 38 | 14 | 12 | 8 | 10 | 7 | 5 | 14 | 39 | 13 | 14 | 8 | 11 |
| 39 | 17 | 10 | 9 | 5 | 9 | 8 | 6 | 50 | 10 | 14 | 10 | 10 |
| 40 | 20 | 12 | 13 | 6 | 10 | 7 | 11 | 44 | 17 | 29 | 6 | 16 |
| 41 | 22 | 11 | 11 | 12 | 15 | 10 | 15 | 55 | 14 | 43 | 22 | 14 |
| 42 | 24 | 10 | 11 | 21 | 20 | 24 | 26 | 62 | 18 | 56 | 28 | 27 |
| 43 | 29 | 12 | 9 | 21 | 20 | 28 | 40 | 66 | 22 | 55 | 36 | 36 |
| 44 | 34 | 13 | 13 | 20 | 20 | 36 | 45 | 64 | 17 | 59 | 41 | 38 |
| 45 | 40 | 16 | 12 | 21 | 20 | 38 | 49 | 57 | 29 | 61 | 42 | 43 |
| 46 | 41 | 18 | 13 | 21 | 20 | 39 | 53 | 49 | 29 | 53 | 41 | 44 |
| 47 | 45 | 19 | 12 | 17 | 18 | 37 | 50 | 51 | 30 | 55 | 39 | 54 |
| 48 | 48 | 21 | 13 | 18 | 16 | 34 | 47 | 46 | 30 | 43 | 32 | 49 |
| 49 | 48 | 24 | 12 | 16 | 16 | 30 | 38 | 31 | 28 | 41 | 27 | 46 |
| 50 | 45 | 22 | 12 | 16 | 10 | 22 | 27 | 22 | 27 | 32 | 23 | 37 |
| 51 | 47 | 22 | 11 | 16 | 8 | 18 | 17 | 9 | 25 | 28 | 12 | 30 |
| 52 | 46 | 21 | 10 | 11 | 9 | 14 | 14 | 5 | 26 | 24 | 12 | 22 |
| 53 | 44 | 19 | 9 | 13 | 6 | 6 | 10 | 6 | 24 | 19 | 9 | 22 |
| 54 | 40 | 18 | 8 | 8 | 5 | 3 | 7 | 4 | 25 | 12 | 5 | 12 |
| 55 | 38 | 17 | 6 | 9 | 2 | 4 | 5 | 2 | 18 | 12 | 3 | 12 |
| 56 | 31 | 19 | 5 | 4 | 2 | 5 | 6 | 2 | 13 | 7 | 5 | 6 |
| 57 | 33 | 16 | 7 | 4 | | 4 | 3 | 3 | 10 | 6 | 2 | 6 |
| 58 | 27 | 11 | 2 | 3 | 3 | 3 | 5 | 5 | 10 | 5 | 1 | 7 |
| 59 | 19 | 14 | 3 | 3 | 2 | 1 | 2 | | 7 | 3 | 1 | 5 |
| 60 | 18 | 7 | 1 | 4 | 2 | 1 | 2 | 1 | 8 | 6 | | 6 |
| 61 | 16 | 4 | 2 | 3 | | 1 | 1 | 2 | 5 | 2 | | 3 |
| 62 | 11 | 3 | 2 | 2 | | 2 | 4 | | 3 | 5 | | |
| 63 | 11 | 2 | 1 | | 1 | 3 | 2 | | 2 | | | |
| 64 | 10 | 2 | | 3 | 1 | | 1 | | 4 | 2 | 1 | 4 |
| 65 | 8 | 3 | 1 | 1 | 1 | | 2 | | 3 | 2 | 1 | |
| 66 | 8 | 2 | 1 | | | | 2 | | 2 | 2 | | 2 |
| 67 | 8 | 2 | | 1 | | | 2 | | 1 | 2 | | |
| 68 | 7 | 4 | | 1 | | | | | 2 | | 1 | |
| 69 | 4 | 3 | 1 | 1 | 1 | | 1 | 1 | 4 | 2 | 1 | |
| 70 | 7 | 3 | | 1 | 2 | | 3 | | 4 | 6 | 6 | 2 |

Table 10. Acoustic survey estimates of Pacific whiting biomass and age composition. Surveys in 1995 and 1998 were cooperative surveys between AFSC and DFO. Biomass and age composition for 1977-89 were adjusted as described in Dorn (1996) to account for changes in target strength, depth and geographic coverage. Biomass estimates at 20 log l - 68 in 1992 and 1995 are from Wilson and Guttormson (1997). The biomass in 1995 includes 27,251 t of Pacific whiting found by the DFO survey vessel W.E. Ricker in Queen Charlotte Sound. (This estimate was obtained from 43,200 t, the biomass at -35 dB/kg multiplied by 0.631, a conversion factor from -35 dB/kg to 20 log l - 68 for the U.S. survey north of 50°30' N lat.). In 1992, 1995, and 1998, 20,702 t, 30,032 t, and 8,034 t of age-1 fish respectively is not included in the total survey biomass. In 2001-2005 no age one fish were captured in survey trawls. Estimates of biomass and numbers at age from 1977-1992 include revised based on year-specific deep-water and northern expansion factors (Helser et al. 2004).

| | Total biomass at 20 log L - 68 | Number at age (million) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | (1,000 mt) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1977 | 1915 | 0.24 | 151.94 | 144.57 | 902.04 | 82.60 | 115.79 | 1001.86 | 138.13 | 102.08 | 58.53 | 54.82 | 28.54 | 10.61 | 2.79 | 3.46 |
| 1980 | 2115 | 0.00 | 16.18 | 1971.21 | 190.90 | 115.65 | 94.42 | 417.83 | 154.83 | 333.21 | 133.62 | 78.76 | 13.26 | 22.81 | 4.75 | 3.49 |
| 1983 | 1647 | 0.00 | 1.10 | 3254.35 | 107.83 | 32.62 | 428.59 | 68.59 | 47.27 | 33.71 | 92.68 | 21.86 | 25.80 | 26.90 | 4.32 | 0.00 |
| 1986 | 2857 | 0.00 | 4555.66 | 119.65 | 21.04 | 148.80 | 2004.57 | 215.71 | 171.63 | 225.45 | 27.33 | 28.72 | 2.08 | 10.85 | 3.49 | 0.00 |
| 1989 | 1238 | 0.00 | 411.82 | 141.76 | 31.19 | 1276.32 | 28.43 | 10.08 | 18.30 | 435.18 | 22.95 | 1.75 | 43.08 | 0.00 | 0.00 | 1.76 |
| 1992 | 2169 | 230.71 | 318.37 | 42.50 | 246.38 | 630.74 | 77.96 | 31.61 | 1541.82 | 46.68 | 28.08 | 14.14 | 533.23 | 27.13 | 0.00 | 28.42 |
| 1995 | 1385 | 316.41 | 880.52 | 117.80 | 32.62 | 575.90 | 26.58 | 88.78 | 403.38 | 5.90 | 0.00 | 429.34 | 0.96 | 17.42 | 0.00 | 130.39 |
| 1998 | 1185 | 98.31 | 414.33 | 460.41 | 386.81 | 481.76 | 34.52 | 135.59 | 215.61 | 26.41 | 39.14 | 120.27 | 7.68 | 4.92 | 104.47 | 29.19 |
| 2001 | 737 | 0.00 | 1471.36 | 185.56 | 109.35 | 117.25 | 54.26 | 54.03 | 29.41 | 17.11 | 12.03 | 5.07 | 4.48 | 8.73 | 0.83 | 3.10 |
| 2003 | 1840 | 5.19 | 99.78 | 84.88 | 2146.50 | 366.87 | 92.55 | 201.22 | 133.09 | 73.54 | 74.67 | 24.06 | 14.18 | 14.63 | 10.33 | 14.12 |
| 2005 | 1265 | 8.65 | 601.86 | 61.02 | 180.86 | 129.98 | 1210.46 | 132.12 | 45.07 | 61.09 | 34.83 | 28.17 | 11.90 | 6.11 | 0.81 | 4.35 |
| 2007 | 879 | 38.27 | 849.10 | 48.34 | 202.04 | 22.86 | 81.75 | 51.65 | 575.01 | 59.95 | 26.72 | 26.16 | 14.25 | 12.07 | 5.51 | 7.79 |

Table 11a. Hake pre-recruit (age-0 fish) indices from the SWFSC Santa Cruz midwater trawl juvenile groundfish survey (estimates are based on log-transformed hake catch per tow in numbers from Monterey outside stratum only, Sakuma and Ralston 1997) and the coast-wide survey which includes data from the PWCC/NMFS and SWFSC Santa Cruz surveys.

| | SWFSC Santa Cruz hake pre-recruit index | | | Coast-wide survey SWFSC/PWCC/NMFS hake pre-recruit index | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | log(numbers) | S.E | Antilog (bias corrected) | Year | Catch per tow | S.D. | CV | S.E. (log space) |
| 1986 | 2.989 | 0.552 | 18.87 | 1986 | - | - | - | - |
| 1987 | 6.691 | 0.537 | 803.92 | 1987 | - | - | - | - |
| 1988 | 5.294 | 0.507 | 198.17 | 1988 | - | - | - | - |
| 1989 | 2.232 | 0.526 | 8.32 | 1989 | - | - | - | - |
| 1990 | 3.778 | 0.526 | 42.72 | 1990 | - | - | - | - |
| 1991 | 4.187 | 0.535 | 64.81 | 1991 | - | - | - | - |
| 1992 | 2.797 | 0.540 | 15.39 | 1992 | - | - | - | - |
| 1993 | 7.266 | 0.522 | 1,430.09 | 1993 | - | - | - | - |
| 1994 | 3.661 | 0.523 | 37.90 | 1994 | - | - | - | - |
| 1995 | 2.131 | 0.523 | 7.43 | 1995 | - | - | - | - |
| 1996 | 4.929 | 0.536 | 137.21 | 1996 | - | - | - | - |
| 1997 | 3.011 | 0.556 | 19.31 | 1997 | - | - | - | - |
| 1998 | 1.716 | 0.539 | 4.56 | 1998 | - | - | - | - |
| 1999 | 4.724 | 0.534 | 111.66 | 1999 | - | - | - | - |
| 2000 | 2.819 | 0.541 | 15.75 | 2000 | - | - | - | - |
| 2001 | 3.637 | 0.526 | 36.99 | 2001 | 9.490 | 4.629 | 0.488 | 0.462 |
| 2002 | 2.347 | 0.558 | 9.45 | 2002 | 6.429 | 3.414 | 0.531 | 0.498 |
| 2003 | 0.733 | 0.526 | 1.08 | 2003 | 6.648 | 3.266 | 0.491 | 0.465 |
| 2004 | 4.771 | 0.526 | 117.05 | 2004 | 19.228 | 7.882 | 0.410 | 0.394 |
| 2005 | 0.540 | 0.511 | 0.72 | 2005 | 3.271 | 2.169 | 0.663 | 0.604 |
| 2006 | 0.409 | 0.509 | 0.51 | 2006 | 1.411 | 0.844 | 0.598 | 0.553 |

Table 11b. Basic data used to develop a coast-wide hake pre-recruit index based on SWFSC Santa Cruz midwater groundfish trawl and PWCC/NMFS midwater trawl surveys. These data include total number of zero and non-zero tows, mean and variance of log(catch numbers) of all and all non-zero tows for each year from 2001-2006 and eight latitudinal strata.

Basic catch data: Tows with zero and non-zero catches

| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Latitudinal Stratum | Num zero | Num pos. | Num zero | Num pos. | Num zero | Num pos. | Num zero | Num pos. | Num zero | Num pos. | Num zero | Num pos. |
| 35 | 5 | 8 | 5 | 10 | 9 | 3 | 15 | 33 | 25 | 30 | 36 | 32 |
| 36 | 11 | 32 | 20 | 25 | 27 | 19 | 15 | 30 | 40 | 12 | 34 | 9 |
| 37 | 10 | 38 | 10 | 27 | 29 | 30 | 12 | 47 | 50 | 4 | 41 | 4 |
| 38 | 2 | 24 | 2 | 22 | 4 | 28 | 4 | 28 | 26 | 5 | 22 | 29 |
| 39 | 2 | 8 | 1 | 9 | 1 | 9 | 1 | 14 | 14 | 7 | 8 | 17 |
| 40 | 3 | 11 | 0 | 10 | 2 | 9 | 5 | 10 | 4 | 7 | 3 | 13 |
| 41 | 6 | 6 | 3 | 7 | 2 | 9 | 0 | 10 | 1 | 9 | 1 | 9 |
| 42 | 26 | 2 | 28 | 2 | 6 | 26 | 26 | 35 | 27 | 40 | 25 | 43 |
| All | 65 | 129 | 69 | 112 | 80 | 133 | 78 | 207 | 187 | 114 | 170 | 156 |
| Proportion positive | | 0.66 | | 0.62 | | 0.62 | | 0.73 | | 0.38 | | 0.48 |

Mean and variance of log catch numbers (all hauls)

| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Latitudinal Stratum | Mean | Var | Mean | Var | Mean | Var | Mean | Var | Mean | Var | Mean | Var |
| 35 | 2.827 | 8.061 | 1.818 | 3.339 | 0.851 | 3.544 | 1.682 | 2.773 | 2.495 | 7.678 | 0.769 | 1.387 |
| 36 | 2.504 | 4.261 | 1.554 | 4.419 | 0.845 | 1.803 | 2.746 | 6.641 | 0.218 | 0.449 | 0.435 | 1.146 |
| 37 | 2.658 | 4.430 | 1.771 | 2.924 | 0.995 | 2.763 | 3.091 | 6.521 | 0.013 | 0.009 | 0.111 | 0.261 |
| 38 | 2.753 | 5.230 | 3.493 | 4.534 | 2.520 | 4.509 | 4.046 | 7.502 | 0.103 | 0.109 | 0.919 | 1.448 |
| 39 | 2.073 | 2.854 | 4.817 | 4.904 | 3.587 | 3.834 | 6.098 | 6.520 | 0.411 | 0.710 | 1.908 | 3.159 |
| 40 | 2.144 | 3.414 | 1.881 | 0.948 | 2.674 | 6.913 | 2.385 | 5.379 | 1.346 | 1.811 | 2.417 | 2.746 |
| 41 | 0.860 | 1.005 | 1.326 | 1.197 | 5.493 | 10.601 | 5.185 | 12.953 | 4.288 | 7.031 | 1.954 | 0.724 |
| 42 | 0.069 | 0.135 | 0.065 | 0.126 | 2.391 | 6.698 | 1.631 | 6.707 | 1.787 | 4.887 | 1.230 | 1.380 |
| All | 2.096 | 4.525 | 1.816 | 4.294 | 1.834 | 5.407 | 2.789 | 7.534 | 1.125 | 4.151 | 0.958 | 1.720 |

Mean and variance of log catch numbers (non-zero hauls)

| | 2001 | | 2002 | | 2003 | | 2004 | | 2005 | | 2006 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Latitudinal Stratum | Mean | Var | Mean | Var | Mean | Var | Mean | Var | Mean | Var | Mean | Var |
| 35 | 4.594 | 4.542 | 2.727 | 2.440 | 3.404 | 6.460 | 2.447 | 2.143 | 4.574 | 4.460 | 1.635 | 1.537 |
| 36 | 3.365 | 2.783 | 2.798 | 4.477 | 2.045 | 1.916 | 4.119 | 4.225 | 0.947 | 1.329 | 2.077 | 2.177 |
| 37 | 3.358 | 3.216 | 2.427 | 2.396 | 1.956 | 3.579 | 3.880 | 5.094 | 0.173 | 0.120 | 1.253 | 1.924 |
| 38 | 2.982 | 4.971 | 3.810 | 3.699 | 2.880 | 4.101 | 4.624 | 5.843 | 0.636 | 0.397 | 1.616 | 1.419 |
| 39 | 2.591 | 2.135 | 5.352 | 2.294 | 3.986 | 2.526 | 6.534 | 3.957 | 1.233 | 1.185 | 2.806 | 2.061 |
| 40 | 2.728 | 2.684 | 1.881 | 0.948 | 3.269 | 6.456 | 3.578 | 3.627 | 2.115 | 1.122 | 2.975 | 1.635 |
| 41 | 1.719 | 0.438 | 1.894 | 0.539 | 6.714 | 4.031 | 5.185 | 12.953 | 4.765 | 5.356 | 2.171 | 0.284 |
| 42 | 0.973 | 1.893 | 0.973 | 1.893 | 2.942 | 6.617 | 2.842 | 8.291 | 2.993 | 4.567 | 1.945 | 0.777 |
| All | 3.152 | 3.468 | 2.935 | 3.650 | 2.937 | 5.420 | 3.839 | 6.333 | 2.969 | 5.494 | 2.003 | 1.501 |

Table 12. Parameter assumptions and model configuration of Stock Synthesis II (Ver. 2.00n) for Pacific hake.

| Parameter | Number Estimated | Bounds (low,high) | Prior (Mean, SD) |
|---|---|---|---|
| *Natural Mortality* | | | |
| base (ages 0-12) | - | NA | Fixed at 0.23 |
| ages 13-15+ (exponential offset) | 1 | (-3,3) | ~N(0,0.8) |
| *Stock and recruitment* | | | |
| Ln(Rzero) | 1 | (11,30) | ~N(15,99) |
| Steepness | 1 | (.2,1.0) | ~*Beta* (.77,113) |
| Sigma R (based on 1967-2005 R devs) | - | NA | Fixed at 1.131 |
| Ln(Recruitment deviations): 1967-2005 | 39 | (-15,15) | ~Ln(N(0.Sigma R)) |
| *Catchability* | | | |
| Ln(Acoustic survey) | 1 | (-5,5) | ~N(0,99) |
| *Selectivity* | | | |
| *US Fishery (double logistic):* | | | |
| Base Period block: 1966 - 1983 | | | |
| Ascending inflection (ln trans.) | 1 | (1,10) | ~N(3,99) |
| Ascending slope | 1 | (0.001,10) | ~N(2.5,99) |
| Descending inflection (ln trans.) | 1 | (1,20) | ~N(12,99) |
| Descending slope | 1 | (0.001,10) | ~N(1.0,99) |
| Temporal blocks for all: 1984-1992, 1993-2000, 2001-2007 | 12 | same as above | same as above |
| *Canadian Fishery (double logistic):* | | | |
| Base Period block: 1966 - 1994 | | | |
| Ascending inflection (ln trans.) | 1 | (1,20) | ~N(3,99) |
| Ascending slope | 1 | (0.001,10) | ~N(1.0,99) |
| Descending inflection (ln trans.) | 1 | (1,40) | ~N(13,99) |
| Descending slope | 1 | (0.001,10) | ~N(1.0,99) |
| Temporal blocks for ascending infl and slp: 1995-2000, 2001-2002, 2003-2007 | 6 | same as above | same as above |
| *Acoustic Survey (double normal):* | | | |
| Peak age | 1 | (2,15) | ~N(8,99) |
| Top (logistic) | - | (-9,3) | fixed at -1.5 |
| Ascending width | 1 | (0,9) | ~N(3,99) |
| Descending width | - | (-5,9) | fixed at 2.75 |
| Final selectivity (logistic) | - | (-5,6) | ~N(0,99) |
| *Individual growth* | | | |
| Sex combined: | | | |
| Length at age min (age 2) | 1 | (10,40) | ~N(33,99) |
| base period Lmax 1966-1983 | 1 | (30,70) | ~N(53,99) |
| blocks for Lmax: 1984-2005 | 1 | (30,70) | ~N(53,99) |
| base period von Bertalanffy K, 1966-1980 and 1987-2005 | 1 | (0.1,0.7) | ~N(0.3,99) |
| blocks for von Bertalanffy K, 1981-1986 | 1 | (0.1,0.7) | ~N(0.3,99) |
| CV of length at age min | 1 | (0.01,0.35) | ~N(0.1,99) |
| CV of length at age max | - | NA | fixed at 0 |

Table 13. Maximum likelihood model parameter estimates with asymptotic standard deviations from Stock Synthesis II (Ver. 2.00n) applied to Pacific hake.

| Parameter | MLE | Asympt. SD |
|---|---|---|
| *Natural mortality* | | |
| M (ages 13-15+, exp offset from 0.23) | 0.927 | 0.064 |
| *Stock and recruitment* | | |
| Ln(Rzero) | 15.214 | 0.117 |
| steepness *h* | 0.744 | 0.168 |
| *Catchability* | | |
| Ln(Acoustic survey) | -0.787 | 0.193 |
| *Selectivity* | | |
| *US Fishery (double logistic):* | | |
| Base Period block: 1966 - 1983 | | |
| Ascending inflection (ln trans.) | 3.944 | 0.166 |
| Ascending slope | 1.036 | 0.079 |
| Descending inflection (ln trans.) | 11.862 | 0.148 |
| Descending slope | 0.828 | 0.050 |
| Block 1984 - 1992 | | |
| Ascending inflection (ln trans.) | 2.262 | 0.110 |
| Ascending slope | 4.888 | 1.934 |
| Descending inflection (ln trans.) | 12.414 | 0.191 |
| Descending slope | 0.814 | 0.063 |
| Block 1993- 2000 | | |
| Ascending inflection (ln trans.) | 3.975 | 0.181 |
| Ascending slope | 0.975 | 0.082 |
| Descending inflection (ln trans.) | 13.522 | 0.363 |
| Descending slope | 0.525 | 0.082 |
| Block 2001- 2007 | | |
| Ascending inflection (ln trans.) | 2.655 | 0.056 |
| Ascending slope | 3.585 | 0.266 |
| Descending inflection (ln trans.) | 9.630 | 1.052 |
| Descending slope | 0.337 | 0.050 |
| *Canadian Fishery (double logistic):* | | |
| Base Period block: 1966 - 1994 | | |
| Ascending inflection (ln trans.) | 5.405 | 0.169 |
| Ascending slope | 1.259 | 0.096 |
| Descending inflection (ln trans.) | 12.322 | 0.364 |
| Descending slope | 0.602 | 0.073 |
| Base Period block: 1995 - 2000 | | |
| Ascending inflection (ln trans.) | 5.244 | 0.478 |
| Ascending slope | 0.555 | 0.069 |
| Base Period block: 2001 - 2002 | | |
| Ascending inflection (ln trans.) | 3.700 | 0.109 |
| Ascending slope | 6.864 | 1.227 |
| Base Period block: 2003 - 2007 | | |
| Ascending inflection (ln trans.) | 4.534 | 0.115 |
| Ascending slope | 1.993 | 0.192 |
| *Acoustic Survey (double normal):* | | |
| Peak age | 6.546 | 0.447 |
| Ascending width | 3.070 | 0.207 |
| Final selectivity (logistic)* | -1.265 | 0.163 |
| *Growth Parameters:* | | |
| Length at age min (Lmin, age 2) | 32.730 | 0.085 |
| Base period Lmax, 1966-1983 | 52.952 | 0.086 |
| Block for Lmax: 1984-2007 | 50.013 | 0.057 |
| Base period K, 1966-1980, 1987-2007 | 0.342 | 0.003 |
| Blocks for K: 1981-1986 | 0.222 | 0.004 |
| CV of length at age min | 0.072 | 0.000 |

Table 14. Time series of estimated 3+ biomass, spawning biomass, recruitment, and utilization from 1966-2008 for Pacific hake using Stock Synthesis II (Ver. 2.00n). U.S. and Canadian exploitation rate is the catch in biomass divided by the vulnerable biomass at the start of the year. Population (3+) and spawning biomass is in millions of tons at the start of the year. Recruitment is given in billions of age-0 fish.

| Year | 3+ Population biomass (mt) | Spawning biomass (mt) | Age 0 Recruits | Depletion % Bzero | Exploitation Rate U.S. exploitation rate | Exploitation Rate Canada exploitation rate | Exploitation Rate Total |
|---|---|---|---|---|---|---|---|
| 1966 | 5.990 | 2.897 | 4.062 | 100.00% | 3.44% | 0.02% | 3.46% |
| 1967 | 5.861 | 2.833 | 5.669 | 97.82% | 4.57% | 1.21% | 5.78% |
| 1968 | 5.680 | 2.745 | 5.993 | 94.75% | 1.62% | 2.12% | 3.74% |
| 1969 | 5.615 | 2.733 | 5.563 | 94.36% | 2.31% | 3.29% | 5.60% |
| 1970 | 5.801 | 2.787 | 16.640 | 96.23% | 4.23% | 2.68% | 6.92% |
| 1971 | 6.036 | 2.886 | 5.140 | 99.62% | 3.31% | 0.97% | 4.28% |
| 1972 | 6.290 | 3.160 | 2.908 | 109.09% | 1.72% | 1.49% | 3.21% |
| 1973 | 8.541 | 3.836 | 11.689 | 132.41% | 2.97% | 0.47% | 3.45% |
| 1974 | 8.812 | 4.171 | 2.576 | 143.98% | 3.44% | 0.47% | 3.91% |
| 1975 | 8.379 | 4.188 | 4.274 | 144.58% | 3.32% | 0.37% | 3.69% |
| 1976 | 9.335 | 4.344 | 2.306 | 149.96% | 3.65% | 0.12% | 3.77% |
| 1977 | 8.718 | 4.245 | 20.312 | 146.54% | 2.02% | 0.11% | 2.13% |
| 1978 | 8.352 | 4.051 | 2.094 | 139.86% | 1.61% | 0.11% | 1.72% |
| 1979 | 7.637 | 3.980 | 3.554 | 137.39% | 2.07% | 0.26% | 2.32% |
| 1980 | 10.110 | 4.508 | 47.524 | 155.63% | 1.21% | 0.38% | 1.60% |
| 1981 | 9.375 | 4.445 | 0.506 | 153.46% | 1.90% | 0.55% | 2.45% |
| 1982 | 8.646 | 4.712 | 0.316 | 162.66% | 1.11% | 0.69% | 1.80% |
| 1983 | 15.063 | 5.828 | 0.845 | 201.20% | 0.95% | 0.80% | 1.75% |
| 1984 | 14.274 | 6.450 | 21.910 | 222.65% | 0.77% | 0.75% | 1.53% |
| 1985 | 12.402 | 5.912 | 0.100 | 204.10% | 0.80% | 0.39% | 1.19% |
| 1986 | 10.620 | 5.433 | 0.761 | 187.54% | 1.61% | 0.76% | 2.36% |
| 1987 | 12.092 | 5.165 | 6.019 | 178.31% | 1.51% | 1.04% | 2.55% |
| 1988 | 10.659 | 5.003 | 2.439 | 172.72% | 1.75% | 1.41% | 3.16% |
| 1989 | 9.146 | 4.506 | 0.410 | 155.55% | 2.72% | 1.67% | 4.39% |
| 1990 | 8.476 | 4.024 | 3.450 | 138.92% | 2.65% | 1.47% | 4.12% |
| 1991 | 7.418 | 3.545 | 1.103 | 122.39% | 3.79% | 2.04% | 5.83% |
| 1992 | 6.022 | 2.979 | 0.402 | 102.85% | 4.68% | 2.50% | 7.17% |
| 1993 | 5.262 | 2.508 | 2.725 | 86.58% | 3.96% | 2.05% | 6.01% |
| 1994 | 4.412 | 2.125 | 3.088 | 73.35% | 8.84% | 4.81% | 13.65% |
| 1995 | 3.290 | 1.638 | 2.288 | 56.54% | 8.13% | 3.68% | 11.81% |
| 1996 | 2.802 | 1.343 | 2.375 | 46.35% | 11.76% | 5.68% | 17.44% |
| 1997 | 2.553 | 1.179 | 2.268 | 40.70% | 15.16% | 6.66% | 21.82% |
| 1998 | 2.291 | 1.065 | 1.898 | 36.76% | 16.86% | 7.30% | 24.16% |
| 1999 | 2.079 | 0.961 | 18.151 | 33.19% | 17.45% | 7.91% | 25.36% |
| 2000 | 1.905 | 0.882 | 0.030 | 30.46% | 17.07% | 2.14% | 19.21% |
| 2001 | 1.798 | 1.048 | 1.374 | 36.19% | 10.87% | 4.36% | 15.24% |
| 2002 | 4.425 | 1.625 | 0.035 | 56.10% | 3.65% | 4.23% | 7.87% |
| 2003 | 4.182 | 1.898 | 1.809 | 65.54% | 3.75% | 3.67% | 7.42% |
| 2004 | 3.887 | 1.827 | 0.414 | 63.09% | 6.39% | 4.61% | 11.00% |
| 2005 | 3.149 | 1.554 | 6.065 | 53.64% | 9.89% | 3.83% | 13.72% |
| 2006 | 2.687 | 1.279 | 3.676 | 44.14% | 13.92% | 4.54% | 18.46% |
| 2007 | 2.046 | 1.067 | 3.556 | 36.85% | 14.19% | 4.79% | 18.98% |
| 2008 | 2.490 | 1.097 | 3.575 | 37.87% | - | - | - |
| 2007 5% - 95% Asymptotic Interval | | | | 36.85% | 23.7% - 50.1% | | |
| 2008 5% - 95% Asymptotic Interval | | | | 37.87% | 21.9% - 53.9% | | |

Table 15. Estimates of uncertainty as expressed by asymptotic 95% confidence intervals of spawning biomass and recruitment to age-0 for Pacific hake based on the Stock Synthesis model (ver2.00n). Deviations from log mean recruitment were estimated between 1967-2005 and values given for 2006-2008 represent mean recruitment from the stock recruitment curve.

| | Spawning biomass (millions, mt) | | | Recruitment to Age-0 (billions) | | |
|---|---|---|---|---|---|---|
| | | Asymptotic interval | | | Asymptotic interval | |
| Year | MLE | 5% | 95% | MLE | 5% | 95% |
| 1966 | 2.897 | 2.234 | 3.559 | 4.062 | 3.230 | 5.108 |
| 1967 | 2.833 | 2.171 | 3.496 | 5.669 | 4.317 | 7.444 |
| 1968 | 2.745 | 2.082 | 3.407 | 5.993 | 4.627 | 7.762 |
| 1969 | 2.733 | 2.065 | 3.402 | 5.563 | 4.282 | 7.227 |
| 1970 | 2.787 | 2.090 | 3.485 | 16.640 | 12.917 | 21.437 |
| 1971 | 2.886 | 2.144 | 3.628 | 5.140 | 3.970 | 6.656 |
| 1972 | 3.160 | 2.339 | 3.981 | 2.908 | 2.244 | 3.769 |
| 1973 | 3.836 | 2.842 | 4.829 | 11.689 | 9.173 | 14.894 |
| 1974 | 4.171 | 3.085 | 5.256 | 2.576 | 2.006 | 3.309 |
| 1975 | 4.188 | 3.085 | 5.291 | 4.274 | 3.354 | 5.446 |
| 1976 | 4.344 | 3.198 | 5.490 | 2.306 | 1.794 | 2.965 |
| 1977 | 4.245 | 3.117 | 5.372 | 20.312 | 16.342 | 25.246 |
| 1978 | 4.051 | 2.979 | 5.123 | 2.094 | 1.633 | 2.684 |
| 1979 | 3.980 | 2.943 | 5.016 | 3.554 | 2.831 | 4.461 |
| 1980 | 4.508 | 3.385 | 5.632 | 47.524 | 39.072 | 57.804 |
| 1981 | 4.445 | 3.358 | 5.532 | 0.506 | 0.348 | 0.737 |
| 1982 | 4.712 | 3.592 | 5.831 | 0.316 | 0.222 | 0.451 |
| 1983 | 5.828 | 4.523 | 7.133 | 0.845 | 0.658 | 1.085 |
| 1984 | 6.450 | 5.053 | 7.846 | 21.910 | 18.552 | 25.876 |
| 1985 | 5.912 | 4.644 | 7.180 | 0.100 | 0.056 | 0.179 |
| 1986 | 5.433 | 4.286 | 6.579 | 0.761 | 0.619 | 0.936 |
| 1987 | 5.165 | 4.095 | 6.235 | 6.019 | 5.219 | 6.941 |
| 1988 | 5.003 | 3.991 | 6.015 | 2.439 | 2.112 | 2.817 |
| 1989 | 4.506 | 3.600 | 5.412 | 0.410 | 0.335 | 0.501 |
| 1990 | 4.024 | 3.219 | 4.829 | 3.450 | 3.013 | 3.950 |
| 1991 | 3.545 | 2.840 | 4.250 | 1.103 | 0.936 | 1.301 |
| 1992 | 2.979 | 2.382 | 3.576 | 0.402 | 0.322 | 0.502 |
| 1993 | 2.508 | 2.002 | 3.014 | 2.725 | 2.269 | 3.271 |
| 1994 | 2.125 | 1.697 | 2.553 | 3.088 | 2.508 | 3.803 |
| 1995 | 1.638 | 1.293 | 1.982 | 2.288 | 1.801 | 2.907 |
| 1996 | 1.343 | 1.054 | 1.631 | 2.375 | 1.813 | 3.111 |
| 1997 | 1.179 | 0.908 | 1.450 | 2.268 | 1.691 | 3.043 |
| 1998 | 1.065 | 0.794 | 1.336 | 1.898 | 1.377 | 2.616 |
| 1999 | 0.961 | 0.687 | 1.236 | 18.151 | 12.905 | 25.529 |
| 2000 | 0.882 | 0.596 | 1.169 | 0.030 | 0.012 | 0.073 |
| 2001 | 1.048 | 0.677 | 1.420 | 1.374 | 0.944 | 1.998 |
| 2002 | 1.625 | 1.028 | 2.222 | 0.035 | 0.015 | 0.081 |
| 2003 | 1.898 | 1.186 | 2.611 | 1.809 | 1.157 | 2.830 |
| 2004 | 1.827 | 1.113 | 2.542 | 0.414 | 0.236 | 0.728 |
| 2005 | 1.554 | 0.889 | 2.218 | 6.065 | 3.371 | 10.910 |
| 2006 | 1.279 | 0.665 | 1.892 | 3.676 | 0.604 | 22.365 |
| 2007 | 1.067 | 0.472 | 1.663 | 3.556 | 0.586 | 21.588 |
| 2008 | 1.097 | 0.419 | 1.775 | 3.575 | 0.573 | 22.317 |

Table 16. Three year stochastic projections of potential Pacific hake landings, spawning biomass and depletion assuming full coastwide catch is taken under the 40:10 rule. Coastwide catches for 2008-2010 represent the average from slicing the marginal posterior distribution of 2008 spawning depletion into 25th, 50th and 75th percentiles. Posterior intervals on spawning biomass and spawning depletion are based on 1,000,000 draws from MCMC simulation.

| Percentile[1] | | | Spawning Biomass (millions, mt) [2] | | | | | Spawning Depletion (% unfished) [2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | Forecast | Coastwide | Posterior Interval | | | | | Posterior Interval | | | | |
| depletion | Year | Catch (mt) | 5th | 25th | 50th | 75th | 95th | 5th | 25th | 50th | 75th | 95th |
| | 2008 | 414,193 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 25% | 2009 | 432,862 | 0.757 | 1.062 | 1.430 | 1.885 | 3.424 | 0.278 | 0.368 | 0.470 | 0.571 | 0.891 |
| | 2010 | 522,299 | 0.670 | 1.083 | 1.609 | 2.250 | 4.369 | 0.244 | 0.372 | 0.512 | 0.673 | 1.236 |
| | 2011 | - | 0.571 | 1.111 | 1.740 | 2.608 | 5.204 | 0.210 | 0.377 | 0.546 | 0.789 | 1.570 |
| | 2008 | 656,604 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 50% | 2009 | 675,032 | 0.765 | 1.009 | 1.321 | 1.720 | 3.199 | 0.281 | 0.349 | 0.427 | 0.517 | 0.814 |
| | 2010 | 751,936 | 0.712 | 0.994 | 1.365 | 1.895 | 3.631 | 0.257 | 0.339 | 0.432 | 0.578 | 1.049 |
| | 2011 | - | 0.685 | 1.005 | 1.417 | 2.056 | 3.878 | 0.240 | 0.337 | 0.451 | 0.631 | 1.192 |
| | 2008 | 1,092,911 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| 75% | 2009 | 1,341,489 | 0.455 | 0.763 | 1.129 | 1.592 | 3.132 | 0.169 | 0.262 | 0.369 | 0.482 | 0.803 |
| | 2010 | 1,502,207 | 0.103 | 0.423 | 0.926 | 1.574 | 3.683 | 0.037 | 0.148 | 0.298 | 0.469 | 1.046 |
| | 2011 | - | 0.019 | 0.270 | 0.716 | 1.562 | 4.187 | 0.006 | 0.092 | 0.230 | 0.477 | 1.238 |
| | 2008 | 250,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 250,000 | 0.951 | 1.299 | 1.748 | 2.727 | 9.203 | 0.351 | 0.446 | 0.557 | 0.718 | 1.102 |
| | 2010 | 250,000 | 1.050 | 1.536 | 2.122 | 3.511 | 10.202 | 0.380 | 0.516 | 0.670 | 0.897 | 1.397 |
| | 2011 | - | 1.164 | 1.780 | 2.485 | 4.201 | 10.813 | 0.412 | 0.593 | 0.778 | 1.037 | 1.793 |
| | 2008 | 300,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 300,000 | 0.807 | 1.112 | 1.481 | 1.935 | 3.473 | 0.297 | 0.385 | 0.485 | 0.586 | 0.907 |
| | 2010 | 300,000 | 0.776 | 1.189 | 1.715 | 2.355 | 4.476 | 0.283 | 0.410 | 0.543 | 0.710 | 1.259 |
| | 2011 | - | 0.765 | 1.308 | 1.936 | 2.801 | 5.401 | 0.280 | 0.441 | 0.609 | 0.854 | 1.634 |
| | 2008 | 400,000 | 0.776 | 1.006 | 1.302 | 1.645 | 2.565 | 0.293 | 0.359 | 0.426 | 0.499 | 0.632 |
| | 2009 | 400,000 | 0.763 | 1.068 | 1.436 | 1.891 | 3.430 | 0.280 | 0.370 | 0.471 | 0.573 | 0.893 |
| | 2010 | 400,000 | 0.690 | 1.104 | 1.629 | 2.271 | 4.390 | 0.251 | 0.379 | 0.518 | 0.680 | 1.241 |
| | 2011 | - | 0.644 | 1.184 | 1.814 | 2.681 | 5.277 | 0.235 | 0.401 | 0.569 | 0.812 | 1.591 |

[1] Coastwide catches for 2008-2010 represent the average from slicing the marginal posterior distribution of 2008 spawning depletion in 25th, 50th and 75t

[2] Posterior intervals are based on 1,000,000 draws from MCMC simulation.

# Minority Report to the 2008 Pacific Hake STAR Panel Report

A. Sinclair[1], S. Martell[2], C. Grandin[1], J. Fargo[1] members of the STAT Team

[1]Fisheries and Oceans Canada
Pacific Biological Station
Nanaimo, BC, Canada

[2]University of British Columbia
Fisheries Centre
Vancouver, BC, Canada

The Canadian component of the Pacific hake stock assessment team has serious reservations about the 2008 hake assessment STAR Panel report and the process followed at this year's review. The Panel failed to follow the assessment terms of reference and produced a base model for catch advice that has serious technical flaws. The ABC forecast from this base model, if implemented, has a high risk of causing serious harm to the hake stock. We undertook two alternative analyses of the hake stock assessment data in accordance with recommendations of previous STAR panel reviews and because of concerns expressed by Canadian fisheries mangers about the accuracy of stock estimates from the current SS2 assessment model. Our work was, for all intents and purposes, ignored by the Panel. Instead of including alternative models to show contrast in management implications, the Panel spent the majority of the meeting fiddling with the SS2 assessment model formulation. The Panel failed to recognize two serious technical flaws in this model. The net result is a predicted ABC almost 120,000 t higher than that in the original SS2 model, 190,000 t higher than that predicted by the two alternative models, and 170,000 t (1.5 times) higher than the maximum historic catch. This is at a time when the hake population is dominated by a single year-class now 9 years old, the population biomass is declining and at its historic minimum, the exploitation rate is increasing and at its historic maximum, and there is no indication of good recruitment. Prudent management suggests catches should be reduced under these circumstances, not increased.

The Canadian and American members of the STAT team met on several occasions in advance of the STAR review to coordinate their work. Three assessment models were developed based on scientifically sound methods (SS2, TINSS, VPA) that have broad international use. Care was taken to use the same input data in each model. The team fully understood the different models and our work was undertaken in an open environment with the intention of gaining insight into model performance. The Panel did not take advantage of this body of work.

The Panel failed to follow these items in their terms of reference.

a) Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the panel and excluded from the set upon which management advice is to be developed.

The panel's rejection of the TINSS and VPA models was not based on "technical flaws or other grounds of questionable performance". Instead, the Panel provided a highly questionable rationale to support what appeared to be a pre-arranged acceptance of the SS2 model, and failed to notice serious technical flaws in the SS2 model. Their rationale for using the SS2 model as the sole base, as given on page 26 of the report, is rebutted below.

1. It makes the most comprehensive use of available data. In fact, each model used the same input data, except that the SS2 model used an age-error table that was not available to the other models. The effect of including the age-error table on the forecast yield was never evaluated, but is likely to be negligible compared to other major issues. The SS2 model used less aggregated data including length compositions of catches, conditional age at length distributions, and age proportions. The TINSS model used age proportions and the VPA model used catch at age, all of which were derived from the SS2 input data using scientifically accepted algorithms. It is not at all clear whether using disaggregated data is an advantage. Several additional structural assumptions are required to predict the disaggregated observations used in SS2 (e.g. converting the state variables numbers at age and year to annual proportions at age, year and length) and these have not been tested. The hyper-sensitivity of the SS2 model estimates to minor changes in model formulation may indeed be related to its use of disaggregated data and misspecification of these additional structural assumptions.

2. It provides a more flexible tool for evaluating different plausible sets of assumptions regarding underlying uncertainties in the data and model structure. This is an opinion we do not share. Both the TINSS and VPA models allowed for varying relative error, whether the ratio of process to observation error in TINSS or errors at age and year in TINSS and VPA. The TINSS paper included a table showing the effects of different assumptions about relative error on the ABC. The Panel did not request to see any additional results from VPA where different error assumptions were used. The VPA model formulations presented to the Panel were structured to investigate dome vs. asymptotic selectivity. The TINSS model could have easily been reformulated to include dome-shaped and time varying selectivity. The Panel did not request to see this nor did they question the author's rationale for how these issues were treated. What took hours to investigate with SS2 took minutes with TINSS and VPA.

3. Results from the SS2 model chosen for the base model encompassed the range of results of TINSS and VPA. This is incorrect. The Panel's base model covered a higher and tighter range of ABC than the original SS2 model formulation (Figure 1). The original SS2 model estimates were closer in scale to the other two model results and covered their distribution to a greater extent than the Panel's base model. That said, it is not at all clear if "encompassing the range of results of TINSS and VPA" is an advantage of SS2. Given the hyper-sensitivity of SS2

estimates to different formulations, it could be tweaked to cover any desired range. Of the three models, the TINSS model made the most comprehensive and explicit treatment of parameter uncertainty.

The Panel did not question the clear technical flaw of the SS2 model indicated by a severely biased retrospective pattern (Figure 19 in the report and Figures 59-60 in Helser et al. revised). As successive years of data were dropped from the analyses, the SS2 estimates of spawning stock biomass systematically scaled upward as did the estimates of steepness and unfished recruitment. The implication is that one should anticipate a downward scaling of the population estimates in future years with the strong potential that any forecast yield from the SS2 model would result in higher than expected exploitation rates and greater than expected decline in stock size. The risk of inflicting serious harm on the hake resource using a model with this diagnostic is enormous. Other scientific panels have rejected assessments with less severe retrospective patterns. The retrospective analyses of the other two models (TINSS and VPA) were remarkably consistent indicating they would be better candidates for the base model for catch advice. That the Panel did not remark on this obvious difference in model performance leads us to conclude they were heavily biased toward using the SS2 model from the outset.

The Panel failed to recognize the clear evidence that the SS2 model did not reach global convergence (Figure 25). The figure shows that the likelihood values were constant for a range of model estimates of final M (0.58 – 0.6). Based on the results shown in Figure 25, it appears there is a ridge in the likelihood surface along which final M values correspond to the exact same likelihood. What is not clear is if other model parameters vary and what are the implications of this covariance structure on the catch advice. Previous sensitivity analysis with M had a profound affect on the management advice (ABC increased by over 120,000 t when M was reduced from 0.23 to 0.19).

b) Alternative models should show contrast in their management implications, which in practical terms means that that they should result in different estimates of current stock size, stock depletion, and ABC.

The Panel elected not to use the TINSS and VPA models as the basis for advice. In effect, the Panel has ignored insights stemming from these technically sound and widely used models.

c) The STAR Panel is not authorized to conduct an alternative assessment representing its own views that are distinct from those of the STAT Team, nor can it impose an alternative assessment on the Team.

The Panel changed the SS2 formulation to such an extent that one could say they produced an alternative assessment. The Panel asked the team to 1) estimate natural mortality (M) on older ages and 2) estimate the survey catchability coefficient and the survey selection at the oldest age (selex). It is well known that catchability, selectivity (i.e. relative catchability at age), and M are confounded in stock assessment models (see 2004 STAR panel report and the response in the appendix of the 2005 Hake Assessment) and it is essentially impossible to freely estimate all three simultaneously with any degree of confidence. Helser et al. recognized this in their original paper (discussion of M on page 32-33, discussion of catchability and selectivity on page 37) and elected to fix M and span uncertainty regarding selectivity by using three fixed values. While it is not mentioned in the report, Helser et al. had to use informative priors on both M and the selex value in order to satisfy the Panels requests for alternative model formulation.

What is noticeably absent from the report is any technical or statistical justification for their selected base model. Each requested change in formulation was exploratory rather than directed by formal model selection criteria (e.g., AIC or BIC). The number of requests was limited only by the time allotted to the meeting. The Panel does not justify why their selected base model is superior to what Helser et al. originally proposed.

The hyper-sensitivity of the SS2 estimates to seemingly minor changes in formulation is demonstrated by the sequence of Panel requests leading to their final base model. The first requested change was to put a less informative prior on M. Initially, Helser et al. used a highly informative prior of M = 0.23. The less informative prior was a mean M of 0.19 with a standard deviation of 0.005. The original 2008 ABC estimate was 409,000 t, the free M estimate was 532,000 t. The Panel then asked the team to fix M for ages 2-13 and estimate it for ages 14 and 15+. This lowered the ABC estimate to 463,000 t. The final Panel request was to keep this M formulation and estimate the selectivity at age 15+ (selex), and to use this as the base model. The meeting terms of reference prohibits the Panel from this very sort of fiddling, presumably because the Panel simply cannot be as familiar with the assessment as the STAT team. At one point, the panel even asked the STAT team what additional runs they should do.

d) STAR Panels include a chairman appointed from the SSC and at least two other members with experience gained from having conducted stock assessments on the U. S. west coast or elsewhere. The total number of STAR Panel members (including the chair) should be 3 unless extenuating circumstances such as a large number of stock assessments scheduled for review at the STAR Panel dictate more reviewers.

The report lists 5 Panel members (page 1). We were under the impression that Drs. Sampson, Haddon and Cadigan were the three panel members with stock assessment expertise and were surprised when Mr. Waldeck stated he was a member of the Panel. What were the extenuating circumstances that expanded the Panel from 3 to 5, why was the Canadian delegation not informed in advance, and does Mr. Waldeck have the requisite expertise in stock assessment to serve as a Panel reviewer?

A recommendation from one of our assessments was vetoed by the Panel and it has not been recorded in the meeting report despite specific requests to do so. This is serious omission which again demonstrates the Panel's bias. The recommendation was to base the 2008 ABC on a *status quo* fishing mortality (i.e., the average fishing mortality over the most recent 5 years), rather than the estimated $F_{msy}$ (or $F_{40\%}$ proxy) with the 40/10 adjustment. The recommendation was to do this on an interim basis while research is conducted to sort out key assessment uncertainties. The recommendation was originally based on the results of the VPA assessment where the estimated F40% was 1.0, four times M. This high estimate was mainly due to the estimated fishery selectivity which was shifted toward older ages, and it is likely to be inaccurate. While the VPA example is extreme, the same pattern was evident in the other two assessment models. As has been noted on several occasions in the report, there is considerable uncertainty about the fishery selectivity estimates and uncertainty in $F_{40\%}$ is probably under-estimated because no uncertainty is assumed in the maturity schedules. Given the current status of the stock, declining biomass, poor recruitment, spiking exploitation rates, and the high degree of uncertainty regarding key vital population parameters, it seems prudent to forecast the ABC at a lower exploitation rate than what has been estimated for the past several years. The recommendation was repeated to the Panel on the final day of the meeting and in e-mail while the report was being drafted, but it was vetoed on the grounds that it had to do with policy and not science. We fail to see the distinction. If a fisheries scientist cannot make this simple set of observations and suggest a reasoned alternative in the STAR process, and if the Panel can decide not even to report its veto, we are in trouble.

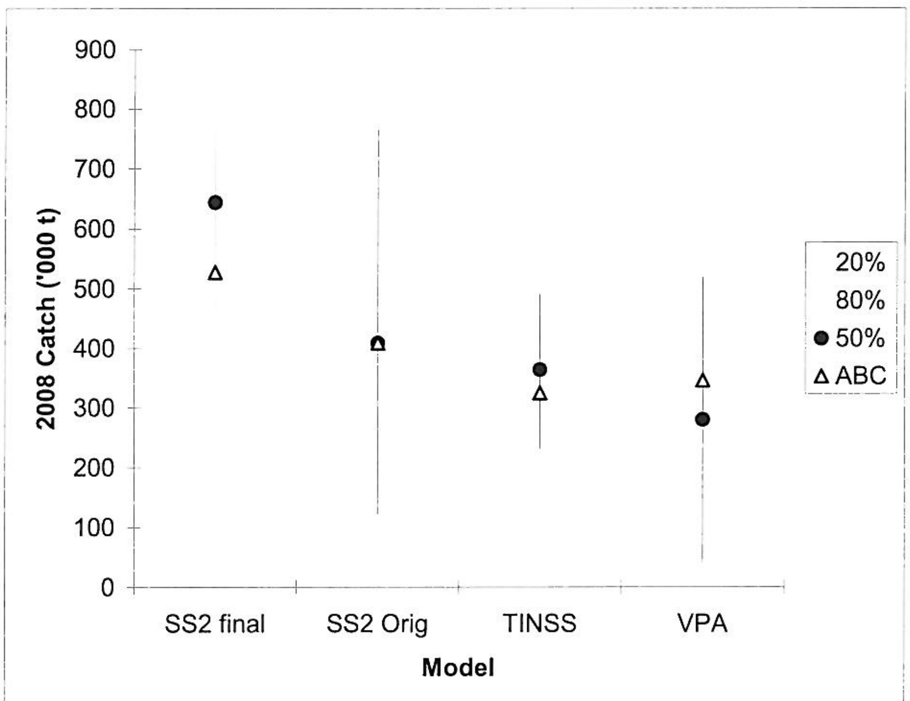



Figure 1: Comparison of predicted 2008 ABCs (open triangles) and ranges from models presented to the 2008 Pacific hake STAR panel. The ranges indicated by the vertical bars for the SS2 final, TINSS, and VPA models span the 20% - 80% probabilities of the catch exceeding the target fishing mortality. The solid circles are the 50% probability catches. The range indicated for the original SS2 model spans the upper and lower limits estimates as the ABCs for the high and low selex options.

# Addendum to the
# Report of the 2008 U.S. / Canada Pacific Hake (Whiting)
# Stock Assessment Review (STAR) Panel -
# STAR Panel Response to the Minority Report

**Review Panelists:**

David Sampson, Panel chair and representative for the Scientific and Statistical Committee of the Pacific Fishery Management Council (PFMC)

Malcolm Haddon, Center for Independent Experts

Noel Cadigan, Fisheries and Oceans, Canada

## Introduction

The Canadian component of the Pacific hake stock assessment team filed a Minority Report to express reservations about the STAR Panel Report and the process followed at the 2008 review. The three reviewers on the STAR Panel offer the following information to clarify events that transpired during the review and to lay bare how the panel arrived at its decision to recommend using only the Stock Synthesis II (SS2) model to develop a base model and decision table for use by the Pacific Fishery Management Council. The STAR Panel gave due consideration to all three models brought to the STAR Panel Meeting; the Panelists chose the model that they considered to provide the best representation of the Pacific hake stock and the uncertainties inherent in the available data.

## The Data

The STAR Panel commends the three sets of analysts for the care they took to use the same input data in their separate assessment models. Differences observed in the results from the three models (SS2, ADAPT / VPA, TINSS) can thus be ascribed to differences in approach to data aggregation and assumptions about model structure. One general finding of the explorations that occurred during the STAR Panel Meeting was that the three modeling platforms could be configured to produce very similar estimated biomass trajectories. Differences in results were driven primarily by assumptions about model structure.

The following sets of compositional data were available to the SS2 analytical team, the ADAPT / VPA analytical team, and the TINSS analyst: length composition data for the US fishery, length composition data for the Canadian fishery, length composition data for the acoustic / midwater trawl survey, age-at-length composition data for the US fishery, age-at-length composition data for the Canadian fishery, age-at-length composition data for the acoustic / midwater trawl survey. The SS2 model maintained these data components separately, thus allowing full exploration and measurement of any lack of agreement among these separate data sources. The ADAPT / VPA and TINSS models collapsed the length and age-at-length compositions to two sets of age composition estimates, one for a combined US / Canadian fishery and a second for the acoustic / midwater trawl survey. Through a series of likelihood profiles the SS2 analytical team showed that there was a clear lack of agreement between the US versus Canadian age composition data. This lack of agreement is incorporated into the SS2 model's estimates of uncertainty, whereas it is ignored by the TINSS model because this model combined the separate fisheries. The ADAPT / VPA model gives no consideration to measurement error in the catch-at-age data.

The SS2 model included a transition matrix to reflect imprecision in age-reading data so that uncertainty due to age reading imprecision would be incorporated into estimates of uncertainty in the SS2 assessment results. The SS2 model also incorporated the uncertainty associated with deriving age-composition estimates from the application of age-length keys to length composition data. Further, the SS2 model included uncertainty in the growth-in-length function due to measurement error and time-variation in growth. In contrast, the ADAPT / VPA and TINSS models assumed there was no age-reading error, no imprecision in the derivation of age from length, and no uncertainty in average weight-at-age by year.

It was (and remains) the Panel's opinion that the SS2 model made better use of the available data to reflect known and potentially influential sources of uncertainty.

## Structural Assumptions

It was also the Panel's opinion that the SS2 model was superior to the two other models in its structural accommodation of several processes known to be potentially influential, including the shape of the selection curves (free to be domed in SS2; assumed to be asymptotic in the ADAPT / VPA and TINSS models) and temporal variation in selection (assumed to be time-varying in SS2 and ADAPT / VPA, but time-invariant in TINSS). The SS2 and TINSS models both allowed some flexibility in the natural mortality coefficient (M) and incorporated this uncertainty into the final assessment results, whereas the ADAPT / VPA had a fixed value for M and thus ignored this important source of uncertainty. The SS2 model generally made less restrictive assumptions than the other models regarding the degree of measurement error in different data sources. For example, the SS2 model assumed that the acoustic / midwater trawl survey estimates of biomass in the first half of the time-series were much less certain than the estimates during the second half, to reflect the major expansion in spatial coverage by the survey starting in 1992. The ADAPT / VPA and TINSS models, in contrast, assumed uniform variation in measurement error by the survey for the entire duration of the time series, thus giving much greater (and undue) leverage to the survey estimates from the early portion of the time series.

## Rationale Leading to Acceptance of the Final SS2 Base Model

During the STAR Panel Meeting the STAR Panel requested a number of exploratory runs with all three of the assessment models in an attempt to better understand the causes of the similarities and differences among the models. The fundamental task of the meeting, however, was to develop a single best model to represent conditions in the stock and the uncertainty associated with stock status. To that end the Panel requested a series of refinements in the structural assumptions of the SS2 model that had been brought to the STAR Panel Meeting. The Minority Report criticizes the STAR Panel Report for not providing "any technical or statistical justification for their selected base model." The sequence of steps leading to the final SS2 base model was described in the STAR Panel Report and is repeated below, but with additional information regarding goodness-of-fit of the different model configurations that were examined. This information on goodness-of-fit of different model configurations was discussed during the STAR Panel meeting but was not included in the STAR Panel Report.

The initial draft of the assessment document for the SS2 model proposed an initial base model and high and low alternatives, where the feature distinguishing the three configurations was the survey selection coefficient for the age-15+ fish. In terms of the negative log-likelihood values associated with the three configurations, the high alternative, which had the "Final survey selex" parameter fixed at 0.3, provided a much better fit to the data (92 log-likelihood units better than the initial base model) (Table 1, part A). When the constraints on the natural mortality coefficient (M) were relaxed (STAR Request 1 from Tuesday afternoon) there was a large improvement in fit (decrease in the negative log-likelihood) (Table 1, part B). The SS2 analytical team felt there was insufficient justification for freeing up M given the maximum age that has been observed for Pacific hake (about 25 years). The STAR concurred. The next step of "fiddling with the SS2 assessment model formulation" was the introduction of an age-dependent formulation for M, whereby M was fixed at $0.23^{-yr}$ (as in the initial base model) for ages up to 13 and then followed a linear ramp for ages-14 and 15+ (Table 1, part C). This slight change in the model configuration resulted in an even larger improvement in fit relative to the initial base model.

The final fiddle with the SS2 model configuration was the free estimation of the parameter for the survey selection coefficient for the oldest fish (Table 1, part D), which had taken fixed values in previous model configurations. The main goal of this step was to move to a base model configuration that would encompass the original high and low alternatives, but without artificial constraints, to facilitate construction of a decision table. The posterior probability density function derived from the base model configuration would be used to assign the alternative states of nature associated with the upper and lower 25% probabilities and the set of base model parameters (and derived management quantities) associated with the central 50% probability. Relative to the initial base model that had been brought to the STAR Panel Meeting, the STAR Panel's fiddling with the SS2 model configuration resulted in a final base model that provided a major improvement in fit to the data (258 log-likelihood units) at the expense of only two additional estimated parameters (M for the oldest fish, and the final survey selection coefficient). Given the rule-of-thumb that one new parameter is worth keeping if it produces an improvement in log-likelihood of at least two units, there should be no doubt that the improvement in fit to the data provided clear support for the final base model.

**The SS2 Model's Severely Biased Retrospective Pattern**

The SS2 analytical team commented on the retrospective pattern shown by the SS2 model and explained that it was likely due to the increasing influence of the early biomass index values from the acoustic / midwater trawl survey, which the final base model did not provide a good fit to. As the later biomass index values were successively removed, the model provided better fits to the early biomass index values, the estimates of the survey catchability coefficient decreased, and the estimated stock biomass was scaled upwards. The STAR Panelists concurred that this was a plausible explanation for what otherwise would be a troublesome feature of the SS2 model.

**Global Convergence of the SS2 Model**

Figure 25 of the STAR Panel report and the analysis on which the figure was based showed that none of the "jittered" runs produced a better fit than that provided by the final base model. While this does not constitute "proof" of convergence, it clearly refutes the Minority Report statement that "the SS2 model did not reach global convergence." That there may be a ridge in the likelihood surface is neither a surprise nor a cause for concern. The uncertainty that this ridge produces should in theory be accounted for in the SS2 model's estimates of uncertainty and in the posterior distribution generated by the MCMC runs.

**Membership of the STAR Panel**

The Minority Report states that the Canadian members were surprised that Mr. Waldeck was a member of the Panel. The "Terms of Reference for STAR Panels and Their Meetings" indicates "the groundfish management team (GMT) and the groundfish advisory panel (GAP) will designate one person each to participate in the review." The first page of the STAR Panel Report lists Dan Waldeck as the "Representative for the PFMC Groundfish Advisory Panel" and John Wallace as the "Representative for the PFMC Groundfish Management Team".

The STAR Panel Report should also have included Jeff Fargo, who served on the Panel as the representative of Fisheries and Oceans Canada. He was included in the list of STAR Panelists at the end of the STAR Panel Report. We regret that his name was inadvertently left off the list on the first page.

**Harvest Management Advice**

The Minority Report states that "it seems prudent to forecast the ABC at a lower exploitation rate than what has been estimated for the past several years." The Report expresses frustration that the STAR Panel vetoed their advice "on the grounds that it had to do with policy and not science." The role of the STAR Panel is to review the assessment data and models for their accuracy and scientific merit. There is nothing in the terms of reference asking the STAR Panel to evaluate target exploitation rates. To the contrary, the Council has an adopted policy that Pacific hake assessments should do catch forecasts based on an F40% rate of fishing mortality as adjusted by the 40-10 harvest control rule. The STAR Panel Report lists various risk factors that the Council may choose to consider in its deliberations regarding an optimum yield (OY) value for 2008. The STAR Panel Report identifies as its highest priority the need for a Management Strategy Evaluation to determine whether the current harvest policy is appropriate for Pacific hake.

Table 1. Goodness-of-fit and maximum likelihood estimates of management quantities from the set of SS2 model runs explored during the STAR Panel Meeting.

A. The initial set of SS2 model runs brought to the STAR Panel Meeting. The information is equivalent to the upper section of Fig. 12 in the STAR Panel Report.

| | Initial base model Final survey selex=0.5 | | | Alt. Low Final survey selex=0.7 | | | Alt. High Final survey selex=0.3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Derived Parameter | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | |
| Neg log likelihood | 14595 | | | 14665 | | | 14503 | | |
| number parameters | 88 | | | 88 | | | 88 | | |
| 2007 Depletion | 0.437 | 0.293 | 0.581 | 0.291 | 0.212 | 0.370 | 0.570 | 0.418 | 0.723 |
| 2008 Depletion | 0.429 | 0.254 | 0.604 | 0.292 | 0.156 | 0.428 | 0.597 | 0.413 | 0.782 |
| MSY | 346,130 | 247,101 | 445,159 | 219,270 | 153,310 | 285,230 | 467,030 | 320,273 | 613,787 |
| $B_{MSY}$ | 637,580 | 359,397 | 915,763 | 434,510 | 248,255 | 620,765 | 917,560 | 504,980 | 1,330,140 |
| $SPR_{MSY}$ | 0.234 | 0.107 | 0.360 | 0.248 | 0.104 | 0.393 | 0.247 | 0.108 | 0.385 |
| 2008 Catch | 401,720 | 190,765 | 612,675 | 111,090 | 22,335 | 199,845 | 750,820 | 411,034 | 1,090,606 |
| Rzero (billions) | 1.210 | 1.010 | 1.410 | 0.787 | 0.700 | 0.874 | 1.674 | 1.376 | 1.971 |
| Bzero (millions, mt) | 1.836 | 1.531 | 2.141 | 1.193 | 1.060 | 1.326 | 2.538 | 2.086 | 2.989 |

B. Revised initial set of SS2 model runs with M (all ages) estimated with a constraining prior. The information is equivalent to the lower section of Fig. 12 of the STAR Panel Report.

| | Revised base model (1) Final survey selex=0.5 | | | Alt. Low Final survey selex=0.7 | | | Alt. High Final survey selex=0.3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Derived Parameter | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | |
| Neg log likelihood | 14484 | | | 14425 | | | 14440 | | |
| number parameters | 89 | | | 89 | | | 89 | | |
| 2007 Depletion | 0.472 | 0.324 | 0.620 | 0.307 | 0.213 | 0.400 | 0.568 | 0.417 | 0.720 |
| 2008 Depletion | 0.485 | 0.302 | 0.668 | 0.271 | 0.147 | 0.395 | 0.603 | 0.417 | 0.789 |
| MSY | 406,060 | 275,863 | 536,257 | 284,320 | 189,227 | 379,413 | 476,520 | 321,950 | 631,090 |
| $B_{MSY}$ | 742,810 | 400,535 | 1,085,085 | 516,020 | 281,878 | 750,162 | 932,550 | 510,464 | 1,354,636 |
| $SPR_{MSY}$ | 0.242 | 0.106 | 0.378 | 0.239 | 0.104 | 0.374 | 0.248 | 0.110 | 0.386 |
| 2008 Catch | 532,400 | 251,160 | 813,640 | 180,080 | 28,264 | 331,896 | 770,080 | 414,399 | 1,125,761 |
| Rzero (billions) | 1.503 | 1.170 | 1.835 | 1.043 | 0.788 | 1.297 | 1.728 | 1.362 | 2.095 |
| Bzero (millions, mt) | 2.086 | 1.692 | 2.480 | 1.461 | 1.188 | 1.734 | 2.567 | 2.088 | 3.047 |

Table 1. (continued) Goodness-of-fit and maximum likelihood estimates of management quantities from the set of SS2 model runs explored during the STAR Panel Meeting.

C. Revised initial set of SS2 model runs with an age-dependent M (ramp starting at age 13). The old-M parameter was estimated; the young-M parameter was fixed. The information is equivalent to Fig. 20 of the STAR Panel Report.

| | Revised base model (2) Final survey selex=0.5 | | | Alt. Low Final survey selex=0.7 | | | Alt. High Final survey selex=0.3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Derived Parameter | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | |
| Neg log likelihood | 14362 | | | 14391 | | | 14340 | | |
| number parameters | 89 | | | 89 | | | 89 | | |
| 2007 Depletion | 0.353 | 0.240 | 0.466 | 0.324 | 0.225 | 0.423 | 0.386 | 0.254 | 0.519 |
| 2008 Depletion | 0.357 | 0.217 | 0.497 | 0.322 | 0.197 | 0.447 | 0.398 | 0.237 | 0.559 |
| MSY | 452,320 | 237,151 | 667,489 | 423,950 | 248,467 | 599,433 | 499,660 | 238,568 | 760,752 |
| $B_{MSY}$ | 1,191,500 | 629,294 | 1,753,706 | 1,045,200 | 561,394 | 1,529,006 | 1,350,100 | 704,280 | 1,995,920 |
| $SPR_{MSY}$ | 0.332 | 0.114 | 0.550 | 0.317 | 0.116 | 0.517 | 0.337 | 0.115 | 0.559 |
| 2008 Catch | 463,510 | 154,144 | 772,876 | 370,290 | 127,132 | 613,448 | 591,290 | 170,008 | 1,012,572 |
| Rzero (billions) | 1.858 | 1.532 | 2.185 | 1.682 | 1.430 | 1.933 | 2.083 | 1.612 | 2.553 |
| Bzero (millions, mt) | 2.631 | 2.171 | 3.092 | 2.379 | 2.024 | 2.734 | 2.958 | 2.293 | 3.623 |

D. The SS2 model runs, but with an age-dependent M (old-M estimated; young-M fixed) and two alternative configurations for survey selection: fixed to be asymptotic versus freely estimated. The information is equivalent to Fig. 24 of the STAR Panel Report.

| | Revised base model (2) Final survey selex=0.5 | | | Asymptotic survey selex | | | Final base model Final survey selex estimated | | |
|---|---|---|---|---|---|---|---|---|---|
| Derived Parameter | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | | MLE | Asymptotic 95% CI | |
| Neg log likelihood | 14362 | | | 14436 | | | 14337 | | |
| number parameters | 89 | | | 89 | | | 88 | | |
| 2007 Depletion | 0.353 | 0.240 | 0.466 | 0.265 | 0.193 | 0.337 | 0.362 | 0.236 | 0.489 |
| 2008 Depletion | 0.357 | 0.217 | 0.497 | 0.248 | 0.151 | 0.345 | 0.372 | 0.217 | 0.527 |
| MSY | 452,320 | 237,151 | 667,489 | 383,790 | 263,961 | 503,619 | 466,270 | 212,391 | 720,149 |
| $B_{MSY}$ | 1,191,500 | 629,294 | 1,753,706 | 796,640 | 428,101 | 1,165,179 | 1,343,800 | 712,602 | 1,974,998 |
| $SPR_{MSY}$ | 0.332 | 0.114 | 0.550 | 0.277 | 0.108 | 0.445 | 0.352 | 0.121 | 0.582 |
| 2008 Catch | 463,510 | 154,144 | 772,876 | 216,180 | 65,131 | 367,229 | 527,180 | 141,707 | 912,653 |
| Rzero (billions) | 1.858 | 1.532 | 2.185 | 1.403 | 1.254 | 1.552 | 1.728 | 1.362 | 2.095 |
| Bzero (millions, mt) | 2.631 | 2.171 | 3.092 | 1.987 | 1.776 | 2.198 | 2.567 | 2.088 | 3.047 |

# Pacific Whiting Fishery Summary, All Sectors, 2007

| | Tribal | | | | Shore-Based | | |
|---|---|---|---|---|---|---|---|
| | **Mothership** | **Shoreside** | **Mothership** | **Catcher/ Processors** | **EFP[1]** | **Non-EFP** | **TOTAL WOC** |
| *Whiting allocation* | *32,500* | | *49,942* | *70,751[2]* | *87,398* | | *240,591[3]* |
| **ROUNDFISH** (mt) | | | | | | | |
| Pacific whiting | 5,167 | 25,010 | 47,809 | 73,263 | 72,751 | 529 | 224,529 |
| Pacific cod | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | | 0.02 |
| Lingcod | 1.01 | 1.29 | 4.26 | 0.95 | 5.01 | | 12.52 |
| Sablefish | 0.00 | 0.00 | 0.09 | 3.05 | 9.04 | | 12.18 |
| **FLATFISH** (mt) | | | | | | | |
| Dover sole | 0.00 | 0.00 | 0.02 | 0.04 | 0.16 | | 0.22 |
| English sole | 0.00 | | 0.00 | 0.00 | 0.06 | | 0.06 |
| Petrale sole | 0.00 | 0.00 | 0.01 | 0.00 | 0.03 | | 0.04 |
| Arrowtooth | 0.48 | 2.85 | 0.67 | 1.85 | 2.85 | | 8.70 |
| Starry flounder | 0.00 | | 0.00 | 0.00 | 0.00 | | 0.00 |
| Other flatfish | 0.01 | 0.01 | 0.10 | 0.16 | 0.97 | | 1.25 |
| **ROCKFISH** (mt) | | | | | | | |
| POP | 0.38 | 0.17 | 0.73 | 2.92 | 23.14 | | 27.34 |
| Shortbelly | 0.00 | | 0.01 | 0.00 | 0.00 | | 0.01 |
| Widow | 0.06 | 1.96 | 72.99 | 72.77 | 88.97 | | 236.75 |
| Canary | 0.03 | 0.92 | 1.62 | 0.35 | 2.01 | | 4.93 |
| Chilipepper | 0.00 | | 0.32 | 0.00 | 5.59 | | 5.91 |
| Splitnose | 0.00 | | 1.75 | 0.43 | [4] | | 2.18 |
| Yellowtail | 10.30 | 72.47 | 40.31 | 29.02 | 184.35 | 1.8 | 338.25 |
| Shortspine thornyhead | 0.00 | 0.00 | 0.07 | 2.66 | 0.21 | | 2.94 |
| Longspine thornyhead | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 |
| Darkblotched | 0.00 | 0.00 | 6.73 | 5.28 | 0.95 | | 12.96 |
| Yelloweye | 0.00 | 0.00 | 0.00 | 0.01 | 0.04 | | 0.05 |
| Black | 0.00 | | 0.00 | 0.00 | 0.94 | | 0.94 |
| All other rockfish | 0.90 | 0.81 | 4.17 | 27.69[5] | 19.81 | | 53.38 |
| **REMAINING GROUNDFISH** | | | | | | | |
| Spiny Dogfish | 68.53 | 21.58 | 22.94 | 63.24 | 51.38 | 0.01 | 227.68 |
| All other groundfish | 0.24 | 0.00 | 1.09 | 0.69 | 0.13 | | 2.15 |
| **PROHIBITED SPECIES** (numbers) | | | | | | | |
| Chinook salmon | 710 | 1,690 | 591 | 733 | 2,462 | | 6,186 |
| Coho salmon | 9 | 98 | 139 | 88 | 141 | | 475 |
| Chum salmon | 0 | 8 | 97 | 73 | 113 | | 291 |
| Pink salmon | 0 | 513 | 16 | 19 | 47 | | 595 |
| Sockeye salmon | 0 | 0 | 0 | 0 | 0 | | 0 |
| Steelhead | 0 | 0 | 0 | 0 | 0 | | 0 |
| Pacific Halibut | 5 | 153 | 51 | 50 | 44 | | 303 |
| Dungeness crab | 0 | | 45 | 1 | 289 | | 335 |
| **NON-GROUNDFISH SPECIES** (mt) | | | | | | | |
| American shad | 8.94 | 6.63 | 3.58 | 1.95 | 14.42 | | 35.52 |
| Pacific herring | 0.01 | | 0.03 | 0.01 | 0.03 | | 0.08 |
| Squid (unidentified) | 0.01 | 0.16 | 7.64 | 58.36 | 166.72 | | 232.89 |
| Jack Mackerel | 0.05 | 0.63 | 0.04 | 0.28 | 7.07 | | 8.07 |
| Pacific Mackerel | 0.00 | | 0.14 | 0.00 | 4.18 | | 4.32 |
| Pacific Sardine | 0.00 | 0.00 | 0.33 | 0.08 | 1.93 | | 2.34 |
| All other non-groundfish | 0.19 | | 3.44 | 47.17[6] | 3.40 | | 54.20 |

[1] Weights include estimates of catch that was dumped at-sea
[2] 6,000 mt of shore-based whiting allocation was reapportioned to the catcher/processor sector on November 28, 2007 (72 FR 72630, December 21, 2007), resulting in revised allocations of the shore-based and catcher/processor allocations.
[3] 2,000 mt was deducted from the OY for research and bycatch in non-groundfish fisheries.
[4] Species specific weights were not available for splitnose rockfish from all states, therefore it has been included within all other rockfish .
[5] 27.17 mt of all other rockfish taken by catcher/processors was rougheye rockfish
[6] The dominant species by weight were ragfish, brown cat shark, Pacific sleeper shark, salmon shark, and king-of-the-salmon

## Chinook Salmon Catch in the Commercial and Tribal Pacific Whiting Fisheries, 1998-2007

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|
| **MOTHERSHIP** | | | | | | | | | | |
| Chinook (number) | 966 | 1,687 | 4,421 | 1,721 | 709 | 2,078 | 417 | 2,206 | 1,080 | 591 |
| Whiting (mt) | 50,087 | 47,580 | 46,840 | 35,823 | 26,593 | 26,021 | 24,102 | 48,571 | 55,355 | 47,809 |
| Rate: (# Chinook/mt whiting) | 0.0193 | 0.0355 | 0.0944 | 0.048 | 0.2269 | 0.0798 | 0.0173 | 0.045 | 0.0195 | 0.0124 |
| | | | | | | | | | | |
| **CATCHER/PROCESSOR** | | | | | | | | | | |
| Chinook (number) | 511 | 2,704 | 1,839 | 847 | 970 | 570 | 388 | 1,754 | 112 | 733 |
| Whiting (mt) | 70,365 | 67,679 | 67,815 | 58,628 | 36,341 | 41,214 | 73,175 | 78,890 | 78,864 | 73,263 |
| Rate: (# Chinook/mt whiting) | 0.0073 | 0.04 | 0.0271 | 0.0144 | 0.0265 | 0.0138 | 0.0053 | 0.0222 | 0.0014 | 0.0100 |
| | | | | | | | | | | |
| **TRIBAL-AT-SEA** | | | | | | | | | | |
| Chinook (number) | 2,085 | 4,497 | 1,947 | 959 | 1,018 | 3,430 | 3,690 | 3,862 | 652 | 710 |
| Whiting (mt) | 24,509 | 25,844 | 6,251 | 6,080 | 21,793 | 19,375 | 23,313 | 23,419 | 5,545 | 5,167 |
| Rate: (# Chinook/mt whiting) | 0.0851 | 0.174 | 0.3115 | 0.1577 | 0.0467 | 0.177 | 0.1583 | 0.1649 | 0.1176 | 0.1374 |
| | | | | | | | | | | |
| **TRIBAL- SHORESIDE** | | | | | | | | | | |
| Chinook (number) | na | na | na | na | na | 9 | 50 | 76 | 1,271 | 1,690 |
| Whiting (mt) | na | na | na | na | na | 4,079 | 5,335 | 10,938 | 29,896 | 25,010 |
| Rate: (# Chinook/mt whiting) | na | na | na | na | na | 0.0021 | 0.0094 | 0.0069 | 0.0425 | 0.0676 |
| | | | | | | | | | | |
| **SHORE-BASED**[1] | | | | | | | | | | |
| Chinook (number) | 1,699 | 1,696 | 3,306 | 2,627 | 1,062 | 425 | 4,206 | 4,018 | 839 | 2,462 |
| Whiting (mt) | 87,627 | 83,388 | 85,563 | 73,326 | 45,276 | 51,061 | 89,670 | 97,378 | 96,619 | 72,751 |
| Rate: (# Chinook/mt whiting) | 0.0194 | 0.0203 | 0.0386 | 0.0358 | 0.0235 | 0.0083 | 0.0469 | 0.0413 | 0.0087 | 0.0339 |
| | | | | | | | | | | |
| **ALL FISHERIES TOTAL** | | | | | | | | | | |
| Chinook (number) | 5,261 | 10,584 | 11,513 | 6,154 | 3,759 | 6,512 | 8,751 | 11,916 | 3,954 | 6,186 |
| Whiting (mt) | 232,588 | 224,453 | 206,471 | 173,857 | 130,003 | 141,885 | 215,176 | 259,196 | 266,279 | 224,000 |
| Rate: (# Chinook/mt whiting) | 0.0226 | 0.0472 | 0.0558 | 0.0354 | 0.0289 | 0.0459 | 0.0409 | 0.0460 | 0.0148 | 0.0276 |

1 2002 shore-based landings do not include 432 mt of whiting or salmon taken by non-EFP vessels
2003 shore-based landings do not include 195 mt of whiting or salmon taken by non-EFP vessels
2004 shore-based landings do not include 1,644 mt of whiting or salmon taken by non-EFP vessels
2005 shore-based landings do not include 310 mt of whiting or salmon taken by non-EFP vessels
2006 shore-based landings do not include 678 mt of whiting or salmon taken by non-EFP vessels
2007 shore-based landings do not include 529 mt of whiting or salmon taken by non-EFP vessels

**Northwest Fisheries Science Center Response to
Technical Issues Regarding the 2008 Pacific Hake Assessment raised in the
"Minority Report to the 2008 Pacific Hake STAR Panel Report" (Sinclair, et al.)**

**March 7, 2008**

- **Characterization of stock status and trend**

In both the first and final paragraphs the Minority Report attempts to create the impression that the hake stock is in dire straits, e.g.: "the population biomass is declining and at its historic minimum, the exploitation rate is increasing and at its historic maximum, and there is no indication of good recruitment." However, both the SS2 and TINSS models indicate that spawning stock biomass is near the target (40% of the unfished level), and the SS2 point estimate for the size of 2005 year class is the second largest since 1984. In the VPA model, not only is the 2005 year class the second largest since 1984, but the 2003 year class is the third largest over that span. The population biomass is not at its historic minimum, according to either the VPA or SS2 formulations, for which biomass was lower in 1999 than in 2008. Further, the SS2 model estimates that the spawning biomass will increase over the next few years due to the recruitment of the 2005 year class.

- **Comments on data used in the assessment models**

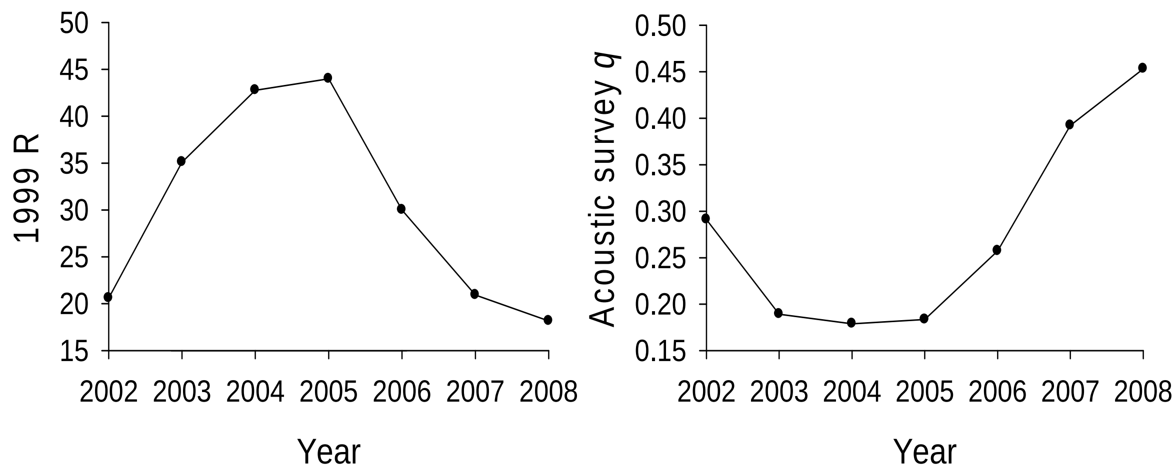
Beginning in the second paragraph, and continuing through 'Point 1.' on the following page, the authors state that all three models used the same input data, with the exception of the ageing-error matrix used in SS2. In fact, there were significant additional differences in the use of data, including 1) the combination of length and age data outside of the VPA and TINSS models versus the inclusion of separate data series in SS2, 2) the use of year-specific weights assigned to sampled data in SS2 versus uniform weighting in the other models, 3) the combination of fishery data for the U.S. and Canadian fleets in both the TINSS and VPA models, 4) the use of an incomplete weight-at-age matrix as an input to the VPA and TINSS models, as opposed to the estimation of age- and year-specific growth in the SS2 model, and 5) differences in the error structure assumed for the survey time series between the SS2 and VPA/TINSS models, which dramatically alters the relative weight placed on early values in the time series.

- **Response to technical issues raised in the Minority Report regarding the SS2 model:**

- "*The panel failed to recognize the clear evidence that the SS2 model did not reach global convergence (Figure 25 STAR report)*" Figure 25 of the STAR report shows that when the SS2 model was jittered from the final base model, smaller negative log likelihood values were not found. This is a common diagnostic to conclude global convergence. The fact that the negative log likelihood changes very little over a range of M-offset values implies a shallow likelihood surface, and that the data in the model are relatively uninformative regarding this parameter. The range of final M, which results in no more than a 1 point change in negative log likelihood (0.58-0.60), is not significant in terms of

- depletion or other parameters. In any case, the final MCMC model run integrates across the range of uncertainty in this parameter.

– "*The Panel did not question the clear technical flaw of the SS2 model indicated by a severely biased retrospective pattern*." While not desirable, the SS2 model does show a retrospective pattern which indicates that some model parameters, such as survey – catchability q, change as new data are added. This is illustrated in the figure below which shows estimates of acoustic survey catchability q and the size of the 1999 year class as functions of the terminal year of data included in the current model. In the case of q, this is not surprising, since the acoustic survey is assumed to be much more precise since 1992 and this provides only **4** reliable data points prior to 2002. The change in q obviously has an effect in the scaling of the population as shown by changes in the estimated strength of the 1999 year class. We believe that the retrospective trend in the estimated value of q reflects a survey time series that has only recently become adequate (in terms of duration, precision, and observed biomass variation) to allow management guidance to be based on models where q is estimated. This is, in fact, a principal reason why prior hake models adopted for management have relied upon fixing the value for q.




• **Final model estimates and range of Spawning Biomass and ABC**

Figure 1 of the Minority Report contains quantities that are not comparable and that differ from those required by the Council TOR. Further, the STAR panel report and draft versions of all three documents report quantities for a range of preliminary, intermediate and final model configurations. To facilitate a clear comparison of the final results reported to the Council for each model, Figure 1, below, illustrates values and confidence intervals for spawning biomass, depletion and 2008 OY amounts.

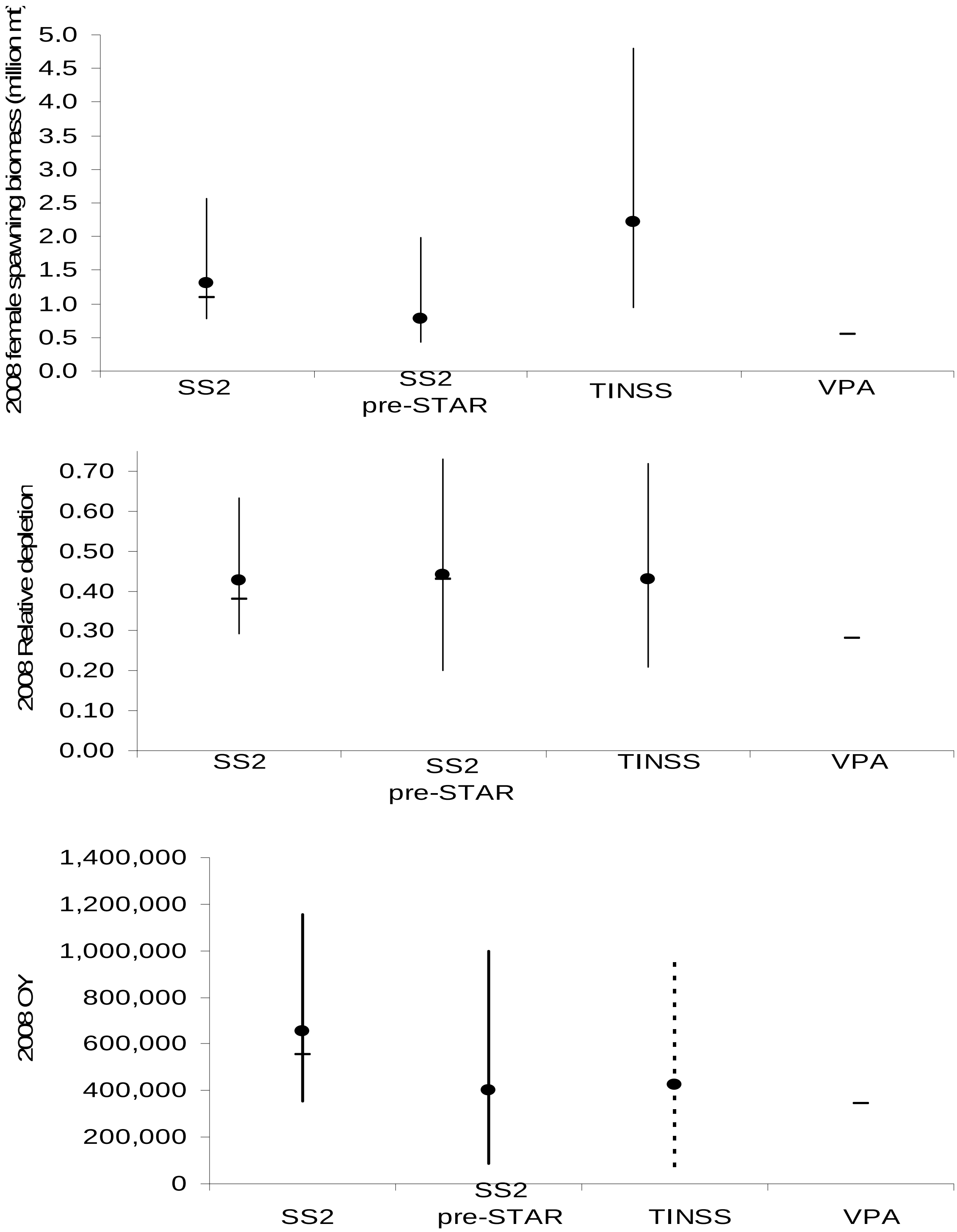



Figure 1. Comparison of 2008 female spawning biomass, relative depletion and OY (40:10 harvest control rule applied to F40% proxy harvest rate) maximum likelihood estimates (horizontal marks) posterior median values (circles) and 90% credibility intervals (vertical lines) for the three models. Note that the dashed credibility interval for TINSS is a 95% interval and uncertainty is not reported for VPA quantities.

Agenda Item F.3.a
Supplemental NWFSC Response PowerPoint Presentation
March 2008

# NWFSC Response to Technical Issues Raised in the Hake "Minority Report"

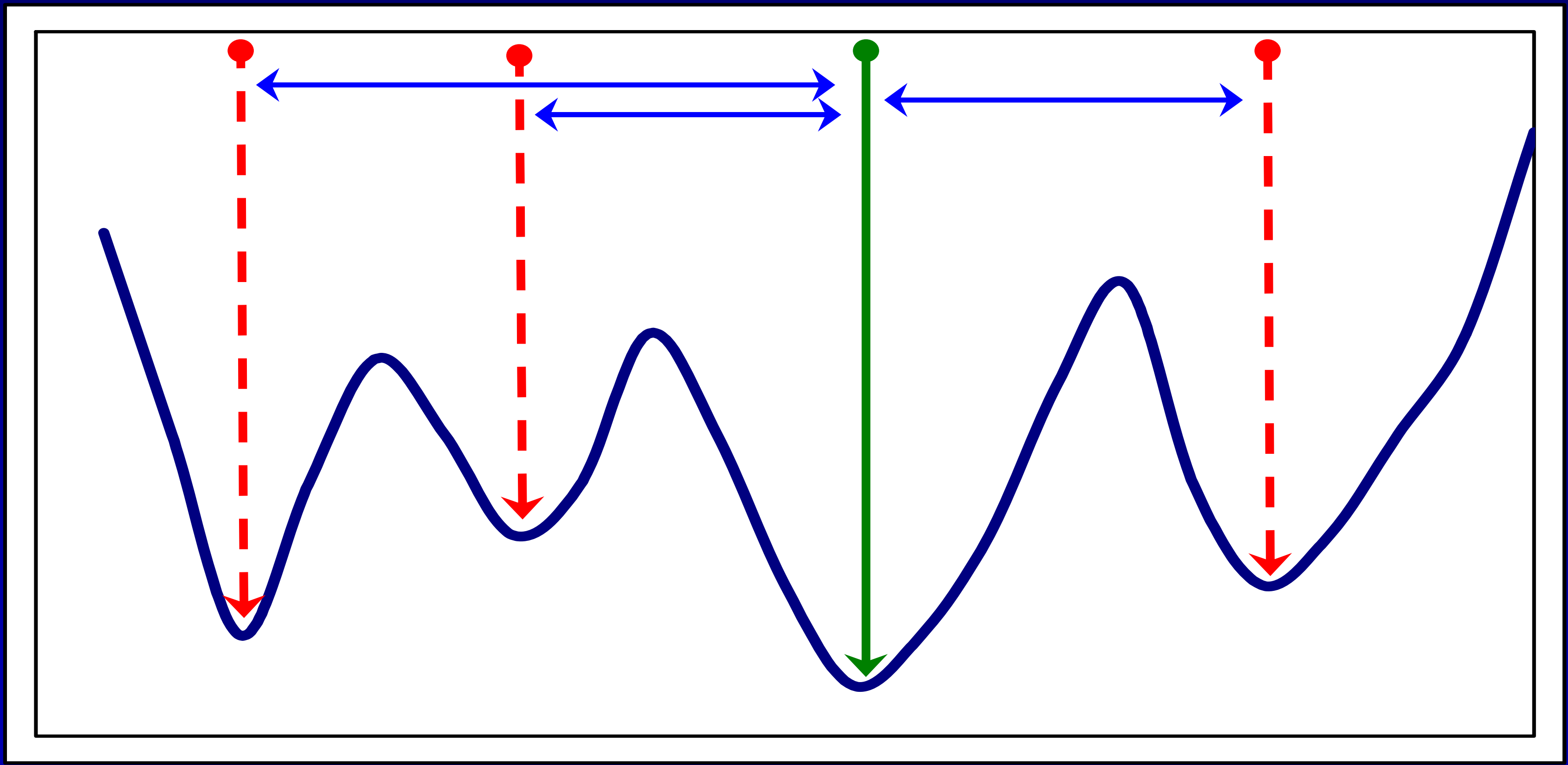
# NWFSC Response to Technical Issues Raised in the Hake "Minority Report"

- Stock status and trend
  - Stock is near biomass target
  - There are indications of good recent recruitment
  - The 2005 year class is expected to increase spawning biomass in the near future
- The same data were available to all 3 models; but they were not used in the same manner
  - There are at least six important ways in which data were treated differently between the U.S. and Canadian models

# NWFSC Response to Technical Issues Raised in the Hake “Minority Report”

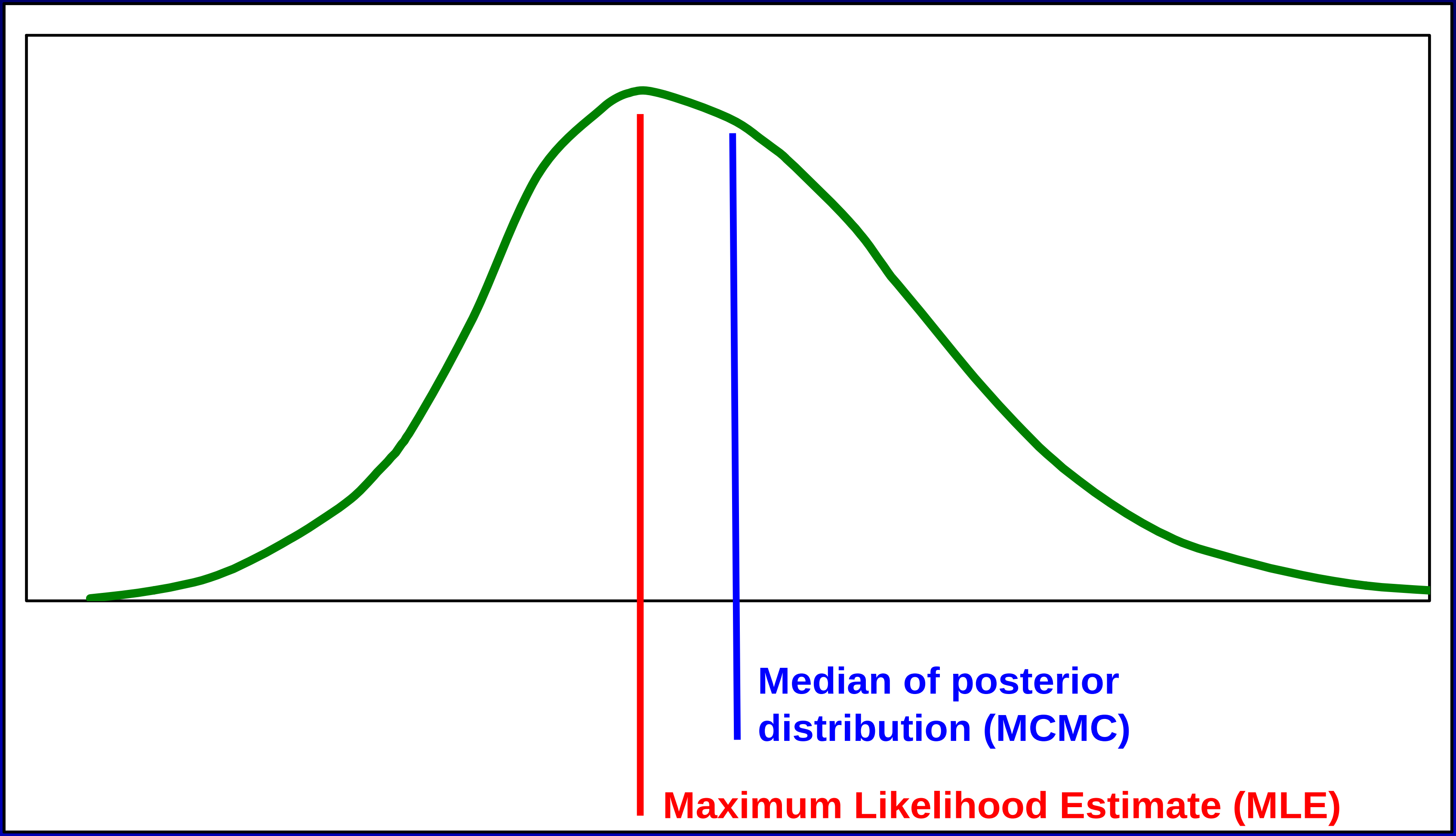
- SS2 model did not reach global convergence
  - The model was tested, using standard methods, with no indication that convergence had not been achieved
  - The MCMC results include the full range of uncertainty incorporated in the model
- SS2 model was subject to a severely biased retrospective pattern
  - The retrospective pattern in estimated ‘q’ reflects a survey time series that has only recently become adequate for models to estimate ‘q’ (q has been fixed, previously)

# Searching for the most likely solution



Model starting values are jittered to ensure that a global optimum is reached

# Difference between MLE and MCMC results




**MLE = Most Likely Single Value**

**Median of posterior = 50% of values above and below**

# GROUNDFISH MANAGEMENT TEAM REPORT ON PACIFIC WHITING HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES FOR 2008

The Groundfish Management Team (GMT) reviewed the Pacific Hake (Whiting) stock assessments and Stock Assessment Review (STAR) Panel report. The joint Canada-U.S. Pacific Hake (Whiting) Stock Assessment Review (STAR) Panel reviewed three stock assessment documents: a SS2 model by Helser *et al.*, an ADAPT/VPA model by Sinclair and Grandin, and Martell's TINSS model. GMT analyses focuses on the STAR Panel and Science and Statistical Committee (SSC) preferred model (SS2); the alternative models (TINSS and VPA) were not preferred by either group.

Unlike the last two whiting STAR panels, where two equally plausible models were put forth based on uncertainty surrounding acoustic survey catchability (*q*), this panel recommended a single base model taken from a particular SS2 model scenario. This approach estimates a broad range of uncertainty in q and propagates that uncertainty into estimates of productivity and relative depletion level of the stock. The base model also estimated the acoustic survey selectivity parameters, the acoustic survey catchability and the natural mortality rate for ages 14 and 15+ and incorporates uncertainty in these parameters into estimates of productivity and depletion.

## Whiting Stock Depletion and Risk Assessment

The GMT's analysis focuses on the SSC-preferred model for the 2008 whiting assessment (Helser *et al*., 2008). The base model suggests the stock is at 42.6% of unfished biomass in 2008 (Agenda Item F.3.a Attachment 1, Table f), with a reported range of 29.3% to 63.2%.

The STAR panel reported that recent catches in the U.S. and Canadian fisheries continue to be dominated by the 1999 year-class. Data from the fishery and acoustic survey suggest a pulse in the 2005 year-class; however, the assessment warns that the size of this cohort is very uncertain as it is based on only one year of data (2007). Fishing mortality rates are increasing and higher than in most recent years, and spawning stock biomass has been in decline since 2003. These factors suggest to the GMT that a precautionary approach to setting the OY for 2008 may be warranted.

In an attempt to narrow the range of coastwide catches presented in the executive summary, the GMT chose the coastwide catches in Table 1. These five coastwide OY values bracket the 2007 status quo (coastwide: 328,358 mt, US: 242,591 mt) with lower and higher coastwide OYs (250,000 mt and 546, 297 mt).

Table 1. Coastwide and US OY values with the associated rationale for analyses.

| Coastwide Catch (MT) | US OY (MT) | Rationale |
|---|---|---|
| 546,297 | 403,604 | Highest harvest allowed within the SPEX analysis |
| 400,000 | 295,520 | Intermediate value |
| 328,358 (SQ) | 242,591 | 2007 Status quo OY |
| 300,000 | 221,640 | Intermediate value |
| 259,775 | 191,922 | Constrained by current widow bycatch limit in the scorecard for the non-tribal whiting fishery (275 mt) |
| 250,000 | 184,700 | Lowest value in Table F of Stock Assessment Executive Summary |

For each of the six coastwide catch values, the GMT compiled forecasts of spawning depletion ranging from pessimistic (5th percentile) to optimistic (75th percentile) (Table 2). Estimates based on catches not presented in Table f of the assessment's executive summary were interpolated.

Table 2. Estimated Percent of Unfished Biomass Based on Catch Level, Year, and Degree of Assessment Uncertainty (the posterior intervals)

| | | Pessimistic ←→ Optimistic | | | |
|---|---|---|---|---|---|
| | | Percentiles of Spawning Depletion | | | |
| Year | Coastwide Catch | 5th | 25th | 50th | 75th |
| 2008 | 546,297 | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 546,297 | 0.281 | 0.359 | 0.448 | 0.543 |
| 2010 | 546,297 | 0.253 | 0.362 | 0.482 | 0.638 |
| 2011 | | 0.237 | 0.377 | 0.525 | 0.744 |
| 2008 | 400,000 | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 400,000 | 0.280 | 0.370 | 0.471 | 0.573 |
| 2010 | 400,000 | 0.251 | 0.379 | 0.518 | 0.680 |
| 2011 | | 0.235 | 0.401 | 0.569 | 0.812 |
| 2008 | 328,358 (SQ) | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 328,358 | 0.292 | 0.381 | 0.481 | 0.582 |
| 2010 | 328,358 | 0.274 | 0.401 | 0.536 | 0.701 |
| 2011 | | 0.267 | 0.430 | 0.598 | 0.842 |
| 2008 | 300,000 | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 300,000 | 0.297 | 0.385 | 0.485 | 0.586 |
| 2010 | 300,000 | 0.283 | 0.410 | 0.543 | 0.710 |
| 2011 | | 0.280 | 0.441 | 0.609 | 0.854 |
| 2008 | 259,775 | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 259,775 | 0.340 | 0.434 | 0.543 | 0.692 |
| 2010 | 259,775 | 0.361 | 0.495 | 0.645 | 0.860 |
| 2011 | | 0.386 | 0.563 | 0.745 | 1.001 |

| | | | | | |
|---|---|---|---|---|---|
| 2008 | 250,000 | 0.293 | 0.359 | 0.426 | 0.499 |
| 2009 | 250,000 | 0.351 | 0.446 | 0.557 | 0.718 |
| 2010 | 250,000 | 0.380 | 0.516 | 0.670 | 0.897 |
| 2011 | | 0.412 | 0.593 | 0.778 | 1.037 |

Helser *et al*. provide risk profiles associated with different coastwide catch levels (Figure 58 of Helser et al.). The GMT used these risk profiles to create Figure 1 which shows the relationship between coastwide catch and the probability of: (1) the fishing mortality rate in 2009 being higher than $F_{40\%}$; (2) 2009 spawning biomass being less than 2008 spawning biomass; (3) spawning biomass being less than 40% of $B_0$; and (4) spawning biomass being less than 25% of $B_0$. In Table 3, the probabilities associated with these events are given for alternative catch levels.

Table 3. Risk profiles based on alternative coastwide catch levels (logistic curves refit from raw data provided by T. Helser, pers. comm.). Values are given in percent probability.

| | Coastwide Catch (mt) | | | | | |
|---|---|---|---|---|---|---|
| Event | 250,000 | 259,775 | 300,000 | 328,358 | 400,00 | 546,297 |
| Probability of 2009 SPR < $SPR_{40\%}$ | 4.2 | 4.5 | 6.1 | 7.5 | 12.4 | 30.7 |
| Probability of 2009 spawning biomass < 2008 spawning biomass (SPB) | 15.5 | 16.2 | 19.4 | 21.9 | 29.0 | 45.6 |
| Probability that 2009 spawning biomass < 40% B0 | 27.0 | 27.2 | 28.4 | 29.3 | 31.7 | 37.5 |
| Probability that 2009 spawning biomass < 25% B0 | 1.4 | 1.4 | 1.7 | 1.9 | 2.5 | 4.3 |

The GMT notes that management of the whiting fishery is in transition from the Groundfish Fishery Management Plan (FMP) to the Pacific Whiting Treaty legislation. Under the FMP, the minimum stock size rule (overfished threshold) is 25% of unfished biomass, or $B_{25\%}$. The GMT notes that since the fishery is in transition, the legal implications of $B_{25\%}$ are unclear. The 2006 Groundfish Harvest Policy Evaluation Workshop Report raised questions regarding the effectiveness of the FMP's minimum stock size rule for short-lived species with highly variable recruitment such as whiting. In short, the workshop report concluded that the whiting stock would be expected to drop below the overfished threshold even if fishing mortality is kept under the current MSY-proxy harvest rate ($F_{40\%}$).[1] The GMT notes that the STAR panel recommended

[1] The workshop report concluded that "[a]pplication of the Council's harvest control rule was predicted to lead to frequent cases in which the stock drops below the overfished threshold of B25% even if F40% is the

conducting a Management Strategy Evaluation to identify robust combinations of data collection, applied stock assessment, and harvest control rules.

**Estimated Bycatch of Overfished Species**

Canary, darkblotched, POP, and yelloweye rockfish bycatch estimates for the 2008 whiting season were developed using a weighted average approach, similar to that used from 2004-2007. For the at-sea sectors, a linear interpolation was used to estimate the widow rockfish bycatch impacts because the widow rockfish bycatch rate shows an increasing trend. Linear interpolation is more appropriate than a weighted average approach because future increases in the bycatch rate should be expected given the increasing widow biomass. This methodology was first implemented for the at-sea sectors in 2007 and was used again in 2008. The GMT also used the linear interpolation methodology for estimating bycatch impacts in the shoreside sector for the first time in 2008 because the increasing widow biomass was apparent in the 2007 data. Bycatch rates from 2003 through 2007 are found in Figures 2-4.

Projecting 2008 rockfish bycatch rates proved somewhat problematic given the difficulty in comparing the 2007 fishery to prior years. In 2007, the GMT used annual bycatch rate data from 2003 – 2006 in projecting bycatch for the year. In 2008, the GMT discussed the problem of comparing the 2007 fishery to prior years because of the premature fishery closure and the bycatch impact implications of the stop-and-start season. To overcome the difficulties in comparing 2007 to prior years, the team compared those days prior to July 26 (the date of the first 2007 closure) from 2004 through 2007. This comparison was used to investigate bycatch rate patterns from year to year and to project rates for 2008. From this information, slightly higher bycatch rates are estimated than if the annual aggregate bycatch rate in 2007 is used.

Bycatch Limit Management

Since 2004, the Council has included bycatch limits as a management tool for use in the whiting fishery. The Council may wish to consider establishing bycatch limits for the 2008 fishery. A summary of bycatch limits from previous years is presented in Table 4. Guidance from NOAA General Counsel indicates that if bycatch limit management is chosen for 2008, the limits should be set at levels that can reasonably accommodate the OY. The Council may make an adjustment in June (after the California early season and a few weeks of the at-sea fishery) or September based on inseason information, if needed. However, the intent, under NMFS guidance, should be to sustain the fishery with the first limit that is set.

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appropriate harvest rate on average (i.e., F40% equals the true FMSY)." (Agenda Item E.1, Situation Summary, March 2007 Briefing Book).

Table 4. Previous range of bycatch limits set by the Council for the nontribal whiting fishery.

| **Species** | **2004** | **2005** | **2006** | **2007** | **2008**[a] |
|---|---|---|---|---|---|
| Canary | 6.2 – 7.3 | 4.7 | 4.0 -4.7 | 4.7 | 4.7 |
| Darkblotched | 9.5 | n/a | 25 | 25 | 25 |
| Widow | n/a | 200 - 212 | 200 - 220 | 200 - 275 | 275[b] |

[a]Year 2008 values represent the numbers currently outlined in the Federal Regulations, which can be modified by the Council.

[b]In September 2007, the Council increased the widow bycatch limit from 220 to 275 mt for the remainder of 2007. A mistake was made when publishing the regulatory text and the 275 mt limit did not sunset at the end of 2007, thus 275 mt is the limit currently specified in regulation.

The GMT analyzed bycatch limit management techniques that could reasonably accommodate the 2008 non-tribal whiting fishery. Historically, the Council has adopted the ABC/OY of Pacific whiting while taking into account bycatch projections, in order to promote harvesting of the whiting OY relative to overfished species constraints. Appendix A contains coastwide and US catches presented in Table 2 and their associated bycatch impacts assuming status quo fleet distributions. This performance standard approach has worked well, however in recent years it appears that the combined suite of bycatch limits may be overly limiting flexibility in whiting fishing strategies. The GMT recommends that the Council consider changes to the bycatch limits that encourage changes in the distribution of fishing effort, which will potentially result in redistribution of bycatch impacts. Particularly, the GMT believes that the Council could consider adjusting the darkblotched rockfish limit in order to encourage fishing distributions that is different from last years, and therefore possibly avoiding the events of 2007. This change is expected to result in more fishing effort occurring in deeper depths, potentially avoiding canary and widow rockfish to a greater degree than last year.

*Interactions Among Darkblotched, Widow, and Canary Rockfish*

Evidence indicates that the darkblotched rockfish limit is restricting fishing flexibility for both the CP and Mothership fleets, resulting in increased widow and canary rockfish impacts. In recent years, higher darkblotched rockfish encounter rates have resulted in pressure on the at-sea sectors to avoid darkblotched, coming from within and between the two at-sea sectors as well as from the shoreside fleet. The response of the at-sea sectors has been to move away from areas of high darkblotched catch to shallower areas where widow and canary are more abundant.

Data from the 2007 at-sea sector demonstrates the interactions between darkblotched and widow rockfish under a restrictive darkblotched limit (Table 5). From May 15 to May 28 the mothership fleet caught 4.6 mt of darkblotched and 23 mt of widow. During this same time period, the CP fleet caught 5.1 mt of darkblotched and 41.5 mt of widow. In total, after only 13 days of the season, approximately 9.7 mt of darkblotched (76% of limit) and 64.5 mt of widow (29% of bycatch limit) had been caught. Discussions were held between members of the whiting industry to discuss fishing strategies to reduce darkblotched impacts. In response, it appears the at-sea fleet moved away from areas of high darkblotched catch to other areas in an effort to prevent a whiting season closure as a result of attainment of the darkblotched limit prior to the start of the shoreside season. Following this shift in effort, bycatch impacts were noticeably redistributed such that more widow and less darkblotched was caught from May 29 to July 26. On July 26, the fishery was closed when the widow bycatch limit of 220 mt was reached.

Table 5. Darkblotched and Widow Rockfish Bycatch Distributions By Season Dates

| Sector | Date | Darkblotched | Widow |
|---|---|---|---|
| Mothership | May 15 – May 28<br>May 29 – July 26 | 4.6 mt (88% of total)<br>0.6 mt (12% of total) | 23 mt (32% of total)<br>48 mt (68% of total) |
| Catcher Processor | May 15 – May 28<br><br>May 29 – July 26 | 5.1 mt (76% of total)<br><br>1.6 mt (24% of total) | 41.5 mt (57% of total)<br>31.2 mt (42% of total) |

The team continues to recommend that if the Council chooses bycatch limit management, a darkblotched limit should be placed on the whiting fishery in order to provide added certainty to non-whiting sectors. However, in light of recent data the limit should be structured in a manner that allows flexibility in whiting fishing strategies. The 2008 darkblotched OY increased from 270 to 330 mt and current scorecard estimates show a balance of 91.7 mt. The Council could consider using some of this balance to increase fishing strategy flexibility to allow for deeper effort distributions resulting in fewer canary and widow rockfish impacts. The Council will need to consider this recommendation while also considering opportunities the increased darkblotched OY may provide to the non-whiting trawl fishery. The GMT is currently exploring inseason action that would increase opportunities seaward of the RCA north of 40º 10' to allow for additional slope opportunities while reducing effort on the shelf and reducing canary impacts.

The GMT analyzed catch rates of whiting and the three bycatch limit species in the 2007 fishery in an attempt to provide an order of magnitude estimate for darkblotched, widow, and canary bycatch limits under the bycatch limit strategy noted above. According to available information, a darkblotched catch of 13 mt within a bycatch limit of 25 mt (approximately 52% of the bycatch limit) appears to influence fishing behavior in the at-sea sectors. Based on catch information from early 2007, over 81% of the darkblotched, 45% of widow, and 34% of the canary rockfish bycatch were caught by the at-sea sectors prior to the 2007 industry meeting over darkblotched bycatch. At the same time, approximately half of the whiting allocation had been taken by the at-sea sectors. This information can be used to interpolate an order of magnitude total catch amount for all sectors in the 2007 fishery if behavior had not changed because of darkblotched concerns. From those interpolated total catch amounts, an order of magnitude for proposed bycatch limits in 2008 can be established. It should be noted that this approach is not being applied to the shoreside whiting fishery because the team does not believe the shoreside sector would choose to fish over the slope if presented the incentive of a higher darkblotched bycatch limit.

The approach described above yields an interpolated overall darkblotched catch level of approximately 19 mt for all sectors combined based on 2007 fishery data and a status quo whiting OY. Maintaining the 52% difference between the interpolated darkblotched catch level and the bycatch limit (which represents the amount under which behavior changes in the fishery) yields a darkblotched bycatch limit of 35 to 40 mt in the whiting fishery (under a status quo whiting OY). The projected widow bycatch amount using the above approach yields 265 to 275 mt, and the projected canary amount yields a projected bycatch of 2 to 2.5 mt. These numbers were estimated based on the 2007 whiting OY. It is logical to assume that these bycatch amounts would increase if the 2008 whiting OY is higher than status quo.

The current balance of canary rockfish in the scorecard is -10.1 mt as a result of higher than anticipated 2006 observer bycatch rates in the non-whiting trawl fishery and the open access nearshore fishery. Additionally, impacts higher than the harvest guideline are predicted for the California recreational fishery under status quo management measures. The team is currently reviewing proposals for the trawl fishery which would reduce the canary impacts from 16.3 mt to 9.1 mt. The GAP has requested that the GMT investigate changes to the open access nearshore fishery which would change impacts from 3.0 to 1.7 mt (the projected impact in 2007). For the California recreational fishery, it may be reasonable to assume that current impacts of 11.5 mt will be reduced to 9.0 which is the California harvest guideline.

For widow rockfish, the current balance in the scorecard is 26.0 mt.

For yelloweye rockfish, the current balance in the scorecard is -5.0 mt as a result of higher than anticipated 2006 observer bycatch rates in the limited entry fixed gear fishery and the open access nearshore fishery. Additionally, impacts higher than the harvest guideline are predicted for the California recreational fishery under status quo management measures. Currently, there is no projected impact of yelloweye rockfish in the whiting fishery, however the GMT notes that if fleet distributions are the same in 2008 as they were in 2007 and the Council chooses the 546,297 coastwide OY, then yelloweye rockfish impacts of 0.1 mt are anticipated and would need to be accounted in the scorecard (Appendix 1).

The GMT notes that inseason analyses are ongoing and balances in the scorecard are subject to change prior to the inseason session on Thursday.

## Other Management Considerations

*Amendment 15*
At this time Amendment 15, the whiting limited entry program, is not in place. Information from the Northwest Region suggests that the earliest Amendment 15 could be in place is in 90 days. Interest in the whiting fishery from new Alaska participants may

be expected given the significantly lower Alaskan pollock total allowable catch and the relatively high exvessel price expected for whiting. Such increased participation could result in an accelerated race for fish.

*Amendment 10*

Amendment 10 will not be in place for the start of the 2008 California early season or the start of the primary whiting season. Discussions with staff at the Northwest Region have indicated that the season will start as a Federal Exempted Fishing Permit (EFP) and then could transition to Amendment 10 when the rulemaking goes into effect. The provisions of Amendment 10 could become effective sometime during the season, a minimum of 90 days from now, but currently the timing of implementation is unknown.

The GMT has concerns with consistency in management if the primary whiting season transitions from an EFP to regulations that are implemented under Amendment 10 in the middle of the season. For example, discussions with the Region staff indicate that the whiting season can be closed upon projected attainment of a bycatch limit under EFP regulations. However, under Amendment 10 a bycatch cap must be reached before the season can be closed. If the fishery is closed upon attainment of the bycatch limit it is reasonable to assume that the fishery will take in excess of that limit because of lags in data reporting. To avoid jeopardizing the OY, the Council may wish to establish a residual between projected catch and the OY. Based on events that occurred in 2007, a residual of 20 mt may need to be established for widow rockfish. However, it is important to note that establishing a residual is only necessary if the Council expects the fishery to be closed as a result of a bycatch limit being reached instead of attainment of the whiting OY. Analysis indicates that if the Council raises the darkblotched limit that the fleet may be able to successfully avoid bycatch limit species while prosecuting the whiting fishery.

The GMT also notes that implementing Amendment 10 in the middle of the whiting season eliminates the possible use of management lines to reduce impacts on overfished stocks. Depth restrictions used to reduce canary and widow bycatch in the shoreside fishery (e.g. 150 fm line) are only available inseason under an EFP. This provision does not appear to be available if Amendment 10 is implemented this year. For the at-sea sectors voluntary compliance with a depth closure is needed whether or not the shoreside fishery operates under Amendment 10 or an EFP.

Because of the above factors, the GMT recommends that the shoreside fishery be operated under the federal EFP for the entire year, effectively delaying the implementation of Amendment 10 until the 2009 fishing season. The GMT is analyzing a range of whiting management measures for inclusion within the 2009/2010 SPEX EIS which will allow for better management of the whiting fishery in 2009.

## Summary

The GMT would like to draw the Council's attention to several considerations when determining harvest specifications and management measures for the 2008 Pacific whiting fishery:

1) The Council should first pick the appropriate ABC for the coastwide stock based on the most recent stock assessment and the risk associated with estimated depletion levels (Table 2). The values in Table 2 reflect a range of estimated depletion (resulting from uncertainty in the assessment model) associated with various constant catch levels.

2) Next the Council should select coastwide and U.S. OYs that reflect their best estimate of the current status of the stock and future biomass projections while taking into account the management measures needed to prosecute the fishery (including bycatch concerns for overfished species). With respect to the latter point, the GMT has identified two potential strategies for bycatch limit management:

   a) The first is to assume fleet distributions and overfished species catch patterns similar to last season (Appendix 1). If the fleet behavior last season is repeated this year, and they are constrained by widow in similar manner, the resultant coastwide and U.S. OYs are projected to be 259,775 mt and 191,922 mt respectively. The Council could set the OY at this level in an attempt to prevent meeting or exceeding the 2008 widow rockfish bycatch limit of 275 mt.

   b) The second is to increase the darkblotched limit to encourage deeper fishing by the CP and Mothership sectors, which reduces impacts on widow and canary. This could also potentially result in increased flexibility in bycatch avoidance strategies for all sectors throughout the season. Under this scenario, the Council could set the OYs based on the current understanding of stock status and then set commensurate bycatch limits that would reasonably accommodate the U.S. OY at the outset of the season.

      Under the status quo whiting OY, a darkblotched bycatch limit of 35 to 40 mt may provide a large enough limit to provide fishing strategy flexibility. The projected widow bycatch amount using the above approach yields 265 to 275 metric tons, and the projected canary amount yields a projected bycatch of 2 to 2.5 metric tons.

Under either bycatch management scenario, the GMT recommends accounting for the ability to close the fishery upon attainment of bycatch limits when those limits are set.

GMT Recommendations:

1. Consider using minimum whiting stock size ($B_{25\%}$) as a precautionary reference point but not the overfished threshold.
2. Adopt a coastwide ABC.
3. Adopt a coastwide and U.S. whiting OY.
4. Consider continued use of non-tribal fleetwide bycatch limits as a management tool.
5. Consider operating the shoreside fishery under the federal EFP for the entire year, effectively delaying the implementation of Amendment 10 until the 2009 fishing season.

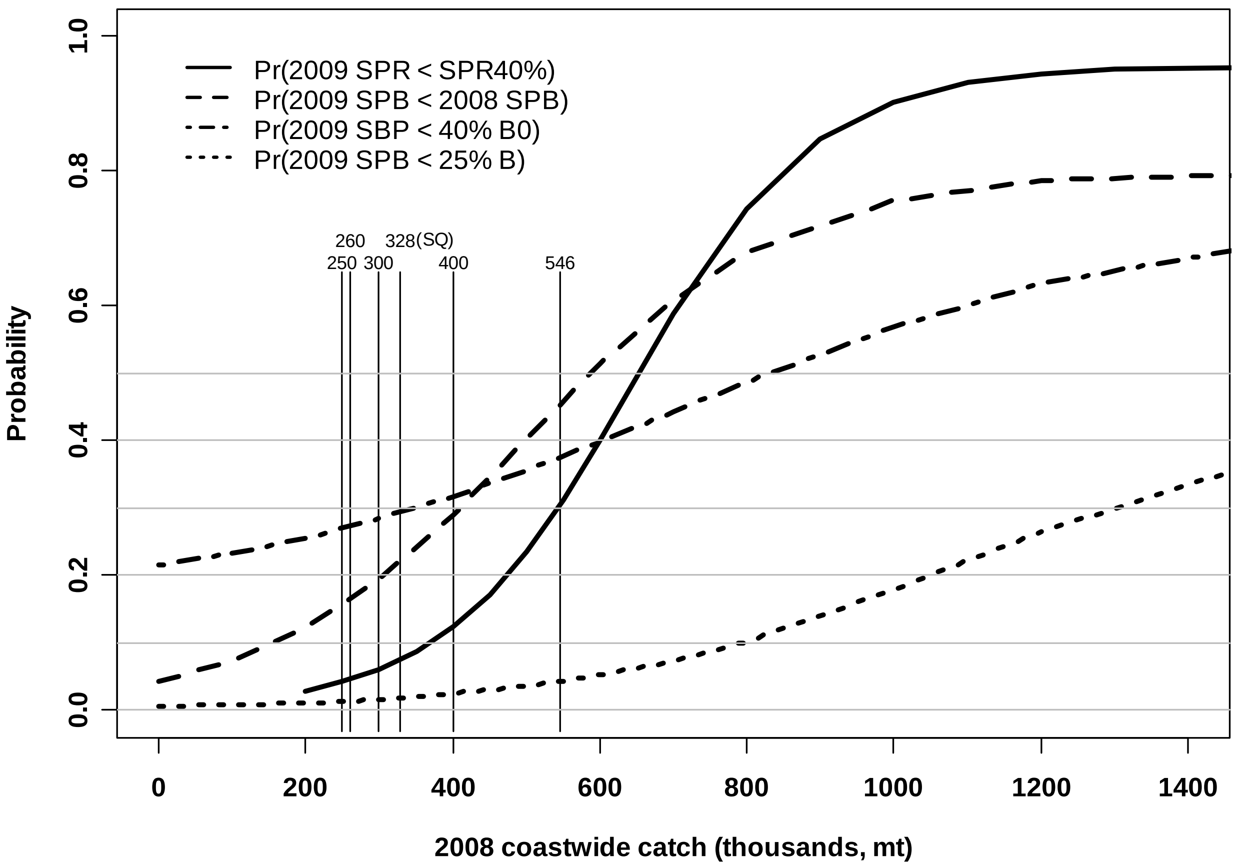


Figure 1. Risk profiles from Fig. 58 (logistic curves refit from raw data provided by T. Helser, pers. comm.) The probabilities show the 2009 SPR rate being less than the $SPR_{40\%}$, 2009 spawning biomass being less than 2008 spawning biomass, and spawning biomass being less than 40% and 25% of $B_0$.

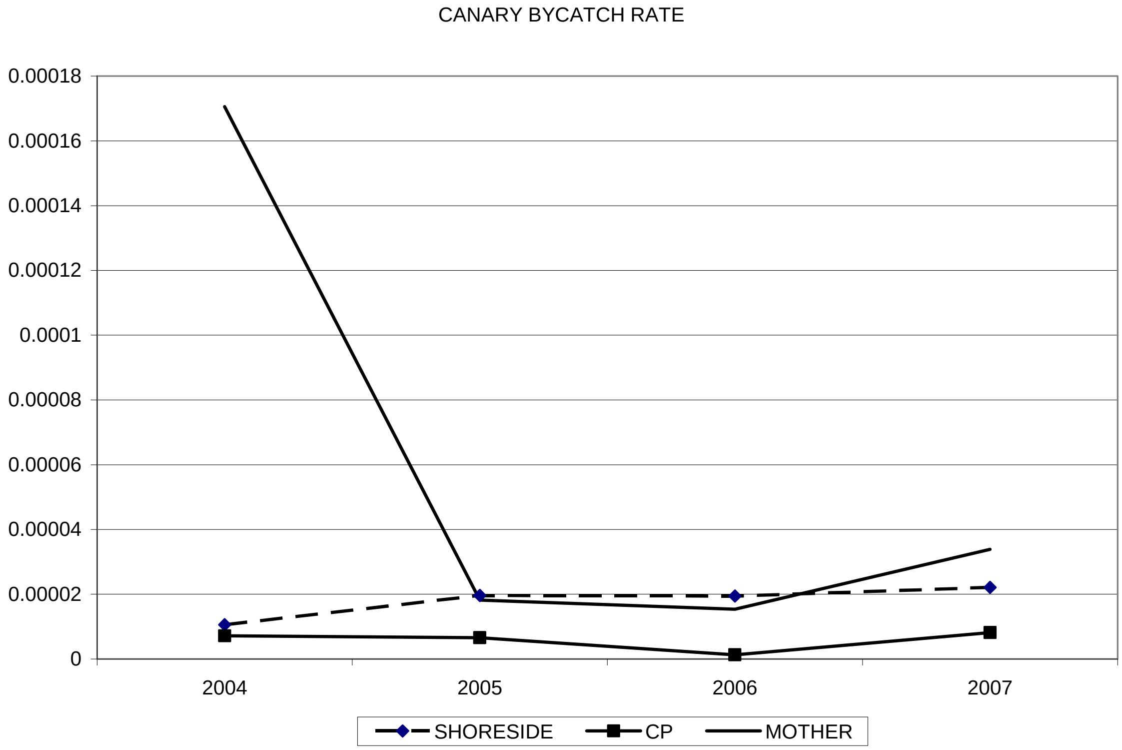


Figure 2. Canary rockfish bycatch rate by year (prior to July 26).

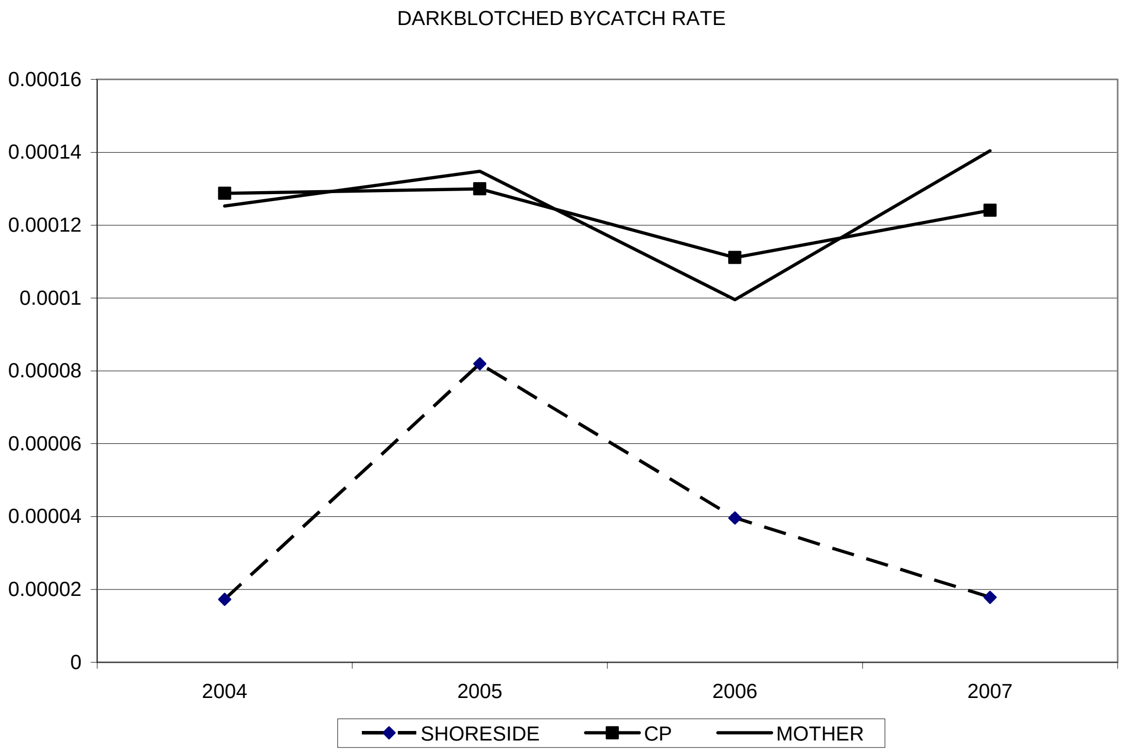


Figure 3. Darkblotched rockfish bycatch rate by year (prior to July 26).

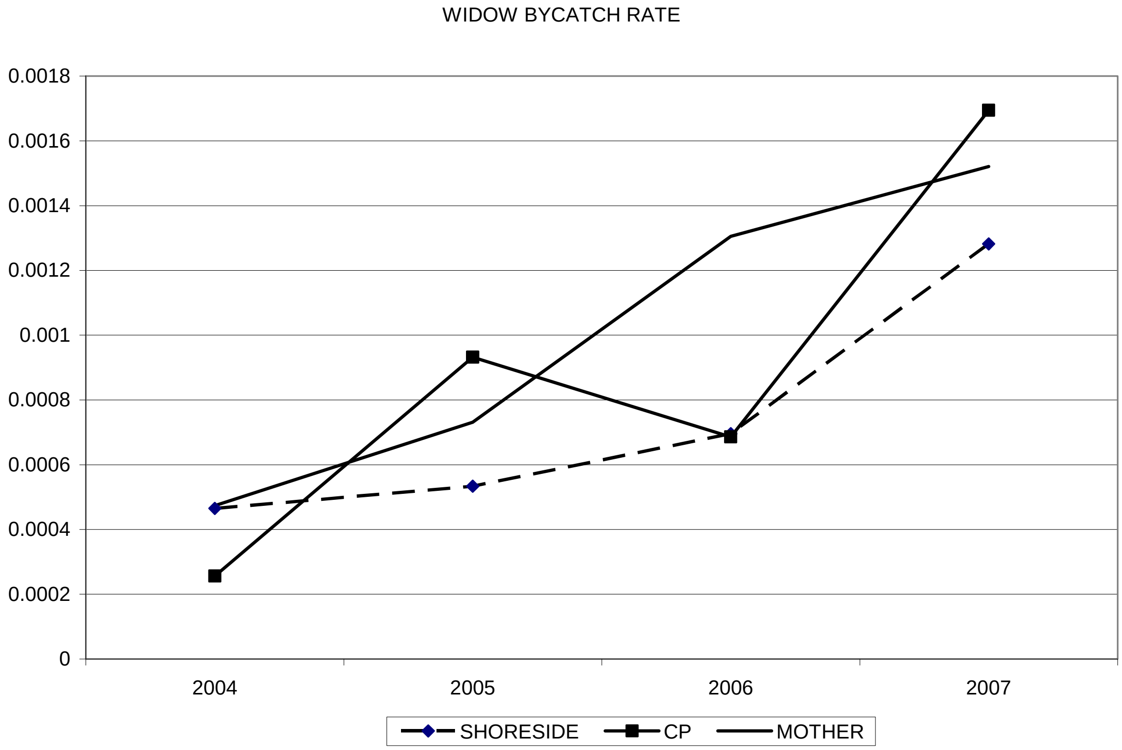


Figure 4. Widow rockfish bycatch rate rockfish bycatch rate by year (prior to July 26).

Appendix 1. Projected overfished species mortality, assuming no changes to darkblotched rockfish bycatch limit.

| Coastwide | US | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **OY (MT)** | **OY (MT)** | | | **Canary** | **Darkblotched** | **POP** | **Widow** | **Yelloweye** |
| **546,297** | **403,604** | Tribal | 35,000 | 1.1 | 0.0 | 0.5 | 2.7 | 0.00 |
| | | Mothership | 87,985 | 3.4 | 9.9 | 1.8 | 168.9 | 0.01 |
| | | CP | 124,645 | 0.4 | 9.7 | 1.8 | 205.4 | 0.01 |
| | | Shoreside | 153,974 | 2.6 | 4.6 | 0.6 | 200.2 | 0.04 |
| | | Non-tribal total | 366,604 | 6.3 | 24.3 | 4.2 | 574.5 | 0.06 |
| | | | **Grand total** | **7.4** | **24.3** | **4.7** | **577.2** | **0.06** |
| **400,000** | **295,520** | Tribal | 35,000 | 1.06 | 0.00 | 0.55 | 2.69 | 0.00 |
| | | Mothership | 62,045 | 2.37 | 6.99 | 1.25 | 119.13 | 0.01 |
| | | CP | 87,897 | 0.29 | 6.87 | 1.29 | 144.85 | 0.01 |
| | | Shoreside | 108,578 | 1.81 | 3.26 | 0.39 | 141.15 | 0.03 |
| | | Non-tribal total | 258,520 | 4.5 | 17.1 | 2.9 | 405.1 | 0.0 |
| | | | **Grand total** | **5.53** | **17.13** | **3.48** | **407.82** | **0.04** |
| **328,104** | **242,403** | Tribal | 32,500 | 1.0 | 0.0 | 0.5 | 2.5 | 0.00 |
| | | Mothership | 49,897 | 1.9 | 5.6 | 1.0 | 96.3 | 0.01 |
| | | CP | 70,687 | 0.2 | 5.5 | 1.0 | 117.0 | 0.01 |
| | | Shoreside | 87,319 | 1.5 | 2.6 | 0.3 | 114.1 | 0.02 |
| | | Non-tribal total | 207,903 | 3.6 | 13.8 | 2.4 | 327.4 | 0.04 |
| | | | **Grand total** | **4.6** | **13.8** | **2.9** | **328.3** | **0.04** |
| **300,000** | **221,640** | Tribal | 30,000 | 0.9 | 0.0 | 0.5 | 2.3 | 0.0 |
| | | Mothership | 45,514 | 1.7 | 5.1 | 0.9 | 87.4 | 0.0 |
| | | CP | 64,478 | 0.2 | 5.0 | 0.9 | 106.3 | 0.0 |
| | | Shoreside | 79,649 | 1.3 | 2.4 | 0.3 | 103.5 | 0.0 |
| | | Non-tribal total | 189,640 | 3.3 | 12.6 | 2.2 | 297.2 | 0.0 |
| | | | **Grand total** | **4.2** | **12.6** | **2.6** | **299.5** | **0.0** |
| **281,238** | **207,778** | Tribal | 30,000 | 0.9 | 0.0 | 0.5 | 2.3 | - |
| | | Mothership | 42,667 | 1.6 | 4.8 | 0.9 | 81.0 | 0.0 |
| | | CP | 60,445 | 0.2 | 4.7 | 0.9 | 98.5 | 0.0 |
| | | Shoreside | 74,667 | 1.2 | 2.2 | 0.3 | 96.0 | 0.0 |
| | | Non-Tribal Total | 177,778 | 3.1 | 11.7 | 2.0 | 275.5 | 0.0 |
| | | | **Grand total** | **4.0** | **11.7** | **2.5** | **277.8** | **0.0** |
| **259,775** | **191,922** | Tribal | 27,500 | 0.83 | 0.00 | 0.43 | 2.11 | 0.00 |
| | | Mothership | 38,981 | 1.49 | 4.39 | 0.79 | 74.84 | 0.01 |
| | | CP | 55,223 | 0.18 | 4.32 | 0.81 | 91.01 | 0.00 |
| | | Shoreside | 68,217 | 1.14 | 2.05 | 0.24 | 88.68 | 0.02 |
| | | Non-tribal total | 162,422 | 2.8 | 10.8 | 1.8 | 254.5 | 0.0 |
| | | | **Grand total** | **3.64** | **10.76** | **2.27** | **256.65** | **0.03** |
| **257,068** | **189,922** | Tribal | 27,500 | 0.8 | 0.0 | 0.4 | 2.1 | - |
| | | Mothership | 38,981 | 1.5 | 4.3 | 0.8 | 73.9 | 0.0 |
| | | CP | 55,223 | 0.2 | 4.3 | 0.8 | 89.9 | 0.0 |
| | | Shoreside | 68,217 | 1.1 | 2.0 | 0.2 | 87.6 | 0.0 |
| | | Non-Tribal Total | 162,422 | 2.8 | 10.6 | 1.8 | 251.4 | 0.0 |
| | | | **Grand total** | **3.6** | **10.6** | **2.3** | **253.5** | 0.0 |
| **250,000** | **184,700** | Tribal | 27,500 | 0.83 | 0.00 | 0.43 | 2.11 | 0.00 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Mothership | 37,248 | 1.42 | 4.20 | 0.75 | 71.52 | 0.01 |
| | | CP | 52,768 | 0.17 | 4.12 | 0.78 | 86.96 | 0.00 |
| | | Shoreside | 65,184 | 1.09 | 1.96 | 0.23 | 84.74 | 0.02 |
| | | Non-tribal total | 155,200 | 2.7 | 10.3 | 1.8 | 243.2 | 0.0 |
| | | | **Grand total** | **3.51** | **10.28** | **2.19** | **245.33** | **0.03** |

PFMC
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# SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON PACIFIC WHITING HARVEST SPECIFICATIONS AND MANAGEMENT MEASURES FOR 2008

The Scientific and Statistical Committee (SSC) discussed three separate stock assessments of Pacific whiting (hake) in U.S. and Canadian waters; one that was based upon the stock synthesis 2 (SS2) modeling platform, a second that utilized a Virtual Population Analysis (VPA), and a third based on a single fleet age-structured population dynamics model (TINSS). Each of the assessments was conducted by different members of the combined U.S.-Canada assessment team but all were based on essentially the same data. There were, however, some fundamental differences in assumptions among the three assessments, specifically regarding selectivity, how the data were aggregated and entered into the models, the weighting of the data, and productivity.

Dr. Thomas Helser presented the SSC with an overview of the SS2-based assessment, and responded to questions during the SSC discussions. Dr. David Sampson summarized the report of the joint Canadian and U.S. Pacific Whiting Stock Assessment and Review (STAR) Panel and discussed the minority report submitted by the Canadian members of the assessment team and the STAR Panel's response to this report. The STAR Panel considered all three assessments. It did not reject any of these as being flawed. However, the Panel did identify a preferred base model based on SS2 because it was considered to provide a more flexible platform for evaluating assumptions and because it made better use of the available data. In particular, unlike TINSS, the SS2 model allowed for either dome-shaped or asymptotic fishery and survey selectivities.

The 2008 SS2-based assessment was similar to the 2007 assessment, except that natural mortality was estimated for older ages, stock-recruitment steepness was estimated although constrained by a prior, ageing error was accounted for, and acoustic survey catchability (Q) and selectivity were estimated. In addition, the pre-recruit survey was removed. The assessment exhibited a marked retrospective pattern in that recruitment and spawning stock biomass changed as the terminal year of the assessment was reduced from 2007 to 2001. The SSC notes that Q has been fixed in previous assessments because of concerns regarding the ability of the data to estimate the value of this parameter.

The SS2-based assessment led to higher acceptable biological catch and optimum yield catch levels than the other two assessments. However, the decision table (which included high, medium and low catch scenarios and constant catch levels of 250,00 mt, 300,000 mt and 400,000 mt) presented in the Executive Summary of the SS2-based assessment encompasses the range of point estimates for coastwide fishery yields that were provided in the other two assessments. The SSC endorses the use of the SS2-based 2008 Pacific whiting assessment and the associated decision table for management purposes and recommends that the results from it form the basis for management advice. Notwithstanding this endorsement, the SSC has concerns about estimating natural mortality and selectivity for the oldest ages as was done with the SS2 assessment. Furthermore, this is the first time that the value of Q has been estimated for whiting, and it is questionable whether the data are informative enough to rely only on the point estimate from the base model for management decisions. The SSC noted the comments in the minority report, in particular the retrospective pattern, but concludes that none of the information provided is sufficient to warrant changing the recommendations of the STAR Panel.

The decision table included in the SS2 assessment is different from those presented for most other groundfish assessments because it reflects uncertainty within one model rather than the implications of different models. For example, the column "25th" in the spawning depletion part of the decision table reflects that there is a 25% probability that the depletion will be equal to the value presented or be lower. The wide range of spawning depletions highlights that the data for whiting are not very informative about absolute population size nor depletion. The SS2 base model indicates that the stock is near the upper bound of the precautionary range (0.25-0.40 $SSB_0$), and has been declining since 2003. The spawning biomass is expected to increase in the near future for a harvest level of about 500,000 mt and lower because a moderate 2005 year class. However, in using these results, the Council should be cognizant of the considerable uncertainty associated with stock size estimates, that the 2005 recruitment has not been sampled adequately to confirm its strength, and that the three assessments presented to the STAR Panel differ in their predictions. Furthermore, the SS2 decision table does not capture the full range of uncertainty from the other models.

The SSC further notes that the population dynamics of whiting may not match the default harvest policy for groundfish. If the fishery were to be conducted under the $F_{40\%}$ harvest policy over an extended period, the biomass would be expected to fluctuate at a level well below $B_{40\%}$. Given that whiting recruitment is very variable, application of the 40-10 harvest policy will lead to frequent excursions into the overfished zone. The SSC recommends that an appropriate harvest policy for whiting be further investigated. The SSC also recommends that the next assessment consider whether natural mortality for the older age classes should be estimated by the model, examine the implications of sexually dimorphic growth, and assess whether the shored-based and at-sea sectors should be modeled as separate fleets.

Finally, the SSC notes that review of this assessment was complicated because three "competing" assessments were presented to the STAR Panel and the STAR Terms of Reference (TOR) does not explicitly address this situation. Since it is likely that multiple models could be brought forward for other future assessments, the SSC recommends that the TOR be revised to provide guidance on dealing with a possible recurrence of this scenario. In addition, it would have been desirable for there to have been a decision table that included the TINSS and VPA assessments as alternative states of nature so that the impacts of model uncertainty could have highlighted. However, the relevant calculations are not available and the STAR Panel did not in any case assign probabilities to each model.

PFMC
03/12/08

Agenda Item F.3.c
Supplemental Public Comment
March 2008

# Pacific Whiting Harvest Specifications and Management Measures


Ben Enticknap, Oceana
Pacific Fishery Management Council Agenda Item F.3
March 2008

OCEANA | Protecting the World's Oceans

# Stock Assessment Concerns

"The Panel failed to follow the assessment terms of reference and produced a base model for catch advice that has serious technical flaws. The ABC forecast from this base model, if implemented, has a high risk of causing serious harm to the hake stock."

- A. Sinclair, S. Martell, C. Grandin, J. Fargo – members of the STAT Team

# Stock Assessment Concerns Cont…

"…the hake population is dominated by a single year-class now 9 years old, the population biomass is declining and at its historic minimum, the exploitation rate is increasing and at its historic maximum, and there is no indication of good recruitment. Prudent management suggests catches should be reduced under these circumstances, not increased." - Ibid.

# 2007 vs. 2008

# Comparison of the SS2 Base Model

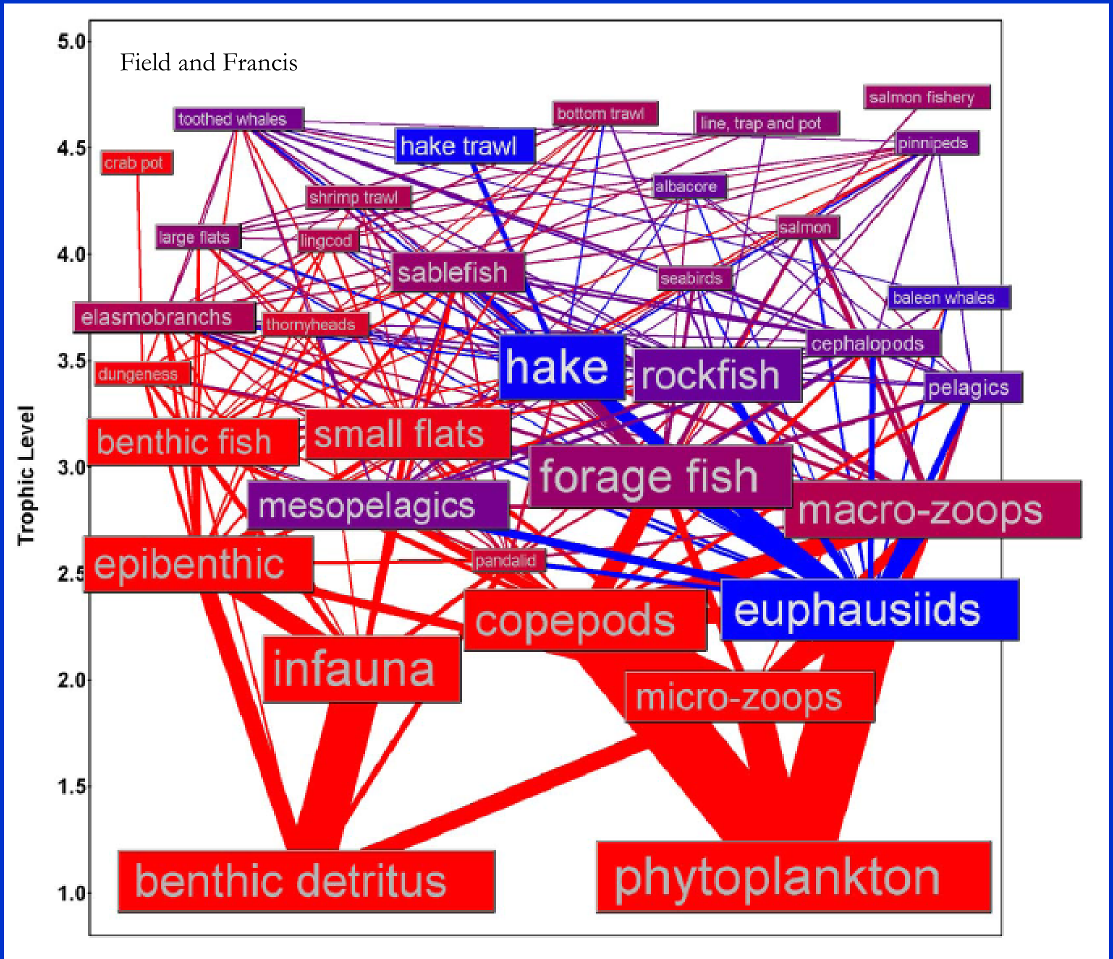
| Year | Spawning Biomass | Unfished Biomass Bzero | Relative Depletion |
|---|---|---|---|
| 2007 - *2007 assessment* | 1.146 million mt (0.79 – 1.502) | 3.57 (3.14 - 4.0) | 32.1% (24.3% - 39.7%) |
| 2007 - *2008 assessment* | 1.067 million mt (0.472 – 1.775) | 2.89 (1.556 – 2.5) | 36.8% (23.7% - 50.1%) |

Hesler et al. February 21, 2008 and Feb. 14, 2007.

"As such, spawning biomass for the most recent years, while generally lower than predicted in the 2007 assessment, is greater relative to the estimate of SBzero and therefore results in a higher depletion estimate."

- Hesler et al. 2008

# Account for Ecosystem Needs




"If the United States is to manage fisheries within an ecosystem context, food-web interactions, life-history strategies, and trophic effects will need to be explicitly accounted for when developing harvesting strategies."

National Research Council Committee on Ecosystem Effects of Fishing (2006).

# Minimize Bycatch

## Chinook Salmon Catch in the Pacific Whiting Fisheries

| Year | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|
| Chinook number | 8,751 | 11,916 | 3,954 | 6,186 |

Photo: At-sea widow rockfish discards

Troll caught chinook.

# Recommendations

- Hard bycatch caps and area closures for overfished/ depleted rockfish and salmon
- Improved monitoring (address EC findings September 2007).
- Management Strategy Evaluation to determine whether the current harvest policy is appropriate for Pacific whiting and ecosystem needs.

# Recommendations

"Given the current status of the stock, declining biomass, poor recruitment, spiking exploitation rates, and the high degree of uncertainty regarding key vital population parameters, it seems prudent to forecast the ABC at a lower exploitation rate than what has been estimated for the past several years."

- A. Sinclair, S. Martell, C. Grandin, J. Fargo – members of the STAT Team

# OY Recommendation

Given high degree of uncertainty in the model, declining trends, and lack of ecosystem considerations, we recommend no increase in the current catch level until a Management Strategy Evaluation is conducted evaluating the best whiting catch strategy and to account for ecosystem needs.

Risk Neutral: Status Quo OY = 328,358 mt coastwide

Risk Averse Policy = 264,000 mt (Martell, S. Feb 19, 2008)

# AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The groundfish federal limited entry program was established in 1994 and did not include all vessels and their catch histories that landed groundfish during the qualification period. Participation in the "open access" (OA) portion of the fishery was left unlimited to ensure that vessels active in state-managed fisheries and/or landing groundfish incidentally in federally-managed fisheries, would continue to have access to that resource. However, conversion of the current open access groundfish fishery to limited entry management has been discussed several times in Council meetings since April 1998 (71 FR 64216) and was established as a Council priority with the adoption of the Groundfish Strategic Plan in 2000.

At the June 2007 Council meeting, a report and recommendation were presented by the California Department of Fish and Game (CDFG) to proceed with the development of an environmental analysis in support of converting the open access fishery to federal permit management. The report recommended a directed fishery permit (B permit) that would be issued to a limited number of current vessel owners and an incidental fishery permit (C permit) that could be registered to any state-licensed commercial fishing vessel. The Council adopted the range of alternatives in the CDFG report and gave direction for the development or inclusion of the following permitting issues: 1) add a B permit alternative without a previous year landing requirement; 2) add the Groundfish Advisory Subpanel (GAP) alternative four to analyze a range of minimum landing requirements; 3) use landings from April 1998-September 2006 to analyze qualifying criteria for B permit issuance; 4) do not count nearshore species' landings in qualifying for a B permit; 5) include an alternative to register all open access vessels, but not limit the number of permits and include another alternative that reflects average recent-year vessel participation, and 6) include an alternative that allows full transferability of B permits.

NMFS considered relevant matters immediately prior to the June 2007 Council meeting and provided a written recommendation that the action alternatives be analyzed under the National Environmental Policy Act via an environmental assessment (EA), accompanied by appropriate analyses under other applicable laws, including among others, the Magnuson-Stevens Fishery Conservation and Management Act and the Regulatory Flexibility Act.

To assist in the Council decision process, CDFG staff with assistance from Washington, Oregon and NMFS staffs has prepared a preliminary Draft EA entitled: Preliminary Draft Environmental Assessment for Pacific Coast Groundfish Fishery Management Plan Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management (Agenda Item F.4.a, Attachment 1). The report analyzes the permitting alternatives and issues that the Council approved at its June 2007 meeting. A possible implementation timeline is attached for Council consideration (Agenda Item F.4.a, Attachment 2). The Council is scheduled to consider future Council meeting agenda items under Agenda Item B.5 on Friday, March 14, 2008.

**Council Action:**

1. **Determine if the June 2007 alternatives have been adequately analyzed and whether additional alternatives are needed or should be removed from the document.**
2. **Based on that discussion, determine when a preferred alternative is to be identified and a schedule for public hearings.**
3. **If appropriate, designate hearing officers, hearing locations and approximate hearing dates.**
4. **Discuss the attached Amendment Development and Implementation Schedule (Agenda Item F.4.a, Attachment 2).**

Reference Materials:

1. Agenda Item F.4.a, Attachment 1: Preliminary Draft Environmental Assessment for Pacific Coast Groundfish Fishery Management Plan Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management.
2. Agenda Item F.4.a, Attachment 2: Proposed Open Access Groundfish Fishery Conversion to Limited Entry and Permit Implementation Schedule.
3. Agenda Item F.4.c, Public Comments.

Agenda Order:

a. Agenda Item Overview — LB Boydstun
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Amendment Alternatives for Public Review

PFMC
02/25/08

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# PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT
## FOR
## PACIFIC COAST GROUNDFISH FISHERY MANAGEMENT PLAN AMENDMENT 22:
## CONVERSION OF THE OPEN ACCESS FISHERY TO FEDERAL PERMIT MANAGEMENT

INCORPORATING THE REGULATORY IMPACT REVIEW
AND
INITIAL REGULATORY FLEXIBILITY ANALYSIS

PREPARED BY
PACIFIC FISHERY MANAGEMENT COUNCIL
7700 NE AMBASSADOR PLACE, SUITE 101
PORTLAND, OR 97220
503-820-2280
WWW.PCOUNCIL.ORG

AND THE

NATIONAL MARINE FISHERIES SERVICE
7600 SAND POINT WAY NE, BIN C15700
SEATTLE, WA 98115-0070
206-526-6150

MARCH 2008

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# COVER SHEET
## March 2008

| | |
|---|---|
| **Title of Environmental Review:** | Environmental Assessment of a Program to Limit Entry into the Open Access Sector of the Pacific Coast Groundfish Fishery (Amendment 22 to the Pacific Coast Groundfish Fishery Management Plan) |
| **Responsible Agency and Official:** | D. Robert Lohn<br>NOAA – National Marine Fisheries Service<br>7600 Sand Point Way N.E.<br>Seattle, WA 98115 |
| **Contacts:** | Frank Lockhart<br>Sustainable Fisheries Division<br>NOAA – National Marine Fisheries Service<br>7600 Sand Point Way NE,<br>Seattle, WA 98115<br>Phone: (206) 526- 6142 |
| **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) off the states of Washington, Oregon, and California |

**Abstract:** This Environmental Assessment examines a program to limit participation in the open access sector of the Pacific Coast groundfish fishery. Since implementation of a limited entry program in 1994, participation in the open access sector has been unlimited to ensure that vessels participating in state-managed fisheries and landing groundfish incidentally to other fisheries would continue to have access to the groundfish resource. The fishery was also left unlimited to allow vessels that did not qualify for the limited entry program in 1994 to directly target groundfish at lower landings rates than in the limited entry fishery. Allowable groundfish landings have been constrained in recent years to protect overfished groundfish species. Despite these overall harvest restrictions, participation in the open access sector of the groundfish fishery remains unrestricted. A limited entry program is being considered because of the overcapitalization that exists in the directed (targeted) component of the open access fishery and because of fishery informational needs associated with other important groundfish management issues, bycatch reduction and overfished species management. The purpose of this Environmental Assessment is to provide decision makers and the public with an evaluation of the environmental and economic impacts of the regulations that would be implemented under the proposed limited entry program.

## EXECUTIVE SUMMARY

This document analyzes the environmental and socioeconomic impacts of proposed Amendment 22 to the Pacific Coast Groundfish Fishery Management Plan (Groundfish Fishery Management Plan; FMP), which is proposed to convert the open access sector of the groundfish fishery to limited entry management. Participation in the open access fishery has been unlimited since in began in 1994 to ensure that vessels participating in state-managed fisheries and landing groundfish incidentally to other fisheries would continue to have access to the groundfish resource and to allow vessels that did not qualify for the limited entry program to directly target groundfish.

### *DOCUMENT ORGANIZATION*

NEPA 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. These issues are covered in Chapters One through Eleven. Chapter Twelve contains appendices that provide additional information in support of comments or conclusions made in the text.

### *PROPOSED ACTION*

Conversion of the open access fishery to limited entry management has been under discussion since April 1998 and was listed in 2000 as a management priority under the Council's Groundfish Strategic Plan. The proposed program is intended to compliment the existing limited entry or A permit program. The proposed action has two parts:

1) Conversion of the directed (target) fishery component to limited entry management wherein vessels with valid registrations or permits would be allowed to directly fish for and land specified groundfish species. This is called the B permit program.
2) Conversion of the incidental (non-target) fishery component of the open access groundfish fishery to a license registration program for all state-registered open access vessels that do not receive a B permit and that seek to retain incidental amounts of specified groundfish. This is called the C permit program

### *NEED FOR LIMITED ENTRY*

The majority of groundfish stocks are now fully harvested by domestic fishermen in the Pacific coast groundfish fishery and expectations of future productivity of most groundfish have been lowered along with estimated OYs since the mid 1990s, particularly for rockfish stocks. The proposed action is needed because:

1) Fishing capacity for federal groundfish species needs to be carefully managed to ensure that capacity and/or effort is maintained consistent with resource availability.
2) Restrictive landing limits have been necessary for some groundfish species because of high fishing capacity. Low landing limits reduce the economic potential of the fishery to local communities, and can exacerbate fishery discards due to trip limit overages and species high grading.
3) Registration of all open access fishery vessels is important to meeting fishery management goals to facilitate projecting fishery catches and discards and efficiently allocating sampling resources to collect fishery biological and economic data among ports.
4) The West Coast states have management programs for their nearshore groundfish fisheries, which has likely pushed unlicensed vessels into federal waters, increasing fishing pressure there.
5) Salmon fishing restrictions have likely resulted in effort shift to directed open access groundfish fisheries, which put additional pressure on overfished groundfish stocks and reduce economic viability of affected groundfish fisheries.
6) Management measures to protect overfished groundfish species have, in recent years, included large area closures and reduced harvest limits. Enforceability of these and other management measures would be improved by managers and enforcement officials being able to identify which

vessels are permitted to participate in the groundfish fisheries. It would also facilitate dissemination of fishery information including fishery regulations.

### *HISTORY OF OPEN ACCESS FISHERY*

The history of the open access fishery, including information on the major reductions in rockfish harvest opportunity during the 1990s, is tracked in **Section 1.4.1.**

### *GROUNDFISH STRATEGIC PLAN*

The 2000 Strategic Plan noted that the groundfish resource could not support the number of vessels catching and landing groundfish. Fishing fleet overcapitalization had been a major factor in fish stock depletions and led to economic and social crises in the industry and in coastal communities. The Plan reported that "...allowing an open access fishery with a total absence of limits on capacity is a serious management problem." The number of open access vessels that would be needed to harvest the 2000 open access groundfish OY of 2,207 mt was estimated to be in the ranged from 47 to 105 boats which yielded an open access capital utilization rate of 6%-13%.

The Plan recommended that the Council consider deferring management of nearshore rockfish, and other species such as cabezon, kelp greenling and California scorpionfish to the states, and that all commercial fisheries should eventually be limited through federal or state license or permit limitation programs.

### *THE COUNCIL'S STRATEGIC PLAN IMPLEMENTATION OVERSIGHT COMMITTEE (SPOC)*

The SPOC developed a list of 15 groundfish action priorities, which included two "critical" elements (science and Council process action items) for Council consideration. The open access permitting issue was ranked seven below the two critical operational elements, A permit buyback, trawl permit stacking, observers, groundfish process, and fixed gear stacking, all of which have been completed.

### *PUBLIC SCOPING*

Public scoping of the open access permitting issue has taken place in Council and state meeting since January 2001. Public comments and Council discussion were generally in favor of consideration of open access fishery conversion to federal permit management. Public and Council discussions are summarized in **Section 1.5**. The decision to move forward with the open access permitting analysis was made at the Council's September 2006 meeting.

### *DESCRIPTION OF THE ALTERNATIVES*

The Council approved six alternatives for EA analysis that pertain to conversion of the open access fishery to permit management at its June 2007 meeting. Note that *while each alternative reads as a complete program option, the components of each alternative could potentially be mixed and matched to create an open access licensing program.*

#### *Alternative 1 (No action)*

Alternative 1 would continue to allow commercial fishing vessels to prosecute federal groundfish species allocated to open access fisheries without federal registration, except as required under the VMS program. The No-action alternative does not limit participation in the open access fishery.

#### *Alternative 2*

This alternative establishes an annual federal license requirement for vessel owners that intend to participate in the open access groundfish fishery. The purpose of this alternative is to identify all vessels and vessel owners that participate in the open access fishery and to aid managers in estimating fishery impacts to target and non-target species. This alternative would not limit fishery participation and the license would be valid for directed or incidental fishing operations.

### *B and C Permit Alternatives*

Alternatives 3-6 are the open access fishery permitting alternatives each of which have provisions for issuance of B (directed fishery) and C (incidental fishery) permits. There are various conditions and assumptions associated with the adoption of any alternative that calls for the issuance of B and C permits. These are presented in **Table ES-1**. Some issues that alternatives 3-6 have in common are as follow:

1. Alternatives 3-5 allow one permit transfer per calendar year, while permit transferability in not specified in Alternative 6.
2. Alternatives 5 and 6 have a previous year landing requirement, which would have to be completed by November 30 for the permit to be renewed by December 31.
3. Alternative 5 has a gear and length endorsement provision, which does not appear in the other alternatives.
4. Alternatives 3 and 4 allow for A and B permit registration to a single vessel and allow for alternate use of the two permit types during the year after notification is made to NMFS of permit type that will be in use before leaving port. Alternatives 5 and 6 prohibit B permit registration to any vessel with an A permit in the same year.

### *Alternative 3*

This is one of three alternatives that have a specific initial fleet size goal for issuance of B permits. The goal for Alternative 3 is based on the average number of vessels that made directed B species landings in the WOC area during the recent years of 2004-September 2006, which computes to be 680 vessels after rounding. The long-term fleet size goal is the same as the initial fleet size goal.

### *Alternative 4*

This alternative was developed to analyze the fishery impacts of a range of B permit qualification criteria. There would be no initial fleet size or long-term goal under this alternative, but no new permits would be issued after the first year.

### *Alternative 5*

Alternative 5 has an initial fleet size goal of 850 vessels combined with two long-term fleet size alternatives: Alternative 5a, 430 vessels; Alternative 5b, 170 vessels. The initial fleet size goal of 850 vessels is the number of vessels that participated in the fishery in 2000 after rounding, while 430 is about 50% of the 2000 fleet size and 170 is 20% of the 2000 fleet size. This alternative would require permit holders to consolidate permits, two for one, as follows: Alternative 5a, after the $5^{th}$ program year; and Alternative 5b, after the $1^{st}$ and $5^{th}$ program years.

### *Alternative 6*

The initial fleet size goal in Alternative 6 is 390 vessels, which is 91% of the average number of vessels (after rounding) that fished at least three years for federal groundfish species, including nearshore species, during 1994-1999**.** The 91% adjustment factor is an extrapolation of fishery data for 2000-2006 used to estimate the proportion of vessels that fished for nearshore species only during 1994-1999 when nearshore rockfish were often recorded as “rockfish unspecified.” The long-term fleet size goal in this alternative is the same as Alternative 5b, 170 vessels, but there is no permit consolidation requirement.

Table ES-1. Basic conditions and assumptions regarding B and C permit programs

1. A major aim of the B permit program would to better match fishing fleet capacity with resource availability.

2. B permits would be assigned to vessels to be consistent with the existing Limited Entry or A permit program.

3. B permits would be issued to *current owners* of vessels that have qualifying *directed* groundfish landings during the window period of 1998-September 2006.

4. A directed open access fishery landing is one in which >50% of the total revenue was of B species groundfish and directed fishery gear was used. Only directed fishery landings of B species groundfish would be considered for B species permits.

5. B permits would apply to the directed taking and landing of all federal groundfish *not including nearshore rockfish, cabezon, kelp greenling and California scorpionfish* (nearshore groundfish*),* which would continue to be protected or managed under state regulations with more restrictive possession and landing limits than federal limits. There would be no federal permit requirement to take nearshore groundfish (since few of these fish occur in federal waters). State nearshore permits may not be used in lieu of obtaining a B permit. NMFS would continue to set catch limits for nearshore groundfish unless management authority is transferred to the states.

6. A vessel must be registered to a C permit to land incidental amounts of federal groundfish excluding nearshore species. A state-issued nearshore permit registered to the vessel or in possession of a fisherman on board the vessel could be used in lieu of obtaining a federal C permit when fishing for and possessing federal groundfish in state or federal waters.

7. Valid B and C permits or state-issued nearshore permits would be required when fishing for, possessing and landing permitted species from US waters off the coasts of Washington, Oregon and California. State nearshore permits may not be used in lieu of obtaining a B permit.

8. The existing biennial regulatory process would be used to manage the B and C permit programs, with in-season adjustment of daily and cumulative landing limits used to keep fisheries within harvest guidelines. Incidental fishery (C permit) landing limits would take into account target species landings (i.e., nearshore or non-groundfish landings). Directed fishery (B permit) limits would be set based upon attainment of open access fishery harvest guidelines and not tied to associated species landings or impacts, except to protect depleted or protected marine resources.

9. That state regulations would continue to be in compliance with federal regulations for the taking, possessing and landing of federal groundfish. This would extend to the application of federal permit requirements to vessels and fishermen fishing in state waters and landing catches at state ports.

10. B permits would be renewed annually and be revocable by NMFS; expired permits would not be renewed. C permits would be applied for annually, but vessel owners do not forfeit their right to a C permit by not renewing in a given year. Timing of annual B permit application would align with current A permit renewals (fall of year prior). C permit issuance would be year-round and effective the next cumulative limit period.

## ALTERNATIVES CONSIDERED BUT REJECTED FOR FURTHER ANALYSIS

The rejected alternatives included permit stacking (to increase trip limits), sablefish tiering, permit transferability conditions, allocations between B and C permit vessels, and sub-area endorsements for sablefish or for other species. These issues were considered outside the scope of the proposed action, could lead to increased fishery discards, or were not considered a management concern at this time.

## PHYSICAL AND BIOLOGICAL CHARACTERISTICS OF THE AFFECTED ENVIRONMENT

Information is provided in **Section 3.1** on ocean currents, physical and biological conditions, and essential fish habitat within the Pacific Coast groundfish area. In the Biological Characteristics section (**Section 3.2**) information is provided on federal groundfish species including 1) overfished and precautionary zone groundfish and 2) non-overfished and unassessed groundfish species that are impacted by federal groundfish regulations. Information is also provided of non-groundfish species and of prohibited and protected species that may be caught or impacted when targeting groundfish.

## MANAGEMENT STRUCTURE OF THE OPEN ACCESS FISHERY

The management structure of the Open Access Fishery is described in **Section 3.3.1.**

## CATCH CHARACTERISTICS—AMOUNTS AND FISHERY VALUES

The B species groundfish fishery is very small compared to other Pacific Coast commercial fisheries. B species landings expressed as a proportion of total WOC commercial fishery landings in 2004-2006 window period years[1] showed a negligible (<0.3%) contribution based on tonnage landed and about 1% based on ex-vessel value of fish landed. For individual ports, B species landings exceeded 3% of total commercial fishery landings either in terms of weight or value of fish landed at six port groups (tonnage and ex-vessel values, respectively, shown in parentheses): Fort Bragg (7% and 9%), Brookings (3% and 4%), Morro Bay (3% and 3%), South Puget Sound (2% and 3%) and Monterey (1% and 3%).

A total of 809 different fish buyers, distributed among 70 ports, purchased B species groundfish during window period years. In 2006, the comparative figures were 214 buyers among 55 ports. A large majority of buyers (79%) operated from California ports, particularly between the San Francisco and San Diego port groups (471). Fishermen landing and selling their own catches likely contributed to the large number of California fish buyers.

The open access groundfish fishery was small when compared to the A permit and recreational groundfish fisheries, averaging 5% of total groundfish landings during the window period. A large majority of the open access harvest was in the directed fishery. The number of vessels that participated in the open access fishery declined from 1,483 in 1999 to 905 in 2006. The number of directed fishery vessels declined from 1,004 in 1998 to 677 in 2004 then increased to 744 in 2006**.**

The most valuable directed fishery species or species groups annually were nearshore species, $2.8 million (55%); and sablefish, $1.5 million (29%) annually. All other species (shelf and slope rockfish, lingcod, sharks and misc.) averaged $800,000 annually (16%)**.** In 2005-2006 revenues from sablefish surpassed those from nearshore species.

The trend in vessels making a directed sablefish landing steadily increased during 1998-2006 except for 2004. The trend in sablefish fishery resource impact (based on landings expressed as a proportion of annual harvest guidelines) followed the vessel participation trend very closely, which contributed to the fishery in the Monterey-Vancouver management area exceeding its allocation by over 40% in 2005 and being closed during October-December 2006 (**Figure ES-**1).

A total of 2,587 different vessels made a B species directed open access fishery landing during the window period, and 69% (1,484) that made a landing during 1998-2003 (2,157) did not make a landing during 2004-2006. A total of 1,103 vessels that made a B species landing during 2004-2006 also made a landing during 1998-2003. A total of 71 (2.7%) vessels made a landing every year of the window period.

Total revenue frequencies for vessels that made B species landing during the window period showed that 50% of vessels (1,283) landed < $1,000 worth of B species groundfish and 4% (105) landed over $100,000 worth of fish during the window period. The remaining 1,199 vessels (46%), landed between $1,000 and $100,000 in B species groundfish for the approximately nine-year window period (**Figure ES-2**).

[1] Window period means April 1998-September 2006 as approved by the Council in June 2007; January 2004-September 2006 is used to represent "recent" years.

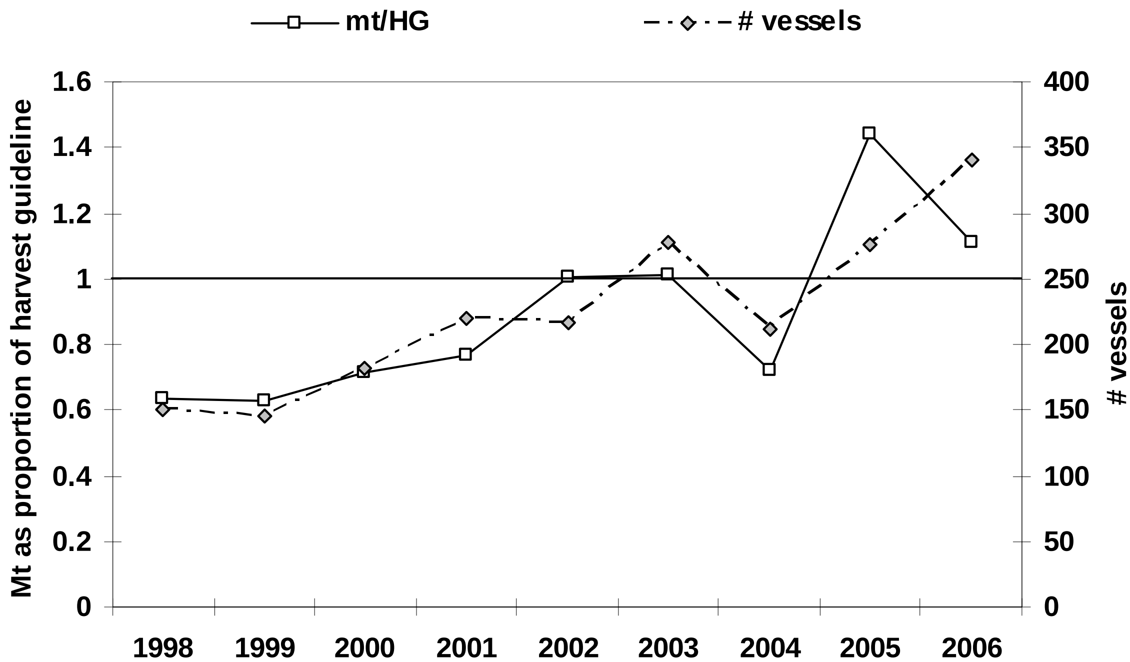


Figure ES-1. Directed open access sablefish fishery trends: number of directed fishery vessels and landings shown as a proportion of annual harvest guideline, Monterey-Vancouver area, 1998-2006 seasons.

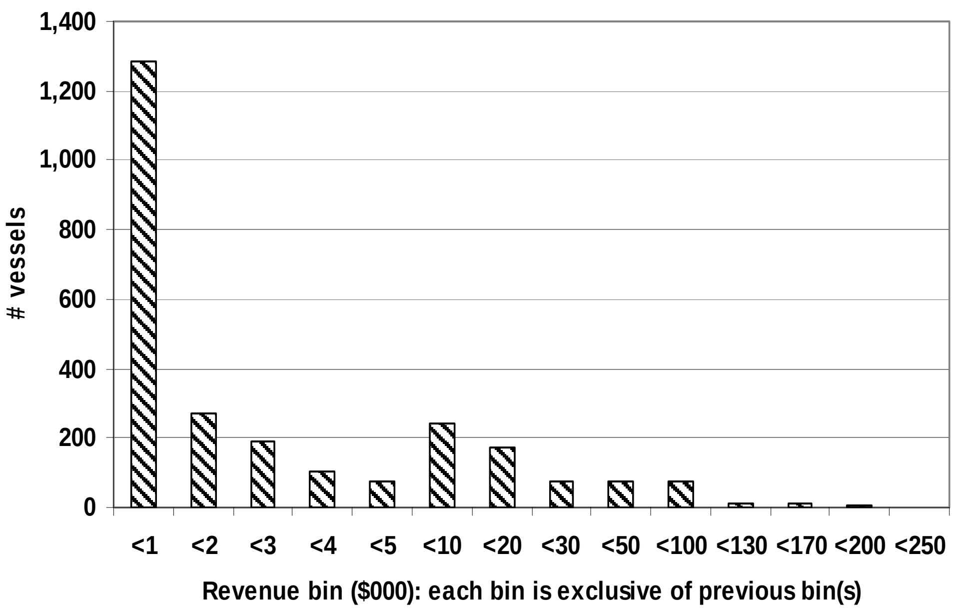


Figure ES-2. Revenue frequencies for WOC vessels that made B species landings during the window period (2,587 vessels)

A total of 2,587 vessels had directed B species groundfish landings during the window period and 66% primarily delivered to California ports and 26% and 8% made landings at Oregon and Washington ports, respectively. The top three port groups for numbers of vessels making landings were Morro Bay (11%), Monterey (10%), and Brookings (9%). The San Francisco port group was very close to the Brookings port group at slightly less than 9%. The large majority (87%) of vessels used hook-and-line gear, followed by pot gear (10%).

California, Oregon and Washington B species vessels averaged 28 ft, 32 ft, and 39 ft in length, respectively. The modal length of Washington vessels was 40-49 ft while the modal length in California and Oregon vessels was 21-24 ft, although there was a second modal length for Oregon vessels at 35-39 ft.

Analysis of commercial fishery data for vessels that made B species groundfish landings showed that B species groundfish comprised 3.6% and 4.4%, respectively, of their total commercial fishery landings in terms of tonnage and revenues. Most of the vessels fished for salmon (63%), crabpot species (56%), and nearshore species (52%). HMS was also important to many vessels (44%). Fisherman revenues were highest in crabpot fisheries at 52% followed by salmon at 15% (**Figure ES-3).** It is important to note that this analysis was based on dependence of B species vessels on other commercial fisheries, not on WOC commercial fishery dependence on B species groundfish.

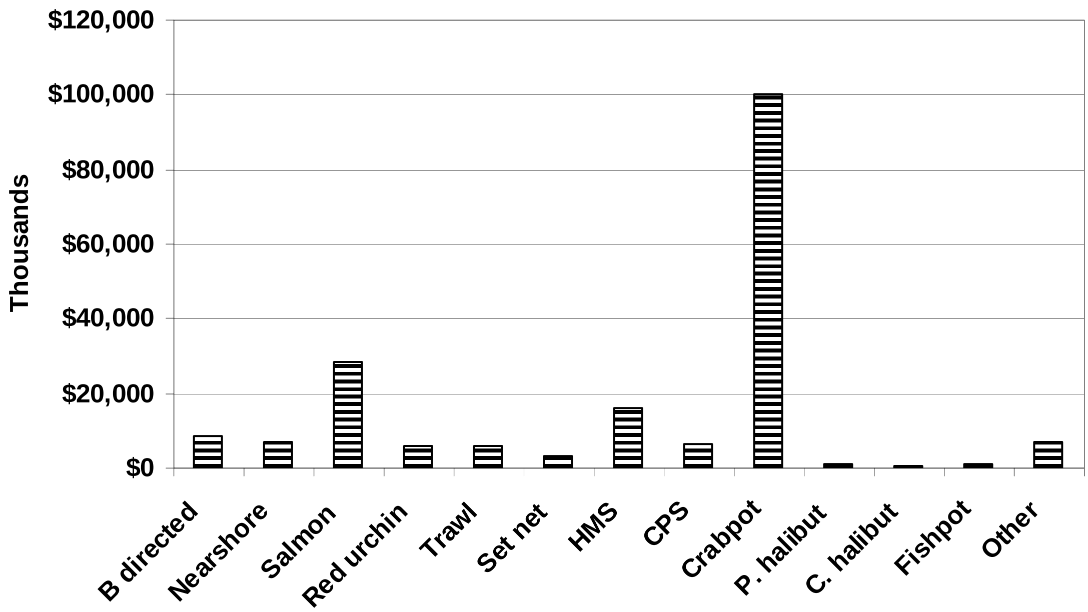


Figure ES-3 Fishery revenues by commercial fishery for vessels that made B species landings during the window period.

### *REVENUE/COSTS TO THE PARTICIPANTS AND TO STATE AND FEDERAL GOVERNMENTS*

Current license renewal and registration costs or web sites where they can be found are presented in **Section 3.3.6.**

## ANALYSIS OF ALTERNATIVES--ENVIRONMENTAL CONSEQUENCES

Commercial fishery catch history data were available from the PacFIN data base for all vessels that made B species landings during the window period. Those data were used in analyzing potential impacts of the alternatives on future commercial fishery landings by qualifying and non-qualifying vessels. The analysis of alternatives 3-6 required the development of permit qualification criteria for use in projecting which vessels would qualify for B permit issuance and which vessels would have to shift effort to other commercial fisheries or revenue sources to make up for loss of B species groundfish harvest opportunity (**Table ES-2**). Any alternative that seeks to implement a B permit program will require the adoption of qualification criteria for use by NMFS in determining which vessels qualify for a B permit.

Table ES-2. Qualification criteria developed by the document writing team and used to analyze and compare alternatives 3-6 with Alternative 1(no action) and Alternative 2 (registration only) presented in Appendix E 1/

| Model Run # | Criterion description |
|---|---|
| 1 | Total B species groundfish landings by individual vessels during 2004-2006 window period years |
| 2 | Total of B species landings by individual vessels during 1998-2006 window period years |
| 3 | Same as Model Run #2 except at least one B species landing was required during 2004-2006 window period years |

1/ One of these criteria (or modification thereof) is proposed to be selected as part of the Council's final action on this initiative for any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

The commercial fishery impact analysis (**Appendix E**) facilitated projection of quantitative impact of the alternatives on 1) the groundfish and non-groundfish biological environments; and 2) the groundfish, non-groundfish, vessel, processor and community socioeconomic environments. Data sets were not available for quantitative evaluation of the alternatives with regard to the following environmental issues: Fishery Management, Prohibited Species, Protected Species, Participation Requirements, and Government Cost. For these issues, a general or qualitative assessment was made using comparative information or through deductive reasoning. These assessments are shown in **Table ES-3**.

The factors to be considered in the application of the principals of Environmental Justice are explained in **Section 3.3.8.** It is concluded that all of the alternatives have low potential for significant impact as none of them target low income or minority communities, thus they would affect all population segments equally.

### *Alternative 1*

There would no significant impact to the environment stemming from the No-action alternative because no change in management is proposed under this alternative. This alternative would not affect the increased demand for directed fishery sablefish and the more restrictive landing and trip limits that are associated with providing for year-round sablefish fishing opportunity. Continued use of restrictive landing and cumulative limits, compared to previous recent years, will lead to further depressed fisherman revenues and increased fishery discards due to trip limit overages and high grading to keep the more valuable fish. The no-action alternative does not provide for identification of fishery participants.

### *Alternative 2*

This alternative would have the same environmental impact as Alternative 1, but provides for licensing of all open access fishery participants, which would provide for identification of fishery participants and improve the ability of managers to project fishery impacts.

### *Alternative 3*

Alternative 3 would provide for the issuance of B and C permits and has an initial and long-term fleet size goal of 680 vessels, which is the average number of directed fishery vessels during 2004-2006 window period years. B permit vessels would have 2% to 9% more B species groundfish (depending on qualification criteria) to harvest due to exclusion of previous fishery participants that had lower catch histories (**Table ES-3)**. This small increase in fish would have no impact on B species trip or cumulative landing limits. An average of 276 vessels prosecuted sablefish during 2004-2006, thus the issuance of 680 permits would not preclude significant effort shift of permitted vessels to the sablefish fishery. The distribution of permits between states would change by between +6 (Washington) to -8 (California) percentage points compared to the distribution of vessels making B permit landings during the 2004-2006 window period. The excluded vessels under this alternative would have to increase revenues from other commercial fisheries or revenue sources by 1% to 2%, on average, to make up for lost B species harvest opportunity. The environmental consequences of this alternative would be similar to Alternative 1 (No-action), but would provide for identification of fishery participants and improve the ability of managers to project fishery impacts.

### *Alternative 4*

Alternative 4 would provide for the issuance of B and C permits. A range of minimum landing requirement (MLR) criteria was developed to analyze the potential fishery and community impacts of this alternative. The MLRs were aimed at retaining fleet harvest capacity goals, based on 1998-2006 vessel landings data, in the range of 50% to 100%. In the analysis Model Run #3 criteria (**Table ES-2**) was used to qualify vessels for B permit issuance, and 2004-2006 commercial fishery landings data were used to determine groundfish, non-groundfish, processor, and community impacts (**Table ES-3)**. The data showed that at the 50% capacity retention level (MLR=47,866 lbs) 65 vessels would qualify and 1,038 vessels would not qualify for B permits. The potential increased revenues to permitted vessels would be $5.5 million (177% increase). The non-qualifying vessels would have to increase revenues by 5%, on average, to make up for lost B species harvest opportunity (**Table ES-4**). At the 80% capacity retention level (MLR=14,374) the potential revenue increase to permitted vessels would be $2.4 million (41% increase) and non-qualifying vessels would have to increase revenues from other sources, on average, by 2.8% (**Table ES-4**).

Table ES-4. Minimum landing requirement impacts on qualifying and non-qualifying vessels.

| | | Qualify | | Non-qualify | | Increased | Non-qualify | |
|---|---|---|---|---|---|---|---|---|
| Goal 1/ | MLR 2/ | #vsls | B (000s) | #vsls | B (000s) | revenue 3/ | Other fish 4/ | Need 5/ |
| 50% | 47,866 | 65 | $3,075 | 1,038 | $5,457 | 177% | $108,920 | 5.0% |
| 60% | 36,090 | 95 | $4,126 | 1,008 | $4,406 | 107% | $105,420 | 4.2% |
| 70% | 21,793 | 139 | $5,014 | 964 | $3,517 | 70% | $100,310 | 3.5% |
| 80% | 14,374 | 209 | $6,051 | 894 | $2,480 | 41% | $89,200 | 2.8% |
| 90% | 6,101 | 341 | $7,214 | 762 | $1,317 | 18% | $65,420 | 2.0% |
| 95% | 3,481 | 474 | $7,826 | 629 | $705 | 9% | $50,017 | 1.4% |
| 98% | 1,603 | 629 | $8,206 | 474 | $325 | 4% | $31,149 | 1.0% |
| 100% | 1 | 1,103 | $8,531 | 0 | $0 | 0% | $0 | 0.0% |

1/ capacity retention proportion, based on ranking of 1998-2006 vessel landings

2/ minimun landing requirement: total 1998-2006 pounds with 1 or more landings during 2004-2006

3/ increased revenues available to qualifying vessels

4/ total commercial fishery revenues other than B species groundfish (000s)

5/ average amount of increase in other revenue sources needed to replace lost B groundfish

Any MLR that provides for a 30% or greater increase in revenues (used as a proxy for available fish) for permitted vessels and that would approximate the size of the recent directed sablefish fishery (276 vessels) would likely provide for substantially increased trip and cumulative landing limits and reduce the potential for a major effort shift to the directed sablefish fishery. This would equate to an MLR in the range of 6,000 to 14,000 lbs. The range in distribution of permits between the three states using Model Run #3 criteria (**Table ES-2)** would be as follow: Washington, 11-21%, Oregon, 26%-33% and California 50%-57%

The environmental consequences of this alternative would be significant at the 50% capacity retention level and similar to Alternative 2 at the 100% retention level. This alternative would be similar to alternatives 2-6 in that it would provide for identification of fishery participants and improve the ability of managers to project fishery impacts.

### *Alternative 5*

Alternative 5 would provide for the issuance of B and C permits and has an initial fleet size goal of 850 vessels and long terms goals of 450 vessels (Alternative 5a) and 170 vessels (Alternative 5b). In the first program year, permitted vessels would have 0% to 5% more fish to harvest (depending on qualification criteria) due to exclusion of previous fishery participants that had lower catch histories (**Table ES-3**). This small increase in available fish would have no impact on B species trip or cumulative landing limits. An average of 276 vessels prosecuted sablefish during 2004-2006, thus the issuance of 850 permits would not preclude significant effort shift of permitted vessels to the sablefish fishery. The distribution of permits between states using Model Run # 3 criteria (**Table ES-2)** would change by between +3 (Washington) to -4 (California) percentage points compared to the distribution of vessels making B permit landings during the 2004-2006 window period. The excluded vessels under this alternative would have to increase revenues from other commercial fisheries or revenue sources by 0% to 2%, on average, to make up for lost B species harvest opportunity (**Table ES-3**).

The long-term fleet size goal alternatives would increase the groundfish harvest for permitted vessels (based on pre-permit issuance analysis) by 7% to 17% under Alternative 5a and 29% to 43% under Alternative 5b (**Table ES-3**). These goals are proposed to be met after five years by applying a permit consolidation provision in which permit holders would be required to obtain a second permit to continue in the fishery. The vessel owners that relinquish permits would have to increase revenues (based on pre-permit issuance analysis) from other sources by 1% to 2% under Alternative 5a and 3% to 4% under alternative 5b to make up for lost B species harvest opportunity. The initial environmental consequences of this alternative would be similar to Alternative 1 (No-action), but would provide for identification of fishery participants and improve the ability of managers to project fishery impacts. The long-term impact under Alternative 5b would provide for substantially increased B species groundfish harvest by permitted vessels.

Vessels and gear would be endorsed under this alternative. There appear to be several alternatives for the Council to consider with regard to the gear endorsement provision. This is because window period data showed many vessels used different combinations of gear types to make B species groundfish landings (e.g., hook and line only, hook and line plus pot, set net plus hook and line, etc). The alternatives that have been developed for the Council to consider are as follows:

1. a single gear type endorsement based on the gear type used to make the most qualifying landings either in terms of weight or ex-vessel value of fish.
2. a multiple gear type endorsement based on all the different gear types used to make qualifying landings either in terms of weight or ex-vessel value of fish.
3. Same as 2. except limit the gear type combinations based on landing thresholds for individual gear types (e.g. >25% of qualifying landings must have been made by a particular gear type to receive an endorsement for that gear type).

The vessel endorsement recommendation is to allow for up to a 5 ft increase in vessel length when permits are transferred for use on different vessels.

### *Alternative 6*

Alternative 6 provides for the issuance of B and C permits and has an initial fleet size goal of 390 vessels and a long term goals of 170 vessels. There is a previous year landing requirement in this alternative that may accelerate permit attrition. In the first program year, permitted vessels would have 9% to 20% more fish to harvest (depending on qualification criteria) due to exclusion of previous fishery participants that had lower catch histories (**Table ES-3**). This amount of increase in fish would likely have no impact on B species trip or cumulative landing limits. An average of 276 vessels prosecuted sablefish during 2004-2006, thus the issuance of 390 permits would help in preventing significant effort shift of permitted vessels to the sablefish fishery. The distribution of initial permits between states using Model Run # 3 criteria (**Table ES-2)** would change by between +6 (Washington) to -6 (California) percentage points compared to the distribution of vessels making B permit landings during the 2004-2006 window period. The excluded vessels under this alternative would have to increase revenues from other commercial fisheries or revenue sources by 1% to 2%, on average, to make up for lost B species harvest opportunity (**Table ES-3**). .

The long-term fleet size goal under this alternative would increase the groundfish harvest for permitted vessels (based on pre-permit issuance analysis) by 29% to 43% (**Table ES-3**). There is no timeline for long-term goal attainment. The vessel owners that give up permits would have to increase revenues (based on pre-permit issuance analysis) from other sources 3% to 4% to make up for lost B species harvest opportunity (**Table ES-3**). The initial environmental consequences of this alternative would be similar to Alternative 1 (No-action), but substantial when the long-term fleet size goal is met due to reduced fleet size. This alternative would provide for identification of fishery participants and improve the ability of managers to project fishery impacts.

Vessels and gear would be endorsed under this alternative. The gear endorsement alternatives developed for this report appear above under the analysis of Alternative 5. The vessel endorsement recommendation is to allow for up to a 5 ft increase in vessel length when permits are transferred for use on different vessels.

## OTHER NEPA ISSUES

These will be addressed in the final EA.

## LIST OF PREPARERS

Kelly Ames, ODFW, fishery specialist
LB Boydstun, CDFG (retired), fishery specialist
Yvonne de Reynier, NMFS-NWR, fishery specialist
Jamie Goen, NMFS-NWR, fishery specialist
Jayna Schaaf-DaSilva, CDFG, fishery specialist
Joanna Grebel, CDFG, fishery specialist and GMT member
Gerry Kobylinski, PSMFC, data analyst
Robert Leos, CDFG, fishery specialist
Caroline McKnight, CDFG, fishery specialist
Melodie Palmer-Zwahlen, CDFG, data analyst
Corinne Pinkerton, NMFS-SWR, fishery economist

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# ACRONYMS

| | |
|---|---|
| CDFG | California Department of Fish and Game |
| Council | Pacific Fishery Management Council |
| EC | Enforcement Consultants |
| EEZ | Exclusive economic zone |
| EFH | Essential fish habitat |
| EIS | Environmental Impact Statement |
| ESA | Endangered Species Act |
| FMP | Fishery management plan |
| GAP | Groundfish Advisory Subpanel |
| GMT | Groundfish Management Team |
| IAC | Intersector Allocation Committee |
| LE | Limited entry or A permit program |
| Magnuson-Stevens Act (MSA) | Magnuson-Stevens Fishery Conservation and Management Act |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| ODFW | Oregon Department of Fish and Wildlife |
| OY | Optimum yield |
| Plan | Groundfish Strategic Plan |
| PSMFC | Pacific States Marine Fisheries Commission |
| RCA | Rockfish Conservation Area |
| Secretary | United States Secretary of Commerce |
| SFA | Sustainable Fisheries Act |
| SSC | Scientific and Statistical Committee |
| USFWS | United States Fish and Wildlife Service |

| | |
|---|---|
| VMS | Vessel monitoring system |
| WOC | Washington, Oregon, and California |
| WDFW | Washington Department of Fish and Wildlife |

## Abbreviations and Species Group Definitions

**Port Groups (principal ports)**
NPS: North Puget Sound (Neah Bay, Port Angeles, Sequim, Port Townsend, Blaine, Bellingham Bay, Anacortes, La Conner, Friday Harbor)
SPS: South Puget Sound (Everett, Seattle, Tacoma, Olympia, Shelton)
CWA: Coastal Washington (La Push, Copalis Beach, Grays Harbor, Westport, Willapa Bay)
CLW: Columbia River, Washington (Ilwaco, Chinook)
CLO: Columbia River, Oregon (Astoria, Gearhart-Seaside, Cannon Beach)
TLA: Tillamook (Tillamook/Garibaldi, Nehalem Bay, Netarts Bay, Pacific City, Salmon River)
NPA: Newport (Depoe Bay, Siletz Bay, Newport, Waldport, Yachats)
CBA: Coos Bay Area (Winchester Bay, Charleston, Bandon, Florence)
BRA: Brookings Area (Port Orford, Gold Beach, Brookings)
CCA: Crescent City Area (Crescent City Harbor)
ERA: Eureka Area (Eureka, Fields Landing, Trinidad)
BGA: Fort Bragg Area (Fort Bragg, Albion, Point Arena)
BDA: Bodega Bay Area (Bodega Bay, Point Reyes, Tomales Bay)
SFA: San Francisco Area (San Francisco, Sausalito, Oakland, Princeton/ Half Moon Bay, Alameda, Berkeley, Richmond)
MNA: Monterey Area (Monterey, Moss Landing, Santa Cruz)
MRA: Morro Bay Area (Morro Bay, Avila)
SBA: Santa Barbara Area (Santa Barbara, Port Hueneme, Oxnard, Ventura)
LAA: Los Angeles Area (Terminal Island, San Pedro, Wilmington, Newport Beach, Dana Point, Long Beach)
SDA: San Diego Area (San Diego, Oceanside)

**Species (PacFIN codes)**
Crab (Dungeness, king, tanner, rock, blue, golden)
Salmon (Chinook, coho, pink, sockeye, chum)
Groundfish (see text)
Shellfish (clams, oysters, cockles, geoduck, scallops)
Shrimp (pink, ghost and mud shrimp; golden, ridgeback and spotted prawns)
HMS (highly migratory species: Dorado; blue and striped marlin; blue shark; basking shark; shortfin mako shark, bigeye, common and pelagic thresher sharks; albacore, blue, yellowfin, bigeye, skipjack tunas; swordfish)
CPS (coastal pelagic species: Pacific and round herring; chub and jack mackerel; market squid; northern anchovy; Pacific bonito; Pacific sardine)
Others (white seabass; Pacific and California halibut; yellowtail; sea urchin; sea cucumber; barracuda; non CPS squid, croakers, eels, surfperch; wahoo, hagfish, non-groundfish sharks and skates; ocean whitefish, octopus, smelt; pomfret, non-groundfish greenlings, and all others do not fit the above species groups)

**Gear Types**
Hkl: hook-and-line
Pot: pot or trap gear
Net: set net gear

**Miscellaneous**
Vsl: vessel
$$: dollars
000s or Ks: thousands
mt: metric ton(s)
lb: pound(s)

# 1.0 PURPOSE OF AND NEED FOR THE ACTION

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 or MSA), 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 socioeconomic, biological, and physical characteristics of the affected environment.
- Chapter Four examines changes in the socioeconomic, biological, and physical environments resulting from the alternative management actions.
- Chapter Five addresses consistency with the FMP and other applicable laws.
- Chapter Six is the regulatory impact review and regulatory flexibility analysis.
- Chapter Seven lists the Federal and State agencies consulted.
- Chapter Eight is a list of individuals who helped prepare this document.
- Chapter Nine provides a list of references.
- Chapter Ten contains the Finding of No Significant Impact.
- Chapter Eleven describes the groundfish fishery management terms used in the text
- Chapter Twelve contains appendices that provide additional information in support of comments or conclusions made in the text

## *1.1 INTRODUCTION*

In 1994, NMFS implemented a limited entry program for the Pacific Coast groundfish fisheries, which created a permitting program to restrict the number of vessels allowed to directly target groundfish. The Council had discussed and developed this limited entry program as Amendment 6 to the FMP in the early 1990s. At that time, Pacific Coast fisheries as a whole were perceived as overcapitalized, meaning that fishing effort (number of vessels participating and fishing power of individual vessels) far exceeded potential Pacific Coast fish and shellfish biological yields. In the Environmental Impact Statement (EIS) for Amendment 6, the Council expressed concern that vessels looking for opportunities to expand their fishing operations would begin to enter the groundfish fishery, which had only recently converted from partial foreign harvest to complete domestic harvest. To prevent this anticipated migration to the groundfish fisheries, the Council adopted the Amendment 6 limited entry program, which essentially capped the number of groundfish fishery participants to those vessels with historic participation in the groundfish fisheries at a qualifying level

The limited entry program did not reserve all groundfish for the limited entry fleet, which allowed for the development of the open access fisheries. Amendment 6 specified that percentages of annual allowable groundfish catch that had been taken by vessels that did not qualify for limited entry permits would be set aside for an open access fishery. This fishery was left unlimited in participation to ensure that vessels participating in state-managed fisheries and landing groundfish incidentally would continue to have access to the groundfish resource. The fishery was also left unlimited to allow smaller vessels to directly target groundfish at lower landings rates than in the limited entry fishery. Since 1994, any vessel without a limited entry permit and using gear other than trawl gear has been allowed to directly target and land groundfish under open access fishery regulations and limits. Additionally, vessels using trawl gear in non-groundfish fisheries, such as shrimp and prawn fisheries, have been allowed to land groundfish taken incidentally in those fisheries under open access fishery regulations and limits. Allowable groundfish landings have been declining in recent years, primarily in response to the Magnuson-Stevens Act that requires NMFS and the fishery management councils to implement measures to rebuild overfished fish stocks. As of 2007, seven groundfish species have been declared overfished and are managed under strict rebuilding guidelines. All of these species co-occur with more abundant groundfish stocks, which mean that harvest of both the overfished stocks and their more abundant co-occurring stocks has been severely restricted to protect the overfished stocks. Despite these overall harvest restrictions, participation in the open access sectors of the groundfish fisheries remains unrestricted.

The open access fishery is characterized by frequent turnover in participants and no fishery registration requirement. This complicates projection of fishery impacts on target species and non-target species such as overfished groundfish species. The large number of vessels that typically participate in the directed fishery component far exceeds the capacity of the resource to sustain harvest on a year round basis. Thus, restrictive trip and cumulative landing limits have been used to ensure year-round fisheries. Restrictive landing limits can lead to trip limit overages and high grading, which exacerbates fishery discard mortality of target and non-target species. The Council first discussed limiting entry in the directed fishery sector of the open access fishery in 1998 and resumed discussion of the issue in 2000 as a management priority under its Groundfish Strategic Plan. The matter has been delayed because of higher priority groundfish issues including the need to develop and implement rebuilding plans for overfished groundfish stocks. In September 2006, the Council revived the open access permitting issue. It determined at that meeting that the resources were available to move forward with FMP Amendment 22 to convert the open access fishery to federal permit management, in part based on an offer by the California Department of Fish and Game (CDFG) and the other member states to assist in the process. At this same meeting, they set a fishery control date of September 13, 2006 to notify the public of its intent to consider open access fishery permitting (71 FR 64216, November 1, 2006).

## *1.2 Description of the Proposed Action*

The proposed action is for the open access sector of the Pacific Coast groundfish fishery and is intended to compliment the existing limited entry or A Permit Program established under Amendment 6 to the FMP. The proposed action has two parts:

1. Conversion of the directed (target) fishery component of the open access groundfish fishery for specified groundfish species to limited entry management wherein vessels with valid registrations or permits would be allowed to directly fish for and land specified groundfish species consistent with the

OYs and trip limits established for the open access sector of the Pacific Coast groundfish fishery. For Alternatives 3-6, this is called the B permit.

2. Conversion of the incidental (non-target) fishery component of the open access groundfish fishery to a registration program for all open access vessels that do not qualify or submit an application for a directed fishery permit and that seek to retain incidental amounts of specified groundfish species consistent with the OYs and trip limits established for the open access sector of the Pacific Coast groundfish fishery. For Alternatives 3-6, this is called the C permit.

### 1.2.1 Action Area

The open access sector of the groundfish fishery takes place in waters between 0 and 200 nautical miles (nm) off the coasts of Washington, Oregon, and California (WOC). However, federal authority for this fishery is from 3 to 200 nm, the Exclusive Economic Zone (EEZ), off of WOC. State authority is from 0 to 3 nm.

### 1.2.2 Scope of the Action

The proposed action relates to the open access sector of the Pacific Coast groundfish fishery and is proposed to compliment the existing limited entry or A Permit Program established under FMP Amendment 6. The proposed action extends to all groundfish species harvested or impacted directly or incidentally by open access fishing operations with the exception of certain nearshore species, explained below in Chapter 2, Alternatives. The analysis of alternatives is proposed to focus on fishery data for open access vessels that used directed fishery gear types during the window period of April 1998 to September 2006.

## 1.3 Purpose of and Need for the Action

### 1.3.1 Need

The majority of groundfish stocks are now fully harvested by domestic fishermen in the Pacific Coast groundfish fishery. Changes in the Magnuson-Stevens Act coupled with new information indicating much lower productivity for many groundfish species has resulted in the determination that several stocks are overfished. Expectations of future productivity of most groundfish have been lowered along with estimated OYs since the mid 1990s. The Council has determined that the groundfish fishery is overcapitalized and a Groundfish Strategic Plan calls for more than a 50 percent reduction in fishing effort. Further, there is a general level of excess harvest capacity existing in most Pacific Coast and North Pacific fishing fleets (e.g., shrimp, crab, halibut, salmon, etc).

The Council and NMFS are considering bringing the open access fishery under a limited entry program to limit overall capacity directed towards groundfish. Without incorporating open access users into a limited entry program, allocation issues will become more acute and additional, more restrictive measures will be needed to prevent overharvest of stocks and increased fishery discards.

Limited entry (aka, restricted access) fishery programs have been established for one or more of the following purposes: 1) to promote resource sustainability; 2) to create an orderly fishery; 3) to promote conservation among fishery participants; and 4) to maintain the long-term economic viability of fisheries (**CFGC 2008**). Most WOC fisheries are under limited entry management. The Council managed fisheries include the non-open access groundfish fishery and the California coastal pelagic finfish fishery (**see: http://www.pcouncil.org/**). The states administer over 50 individual species or species/gear-based limited entry programs (**Appendix C**).

The proposed action is needed because:

1. Fishing capacity for federal groundfish species needs to be carefully managed to ensure that capacity and/or effort is maintained consistent with resource availability.
2. Restrictive landing limits have been necessary for some groundfish species because of high fishing capacity. Low landing limits reduce the economic potential of the fishery to local communities, and can exacerbate fishery discards due to trip limit overages and species high grading.
3. Registration of all open access fishery vessels is important to meeting fishery management goals to facilitate projecting fishery catches and discards and efficiently allocating sampling resources to collect fishery biological and economic data among ports.
4. The Pacific Coast states have management programs for their nearshore groundfish fisheries, which has likely pushed unlicensed vessels into federal waters, increasing fishing pressure there.
5. Salmon fishing restrictions have likely resulted in effort shift by salmon vessels to directed open access groundfish fisheries, which puts added pressure on overfished groundfish stocks and reduces economic viability of affected groundfish fisheries.
6. Management measures to protect overfished groundfish species have, in recent years, included large area closures and reduced harvest limits. Enforceability of these and other management measures would be improved by managers and enforcement officials being able to identify which vessels are permitted to participate in the groundfish fisheries. It would also facilitate dissemination of fishery information including fishery regulations.

### 1.3.2 Purpose of the Proposed Action

The open access fishery is composed of a diversity of fishers. Some fishers participate in more than one fishery while others are solely dependent on the groundfish fishery as an income source. Some occasionally land groundfish caught incidentally with other gears such as shrimp trawl and salmon troll. Strong market incentives for groundfish (e.g., live and fresh fish markets) have encouraged participation by fixed gear/hook and line limited entry and open access fishers even though groundfish trip limits have been severely restrained. A large number of recent participants fish in nearshore fisheries for groundfish, but only land a small amount of fish on an annual basis. There is not much opportunity for the development of new fisheries given the constraints on the current fisheries to reduce bycatch of overfished stocks. The purpose of the proposed action is to:

1. Meet the Council's Strategic Plan goals of reducing capacity in the groundfish fisheries and the Council's commitment to an open access permitting program.
2. Meet the FMP's Objective #2, as revised by Amendment 18 to the FMP: 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 diverse, stable, and profitable. This reduced capacity should lead to more effective management for many other fishery problems.
3. Ensure that federal management of the open access fisheries is compatible with state license limitation programs for nearshore and other state-managed fisheries

## *1.4 Background*

### 1.4.1 History of the Open Access Fishery

At the request of members of the Groundfish Advisory Panel (GAP), the Council appointed a diverse committee to begin studying options for limited entry in the groundfish fishery in the spring of 1987. By that summer, the Council had adopted a July 11, 1987 control date, with the intention that landings made after that date would not be used in evaluating qualification for a limited entry program. Because this control date was not published in the *Federal Register*, a subsequent control date of August 1, 1988 was adopted by the Council and published along with a date of July 11, 1984, which would serve as the beginning of the qualifying window.

Early plans for limiting entry included gear endorsements for groundfish trawl, longline and pot gears within the limited entry fishery, with a remaining open access fishery only for what were termed "exempted" gears--consisting primarily of gill net, shrimp trawl, salmon troll, and other line gears not meeting the longline definition. This collection of open access gears included some for which groundfish was caught as bycatch while targeting other species, and some for which groundfish was often the target species.

The public voiced concern regarding the potential impact of this structure on small line and pot vessels, many of whom had only recently shifted much of their effort to groundfish as a result of the depressed fishery for salmon. To address this concern, the list of gears available for use in the open access fishery was expanded to include the use of the non-trawl gears included in limited entry--pot and longline. However, an additional stipulation was added, whereby only landings of more than 500 pounds of groundfish would count towards meeting the minimum landing requirement for a limited entry permit. This transformation increased the opportunities for open access vessels to target sablefish, and some rockfish species, for which longline/pot gears were more effective than exempted gears. Although enlarging the suite of gears available for targeting groundfish--relative to the original plan--addressed many of the concerns of small-boat fishers interested in targeting groundfish, it also eventually brought traditional bycatch users into greater conflict with those targeting groundfish under the same open access allocations.

While the Council approved the limited entry program (Amendment 6 to the FMP) in 1991, it was not implemented until the 1994 fishing season. During the interim, participation in some segments of the groundfish fishery increased considerably. Some of those who expanded their ability to harvest groundfish during this period, but did not initially qualify for permits, purchased permits following the program's implementation. The vast majority did not, and either continued as part of the open access fishery, or discontinued fishing groundfish.

Implementation of a limited entry program for Pacific Coast groundfish in 1994 effectively froze participation in the limited entry fishery, but effort continued to shift in and out of the open access fishery. The commercial open access groundfish fishery consists of vessels that do not necessarily depend on revenues from the fishery as a major source of income. Many vessels that predominately fish for other species inadvertently catch and land groundfish. Or, in times and areas when fisheries for other species are not profitable, some vessels will transition into the groundfish open access fishery for short periods. The commercial open access fishery for groundfish is split between vessels targeting groundfish (*directed fishery*) and vessels targeting other species (*incidental fishery*).

Overall levels of fishing effort and catch are dependent on stock availability, which is used to establish overall harvest limits for all sectors called optimum yields (OYs). These are used to allocate between sectors, which are called harvest guidelines (HGs). In establishing OYs for Pacific Coast groundfish, an initial step is to calculate allowable biological catches (ABCs) for major stocks or management units (groups of species). ABC is the estimated maximum sustainable yield (MSY) harvest level associated with the current stock abundance. The term “overfishing” is used to denote situations where catch exceeds or is expected to exceed the ABC or maximum sustainable yield (MSY) proxy. This can also be expressed as where catch exceeds or is expected to exceed the maximum fishing mortality threshold (MFMT). The term “overfished” describes a stock whose abundance is below its overfished/rebuilding threshold, or minimum stock size threshold (MSST). Overfished/rebuilding thresholds, in general, are linked to the same productivity assumptions that determine the ABC levels (**PFMC 2008**).-

There were indications of stock depression for bocaccio and canary rockfish in the early and mid-1990s, which resulted in the Council and NMFS taking action to reduce ABCs, OYs, and HGs (**Appendix F)**. Harvest shares by the limited entry and open access sectors have been computed based on historical landings, which have been established as fishery allocations since 1994. Between 1994 and 1997 the open access fishery HGs were reduced from over 9,000 mt to 5,600 mt (39%) for all species combined and from 6,300 mt to 3,900 mt (38%) for the rockfish (*Sebastes*) complex. The reductions were based on conservation concerns for these and other groundfish species (**Table 1-1**). Trip and cumulative landing limit management for vessels have long been used by the Council to achieve HGs. However, there were no notable changes in open access fishery landing limits as a result of HG reductions during 1994-1997 (**Table 1-2).**

Groundfish stock assessments during 1998-2001 resulted in the following stocks being declared overfished: lingcod, southern bocaccio, Pacific Ocean perch, canary rockfish, cowcod, darkblotched rockfish, widow rockfish and yelloweye rockfish. In response additional reductions were made in ABCs and HGs for these and associated groundfish species. During 1998-2006, the open access fishery HG for all species combined was reduced from 4,700 mt to 2,800 mt (40%) and for the rockfish complex from 3,500 mt to 1,900 mt (46%) (**Table 1-1; Figure 1-1**). The corresponding landing limit reductions went from 40,000 lbs of rockfish per vessel-month in 1998 to a low of 575 lbs per vessel-month depending on area in 2006, a reduction of 86%. Prohibition on fishery take and landing was extended to canary, cowcod and yelloweye rockfish, and the southern bocaccio landing limit could be no larger than the total shelf landing limit for an individual vessel for the entire month (**Table 1-2).**

In 2000, rockfish species management was partitioned into ecological zones base on water column depth contours wherein individual species were normally found, as follows: nearshore species, shoreline to 20 fathoms (fms); shelf rockfish, 20 fms to 100 fms and slope rockfish, >100 fms. The species within these ecological zones are discussed in subsection 3, Affected Environment. Historically, shelf rockfish was the mainstay of the open access directed fishery and included such high volume species as bocaccio, canary, chilipepper, widow, and yellowtail rockfish. Beginning in 2000 the fishery for shelf rockfish was closed during some two-month cumulative landing periods or reduced to an equivalent of 100 lbs of fish per month **(Table 1-2).**

The directed open access fishery historically targeted groundfish in the “dead” and/or “live” fish fishery using a variety of gears. The terms dead and live fish fisheries referred to the state of the fish when they were landed. The dead fish fishery was historically the most common way to land fish. Beginning in the late 1990s, the higher market value for live fish resulted in increased landings of live groundfish. Most of the fish harvested in the live fish fishery were taken in the nearshore ecosystem and included nearshore rockfish species. The states have dealt with management of their nearshore commercial fisheries in different ways, which will be discussed in subsection 3.3.3.4.2.

Fishing opportunity for *Sebastes* was greatly reduced during 1994-2006 while fishing for sablefish was relatively stable with HGs in the Monterey-Vancouver area (northern area) ranging from 278 mt in 1998 to 629 mt in 2004 and averaging 499 mt. The same was true for the Conception area, except for a precautionary commercial fishery HG adjustment in 2001. The Conception area HG ranged from 212 mt in 2001 to 425 mt during 1994-2000 and averaged 355 mt (**Table 1-1).** The sablefish fishery was typically managed using a daily trip limit of 300 lbs in the northern area and 350 lbs in the Conception

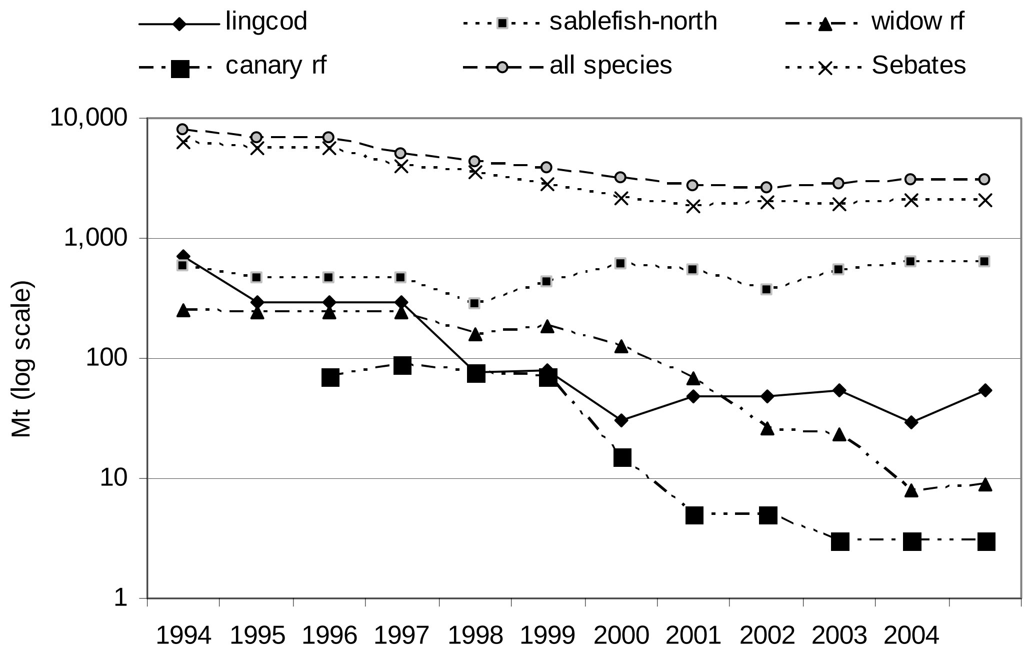


Figure 1-1. Open access fishery harvest guidelines for key groundfish stocks and in total, 1994-2006

area. Two-month cumulative landing limits were used in both areas as a way of slowing the harvest. The monthly equivalent sablefish limits in the northern area at the start of the season ranged from 900 lbs in 1998 to 2,500 lbs for a period in 2006. The comparable limits at the start of the season in the Conception area ranged from 10,500 lbs during 1994-2001 to 4,200 lbs in 2006 (**Table 1-2).** Weekly landing limits were implemented as a way of further slowing the harvest in the northern fishery beginning in 1998 and in the Conception area in 2002

In season actions were routinely taken in both sablefish management areas to stay within HGs. The adjustments were usually made during October-December and usually involved increases in two-month or monthly cumulative landing limits. A major exception was in 2006 when action was taken to reduce the daily/once weekly/two-month cumulative landing limits in the northern area fishery of from 300 lbs/1000 lbs/5000 lbs to 300 lbs/1000 lbs/ 3000 lbs. This was done in May in anticipation of effort shift from the salmon fishery to the directed sablefish fishery because of highly restrictive salmon fishing regulations (see: http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf). However, beginning in October the directed sablefish fishery in the northern area had to be closed due to sablefish HG attainment. This was the only year since the fishery began in 1994 that the directed open access sablefish fishery had to be closed because of HG attainment. The salmon fishery had less restrictive regulations in 2007, which in combination with restrictive sablefish landing limits during summer months of 300 lbs/700 lbs/2100 lbs, may have deflected salmon fleet effort shift to the directed sablefish fishery that year because the sablefish fishery remained open all year.

Lingcod was declared over fished in 1999 and declared rebuilt in 2005. Except for large OY adjustments in 1995 and 1998, the open access fishery lingcod HG ranged from 29 mt in 2004 to 80 mt in 1999 and averaged 53 mt during 1998-2006 (**Table 1-1).** Since 1998 there have been season closures to protect spawning fish. When the season was open for lingcod since 1998 the monthly equivalent landing limit ranged from 250-500 lbs and was typically 300 lbs per vessel-month.

Table 1-2. Daily limits (pounds/day), trip limits (pounds/trip) and monthly-equivalent limits (pounds/month) for groundfish open access participants using open access gear by species category and year, 1994-2006 1/

| Species Category | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Monthly equivalent units for *Sebastes* North and South Taken with Open Access Gear 2/** | | | | | | | | | | | | | |
| *Sebastes* north (Cape Mendocino) | 40,000 | 35,000 | 35,000 | 40,000 | 40,000 | 5,700 | 3,850 | 5,950 | 3,600 | 2,700 | 3,250 | 3,250/ 3,300 | 2,975/ 3,425 |
| Canary | | | | | | 1,000 | 50 | 50 | 0 | 0 | 0 | 0 | 0 |
| Yellowtail | | | | | | 2,600 | 100 | 100 | | | | | |
| Yelloweye | | | | | | | | | 0 | 0 | 0 | 0 | 0 |
| Widow (add-on) | | | | | | 2,000 | 3,000 | 3,000 | | | | | |
| POP (add-on) | | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Minor *Sebastes* | | | | | | 3,600 max | | | | | | | |
| Minor slope rockfish | | | | | | | 250 | 250 | 300 | 400 | 450 | 450 | 375/ 625 |
| Minor shelf rockfish | | | | | | | 100 max | 100 max | 200 max | 200 max | 200 max | 200 max | 0-150 max |
| Minor nearshore | | | | | | | 250 | 1,000 | 1,500 | 600 | 600 | 600 | 600 |
| Black and blue rf (add-on) | | | | | | | 250 | 1,500 | 1,500 | 1,400 | 1,900 | 1,900/ 1,950 3/ | 1,900/ 1,950 3/ |
| *Sebastes* south (Cape Mendocino-Pt. Conception) | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 | 10,100 | 3,925 | 3,300/ 6,500 | 1,100- 6,700 | 850- 1,175 | 650- 1,350 | 650-1,350 | 575-1,525 |
| Canary | | | | | | 1,000 | 50 | 0/50 | 0 | 0 | 0 | 0 | 0 |
| Bocaccio | | | | 2,000 | 1,000 | 500 | 200 | 0/200 | 0/200 | 0 | 0/100 | 0/100 | 0/100 |
| Bocaccio-set/trammel net (add-on) | | | | 4,000 | 2,000 | 1,000 | | | | | | | |
| Yelloweye | | | | | | | | | 0 | 0 | 0 | 0 | 0 |
| Widow (add-on) | | | | | | 2,000 | 3,000 | 0/3,000 | | | | | |
| Chilipepper | | | | | | 6,000 | 2,000 | 0/2,500 | 0/500 | | | | |
| Splitnose (add-on) | | | | | | 100 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Cowcod | | | | | | | 1 fish | 0 | 0 | 0 | 0 | 0 | 0 |
| Minor *Sebastes* | | | | | | 2,000 max | | | | | | | |
| Minor slope rockfish 6/ | | | | | | | 250 | 2,500 | 900- 5,000 | 400 | 450 | 450 | 375/ 625 |
| Minor shelf rockfish | | | | | | | 200 max | 0/200 max | 0/200 max | 50/125 max | 0/150 max | 0/150 max | 0/150 max |
| Minor nearshore rockfish | | | | | | | 275 | 600 | 0/600 | 200-450 | 0-550 | 0-550 | 0-550 |
| *Sebastes* south (S of Pt. Conception) | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 | 10,100 | 3,925 | 3,300/ 6,500 | 5,200/ 6,300 | 5,450- 6,175 | 5,200- 6,250 | 5,200- 6,375 | 5,575- 6,375 |
| Canary | | | | | | 1,000 | 50 | 0/50 | 0 | 0 | 0 | 0 | 0 |
| Bocaccio | | | | 2,000 | 1,000 | 500 | 200 | 200 | 0/200 | 0 | 0/50 | 0/50 | 0/50 |
| Bocaccio-set/trammel net (add-on) | | | | 4,000 | 2,000 | 1,000 | | | | | | | |
| Yelloweye | | | | | | | | | 0 | 0 | 0 | 0 | 0 |
| Widow (add-on) | | | | | | 2,000 | 3,000 | 0/3,000 | | | | | |
| Chilipepper | | | | | | 6,000 | 2,000 | 0/2,500 | 0/2,500 | | | | |
| Splitnose (add-on) | | | | | | 100 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Cowcod | | | | | | | 1 fish | 0 | 0 | 0 | 0 | 0 | 0 |
| Minor *Sebastes* | | | | | | 2,000 max | | | | | | | |
| Minor slope rockfish | | | | | | | 250 | 2,500 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Minor shelf rockfish | | | | | | | 200 max | 0/200 max | 0/500 max | 50/125 max | 0/250 max | 0/375 max | 375 max |
| Minor nearshore rockfish | | | | | | | 275 | 600 | 0/600 | 200- 850 | 0-800 | 0-800 | 0-800 |
| **Daily Limits for Thornyheads Taken with Open Access Gear** | | | | | | | | | | | | | |
| North (Monterey and north) | - | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| South (Conception) | - | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| **Daily and Cumulative Monthly Equivalent Limits for Sablefish Taken with Open Access Gear** | | | | | | | | | | | | | |
| Daily North (Monterey-Vancouver) | 250 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Monthly cumul equiv limits | 7,500 | 9,000 | 9,000 | 1,500 | 900 | 900 | 1050- 1650 | 2,400 | 1,200 | 1,600 | 1,800 | 1,800 | 1,500/ 2,500 |
| Daily South (Conception) | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350/ 300 | 350 | 350 | 350 | 350 |
| Monthly cumul equiv limits | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | 4,200/ 3,600 | 4,200 | 4,200 | 4,200 | 4,200 |
| **Monthly Equivalent Limits for Other Groundfish Taken with Open Access Gear** | | | | | | | | | | | | | |
| Lingcod | | 20,000 | 10,000 | 10,000 | 0-500 | 0/250 | 0/400 | 0/400 | 0/300 | 0/300 | 0/300 | 0/300 | 0/300 |
| Dover sole | | | | | | 100 | 300 | 300 | | | | | |
| Pacific sanddab (flatfish add-on) | | | | | | | 300 | 300 | 2,700 | 2,700 | 2,700 | 2,700 | 2,700 |
| Arrowtooth flounder | | | | | | 200 | 200 | 300 | | | | | |
| Flatfish (all species) | | | | | | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Pacific whiting | | | | | | 100 | 100 | 300 | 300 | 300 | 300 | 300 | 300 |
| **Trip Limits for Groundfish Taken with Non-groundfish Trawl Gear** | | | | | | | | | | | | | |
| Pink shrimp | 1,500 | 1,500 | 1,500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| Spot/ridgeback prawn | 1,000 | 1,000 | 1,000 | 500 | 500 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| CA halibut/sea cucumber | 500 | 500 | 500 | 500 | 500 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| **Monthly Cumulative Limit for Yellowtail Rockfish Taken with Salmon Troll Gear 4/** | | | | | | | | | | | | | |
| North of Cape Mendocino | | | | | | | | | | | 200 | 200 | 200 |

1/ These are January-February adopted landing limits and do not reflect in-season change to keep within harvest guidelines; "max" means limit applies to all shelf species, excluding widow.

2/ Separate *Sebastes* limits were set north and south of Point Lookout OR in 1994, and north and south of Cape Mendocino, CA since 1995. In addition to being subject to cumulative landings limits, *Sebastes* north and south were subject to a 10,000 pound trip limit.

3/ An additional 500 lbs of black and blue rockfish was allowed in the area between Cape Mendocino and the CA/OR border, which is not shown in the table.

4/ 1 lb of yellowtail could landed with every 2 lbs of salmon up to the monthly limit.

www references:

1994-2001:http://www.pcouncil.org/groundfish/gfsafe0702/tbl29.pdf

2002: http://www.nwr.noaa.gov/Publications/FR-Notices/2002/upload/67FR1555.pdf

2003:http://www.nwr.noaa.gov/Publications/FR-Notices/2003/upload/68FR936.pdf

2004: http://www.nwr.noaa.gov/Publications/FR-Notices/2004/upload/01-08-04_Measures04Mar-Dec_PropRule.pdf

2005-2006: http://www.nwr.noaa.gov/Publications/FR-Notices/2004/upload/69FR77012_2005-2006MgmtMeasures.pdf

Landing limit management of all groundfish in the non-groundfish trawl fisheries went through three phases of landing limit reduction during 1994-2006. The first was in 1997 when the pink shrimp and prawn fishery limit were each reduced from 1,500 lbs and 1,000 lbs per month, respectively, to 500 lbs per month each, which made them the same as the California halibut and sea cucumber fishery limits. The second change was in 1999 when the prawn fishery and halibut and sea cumber limits were reduced to 300 lbs per vessel per month. In all years, the non-groundfish trawl fisheries could not land more groundfish than the target species. A yellowtail rockfish incidental landing allowance of up to 200 lbs per vessel per month was allowed in the salmon troll fishery north of Cape Mendocino beginning in 2004 (**Table 1-2 ).**

The Council and NMF have used a two prong approach to protecting depleted and overfished groundfish stocks: 1) reductions in ABCs and OYs of overfished stocks and associated species, as discussed above, and 2) adoption of large conservation areas wherein fishing methods or allowable gear types are regulated in order to protect particular species or species groups of fish and their habitats. Pacific Coast groundfish fisheries, and fisheries that may take groundfish incidentally, are managed with a variety of closed areas intended to either minimize the bycatch of overfished groundfish species, or to protect groundfish habitat. Many of the closed areas are gear-specific, meaning that they are closed to some particular gear types, but not others. In addition, the states of Washington, Oregon and California have marine areas closed to fishing that provide addition protection to depleted groundfish stocks. The Yelloweye Rockfish Conservation Areas off the northern Washington Coast was the first large conservation area adopted by the Council to provide added protection to depleted yelloweye rockfish. This was in 1998. The next large groundfish closure areas were the southern California Cowcod Conservation Areas in 2001; followed by the coastwide Rockfish Conservation Areas in 2002, the Farallon Islands Closed Area off Central California in 2004; and the Cordell Banks Closed Area off Central California in 2005. These closed areas have differing fishery impacts depending on gear type used. **Appendix G** provides details on the regulations for the groundfish conservation areas.

The effect of declining rockfish OYs, associated reductions in rockfish landing limits and the use of conservation areas to provided added protection to overfished rockfish stocks are discussed in **Section 3.**

### 1.4.2 Groundfish Strategic Plan

The Council's Groundfish Strategic Plan (Plan) was adopted in 2000. The Plan noted that the groundfish resource could not support the number of vessels catching and landing groundfish, which numbered over 2,000 commercial fishers, and many thousands of recreational anglers. To bring harvest capacity in line with resource productivity, the number of vessels in most fishery sectors needed to be reduced by at least 50%. Fishing fleet overcapitalization had been a major factor in fish stock depletions and led to economic and social crises in the industry and in coastal communities. The Plan reported that

> "...allowing an open access fishery with a total absence of limits on capacity is a serious management problem. Decreased participation in non-groundfish fisheries such as salmon, improved prices for some groundfish species like sablefish, and the development of the live rockfish fishery had transformed the open access fishery from a primarily bycatch fishery with a small directed fishery component, to a much larger fishery with many more participants relying on the fishery for large portions of their annual incomes. Reducing capacity in the fishery is fundamentally necessary to reducing overfishing, minimizing bycatch and improving the economic outlook for the Pacific Coast fishing industry. Capacity reduction should not be seen as just another type of management measure. Capacity reduction must be a key element of any plan to ensure management effectiveness and economic viability of the Pacific Coast groundfish fishery. Without significant capacity reduction, the Council will continue to find it difficult, if not impossible, to achieve many of the conservation and economic objectives of the Groundfish FMP. Current capital utilization rates are quite low for all sectors of the commercial groundfish fishery."

The Council's Scientific and Statistical Committee (SSC) compared potential harvest capacity for the fish actually available for harvest in 2000 and calculated a measure of overcapitalization in several different fishery sectors which they called "current capital utilization rate." This parameter was used to describe the percentage of vessels in the current fleet that could harvest the available groundfish. They sorted vessel landings data by fishery sector for each year during 1984-1992 in descending order of total annual and cumulative groundfish landings and counted down the vessel list from the more to less productive vessels to determine the number of vessels needed each year to harvest the available groundfish. They used 1984-1992 for this comparison because vessel harvest constraints were much less restrictive in those earlier years and catches from those years seemed to be a better indicator of what vessels were able to harvest. The number of open access vessels needed to harvest the 2000 open access groundfish OY of 2,207 mt ranged from 47 to 105 boats (**Table 1-3**). Based on these results, 50 and 100 were used as lower and upper estimates of the number of open access boats needed to harvest the 2000 open access groundfish allocation. Dividing the lower and upper limits of the number of vessels needed to harvest the 2000 open access OY by 794 vessels (the number of active directed open access fishery participants in 2000) yielded an open access capital utilization rate of 6%-13%

Table 1-3. Estimates of number of open access directed fishery "highliners" needed to harvest the 2000 non-whiting groundfish OYs. Source: SSC 2000.

| Year | # Vessels | Cumulative Mt |
|---|---|---|
| 1984 | 13 | 2,222 |
| 1985 | 25 | 2,218 |
| 1986 | 52 | 2,222 |
| 1987 | 53 | 2,208 |
| 1988 | 83 | 2,214 |
| 1989 | 83 | 2,212 |
| 1990 | 105 | 2,215 |
| 1991 | 69 | 2,224 |
| 1992 | 47 | 2,218 |

Since the SSC analysis was done the number of vessels participating in the directed open access fishery has either been higher than or about the same level as it was in 2000 (see **sections 2 and 3)**. However, the open access fishery OY for all species has substantially declined which indicates that fishery overcapitalization is even greater today than it was in 2000 (**Table 1-1)**. Updated vessel participation and harvest data are presented in **Section 3.3**.

The Plan also recommended that the Council consider deferring management of nearshore rockfish, and other species such as cabezon, kelp greenling and California scorpionfish to the states, and that all commercial fisheries should eventually be limited through federal or state license or permit limitation programs.

### 1.4.3 Strategic Plan Implementation Oversight Committee

Following adoption of its Strategic Plan, the Council convened the Strategic Plan Oversight Committee (SPOC) to monitor the Council's progress toward the goals of the Strategic Plan. The SPOC developed a list of 15 groundfish action priorities, which included two "critical" elements (science and Council process action items) for Council consideration. The open access permitting issue was ranked seven below the two critical operational elements, buyback, trawl permit stacking (a provision to allow for the use of two or more permits to provide for increased landings by a single vessel), observers, groundfish process, and fixed gear stacking. A subcommittee of the SPOC was formed to look at open access capacity reduction issues, the Ad-Hoc Open Access Permitting Subcommittee (OAPS).

The OAPS first met in January 2001 and continued with a series of meetings through March 2002. These meetings ceased for the remainder of 2002 due to increased Council's workload on other higher priority issues. However, the Council reviewed its progress with Strategic Plan recommendations in November 2002 and decided at that point that it would begin development of an open access permitting program and drafted the associated analysis for such a program in 2003. The proposed FMP amendment was intended to meet the Strategic Plan goal of reducing capacity in the open access fisheries landing groundfish and to meet the Council's commitment to an open access permitting program. Considerable advisory body and public input was provided in response to meetings of the OAPS (subsection 1.5, Scoping Process). A summary of findings from the analysis of 1990-2001 open access groundfish fishery data provided to the OAPS is presented in Appendix A. Based on groundwork laid by the SPOC and OAPS, NMFS staff led a joint Council/NMFS working session to identify key issues and concerns that would need to be addressed in developing a plan amendment for conversion of the open access fishery to limited entry management. Based on those discussions, the NMFS staff began initial drafting of an EIS to support deliberations on the issue. The first chapter of that document was provided to the Council at its November 2003 meeting (PFMC 2003). That draft "first step" document was used in preparing this preliminary draft Environmental Assessment (EA).

## *1.5 Scoping Process*

The Council has been conducting scoping on the issue of requiring permitting in the open access fisheries since January 2001. Both the scoping activities and public issues and concerns regarding this action that were conducted or expressed prior to the preparation of this EA are described below.

### 1.5.1 Council Meetings

JANUARY 2001

The Open Access Permitting Subcommittee (OAPS) of the Strategic Plan Oversight Committee (SPOC) had its first meeting via teleconference on January 18, 2001. The OAPS initially identified two fishery strategies wherein open access vessels were directly targeting groundfish: directed hook-and-line fisheries and directed setnet fisheries. Additionally, the OAPS identified the following gear types as being used to take groundfish incidentally in the open access fisheries: exempted trawl gear (non-groundfish trawl gear), salmon troll, halibut longline, non-directed setnet fisheries. The OAPS also noted that several of these fisheries are geographically distinct, which should be taken into account when developing initial permitting and allocation strategies. Finally, the OAPS recommended that the Council form a policy group to explore developing a restricted access program for the open access fisheries.

APRIL-MAY 2001

At the April 2001 Council meeting, the Council provided guidance for the SPOC on capacity reduction issues, but only briefly discussed license limitation in the open access fisheries. The OAPS met in April 2001 and the SPOC in May 2001, with both groups providing minutes to the Council at the Council's June 2001 meeting. At this meeting, the OAPS discussed setting a priority for introducing permitting for the directed fisheries for groundfish, with permitting for the incidental fisheries being a lower priority. The OAPS also reviewed Dr. James Hastie's "Analysis of Open Access Fishery," an analysis of groundfish landings data, which provides a profile of groundfish catches occurring in the open access fisheries (Hastie 2001). Following this review of Hastie's fleet profile, the OAPS composed six questions that it felt the Council should consider before embarking on a permitting program for the directed open access fisheries. OAPS recommendations from this meeting were reviewed by the SPOC at its May 2001 meeting, but the SPOC made no recommendations on this issue other than that the OAPS material should be provided to the Council and public at the June 2001 Council meeting.

JUNE 2001

At the June 2001 Council meeting, the Council discussed the results of the meetings of the OAPS and the SPOC and the various priority actions in the Strategic Plan. During Council discussions, members of the Council recommended that the Council proceed first with developing a directed groundfish permit for those vessels currently in the open access fisheries that target groundfish directly, and then look at fisheries that take groundfish incidentally. Council members further commented that one of the most important issues in considering a license limitation program for the open access fisheries is allocation between the different fisheries. There was some concern from Council members that this program might take too much time in an already overburdened schedule. The Council's Groundfish Advisory Subpanel (GAP) also commented on this issue at this meeting, noting that limiting access in the open access fisheries will take a lot of time and effort and that the states are already proceeding with license limitation in their nearshore fisheries. However, both of the open access fishery representatives on the GAP were in favor of proceeding with license limitation for the open access fisheries.

JULY--AUGUST 2001

The OAPS met on July 31, 2001 to discuss the Council's recommendations from their June meeting. At that meeting, the OAPS reviewed Dr. Hastie's analysis of historical fishing activities within the open access fleets, discussed whether the states could help with developing this program by providing state-level profiles of their open access fisheries, discussed whether it would be more or less complicated to include fisheries that incidentally take groundfish in the whole-fleet profile, discussed whether the program should include an allocation between directed and incidental open access groundfish fisheries, and provided outlines of nearshore groundfish management off each of the three states. The SPOC met on August 30, 2001, and discussed all of the Strategic Plan's priorities, including license limitation in the open access fisheries and the July OAPS meeting. The SPOC made the following recommendations for the Council's consideration at its September meeting: Council staff's Executive Director to provide a report on funds available for Strategic Plan implementation at the Council's October/November meeting; a meeting of the OAPS should be held after the October/November meeting; Dr. Hastie should continue development of a historical analysis of participation and catch in open access fisheries; the SPOC will re-consider whether to develop an incidental groundfish permit (for nontargeting open access fisheries) after the historical analysis is complete.

SEPTEMBER 2001

The Council discussed the results of the OAPS and SPOC meetings held over the summer, but did not address open access license limitation beyond recommending that the OAPS hold another meeting after the October/November Council meeting. The Council's GAP commented only that work on this issue should be delayed until after the October/November Council meeting.

JANUARY 2002

The OAPS met January 30-31, 2002 and reviewed the FMP's goals for the original limited entry fishery, modifying it for license limitation in the open access fisheries so that it reads, "The primary objective of the limited entry program will be to match harvest capacity in the Pacific Coast groundfish fishery with the productivity of the resource." The OAPS also detailed objectives for a new license limitation program: to allow sustainable prosecution of fisheries for non-groundfish species without groundfish waste; and to set qualification criteria for a license limitation program high enough to reduce the number of vessels being licensed, then to bring both the current open access harvest allocations and the newly licensed vessels into the limited entry program. The OAPS also provided further data requests to NOAA Fisheries analysts for dividing historical open access landings data by fishery, geographic area, and gear type.

MARCH 2002

At its March 2002 meeting, the Council discussed Strategic Plan implementation, including license limitation in the open access fisheries. The OAPS report to the March Council meeting was intended to be a draft report, with the final available at the April 2002 Council meeting.

APRIL 2002
During its April 2002 meeting, the Council again discussed Strategic Plan implementation, with a more full report from the OAPS January meeting. At this meeting, a Council member recommended including a qualification criteria option proposed by a member of the public: that open access vessels be allowed to join the limited entry fishery based on landings made by gears other than the three limited entry gears (trawl, fishpot, longline) during the limited entry qualifying period of 1984-1988. At this meeting, the GAP commented only that the issues and alternatives associated with open access license limitation had not been fleshed out well enough for a comprehensive analysis on the effects of a new license limitation program.

NOVEMBER 2002
At its November 2002 meeting, the second anniversary of the Council's adoption of the Strategic Plan, the Council reviewed all of its Strategic Plan priorities. On the issue of open access license limitation, the Council recommended that an open access permitting development team meet to develop options for a moratorium permit for directed open access groundfish fisheries. Permits would be based on minimum historic participation, non-transferable, renewable, interim until a formal limited entry program were developed. At this meeting, the Council's Groundfish Management Team (GMT) commented that converting the directed open access fishery to a limited entry fishery has been a priority of the GMT for many years; however, the GMT also noted that there were ongoing state efforts to limit commercial groundfish fisheries participation. With state license limitation programs in place, only groundfish occurring outside of the three-mile state boundary, primarily sablefish and southern slope rockfish, would remain directed open access fisheries. Finally, the GMT noted that converting open access vessels to a permitted fleet would offer other management benefits, particularly because it would allow managers and enforcement agencies to better identify fleet participants for vessel monitoring system and observer program coverage. The GAP noted the state license limitation efforts could reduce open access directed groundfish fisheries participation coastwide and recommended that the Council continue regular meetings of its OAPS.

MARCH 2003
No discussion of OA permitting (except under workload priorities).
(http://www.pcouncil.org/minutes/2003/0303min.pdf).

SEPTEMBER 2003
Under agendum B.7.c. Council Member Robinson reported he will have comments on open access at the November meeting.  Council Member Vojkovich noted resolving the open access problem is imperative in CA.  Dr. McIsaac said this item is moving up in the priorities and suggested taking the open access agenda item update and turning it into a planning session.
(http://www.pcouncil.org/minutes/2003/0903min.pdf).

NOVEMBER 2003
Agendum D.15 addressed Open Access Limitation Discussion and Planning.  Council staff presented the overview.  Council Member Brown noted we still need to define the "directed" open access fishery.  Council Member Vojkovich suggested working on the issue over the winter and to have a phone call in January (agendum I.4.).  NMFS staff presented an initial start at a NEPA document (see: http://www.pcouncil.org/bb/2003/1103/exd15.pdf).  Open Access Limitation update was proposed for April and June 2004 meetings (http://www.pcouncil.org/bb/2003/1103/exi4.pdf).  Council members expressed concern about continuation of unrestricted participation in the open access fishery and displacement of open access effort onto the shelf with implementation of the state nearshore limited entry system. There are several ways to approach the problem. One would be to move forward with a

moratorium permit. It was also agreed it was premature to discuss a new control date at this point and the issue needed to be addressed in terms of staff workload.

APRIL 2004
The Council discussed elevating the OA permitting issue but noted there were still other high priority issues to deal with, such as inseason management policies

SEPTEMBER 2004
Under B.8.d. Council Member Vojkovich asked if NMFS policy for handling fishing capacity had funds with it to support the OA permitting initiative. It is noted under C.11.d that identification of open access vessels is not possible in the VMS system. (http://www.pcouncil.org/minutes/2004/0904min.pdf).

APRIL 2005
The Council discussed whether the open access VMS requirement would reasonably address the need for permitting the OA fisheries. It was noted that most vessels that target groundfish operate in state waters which would be exempt from the VMS requirement. The Council considered adopting a control date for the longline spiny dogfish fishery which led to a discussion about the overall need for OA fishery permitting.

SEPTEMBER 2005
Motion was passed to look at fishery impacts from expanded fishing on spiny dogfish by longliners under open access landing limits. Support was expressed to find time to work on OA permitting.

NOVEMBER 2005
The Council discussion regarding regulatory streamlining led to OA permitting issues and that it may be useful to begin documenting the steps that would be involved and develop a concrete plan, which would be like the groundfish harvest specifications planning schedule, but more fleshed out. Thus it could be a candidate for this regulatory streamlining exercise. The Council also discussed OA permitting in the context of groundfish work planning, bycatch reduction and the need to identify OA vessels and estimate their catches.

MARCH 2006
OA Permitting suggested for June 2006 meeting.
http://www.pcouncil.org/bb/2006/0306/agb5a_supp_att1.pdf

APRIL 2006
OA Permitting issue moved from June to September 2006 meeting:
http://www.pcouncil.org/bb/2006/0406/agb5a_supp_att1.pdf

JUNE 2006
Council member Moore stated that the open access limitation issue needs to be done to be able to complete trawl individual quota and intersector allocation issues.

SEPTEMBER 2006
The Council and NMFS discussed the effectiveness of the November 1999 open access permitting control date. Legal Council noted that control dates are public notices of possible Council action and have no regulatory effect. Also, control dates do not preclude the use of earlier catch histories for issuing permits. The Council moved to set a new control date of September 13, 2006 to give people notice that landings after that date may not apply to catch history used to qualify for an OA limited entry permit. Council member Vojkovich, California, offered staff to undertake the plan amendment analysis and paperwork because a full-time Council member staff position would be needed to do the work. The GMT reported

that they are in favor of reducing the size of the OA fleet and that a federal permit is recommended. The GAP prioritized open access limitation behind trawl individual quotas, intersector allocation and Amendment 15. The Enforcement Consultants (EC) reported that VMS will not identify all open access participants because VMS only applies in federal waters. The Council members expressed a wish for a simple program but noted public input will likely be substantial which could complicate the matter. The Council expressed support to get the process started in 2007. NMFS noted the observer program would be more effective with all sectors under a federal permit. Legal Council noted a NEPA analysis would be required, but it may not need to be an environmental impact statement.

MARCH 2007
Open Access Limitation issue tentatively placed on June 2007 agenda, described as "Next Steps." (http://www.pcouncil.org/bb/2007/0307/Ag_D1.pdf).

APRIL 2007
CDFG Report (Agendum C.1.a, supplemental CDFG report) submitted requesting June 2007 agenda item for Open Access Permitting. Issue is on June 2007 agenda for "Direct Development of Alternatives." (http://www.pcouncil.org/bb/2007/0407/C.1a_CDFG_sup.pdf).

JUNE 2007
The Council and NMFS heard a CDFG report on the status of open access fisheries and recommendations for the implementation of B and C permit programs for directed and incidental fisheries, respectively (http://www.pcouncil.org/bb/2007/bb0607.html#groundfish0. A menu of permitting alternatives was recommended, each of which required differing degrees of directed fishery fleet size reduction (Agenda Item E.4.a, Attachment 2). The recommendations were based on a combination of sources including an open access fishery capacity analysis produced by the Economic Subcommittee of the Council's SSC (PFMC 2000), public scoping at Council meetings since 1998, input from Council advisory committees, and member states' and NMFS input at those same meetings. NMFS reported that the proposed Purpose and Need statement for the initiative appeared to be adequate, and that an Environmental Assessment should be the appropriate NEPA path for regulation adoption. The Council received advisory body and public input at the meeting and expanded upon the range of alternatives for further analysis. The Council adopted an FMP amendment schedule with a 2009-2010 management cycle target implementation date (Agenda Item E.4.a, Attachment 1), the CDFG recommendations menu, three additional fleet size alternatives (including a GAP socio-economic recommendation), and a provision for less restrictive permit transfer conditions. (http://www.pcouncil.org/decisions/currentdec.html#groundfish).

SEPTEMBER 2007
Further action on open access permitting was postponed from the November 2007 Council meeting agenda until 2008 because of Council workload.

### 1.5.2 Public Comments from Council Meetings

APRIL - MAY 2001
The Council held a discussion and public comment session at its April 2001 meeting for the activities of the SPOC, which included discussions of license limitation for the open access fisheries. Public comment during that session included: an offer by a non-profit organization to create a fleet effort profile of where fishing activities take place; concern expressed that reduction of the groundfish fleet as a whole would require allocation between different users; observation that, under the Strategic Plan, all sectors of the fleet are to be reduced by 50%; comment that Council's current advisory committee structure might not be the most useful for moving the Council forward through SPOC priorities. Public comment at the May 2001 SPOC meeting was limited to a request that OAPS materials be provided to the Council's advisory bodies and the public prior to the June Council meeting.

JUNE 2001

During the public comment session at the Council's June 2001 meeting, public comment addressed open access fisheries license limitation: participation in the open access fisheries be not merely capped, but be reduced by 50%, as recommended in the Strategic Plan; if effort is only capped in the open access fisheries, not reduced, groundfish trip limits will remain at such low levels that groundfish will not provide reasonable income levels for participants; people come and go in open access fisheries all the time, many part-timers get involved who then fail; a license limitation program will be politically challenging for the Council and the fishing communities, but it is essential nevertheless; permits should be issued to vessels, rather than to persons as is done in the California nearshore plan; qualification criteria should be sufficiently high enough to cut the fleet down to about 300-350 boats, with consideration for the years before the control date, 1994-1999, perhaps some combination of annual or cumulative landings levels along with participation in at least 4 out of 6 years, or similar; salmon fishermen do encounter groundfish and they would like to continue to have access to groundfish, regardless of how the open access license limitation program comes out, perhaps by limiting groundfish take by allowing so many pounds of groundfish per pounds of salmon taken.

JULY--AUGUST 2001

Public comment at the OPAS meeting in July 2001: Concern was expressed about 1) providing for a directed groundfish fishery 2) allocation of open access groundfish between the directed and incidental sectors which could result in lower landings limits and in increased discards, and 3) permitting of vessels with small catch histories. Members of the public attending the August 2001 SPOC meeting did not comment on the open access license limitation issues.

SEPTEMBER 2001 - MARCH 2002

At the September 2001 Council meeting, the public did not have specific recommendations on license limitation in the open access fishery, although there were comments on other aspects of the Strategic Plan. Similarly, the public did not specifically provide comments on open access license limitation at the March Council meeting, except that one commenter expressed disappointment that capacity reduction issues seem to be falling lower and lower on the Council's priority list.

APRIL 2002

Public comments at the April 2002 Council meeting on license limitation for the open access fisheries: 1) knowing the time it took to implement the original limited entry permit program, it doesn't seem possible to implement a new license limitation program for another five years; 2) if there's going to be a new license limitation program for the boats now in the open access fisheries, all of the fish allocated to the open access fisheries with the original limited entry program should be shifted to the limited entry fisheries; 3) failing to eliminate the open access fishery in 1994 was a mistake and fixing it with another limited entry program would be a bigger mistake; 4) the Council should consider the option of closing the directed portion of the open access fleet by 2004, allocating the necessary portion of the open access quota to the open access incidental fisheries and redistribute the remainder of the open access quota to the existing limited entry fleet and recreational fisheries; 5) he alternative of eliminating the directed open access fleet altogether would be an FMP amendment that would allow vessels using gears other than the three limited entry gears to purchase a limited entry permit and convert that permit's gear endorsement to their non-limited entry gear, additionally; 6) new "A" permits should be issued to groundfish directed fishing vessels that met the original limited entry qualifying criteria during the qualifying period with gear other than the three limited entry gears; finally, 7) the goals and objectives that you've set for yourself cannot be met with limited entry programs and trip limit management alone.

NOVEMBER 2002

At the November 2002 Council meeting, the public did not have specific recommendations on license limitation in the open access fishery, although there were comments on other aspects of the Strategic Plan.

JUNE 2005
Public comment was made during Public Comment that the time is right to revisit the open access permitting issue**.**

JUNE 2007
Public comments were received on the CDFG recommendations for open access permitting alternatives: Need to protect "drop-in" fishermen; Support initiative, but no big fleet size reduction is necessary, reductions will adversely affect communities, cap fishery at reasonable number; Industry should have prepared document not biologists, support GAP statement, not possible to match capacity with resource because resource abundance is not known; add one meeting to adoption process and move issue forward, allow A boats to use B permits; B permits will result in ports w/o fishermen, permits should be assigned to ports; No need for permits, more fish than you think, give 20-yr fishermen permits; Give permits to all vessels since 1994, make permits non-transferable and give property rights based on historic catches.

SEPTEMBER 2007

### 1.5.3 State Meetings

**CALIFORNIA**
The California Department of Fish and Game (CDFG) held four small focus group meetings in July and August 2007 to discuss the federal open access permitting process and get a better understanding of the needs and perspectives of California fishermen. The concerns were very similar among the groups. Several individuals wanted the catch history to go the individual instead of the vessel because state permits are issued to the individual as opposed to the vessel. Many individuals preferred status quo management without any changes to the current fishery, but if changes had to be made they preferred capping the fleet size at the current level and any qualifying criteria be set low enough to allow most participants to qualify. Other individuals felt that the sablefish fishery should be permitted and other species left alone.

**OREGON**
Oregon held three public meetings in September of 2007 and one in October at which the possibility of an Open Access limitation program was mentioned however specific details and alternatives were not discussed at any length. Oregon will conduct meetings prior to final action to inform and receive public input about the Open Access limitation program.

**WASHINGTON**
Washington held a public meeting on January 9, 2008. The primary purpose of the meeting was to review the options and process being considered by the Pacific Fishery Management Council (PFMC) for converting the open access groundfish fishery to a federal limited entry permitted fishery.

## *1.6 Related NEPA Analyses*

Other recent NEPA documents prepared for the Pacific Coast groundfish fishery provide detailed information pertaining to the open access groundfish fishery. These NEPA documents are listed below. 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.

- Expanded Coverage of the Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery, Final Environmental Assessment (NMFS 2006)

- The Pacific Coast Groundfish Fishery Management Plan, Essential Fish Habitat Designation and Minimization of Adverse Impacts, Final Environmental Impact Statement (NMFS 2005)

- Proposed Acceptable Biological Catch and Optimum Yield Specifications and Management Measures for the 2007-2008 Pacific Coast Groundfish Fishery and Amendment 16-4: Rebuilding Plans for Seven Depleted Pacific Coast Groundfish Species; Final Environmental Impact Statement Including Regulatory Impact Review and Initial Regulatory Flexibility Analysis (PFMC and NMFS 2006)

## 2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section details the alternatives analyzed in subsections 2.1 [Alternative 1 (No-action)] through subsection 2.6 (Alternative 6) and describes those that were rejected from further analysis in subsection 2.7 (Alternatives Considered but Rejected for Further Analysis) . *While each alternative reads as a complete program option, the components of each alternative could potentially be mixed and matched to create an open access licensing program.*

The key issues to be considered in the alternatives for permit management of the open access fishery include (1) limitation on the number of fishery participants in the directed open access fishery and (2) registration of all other open access fishery participants. Limiting the number of vessels in the directed fishery is important for stabilizing harvest opportunity in the permitted fleet and to prevent fishing effort increases during times of increased groundfish availability or demand. Registration of all open access fishery participants is important for projecting fishery impacts and providing for year-round fishing opportunity. Alternative 1 would maintain current management of the open access fishery. Alternative 2 considers a licensing system for all open access fishery participants but does not limit participation. Alternatives 3 through 6 consider a limited entry program with a B permit program for the directed fishery participants and a C permit program for vessel owners that do not qualify for a B permit and that may want to land B species groundfish caught incidentally to fishing operations for non-federal groundfish species. Basic conditions and assumptions regarding issuance and application of B and C permits are explained in **Table 2-1**.

Table 2-1. Basic conditions and assumptions regarding B and C permit programs

1. A major aim of the B permit program would to better match fishing fleet capacity with resource availability.

2. B permits would be assigned to vessels to be consistent with the existing Limited Entry or A permit program.

3. B permits would be issued to *current owners* of vessels that have qualifying *directed* groundfish landings during the window period of 1998-September 2006.

4. A directed open access fishery landing is one in which >50% of the total revenue was of B species groundfish and directed fishery gear was used. Only directed fishery landings of B species groundfish would be considered for B species permits.

5. B permits would apply to the directed taking and landing of all federal groundfish *not including nearshore rockfish, cabezon, kelp greenling and California scorpionfish* (nearshore groundfish*),* which would continue to be protected or managed under state regulations with more restrictive possession and landing limits than federal limits. There would be no federal permit requirement to take nearshore groundfish (since few of these fish occur in federal waters). State nearshore permits may not be used in lieu of obtaining a B permit. NMFS would continue to set catch limits for nearshore groundfish unless management authority is transferred to the states.

6. A vessel must be registered to a C permit to land incidental amounts of federal groundfish excluding nearshore species. A state-issued nearshore permit registered to the vessel or in possession of a fisherman on board the vessel could be used in lieu of obtaining a federal C permit when fishing for and possessing federal groundfish in state or federal waters.

7. Valid B and C permits or state-issued nearshore permits would be required when fishing for, possessing and landing permitted species from US waters off the coasts of Washington, Oregon and California. State nearshore permits may not be used in lieu of obtaining a B permit.

8. The existing biennial regulatory process would be used to manage the B and C permit programs, with in-season adjustment of daily and cumulative landing limits used to keep fisheries within harvest guidelines. Incidental fishery (C permit) landing limits would take into account target species landings (i.e., nearshore or non-groundfish landings). Directed fishery (B permit) limits would be set based upon attainment of open access fishery harvest guidelines and not tied to associated species landings or impacts, except to protect depleted or protected marine resources.

9. That state regulations would continue to be in compliance with federal regulations for the taking, possessing and landing of federal groundfish. This would extend to the application of federal permit requirements to vessels and fishermen fishing in state waters and landing catches at state ports.

10. B permits would be renewed annually and be revocable by NMFS; expired permits would not be renewed. C permits would be applied for annually, but vessel owners do not forfeit their right to a C permit by not renewing in a given year. Timing of annual B permit application would align with current A permit renewals (fall of year prior). C permit issuance would be year-round and effective the next cumulative limit period.

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A directed open access fishery landing is defined as one in which directed fishery gear (non-salmon hook and line, fishpot, and setnet) was used and specified groundfish revenue was >50% of the total revenue from all fishery products on the same trip as recorded in the PacFIN data base of the Pacific States Marine Fisheries Commission. Landings data were used as a proxy for actual fisherman harvest strategy. This definition is consistent with previous open access fishery studies (**Goen and Hastie 2002; Burden 2005**) but is not the same as the approach used by the Council's Intersector Allocation Committee (IAC). The IAC uses weight of fish in the landing rather than revenue as the metric for defining a directed open access fishery landing. The IAC also uses different criteria for assigning landings to the Limited Entry and open access sectors (**John DeVore 2007**). Open access fishery data were analyzed to compare the weight and revenue based approaches for defining directed fishery landings. The weight-based and revenue-based approaches produced nearly identical results for all B permit groundfish species except sharks and miscellaneous (other) species. The latter are relatively high volume, low value groundfish species (**Appendix B).** Based on this analysis, the work group believes that a revenue-based criterion is appropriate for the purpose of the current document and should not compromise the findings and recommendations of the IAC.

As discussed above in subsection 1.5, Scoping Process, the Council has a long history of evaluating excess capacity in the open access fisheries and making recommendations on the levels of capacity that might be suitable to ensure that ongoing vessel participation levels in the fishery are more compatible with available harvest. Alternatives 3 through 6 collectively consider a window period of April 1998—September 2006[2] for permit qualification, as approved by the Council at its June 2007 meeting. These years were chosen because April 9, 1998 was the initial open access fishery control date (63 FR 53637, October 6, 1998) and September 13, 2006 was the most recent control date (71 FR 64216, November 1, 2006). These dates reflect participation in the fishery for about a decade. Each of these alternatives is based on one or more Council assessments of appropriate fishery participation levels. Alternative 3 would capture the fleet size set by market forces during some of the years when the overall groundfish fisheries were most constrained by overfished species rebuilding measures. Alternative 5 is based on a 2000 fishery capacity socio-economic analysis by the Council's SSC of what groundfish fleet sizes might be if they were better matched with then-available harvest levels. By contrast, Alternative 4 requires a new socio-economic analysis to determine the appropriate fleet size based on the contemporary needs of fishing communities.

Alternative 6 is similar to Alternative 3, in that it chooses a fleet size goal from those vessels with concentrated B species landings, but it takes its fleet size goal from a series of earlier years, 1994-1999.

Nearshore rockfish, cabezon, kelp greenling and California scorpionfish (nearshore species) are removed from any federal license or permit requirement in Alternatives 2 through 6. This was done because these species predominately occur in state waters, and because the states manage and regulate or affect the take of those species (see **Appendix D** for information on the states' nearshore management efforts).

[2] Throughout this document "window period" means April 1998-September 2006; 2004-2006 window period years means January 1, 2004-September 2006.

Therefore, removal of these nearshore species avoids duplicate licensing or permitting requirements between state and federal agencies for fishermen or vessels. The remaining groundfish species include species groups that are identified in Federal regulation at 50 CFR Part 660 as shelf and slope rockfish, roundfishes, flatfishes, sharks, and other species (**Table 2-2).**

**Table 2-2. Listing of Federal Groundfish Species including Ones Proposed for New Federal Permit Program (B Species Program)**

**Nearshore rockfishes:** All proposed for exclusion from federal B permit program

*Overfished species*: None identified

*Minor Nearshore Species*: black rockfish (*Sebastes melanops*), black-and-yellow rockfish (*Sebastes chrysomelas*), blue rockfish (*Sebastes mystinus*), brown rockfish (*Sebastes auriculatus*), calico rockfish (*Sebastes dalli*), California scorpionfish (*Scorpaena guttata*), China rockfish (*Sebastes nebulosus*), copper rockfish (*Sebastes caurinus*), gopher rockfish (*Sebastes carnatus*), grass rockfish (*Sebastes rastrelliger*), kelp rockfish (*Sebastes atrovirens*), olive rockfish (*Sebastes serranoides*), quillback rockfish (*Sebastes maliger)*, and treefish (*Sebastes serriceps*)

**Shelf rockfishes:** All proposed for inclusion in federal B permit program

*Overfished species*: bocaccio (*Sebastes paucispinis*) (South of Cape Mendocino), canary rockfish (*Sebastes pinniger*), cowcod (*Sebastes levis)* (South of Pt. Conception), widow rockfish (Sebastes entomelas), and yelloweye rockfish (*Sebastes ruberrimus*)

*Minor Shelf Species*: bronzespotted rockfish (*Sebastes gilli*), chameleon rockfish (*Sebastes phillipsi)*, chilipepper rockfish (*Sebastes goodei*), dusky rockfish (*Sebastes variabilis*), dusky rockfish (*Sebastes ciliatus*), dwarf-red rockfish (*Sebastes rufianus*), flag rockfish (*Sebastes rubrivinctus*), freckled rockfish (*Sebastes lentiginosus*), greenblotched rockfish (*Sebastes rosenblatti*), greenspotted rockfish (*Sebastes chlorostictus*), greenstriped rockfish (*Sebastes elongatus*), halfbanded rockfish (*Sebastes semicinctus*), harlequin rockfish (*Sebastes variegatus*), honeycomb rockfish (*Sebastes umbrosus*), longspine thornyhead (*Sebastolobus altivelis*), Mexican rockfish (*Sebastes macdonaldi*), pink rockfish (*Sebastes eos*), pinkrose rockfish (*Sebastes simulator*), pygmy rockfish (*Sebastes wilsoni*), redstripe rockfish (*Sebastes proriger*), rosethorn rockfish (Sebastes helvomaculatus), rosy rockfish (*Sebastes rosaceus*), shortbelly rockfish (*Sebastes jordani)*, shortspine thornyhead (*Sebastolobus alascanus*), silvergray rockfish (*Sebastes brevispinis)*, speckled rockfish (Sebastes ovalis), squarespot rockfish

*(Sebastes hopkinsi), starry rockfish (Sebastes constellatus), stripetail rockfish (Sebastes saxicola), swordspine rockfish (Sebastes ensifer), tiger rockfish (Sebastes nigrocinctus), vermilion rockfish (Sebastes miniatus), and yellowtail rockfish (Sebastes flavidus)*

**Slope Rockfishes:** All proposed for inclusion in federal B permit program

*Overfished species*: darkblotched rockfish (*Sebastes crameri*) (north of Pt. Arena, CA), Pacific Ocean perch (*Sebastes alutus*) (WA and OR)

*Minor Slope Species*: Aurora Rockfish (*Sebastes aurora*), Bank Rockfish (*Sebastes rufus*), Blackgill Rockfish (*Sebastes melanostomus*), Redbanded Rockfish (*Sebastes babcocki*), Rougheye Rockfish (*Sebastes aleutianus*), Sharpchin Rockfish (*Sebastes zacentrus*), Shortraker Rockfish (*Sebastes borealis*), Splitnose Rockfish (*Sebastes diploproa*), and Yellowmouth Rockfish (*Sebastes reedi*)

**Roundfishes:** All proposed for inclusion in federal B permit program except as noted

*Overfished species*: None identified

lingcod (*Ophiodon elongatus*), cabezon (*Scorpaenichthys marmoratus*) (B permit excluded species), kelp greenling (*Hexagrammos decagrammus*) (B permit excluded species), Pacific cod (*Gadus macrocephalus*), Pacific hake (Pacific Whiting) (*Merluccius productus*), Pacific flatnose (finescale codling) (*Antimora microlepis*), Pacific grenadier (Pacific rattail) (*Coryphaenoides acrolepis*), sablefish (*Anoplopoma fimbria*)

**Flatfishes:** All proposed for inclusion in B permit program

*Overfished species*: None identified

arrowtooth flounder (*Atheresthes stomias*), butter sole (*Isopsetta isolepis*), curlfin sole (*Pleuronichthys decurrens*), Dover sole (*Microstomus pacificus)*, English sole (*Parophrys vetulus*), flathead sole (*Hippoglossoides elassodon*), Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), rex sole (*Glyptocephalus zachirus)*, rock sole (*Lepidopsetta bilineata), northern rock sole (L. polyxystra*), sand sole (*Psettichthys melanostictus*), and starry flounder (*Platichthys stellatus*)

**Sharks, Skates, and Chimaeras:** All proposed for inclusion in B permit program

*Overfished species*: None identified

leopard shark (*Triakis semifasciata*), soupfin shark (*Galeorhinus galeus*), spiny dogfish (*Squalus acanthias)*, big skate (*Raja binoculata*), California skate (*Raja inornata*), longnose skate (*Raja rhina*), and spotted ratfish (*Hydrolagus colliei*)

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Each of the alternatives is described in subsections 2.1 through 2.6 and is summarized in **Table 2-3**. The NMFS may use combinations of alternatives, including retention and transfer conditions, in developing its preferred alternative. However, if the B permit program strays from the basic characteristics of the A permit program the added implementation burden and costs will likely be passed back to the industry.

The alternatives address the following issues which are consistent with Council discussion and direction from its June 2007 meeting:

- Initial directed fishery fleet size. This is the number of vessels that would be allowed B permits in the first year of the program. This issue only applies to alternatives 3-6 with a range of from 390 to 850 to vessels. Directed fishery landings for B permit species groundfish during the window period were used to compute initial fleet sizes (**Figure 2-1; Table 2-4**). The qualification criteria alternatives used to analyze the Council's fishery management alternatives are presented in **Section 4**. These criteria (or modifications thereof) are proposed to be used by the Council and NMFS to determine which vessels and their current vessel owners would qualify for B groundfish permits.
- Directed fishery fleet size goal. This is the number of vessels that the program strives to maintain long-term and only applies to alternatives 3-6. Directed fishery landings for B permit species during the window period were used to compute long-term fleet size goals (**Figure 2-1; Table 2-4**). The range is from 170 to 680 vessels.
- Permit consolidation requirement. This is a requirement in Alternative 5 in which vessel owners would be required to obtain an additional permit to remain in the fishery. One option in Alternative 5 requires consolidation after the first and fifth program years; the other option requires consolidation after the fifth program year.
- Permit transferability. This is a provision to allow B permit holders to transfer their permit rights to another person or entity. Most alternatives provide or require permit transferability for B permits, but the issue is not addressed in Alternative 6. This gives the Council flexibility to specify permit transfer conditions, including a freeze on transferability until certain management goals are met. C permits would not be transferable, because it is a license registry system and could be applied for at any time of the year.
- Landing requirement. In alternatives 5 and 6, a previous year's groundfish landing requirement is necessary to retain the right to renew a B permit. It is proposed that vessels must make necessary landings by November 30 in order to renew the permit by December 31 of each year. There would not be a previous year's landing requirement for C permits.
- Vessel length and gear endorsements. Under alternatives 5 and 6, B permitted vessels would be endorsed for length and gear type used to qualify for a permit. A vessel that meets the qualifying requirements and fished multiple open access gears during the qualifying period would receive an endorsement for each gear type. Length endorsements would be used to prevent transfer of permits to larger vessels with associated higher fishing capacities. There would not be vessel length or gear endorsements for C permits.
- Use of A and B permits. The alternatives are varied with regard to the use of A and B permits on the same vessel. In alternatives 3 and 4, both permit types could be used simultaneously during the year, and a pre-fishing declaration of permit-type usage would need to be submitted to NMFS. Under Alternative 5, each vessel would be limited to one permit-type change per year. Under Alternative 6, no vessel owner would be allowed to use both permit types (A and B) on the same

vessel in any year. Thus, vessel owners that have an A permit vessel and would qualify for a B permit for the same vessel would have to place the B permit on a different vessel that does not have an A permit.

- B and C permit coverage. B and C permit conditions and assumptions which apply to alternatives 3-6 are described in **Table 2-1**.

Table 2-3. Summary of Council's federal license or permit management alternatives 1/

| | Alternative | | | | | |
|---|---|---|---|---|---|---|
| Issue to be addressed | A-1 (no action) | A-2 (license registration) | A-3 | A-4 | A-5 | A-6 |
| Initial fleet size | n/a | n/a | recent average (680 vessels) | based on permit qualification criteria impact | 2000 fleet size (850 vessels) | 1994-99 fleet size (390 vessels) |
| Fleet size goal | n/a | n/a | Same as initial fleet size | Same as initial fleet size | a. 50% reduction (to 430)<br>b. 80% reduction (to 170) | 80% reduction from 2000 fleet size (to 170) |
| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | n/a | n/a | yes, once per year | yes, once per year | yes, once per year | not specified |
| Previous year landing requirement | n/a | n/a | no | no | yes | yes |
| Length and gear endorsement | n/a | n/a | none | none | yes | yes |
| A & B permit usage on same vessel | n/a | n/a | yes, alternately in same yr 2/ | yes, alternately in same yr 2/ | not in same yr | not in same yr |
| B and C permit coverage on same vessel | n/a | n/a | See Table 2-1 | See Table 2-1 | See Table 2-1 | See Table 2-1 |

1/ There may be hardship conditions under which deviation from the entries in this table might be allowed.

2/ a pre-fishing declaration would be used to notify NMFS of permit type changes.

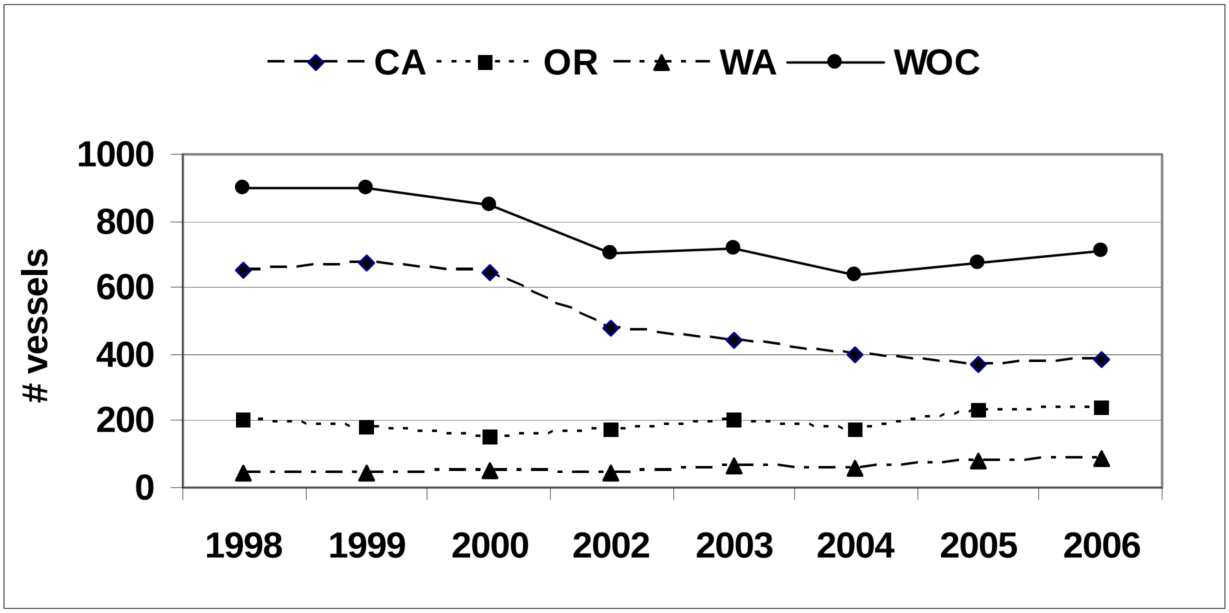


Figure 2-1. Directed fishery trends in numbers of vessels for B species groundfish by state and overall, 1998-2006 window period.

## 2.1 Alternative 1 (No action)

Alternative 1, No-action, would continue to allow commercial fishing vessels to prosecute federal groundfish species allocated to open access fisheries without federal registration, except as required under the Vessel Monitoring System (VMS) program (72 FR 69162, December 7, 2007). The VMS program requires commercial vessels to register with NMFS and utilize VMS equipment if they intend to take federal groundfish in federal waters in the WOC area. The No-action alternative does not limit participation in the open access fishery.

## 2.2 Alternative 2

This alternative establishes an annual federal license requirement for vessel owners that intend to participate in the open access groundfish fishery. The purpose of this alternative is to identify all vessels and vessel owners that participate in the open access fishery and to aid managers in estimating fishery impacts to target and non-target species. This alternative would not limit fishery participation. To be eligible for an open access license, the vessel owner must have a valid commercial fishing license with Washington, Oregon, or California and the vessel must be currently documented by the United States Coast Guard (USCG) or state registered. As with A permits, NMFS would require that the applicant/vessel owner certify that he/she is eligible to own a US-documented vessel. NMFS would issue a single open access license that would authorize the vessel to participate in both the directed and incidental components of the open access fishery. NMFS would mail open access license applications to vessel owners prior to the calendar year and would encourage submission of applications at least 30 days prior of the calendar year (and start of the open access fishery). However, a vessel owner may apply for an open access license at any time during the year.

## 2.3 Alternative 3

Alternative 3 is one of three alternatives that have a specific initial fleet size goal for issuance of B permits. The goal for Alternative 3 is based on the average number of vessels that made directed B species landings in the WOC area during the recent years of 2004-September 2006, which computes to be 680 vessels after rounding (**Table 2-4; Figure 2-1**).[3] The long-term fleet size goal is the same as the initial fleet size goal. The purpose of this alternative is to limit participation in the directed open access fishery and to register all other vessels that encounter groundfish on an incidental basis. This alternative would aid managers in projecting fishery impacts for target and non-target species. A B permit would be issued to those in the directed open access fishery and a C permit would be issued to those vessels that incidentally land groundfish, excluding nearshore species, for all vessels that do not have an A or B permit or state-issued nearshore permit.

Under this alternative, a B permit could be transferred to a different vessel once per calendar year and vessels could be registered to both an A and B permit and used the two permits alternately during the year. The permit holder would be required to notify NMFS prior to leaving port of the permit type that would be in use. B permits under this alternative would not have a size or gear endorsement and any vessel registered to a B permit could be transferred to any size of vessel and use any directed OA gears.

[3] "Recent years" in this draft EA refers to the period January 2004-September 2006. The selection of years for defining recent participation was restricted to 1) two or more successive years in order to compute an "average" participation level and 2) one of the three recent three successive year periods (2003-2006, 2004-2006 and 2005-2006) because the selection of any period prior to 2003 would represent "most" of the window period. The period 2004-2006 was selected over the other possible periods because 2004-2006 encompassed 1) the longest period of increasing participation in the WOC directed open access fishery during the 1998-2006 window period and 2) 2004 was the nadir in terms of vessel participation in the directed open access fishery for the entire window period (**Table 2-4; Figure 2-1**).

C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be available year-round and would be available to all state-registered commercial fishing vessels. A state-issued nearshore permit registered to the vessel or a fisherman on board the vessel could be used in lieu of a C permit registration to the vessel, but could not be used in lieu of a B permit registration.

## 2.4 Alternative 4

Alternative 4 was recommended by the Groundfish Advisory Committee at the June 2007 Council meeting who asked for an analysis of different minimum landing requirements for B permit qualification. There would be no initial fleet size or long-term goal under this alternative, but no new permits would be issued after the first year.

The B permit program would operate similar to the current limited entry permit program (A permits) under this alternative. Permits would be transferable, with transfers being allowed once per calendar year and effective at the start of the next two-month cumulative limit period. In addition, vessels could be registered to A and B permits simultaneously and the vessel would be able to use the two permit types alternately during the year. The permit holder would be required to notify NMFS of the permit type that would be in use prior to leaving port. In the B permit program, transfers would be allowed between vessels without regard to vessel length or gear used to qualify for the permit and there would be no permit consolidation or previous year landing requirement for permit re-issuance. C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits could be applied for at any time of year. A state-issued nearshore permit registered to the vessel or a fisherman on board the vessel, could be used in lieu of a C permit registration, but could not be used in-lieu of a B permit registration.

## 2.5 Alternative 5

Alternative 5 has an initial fleet size objective of 850 vessels combined with two long-term fleet size alternatives: Alternative 5a, 430 vessels; Alternative 5b, 170 vessels. These are values derived from the Council's Groundfish Strategic Plan (**PFMC 2000**) and an SSC, Economic Subcommittee analysis (**SSC 2000**) of directed open access fishery fishing fleet capacity to harvest the available groundfish circa 2000. The initial fleet size objective of 850 vessels is the number of vessels that participated in the fishery in 2000, while 430 is about 50% of the 2000 fleet size and 170 is 20% of the 2000 fleet size (**Table 2-4; Figure 2-1**).

The approach recommended for reducing the fleet size after initial permit issuance is to require permit holders to consolidate permits, two for one, at specified intervals in order to continue in the fishery. At certain dates after the initial B permit issuance, NMFS would require that every unique B permit holder to hold two B permits in order maintain one B permit in the future. This staged approach allows vessel owners time to transition out of the fishery over a period of time and find alternative revenue sources and for others it allows them time to demonstrate directed fishing activity to stay in the fishery and/or time to buy a 2$^{nd}$ permit to stay in the fishery. Permit consolidation would occur once, after the fifth program year under Alternative 5a, and twice, once each after the first and fifth program years, under Alternative 5b. When permits are consolidated, every unique permit holder that has a permit as of a specified date in the 5$^{th}$ year would have to obtain another permit under exactly the same name as the unique permit holder. Permits would be fully transferable under both alternatives in order to achieve the respective long-term fleet size objectives.

A previous year landing requirement is an added element to these alternatives. In order to allow that all renewals are completed by December 31, the previous year landing requirement must occur by November 30. The aim here is to accelerate permit attrition. Vessels would be length and gear endorsed in order to limit fleet fishing capacity. There would be no provision for combining permits to increase the size endorsement of one permit (as there currently is in the A permit program). Any individual or entity could possess both an A and B permit simultaneously, but a single vessel could be registered only to an A or B permit at any time during the year. (So if a vessel is registered to an A permit on January 1, that vessel would not be eligible to be registered to a B permit for the remainder of that year). However, failure to fish a B permit would lead to loss of the permit because of the previous year landing requirement.

C permits would be required to land groundfish, excluding nearshore species, for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be applied for annually and would be non-transferable. .A state-issued nearshore permit registered to the vessel or a fisherman on board the vessel could be used in lieu of a C permit registration, but could not be used in lieu of a B permit registration.

## *2.6 Alternative 6*

In Alternative 6, the initial fleet size goal is 390 vessels, which is 91% of the average number of vessels that fished at least three years for federal groundfish species, including nearshore species, during 1994-1999 **(Appendix A).** The 91% adjustment factor is extrapolated from the relationship between total number of vessels that had directed fishery landings of federal groundfish and those that had directed fishery landings of B species groundfish during 2000-2006 **(tables 2-4 and 3-5)**. This period of time was used because specificity of landings data was much lower in the earlier years, compared to the latter years, because a high proportion of rockfish were recorded as "unspecified rockfish" (Gerry Kobylinski 2007). The long-term fleet size goal is the same as Alternative 5b, 170 vessels. There is no permit consolidation requirement as required in Alternative 5, but there is a previous year landing requirement. Permit transferability is not addressed, which allows the Council to consider and specify transfer conditions, including a no transfer provision until specific management objectives are met (e.g., long-term fleet size goal). A previous year landing requirement is an added element to this alternative. In order to allow that all renewals are completed by December 31, the previous year landing requirement must occur by November 30. The aim here is to accelerate permit attrition. There would be a vessel length and gear endorsement requirement in this alternative in order to constrain fleet fishing capacity. There would be no provision for combining permits to increase the size endorsement of one permit (as there currently is in the A permit program). A vessel owner could own single or multiple A and B permitted vessels, but a single vessel could not be registered to both permit types in the same year.. (So if a vessel is registered to an A permit on January 1, that vessel would not be eligible to be registered to a B permit for the remainder of the year). C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits could be applied for at any time of year. A state-issued nearshore permit, registered to the vessel or a fisherman on board the vessel, could be used in lieu of a C permit registration to the vessel.

## *2.7 Alternatives Considered but Not Analyzed in Detail*

Several alternatives were considered but not accepted for full analysis:

**Permit stacking to allow for increased landings by single vessels**.
This concept was considered to be outside the scope of the proposed permit management program.
**Directed sablefish fishery tiering and possible integration with the A permit sablefish program**:
This concept was considered to be outside the scope of the proposed permit management program.
**Fish allocations between B permit gear types (hook-and-line, pot and set-net)**
Additional allocations of fish could lead to increased fishery discards due to allocation attainment with potentially negative impacts to overfished groundfish species.
**Sub-area endorsements (e.g., sablefish endorsements for the Conception area and the Monterey-Vancouver area)**

Cross-over of vessels between management areas is not a problem under current management, thus the need for additional fishery regulation is not warranted.

# 3.0 AFFECTED ENVIRONMENT

- This section describes the Pacific Coast groundfish fishery and the resources that would be affected by the alternatives. Physical resources are discussed in Section 3.1, biological resources are described in Section 3.2, and socioeconomic resources are described in Section 3.3. Other recent NEPA documents prepared for the Pacific Coast groundfish fishery provide detailed information pertaining to the physical, biological and socioeconomic environment (See subsection 1.6, Related NEPA Analyses, of this EA).

## *3.1 Physical Characteristics of the Affected Environment*

### 3.1.1 General Characteristics

#### *3.1.1.1 Ocean currents*

In the North Pacific Ocean, the large, clockwise-moving North Pacific Gyre circulates cold, sub arctic surface water eastward across the North Pacific, splitting at the North American continent into the northward-moving Alaska Current and the southward-moving California Current. Pacific Coast, the surface California Current flows southward through the United States Pacific Coast EEZ. The California Current is known as an eastern boundary current, meaning it draws ocean water along the eastern edge of an oceanic current gyre. The northward-moving California Undercurrent flows along the continental margin and beneath the California Current. Influenced by the California Current system and coastal winds, waters off the United States Pacific Coast are subject to major nutrient upwelling, particularly off Cape Mendocino. Shoreline topographic features such as Cape Blanco and Point Conception, and bathymetric features such as banks, canyons, and other submerged features, often create large-scale current patterns such as eddies, jets, and squirts. The effect of El Niño-Southern Oscillation (ENSO) events on climate and ocean productivity in the northeast Pacific is relatively well-known. In the past decade a still longer period cycle, termed the Pacific Decadal Oscillation or PDO, has been identified. Although similar in effect, instead of the one-year to two-year periodicity of ENSO, PDO events affect ocean conditions for 15 years to 25 years (**PFMC 2004**).

#### *3.1.1.2 Physical and biological conditions*

There are distinct large-scale patterns of biological distribution along the Pacific Coast that provide for a first-order characterization of habitat into large zoogeographic provinces: the Oregonian and San Diego. The Oregonian Province extends from the Straight of Juan de Fuca in the North to Point Conception in the South. The San Diego Province begins at Point Conception in the north and runs south past the terminus of the EEZ (NMFS 2005). Cape Mendocino represents an important ecological break in the distribution of many groundfish species (particularly rockfish) (**PFMC 2004**).

The United States Pacific Coast is characterized by a relatively narrow continental shelf. The 200 m depth contour shows a shelf break closest to the shoreline off Cape Mendocino, Point Sur, and in the Southern California Bight; and widest from Central Oregon north to the Canadian border, as well as off Monterey Bay. Deep submarine canyons pocket the EEZ, with depths greater than 4,000 m south of Cape Mendocino (**PFMC 2004**).

Estuaries such as San Francisco Bay and Pugent Sound are important habitats for many fish and wildlife species and some groundfish species. Other important smaller estuaries include Gray's Harbor, Washington and Yaquina Bay, Oregon. Kelp forest communities are found relatively close to shore along the open coast. These subtidal communities provide vertically structured habitat through the water column on the rocky shelf from the waterline to a depth of up to 10 meters. Surfgrass beds are found on

hard-bottom substrates along higher energy coasts. (Studies have shown seagrass beds to be among the areas of highest primary productivity in the world). Tide pool habitats are common along the coasts of all three states and are often inhabited by a variety of attached algae, invertebrates, and small fishes. Unconsolidated bottom habitats are composed of small particles (i.e. gravel, sand, mud, silt, and various mixtures of these particles) and contain little to no vegetative growth due to the lack of stable surfaces for attachment. Such areas are scattered along nearshore and coastal shelf zones. Coastal unconsolidated bottom habitats are utilized by a number of managed fish species. Hard bottom habitats in the coastal zone may be composed of bedrock, boulders, cobble, or gravel/cobble. Hard substrates are one of the least abundant benthic habitats off the respective states, yet they are among the most important habitats for fishes. There are a number of species and life stages of groundfish that occur in the water column, but do not have any association with benthic substrate. Structure-forming invertebrates (such as corals, basketstars, brittlestars, demosponges, gooseneck barnacles, sea anemones, sea lilies, sea urchins. sea whips, tube worms, and vase sponges) have created important ocean bottom habitats in the shelf and slope zones. Offshore, unconsolidated bottom habitats are composed of small particles (i.e. gravel, sand, mud, silt, and various mixtures of these particles) and contain little to no vegetative growth due to the lack of stable surfaces for attachment. A large number of managed groundfish species utilize offshore unconsolidated bottom habitat during at least part of their life. Hard bottom habitats in the offshore zone may be composed of bedrock, boulders, cobble, or gravel/cobble. Many managed species are dependent on hard bottom habitat during some portion of their life cycle.
(**NMFS 2005**)

### 3.1.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires NMFS and the Council to describe Essential Fish Habitat (EFH) and enumerate potential threats to EFH from both fishing and nonfishing activities for the managed species.

> EFH is defined at 50 CFR 600.10 as: hose waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle.

The EFH EIS contains detailed information on the Pacific Coast marine habitat and physical oceanography (Section 3.2, NMFS 2005). In response to the EFH EIS, NMFS implemented regulations designating EFH for Pacific Coast groundfish (50 CFR 660.395) and closing several areas to fishing with bottom trawl gear and bottom contact gear (50 CFR 660.306(h)).

## *3.2 Biological Characteristics of the Affected Environment*

### 3.2.1 Groundfish Species

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. Information on the interactions between the various groundfish species and between groundfish and non-groundfish species varies in completeness. While a few species have been intensely studied, there is relatively little information on most (**PFMC 2005)**. Table 4-1 in the 2007-2008 Specifications EIS lists the latitudinal and depth distributions of adult groundfish species (NMFS 2008).

The Acceptable Biological Catch (ABC) is an estimate of the amount of stock that may be harvested each year without jeopardizing the continual sustainability of the resource. The Council and NMFS use the results of quantitative stock assessment to develop annual ABCs for major groundfish stocks. For groundfish species where there are little or no detailed biological data available to develop ABCs, rudimentary stock assessments are prepared using the best available data, or the ABC levels are based on 50% of historical landings. The ABC may be modified with precautionary adjustments to account for uncertainty. A stock's optimum yield (OY) is its target harvest level, and is usually lowered from its ABC. ABCs and OYs for groundfish species are published in Federal regulation at 50 CFR Part 660, Tables 1a-1c and 2a-2c.

The Magnuson-Stevens Act requires an FMP to prevent overfishing. Overfishing is defined in the National Standards Guidelines (**63 FR 24212, May 1, 1998**) as exceeding the fishing mortality rate needed to produce maximum sustainable yield on a continuing basis. For Pacific Coast groundfish, overfishing occurs if total mortality estimates exceed the ABC in a given year. 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. The default value of this threshold for the groundfish FMP is 25 percent of the estimated unfished biomass level. In 2007, seven groundfish species continue to be designated as overfished: bocaccio (south of Monterey), canary rockfish, cowcod (south of Point Conception), darkblotched rockfish, Pacific ocean perch, widow rockfish, and yelloweye rockfish.

The following section presents a brief summary of the biological characteristics of the most common federally-managed groundfish species encountered in the open access fishery, including overfished and precautionary zone stocks, non-overfished stocks and unassessed stocks.

#### *3.2.1.1 Overfished and Precautionary Zone Groundfish Species*

Seven species of Pacific Coast groundfish, all rockfish species, are currently declared overfished by NMFS. They are:

- Cowcod (*Sebastes levis*)
- Canary Rockfish (*Sebastes pinniger*)
- Darkblotched Rockfish (*Sebastes crameri*)
- Pacific Ocean Perch (*Sebastes alutus*)
- Bocaccio (*Sebastes paucispinis*)
- Widow Rockfish (*Sebastes entomelas*)
- Yelloweye Rockfish (*Sebastes ruberrimus*)

Rockfish are long-lived, late maturing, and slow-growing species. These traits make them particularly vulnerable to overfishing. "Overfishing" and "overfished" are defined in the Pacific Coast Groundfish FMP for each species or species complex. According to the FMP's definition, a stock (or fish population) is overfished when its spawning stock abundance declines to 25% of its estimated "unfished biomass" (the spawning population size if the stock had never been fished; biomass is the weight of a population of fish). Once a stock is declared overfished, measures must be taken to rebuild stock abundance to a level that supports maximum sustained yield (MSY). For most Pacific Coast groundfish stocks, that level is defined as 40% of the stock's virgin, unfished abundance. "Overfishing" is defined as a harvest rate that is predicted to cause a stock to decline to an overfished level. The FMP further defines overfishing as fishing at a rate that exceeds Fmsy. The Magnuson-Stevens Act and FMP require management measures that end overfishing. The Magnuson-Stevens Act also requires that the Council rebuild an overfished stock within ten years, if the stock's biology allows it to be rebuilt within this relatively short timeframe. Rebuilding the currently overfished rockfish species will probably take significantly longer. If a stock cannot be rebuilt within ten years, then the maximum allowable time to rebuild the stock is the time to rebuild the stock in the absence of fishing, plus one mean generation time. (Mean generation time is the time it takes for a sexually mature female to replace herself in the population). Historically, these species were taken by trawl, hook and line, and sport gear. Overfished shelf rockfish species are still incidentally caught with commercial and sport line gear. Depth-based restrictions have been adopted to reduce harvest of overfished groundfish, to end overfishing, and to rebuild these stocks.

The following species are considered to be precautionary zone species:

- Cabezon (*Scorpaenichthys marmoratus*)
- Petrale sole (*Eopsetta jordani*)
- Sablefish (*Anoplopoma fimbria*)

Some assessed species, including some of the most important target species such as sablefish (*Anoplopoma fimbria*), are below the target biomass, $B_{MSY}$, although not overfished. These species are classified as precautionary zone species and OYs for these stocks are set according to a precautionary formula that progressively reduces the OY below the ABC as the estimated stock size is lower. This precautionary reduction provides surplus production to allow the stock to increase to the target biomass over time.

Biological, life history and available stock status information on overfished and precautionary zone species are presented in Appendix F.

#### *3.2.1.2 Non-overfished and Unassessed Groundfish Stocks*

The following Groundfish FMP species are considered non-overfished or unassessed.

**Non-over fished stocks**
California Skate (*Raja inornata*)
Longnose Skate (*Raja rhina*)
Pacific Whiting (Pacific Hake) (*Merluccius productus*)
Bank Rockfish (*Sebastes rufus*)
Black Rockfish (*Sebastes melanops*)
Blackgill Rockfish (*Sebastes melanostomus*)
California Scorpionfish (*Scorpaena guttata*)
Chilipepper (*Sebastes goodei*)
Gopher Rockfish (*Sebastes carnatus*)
Lingcod (*Ophiodon elongatus*)
Longspine Thornyhead (*Sebastolobus altivelis*)
Shortbelly Rockfish (*Sebastes jordani*)
Shortspine Thornyhead (*Sebastolobus alascanus*)
Splitnose Rockfish (*Sebastes diploproa*)
Yellowtail Rockfish (*Sebastes flavidus*)
Arrowtooth Flounder (*Atheresthes stomias*)
English Sole (*Pleuronectes vetulus*)
Starry Flounder (*Platichthys stellatus*)

**Unassessed Stocks**
Aurora rockfish (*Sebastes aurora*)
Big skate (*Raja binoculata*)
Black-and-yellow rockfish (*Sebastes chrysomelas*)
Blue rockfish (*Sebastes mystinus*)
Bronzespotted rockfish (*Sebastes gilli*)
Brown rockfish (*Sebastes auriculatus*)
Butter sole (*Isopsetta isolepis*)
Calico rockfish (*Sebastes dalli*)
California skate (*Raja inornata*)
China rockfish (*Sebastes nebulosus*)
Copper rockfish (*Sebastes caurinus*)
Curlfin sole (*Pleuronichthys decurrens*)
Dusky/dark rockfish *(Sebastes. variabilis)* (dusky rockfish) and *S. cilliatus* (dark rockfish)
Finescale codling (*Antimora microlepis*)
Flag rockfish (*Sebastes rubrivinctus*)
Flathead sole (*Hippoglossoides elassodon*)
Grass rockfish (*Sebastes rastrelliger*)
Greenblotched rockfish (*Sebastes rosenblatti*)
Greenspotted rockfish (*Sebastes chlorostictus*)
Greenstriped rockfish (*Sebastes elongatus*)
Harlequin rockfish (*Sebastes variegatus*)

Honeycomb rockfish (*Sebastes umbrosus*)
Kelp greenling (*Hexagrammos decagrammus*)
Kelp rockfish (*Sebastes atrovirens*)
Leopard shark (*Triakis semifasciata*)
Mexican rockfish (*Sebastes macdonaldi*)
Olive rockfish (*Sebastes serranoides*)
Pacific cod (*Gadus macrocephalus*)
Pacific grenadier (*Coryphaenoides acrolepis*)
Pacific sanddab (*Citharichthys sordidus*)
Pink rockfish (*Sebastes eos*)
Quillback rockfish (*Sebastes maliger*)
Spotted ratfish (*Hydrolagus colliei*)
Redbanded rockfish (*Sebastes babcocki*)
Redstripe (*Sebastes proriger*)
Rex sole (*Glyptocephalus zachirus*)
Rock sole (*Lepidopsetta polyxystra and L. bilineata*),
Rosethorn rockfish *(Sebastes helvomaculatus)*
Rosy rockfish (*Sebastes rosaceus*)
Rougheye rockfish (*Sebastes aleutianus*)
Sand sole (*Psettichthys melanostictus*)
Sharpchin rockfish (*Sebastes zacentrus*)
Shortraker rockfish (*Sebastes borealis*)
Silvergray rockfish (*Sebastes brevispinis)*
Soupfin shark (*Galeorhinus galeus*)
Spiny dogfish (*Squalus acanthias*)
Speckled rockfish (*Sebastes ovalis*)
Squarespot rockfish *(Sebastes hopkinsi*)
Starry rockfish *(Sebastes constellatus)*
Stripetail rockfish *(Sebastes saxicola)*
Tiger rockfish *(Sebastes nigrocinctus)*
Treefish (*Sebastes serriceps*)
Vermilion rockfish *(Sebastes miniatus)*
Yellowmouth rockfish (*Sebastes reedi*)

Biological, life history and available stock status information on non-overfished and unassessed groundfish species are presented in **Appendix F**.

### 3.2.2 Non-groundfish Species (State-managed or under other FMPs)

The following non-groundfish species may be caught incidentally in fisheries targeting groundfish. Thus, changes in fishing regulations in groundfish fisheries could increase or decrease fishing mortality on incidentally caught species. Alternatively, those fisheries targeting nongroundfish species may be affected by management measures intended to reduce or eliminate incidental catches of overfished groundfish species in these fisheries.

- California halibut (*Paralichthys californicus*)
- California sheephead (*Semicossyphus pulcher*)
- Coastal Pelagic Species (CPS) as follows:
    - Northern anchovy (*Engraulis mordax*)
    - Pacific sardine (*Sardinops sagax*)
    - Pacific (chub) mackerel (*Scomber japonicus*)
    - Jack mackerel (*Trachurus symmetricus*)
    - Market squid (*Decapoda sp*
- Dungeness crab (*Cancer magister*)
- Greenling species other than kelp greenling (*Hexagrammos decagrammus*) as follows:
    - Rock greenling (*H. agocephalus*)
    - Painted greenling (*Oxylebius pictus*)
    - White spotted greenling (*H. stelleri)*
- Highly migratory species (HMS) as follows:
    - Striped marlin *Tetrapturus audax*
    - Swordfish *Xiphias gladius*
    - Common thresher shark *Alopias vulpinus*
    - Pelagic thresher shark *Alopias pelagicus*
    - Bigeye thresher shark *Alopias superciliosus*
    - Shortfin mako (bonito shark) *Isurus oxyrinchus*
    - Blue shark *Prionace glauca*
    - North Pacific albacore *Thunnus alalunga*
    - Yellowfin tuna *Thunnus albacares*
    - Bigeye tuna *Thunnus obesus*
    - Skipjack tuna *Katsuwonus pelamis*
    - Northern bluefin tuna *Thunnus orientalis*
    - Dorado (a.k.a. mahi mahi, dolphinfish) *Coryphaena hippurus*
- Ocean whitefish (*Caulolatilus princeps*)
- Pacific pink shrimp (*Pandalus jordani*)
- Pacific halibut (*Hippoglossus stenolepis*)
- Ridgeback prawn (*Sicyonia ingentis*
- Sea cucumber species as follows:
    - California sea cucumber *(Parastichopus californicus*)
    - Warty sea cucumber (*P. parvimensis*
- Spot prawn (*Pandalus platyceros*)
- White seabass (*Atractoscion nobilis)*

Biological, life history and available stock status information on non-overfished and unassessed groundfish species are presented in **Appendix F**.

### 3.2.3 Prohibited Species

Under the Pacific Coast groundfish FMP, prohibited species are those groundfish species or species groups for which quotas have been achieved and/or the fishery closed. Prohibited species are also any species of salmonid, Pacific halibut, or, seaward of Washington or Oregon, Dungeness crab. Regulations at 50 CFR 660.306 prohibit retention of prohibited species and they must be returned to the sea as soon as practicable with a minimum of injury when caught and brought on board. This section focuses on the later definition of prohibited species: salmon, Pacific halibut and Dungeness crab.

#### *3.2.3.1 Pacific salmon*

Salmon are anadromous which means they hatch in freshwater streams and rivers, migrate to the ocean for feeding and growth, and return to their natal streams to spawn. Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon *(O. kisutch*) are the main salmon species managed by the Council. In odd-numbered years, the Council may manage special fisheries near the Canadian border for pink salmon (O. *gorbuscha*). Sockeye (*O. nerka*) and chum (*O. keta*) salmon and steelhead trout (*O. mykiss*) are rarely caught in the Council's ocean fisheries. Salmon are affected by a wide variety of factors in the ocean and on land, including ocean and climatic conditions, dams, habitat loss, urbanization, agricultural and logging practices, water diversion, and predators (including humans). Salmon are an important source of spiritual and physical sustenance for Indian tribes, and they are symbolically important to many other residents of the Pacific Coast. Because salmon migrate so far when in the ocean, managing the ocean salmon fisheries is an extremely complex task.

#### *3.2.3.2 Pacific halibut*

Pacific halibut (*Hippoglossus stenolepis*) is described in **Section 3.2.2** on non-groundfish fisheries that incidentally catch groundfish. Pacific halibut is a prohibited species for all groundfish fisheries except for the limited entry fixed gear primary sablefish fishery north of Pt. Chehalis, WA, as provided for in groundfish and halibut regulations.

#### *3.2.3.3 Dungeness crab*

Dungeness crab (*Cancer magister*) is described in **Section 3.2.2** on non-groundfish fisheries that incidentally catch groundfish. Dungeness crab is a prohibited species for all groundfish fisheries.

### *3.2.4 Protected Species*

Marine species listed as endangered or threatened under the Endangered Species Act (ESA) include marine mammals, seabirds, sea turtles, salmon, and green sturgeon. Under the ESA, a species is listed as "endangered" if it is in danger of extinction throughout a significant portion of its range and "threatened" if it is likely to become an endangered species within the foreseeable future throughout all, or a significant portion, of its range. Marine mammals and seabirds are also protected under other laws described below.

#### *3.2.4.1 Pacific Salmon*

Several species of salmon found along the Pacific Coast have been listed under the ESA (see Insert, below). ESA-listed species are managed under ESA regulations. "Take" (a term that covers a broader range of impacts than just mortality) of listed species may be allowed as long as it is not the primary purpose of the activity. (Therefore, catches of ESA-listed stocks are termed incidental take.) As part of the process authorizing such take, regulatory agencies must consult with NMFS in order to ensure fisheries conducted in the Council area do not "jeopardize the continued existence of the species" (or in the case of salmon, the listed ESUs). Because of the Council's central role in developing fishery management regimes, it must take the results of such consultations into account. Typically this process, termed a "Section 7 consultation" after the relevant section in the ESA, results in a biological opinion (BO) that applies a set of consultation standards to the subject activity and mandates those actions that must be taken in order to avoid such jeopardy. In addition to the Section 7 consultation, actions that fall under the jurisdiction of the ESA may also be permitted through ESA Section 10 and ESA Section 4(d). Section 10 generally covers scientific, research, and propagation activities that may affect ESA-listed species. Section 4(d) covers the activities of state and local governments and private citizens. Section 4(d) of the ESA requires NMFS and the U.S Fish and Wildlife Service to promulgate "protective regulations" for threatened species (Section 4(d) is not applicable to species listed as endangered) whenever it is deemed "necessary and advisable to provide for the conservation of such species." "Whenever any species is listed as a threatened species pursuant to subsection (c) of this section, the Secretary shall issue such regulations as he deems necessary and advisable to provide for the conservation of such species. The Secretary may by regulation prohibit with respect to any threatened species any act prohibited under section 9(a)(1) of this title ..." These protective rules for threatened species may apply to any or all of the ESA Section 9 protections that automatically prohibit take of species listed as endangered. The rules need not prohibit all take. There may be an "exception" from the prohibitions on take, so long as the take occurs as the result of a program that adequately protects the listed species and its habitat. In other words, the 4(d) rule can restrict the situations to which the take prohibitions apply. Sec 9(a)(1) includes the take prohibition. The U.S Fish and Wildlife Service adopted a blanket regulation automatically applying the take prohibition to all threatened species upon listing. NMFS has no comparable blanket 4(d) regulation. Instead, NMFS promulgates 4(d) regulations on a species-by species basis once a species is listed as threatened. In proposing and finalizing a 4(d) rule, NMFS may establish exemptions to the take prohibition for specified categories of activities that NMFS finds contribute to conserving listed salmonids. Other exemptions cover habitat-degrading activities (and tribal and recreational fishing activities) that NMFS believes are governed by a program that adequately limits impacts on listed salmonids. As part of the process for developing annual management measures, NMFS summarizes the current consultation standards and may provide additional guidance to the Council on minimizing the take of listed species.

#### *3.2.4.2 Marine Mammals*

The waters off Washington, Oregon, and California support a wide variety of marine mammals. Approximately thirty species, including seals and sea lions, sea otters, and whales, dolphins, and porpoise occur within the EEZ. Many marine mammal species seasonally migrate through Pacific Coast waters, while others are year round residents.
The Marine Mammal Protection Act (MMPA) and the ESA are the Federal legislations that guide marine mammal species protection and conservation policy. Under the MMPA, NMFS is responsible for the management of cetaceans and pinnipeds, while the U.S. Fish and Wildlife Service manages sea otters. Stock assessment reports review new information every year for strategic stocks (those whose human-caused mortality and injury exceeds the potential biological removal (PBR)) and every three years for non-strategic stocks. Marine mammals whose abundance falls below the optimum sustainable population are listed as "depleted" according to the MMPA.

Fisheries that interact with species listed as depleted, threatened, or endangered may be subject to management restrictions under the MMPA and ESA. NMFS publishes an annual list of fisheries in the *Federal Register* separating commercial fisheries into one of three categories, based on the level of serious injury and mortality of marine mammals occurring incidentally in that fishery. The categorization of a fishery in the list of fisheries determines whether participants in that fishery are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. The Pacific Coast groundfish fisheries are in Category III, indicating a remote likelihood of, or no known serious injuries or mortalities, to marine mammals.

#### *3.2.4.3 Seabirds*

The California Current System supports more than two million breeding seabirds and at least twice that number of migrant visitors. Tyler et al. (1993) reviewed seabird distribution and abundance in relation to oceanographic processes in the California Current System and found that over 100 species have been recorded within the EEZ including: albatross, shearwaters, petrels, storm-petrels, cormorants, pelicans, gulls, terns and alcids (murres, murrelets, guillemots, auklets and puffins). In addition to these “classic” seabirds, millions of other birds are seasonally abundant in this oceanic habitat including: waterfowl, waterbirds (loons and grebes), and shorebirds (phalaropes). There is considerable overlap of fishing areas and areas of high bird density in this highly productive upwelling system. The species composition and abundance of birds varies spatially and temporally. The highest seabird biomass is found over the continental shelf and bird density is highest during the spring and fall when local breeding species and migrants predominate.

U.S. Fish and Wildlife Service is the primary Federal agency responsible for seabird conservation and management. Under the Magnuson-Stevens Act, NMFS is required to ensure fishery management actions comply with the laws designed to protect seabirds.

#### *3.2.4.4 Sea Turtles*

Sea turtles are highly migratory and four of the six species found in U.S. waters have been sighted off the Pacific Coast. Little is known about the interactions between sea turtles and Pacific Coast commercial fisheries. The directed fishing for sea turtles in WOC groundfish fisheries is prohibited, because of their ESA listings. The management and conservation of sea turtles is shared between NMFS and USFWS.

#### *3.2.4.5 Green Sturgeon*

The Southern Distinct Population Segment (DPS) of green sturgeon (*Acipenser medirostris*) (71 FR 17757, April 7, 2006) are listed as threatened under the ESA. Green sturgeons are found from Ensenada, Mexico, to Southeast Alaska. Green sturgeons are not abundant in any estuaries along the Pacific Coast, although they are caught incidentally in estuaries while fishing for white sturgeon.

The green sturgeon is a primitive, bottom dwelling fish. It is characterized by its large size and long round body. The sturgeon has no scales, instead it has "scutes" (or plates) located along its body. Scutes are actually large modified scales that serve as a type of armor or protection. The dorsal body color is a dark olive-green, with the ventral surface a lighter whitish green, with the scutes having a lighter coloration than the body. Green sturgeon can reach 7 feet in length and weigh up to 350 lbs.

The green sturgeon is an anadromous fish that spends most of its life in salt water and returns to spawn in fresh water. It is a slow growing and late maturing fish that apparently spawns every 4 to 11 years during the spring and summer months. Feeding on algae and small invertebrates while young, green sturgeon migrate downstream before they are two years old. Juveniles remain in the estuaries for a short time and migrate to the ocean as they grow larger. Adult green sturgeon feed on benthic invertebrates and small fish. The green sturgeon can become highly migratory later in life. They have been documented as traveling over 600 miles between freshwater and estuary environments (**PSMFC 2007**)

## *3.3 Socioeconomic Characteristics of the Affected Environment*

### 3.3.1 Management Structure of the Open Access Fishery - Past, Present and Reasonably Foreseeable Future

A brief description of the current management of open access groundfish fisheries is presented in this section. A more detailed description of the open access fisheries is provided in the Draft EA entitled “Expanded Coverage of the Program to Monitor Time-Area Closures in the Pacific Coast Groundfish Fishery” (**PFMC 2007**).

#### *3.3.1.1 Federal Management*

The open access component of the groundfish fishery is allocated a portion of the available harvest to fishers targeting groundfish without limited entry permits, and fishers who target non-groundfish fisheries that incidentally catch groundfish (**PFMC 2007).** The *directed* fisheries are those that harvest (1) shelf rockfish primarily using hook-and-line gear; (2) sablefish, primarily using hook-and-line or pot gear; (3) nearshore species, primarily using hook-and-line or pot gear; and (4) "other" species, primarily using hook-and-line or setnet gear. Groundfish trawl gear may not be used in the open access fishery. Trawl gears for target species such as pink shrimp, California halibut, ridgeback prawns, and sea cucumbers, called non-groundfish trawl gear in Federal regulations, are exempted from this rule and may land incidental amounts of groundfish.

All sectors of the groundfish fishery, limited entry, open access, recreational and tribal fisheries, are constrained by the need to rebuild groundfish species that have been declared overfished. Groundfish specification and management measures are set on a biennial basis with inseason adjustments made at regularly scheduled Council meetings, when necessary, in order to keep the fisheries within species' harvest limits or rebuilding plans established for overfished species (**PFMC 2007).**

Trip limits and landing frequency have been designated as routine for many species or species groups, all of which are potentially affected by open access fishers. This means that management measures for these species or species groups can be changed more rapidly. Inseason actions to change management measures can be published after one Council meeting and without full notice and comment rulemaking (i.e., through a final rule with no comment period). Generally, directed open access vessels have substantial harvest opportunities for a variety of groundfish species, including but not limited to sablefish, nearshore rockfish, slope rockfish south of Point Conception, California scorpionfish, cabezon, kelp greenling, Pacific sanddab, and spiny dogfish. A relatively low harvest opportunity is provided for lingcod coastwide (**NMFS 2007**). More restrictive salmon fishing opportunities in 2006 likely led those fishers to pursue other species, ultimately causing an increase in open access sablefish landing rates and causing early (October) closure of the directed sablefish fishery in that year (**NMFS 2006**)

Minor shelf rockfish assemblages are divided north and south of 40°10' N latitude. Access to northern shelf species has been substantially limited since the implementation of Rockfish Conservation Areas (RCAs; **Appendix G**) in 2002 largely to reduce mortalities of canary and yelloweye rockfish. Access to southern shelf species has also been substantially limited since the implementation of RCAs under permanent regulations to reduce catch of depleted species, particularly bocaccio and canary rockfish.

Minor slope rockfish assemblages are also divided north and south of 40°10' N latitude with nine species of rockfish in each assemblage. The bulk of the fishery for these species has been harvested with trawl gear with longline gear impacting the resource to a much lesser degree. Areas have been reopened to hook-and-line vessels under recent management alternatives.

Federal regulations do not currently allow for LE trawl fishery landings of nearshore species except for vessels using selective flatfish trawl gear, which are allowed to take up to 300 lbs per month. Limited Entry and open access fixed gear fisheries currently are allowed to take up to 5,000 and 6,000 lbs per 2-mo landing period north and south of the Oregon-California border to Cape Mendocino, respectively, except no more than 1,200 lb may be species other than black or blue rockfish. Current LE fixed gear regulations allow for the taking and landing of 600-800 lbs per 2-mo cumulative landing period depending on time of year and species south of Cape Mendocino. Pink shrimp trawl vessels are allowed to take up to 1,500 lbs of groundfish per trip depending on number of days in the trip **(NMFS 2007).**

#### *3.3.1.2 State Management*

The coastal states have management programs or regulations affecting fishermen and vessels that harvest federal groundfish either as target species or incidental to fishing for federal or state managed species.

The state limited entry programs cover a variety of species and gear types (**Appendix C**). Nearshore species management has been addressed by the states in different ways. Washington law prohibits directed commercial fishing for groundfish in state waters, except for tribal fisheries (Makah, Quillayute, Hoh, and Quinault), which may fish for groundfish in the Usual and Accustomed fishing areas. Oregon and California have developed nearshore fishery management plans and associated limited entry programs that are aimed at capping or reducing harvest capacity in their nearshore fisheries (see **Appendix D** for more information on the states' nearshore regulations or management programs).

Oregon and California have extraterritorial jurisdiction in the EEZ over fishing vessels that are registered in their respective states. In both states nearshore species may only be taken and landed by permitted vessels or permitted fishermen. State extraterritorial jurisdiction does not extend to fishing activities in the EEZ or beyond by vessels not registered in Oregon or California. Nearshore species are occasionally caught in federal waters, which make them vulnerable to take off Oregon and California and landing in Washington by vessels not registered in the bordering states. NMFS regulations do not allow for the taking of groundfish by foreign vessels. Washington laws allow for the taking and landing of nearshore species taken in federal waters except as prohibited by RCA or other conservation area regulations, which encompass the vast majority of the EEZ.

There has been a virtual absence of nearshore species landings by open access fishermen at Washington ports since before 1998, as shown in Section 3.3.2.4.3 below. This shows there currently is no interest or opportunity for fishermen to take nearshore species off the Washington coast or either of the other two states. Oregon and California nearshore landings, which have been substantial over the years, have been regulated and enforced by the respective states (for California see: 14 CCR §150.16).

In developing a federal license limitation program, the coastal states, tribes, Council and NMFS must ensure that state and federal capacity reduction programs are compatible with each other and that together the programs ultimately result in less fishing pressure on both overfished and more abundant groundfish species. The Council process will provide a forum for this cooperation.

### *3.3.1.3 Pacific Coast Observer Programs for Groundfish*

The Magnuson-Stevens Act requires that FMPs establish a standardized reporting methodology to assess the amounts and types of bycatch in a fishery, and requires that FMPs identify and rebuild overfished stocks. For the Pacific Coast groundfish fishery, federal observer programs gather information to help manage bycatch and overfished species.

There are currently two Federal observer programs being operated by the NMFS Northwest Fisheries Science Center in the Pacific Coast groundfish fishery: the At-sea Hake Observer Program and the Pacific Coast Groundfish Observer Program (WCGOP). These two programs are very different from each other particularly in how they are funded, the type of sampling and fishery data that are used to derive total catch, and availability of data for inseason management. Participation in the at-sea hake/whiting fishery is restricted to vessels with limited entry trawl permits. Therefore, that program is not relevant to this NEPA document on the open access fishery.

The WCGOP is a year round federally funded program that provides observers for all of the commercial groundfish fisheries, except the Pacific whiting fishery. Because monitoring of the Pacific whiting shoreside sector has been carried out under the EFPs, WCGOP observers have not been used to provide coverage for that sector. The Pacific States Marine Fish Commission is under contract to provide observers who are trained by NMFS. All sampling protocols and coverage strategies are defined by NMFS. Because there are few observers in relation to the number of vessels in the groundfish fishery, observer sampling coverage has focused on obtaining bycatch data at sea which can be combined with state fish ticket data to derive bycatch ratios for different fishing areas and target fishing strategies. Trawl vessel logbook data is used to estimate trawl vessel fishing effort. Using observer, fish ticket, and trawl logbook data, the fishery is modeled to derive estimate of total catch by species. Due to the delayed availability of fish ticket and logbook data, and the time needed to process observer data, the final analysis of estimated total catch by species is typically not finalized until the year after the fishing year has ended (WCGOP 2007).

Currently, WCGOP has two observer program data reports for the open access fisheries (WCGOP 2005 & 2007). Both reports focus on the open access nearshore fisheries in depths of less than 50 fathoms, but include any other open access fixed-gear trips in depths of less than 50 fathoms.

### 3.3.2 Catch Characteristics - Amounts and Fishery Values

PacFIN data were used to characterize effort and catch in commercial groundfish fisheries during the window period. Recreational data were extracted from the RecFIN web site.

#### *3.3.2.1 Pacific Coast Groundfish Fisheries*

Landed weight of groundfish in specified Pacific Coast groundfish fisheries declined from about 46,000 mt to 21,000 mt during the window period. The commercial and recreational portions of the catch averaged 90% and 10%, respectively, with the commercial portion varying between 86% and 93% annually. The landing trend in all fisheries was generally downward. The open access portion averaged about 5% of the total groundfish landed and ranged from about 4% to 7% annually (**Table 3-1; Figure 3-1**).

Table 3-1. WOC shoreside groundfish landing metrics (excluding tribal, research, shoreside whiting, and at-sea catches) by year and sector, 1998-2006 1/

| Part 1: metric tons | | | | | | |
|---|---|---|---|---|---|---|
| Year | LE | OA-D | OA-I | OA-T | Recreational | Total |
| 1998 | 31,827 | 2,152 | 465 | 2,617 | 2,876 | 39,473 |
| 1999 | 38,895 | 1,377 | 449 | 1,826 | 3,509 | 45,607 |
| 2000 | 34,204 | 1,127 | 341 | 1,468 | 3,110 | 39,908 |
| 2001 | 27,296 | 1,134 | 288 | 1,422 | 3,142 | 32,994 |
| 2002 | 24,000 | 1,089 | 130 | 1,219 | 3,023 | 29,331 |
| 2003 | 23,209 | 1,185 | 79 | 1,264 | 4,040 | 29,698 |
| 2004 | 22,139 | 1,153 | 94 | 1,247 | 2,321 | 26,860 |
| 2005 | 22,181 | 1,451 | 103 | 1,553 | 2,488 | 27,673 |
| 2006 | 16,260 | 1,166 | 81 | 1,247 | 2,551 | 21,224 |
| AVG | 26,668 | 1,315 | 226 | 1,540 | 3,007 | 32,530 |
| Part 2: proportion of total for all fisheries | | | | | | |
| 1998 | 80.6% | 5.5% | 1.2% | 6.6% | 7.3% | 100.0% |
| 1999 | 85.3% | 3.0% | 1.0% | 4.0% | 7.7% | 100.0% |
| 2000 | 85.7% | 2.8% | 0.9% | 3.7% | 7.8% | 100.0% |
| 2001 | 82.7% | 3.4% | 0.9% | 4.3% | 9.5% | 100.0% |
| 2002 | 81.8% | 3.7% | 0.4% | 4.2% | 10.3% | 100.0% |
| 2003 | 78.2% | 4.0% | 0.3% | 4.3% | 13.6% | 100.0% |
| 2004 | 82.4% | 4.3% | 0.4% | 4.6% | 8.6% | 100.0% |
| 2005 | 80.2% | 5.2% | 0.4% | 5.6% | 9.0% | 100.0% |
| 2006 | 76.6% | 5.5% | 0.4% | 5.9% | 12.0% | 100.0% |
| AVG | 81.5% | 4.2% | 0.6% | 4.8% | 9.5% | 100.0% |

1/ Commercial data from PacFIN; recreational from RecFIN

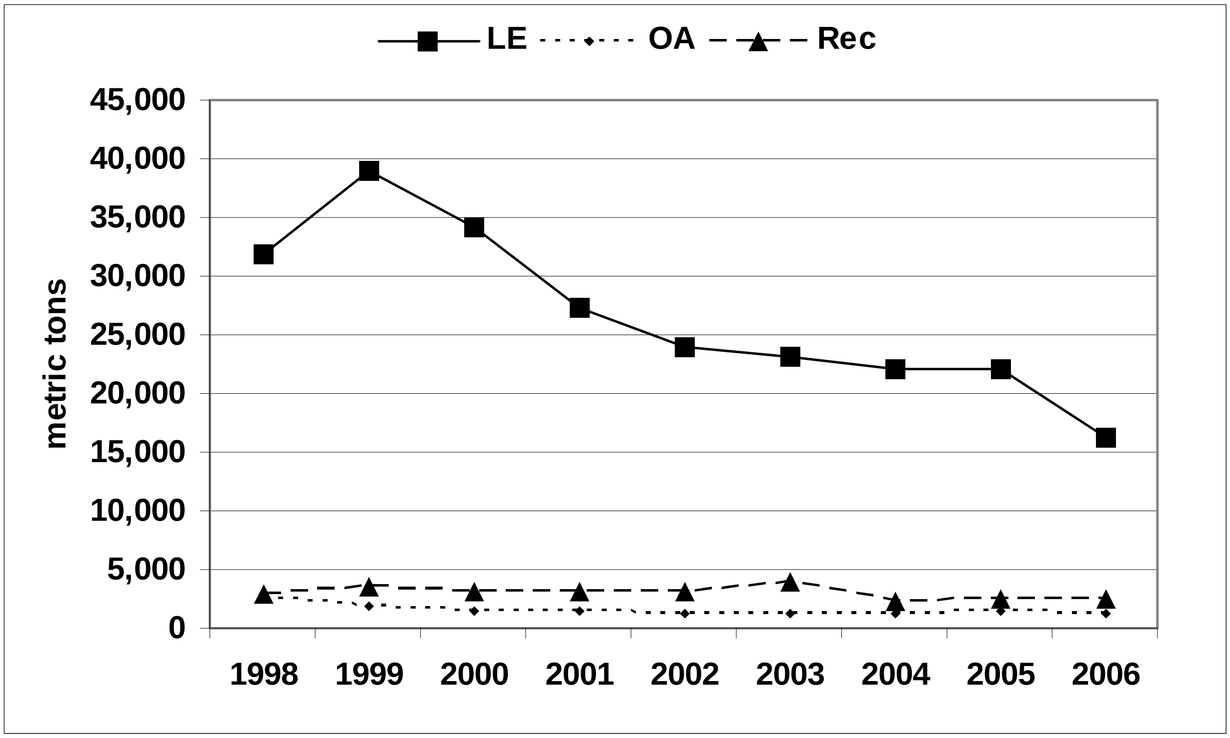


Figure 3-1. Landing trends in WOC groundfish fisheries by sector and year, 1998-2006 window period

### *3.3.2.2 Open Access Fisheries*

Open access fisheries are made up of those vessels landing Federal groundfish species without a federal limited entry groundfish permit (A permits). Participants in the open access fisheries generally fall into two categories: 1) those that target groundfish (directed) and 2) those that catch groundfish while fishing for other species (incidental). The number of vessels that participated in open access fisheries declined from 1,483 in 1999 to 905 in 2006 (**Table 3-2; Figure 3-2**). The weight of fish landed by open access vessels averaged 1,547 metric tons (mts) and ranged from 2,609 mts to 1,215 mts (**Table 3-2 and Figure 3-3**).

During 1994-2006, landed catches of allocated groundfish species in open access fisheries declined from 2,767 mt in 1994 to 733 mt in 2002 (74% decrease) then increased to 1,181 mt in 2005. The recent years' increase in landings was due to increased landings of sablefish, mostly in the Monterey-Vancouver management area (**Table 3.1.1).** During the same period the landed catch of rockfish (*Sebastes)* declined from 1,627 mt in 1994 to 186 mt in 2005 then increase to 196 mt, an overall 88% decrease in landings (**Table 3.1.1).**

### 3.3.2.3.1 Fishery Descriptions

Groundfish are caught incidentally in all major Pacific Coast commercial fisheries, including the following non-groundfish trawl fisheries: California halibut, pink shrimp, ridgeback prawn, sea cucumber and spot prawn. The fixed gear fisheries that take incidental amounts of groundfish include California halibut, coastal pelagic species, crab pot, fish pot, highly migratory species, Pacific halibut, salmon, sea urchin, and set net fisheries. Incidental fisheries are described in this section. For more information on individual gear types see: **Recht 2003** and **NMFS 2005**.

### *3.3.2.3 Incidental Open Access Fisheries*

Table 3-2. Total open access fishery data including incidental catch tonnages and proportions (P) of 1998-2006 totals

| | | Total OA | | Incidental | |
|---|---|---|---|---|---|
| Year | State | # vsls | mt | mt | P |
| 1998 | CA | 987 | 1,823.2 | 172.2 | 0.09 |
| | OR | 410 | 562.2 | 169.2 | 0.30 |
| | WA | 79 | 224.0 | 123.3 | 0.55 |
| | sub | 1,476 | 2,609.4 | 464.7 | 0.18 |
| 1999 | CA | 1,004 | 1,162.2 | 191.1 | 0.16 |
| | OR | 380 | 538.9 | 207.4 | 0.38 |
| | WA | 99 | 114.0 | 50.7 | 0.44 |
| | sub | 1,483 | 1,815.1 | 449.2 | 0.25 |
| 2000 | CA | 967 | 1,017.2 | 171.0 | 0.17 |
| | OR | 376 | 335.7 | 123.8 | 0.37 |
| | WA | 87 | 109.1 | 46.1 | 0.42 |
| | sub | 1,430 | 1,462.0 | 340.9 | 0.23 |
| 2001 | CA | 783 | 877.7 | 95.0 | 0.11 |
| | OR | 404 | 444.4 | 165.6 | 0.37 |
| | WA | 95 | 94.7 | 27.8 | 0.29 |
| | sub | 1,282 | 1,416.8 | 288.4 | 0.20 |
| 2002 | CA | 707 | 777.6 | 70.8 | 0.09 |
| | OR | 366 | 342.8 | 38.1 | 0.11 |
| | WA | 86 | 94.9 | 20.9 | 0.22 |
| | sub | 1,159 | 1,215.3 | 129.8 | 0.11 |
| 2003 | CA | 633 | 741.5 | 59.8 | 0.08 |
| | OR | 338 | 347.9 | 15.8 | 0.05 |
| | WA | 100 | 171.3 | 3.7 | 0.02 |
| | sub | 1,071 | 1,260.7 | 79.3 | 0.06 |
| 2004 | CA | 558 | 748.1 | 64.0 | 0.09 |
| | OR | 353 | 304.8 | 26.2 | 0.09 |
| | WA | 87 | 191.4 | 4.2 | 0.02 |
| | sub | 998 | 1,244.3 | 94.4 | 0.08 |
| 2005 | CA | 501 | 873.6 | 71.1 | 0.08 |
| | OR | 374 | 475.6 | 24.9 | 0.05 |
| | WA | 101 | 258.0 | 6.8 | 0.03 |
| | sub | 976 | 1,607.2 | 102.8 | 0.06 |
| 2006 | CA | 484 | 596.5 | 55.1 | 0.09 |
| | OR | 309 | 423.4 | 20.6 | 0.05 |
| | WA | 112 | 275.4 | 4.8 | 0.02 |
| | sub | 905 | 1,295.3 | 80.5 | 0.06 |
| AVGS | CA | 736 | 957.5 | 105.6 | 0.11 |
| | OR | 368 | 419.5 | 88.0 | 0.21 |
| | WA | 94 | 170.3 | 32.0 | 0.19 |
| | TOTAL | 1,198 | 1,547.3 | 225.6 | 0.15 |

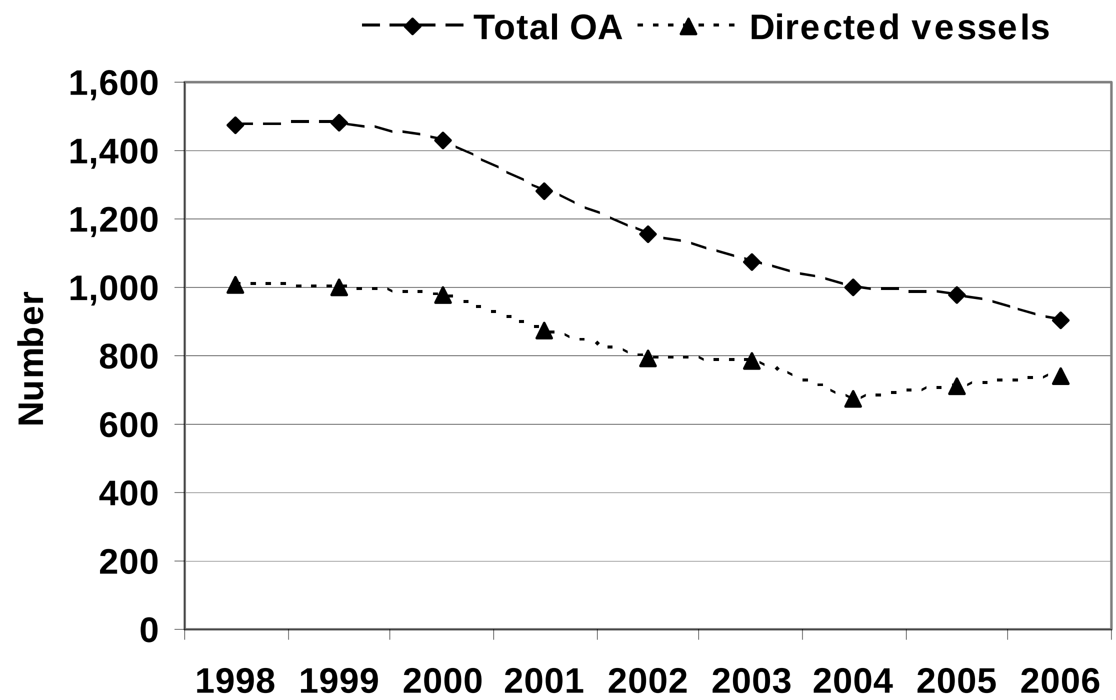


Figure 3-2. Number vessels in total and directed open access fisheries, 1998-2006 window period

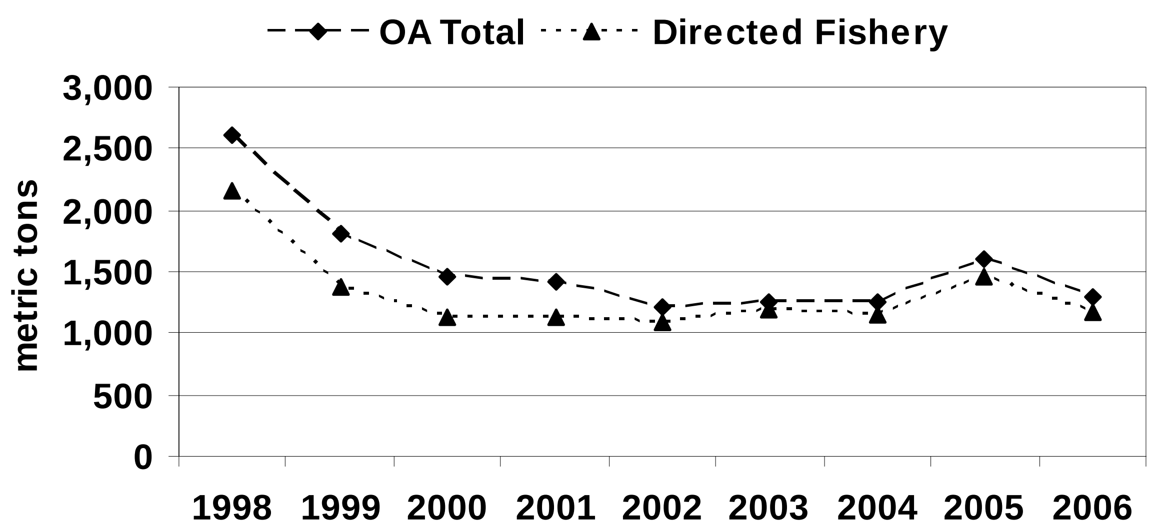


Figure 3-3. Tonnages landed in total and directed open access fisheries, 1998-2006 window period

### *3.3.2.3.1.1 California Halibut*

California halibut are commercially harvested by three principal gears: otter trawl, entangling nets (set gill net and set trammel net), and hook-and-line, all of which intercept groundfish. Trawling for California halibut is permitted in federal waters from 3 to 200 nautical miles (nm) offshore under specified regulations. Trawling is prohibited in California waters, except in the designated "California halibut trawl grounds," which encompass the area between Point Arguello (Santa Barbara County) and Point Mugu (Ventura County) in waters not less than 1 nm from the mainland shore (**CDFG 2007).** Trawlers annually take about 71% of the commercial halibut harvest, followed by 15% from entangling nets, and 14% from hook-and-line gear in recent years. Approximately 19% of the state's total annual catch in recent years was landed in a live condition which can command a premium price about 1.5 times greater than in a dead condition. **(Stephen P. Wertz 2007*).***

### *3.3.2.3.1.2 Pink Shrimp*

The Pacific Coast's pink shrimp fishery began in the 1950s in California and is now concentrated in Oregon and Washington. Regulations have evolved over time, but in 1981 they were changed, based on a three-state agreement, to establish uniform coastwide management measures. The resulting regulations, which are still in effect, include an open season from April 1 through October 31. A minimum mesh size of 1 3/8 inches measured inside the knots (California waters only), and a maximum count per pound of 160 are enforced when landing pink shrimp in a port. The pink shrimp fishery off the Pacific Coast is managed by the states, but trip limits for incidental groundfish catch, a vessel monitoring system beginning in 2008, and area restrictions protecting groundfish EFH are enforced in the federal open access fishery. Additionally, in 2000, the Council determined canary rockfish to be overfished. In response, the three states required fishermen to use approved Bycatch Reduction Devices (BRDs). BRDs were required in California in 2002, and in Oregon and Washington, they were required mid-season in 2001 and 2002; and permanently beginning in 2003. These devices have greatly reduced fish bycatch. The landings of other fin fish species now comprise less than 0.01 percent of the total value. The pink shrimp trawl fishery is exempted from RCA boundaries because of BRDs that effectively reduce rockfish bycatch. Pink shrimp are harvested by trawl vessels using a single net fished from the stern (single rig) or two independent nets set out from the vessel by trawl arms (double rig). Vessels generally work between 75 and 125 fathoms on green mud or muddy-sand substrates (**Adam J. Frimodig 2007 and Kelly Ames 2008*).***

### *3.3.2.3.1.3 Ridgeback prawn*

Ridgeback prawns (*Sicyonia ingentis*) are harvested commercially using bottom trawl gear in California south of Pt. Conception, mostly in the Santa Barbara Channel and off Santa Monica Bay. NMFS regulations allow the ridgeback prawn trawl fishery to operate in the RCA to 100 fm when the shoreward boundary is at 75 fm. A regulation summary and Title 14, California Code of Regulation reference, is available on the CDFG web site at: http://www.dfg.ca.gov/marine/pdfs/commercialdigest2007.pdf. The ridgeback prawn fishery operates primarily between 35 fm and 90 fm, with an average fishing depth of 75 fm. Trawl log data show that 99 percent of ridgeback prawns are caught in depths of 101 fm or less. Trawl data from 2001 showed that 40 percent of the annual catch occurred in depths of 75 fm to 100 fm **(Robert Leos 2007**).

### *3.3.2.3.1.4 Sea Cucumber*

Two sea cucumber species are targeted commercially: the California sea cucumber (*Parastichopus californicus*) and the warty sea cucumber (*P. parvimensis*). Commercial dive fisheries for sea cucumbers take place in Washington, Oregon, Alaska, and the coast of British Columbia, Canada. Additionally, California has a trawl fishery for sea cucumbers. Of the three states, Washington and California are the major producers with only small amounts taken occasionally in Oregon. Oregon's cucumber fishery is classified as a developmental fishery. Washington regulations prohibit the take of sea cucumber by means other than by dive gear, which precludes incidental take of groundfish. California's trawl fishery is subject to groundfish incidental take regulations. California's trawl (and dive) sea cucumber fishery is a restricted access fishery requiring possession of a permit. Trawl landings have remained relatively stable since peaking in 2002 with all but a small fraction (1%) taken in southern California ports. Ten trawlers took approximately 30% of the state's catch in 2006. Trawl catches also take place when vessels fish for California halibut since there is no limit to the amount that may be taken when trawl vessels are fishing in the California halibut trawl grounds, with trips lasting from one to several days in length. (**Laura Rogers-Bennett and David S. Ono 2007).**

### *3.3.2.3.1.5 Spot Prawn*

California is the only state with a major spot prawn fishery. Oregon's spot prawn fishery is part of its Developmental Fishery Program, with permits required to harvest this species (permits are not needed to harvest these species as bycatch in other established fisheries). In California, spot prawn is currently caught only with trap gear under specified regulations, although a small amount shows up as bycatch in the ridgeback trawl fishery (< 0.5 mt/year). A 50 lb allowance of spot prawn while trawling for ridgeback prawn is still legal, but spot prawn may not be landed as bycatch when trawling for pink shrimp (**CDFG 2007).** The baited traps are fished in strings at depths of 100 –167 fm along submarine canyons or shelf breaks. Each string consists of a groundline with anchors and a buoy at one or both ends, and 10 to 30 traps attached. No other species may be taken in a prawn trap so all bycatch is returned to the water immediately. Until 2002, spot prawn were harvested in California by trawl and trap gear. In 2003, the use of trawl gear for the take of spot prawn was outlawed because of the bycatch of rockfish, particularly bocaccio, an overfished species. Oregon and Washington banned the use of trawl gear to take spot prawn in 2004 due to concerns about habitat destruction. Both states currently allow the use of pot gear for spot prawn take and landing. Almost all spot prawn harvested is sold live, with ex-vessel prices ranging from $10.00 to $13.50/pound. Fresh dead spot prawn generally sells for half the price of live (**Kristine Barsky 2007 and Kelly Ames 2008**).

### *3.3.2.3.1.6 Coastal Pelagic Species*

Coastal pelagic species (CPS) include northern anchovy, market squid, Pacific bonito, Pacific saury, Pacific herring, Pacific sardine, Pacific (chub or blue) mackerel, and jack (Spanish) mackerel. Coastal pelagic species fisheries are concentrated in California, but fishing also takes place in Washington and Oregon. Management of the CPS is now governed by the CPS Fishery Management Plan including provisions for limited entry management. During the 1940s and 1950s, approximately 200 vessels participated in the Pacific sardine fishery. Some present day CPS vessels are remnants of that fleet. Coastal pelagic species are harvested directly and as bycatch in other fisheries. Generally, they are targeted with "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets. These species are also taken incidentally with midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. CPS finfish are sold as relatively high volume/low value products (e.g., Pacific mackerel canned for pet food, Pacific sardine frozen and shipped to Australia to feed penned tuna, and northern anchovy reduced to meal and oil). In addition to fishing for CPS finfish, many of these vessels fish for market squid, Pacific bonito, bluefin tuna, and Pacific herring. Vessels using round-haul gear account for approximately 99% of the CPS landings and revenue per year. Crew sizes vary, with larger purse seiners using between six to 10 crew members. Fishing is usually done in relatively shallow waters (<20 fathoms) with trips of no more than a day in length. Because CPS are harvested mostly with purse seine gears schools relatively near the water's surface, where fish are easily identified, the incidental catch of groundfish is thought to be minimal. However, incidental catch increases when purse seines are set in shallow water, nearshore, such that the seine net comes in contact with the bottom or a rocky outcropping (**Goen and Hastie 2002**).

### *3.3.2.3.1.7 Crabpot*

Dungeness crab (*Cancer magister*) exist in commercial quantities from Alaska to south of San Francisco, California. Dungeness crab lives in the intertidal zone to a depth of 170 m. Washington's coastal commercial crab grounds extend from the Columbia River to Cape Flattery near Neah Bay and include the estuaries of the Columbia River, Grays Harbor, and Willapa Bay. Oregon has consistently been one of the largest producers of Dungeness crab on the Pacific Coast, and its Dungeness crab fishery is the largest single species commercial fishery by value of the state. California's fishery is centered in northern California with the central California fishery taking place around the San Francisco port complex. Washington, Oregon, and California undertake coordinated management of the fishery under the auspices of the Pacific States Marine Fisheries Commission. An average of about 1,700 vessels per year has participated in the coastwide fishery since 1998. Crab pots are used for most all commercial crabbing. Pots must conform to construction guidelines that efficiently minimize their impact on undersize and non-target species. Multiple crab pots are set in rows, each on an individual line. Pots are retrieved using hydraulic "crab blocks" which are essentially power driven winches. An efficient crew can hoist and re-bait as many as 400 pots per day. Pots are predominantly set between 10 and 50 fathoms (60-300 feet) although Dungeness crab commonly occur from intertidal areas to 200 fathoms (1,200 feet). Crabs are stored live in holds on boats that are filled with re-circulating sea water and are delivered every few days to fish processing plants. Groundfish are caught incidentally in Dungeness crab pots off all three states, but can only be landed in California ports (**Robert Leos 2007**).

Lobster fishermen typically use 100-500 traps, although some fishermen may use as many as 750 traps at the peak of the season. Lobster traps are box-like devices usually constructed of heavy wire mesh, although other materials (such as plastic) may be used. Traps are baited with whole or cut fish, and placed on the sea floor using cement, bricks, or steel as ballast. The incidental take of groundfish in this fishery is minimal. For example, in 2006, of the 158 OA vessels that made lobster landings, about 0.25 mt of groundfish was taken with trips where lobster were also landed (**Robert Leos 2007**).

### *3.3.2.3.1.8 Finfish Pot (California sheephead and hagfish)*

Fin fish pot gear is used for targeting sablefish, thornyheads and nearshore species, and for non-groundfish species such as California sheephead and hagfish. Sheephead was not a targeted species until recent years due to the live fish fishery and high demand for this particular species. California sheephead are under state management and are subject to the regulations that govern the state's nearshore fishery complex. The sheephead total allowable catch has been 75,200 pounds per year. Other regulations include a 13 inch (total length) minimum size limit, and two-month cumulative trip limits per nearshore fishery permit holder. From 2004-2006, trap (pot) gear was used to catch the majority of landed sheephead, accounting for 85% (100 mt) of the three-year total of 118 mt in the open access fishery (includes directed and incidental). At least 90% of this take was landed in live condition. Of the 45 fishermen who made any sheephead landings using trap gear during this three-year period, 10 of them accounted for approximately 66% of the total sheephead take (**Robert Leos 2007**). Only one pot permit is allowed in Oregon's nearshore fishery (**Kelly Ames 2008**).

In the developing hagfish fishery, the take is made largely with bucket trap gear with no incidental take of other species. Bucket traps are basically modified plastic barrels. Korean traps are permitted but are not generally used because of their smaller size. Oregon has had the largest fishery followed by Washington and California, primarily in the Conception area. The market for this fishery is exports to Korea in a live condition. In Oregon hagfish are under the Developmental Fishery Program. Permits are valid for 90 days from issuance, unless five landings of 1,000 lb or 25,000 lb total is landed within the 90-day time period, in which case the permit is valid for the rest of the year. Currently, there are 25 permits for harvest by pot gear. Roughly 100 pots are fished using 55 gallon plastic drums. In 2007, four permits were issued and roughly 850,000 lbs of hagfish were landed in Oregon. No other open access finfish pot fisheries exist in Oregon (**Robert Leos 2007; Kelly Ames 2008**)

### *3.3.2.3.1.9 Highly Migratory Species*

Highly migratory species (HMS) include tunas, billfishes, dorado, and certain pelagic sharks. The Council's HMS FMP applies to all U.S. vessels that fish for HMS within the EEZ (3-200 nautical miles) off California, Oregon, or Washington and to U.S. vessels that pursue HMS on the high seas (seaward of the EEZ) and land their fish in California, Oregon, or Washington. There are 5 distinctive gear types used to harvest HMS commercially, with hook-and-line gear being the oldest and most common. Other gears used to target HMS are driftnet, pelagic longline, purse seine, and harpoon. Vessels targeting HMS take groundfish incidentally in small quantities. A notable source of groundfish species mortality within the HMS fishery has been due to "mixed trips," in which a vessel operating under a VMS license also targets groundfish during a single trip. The expansion of VMS coverage into the open access fishery, effective February 7, 2008 (72 FR 69162, December 7, 2007), is expected to reduce mixed trip impacts on groundfish, and depleted species in particular **(Steve Wertz 2007)**

### *3.3.2.3.1.10 Pacific Halibut Longline*

Pacific halibut (*Hippoglossus stenolepis*) are managed by the bilateral (United States./Canada) International Pacific Halibut Commission (IPHC) with implementing regulations set by Canada and the United States in their own waters. The Pacific Halibut Catch Sharing Plan for waters off Washington, Oregon, and California (Area 2A) specifies IPHC management measures for Pacific halibut on the Pacific Coast. Implementation of IPHC catch levels and regulations is the responsibility of the Council, the states of Washington, Oregon, and California, and the Pacific halibut treaty tribes. The directed fishery is responsible for most of the non-treaty commercial catch of Pacific halibut, while the treaty catch is approximately 35% of the total allowable catch. An incidental halibut fishery occurs within the primary sablefish fishery north of Point Chehalis, Washington (46° 53' 18" N. latitude). To allow landing of these halibut, the Catch Sharing Plan stipulates that when the Area 2A total allowable catch (TAC) is above 900,000 pounds, halibut may be retained in the limited entry primary sablefish fishery Rockfish are also caught in the halibut fishery, particularly yelloweye rockfish. However, encounters have been significantly reduced in the non-treaty commercial fishery in recent years by restricting the fishery to depths greater than 100 fm. Sablefish are commonly intercepted, as they are found in similar habitat to Pacific halibut and are easily caught with longline gear. Landings of halibut are monitored by state fish tickets and through the mandatory logbooks required in the directed commercial halibut fishery. In 2006, the IPHC issued 298 licenses for the directed commercial fishery (including the incidental halibut during the sablefish fishery) for Area 2A. The directed commercial fishery consisted of three 10-hour fishing periods with fishing period limits. Fishing periods are set up using vessel size classes (Jamie Goen 2007 and Kelly Ames 2008)

### *3.3.2.3.1.11 Salmon Troll*

Salmon are targeted with troll gear off of all three states. Troll gear consists of heavily weighted main troll lines from which multiple leaders with attached lures or baited hooks are used to catch Chinook salmon off all three states and coho salmon off Oregon and Washington. The ocean commercial salmon fishery, both nontreaty and treaty, is under federal management with a suite of seasons, gear restrictions, and total allowable harvest levels. The Council manages commercial fisheries in federal waters, while the states manage fisheries in territorial waters, which are usually in close conformance to the federal regulations. Annual average salmon troll vessels for the window period were 634 in California, 422 in Oregon and 66 in Washington. Bycatch of fish other than salmon is generally limited by regulation. The EIS for 2007-2008 groundfish management measures determined that catch levels for target salmon fisheries would not have a significant impact on overfished groundfish species (**Robert Leos 2007**).

### *3.3.2.3.1.12 Red sea urchin*

Some California dive boats used fixed fishing gear to harvest fin fish species during diving operations for red sea urchin during the window period. Both state and federally managed species may be harvested including federal groundfish. The fixed gear types used during dive operations are not generally recorded on fish tickets and probably include one or a combination of hook and line and fish pot gear types **(Robert Leos 2007).**

### *3.3.2.3.1.13 Setnet Fishery*

The California setnet fishery uses anchored gill or trammel nets to catch target fish species, including federal groundfish. California regulations limit the fishery to specific times and areas (**CDFG 2007).**

The three top species targeted are California halibut, white seabass, and thresher shark. These three species make up approximately 72% of all landings. California halibut is the major target species, making up approximately 35% of the cumulative window period total. Other species taken in appreciable numbers include: yellowtail, soupfin shark, skates, and leopard shark. Fishery activity has been concentrated in ports south of Point Conception where 87 different vessels made landings during the window period. Thirty made landings in the south-central region with only 6 making landings in the north-central region. The most vessels that fished in any single year was in the south region with 36 in 1999. That region averaged 26 vessels per year. This indicates that many vessels move out and move into the fishery on a year-to-year basis (**Robert Leos 2007**).

#### 3.3.2.3.2 Landings Characteristics of Incidental Fisheries

The overall contribution of incidental fisheries to WOC groundfish fisheries was discussed above. Here we describe the landings in individual fisheries for which landings data are available. There were substantial incidental landings during 1998-2001 window period years that cannot be tied to particular fisheries, and appear to be the result of data coding errors or the inclusion of limited entry data in open access fishery files. The unaccounted for fishery landings in incidental fisheries declined from 58 mt to 96 mt during 1998-2001 to an annual range of 3 mt to 7 mt during 2002-2006 (**Table 3-3).** The available data show that fisheries with the greatest incidental impact on federal groundfish during the window period were the pink shrimp trawl, California set net, California halibut trawl and salmon troll fisheries, which collectively averaged 153.5 mt per year or 81% of the total for all fisheries combined. Starting in 2003 there were reductions in incidental fishery landings in several fisheries. The most notable reduction was in the pink shrimp trawl fishery which fell from 47 mt in 2002 to 1.3 mt in 2003 and continued to decline toward zero in most years thereafter (**Table 3-3).** Average annual incidental fishery landings for all fisheries combined during 2003-2006 window period years were 89 mt tons, which was 45% of the window period average of 190 mt for landings that can be attributed to individual fisheries.

Landings of target species by fisheries that made incidental groundfish landings averaged about 195,000 mt worth about $ 149 million ex-value price annually during the window period. The groundfish landings associated with these deliveries contributed ≤0.2 % in terms of weight or value of the landed catch (**Table 3-4**). Federal groundfish incidental fishery landing contributions varied in importance between fisheries. The fisheries with highest groundfish contributions were the California halibut trawl fishery (26% by weight; 9% by value), Pacific halibut long-line fishery (16% by weight; 10% by value), California spot prawn trawl fishery (11% by weight; 1% by value) and the California set net fishery (9% by weight; 3% by value). All other fisheries showed average groundfish landings of ≤5% by weight or value compared to target species landings (**Table 3-4).**

Table 3-3. Federal groundfish landings in incidental fisheries, 1998-2006 including averages

| Fishery | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | AVG |
|---|---|---|---|---|---|---|---|---|---|---|
| Non-groundfish trawl | | | | | | | | | | |
| California halibut | 56.6 | 47.3 | 22.5 | 21.7 | 14.3 | 10.6 | 28.1 | 31.6 | 22.7 | 28.4 |
| Pink shrimp | 186.5 | 220.8 | 153.0 | 94.2 | 47.0 | 1.3 | 1.8 | 0.1 | 0.0 | 78.3 |
| Ridgeback prawn | 1.9 | 4.1 | 8.0 | 9.1 | 3.8 | 3.4 | 0.9 | 1.2 | 3.4 | 4.0 |
| Sea cucumber | 3.1 | 1.6 | 1.2 | 1.4 | 0.9 | 1.1 | 0.3 | 0.1 | 0.0 | 1.1 |
| Spot prawn 1/ | 28.8 | 16.0 | 6.0 | 3.4 | 2.0 | 0.2 | 0.0 | 0.0 | 0.0 | 6.3 |
| subtotal | 276.9 | 289.8 | 190.7 | 129.8 | 68.0 | 16.6 | 31.1 | 33.0 | 26.1 | 118.0 |
| California halibut HL 2/ | 4.7 | 5.8 | 5.2 | 3.7 | 2.3 | 3.4 | 3.0 | 1.2 | 1.1 | 3.4 |
| CPS | 6.2 | 3.6 | 2.5 | 2.8 | 2.0 | 4.3 | 2.9 | 0.8 | 1.9 | 3.0 |
| Crabpot | 1.5 | 1.0 | 1.2 | 0.7 | 0.6 | 0.9 | 1.2 | 4.3 | 6.1 | 1.9 |
| Fish pot 2/ | 3.7 | 3.1 | 6.8 | 9.0 | 3.1 | 3.9 | 4.5 | 2.3 | 1.2 | 4.2 |
| HMS | 3.8 | 2.7 | 2.9 | 3.4 | 4.1 | 1.9 | 2.1 | 1.7 | 1.7 | 2.7 |
| Pacific halibut LL 2/ | 2.0 | 4.6 | 3.7 | 5.6 | 4.1 | 10.9 | 15.9 | 20.3 | 20.3 | 9.7 |
| Salmon | 37.8 | 22.5 | 18.0 | 13.4 | 9.3 | 8.7 | 13.1 | 11.5 | 4.1 | 15.4 |
| Sea urchin | 0.0 | 0.1 | 0.5 | 0.1 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.1 |
| Set net 2/ | 31.9 | 57.7 | 46.3 | 38.8 | 29.2 | 25.8 | 16.8 | 22.3 | 14.4 | 31.5 |
| subtotal | 91.6 | 100.9 | 87.1 | 77.5 | 54.9 | 60.1 | 59.6 | 64.4 | 50.8 | 71.9 |
| TOTAL | 368.5 | 390.7 | 277.8 | 207.3 | 122.9 | 76.7 | 90.7 | 97.4 | 76.9 | 189.9 |
| Fishery unknown | 96.2 | 58.4 | 63.1 | 81.2 | 6.9 | 2.7 | 3.6 | 5.4 | 3.6 | 35.7 |
| TOTAL (2) | 464.7 | 449.1 | 340.9 | 288.5 | 129.8 | 79.4 | 94.3 | 102.8 | 80.5 | 225.6 |

1/ Prohibited in California starting April 2003. Incidental landings are allowed with ridgeback prawn landings

2/ excludes B species directed fishery landings

Table 3-4. Summary of open access fishery incidental fishery landings of federal groundfish, 1998-2006 annual averages

| | Target species | | Federal groundfish | | Federal groundfish % based on | |
|---|---|---|---|---|---|---|
| Fishery | mt | K$$ | mt | K$$ | mt | K$$ |
| Non-groundfish trawl | | | | | | |
| California halibut | 111.2 | 759.4 | 28.4 | 66.1 | 25.5% | 8.7% |
| Pink shrimp | 8,244.7 | 6,254.2 | 78.3 | 90.9 | 0.9% | 1.5% |
| Ridgeback prawn | 219.6 | 625.5 | 4.0 | 7.6 | 1.8% | 1.2% |
| Sea cucumber | 91.5 | 162.4 | 1.1 | 2.7 | 1.2% | 1.6% |
| Spot prawn 1/ | 57.5 | 929.7 | 6.3 | 11.3 | 10.9% | 1.2% |
| subtotal | 8,724.6 | 8,731.1 | 118.0 | 178.5 | 1.4% | 2.0% |
| California halibut HL 2/ | 66.1 | 467.6 | 3.4 | 15.3 | 5.1% | 3.3% |
| CPS | 149,012.7 | 31,799.8 | 3.0 | 5.3 | 0.0% | 0.0% |
| Crabpot | 15,428.1 | 60,653.2 | 1.9 | 7.2 | 0.0% | 0.0% |
| Fish pot 2/ | 288.8 | 542.0 | 4.2 | 41.7 | 1.4% | 7.7% |
| HMS | 12,194.8 | 22,361.4 | 2.7 | 4.9 | 0.0% | 0.0% |
| Pacific halibut LL 2/ | 62.0 | 308.3 | 9.7 | 31.8 | 15.6% | 10.3% |
| Salmon | 3,196.3 | 13,655.2 | 15.4 | 24.1 | 0.5% | 0.2% |
| Sea urchin | 5,618.8 | 9,336.6 | 0.1 | 1.0 | 0.0% | 0.0% |
| Set net 2/ | 351.5 | 1,356.7 | 31.5 | 37.8 | 9.0% | 2.8% |
| subtotal | 186,219.0 | 140,480.8 | 71.9 | 169.1 | 0.0% | 0.1% |
| TOTAL | 194,943.6 | 149,212.0 | 189.9 | 347.6 | 0.1% | 0.2% |
| Unknown | NA | NA | 35.7 | NA | NA | NA |
| Total (2) | 194,943.5 | 149,211.9 | 225.6 | NA | NA | NA |

1/ spot prawn trawling prohibited in California starting April 2003. Incidental landings allowed with ridgeback prawn landings

2/ excludes B species directed fishery landings

### *3.3.2.4 Directed Open Access Fishery*

#### 3.3.2.4.1 Fishery Descriptions

Directed fishery groundfish catches are made using hook and line, fish pot and set net gear. The directed fisheries are described in this section. For more specific information on individual gear types, see**: Recht, F. 2003 and NMFS 2005.**

##### *3.3.2.4.1.1 Groundfish Hook-and-Line*

Open access hook-and-line gears include longline, vertical hook-and-line (Portuguese longline), jigs, handlines, rod and reels, vertical and horizontal setlines, troll lines, cable gear and stick gear. Vessels fishing off Washington, Oregon, and California use these gears to target sablefish, lingcod, nearshore shelf, and slope rockfishes, cabezon, greenlings, spiny dogfish, Pacific sanddab, grenadier, and other federal groundfish. Fish are landed in live or dead condition in Oregon and California but not in Washington where possession of live bottom fish taken under a commercial fishing license is prohibited (**Robert Leos 2007**).

Longline gear is the most common open access hook-and-line gear used by vessels directly targeting sablefish. Both vertical and horizontal long-line types are used. They are generally fished in waters up to 600 fathoms, though sometimes as deep as 760-800 fathoms. Nearly all are landed dead in all three states, but some sablefish are landed live in the Oregon fishery. Lingcod have been a target of commercial fisheries since the early 1900s in California, and since the late 1930s in Oregon and Washington. Longline and hook-and-line gear are used to target lingcod. Lingcod are taken from near the surface to about 60 fathoms, but are found in depths to 200+ fathoms. The longline fishery for spiny dogfish is currently prosecuted by a limited number of vessels specializing in the fishery during the winter and early spring months when dogfish occur in fishable concentrations off the north Washington Coast. During the window period, Washington's fishery accounted for almost all the landings of this species. Pacific grenadier (*Coryphaenoides acrolepis*) are among the most abundant fishes of the continental slope and are found at depths from 155 to 3,825 m, most commonly between 600 and 2,500 m. Since 1998, approximately 300 mt of grenadier have been taken by OA longline vessels with peak landings in 2000 (89 mt). Since then, landings have decreased with four mt landed by OA vessels using longline in 2006. Pacific sanddab (*Citharichthys sordidus*) is taken in the hook-and-line fishery, mostly in California. South of 42° N latitude, when fishing for Pacific sanddab (and "other flatfish") vessels using hook-and-line gear with no more than 12 hooks per line, using hooks no larger than "Number 2" hooks, and up to two 1 pound weights per line, are not subject to the RCA restrictions **(Robert Leos 2007).**

The nearshore fishery is defined, in part, by the area from the coastal high-tide line offshore to approximately 30 fathoms. The number of species included in the nearshore fishery complex range from 19 in California to 23 in Oregon. The nearshore fishery is a restricted access fishery in that each state has jurisdiction over the number and type of permits issued, the included species, and where those permits may be used. Washington has no commercial nearshore fishery. The primary gears used in the nearshore area are hook-and-line, including rod-and-reel, vertical hook-and-line, cable gear, stick gear, and set longline. Much of the fishing is done by single operators in smaller vessels including kayaks, skiffs, and small boats. Trips generally last only a day because much of the harvest is directed at the live-fish fishery, which yields a higher price per pound. In California, hook and line gear for the live fish fishery has been limited to a maximum of 150 hooks per vessel and 15 hooks per line within one mile of the mainland shore since 1995.

The Oregon nearshore fishery occurs in waters from shore to 30 fm, but mostly in 10 fm (18 meters) or less. Nearshore rockfish and species such as cabezon and greenling are the primary target of the live fish fishery in Oregon. Black rockfish is the primary target for the fresh fish market. One permit is issued allowing for the use of pot gear (typically targeting cabezon). Dive and trawl gear are not legal while used in conjunction with the Black/Blue/Nearshore permit. Commercial fishing for food fish is prohibited in Oregon bays and estuaries and within 183 meters (200 yards) from a man-made structure.

Nearshore fishing activity peaks during the summer months when sea and weather conditions are more condusive to fishing. This is especially true for fishing activity in Oregon and northern California waters. For the nine-year period, black rockfish was the dominate species landed by OA hook-and-line vessels, making up approximately 41% of the total landings (about 4,100 mt). Cabezon was next with 19%, followed by greenlings, gopher and grass rockfishes, with 7%, 6%, and 5%, respectively **(Robert Leos 2007; Kelly Ames 2008).**

### *3.3.2.4.1.2 Groundfish Trap*

Approximately 20% of federal groundfish landed in the directed OA fishery was made using fish trap (pot) gear during the window period. Traps are highly selective for sablefish and are fished off a long-line in series (a set of traps) in waters up to 600 fathoms, though sometimes as deep as 760-800 fathoms. Up to 50 traps are attached to each main line. The traps are rectangular, trapezoidal or conical in shape. The most common, trapezoidal traps are approximately 6' x 2.5' in size and weigh about 55 pounds. The bigger rectangular traps may be over 100 pounds in weight. Traps are usually baited with Pacific whiting or sometimes whiting and squid. Many sablefish trap fishermen are now using escape rings to allow the escape of smaller fish while the trap is fishing. This reduces the number of fish the fishermen have to handle and reduces fish mortality due to handling in the release of small fish.

Cabezon was a distant second in the OA vessel directed groundfish trap fishery, with 1.8% (approximately 120 mt) of the total take of federal groundfish. In this fishery, California fishermen made the majority of the landings, with about 90% of the total take of cabezon. A total of 126 California vessels participated in the cabezon fishery with Oregon's total at three historically, with only one issued an Oregon Limited Entry Nearshore Permit in 2004. There were no Washington OA vessels recorded as having made cabezon landings using trap gear. Other species commonly taken in directed OA landings where cabezon were caught included: California sheephead, lingcod, gopher, kelp, grass, black-and-yellow, and black rockfishes. The majority of California's cabezon landings in the more recent years has centered on the Morro Bay port complex. Since 2003, California fishermen have been required to possess a nearshore fishing permit to catch and land cabezon since this species is included in the state's shallow species nearshore complex. Since 2003, fishers in Oregon have been required to possess a nearshore permit to land more than incidental amounts of cabezon **(Robert Leos 2007; Kelly Ames 2008).**

### *3.3.2.4.1.3 Groundfish Setnet*

Setnet gear is legal to use to target federal groundfish in the open access fishery south of 38° N. lat. only. The fishermen generally target non-groundfish species, but some have made groundfish landings that met the definition used in this report for directed open access groundfish fishing. The set net fishery is generally described in **Section 3.3.2.3.1.13**. The number of vessels that participated in the directed setnet fishery for groundfish species ranged from a high of about 50 in 1999 and 2000 to about one half those amounts in 2005 and 2006. Landings of federal groundfish taken in the directed segment of California's setnet fishery during the window period were dominated by bank rockfish, soupfin shark, chilipepper and widow rockfishes, and the unspecified rockfishes market category group **(Robert Leos 2007).**

#### 3.3.2.4.2 Directed Groundfish Vessels and Landings

The number of directed groundfish fishery vessels declined from about 1,000 in 1998 to 677 in 2004 then increased to 709 and 744 in 2005 and 2006, respectively (**Table 3-5**). Sablefish and nearshore species accounted for an average of 84% with an annual range of 60%-91% of directed fishery revenues during the window period (**Table 3-5; Figure 3-4**). The sablefish component of revenues increased from 7% in 1998 to 50% in 2006 (**Table 3-5; Figure 3-4**). The nearshore component increased from 53% to 65% of revenues during 1998-2001 window period years then declined to 40% in 2006 (**Table 3-5; Figure 3-4**). The remaining revenues were from shelf and slope rockfish landings and other species such as lingcod, grenadiers, thornyheads, and specified sharks and rays. The major drop in shelf rockfish landings between 1998 and subsequent years reflects the reduced harvest guidelines and more restrictive rockfish limits that began to be implemented at that time in response to depressed status of certain key rockfish stocks and that was discussed in **Section 1.4.1**. The turnaround in open access revenues that began in 2005 was associated with increased sablefish landings (**Figure 3-4)**.

The trend in vessels making at least one directed sablefish landing in the WOC area steadily increased during the window period except for 2004 when there was a downturn in participation. The trend in sablefish impact, based on landings expressed as a proportion of annual allocations for the Monterey-Vancouver management area (northern area) (**Table 1-1**), followed the directed fishery vessel participation trend very closely (**Table 3-5; Figure 3-5**). In 2005 the northern area fishery exceeded its harvest guideline by over 40% (**tables 1.1 and 3.1.1; Figure 3-5)**. More restrictive sablefish landing and cumulative landing limits were implemented during May-September 2006 in anticipation of a possible effort shift by salmon vessels to the sablefish fishery because of reduced salmon fishing opportunity. However, the restrictions did not work and the fishery had to be closed during October-December because of projected allocation attainment (see: http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/71FR58289.pdf).

It is not clear that reduced salmon fishing opportunity contributed to the high sablefish harvest in 2005. This because the commercial fishery south of Cape Falcon to the US/Mexico border landed 582,000 Chinook salmon, which was just below the precious 10-year fishery average of 602,000 Chinook salmon, while the fishery between the US/Canada border to Cape Falcon landed 87,000 Chinook salmon, which was substantially above its previous 10-year average of 48,000 Chinook salmon (see: http://www.pcouncil.org/salmon/salbluebook/App_A_Hist_Ocean_Effort_Land.xls).

### *3.3.3 Vessel and Fisherman Characteristics*

B permit species fishery data for the window period were used to characterize fisherman and vessels. The window period was divided in some analyses into three periods: 1998-2003, 2004-2006 and 1998-2006.

#### *3.3.3.1 Vessel Participation Frequencies*

A total of 2,587 different vessels participated in the directed open access fishery during the window period, and 69% (1,484) of the vessels that made a landing during 1998-2003 (2,157) did not make a directed fishery landing during 2004-2006. Conversely, 1,103 vessels (31%) that made a landing during 2004-2006 also made a landing during 1998-2003. A total of 430 new vessels entered the fishery during 2004-2006. A total of 71 vessels (3%) made a landing every year and 443 vessels (17 %) made a directed fishery landing in most (≥5) years of the window period (**Table 3-6**).

Table 3-5. Directed open access fishery participation and landings statistics, 1998-2006. Page 1

| | | Sablefish | | | Nearshore | | | Shelf RF | | | Slope RF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yr | State | No. Vsls | mts | (000s) | No. Vsls | mts | (000s) | No. Vsls | mts | (000s) | No. Vsls | mts | (000s) |
| 1998 | CA | 83 | 94.6 | $218.7 | 461 | 471.6 | $2,420.7 | 251 | 797.3 | $1,160.6 | 90 | 192.3 | $220.3 |
| | OR | 29 | 16.3 | $45.4 | 93 | 152.2 | $276.3 | 98 | 178.5 | $272.4 | 1 | 4.4 | $6.4 |
| | WA | 29 | 25.6 | $79.5 | 0 | 0.0 | $0.0 | 10 | 12.4 | $9.4 | 0 | 0.0 | $0.0 |
| | Total | 141 | 136.5 | $343.6 | 554 | 623.8 | $2,697.0 | 359 | 988.2 | $1,442.4 | 91 | 196.7 | $226.7 |
| 1999 | CA | 97 | 176.9 | $453.8 | 495 | 404.4 | $2,641.7 | 281 | 264.1 | $538.5 | 30 | 16.9 | $28.6 |
| | OR | 14 | 20.6 | $64.9 | 108 | 176.3 | $533.3 | 90 | 93.3 | $193.6 | 1 | 1.2 | $1.7 |
| | WA | 28 | 36.0 | $114.6 | 0 | 0.0 | $0.1 | 7 | 9.1 | $7.3 | 0 | 0.0 | $0.0 |
| | Total | 139 | 233.5 | $633.3 | 603 | 580.7 | $3,175.0 | 378 | 366.5 | $739.4 | 31 | 18.1 | $30.3 |
| 2000 | CA | 112 | 299.0 | $944.2 | 505 | 323.9 | $2,898.4 | 197 | 96.3 | $281.5 | 26 | 8.5 | $21.5 |
| | OR | 34 | 43.6 | $158.6 | 126 | 147.4 | $565.9 | 36 | 7.3 | $19.4 | 1 | 0.5 | $0.7 |
| | WA | 32 | 51.9 | $201.8 | 0 | 0.0 | $0.0 | 9 | 1.7 | $2.6 | 2 | 1.5 | $1.5 |
| | Total | 178 | 394.5 | $1,304.6 | 631 | 471.3 | $3,464.3 | 242 | 105.3 | $303.5 | 29 | 10.5 | $23.7 |
| 2001 | CA | 109 | 273.7 | $820.0 | 441 | 319.1 | $2,557.8 | 114 | 66.7 | $177.4 | 25 | 25.9 | $51.5 |
| | OR | 64 | 58.9 | $199.1 | 137 | 189.4 | $742.4 | 12 | 5.5 | $14.6 | 1 | 0.6 | $0.6 |
| | WA | 44 | 60.3 | $217.7 | 1 | 0.1 | $0.1 | 7 | 0.8 | $1.0 | 2 | 1.4 | $1.4 |
| | Total | 217 | 392.9 | $1,236.8 | 579 | 508.6 | $3,300.3 | 133 | 73.0 | $193.0 | 28 | 27.9 | $53.5 |
| 2002 | CA | 118 | 268.3 | $797.7 | 344 | 257.8 | $2,059.8 | 75 | 19.7 | $72.1 | 38 | 60.7 | $132.7 |
| | OR | 52 | 49.7 | $179.7 | 147 | 223.4 | $1,065.4 | 5 | 3.6 | $9.1 | 0 | 0.1 | $0.8 |
| | WA | 44 | 65.2 | $236.6 | 1 | 0.2 | $0.1 | 0 | 0.0 | $0.0 | 0 | 0.0 | $0.0 |
| | Total | 214 | 383.2 | $1,214.0 | 492 | 481.4 | $3,125.3 | 80 | 23.3 | $81.2 | 38 | 60.8 | $133.5 |
| 2003 | CA | 118 | 312.6 | $945.9 | 296 | 164.1 | $1,504.2 | 42 | 8.7 | $39.4 | 43 | 82.4 | $194.0 |
| | OR | 96 | 134.3 | $492.4 | 126 | 163.8 | $654.0 | 7 | 3.3 | $7.8 | 0 | 0.8 | $1.1 |
| | WA | 64 | 118.2 | $449.8 | 0 | 0.0 | $0.0 | 0 | 0.0 | $0.0 | 0 | 0.0 | $0.0 |
| | Total | 278 | 565.1 | $1,888.1 | 422 | 327.9 | $2,158.2 | 49 | 12.0 | $47.2 | 43 | 83.2 | $195.1 |
| 2004 | CA | 91 | 288.3 | $831.0 | 224 | 201.2 | $1,837.6 | 88 | 23.9 | $104.4 | 38 | 52.2 | $129.7 |
| | OR | 67 | 73.6 | $225.0 | 112 | 169.5 | $750.6 | 12 | 2.9 | $6.6 | 3 | 1.0 | $1.3 |
| | WA | 53 | 96.4 | $325.8 | 0 | 0.0 | $0.0 | 1 | 0.5 | $0.5 | 2 | 1.4 | $1.3 |
| | Total | 211 | 458.3 | $1,381.8 | 336 | 370.7 | $2,588.2 | 101 | 27.3 | $111.5 | 43 | 54.6 | $132.3 |
| 2005 | CA | 101 | 458.3 | $1,312.1 | 208 | 195.1 | $1,811.0 | 70 | 21.2 | $98.6 | 37 | 30.8 | $84.0 |
| | OR | 107 | 257.6 | $915.9 | 114 | 150.3 | $759.3 | 10 | 3.4 | $8.7 | 4 | 5.1 | $7.3 |
| | WA | 68 | 182.2 | $677.9 | 0 | 0.0 | $0.0 | 2 | 0.4 | $0.7 | 2 | 6.5 | $7.6 |
| | Total | 276 | 898.1 | $2,905.9 | 322 | 345.4 | $2,570.3 | 82 | 25.0 | $108.0 | 43 | 42.4 | $98.9 |
| 2006 | CA | 122 | 279.9 | $941.5 | 201 | 141.7 | $1,463.0 | 74 | 21.3 | $103.0 | 29 | 33.0 | $85.4 |
| | OR | 132 | 250.8 | $983.6 | 103 | 112.6 | $580.7 | 9 | 3.0 | $9.1 | 3 | 5.1 | $7.3 |
| | WA | 86 | 157.5 | $612.2 | 0 | 0.0 | $0.0 | 0 | 0.0 | $0.0 | 1 | 0.8 | $0.8 |
| | Total | 340 | 688.2 | $2,537.3 | 304 | 254.3 | $2,043.7 | 83 | 24.3 | $112.1 | 33 | 38.9 | $93.5 |
| AVG | CA | 106 | 272.4 | $807.2 | 353 | 275.4 | $2,132.7 | 132 | 146.6 | $286.2 | 40 | 55.9 | $105.3 |
| | OR | 66 | 100.6 | $362.7 | 118 | 165.0 | $658.7 | 31 | 33.4 | $60.1 | 2 | 2.1 | $3.0 |
| | WA | 50 | 88.1 | $324.0 | 0 | 0.0 | $0.0 | 4 | 2.8 | $2.4 | 1 | 1.3 | $1.4 |
| | Total | 222 | 461.1 | $1,493.9 | 471 | 440.5 | $2,791.4 | 167 | 182.8 | $348.7 | 42 | 59.2 | $109.7 |

1/ others includes unspecified rockfish, flatfish, lingcod, sharks, rays and chimeras

Table 3-5. Directed open access fishery participation and landings statistics, 1998-2006. Page 2

| | | Lingcod | | | Sharks | | | Others 1/ | | | Total Directed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yr | State | vsl | mts | 000s | vsl | mts | 000s | vsl | mts | 000s | No. Vsls | mts | (000s) |
| 1998 | CA | 80 | 54.2 | $124.6 | 53 | 26.5 | $36.8 | 43 | 20.2 | $20.6 | 748 | 1,658.7 | $4,208.9 |
| | OR | 62 | 20.8 | $47.1 | 0 | 0.0 | $0.0 | 39 | 20.9 | $37.7 | 210 | 393.0 | $685.1 |
| | WA | 17 | 5.6 | $6.7 | 0 | 0.0 | $0.0 | 20 | 57.2 | $64.8 | 46 | 100.7 | $160.4 |
| | Total | 159 | 80.6 | $178.4 | 53 | 26.5 | $36.8 | 102 | 98.3 | $123.1 | 1004 | 2,152.4 | $5,054.4 |
| 1999 | CA | 108 | 45.0 | $134.0 | 49 | 26.9 | $38.9 | 63 | 42.0 | $69.2 | 764 | 977.9 | $3,910.7 |
| | OR | 83 | 28.0 | $76.5 | 0 | 0.0 | $0.0 | 49 | 12.2 | $40.5 | 184 | 331.7 | $910.5 |
| | WA | 14 | 4.8 | $6.5 | 2 | 8.7 | $2.5 | 15 | 4.6 | $10.4 | 50 | 67.1 | $142.2 |
| | Total | 205 | 77.8 | $217.0 | 51 | 35.6 | $41.4 | 127 | 58.8 | $120.1 | 998 | 1,376.7 | $4,963.4 |
| 2000 | CA | 64 | 21.7 | $70.3 | 52 | 23.4 | $32.2 | 85 | 77.7 | $110.4 | 760 | 852.4 | $4,365.1 |
| | OR | 44 | 12.3 | $44.6 | 2 | 0.1 | $0.2 | 0 | 0.1 | $0.1 | 172 | 211.3 | $789.5 |
| | WA | 11 | 4.8 | $6.5 | 1 | 1.5 | $0.6 | 2 | 1.3 | $2.0 | 49 | 63.0 | $215.2 |
| | Total | 119 | 38.8 | $121.4 | 55 | 25.0 | $33.0 | 87 | 79.1 | $112.5 | 981 | 1,126.7 | $5,369.8 |
| 2001 | CA | 84 | 32.9 | $112.2 | 43 | 26.1 | $35.5 | 71 | 42.2 | $89.3 | 627 | 788.0 | $3,848.3 |
| | OR | 51 | 24.2 | $81.9 | 0 | 0.0 | $0.0 | 2 | 0.1 | $0.1 | 194 | 278.7 | $1,038.7 |
| | WA | 12 | 3.6 | $4.8 | 0 | 0.0 | $0.0 | 0 | 0.7 | $0.5 | 54 | 67.0 | $225.4 |
| | Total | 147 | 60.7 | $198.9 | 43 | 26.1 | $35.5 | 73 | 43.0 | $89.8 | 875 | 1,133.7 | $5,112.4 |
| 2002 | CA | 99 | 40.7 | $159.1 | 39 | 16.3 | $24.0 | 44 | 45.7 | $52.1 | 543 | 709.9 | $3,300.7 |
| | OR | 65 | 27.4 | $93.5 | 0 | 0.0 | $0.0 | 0 | 0.4 | $0.4 | 201 | 304.6 | $1,348.3 |
| | WA | 9 | 2.9 | $4.2 | 1 | 4.2 | $1.4 | 0 | 0.7 | $0.4 | 48 | 74.5 | $244.0 |
| | Total | 173 | 71.8 | $256.8 | 40 | 20.5 | $25.4 | 44 | 46.0 | $52.9 | 792 | 1,089.0 | $4,893.0 |
| 2003 | CA | 106 | 36.3 | $146.6 | 45 | 32.2 | $41.1 | 34 | 47.4 | $30.7 | 502 | 685.1 | $2,908.4 |
| | OR | 78 | 29.7 | $91.9 | 0 | 0.0 | $0.0 | 0 | 0.0 | $0.0 | 212 | 332.0 | $1,247.4 |
| | WA | 4 | 2.1 | $3.2 | 1 | 43.9 | $17.7 | 1 | 1.8 | $0.7 | 68 | 167.7 | $473.2 |
| | Total | 188 | 68.1 | $241.7 | 46 | 76.1 | $58.8 | 34 | 49.2 | $31.4 | 782 | 1,184.8 | $4,629.0 |
| 2004 | CA | 104 | 43.9 | $175.2 | 40 | 24.9 | $49.9 | 42 | 51.9 | $33.0 | 435 | 686.8 | $3,164.0 |
| | OR | 73 | 31.0 | $97.3 | 0 | 0.2 | $0.0 | 1 | 0.5 | $0.3 | 185 | 278.8 | $1,081.9 |
| | WA | 4 | 1.7 | $2.8 | 4 | 86.1 | $37.9 | 0 | 1.2 | $0.6 | 57 | 187.3 | $369.0 |
| | Total | 181 | 76.6 | $275.3 | 44 | 111.2 | $87.8 | 43 | 53.6 | $33.9 | 677 | 1,152.9 | $4,614.9 |
| 2005 | CA | 80 | 41.8 | $173.8 | 36 | 26.8 | $34.3 | 32 | 28.5 | $1.2 | 391 | 803.4 | $3,519.1 |
| | OR | 89 | 31.4 | $101.8 | 1 | 0.2 | $0.2 | 1 | 2.8 | $1.0 | 240 | 450.8 | $1,794.2 |
| | WA | 5 | 2.4 | $3.9 | 2 | 3.2 | $1.6 | 0 | 0.9 | $0.9 | 78 | 196.3 | $693.5 |
| | Total | 174 | 75.6 | $279.5 | 39 | 30.2 | $36.1 | 33 | 32.2 | $3.1 | 709 | 1,450.5 | $6,006.8 |
| 2006 | CA | 92 | 31.5 | $136.4 | 30 | 24.1 | $44.6 | 20 | 9.5 | $6.8 | 405 | 541.9 | $2,784.3 |
| | OR | 78 | 30.5 | $110.0 | 0 | 0.0 | $0.0 | 0 | 0.8 | $0.4 | 249 | 402.8 | $1,691.3 |
| | WA | 4 | 2.7 | $4.7 | 2 | 59.8 | $30.9 | 0 | 0.6 | $0.3 | 90 | 221.6 | $649.1 |
| | Total | 174 | 64.7 | $251.1 | 32 | 83.9 | $75.5 | 20 | 10.9 | $7.5 | 744 | 1,166.3 | $5,124.7 |
| AVG | CA | 91 | 38.7 | $136.9 | 43 | 25.2 | $37.5 | 48 | 40.6 | $45.9 | 575 | 856.0 | $3,556.6 |
| | OR | 69 | 26.1 | $82.7 | 0 | 0.1 | $0.0 | 10 | 4.2 | $8.9 | 205 | 331.5 | $1,176.3 |
| | WA | 9 | 3.4 | $4.8 | 1 | 23.0 | $10.3 | 4 | 7.7 | $9.0 | 60 | 127.2 | $352.4 |
| | Total | 169 | 68.3 | $224.5 | 45 | 48.3 | $47.8 | 63 | 52.3 | $63.8 | 840 | 1,314.8 | $5,085.4 |

1/ others includes unspecified rockfish, flatfish, lingcod, sharks, rays and chimeras

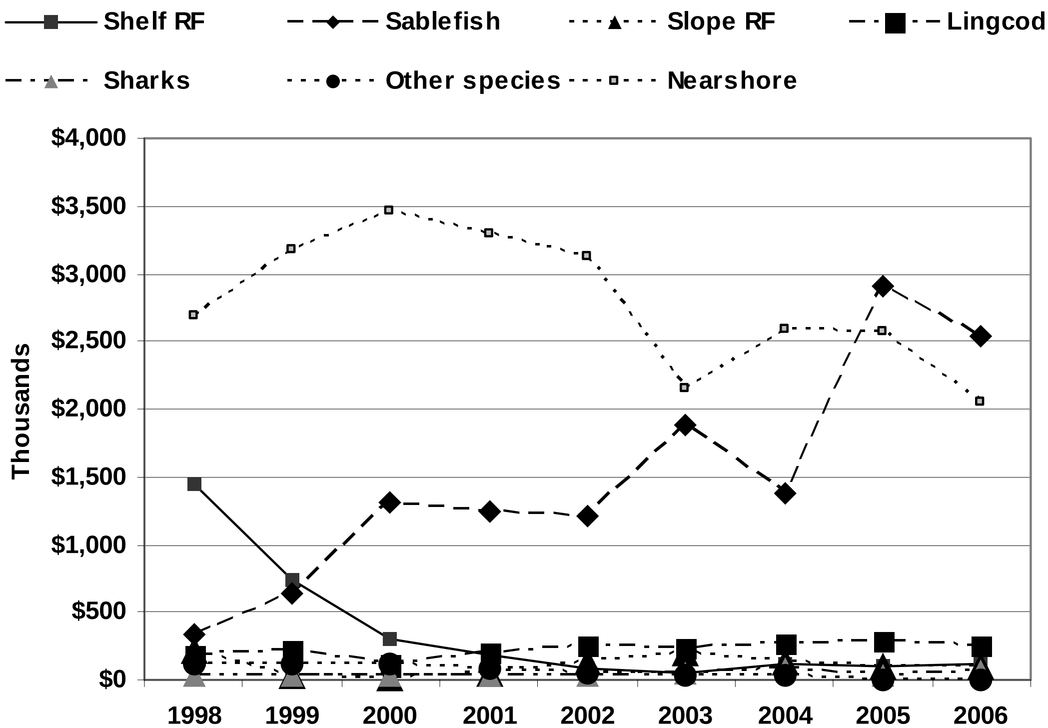


Figure 3-4. Trends in directed fishery revenues by species and year, 1998-2006 window period.

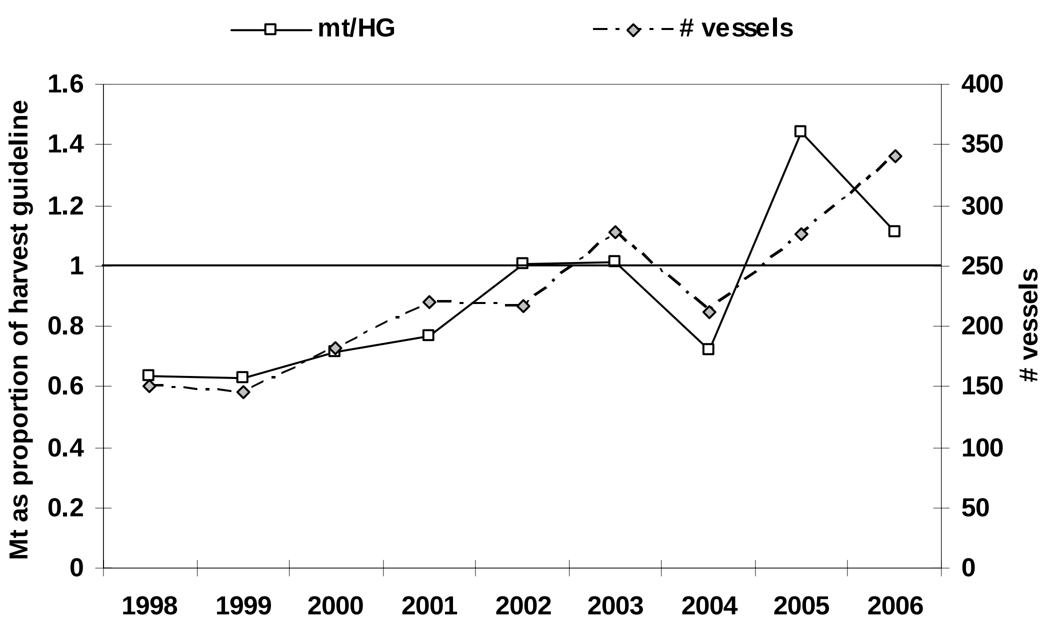


Figure 3- 5. Directed open access sablefish fishery trends: number of directed fishery vessels and landings shown as a proportion of annual harvest guideline, Monterey-Vancouver area, 1998-2006 seasons.

Table 3-6. Vessel participation frequencies by time period, 1998-2006

| # yrs | 1998-2003 | 2004-2006 | 1998-2006 |
|---|---|---|---|
| 0 | 430 | 1484 | 0 |
| 1 | 1009 | 508 | 1117 |
| 2 | 462 | 287 | 517 |
| 3 | 265 | 308 | 309 |
| 4 | 182 | | 201 |
| 5 | 118 | | 157 |
| 6 | 121 | | 93 |
| 7 | | | 62 |
| 8 | | | 60 |
| 9 | | | 71 |
| Total | 2587 | 2587 | 2587 |

### *3.3.3.2 States' Abilities to Track Vessel Owners and Vessel Ownership Frequencies*

Personal catch history is not part of the PacFIN database. Such information would have to be tracked at the state level if the Council and NMFS decided to issue permits to fishermen rather than vessels.

**California**
California is able to track vessel ownership on an annual basis since before 1998 and assigns landings or revenues to commercial fisherman license number, which is recorded on each commercial dealer receipt. The ownership records of California vessels showed that 67% of vessels (1,154) that landed B species groundfish during the window period had a single owner based on annual registration documents. The remaining 33% of vessels (576,) had between two and five owners. The maximum number of owners, assuming all owners had not previously owned an open access fishery vessel, was 2,461 for an average of 1.42 owners per vessel (**Table 3-7**).

Table 3-7. California vessel ownerships frequencies, 1998-2006

| # owners | Frequency | Proportion | Max owners |
|---|---|---|---|
| 1 | 1154 | 66.70% | 1154 |
| 2 | 447 | 25.80% | 894 |
| 3 | 106 | 6.10% | 318 |
| 4 | 20 | 1.20% | 80 |
| 5 | 3 | 0.20% | 15 |
| Total | 1730 | 100.00% | 2461 |

**Oregon**
(report in progress)

**Washington**
Since the mid 1990's the fishing license in Washington has been owned by a person or business. Prior to then, the vessel owned the license. Washington now assigns the vessel to the license. Therefore, for the years under consideration for open access limitation, WDFW could track personal/business catch history as long as they owned the license and weren't just operators or crew members.

**Possible Ways to Issue Permits to Fishermen or Previous Vessel Owners**
The concern regarding issuance of B permits to current owners of qualifying vessels is that 1) vessel operators (i.e., the fishermen) do not get catch history credits for use in qualifying for a permit and 2)

previous vessel owners do not receive catch history credits for the time they owned a vessel for use in qualifying for a permi

The problem in issuing permits to fishermen or previous vessel owners is that the PacFIN data base does not store such information. This means that either major revision to the PacFIN data base would have to be made or the responsibility for recommending individuals or entities for permit issuance would fall back on the states. Revisions to the data base would be very costly and time consuming to complete. Moreover, the changes might not be useful for any other Council or NMFS purpose than for B permit issuance.

For the states to recommend fishermen or vessel owners for permit issuance, the Council and NMFS would need to provide specific guidance about how to organize and rank catch history data in a fair and equitable manner and how to deal with fishermen and vessel owners that fished in more than one state. All three states would need to agree upon a timeline for project completion and commit staff resources to undertake the assignment.

#### *3.3.3.3 Landing Frequencies*

Vessel cumulative tonnage landing frequencies showed that 56% of vessels (1,443) landed < 0.5 mt and 12% (322) landed over 5 mt during the window period. The remaining vessels, 822, landed between 0.5 mt and 5 mt in total. Vessel tonnage frequencies were generally higher on a per vessel basis during 2004-2006 compared to 1998-2003 even though the accounting period was shorter by three years (**Table 3-8**).

Table 3-8. Vessel tonnage frequencies by time period, 1998-2006

| | 1998-2003 | | 2004-2006 | | 1998-2006 | |
|---|---|---|---|---|---|---|
| mt bin 1/ | # vsls | Prop. | # vsls | Prop. | # vsls | Prop. |
| zero | 434 | | 1,484 | | 0 | |
| <0.5 mt | 1,310 | 60.8% | 548 | 49.7% | 1,443 | 55.8% |
| <1 mt | 231 | 10.7% | 154 | 14.0% | 290 | 11.2% |
| <2 mt | 194 | 9.0% | 135 | 12.2% | 256 | 9.9% |
| < 3 mt | 63 | 2.9% | 30 | 2.7% | 77 | 3.0% |
| < 4 mt | 98 | 4.6% | 59 | 5.3% | 144 | 5.6% |
| < 5 mt | 42 | 2.0% | 31 | 2.8% | 55 | 2.1% |
| > 5 mt | 215 | 10.0% | 146 | 13.2% | 322 | 12.4% |
| Total | 2,153 | 100.0% | 1,103 | 100.0% | 2,587 | 100.0% |

1/ each bin is exclusive of previous bin(s)

Vessel cumulative value landing frequencies show that 50% of vessels (1,283) landed < $1,000 worth of B species groundfish and 4% (105) landed over $100,000 worth of fish during the window period. The remaining vessels, 1,199 vessels, landed between $1,000 and $100,000 in fish. Vessel value frequencies were generally higher on a per vessel basis during 2004-2006 compared to 1998-2003 even though the accounting period was shorter by three years (**Table 3-9; Figure 3-6**).

Table 3-9. Cumulative ex-vessel frequencies by time period, 1998-2006

| | 1998-2003 | | 2004-2006 | | 1998-2006 | |
|---|---|---|---|---|---|---|
| $$ 000 bin 1/ | # vsls | Prop. | # vsls | Prop. | # vsls | Prop. |
| <1 | 1,188 | 55.0% | 441 | 40.0% | 1,283 | 49.6% |
| <2 | 257 | 11.9% | 127 | 11.5% | 270 | 10.4% |
| <3 | 139 | 6.5% | 90 | 8.2% | 188 | 7.3% |
| <4 | 64 | 3.0% | 66 | 6.0% | 103 | 4.0% |
| <5 | 72 | 3.3% | 41 | 3.7% | 76 | 2.9% |
| <10 | 165 | 7.7% | 122 | 11.1% | 241 | 9.3% |
| <20 | 114 | 5.3% | 98 | 8.9% | 170 | 6.6% |
| <30 | 50 | 2.3% | 37 | 3.4% | 77 | 3.0% |
| <50 | 57 | 2.6% | 40 | 3.6% | 74 | 2.9% |
| <100 | 40 | 1.9% | 38 | 3.4% | 73 | 2.8% |
| <130 | 4 | 0.2% | 2 | 0.2% | 14 | 0.5% |
| <170 | 6 | 0.3% | 1 | 0.1% | 12 | 0.5% |
| <200 | 1 | 0.0% | | 0.0% | 4 | 0.2% |
| <250 | | 0.0% | | 0.0% | 2 | 0.1% |
| Total | 2,157 | 100.0% | 1,103 | 100.0% | 2,587 | 100.0% |

1/ each bin is exclusive of previous bin(s)

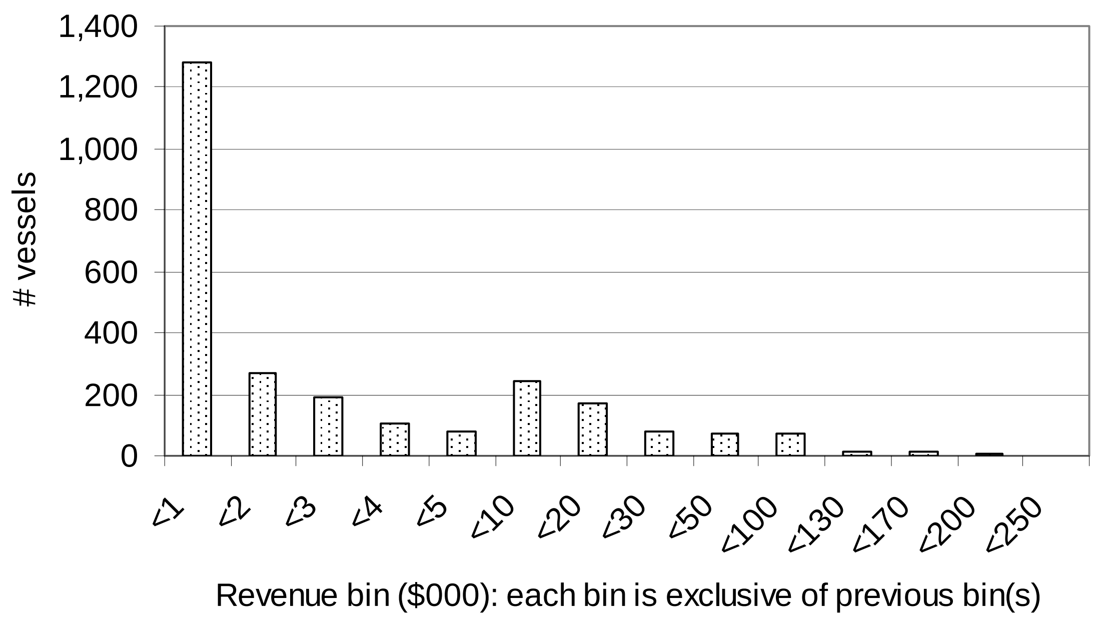


Figure 3-6. Revenue frequencies for WOC vessels that made B species landings during the window period (2,587 vessels)

### *3.3.3.4 Distribution of Vessels and Primary Gear Types*

A total of 2,587 vessels had directed B species groundfish landings during the window period. Their distribution by state and PacFIN port group was estimated based on port group where most B species landings were made by individual vessels. The data showed that 66% of vessels delivered to California ports and 26% and 8% made landings at Oregon and Washington ports, respectively. The top three port groups for numbers of vessels were Morro Bay (11%), Monterey (10%), and Brookings (9%). San

Francisco was very close to Brookings at slightly less than 9% (**Table 3-10**). Primary gear types used by individual vessels were estimated based on gear type used to make most B species landings by time period and landing location[4]. The large majority of vessels--87% for all areas combined--used hook and line gear[5]. Pot gear [6] was the second most common gear type (10%) and was the most common gear type in the Columbia River, Washington area (33 of 65 vessels). Set net gear [7]was used by 3.4% of the vessels, all off California. Four California dive boats made directed B species fishery landings (gear type unknown) **(Table 3-10**).

The distribution of the 1,103 vessels that made landings during 2004-2006 showed a northward shift compared to 1998-2003 vessel distributions. The California proportion was lower by 12 points to 57% while Oregon increased 7 points to 31% and Washington 4 points to 11%. The Brookings port group had the most vessels during this more recent period at 10%, followed by Morro Bay and Monterey at 9% each. Coos Bay, Oregon and Fort Bragg, California each were at 8% (tables 3-8 and 3-9). Hook and line gear was the primary gear type but declined 9 points, while pot gear increased by a corresponding amount compared to the previous period. Pot gear was by far the predominant gear type in the Columbia River, Washington area and was nearly as common as hook and line gear in the Fort Bragg area. Set net gear declined from about 4% to 3% of the coastwide gear totals during the 1998-2003 and 2004-2006 time periods. Two California dive boats made directed fishery landings during each of the latter periods (**Table 3-10**).

#### *3.3.3.5 Vessel Size Classes*

The lengths of vessels that participated in the B species directed fishery during the window period showed decreasing vessel length from north to south. The average lengths of California, Oregon and Washington vessels were 28 ft, 32 ft, and 39 ft, respectively. The modal length of vessel in Washington was 40-49 ft while the modal length in California and Oregon was 21-24 ft, although there was a second modal length of Oregon vessels at 35-39 ft. (**Table 3-11**). The smaller vessels in California and Oregon may indicate participation in nearshore fisheries wherein smaller vessels may be able to fish more effectively closer to shore than larger vessels. The larger size of Washington vessels may be due to their dependence on sablefish, which are found farther offshore and require more working space to carry longline or pot fishing gear.

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4 Visual inspection of gear type data showed many vessels used more than one gear type to harvest B species groundfish, and the amount of catch taken by individual gear types by individual vessels varied between years and landings made at different ports within the same year. The gear type combinations were too varied to make a succinct (and meaningful) analysis of gear type combinations used to make B species landings during window period years. Thus, an algorithm was applied to vessel landings data to identify primary gear types, as explained in Appendix E.

5 There is a variety of commercial fishing gear that uses hooks and lines in various configurations to catch finfish. These include longline, vertical hook and line, jigs, handlines, rod and reels, vertical and horizontal setlines, troll lines, cable gear and stick gear.

6 The words “pot” and “trap” are used interchangeably to mean baited boxes set on the ocean floor to catch various fish and shellfish. They can be circular, rectangular or conical in shape. The pots may be set out individually or fished in strings . On the Pacific Coast, live sablefish, Dungeness crab, spot prawns, rock, box, and hermit crabs, spider crabs, spiny lobster and finfish (California sheephead, cabezon, kelp and rock greenling, California scorpionfish, moray eels, and many species of rockfish) are caught in pots.

7 Set net is a stationary, buoyed, and anchored gillnet or trammel net.

Table 3-11. Length frequencies of B species directed fishery vessels by 5-ft bins, 1998-2006

| AGY | <10 | 10-14 | 15-20 | 21-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | >69 | # vsls | Avg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA | 3 | 137 | 256 | 319 | 277 | 252 | 202 | 132 | 73 | 35 | 14 | 8 | 2 | 9 | 1,719 | 28.5 |
| OR | 1 | 7 | 54 | 172 | 81 | 80 | 95 | 68 | 45 | 28 | 12 | 4 | 8 | 6 | 661 | 32.3 |
| WA | 1 | 1 | 4 | 31 | 13 | 24 | 22 | 35 | 35 | 18 | 15 | 4 | 1 | 3 | 207 | 39.3 |
| WOC | 5 | 145 | 314 | 522 | 371 | 356 | 319 | 235 | 153 | 81 | 41 | 16 | 11 | 18 | 2,587 | 30.3 |

#### *3.3.3.6 Participation in Other Fisheries*

Landings data for the 2004-2006 window period were used to assess the dependence of B species vessels on other commercial fisheries. The analysis looked at landings and revenues from all major WOC commercial fisheries for vessels that made at least one directed B species landing during 2004-2006 window period years. The analysis showed that B species groundfish comprised 3.6% and 4.4%, respectively, of total fishery landings by B species vessels in terms of tonnage and revenues. Total fishery landings represented the sum of all commercial fishery tonnages and revenues by B species vessels during the specified years. Most of the vessels fished for salmon (63%), crabpot species (56%), nearshore species (52%), and miscellaneous (other) species (55%). HMS was also important to many vessels (44%) **(Table 3-12)**. Tonnage landed was highest in crabpot fisheries (35%), followed by CPS (27%) and HMS (11%). Fisherman revenues were highest by a wide margin in crabpot fisheries at 52% of total revenues. Salmon was second at 15% of revenues (**Table 3-12; Figure 3-7).**

Note: this analysis did not show the dependence of WOC commercial fishing vessels on B species groundfish. Some of the vessels in the other commercial fisheries likely made no B species groundfish landings during the specified years. If the analysis were done to show the dependence of WOC commercial fishing vessels on B species groundfish the contribution of B species landings would be <3.3% and <4.4% by weight and value, respectively.

Table 3-12. Total fishery landings by vessels that made directed B species landing during 2004-2006 window period years, all years combined.

| Fishery | # vsls | mts | 000s | #vsls | mts | $$ |
|---|---|---|---|---|---|---|
| B directed | 1103 | 2,796.0 | $8,531.4 | 100.0% | 3.6% | 4.4% |
| Nearshore | 573 | 979.3 | $7,221.7 | 51.9% | 1.3% | 3.8% |
| Salmon | 692 | 4,640.9 | $28,557.3 | 62.7% | 6.1% | 14.9% |
| Red urchin | 57 | 4,977.1 | $5,978.0 | 5.2% | 6.5% | 3.1% |
| Trawl | 56 | 4,694.9 | $5,906.8 | 5.1% | 6.1% | 3.1% |
| Set net | 64 | 702.5 | $3,158.7 | 5.8% | 0.9% | 1.6% |
| HMS | 487 | 8,179.8 | $16,330.7 | 44.2% | 10.7% | 8.5% |
| CPS | 136 | 20,869.6 | $6,492.6 | 12.3% | 27.2% | 3.4% |
| Crabpot | 617 | 27,072.4 | $100,263.4 | 55.9% | 35.3% | 52.2% |
| P. halibut | 106 | 200.1 | $1,211.3 | 9.6% | 0.3% | 0.6% |
| C. halibut | 214 | 89.4 | $751.3 | 19.4% | 0.1% | 0.4% |
| Fishpot | 41 | 510.7 | $1,057.5 | 3.7% | 0.7% | 0.6% |
| Other | 607 | 952.7 | $6,737.3 | 55.0% | 1.2% | 3.5% |
| Total | 1103 | 76,665.4 | $192,198.0 | 100.0% | 100.0% | 100.0% |

### 3.3.4 Processor Characteristics Over Action Time Period - Number, Size Class, Revenues, Dependence, Other Fishery Participation.

Data on the number of fish processing plants and their employees are presented in subsection 6.2, Regulatory Impact Review and Regulatory Flexibility Analysis.

WOC fish buyers and fish processing plants received about 990 thousand metric tons of fishery products during the 2004-2006 window period. The ex-vessel value of the landings was about $784 million. CPS species comprised 42% of the landings by weight while crab was the most valuable species group at 37% for all species combined. Groundfish represented 39% by weight and 20% by ex-vessel value of total fishery landings. The leading port groups in terms of weight of fish landed were Oregon-Columbia River (CLO, 20%), Los Angeles Area (LAA, 17%), Washington-Columbia River (CWA, 15%) and Newport (NPA, 14%). The leading port groups in terms of ex-vessel value of fish landed were Coastal Washington (CWA, 14%), Newport (NPA, 11%), Los Angeles Area (LAA, 9%), Coos Bay (CBA, 8%) and Santa Barbara Area (SBA, 8%) (**Table 3-13).**

A total of 809 different fish buyers, distributed among 70 ports, purchased B species groundfish during window period years. In 2006, the comparative figures were 214 buyers among 55 ports. A large majority of buyers (79%) operated from California ports, particularly between San Francisco (SFA) and San Diego (SDA) (471). Fishermen landing and selling their own catches likely contributed to the large number of fish buyers at California ports (**Table 3-14**).

Total B species landings for the window period years were 7,906 mt of fish with an ex-vessel value of $20.7 million. The leading state for B species groundfish landings (for directed fishery and incidental fishery landings combined) was California with 66% by weight and 62% by ex-vessel value of WOC window period totals (**Table 3-14**).

### 3.3.5 Participation Requirements, Restrictions, Licensing

There is no Federal permitting or licensing requirement to participate in the open access fishery, beyond the requirement to have an operational VMS unit when fishing in federal waters. .

**California**

California requires open access vessel owners and fishermen to annually register their vessel and obtain commercial fishing licenses for all persons on the vessel with CDFG. There is no state permit requirement to take federal species except for nearshore species which are managed under three independent types of limited entry permit: 1) shallow nearshore species, 2) deeper nearshore species, and 3) a bycatch permit A permit is required of any person to directly or incidentally take either nearshore species group. California requires commercial fish buyers and processors to obtain appropriate licenses in advance of receiving and processing federal groundfish. There is no restriction on the number of fishermen or vessels that may participate in the groundfish fishery, other than for nearshore species as described above. California commercial fishery registration and license information are available on the CDFG web site at: http://www.dfg.ca.gov/licensing/commercial/commercialinfo.html

**Oregon**

In Oregon licenses are required for any boat, vessel, or floating craft used in taking of food fish or shellfish for commercial purposes, except clams and crayfish. Boat licenses are not required to take fish for bait under a bait fishing license. A single delivery license may be obtained in lieu of commercial fishing and boat licenses for each separate landing of catch. Oregon commercial fishery license information is available on the ODFW web site at: http://www.dfw.state.or.us/fish/commercial/forms.asp.

Table 3-14. B species fish buyer data by state and in total for 1998-2006 with 2006 data in parentheses

| | Port group | # ports | # buyers | mts | $$K |
|---|---|---|---|---|---|
| WA | NPS | 4 (3) | 15 ( 4) | 405.9 ( 68.8) | 739.6 (62.8) |
| | SPS | 1 (1) | 3 ( 1) | 20 ( 4.7) | 77.9 (19.3) |
| | CWA | 4 (2) | 14 ( 4) | 419.9 ( 39.6) | 1272.2 (151.9) |
| | CLW | 2 (1) | 13 ( 3) | 298.8 (109.6) | 1,096.8 (420.1) |
| | WAU | 1 (0) | 1 ( 0) | .3 (0) | .9 (0) |
| | sub | 12 (7) | 46 (12) | 1,144.9 (222.7) | 3,187.4 (654.1) |
| OR | CLO | 1 (1) | 9 ( 4) | 198.6 (33.8) | 768.8 (131.4) |
| | TLA | 2 (2) | 21 (10) | 70.9 (14.0) | 192.1 (54.9) |
| | NPA | 2 (2) | 37 (10) | 146.2 (36.0) | 426.9 (153.5) |
| | CBA | 4 (4) | 28 (11) | 392.8 (96.6) | 1,207.9 (372.7) |
| | BRA | 3 (3) | 28 ( 6) | 706.4 (115.2) | 2,117.9 (419.5) |
| | sub | 12 (12) | 123 (41) | 1,514.9 (295.6) | 4,713.6 (1132.0) |
| CA | CCA | 2 (1) | 27 (4) | 147.3 (12.3) | 500.6 (46.4) |
| | ERA | 4 (3) | 39 (10) | 424.4 (38.8) | 1,118.3 (125.1) |
| | BGA | 4 (4) | 41 (11) | 1,234.6 (157.7) | 3,456.7 (483.2) |
| | BDA | 5 (3) | 61 (11) | 527.9 (3.2) | 788.1 (12.2) |
| | SFA | 8 (5) | 133 (33) | 490.9 (33.1) | 1,101.9 (143.6) |
| | MNA | 4 (4) | 74 (18) | 1,422.9 (72.5) | 2,767.8 (192.0) |
| | MRA | 3 (3) | 49 (22) | 307.8 (36.0) | 842.8 (118.7) |
| | SBA | 5 (4) | 87 (21) | 231.4 (9.6) | 655.1 (32.7) |
| | LAA | 7 (6) | 71 (15) | 187.2 (12.8) | 606.2 (49.7) |
| | SDA | 3 (3) | 57 (16) | 271.3 (25.0) | 974.6 (117.3) |
| | CAU | 1 (0) | 1 ( 0) | .4 (0) | 1 (0) |
| | sub | 46 (36) | 640 (161) | 5,246.1 (401.0) | 12,813.1 (1,320.9) |
| WOC | Total | 70 (55) | 809 (214) | 7,905.9 (919.3) | 20,714.1 (3,107.0) |

**Washington**
(report in progress)

## 3.3.6 Revenue/Costs to the Participants and to State and Federal Governments

**California**
California registration and license fee information are posted on CDFG's web site as follows: http://www.dfg.ca.gov/licensing/commercial/commercialinfo.html. Commercial fees are as high as $1,560 annually for a multi-purpose fish business license. The basic commercial fishing license is $108.25 annually for resident fishermen. The vessel registration fee is $284 annually for a resident vessel owner.

**Oregon**
Oregon registration and license information can be found at http://www.dfw.state.or.us/fish/commercial/forms.asp . Every individual operating or assisting in the operation of any commercial fishing gear or fishing boat must have a commercial fishing license or crewmember license (except for albacore). Every member of the crew on a commercial fishing boat must be licensed. Residential commercial fishing licenses are $50.00, nonresident commercial fishing license are $290, and a crewmember license is $85.00.

**Washington**
Washington requires a non-salmon delivery permit to land groundfish if an individual does not have a limited entry license. Washington commercial fishery registration and license information are available on the WDFW web site at: http://wdfw.wa.gov/lic/commercial/index.htm

**NMFS**
Currently, NMFS charges only for initial issuance and annual renewal of Pacific Coast Groundfish Limited Entry Permits but it has the authority to charge fees for a broader range of limited entry permit services (i.e.; transfer, permit replacement). In 2008, it is anticipated that the fee for the renewal of a Limited Entry Permit will be about $125. NMFS assessed an initial issuance fee for the A Limited Entry Permit (~$200 in 1993) and a subsequent Sablefish Endorsement (~$800 in 1997). Costs of each alternative would be dependent on the incremental activities and resources required to implement the permit requirements and on the number of permit holders/applicants.

### 3.3.7 Groundfish-dependent Communities

Landings data for vessels that made directed fishery landings of B species groundfish during 2004-2006 window period years were analyzed to determine the relative importance of B species directed fishery landings to the states and port groups within states. The data showed that Washington, Oregon and California landings totaled 2,796 mt of fish worth about $8.5 million to the fishermen for all years combined (**Table 3-15).** Washington received 22%, Oregon 25% and California 64% by weight of the coastwide total. The respective state proportions in terms of value of catch to the fishermen were 20%, 29% and 51% respectively. The Brookings port group had the greatest activity in terms of number of landings (19%), followed by Fort Bragg (15%) and Morro Bay (14%) port groups. The Fort Bragg port group had the greatest total weight landed (22%) followed by Monterey and Brookings port groups (13% and 12%, respectively). The Fort Bragg port group was also highest in terms of fisherman revenues followed by Brookings and Columbia River, Washington port groups at 20%, 14% and 11%, respectively. The highest price paid for B species groundfish was in San Diego port group at $1.99 and lowest in North Puget Sound port group at $0.51. The coastwide average price paid per pound was $1.38.

States' landings data for individual groundfish species and year are shown in **Table 3-5.** The primary port of landing by vessels that made B species landings during 2004-2006 window period years and the gear types used are tabulated in **Table 3-10**.

B species landings expressed as proportion of total WOC fishery landings in recent years (2004-2006 window period) showed a negligible (<0.3%) contribution rate based on tonnage landed and about a 1% rate based on ex-vessel value of fish landed (**tables 3-14 and 3-15**). For individual ports, B species landings exceeded 3% of total landings either in terms of weight or value of fish landed at six port groups (tonnage and ex-vessel values, respectively, shown in parentheses): Fort Bragg (BDA, 7% and 9%), Brookings (BRA, 3% and 4%), Morro Bay (MRA, 3% and 3%), South Puget Sound (SPS, 2% and 3%) and Monterey (MNA, 1% and 3%) (**Figure 3-7**).

The "2007-2008 Groundfish Specifications and Management Measures Amendment 16-4: Rebuilding Plans Environmental Impact Statement" Appendix A "Additional Socioeconomic Analysis" contains a study called "Fishing Community Engagement, Dependence, Resilience and Identification of Potentially Vulnerable Communities" in Section A.4.1. This study looked at four categories to categorize communities, which are: engagement, dependency, resiliency and vulnerability. Each category was developed using various indicators. For this analysis, dependence, resilience and vulnerability are applicable indicators. Dependence refers to a community's dependence upon the groundfish fishery. This includes both limited entry and open access fishing. Resilience refers to the ability for a community to adapt to changes in management measures and vulnerability highlights areas that exhibit both high dependence and low resilience. The following table shows the categories and indicators, used for each category. Notice the scale for dependence and resilience range by the number of indicators.

| Category | Indicator | Scale |
|---|---|---|
| Dependence | • Number of federal and state groundfish permits as a percentage of each state's total number of groundfish permits (based on owner's mailing address)<br>• Groundfish revenue as a percentage of total community fisheries revenue<br>• Groundfish revenue as a percentage of total groundfish revenue coastwide | 0-3 |
| Resilience | • Industry diversity index<br>• Unemployment rate<br>• Percentage of the population living below that poverty line<br>• Isolated cities<br>• Population density | 0-5 |
| Vulnerable | • Communities that are both relatively highly dependent and have relatively low resilience. These are areas that scored a 1 or greater for both dependence and resilience | Yes/No |

The methodology of this study was to comprise the data sets for each indicator by category and community. Then communities were ranked highest to lowest for each indicator value. The top 1/3 communities were identified for each indicator and the number of times a community was listed in the top 1/3 for each indicator was tallied.

This report analyzed 131 communities; 74 communities had a dependence score of one or higher and 18 cities had a score of two or higher, these are: Astoria, Bellingham, Brookings, Coos Bay, Crescent City, Eureka, Fort Bragg, Morro Bay, Newport, Port Orford, San Francisco, which had a score of three and Blaine, Gold Beach, Moss Landing, Neah Bay, Pacific City, Port Angeles, and Westport, which had a score of two. Out of these 18 cities 15 had a resilience score of 1 or greater while Brookings, San Francisco and Blaine had a score of 0 and are therefore had no indicators ranked in the top 1/3 of all areas analyzed. According to this report's definition of vulnerability, the 15 cities identified with a score of 1 or greater in both categories would be considered vulnerable. However, given that the resilience scale is based on 5 criteria, areas with a score of three or greater should be paid particular attention. These are: Moss Landing and Neah Bay.

Table 3-15. B species groundfish landings in tons and ex-vessel value by port group and state during the 2004-2006 window period, all years combined including number of landings, average price paid per pound of fish, round weight, and port group landings expressed as a proportion of coastwide totals

| Port/AGY | # ldgs | mt | 000s | Price/ lb | P ldgs | P mt | P $$ |
|---|---|---|---|---|---|---|---|
| SPS | 19 | 7 | $30 | $1.85 | 0% | 0% | 0% |
| NPS | 208 | 198 | $225 | $0.51 | 1% | 7% | 3% |
| CWA | 682 | 157 | $553 | $1.60 | 3% | 6% | 6% |
| CLW | 691 | 242 | $903 | $1.69 | 3% | 9% | 11% |
| WA | 1,600 | 604 | $1,711 | $1.28 | 8% | 22% | 20% |
| CLO | 291 | 94 | $363 | $1.75 | 1% | 3% | 4% |
| TLA | 898 | 31 | $107 | $1.56 | 4% | 1% | 1% |
| NPA | 245 | 48 | $187 | $1.78 | 1% | 2% | 2% |
| CBA | 673 | 188 | $666 | $1.60 | 3% | 7% | 8% |
| BRA | 3,953 | 338 | $1,153 | $1.55 | 19% | 12% | 14% |
| OR | 6,060 | 700 | $2,476 | $1.60 | 29% | 25% | 29% |
| CCA | 1,111 | 36 | $133 | $1.67 | 5% | 1% | 2% |
| ERA | 517 | 126 | $395 | $1.43 | 2% | 4% | 5% |
| BGA | 3,144 | 605 | $1,706 | $1.28 | 15% | 22% | 20% |
| BDA | 381 | 11 | $38 | $1.60 | 2% | 0% | 0% |
| SFA | 1,231 | 81 | $304 | $1.70 | 6% | 3% | 4% |
| MNA | 1,954 | 370 | $774 | $0.95 | 9% | 13% | 9% |
| MRA | 3,006 | 96 | $319 | $1.50 | 14% | 3% | 4% |
| SBA | 468 | 33 | $112 | $1.55 | 2% | 1% | 1% |
| LAA | 493 | 36 | $133 | $1.66 | 2% | 1% | 2% |
| SDA | 1,170 | 98 | $430 | $1.99 | 6% | 3% | 5% |
| CA | 13,475 | 1,492 | $4,345 | $1.32 | 64% | 53% | 51% |
| WOC | 21,135 | 2,796 | $8,531 | $1.38 | 100% | 100% | 100% |

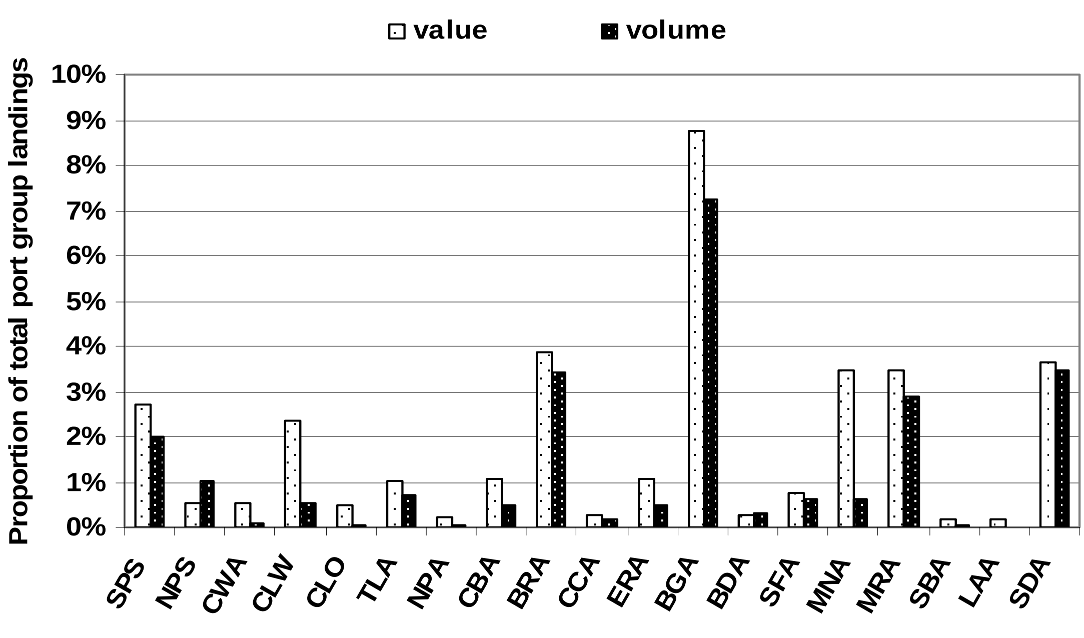


Figure 3-7. B species groundfish landings expressed as a proportion of WOC port group landings, 2004-2006 window period years combined

### 3.3.8 Environmental Justice

Executive Order (EO) 12898 obligates Federal agencies to identify and address "disproportionately high adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations in the United States" as part of any overall environmental impact analysis associated with an action. NOAA guidance, NAO 216-6, at '7.02, states that "consideration of EO 12898 should be specifically included in the NEPA documentation for decision-making purposes." Agencies should also encourage public participation--especially by affected communities--during scoping, as part of a broader strategy to address environmental justice issues.

The environmental justice analysis must first identify minority and low-income groups that live in the project area and may be affected by the action. Typically, census data are used to document the occurrence and distribution of these groups. Agencies should be cognizant of distinct cultural, social, economic, or occupational factors that could amplify the adverse effects of the proposed action. Once communities have been identified and characterized, and potential adverse impacts of the alternatives are identified, the analysis must determine whether these impacts are disproportionate. Because of the context in which environmental justice is developed, health effects are usually considered, and three factors may be used in an evaluation: whether the effects are deemed significant, as the term is employed by NEPA; whether the rate or risk of exposure to the effect appreciably exceeds the rate for the general population or some other comparison group; and whether the group in question may be affected by cumulative or multiple sources of exposure. If disproportionately high adverse effects are identified, mitigation measures should be proposed. Community input into appropriate mitigation is encouraged.

Participation in decisions about the proposed action by communities that could experience disproportionately high and adverse impacts is another important principle of the EO. The Council offers a range of opportunities for participation by those affected by its actions and disseminates information to affected communities about its proposals and their effects through several channels. In addition to Council membership, which includes representatives from the fishing industries affected by Council action, the GAP, a Council advisory body, draws membership from fishing communities affected by the proposed action. While no special provisions are made for membership to include representatives from low income and minority populations, concerns about disproportionate effects to minority and low income populations could be voiced through this body or to the Council directly. Although Council meetings are not held in isolated coastal communities for logistical reasons, they are held in different places up and down the Pacific Coast to increase accessibility. In addition, fishery management agencies in Oregon and California sponsored public hearings in coastal communities to gain input on the proposed action. The comments were made available to the Council in advance of their decision to choose a preferred alternative.

The Council disseminates information about issues and actions through several media. Although not specifically targeted at low income and minority populations, these materials are intended for consumption by affected populations. Materials include a newsletter, describing business conducted at Council meetings, notices for meetings of all Council bodies, and fact sheets intended for the general reader. The Council maintains a postal and electronic mailing list to disseminate this information. The Council also maintains a website (www.pcouncil.org) providing information about the Council, its meetings, and decisions taken. Most of the documents produced by the Council, including NEPA documents, can be downloaded from the website.

Sections 8.5.7 in Chapter 8 to the 2005-06 groundfish harvest specifications EIS describes a methodology, using 2000 United State Census data, to identify potential "communities of concern" because their populations have a lower income or a higher proportion of minorities than comparable communities in their region. Pacific Coast ports identified in the PacFIN database were examined in this way.  These ports were evaluated using five criteria: the percentage nonwhite population, percentage Native American population, percentage Hispanic population, average income, and the poverty rate. Data were evaluated for both census places and census block groups corresponding to the area around these census places. The values for these statistics were compared to the average value for one of three regions, covering coastal block groups in Washington, Oregon, and northern California; central California; and southern California. For each of the five statistics potential communities of concern were identified. These are communities that have a significantly higher percentage minority population and poverty rate or lower average income than the surrounding reference region.

About two-thirds of the port communities analyzed are above the cutoff threshold for one or more of the statistics, measured either by the census place value or the equivalent block groups. This suggests that additional criteria need to be applied to more realistically identify which ports should be of concern. It should be noted that the population affected by the proposed action, which would be predominantly fishers and those involved in allied industries (e.g., marine supplies, fish processing and equipment) is a small percentage of the population in most communities. It stands to reason that in larger communities and more urban areas, fishery participants are a smaller and potentially less representative component of the population. In isolated rural communities there are usually fewer alternative employment alternatives, making it harder to find work or switch from one occupation to another in response to changes in one economic sector such as fisheries. Given these conditions, another criterion to focus on communities of concern would be population size and urbanization. Eliminating ports with a population greater than 50,000 and of those ports with a population less than 50,000, those for which the block group area is more than 75 percent urban leaves the list of ports shown in Table 7-48 as potential communities of concern.

It should be noted that fishery participants usually make up a small component of the population and fisheries may be a small part of the local economy in many places. Thus, even if a community has a high proportion of minority or low income residents, these people might not participate in fisheries and are thus minimally affected by the proposed action. Furthermore, within the affected population some segments are more likely to be low income and minority than others. For example, employees in a fishing processing plant may be predominantly from a minority group, and crew on vessels are likely to have a lower earnings than the skipper or vessel owner, making them more likely to be low income. Unfortunately, the kind of detailed population data necessary to determine the characteristics of the population affected by the proposed action are not available. For this reason, the ports identified in Table 3-16 represent an initial screening.

Table 3-16 . Environmental Justice—Communities of Concern

| State | Community | Qualifying Demographic Criteria |
|---|---|---|
| Washington: | Blaine | poverty rate |
| | La Conner | % Hispanic |
| | Neah Bay | % nonwhite, % Native American, average income, poverty rate |
| | La Push | % nonwhite, % Native American, poverty rate |
| | Copalis Beach | income |
| | Westport | income, poverty rate |
| | Willapa Bay | income, poverty rate |
| Oregon: | Salmon River | % Native American |
| | Siletz Bay | % Native American |
| | Waldport | income |
| | Winchester Bay | income, poverty rate |
| | Port Orford | income, poverty rate |
| | Brookings | % Native American, income |
| California: | Trinidad | % Native American, income, poverty rate |
| | Fort Bragg | % Hispanic |
| | Albion | % Hispanic |
| | Point Arena | % Native American, % Hispanic |
| | Moss Landing | % Native American, % Hispanic |

The direct source of stress on these communities resulting from the proposed action would be any decline in employment and related personal income in response to additional restrictions placed on groundfish fisheries. However, because the open access groundfish fishery has had historically sporadic participation and comprises a small portion of all Pacific Coast groundfish fishing, it is unlikely that fishermen partake in this fishery for their sole income and rather use it as supplementary income. Further, no alternatives analyzed in this EA terminate this fishery, and rather, the alternatives would limit participation. Therefore, the alternatives should have no to limited impacts on communities of concern.

# 4.0 ENVIRONMENTAL CONSEQUENCES

The terms "effect" and "impact" are used synonymously under NEPA. Impacts include effects on the environment that are ecological, aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Direct effects are caused by the action itself and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Cumulative impacts are those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Chapter 4 is organized by alternatives. All resource impacts from a single alternative appear under the discussion for that alternative. Sections 4.1 through 4.6 of this document discuss each alternative and the direct and indirect impacts on the physical, biological, and socioeconomic environment that are likely to occur. Section 4.7 presents the reasonably foreseeable cumulative effects of the environment from the proposed alternatives.

A summary of registration requirements, fleet size goals, fleet size expectations, and environmental consequences associated with the Council's alternatives is presented in **Table 4-1**. The environmental consequences associated with each of the alternatives are discussed in following sections.

## 4.1 Alternative 1 (No-action)

Alternative 1, which is the No-action Alternative, would continue to allow commercial fishing vessels to prosecute federal groundfish species allocated to open access fisheries without federal registration, except as required under the Vessel Monitoring System (VMS) program (**72 FR 69162, December 7, 2007**). The VMS program requires most vessels to register with NMFS and utilize VMS equipment if they intend to take and retain federal groundfish in federal waters in the WOC area.

A total of 1,103 different vessels participated in the directed open access fishery for B species groundfish during 2004-2006 window period years. This is likely to be the maximum number of vessels that can be anticipated to participate in the fishery in any near term year. The average number of directed fishery vessels in recent years (2004-2006) was 680 (**Table 4-1**; **Figure 4-1**).

### 4.1.1 Effects on the Physical Environment including EFH

The affected environment including EFH is described in **Section 3.1**. The No-action alternative would allow vessel owners to continue to fish for B species groundfish as they have in the past to the extent that future groundfish stock status allows. The directed open access fleet has been increasing in recent years in the WOC area (**Figure 2-1**), particularly for sablefish (**figures 3-4 and 3-5)**. Continuation of the upward trend in vessel participation in the open access fishery would have a corresponding increase in physical environmental impacts, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, no adverse impact to the environment would be expected because no change in management is proposed under this alternative.

Table 4-1. Summary of registration requirements, fleet size goals, fleet size expectations, and environmental consequences associated with the Council's alternatives

| | | | Alternative | | | | | |
|---|---|---|---|---|---|---|---|---|
| Issue | Stage | Reference | A-1 | A-2 | A-3 | A-4 | A-5 | A-6 |
| Registration requirement? | | § 2.0 | No | Yes | Yes | Yes | Yes | Yes |
| Fleet size goal | | | | | | | | |
| Initial | 1) | § 2.0 | None | None | 680 | 65-1103 **2/** | 850 | 390 |
| Long-term | 2) | § 2.0 | same | same | 680 | 65-1103 **2/** | a) 450 b) 170 | 170 |
| Initial fleet size expectation **1/** | | Tabs E-7, E-8, E-9 | 680-1103 | 680-1103 | 468-680 | see FS goal | 561-850 | 286-390 |
| Long-term fleet size expectation | | Tab E-9 | 680-1103 | 680-1103 | 468-680 | see FS goal | 128-450 | 128-170 |
| Environmental impact | | | | | | | | |
| Physical environment | | § 3.1, and § 4.0 | N/C | N/C | N/C | N/C | N/C | N/C |
| Biological environment | | | | | | | | |
| Groundfish | | § 3.2.1 | 7/ | 7/ | N/C | N/C | N/C | N/C |
| Non-groundfish | | § 3.2.2 | N/C | N/C | N/C | N/C | N/C | N/C |
| Prohibited species | | § 3.2.3 | N/C | N/C | N/C | N/C | N/C | N/C |
| Protected species | | § 3.2.4 | N/C | N/C | N/C | N/C | N/C | N/C |
| Socioeconomic environment | | | | | | | | |
| Fishery mgmt 3**/** | | § 2.0 | N/C | + | + | N/C to > | + or > | > |
| Catch comp. | | | | | | | | |
| Groundfish **4/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 2% to 9% | 0% to 64% | 0%-5% | 9%-20% |
| | 2) | | | | N/A | N/A | a) 7%-17% b) 29%-43% | 29%-43% |
| Non-groundfish **5/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 1% to 2% | 0%-5% | 0% to 2% | 1%-2% |
| | 2) | | | | N/A | N/A | a) 1%-2% b) 3%-4% | 3%-4% |
| Vessels char. 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Processors 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Licensing, etc. | | § 3.3.5, § 3.3.6 | N/C | N/C | N/C | N/C | N/C | N/C |
| Costs | | § 2.0 | N/C | minor | minor | minor | minor | minor |
| Communities 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Environmental Justice | | § 1.5 and § 3.3.8 | N/C | N/C | N/C | N/C | N/C | N/C |

1/ A-2 and A-3 ranges show average and total number B species vessels that fished in 2004-2006 window period; A-3, A-5 and A-6 ranges show numbers of qualifying vessels that fished during 2004-2006 window period.

2/ Range shows numbers of vessels that took 50%-100% of B species groundfish during 2004-2006 window period (Appendix E).

3/ + means improved management and > means substantially improved management, the degree to which cannot be quantified.

4/ Impacts are for B species groundfish. Ranges show proportion of B species harvest made by non-qualifying vessels during 2004-2006 window period from model runs 1-3. These fish would be made available for future harvest by qualifying vessels (Appendix E)

5/ Ranges show amount of total fishery revenues comprised of B species groundfish by non-qualifying vessels during 2004-2006 window period from model runs 1-3. These values indicate the amount of increase in revenues that would be need to make up for lost B species groundfish landings by non-permitted vessels (Appendix E)

6/ Proportions indicate potential percentage point shifts between states in vessels that would initially qualify for a permit compared to 2004-2006 vessel distributions. Under all alternatives the pluses are WA vessels and the minuses are CA vessels; OR is about even in all comparisons (Appendix E).

7/ negative groundfish and associated overfished species impacts can be expected in years of salmon vessel effort shift to the sablefish fishery as occurred in 2006.

## 4.1.2 Effects on the Biological Environment

### *4.1.2.1 Groundfish Species*

Groundfish species including overfished groundfish species are described in **Section 3.2.1**.and **Appendix F.** No change in level of groundfish impacts would be expected under this alternative. Effort may fluctuate, but allowable impacts would be the same as in recent years. Trip and cumulative landing limits would likely continue to be used to constrain harvests to provide for year-round fishing.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:** http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.

Continued high level of vessel participation in directed sablefish fishery will result in more restrictive sablefish landing and cumulative limits than in the past. Further reduction in sablefish limits will increase discards of sablefish and associated overfished groundfish stocks due to trip limit overages and high grading to land the most valuable fish.

### *4.1.2.2 Non-groundfish Species (State-managed or under other FMPs)*

Non-groundfish species are described in **Section 3.2.2** and **Appendix F**. No change in level of non-groundfish landings or impacts would be expected under this alternative because no change in fishery management is proposed.

### *4.1.2.3 Prohibited Species*

Prohibited species are generally described in **Section 3.2.3**. No change in level of impact of open access fishery vessels on prohibited species would be expected because no change is management is proposed under this alternative.

### *4.1.2.4 Protected Species*

Protected species are generally described in **Section 3.2.4**. No change in level of impact of open access fishery vessels on prohibited species would be expected because no change in fishery management is proposed under this alternative.

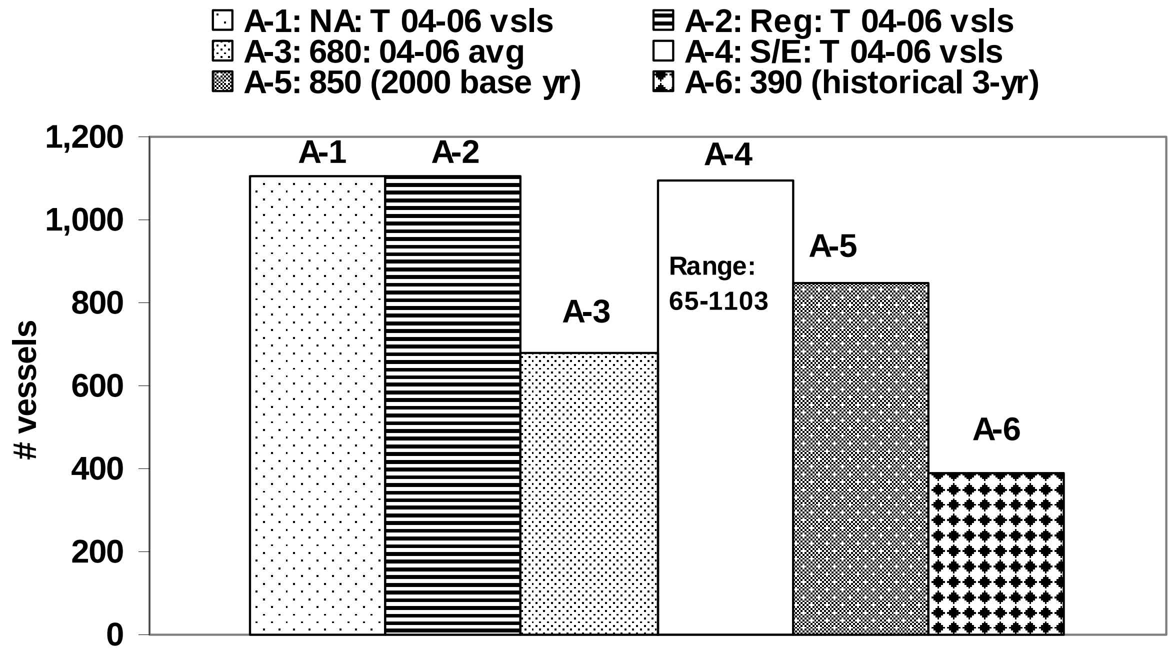


Figure 4-1. Potential and proposed initial fleet sizes under Council alternatives *1-6*

### 4.1.3 Effects on the Socioeconomic Environment

#### *4.1.3.1 Management Structure of the Open Access Fishery*

The open access fishery management structure is described in **Section 3.3.1**. No change in management structure would be expected because no change in fishery management is proposed under this alternative. The state and tribal fishery agencies maintain data bases on vessels that are eligible to commercially fish for groundfish in state and federal waters. These data are available to the Council and NMFS for use in identifying potential open access fishery participants. Historical open access fishery data could be used to further narrow the field of potential open access fishery participants. Such data could be used for projecting open access fishery impacts on federal groundfish species.

#### *4.1.3.2 Catch Characteristics*

Catch characteristics of the open access fisheries are described in **Section 3.3.2**. No change in fishery management is proposed under this alternative. The status quo alternative allows the fishery to expand in a rapid manner in response to the cost of conducting fishing operations and market conditions associated with trip and cumulative landing limits for federal groundfish species. Fishing vessel participation has been increasing off the WOC in recent years **(Figure 2-1**) and the northern area sablefish fishery exceeded its harvest guideline by over 40% in 2005 and had to be closed early in 2006 due to heavy fishing pressure. The recent sablefish effort increase may have been in response to restrictive salmon fishing regulations and low salmon availability. Continued high level of fishing effort in the sablefish fishery will result in reduced daily and cumulative landing limits with increased negative impacts on fisherman revenues and overfished species compared to recent years.

#### *4.1.3.3 Vessel Characteristics*

Vessel characteristics are described in **Section 3.3.3**. No change in vessel characteristics would be expected because no change in fishery management is proposed under this alternative.

#### *4.1.3.4 Processor Characteristics*

Processor characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected because no change in fishery management is proposed under this alternative.

#### *4.1.3.5 Participation Requirements, Restrictions, Licensing*

Participation requirements, restriction and licensing are described in **Section 3.3.5.** There would be no change in the management of open access fisheries with regard to fishing vessel participation opportunity or federal licensing requirement because no change in fishery management is proposed under this alternative. Participation in the open access fisheries would continue to be unrestricted, except for state or tribal laws requiring fisherman and vessel registration requirements and for federal VMS program requirements. There would be no added paperwork or time management stress for obtaining and completing federal permit applications, providing copies of supporting documents, and meeting federal permit application deadlines.

#### *4.1.3.6 Revenue/Costs to the Participants and to State and Federal Governments*

These issues are discussed in **Section 3.3.6**. There would be no added cost to conducting commercial fishing for federal groundfish stemming from federal permit fees because no change is management is proposed under this alternative. There would be no added cost to state and federal governments that can be identified, as a result of this alternative.

#### *4.1.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are described in **Section 3.3.7**. No change in the dependence of fishing communities on groundfish would be expected because no change in fishery management is proposed under this alternative.

#### *4.1.3.8 Environmental Justice*

The factors to be considered in the application of the principals of Environmental Justice are explained in **Section 3.3.8.** This regulation process was prosecuted in full view of and in concert with potentially affected ethnic groups, religious sectors, and other interested public members. Public member concerns were recorded and considered in the development and interpretation of the alternatives and subsequent analysis of their impacts on coastal fishing communities and residents. The status quo alternative means no change in the current fishery management, thus there is no expectation of community impact with regard to the factors listed in **Section 3.3.8**.

## *4.2 Alternative 2*

This alternative is the same as the No-action Alternative, but establishes an annual licensing requirement in which vessel owners could submit a license application at any time during the year. There would be no differentiation with regard to whether individual vessel owners intended to fish in a directed or incidental fishing mode or to combine the two modes. This alternative would be expected to have fishery and human impacts comparable to Alternative 1 because no change in current fishery management is proposed under this alternative.

### 4.2.1 Effects on the Physical Environment including EFH

The affected physical environment including EFH is described in **Section 3.1**. This alternative would allow vessel owners to continue to fish for groundfish as they have in the past to the extent that future groundfish stock status allows. The directed open access fleet has been increasing in recent years in the WOC area (**Figure 2-1**), particularly for sablefish (**figures 3-4 and 3-5)**. Continuation of the upward trend in vessel participation in the open access fishery could have a corresponding increase in physical environmental impacts, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, no adverse impact to the environment would be expected because no change in current fishery management is proposed in this alternative.

## 4.2.2 Effects on the Biological Environment

### *4.2.2.1 Groundfish Species*

Groundfish species are described in **Section 3.2.1** and Appendix F. No change in level of groundfish landings or impacts would be expected because no change in current fishery management is proposed under this alternative. Effort levels may fluctuate but allowable catch and impact levels are expected to be similar to recent years. Trip and cumulative landing limits would likely continue to be used to constrain harvest and to provide for year-round fishing.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:** http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.

### *4.2.2.2 Non-groundfish Species (State-managed or under other FMPs)*

Non-groundfish species important to WOC fisheries are described in **Section 3.2.2**.and **Appendix F.** No change in level of non-groundfish landings or impacts would be expected because no change in current fishery management is proposed under this alternative.

### *4.2.2.3 Prohibited Species*

Prohibited species are described in **Section 3.2.3**. No change in level of impact of open access fishery vessels on prohibited species would be expected because no change in current fishery management is proposed under this alternative.

### *4.2.2.4 Protected Species*

Protected species are generally described in **Section 3.2.4**. No change in level of impact of open access fishery vessels on prohibited species would be expected because no change in current fishery management is proposed under this alternative.

## 4.2.3 Effects on the Socioeconomic Environment

### *4.2.3.1 Management Structure of the Open Access Fishery*

The open access fishery management structure is described in **Section 3.3.1**. Pre-season registration and licensing of open access fishery participants would facilitate projection of open access fishery landings and impacts, which could lead to better utilization of harvestable resources and protection of overfished groundfish species. This alternative would allow NMFS to use historical fishery information to determine whether individual vessels are likely to fish in a directed or incidental fishing mode. This alternative does not address potential fishery impacts of new fishery participants in the directed open access fishery; ie, there would be no limit on the number of future fishery participants. No change in the current management structure is proposed under this alternative. Fisheries would likely continue to be managed using trip and cumulative landing limits with the aim of providing for year round fishing.

#### 4.2.3.2 Catch Characteristics

Catch characteristics of the open access fisheries are described in **Section 3.3.2**. The registration requirement under this alternative would help to more accurately project fishery impacts and landings on a pre-and in-season basis, thus minimizing the need for major late season trip limit changes to stay within or meet fishery allocations. This alternative allows the fishery to expand in a rapid manner in response to the cost of conducting fishing operations and market conditions associated with trip and cumulative landing limits for federal groundfish species. Total fishing vessel participation has risen in recent years in the WOC area **(Figure 2-1)** and the northern area sablefish fishery exceeded its harvest guideline by over 40% in 2005 and had to be closed early in 2006 due to heavy fishing pressure. The recent sablefish effort increase may have been in response to restrictive salmon fishing regulations and low salmon availability. Continued high level of fishing effort in the sablefish fishery will result in reduced daily and cumulative landing limits with increased negative impacts on fisherman revenues and to overfished species compared to recent previous years.

#### 4.2.3.3 Vessel Characteristics

Vessel characteristics are described in Section **3.3.3**. No change in vessel characteristics would be expected because no change in current fishery management is proposed under this alternative.

#### 4.2.3.4 Processor Characteristics

Process characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected because no change in current fishery management is proposed under this alternative.

#### 4.2.3.5 Participation Requirements, Restrictions, Licensing:

Participation requirement, restriction and licensing are described in **Section 3.3.5.** This alternative would require all vessels that participate in open access fisheries to register with NMFS before any directed or incidental fishing takes place, which would be a new fishery participation requirement. Any vessel owner that holds a valid commercial fishing registration with one the coastal states would be allowed to register with NMFS to participate in the open access fishery, and there would be no federal limited entry permit requirement.

#### 4.2.3.6 Revenue/Costs to the Participants and to State and Federal Governments

These issues are discussed in **Section 3.3.6**. There would be a cost to fishermen and governments, associated with annual vessel licensing under this alternative. The current A permit renewal fee is $125. Vessel owners would be required to register their vessel with NMFS in advance of participating in the fishery. In order to provide NMFS with adequate time to complete a vessel registration, vessel owners would need to submit to NMFS an application at least 30 days in advance of the date the vessel owner wishes to begin participation in the fishery.

Adoption of any alternative that requires federal licensing or permitting of current open access vessels to take and possess specified federal groundfish may require that those vessels participate in the federal groundfish fishery vessel monitoring program (VMS program) when fishing for specified federal groundfish in federal or state waters. Some current open access fishermen may not seek to participate in the VMS program because of program cost, and intend to commercially fish for and take specified federal groundfish in state waters only where VMS program participation may not be required. Federal groundfish registration might compromise that strategy. Registration for a federal groundfish license or permit may require vessel participation in the groundfish VMS program. Furthermore, adoption of any alternative that requires federal licensing or permitting may increase the probability of a vessel being selected to participate in the Pacific Coast Groundfish Observer Program. There is an added cost to vessel owners to carry a federal observer on their vessel.

#### *4.2.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are in **Section 3.3.7**. No change in dependence of fishing communities on groundfish would be expected because no change is current management structure is proposed under this alternative and the cost of registering their vessel is expected to be nominal.

#### *4.2.3.8 Environmental Justice*

The factors to be considered with regard to environmental justice are described in **Section 3.3.8.** This regulation process was prosecuted in full view of and in concert with potentially affected ethnic groups, religious sectors, and other interested public members. All public member concerns were recorded and considered in the development and interpretation of the alternatives and subsequent analysis of their impacts to coastal fishing communities and their residents. This alternative basically means no change in the current fishery management thus there is no expectation of community impact with regard to the factors listed in **Section 3.3.8**.

## *4.3 Alternative 3*

Alternative 3 is one of three alternatives that have a specific initial B species fleet size goal and that provide for issuance of B and C permits. The directed fishery fleet size goal for Alternative 3 is based on the average directed B species vessel fleet size during the window period years of 2004-2006 of 680 vessels (**Figure 4-1**). The long-term fishery goal is the same as the initial fleet size goal. Permits could be transferred once per year without regard to vessel size or gear used to qualify for a permit. A and B permit holders would be able to register their vessels to both permit types at the same time and use the two permit types alternately during the year. Vessel owners would be required to notify NMFS of permit usage change prior to leaving port. C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be available to any state registered commercial fishing vessel and could be applied for at any time during the year.

**Appendix E** presents an analysis of this alternative using specified B permit qualification criteria. The selection of qualification criteria for issuing B permits ranks vessels and has allocative as well as biological and economic implications. The qualification criteria used in the analysis for Council consideration (including associated model run numbers in parentheses) were:

1) cumulative vessel landings in pounds of B species groundfish during 2004-2006 window period years (Model Run #1),
2) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period (Model Run #2), and
3) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period in combination with a 2004-2006 window period B permit species landing requirement (Model Run #3).

The proposed qualification criteria used to analyze and compare alternatives 3-6 with Alternative 1 (No-action) and Alternative 2 (federal license) presented in **Appendix E** are described in **Table 4-2**. One of these criteria (or modification thereof) is proposed to be selected as part of the final action on any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

Table 4-2. Qualification criteria developed by the document writing team and used to analyze and compare alternatives 3-6 with Alternative 1(no action) and Alternative 2 (registration only) presented in Appendix E 1/

| Model Run # | Criterion description |
|---|---|
| 1 | Total B species groundfish landings by individual vessels during 2004-2006 window period years |
| 2 | Total of B species landings by individual vessels during 1998-2006 window period years |
| 3 | Same as Model Run #2 except at least one B species landing was required during 2004-2006 window period years |

1/ One of these criteria (or modification thereof) is proposed to be selected as part of the Council's final action on this initiative for any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

The minimum landing requirement (MLR) for a B permit in this alternative ranged from 583 lbs (Model Run #1) to 3,574 lbs (Model Run #2). The MLR for permit issuance under Model Run #3 criteria was 1,221 lbs.

### *4.3.1 Effects on the Physical Environment*

The affected environment, including EFH, is described in **Section 3.1**. This alternative would reduce the number of vessels eligible to target B species groundfish, which could have a beneficial effect by reducing fishing impacts on habitat. Vessels displacement due to permit non-qualification could result in effort shifts to associated species such as salmon, HMS or crab to make up for B species revenue loss **(Appendix E**). It is not clear that such effort shifts would have any impact on marine habitats. The directed fishery open access fleet has been increasing in recent years (**Figure 2-1**), particularly for sablefish (**figures 3-4 and 3-5)**. Continuation of the upward trend in vessel participation in the open access fishery would stop under this alternative because the initial fleet size goal is the same as the 2004-2006 window period average. However, the permit issuance program would not affect the ability of permitted vessels to exert additional fishing pressure in the event of increased groundfish availability, increased market demand for fish, or downturn in associated commercial fishing opportunity (e.g., salmon). Any effort increase by permitted vessels would have a corresponding impact on the physical environmental, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, the reduction in potential average annual fleet size and effort shift of vessels to other fisheries should not have a significant impact on the physical environment because of the small amount of effort and landings in this fishery compared to other Pacific Coast commercial fisheries (see **Section 3.3.7** for fishery comparisons)

### 4.3.2 Effects on the Biological Environment

#### *4.3.2.1 Groundfish Species*

Groundfish species are described in **Section 3.2.1**. No change in level of groundfish impacts would be expected under this alternative, thus there is low potential for significant impact to groundfish species, including overfished groundfish species and protected species. Trip and cumulative landing limits would likely continue to be used to constrain harvest and to provide for year-round fishing.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:** http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.

Continued high level of vessel participation in directed sablefish fishery will result in more restrictive sablefish landing and cumulative limits than in the past. Further reduction in sablefish limits will increase discards of sablefish and associated overfished groundfish stocks due to trip limit overages and high grading to land the most valuable fish compared to previous recent years. The number of permits proposed to be issued under this alternative (680) is nearly 150% greater than the average number of vessels that participated in the WOC directed sablefish fishery during 2004-2006 window period years (276 vessels; **Table 2-4**). Thus the potential is high under this alternative for continued high effort level in the directed sablefish fishery.

#### *4.3.2.2 Non-groundfish Species (State-managed or under other FMPs)*

Open access fishery impacts on non-groundfish species are described in **Section 3.2.2**. Increase in fishing effort and catch of state-managed and federal non-groundfish fisheries from displaced (non-qualifying) vessels would be expected to be very small (1%-2%) under this alternative to compensate for lost groundfish revenues, thus no significant impact to non-groundfish species would be expected under this alternative (**Figure 4-2; Appendix E: Table E-7**).

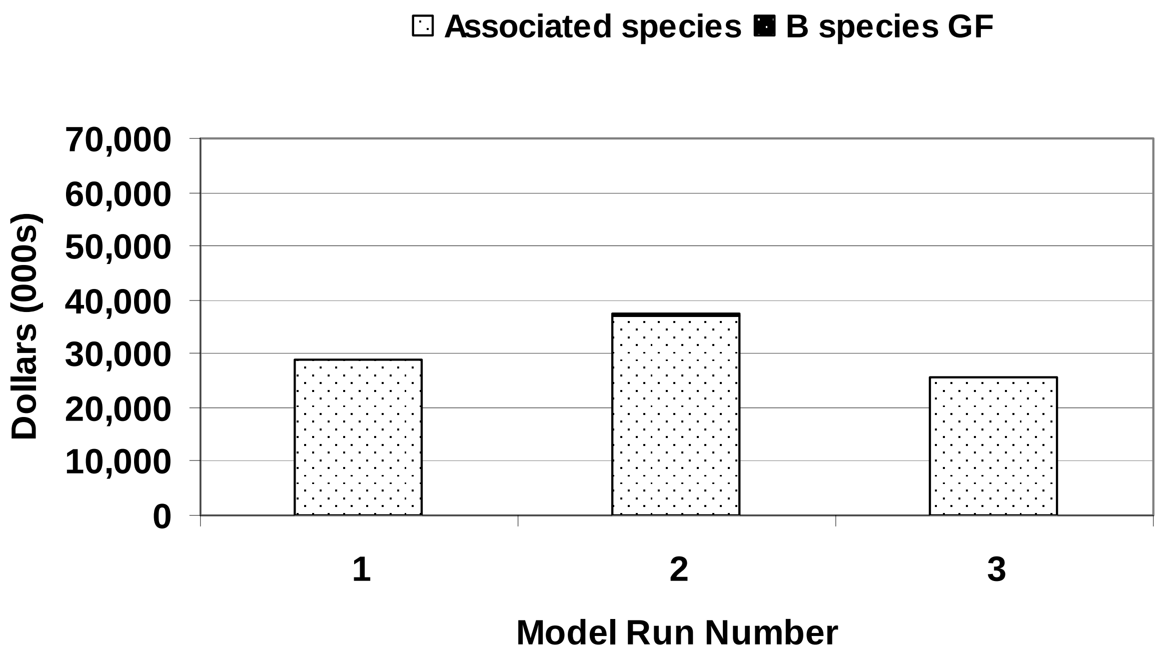


Figure 4-2. Fishery revenues during 2004-2006 by vessels that would not qualify for a B permit under A-3 (680 vsls) by model run #

#### *4.3.2.3 Prohibited Species*

Prohibited species impacts in open access fisheries are described in **Section 3.2.3**. No change in level of impact of open access fishery vessels on prohibited species would be expected under this alternative because of overall low impacts on harvest of B species groundfish harvest and low potential for significant effort shift to associated species, as described above.

#### *4.3.2.4 Protected Species*

Protected species impacts in open access fisheries are described in **Section 3.2.4**. No change in level of impact of open access fishery vessels on protected species would be expected under this alternative because of overall low impact on harvest of B species groundfish and low potential for significant effort shift to associated species, as described above.

### 4.3.3 Effects on the Socioeconomic Environment

#### *4.3.3.1 Management Structure of the Open Access Fishery*

The open access fishery management structure is described in **Section 3.3.1**. Permitting of open access fishery participants under this alternative would facilitate projection of open access fishery landings and impacts, which could lead to better utilization of harvestable resources and protection of overfished groundfish species. No change in the current management structure is proposed under this alternative. Fisheries would continue to be managed using trip and cumulative landing limits with the aim of providing for year round fishing.

#### *4.3.3.2 Catch Characteristics*

Catch characteristics of the open access fisheries are described in **Section 3.3.2**. The permit requirement under this alternative would help to more accurately project fishery impacts and landings on a pre-and in-season basis compared to the no-action alternative, thus minimizing the need for major late season landing limit changes to stay within or meet fishery allocations. The amount of B species groundfish harvested by vessels that would qualify for a permit under this alternative represented 92%-98% of the total B species groundfish landed by directed fishery vessels during the 2004-2006 window period (**Figure 4-3**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

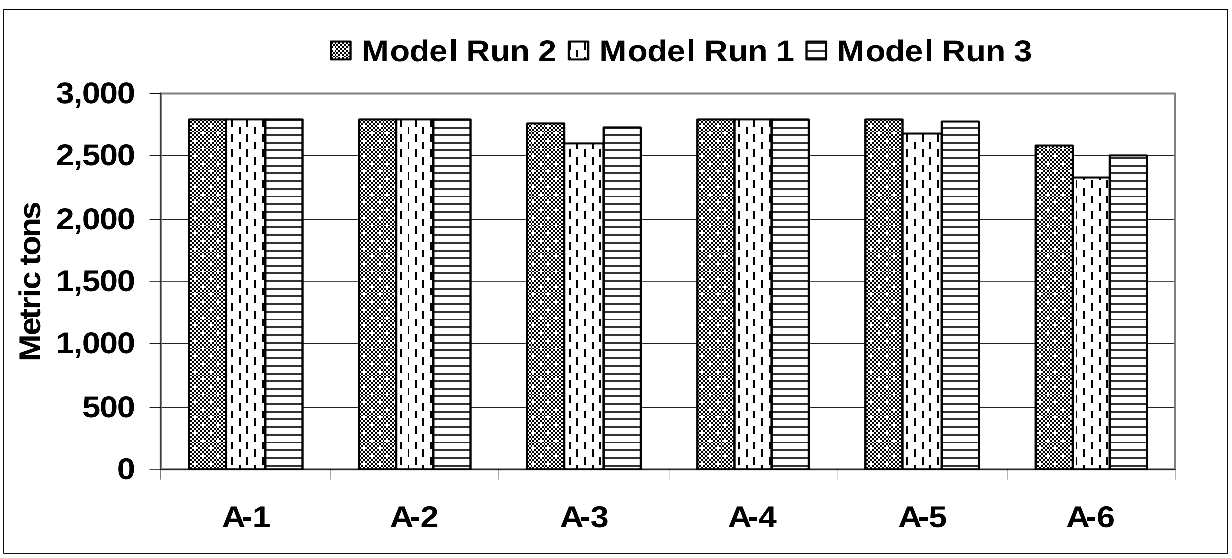


Figure 4-3. 2004-2006 B species harvest by alternative and model run

Reduction in number of vessels eligible to prosecute B species groundfish under this alternative to 680 would not result in a change in B species fishery trip or cumulative landing limits. This is because of the amount of fish harvested by non-qualifying vessels and that would be available for harvest by the permitted vessels (2%-8%) would be too small to impact the fishery **(Appendix E: Table E-7**). However, if the permitted vessel owners change fishing strategy or decided to sell their permits to individuals or entities with different fishing strategies, there could be negative impacts on trip limits, fisherman revenues, and overfished species impacts. If, for example, permitted vessels were to increase pressure on sablefish because of their high market value (**Section 3.3.2.4**), trip and cumulative landing limits might need to be further reduced, which would exacerbate the discard situation and increase impacts to overfished species that associate with sablefish. Many of the vessels that would qualify for a permit under this alternative also fish for salmon (**Section 3.3.3.6**). Total fishing vessel participation in the directed B species groundfish fishery has risen in recent years in the WOC area **(Figure 2-1),** and the northern area sablefish fishery exceeded its harvest guideline by over 40% in 2005 and had to be closed early in 2006 due to heavy fishing pressure. The recent sablefish effort increase may have been in response to restrictive salmon fishing regulations and low salmon availability. Continued high level of fishing effort in the sablefish fishery will result in reduced daily and cumulative landing limits with increased negative impacts on fisherman revenues and overfished species compared to recent previous years. The number of permits proposed to be issued under this alternative (680) is nearly 150% greater than the average number of vessels that participated in the WOC directed sablefish fishery during 2004-2006 window period years (276 vessels; **Table 2-4**).

Non-qualifying vessels under this alternative would need to increase effort or find alternative revenue sources to make up for revenues lost due to non qualification for B permit issuance. The amount of revenue increase that would be required is estimated to be in the range, on average, of 1%-2% based on the contribution of B species groundfish to total 2004-2006 window period fishery revenues of non-qualifying vessels (**Figure 4-2; Appendix E: Table E-7).**

The estimated distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 16%-17% (11%); Oregon, 29%-34% (31%); and California 49%-55% (57%) (**Appendix E: Table E-7; figures E-1, E-2 and E-3**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.3.3.3 Vessel Characteristics*

Vessel characteristics are described in **Section 3.3.3.** The annual number of B species fishery participants can be expected to decline from recent year levels under this alternative because 1) the initial permit issuance goal is based on a recent year average and 2) vessels are not required to participate in the fishery to be eligible for permit renewal. The actual number of different vessels that made B species landings during the years used to compute the initial fleet size goal was 1,103 (**Appendix E: Table E-7**). A high proportion of vessels did not participate every year in the fishery (**Section 3.3.3.1**), thus fewer than 680 permitted vessels could be expected to participate in any future year under this alternative. However, permit transfers from latent or low producing vessels to new permit owners has the potential to increase overall groundfish effort because the new permit holders would be more likely to use their new permits compared to the previous owners.

Average size of vessel in the fleet could change under this alternative, because vessel length would not be a constraining factor in permit transfers; i.e., there is no vessel length endorsement provision. Gear used to make the catch could potentially change because there would be no restriction on the type of gear vessels could use or that future permit holders would be allowed to use with their permit.

The estimated distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 16%-17% (11%); Oregon, 29%-34% (31%); and California 49%-55% (57%) (**Appendix E**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.3.3.4 Processor Characteristics*

Processor characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected under this alternative. However, the distribution of B permits could affect fish buying opportunities by commercial fish processors. The estimated distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 16%-17% (11%); Oregon, 29%-34% (31%); and California 49%-55% (57%) (**Appendix E**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.3.3.5 Participation Requirements, Restrictions, Licensing*

Participation requirements, restrictions, and licensing are described in **Section 3.3.5.** Adoption of this alternative would require vessel owners that qualify for a B permit to submit application to NMFS to obtain their initial permit and to apply for permit renewal each year thereafter. There would be no annual fishery participation requirement. Vessel owners that seek a C permit would be required to submit application for permit issuance, but there would be no federal qualification requirements associated with C permit issuance. Vessel owners would be required to obtain appropriate permit types before any directed or incidental fishing takes place.

Owners of A and B permits would be allowed to use both permit types alternately in the same year. However, there would be an advance notice requirement to switch permit type usage between fishing trips. This provision would allow vessels to fish from both A and B permit allocations in the same landing period.

#### *4.3.3.6 Revenue/Costs to the Participants and to State and Federal Governments*

These issues are discussed in **Section 3.3.6**. For both B and C permits, NMFS would charge fees for the range of administrative costs incurred by NMFS in issuing, renewing, transferring, appealing and replacing permits. Vessels owners would be required to meet certain permit application deadlines, which if not met could create delay in being able to participate in the B or C fisheries.

Adoption of any alternative that requires federal licensing or permitting of current open access vessels to take and possess specified federal groundfish may require that those vessels participate in the federal groundfish fishery vessel monitoring program (VMS program) when fishing for specified federal groundfish in federal or state waters. Some current open access fishermen may not seek to participate in the VMS program because of program cost, and intend to commercially fish for and take specified federal groundfish in state waters only where VMS program participation may not be required. Federal groundfish registration might compromise that strategy. Registration for a federal groundfish license or permit may require vessel participation in the groundfish VMS program. Furthermore, adoption of any alternative that requires federal licensing or permitting may increase the probability of a vessel being selected to participate in the Pacific Coast Groundfish Observer Program. There is an added cost to vessel owners to carry a federal observer on their vessel.

#### *4.3.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are discussed in **Section 3.3.7**. No change in the dependence of fishing communities on groundfish would be expected under this alternative. The fleet size reduction expected under this alternative would consolidate the catch among slightly fewer vessels compared to recent years with no impact on level of groundfish landings. Displaced fishers would be expected to shift effort to other fisheries to compensate for lost groundfish revenues, as discussed in **Section 4.3.3.2**. The 07-08 Specs EIS completed in 2006 included a comprehensive analysis of Pacific Coast groundfish fishing communities and their engagement in various groundfish fisheries. Most Pacific Coast fishing ports with groundfish landings have some vessels that land open access groundfish. Appendix A to the 07-08 Specs EIS evaluated fishing communities for their dependence on groundfish resources and for their vulnerability to changes in availability of groundfish harvest. This action would not alter the overall available groundfish harvest, but it would affect some vessels in particular ports, either by providing those vessels with a potentially valuable license to participate in the fishery or by eliminating opportunities for those vessels to participate in the fishery. Port cities that Appendix A identified as both having some history of open access groundfish landings and a relatively higher dependency on availability of groundfish resources are: Astoria, Bellingham, Brookings, Coos Bay, Crescent City, Eureka, Fort Bragg, Morro Bay, Newport, Port Orford, and San Francisco. Additional information on the importance of groundfish to fishing communities is provided in **Section 3.3.7.** The distribution of B species landings could be affected under this alternative because of the distribution of qualifying vessels. The estimated distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 16%-17% (11%); Oregon, 29%-34% (31%); and California 49%-55% (57%) (**Appendix E**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.3.3.8 Environmental Justice*

The factors to be considered with regard to environmental justice are described in **Section 3.3.8.** This action has low potential for significant impact as it does not target low income or minority communities; it would affect all population segments equally. Some Pacific Coast fishing communities have open access fishery participants that are not native-English speakers, but few of them participate in the fishery management process. Fishing families from these same communities also participate in the limited entry groundfish fishery, so there are within-community networks of translators. NMFS has not historically translated its groundfish fishery regulations from English into other languages. Some of the communities with relatively high open access fishery landings are considered vulnerable to shifts in groundfish fishing opportunity, although open access landings themselves may not make up the majority of groundfish fishing income to the community. This action does not alter or affect tribal treaty rights to or tribal allocations of groundfish.

## *4.4 Alternative 4*

Alternative 4 was developed to analyze a range of minimum landing requirements for B permit issuance. C permit provisions would be same as under alternatives 3-5 and 6. There would be no initial B species fleet size or long-term goal under this alternative (**Figure 4-3**), but no new permits would be issued after the first year. Under this alternative, permits would be transferable once per year without regard to vessel size or gear used to qualify for the permit. A and B permit holders would be able to register their vessels to both permit types and use the two permit types alternately during the year, but would be required to notify NMFS whenever they make a permit usage change before leaving port. C permits would be required to land groundfish, excluding nearshore species, for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be available to any state registered commercial fishing vessel and could be applied for at any time during the year.

**Appendix E** presents an analysis of a wide range of minimum landing requirements (MLRs) for B permit qualification criteria using Model Run #3 data. The results are summarized as follows:

- There was a steep increase in the proportion of B species landings associated with declining MLRs (increasing catch proportions) in the range 47,866 lbs and 14,374 lbs (50% and 80% harvest retention levels). The relationship then flattened out (**Appendix Figure E-4).**
- Respective totals of 762 and 894 of the least productive vessels harvested 10% and 20% of the B species groundfish during 2004-2006 window period years. This averages 1.31 and 2.23 percentage points, respectively, for each 100 vessels in these two vessel groups (**Appendix Table E-9).**
- There was a negative relationship between vessel dependence (expressed as a proportion of total fishery landings) on B species groundfish landings and MLRs with a natural break based on

weight of fish between the 14,374 and 6,101 MLRs (80% and 90% catch retention levels). No such break was apparent based on value of fish (**Appendix Figure E-5**).

- None of the MLRs within the range examined would cause a reduction in total species fishery impact of >5%, which would be 1% at the 1,603-lb MLR level (**Appendix Table E-9).**

The proposed qualification criteria used to analyze and compare alternatives 3-6 with Alternative 1 (No-action) and Alternative 2 (licensing) presented in **Appendix E** are described in **Table 4-2**. One of these criteria (or modification thereof) is proposed to be selected as part of the Council's final action on any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

The minimum landing requirement to qualify for a B permit under this alternative ranged from one lb (100% fleet capacity retention) to about 48 thousand pounds (50% fleet capacity retention). The analysis of alternative MLRs developed for this alternative used Model Run# 3 criteria (total of 1998-2006 window period landings with at least one landing during the 2004-2006 window period) (**Appendix E**).

### 4.4.1 Effects on the Physical Environment including EFH

The affected environment, including EFH, is described in **Section 3.1**. This alternative has the flexibility to substantially reduce the number of vessels eligible to target B species groundfish, which could have a beneficial effect by reducing fishing impacts on habitat. Vessel displacement due to permit non-qualification could result in effort shifts to associated species such as salmon, HMS or crab to make up for revenue loss (**Appendix E** for effort shift estimates). It is not clear that such effort shifts would have a substantial impact on marine habitats. The directed open access fleet has been increasing in recent years (**Figure 2-1**), particularly for sablefish (**figures 3-4 and 3-5)**.. Continuation of the upward trend in vessel participation in the open access fishery could possibly stop under this alternative, depending on qualification criteria used for B permit qualification. However, the permit issuance program will not affect the ability of permitted vessels to exert additional fishing pressure in the event of increased groundfish availability, increased market demand for fish, or reduced fishing opportunity in associated fisheries, such as salmon. Any effort increase by permitted vessels would have a corresponding impact on the physical environmental, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, this alternative is not likely to significantly affect the physical environment because the small size of the fishery compared to other Pacific Coast fisheries (see **Section 3.3.7, Groundfish-dependent Communities)**.

#### *4.4.2.1 Groundfish Species*

Open access fishery impacts on groundfish species are described in **Section 3.2.1**. The level of change in groundfish landings or impacts under this alternative would depend on the level of fleet harvest capacity and associated MLR that the Council and NMFS might approve. For example, an MLR aimed at retaining 50% harvest capacity in the permitted fleet would likely result in substantially increased trip and cumulative limits by permitted vessels to harvest groundfish formerly harvested by non-permitted vessels. This alternative has the potential to substantially reduce fleet fishing capacity and participation in the groundfish fishery, which could in turn have a beneficial effect on overfished groundfish species by reducing gear interactions with those species (**Appendix E: Table E-8 and Figure E-6)**.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:**

http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.). Continued high level of vessel participation in the directed sablefish fishery will result in more restrictive sablefish landing and cumulative limits than in the past. Further reduction in sablefish limits will increase discards of sablefish and associated overfished groundfish stocks due to trip limit overages and high grading to land the most valuable fish compared to previous recent years.

An average of 276 vessels participated in the WOC directed sablefish fishery in the recent window period years of 2004-2006 (**Table 2-4**). An MLR of 14,374 lbs and using Model Run #3 qualification criteria (Table 4-2) would result in a fleet of 202 vessels, while an MLR of 6,101 lbs and the same criteria would produce of fleet of 341 vessels.

#### *4.4.2.2 Non-groundfish Species (State-managed or under other FMPs)*
Open access fishery impacts on non-groundfish species are described in **Section 3.2.2**. A large decrease in groundfish harvest would likely result in effort shift by permitted vessels to associated fisheries. In the example above, the 47,866-lb MLR associated with 50% fleet harvest capacity retention would require non-permitted vessels to increase fishery incomes by 5% in associated fisheries to make up B species groundfish revenue losses (**Appendix E: Table E-8 and Figure E-6**).

#### *4.4.2.3 Prohibited Species*
Prohibited species impacts in open access fisheries are described in **Section 3.2.3**. No change in level of impact of open access fishery vessels on prohibited species would be expected under this alternative. The bycatch of salmonids (listed and non-listed) is low in the open access groundfish fishery. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

#### *4.4.2.4 Protected Species*
Protected species impacts in open access fisheries are described in **Section 3.2.4**. No change in level of impact of open access fishery vessels on protected species would be expected under this alternative. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

### 4.4.3 Effects on the Socioeconomic Environment
#### *4.4.3.1 Management Structure of the Open Access Fishery*
The open access fishery management structure is described in **Section 3.3.1**. Permitting of open access fishery participants would facilitate projection of open access fishery landings and impacts, which could lead to better utilization of harvestable resources and protection of overfished groundfish species. No change in the current management structure would be expected under this alternative. Fisheries would likely continue to be managed using trip and cumulative landing limits with the aim of providing for year round fishing.

#### *4.4.3.2 Catch Characteristics*
Catch characteristics of the open access fisheries are described in **Section 3.3.2**. For this alternative a range of harvest capacity goals was established that retained specific proportions of the total harvest of B species groundfish during the 1998-2006 window period using Model Run #3 criteria for permit qualification. The minimum landing requirement to retain 50% of 1998-2006 fleet capacity was 47,866 pounds, and a total of 65 vessels met this standard. These 65 vessels harvested 1,215 mt of B species groundfish worth $3.1 million ex-vessel price during the 2004-2006 window period. Thus 6% of the fleet landed 43% by weight and 36% by value of B species groundfish during the 2004-2006 window period.

There was a steep decline in the average amount of harvest of B species groundfish during 2004-2006 window period by qualifying vessels associated with declining MLRs. The range was from 18.7 mt at the 47,866 lb MLR level to 2.5 mt at the one lb MLR level (**Figure 4-4)**. There was a noticeable change in the rate of decline by qualifying vessels at MLR levels below 6,101 lbs (**Figure 4-4)**. This rate change was caused by the comparatively low landings by vessels that landed less than 6,101 lbs of fish. Adoption of a 6,101-lb MLR for B permit qualification would result in a fleet of 341 vessels based on Model Run # 3 criteria (**Table 4-2).** A total of 762 vessels that made at least one landing during the 2004-2006 window period and that landed 355 mt of B species groundfish worth $1.3 million ex-vessel price would not qualify at the 6,101 lb MLR level/

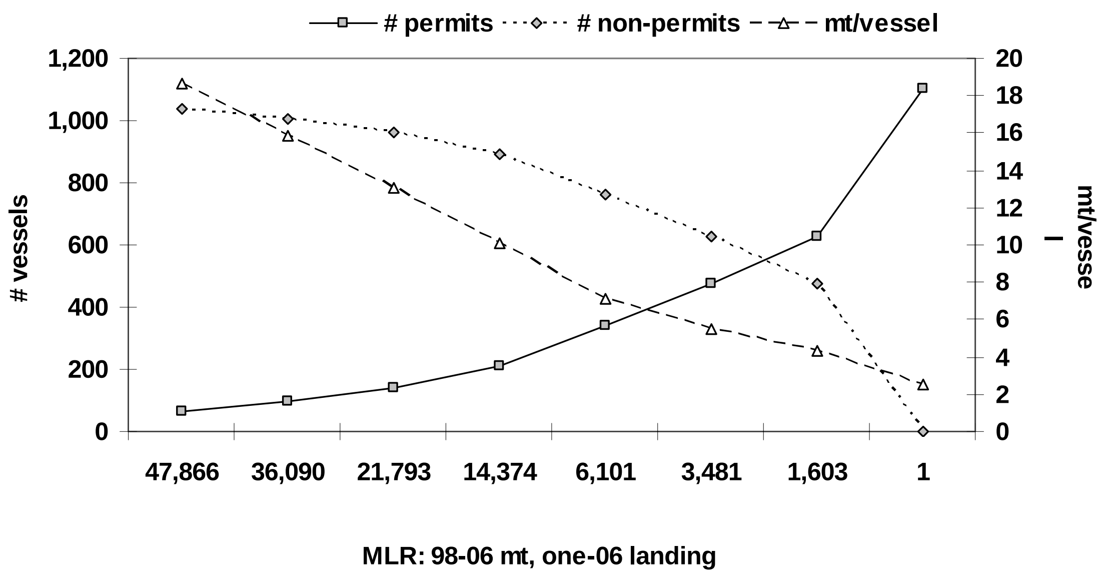


Figure 4-4: Number of qualifying and non-qualifying vessels based on minimum landing requirements (MLRs) aimed at retaining 50% to 100% of 1998-2006 B fleet harvest capacity, including mt/vessel averages for qualifying vessels based on Model Run # 3 qualification criteria

The level of change in groundfish landings or impacts under this alternative would depend on the level of fleet harvest capacity and associated MLRs that would meet the community impact objective of this alternative. For example, an MLR aimed at retaining 50% harvest capacity in the permitted fleet would likely result in substantially increased trip and cumulative limits by permitted vessels to harvest groundfish formerly harvested by non-permitted vessels. An MLR of 6,101 lbs would eliminate a large number of vessels from the fleet (69%) but would not result in a substantial increase in B species harvest opportunity by permitted vessels based on tonnage (13%) or revenues (15%) from landings by non-qualifying vessels during the 2004-2006 window period (**Appendix E: Table E-8**). However, a fleet size adjustment that would come close to matching the number of vessels that had directed landings sablefish landings during recent years could substantially reduce the potential negative impacts of a large effort shift to the directed sablefish fishery stemming from permit transfers to new owners or redirection of effort to sablefish by permitted vessels that participate in other fisheries such as salmon. An average of 276 vessels had directed sablefish landings in the WOC area during the 2004-2006 window period (**Table 2-4**). An MLR of 14,374 lbs and using Model Run #3 qualification criteria (Table 4-2) would qualify a fleet of 202 vessels, while an MLR of 6,101 lbs and applying the same criteria would qualify a fleet of 341 vessels.

The impact to non-qualifying vessels varies substantially between the different MLR levels and ranges from a high of 1,582 mt of fish worth $5.5 million at the 47,866 MLR level to zero impact at the one-lb

MLR level. The amount of effort shift to other fisheries to compensate for loss of B species groundfish landings ranges from a high of 4% based on tonnage and 5% based on revenues at the 47,866 MLR level to zero impact at the one-lb MLR level. The comparative effort shift levels at the 6,101-lb MLR level were 2% based on either weight or value of the catch (**Appendix E: Table E-8).** These relatively low effort shift values to compensate for loss of B species groundfish opportunity stem from low dependence of the vast majority of open access fishery participants on B species groundfish (see **Section 3.3.3.6**).

The distribution of permits by state under the different MLRs can be inferred from data presented in **Appendix E**. Those data show that an MLR in the range of 14,000 to 22,000 lbs (to achieve 170 vessel fleet size) would result in the issuance of permits between states (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) as follow: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%) (**Appendix E**). The comparative values at the 6,101 MLR level (using 390 fleet size as a proxy) would be as follows: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.4.3.3 Vessel Characteristics*

Vessel characteristics are described in **Section 3.3.3**. Fishery attrition would be low under this alternative because permits would be transferable regardless of MLR adopted for permit qualification Permit transfers from latent vessels that might receive a permit (particularly at low MLR levels) to new permit owners could increase overall groundfish effort because the new permit holders would have greater incentive to use their new permits. Also, at low MLRs, many salmon vessels would likely receive permits and could increase effort in the B species fisheries to make up for lost salmon revenues due to restrictive salmon fishing regulations, which appeared to happen in 2006. Average size of vessel in the fleet could change under this alternative, because vessel length would not be a constraining factor in permit transfers; i.e., there is no vessel length endorsement provision. Gear used to make the catch could potentially change because there would be no restriction on the type of gear vessels could use or that future permit holders would be allowed to use with their permit. The distribution of permits by state under the different MLRs can be inferred from data presented in **Appendix E**. Those data show that an MLR in the range of 14,000 to 22,000 lbs (to achieve 170 vessel fleet size) would result in the issuance of permits between states (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) as follow: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%) (**Appendix E**). The comparative values at the 6,101 MLR level (using 390 fleet size as a proxy) would be as follows: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E**). The ranges in proportions stem from the differing impacts of the permitting criteria used in the analysis (**Table 4-2**).

#### *4.4.3.4 Processor Characteristics*

Process characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected under this alternative. However, the distribution of B permits could affect fish buying opportunities for commercial fish processors. The distribution of permits by state under the different MLRs can be inferred from data presented in **Appendix E**. Those data show that an MLR in the range of 14,000 to 22,000 lbs (to achieve 170 vessel fleet size) would result in the issuance of permits between states (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) as follow: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%) (**Appendix E**). The comparative values at the 6,101 MLR level (using 390 fleet size as a proxy) would be as follows: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E**). The ranges in proportions stem from the differing impacts of the permitting criteria used in the analysis (**Table 4-2**).

#### *4.4.3.5 Participation Requirements, Restrictions, Licensing:*

Participation requirement, restriction and licensing are described in **Section 3.3.5.** Adoption of this alternative would require vessel owners that qualify for a B permit to submit application to NMFS to obtain their initial permit and to apply for permit renewal each year thereafter. Vessel owners that seek a C permit would be required to submit application for permit issuance, but there would be no federal qualification requirements associated with C permit issuance. Vessel owners would be required to obtain appropriate permit types before any directed or incidental fishing takes place.

Owners of A and B permits would be allowed to use both permit types alternately in the same year. However, there would be an advance notice requirement to switch permit type usage between fishing trips. This provision would allow vessels to fish from both A and B permit allocations in the same cumulative landing period.

#### *4.4.3.6 Revenue/Costs to the Participants and to State and Federal Governments*

These issues are discussed in **Section 3.3.6**. There would be a cost, expected to be nominal, associated with B and C permit issuance and permit renewal. Vessels owners would be required to meet certain permit application deadlines, which if not met could create delay in being able to participate in the B or C fisheries.

Adoption of any alternative that requires federal licensing or permitting of current open access vessels to take and possess specified federal groundfish may require that those vessels participate in the federal groundfish fishery vessel monitoring program (VMS program) when fishing for specified federal groundfish in federal or state waters. Some current open access fishermen may not seek to participate in the VMS program because of program cost, and intend to commercially fish for and take specified federal groundfish in state waters only where VMS program participation may not be required. Federal groundfish registration might compromise that strategy. Registration for a federal groundfish license or permit may require vessel participation in the groundfish VMS program. Furthermore, adoption of any alternative that requires federal licensing or permitting may increase the probability of a vessel being selected to participate in the Pacific Coast Groundfish Observer Program. There is an added cost to vessel owners to carry a federal observer on their vessel.

#### *4.4.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are discussed in **Section 3.3.7**. No change in the dependence of fishing communities on groundfish would be expected under this alternative because of the relatively low contribution of B species groundfish to local fisheries. Any level of fleet size reduction below 680 vessels under this alternative would be expected to consolidate the catch among fewer vessels compared to recent years with no impact on level of groundfish landings. Displaced fishers would be expected to shift effort to other fisheries to compensate for lost groundfish revenues (see **Appendix E**). NMFS completed an Environmental Impact Statement (EIS) in 2006 that included a comprehensive analysis of Pacific Coast groundfish fishing communities and their engagement in various groundfish fisheries. Most Pacific Coast fishing ports with groundfish landings have some vessels that land open access groundfish. Appendix A to the EIS evaluated fishing communities for their dependence on groundfish resources and for their vulnerability to changes in availability of groundfish harvest. This action would not alter the overall available groundfish harvest, but it would affect particular vessels in particular ports, either by providing those vessels with a potentially valuable license to participate in the fishery or by eliminating opportunities for those vessels to participate in the fishery. Port cities that Appendix A identified as both having some history of open access groundfish landings and a relatively higher dependency on availability of groundfish resources are: Astoria, Bellingham, Brookings, Coos Bay, Crescent City, Eureka, Fort Bragg, Morro Bay, Newport, Port Orford, and San Francisco. Additional information on the importance of groundfish to fishing communities is provided in **Section 3.3.7**. A substantial reduction in permits under this alternative has the potential for compaction of permits in a few ports and the absence of permits in other ports depending on the distribution of the more productive boats.

The distribution of permits by state under the different MLRs can be inferred from data presented in **Appendix E**. Those data show that an MLR in the range of 14,000 lbs to 22,000 lbs (to achieve 170 vessel fleet size) would result in the issuance of permits between states (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) as follow: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%) (**Appendix E**). The comparative values at the 6,101-lb MLR level (using 390 fleet size as a proxy) would be as follows: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E**). The ranges in proportions stem from the differing impacts of the permitting criteria used in the analysis (**Table 4-2**).

#### *4.4.3.8 Environmental Justice*

The factors to be considered with regard to environmental justice are described in **Section 3.3.8.** This action has low potential for significant impact as it does not target low income or minority communities; it would affect all population segments equally. Some Pacific Coast fishing communities have open access fishery participants that are not native-English speakers, but few of them participate in the fishery management process. Fishing families from these same communities also participate in the limited entry groundfish fishery, so there are within-community networks of translators. NMFS has not historically translated its groundfish fishery regulations from English into other languages. Some of the communities with relatively high open access fishery landings are considered vulnerable to shifts in groundfish fishing opportunity, although open access landings themselves may not make up the majority of groundfish fishing income to the community. This action does not alter or affect tribal treaty rights to or tribal allocations of groundfish.

## *4.5 Alternative 5*

Alternative 5 has an initial fleet size goal of 850 vessels combined with two long-term fleet size goals: Alternative 5a, 430 vessels; Alternative 5b, 170 vessels. C permit provisions would be the same as under alternatives 3-4 and 6. Permit holders would be required to consolidate (combine) permits, two for one, at specified intervals in order to continue in the fishery. Permit consolidation would occur once, after the fifth program year, under Alternative 5a, and twice, once each after the first and fifth program years, under Alternative 5b. Permits would be fully transferable under both alternatives in order to achieve the respective long-term fleet size objectives. Permit holders would be required to make a B species groundfish landing every year by November 30 or their permit would not be renewed. Permitted vessels would be gear and length endorsed. Vessel owners would be allowed to acquire A and B permits and would be allowed one permit transfer on any vessel per year consistent with gear and length transfer provisions. C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be available to any state registered commercial fishing vessel and could be applied for at any time during the year.

**Appendix E** presents an analysis of this alternative using specified B permit qualification criteria. The selection of qualification criteria for issuing B permits has allocative as well as biological and economic implications. The qualification criteria used in the analysis for Council consideration (including associated model run numbers in parentheses) were:

1) cumulative vessel landings in pounds of B species groundfish during 2004-2006 window period years (Model Run #1),

2) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period (Model Run #2), and
3) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period in combination with a 2004-2006 window period B permit species landing requirement (Model Run #3).

The proposed qualification criteria used to analyze and compare alternatives 3-6 with Alternative 1 (No-action) and Alternative 2 (registration only) presented in Appendix E are described in **Table 4-2**. One of these criteria (or modification thereof) is proposed to be selected as part of the Council's final action on any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

The minimum landing requirement to qualify for B permit issuance under this alternative ranged from 229 lbs (Model Run #1; total of 2004-2006 window period landings) to 2,240 lbs (Model Run #2; total of 1998-2006 window period landings). The minimum landing requirement for permit issuance using Model Run #3 criteria was 426 lbs (total of 1998-2006 window period landings with at least one landing during the 2004-2006 window period) (**Appendix E**).

### 4.5.1 Effects on the Physical Environment

The affected environment, including EFH, is described in **Section 3.1**. This alternative is expected to eventually reduce the number of vessels eligible to target B species groundfish. The initial fleet size goal of 850 vessels is 170 vessels (25%) greater than the average number of vessels that participated in the fishery during 2004-2006 window period years (**Table 2-4; Figure 2-1)**. Vessel displacement in future years due to permit reduction could result in effort shifts to associated species such as salmon, HMS or crab to make up for revenue loss. There would be an attendant increase in habitat impacts in associated fisheries. It is not possible to evaluate overall habitat impacts associated with fishery effort shifts because of unknown fishery-specific impacts. The directed open access fisheries have been increasing in recent years in the WOC area (**Figure 2-1**), particularly for sablefish (**figures 3-4 and 3-5)**.Continuation of the upward trend in vessel participation in the open access fishery could continue for five more years under Alternative 5a but only one more year under Alternative 5b because of permit consolidation requirements at the end of those years. The permit issuance program would not affect the ability of permitted vessels to exert additional fishing pressure in the event of increased groundfish availability, increased market demand for fish, or reduced fishing opportunity in associated fisheries, such as salmon. Any effort increase by permitted vessels would have a corresponding impact on the physical environmental, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, this alternative is not likely to significantly affect the physical environment because the small size of the fishery compared to other Pacific Coast fisheries (see **Section 3.3.7, Groundfish-dependent Communities).**

### 4.5.2 Effects on the Biological Environment

#### *4.5.2.1 Groundfish Species*

Groundfish species are described in **Section 3.2.1**. No change in level of groundfish landings or impacts would be expected in the first program year. Vessel participation would eventually decrease under both sub-alternatives. Overall groundfish impacts would likely be the same as in recent years but trip and cumulative limits could be increased to harvest the available fish. This alternative aims to eventually reduce fleet fishing capacity and participation in the B species groundfish fishery, which would have a beneficial effect on the target species, overfished groundfish, and protected and prohibited species, by reducing gear interactions with those species.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-**

**5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:** http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.). Continued high level of vessel participation in the directed sablefish fishery will result in more restrictive sablefish landing and cumulative limits than in the past. Further reduction in sablefish limits will increase discards of sablefish and associated overfished groundfish stocks due to trip limit overages and high grading to land the most valuable fish compared to previous recent years.

The number of permits proposed to be initially issued under this alternative (850) is 200% greater than the average number of vessels that participated in the WOC directed sablefish fishery during 2004-2006 window period years (276 vessels; **Table 2-4**). Thus the potential is high under this alternative for continued high effort level in the directed sablefish fishery until the permit holders are required to consolidate their permits.

#### *4.5.2.2 Non-groundfish Species (State-managed or under other FMPs)*

Open access fishery impacts to non-groundfish species are described in **Section 3.2.2**. Eventual increase in fishing effort and catch of state-managed and federal non-groundfish fisheries could be expected under alternatives 5a (450 vessels) and 5b (170 vessels) from displaced (non-permitted or previously permitted) vessels. The amount of effort shift to associated fisheries to make up for loss of B species groundfish revenues under these sub-alternatives were in the range of 1%-4% (**Appendix E: Table E-9; Figure 4-5**).

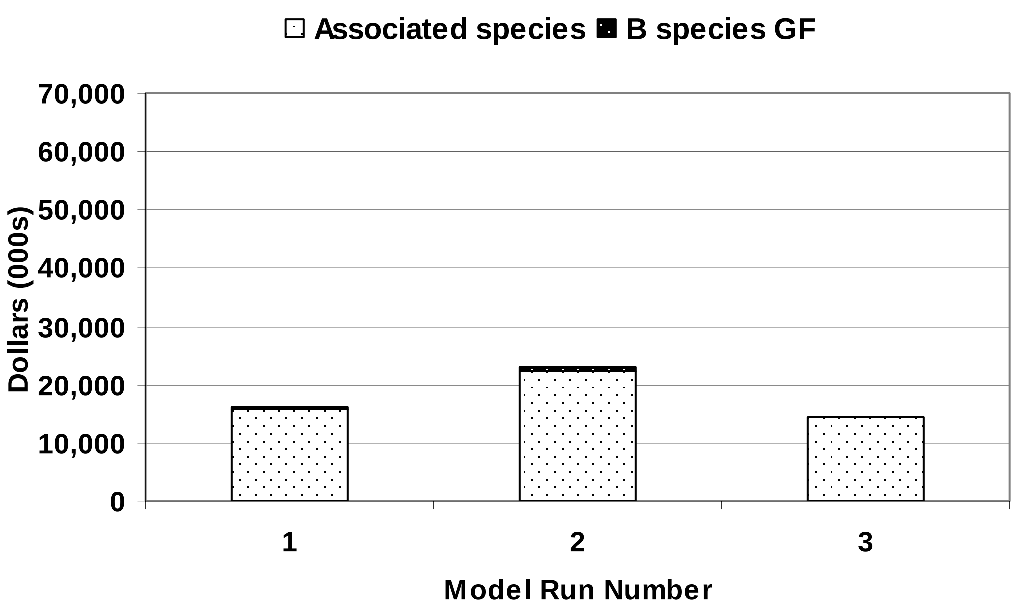


Figure 4-5. Fishery revenues during 2004-2006 by vessels that would not qualify for a B permit under A-5 (850 vsls) by model run #

#### *4.5.2.3 Prohibited Species*

Prohibited species impacts in open access fisheries are described in **Section 3.2.3**. No change in level of impact of open access fishery vessels on prohibited species would be expected under this alternative, as discussed above. The bycatch of salmonids (listed and non-listed) is low in the open access groundfish fishery. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

#### *4.5.2.4 Protected Species*

Protected species impacts in open access fisheries are described in **Section 3.2.4**. No change in level of impact of open access fishery vessels on protected species would be expected under this alternative, as discussed above. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

### 4.5.3 Effects on the Socioeconomic Environment

#### *4.5.3.1 Management Structure of the Open Access Fishery*

The open access fishery management structure is described in **Section 3.3.1**. Permitting of open access fishery participants would facilitate projection of open access fishery landings and impacts, which could lead to better utilization of harvestable resources and protection of overfished groundfish species. No change in the current management structure is proposed under this alternative. Fisheries would continue to be managed using trip and cumulative landing limits with the aim of providing for year round fishing.

#### *4.5.3.2 Catch Characteristics*

Catch characteristics of the open access fisheries are described in **Section 3.3.2**. . The permit requirements under this alternative would help to more accurately project fishery impacts and landings on a pre-and in-season basis, thus minimizing the need for major late season landing limit changes to stay within or meet fishery allocations. The amount of B species groundfish harvested by vessels that would qualify for a permit under this alternative represented 95%-100% of the total B species groundfish landed by directed fishery vessels during the 2004-2006 window period and would not in itself result in increase landing or cumulative groundfish limits (**Figure 4-2; Appendix E: Table E-7**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

Increased B species fishing effort for high demand species such as sablefish would be a concern in early program years under this alternative because of its high initial fleet size goal of 850 vessels compared to the average fleet size of 680 vessels during 2004-2006 window period years. The effort increase could come from 1) permit transfers from latent vessels to vessel owners that would have greater interest in using their new permits and/or 2) effort shift to sablefish by permitted vessels that participate in other fisheries (e.g., salmon).

Eventual reduction in number of vessels eligible to prosecute B species groundfish could result in increased trip and cumulative landing limits by permitted vessels in order to harvest the fish that were formerly harvested by previously permitted vessels. Analysis of Alternative 5a showed results that were intermediate to those for alternatives 3 and 6 as could be expected because the consolidation goal of 450 vessels was within the range of the latter alternatives (680 and 390 vessels, respectively) plus the same analytical approach was used. The 170 vessel permit consolidation analysis for Alternative 5b showed relatively high landings during 2004-2006 window period years by vessels that would not likely receive a permit as follows: 24%-37% by weight and 29% to 43% by value of total B species landings. These relative amounts of fish would be available for harvest by permitted vessels and would result in substantially increased landings by permitted vessels and reduced impacts on target and non-target species by reducing fishery discards (**Appendix E: Table E-8**).

A fleet size adjustment that would come close to matching the number of vessels that had directed sablefish landings during recent years could substantially reduce the potential for a large effort shift to the directed sablefish fishery stemming from permit transfers or redirection of effort by permitted salmon vessels during depressed salmon years. An average of 276 vessels had directed sablefish landings in the WOC area during the 2004-2006 window period (**Table 2-4**), which is intermediate to the long-term fleet size goal under Alternative 5a of 450 vessels and under Alternative 5b of 170 vessels.

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 14%-16% (11%); Oregon, 29%-33% (31%); and California 53%-55% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be as follows for alternative 5a (using 500 fleet size goal as a proxy): Washington, 16%-20% (11%); Oregon, 27%-34% (31%); and California 46%-57% (57%). For alternative 5b the long-term distribution would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

Non-qualifying vessels under this alternative would need to increase effort or find other revenue sources to make up for revenues lost due to non qualification for B permit issuance. The amount of revenue increase that would be required of vessels not meeting initial permit qualification criteria is estimated to be in the range of 0%-2% based on the contribution of B species groundfish to total 2004-2006 window period fishery revenues of non-qualifying vessels (**Appendix E: Table E-7**; **Figure 4-5).** The long-term impact in terms of lost revenue would be 1%-2% under Alternative 5a (450 vessels) and 3%-4% under Alternative 5b (**Appendix E: Table E-9**).

#### *4.5.3.3 Vessel Characteristics*

Fishery attrition would be high under both sub-alternatives due to permit consolidation requirements, which differ between sub-alternatives. Gear and vessel size composition would not be expected to change substantially in the near future under this alternative because of the provision for gear and vessel size endorsements.

There appear to be several alternatives for the Council to consider with regard to the gear endorsement provision. This is because window period data showed many vessels used different combinations of gear types to make B species groundfish landings (e.g., hook and line only, hook and line plus pot, set net plus hook and line, etc). The alternatives that have been developed for the Council to consider are as follows:

1. a single gear type endorsement based on the gear type used to make the most qualifying landings either in terms of weight or ex-vessel value of fish.
2. a multiple gear type endorsement based on all the different gear types used to make qualifying landings either in terms of weight or ex-vessel value of fish.
3. Same as 2. except limit the gear type combinations based on landing thresholds for individual gear types (e.g. >25% of qualifying landings must have been made by a particular gear type to receive an endorsement for that gear type).

The vessel endorsement recommendation is to allow for up to a 5 ft increase in vessel length when permits are transferred for use on different vessels.

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 14%-16% (11%); Oregon, 29%-33% (31%); and California 53%-55% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be as follows for alternative 5a (using 500 fleet size goal as a proxy): Washington, 16%-20% (11%); Oregon, 27%-34% (31%); and California 46%-57% (57%). For alternative 5b the long-term

distribution would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.5.3.4 Processor Characteristics*

Processor characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected under this alternative. However, the distribution of B permits could affect fish buying opportunities by commercial fish processors. The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 14%-16% (11%); Oregon, 29%-33% (31%); and California 53%-55% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be as follows for alternative 5a (using 500 fleet size goal as a proxy): Washington, 16%-20% (11%); Oregon, 27%-34% (31%); and California 46%-57% (57%). For alternative 5b the long-term distribution would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The range in proportions stems from differing impacts of the permitting criteria used in the analysis (**Table 4-2**).

#### *4.5.3.5 Participation Requirements, Restrictions, Licensing:*

Participation requirement, restriction and licensing are described in **Section 3.3.5.** Adoption of this alternative would require vessel owners that qualify for a B permit to submit application to NMFS to obtain their initial permit and to apply for permit renewal each year thereafter. B permit holders would be required to make a B species landing every year to be eligible for permit renewal. In addition, B permit holders would be required to obtain a second permit in order to be eligible for future permit renewal as follow: after the fifth program year under sub-alternative 5a; and after the first and fifth programs years under sub-alternative 5b. Either of these sub-alternatives could lead to compaction of permits within some ports, especially sub-alternative 5b which has the much lower fleet size goal. Vessel owners that seek a C permit would be required to submit application for permit issuance, but there would be no federal qualification requirements associated with C permit issuance. Vessel owners would be required to obtain appropriate permit types before any directed or incidental fishing takes place.

Vessel owners would be allowed to transfer permits once per year, but could not register a B permit on a vessel that had an A permit in the same year. There would be an annual landing requirement to retain a B permit under this alternative. Vessel owners faced with the choice of using either permit type might have to lease or use their B permit to retain eligibility for B permit renewal. For permit renewal purposes, vessels would have to make a B species landing by November 30 or each year in order for the permit to be renewed by December 31.

#### *4.5.3.6 Revenue/Costs to the Participants and to State and Federal Governments*

These issues are discussed in **Section 3.3.6**. It is not possible to project the actual cost of obtaining a second permit to meet the permit consolidation requirements under sub-alternatives 5a and 5b with any degree of confidence. We can speculate, however, on relative costs. Sub-alternative 5 b would be the more costly of the two sub-alternatives because the initial fleet size goal is the same under both sub-alternatives, but the fleet size goal under sub-alternative 5b (170 vessels) is much lower than it is under sub-alternative 5a (430 vessels). The cost of obtaining a second permit would likely be relatively low after the first program year under alternative 5b and after year five under alternative 5a, but still could be inflated. This is because of the relatively large number of permits initially issued and that would likely be available for transfer or purchase. The cost to continue in the fishery after year five under sub-alternative 5b would likely be very high because of the reduced number of permits available for transfer or purchase stemming from permit consolidation after year one and high demand for the permits overall. Permit holders that are not able to combine their permit with a second permit by the permit consolidation deadline would be denied permit renewal. There would be a cost, expected to be nominal, associated with B and C permit issuance and annual B permit renewal under both sub-alternatives. Vessels owners would be required to meet certain permit application deadlines, which if not met could create delay in being able to participate in the B or C fisheries.

Adoption of any alternative that requires federal licensing or permitting of current open access vessels to take and possess specified federal groundfish will likely require that those vessels participate in the federal groundfish fishery vessel monitoring program (VMS program) when fishing for those specified federal groundfish in federal or state waters. Some current open access fishermen may not want to participate in the VMS program because of program cost, and intend to commercially fish for and take those specified federal groundfish only in state waters where VMS program participation may not be required. Federal groundfish registration would likely compromise that strategy. Open access vessel owners should be aware that registration for a federal groundfish license or permit may require their participation in the groundfish VMS program. Furthermore, adoption of any alternative that requires federal licensing or permitting may increase the probability of vessels being selected to participate in the Pacific Coast Groundfish Observer Program. There is an added cost to vessel owners to carry a federal observer on their vessel.

#### *4.5.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are discussed in **Section 3.3.7**. No change in the dependence of fishing communities on groundfish would be expected under this alternative because of the relatively low contribution of B species groundfish to local fisheries. The long-term fleet size reduction proposed under both sub-alternatives would be expected to consolidate the catch among fewer vessels with no impact on level of groundfish landings. Compaction of permits due to permit consolidation could lead to redistribution of harvest between port groups and states. Displaced fishers would be expected to shift effort to other fisheries to compensate for lost groundfish revenues. NMFS completed an Environmental Impact Statement (EIS) in 2006 that included a comprehensive analysis of Pacific Coast groundfish fishing communities and their engagement in various groundfish fisheries. Most Pacific Coast fishing ports with groundfish landings have some vessels that land open access groundfish. Appendix A to the EIS evaluated fishing communities for their dependence on groundfish resources and for their vulnerability to changes in availability of groundfish harvest. This action would not alter the overall available groundfish harvest, but it would affect particular vessels in particular ports, either by providing those vessels with a potentially valuable license to participate in the fishery or by eliminating opportunities for those vessels to participate in the fishery. Port cities that Appendix A identified as both having some history of open access groundfish landings and a relatively higher dependency on availability of groundfish resources are: Astoria, Bellingham, Brookings, Coos Bay, Crescent City, Eureka, Fort Bragg, Morro Bay, Newport, Port Orford, and San Francisco. Additional information on the importance of groundfish to fishing communities is provided in **Section 3.3.7.**

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 14%-16% (11%); Oregon, 29%-33% (31%); and California 53%-55% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be as follows for alternative 5a (using 500 fleet size goal as a proxy): Washington, 16%-20% (11%); Oregon, 27%-34% (31%); and California 46%-57% (57%). For alternative 5b the long-term distribution would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The range in proportions stems from differing impacts of the permitting criteria used in the analysis (**Table 4-2**).

#### *4.5.3.8 Environmental Justice*

The factors to be considered with regard to environmental justice are described in **Section 3.3.8.** This action has low potential for significant impact as it does not target low income or minority communities; it would affect all population segments equally. Some Pacific Coast fishing communities have open access fishery participants that are not native-English speakers, but few of them participate in the fishery management process. Fishing families from these same communities also participate in the limited entry groundfish fishery, so there are within-community networks of translators. NMFS has not historically translated its groundfish fishery regulations from English into other languages. Some of the communities with relatively high open access fishery landings are considered vulnerable to shifts in groundfish fishing opportunity, although open access landings themselves may not make up the majority of groundfish fishing income to the community. This action does not alter or affect tribal treaty rights to or tribal allocations of groundfish.

## *4.6 Alternative 6*

The initial fleet size goal under this alternative is 390 vessels, which is 91% of the average number of vessels that fished at least three years for federal groundfish species, including nearshore species, during 1994-1999 (**Appendix A, Table 3**). The 91% adjustment factor is extrapolated from the relationship between total number of vessels that had directed fishery landings of federal groundfish and those that had directed fishery landings of B species groundfish during 2000-2006 window period years. An adjustment factor is used because species composition of rockfish landings was less reliable in years prior to 2000 compared to the latter years and often appeared on tickets as "unspecified rockfish." The long-term fleet size goal is the same as Alternative 5b, 170 vessels. There is no permit consolidation requirement, but there is a previous year landing requirement, which would require vessels to make a B species landing by November 30 of each year in order to renew the permit by December 31. Permit transferability is not addressed, which allows the Council to consider and specify transfer conditions, including non-transferability of permits until certain fishery management objectives are met. There would be a vessel length and gear endorsement requirement in order to constrain fleet fishing capacity and no vessel owner would be allowed to use both permit types (A and B) on the same vessel in any year. C permits would be required to land groundfish excluding nearshore species for all vessels that do not have an A or B permit or a state-issued nearshore fishery permit. C permits would be available to any state registered commercial fishing vessel and could be applied for at any time during the year.

**Appendix E** presents an analysis of this alternative using specified B permit qualification criteria. The selection of qualification criteria for issuing B permits has allocative as well as biological and economic implications. The qualification criteria used in the analysis for Council consideration (including associated model run numbers in parentheses) were:

1) cumulative vessel landings in pounds of B species groundfish during 2004-2006 window period years (Model Run #1),
2) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period (Model Run #2), and
3) cumulative vessel landings in pounds of B species groundfish during the 1998-2006 window period in combination with a 2004-2006 window period B permit species landing requirement (Model Run #3).

The proposed qualification criteria used to analyze and compare alternatives 3-6 with Alternative 1 (No-action) and Alternative 2 (registration only) presented in Appendix E are described in **Table 4-2**. One of these criteria (or modification thereof) is proposed to be selected as part of the Council's final action on any preferred alternative that limits the initial number of vessels eligible for B permit issuance.

The minimum landing requirement to qualify for B permit issuance under this alternative ranged from 2,370 lbs (Model Run #1; total of 2004-2006 window period landings) to 8,415 lbs (Model Run #2; total of 1998-2006 window period landings). The minimum landing requirement for permit issuance using Model Run #3 criteria was 4,861 lbs (total of 1998-2006 window period landings with at least one landing during the 2004-2006 window period) (**Appendix E**).

### 4.6.1 Effects on the Physical Environment

The affected environment, including EFH, is described in **Section 3.1**. This alternative would reduce the number of vessels eligible to target B species groundfish from a recent year average of 680 vessels to 390 (43%). Vessel displacement due to permit reductions could result in effort shifts to associated species such as salmon, HMS or crab to make up for revenue loss. There would be an attendant increase in habitat impacts in associated fisheries. It is not possible to evaluate overall habitat impacts associated with fishery effort shifts because of unknown fishery-specific impacts. Adoption of this alternative would not allow any new vessels in the fishery and would stop the vessel participation increase seen in the WOC area in recent years **(Figure 2-1),** but would not affect the ability of permitted vessels to exert additional fishing pressure in the event of increased groundfish availability, increased market demand for fish, or reduced fishing opportunity in other fisheries.. Any effort increase by permitted vessels would have a corresponding impact on the physical environmental, including gear loss impacts, habitat alteration caused by fishing gear contact with habitat structures, and water pollution associated with vessel fuel and waste spillages. Overall, this alternative is not likely to significantly affect the physical environment because the small size of the fishery compared to other Pacific Coast fisheries (see **Section 3.3.7, Groundfish-dependent Communities).**

### 4.6.2 Effects on the Biological Environment

#### *4.6.2.1 Groundfish Species*

Groundfish species are described in **Section 3.2.1.** No change in level of groundfish landings would be expected under in the first program year or long-term under this alternative. This alternative aims to reduce fleet fishing capacity and participation in the groundfish fishery, which would in turn have a beneficial effect on overfished groundfish, protected and prohibited species by reducing gear interactions with those species.

In 2005, the sablefish harvest guideline was exceeded in the northern management area (Monterey-Vancouver) by over 40% due to increased level of vessel participation in the fishery (**figures 3-4 and 3-5)**. In 2006, the directed sablefish fishery in the northern management area was closed during October-December due to attainment of the sablefish harvest guideline (HG). This was the only year since the fishery began in 1994 that the fishery had to be closed and may have been due to effort shift of salmon vessels to the directed sablefish fishery because of restrictive salmon fishing regulations (see**:** http://www.nwr.noaa.gov/Publications/FR-Notices/2006/upload/Halibut-Inseason-May06.pdf.). Salmon regulations were less restrictive in 2007, which, in combination with more restrictive sablefish regulations, may have constrained the effort increase in the directed sablefish fishery (**Section 1.4.1**.). Continued high level of vessel participation in the directed sablefish fishery will result in more restrictive sablefish landing and cumulative limits than in the past. Further reduction in sablefish limits will increase discards of sablefish and associated overfished groundfish stocks due to trip limit overages and high grading to land the most valuable fish compared to previous recent years.

The number of permits proposed to be initially issued under this alternative (390) is about 40% greater than the average number of vessels that participated in the WOC directed sablefish fishery during 2004-2006 window period years (276 vessels; **Table 2-4**). Thus the potential is greatly reduced for a large effort shift to the directed sablefish fishery under this alternative compared to alternatives 3 and 5 and potentially under Alternative 4. The long-term fleet size objective of 170 vessels in this alternative would substantially reduce (or eliminate) the potential for large effort increase in the directed sablefish fishery.

#### *4.6.2.2 Non-groundfish Species (State-managed or under other FMPs)*

Open access fishery impacts on non-groundfish species are described in **Section 3.2.2**. Eventual increase in fishing effort and catch of state-managed and federal non-groundfish fisheries from displaced (non-permitted or previously permitted) vessels would be expected to be ≤2% under this alternative (**Figure 4-6**; **Appendix E: Table E-7**).

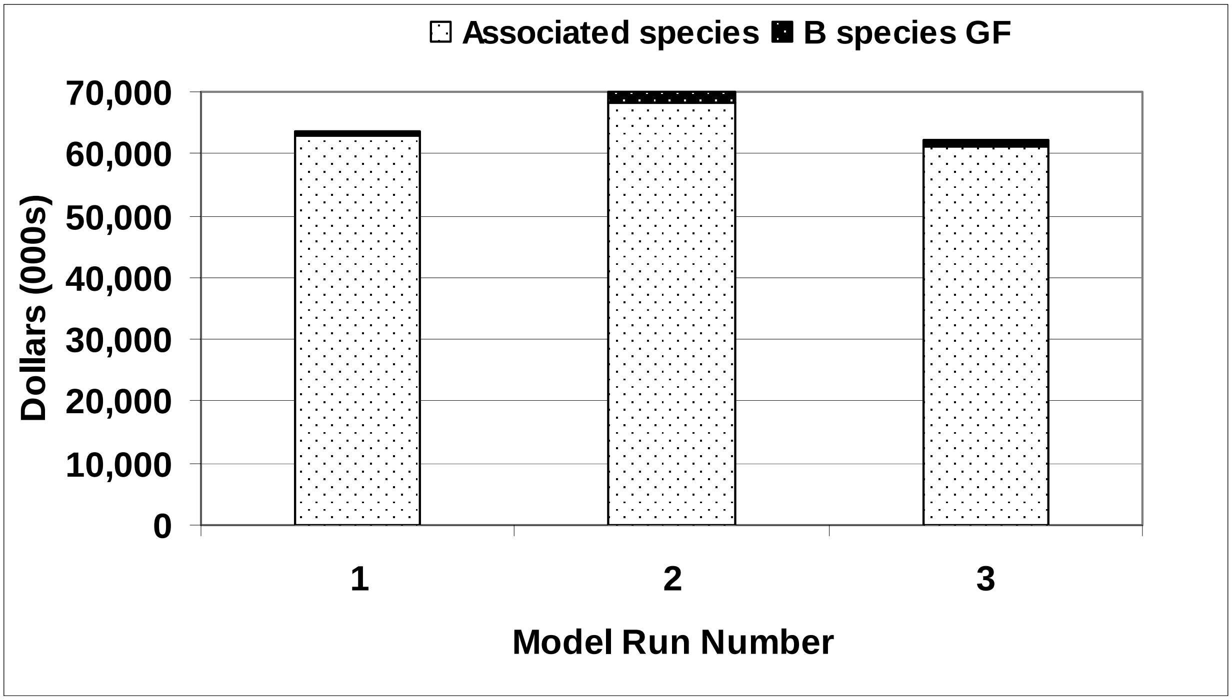


Figure 4-6. Fishery revenues during 2004-2006 by vessels that would not qualify for a B permit under A-6 (390 vsls) by model run #

#### *4.6.2.3 Prohibited Species*

Prohibited species impacts in open access fisheries are described in **Section 3.2.3**. . Reduced fishery participation stemming from increased trip and cumulative limits could have beneficial effects on prohibited species, as discussed above. The bycatch of salmonids (listed and non-listed) is low in the open access groundfish fishery. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

#### *4.6.2.4 Protected Species*

Protected species impacts in open access fisheries are described in **Section 3.2.4**. Reduced fishery participation stemming from increased trip and cumulative limits could have beneficial effects on protected species, as discussed above. If capacity and participation in the groundfish fishery were reduced by this action, bycatch of salmonids could in turn be reduced.

### 4.6.3 Effects on the Socioeconomic Environment

#### *4.6.3.1 Management Structure of the Open Access Fishery*

The open access fishery management structure is described in **Section 3.3.1**. Permitting of open access fishery participants would facilitate projection of open access fishery landings and impacts, which could lead to better utilization of harvestable resources and protection of overfished groundfish species. No change in the current management structure would be expected under this alternative. Fisheries would likely continue to be managed using trip and cumulative landing limits with the aim of providing for year round fishing.

### *4.6.3.2 Catch Characteristics*

Catch characteristics of the open access fisheries are described in **Section 3.3.2**. . The permit requirements under this alternative would help to more accurately project fishery impacts and landings on a pre-and in-season basis, thus minimizing the need for major late season landing limit changes to stay within or meet fishery allocations. The initial fleet size goal under this alternative would reduce the average fleet in recent years from 680 vessels to 390 vessels (**Figure 4-3**) and would bring the fleet size closer to the average directed sablefish fishery fleet size of 276 vessels during the 2004-2006 widow period years than of any the alternatives that have a fixed initial fleet size goal. This is an important consideration because of the potential for increased sablefish effort stemming from permit transfers from latent vessels to vessel owners that would be motivated to use their new permits. Also, the potential impact of salmon vessel effort shift by permitted vessels due to low salmon availability or restrictive salmon fishing regulations would be lower than the other alternatives that have a fixed initial fleet size goal.

The amount of B species groundfish harvested by vessels that would initially qualify for a permit under this alternative represented 80%-91% of the total B species groundfish landed by directed fishery vessels during the 2004-2006 window period. Thus non-qualifying vessels would provide 9% -20% more B species groundfish for harvest by permitted vessels (**Appendix E: Table E-7**). Attainment of the long-term fleet size goal of 170 vessels has the potential to increase the allowable catch by permitted vessels a total of 29%-43% based on 2004-2006 window period landings (**Appendix E: Table E-9),** and would likely provide for substantially higher landing and cumulative limits for some B species groundfish such as sablefish. Discards and overfished species impacts would also be reduced stemming from increased trip limits.

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be for a 170-vessel fleet: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

Non-qualifying vessels under this alternative would need to increase effort in other fisheries or find other revenue sources to make up for revenues lost due to non qualification for B permits. The amount of revenue increase that would be required of vessels not meeting the initial permit qualification criteria is estimated to be in the range of 1%-2% based on the contribution of B species groundfish to total 2004-2006 window period fishery revenues of non-qualifying vessels (**Appendix E: Table E-7**; **Figure 4-6).** The long-term impact of reducing the fleet to 170 vessels in terms of lost revenue would be 3%-4% for vessels that would lose their permits due to failure to make a B species landing every year or for failing to reapply for permit issuance (**Appendix E: Table E-9**).

### *4.6.3.3 Vessel Characteristics*

Permit transferability is not addressed under this alternative, which gives the Council flexibility in specifying permit transfer conditions in their final recommendation. Such conditions can affect rate of fishery attrition and fleet fishing capacity increase stemming from transfer of latent permits to potentially active fishery participants. The annual landing requirement under this alternative better ensures a small level of annual fishery attrition. Gear and vessel size composition would not be expected to change substantially in the near future under this alternative because of the provision for gear and vessel size endorsements.

There appear to be several alternatives for the Council to consider with regard to the gear endorsement provision. This is because window period data showed many vessels used different combinations of gear types to make B species groundfish landings (e.g., hook and line only, hook and line plus pot, set net plus hook and line, etc). The alternatives that have been developed for the Council to consider are as follows:

1. a single gear type endorsement based on the gear type used to make the most qualifying landings either in terms of weight or ex-vessel value of fish.
2. a multiple gear type endorsement based on all the different gear types used to make qualifying landings either in terms of weight or ex-vessel value of fish.
3. Same as 2. except limit the gear type combinations based on a landing threshold for individual gear types (e.g. ≥25% of qualifying landings must have been made by a particular gear type to receive an endorsement for that gear type).

The vessel endorsement recommendation is to allow for up to a 5 ft increase in vessel length when permits are transferred for use on different vessels.

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach would be for a 170-vessel fleet: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.6.3.4 Processor Characteristics*

Processor characteristics are described in **Section 3.3.4**. No change in processor characteristics would be expected under this alternative. However, the distribution of permits could affect the ability of commercial fish processors to buy B species groundfish. The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach for a 170-vessel fleet would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California 49%-64% (57%). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.6.3.5 Participation Requirements, Restrictions, Licensing:*

Participation requirement, restriction and licensing are described in **Section 3.3.5.** Adoption of this alternative would require vessel owners that qualify for a B permit to submit application to NMFS to obtain their initial permit and to apply for permit renewal each year thereafter. B permit holders would be required to make a B species landing every year to be eligible for permit renewal. Vessel owners that seek a C permit would be required to submit application for permit issuance, but there would be no federal qualification requirements associated with C permit issuance. Vessel owners would be required to obtain appropriate permit types before any directed or incidental fishing takes place.

Vessel owners would not be allowed to use A and B permits on the same vessel in the same year. Vessel owners that own an A permit and would qualify for a B permit for the same vessel would have to place the B permit on a vessel that does not have an A permit. B permit transfer conditions are not specified under this alternative which gives the Council that option of disallowing permit transfers until the long term fleets size goal of 170 vessels is met.

#### *4.6.3.6 Revenue/Costs to the Participants and to State and Federal Governments*

There would be a cost, expected to be nominal, associated with B and C permit issuance and annual B permit renewal under this alternative. Vessels owners would be required to meet certain permit application deadlines, which if not met could create a delay in being able to participate in the B or C fisheries.

Adoption of any alternative that requires federal licensing or permitting of current open access vessels to take and possess specified federal groundfish may require that those vessels participate in the federal groundfish fishery vessel monitoring program (VMS program) when fishing for those specified federal groundfish in federal or state waters. Some current open access fishermen may not want to participate in the VMS program because of program cost, and intend to commercially fish for and take those specified federal groundfish only in state waters where VMS program participation may not be required. Federal groundfish registration might compromise that strategy. Open access vessel owners should be aware that registration for a federal groundfish license or permit may require their participation in the groundfish VMS program. Furthermore, adoption of any alternative that requires federal licensing or permitting may increase the probability of a vessel being selected to participate in the Pacific Coast Groundfish Observer Program. There is an added cost to vessel owners to carry a federal observer on their vessel.

#### *4.6.3.7 Groundfish-dependent Communities*

Groundfish-dependent communities are discussed in **Section 3.3.7**. No change in the dependence of fishing communities on groundfish would be expected under this alternative. The proposed level of fleet size reduction would be expected to consolidate the available harvest among fewer vessels with no impact on level of total groundfish landings. Displaced fishers would likely shift effort to other fisheries to compensate for lost groundfish revenues. NMFS completed an Environmental Impact Statement (EIS) in 2006 that included a comprehensive analysis of Pacific Coast groundfish fishing communities and their engagement in various groundfish fisheries. Most Pacific Coast fishing ports with groundfish landings have some vessels that land open access groundfish. Appendix A to the EIS evaluated fishing communities for their dependence on groundfish resources and for their vulnerability to changes in availability of groundfish harvest. This action would not alter the overall available groundfish harvest, but it would affect particular vessels in particular ports, either by providing those vessels with a potentially valuable license to participate in the fishery or by eliminating opportunities for those vessels to participate in the fishery. Port cities identified in Appendix A having both having some history of open access groundfish landings and a relatively higher dependency on availability of groundfish resources are: Astoria, Bellingham, Brookings, Coos Bay, Crescent City, Eureka, Fort Bragg, Morro Bay, Newport, Port Orford, and San Francisco. Additional information on the importance of groundfish to fishing communities is provided in **Section 3.3.7.**

The projected initial distribution of permits by state (with the proportion of vessels making landings by state during the 2004-2006 window period shown in parentheses) would be as follow: Washington, 17%-22% (11%); Oregon, 26%-32% (31%); and California 45%-56% (57%) (**Appendix E: tables E-6 and E-7; figures E-1, E-2 and E-3**). The long-term distribution of permits using the same analytical approach for a 170-vessel fleet would be: Washington, 18%-24% (11%); Oregon, 18%-27% (31%); and California

49%-64% (57%). These ranges in proportions stem from differences in the permitting criteria used in ranking vessels for permit qualification (**Table 4-2**).

#### *4.6.3.8 Environmental Justice*

The factors to be considered with regard to environmental justice are described in **Section 3.3.8.** This alternative has low potential for significant impact as it does not target low income or minority communities; it would affect all population segments equally. Some Pacific Coast fishing communities have open access fishery participants that are not native-English speakers, but few of them participate in the fishery management process. Fishing families from these same communities also participate in the limited entry groundfish fishery, so there are within-community networks of translators. NMFS has not historically translated its groundfish fishery regulations from English into other languages. Some of the communities with relatively high open access fishery landings are considered vulnerable to shifts in groundfish fishing opportunity, although open access landings themselves may not make up the majority of groundfish fishing income to the community. This action does not alter or affect tribal treaty rights to or tribal allocations of groundfish.

## *4.7 Cumulative Effects*

(Under development)

# 5.0 CONSISTENCY WITH THE FMP AND OTHER APPLICABLE LAWS

## *5.1 CONSISTENCY WITH THE FMP*

(Under development)

## *5.2 MAGNUSON-STEVENS CONSERVATION AND MANAGEMENT ACT*

(Under development)

## *5.3 ENDANGERED SPECIES ACT*

(Under development)

## *5.4 MARINE MAMMAL PROTECTION ACT*

(Under development)

## *5.5 COASTAL ZONE MANAGEMENT ACT*

(Under development)

## 5.6 PAPERWORK REDUCTION ACT

(Under development)

## 5.7 EXECUTIVE ORDER 12866

(Under development)

## 5.8 EXECUTIVE ORDER 13175

(Under development)

## 5.9 MIGRATORY BIRD TREATY ACT AND EXECUTIVE ORDER 13186

(Under development)

## 5.10 EXECUTIVE ORDER 12898 (ENVIRONMENTAL JUSTICE) AND 13132 (FEDERALISM)

(Under development)

# 6.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

(Under development)

## 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 6.0.1. above for a reference of where to find the RIR elements in this EA.

## 6.2 *Initial Regulatory Flexibility Analysis*

The RFA, 5 U.S.C. 603 et seq., requires government agencies to assess the effects that various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those effects. When an agency proposes regulations, the RFA requires the agency to prepare and make available for public comment an IRFA that describes the impact on small businesses, non-profit enterprises, local governments, and other small entities. The IRFA is to aid the agency in considering all reasonable regulatory alternatives that would minimize the economic impact on affected small entities. To ensure a broad consideration of impacts on small entities, NMFS has prepared this IRFA without first making the threshold determination whether this proposed action could be certified as not having a significant economic impact on a substantial number of small entities. NMFS must determine such certification to be appropriate if established by information received in the public comment period.

The Small Business Administration (SBA) uses the following definitions to identify small businesses:

- Fish Harvesting: ≤ $4.0 million annually
- Fish Processing: ≤ 500 employees
- Wholesale: ≤ 100 employees

And not dominant in its field of operation.

**Fish Harvesting**

In 2006, there were 713 vessels that participated in the open access fishery, excluding incidental catches and nearshore species, which accounted for about $3,100,000. The past five year average (2002-2006) included about 699 vessels, which accounted for about $2,600,000. Therefore, approximately 700 vessels would be affected by this amendment and the vast majority if not all vessels earn less than $4.0 million annually from this fishery and consequently would be considered small businesses. Most fishermen do fish in multiple fisheries and may possibly own more than one vessel. The total revenue, including multiple vessels and various fisheries earned by a fishermen, is what is used to determine small business eligibility. Historically, on the Pacific Coast, most fishermen earn well under $4.0 million annually. In 2004, for example there were a total of 3,622 unique vessels that participated in Pacific Coast commercial fishing with a total revenue of $366 million (Groundfish spex document, October 2006), which averages to about $100,000/vessel. There may be some exceptions, such as if a company owns multiple vessels, but that data is not readily available.

Because, the vast majority, if not all, participants are considered small businesses, there would not be a disproportionate effect on small entities compared to large entities. All of the alternatives presented in this amendment with the exception of the No-action alternative would have an impact on the profitability of the participants; however, as stated previously most vessels participate in various fisheries and because the open access groundfish fishery is a small portion of all other fisheries (<0.3% by weight), the impacts should be minor.

**Fish Processing and Wholesale**

State data from the United States Census Bureau was retrieved in order to estimate how many fish processing and wholesale establishments may be affected by this amendment and which ones would be defined as a small business.

The following table shows number of fresh and frozen seafood processing (**NAICS industry code 311712**) establishments by employment size class.

| | | Number of Establishments by Employment-size class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **State** | **Total Estabs** | **1-4** | **5-9** | **10-19** | **20-49** | **50-99** | **100-249** | **250-499** | **500-999** | **1000 or more** |
| **CA** | 31 | 8 | 2 | 3 | 6 | 4 | 6 | 2 | 0 | 0 |
| **OR** | 17 | 5 | 2 | 2 | 3 | 2 | 3 | 0 | 0 | 0 |
| **WA** | 72 | 11 | 4 | 5 | 17 | 17 | 16 | 2 | 0 | 0 |
| **Total** | 120 | 24 | 8 | 10 | 26 | 23 | 25 | 4 | 0 | 0 |

Source: United States Census Bureau 2005 County Business Patterns (NAICS), Year 2005 Data Extracted: 9/27/07

Using the data above, all 120 establishments would be considered a small business. However, all of these processing facilities may not process groundfish. There is no breakdown in the data on which fish species each processing plant works with and further, establishments are defined as:

An establishment is a single physical location at which business is conducted or services or industrial operations are performed. It is not necessarily identical with a company or enterprise, which may consist of one or more establishments. When two or more activities are carried on at a single location under a single ownership, all activities generally are grouped together as a single establishment. The entire establishment is classified on the basis of its major activity and all data are included in that classification.

Yet when determining if a business is small based on SBA standards, the employees of the business, including all of its affiliates regardless of the types of other businesses is accounted for. Therefore, 120 would be the maximum number of small fish processing businesses. The Groundfish Spex document, October 2006, provides business descriptions for three of the top ten seafood suppliers in the United States that participate in Pacific Groundfish Fisheries: Pacific Seafood Group, Trident Seafood Corp. and American Seafoods Group. All three of these companies have multiple Pacific Coast facilities. Trident Seafoods has 5 plants in Oregon and Washington combined with over 820 employees (www.tridentseafoods.com) and therefore those 5 plants would not be considered a small business. Further, Pacific Seafood Group has 22 (www.pacseafood.com) locations (processing, distribution and office facilities) located in WA, OR and CA combined, with other facilities beyond the Pacific Coast States. We do not have specific data to show what each facility does and how many employees they have, but www.hoovers.com, shows a total of about 1,000 employees within all of Pacific Seafood Group. These are just two examples of multiple facilities owned by one company that when combined, do not fit the definition of a small business.

Because of data limitations, an exact number of small business processing facilities that would be affected by this amendment cannot be identified; however, as stated previously, the open access groundfish fishery is a small fishery in comparison to all other Pacific Coast fisheries and consequently it is likely that processing companies do not rely on this fishery for the majority of their income.

The following table shows number of fish and seafood merchant wholesalers (NAICS industry code 42446) establishments by employment size class

| | | Number of Establishments by Employment-size class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| State | Total Estabs | 1-4 | 5-9 | 10-19 | 20-49 | 50-99 | 100-249 | 250-499 | 500-999 | 1000 or more |
| CA | 258 | 130 | 45 | 29 | 36 | 13 | 4 | 0 | 1 | 0 |
| OR | 23 | 16 | 2 | 3 | 1 | 1 | 0 | 0 | 0 | 0 |
| WA | 126 | 81 | 20 | 10 | 10 | 3 | 2 | 0 | 0 | 0 |
| Total | 407 | 227 | 67 | 42 | 47 | 17 | 6 | 0 | 1 | 0 |

Source: United States Census Bureau 2005 County Business Patterns (NAICS), Year 2005 Data Extracted: 9/27/07

Using the above data, about 400 wholesalers would be considered a small business, but yet again, for reasons identified above this would be a maximum number, because all of the establishments identified in the table may not distribute groundfish obtained in the open access fishery and some establishments may be part of a larger company that when combined would not fit the small business definition.

Because of data limitations, an exact number of small business wholesale facilities that would be affected by this amendment cannot be identified; however, once more, the open access groundfish fishery is a small fishery in comparison to Pacific Coast fishing and it is likely that wholesale companies do not rely on this fishery for the majority of their income.

# 7.0 AGENCIES CONSULTED

California Department of Fish and Game
National Marine Fisheries Service, Southwest Region
Oregon Department of Fish and Wildlife
Pacific Fishery Management Council
Washington Department of Fish and Wildlife

# 8.0 LIST OF PREPARERS AND CONTRIBUTORS

Kelly Ames, ODFW, fishery specialist
LB Boydstun, CDFG (retired), fishery specialist
Yvonne de Reynier, NMFS-NWR, fishery specialist
Jamie Goen, NMFS-NWR, fishery specialist
Jayna Schaaf-DaSilva, CDFG, fishery specialist
Joanna Grebel, CDFG, fishery specialist and GMT member
Gerry Kobylinski, PSMFC, data analyst
Robert Leos, CDFG, fishery specialist
Caroline McKnight, CDFG, fishery specialist
Melodie Palmer-Zwahlen, CDFG, data analyst
Corinne Pinkerton, NMFS-SWR, fishery economist

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## 10.0 FINDING OF NO SIGNIFICANT IMPACT

(To be completed by NMFS)

## 11.0 OPERATIONAL TERMS

Acceptable Biological Catch (ABC): This is a biologically based estimate of the amount of fish that may be harvested from the fishery each year without jeopardizing the resource. It is a seasonally determined catch that may differ from MSY for biological reasons. It may be lower or higher than MSY in some years for species with fluctuating recruitment. The ABC may be modified to incorporate biological safety factors and risk assessment due to uncertainty. Lacking other biological justification, the ABC is defined as the MSY exploitation rate multiplied by the exploitable biomass for the relevant time period.

"A" permit: This is another term for the Council's limited entry permit program for trawl and fixed gear vessels that was implemented under Groundfish Plan Amendment 6 which took effect in 1994. The limited entry or A permit fishery allocations are determined as part of the biennial management process.

B permit: A proposed new groundfish limited entry program. The program would allow owners of qualified open access vessels to obtain a federal permit to participate in the directed fishery for specified federal groundfish species that are allocated to the open access sector of the Pacific Coast groundfish fishery as part of the biennial specifications and management measures process.

B species groundfish. This is the group of federal groundfish that B permit vessels would be allowed to prosecute in federal and state waters, exclusive of the RCA and other conservation areas. It includes all federal groundfish exclusive of nearshore species (see below).

Biennial fishing period. This period is defined as a 24-month period beginning January 1 and ending December 31.

Biennial management/regulatory process: The Council sets groundfish harvest levels through a biennial regulatory process. This process establishes harvest "specifications", which are harvest levels or limits such as Acceptable Biological Catches (ABCs,) optimum yields (OYs,) or allocations for different user groups. Management measures, such as trip limits, closed times and areas, and gear restrictions are also set in the annual regulatory process. Management measures are partnered with the specifications in the annual process because these measures are specifically designed to allow the fisheries to achieve, but not to exceed, the specifications harvest levels. Annual development of specifications and management measures, with regulatory review and implementation by NMFS, is authorized the FMP. Certain management measures have been designated as routine for many of the groundfish species managed under the FMP. The Council annually publishes a list of those management measures designated as routine in its Stock Assessment and Fishery Evaluation (SAFE) Report.

Bottom (or flatfish bottom) trawl. This is a trawl in which the otter boards or the footrope of the net are in contact with the seabed. It includes roller (or bobbin) trawls, Danish and Scottish seine gear, and pair trawls fished on the bottom. Bottom-contact gear by design, or as modified, and through normal use makes contact with the sea floor.

Bycatch. Bycatch means fish which are harvested in a fishery, but which are not sold or kept for personal use and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program.

C permit. A proposed new groundfish permit that would be issued to vessel owners that may want to take and land incidental amounts of B species groundfish.

Closure. When referring to closure of a fishery, means that taking and retaining, possessing or landing the particular species or species complex is prohibited.

Coastal Pelagic Species (CPS). CPS are schooling fish, not associated with the ocean bottom, that migrate in coastal waters. They usually eat plankton and are the main food source for higher level predators such as tuna, salmon most groundfish and humans. Examples are herring squid, anchovy, sardine and mackerel.

Commercial fishing. Commercial fishing is (1) fishing by a person who possesses a commercial fishing license or is required by law to possess such license issued by one of the states or the federal government as a prerequisite to taking, landing, and/or sale; or (2) fishing which results in or can be reasonably expected to result in sale, barter, trade, or other disposition of fish for other than personal consumption.

Council. Council means the Pacific Fishery Management Council, including its Groundfish Management Team (GMT), Scientific and Statistical Committee (SSC), Groundfish Advisory Subpanel (GAP), and any other committee established by the Council.

Daily trip limit (DTL) fishery. The daily trip limit allowed for the sablefish fishery, unless otherwise specified.

Directed open access fishery landing: A directed open access fishery landing is one in which directed fishery gear was recorded as used and specified groundfish revenue was >50% of the total revenue from all fishery products on the same state agency landing receipt and recorded in the PacFIN data base of the Pacific States Marine Fisheries Commission.

Endangered Species Act (ESA). An act of federal law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants. Councils are required when preparing FMPs to consult with the NMFS and USFWS to determine whether the fishing under an FMP is likely to jeopardize the continued existence of an ESA-listed species, or to result in harm to its habitat.

Endorsement. A designation on a groundfish permit that authorizes the use of the permit for a particular gear, length of vessel, or in a particular segment of the fishery.

Environmental Assessment (EA). An EA is a concise public document that provides evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact, as provided under the National Environmental Policy Act (NEPA).

Essential fish habitat (EFH). EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Exclusive Economic Zone (EEZ). A zone under national jurisdiction of up to 200 nautical miles wide within which the coastal state has the right to explore and exploit, and the responsibility to conserve and manage the living and non-living resources.

Fishery management plan (FMP). A plan, and its amendments, that contains measures for conserving and managing specific fisheries and fish stocks.

Fishing. Fishing means (1) the catching, taking, or harvesting of fish; (2) the attempted catching, taking, or harvesting of fish; (3) any other activity which can reasonably be expected to result in the catching, taking, or harvesting of fish; or (4) any operations at sea in support of, or in preparation for, any activity described above. This term does not include any activity by a vessel conducting authorized scientific research.

Fishing year. The fishing year is defined as January 1 through December 31.

Fishing community. Fishing community means a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economy needs and includes fishing vessel owners, operators, crew, and recreational fishers and United States fish processors that are based in such community.

Fixed gear. Fixed gear (anchored nontrawl gear) includes longline, trap or pot, set net, and stationary hook-and-line gear (including commercial vertical hook-and-line) gears.

Final Regulatory Flexibility Analysis (FRFA). The FRFA includes all the information from the IRFA. Additionally, it provides a summary of significant issues raised by the public, a statement of any changes made in the proposed rune as a result of such comments, and a description of steps taken to minimize the significant adverse economic impact on small entities consistent with stated objectives.

Finding of No Significant Impact (FONSI). A finding of no significant impact (FONSI) is a document that explains why an action that is not otherwise excluded from the NEPA process, and for which an EIS will not be prepared, will not have a significant effect on the human environment.

Gear. A designation on a permit indicating the gear(s) that a vessel may use in the fishery. Permits may be endorsed for one or more gear types.

Groundfish Advisory Subpanel (GAP). The Council's GAP was established to obtain the input of the people most affected by, or interested in the management of the groundfish fishery. This advisory body is made up of representatives with recreational, trawl, fixed gear, open access, tribal, environmental, and process interests. Their advice is solicited when preparing FMPs, reviewing plans before sending them to the Secretary, reviewing the effectiveness of plans once they are in operation, and developing annual and inseason management recommendations.

Groundfish Management Team (GMT). The GMT prepares groundfish management plans and annual and inseason management recommendations. The GMT consists of scientists and managers with specific technical knowledge of the groundfish fishery.

Groundfish Conservation Area (GCA). This means a geographic area defined by coordinates expressed in degrees latitude and longitude, wherein fishing by a particular gear type or types may be prohibited. GCAs are created and enforced for the purpose of contributing to the rebuilding of overfished Pacific Coast groundfish species. Regulations at §660.390 define coordinates for these polygonal GCAs: Yelloweye Rockfish Conservation Areas, Cowcod Conservation Areas, waters encircling the Farallon Islands, and waters encircling the Cordell Banks. GCAs also include Rockfish Conservation Areas or RCAs, which are areas closed to fishing by particular gear types, bounded by lines approximating particular depth contours. RCA boundaries may and do change seasonally according to the different conservation needs of the different overfished species. Regulations at §§660.390 through 660.394 define RCA boundary lines with latitude/longitude coordinates; regulations at Tables 3–5 of Part 660 set RCA seasonal boundaries. Fishing prohibitions associated with GCAs are in addition to those associated with 660.G 11 June 8, 2007 Essential Fish Habitat Conservation Areas, regulations which are provided at §660.306 and §§660.396 through 660.399. {revised at 71 FR 78638, December 29, 2006}

Gillnet. Gillnet is a single-walled, rectangular net which is set upright in the water.

Harvest guideline (HG). HG is an specified numerical harvest objective which is not a quota. Attainment of a HG does not require closure of a fishery.

Highly migratory species (HMS). These are large

Hook-and-line. Hook-and-line means one or more hooks attached to one or more lines. Commercial hook-and-line fisheries may be mobile (troll) or stationary (anchored).

Hook-and-Line Gear. There is a variety of commercial fishing gear that uses hooks and lines in various configurations to catch finfish. These include longline, vertical hook and line, jigs, handlines, rod and reels, vertical and horizontal setlines, troll lines, cable gear and stick gear.

Initial Regulatory Flexibility Analysis (IRFA). An IRFA is required anytime an agency publishes notice of proposed rule making and the rule may have a significant impact on a substantial number of small entities. It describes the impact of the proposed rule on small entities and includes a description of the action, why it is necessary, the objectives and the legal basis for the action, the small entities that will be impacted by the action, and projected reporting, record-keeping, and other compliance requirements of the proposed rule. Rules that duplicate, overlap, or conflict with the proposed rule are also identified.

Incidental catch or incidental species. These terms refer to groundfish species caught when fishing for the primary purpose of catching a different species.

Individual fishing quota (IFQ). IFQ means a federal permit under a limited access system to harvest a quantity of fish expressed by a unit or units representing a percentage of the total allowable catch of a fishery that may be received or held for exclusive use by a person.

Limited entry fishery means the fishery composed of vessels registered for use with limited entry permits.

Limited entry gear means longline, trap (or pot), or groundfish trawl gear used under the authority of a valid limited entry permit affixed with an endorsement for that gear.

Limited entry permit means the Federal permit required to participate in the limited entry fishery, and includes any gear, size, or species endorsements affixed to the permit.

Longline. Longline is a stationary, buoyed, and anchored groundline with hooks attached, so as to fish along the seabed.

Magnuson-Steven Act. The Magnuson-Steven Conservation and Management Act or MSA , sometimes known as the "Magnuson-Stevens Act," established the 200-mile fishery conservation zone, the regional fishery management council system, and other provisions of US marine fishery law.

Maximum sustainable yield (MSY). MSY is an estimate of the largest average annual catch or yield that can be taken over a significant period of time from each stock under prevailing ecological and environmental conditions. It may be presented as a range of values. One MSY may be specified for a group of species in a mixed-species fishery. Since MSY is a long-term average, it need not be specified annually, but may be reassessed periodically based on the best scientific information available.

Metric ton (mt). A metric ton is 1,000 kilos or 2,204.62 pounds.

Midwater (pelagic or off-bottom) trawl. Midwater trawl is a trawl in which the otter boards may occasionally contact the seabed, but the footrope of the net remains above the seabed. It includes pair trawls if fished in midwater. A midwater trawl has no rollers or bobbins on the net.

National Marine Fisheries Service (NMFS). A division of the US Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). NMFS is responsible for conservation and management of offshore fisheries and inland salmon. The NMFS Regional Director is a voting member of the Council.

Nearshore groundfish. These are groundfish species that primarily occur in state waters and federal waters less than about 300 ft in depth. The complex includes nearshore rockfish, cabezon and kelp greenling. State management or regulatory programs are in place to protect this important complex of federal groundfish species.

Nontrawl gear. Nontrawl gear means all legal commercial gear other than trawl gear.

Open access allocation: The total amount of groundfish available for harvest is determined as part of the biennial groundfish regulatory process. The commercial allocation is divided between the limited entry and open access sectors based on historic landing percentages (see Chapter 11.2.2 of the groundfish plan for more specific information).

Open access fishery means the fishery composed of vessels using open access gear fished pursuant to the harvest guidelines, quotas, and other management measures governing the open access fishery. Any commercial fishing vessel that does not have a limited entry permit and which lands groundfish in the course of commercial fishing is a participant in the open access fishery.

Open access gear means all types of fishing gear except:

(1) Longline or trap (or pot) gear fished by a vessel that has a limited entry permit affixed with a gear endorsement for that gear.

(2) Trawl gear.

Open access gear is gear used to take and retain groundfish from a vessel that is not registered for use with a limited entry permit for the Pacific Coast groundfish fishery with an endorsement for the gear used to harvest the groundfish. This includes longline, trap, pot, hook-and-line (fixed or mobile), setnet (anchored gillnet or trammel net, which are permissible south of 38° N. lat. only), spear and non-groundfish trawl gear (trawls used to target nongroundfish species: pink shrimp or ridgeback prawns, and, south of Pt. Arena, CA (38°57.50' N. lat.), California halibut or sea cucumbers). Restrictions for gears used in the open access fisheries are as follows:

(1) Non-groundfish trawl gear. Non-groundfish trawl gear is any trawl gear other than limited entry groundfish trawl gear as described at §660.381(b) and as defined at §660.302 for trawl vessels with limited entry groundfish permits. Non-groundfish trawl gear is generally trawl gear used to target pink shrimp, ridgeback prawn, California halibut and sea cucumber. Non-groundfish trawl gear is exempt from the limited entry trawl gear restrictions at §660.381(b).

(2) Fixed gear.

(i) Fixed gear (longline, trap or pot, set net and stationary hook-and-line gear, including commercial vertical hook-and-line gear) must be:

(ii) Commercial vertical hook-and-line gear that is closely tended may be marked only with a single buoy of sufficient size to float the gear. “Closely tended” means that a vessel is within visual sighting distance or within 0.25 nm (463 m) as determined by electronic navigational equipment, of its commercial vertical hookand-line gear.

(iii) A buoy used to mark fixed gear under paragraph (b)(2)(i)(A) or (b)(2)(ii) of this section must be marked with a number clearly identifying the owner or operator of the vessel. The number may be either: {revised at 71 FR 78638, December 29, 2006}
(A) If required by applicable state law, the vessel's number, the commercial fishing license number, or buoy brand number; or

Optimum yield (OY). OY means the amount of fish which will provide the greatest overall benefit to the United States, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems, 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 in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Overfished. Overfished describes any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding. The term generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized.

Overfishing. Overfishing means fishing at a rate or level that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. More specifically, overfishing is defined as exceeding a maximum allowable fishing mortality rate. For any groundfish stock or stock complex, the maximum allowable mortality rate will be set at a level not to exceed the corresponding MSY rate (FMSY) or its proxy (e.g., F35%).

Pacific Coast Groundfish Fishery Management Plan: The Groundfish Plan, which was adopted in 1982, has been amended 18 times. The Plan specifies how the Council develops recommendations for management of the Pacific Coast groundfish fishery.

Partnership is two or more individuals, partnerships, or corporations, or combinations thereof, who have ownership interest in a permit, including married couples and legally recognized trusts and partnerships, such as limited partnerships (LP), general partnerships (GP), and limited liability partnerships (LLP).

Pot and Trap Gear. The words “pot” and “trap” are used interchangeably to mean baited boxes set on the ocean floor to catch various fish and shellfish. They can be circular, rectangular or conical in shape. The pots may be set out individually or fished in stings. On the Pacific Coast, live sablefish, Dungeness crab, spot prawns, rock, box, and hermit crabs, spider crabs, spiny lobster and finfish (California sheephead, cabezon, kelp and rock greenling, California scorpionfish, moray eels, and many species of rockfish) are caught in pots. All pots contain entry ports and escape ports that allow undersized species to escape. Additionally, all pots used must have biodegradable escape panels or fasteners that prevent the pot from holding fish or crab if the pot is lost. All pots are marked at the surface. The markings are set by regulation. Pots fished in a line need to be marked at each terminal end, with a pole and flag, and sometimes, additionally, a light or radar reflector. Dungeness pots must be fished individually and each is marked by a buoy.

Processing or to process. This means the preparation or packaging of groundfish to render it suitable for human consumption, retail sale, industrial uses, or long-term storage, including, but not limited to, cooking, canning, smoking, salting, drying, filleting, freezing, or rendering into meal or oil, but does not mean heading and gutting unless additional preparation is done.

Processor. Processor means a person, vessel, or facility that (1) engages in processing, or (2) receives live groundfish directly from a fishing vessel for sale without further processing.

Prohibited species. Prohibited species are those species and species groups which must be returned to the sea as soon as is practicable with a minimum of injury when caught and brought aboard except when their retention is authorized by other applicable law. Exception may be made in the implementing regulations for tagged fish, which must be returned to the tagging agency, or for examination by an authorized observer.

Quota. Quota means a specified numerical harvest objective, the attainment (or expected attainment) of which causes closure of the fishery for that species or species group. Groundfish species or species groups under this FMP for which quotas have been achieved shall be treated in the same manner as prohibited species.

Recreational fishing. This means fishing for sport or pleasure, but not for sale.

Regulatory Flexibility Act (RFA). The RFA requires federal agencies to consider the effects of their regulatory actions on small businesses and other small entities and to minimize any undue disproportionate burden.

Regulatory Impact Review (RIR). RIRs are prepared to determine whether a proposed regulatory action is "major." The RIR examines alternative management measures and their economic impacts.

Scientific and Statistical Committee (SSC). An advisory committee of the Council made up of scientists and economists. The Magnuson-Stevens Act requires the each Council maintain an SSC to assist in gathering and analyzing statistical, biological, economic, social, and other scientific information that is relevant to the management of Council fisheries.

Secretary. The US Secretary of Commerce

Set net. Set net is a stationary, buoyed, and anchored gillnet or trammel net.

Specification is a numerical or descriptive designation of a management objective, including but not limited to: ABC; optimum yield; harvest guideline; quota; limited entry or open access allocation; a setaside or allocation for a recreational or treaty Indian fishery; an apportionment of the above to an area, gear, season, fishery, or other subdivision.

Stacking is the practice of registering more than one limited entry permit for use with a single vessel.

Sustainable Fisheries Act. See Magnuson-Stevens Act, above.

Target fishing. This means fishing for the primary purpose of catching a particular species or species group (the target species).

Trammel net. Trammel net is a gillnet made with two or more walls joined to a common float line.

Trap (or pot). Trap is a portable, enclosed device with one or more gates or entrances and one or more lines attached to surface floats.

Trip limits. Trip limits are used in the commercial fishery to specify the maximum amount of a fish species or species group that may legally be taken and retained, possessed, or landed, per vessel, per fishing trip, or cumulatively per unit of time, or the number of landings that may be made from a vessel in a given period of time, as follows:

U.S. Fish and Wildlife Service (USFWS). An agency with the Department of Interior that must be consulted with regard to potential impacts regulations or management plans may have on terrestrial animals and plants, birds, and some marine animals.

Vertical hook-and-line gear (commercial). This is hook-and-line gear that involves a single line anchored at the bottom and buoyed at the surface so as to fish vertically.

Washington/Oregon/California (WOC). The Pacific States that border the Council management area.

## 12.0 APPENDICES

### *APPENDIX A: Summary of Findings by the Open Access Permitting Subcommittee of the Strategic Plan Oversight Committee*

Not included in this draft.

### *APPENDIX B: Analysis of Revenue-and Weight-based Criteria for Defining Directed and Incidental Open Access Fishery Fishing Trips*[8]

**INTRODUCTION**

Previous studies of open access groundfish fisheries used gear-type information in combination with landings composition data to infer vessel target fishing strategy (**Goen and Hastie 2002; Burden 2005**). This approach probably results in a reasonable approximation of pre fishing strategy for trips in which the landing was predominately 1) non-groundfish species (e.g., non-groundfish trawl fisheries) or 2) federal groundfish caught with groundfish-specific gear types (long-line or fishpot). Catch composition analysis becomes more problematic in terms of defining pre-fishing harvest strategy when directed fishery open access gear was reportedly used and the mix of non-groundfish and groundfish species is similar. Landing receipt coding errors add to the uncertainty of pre-fish harvest strategy assessments.

The previous studies excluded inland waters catches (e.g., Puget Sound and San Francisco Bay), tribal catches, and catches made with various non-groundfish gear types (e.g., non-groundfish trawl, drift gillnet, crabpot). For landings that used directed fishing gear (hook and line, fish pot and set net), they applied a >50% revenue criterion for differentiating between directed and incidental fishing trips. A more recent analysis of the directed open access fishery used the same gear type criteria but applied a >50% weight-based criterion for differentiating between the two fishing modes (**John DeVore 2007**). In this paper we examine the efficacy of the revenue-and weight-based approaches for characterizing the directed open access groundfish fishery.

We found that both approaches had similar results for B species groundfish, not including sharks and miscellaneous groundfish. Vessels that fished for the latter species benefited under the weight-based approach for accruing vessel catch history for possible use in obtaining a proposed directed open access fishery permit (B permit). Both methods were found to be inclusive of >95% of total directed open access fishery landings by weight and value. The recommendation here is to use the revenue-based approach for defining directed fishery landings for use in qualifying for a B permit for the reasons explained below.

**METHODS**

Our approach to comparing the two methods was to generate and compare data outputs using a common open access fishery extract from the PacFIN data base. The extract was limited to the period April 1998-September 2006; was exclusive of nearshore groundfish species; and was restricted to landings made with directed open access fishery gear (hook-and-line, bottom troll, fish pot and set net gear). The data outputs

[8] Prepared by LB Boydstun and Gerry Kobylinski, California Department of Fish and Game, September 15, 2007, 2007.

were as follows: 1) groundfish landing frequencies based on 10 percentage point bins for all years and states combined, and 2) catch and effort estimates compiled by state, species, year, and 1998-2006 totals.

**RESULTS**

The revenue based analysis showed that over 92% and 93%, respectively, of B species landings, in terms of mts and revenues, occurred in landings in which fishery revenues were 90% or greater of B species groundfish. For all other 10% revenue groups, B species landing contributions were very small individually (≤ 2%) or collectively (< 7%) compared to the 90% group. The 50% or greater revenue groups were inclusive of 93% by tonnage and 94% by revenue of total B species landings. The trend in results was consistent between the states. It is noteworthy that over 96% of B species landings in Washington by either method were in the 90% revenue category. This probably reflects the relatively high importance of sablefish to that state, and, conversely, the more diverse nature of the open access fisheries in Oregon and California. B species groundfish landings by weight using the revenue method were distributed as follow: 67% in California, 19% in Oregon, and 14% in Washington (**Table B-1; Figure B-1).**

The weight-based analysis showed slightly higher landing tonnages and revenues in each of the 30%-90% bins (**Table B-2, Figure B-2**) compared to the revenue-based analysis. Tonnage and revenue in the weight-based 90% bin was 0.5 and 0.2 percentage points, respectively, higher than the comparative data in the revenue-based analysis. Cumulative total tonnage and revenue in the weight-based analysis for bins ≥50% were 1.4 and .6 percentage points higher than comparative data in the revenue-based analysis.

Sablefish was the primary species landed in the directed open access fishery during the window period both in terms of weight (461.1 mt average, 53% overall) and revenues ($1.494 million average, 65% overall) using the revenue based criterion for determining directed fishery landings (**Table 3-5**). The next most important species group was shelf rockfish (21% of tonnage; 15% of revenues). No other species group contributed more than 9% in terms of weight or value of landings. Over 47% of vessels made at least one directed fishery landing of shelf rockfish and lingcod while about 29% of vessels made at least one directed sablefish landing on average during the window period based on the revenue-based criterion (**Tables 3-5**).

The weight-based criterion for determining directed fishery landings produced almost identical results as the revenue-based approach for sablefish, shelf rockfish, slope rockfish and lingcod (≤1% difference in mts). The revenue-based method produced about 19% and 5% less estimated directed fishery landings of sharks and other species, respectively, compared to the weight-based method (**tables 3-5 and B-4; Figure B-3**). The overall decrease in estimated directed fishery landings of B species groundfish using the revenue-based criterion averaged 13 mt (1%) per year (**tables 3-5 and B-4).** Nearly all of the tonnage decrease was in the California shark fishery (primarily the southern California set net fishery). The average number of vessels that made a directed fishery landing was higher under the weight-based approach at 772 compared to 760 (<2% difference) for the revenue-based approach All of the decrease using the revenue-based criterion for all years combined was in California-based vessels (Tables 3-6 and A-4). .

| Table B-1. B species groundfish landings in WOC open access fisheries summarized by 10% revenue category, 1998-2006. Directed fishery gear only. >50% *revenue* analysis. | | | | | | |
|---|---|---|---|---|---|---|
| | Revenue category | | Totals | | Prop. Total | |
| State | from | to | mts | $$ (000s) | mts | $$ |
| Ca | 90% | 100% | 5,076 | 12,452 | 91.4% | 93.9% |
| Or | | | 1,466 | 4,536 | 93.2% | 92.6% |
| Wa | | | 1,136 | 3,139 | 96.8% | 96.3% |
| Sub-total | | | 7,678 | 20,127 | 92.5% | 93.9% |
| Ca | 80% | 90% | 47 | 120 | 0.8% | 0.9% |
| Or | | | 6 | 23 | 0.4% | 0.5% |
| Wa | | | 1 | 3 | 0.1% | 0.1% |
| Sub-total | | | 54 | 146 | 0.7% | 0.7% |
| Ca | 70% | 80% | 39 | 87 | 0.7% | 0.7% |
| Or | | | 9 | 32 | 0.6% | 0.7% |
| Wa | | | 2 | 6 | 0.2% | 0.2% |
| Sub-total | | | 50 | 125 | 0.6% | 0.6% |
| Ca | 60% | 70% | 29 | 68 | 0.5% | 0.5% |
| Or | | | 9 | 38 | 0.6% | 0.8% |
| Wa | | | 2 | 6 | 0.2% | 0.2% |
| Sub-total | | | 40 | 112 | 0.5% | 0.5% |
| Ca | 50% | 60% | 29 | 62 | 0.5% | 0.5% |
| Or | | | 8 | 30 | 0.5% | 0.6% |
| Wa | | | 4 | 18 | 0.3% | 0.6% |
| Sub-total | | | 41 | 110 | 0.5% | 0.5% |
| Ca | 40% | 50% | 35 | 62 | 0.6% | 0.5% |
| Or | | | 7 | 24 | 0.4% | 0.5% |
| Wa | | | 2 | 7 | 0.2% | 0.2% |
| Sub-total | | | 44 | 93 | 0.5% | 0.4% |
| Ca | 30% | 40% | 38 | 67 | 0.7% | 0.5% |
| Or | | | 11 | 38 | 0.7% | 0.8% |
| Wa | | | 4 | 13 | 0.3% | 0.4% |
| Sub-total | | | 53 | 118 | 0.6% | 0.6% |
| Ca | 20% | 30% | 51 | 76 | 0.9% | 0.6% |
| Or | | | 14 | 49 | 0.9% | 1.0% |
| Wa | | | 4 | 15 | 0.3% | 0.5% |
| Sub-total | | | 69 | 140 | 0.8% | 0.7% |
| Ca | 10% | 20% | 72 | 97 | 1.3% | 0.7% |
| Or | | | 25 | 81 | 1.6% | 1.7% |
| Wa | | | 3 | 11 | 0.3% | 0.3% |
| Sub-total | | | 100 | 189 | 1.2% | 0.9% |
| Ca | >0% | 10% | 129 | 150 | 2.3% | 1.1% |
| Or | | | 17 | 47 | 1.1% | 1.0% |
| Wa | | | 3 | 12 | 0.3% | 0.4% |
| Sub-total | | | 149 | 209 | 1.8% | 1.0% |
| Ca-Total | >0% | 100% | 5,553 | 13,266 | 100.0% | 100.0% |
| Or-Total | | | 1,573 | 4,900 | 100.0% | 100.0% |

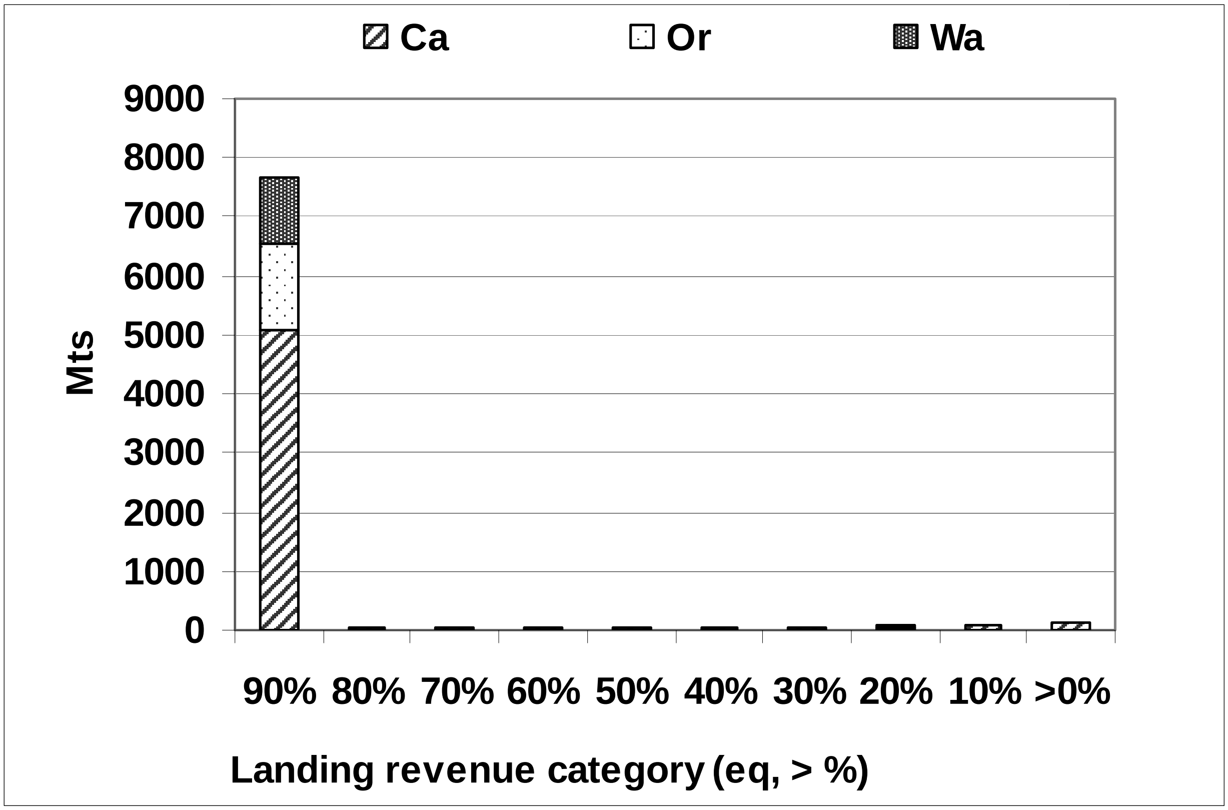


Fig B-1. B species tonnages grouped by landing revenue category and state, 1998-2006 combined landings. >50% revenue analysis.

| Table B-2. B species groundfish landings in WOC open access fisheries summarized by 10% revenue category, 1998-2006. Directed fishery gear only. >50% *weight* analysis. | | | | | | |
|---|---|---|---|---|---|---|
| | Revenue category | | Totals | | Prop. Total | |
| State | from | to | mts | $$ (000s) | mts | $$ |
| Ca | 90% | 100% | 5,115 | 12,483 | 92.1% | 94.1% |
| Or | | | 1,466 | 4,534 | 93.2% | 92.5% |
| Wa | | | 1,137 | 3,141 | 96.8% | 96.4% |
| Sub-total | | | 7,718 | 20,158 | 93.0% | 94.1% |
| Ca | 80% | 90% | 62 | 126 | 1.1% | 0.9% |
| Or | | | 11 | 40 | 0.7% | 0.8% |
| Wa | | | 2 | 7 | 0.2% | 0.2% |
| Sub-total | | | 75 | 173 | 0.9% | 0.8% |
| Ca | 70% | 80% | 51 | 98 | 0.9% | 0.7% |
| Or | | | 10 | 39 | 0.6% | 0.8% |
| Wa | | | 3 | 10 | 0.3% | 0.3% |
| Sub-total | | | 64 | 147 | 0.8% | 0.7% |
| Ca | 60% | 70% | 57 | 95 | 1.0% | 0.7% |
| Or | | | 10 | 35 | 0.6% | 0.7% |
| Wa | | | 3 | 14 | 0.3% | 0.4% |
| Sub-total | | | 70 | 144 | 0.8% | 0.7% |
| Ca | 50% | 60% | 41 | 76 | 0.7% | 0.6% |
| Or | | | 8 | 29 | 0.5% | 0.6% |
| Wa | | | 3 | 11 | 0.3% | 0.3% |
| Sub-total | | | 52 | 116 | 0.6% | 0.5% |
| Ca | 40% | 50% | 43 | 80 | 0.8% | 0.6% |
| Or | | | 12 | 43 | 0.8% | 0.9% |
| Wa | | | 3 | 9 | 0.3% | 0.3% |
| Sub-total | | | 58 | 132 | 0.7% | 0.6% |
| Ca | 30% | 40% | 47 | 75 | 0.8% | 0.6% |
| Or | | | 13 | 45 | 0.8% | 0.9% |
| Wa | | | 3 | 11 | 0.3% | 0.3% |
| Sub-total | | | 63 | 131 | 0.8% | 0.6% |
| Ca | 20% | 30% | 49 | 77 | 0.9% | 0.6% |
| Or | | | 16 | 54 | 1.0% | 1.1% |
| Wa | | | 3 | 10 | 0.3% | 0.3% |
| Sub-total | | | 68 | 141 | 0.8% | 0.7% |
| Ca | 10% | 20% | 43 | 69 | 0.8% | 0.5% |
| Or | | | 17 | 56 | 1.1% | 1.1% |
| Wa | | | 2 | 9 | 0.2% | 0.3% |
| Sub-total | | | 62 | 134 | 0.7% | 0.6% |
| Ca | >0% | 10% | 36 | 61 | 0.6% | 0.5% |
| Or | | | 8 | 24 | 0.5% | 0.5% |
| Wa | | | 2 | 7 | 0.2% | 0.2% |
| Sub-total | | | 46 | 92 | 0.6% | 0.4% |
| Ca-Total | >0% | 100% | 5,553 | 13,266 | 100.0% | 100.0% |
| Or-Total | | | 1,573 | 4,900 | 100.0% | 100.0% |

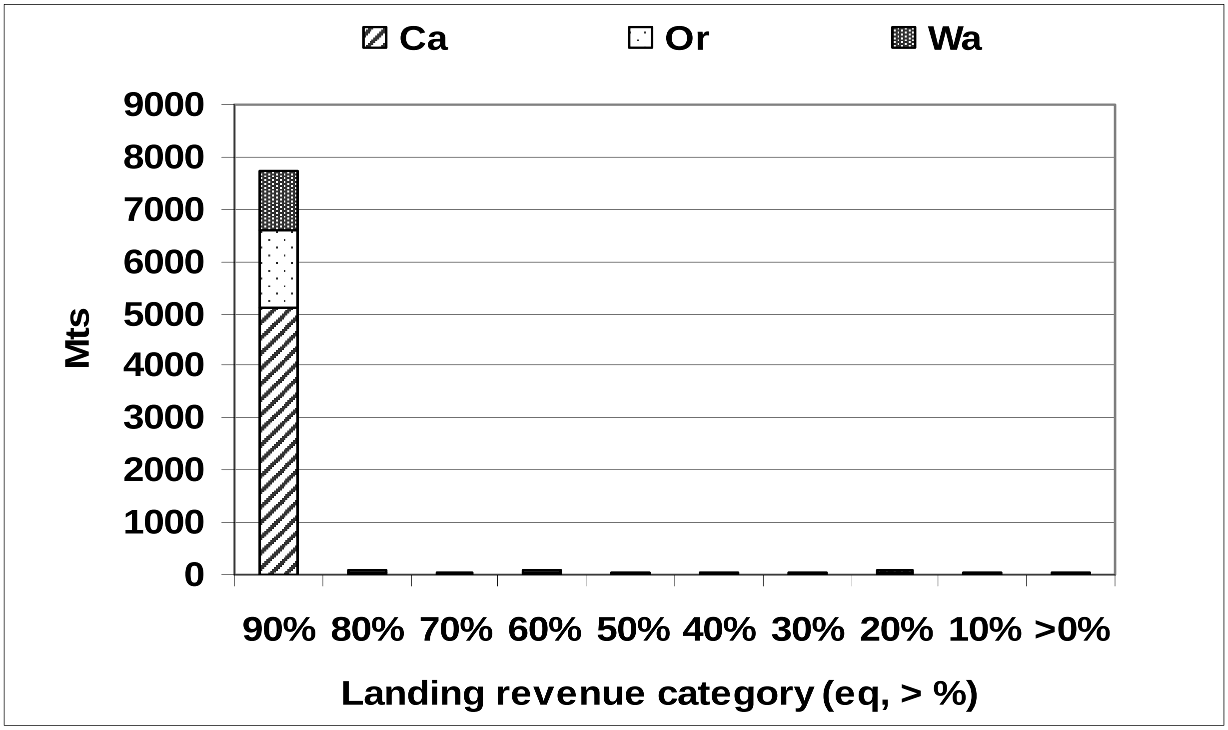


Fig B-2. B species tonnages grouped by landing revenue category and state, 1998-2006 combined landings. >50% weight analysis.

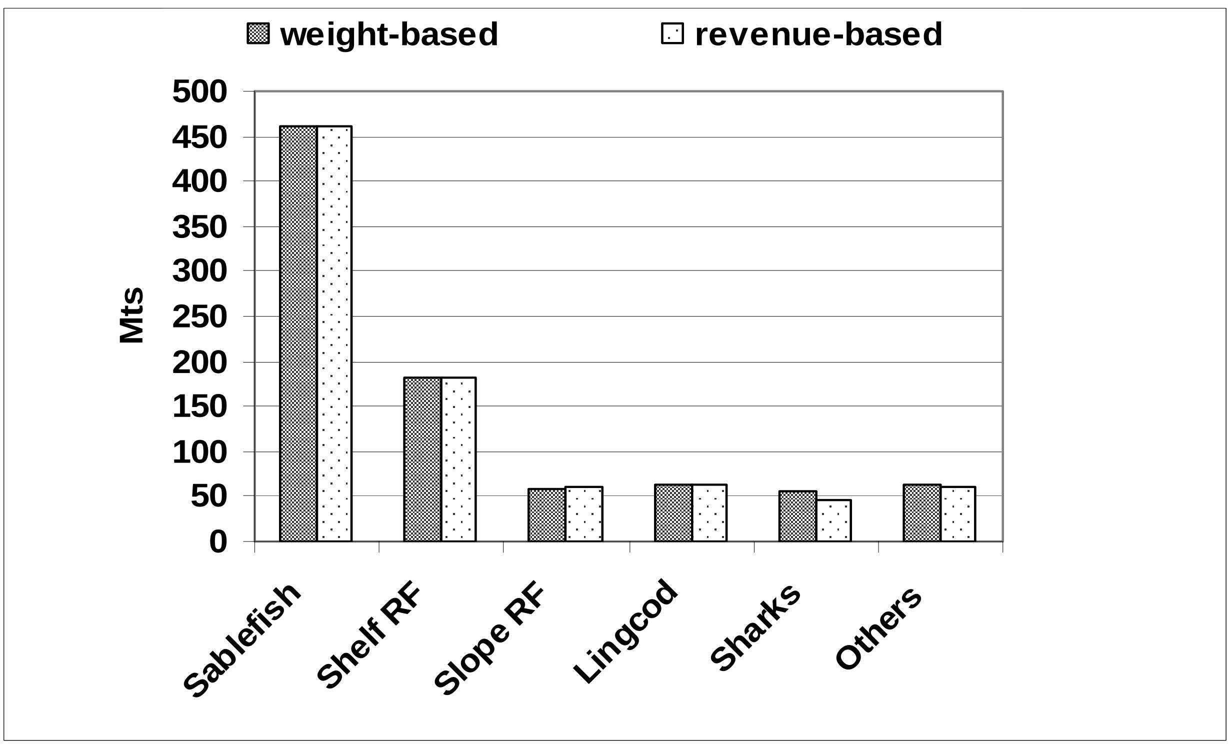


Fig B-3. Estimated average annual directed open access fishery landings by species during 1998-2006 window period years based on >50% weight and > 50% revenue criteria

**Explanation for Recommending 50% Revenue-based Criterion for B Permit Issuance**
The weight-based and revenue-based approaches for defining directed fishing trips produced nearly identical results for all B permit groundfish species except sharks and miscellaneous (other) species. The latter are relatively high volume, low value groundfish species. Grenadiers fall into this category and are included in the other species category. There were minor catch limitations in place during the window period years for these species compared to the other, higher priced B species, such as sablefish. This gave shark and other species vessels an advantage over other vessels in terms of accruing B permit catch history credits for possible future B permit issuance. For example, final 2006 shark species vessel landings were not limited by state or federal regulation except for spiny dogfish, which had a 100,000 lb per 2-month period limit in federal regulations. There was no limit on grenadiers. By comparison the federal sablefish landing limit per open access vessel was 1,050 lbs per week but not more than 3,000 lbs total for the month of December.

The weight-based approach is insensitive to ex-vessel price, which is important in terms of fisherman spending power in fishing communities. The revenue-based approach takes into account both weight and ex-vessel price of fish in landed fishing trips, and is a better proxy of incentive and behavior under a commercial structure (**Burden 2005**). The recommendation here is to use the revenue-based approach for defining directed and incidental fishing trips for use in the issuance of permits under the proposed B permit program.

**References**

Burden, M. 2005. Estimating directed open access landings in Pacific Coast groundfish fisheries. Office Report. NMFS, Northwest Region, Seattle WA. 14p.

DeVore, John. 2007. Personal communication re: Intersector Allocation Committee initiative. Council staff, Portland OR

Goen, J., and J. Hastie. 2002. Pacific Coast Groundfish Open Access Fishery Report. Working Draft. NMFS, Northwest Fisheries Science Center, Seattle, WA. 30p

## *APPENDIX C: State Limited Entry Program Information*

Not included in this draft.

## *APPENDIX D: Description of Coastal States' Nearshore Fishery Management and Limited Entry Programs*

Not included in this draft.

## *APPENDIX E: Analysis of Qualification Criteria: Allocative, Biological and Economic Implications* [9]

**Introduction**
The Council has approved a range of alternatives regarding federal permitting of open access groundfish fisheries. Four of the six alternatives propose to limit the number of vessels that would initially be allowed to target (directly fish for) specified groundfish species. Three alternatives have initial fleet size capacity goals associated with them, while another alternative limits the initial fleet size based on socio-economic analysis of permitting criteria impacts on fishing communities (see Chapter 2 for details of the alternatives).

Open access fishery participation differs between states and ports. In some ports, the majority of vessels participate only occasionally, often not making open access landings in two consecutive years. In other ports, there may be a core group of regular open access participants who are active in the fishery throughout the year and on a year-to-year basis. Chapter 4 of this EA is intended to both look at the effects of the alternatives on the environment as a whole, and to assess the effects of the different alternatives on particular ports or port groups along the length of the coast.

Fishing regulation changes over time or regulation differences between areas can affect the ability of vessels in some areas to harvest fish compared to vessels in areas with less restrictive regulations. Washington prohibits directed commercial fishing in state waters while fishermen in all three states have had to deal with large area closures aimed at protecting sensitive or overfished fish species. No areas of the coast have been denied open access groundfish fishing opportunity, which has likely resulted in increased fishing effort in the remaining open fishing areas. The number of vessels that made directed B species landings in the WOC area has increased in recent years. This suggests that fishers in the respective states are coping with their local regulations.

The open access directed fishery has changed over time from one that harvested large amounts of shelf rockfish to one that now primarily harvests sablefish off of all three states and B species groundfish in association with nearshore species off of Oregon and California. Some previous vessels no longer participate in the fishery while several new vessels have joined the fleet in recent years. Trends in fishing effort have varied between states and ports over time, possibly related to fishing regulation changes aimed at protecting overfished groundfish species, market changes or fluctuations in other fisheries such as salmon and Dungeness crab. The selection of base years for permit qualification is an important decision

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[9] Prepared by LB Boydstun, Melodie Palmer Zwahlen and Gerry Kobylinski, California Department of Fish and Game, September 10, 2007

because it determines, along with associated landing data, which vessels will be eligible for permit qualification. A variety of landings criteria that have been used in other fisheries are considered here for the directed open access groundfish fishery for use in determining which vessels should be eligible for a directed fishery permit. The selection of permit qualification criteria has allocative as well as biological and economic implications. The following analysis is aimed at describing and evaluating the impacts of selected permit qualification criteria relative to these issues.

## Methods

*Qualification Analysis Model*

A vessel permit qualification analysis was done using the catch histories of all vessels that made at least one directed open access fishery landing of B species groundfish during the window period and applying qualification criteria recommended by plan amendment team members and the public.[10] Vessel-specific catch history data were downloaded to CDFG desktop computers from the PacFIN data base for use in determining vessel qualifications relative to the Council's alternatives. Visual FoxPro software was used to construct a computer model that was used to facilitate the analysis. The analysis applied one or more of the following participation standards: 1) recent year participation; 2) long-term fishery participation; 3) ability to make substantial fishery landings; and 4) ability to contribute to coastal communities. The rationale for using these standards and the analytical objectives for the associated data extracts are explained in **Table E-1**.

**Table E-1. Participation standards and analytical approach for developing B permit qualification criteria**

| Standard | Rationale | Action |
|---|---|---|
| 1: Recent year participation | Vessel owner recently dependent on fishery | Determine the number of recently active vessels and their landing frequencies |
| 2: Long-term directed fishery participation | Shows historic dependence on the fishery | Show vessel participation and landing frequencies for the window period |
| 3: Ability to contribute substantial landings | Shows vessel ability to harvest fish | Show vessel participation and tonnage frequencies for all window period years |
| 4: Ability to contribute to coastal communities | Standard may be needed to offset possible skewed effect of high volume, low value species landings by some vessels | Show annual revenue frequencies for all vessels during window period |

[10] Several preliminary analyses were made of alternative qualification criteria, which were reviewed August 24, 2007 by the state/federal plan development team. This review resulted in the selection of the base period criteria used in this report. Public focus group meetings held in California during July-August 2007 resulted in two supplemental model runs that evaluated alternative minimum landings criteria.

A total of five model runs was made to evaluate qualification criteria impacts on fishery participants, states and fishing communities. Building off of the standards in Table E-1, the criteria were as follows:

1. Model Run #1 ranked vessels based on cumulative landing poundage for the period 2004-2006.
2. Model Run #2 ranked vessels based on cumulative landing poundage for the window period, 1998-2006.
3. Model Run #3 was the same as Model Run #2 except each vessel had to make at least one directed fishery landing during 2004-2006.
4. Model Run #4 was the same as Model Run #3 except each vessel had to land >500 lbs of B species groundfish during 1998-2006.
5. Model Run #5 was the same as Model Run #3 except each vessel had to land >1000 lbs of B species groundfish during 1998-2006.

Model outputs showed vessels ranked in descending order based on cumulative poundage. This allowed for permit qualification analyses relative to each of the following initial fleet size goals, with two exceptions, which will be explained in the Results section.

1. 390 vessels(A-6 goal),
2. 500 vessels (intermediate to A-3 and A-6 goals),
3. 680 vessels (A-3 goal), and
4. 850 (A-5 goal).

Initial fleet size goals were determined based on the intent of the alternatives. For example, Alternative 5 (A-5) intends to reduce the open access fleet to the size it was in the year 2000, 850 vessels. For more information on initial fleet size goals, see Chapter 2, "*ALTERNATIVES INCLUDING THE PROPOSED ACTION*."

Ranking of vessels in the various model runs was useful in terms of projecting and analyzing permit issuance impacts relative to such issues as potential distribution of permits and biological and economic impacts associated with retaining or eliminating specific vessels from the fleet based on their historic catch histories. The impact of eliminating permits under the long-term goals specified in alternatives 5 and 6 is more difficult to analyze. This is because such an analysis would require projection of who will actually obtain their permits, how permit holders will use (or not use) their permits, and how permits will be retired from the fishery. For this report, we used model runs 1-3 to rank vessels and approximate impacts associated with meeting the long-term fleet size goal of 170 vessels specified in both of these alternatives. This approach may be useful in terms of analyzing *relative* impacts of the alternatives, but recognize that fisherman behavior in obtaining and using their permits could be similar to (best case scenario) or substantially different from (worse case scenario) those presented in this report. The effect of reducing the permitted fleet to 450 vessels was not analyzed separately because such impacts would be reasonably the same as those produced for an initial fleet size of 500 vessels.

*Biological and Economic Analytical Methods*

The status quo alternative (A-1) was used as the base for comparison of B permit issuance impacts associated with alternatives 3-6. Alternative 2 is a proposed registration process that is assumed to be the same in terms of biological and economic impacts as the No-action alternative. The analysis of alternatives 3-6 looked at B species landing impacts as well as associated species landings (e.g., salmon, crabpot, HMS, etc.) by potentially qualifying and non-qualifying vessels. The biological and economic analyses for alternatives 3-6 were based on analysis of 2004-2006 window period data. Data prior to 2004 were not used because of the transient nature of the open access fishery; i.e., relatively few vessels have participated in the fishery on a long-term basis as shown in this report and previously by Goen and Hastie 2002. More specifically, the period 2004-2006 comprised the years used to compute the initial fleet size goal in Alternative 3; is "recent" in the context of the eight-year window period; and represents the years in which there was an increase in B permit species vessel activity off the combined coastal states (**Figure 2-1)**. The analysis of alternatives 3-6 included a projection of permit qualification impacts with no catch or effort shift in B species groundfish landings and associated fishery landings. A second analysis was done to examine the degree of fishery effort shift that would be required to offset the potential revenue loss stemming from B permit issuance.

Limited entry (permit) management has the potential for reduced fishery discards stemming from enhanced trip and cumulative landing limits. Trip limit overages and high grading are associated with restrictive trip limits. The possibility for increased trip and cumulative landing limits are discussed in Section 4 in the analyses of the respective alternatives. Other potential benefits associated with B permit management would accrue in the form of 1) improved fish handling techniques, 2) increased level of fisherman regulation compliance and 3) increased cooperation with fishery sampling programs. These are recognized attributes of limited entry management, but are not readily quantifiable in terms of future fishery yield (in pounds or revenues) or reduced level of regulation enforcement or fishery monitoring required for effective fishery management.

**Results**

*Allocative Implications of Initial Fleet Size Goals*

Not all model runs met all five fleet size goals. The minimum poundage criterion used in model runs 4 and 5 limited the number of qualifying vessels to 827 and 727, vessels, respectively. The qualification thresholds for B permit issuance ranged from 2,370 lbs under Model Run # 1 to 8,415 lbs under Model Run # 2 for the 390 vessel goal. For the 850 vessel fleet size goal, the qualification thresholds ranged from 229 lbs under Model Run # 1 to 2,240 lbs under Model Run # 2. The values differed between model runs because of differences in criteria used for permit qualification (**Table E-2**).

**Table E-2. Summary of vessel model qualification criteria and minimum landing requirement**

| | Model#1 | Model#2 | Model#3 | Model#4 | Model#5 |
|---|---|---|---|---|---|
| **Variables:** | | | | | |
| # 04-06 ldgs | ≥1 | 0 | ≥1 | ≥1 | ≥1 |
| variable | ttllbs0406 | ttllbs9806 | ttllbs9806 | ttllbs9806 | ttllbs9806 |
| min lbs | 0 | 0 | 0 | 500 | 1000 |
| **Results:** | | | | | |
| # vsls | 1,103 | 2,587 | 1,103 | 827 1/ | 727 1/ |
| Fleet size | ttl lbs | ttl lbs | ttl lbs | ttl lbs | ttl lbs |
| 390 | 2,370 | 8,415 | 4,861 | 4,861 | 4,861 |
| 500 | 1,389 | 5,802 | 3,008 | 3,008 | 3,008 |
| 680 | 583 | 3,574 | 1,221 | 1,221 | 1,221 |
| 850 | 229 | 2,240 | 426 | 500 1/ | 1000 1/ |

1/ does not meet 850 fleet size goal

*Model Run #1* This model run ranked vessels based on cumulative landings during 2004-2006. A total of 1,103 vessels landed B species groundfish during the qualification period, including two dive boats. The two dive boats were not included in the analysis in this section as their primary gear type was not known. The proportion of vessels making primary landings in the respective states was: Washington, 11%; Oregon, 31%; and California, 57%. The top five port groups for potential B permit issuance were Brookings (10%), Monterey and Morro Bay (9% each), and Coos Bay and Fort Bragg (8% each). The primary gear type used for all three states combined was 80% hook and line, 16% pot, and 3.4% set net. Washington vessels used a higher proportion of pot gear (37%) compared to the other states (Oregon 15% and California 13%) (**Table E-3**).

The trend in initial permit issuance between the three states under this qualification criterion can be described as follow:

- The Washington proportion increases from 14% to 22% of the total permits between the 850 and 390 fleet size goals.
- The Oregon proportion is maximal at 34% under the 680 and 500 fleet size goals, then declines to 32 % under the 390 vessel goal.

  The California proportion declines from 53% to 45% under all decreasing fleet size goals.

*Model Run # 2* This model run ranked vessels based on cumulative landings during 1998-2006. The analysis showed that 2,587 vessels made at least one B species groundfish landing including 4 dive boats, which were not included in the analysis because their primary gear type was not known. The proportion of vessels making primary landings in the respective states were: Washington, 8%; Oregon, 26%; and California, 66%). The top five port groups for potential B permit issuance were: Morro Bay (11%), Monterey (10%), San Francisco and Brookings (9% each), and Bodega Bay (8%). The primary gear type used for all three states combined was 87% hook and line, 10% pot, and 3.4% set net (**Table E-4)**.

The trend in permit issuance between the three states under this qualification criterion can be described as follows:

- Washington vessels receive 16% of permits under all fleet size goals and increases to 17% under the 390 vessel goal.
- The Oregon proportion of permits declines from 29% to 26 % between the 680 and 390 goals.
- The California proportion varies between 55% and 57% under all goals.

*Model Run # 3* This model run was the same as Model Run #2 except at least one B species landing was required during 2004-2006. This analysis resulted in the ranking of 1,103 vessels, including two dive boats, which are excluded from the analysis. The proportion of vessels making primary landings in the respective states were: Washington, 11%; Oregon, 31%; and California, 57% The top five port groupsfor potential B permit issuance were: Brookings (10%), Morro Bay (9%), Monterey (9%), Coos Bay and Fort Bragg (8% each). The primary gear type used for all three states combined was 80% hook and line, 16% pot, and 3.8% set net (**Table E-5**). .

Table E-3. No. vessels qualifying by port group, state and gear type. Model Run # 1, by Fishery Goal.

Goal: 170 (for comparison only)

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 7 | 0 | 0 | 7 | 0.04 |
| | SPS | 1 | 0 | 0 | 1 | 0.01 |
| | CWA | 11 | 0 | 0 | 11 | 0.06 |
| | CLW | 10 | 11 | 0 | 21 | 0.12 |
| | sub | 29 | 11 | 0 | 40 | 0.24 |
| OR | CLO | 6 | 0 | 0 | 6 | 0.04 |
| | TLA | 0 | 0 | 0 | 0 | 0.00 |
| | NPA | 1 | 1 | 0 | 2 | 0.01 |
| | CBA | 10 | 6 | 0 | 16 | 0.09 |
| | BRA | 22 | 0 | 0 | 22 | 0.13 |
| | sub | 39 | 7 | 0 | 46 | 0.27 |
| CA | CCA | 0 | 0 | 0 | 0 | 0.00 |
| | ERA | 9 | 2 | 0 | 11 | 0.06 |
| | BGA | 4 | 30 | 0 | 34 | 0.20 |
| | BDA | 0 | 0 | 0 | 0 | 0.00 |
| | SFA | 4 | 0 | 1 | 5 | 0.03 |
| | MNA | 16 | 5 | 1 | 22 | 0.13 |
| | MRA | 3 | 0 | 2 | 5 | 0.03 |
| | SBA | 0 | 0 | 0 | 0 | 0.00 |
| | LAA | 1 | 0 | 1 | 2 | 0.01 |
| | SDA | 2 | 2 | 1 | 5 | 0.03 |
| | sub | 39 | 39 | 6 | 84 | 0.49 |
| WOC | | 107 | 57 | 6 | 170 | 1.00 |

Goal: 390

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 14 | 0 | 0 | 14 | 0.04 |
| | SPS | 2 | 0 | 0 | 2 | 0.01 |
| | CWA | 29 | 4 | 0 | 33 | 0.08 |
| | CLW | 12 | 26 | 0 | 38 | 0.10 |
| | sub | 57 | 30 | 0 | 87 | 0.22 |
| OR | CLO | 15 | 4 | 0 | 19 | 0.05 |
| | TLA | 8 | 2 | 0 | 10 | 0.03 |
| | NPA | 8 | 5 | 0 | 13 | 0.03 |
| | CBA | 25 | 16 | 0 | 41 | 0.11 |
| | BRA | 42 | 1 | 0 | 43 | 0.11 |
| | sub | 98 | 28 | 0 | 126 | 0.32 |
| CA | CCA | 9 | 3 | 0 | 12 | 0.03 |
| | ERA | 21 | 2 | 0 | 23 | 0.06 |
| | BGA | 12 | 36 | 0 | 48 | 0.12 |
| | BDA | 2 | 0 | 0 | 2 | 0.01 |
| | SFA | 14 | 2 | 1 | 17 | 0.04 |
| | MNA | 20 | 10 | 1 | 31 | 0.08 |
| | MRA | 15 | 3 | 2 | 20 | 0.05 |
| | SBA | 7 | 0 | 1 | 8 | 0.02 |
| | LAA | 3 | 0 | 1 | 4 | 0.01 |
| | SDA | 6 | 4 | 2 | 12 | 0.03 |
| | sub | 109 | 60 | 8 | 177 | 0.45 |
| WOC | | 264 | 118 | 8 | 390 | 1.00 |

Goal: 500

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 14 | 1 | 0 | 15 | 0.03 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 34 | 7 | 0 | 41 | 0.08 |
| | CLW | 14 | 30 | 0 | 44 | 0.09 |
| | sub | 64 | 38 | 0 | 102 | 0.20 |
| OR | CLO | 21 | 7 | 0 | 28 | 0.06 |
| | TLA | 13 | 3 | 0 | 16 | 0.03 |
| | NPA | 10 | 7 | 0 | 17 | 0.03 |
| | CBA | 33 | 17 | 0 | 50 | 0.10 |
| | BRA | 56 | 2 | 0 | 58 | 0.12 |
| | sub | 133 | 36 | 0 | 169 | 0.34 |
| CA | CCA | 13 | 5 | 0 | 18 | 0.04 |
| | ERA | 27 | 2 | 0 | 29 | 0.06 |
| | BGA | 15 | 38 | 0 | 53 | 0.11 |
| | BDA | 5 | 0 | 0 | 5 | 0.01 |
| | SFA | 20 | 2 | 1 | 23 | 0.05 |
| | MNA | 29 | 11 | 1 | 41 | 0.08 |
| | MRA | 24 | 3 | 2 | 29 | 0.06 |
| | SBA | 9 | 0 | 2 | 11 | 0.02 |
| | LAA | 4 | 0 | 2 | 6 | 0.01 |
| | SDA | 7 | 4 | 3 | 14 | 0.03 |
| | sub | 153 | 65 | 11 | 229 | 0.46 |
| WOC | | 350 | 139 | 11 | 500 | 1.00 |

Goal: 680

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 14 | 1 | 0 | 15 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 38 | 9 | 0 | 47 | 0.07 |
| | CLW | 17 | 32 | 0 | 49 | 0.07 |
| | sub | 71 | 42 | 0 | 113 | 0.17 |
| OR | CLO | 28 | 9 | 0 | 37 | 0.05 |
| | TLA | 22 | 5 | 0 | 27 | 0.04 |
| | NPA | 23 | 10 | 0 | 33 | 0.05 |
| | CBA | 40 | 20 | 0 | 60 | 0.09 |
| | BRA | 72 | 2 | 0 | 74 | 0.11 |
| | sub | 185 | 46 | 0 | 231 | 0.34 |
| CA | CCA | 19 | 5 | 0 | 24 | 0.04 |
| | ERA | 37 | 2 | 0 | 39 | 0.06 |
| | BGA | 22 | 39 | 0 | 61 | 0.09 |
| | BDA | 8 | 0 | 0 | 8 | 0.01 |
| | SFA | 31 | 2 | 1 | 34 | 0.05 |
| | MNA | 42 | 12 | 1 | 55 | 0.08 |
| | MRA | 44 | 5 | 2 | 51 | 0.08 |
| | SBA | 16 | 1 | 6 | 23 | 0.03 |
| | LAA | 13 | 0 | 6 | 19 | 0.03 |
| | SDA | 11 | 4 | 6 | 21 | 0.03 |
| | sub | 243 | 70 | 22 | 335 | 0.49 |
| WOC | | 499 | 158 | 22 | 679 | 1.00 |

1/ one LAA dive boat qualifies

Goal: 850

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 15 | 1 | 0 | 16 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 39 | 10 | 0 | 49 | 0.06 |
| | CLW | 17 | 32 | 0 | 49 | 0.06 |
| | sub | 73 | 43 | 0 | 116 | 0.14 |
| OR | CLO | 31 | 10 | 0 | 41 | 0.05 |
| | TLA | 31 | 6 | 0 | 37 | 0.04 |
| | NPA | 30 | 11 | 0 | 41 | 0.05 |
| | CBA | 56 | 20 | 0 | 76 | 0.09 |
| | BRA | 83 | 2 | 0 | 85 | 0.10 |
| | sub | 231 | 49 | 0 | 280 | 0.33 |
| CA | CCA | 26 | 7 | 0 | 33 | 0.04 |
| | ERA | 39 | 2 | 0 | 41 | 0.05 |
| | BGA | 33 | 40 | 0 | 73 | 0.09 |
| | BDA | 15 | 0 | 0 | 15 | 0.02 |
| | SFA | 42 | 2 | 1 | 45 | 0.05 |
| | MNA | 60 | 12 | 1 | 73 | 0.09 |
| | MRA | 69 | 9 | 2 | 80 | 0.09 |
| | SBA | 30 | 1 | 6 | 37 | 0.04 |
| | LAA | 20 | 0 | 9 | 29 | 0.03 |
| | SDA | 16 | 4 | 7 | 27 | 0.03 |
| | sub | 350 | 77 | 26 | 453 | 0.53 |
| WOC | | 654 | 169 | 26 | 849 | 1.00 |

1/ two LAA dive boat qualifies

Goal: ALL

| AGY | Port | Hkl | Pot | Net | Tot | Pct |
|---|---|---|---|---|---|---|
| WA | NPS | 18 | 1 | 0 | 19 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 41 | 11 | 0 | 52 | 0.05 |
| | CLW | 19 | 34 | 0 | 53 | 0.05 |
| | sub | 80 | 46 | 0 | 126 | 0.11 |
| OR | CLO | 33 | 12 | 0 | 45 | 0.04 |
| | TLA | 43 | 7 | 0 | 50 | 0.05 |
| | NPA | 40 | 11 | 0 | 51 | 0.05 |
| | CBA | 70 | 20 | 0 | 90 | 0.08 |
| | BRA | 107 | 2 | 0 | 109 | 0.10 |
| | sub | 293 | 52 | 0 | 345 | 0.31 |
| CA | CCA | 30 | 7 | 0 | 37 | 0.03 |
| | ERA | 44 | 2 | 0 | 46 | 0.04 |
| | BGA | 44 | 43 | 0 | 87 | 0.08 |
| | BDA | 28 | 0 | 0 | 28 | 0.03 |
| | SFA | 72 | 3 | 1 | 76 | 0.07 |
| | MNA | 85 | 12 | 1 | 98 | 0.09 |
| | MRA | 92 | 10 | 2 | 104 | 0.09 |
| | SBA | 53 | 1 | 9 | 63 | 0.06 |
| | LAA | 42 | 0 | 15 | 57 | 0.05 |
| | SDA | 20 | 5 | 9 | 34 | 0.03 |
| | sub | 510 | 83 | 37 | 630 | 0.57 |
| WOC | | 883 | 181 | 37 | 1101 | 1.00 |

1/ plus two LAA dive boats

Table E-4 No. vessels qualifying by port group, state and gear type. Model Run # 2, by Fishery Goal.

| Goal: | 170 (for comparison only) | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 7 | 0 | 0 | 7 | 0.04 |
| | SPS | 1 | 0 | 0 | 1 | 0.01 |
| | CWA | 12 | 0 | 0 | 12 | 0.07 |
| | CLW | 8 | 2 | 0 | 10 | 0.06 |
| | sub | 28 | 2 | 0 | 30 | 0.18 |
| OR | CLO | 2 | 0 | 0 | 2 | 0.01 |
| | TLA | 0 | 0 | 0 | 0 | 0.00 |
| | NPA | 3 | 0 | 0 | 3 | 0.02 |
| | CBA | 5 | 2 | 0 | 7 | 0.04 |
| | BRA | 19 | 0 | 0 | 19 | 0.11 |
| | sub | 29 | 2 | 0 | 31 | 0.18 |
| CA | CCA | 1 | 2 | 0 | 3 | 0.02 |
| | ERA | 11 | 1 | 0 | 12 | 0.07 |
| | BGA | 5 | 25 | 0 | 30 | 0.18 |
| | BDA | 7 | 0 | 0 | 7 | 0.04 |
| | SFA | 6 | 0 | 3 | 9 | 0.05 |
| | MNA | 30 | 1 | 2 | 33 | 0.19 |
| | MRA | 4 | 0 | 1 | 5 | 0.03 |
| | SBA | 1 | 0 | 0 | 1 | 0.01 |
| | LAA | 3 | 0 | 1 | 4 | 0.02 |
| | SDA | 1 | 3 | 1 | 5 | 0.03 |
| | sub | 69 | 32 | 8 | 109 | 0.64 |
| WOC | | 126 | 36 | 8 | 170 | 1.00 |

| Goal: | 390 | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 14 | 0 | 0 | 14 | 0.04 |
| | SPS | 1 | 0 | 0 | 1 | 0.00 |
| | CWA | 26 | 1 | 0 | 27 | 0.07 |
| | CLW | 13 | 12 | 0 | 25 | 0.06 |
| | sub | 54 | 13 | 0 | 67 | 0.17 |
| OR | CLO | 11 | 3 | 0 | 14 | 0.04 |
| | TLA | 3 | 1 | 0 | 4 | 0.01 |
| | NPA | 13 | 1 | 0 | 14 | 0.04 |
| | CBA | 23 | 6 | 0 | 29 | 0.07 |
| | BRA | 42 | 0 | 0 | 42 | 0.11 |
| | sub | 92 | 11 | 0 | 103 | 0.26 |
| CA | CCA | 7 | 4 | 0 | 11 | 0.03 |
| | ERA | 26 | 3 | 0 | 29 | 0.07 |
| | BGA | 10 | 39 | 0 | 49 | 0.13 |
| | BDA | 16 | 0 | 0 | 16 | 0.04 |
| | SFA | 15 | 2 | 3 | 20 | 0.05 |
| | MNA | 44 | 7 | 2 | 53 | 0.14 |
| | MRA | 6 | 0 | 2 | 8 | 0.02 |
| | SBA | 9 | 0 | 2 | 11 | 0.03 |
| | LAA | 11 | 0 | 3 | 14 | 0.04 |
| | SDA | 3 | 3 | 3 | 9 | 0.02 |
| | sub | 147 | 58 | 15 | 220 | 0.56 |
| WOC | | 293 | 82 | 15 | 390 | 1.00 |

| Goal: | 500 | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 18 | 0 | 0 | 18 | 0.04 |
| | SPS | 1 | 0 | 0 | 1 | 0.00 |
| | CWA | 30 | 1 | 0 | 31 | 0.06 |
| | CLW | 16 | 16 | 0 | 32 | 0.06 |
| | sub | 65 | 17 | 0 | 82 | 0.16 |
| OR | CLO | 14 | 5 | 0 | 19 | 0.04 |
| | TLA | 7 | 1 | 0 | 8 | 0.02 |
| | NPA | 15 | 2 | 0 | 17 | 0.03 |
| | CBA | 28 | 9 | 0 | 37 | 0.07 |
| | BRA | 53 | 1 | 0 | 54 | 0.11 |
| | sub | 117 | 18 | 0 | 135 | 0.27 |
| CA | CCA | 12 | 4 | 0 | 16 | 0.03 |
| | ERA | 32 | 3 | 0 | 35 | 0.07 |
| | BGA | 17 | 41 | 0 | 58 | 0.12 |
| | BDA | 22 | 0 | 0 | 22 | 0.04 |
| | SFA | 22 | 2 | 3 | 27 | 0.05 |
| | MNA | 50 | 9 | 3 | 62 | 0.12 |
| | MRA | 11 | 1 | 2 | 14 | 0.03 |
| | SBA | 12 | 0 | 3 | 15 | 0.03 |
| | LAA | 14 | 0 | 4 | 18 | 0.04 |
| | SDA | 7 | 3 | 6 | 16 | 0.03 |
| | sub | 199 | 63 | 21 | 283 | 0.57 |
| WOC | | 381 | 98 | 21 | 500 | 1.00 |

| Goal: | 680 | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 22 | 0 | 0 | 22 | 0.03 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 40 | 2 | 0 | 42 | 0.06 |
| | CLW | 20 | 21 | 0 | 41 | 0.06 |
| | sub | 84 | 23 | 0 | 107 | 0.16 |
| OR | CLO | 22 | 7 | 0 | 29 | 0.04 |
| | TLA | 11 | 1 | 0 | 12 | 0.02 |
| | NPA | 20 | 3 | 0 | 23 | 0.03 |
| | CBA | 44 | 14 | 0 | 58 | 0.09 |
| | BRA | 77 | 1 | 0 | 78 | 0.11 |
| | sub | 174 | 26 | 0 | 200 | 0.29 |
| CA | CCA | 17 | 6 | 0 | 23 | 0.03 |
| | ERA | 37 | 4 | 0 | 41 | 0.06 |
| | BGA | 23 | 49 | 0 | 72 | 0.11 |
| | BDA | 26 | 0 | 0 | 26 | 0.04 |
| | SFA | 28 | 4 | 3 | 35 | 0.05 |
| | MNA | 63 | 11 | 5 | 79 | 0.12 |
| | MRA | 21 | 3 | 3 | 27 | 0.04 |
| | SBA | 16 | 0 | 5 | 21 | 0.03 |
| | LAA | 18 | 0 | 6 | 24 | 0.04 |
| | SDA | 12 | 6 | 7 | 25 | 0.04 |
| | sub | 261 | 83 | 29 | 373 | 0.55 |
| WOC | | 519 | 132 | 29 | 680 | 1.00 |
| | 1/ plus two dive boats, SDA,BGA | | | | | |

| Goal: | 850 | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 28 | 0 | 0 | 28 | 0.03 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 49 | 5 | 0 | 54 | 0.06 |
| | CLW | 24 | 24 | 0 | 48 | 0.06 |
| | sub | 103 | 29 | 0 | 132 | 0.16 |
| OR | CLO | 27 | 9 | 0 | 36 | 0.04 |
| | TLA | 16 | 1 | 0 | 17 | 0.02 |
| | NPA | 23 | 4 | 0 | 27 | 0.03 |
| | CBA | 60 | 17 | 0 | 77 | 0.09 |
| | BRA | 91 | 1 | 0 | 92 | 0.11 |
| | sub | 217 | 32 | 0 | 249 | 0.29 |
| CA | CCA | 23 | 7 | 0 | 30 | 0.04 |
| | ERA | 44 | 4 | 0 | 48 | 0.06 |
| | BGA | 35 | 52 | 0 | 87 | 0.10 |
| | BDA | 30 | 0 | 0 | 30 | 0.04 |
| | SFA | 37 | 4 | 3 | 44 | 0.05 |
| | MNA | 73 | 13 | 5 | 91 | 0.11 |
| | MRA | 37 | 4 | 4 | 45 | 0.05 |
| | SBA | 22 | 1 | 8 | 31 | 0.04 |
| | LAA | 24 | 0 | 9 | 33 | 0.04 |
| | SDA | 15 | 6 | 9 | 30 | 0.04 |
| | sub | 340 | 91 | 38 | 469 | 0.55 |
| WOC | | 660 | 152 | 38 | 850 | 1.00 |
| | 1/ plus two dive boats | | | | | |

| Goal: | ALL | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 49 | 1 | 0 | 50 | 0.02 |
| | SPS | 3 | 0 | 0 | 3 | 0.00 |
| | CWA | 72 | 17 | 0 | 89 | 0.03 |
| | CLW | 32 | 33 | 0 | 65 | 0.03 |
| | sub | 156 | 51 | 0 | 207 | 0.08 |
| OR | CLO | 48 | 16 | 0 | 64 | 0.02 |
| | TLA | 93 | 6 | 0 | 99 | 0.04 |
| | NPA | 97 | 10 | 0 | 107 | 0.04 |
| | CBA | 136 | 22 | 0 | 158 | 0.06 |
| | BRA | 230 | 3 | 0 | 233 | 0.09 |
| | sub | 604 | 57 | 0 | 661 | 0.26 |
| CA | CCA | 85 | 10 | 0 | 95 | 0.04 |
| | ERA | 89 | 5 | 0 | 94 | 0.04 |
| | BGA | 148 | 67 | 0 | 215 | 0.08 |
| | BDA | 110 | 1 | 1 | 112 | 0.04 |
| | SFA | 220 | 6 | 3 | 229 | 0.09 |
| | MNA | 238 | 17 | 8 | 263 | 0.10 |
| | MRA | 262 | 13 | 9 | 284 | 0.11 |
| | SBA | 140 | 9 | 14 | 163 | 0.06 |
| | LAA | 123 | 4 | 32 | 159 | 0.06 |
| | SDA | 70 | 10 | 21 | 101 | 0.04 |
| | sub | 1485 | 142 | 88 | 1715 | 0.66 |
| WOC | | 2245 | 250 | 88 | 2583 | 1.00 |
| | 1/ plus four dive boats | | | | | |

Table E-5. No. vessels qualifying by port group, state and gear type. Model Run # 3, by Fishery Goal.

| Goal: | 170 (for comparison only) | | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 7 | 0 | 0 | 7 | 0.04 |
| | SPS | 1 | 0 | 0 | 1 | 0.01 |
| | CWA | 14 | 0 | 0 | 14 | 0.08 |
| | CLW | 9 | 4 | 0 | 13 | 0.08 |
| | sub | 31 | 4 | 0 | 35 | 0.21 |
| OR | CLO | 6 | 1 | 0 | 7 | 0.04 |
| | TLA | 1 | 0 | 0 | 1 | 0.01 |
| | NPA | 2 | 0 | 0 | 2 | 0.01 |
| | CBA | 9 | 2 | 0 | 11 | 0.06 |
| | BRA | 23 | 0 | 0 | 23 | 0.14 |
| | sub | 41 | 3 | 0 | 44 | 0.26 |
| CA | CCA | 2 | 2 | 0 | 4 | 0.02 |
| | ERA | 11 | 2 | 0 | 13 | 0.08 |
| | BGA | 5 | 27 | 0 | 32 | 0.19 |
| | BDA | 1 | 0 | 0 | 1 | 0.01 |
| | SFA | 4 | 0 | 1 | 5 | 0.03 |
| | MNA | 20 | 2 | 0 | 22 | 0.13 |
| | MRA | 3 | 0 | 1 | 4 | 0.02 |
| | SBA | 1 | 0 | 0 | 1 | 0.01 |
| | LAA | 2 | 0 | 1 | 3 | 0.02 |
| | SDA | 2 | 3 | 1 | 6 | 0.04 |
| | sub | 51 | 36 | 4 | 91 | 0.54 |
| WOC | | 123 | 43 | 4 | 170 | 1.00 |

| Goal: | | 390 | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 11 | 0 | 0 | 11 | 0.03 |
| | SPS | 1 | 0 | 0 | 1 | 0.00 |
| | CWA | 23 | 1 | 0 | 24 | 0.06 |
| | CLW | 14 | 18 | 0 | 32 | 0.08 |
| | sub | 49 | 19 | 0 | 68 | 0.17 |
| OR | CLO | 13 | 3 | 0 | 16 | 0.04 |
| | TLA | 8 | 1 | 0 | 9 | 0.02 |
| | NPA | 13 | 2 | 0 | 15 | 0.04 |
| | CBA | 25 | 9 | 0 | 34 | 0.09 |
| | BRA | 48 | 1 | 0 | 49 | 0.13 |
| | sub | 107 | 16 | 0 | 123 | 0.32 |
| CA | CCA | 12 | 3 | 0 | 15 | 0.04 |
| | ERA | 23 | 3 | 0 | 26 | 0.07 |
| | BGA | 13 | 36 | 0 | 49 | 0.13 |
| | BDA | 7 | 0 | 0 | 7 | 0.02 |
| | SFA | 16 | 2 | 1 | 19 | 0.05 |
| | MNA | 27 | 10 | 0 | 37 | 0.09 |
| | MRA | 12 | 1 | 3 | 16 | 0.04 |
| | SBA | 6 | 0 | 2 | 8 | 0.02 |
| | LAA | 6 | 0 | 2 | 8 | 0.02 |
| | SDA | 6 | 3 | 5 | 14 | 0.04 |
| | sub | 128 | 58 | 13 | 199 | 0.51 |
| WOC | | 284 | 93 | 13 | 390 | 1.00 |

| Goal: | | 500 | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 14 | 0 | 0 | 14 | 0.03 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 30 | 3 | 0 | 33 | 0.07 |
| | CLW | 15 | 22 | 0 | 37 | 0.07 |
| | sub | 61 | 25 | 0 | 86 | 0.17 |
| OR | CLO | 20 | 6 | 0 | 26 | 0.05 |
| | TLA | 11 | 1 | 0 | 12 | 0.02 |
| | NPA | 15 | 4 | 0 | 19 | 0.04 |
| | CBA | 32 | 12 | 0 | 44 | 0.09 |
| | BRA | 60 | 1 | 0 | 61 | 0.12 |
| | sub | 138 | 24 | 0 | 162 | 0.32 |
| CA | CCA | 13 | 4 | 0 | 17 | 0.03 |
| | ERA | 25 | 4 | 0 | 29 | 0.06 |
| | BGA | 19 | 38 | 0 | 57 | 0.11 |
| | BDA | 9 | 0 | 0 | 9 | 0.02 |
| | SFA | 19 | 3 | 1 | 23 | 0.05 |
| | MNA | 33 | 11 | 0 | 44 | 0.09 |
| | MRA | 25 | 2 | 3 | 30 | 0.06 |
| | SBA | 9 | 0 | 5 | 14 | 0.03 |
| | LAA | 7 | 0 | 4 | 11 | 0.02 |
| | SDA | 8 | 5 | 5 | 18 | 0.04 |
| | sub | 167 | 67 | 18 | 252 | 0.50 |
| WOC | | 366 | 116 | 18 | 500 | 1.00 |

| Goal: | | 680 | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 14 | 1 | 0 | 15 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 39 | 8 | 0 | 47 | 0.07 |
| | CLW | 17 | 28 | 0 | 45 | 0.07 |
| | sub | 72 | 37 | 0 | 109 | 0.16 |
| OR | CLO | 27 | 8 | 0 | 35 | 0.05 |
| | TLA | 18 | 3 | 0 | 21 | 0.03 |
| | NPA | 23 | 4 | 0 | 27 | 0.04 |
| | CBA | 45 | 15 | 0 | 60 | 0.09 |
| | BRA | 76 | 2 | 0 | 78 | 0.11 |
| | sub | 189 | 32 | 0 | 221 | 0.33 |
| CA | CCA | 17 | 7 | 0 | 24 | 0.04 |
| | ERA | 32 | 4 | 0 | 36 | 0.05 |
| | BGA | 25 | 39 | 0 | 64 | 0.09 |
| | BDA | 12 | 0 | 0 | 12 | 0.02 |
| | SFA | 31 | 3 | 1 | 35 | 0.05 |
| | MNA | 47 | 12 | 0 | 59 | 0.09 |
| | MRA | 48 | 3 | 5 | 56 | 0.08 |
| | SBA | 16 | 0 | 8 | 24 | 0.04 |
| | LAA | 11 | 0 | 6 | 17 | 0.03 |
| | SDA | 10 | 5 | 8 | 23 | 0.03 |
| | sub | 249 | 73 | 28 | 350 | 0.51 |
| WOC | | 510 | 142 | 28 | 680 | 1.00 |

| Goal: | | 850 | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 16 | 1 | 0 | 17 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 39 | 9 | 0 | 48 | 0.06 |
| | CLW | 19 | 30 | 0 | 49 | 0.06 |
| | sub | 76 | 40 | 0 | 116 | 0.14 |
| OR | CLO | 31 | 8 | 0 | 39 | 0.05 |
| | TLA | 33 | 4 | 0 | 37 | 0.04 |
| | NPA | 34 | 8 | 0 | 42 | 0.05 |
| | CBA | 55 | 18 | 0 | 73 | 0.09 |
| | BRA | 88 | 2 | 0 | 90 | 0.11 |
| | sub | 241 | 40 | 0 | 281 | 0.33 |
| CA | CCA | 23 | 8 | 0 | 31 | 0.04 |
| | ERA | 38 | 4 | 0 | 42 | 0.05 |
| | BGA | 34 | 39 | 0 | 73 | 0.09 |
| | BDA | 14 | 0 | 0 | 14 | 0.02 |
| | SFA | 43 | 3 | 1 | 47 | 0.06 |
| | MNA | 62 | 12 | 0 | 74 | 0.09 |
| | MRA | 64 | 7 | 5 | 76 | 0.09 |
| | SBA | 30 | 0 | 9 | 39 | 0.05 |
| | LAA | 17 | 0 | 12 | 29 | 0.03 |
| | SDA | 13 | 5 | 9 | 27 | 0.03 |
| | sub | 338 | 78 | 36 | 452 | 0.53 |
| WOC | | 655 | 158 | 36 | 849 | 1.00 |

1/ one LAA dive boat qualifies

| Goal: | | ALL | | | | |
|---|---|---|---|---|---|---|
| AGY | Port | Hkl | Pot | Net | Tot | Pct |
| WA | NPS | 18 | 1 | 0 | 19 | 0.02 |
| | SPS | 2 | 0 | 0 | 2 | 0.00 |
| | CWA | 41 | 11 | 0 | 52 | 0.05 |
| | CLW | 21 | 32 | 0 | 53 | 0.05 |
| | sub | 82 | 44 | 0 | 126 | 0.11 |
| OR | CLO | 34 | 11 | 0 | 45 | 0.04 |
| | TLA | 44 | 6 | 0 | 50 | 0.05 |
| | NPA | 43 | 8 | 0 | 51 | 0.05 |
| | CBA | 72 | 18 | 0 | 90 | 0.08 |
| | BRA | 107 | 2 | 0 | 109 | 0.10 |
| | sub | 300 | 45 | 0 | 345 | 0.31 |
| CA | CCA | 29 | 8 | 0 | 37 | 0.03 |
| | ERA | 42 | 4 | 0 | 46 | 0.04 |
| | BGA | 45 | 42 | 0 | 87 | 0.08 |
| | BDA | 28 | 0 | 0 | 28 | 0.03 |
| | SFA | 71 | 4 | 1 | 76 | 0.07 |
| | MNA | 86 | 12 | 0 | 98 | 0.09 |
| | MRA | 90 | 8 | 6 | 104 | 0.09 |
| | SBA | 53 | 1 | 9 | 63 | 0.06 |
| | LAA | 40 | 0 | 17 | 57 | 0.05 |
| | SDA | 19 | 6 | 9 | 34 | 0.03 |
| | sub | 503 | 85 | 42 | 630 | 0.57 |
| WOC | | 885 | 174 | 42 | 1101 | 1.00 |

1/ plus two LAA dive boats

The trend in permit issuance between the three states under this qualification criterion can be described as follows:

- The Washington proportion increases from 14% to 17% between the 850 and 390 fleet size goals.
- The Oregon proportion of permits declines from 33% to 32 % between the high and low fleet size goals.
- The California proportion declines from 53% to 51% between the high and low fleet size goals

*Model runs 4 and 5.* These model runs produced vessel goal impacts that were the same as Model Run # 3. The only difference was that there would be 827 and 727 vessels eligible for permit issuance stemming from a minimum landing requirement of 500 and 1000 lbs, respectively, rather than 1,103 vessels with no minimum landing requirement.

*Comparison of Model Run Results:* The 2004-2006 qualification period (Model Run # 1) benefits Oregon and Washington vessels more so than California vessels when the fleet capacity goal is in the range of 390-680 vessels (**Table E-6; Figure E-1**). The California fishery does better in absolute terms when the 1998-2006 qualification period is used without a recent year (2004-2006) landing requirement (Model Run #2, **Table E-6 and Figure E-2**)). The respective tri-state proportions vary by 1% or less when the 1998-2006 qualification period is used in combination with a recent year landing requirement and the fleet goal is in the range of 390-680 vessels (Model Run # 3, **Table E-6 and Figure E-3**).

*Allocative Implications of 170-Vessel Long-term Fleet Size Goal under Alternatives 5 and 6*

*Model Run #1:* Reducing the fleet size to 170 vessels in this model run resulted in 24% of the permits being assigned to Washington vessels while Oregon and California vessels received 27% and 49% of the permits, respectively (**Table E-3**). Most (58%) of the permits were distributed among vessels at four port groups: Fort Bragg (34 permits, 20%), Monterey and Brookings (22 permits each, 13%) and Columbia River-Washington (21 permits, 12%). A total of three port groups (37%) had no permitted vessels (Tillamook, Crescent City, Bodega Bay and Santa Barbara) and four port groups had one or two permitted vessels each (South Puget Sound, Newport, Bodega Bay and Los Angeles Area).

*Model Run #2:* The 170 fleet size goal in this model run resulted in the following distribution of permits: Washington, 18%, Oregon, 18%, and California 64% (**Table E-4**). About half (48%) of the permits were distributed among vessels at three port groups: Monterey (33 permits, 19%), Fort Bragg (30 permits, 18%), and Brookings (19 permits, 11%). One port group had no permitted vessels (Tillamook) and three port groups had one or two permits each (South Puget Sound, Columbia River-Oregon, and Santa Barbara.

*Model Run #3:* Reducing the fleet size to 170 vessels in this model run resulted in the following distribution of permits: Washington, 20%; Oregon 26% and California, 54% (Table **E-5**). Almost half (45%) of the permits were distributed among vessels at three port groups: Fort Bragg (33 permits, 19%), Brookings (23 permits, 14%), and Monterey (22 permits, 13%). Every port group had at least one permitted vessel, but four port groups had only one permitted vessel each: South Puget Sound, Tillamook, Bodega Bay and Santa Barbara.

Table E-6. Model run results: projected distribution of B permits by state expressed as proportion of specified fleet size goals 1/

| Fleet goal | | Model Run | | | | |
|---|---|---|---|---|---|---|
| #vsls | AGY | #1 | #2 | #3 | #4 | #5 |
| 170 | WA | 0.24 | 0.18 | 0.21 | 0.21 | 0.21 |
| | OR | 0.27 | 0.18 | 0.26 | 0.26 | 0.26 |
| | CA | 0.49 | 0.64 | 0.54 | 0.54 | 0.54 |
| 390 | WA | 0.22 | 0.17 | 0.17 | 0.17 | 0.17 |
| | OR | 0.32 | 0.26 | 0.32 | 0.32 | 0.32 |
| | CA | 0.45 | 0.56 | 0.51 | 0.51 | 0.51 |
| 500 | WA | 0.20 | 0.16 | 0.17 | 0.17 | 0.17 |
| | OR | 0.34 | 0.27 | 0.32 | 0.32 | 0.32 |
| | CA | 0.46 | 0.57 | 0.50 | 0.50 | 0.50 |
| 680 | WA | 0.17 | 0.16 | 0.16 | 0.16 | 0.16 |
| | OR | 0.34 | 0.29 | 0.33 | 0.33 | 0.33 |
| | CA | 0.49 | 0.55 | 0.51 | 0.51 | 0.51 |
| 850 | WA | 0.14 | 0.16 | 0.14 | 0.14 | 0.15 |
| | OR | 0.33 | 0.29 | 0.33 | 0.33 | 0.32 |
| | CA | 0.53 | 0.55 | 0.53 | 0.53 | 0.52 |
| All | WA | 0.11 | 0.08 | 0.11 | 0.11 | 0.11 |
| | OR | 0.31 | 0.26 | 0.31 | 0.31 | 0.31 |
| | CA | 0.57 | 0.66 | 0.57 | 0.57 | 0.57 |

1/ see tables E-3, E-4, and E-5 for port group and gear data

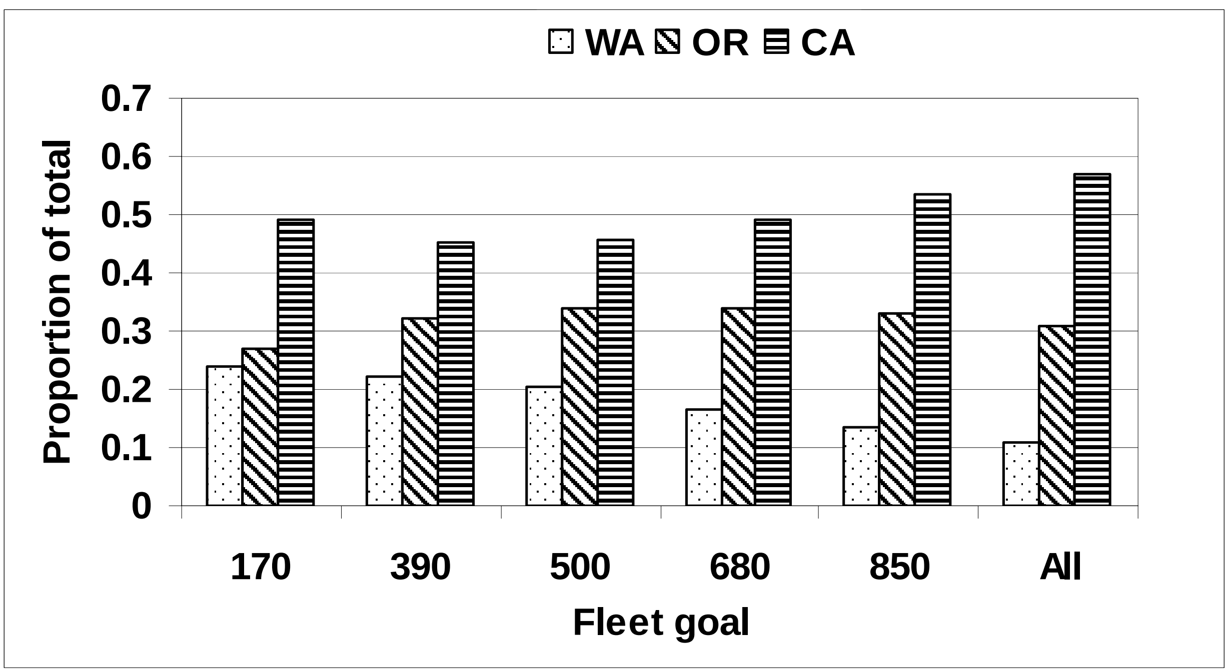


Fig E-1. Projected distribution of B permits by state and fleet size goal: Model Run #1 (04-06 cumulative landings)

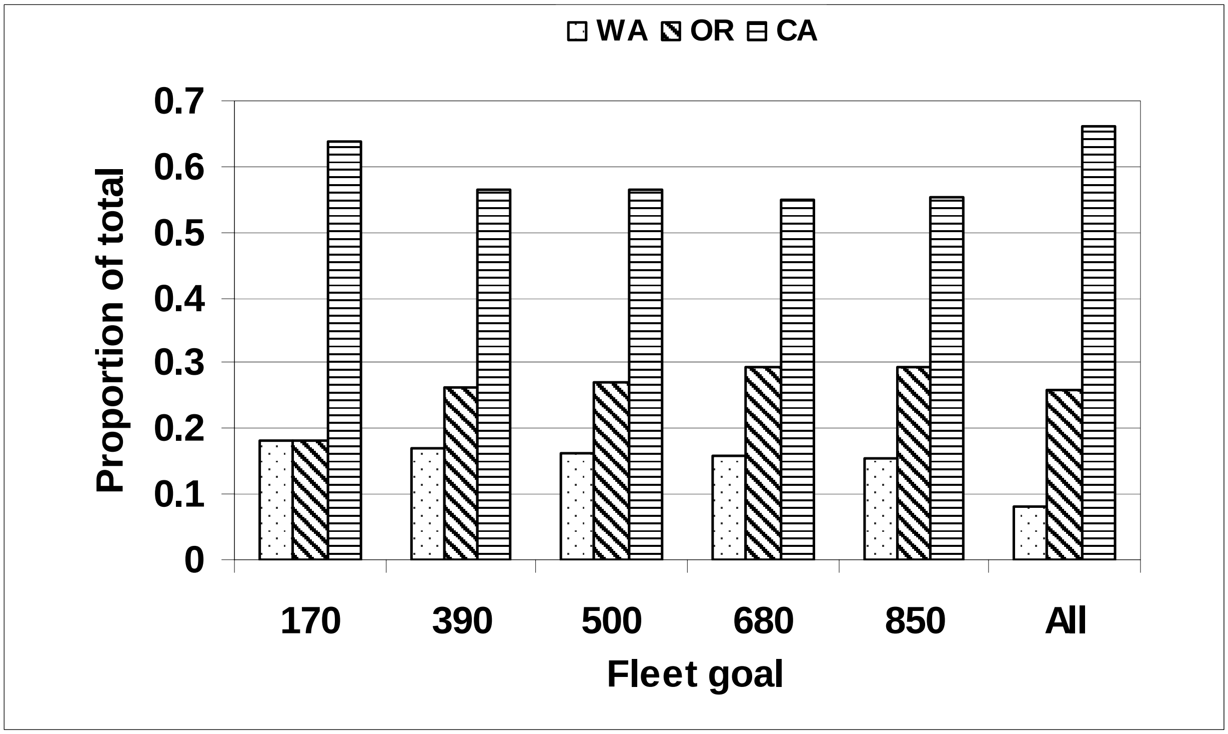


Fig E-2 Projected distribution of B permits by state and fleet size goal: Model Run #2 (98-06 cumulative landings)

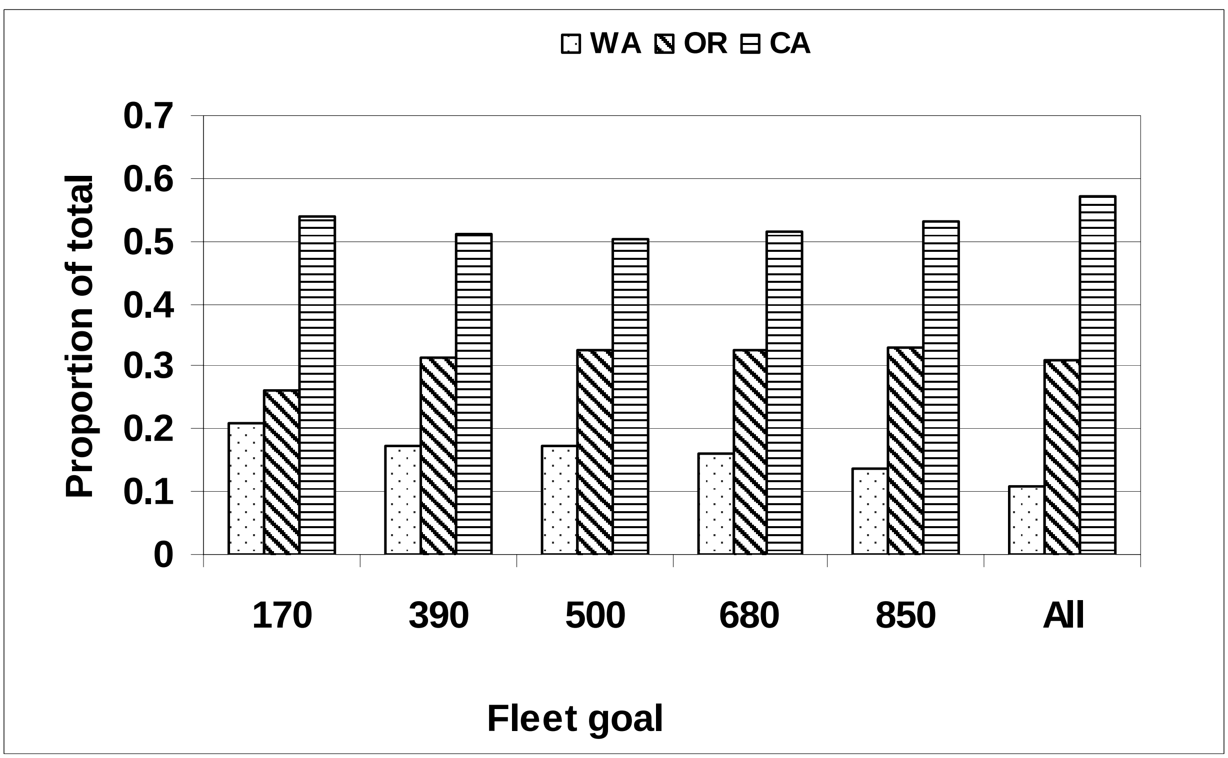


Figure E-3. Projected distribution of B permits by state and fleet size goal: Model Run #3 (98-06 cumulative landings; one 04-06 landing)

*Comparison of Model Run Results:* The 170-vessel long-term fleet size goal is projected to have permit distributional impacts that are different from those presented for initial fleet size goals of 390, 500, 680, and 850 vessels. The 170 fleet size comparisons show that Washington- and California-based vessels would each receive higher proportions of permits while Oregon-based vessels would receive a lower proportion of permits compared to model runs for all higher initial fleet size goals (**Table E-6**). The combined model runs indicate that between four and seven port groups would have 0-2 permitted vessels each.

*Biological and Economic Impacts of Model Run Criteria Relative to Initial and Long-term Fleet Size Goals*

*Analysis of Initial Fleet Size Goals: Alternatives 3, 5 and 6*: These alternatives were analyzed separate from Alternative 4 because they have fixed fleet size goals while alternative 4 uses analysis of fleet qualification criteria impacts to determine the number of vessels that would initially qualify for a permit.

Fishery data for 2004-2006 window period years were used as the base years for analysis of these alternatives using results from model runs 1-3 (see **Table E-2** for criteria). The data were organized to show B species directed fishery, associated fishery, and total fishery metrics for each alternative and model run. Outputs were generated separately for vessels that were determined, based on cumulative poundage ranking, to be "qualifying" or "non-qualifying" vessels (i.e., they ranked above or below the vessel fleet size goal associated with the respective alternatives) for B permit issuance. Vessels that made at least one B species landing during 2004-2006 window period years were classified as active while those that did not were classified as inactive. Statistics were generated showing the relative dependence of "active" and "inactive" vessels for the various categories of fish in terms of weight and ex-vessel value of fish.

The data from model runs 1 and 3 showed that 1,103 different vessels made B species landings during 2004-2006 window period years. Model run 2 data showed a total of 2,587 different vessels made B species groundfish landings during window period years. Of these latter vessels, 1,103 (43%) were active during 2004-2006. The total tonnage and revenues from B species vessel landings during 2004-2006 were 2,796 mt and about $8.5 million, respectively. The associated fishery landings by these vessels during 2004-2006 were 42,720 mt worth about $116 million to the fishermen. Expressed as a proportion of total fishery landings during 2004-2006, B species groundfish represented 6% by weight and 7% by value of total landings (**Table E-7**).

*Alternative 3* calls for a B permit fleet size of 680 vessels. Model run 1 and 3 outputs show this alternative would exclude 423 vessels (38%) that made B species landings during 2004-2006. Model run 2 shows that of 680 permitted vessels, 468 (69%) were active during 2004-2006 and that 1,907 vessels (74% of 1998-2006 total) would not receive permits, including 635 (58% of 2004-2006 total) that were active during 2004-2006. B species groundfish landings by permitted vessels under model runs 1 and 3 represented ≥98% by weight and ≥97% by value of total B species groundfish landed by directed fishery vessels during 2004-2006. Model run 2 data show that of the 468 vessels that would receive permits and that were active during 2004-2006, their landings represented 93% by weight and 91% by value of the total landings of B species groundfish landed by directed fishery vessels during 2004-2006 (**Table E-7**). The non-qualifying vessels represented the balance of B species groundfish landings. The amount of B species groundfish landed by non-qualifying vessels based on model run 1 and 3 results was ≤ 1% by weight or value of total fishery landings during 2004-2006. The comparable value based on Model Run #2 was ≤ 2% (**Table E-7**). These latter revenue figures (≤ 1% and ≤ 2%) represent estimates of the amount of increase in revenues that non-permitted vessels would have had to generate on average from other revenue sources to compensate for not receiving B species groundfish permits.

Table E-7. Evaluation of initial fleet size goals contained in alternatives 3, 5 and 6 based on model runs 1, 2 and 3 with comparisons to alternatives 1 (status quo) and 2 (registration); 2004-2006 landings data are used as the base years in comparisons between vessels assigned to qualified and non-qualified categories.

| | | | Directed fishery metrics | | | | | | Associated fishery metrics | | | | Total fishery history | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Model | | Active | GF | | GF | | Total | | Total | | Total | GF | Total | GF |
| Alternative | Goal | Run # | # vsls | 04-06 | mt | P | $ 000s | P | mt | P | $ 000s | P | mt | P | $ 000s | P |
| A-1 | n/a | 1 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 2 | 2,587 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 3 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| A-2 | n/a | 1 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 2 | 2,587 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 3 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-3 | 680 | 1 | 680 | 680 | 2,756.9 | 0.99 | 8,379.1 | 0.98 | 34,349.8 | 0.80 | 87,443.1 | 0.75 | 37,106.8 | 0.07 | 95,822.2 | 0.09 |
| | | 2 | 680 | 468 | 2,602.1 | 0.93 | 7,797.3 | 0.91 | 33,105.4 | 0.77 | 79,296.3 | 0.68 | 35,707.5 | 0.07 | 87,093.6 | 0.09 |
| | | 3 | 680 | 680 | 2,736.5 | 0.98 | 8,297.1 | 0.97 | 34,576.5 | 0.81 | 90,679.3 | 0.78 | 37,313.0 | 0.07 | 98,976.4 | 0.08 |
| A-4 | See Table D-8 | | | | | | | | | | | | | | | |
| A-5 | 850 | 1 | 850 | 850 | 2,785.8 | 1.00 | 8,492.0 | 1.00 | 37,764.7 | 0.88 | 100,229.1 | 0.86 | 40,550.5 | 0.07 | 108,721.1 | 0.08 |
| | | 2 | 850 | 561 | 2,674.7 | 0.96 | 8,065.5 | 0.95 | 38,065.9 | 0.89 | 93,766.2 | 0.81 | 40,740.6 | 0.07 | 101,831.7 | 0.08 |
| | | 3 | 850 | 850 | 2,780.1 | 0.99 | 8,469.0 | 0.99 | 38,320.4 | 0.90 | 101,650.5 | 0.88 | 41,100.5 | 0.07 | 110,119.5 | 0.08 |
| A-6 | 390 | 1 | 390 | 390 | 2,589.6 | 0.93 | 7,751.5 | 0.91 | 23,886.5 | 0.56 | 53,193.8 | 0.46 | 26,476.1 | 0.10 | 60,945.2 | 0.13 |
| | | 2 | 390 | 286 | 2,329.7 | 0.83 | 6,801.8 | 0.80 | 13,449.6 | 0.31 | 48,020.5 | 0.41 | 15,779.2 | 0.15 | 54,822.3 | 0.12 |
| | | 3 | 390 | 390 | 2,510.0 | 0.90 | 7,463.0 | 0.87 | 23,635.8 | 0.55 | 55,005.5 | 0.47 | 26,145.8 | 0.10 | 62,468.5 | 0.12 |
| NON-QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-3 | 680 | 1 | 423 | 423 | 39.0 | 0.01 | 152.4 | 0.02 | 8,370.4 | 0.20 | 28,717.3 | 0.25 | 8,409.4 | 0.00 | 28,869.6 | 0.01 |
| | | 2 | 1,907 | 635 | 193.8 | 0.07 | 734.1 | 0.09 | 9,614.8 | 0.23 | 36,864.1 | 0.32 | 9,808.7 | 0.02 | 37,598.3 | 0.02 |
| | | 3 | 423 | 423 | 59.5 | 0.02 | 234.3 | 0.03 | 8,143.7 | 0.19 | 25,481.1 | 0.22 | 8,203.2 | 0.01 | 25,715.4 | 0.01 |
| A-4 | See Table D-8 | | | | | | | | | | | | | | | |
| A-5 | 850 | 1 | 253 | 253 | 10.2 | 0.00 | 39.5 | 0.00 | 4,955.5 | 0.12 | 15,931.3 | 0.14 | 4,965.7 | 0.00 | 15,970.8 | 0.00 |
| | | 2 | 1,737 | 542 | 121.2 | 0.04 | 465.9 | 0.05 | 4,654.3 | 0.11 | 22,394.2 | 0.19 | 4,775.5 | 0.03 | 22,860.2 | 0.02 |
| | | 3 | 253 | 253 | 15.8 | 0.01 | 62.4 | 0.01 | 4,399.9 | 0.10 | 14,509.9 | 0.12 | 4,415.7 | 0.00 | 14,572.3 | 0.00 |
| A-6 | 390 | 1 | 713 | 713 | 206.3 | 0.07 | 780.0 | 0.09 | 18,833.7 | 0.44 | 62,966.7 | 0.54 | 19,040.1 | 0.01 | 63,746.6 | 0.01 |
| | | 2 | 2,197 | 817 | 466.3 | 0.17 | 1,729.7 | 0.20 | 29,270.7 | 0.69 | 68,139.9 | 0.59 | 29,737.0 | 0.02 | 69,869.5 | 0.02 |
| | | 3 | 713 | 713 | 286.0 | 0.10 | 1,068.4 | 0.13 | 19,084.4 | 0.45 | 61,154.9 | 0.53 | 19,370.4 | 0.01 | 62,223.3 | 0.02 |

*Alternative 5* calls for an initial fleet size of 850 vessels. Model runs 1 and 3 outputs show this alternative would exclude 253 vessels (23%) that made B species groundfish landings during 2004-2006 window period years. Model run 2 shows that of 850 permitted vessels, 561 vessels (66%) were active during 2004-2006 and that 1,737 vessels (67% of 1998-2006 total) would not receive permits, including 542 (49% of 2004-2006 total) that were active during 2004-2006 window period years. B species groundfish landings by permitted vessels under model runs 1 and 3 represented ≥99% by weight and ≥99% by value of the total B species groundfish landed by directed fishery vessels during 2004-2006. Model run 2 data show that of the 561 vessels that would receive permits and that were active during 2004-2006, their landings represented 96% by weight and 95% by value of total landings of B species groundfish landed by directed fishery vessels during 2004-2006 (**Table E-7**). The non-qualifying vessels took the balance of B species groundfish landings. The amount of B species groundfish landed by non-qualifying vessels based on model 1 and 3 results was < 1% by weight or value of their total fishery landings during 2004-2006. The comparable value based on model run 2 was 3% by weight 2% by value (**Table E-7**). These latter revenue figures (≤ 1% and ≤ 2%) represent estimates of the amount of increase in revenues that non-permitted vessels would have to generate on average from other revenue sources to compensate for not receiving a B species groundfish permit.

*Alternatives 5a and 5b* call for eventual fleet size goals of 450 and 170 vessels, respectively. The analysis showed that vessels not receiving permits at the 450 permit level harvested between 5% and 14% based on weight and 7% and 17% based on value of B species groundfish that were landed during 2004-2006 window period years (**Table E-8**). These values represent relative amounts of additional B species groundfish that would be available for harvest by permitted vessels in future years. Landings of B species groundfish by the non-qualifying vessels under the 450 fleet size level represented 1% by weight and 1%-2% by value of their total fishery landings during 2004-2006 window period years (**Table E-8**). These values represent of the amount of effort shift that would be required by non-permitted vessels to other fisheries to offset the loss of B species groundfish in future years stemming from adoption of this alternative. At the 170 vessel level, B species landings by non-qualifying vessels amounted to 24%-37% by weight and 29% to 43% by value of total B species landings during the 2004-2006 window period years (**Table E-8)**. These relative amounts of fish would be available to harvest by permitted vessels in future years under this alternative. The relative contributions of B species groundfish to total fishery landings by non-qualifying vessels at the 170 vessel level during 2004-2006 window period years were as follows: 2%-3% by weight and 3-4% by value (**Table E-8)**. These values represent the amount of effort shift to other fisheries that would be required by non-permitted vessels to make up for loss of B species groundfish opportunity in future years at the 170 vessel level.

Table E-8. Evaluation of alternatives 5a and 5b based on model runs 1, 2 and 3 with comparisons to alternatives 1 (no action) and 2 (registration); 2004-2006 landings data are used as the base years in comparisons between vessels assigned to qualified and non-qualified categories.

| | | | Directed fishery metrics | | | | | | Associated fishery metrics | | | | Total fishery history | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Model | | Active | GF | | GF | | Total | | Total | | Total | GF | Total | GF |
| Alternative | Goal | Run # | # vsls | 04-06 | mt | P | $ 000s | P | mt | P | $ 000s | P | mt | P | $ 000s | P |
| A-1 | n/a | 1 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 2 | 2,587 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 3 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| A-2 | n/a | 1 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 2 | 2,587 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| | | 3 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-5a | 450 | 1 | 450 | 450 | 2,644.1 | 0.95 | 7,955.8 | 0.93 | 26,082.3 | 0.61 | 60,626.5 | 0.52 | 28,726.4 | 0.09 | 68,582.3 | 0.12 |
| | | 2 | 450 | 320 | 2,407.4 | 0.86 | 7,087.6 | 0.83 | 14,959.7 | 0.35 | 53,136.6 | 0.46 | 17,367.1 | 0.14 | 60,224.1 | 0.12 |
| | | 3 | 450 | 450 | 2,576.5 | 0.92 | 7,907.4 | 0.93 | 27,623.8 | 0.65 | 68,706.3 | 0.59 | 30,200.3 | 0.09 | 76,613.7 | 0.10 |
| A-5b | 450 | 1 | 450 | 450 | 2,644.1 | 0.95 | 7,955.8 | 0.93 | 26,082.3 | 0.61 | 60,626.5 | 0.52 | 28,726.4 | 0.09 | 68,582.3 | 0.12 |
| | | 2 | 450 | 348 | 2,407.4 | 0.86 | 7,087.6 | 0.83 | 14,959.7 | 0.35 | 53,136.6 | 0.46 | 17,367.1 | 0.14 | 60,224.1 | 0.12 |
| | | 3 | 450 | 450 | 2,576.5 | 0.92 | 7,907.4 | 0.93 | 27,623.8 | 0.65 | 68,706.3 | 0.59 | 30,200.3 | 0.09 | 76,613.7 | 0.10 |
| | 170 | 1 | 170 | 170 | 2,117.1 | 0.76 | 6,042.2 | 0.71 | 7,055.4 | 0.17 | 24,099.4 | 0.21 | 9,172.5 | 0.23 | 30,141.5 | 0.20 |
| | | 2 | 170 | 128 | 1,756.5 | 0.63 | 4,844.1 | 0.57 | 3,864.7 | 0.09 | 15,702.2 | 0.14 | 5,621.1 | 0.31 | 20,546.3 | 0.24 |
| | | 3 | 170 | 170 | 1,977.6 | 0.71 | 5,585.8 | 0.65 | 5,198.8 | 0.12 | 20,326.0 | 0.17 | 7,176.3 | 0.28 | 25,911.8 | 0.22 |
| NON-QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-5a | 450 | 1 | 653 | 653 | 151.8 | 0.05 | 575.6 | 0.07 | 16,637.9 | 0.39 | 55,533.9 | 0.48 | 16,789.7 | 0.01 | 56,109.5 | 0.01 |
| | | 2 | 2,137 | 783 | 388.6 | 0.14 | 1,443.9 | 0.17 | 27,760.5 | 0.65 | 63,023.8 | 0.54 | 28,149.1 | 0.01 | 64,467.7 | 0.02 |
| | | 3 | 653 | 653 | 219.4 | 0.08 | 624.0 | 0.07 | 15,096.4 | 0.35 | 47,454.1 | 0.41 | 15,315.8 | 0.01 | 48,078.1 | 0.01 |
| A-5b | 450 | 1 | 653 | 653 | 151.8 | 0.05 | 575.6 | 0.07 | 16,637.9 | 0.39 | 55,533.9 | 0.48 | 16,789.7 | 0.01 | 56,109.5 | 0.01 |
| | | 2 | 2,137 | 755 | 388.6 | 0.14 | 1,443.9 | 0.17 | 27,760.5 | 0.65 | 63,023.8 | 0.54 | 28,149.1 | 0.01 | 64,467.7 | 0.02 |
| | | 3 | 653 | 653 | 219.4 | 0.08 | 624.0 | 0.07 | 15,096.4 | 0.35 | 47,454.1 | 0.41 | 15,315.8 | 0.01 | 48,078.1 | 0.01 |
| | 170 | 1 | 933 | 933 | 678.8 | 0.24 | 2,489.3 | 0.29 | 35,664.8 | 0.83 | 92,061.0 | 0.79 | 36,343.6 | 0.02 | 94,550.3 | 0.03 |
| | | 2 | 2,417 | 975 | 1,039.5 | 0.37 | 3,687.4 | 0.43 | 38,855.6 | 0.91 | 100,458.2 | 0.86 | 39,895.1 | 0.03 | 104,145.5 | 0.04 |
| | | 3 | 933 | 933 | 818.4 | 0.29 | 2,945.6 | 0.35 | 37,521.5 | 0.88 | 95,834.4 | 0.83 | 38,339.9 | 0.02 | 98,780.0 | 0.03 |

*Alternative 6* calls for an initial fleet size of 390 vessels and a long-term fleet size goal of 170 vessels, which is the same as Alternative 5b. There is a previous year landing requirement to retain the permit under this alternative but no specific time frame is identified for achieving the long-term goal. Model run 1 and 3 outputs show this alternative would exclude 713 vessels (65%) that made B species groundfish landings during 2004-2006 window period years. Model Run #2 shows that of 390 permitted vessels, 286 vessels (73%) were active during 2004-2006 and that 2,197 vessels (85% of 1998-2006 total) would not receive permits, including 817 (74 % of 2004-2006 total) that were active during 2004-2006 window period years. B species groundfish landings by permitted vessels under model runs 1 and 3 represented ≥90% by weight and ≥87% by value of total B species groundfish landed by directed fishery vessels during 2004-2006. Model Run #2 data show that of the 286 vessels that would have received permits and that were active during 2004-2006, their landings represented 83% by weight and 80% by value of total landings of B species groundfish made by directed fishery vessels during 2004-2006 (**Table E-7**). The non-qualifying vessels took the balance of B species groundfish landings. The amount of B species groundfish landed by non-qualifying vessels based on model run 1 and 3 results was ≤ 1% by weight and

≤2% by value of total fishery landings during 2004-2006. The comparable value based on model run 2 was ≤2% by weight or value (**Table E-7**). These latter revenue figures (≤ 2% in both cases) represented estimates of the amount of increase in revenues that non-permitted vessels would have to generate on average from other revenue sources to compensate for not receiving a B species groundfish permit.

At the 170 vessel level, B species landings by non-qualifying vessels amounted to 24%-37% by weight and 29% to 43% by value of total B species landings during the 2004-2006 window period years (**Table E-8)**. These relative amounts of fish would be available to harvest by permitted vessels in future years under this alternative. The relative contributions of B species groundfish to total fishery landings by non-qualifying vessels at the 170 vessel level during 2004-2006 window period years were as follows: 2%-3% by weight and 3-4% by value (**Table E-8)**. These values represent the amount of effort shift to other fisheries that would be required by non-permitted vessels to make up for loss of B species groundfish opportunity in future years at the 170 vessel level.

Data for these three alternatives show there was a positive relationship between fleet size goal and proportion of the landed catch that was comprised of fish species other than B species groundfish (i.e., higher the goal, the higher the proportion of non-B species groundfish). This shows the greater reliance of "core" group groundfish vessels on B species groundfish compared to other vessels (or conversely the higher reliance of non-core group vessels on non-B species groundfish).
*Analysis of Permit Qualification Criteria: Alternative 4:* A series of minimum landing requirements (MLRs) were developed for this analysis. Each MLR retained specified proportions of B species landings using Model Run #3 output data. The range in MLRs was from 1 lb to 47,866 lbs. The corresponding landing retention levels ranged were from 100% to 50% (**Table E-9**).

Table E-9. Minimum landing criteria aimed at retaining specified proportions of fleet fishing capacity: Alternative 4 approach to setting vessel qualification criteria 1/

| | | | Directed fishery metrics | | | | | | Associated fishery metrics | | | | Total fishery history | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Active | GF | | GF | | Total | | Total | | Total | GF | Total | GF |
| Alternative | Goal 2/ | Min lbs | # vsls | 04-06 | mt | P | $ 000s | P | mt | P | $ 000s | P | mt | P | $ 000s | P |
| A-1 | n/a | n/a | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-4 | 50% | 47,866 | 65 | 65 | 1,214.5 | 0.43 | 3,075 | 0.36 | 1,793 | 0.04 | 7,240 | 0.06 | 3,007.8 | 0.40 | 10,314.8 | 0.30 |
| | 60% | 36,090 | 95 | 95 | 1,507.5 | 0.54 | 4,126 | 0.48 | 2,563 | 0.06 | 10,741 | 0.09 | 4,070.7 | 0.37 | 14,866.2 | 0.28 |
| | 70% | 21,793 | 139 | 139 | 1,809.8 | 0.65 | 5,014 | 0.59 | 3,969 | 0.09 | 15,851 | 0.14 | 5,778.8 | 0.31 | 20,864.6 | 0.24 |
| | 80% | 14,374 | 209 | 209 | 2,111.8 | 0.76 | 6,051 | 0.71 | 7,183 | 0.17 | 26,960 | 0.23 | 9,294.5 | 0.23 | 33,011.4 | 0.18 |
| | 90% | 6,101 | 341 | 341 | 2,441.2 | 0.87 | 7,214 | 0.85 | 22,773 | 0.53 | 50,741 | 0.44 | 25,214.0 | 0.10 | 57,954.8 | 0.12 |
| | 95% | 3,481 | 474 | 474 | 2,609.0 | 0.93 | 7,826 | 0.92 | 26,852 | 0.63 | 66,144 | 0.57 | 29,461.1 | 0.09 | 73,969.9 | 0.11 |
| | 98% | 1,603 | 629 | 629 | 2,713.2 | 0.97 | 8,206 | 0.96 | 32,829 | 0.77 | 85,012 | 0.73 | 35,542.4 | 0.08 | 93,218.1 | 0.09 |
| | 100% | 1 | 1,103 | 1,103 | 2,796.0 | 1.00 | 8,531.4 | 1.00 | 42,720.2 | 1.00 | 116,160.4 | 1.00 | 45,516.2 | 0.06 | 124,691.8 | 0.07 |
| NON-QUALIFYING VESSELS | | | | | | | | | | | | | | | | |
| A-4 | 50% | <47866 | 1,038 | 1,038 | 1,581.5 | 0.57 | 5,456.9 | 0.64 | 40,926.9 | 0.96 | 108,920.2 | 0.94 | 42,508.4 | 0.04 | 114,377.0 | 0.05 |
| | 60% | <36090 | 1,008 | 1,008 | 1,288.4 | 0.46 | 4,405.9 | 0.52 | 40,157.0 | 0.94 | 105,419.7 | 0.91 | 41,445.4 | 0.03 | 109,825.6 | 0.04 |
| | 70% | <21793 | 964 | 964 | 986.2 | 0.35 | 3,517.3 | 0.41 | 38,751.2 | 0.91 | 100,309.9 | 0.86 | 39,737.3 | 0.02 | 103,827.2 | 0.03 |
| | 80% | <14374 | 894 | 894 | 684.2 | 0.24 | 2,480.2 | 0.29 | 35,537.5 | 0.83 | 89,200.3 | 0.77 | 36,221.7 | 0.02 | 91,680.5 | 0.03 |
| | 90% | <6101 | 762 | 762 | 354.7 | 0.13 | 1,317.2 | 0.15 | 19,947.5 | 0.47 | 65,419.8 | 0.56 | 20,302.2 | 0.02 | 66,737.0 | 0.02 |
| | 95% | <3481 | 629 | 629 | 186.9 | 0.07 | 705.4 | 0.08 | 15,868.2 | 0.37 | 50,016.5 | 0.43 | 16,055.1 | 0.01 | 50,721.9 | 0.01 |
| | 98% | <1603 | 474 | 474 | 82.8 | 0.03 | 325.1 | 0.04 | 9,891.0 | 0.23 | 31,148.6 | 0.27 | 9,973.8 | 0.01 | 31,473.7 | 0.01 |
| | 100% | <1 | 0 | 0 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 |

1/ this analysis used model run 3 base period criteria: 1998-2006 cumulative lbs and 1 or more B species landings during 2004-2006

2/ based 1998-2006 cumulative pounds

The analysis showed that there was a core group of about 65 vessels (6% of the 2004-2006 fleet size) that landed 43% by weight and 36% by value of B species groundfish during 2004-2006. Total fishery data for these vessels showed that B species groundfish comprised 40% by weight and 30% by value of their combined total fishery landings during 2004-2006 window period years. For the 47,866-lb MLR, a total of 1,038 vessels that made B species landings during 1998-2006 and 2004-2006 window period years would not qualify for a permit. These potentially non-permitted vessels harvested 57% by weight and 64% by value of the B species groundfish during 2004-2006. Their exclusion from B species fishing opportunity would have potentially reduced total fishery landings during 2004-2006 window period years by 4% based on weight and 5% based on value of landed fish. Effort shift to other fisheries would have offset these losses to an unknown degree. Reduced fishing effort for B species groundfish stemming from B permit issuance would have allowed for increased fishing opportunity by permitted vessels, the net effect of which is difficult to project (**Table E-9**).

Analysis of impacts of the other MLRs can be summarized as follows;

- There was a steep increase in the proportion of B species landings associated with declining MLRs (increasing catch proportions) in the range 47,866 lbs and 14,374 lbs (50%-80% harvest retention level). The relationship then flattened out (**Figure E-4).**
- Respective totals of 762 and 894 of the least productive vessels harvested 10% and 20% of the B species groundfish during 2004-2006 window period years. This averaged 1.31 and 2.23 percentage points, respectively, for each 100 vessels in these two vessel groups (**Table E-9).**
- There was a negative relationship between vessel dependence (expressed as a proportion of total fishery landings) on B species groundfish landings and MLRs with a natural break based on weight of fish between the 14,374 and 6,101 MLRs (80% and 90% catch retention levels). No such break was apparent based on value of fish (**Figure E-5**).
- None of the MLRs would cause a reduction in total fishery revenues of >5% for the non-qualifying vessels, which could be 1% at the 1,603-lb MLR level (**Table E-9; Figure E-6)**. In other words, the non-qualifying vessels had very low dependence as a group on B species groundfish under all MLRs.

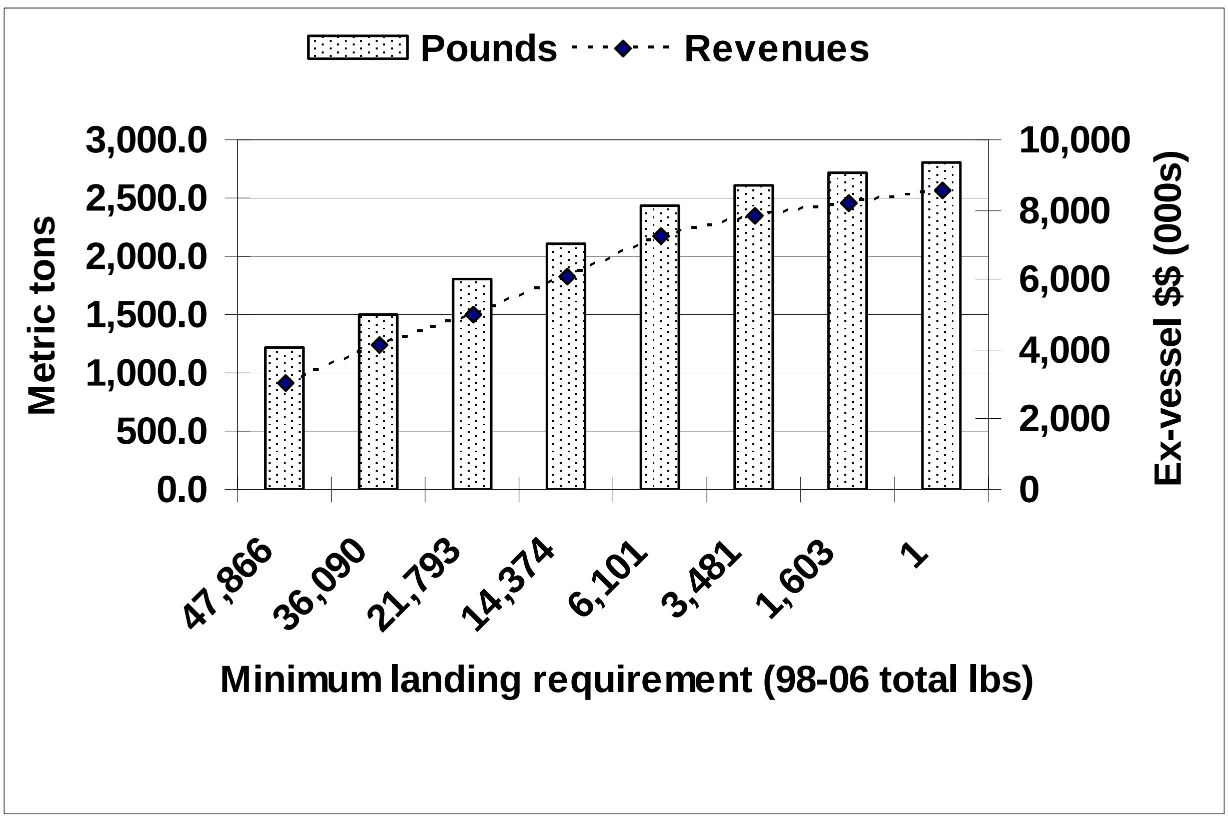


Figure E-4. B species groundfish landings by vessels meeting specified MLRs using Model Run #3 output data and based on 2004-2006 vessel landings. See Table E-9 for fleet sizes associated with MLRs.

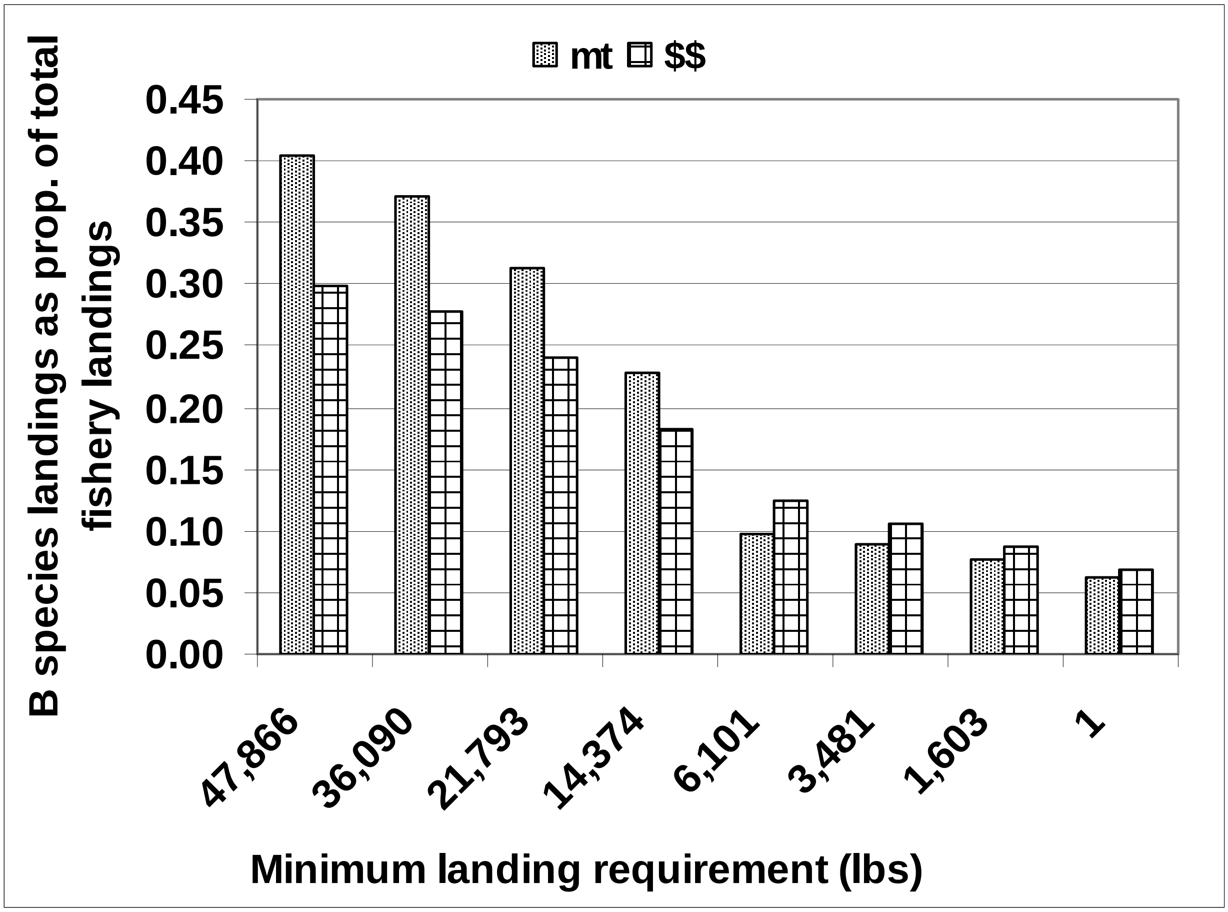


Figure E-5 Relationship between vessel dependence on B species GF and minimum landing requirements using Model Run #3 data. See Table E-9 for fleet size associated with MLRs.

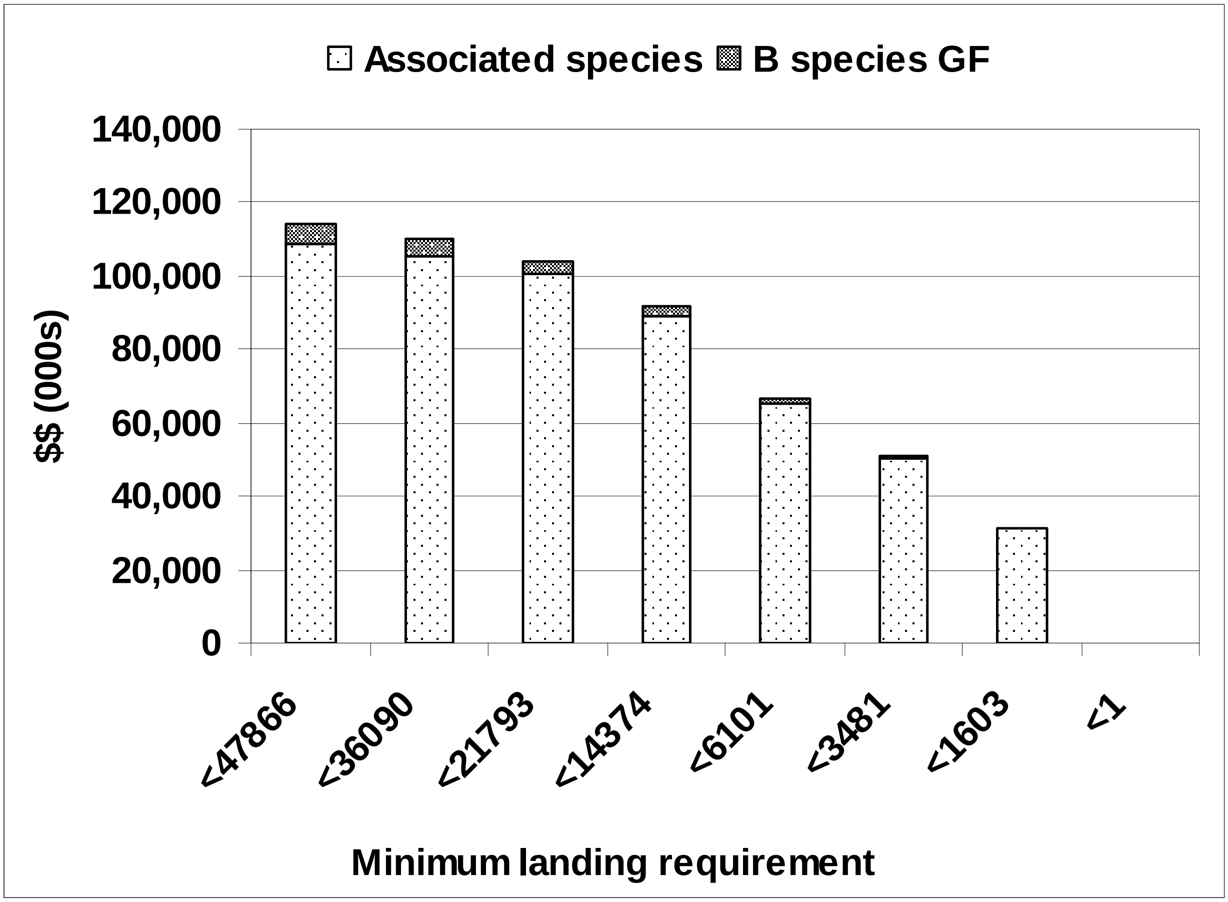


Figure E-6. Fishery landings by non-qualifying vessels using Model Run #3 data during 2004-2006. See Table E-9 for fleet sizes associated with MLRs.

**Discussion**

None of the initial fleet size goals contained in the Council's alternatives appear to threaten the viability of fishing communities stemming from federal permit management. The core group of B species vessels had historically high cumulative landings that should safeguard their continued fishery participation. The one criterion that is critical to continued participation by some recent fishery participants is a recent year landing requirement. Many vessels have high cumulative landings during the window period, but have dropped out of the fishery in recent years. These vessels represent potentially latent fishing effort, the permitting of which might result in non-active permits becoming active or transfer, depending on adopted transfer conditions, to other vessels whose owners would likely be interested in using their new permits. Under Model Run # 2, permitting of non-active vessels was shown to exclude vessels that have been active in the fishery in recent years, but that have small catch histories by comparison.

The potential loss of B species groundfish landings either in terms of weight or value of fish associated with the different qualification criteria were relatively small (<14%) in all analyses that required a recent year landing requirement. A change in harvest opportunity for B species groundfish would, for some species, likely be met with increased trip or cumulative landing limits for the permitted vessels. The loss of B permit groundfish opportunity by non-qualified vessels was also determined to be very small in comparison with the harvest by these same vessels of non-B species groundfish. The amount of effort increase in other fisheries to cover this loss was estimated to be from <1% to 3% depending on qualification criteria.

The decision of which initial fleet size goal to adopt should take into consideration the allocative as well as the biological and economic impacts associated with the qualification criteria used to meet those goals. The criteria used in this analysis were shown to affect the distribution of permits between states and ports to varying degrees based on fleet size goal and base years used for permit qualification.

Analysis of alternative 5a showed results that were intermediate to those for alternatives 3 and 6 as could be expected because the consolidation goal of 450 vessels was within the range of the latter alternatives (680 and 390, respectively) and because the same analytical approach was used. The 170 vessel permit consolidation analysis for alternative 5b showed relatively high landings during 2004-2006 window period years by vessels that would not likely receive or retain a permit as follows: 24%-37% by weight and 29% to 43% by value of total B species landings. These relative amounts of fish would be available for harvest by permitted vessels. The amount of effort shift to associated fisheries required by non-permitted vessels to make up for loss of B species groundfish revenues under the 170 vessel alternative was estimated to be 3%-4% on average.

Alternative 4 was difficult to evaluate in terms of qualification impacts to fishing communities because there were no set of fishery parameters or policies with which to compare the results. Focus group meetings in California supported the use of a “nominal” set of qualification criteria for B permit issuance, the definition of which appeared to be related to the catch history of the individual fisherman (those with large catch histories tended to be more supportive of higher catch history credentials). Two of the recommendations were included in this report as model runs 4 and 5 (**Table E-2**). Analysis of minimum landing requirement (MLR) levels using Model Run #3 data showed an overall low dependence of coastal fishing communities on B species groundfish compared to other Pacific Coast fisheries. The relationship between total fishery harvest and MLR was shown to flatten out above the 80% catch retention level (MLR=14,374 lb).

The fishermen have a stake in the outcome of this decision process. The optimal fleet size is one that accrues benefits to the fishery participants in the form of potential increased landing limits and fishing opportunity, which may be possible for such species as sablefish and in some areas slope rockfish. Management should also benefit from the decision in the form of increased cooperation with regulation enforcement and fishery sampling and reduced fishery discards stemming from trip limit overages and high grading.

## *APPENDIX F: Groundfish and Non-groundfish Species Biological Characteristics, Life History Traits, and Stock Status Information*

Not included in this draft.

## *APPENDIX G: Groundfish Closed Areas*

Not included in this draft.

Agenda Item F.4.a
Attachment 2
March 2008

# Possible Open Access Groundfish Fishery Conversion to Limited Entry and Permit Implementation Schedule (Updated)

| Step | Dates |
|---|---|
| Overview and Council direction re: OA permitting alternatives | June 2007 |
| Evaluation of alternatives and preparation of first preliminary draft environmental assessment | June 2007 February 2008 |
| Council meeting: adopt preliminary range of alternatives for public review | March 2008 |
| Council meeting: final action | September 2008 |
| Implementation phase and initial permit issuance | September 2008 thru September 2009 |
| B and C permits required | January 2010 |

**Process notes:**
The CDFG will have the lead role in this process with assistance provided by the states of Washington and Oregon, Council staff, and the National Marine Fisheries Service. Washington tribal input will be welcomed.

Advisory Body and Public input will be received at regularly scheduled Council meetings.

# Errata

The attached table ES-3 was inadvertently left out of the "Preliminary Draft Environmental Assessment for Pacific Coast Groundfish Fishery Management Plan Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management" (Agenda Item F.4.a, Attachment 1). Please insert the attached table ES-3 in page xi of the document.

Table ES-3. Summary of registration requirements, fleet size goals, fleet size expectations, and environmental consequences associated with the Council's alternatives

| | | | Alternative | | | | | |
|---|---|---|---|---|---|---|---|---|
| Issue | Stage | Reference | A-1 | A-2 | A-3 | A-4 | A-5 | A-6 |
| Registration requirement? | | § 2.0 | No | Yes | Yes | Yes | Yes | Yes |
| Fleet size goal | | | | | | | | |
| Initial | 1) | § 2.0 | None | None | 680 | 65-1103 **2/** | 850 | 390 |
| Long-term | 2) | § 2.0 | same | same | 680 | 65-1103 **2/** | a) 450 b) 170 | 170 |
| Initial fleet size expectation **1/** | | Tabs E-7, E-8, E-9 | 680-1103 | 680-1103 | 468-680 | see FS goal | 561-850 | 286-390 |
| Long-term fleet size expectation | | Tab E-9 | 680-1103 | 680-1103 | 468-680 | see FS goal | 128-450 | 128-170 |
| Environmental impact | | | | | | | | |
| Physical environment | | § 3.1, and § 4.0 | N/C | N/C | N/C | N/C | N/C | N/C |
| Biological environment | | | | | | | | |
| Groundfish | | § 3.2.1 | 7/ | 7/ | N/C | N/C | N/C | N/C |
| Non-groundfish | | § 3.2.2 | N/C | N/C | N/C | N/C | N/C | N/C |
| Prohibited species | | § 3.2.3 | N/C | N/C | N/C | N/C | N/C | N/C |
| Protected species | | § 3.2.4 | N/C | N/C | N/C | N/C | N/C | N/C |
| Socioeconomic environment | | | | | | | | |
| Fishery mgmt 3**/** | | § 2.0 | N/C | + | + | N/C to > | + or > | > |
| Catch comp. | | | | | | | | |
| Groundfish **4/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 2% to 9% | 0% to 64% | 0%-5% | 9%-20% |
| | 2) | | | | N/A | N/A | a) 7%-17% b) 29%-43% | 29%-43% |
| Non-groundfish **5/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 1% to 2% | 0%-5% | 0% to 2% | 1%-2% |
| | 2) | | | | N/A | N/A | a) 1%-2% b) 3%-4% | 3%-4% |
| Vessels char. 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Processors 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Licensing, etc. | | § 3.3.5, § 3.3.6 | N/C | N/C | N/C | N/C | N/C | N/C |
| Costs | | § 2.0 | N/C | minor | minor | minor | minor | minor |
| Communities 6**/** | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Environmental Justice | | § 1.5 and § 3.3.8 | N/C | N/C | N/C | N/C | N/C | N/C |

1/ A-2 and A-3 ranges show average and total number B species vessels that fished in 2004-2006 window period; A-3, A-5 and A-6 ranges show numbers of qualifying vessels that fished during 2004-2006 window period.

2/ Range shows numbers of vessels that took 50%-100% of B species groundfish during 2004-2006 window period (Appendix E).

3/ + means improved management and > means substantially improved management, the degree to which cannot be quantified.

4/ Impacts are for B species groundfish. Ranges show proportion of B species harvest made by non-qualifying vessels during 2004-2006 window period from model runs 1-3. These fish would be made available for future harvest by qualifying vessels (Appendix E)

5/ Ranges show amount of total fishery revenues comprised of B species groundfish by non-qualifying vessels during 2004-2006 window period from model runs 1-3. These values indicate the amount of increase in revenues that would be need to make up for lost B species groundfish landings by non-permitted vessels (Appendix E)

6/ Proportions indicate potential percentage point shifts between states in vessels that would initially qualify for a permit compared to 2004-2006 vessel distributions. Under all alternatives the pluses are WA vessels and the minuses are CA vessels; OR is about even in all comparisons (Appendix E).

7/ negative groundfish and associated overfished species impacts can be expected in years of salmon vessel effort shift to the sablefish fishery as occurred in 2006.

**Agenda Item F.4.a**
**Supplemental Attachment 4**
**March 2008**

# Amendment 22: Open Access License Limitation

**LB Boydstun**

**March 13, 2008**

# Description of the Proposed Action

The proposed action is intended to compliment the existing A permit limited entry program.  It has two parts:

1. Conversion of the **directed** (target) fishery component of the open access fishery to limited entry management (B permit program).

2. Conversion of the **incidental** (non-target) fishery component of the open access fishery to a registration program (C permit program).

The **Purpose and Need Statement** was reviewed at the June 2007 Council Meeting and appears in Subsection 1.3 of the Environmental Assessment.

# Direction from June 2007 Meeting

Include the range of alternatives in the CDFG report and:

1. Add a B permit alternative without a previous year landing requirement;
2. add the GAP alternative to analyze a range of minimum landing requirements;
3. use landings from April 1998-September 2006 to analyze B permit criteria (“window period”);
4. exclude nearshore species' landings in qualifying for a B permit;
5. add an alternative to register, but not limit, all open access vessels;
6. add an alternative that reflects average recent-year vessel participation; and
7. add an alternative that allows full transferability of B permits.

# Table 2-1. Conditions and Assumptions Regarding B & C Permit Programs (Page 1.)

1. The B permit program is intended to better match fleet capacity with resource availability.

2. B permits would be issued to current owners of qualifying vessels and permits would be registered to single vessels.

3. B permits would apply to the directed taking and landing of all federal groundfish not including, nearshore rockfish, cabezon, kelp greenling and California scorpionfish (nearshore groundfish), which are protected under state regulations.

4. A directed open access fishery landing is one in which >50% of the total revenue was of B species groundfish, and directed fishery gear was used. Only landings of B species of groundfish during April 1998 - September 2006 would be considered.

5. State nearshore permits may <u>not</u> be used in lieu of obtaining a B permit.

# Table 2-1. Conditions and Assumptions Regarding B & C Permit Programs (Page 2)

6. A C permit must be registered to a vessel to land incidental amounts of federal groundfish excluding nearshore species. A state-issued nearshore permit registered to the vessel or in possession of a fisherman on board the vessel may be used in lieu of obtaining a federal C permit.

7. Valid B and C permits or state-issued nearshore permits would be required when fishing for, possessing and landing permitted species in U.S. waters off the coasts of Washington, Oregon and California (0-200 miles).

8. B permit limits would be set based upon open access fishery allocations previously established by the Council. C permit landing limits would take into account target species landings (i.e., nearshore or non-groundfish landings).

9. State regulations would continue to be in compliance with federal regulations.

10. B permits would be renewed annually; expired permits would not be renewed. Timing of annual B permit application would align with current A permit renewals (fall of year prior).

# Issues Addressed in Council Alternatives

- Initial fleet size
- Final fleet size goal
- Permit consolidation requirement
- Permit transferability
- Previous year landing requirement
- Length & gear endorsement
- A & B permit usage on same vessel
- B & C permit coverage on same vessel

# Alternatives

Table 2-3. Summary of Council's federal license or permit management alternatives

| Issue to be addressed | Alt 1 No Action | Alt 2 License Registration | Alt 3 Recent Average | Alt 4 Minimum Landing Requirement | Alt 5 Fleet Reduction | Alt 6 Fleet Reduction |
|---|---|---|---|---|---|---|
| **Initial fleet size** | | | | | | |
| **Fleet size goal** | | | | | | |
| **Permit consolidation requirement** | | | | | | |
| **Permit transferability** | | | | | | |
| **Previous year landing requirement** | | | | | | |
| **Length and gear endorsement** | | | | | | |
| **A & B permit usage on same vessel** | | | | | | |
| **B and C permit coverage on same vessel** | | | | | | |

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| Issue to be addressed | Alt 1 No Action | Alt 2 License Registration | Alt 3 Recent Average | Alt 4 Minimum Landing Requirement | Alt 5 Fleet Reduction | Alt 6 Fleet Reduction |
|---|---|---|---|---|---|---|
| **Initial fleet size** | **n/a** | **n/a** | **recent average (680 vessels)** | **based on permit qualification criteria impact** | **2000 fleet size (850 vessels)** | **1994-99 fleet size (390 vessels)** |
| **Fleet size goal** | | | | | | |
| **Permit consolidation requirement** | | | | | | |
| **Permit transferability** | | | | | | |
| **Previous year landing requirement** | | | | | | |
| **Length and gear endorsement** | | | | | | |
| **A & B permit usage on same vessel** | | | | | | |
| **B and C permit coverage on same vessel** | | | | | | |

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|---|---|---|---|---|---|---|
| Initial fleet size | n/a | n/a | recent average (680 vessels) | based on permit qualification criteria impact | 2000 fleet size (850 vessels) | 1994-99 fleet size (390 vessels) |
| Fleet size goal | n/a | n/a | Same as initial fleet size | Same as initial fleet size | a. 50% reduction (to 430)<br><br>b. 80% reduction (to 170) | 80% reduction from 2000 fleet size (to 170) |
| Permit consolidation requirement | | | | | | |
| Permit transferability | | | | | | |
| Previous year landing requirement | | | | | | |
| Length and gear endorsement | | | | | | |
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| Fleet size goal | n/a | n/a | Same as initial fleet size | Same as initial fleet size | a. 50% reduction (to 430)<br>b. 80% reduction (to 170) | 80% reduction from 2000 fleet size (to 170) |
| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | | | | | | |
| Previous year landing requirement | | | | | | |
| Length and gear endorsement | | | | | | |
| A & B permit usage on same vessel | | | | | | |
| B and C permit coverage on same vessel | | | | | | |

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| Fleet size goal | n/a | n/a | Same as initial fleet size | Same as initial fleet size | a. 50% reduction (to 430)<br>b. 80% reduction (to 170) | 80% reduction from 2000 fleet size (to 170) |
| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | n/a | n/a | yes, once per year | yes, once per year | yes, once per year | not specified |
| Previous year landing requirement | | | | | | |
| Length and gear endorsement | | | | | | |
| A & B permit usage on same vessel | | | | | | |
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Table 2-3. Summary of Council's federal license or permit management alternatives

| Issue to be addressed | Alt 1<br>No Action | Alt 2<br>License Registration | Alt 3<br>Recent Average | Alt 4<br>Minimum Landing Requirement | Alt 5<br>Fleet Reduction | Alt 6<br>Fleet Reduction |
|---|---|---|---|---|---|---|
| **Initial fleet size** | **n/a** | **n/a** | **recent average (680 vessels)** | **based on permit qualification criteria impact** | **2000 fleet size (850 vessels)** | **1994-99 fleet size (390 vessels)** |
| **Fleet size goal** | **n/a** | **n/a** | **Same as initial fleet size** | **Same as initial fleet size** | **a. 50% reduction (to 430)**<br><br>**b. 80% reduction (to 170)** | **80% reduction from 2000 fleet size (to 170)** |
| **Permit consolidation requirement** | **n/a** | **n/a** | **none** | **none** | **yes** | **none** |
| **Permit transferability** | **n/a** | **n/a** | **yes, once per year** | **yes, once per year** | **yes, once per year** | **not specified** |
| **Previous year landing requirement** | **n/a** | **n/a** | **no** | **no** | **yes** | **yes** |
| **Length and gear endorsement** | | | | | | |
| **A & B permit usage on same vessel** | | | | | | |
| **B and C permit coverage on same vessel** | | | | | | |

# Alternatives

Table 2-3. Summary of Council's federal license or permit management alternatives

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| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | n/a | n/a | yes, once per year | yes, once per year | yes, once per year | not specified |
| Previous year landing requirement | n/a | n/a | no | no | yes | yes |
| Length and gear endorsement | n/a | n/a | none | none | yes | yes |
| A & B permit usage on same vessel | | | | | | |
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| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | n/a | n/a | yes, once per year | yes, once per year | yes, once per year | not specified |
| Previous year landing requirement | n/a | n/a | no | no | yes | yes |
| Length and gear endorsement | n/a | n/a | none | none | yes | yes |
| A & B permit usage on same vessel | n/a | n/a | yes, alternately in same yr 2/ | yes, alternately in same yr 2/ | not in same yr | not in same yr |
| B and C permit coverage on same vessel | | | | | | |

# Alternatives

Table 2-3. Summary of Council's federal license or permit management alternatives

| Issue to be addressed | Alt 1 No Action | Alt 2 License Registration | Alt 3 Recent Average | Alt 4 Minimum Landing Requirement | Alt 5 Fleet Reduction | Alt 6 Fleet Reduction |
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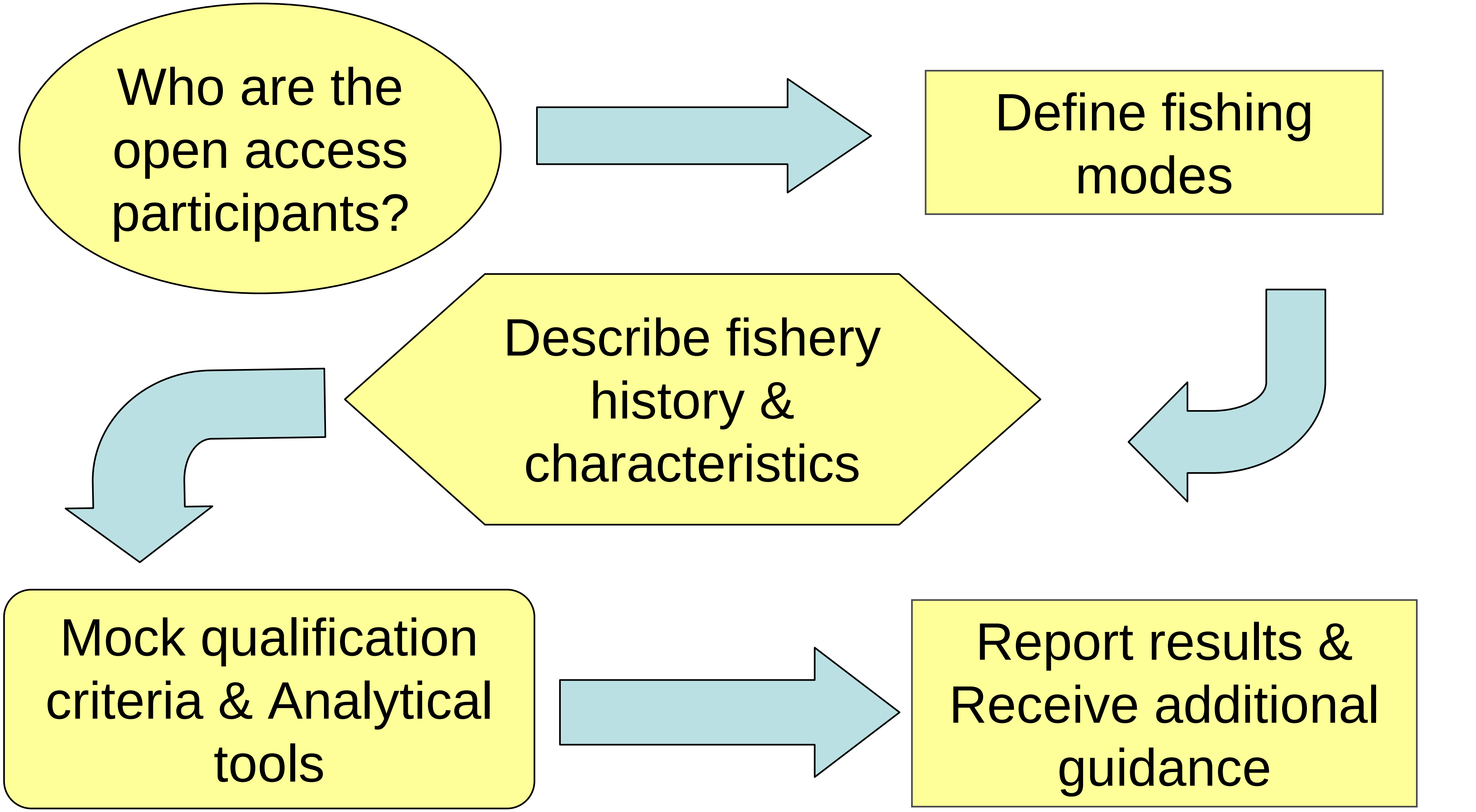
| Fleet size goal | n/a | n/a | Same as initial fleet size | Same as initial fleet size | a. 50% reduction (to 430)<br><br>b. 80% reduction (to 170) | 80% reduction from 2000 fleet size (to 170) |
| Permit consolidation requirement | n/a | n/a | none | none | yes | none |
| Permit transferability | n/a | n/a | yes, once per year | yes, once per year | yes, once per year | not specified |
| Previous year landing requirement | n/a | n/a | no | no | yes | yes |
| Length and gear endorsement | n/a | n/a | none | none | yes | yes |
| A & B permit usage on same vessel | n/a | n/a | yes, alternately in same yr 2/ | yes, alternately in same yr 2/ | not in same yr | not in same yr |
| B and C permit coverage on same vessel | n/a | n/a | See Table 2-1 | See Table 2-1 | See Table 2-1 | See Table 2-1 |

# The Open Access Permitting Process Initial Steps



# Who Are the Participants?

- Non-A permit registered commercial fishing vessels; i.e., vessels with federal groundfish landings that counted against open access allocations or general commercial harvest guidelines, and

- Used open access gear; i.e., longline, trap, pot, hook-and-line, setnet (S. of 38° N. lat) and non-groundfish trawl (pink shrimp, California halibut, and sea cucumber).

# Fishing Modes

There are two recognized modes of open access fishing: (1) targeted or directed groundfish fishing and (2) incidental groundfish fishing. Vessels may have participated in one or both modes within the same landing period. Individual fishing trip modes are differentiated as follows:

- Directed fishing trips are defined as those in which 1) non-salmon hook-and-line, fishpot or set net gear was used and 2) 50% or greater of the revenues were of specified federal groundfish.
- All other open access fishing trips are defined as incidental fishing trips. These include salmon troll, non-groundfish trawl, non-open access gear landings, and open access gear landings with <50% revenues of specified groundfish.

# How a Directed Fishery Landing is Computed

**Directed landing** = 50% or greater of revenues were of B species groundfish, excluding nearshore species.

Example 1

| Landing Receipt Scenario | |
|---|---|
| Sablefish | $50 |
| ~~Black RF~~ | ~~$120~~ |
| White croaker | $30 |
| TOTAL | $200 |

$$\frac{\$50 \text{ (Sablefish)}}{\$80 \text{ (Sablefish + White croaker)}} = 62\%$$

***Included as a Directed Landing***

# How a Directed Fishery Landing is Computed

**Directed landing** = 50% or greater of revenues were of B species groundfish, excluding nearshore species.

Example 2

| Landing Receipt Scenario | |
|---|---|
| Lingcod | $10 |
| ~~Cabezon~~ | ~~$180~~ |
| Halibut | $160 |
| TOTAL | $350 |

$$\frac{\$10\ \text{(Lingcod)}}{\$170\ \text{(Lingcod + Halibut)}} = 5\%$$

***NOT Included as a Directed Landing***

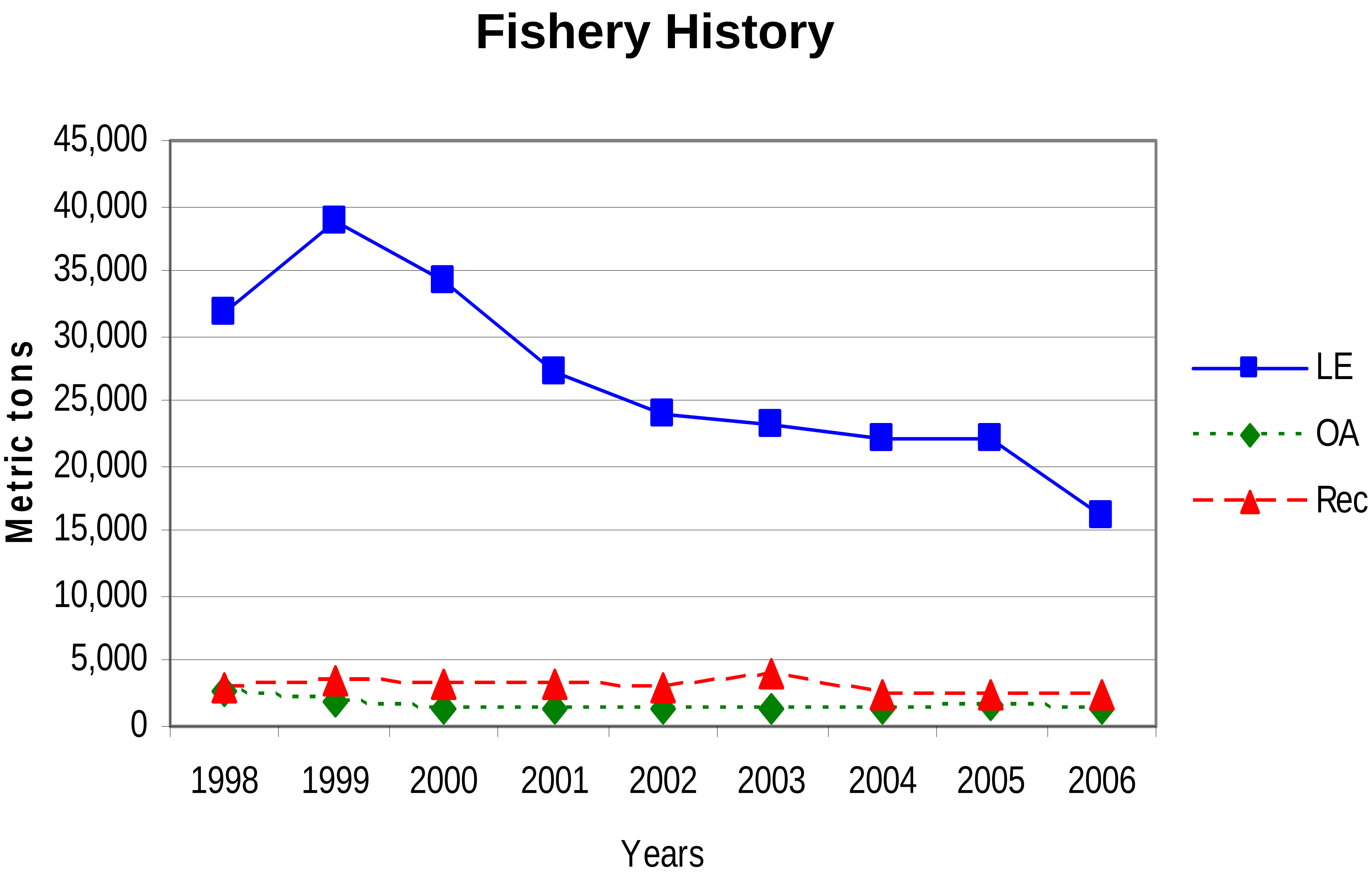



Figure 3-1. Groundfish landing trends in WOC groundfish fisheries by sector and year

# Fishery History

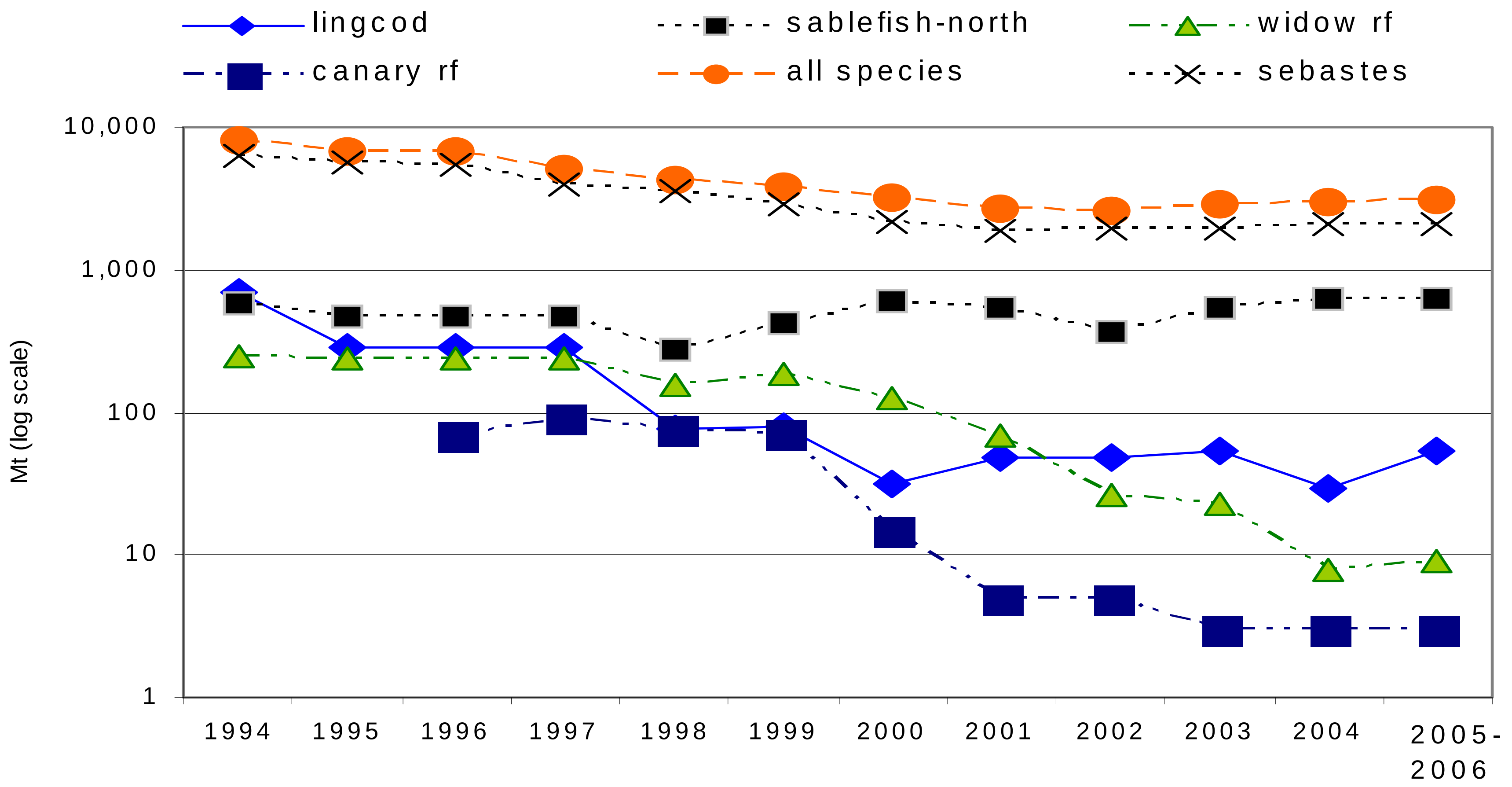



Figure 1-1. Open access fishery harvest guidelines for key groundfish stocks and in total, 1994-2006

# Fishery History

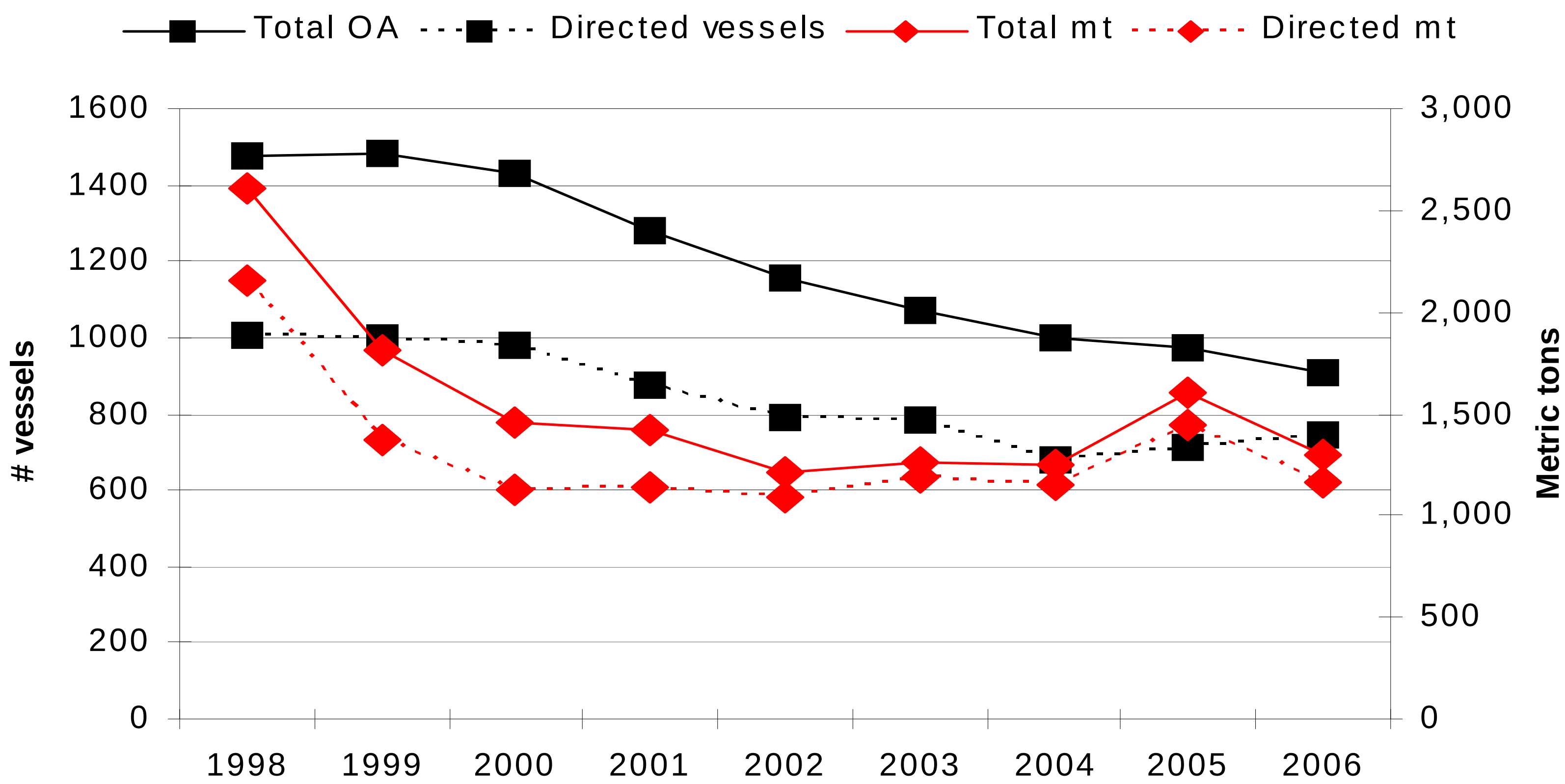



Figure 3-2. Number of vessels and directed landings of total and directed open access fisheries (1998-2006)

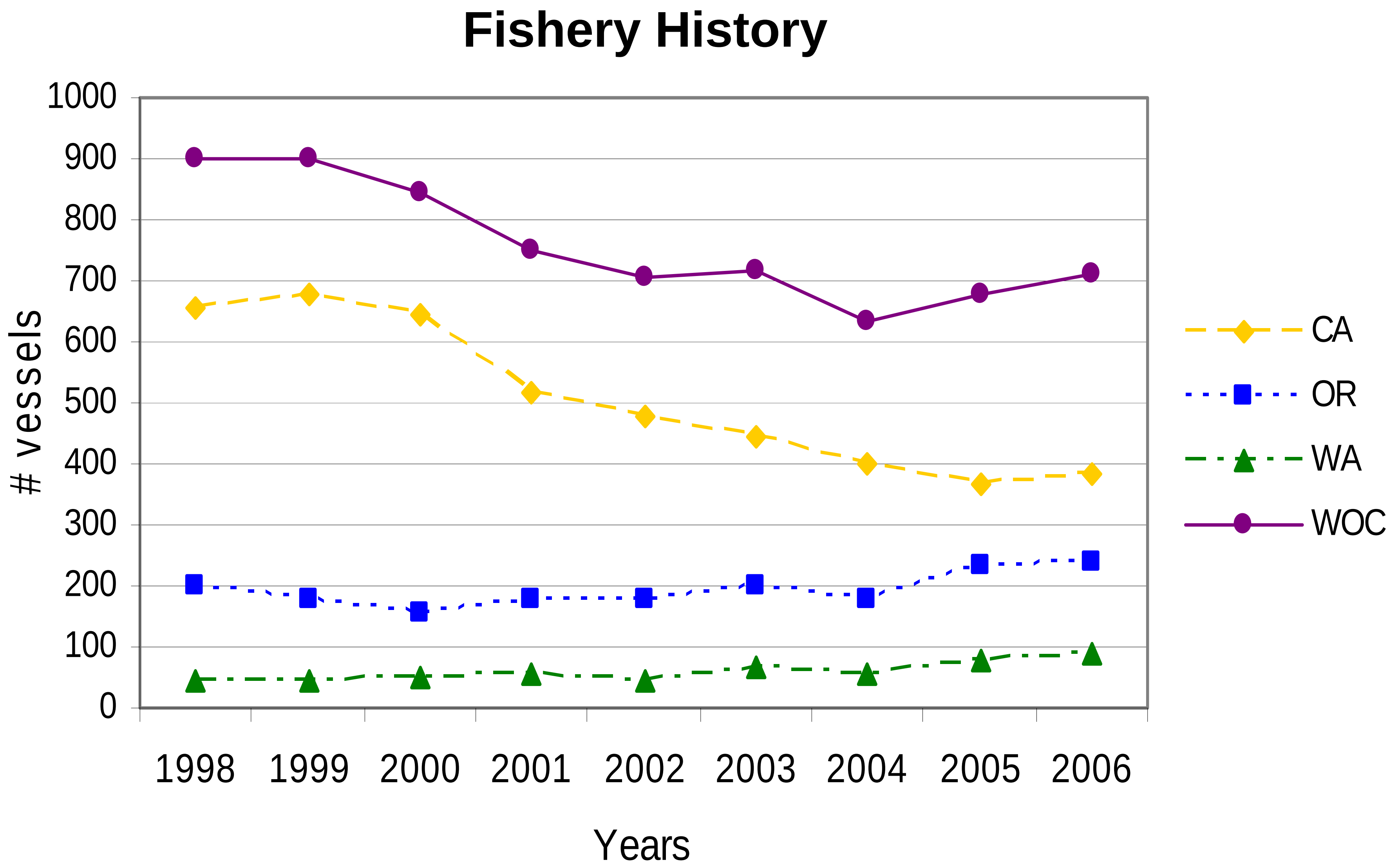



Fig 2-1. Number of vessels directly targeting open access groundfish species by state and coastwide, 1998-2006.

# Fishery Characteristics

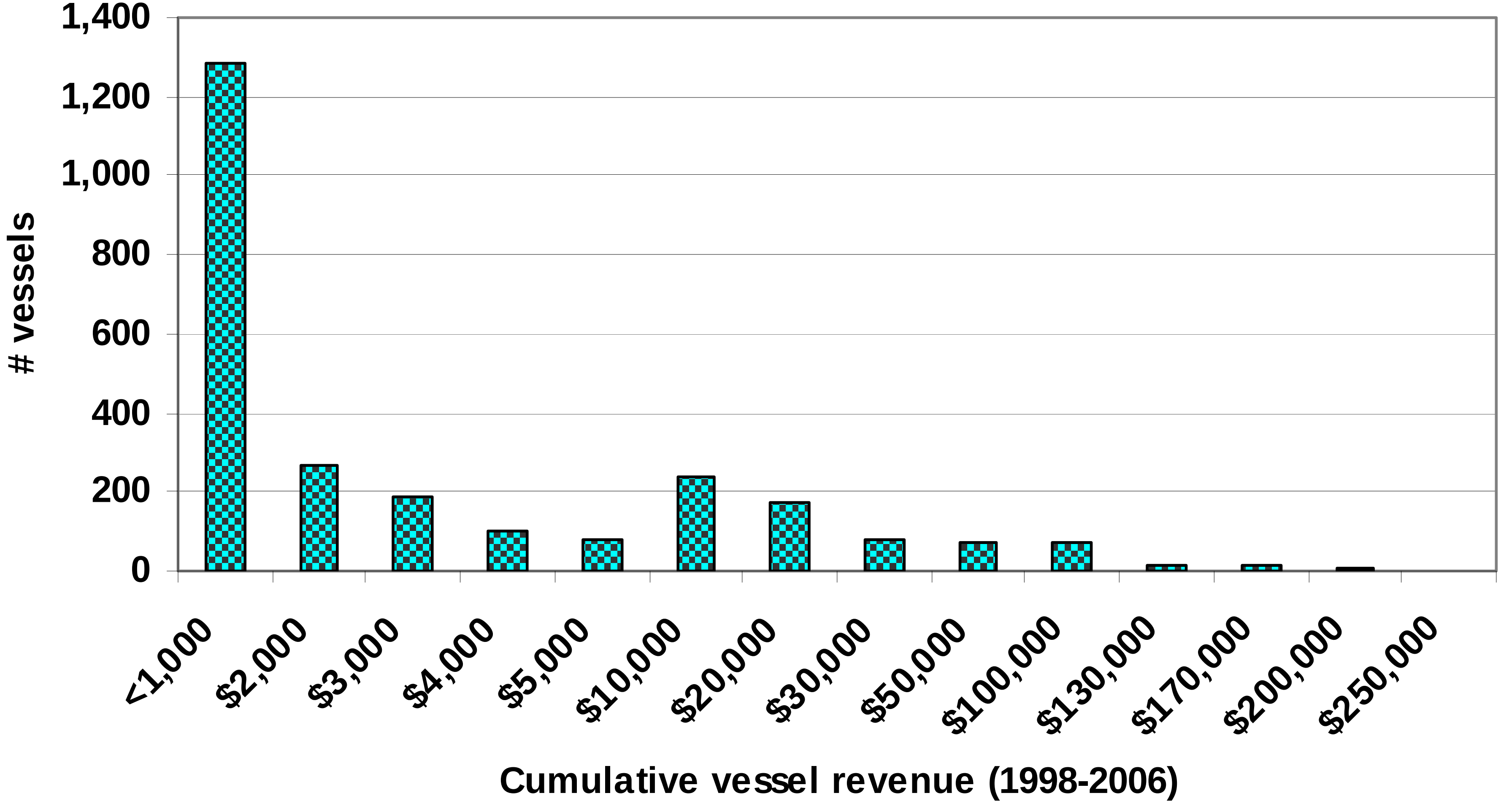



Figure ES-2. Total revenue frequencies for WOC vessels (n = 2,857) that made B species landings during 1998-2006.

# Fishery Characteristics

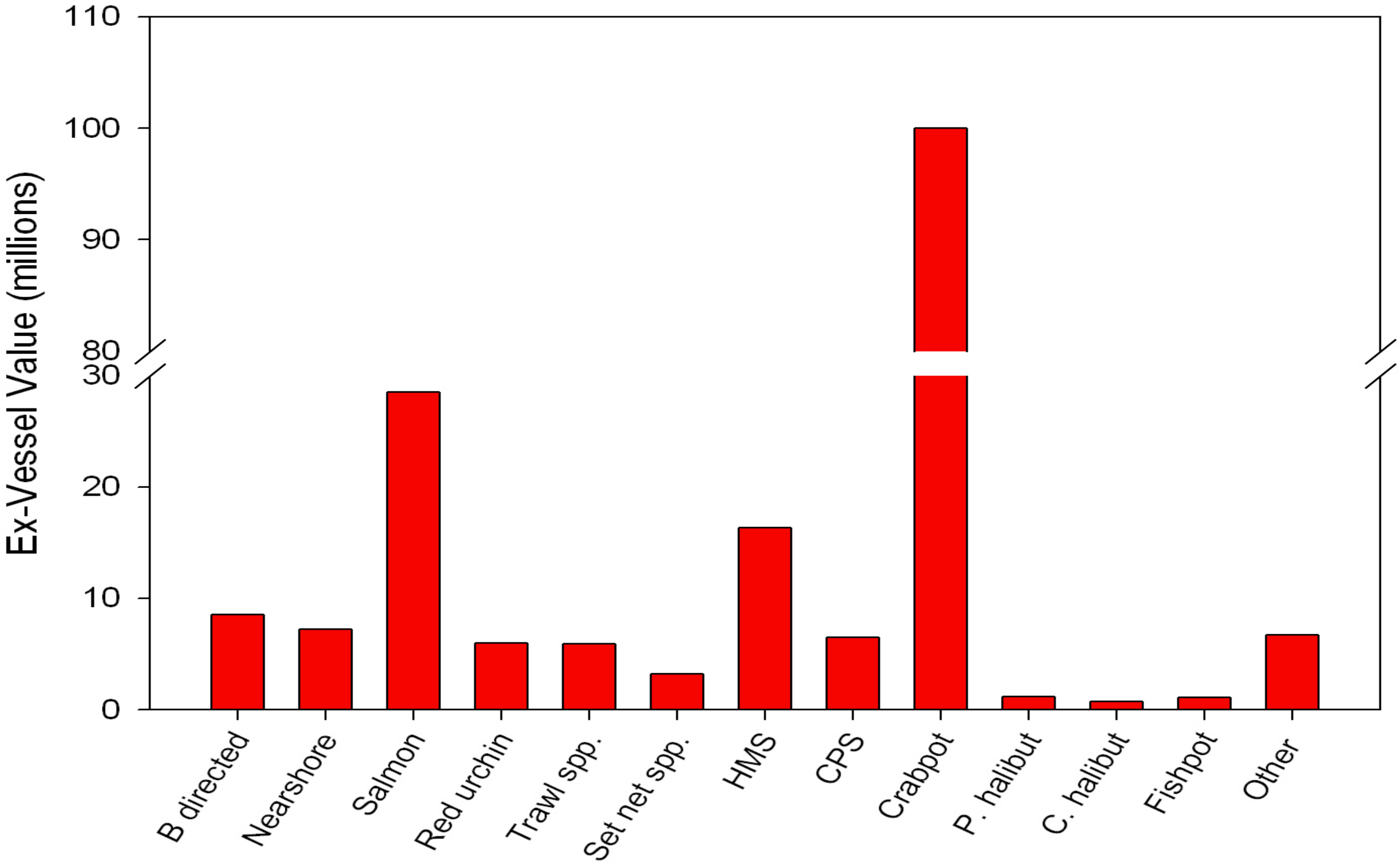



Figure ES-3 Commercial fishery revenues for B directed vessels, 1998-2006.

# Fishery Characteristics

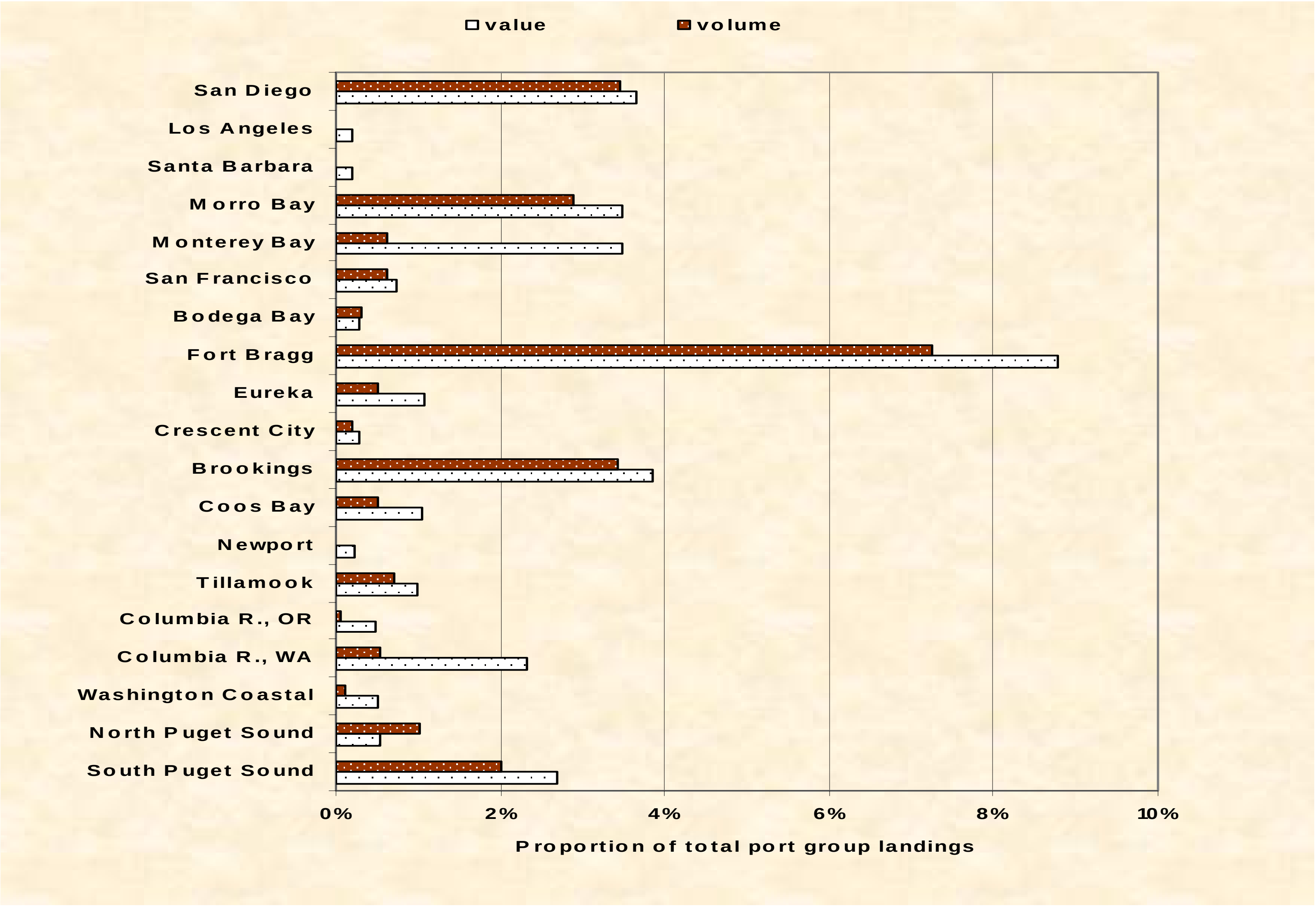



Fig 3-7. B species groundfish landings expressed as a proportion of WOC port group commercial fishery landings, 2004-2006 combined

# Fishery Characteristics

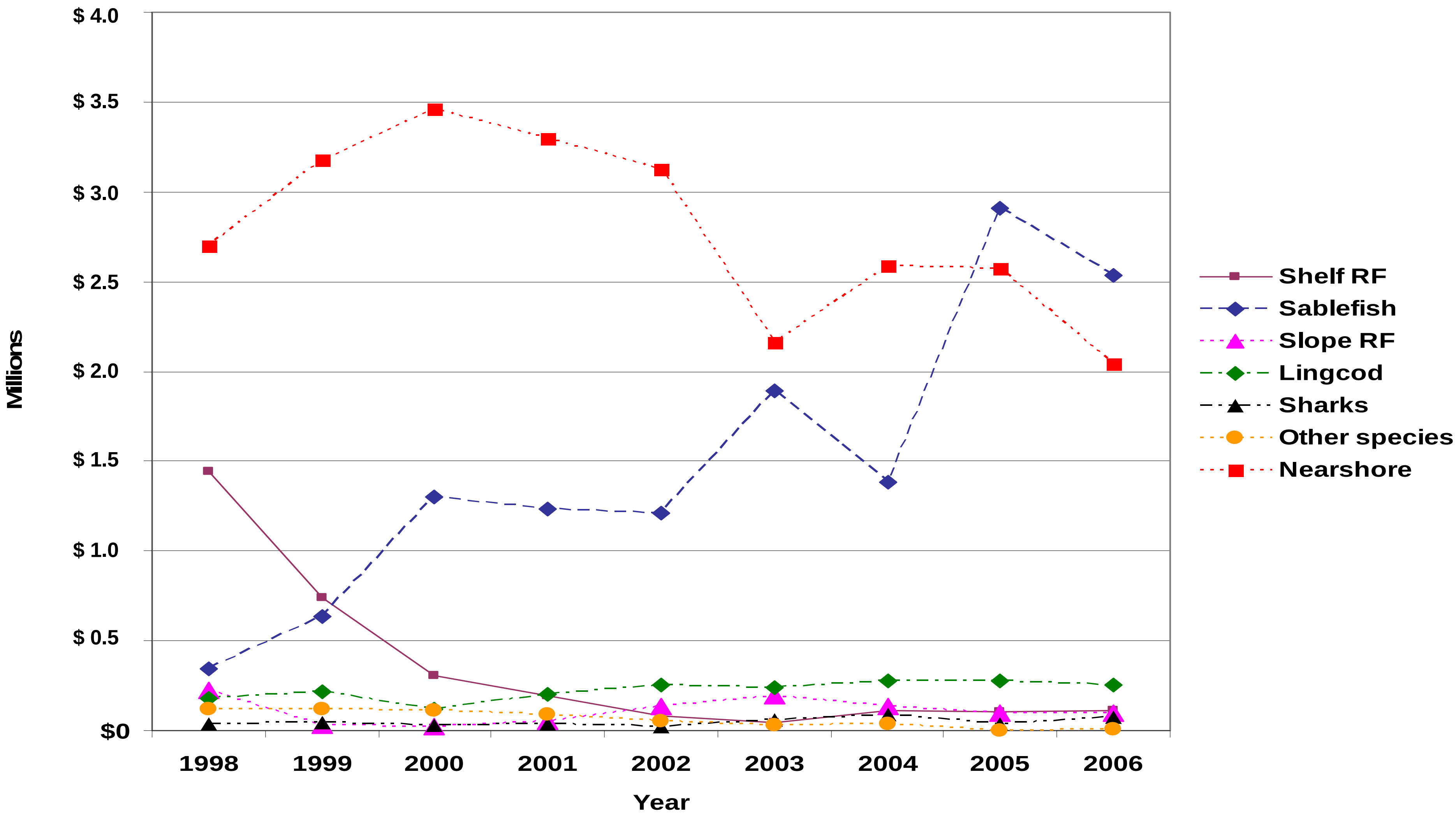



Figure 3-4. Trends in directed fishery revenues by species and year, 1998-2006

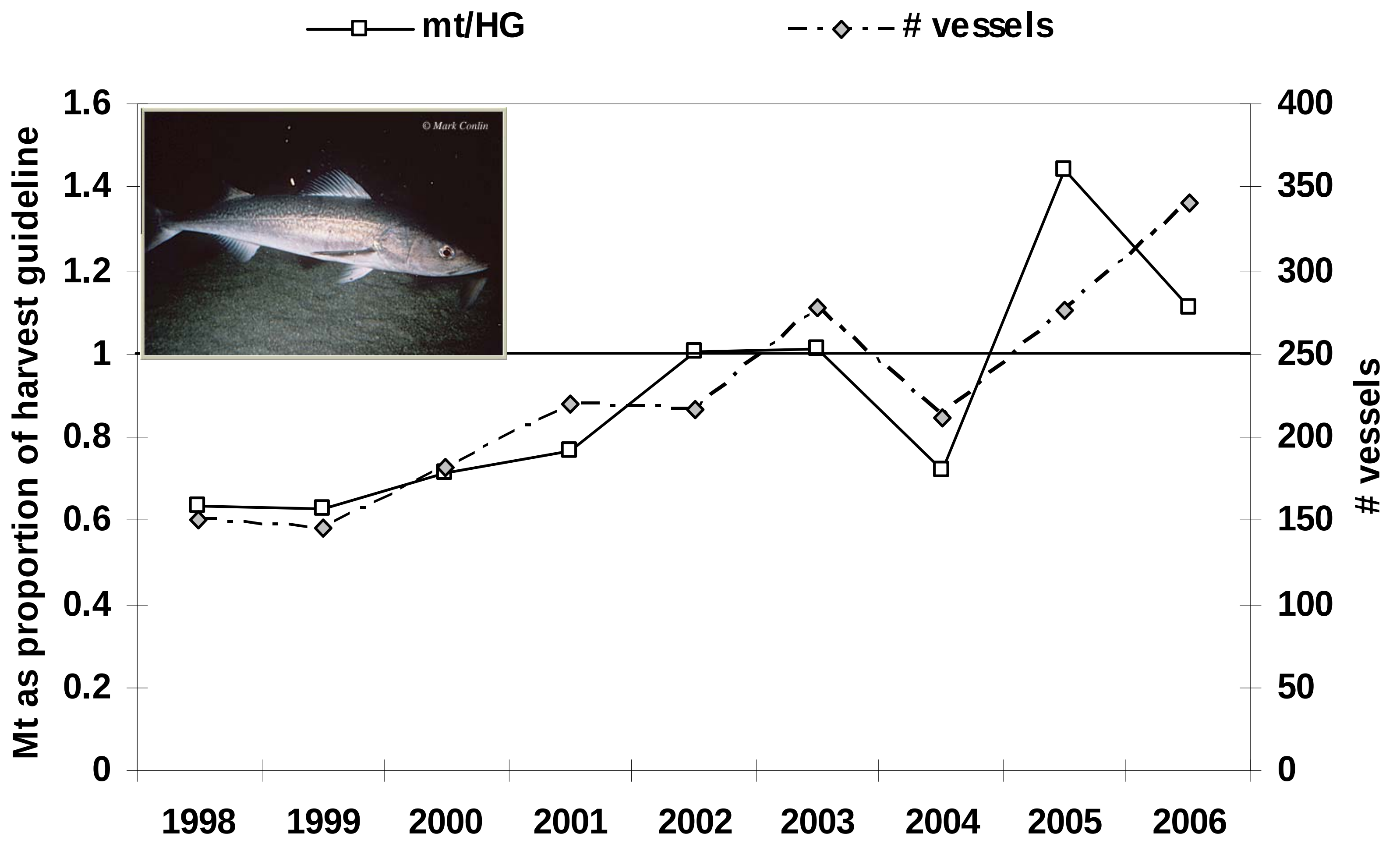



**Figure 3- 5. Number of vessels directly targeting sablefish and landings shown as a proportion of annual sablefish allocation, Monterey-Vancouver area, 1998-2006.**

# Fishery Characteristics

| # years | 1998-2006 | 2004-2006 |
|---|---|---|
| 1 | 1117 | 508 |
| 2 | 517 | 287 |
| 3 | 309 | 308 |
| 4 | 201 | |
| 5 | 157 | |
| 6 | 93 | |
| 7 | 62 | |
| 8 | 60 | |
| 9 | 71 | |
| | 2,587 | 1,103 |

403 new vessels entered that had not fished previously during 1998-2003

1,484 vessels had landings during 1998-2003, but had no landings during 2004-2006

**Many vessels (63%) participated in one or two years, while few vessels (17%) participated in most years (>4) of the window period.**

# Qualification Criteria: "Toggles" and "Dials"

- Minimum poundage or revenue requirement in any year or combination of years (yes/no toggle).
- Cumulative poundage or revenues in any series or combination of years (adjustable dial).
- Directed fishery landing (trip) requirement in any year or combination of years (yes/no toggle).
- Others?

# Mock Qualification Criteria used for Analysis of Alternatives

1. **Model Run #1:** Cumulative vessel landings in pounds of B species groundfish during *2004-2006*

2. **Model Run #2**: Cumulative vessel landings in pounds of B species groundfish during the *1998-2006*

3. **Model Run #3:** Cumulative vessel landings in pounds of B species groundfish during the *1998-2006 in combination with a 2004-2006* B permit species landing requirement

***Qualifying criteria can be added to any model run*

Table ES-3. Summary of registration requirements, fleet size goals, fleet size expectations, and environmental consequences associated with the Council's alternatives

| Issue | Stage | Reference | Alternative A-1 | A-2 | A-3 | A-4 | A-5 | A-6 |
|---|---|---|---|---|---|---|---|---|
| Environmental impact | | | | | | | | |
| Physical environment | | § 3.1, and § 4.0 | N/C | N/C | N/C | N/C | N/C | N/C |
| Biological environment | | | | | | | | |
| Groundfish | | § 3.2.1 | 7/ | 7/ | N/C | N/C | N/C | N/C |
| Non-groundfish | | § 3.2.2 | N/C | N/C | N/C | N/C | N/C | N/C |
| Prohibited species | | § 3.2.3 | N/C | N/C | N/C | N/C | N/C | N/C |
| Protected species | | § 3.2.4 | N/C | N/C | N/C | N/C | N/C | N/C |
| Socioeconomic environment | | | | | | | | |
| Fishery mgmt 3/ | | § 2.0 | N/C | + | + | N/C to > | + or > | > |
| Catch comp. | | | | | | | | |
| Groundfish **4/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 2% to 9% | 0% to 64% | 0%-5% | 9%-20% |
| | 2) | | | | N/A | N/A | a) 7%-17% b) 29%-43% | 29%-43% |
| Non-groundfish **5/** | 1) | Tabs E-7, E-8, E-9 | N/C | N/C | 1% to 2% | 0%-5% | 0% to 2% | 1%-2% |
| | 2) | | | | N/A | N/A | a) 1%-2% b) 3%-4% | 3%-4% |
| Vessels char. 6/ | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Processors 6/ | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Licensing, etc. | | § 3.3.5, § 3.3.[illegible] | N/C | N/C | N/C | N/C | N/C | N/C |
| Costs | | § 2.0 | N/C | minor | minor | minor | minor | minor |
| Communities 6/ | | Tabs E-3, E-4, E-5 | N/C | N/C | +6 to -8 | +13 to -8 | +5 to -2 | +11 to -12 |
| Environmental Justice | | § 1.5 and § 3.3.8 | N/C | N/C | N/C | N/C | N/C | N/C |

Very important information; discussed in next slides

# B Permit Benefits: Less Restrictive Landing Limits?

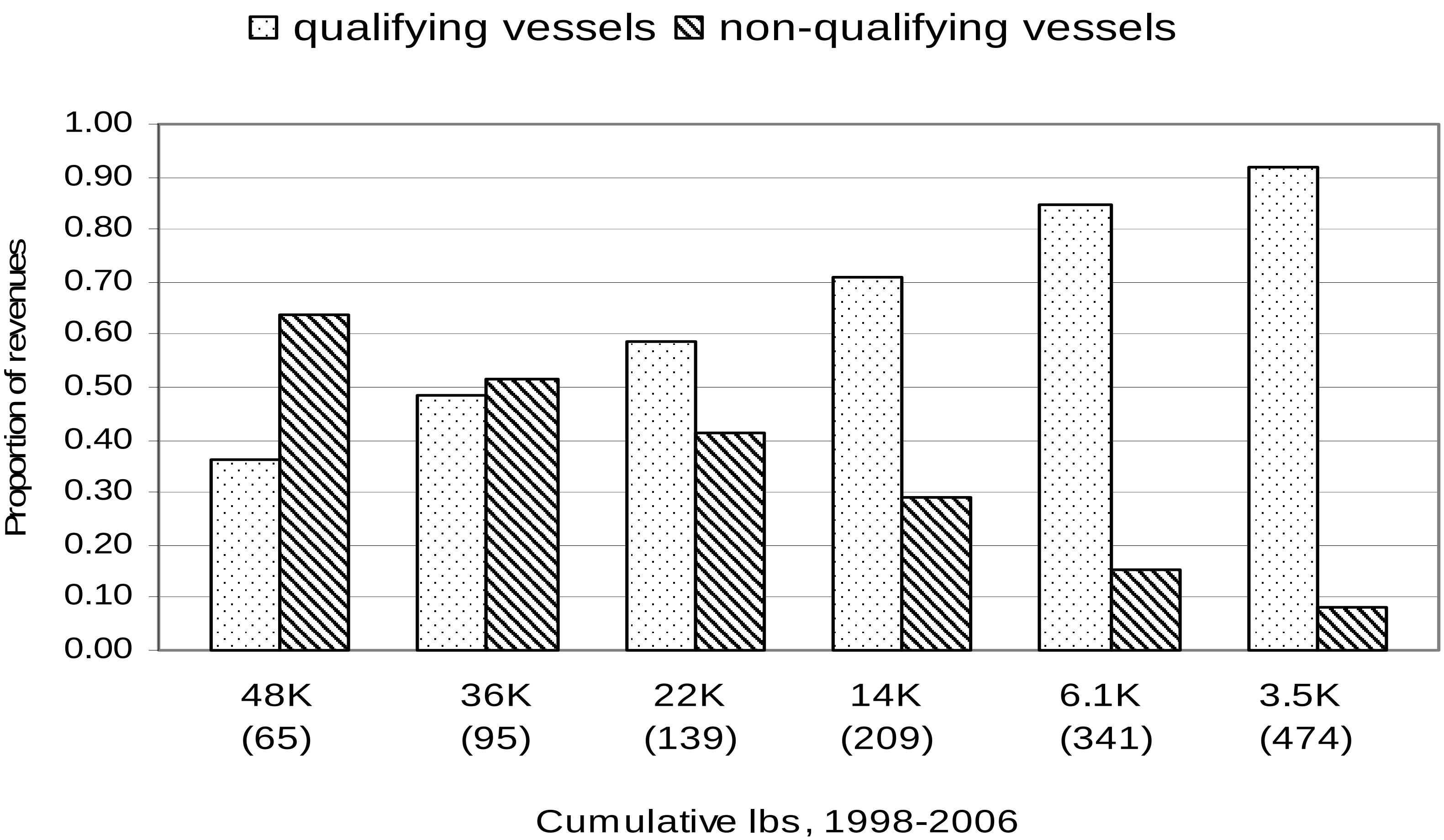



**Figure E-8. Proportion of B species revenues (2004-2006) by vessels that met specified minimum landing requirements using Model Run # 3 qualification criteria.**

# Lost Revenues by Non-Qualifying Vessels

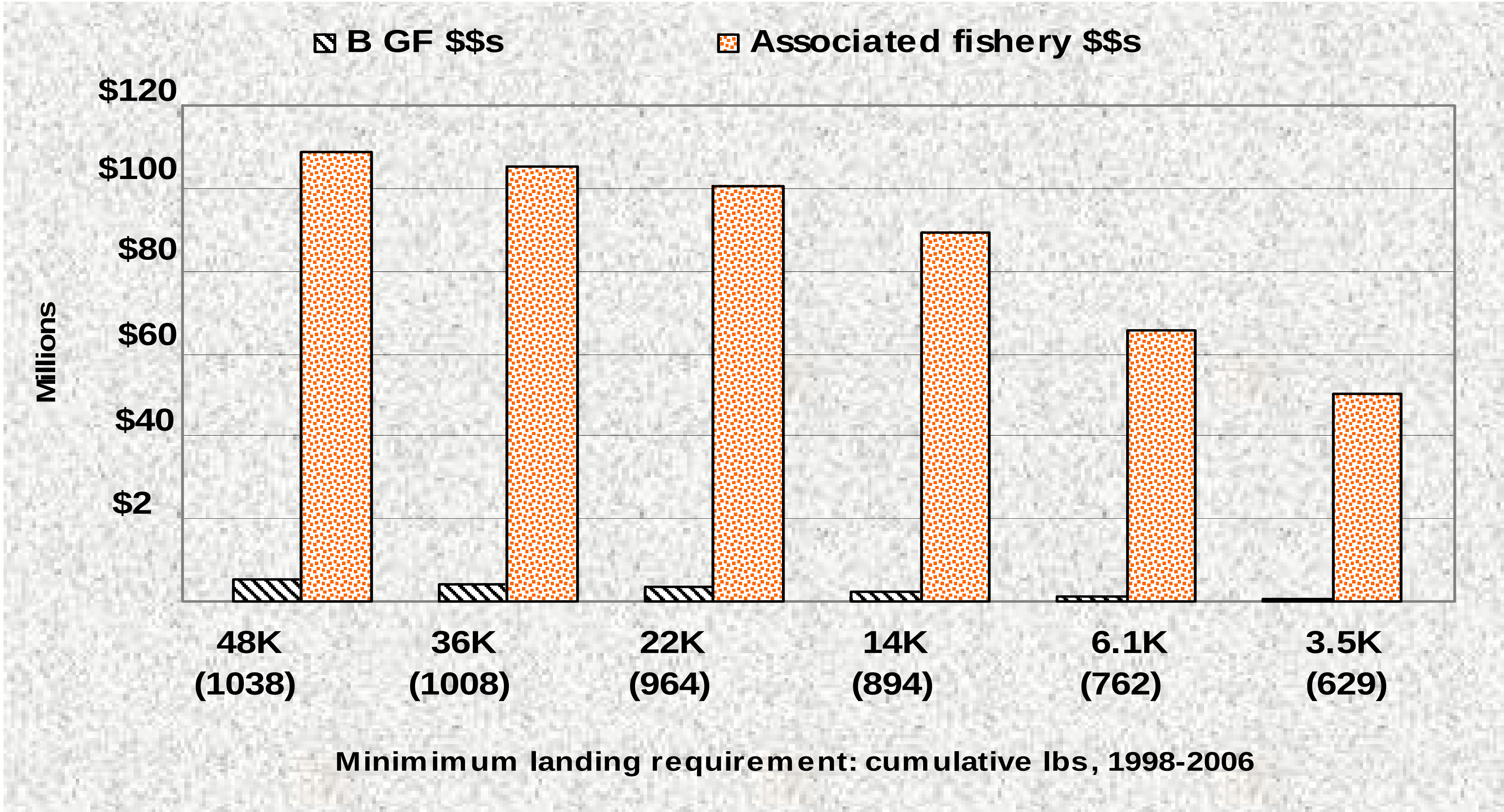
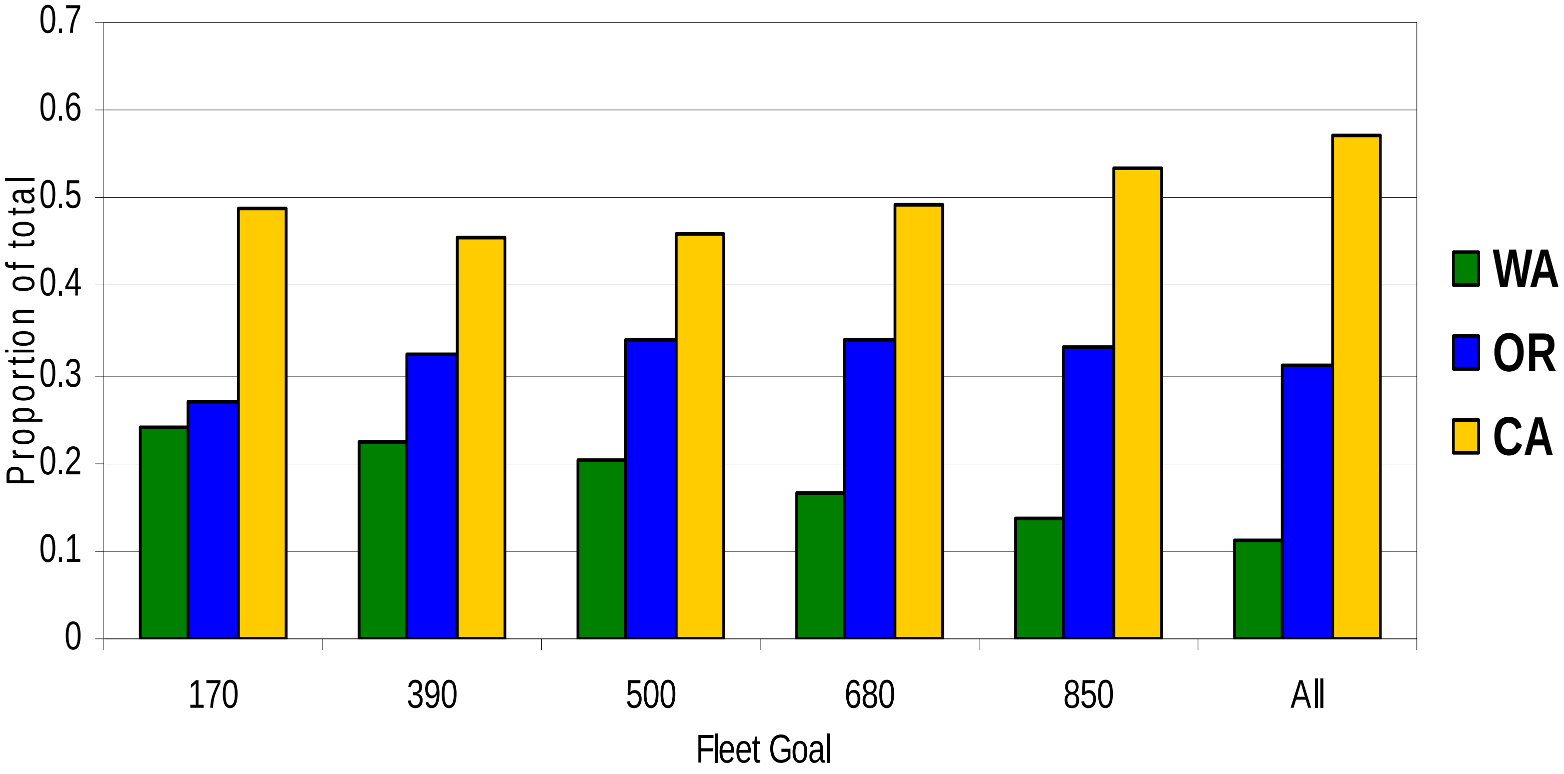



Figure E-8b. B species and associated commercial species revenues during 2004-2006 by vessels not meeting specified minimum landing requirements (# vessels)

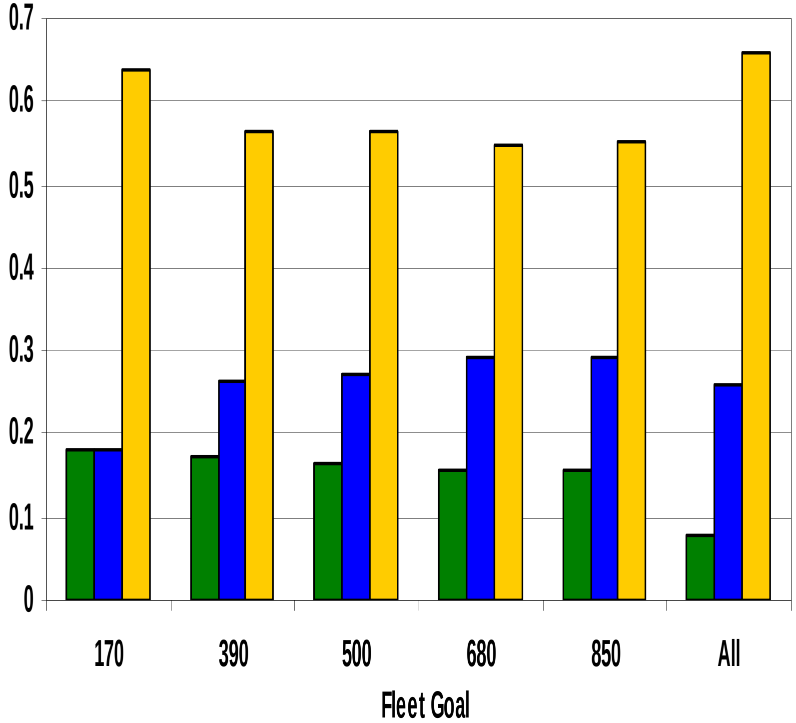
# Results of Model Runs: Allocative Implications

Model # 1 (04-06)
1,103 vessels

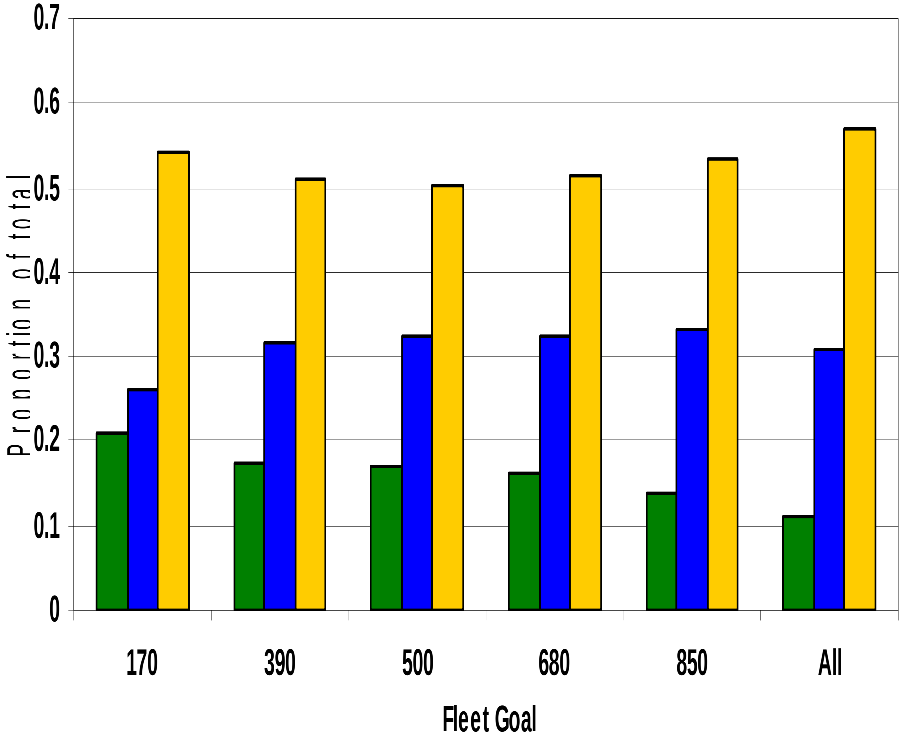


# Results of Model Runs: Allocative Implications

Model # 2 (98-06)
2,587 vessels




Model # 3 (98-06 & 04-06)
1,103 vessels



# Issues to be Resolved: Direction Requested

Council direction on what type of opportunity the future open access fishery should provide

- Qualification criteria? Specify toggles and dials.
- Additional or replacement alternatives, issues within alternatives, or analytical techniques to use?
- Gear endorsement provision: single or multiple gear types? Threshold level to use for multiple gear types?
- Timeline for EA completion?


Questions ?

Agenda Item F.4.c
Supplemental Public Comment 2
March 2008

**Statement by Dr. Stephen M. Barrager, member, Groundfish Advisory Subpanel, to the Pacific Fishery Fishery Management Council regarding Management Plan Amendment 22: Open Access License Limitation.**

Ladies and Gentlemen, I am asking you to consider a new alternative for evaluation. The alternative is to use tradable Dedicated Access Privileges (DAPs, aka, Individual Quotas or catch shares) as the economic instrument to allocate and manage a limited access fishery. This approach is significantly different and I think it is compelling.

**Context**

The West Coast fishing industry is in the process of being rationalized. The objective of rationalization is to increase efficiency and profitability. DAP's have been selected as an important tool in this rationalization process.

If DAPs are successful we can envision a day when they are used across virtually all fisheries. The hope is that we will move from an era of cumbersome regulation to efficient, profitable and more-or-less self-regulating markets. Although this is not a certainty, it does have a high probability of happening.

**Rational**

Conversion of the Open Access Fishery to federal management presents an opportunity to implement a DAP-based system rather than using traditional regulatory approaches. This would move rationalization forward one more significant step.

If we don't do DAPs now then we will probably want to do them in the not- too-distant future. It would be wasteful to go through this process twice -- first to implement permits, then to go from permits to DAPs. The end result is the same but the work is doubled. What is the logic of this?

I think we would all learn a lot by putting this option on the table and evaluating it. Much of the required analysis is probably being done in connection with the Individual Trawl Quota (ITQ) program. The incremental work load might be nominal.

The upside of this alternative is that we save money and time, speed rationalization and add to our skill in rolling out a new way of doing business.

Thank you for your attention and your kind consideration.

# ENFORCEMENT CONSULTANTS REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The Enforcement Consultants (EC) have evaluated Agenda Item F.4.a Attachment 1, March 2008, Preliminary Draft Environmental Assessment for Pacific Coast Groundfish Fishery Management Plan Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management, and have the following comments.

The EC strongly endorse the efforts by this Council to convert the Open Access Fishery to a federally permitted program, and offer the following suggested changes/additions for consideration.

Bullet 6, found in *Table ES-1 Basic conditions and assumptions regarding B and C permit programs*, reads as follows: *A vessel must be registered to a C permit to land incidental amounts of Federal groundfish excluding nearshore species. A state issued nearshore permit registered to the vessel or in possession of a fisherman on board the vessel could be used in lieu of obtaining a Federal C permit when fishing for and possessing Federal groundfish in state or Federal waters.* We proposed this nearshore permit option be restricted to state waters only, and that a B or C permit be required to fish in Federal waters. With this change, fishing in Federal waters would require a Federal permit. Fisherman fishing exclusively in state waters would not be required to have a Federal permit, and would be permitted to fish for and land federally managed groundfish under their nearshore permit. The EC believes this is a straight forward, understandable permitting requirement that meets the stated objectives of the needs statement found on page iii, while preserving the California and Oregon nearshore permit programs.

The EC recommends that when this program is implemented, that vessels assigned a B or C permit be required to carry Vessel Monitoring System (VMS). Vessels fishing exclusively in state waters under a nearshore permit would be exempt from any VMS requirement. This provision will preserve the status quo of the current VMS program requirements for the Open Access fishery and provides a seamless transition regarding VMS requirements as we implement this new Federal permit program.

In Summary the EC recommends:

1. Restrict fishing under a nearshore permit to state waters.
2. Require either a B or C permit to fish Open Access in Federal waters.
3. Upon implementation, all vessels assigned a B or C permit will be required to carry VMS.

PFMC
03/12/08

# Groundfish Allocation Committee Report

Pacific Fishery Management Council
Sheraton Portland Airport Hotel
Cascade Room
8235 N.E. Airport Way
Portland, Oregon 97220
February 22, 2008

**Committee Members Present:**
Mr. Donald Hansen, Dana Wharf Sport Fishing, Pacific Fishery Management Council Chairman
Dr. David Hanson, Pacific States Marine Fisheries Commission
Ms. Gway Kirchner, Oregon Department of Fish and Wildlife Representative
Ms. Michele Culver, Washington Department of Fish and Wildlife Representative
Ms. Marija Vojkovich, California Department of Fish and Game Representative
Mr. Frank Lockhart, National Marine Fisheries Service Northwest Regional Office, NMFS Representative

**Non-voting Advisors Present:**
Mr. Pete Leipzig, Limited Entry Trawl Representative
Ms. Heather Mann, Shoreside Processor Representative
Mr. Shems Jud, Conservation Representative
Mr. Robert Osborn, Recreational Representative
Ms. Michele Longo-Eder, Limited Entry Fixed Gear Representative
Mr. Tom Ghio, Open Access Representative
Mr. Dan Waldeck, At-sea Processor Representative
Ms. Eileen Cooney, National Oceanic and Atmospheric Administration (NOAA) General Counsel

**Others Present:**
Mr. L.B. Boydstun, Pacific Fishery Management Council Consultant
Mr. Rod Moore, West Coast Seafood Processors Association, Council Member
Dr. Donald McIsaac, Pacific Fishery Management Council Executive Director
Mr. Corey Niles, Washington Department of Fish and Wildlife, GMT Member
Ms. Heather Reed, Washington Department of Fish and Wildlife, GMT Member
Ms. Joanna Grebel, California Department of Fish and Game, GMT Member
Mr. Robert Jones, Northwest Indian Fisheries Commission, GMT Member
Mr. Jim Seger, Pacific Fishery Management Council Staff
Mr. John DeVore, Pacific Fishery Management Council Staff
Ms. Heather Brandon, Pacific Fishery Management Council Staff
Ms. Kelly Ames, Oregon Department of Fish and Wildlife, GMT Member
Mr. Marion Larkin, Washington Trawl, GAP Member
Mr. Dayna Mathews, NOAA Office for Law Enforcement
Ms. Laura Pagano, Natural Resources Defense Council

Mr. Steve Bodnar, Coos Bay Trawlers Association and Bandon Submarine Cable Committee
Mr. Randy Fisher, Pacific State Marine Fisheries Commission
Mr. Bill James, Open Access Fisherman
Mr. William Daspit
Ms. Lucia Morici

The Groundfish Allocation Committee (GAC) identified the following issues regarding Amendment 22: Open Access Limitation: Adopt Alternatives for Public Review (Agenda Item F.4, March 2008).

- Consider Amendment 22 Open Access Limitation alternatives at the March 2008 Council meeting.
- Consider selecting a preliminary preferred alternative at the September 2008 Council meeting with a final preferred alternative at a future Council meeting in order to facilitate a 2010 implementation goal.
- The intent of the range of alternatives before the Council in March is to provide program elements that can be combined in order to create a preferred alternative with acceptable elements.
- Some draft alternatives allow use of both a "B" permit and an "A" permit on the same vessel during the same year, and other draft alternatives do not.
- Some GAC members felt that the goal of Amendment 22 should be to limit capacity to current levels, while others stated that the intent of the proposed program should be to reduce the number of participants in that fishery.
- There may be an issue for someone who has fished a small amount of groundfish in nearshore waters in Oregon and California. Nearshore groundfish species are not counted towards the landings history of an individual fisherman. Currently, as it is written in the Environmental Assessment, someone who targets nearshore groundfish species and made one landing of any amount of a "B" permit species, regardless of the proportion of contribution of "B" permit species in the landings, would get a "B" permit. This effect may have a coastwide permit allocation implication depending on how the program is developed and implemented.
- Uniformity in tracking the landings history is lacking across Washington, Oregon, and California. Oregon records catch history by vessel, Washington records catch history by individual, and California uses both. The Council may wish to provide guidance to help the three states achieve uniformity, such as calling the entity used for tracking the "permit holder," and defining permit holder as an individual or a vessel.
- There are allocation issues depending on how the qualification criteria for "B" permits are set up, which warrants further analysis.

PFMC
03/05/08

# GROUNDFISH ADVISORY SUBPANEL REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The Groundfish Advisory Subpanel (GAP) heard a presentation from Mr. LB Boydstun on the Open Access License Limitation proposals and draft environmental analysis. The GAP notes that limiting the open access fishery is a complex issue and we spent several hours discussing the intricacies of the proposed options. At this point the GAP does not have a unified vision for what we believe the open access fishery should look like in the future. A majority of the GAP believes the current suite of options represents a reasonable range of alternatives for limiting access in the open access fishery. The GAP has some requests for analysis of the options:

1. Analyze the geographic ramifications of the options. There is some concern from industry that the more restrictive options could unintentionally harm certain coastal communities.

2. Provide an analysis of number of landings versus number of pounds landed in reference to qualifying criteria.

PFMC
3/12/08

# GROUNDFISH MANAGEMENT TEAM REPORT ON FISHERY MANAGEMENT PLAN 22: OPEN ACCESS LIMITATION

The Groundfish Management Team (GMT) reviewed the Preliminary Draft Environmental Assessment (EA) for Pacific Coast Fishery Management Plan Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management" (Agenda Item F.4) and provides the following comments.

*Additional Benefits and Consequences of Limited Entry*

Consistent with the emphasis in the Council's "Groundfish Fishery Strategic Plan," the EA focuses primarily on the net economic impact of limiting open access. The primary benefits of limited entry are economic, however the team also identified non-economic benefits, like decreased discard rates and improved overfished species management, which should be thoroughly explored in the EA. Improvements in conservation and management were envisioned by the Strategic Plan and should be given more emphasis in the EA.

Additionally, the GMT suggests that the EA should more fully explore the potential economic benefits of the trip limit increases that would presumably occur after entry is limited. Trip limits would be expected to increase as fishing capacity and effort go down. In turn, higher trip limits could translate into more profitability for the remaining fishery participants.

On the other hand, there could be significant, unintended consequences related to the conversion of the current fishery to a tradable, coastwide permit system. Once permits become tradable they are free to move up and down the coast to those willing to pay the most to participate in the fishery. Trading will create shifts in effort, with respect to both geography and target strategies, causing unknown impacts to coastal communities and overfished species management. The EA only analyzes the geographical distribution of permits at initial issuance; it does not go into where permits might go in the following months and years. While analysis of initial permit distribution is important to understand, post issuance permit distribution could be even more crucial in understanding biological and economic impacts of the limited entry permit.

While the GMT cannot answer the question of where the permits will ultimately go, the team did discuss potential scenarios that help illustrate the potential negative effects of effort shift. For example, if vessels in State A are willing to pay more for permits than vessels in than State B, overall effort in that State A could increase instead of decrease, or decrease less than desired under a given fleet size goal. Another potential shift involves changes in target strategies. While the opportunity to harvest all species/species groups is available in the current open access fishery, when a permit is issued it has an associated value and the permit owner may choose to sell to a person who can/will access all opportunities or to diversify his target strategy. These effort shifts may result in a greater number of vessels targeting a species/species group relative to historical or status quo levels.

*Purpose and Need*

The ultimate goal of limiting open access is to bring harvest capacity in line with the resource availability. The GMT discussed the need to examine current levels of participation relative to fish stock distributions. The GMT notes that such an analysis would be useful in determining sustainable levels of effort on a regional basis and inform future decisions as to the need of regional or coastwide reductions. Although data to fully inform this analysis is unavailable at this time it should be identified as a research and data need for future management.

The three states have taken different approaches in managing their open access fisheries. The differing management strategies have likely resulted in differing ideas of the optimal fleet size and the need for effort reduction. This situation may complicate implementation of a coastwide program with a single set of goals and objectives especially when looking at alternatives that consider fleet size goals that are reduced from current levels.

*Fleet Size Reduction / Consolidation*
In 2000, the Scientific and Statistical Committee (SSC) presented a report to the Council that stated the open access fishery is overcapitalized and that “the Council should take immediate action to develop stringent capacity reduction programs for all sectors of the West Coast groundfish fishery” (NMFS 2000[1]). At the time that this report was prepared, many stocks had just been declared overfished and since many optimum yields (OYs) would not be increasing in the near future, the only viable option available to the SSC at the time, to reduce overcapitalization, was to remove potential harvest capacity. As part of this report the SSC also included potential solutions to an overcapitalized fleet including IFQs, permit stacking, vessel buy back programs, and limited entry.

The EA states that since the open access OYs have declined for all species, overcapitalization is even greater and there is an increased need for limiting the open access fishery. The purpose and need for this fleet size reduction is based on an analyses performed by the SSC in years when the fishery was unrestricted (1983-1999), numerous species were declared overfished, and many OYs were declining. Since this study, many regulatory changes have gone into effect which reduced the open access fleet size (e.g., complex RCAs and restrictive trip limits) and OYs for many overfished species are increasing. Additionally, VMS, which was recently adopted for the open access fishery, may also have fleet reduction implications.

The GMT suggests the purpose and need for fleet size reduction be based on analyses using the current fleet size (year 2006) or the average fleet size from 2004-2006. This would allow the Council to examine impacts of a fleet size reduction program on the current fishery, not a fishery which no longer exists. Inclusion of the year 2000 fleet size is important to inform the Council of the potential impacts of an unrestricted open access fishery, but the year 2000 fleet size may not be the best choice for understanding the effects of the alternatives relative to the current fishery.

The GMT suggests that the Council may want to have further discussions on what type of opportunity the future open access fishery should provide. The fishery has changed significantly since 2000 and has some characteristics that make it different from other fisheries under the Council’s jurisdiction. For example, the open access fishery provides a valuable opportunity for fishers to supplement the primary income they earn in, for example, the salmon troll and Dungeness crab fisheries. The Council may want to maintain this opportunity by choosing status

[1] NMFS 2000. Report for review: overcapitalization in the West Coast groundfish fishery: background, issues and solutions. Economic subcommittee of the SSC. PFMC, Portland, OR.

quo or the registration only alternative (A-2) rather than reduce capacity to a level where participants focus on the fishery for their full source of income. While there may be conservation benefits to limiting entry in this fishery, the GMT notes that the intended benefits appear to be primarily economic in nature. Given this, the Council should take a closer look at what the current economics are and what they could be (considering the current quota available to the open access fishery) rather than what they were in 2000.

*Qualification Criteria*

Section 303(6) of the MSA requires the Council to consider specific factors when establishing a limited access system, namely:

> (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;
> (F) the fair and equitable distribution of access privileges in the fishery;[2]
> (G) any other relevant considerations.

The GMT would like to draw the Council's attention to factor (B) in particular. The Council itself focused on this factor in its Strategic Plan discussion of potential limited entry program for the open access fishery, stating that "[m]inimum landing requirements for a federal permit should reflect significant dependence on the fishery."

In reviewing Appendix E, a single landing where groundfish accounted for more than 50% of the ex-vessel revenue is the starting point for the analysis. The Council should determine whether a single landing is truly indicative of historical fishing practices in and dependence on the fishery. It is not difficult to imagine a scenario where receiving a Federal permit based on such a minimal landing would be an undeserved windfall to the recipient. The GMT suggests that additional analyses examine frequency of landings and economic dependence on the open access fishery (e.g., looking at the proportion of annual income earned from the open access fishery) as a metric to examine present and historical dependence on the directed open access fishery.

*Revenue versus Pounds*

The GMT discussed the use of revenue versus pounds in the current analyses and determined that while either metric would be appropriate there are important differences between the two with implications for allocation. As noted in Appendix B of the EA, basing the analysis on revenue tends to disadvantage fishing strategies that target high volume, low value species (e.g., dogfish and sharks). If these participants are combined with low volume, high value fisheries (e.g., shortspine thornyhead live fish fishery) and medium volume, medium value fisheries (e.g., sablefish DTL fishery), the high volume, low value fishers might be edged out if the fleet size is reduced. If the Council wants to recognize dependence on the fishery and not disadvantage one strategy over another, then revenue might not tell the whole story.

[2] Note: (F) was the only factor added in 2006 by the MSRA.

*Incidental "C" Permits*
The GMT discussed the purpose and need for an unlimited incidental "C" permit. The "C" permit as described in the EA is a permit that would be available for the incidental (non-target) fishery component of the open access fishery who do not qualify or submit an application for a directed fishery permit and that seek to retain incidental amounts of specified groundfish consistent with OYs and trip limits. The number of "C" permits would be left unlimited and could be renewed annually. The GMT notes that unintended consequences may result if the "C" permit is left unlimited and these consequences should be further discussed in the EA. If the Council chooses to restrict the number of "C" permits, impact analyses and permitting mechanisms would need further exploration.

*Overfished Species*
The EA has an extensive discussion of the biological characteristics, life history traits, and stock status of overfished species, yet there is currently no discussion of the impacts to overfished species under the various alternatives. The EA should further explore whether overfished species will be affected under the various alternatives.

*Endorsements*
Endorsements were one of the alternatives that were considered but rejected due to the heavy workload associated with additional analyses. Since the Strategic Plan recommended establishing a rockfish endorsement for the open access fishery, the EA should explore the consequences of excluding endorsements in the initial program. Endorsements could help mitigate some of the potential effort shifts by species/species group that were addressed above. Other endorsements such as port endorsements, which would tie a permit to particular communities, could be used to mitigate against other effort shifts.

Regarding gear endorsements, the GMT points out that the Council has been moving away from management measures that require fishers to commit to fishing with a specific type of gear exclusively. In the past it may have benefited managers when modeling catch predictions to have some certainty of the type of gear that would be used for particular target strategies. The team notes that modeling issues and catch estimation could be addressed with a declaration system or in some situations VMS. The GMT notes that gear endorsements may not provide fishers with adequate flexibility to modify their operations to maximize harvest of target species while avoiding bycatch species.

## GMT Recommendations

1. Benefits like discard rate, bycatch reductions, and improved overfished species management exist and should be further documented in the EA.

2. More detailed discussion of the additional trip limit opportunities (i.e., economic benefits) that could be provided by limiting open access should be included in the EA.

3. The purpose and need for fleet size reduction should be based on analyses using the current fleet size (year 2006) or the average fleet size from 2004-2006, which allow the

Council to examine impacts of a fleet size reduction on the current fishery.

4. The Council should discuss whether a single landing during the window period, based on the sole criterion that groundfish made for >50% of the revenue, is sufficient criteria for the analysis.

5. Given the distinct history of the open access fishery over the window period, the Council should discuss which qualification criteria best reflects historical participation and dependence on the fishery.

6. If the "C" permit is left unlimited, any resulting unintended consequences should be discussed in the EA. If the Council chooses to restrict the number of "C" permits, impact analyses and permitting mechanisms would need further exploration.

7. The EA should further explore whether overfished species will be affected under the various alternatives.

8. The EA should explore the potential unintended consequences of shifts in effort resulting from the transition to coastwide, tradable permits and the ability of port endorsements to mitigate this impact.

9. The EA should explore the consequences of excluding endorsements in the initial program.

# WASHINGTON AND OREGON DEPARTMENTS OF FISH AND WILDLIFE JOINT REPORT ON AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The Washington Department of Fish and Wildlife (WDFW) and the Oregon Department of Fish and Wildlife (ODFW) would like to offer the following comments and recommendations relative to the alternatives describes in the Preliminary Draft Environmental Assessment (EA) for Amendment 22 (Agenda Item F.4.a, Attachment 1):

1. Chapter 2, Description of the Alternatives, Section 2.3 (p. 26), WDFW and ODFW recommend revising Alternative 3 to reflect a fleet size goal that includes permit holders who participated in the open access fishery in recent years. Fleet size goals and qualifications for B permits would be based on one of the following sub-options:

    a. Average number of vessels for 2004-06 period; permits would be issued to the top producers in order of ranking (e.g., if total fleet size is 680 vessels, then permits would be issued to the 680 vessels with the highest landings during the 2004-06 period)

    b. Number of vessels that participated in 2006 (713); permits would be issued to those vessels that had a minimum of one delivery in 2006.

    c. Number of vessels resulting from one of the following participation requirements:

        i. Minimum of one delivery in 2004 or 2005 or 2006

        ii. Minimum of one delivery per year in two of the three years (2004-2006)

        iii. Minimum landings of 100, 500, 1000, or 2000 lbs. of groundfish excluding nearshore species in one year in 2004, 2005, or 2006

        iv. Minimum cumulative landings of 100, 500, 1000, or 2000 lbs. of groundfish excluding nearshore species across the three-year period (2004-2006)

    The other components of Alternative 3 would remain as specified in the draft EA.

2. A comprehensive review of the performance of the open access fishery would occur seven years after the date of implementation; participation levels would be evaluated at that time, and reductions may be taken if deemed necessary.

3. Across all alternatives, analyze individual permit holders (not vessels or vessel owners) for Washington participants. We understand that this data may not be readily available in the PacFIN database; however, WDFW could provide the data for this analysis. Across all alternatives, analyze vessel history and vessel owner history for Oregon participants. Vessel history information resides in the PacFIN database. Vessel owner history information can be provided by ODFW.

4. To recognize and respect the differences in nearshore fishery management plans and resulting fishing opportunities among the states, WDFW and ODFW continue to advocate including state-specific objectives in the EA. The intent is to allow each state to select the alternative that best achieves their state-specific objective while still achieving the overall goals for the amendment. For example, if one state has a need to reduce open access participation to a greater degree than another state (e.g., to achieve an economic viability goal), then that option would be available when the Council considers final action on this matter. This option would only apply to Alternatives 3-6 (i.e., those alternatives with a limitation on the number of permits).

5. Finally, WDFW and ODFW continue to be concerned by the allocative implications of the different alternatives and how they will be analyzed. These items were briefly touched upon at the last Groundfish Allocation Committee (GAC) meeting; however, the information and time available were not sufficient for a thorough discussion. In order to have that much-needed discussion, WDFW and ODFW would support scheduling this item on a future GAC agenda prior to final action by the Council.

# SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON FISHERY MANAGEMENT PLAN AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The Scientific and Statistical Committee (SSC) reviewed the Preliminary Draft Environmental Assessment (EA) for Amendment 22: Conversion of the Open Access Fishery to Federal Permit Management. Mr. LB Boydstun gave a presentation to the SSC and answered questions.

The choice of whether to base directed trips on exvessel revenue or landings weight has a relatively small effect on the number of qualifying vessels. However, it is not clear from the EA how the qualification of particular vessels is affected, rather than the aggregate number. It would be informative to know if there are differences in the characteristic of these vessels (e.g., landing ports). The choice of which method to use ultimately depends on the Council's objectives and priorities. The revenue based method is a reasonable way to identify directed trips. It has the advantage of focusing on an economic variable that may be correlated with vessel operator incentives to maximize net-earnings, and thus focuses on vessels that intended to primarily harvest B species for economic reasons.

The EA's economic analysis and discussion of the economic effects is incomplete; and at times appears to be misinterpreted. The EA should address at least two general types of economic effects: net benefits to the nation and regional economic impacts. Although data and models are unlikely to exist for a quantitative analysis, a qualitative analysis can be conducted. Text in the EA that incorrectly assumes revenue is a proxy for community impacts should be revised. Fishing expenditures, rather than revenues, are what determine community impacts. Although total revenue may not change much across the alternatives, fleet expenditures will likely decrease for alternatives with smaller fleets. These impacts may not be uniform across states and ports.

The EA does not comprehensively address whether and to what degree the alternatives meet the stated need for limited entry. Each alternative should have a summary table that describes to what degree it meets each need. One important objective is capacity reduction which does not necessarily correspond to vessel reduction. The SSC notes that matching a correct level of capacity reduction to available harvest is very challenging. It is also difficult to control capacity through license limitation programs.

Alternatives 5 and 6 include length and gear endorsements. A program without a length endorsement will likely be more subject to an escalation of capacity over time. The SSC notes, however, that a length endorsement could make a program with periodic reductions in vessels more complicated since permit sales would need to be matched based on the length endorsement.

The tables in the EA are difficult to follow, and likely will lead to some confusion regarding their information content. Each table should be clearly explained in the document.

PFMC
03/12/08

Agenda Item F.4.b
Supplemental WDFW Report
March 2008

# WASHINGTON DEPARTMENT OF FISH AND WILDLIFE REPORT ON AMENDMENT 22: OPEN ACCESS LICENSE LIMITATION

The Washington Department of Fish and Wildlife (WDFW) held a public meeting on January 9, 2008, to review and solicit input on the Pacific Fishery Management Council's consideration for limiting participation in the open access groundfish fishery. Seventeen people attended the meeting. The meeting agenda included: a brief explanation of the Council process; the proposed timeline for rulemaking, including future opportunity to comment; an overview of the draft alternatives; and a comment and discussion period. The overview included a description of the purpose and need, a brief history of the Washington open access fishery and fleet profile, the proposed system of B and C permits, and the preliminary range of alternatives.

In general, the group favored a moratorium-type approach that would allow anyone who had fished in the 2004-06 period to attain a federal B permit. Specific questions and comments focused on: recognition of the reductions already made in the Washington nearshore fishery (e.g., there used to be 25 vessels fishing out of Neah Bay, and now there are only a few); how individual catch histories would be considered for qualifying (i.e., individual vs. vessel catch history); whether state-specific goals and management could be considered; and vessel monitoring system requirements for participation in the open access fishery.

There was also a general consensus among the group that increased open access effort was not desirable; however, the group also wanted to ensure that participants retained the opportunity to participate in the future. A large proportion of Washington open access fishers participate in other fisheries (e.g., salmon troll, Dungeness crab, albacore troll), and the fishing opportunity in those fisheries is variable from year to year. Therefore, having a narrowly defined recent participation requirement (e.g., 2006 only) to qualify and having an annual minimum landing requirement to renew permits in the future would not accommodate the typical fishing practices of the Washington open access fleet.

WDFW plans to hold another public meeting this summer to present and discuss the refined range of alternatives developed at this Council meeting. We will provide a summary of those discussions to the Council.

Agenda Item F.4.c
Public Comments
March 2008

**Subject:** To the Council
**From:** Jerry&Nancy Jacobson <tunajerry@centurytel.net>
**Date:** Fri, 15 Feb 2008 09:26:29 -0800
**To:** John Devore <John.DeVore@noaa.gov>
**X-Mozilla-Status:** 0001
**X-Mozilla-Status2:** 00000000
**Return-path:** <tunajerry@centurytel.net>
**Received:** from relay-west.nems.noaa.gov ([161.55.16.17]) by vmail4.nems.noaa.gov (Sun Java System Messaging Server 6.2-7.05 (built Sep 5 2006)) with ESMTP id <0JWA00D43J3J2110@vmail4.nems.noaa.gov> for john.devore@noaa.gov; Fri, 15 Feb 2008 09:26:07 -0800 (PST)
**Received:** from mx-west.nems.noaa.gov ([140.172.10.153]) by relay-west.nems.noaa.gov (Sun Java System Messaging Server 6.2-3.04 (built Jul 15 2005)) with ESMTP id <0JWA00G35J3HQTP2@relay-west.nems.noaa.gov> for john.devore@noaa.gov (ORCPT john.devore@noaa.gov); Fri, 15 Feb 2008 09:26:07 -0800 (PST)
**Received:** from mail26c35.nsolutionszone.com ([209.235.148.36]) by mx-west.nems.noaa.gov with ESMTP; Fri, 15 Feb 2008 17:20:22 +0000
**Received:** from jacobson (d42-222.rb.gh.centurytel.net [207.118.5.222]) by mail26c35.nsolutionszone.com (8.13.6.20060614/8.13.1) with ESMTP id m1FHQ0lH010741 for <john.devore@noaa.gov>; Fri, 15 Feb 2008 17:26:02 +0000 (GMT)
**Message-ID:** <000201c86ff7$e8561520$2f01a8c0@jacobson>
**MIME-Version:** 1.0
**X-MIMEOLE:** Produced By Microsoft MimeOLE V6.00.2900.3198
**X-Mailer:** Microsoft Outlook, Build 10.0.2627
**Content-type:** multipart/alternative; boundary="----=_NextPart_000_0003_01C86FB4.DA32D520"
**Importance:** Normal
**X-Priority:** 3 (Normal)
**X-MSMail-priority:** Normal
**X-IronPort-Anti-Spam-Filtered:** true
**X-IronPort-Anti-Spam-Result:** AgAAALxZtUfR65Qknmdsb2JhbACCQTCNXQEBAQEBBgQGBwoYnWA
**X-IronPort-AV:** E=Sophos;i="4.25,359,1199664000"; d="scan'208,217";a="27439481"
**Original-recipient:** rfc822;john.devore@noaa.gov

To the Council:

I have been fishing the same boat in the Sablefish access fishery for 15 years. I have even continued to fish through the bad times, when a lot of other fishermen dropped out.

I know you have a difficult job listening to everyone, but on the Sablefish access fishery limited entry, I think the access Sablefish permits should be transferable. Two summers ago, some of the Salmon trollers showed up in La Push, Wa. and started saying how they were going to take our Sablefish fishery away from us. I, along with other access fishermen have worked hard to make a living at this fishery, longlining for Sablefish(Black Cod).They claim to be able to catch Sablefish on Salmon Troll Gear. I know from past experience of having my own Salmon Troll boat in the 60's and 70's that you cannot catch Sablefish on Salmon troll gear. You could snag a few very small ones inside 100 fathoms, but that's it. Salmon Troll boats don't have reels for longlining the Sablefish as longliners do.

I feel the Salmon Trollers are not telling the truth when they claim to be able to catch Sablefish on Salmon troll gear. They are Salmon Trollers, not Longliners, Jiggers or Trawlers. Please keep the access fishery cut off date of September 1995.

Please confirm receipt of this e-mail to tunajerry@centurytel.net

Thank you, Jerry L. Jacobson
F/V MARANATHA
211 Salmon Drive
Forks, Washington 98331

JOHN E. LAW
2795 MASSACHUSETTS AVE.
LEMON GROVE, CA. 91945
(858) 414-9731
WILDWESTJL@YAHOO.COM

FEBRUARY 14, 2008

PUBLIC COMMENT - OPEN ACCESS LICENSING

COUNCIL MEMBERS,

At each stage of the proposed licensing of the open access fleet I have submitted comment. Today, as I prepared to write these comments, I reviewed each of my past comment documents. My opinion has not changed over time.

GET IT RIGHT.

The council should take the time to get it right and not bow to pressure from any group or state agency. The members of the council should consider themselves to be members of a jury and make the right decision.

REFER TO THE STRATEGIC PLAN DOCUMENT.

Although it is not exactly the groundfish bible, it is the document that guided the way many fishermen conducted themselves during the initial years of closures and restrictions.

OPINION

Those of us who have suffered through the restrictions and closures in the groundfish fishery have earned the opportunity to participate in a fishery where there is a legitimate chance to make a good living. The only way for this to happen is to reduce the number of participants and raise the amount that each can catch.  An individual that did not participate in the fishery for a majority of the years 1999-2007 should not be considered. Additional considerations should be an individuals participation in the observer program and compliance with new VMS regulations. Many new participants have joined the fishery recently in an attempt to be issued a groundfish license, even though control dates were established, these participants should not be considered for licensing.

Dear Council Members,
Recent council action to consider transitioning the open access groundfish fishery into a limited access fishery has raised some concerns as how the qualifying rules are going to be decided. I wish to address several concerns I have.
My recommendation is to issue permits to the fisherman and not the vessel. That way those fishermen that have changed vessels since the control date are not displaced from what used to be open access. By issuing permits to fishermen instead of vessels the goal of establishing the number of open access fishery participants will be accomplished while allowing those with fishing history to continue to fish. Forcing fishermen with long catch history out of a fishery simply because an old vessel was replaced makes no sense. Since I have sold the vessel formerly used to catch federally managed fish and neither one of my present vessels have landings prior to 2003 or 2006 respectively I might not qualify for a permit if vessel criteria were used. This is despite the fact that as a fisherman I have landings dating back to the early 1980's. There are certainly others with similar situations where vessels have been replaced.
Presently federal trip limits for federally managed fish are applied to the vessel, while trip limits for state managed fish are applied to the fisherman. As a holder of California nearshore permits I also land federally managed fish such as Lingcod and Vermillion rockfish in both state waters and federal waters. It is my understanding that only one permit will be issued to a fisherman owning more than one vessel under the open/limited access fishery limitation proposals. That seems reasonable. As an owner of two vessels, I am concerned that if permits are issued to the vessel, I will be forced to decide which vessel to place the permit on. The problem in placing the permit on one and not the other is that I will be forced to discard open access fish such as lingcod and Vermillion when using the other vessel to catch state managed nearshore fish. This would be wasteful and unnecessary if permits were issued to the vessel instead of to the fisherman.

Robert Kraencke

**Subject:** Comment on Open Access Limitation
**From:** khensel@charter.net
**Date:** Wed, 20 Feb 2008 12:37:30 -0800
**To:** John DeVore <John.DeVore@noaa.gov>
**X-Mozilla-Status:** 0001
**X-Mozilla-Status2:** 00000000
**Return-path:** <khensel@charter.net>
**Received:** from relay-west.nems.noaa.gov ([161.55.16.17]) by vmail4.nems.noaa.gov (Sun Java System Messaging Server 6.2-7.05 (built Sep 5 2006)) with ESMTP id <0JWK0040D1AL0120@vmail4.nems.noaa.gov> for John.Devore@noaa.gov; Wed, 20 Feb 2008 12:37:33 -0800 (PST)
**Received:** from mx-east.nems.noaa.gov ([140.90.121.147]) by relay-west.nems.noaa.gov (Sun Java System Messaging Server 6.2-3.04 (built Jul 15 2005)) with ESMTP id <0JWK00A6S1A7OXF1@relay-west.nems.noaa.gov> for John.Devore@noaa.gov (ORCPT John.Devore@noaa.gov); Wed, 20 Feb 2008 12:37:33 -0800 (PST)
**Received:** from mtai01.charter.net ([209.225.8.181]) by mx-east.nems.noaa.gov with ESMTP; Wed, 20 Feb 2008 20:32:06 +0000
**Received:** from aarprv03.charter.net ([10.20.200.73]) by mtai01.charter.net (InterMail vM.7.08.02.02 201-2186-121-104-20070414) with ESMTP id <20080220203730.HLZG20099.mtai01.charter.net@aarprv03.charter.net> for <John.Devore@noaa.gov>; Wed, 20 Feb 2008 15:37:30 -0500
**Received:** from fepweb11 ([10.20.200.81]) by aarprv03.charter.net with ESMTP id <20080220203730.QQRJ18753.aarprv03.charter.net@fepweb11> for <John.Devore@noaa.gov>; Wed, 20 Feb 2008 15:37:30 -0500
**X-Originating-IP:** from 68.118.67.76 by mail.charter.net; Wed, 20 Feb 2008 15:37:29 -0500
**Message-ID:** <20080220153730.N8SSI.74418.root@fepweb11>
**MIME-Version:** 1.0
**Content-type:** text/plain; charset=utf-8
**Content-transfer-encoding:** quoted-printable
**X-Priority:** 3 (Normal)
**Sensitivity:** Normal
**X-IronPort-Anti-Spam-Filtered:** true
**X-IronPort-Anti-Spam-Result:** Ao8CALIevEfR4Qi1ZWdsb2JhbACPOip4CwQDCggTBYEWnkM
**X-IronPort-AV:** E=Sophos;i="4.25,382,1199664000"; d="scan'208";a="43035872"
**X-Chzlrs:** 0
**Original-recipient:** rfc822;John.Devore@noaa.gov

thanks for your help John, more on VMS to fallow. Kenyon

Kenyon Hensel
871 Elk Valley Rd
Crescent City Ca
95531
707-465-6857

To the Pacific Fisheries Management Council,

Having reviewed the latest Open Access permitting proposals, I feel qualifying criteria must limit the number of boats who can apply for the first round of permit issues. In alternates one and two this is not necessary as number of participants is not to be restricted, but in the rest of the alternatives, I do not see any language that states that there be some kind of prier landing requirement. The starting group of any alternative should to be chosen by participation during the years of 2004 thru

2006.

As to alternatives that include some requirement of buy backs for continuing participation, I am strongly opposed. Such a requirement would lead to extreme over pricing of permits and the possibility of permits being obtained by fishermen who have money instead of prier history. Also it could lead to so few boats in each harbor that infrastructures and markets would be lost. Open Access fishermen tend to be small boats with very different marketing strategies; one boat cannot be expected to support one buyer. 680 participants is less then half of the numbers of boats working in open access when the fifty percent reduction language was written in the strategic plan. Later on permits could be made stackable, buyback programs created, and a reduction in the number of fishermen could be achieved with much less social and economic turmoil. The way the open access catch is controlled and accounted for, number of fishermen fishing is not nearly as important as well designed inseason adjustments.

I think it is important to remember that the evolution of this fishery once limited, will be an on-going process. Our first actions should not be expected to create a completely trimmed package.

Included below is the alternative that best fits the fisheries intentions on first cut to limit the open access fishery. What is missing is language that states a preliminary requirement of one landing during the window years of 2004-2006 to be eligible for this permit.

2.3 Alternative 3

Alternative 3 is one of three alternatives that have a specific initial fleet size goal for issuance of B permits. The goal for Alternative 3 is based on the average number of vessels that made directed B species landings in the WOC area during the recent years of 2004-September 2006, which computes to be 680 vessels after rounding (Table 2-4; Figure 2-1). The long-term fleet size goal is the same as the initial fleet size goal. The purpose of this alternative is to limit participation in the directed open access fishery and to register all other vessels that encounter groundfish on an incidental basis. This alternative would aid managers in projecting fishery impacts for target and non-target species. A B permit would be issued to those in the directed open access fishery and a C permit would be issued to those vessels that incidentally land groundfish, excluding nearshore species, for all vessels that do not have an A or B permit or state-issued nearshore permit.

Under this alternative, a B permit could be transferred to a different vessel once per calendar year and vessels could be registered to both an A and B permit and used the two permits alternately during the year. The permit holder would be required to notify NMFS prior to leaving port of the permit type that would be in use. B permits under this alternative would not have a size or gear endorsement and any vessel registered to a B permit could be transferred to any size of vessel and use any directed OA gears.

Agenda Item F.4.c
Supplemental Public Comments
March 2008

**Subject:** keeping bycatch

**Date:** Thu, 21 Feb 2008 16:40:23 -0800
**From:** mat keller <mkel@sonic.net>
**To:** Jim.Seger@noaa.gov

I understand that the Council is discussing the elimination of open access in the groundfish fishery, and that a new permit category is being considered ("C") to allow near-shore permit holders to keep incidental catch of deeper water species. I am not a rockfish permit holder, but that sounds like a reasonable plan, why create wasted bycatch.

I fish salmon out of Bodega Bay, and when fishing inside the RCA I sometimes bring up rockfish or lingcod. If they are rockfish that I can retain under both the federal and state regulations I do so. As a holder of a Fisherman's Retail license I sell these fish at farmers markets or to neighbors. A small part of my income, but much better than releasing "floaters" to be pecked to death by the gulls. Other trollers will sometimes take the two or three fish home for their families.

If open access is ended I would like to see provision for salmon (and California halibut) trollers to continue to retain the bycatch that they have been able to retain under open access. This would not increase the take of rockfish, since the troller is not going to alter his activity to target them, their price being so much lower than that of salmon.

I hope this will be discussed.

Mat Keller
F/V Candice

RECEIVED

FEB 1 4 2008

PFMC

Members of the P F.M.C

My name is Bill Forkner, I'm a commercial fisherman with more than 40 years of fishing out of Noyo Harbor in Fort Bragg, California.

I write to you in regards to the up coming talks on the open access Black Cod fishery. I've participated in this fishery since it began and have watched it go from a clean, unpressured, open fishery, to a high pressured, gear laden fiasco, taken over by a few greedy individuals intent on grabbing as much of a small quota ass possible with no regard to the health of the fishery, the condition of the grounds, they are saturating with gear, or the well being of their fellow fisherman.

At the fall informational meeting in Santa Rosa we read how it was the counsel's goal to prevent over capitalization of this fishery. I recently did a count of the vessels in Novo that either are or at some point have been involved in open access Black Cod. Of the 39 boats in total, a mere 3 owners own 19. One father and son team fish 11 boats weekly. Sometimes fishing 2 boats each in one day. The problem with this type of high production fishing is the gear needed to catch the limits needed.

Most single vessel owners have between 3 and 5 sets of gear in the water where as the father and son team has reported to 50 sets of Black Cod gear. Neither the grounds nor the Cod population can handle this pressure.

What myself and most of the coast fisherman, (over 90% by the meetings held coast wide) would like to see is if you are going to make open access a limited fishery is to put any permit on the man and not the boat, thus protecting this fishery from the over capitalization it's experiencing now, while at the same time returning this fishery to the equal opportunity for all involved fishery it once was.

Another solution is that if the permit must go to the boat perhaps you can put a limit on the number of boats one can have involved in this fishery, hopefully no more than 2, to help restore sensibility to this fishery.

I know you folks have many hard decisions to make and this is one of them. I hope you can take into consideration not just the people involved but the fishery itself, when you make your decision.

Thank you for your time,

Bill Forkner

Bill Forkner
Vice Present
Salmon Trollers Marketing Assoc.
Fort Bragg, Ca
707-964-7064

**Subject:** open access/limited entry
**From:** lucky50@humboldt1.com
**Date:** Tue, 04 Mar 2008 18:06:03 -0800 (PST)
**To:** John.DeVore@noaa.gov
**X-Mozilla-Status:** 0001
**X-Mozilla-Status2:** 00000000
**Return-path:** <lucky50@humboldt1.com>
**Received:** from relay-central.nems.noaa.gov ([140.172.10.152]) by vmail4.nems.noaa.gov (Sun Java System Messaging Server 6.2-7.05 (built Sep 5 2006)) with ESMTP id <0JX800JU0J5XCZ90@vmail4.nems.noaa.gov> for john.devore@noaa.gov; Tue, 04 Mar 2008 18:05:58 -0800 (PST)
**Received:** from mx-east.nems.noaa.gov ([140.90.121.147]) by relay-central.nems.noaa.gov (Sun Java System Messaging Server 6.2-3.04 (built Jul 15 2005)) with ESMTP id <0JX80090BJ5X5GE0@relay-central.nems.noaa.gov> for john.devore@noaa.gov (ORCPT john.devore@noaa.gov); Tue, 04 Mar 2008 19:05:57 -0700 (MST)
**Received:** from exthelm-1.humboldt1.com (HELO humboldt1.com) ([206.13.45.11]) by mx-east.nems.noaa.gov with ESMTP; Wed, 05 Mar 2008 01:59:51 +0000
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**Received:** from 208.106.101.52 (SquirrelMail authenticated user lucky50) by dialmon.humboldt1.com with HTTP; Tue, 04 Mar 2008 18:06:03 -0800 (PST)
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**User-Agent:** SquirrelMail/1.4.2
**Original-recipient:** rfc822;john.devore@noaa.gov

John,
Here's a copy of the letter I sent in August regarding open access. Can you make sure it's on file for the upcoming meeting.
Thanks Mike

Mike Zamboni
August, 4 2007
CA Commercial Beach Fishermens Assn.
1341 Belnor Rd
Mckinleyville, CA 95519

Mr. Donald K. Hansen
Pacific Fisheries Management Council
7700 NE Ambassador Place Suite 101
Portland, Oregon 97220-1384

RE: Limited entry for open access

Dear Chairman Hansen,

We would like to see a prefered alternative adopted for the open access groundfish fisheries that caps number of participants in the fishery but does not significantly reduce it from existing levels. With the possible exception of Nearshore, which is currently state permited, the open access portion of the groundfish fishery was not designed to become a limited-entry fishery but rather a supplemental fishery on poor crab and salmon years. During the previous two years of minimal salmon seasons, open access groundfish was the only source of summer income for many of our members.

Allowing recent participants as well as those with a long history of landings to qualify you will allow those individuals who currently depend on the fishery continued access. The federal 40'10" line may need to be used in establishing qualifying criteria since quotas of federally managed open-access groundfish are significantly higher south of the line. Our reccomendation is for qualifying criteria North of the federal management line.

We reccomend that the preferred alternative include all fishermen that have landed at least 1000 lbs. of open-access groundfish during the window period 1998 to September 2006 with at least one of those landings in 2005 or 2006 to show recent participation. All qualifying fishermen should be allowed continued access to all open access federal groundfish fisheries (Sable, Shelf, Slope, Lingcod, Shark). This option would allow current participants as well as long term participants to remain fishing.

A California open-access fleet of aproximately 500 vessels a similar amount as in 2006 is a reasonable number to maintain the fishery. Any applicants whose permit application is denied must be able to appeal to a mandatory review board for consideration of outstanding circumstances. If a limited entry program is adopted the permits must remain transferrable to continue the current level of participation and the markets and infrastructure that are dependent upon it. By adopting this measure as the criteria for eligibility you can achieve your capacity goals without causing unnecessary hardship for longterm fishermen.

Sincerely,
Mike Zamboni
President, CA Commercial Beach Fishermen's assn. (15 members)
Aron Newman President ,
Humboldt Fishermen's Marketing Association (40 members)
Craig Goucher President,
Trinidad Bay Fishermens Marketing Assn.

# CONSIDERATION OF INSEASON ADJUSTMENTS

Management measures for the 2008 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 (OYs). This agenda item will consider inseason adjustments to ongoing 2008 fisheries. Potential inseason adjustments under this agenda item include adjustments to 2008 California recreational fishery management measures, and adjustments to limited entry non-whiting trawl fishery cumulative limits and Rockfish Conservation Area boundaries.

The Groundfish Management Team (GMT) and the Groundfish Advisory Subpanel (GAP) will begin meeting on Sunday, March 9, 2008, to discuss and recommend inseason adjustments to ongoing 2008 groundfish fisheries. Under this agenda item, the Council is scheduled to hear advisory body advice and public comment on the status of 2008 fisheries and consider preliminary or final inseason adjustments. Agenda Item F.7 is scheduled for Friday, March 19, 2008, should further analysis or clarification be needed.

**Council Action:**

**Consider information on the status of 2008 fisheries and adopt preliminary or final inseason adjustments as necessary.**

Reference Materials: None.

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 Preliminary or Final Recommendations for Adjustments to 2008 Fisheries

PFMC
02/22/08

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

The Groundfish Management Team (GMT) considered the most recent information from the West Coast Groundfish Observer Program and the status of ongoing fisheries and provides the following considerations and recommendations for 2008.

## RECREATIONAL

At this time it is unclear what effect salmon restrictions will have on effort in the groundfish recreational fisheries. Depending on the amount of effort shift predicted, changes to inseason management may or may not be necessary. The states will continue to monitor catch and effort inseason and revisit this issue at future Council meetings.

*California*
In September 2007, California Department of Fish and Game (CDFG) proposed and implemented inseason actions to keep the recreational fishery within their harvest guidelines for canary (9.0 mt) and yelloweye rockfish (2.1 mt). Despite inseason action, the harvest guidelines for yelloweye and canary rockfish were exceeded by 5.9 mt and 1.9 mt, respectively. For 2008, CDFG developed management measures to reduce the projected catch of these species in order to stay within recreational harvest guidelines. The GMT discussed the proposal, though at this time, no formal CDFG Report has been submitted to the Council under this agenda item. The proposed management actions include:

- 20 fm depth restriction in the Northern and North-Central Management Areas;
- implementation of five Yelloweye Rockfish Conservation Areas (YRCAs) north of Point Arena (38°57' N. lat.) to the Oregon/California border in state waters (3 nmi);
- the use of the Point Arena (38° 57' N. lat.) management line to refine management measures such as season or depth restrictions within the North-Central Management Area; and
- improved monitoring and tracking of catch for inseason management.

The 20 fm depth restriction and the use of the Point Arena management line are available inseason and for conforming Federal action since they were analyzed in the 2007/2008 SPEX process. The YCRA boundaries were not analyzed in the SPEX, but since they are located within state waters can be implemented in state rule and Federal conforming action is not necessary.

The GMT discussed the proposal and examined the methodologies to estimate catch savings. The GMT has not reviewed, nor approved, the quantitative modeling approach proposed in the CDFG proposal; only the concepts and proposed management measures. The California GMT representative informed the team that while the quantitative modeling results were not available for review, the final numbers result in impacts slightly less than the harvest guidelines for canary and yelloweye rockfish.

In order to facilitate the Council process and timeline, the current scorecard contains the California recreational harvest guidelines for canary (9.0 mt), yelloweye (2.1 mt), and widow (8.0 mt). These numbers were based on the belief that the team will be able to review the quantitative modeling approach later today, the results are near the harvest guidelines, and that a formal CDFG Report will be forthcoming for advisory body and Council review. If these steps are not accomplished today, status quo impacts to the California recreational fisheries will be placed in the scorecard (canary = 11.5 mt, yelloweye = 8.5 mt, Boccaccio 49.5, cowcod = 0.1, widow = 6.1 mt) for the final inseason agenda item on Friday (Agenda Item F.7), possibly disrupting inseason actions taken under this agenda item.

**COMMERCIAL**

*Limited Entry Non-Tribal Whiting Trawl*

Bycatch limits

The GMT examined two approaches for setting bycatch limits for the 2008 fishery (Supplemental GMT Report under Agenda Item F.3). The first is the status quo bycatch modeling approach where bycatch is estimated using a weighted average (canary, darkblotched, POP, yelloweye) and a linear interpolation (widow) from 2004-2007 fishery data, based on the commercial optimum yield (OY) recommended by the Council under Agenda Item F.3. This approach assumes that fleet depth distributions are similar to 2004-2007. The second approach uses increased darkblotched limits to influence deeper fleet depth distributions, which would reduce projected impacts to canary and widow, compared to the first approach. It is estimated that a darkblotched bycatch limit of 41 mt may provide a large enough limit to provide fishing strategy flexibility in deeper waters. The projected bycatch of overfished species under each approach associated with the 2008 OY, are shown in Tables 1a and 1b.

Table 1a. Projected impacts on overfished species based on the status quo bycatch modeling approach and fleet depth distributions from 2004-2007.

| U.S. whiting OY (mt) | Commercial OY (mt) | Commercial Sector | Allocation (mt) | Projected catch (mt) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Canary | DB | POP | Widow |
| 269,545 | 232,545 (U.S. OY minus 2,000 mt for research and other fishery catch, minus 35,000 mt for the tribal allocation.) | Mothership | 55,811 | 2.1 | 6.19 | 1.13 | 107.2 |
| | | Catcher Processor | 79,065 | 0.3 | 6.18 | 1.16 | 130.3 |
| | | Shoreside | 97,669 | 1.6 | 2.9 | 0.3 | 127.0 |
| | | TOTAL | 232,545 | 4.2 | 15.4 | 2.6 | 364.4 |

Table 1b. Projected impacts of a 41.0 mt darkblotched bycatch limit on canary and widow rockfish, assuming deeper at-sea fleet depth distributions.

| U.S. whiting OY (mt) | Commercial OY (mt) | Projected catch (mt) | |
|---|---|---|---|
| | | Canary | Widow |
| 269,545 | 232,545 (U.S. OY minus 2,000 mt for research and other fishery catch, minus 35,000 mt for the tribal allocation.) | 3.0 | 295.6 |

Under the 2008 U.S. whiting OY, and for either bycatch limit approach that may be adopted by the Council, projected yelloweye rockfish impacts are below 0.05 mt and thus scorecard values would be 0.0 mt.

The non-tribal whiting fleetwide bycatch limits specified in Federal Regulations for the 2008 whiting fishery are currently: 4.7 mt for canary rockfish, 25 mt for darkblotched rockfish, and 275 mt for widow rockfish.

The GMT recommends that the Council adopt a darkblotched bycatch limit of approximately 41 mt in order to encourage deeper fleet depth distributions. When considering appropriate bycatch limits for canary and widow rockfish, the GMT recommends the Council take into consideration the projected impacts to these species under this effort distribution (Table 1.b).

*Open Access*

Sablefish Daily Trip Limit Fishery (DTL)

The GMT considered restrictions to management measures in DTL fishery due to increased participation as a result of a poor salmon season. At this time it is unclear what effect salmon restrictions will have on effort in the DTL fishery. Depending on the amount of effort shift predicted, changes to inseason management may be necessary. The GMT will revisit this issue at the April Council meeting.

*Limited Entry Non-whiting Trawl Fishery North of 40°10' N. lat. and the Open Access Nearshore Fishery North and South of 40°10' N. lat.*

Introduction

The GMT developed two options for commercial inseason adjustments in the limited entry non-whiting trawl fishery north of 40°10' N. lat. and the open access nearshore fishery north and south of 40°10' N. lat. These two options focus on reducing canary impacts in the nearshore and non-whiting trawl fisheries. Option 1 reduces canary impacts in the non-whiting trawl fishery more than Option 2 by incorporating more restrictive RCA boundaries, but leaves open access nearshore groundfish fisheries unaffected. Option 2 reduces canary impacts in the limited entry non-whiting trawl fishery from status quo, but not as severely as Option 1, and reduces canary impacts in the open access nearshore fishery to 1.7 metric tons (the impact estimated for this fishery in 2007).

These two options result in canary impacts that exceed the 2008 canary rockfish OY if no other adjustments are made to other fisheries. In Option 1, canary impacts are estimated to be 0.4 metric tons over the 2008 canary rockfish OY, while Option 2 results in canary impacts that are estimated to be 0.2 metric tons over the OY. The GMT requests Council guidance on how to achieve the necessary catch reductions in order to bring estimated catch levels within the OY. Additionally, the GMT will meet with the GAP to explore further options.

Open Access Nearshore Commercial Fisheries North and South of 40°10' N. lat.

The GMT considered restrictions to management measures in the nearshore commercial open access fishery due to higher than anticipated impacts on canary rockfish as a result of the latest bycatch rates. Based on that information, the encounter rate for canary rockfish is several times higher in the open access fishery south of 40°10' N. lat. than originally predicted. Projected canary rockfish impacts under previous bycatch rates were 1.7 mt., while impacts based on updated rates are 3.0 mt under status quo management measures. The GMT explored restrictions in management measures to reduce the projected impacts of the open access commercial nearshore fishery back down to 1.7 mt (see Table 2). Due to low canary impacts south of 34°27' N. lat., no changes are proposed for this area of the coast.

Table 2. Projected impacts of possible adjustments to management measures for the open access nearshore fishery.

| Range of Options | Canary Impacts | Sector Total |
|---|---|---|
| *Status Quo* | | |
| North of 40°10' N. lat – 30 fm RCA | 1.32 | 3.03 *Option 1* |
| Between 40°10' and 34°27' N. lat – 30 fm RCA | 1.71 | |
| | | |
| *Depth Restrictions* | | |
| North of 40°10' N. lat – 20 fm RCA+ ***30%*** target catch reduction | 0.87 | 1.7 |
| Between 40°10' and 34°27' N. lat – 20 fm RCA+ ***50%*** target catch reduction | 0.81 | |

The GMT would like to point out that although the open access nearshore fishery is currently open north of 40°10' N. lat., it is closed until May 1, 2008 south of 40°10' N. lat.

The GMT could explore more refined area management to address reductions of canary impacts in the open access nearshore fishery between 40°10' N. lat. and 34 27' N. lat. and will request observer data to inform this analysis. However, this analysis is not likely possible in the near term.

Limited Entry Non-Whiting Trawl Fishery North of 40°10' N. lat.

In the fall of 2007, the Northwest Fisheries Science Center (NWFSC) released the most recent observer data. This data covered the period from 2006 through the first several months of 2007. At the November meeting, the GMT generally used the past practice of incorporating this latest data by utilizing a weighted average approach which combined the most recent observer data with observer data from prior years. In addition to this approach, however, the GMT attempted to tease apart the effect of a correlation between arrowtooth flounder and canary rockfish that appeared to exist in the latest observer data. At the time, the information suggested a lower canary bycatch rate should be expected if arrowtooth targeting in the areas shoreward of the RCA was eliminated. However, according to industry representatives, the apparent correlation is coincidental. This leads to higher canary rockfish bycatch rates than would be the case if a correlation could be identified. Data from year to year indicates substantial changes in the canary bycatch rate annually by sub-area. The wide degree of variation suggests that broader restrictions should be put in place than what occurred during 2007. Namely, that restriction to protect canary may need to be applied to a wider portion of the Washington coast, the southern Oregon coast, and northern California coast than previously thought. The following figure illustrates canary bycatch rates shoreward of the trawl RCA by observer year and sub-area.

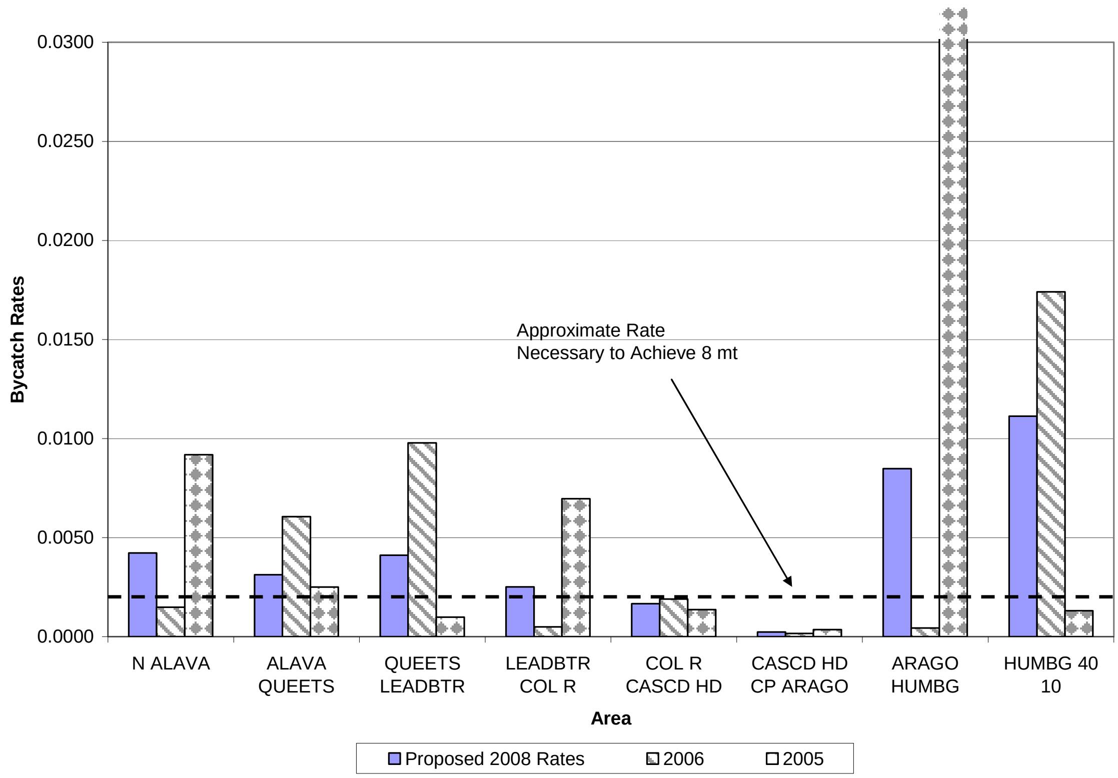


**Figure 1 Canary Bycatch Rates in the Non-Whiting Trawl Fishery by Sub-Area and Year (75 fathoms)**

In February of 2008, the NWFSC released the latest report estimating the total mortality of groundfish in the 2006 calendar year. This report shows that the catch of canary rockfish in the non-whiting trawl fishery during 2006 was substantially higher than estimated by the GMT during that same year. In addition, using the bycatch rates from that year within the GMT trawl model and re-estimating the 2006 impacts continued to result in the model under-projecting canary rockfish on a coastwide basis. In the north, the model under-projected canary rockfish bycatch by 33 percent, while in the south the model over-projected by approximately 6 percent. Based on this comparison, bycatch rates for canary rockfish in the trawl model were scaled upward by 33 percent in the north, and down by 6 percent in the south. The result is a substantially higher canary rockfish impact estimate in the 2008 fishery than estimated at the November 2007 Council meeting.

Tables 3a and 3b show the results of using the old bycatch rates (Table 3a, as presented at the November 2007 Council meeting) and the result of modifying those rates based the revised methodology adopted by the GMT.

**Table 3a Estimated Mortality in the 2008 Non-Whiting Trawl Fishery at the November 2007 Council meeting**

| | | North | South | Total |
|---|---|---|---|---|
| | Canary | 5.3 | 2.7 | 8.0 |
| Rebuilding | POP | 80.9 | 0.0 | 80.9 |
| Species | Darkbltch | 180.5 | 28.5 | 209.1 |
| | Widow | 1.6 | 5.1 | 6.6 |
| | Bocaccio | - | 11.5 | 11.5 |
| | Yeye | 0.5 | 0.0 | 0.5 |
| | Cowcod | - | 1.4 | 1.4 |
| Target | Sablefish | 1,909 | 477 | 2,386 |
| Species | Longsp | 509 | 385 | 894 |
| | Shortsp | 754 | 244 | 998 |
| | Dover | 8,212 | 2,191 | 10,403 |
| | Arrowtth | 1,443 | 64 | 1,507 |
| | Petrale | 1,937 | 347 | 2,284 |
| | Otr Flat | 1,431 | 559 | 1,989 |
| | Slope Rocl | 45 | 115 | 160 |

**Table 3b Estimated Mortality in the 2008 Non-Whiting Trawl Fishery as a Result of Modified Bycatch Rates**

| | | North | South | Total |
|---|---|---|---|---|
| Rebuilding | Canary | 13.6 | 2.7 | 16.3 |
| Species | POP | 80.9 | 0 | 80.9 |
| | Darkblotch | 180.5 | 28.5 | 209.1 |
| | Widow | 1.6 | 5.1 | 6.6 |
| | Bocaccio | | 11.5 | 11.5 |
| | Yeye | 0.5 | 0 | 0.5 |
| | Cowcod | | 1.4 | 1.4 |
| Target | Sablefish | 1,909 | 477 | 2,386 |
| Species | Longspine | 509 | 385 | 894 |
| | Shortspine | 754 | 244 | 998 |
| | Dover | 8,212 | 2,191 | 10,403 |
| | Arrowtooth | 1,443 | 64 | 1,507 |
| | Petrale | 1,937 | 347 | 2,284 |
| | Other Flat | 1,431 | 559 | 1,989 |
| | Slope Rocl | 45 | 115 | 160 |

## <u>GMT Recommendations:</u>

Limited Entry trawl, non-tribal whiting bycatch limits

- The GMT recommends that the Council adopt a darkblotched bycatch limit of approximately 41 metric tons in order to encourage deeper fleet depth distributions. When considering appropriate bycatch limits for canary and widow rockfish, the GMT recommends the Council take into consideration the projected impacts to these species under this effort distribution (Table 1.b). This action is scheduled for completion under Agenda Item F.3 on Friday.

Open Access Sablefish Daily Trip Limit Fishery

- The GMT recommends revisiting this issue at the April Council meeting.

Limited Entry Non-whiting Trawl Fishery North of 40°10’ N. lat. and the Open Access Nearshore Fishery North and South of 40°10’ N. lat.

- The GMT recommends that the Council consider Option 1 and Option 2 adjustments for these fisheries and provide guidance.

Table 4: Non-Whiting Trawl Cumulative Limits Are the Same Under Option 1 and Option 2

| SUBAREA | Period | RCA Config INLINE | RCA Config OUTLINE | Sable | Longsp | Shortsp | Dover | Otr Flat | Petrale | Arrowtth | Slope Rk |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N 40 10 Large Footrope | 1 | see attached table | | 14,000 | 25,000 | 25,000 | 80,000 | 110,000 | 40,000 | 150,000 | 2,500 |
| | 2 | | | 14,000 | 25,000 | 25,000 | 80,000 | 110,000 | 30,000 | 150,000 | 2,500 |
| | 3 | | | 19,000 | 25,000 | 25,000 | 80,000 | 110,000 | 20,000 | 150,000 | 2,500 |
| | 4 | | | 19,000 | 25,000 | 25,000 | 80,000 | 110,000 | 20,000 | 150,000 | 2,500 |
| | 5 | | | 19,000 | 25,000 | 25,000 | 80,000 | 110,000 | 20,000 | 150,000 | 2,500 |
| | 6 | | | 14,000 | 25,000 | 25,000 | 80,000 | 110,000 | 40,000 | 150,000 | 2,500 |
| N 40 10 SFFT | 1 | see attached table | | 5,000 | 3,000 | 3,000 | 40,000 | 70,000 | 10,000 | 10,000 | 3,000 |
| | 2 | | | 5,000 | 3,000 | 3,000 | 50,000 | 70,000 | 18,000 | 10,000 | 3,000 |
| | 3 | | | 5,000 | 3,000 | 3,000 | 40,000 | 50,000 | 18,000 | 10,000 | 3,000 |
| | 4 | | | 5,000 | 3,000 | 3,000 | 40,000 | 50,000 | 18,000 | 10,000 | 3,000 |
| | 5 | | | 5,000 | 3,000 | 3,000 | 40,000 | 50,000 | 18,000 | 10,000 | 3,000 |
| | 6 | | | 5,000 | 3,000 | 3,000 | 40,000 | 50,000 | 10,000 | 10,000 | 3,000 |
| 40 10 - 38 | 1 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 15,000 |
| | 2 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 15,000 |
| | 3 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 15,000 |
| | 4 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 15,000 |
| | 5 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 15,000 |
| | 6 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 15,000 |
| S 38 | 1 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 55,000 |
| | 2 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 3 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 4 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 5 | 100 | 150 | 19,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 6 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 55,000 |

Table 5a: Trawl RCA Boundaries in the North under Option 1

<table>
<tr><th colspan="2"></th><th>JAN-FEB</th><th>MAR-APR</th><th>MAY-JUN</th><th>JUL-AUG</th><th>SEP-OCT</th><th>NOV-DEC</th></tr>
<tr><td colspan="2">Rockfish Conservation Area (RCA)</td><td colspan="6"></td></tr>
<tr><td>N Alava</td><td>North of 48°10.00' N. lat.</td><td>shore - modified 200 fm</td><td>shore - 200 fm</td><td colspan="2">shore - 150 fm</td><td>shore - 150 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>Alava to Queets</td><td>48°10.00' N. lat. - 46°38.17' N. lat.</td><td rowspan="4">75 fm - modified 200 fm</td><td>60 fm - 200 fm</td><td colspan="3">60 fm - 150 fm</td><td rowspan="4">75 fm - modified 200 fm</td></tr>
<tr><td>Queets to Leadbetter</td><td>46°38.17' N. lat. - 46°16.00 N. lat.</td><td>60 fm - 200 fm</td><td colspan="3">60 fm -150 fm</td></tr>
<tr><td>Leadbetter to OR/WA Border</td><td>46°16.00 N. lat. - 45°03.83 N. lat.</td><td>75 fm - 200 fm</td><td colspan="3">60 fm - 200 fm</td></tr>
<tr><td>OR/WA Border to Cape Arago</td><td>45°03.83' N. lat. - 43°20.83' N. lat.</td><td colspan="4">75 fm - 200 fm</td></tr>
<tr><td>Cape Arago to Humbug mt</td><td>43°20.83' N. lat. - 42°40.50' N. lat.</td><td>shore - modified 200 fm</td><td colspan="4">shore - 200 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>Humbug mt to 40 10</td><td>42°40.50' N. lat. - 40°10.00' N. lat.</td><td>75 fm - modified 200 fm</td><td>75 fm - 200 fm</td><td colspan="3">60 fm - 200 fm</td><td>75 fm - modified 200 fm</td></tr>
</table>

Table 6a: Estimated Trawl Impacts under Option 1

| | North | South | Total |
|---|---|---|---|
| Canary | 6.6 | 2.6 | 9.1 |
| POP | 81.6 | 0.0 | 81.6 |
| Darkbltch | 225.9 | 37.7 | 263.6 |
| Widow | 1.6 | 5.2 | 6.8 |
| Bocaccio | - | 11.6 | 11.6 |
| Yelloweye | 0.6 | 0.0 | 0.6 |
| Cowcod | - | - | - |
| Sablefish | 2,015 | 508 | 2,523 |
| Longspine | 509 | 385 | 893 |
| Shortspine | 1,002 | 244 | 1,245 |
| Dover | 8,166 | 2,191 | 10,356 |
| Arrowtth | 1,454 | 64 | 1,518 |
| Petrale | 1,932 | 347 | 2,279 |
| Other Flat | 1,492 | 559 | 2,051 |
| Slope Rock | 49 | 124 | 173 |

Table 5b: Trawl RCA Boundaries in the North under Option 2

<table>
<tr><th colspan="2"></th><th>JAN-FEB</th><th>MAR-APR</th><th>MAY-JUN</th><th>JUL-AUG</th><th>SEP-OCT</th><th>NOV-DEC</th></tr>
<tr><td colspan="2">Rockfish Conservation Area (RCA)</td><td colspan="6"></td></tr>
<tr><td>N Alava</td><td>North of 48°10.00' N. lat.</td><td>shore - modified 200 fm</td><td>shore - 200 fm</td><td colspan="2">shore - 150 fm</td><td>shore - 150 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>Alava to Queets</td><td>48°10.00' N. lat. - 46°38.17' N. lat.</td><td rowspan="4">75 fm - modified 200 fm</td><td>60 fm - 200 fm</td><td colspan="3">60 fm - 150 fm</td><td rowspan="4">75 fm - modified 200 fm</td></tr>
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<tr><td>Leadbetter to OR/WA Border</td><td>46°16.00 N. lat. - 45°03.83 N. lat.</td><td>75 fm - 200 fm</td><td colspan="3">60 fm - 200 fm</td></tr>
<tr><td>OR/WA Border to Cape Arago</td><td>45°03.83' N. lat. - 43°20.83' N. lat.</td><td colspan="4">75 fm - 200 fm</td></tr>
<tr><td>Cape Arago to Humbug mt</td><td>43°20.83' N. lat. - 42°40.50' N. lat.</td><td>shore - modified 200 fm</td><td colspan="4">shore - 200 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>Humbug mt to 40 10</td><td>42°40.50' N. lat. - 40°10.00' N. lat.</td><td>75 fm - modified 200 fm</td><td>75 fm - 200 fm</td><td colspan="2">60 fm - 200 fm</td><td>75 - 200 fm</td><td>75 fm - modified 200 fm</td></tr>
</table>

Table 6b: Estimated Trawl Impacts under Option 2

| | North | South | Total |
|---|---|---|---|
| Canary | 7.5 | 2.6 | 10.2 |
| POP | 81.6 | 0.0 | 81.6 |
| Darkbltch | 214.6 | 37.7 | 252.3 |
| Widow | 1.6 | 5.2 | 6.8 |
| Bocaccio | 0.0 | 11.6 | 11.6 |
| Yelloweye | 0.6 | 0.0 | 0.6 |
| Cowcod | 0.0 | 0.0 | 0.0 |
| Sablefish | 2,015 | 508 | 2,523 |
| Longspine | 509 | 385 | 893 |
| Shortspine | 1,002 | 244 | 1,245 |
| Dover | 8,166 | 2,191 | 10,356 |
| Arrowtth | 1,454 | 64 | 1,518 |
| Petrale | 1,932 | 347 | 2,279 |
| Other Flat | 1,492 | 559 | 2,051 |
| Slope Rock | 49 | 124 | 173 |

## 2008 Projected mortality impacts (mt) of overfished groundfish species under GMT option 1

**11/06/07**

| Fishery | Bocaccio b/ | Canary | Cowcod | Dkbl | POP | Widow | Yelloweye |
|---|---|---|---|---|---|---|---|
| **Limited Entry Trawl- Non-whiting** | **11.6** | **9.1** | **0.0** | **263.6** | **81.6** | **6.8** | **0.6** |
| **Limited Entry Trawl- Whiting** | | | | | | | |
| At-sea whiting motherships a/ | | | | | 1.9 | | 0.0 |
| At-sea whiting cat-proc a/ | | 4.7 | | 25.0 | | **275.0** | 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 | | | | | **2.2** |
| Sablefish | 13.4 | | 0.0 | **0.6** | **0.3** | **0.9** | |
| Non-Sablefish | | | 0.1 | **0.4** | | 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 | **3.0** | 0.1 | 0.0 | 0.0 | 0.5 | **1.4** |
| Nearshore (South of 40°10' N. lat.) | **0.1** | | | 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 | | | | | 6.2 |
| OR | | | | | | 1.4 | |
| CA | **49.5** | **9.0** | **0.1** | | | **6.1** | **2.1** |
| **EFPs** | 11.0 | 0.1 | 0.2 | 1.0 | | 3.4 | 0.1 |
| **Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/** | | | | | | | |
| | 2.0 | 5.5 | 0.2 | 2.0 | 2.0 | 1.1 | 3.0 |
| **TOTAL** | 99.5 | 44.4 | 0.7 | 292.9 | 90.2 | 342.2 | 18.7 |
| **2008 OY** | 218 | 44.0 | 4.0 | **330** | 150 | 368 | 20 |
| **Difference** | 118.5 | -0.4 | 3.3 | 37.2 | 59.8 | 25.8 | 1.3 |
| **Percent of OY** | 45.6% | 100.9% | 17.5% | 88.7% | 60.2% | 93.0% | 93.5% |
| Key | | = either not applicable; trace amount (<0.01 mt); or not reported in available | | | | | |

a/ Non-tribal whiting numbers reflect bycatch limits for the non-tribal whiting sectors.

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 2008 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 November 2007.

**2008 Projected mortality impacts (mt) of overfished groundfish species under Option 2**

**11/06/07**

| Fishery | Bocaccio b/ | Canary | Cowcod | Dkbl | POP | Widow | Yelloweye |
|---|---|---|---|---|---|---|---|
| **Limited Entry Trawl- Non-whiting** | 11.6 | **10.2** | 0.0 | 252.3 | 78.1 | 6.8 | 0.6 |
| **Limited Entry Trawl- Whiting** | | | | | | | |
| At-sea whiting motherships a/ | | 4.7 | | 25.0 | 1.9 | **275.0** | 0.0 |
| At-sea whiting cat-proc a/ | | | | | | | 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 | | | | | **2.2** |
| Sablefish | 13.4 | | 0.0 | **0.6** | **0.3** | **0.9** | |
| Non-Sablefish | | | 0.1 | **0.4** | | 0.5 | |
| **Open Access: Directed Groundfish** | | 1.0 | | | | | |
| Sablefish DTL | 0.0 | 0.2 | 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 | **1.4** |
| Nearshore (South of 40°10' N. lat.) | **0.1** | | | 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 | | | | | 6.2 |
| OR | | | | | | 1.4 | |
| CA | **49.5** | **9.0** | **0.1** | | | **6.1** | **2.1** |
| **EFPs** | 11.0 | 0.1 | 0.2 | 1.0 | | 3.4 | 0.1 |
| **Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/** | | | | | | | |
| | 2.0 | 5.5 | 0.2 | 2.0 | 2.0 | 1.1 | 3.0 |
| **TOTAL** | 99.5 | 44.2 | 0.7 | 281.6 | 86.7 | 342.2 | 18.7 |
| **2008 OY** | 218 | 44.0 | 4.0 | **330** | 150 | 368 | 20 |
| **Difference** | 118.5 | -0.2 | 3.3 | 48.5 | 63.3 | 25.8 | 1.3 |
| **Percent of OY** | 45.6% | 100.5% | 17.5% | 85.3% | 57.8% | 93.0% | 93.5% |
| Key | | = either not applicable; trace amount (<0.01 mt); or not reported in available | | | | | |

a/ Non-tribal whiting numbers reflect bycatch limits for the non-tribal whiting sectors.

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 2008 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 November 2007.

# CALIFORNIA DEPARTMENT OF FISH AND GAME REPORT ON CONSIDERATION OF INSEASON ADJUSTMENTS

## 2008 California Recreational Groundfish Inseason Management Measures

In 2007 the recreational fishery exceeded the harvest guideline of yelloweye and canary rockfish (see Table 1).

Table 1. 2008 Projected Rebuilding Species Impacts in the California Recreational Fishery with Status Quo Regulations.

| **Species** | | **2008 Projected Impacts Status Quo (mt)** | **Harvest Guideline** |
|---|---|---|---|
| **Rebuilding Species** | **Bocaccio** | 49.5 | 66.3 |
| | **Canary** | 11.5 | 9 |
| | **Cowcod** | 0.1 | 0.3 |
| | **Darkblotched** | NA | NA |
| | **Lingcod** | 229 | 422 |
| | **POP** | NA | NA |
| | **Widow** | 6.1 | 8.0 |
| | **Yelloweye** | 8.5 | 2.1 |

The California Department of Fish and Game (CDFG) has developed management measures to reduce the projected catch of these species to conform with the harvest guidelines in the 2008 recreational groundfish season (see figure 1). The necessary changes will be relegated to the Northern Management Area (NMA) encompassing Cape Mendocino (40-10) to the Oregon Border and the North-Central Management Area (CNMA) encompassing Pigeon Pt. to Cape Mendocino (40-10) as the vast majority of the catch of yelloweye and canary rockfish originated from these management areas. The proposed management actions to be implemented in the 2008 recreational groundfish fishery to address the harvest guideline overages (see table 2) include:

- 120 ft. Depth Restriction in the Northern and North-Central Management Areas.
- Implementation of five Yelloweye Rockfish Conservation Areas (YRCAs) north of Point Arena to the Oregon/California border.
- Use of the Pt. Arena Management Line to provide for more refined management measures such as season or depth restrictions in the southern portion of the North-Central Management Area where yelloweye rockfish are less common.
- Improved inseason monitoring and tracking of catch.

(No management changes will apply to shore-based anglers or divers.)

Table 2. 2008 Projected Impacts on Rebuilding Species in the California Recreational Fishery with Proposed Management Actions.

| **Species** | | **2008 Projected Impacts (mt) with Management Actions** |
|---|---|---|
| **Rebuilding Species** | **Bocaccio** | 66.3 |
| | **Canary** | 9 |
| | **Cowcod** | 0.3 |
| | **Darkblotched** | NA |
| | **Lingcod** | 422 |
| | **POP** | NA |
| | **Widow** | 8.0 |
| | **Yelloweye** | 2.1 |

**Use of the 120 ft. Depth Restriction**

Catch reductions resulting from the 120 ft depth restriction were estimated using the RecFISH catch projection model with adjustments for depth distribution of catch and timing of catch described at the January 2008 GMT meeting.

**Yelloweye Rockfish Conservation Area Analysis**

The 2007 CRFS effort and yelloweye catch data (both sampler examined and reported) with latitude and longitude of catch data from the Northern California (Pt. Conception to the OR/CA Border) were used to identify one square nautical mile blocks with high yelloweye rockfish catch per unit effort (CPUE, average number of yelloweye caught per angler day fished). Five areas of high yelloweye catch were identified including 2 proposed YRCAs in the Northern Management Area and 3 YRCAs in the North-Central Management Area (See Figure 1). The YRCAs are in the vicinity of Crescent City, Shelter Cove and Fort Bragg from which over 75% of the yelloweye rockfish catch for California originated in 2007. Thus the effect is well directed requiring the ports directly responsible for the catch to bear the burden of catch reduction rather than closing entire management areas. The proportion of yelloweye catch from private and rental boat anglers within the proposed YRCAs in 2007 was used as a multiplicative catch reduction factor to approximate the potential reduction in catch resulting from YRCA's in each management area. The vast majority of the yelloweye catch originated from private vessels thus only catch from this mode was used.

**Figure 1:** Proposed California Yelloweye Rockfish Conservation Areas


**Use of the Pt. Arena Management Area**

Catch projections for the North-Central Management Area north and south of Pt. Arena were modeled separately in the RecFISH projection model.

**Improved Inseason Monitoring and Tracking of Yelloweye and Canary Rockfish Catch**

Given the higher abundance of yelloweye rockfish in the recreational fishery north of Pt. Arena and the variable geographic distribution of fishing effort in the recreational fishery depending, the ability to track catch inseason is critical to keeping the catch below the HG. The following actions will be taken to improve the tracking of catch inseason:

***Weekly Reporting by CRFS Samplers (1 week lag):***

CRFS Samplers North of Pt. Conception will be providing weekly tallies with the number of yelloweye and canary rockfish reported and examined at each port sampled in the previous week of sampling. The catch data will be used in the following 3 ways:

- *Comparison to Tracking of Sampled Catch from Previous Years:* The rate of accrual of the catch of yelloweye and canary rockfish sampler examined and reported released catch can be compared to the rate in previous years (2005, 2006, and 2007) as an early warning of above or below average rates of yelloweye and canary rockfish catch accrual.
- *Direction of Enforcement Efforts:* Enforcement will be informed of ports at which prohibited species (yelloweye and canary rockfish) are being retained to address catch accruing due to non compliance with restrictions on retention.
- *Direction of Outreach and Education Efforts:* The weekly tallies will be used to identify ports with high interaction rates and direct outreach efforts and restocking of the yelloweye, canary and vermilion rockfish identification flyers.

***CRFS Preliminary Catch Estimates (1 month lag)*:**

The CRFS program provides preliminary catch estimates on a 1 month lag. The catch estimates will be tracked inseason and compared with the projected catch by month from the RecFISH model. The CRFS catch estimates will be combined with the projected catch for the remainder of the season and when the projected catch estimate is projected to exceed the HG, immediate action can be taken to reduce catch rates or close Management Areas to keep the catch within the HG.

**Failsafe Management Actions**

If the projected catch estimates for yelloweye and canary rockfish are projected to exceed the harvest guideline before the scheduled season ending date, either the Northern or North-Central Management Areas (North and/or South of Pt. Arena) or a combination of these areas can be closed within state waters 10 days after a press release has been issued by CDFG. With a 120 ft. depth restriction the majority of the fishable area resides within state waters and such action would result in nearly complete closure of a management area to Rockfish, Cabezon and Kelp Greenling and Lingcod catch until conforming actions can be taken in Federal waters.

**Conforming Actions in Federal Waters**

CDFG will seek conforming actions in Federal waters for the 120 ft. depth restriction and use of the Pt. Arena management line. The proposed YRCA's reside in state waters and will not require conforming actions in Federal waters in 2008.

PFMC
03/13/08
11:33 a.m.

# TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

At its November 2007 meeting, the Council finalized for analysis the trawl rationalization alternatives, with the exception of certain sections on program administration related to tracking and monitoring and costs and fees. At that meeting, the Council established an Ad Hoc Trawl Rationalization Tracking and Monitoring Committee (TRTMC) to advise staff on refinement of the tracking and monitoring program. Since then, the TRTMC has met twice. At this meeting, the Council is being asked to provide guidance on development of the tracking and monitoring program provisions. At its June 2008 meeting, the Council is scheduled to select a preliminary preferred alternative on all aspects of the trawl rationalization alternatives. Based on the preferred alternative, the environmental impact statement will be finalized over the summer and released for public review in the early fall so that the Council can take final action at its November 2008 Council meeting.

The tracking and monitoring program provisions contained within the current IFQ alternative are provided in Agenda Item F.6.a, Attachment 1. The TRTMC met November 30, 2007, and February 13, 2008. At their first meeting, they reviewed the current tracking and monitoring program provisions and developed an approach for evaluating and refining them. At their second meeting, they developed goals and objectives and on that basis provided guidance to staff on refining the program provisions. A refined version of the goals and objectives and tracking and monitoring provisions will be provided to the Council in its supplemental materials (Agenda Item F.6.b, Supplemental T&M Draft Revisions). Some tracking and monitoring program elements that will be in that draft that are not part of the current Council alternative are:

- specification of different at-sea monitoring requirements for whiting and nonwhiting vessels and
- the mandatory submission of processor production reports.

The Council should review the supplemental materials and provide guidance as needed for the ongoing effort to develop the tracking and monitoring program.

## <u>Council Action:</u>

**Provide guidance on development of tracking and monitoring program alternatives.**

<u>Reference Materials:</u>

1. Agenda Item F.6.a, Attachment 1: Current Tracking and Monitoring Program Provisions.
2. Agenda Item F.6.b, Supplemental T&M Draft Revisions: Draft Revisions to Tracking and Monitoring Program Alternatives.
3. Agenda Item F.6.d, Groundfish Allocation Committee Report.

Agenda Order:

a. Agenda Item Overview — Jim Seger
b. Current Status of Program Administration Issues — Steve Freese
c. Agency and Tribal Comments
d. Reports and Comments of Advisory Bodies
e. Public Comment
f. **Council Action:** Refine Tracking and Monitoring and Other Program Administration Provisions as Appropriate for Analysis

PFMC
02/26/08

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Agenda Item F.6.a
Attachment 1
March 2008

# CURRENT TRACKING AND MONITORING PROGRAM PROVISIONS (AS SPECIFIED IN ALTERNATIVES REVIEWED BY THE COUNCIL NOVEMBER 2007)

The following is a list of elements of the Tracking and Monitoring Programs, as incorporated in the Council alternatives to date.

## Central Program Elements

- Onboard compliance monitors
- Camera monitoring
- Retention requirement
- Dockside compliance monitors
- Vessel monitoring system (VMS)

## Complementary Elements Affecting Program Effectiveness

- Upgraded bycatch reporting system
- Electronic landings tracking system
- Electronic individual fishing quota tracking systems with information on vessel quota pound (QP) accounts, quota share (QS)/QP transaction information and a lien registry.

## Cost and Impact Mitigation

- Hailing requirements (advance notice of landing)
- Limited delivery ports
- Limited delivery sites
- Limited landing hours
- Small vessel exemptions for onboard compliance observers

The Trawl Individual Quota Enforcement Group originally developed this list and arrayed the elements into three programs it believed might reasonably be expected to achieve adequate levels of tracking and monitoring. There have been some modifications since that time. The programs as they are specified in the current alternatives are listed on the following page, and summarized in the attached table. Staff will present a set of tracking and monitoring program provisions at the March 2008 Council meeting, revised based on input from the Trawl Rationalization Tracking and Monitoring Committee and Groundfish Allocation Committee.

**Language From A-2.3.1 Of The IFQ Alternative**

These provisions are summarized in Table 1. Grey text indicates areas where additional detail may need to be provided:

For all tracking, monitoring and enforcement options: VMS and advance notice of landings will be required; there will be an electronic landings tracking system; QP account information for vessels will be tracked electronically and available in the field; and there will be a central QS/QP transaction system that will include a QS lien registry.

**Option 1:**100% at-sea compliance monitors/observers (small vessel exception, if feasible).

Discarding will be allowed. Allowing discarding will require that the timeliness of discard reporting be improved to match that for landings reporting. Such timeliness will be necessary to track QP usage.

Electronic landings tracking (state landings system), advance notice of landings, unlimited landing hours. Some shoreside monitoring.

Some costs will be controlled through a requirement that delivery sites be licensed. Site licenses (license criteria to be specified) will ensure that certain standards will be met that will facilitate monitoring and will aid work force planning. Any landing not made at a licensed site will be illegal.

The lien registry system will include only essential ownership information.

**Option 2:** Same as Option 1 except as follows. No small vessel exception. There will be full retention and 100% shoreside monitoring, so the discard reporting system will not need to be upgraded. The site licensing program will be replaced by a limitation on the ports (ports to be specified) to which deliveries could be made. Costs will be further controlled by limiting landing hours (to be specified). A lien registry system will contain expanded ownership information.

**Option 3:** Same as Option 1 except as follows. No small vessel exception. Cameras might be provided as an option for vessels to use in place of compliance observers (feasibility to be determined). Discards will be allowed (except when cameras are used, in which case full retention will be required). Instead of creating an electronic state fish ticket system, a Federal system will be created to track trawl landings. A lien registry system will contain expanded ownership information.

In addition to the above options, the Council has indicated it will pursue a process to consider the creation of an electronic logbook system and allowing vessels to split loads between different delivery locations.

Table 1. TIQ Enforcement Group preliminary scoping of possible enforcement programs (UPDATED BASED ON CURRENT OPTIONS – 02/07/08). Yellow (grey) indicates elements in common with Program 1.

| | Program 1 | Program 2 | Program 3 |
|---|---|---|---|
| At-Sea Monitoring | 100% (Compliance Monitors) Small vessel exception, if feasible. | 100% (Compliance Monitors) | 100% (Compliance Monitors or Camera, if Feasible) |
| Retention Requirement | Discards Allowed | Full Retention | Full if Camera,<br>Discards Allowed if Compliance Monitor Present (see NOTE) |
| Bycatch Reporting System Comparable to Landing Tracking System | System Upgrade Needed (electronic) | System Upgrade Not Needed | System Upgrade Needed (electronic) |
| Landing Tracking System | Electronic | Electronic | Parallel Electronic Federal System (maintain paper fishtickets) |
| Shorebased Monitoring | Some Shoreside Monitoring | 100% Shoreside Monitoring | Some Shoreside Monitoring |
| Vessel Provides Advance Notice of Landing | Yes | Yes | Yes |
| Limited Landing Locations | Site Licenses | Specified Ports | Site Licenses |
| Electronic IFQ Reporting | Yes | Yes | Yes |
| Limited Landing Hours | No | Yes | No |

VMS is an assumed component of the enforcement environment.

A QS lien registry is included in all programs. Under programs 2 and 3, the lien registry would include expanded ownership information.

# Draft Revisions to Tracking and Monitoring Program Alternatives.

## Description of the Proposed Action (3/11/08 draft)

The proposed action is to develop a tracking and monitoring program for managing the catch of groundfish relative to allocations made to individuals or groups (Co-ops) as part of a rationalization program being proposed for the Pacific Coast groundfish limited entry trawl fishery. The proposed tracking and monitoring programs are intended to provide the information needed to meet the Magnuson-Stevens Act requirements; to encourage a high level of compliance with the provisions of the rationalization program; to allow participating businesses flexibility that will allow for efficient operations; and, to allow the fishery to be operated in a manner that is consistent with the Endangered Species Act and with the International Pacific Halibut Treaty. (Note—The discussion below needs to be expanded to address co-ops. Generally speaking, the term "Co-op" can be substituted for the term "IQ")

## The Purpose and Need for a Tracking and Monitoring Program

A tracking and monitoring program is needed to maintain the integrity of the rationalization program such that: each individual (or group of individuals quota share in the case of co-ops) holder is held responsible for keeping the total catch of ITQ or IBQ species within the species quota shares allocated or held by them during each defined period and for each defined area; individuals do not acquire more than the allowed proportion of shares; and, the overall total catch of each groundfish species or species group taken by vessels registered to limited entry trawl permits can be managed to stay within the annual trawl fishery allocations such that the risk of exceeding a groundfish species OYs is reduced.

## The Objectives of the Tracking and Monitoring Program are:

1. To allow for the enforcement of clear and concise supporting regulations for catch accounting, including: monitoring, sorting, weighing, and reporting.

2. To provide adequate data so that the total catch of IQ and IBQ species or species groups is accurately reported and that there is accurate estimation of prohibited species catch.

3. To provide data that is adequate to hold the IQ holder responsible if IQs are exceeded and adequate shares are not obtained within 30 days to cover overages.

4. To provide IQ species data that is adequate for enforcement purposes such that there is a high rate of detection of illegal activities, including: discarding of catch without required monitoring and documentation, misreporting IQ species or species groups, reporting inaccurate weights for IQ species or species groups, or in accurately reporting IQ species or species groups.

5. For the cost of monitoring to be offset by the increased benefits of IQ.

6. For State and Federal enforcement agreements that allow the exchange of relevant data to ensure compliance with IQ quotas.

7. To provide for the mandatory socio-economic data collection and other data necessary to monitor the long-term effectiveness of the rationalization program.

8. To provide verification and reporting procedures that instill a high level of confidence by the industry and the public that the program is well managed and resulting information and data is accurate.

The data necessary for tracking and monitoring need to be sufficiently accurate and available for detecting illegal activities such that it effectively deters such activities. When illegal activities are not deterred, the program needs to provide data that is adequate to support prompt enforcement of violations.

A tracking and monitoring program is needed to collect socioeconomic data from harvesters and processors. Socioeconomic data is necessary to monitor the long-term effectiveness of the rationalization program relative to the Magnuson-Steven's Act requirements (sec. 303A (c)(1)(J)).

The information gathered under the monitoring program needs to be sufficiently accurate and available such that fishers and processors can use the information to make informed business decisions that reduced their risk of exceeding their ITQ, IBQ, or bycatch species quota shares and to provide flexibility in where and when fishing is conducted or catch is delivered.

## Alternative Programs for Tracking and Monitoring Total Catch in ITQ Trawl Fisheries

| **<u>Alternative Program 1</u>:** Discarding of ITQ species *allowed* in limited entry non-whiting trawl fisheries | **<u>Alternative Program 2</u>:** Discarding of ITQ species *prohibited* in limited entry non-whiting trawl fisheries |
|---|---|
| <u>Non-whiting</u><br><br>• *Discarding of ITQ allowed*<br>• Discarding of IBQ required<br>• Discarding of non-groundfish species allowed | <u>Non-whiting</u><br><br>• *Discarding of ITQ species prohibited*<br>• Discarding of IBQ required<br>• Discarding of non-groundfish species allowed |
| <u>Shoreside whiting</u><br><br>*Maximized retention vessels:*<br>• Discarding of ITQ, IBQ, and non-groundfish species prohibited<br><br>*Vessels sorting at sea:*<br>• Discarding of ITQ allowed<br>• Discarding of IBQ required<br>• Discarding of non-groundfish species allowed | <u>Shoreside whiting</u><br><br>• Same as Program 1 |
| <u>At-sea whiting</u><br><br>• Discarding of ITQ allowed by processors<br>• Discarding of IBQ required by processors<br>• Discarding of non-groundfish species allowed by processors<br>• Mothership catcher vessels prohibited from discarding catch | <u>At-sea whiting</u><br><br>• Same as Program 1 |

| **Alternative Program 1:** Discarding of ITQ species *allowed* in limited entry non-whiting trawl fisheries | **Alternative Program 2:** Discarding of ITQ species *prohibited* in limited entry non-whiting trawl fisheries |
|---|---|

## At Sea Catch Monitoring

*The purpose is to*: monitor catch sorting; monitor catch retention when it's required; and, monitor weighing of ITQ and IBQ species when discarding is allowed or required.

| Alternative Program 1 | Alternative Program 2 |
|---|---|
| Non-whiting<br>The sorting, weighing and discarding of any ITQ or IBQ species must be monitored by an observer with supplemental video monitoring. | Non-whiting<br>The sorting of catch must be monitored by an observer. The weighing and discarding of any IBQ species must be monitored by an observer. The retention of ITQ species monitored by the observer. |

Shoreside whiting

*For maximized retention vessels*: video monitoring as proposed under Amendment 10 [1]

*For vessels that sort at sea:* The sorting, weighing and discarding of any ITQ or IBQ species must be monitored by an observer with supplemental video monitoring.

At-sea whiting

*Motherships, catcher vessels and catcher/processors*: The sorting, weighing and discarding of any ITQ or IBQ species must be monitored by an observer with supplemental video monitoring on all catcher vessels. Supplemental video monitoring on processors may also be used.

## Shoreside Catch Monitoring

*The purpose is to*: verify that: the catch was sorted to the correct species; the catch was weighed accurately; and, the catch was reported correctly.

Non-whiting

The sorting, weighing and reporting of any ITQ or IBQ species must be monitored by a catch monitor or qualified observer.

Shoreside whiting

The sorting, weighing and reporting of any ITQ or IBQ species must be monitored by a catch monitor.

[1] Amendment 10 requires the retention of all catch at-sea with the exception of animals over 6' in length and operational discards of Pacific whiting not to exceed one basket.

| **Alternative Program 1:** Discarding of ITQ species *allowed* in limited entry non-whiting trawl fisheries | **Alternative Program 2:** Discarding of ITQ species *prohibited* in limited entry non-whiting trawl fisheries |
|---|---|

**Catch Tracking Mechanisms** (tools necessary under each alternative)

*Electronic vessel logbook report* [2] - For tracking fishing activity by location and for IQ fishers to document catch by species

*Vessel landing declaration report* - Advance notice of landing to allow enforcement to better monitor IQ deliveries

*Electronic ITQ landing report* - Used for tracking IQ landings in real time[3]

*Processor production report* – Used to collect socioeconomic data and for catch verification

**Electronic vessel logbook report**

Non-whiting, shoreside whiting and at-sea whiting

VMS based electronic logbook required to be transmitted from vessel. At sea entry by vessel personnel required including catch weight by species and if retained or discarded

**Vessel landing declaration report**

Non-whiting and shoreside whiting

Mandatory declaration reports

**Electronic ITQ landing report**

Non-whiting and shoreside whiting

Mandatory reports completed by processors and similar to electronic fish ticket report

**Processor production report**

Non-whiting, shoreside whiting and at-sea whiting

Mandatory reports

[2] Sensors -winch sensors may be used to start and stop video recording and for documenting fishing location in logbook system

[3] Real time means that preliminary catch weights would be available in a central database within a relatively short period of time from the date the was catch landed

| **<u>Alternative Program 1</u>:** Discarding of ITQ species *allowed* in limited entry non-whiting trawl fisheries | **<u>Alternative Program 2</u>:** Discarding of ITQ species *prohibited* in limited entry non-whiting trawl fisheries |
|---|---|
| **Control Mechanisms**<br><br>*Landing hour restrictions* - To allow enforcement to better focus resources.<br><br>*Site licenses* - To allow only processors that meet the specific monitoring requirements to take deliveries with ITQ species<br><br>*Vessel Certification*- To allow only vessels that meet the specific monitoring requirements to take ITQ species | |
| **Landing hour restrictions**<br><br><u>Non-whiting and shoreside whiting</u><br>Landing hours not limited | **Landing hour restrictions**<br><br><u>Non-whiting and shoreside whiting</u><br>Limit landing hours |
| **Site licenses**<br><br><u>Non-whiting and shoreside whiting</u><br>Mandatory license, can be issued to any site that meets the monitoring requirements | |
| **Vessel Certification**<br><br><u>Non-whiting, shoreside whiting and at-sea whiting</u><br>Mandatory certification, can be issued to any vessel that meets the monitoring requirements | |

| **<u>Alternative Program 1</u>:** Discarding of ITQ species *allowed* in limited entry non-whiting trawl fisheries | **<u>Alternative Program 2</u>:** Discarding of ITQ species *prohibited* in limited entry non-whiting trawl fisheries |
|---|---|
| Integrate into the Program, mandatory data collection and other procedures that allow evaluation of the effectiveness of the rationalization program relative to MSA requirements. | |
| | |
| Performance Measures<br>• Cost, earnings and profitability<br>• Economic efficiency and stability<br>• Capacity measures<br>• Net benefits to society<br>• Distribution of net benefits<br>• Product quality<br>• Functioning of quota market<br>• Incentives to reduce bycatch<br>• Market power<br>• Spillover effects into other fisheries<br>• Contribution to regional economies (income and employment)<br>• Distributional effects/Community Impacts<br>• Employment-seafood catching and processing<br>• Safety<br>• Bycatch and discards<br>• Administrative, enforcement, and management costs | |
| | |
| | |

## Alternative Programs for Tracking and Monitoring

**<u>Alternative Program 1</u>**: *Discarding of ITQ species allowed in limited entry non-whiting trawl fisheries*

Under Alternative Program 1, non-whiting vessels: would be allowed to discard unwanted ITQ species at sea; would be required to discard all IBQ species, and could choose to retain or discard non-groundfish species. Vessels participating in the Pacific whiting shoreside fishery would be subject to a maximized retention program that allows minor discard events associated with large animals (>6ft in length) and minor levels of operational discard.[4] Pacific whiting shoreside fishery vessels that meet qualifying criteria may be permitted to sort catch at sea and discard unwanted ITQ species. Whiting vessels that sort at sea would be required to discard IBQ species, but could choose to retain or discard unwanted non-groundfish species. At-sea processing vessels would be allowed to discard unwanted ITQ species at sea; would be required to discard all IBQ species, and could choose to retain or discard non-groundfish species. Other than minor amounts of operational discard, catcher vessels in the mothership sector would be prohibited from discarding catch before delivery to a mothership.

*Monitoring mechanisms.*

Under this alternative all non-whiting vessels would be required to carry an adequate number of obsevers for monitoring the sorting of all catch and the weighing and discarding of any ITQ or IBQ species. A supplemental video-based monitoring system, focused on the sorting and weighing area would be used to deter unobserved sorting of catch and difficult or unobservable discard events. A supplemental video-based monitoring system could also be used to resolve disputes between vessel and observer reported information.

Pacific whiting shoreside vessels participating under the maximized retention program would be required to retain all catch and to use an EMS video-base monitoring system as specified in the regulations implementing Amendment 10 of the groundfish FMP. Pacific whiting shoreside vessels that sort at sea would be required to carry an adequate number of obsevers for monitoring the sorting of all catch and the weighing and discarding of any ITQ or IBQ species with a supplemental video-based monitoring system.

All at-sea whiting processors would be required to carry an adequate number of observers for monitoring the sorting of all catch and the weighing of any ITQ or IBQ species. A supplemental video-based monitoring system, focused on the deck could be used to deter unobserved sorting of catch and difficult or unobservable discard events. Catcher vessels in the mothership fishery would be required to have a video-based monitoring systems.

*Catch tracking mechanisms*

All vessels that fish for ITQ species would be required have and use a VMS based electronic logbook and to transmit the required data from the vessel before arriving in port. Electronic logbook entries would include an accurate[5] weight of all discarded ITQ and IBQ catch by species or species group. Estimated weights for retained ITQ species and non-groundfish species may be allowed. The submission of a declaration report using a NMFS-approved method would be required. Individuals at sites that receive ITQ landings[6] and Pacific whiting shoreside fishery first receivers that accept deliveries containing ITQ species, would be required to use an electronic ITQ

[4] Operational discard is whiting that has been caught in the net mesh or lost when a codend is separated from the intermediate section of the net to a it to be transferred to the mothership processor.

[5] An accurate weight is a weight derived from a scale that is appropriate for use under the conditions, is in good working order, has been adequately tested for accuracy, and is being used as intended by the manufacture.

[6] Sites could be located at individual processor or a shared site sponsored by several processors or a community.

landing report to submit catch information to NMFS within 24 hours of the date of landing. All processors (including at-sea processing sectors), and first receivers would be required to submit processor production reports.

*Control mechanisms*
Under this alternative there would be no ITQ landing hour restrictions. However, landing locations for non-whiting and shoreside whiting would be restricted to licensed sites. Facilities would be approved for a site license by NMFS following the submission of a monitoring plan and verification that specific monitoring requirements can be met that allow for accurate sorting, weighing and reporting of landed ITQ species. Similarly, vessel certifications would be given by NMFS following the submission of a monitoring plan and verification that specific monitoring requirements can be met that allow for accurate sorting, weighing and reporting of landed ITQ species at sea.

**Alternative Program 2**: *Discarding of ITQ species prohibited in limited entry non-whiting trawl fisheries*

Under Alternative Program 2, non whiting vessels would be prohibited from discarding unwanted ITQ species at sea; would be required to discard all IBQ species, and could choose to retain or discard non-groundfish species. Vessels participating in the Pacific whiting shoreside fishery would be subject to a maximized retention program, in which case only minor amounts of operational discard or very large non-ITQ or non-IBQ species animals could be discarded at sea (> 6 ft). Pacific whiting shoreside fishery vessels that meet qualifying criteria may be permitted to sort catch at sea and discard unwanted ITQ species. Whiting vessels that sort at sea would be required to discard IBQ species, but could choose to retain or discard unwanted non-groundfish species. At-sea processing vessels would be allowed to discard unwanted ITQ species at sea; would be required to discard all IBQ species, and could choose to retain or discard non-groundfish species. Other than minor amounts of operational discard, catcher vessels in the mothership sector would be prohibited from discarding catch before delivery to a mothership.

*Monitoring mechanisms.*
Under this alternative all non-whiting vessels would be required to carry an adequate number of obsevers for monitoring the sorting of all catch and the weighing and discarding of any IBQ and the retention of ITQ species.

Pacific whiting shoreside vessels participating under the maximized retention program would be required to retain all catch and use an EMS video-base monitoring system as specified under regulations implementing Amendment 10 to the groundfish FMP. Pacific whiting shoreside vessels that sort at sea would be required to carry an adequate number of obsevers for monitoring the sorting of all catch and the weighing and discarding of any ITQ or IBQ species with a supplemental video-based monitoring system.

All at-sea whiting processors would be required to carry an adequate number of observers for monitoring the sorting of all catch and the weighing of any ITQ or IBQ species. A supplemental video-based monitoring system, focused on the deck could be used to deter unobserved sorting of catch and difficult or unobservable discard events. Catcher vessels in the mothership fishery would be required to have a video-based monitoring system.

*Catch tracking mechanisms*
All vessels that fish for ITQ species would be required have and use a VMS based electronic logbook and to transmit the required data from the vessel before arriving in port. Electronic logbook entries would include an accurate weight of all discarded IBQ species. Estimated weights for retained ITQ species and non-groundfish species may be allowed. The submission of a declaration report using a NMFS-approved method would be required. Individuals at sites that receive ITQ landings and Pacific whiting shoreside fishery first receivers that accept deliveries containing ITQ species, would be required to use an electronic ITQ landing report to submit catch information to NMFS within 24 hours of the date of landing. All processors (including at-sea processing sectors), and first receivers would be required to submit processor production reports.

*Control mechanisms*
Under this alternative there would be ITQ landing hour restrictions. Restricting landing hours allows enforcement resources to be used efficiently. Landing locations for non-whiting and shoreside whiting would be restricted to licensed sites. Facilities would be approved for a site license by NMFS following the submission of a monitoring plan and verification that specific monitoring requirements can be met that allow for accurate sorting, weighing and reporting of landed ITQ species. Similarly, vessel certifications would be given by NMFS following the submission of a monitoring plan and verification that specific monitoring requirements can be met that allow for accurate sorting, weighing and reporting of landed ITQ species.

Other Issues to be considered—1) tracking of codends lost during tranfers; 2) tracking of emergency dumping events; 3) tracking of fish unprocessed fish between first receivers who do not process fish and the actual processor. 4) Incorporation of co-op specific monitoring, tracking, and control mechanisms.

**Alternatives considered but not analyzed**

Three additional alternatives programs were initially considered. Two of these programs were excluded from the analysis because they did not meet the stated purpose and need for the tracking and monitoring program, or the stated objectives. One alternative considered partial observer coverage for monitoring non-whiting vessels at sea and the other considered no observer coverage or at-sea monitoring. The integrity of the rationalization program would be difficult to maintain with partial or no monitoring at sea and on shore. Accurate data on ITQ catch are needed to effectively detect and deter prohibited activities. When prohibited activities are not detected, the information needed to support prompt enforcement of violations is inadequate. If prompt enforcement action cannot be taken, others may choose to engaging in prohibited activities because they perceive a low risk of being caught and penalized. Provisions that would allow small or unsafe vessels to be exempt from at-sea monitoring by observers was not analyzed for the same reasons as the alternatives based on no or partial observer coverage. Providing such an exception could result in a shift to smaller or less safe vessels to avoid monitoring.

The third monitoring program considered but not analyzed was a hybrid approach between Alternative Program 1 and Program 2. The hybrid alternative would have allowed vessels to choose if they wanted to discard ITQ catch at sea and incur more burdensome at-sea monitoring or if they wanted to retain ITQ species and have lower monitoring costs. The intent of the hybrid program was to provide the maximum flexibility to the ITQ Holder. However, during initial discussions it was determined that effect of Alternatives 1 and 3 were essentially the same because nothing under Alternative 1 precludes a vessels from retaining all ITQ catch. Therefore, the hybrid alternative was not given further consideration in the analysis.

# GROUNDFISH ALLOCATION COMMITTEE (GAC) REPORT ON TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

The GAC reviewed a preliminary presentation on tracking and monitoring from Steve Freese (Northwest Region). The presentation contained draft objectives and some initial revisions to the tracking and monitoring provisions. Based on the presentation, the GAC provided the following guidance for staff to consider in developing the report that will be provided to the Council in supplemental materials at this meeting.

1. Include an objective pertaining to the accurate estimation of prohibited species catch.
2. Do not include a separate tracking and monitoring alternative which explicitly provides fishermen a choice between discarding and not discarding (this was the third alternative in the preliminary report viewed by the GAC). The first alternative in the preliminary report allows discarding and implicitly allows retention, therefore, in that regard, the third alternative in the report duplicated the first.

PFMC
02/26/08

# ENFORCEMENT CONSULTANTS REPORT ON TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

The Enforcement Consultants (EC) has evaluated Agenda Item F.6.b, Supplemental Tracking and Monitoring Draft Revisions, March 2008, Draft Revisions to Tracking and Monitoring Program Alternatives and have the following comments.

The EC believes Alternatives 1 and 2, as proposed meet the objectives stated on page 1 and endorses moving these alternatives forward for analysis.

The EC recommends changing one of The Objective of Tracking and Monitoring Program.

”For State and Federal enforcement agreements that allow the exchange of relevant data to ensure compliance with IQ quotas”

changed to read

“For State and Federal enforcement officers to have access to all data relating to IQ quotas for enforcement purposes.”

The EC wants to ensure State enforcement officers have the same access to all confidential individual quota (IQ) information as Federal enforcement officers. All three states have confidentiality agreements with NOAA already in place or in the works through the Joint Enforcement Agreement program.

PFMC
3/13/08

# GROUNDFISH ADVISORY SUBPANEL REPORT ON TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

The Groundfish Advisory Subpanel (GAP) heard a presentation from Dr. Steve Freese on the tracking and monitoring proposals being developed by the committee and discussed the proposed program which has been developed to date.

We also heard extensively from Brian Mose, a British Columbia trawler, about the Canadian experience in development of their IQ system and in particular, their experience with respect to monitoring. His valuable insight is appreciated.

The GAP makes the following recommendations and general comments regarding monitoring:

**1. Monitoring**: The industry recognizes and supports that 100 percent monitoring is necessary for a successful ITQ program.

**2. Objective:** There will be many benefits in addition to accurate monitoring and accounts resulting from the Monitoring Program. Real time information on total catch gives us a new level of accuracy in scientific information used by management and stock assessment authors, as well as the fishing industry.
A data base of accurate place, time and species of catch will give fishermen the tools to change fishing behavior. Some anticipated results are a lowering of non-directed catch, increased efficiency of catch, as well as more accurate information concerning the location of areas of preferred habit of species. Thorough and accurate monitoring is essential to reaching most Objectives of the Trawl Rationalization Program.

The GAP recommends the following Objective be added to the Monitoring Objectives:

*"To provide catch and scientific data which will facilitate reaching the Goals and Objectives of the Trawl Rationalization Program."*

**3. Data Processing and Flow**: Accurate and timely data collection is of little utility if it gets bogged down in the processing system. Information/data flow must move smoothly and expeditiously though the system if it is to be useable by industry to form a business plan and prosecute a fishery. This will require the states to interface seamlessly with the data collection system.

The system developed by the states and Federal Government is just as important as the collection of catch data.

**4. Industry Participation:** The document reflects the concerns of management and not those of the industry.

The GAP wishes to impress on the Council the need to include the fishing industry in the process of developing the Monitoring Program. The devil being in the details, industry is particularly interested in the rules which will implement the program. They are the ones who will be affected at the field level.

**5. Free Market Solutions:** Competition in administration, monitoring, data collection and processing is important if costs are to be reduced. This may require the farming out of activities such as monitoring, both at sea and ashore, data processing and reporting. This may change the role of fisheries managers but could results in cost savings as well as increased efficiencies. Industry will be more willing to bear these costs knowing there is competition in the process.

**6. Processor Production Reports**. Lastly the GAP questions the requirement of mandatory processor production reports. It is unclear what the need for this is and what information would be reported that would be informative beyond the observer data collected at the dock regarding amounts and types of species landed. It is possible that the additional information being requested in the production report is likely proprietary.

PFMC
3/12/08

# GROUNDFISH MANAGEMENT TEAM REPORT ON THE TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

The Groundfish Management Team (GMT) reviewed and discussed Current Tracking and Monitoring Program Provisions (Agenda F.6.a, Attachment 1) and Draft Revisions to Tracking and Monitoring Program Alternatives (Agenda Item F.6.b). The team also attended the Groundfish Advisory Subpanel's discussion, which included a presentation on the British Columbia tracking and monitoring systems by Brian Mose.

The GMT recommends that the Council prioritize an analysis of a basic framework necessary to accomplish total catch accountability at the vessel level, which should be a primary objective of the tracking and monitoring effort. Major benefits of trawl rationalization (e.g., improved data on location of bycatch, the incentive to avoid bycatch, etc.) flow from the ability to collect information on discards and landings and then match it to each individual quota holder. The tools and components included in the alternatives provide a broad range of tracking and monitoring tools for analysis to accomplish this objective. However, a basic framework for total catch accountability at the vessel level should be the analysis priority. Once this framework is established, additional tools and systems can then be evaluated for what they would add to the program in terms of accuracy, speed, measuring program performance, and enforceability.

The team distilled the eight objectives in the draft alternatives into three themes: (1) conservation and management needs, (2) industry needs (accountability, business flexibility and certainty), and (3) enforceability. The core needs of all three themes are tied to accounting of total catch at the vessel level. Options not based on this concept may be of secondary importance.

Lastly, the team recognizes that cost is a major concern and understands that increases in speed and accuracy come with increases in cost. The team suggests that the foremost task in the analysis is to identify a level of speed and accuracy that achieves the full benefits of trawl rationalization as outlined above. Measures taken to decrease costs should be evaluated not just for losses in speed and accuracy, but also for what they subtract in terms of the loss in these benefits to management, industry, and enforcement.

*British Columbia and Alaska*

The team believes that the Council would benefit from learning more about the British Columbia's trawl fishery "performance standard" model. Our understanding is this model starts with a performance standard (e.g., "total accounting of catch") and then uses iterative negotiation and evaluation processes between industry and government to explore the most flexible and effective methods for achieving the standard. The team also notes that Alaska has substantial experience with the tracking and monitoring of various rationalization systems and thinks the Council would benefit from more information on the design of the Alaskan tracking and monitoring systems.

GMT Recommendations:

1. Add an additional objective to the analysis: “To develop a program that provides for total catch accountability at the vessel level in order realize the full benefits of trawl rationalization.” This objective should be recognized as paramount to the success of the program.

2. Prioritize a basic framework necessary to accomplish total catch accountability at the vessel level. Secondary analyses could include additional tools and systems, as needed, to improve program performance.

3. Include end-to-end process diagrams and descriptions of the catch accounting systems used in British Columbia and Alaska.

4. Analyze and explore the “performance standard” approach used in the British Columbia.

PFMC
3/13/08

# SCIENTIFIC AND STATISITCAL COMMITTEE REPORT ON TRACKING AND MONITORING FOR TRAWL RATIONALIZATION PROGRAM

Dr. Steve Freese (Northwest Region) provided the Scientific and Statistical Committee (SSC) with a general outline of two alternative tracking and monitoring programs being considered for trawl rationalization. The two alternatives differ in that one allows and the other prohibits discarding of individual trawl quota (ITQ) species in the non-whiting fishery. This difference has implications for observer and shoreside monitoring requirements.

More detailed specification of monitoring and other requirements is needed to allow estimation of costs associated with each program alternative. Cost analysis should address (1) at-sea and shoreside monitoring requirements, (2) data systems for collection, management, analysis, validation and timely dissemination of needed data (e.g., logbooks, fish tickets, observer data, economic data), and (3) types and levels of enforcement needed to ensure an acceptable level of compliance. Cost analysis will be useful for of identifying cost-effective alternatives and ensuring that program costs are offset by the benefits of rationalization.

PFMC
3/11/08

# FINAL CONSIDERATION OF INSEASON ADJUSTMENTS – IF NEEDED

Consideration of inseason adjustments to 2008 groundfish fisheries may be a two-step process at this meeting. The Council will meet on Thursday, March 13, 2008, and consider advisory body advice and public comment on inseason adjustments under Agenda Item F.5. If the Council elects to make final inseason adjustments under Agenda Item F.5, then this agenda item may be cancelled, or the Council may wish to clarify and/or confirm these decisions. If the Council tasks advisory bodies with further analysis under Agenda Item F.5, then the Council task under this agenda item is to consider advisory body advice and public comment on the status of 2008 groundfish fisheries and adopt final inseason adjustments as necessary.

## Council Action:

**Consider information on the status of ongoing 2008 fisheries and adopt inseason adjustments as necessary.**

Reference Materials: None.

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 or Confirm Final Adjustments to 2008 Fisheries

PFMC
02/22/08

Agenda Item F.7.b
Supplemental GMT Report
March 2008

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

The Groundfish Management Team (GMT) considered the most recent information on the status of fisheries and provides the following considerations and recommendations for 2008.

## RECREATIONAL

### *California*

The GMT considered the California recreational inseason proposal and new CDFG inseason response capabilities (Agenda Item F.5.c Supplemental Revised CDFG Report). CDFG has indicated that the proposed action reduces impacts to overfished species to a level that approximates the harvest guidelines in the scorecard. While the GMT has not had the opportunity to review these actual estimates, the GMT has placed the harvest guidelines for this fishery into the scorecard. Given the proposed management measures and new inseason response capabilities, the GMT believes that the harvest guidelines reflect a better impact estimate than the impacts that correspond to status quo. Thus, the GMT recommends that the Council approve the proposed 2008 California inseason recreational groundfish management measures and conforming actions for the 20 fm depth restriction in the Northern and North-Central Management Area and use of the Pt. Arena management line for refinement of management measures within the North-Central Management Area.

The GMT discussed at length the allocative implications of using harvest guidelines vs. projected impacts in the scorecard. The team notes that if all three states used harvest guidelines, canary impacts would be over-prescribed by 2.5 mt under the current inseason proposals.

## COMMERCIAL

### *Limited Entry Non-Tribal Whiting Trawl*

The GMT considered bycatch limits in the whiting fishery and recommends the following limits and considerations. The GMT recommends that the Council adopt a darkblotched bycatch limit of approximately 40 metric tons and a widow bycatch limit of 275-295.6 mt. During the 2007 season, it was apparent that the increasing biomass of widow rockfish resulted in a higher widow bycatch rate than expected. A review of available data shows an increasing trend over the past 4 years. If this trend continues, an even higher bycatch rate should be expected this year, thus justifying the need for a higher bycatch limit. However, an increase in the darkblotched limit is expected to alter the at-sea fleet depth distribution, leading to a somewhat lower bycatch rate for canary and widow rockfish (Table 1a) than would be expected without an increase in the darkblotched limit (Table 1b).

The GMT recommends that the Council adopt a canary bycatch limit of 4.7 mt. This limit has accommodated the fishery over the past few years and the bycatch scorecard with the proposed inseason actions can accommodate this limit. Furthermore, the GMT is concerned that, if the Council reduces the bycatch limit below 4.7 mt, that this limit would be less likely to reasonably accommodate the whiting OY. Lowering the bycatch limit may lead to a higher canary bycatch rate than currently assumed in Table 1a. Bycatch rates may potentially be higher than assumed

because industry representatives may not believe that a lower limit can be successfully managed. If this belief is spread across enough participants in the fishery, then it is likely that an accelerated race for fish could ensue, limiting the opportunity to carefully avoid bycatch. Under such conditions, it is likely that communication among the fleets and the existing attempts at cooperative bycatch management would break down and higher bycatch rates would result. The implication would be less whiting harvest than may otherwise be the case, potentially leading to disproportionate losses across the whiting sectors.

The whiting fishery will be in transition from a Federal Exempted Fishing Permit to Amendment 10 during 2008 and it is uncertain what other tools are available to manage whiting fishery bycatch. For example, it is unclear whether fathom lines/depth closures can be used to slow catches of canary and widow. Additionally, it is unclear whether the whiting season could be closed upon projected attainment of a bycatch limit or whether the fishery could be closed upon attainment of a bycatch limit. If the fishery is closed upon attainment of the bycatch limit, it is reasonable to assume that the fishery will take in excess of that limit because of the amount of effort and catch that occurs between the closure notice and actual closure. To avoid jeopardizing the OY, the Council may wish to establish a residual between projected catch in the scorecard and the OY. Based on events that occurred in 2007, a residual of 20 mt or more may need to be established for widow rockfish. However, it is important to note that establishing a residual is only necessary if the Council expects the fishery to be closed as a result of a bycatch limit being reached instead of attainment of the whiting sector allocations. Analysis indicates that if the Council raises the darkblotched limit that the fleet may be able to successfully avoid canary and widow while prosecuting the whiting fishery.

**Table 1a. Projected impacts of a 40.0 mt darkblotched bycatch limit on canary and widow rockfish, assuming deeper at-sea fleet depth distributions.**

| U.S. whiting OY (mt) | Commercial OY (mt) | Projected catch (mt) | |
|---|---|---|---|
| | | Canary | Widow |
| 269,545 | 232,545 (U.S. OY minus 2,000 mt for research and other fishery catch, minus 35,000 mt for the tribal allocation.) | 3.0 | 295.6 |

**Table 1b. Projected impacts at the beginning of the year for overfished species, based on the 2008 bycatch modeling approach (described in Agenda Item F.3.B Supplemental GMT report) and fleet depth distributions from 2004-2007.**

| Year | U.S. whiting OY (mt) | Commercial OY (mt) | Commercial Sector | Allocation (mt) | Projected catch (mt) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Canary | DB | POP | Widow |
| 2008 | 269,545 | 232,545 (U.S. OY minus 2,000 mt for research and other fishery catch, minus 35,000 mt for the tribal allocation.) | Mothership | 55,811 | 2.1 | 6.19 | 1.13 | 107.2 |
| | | | Catcher Processor | 79,065 | 0.3 | 6.18 | 1.16 | 130.3 |
| | | | Shoreside | 97,669 | 1.6 | 2.93 | 0.35 | 127.0 |
| | | | TOTAL | ~ | 4.0 | 15.3 | 2.6 | 364.5 |
| 2007 | 242,591 | 208,091 | TOTAL | ~ | 3.9 | 12.4 | 2.9 | 217.6 |

For reference, Appendix A includes the 2007 projected impacts for overfished species, based on the 2007 bycatch modeling approach and OY.

*Limited Entry Non-Whiting Trawl*

The GMT further evaluated non-whiting trawl inseason adjustments for 2008 and focused on strategies that would shift trawl effort to areas seaward of the RCA. Industry members indicated that a 150 fathom line off Washington may not induce as much seaward effort as would be the case if a 150 fathom line was established immediately south of the OR/WA border. A review of available data indicates that darkblotched rockfish (the species of most concern seaward of the RCA in the north) has a relatively low bycatch rate between the OR/WA border and Cape Falcon. Industry members indicated that this area constitutes relatively productive fishing grounds, and therefore would entice trawl vessels to fish seaward of the RCA. The following figure illustrates the bycatch rate of darkblotched in select areas off Washington and Oregon.

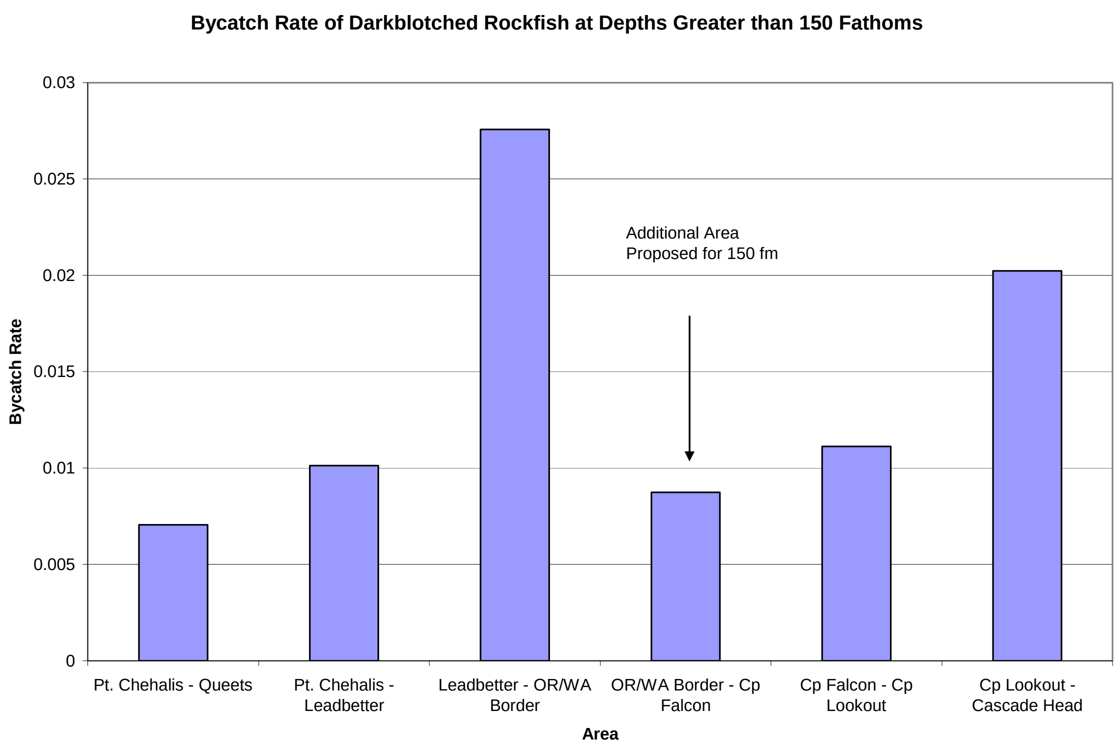


**Figure 1 Bycatch Rate of Darkblotched Rockfish Seaward of the Trawl RCA by Subarea**

Based on this information, the GMT proposes shifting the seaward RCA boundary between the OR/WA border (46°16’ N. lat.) and Cape Falcon (45°46’ N. lat.) to 150 fathoms in periods 3 and 4 (Table 2). Additionally, the GMT recommends that the shoreward boundary of the RCA north of 40°10’ N. lat. be shifted to 60 fathoms in all areas except for that area between the OR/WA border and Cape Arago (where the shoreward boundary is proposed at 75 fathoms), between Cape Arago and Humbug mountain (where the RCA is pushed in to shore), and north of Cape Alava (where the RCA is pushed in to shore).

The GMT would like to acknowledge the adverse consequences that the closure north of Cape Alava and between Cape Arago and Humbug mountain has had on members of industry. The GMT was recently made aware that multiple trawlers off northern Washington have left the fishery because of these closures. However, the GMT proposes to leave the area north of Cape Alava, shoreward of the RCA, closed for the year because logbook, survey, and observer data, and qualitative information indicates that canary abundance is high in that area. The same holds for the area between Cape Arago and Humbug Mountain. Table 2 illustrates the proposed RCA boundaries north of 40°10' N. lat. by sub-area.

**Table 2 Proposed Trawl RCA Boundaries north of 40 10**

Proposed Non-Whiting Trawl RCA Boundaries North of 40 10

<table>
<tr><th></th><th></th><th>JAN-FEB</th><th>MAR-APR</th><th>MAY-JUN</th><th>JUL-AUG</th><th>SEP-OCT</th><th>NOV-DEC</th></tr>
<tr><td>North of 48°10.00' N. lat.</td><td>N Alava</td><td>shore - modified 200 fm</td><td>shore - 200 fm</td><td colspan="3">shore - 150 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>48°10.00' N. lat. - 47°31.7' N. lat.</td><td>Alava - Queets</td><td rowspan="5">75 fm - modified 200 fm</td><td>60 fm - 200 fm</td><td colspan="3">60 fm - 150 fm</td><td rowspan="5">75 fm - modified 200 fm</td></tr>
<tr><td>47o31.7' N. lat. - 46o38.17 N. lat.</td><td>Queets - Leadbetter</td><td>60 fm - 200 fm</td><td colspan="3">60 fm -150 fm</td></tr>
<tr><td>46°38.17' N. lat. - 46o16' N lat</td><td>Leadbetter - OR/WA Border</td><td colspan="2">60 fm - 200 fm</td><td colspan="2">60 fm - 150 fm</td></tr>
<tr><td>46o16.00 N. lat. - 45o46 N. lat.</td><td>OR/WA Border - Cp Falcon</td><td>75 fm - 200 fm</td><td colspan="2">75 fm - 150 fm</td><td>75 - 200 fm</td></tr>
<tr><td>45o46' N. lat. - 43o20.83' N. lat.</td><td>Cp Falcon - Cp Arago</td><td colspan="4">75 fm - 200 fm</td></tr>
<tr><td>43°20.83' N. lat. - 42°40.50' N. lat.</td><td>Cp Arago - Humbug mt</td><td>shore - modified 200 fm</td><td colspan="4">shore - 200 fm</td><td>shore - modified 200 fm</td></tr>
<tr><td>42°40.50' N. lat. - 40°10.00' N. lat.</td><td>Humbug mt - 40 10</td><td>75 fm - modified 200 fm</td><td>75 fm - 200 fm</td><td colspan="3">60 fm - 200 fm</td><td>75 fm - modified 200 fm</td></tr>
</table>

In addition to these proposed RCA boundaries, the following cumulative limits are proposed for the remainder of the year. These limits reduce opportunities for Dover, Other Flatfish, and petrale sole in areas shoreward of the trawl RCA in the north, while increasing opportunities for sablefish coastwide, for shortspine south of 40° 10' N. lat., and for slope rockfish between 38° and 40° 10' N. lat. These limits are intended to encourage vessels to fish seaward of the trawl RCA while providing additional fishing opportunities for sablefish and thornyheads.

**Table 3 Proposed Cumulative Limits for Non-Whiting Trawl**

| SUBAREA | Period | RCA Config INLINE | RCA Config OUTLINE | Sable | Longsp | Shortsp | Dover | Otr Flat | Petrale | Arrowtth | Slope Rk |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N 40 10 Large Footrope | 1 | see attached table | | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 40,000 | 150,000 | 1,500 |
| | 2 | | | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 150,000 | 1,500 |
| | 3 | | | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 20,000 | 150,000 | 1,500 |
| | 4 | | | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 20,000 | 150,000 | 1,500 |
| | 5 | | | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 20,000 | 150,000 | 1,500 |
| | 6 | | | 14,000 | 25,000 | **25,000** | 80,000 | 110,000 | 40,000 | 150,000 | 1,500 |
| N 40 10 SFFT | 1 | see attached table | | 5,000 | 3,000 | 3,000 | 40,000 | 70,000 | 10,000 | 10,000 | 1,500 |
| | 2 | | | 5,000 | 3,000 | 3,000 | 50,000 | 70,000 | 18,000 | 10,000 | 1,500 |
| | 3 | | | 5,000 | 3,000 | 3,000 | **40,000** | **50,000** | **18,000** | 10,000 | 1,500 |
| | 4 | | | 5,000 | 3,000 | 3,000 | **40,000** | **50,000** | **18,000** | 10,000 | 1,500 |
| | 5 | | | 5,000 | 3,000 | 3,000 | **40,000** | **50,000** | **18,000** | 10,000 | 1,500 |
| | 6 | | | 5,000 | 3,000 | 3,000 | 40,000 | **50,000** | 10,000 | 10,000 | 1,500 |
| 40 10 - 38 | 1 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 15,000 |
| | 2 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 15,000 |
| | 3 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | **15,000** |
| | 4 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | **15,000** |
| | 5 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | **15,000** |
| | 6 | 100 | 150 | 14,000 | 25,000 | **25,000** | 80,000 | 110,000 | 50,000 | 10,000 | 15,000 |
| S 38 | 1 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 50,000 | 10,000 | 55,000 |
| | 2 | 100 | 150 | 14,000 | 25,000 | 12,000 | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 3 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 4 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 5 | 100 | 150 | **19,000** | 25,000 | **25,000** | 80,000 | 110,000 | 30,000 | 10,000 | 55,000 |
| | 6 | 100 | 150 | 14,000 | 25,000 | **25,000** | 80,000 | 110,000 | 50,000 | 10,000 | 55,000 |

The following mortality estimates are based on the proposed actions above.

**Table 4 Estimated Impacts from Proposed Trawl RCAs and Cumulative Limits**

| | North | South | Total |
|---|---|---|---|
| Canary | 6.5 | 2.6 | 9.1 |
| POP | 81.5 | 0.0 | 81.5 |
| Darkbltch | 218.1 | 40.8 | 258.9 |
| Widow | 1.6 | 5.5 | 7.1 |
| Bocaccio | - | 11.7 | 11.7 |
| Yelloweye | 0.6 | 0.0 | 0.6 |
| Cowcod | - | - | - |
| Sable | 2,015 | 508 | 2,523 |
| Longspine | 509 | 385 | 893 |
| Shortsp | 1,002 | 508 | 1,509 |
| Dover | 8,166 | 2,191 | 10,356 |
| Arrowtth | 1,454 | 64 | 1,518 |
| Petrale | 1,932 | 347 | 2,279 |
| Otr Flat | 1,492 | 559 | 2,051 |
| Slope Rock | 46 | 124 | 170 |

*Open Access Sablefish Daily Trip Limit Fishery North of 36º*

The GMT considered the effect of the upcoming poor salmon year on participation in the open access sablefish DTL fishery. Assuming spill over into the DTL fishery is similar to that which occurred as a result of the 2006 salmon season, then the GMT predicts that the open access catch of sablefish will exceed the allocation. Therefore, the GMT explored reductions to fishing opportunities in this fishery in order to prevent exceeding the allocation. According to industry members, a reduction in the daily limit will make fishing opportunities unprofitable for many participants. Based on the GMT model for this fishery, varying the weekly limit does not appear to impact overall catch. Therefore, the GMT proposes reducing the bimonthly limit for open access sablefish north of the Conception area to 2,200 lbs per two months from 2,400 lbs per two months.

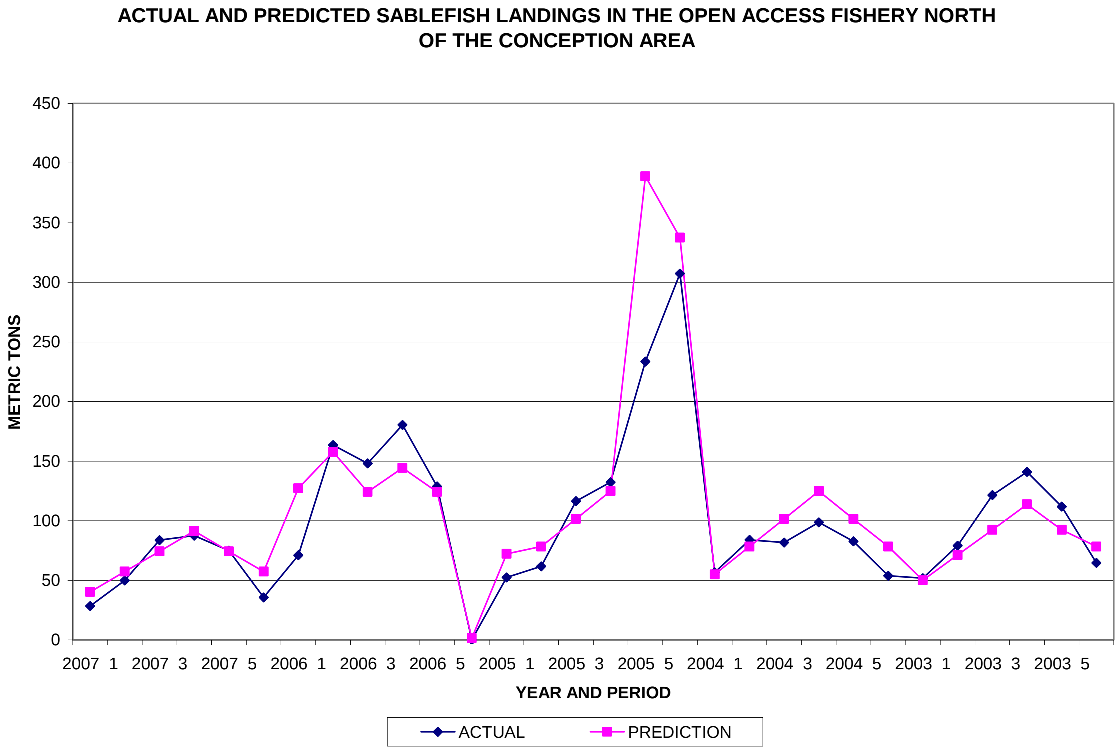


**Figure 2 Predicted and Actual Catch in the OA Sablefish Fishery North of 36º**

*Open Access Nearshore Commercial Fisheries North and South of 40°10' N. lat.*

The GMT reviewed the bycatch mortality estimates used to inform the open access nearshore model and determined they were not based on a weighted average, which is the practice historically used by the GMT. Using weighted average bycatch mortality estimates, canary impacts decreased from 3.0 mt to 2.6 mt under status quo management. Yelloweye impacts increased from 1.4 mt to 1.6 mt. The GMT acknowledges that the canary impacts are greater than past projected impacts of 1.7 mt, but are not recommending any changes from status quo management measures at this time.

The GMT could explore more refined area management to address reductions of canary impacts in the open access nearshore fishery between 40°10' N. lat. and 34 27' N. lat. and will request observer data to inform this analysis. However, this analysis is not likely possible in the near term.

This morning, the GAP requested an analysis of changes to RCAs between 40°10' N. lat. and 34 27' N. lat. to decrease canary impacts. Unfortunately, given the schedule today, the team is unable to accomplish model runs at this time. However, we will provide this information at the April Council meeting. If RCA boundaries are adopted in April, they can go into effect immediately after the inseason publication of a Federal Register Notice near the start of the southern open access nearshore season (May 1).

*Incidental Canary in the Salmon Troll Fishery*

Currently, the GMT estimates that 0.8 mt of canary rockfish will be taken incidentally by the coastwide salmon troll fishery. This amount was based on a rate estimated from data collected during ride-along observations from 2003-2005 in the salmon troll fishery off the north coast of Washington. Severely reduced salmon troll opportunities south of Cape Falcon, Oregon in 2008 may result in reduced impacts to canary rockfish. The GMT will continue to explore available data sources to inform any changes in the canary rockfish projection after the Council takes final action on salmon troll fisheries in April.

**GMT Recommendations**

1. Recreational
    a. Approve the proposed 2008 California inseason adjustments
2. Limited entry non-tribal whiting trawl
    a. Specify a darkblotched bycatch limit of approximately 40 mt
    b. Specify a widow bycatch limit of 275-295.6 mt
    c. Specify a canary bycatch limit of 4.7 mt
3. Limited entry non-whiting trawl
    a. Adjust the RCA boundary north of 40º10' N. lat. (Table 2)
    b. Adjust cumulative limits coastwide (Table 3)
4. Open access sablefish DTL north of 36º N. lat.
    a. Adjust the bimonthly limit from 2,400 lbs per two months to 2,200 lbs per two months.

Appendix A.

Table 1. 2007 projected impacts for overfished species, based on the 2007 bycatch modeling approach and OY.

| U.S. whiting OY (mt) | Commercial OY (mt) | Commercial Sector | Allocation (mt) | Projected catch (mt) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Canary | Darkblotched | POP | Widow |
| 242,591 | 208,091 | Mothership | 49,942 | 2.3 | 4.4 | 1.0 | 86 |
| | | Catcher Processor | 70,751 | 0.2 | 5.6 | 1.5 | 86 |
| | (242,591 mt minus 2,000 mt for research and other fishery catch, minus 32,500 mt for the tribal allocation) | Shoreside | 87,398 | 1.4 | 2.4 | 0.3 | 45.6 |
| | | Total | 208,091 | 3.9 | 12.4 | 2.9 | 217.6 |

**2008 Projected mortality impacts (mt) of overfished groundfish species under inseason proposals and recommended bycatch limits for the LE non-tribal whiting fishery.**

**3/14/08**

| Fishery | Bocaccio b/ | Canary | Cowcod | Dkbl | POP | Widow | Yelloweye |
|---|---|---|---|---|---|---|---|
| **Limited Entry Trawl- Non-whiting** | **11.7** | **9.1** | **0.0** | **258.6** | **81.5** | **7.1** | **0.6** |
| **Limited Entry Trawl- Whiting** | | | | | | | |
| At-sea whiting motherships a/ | | | | | 1.9 | | 0.0 |
| At-sea whiting cat-proc a/ | | **4.7** | | **40.0** | | **275-295.6** | 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 | | | | | 2.2 |
| Sablefish | 13.4 | | 0.0 | 0.6 | 0.3 | 0.9 | |
| Non-Sablefish | | | 0.1 | 0.4 | | 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 | 2.6 | 0.1 | 0.0 | 0.0 | 0.5 | 1.6 |
| Nearshore (South of 40°10' N. lat.) | 0.1 | | | 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 | | | | | 6.2 |
| OR | | | | | | 1.4 | |
| CA | **66.3** | **9.0** | **0.3** | | | **8.0** | **2.1** |
| **EFPs** | 11.0 | 0.1 | 0.2 | 1.0 | | 3.4 | 0.1 |
| **Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/** | | | | | | | |
| | 2.0 | 5.5 | 0.2 | 2.0 | 2.0 | 1.1 | 3.0 |
| **TOTAL** | 116.4 | 44.0 | 0.9 | 302.9 | 90.1 | **342.5-363.5** | 18.9 |
| **2008 OY** | 218 | 44.0 | 4.0 | 330 | 150 | 368 | 20 |
| **Difference** | 101.6 | 0.0 | 3.1 | 27.1 | 59.9 | **2.6 - 23.6** | 1.1 |
| **Percent of OY** | 53.4% | 100.0% | 22.5% | 91.8% | 60.1% | - | 94.3% |
| Key | | = either not applicable; trace amount (<0.01 mt); or not reported in available data | | | | | |

a/ Non-tribal whiting numbers reflect bycatch limits for the non-tribal whiting sectors.

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 for WA and OR. However, harvest guidelines for 2008 are as follows: canary in WA and OR combined = 8.2 mt; yelloweye in WA and OR combined = 6.8 mt. For California, harvest guidelines are represented.

f/ Research projections updated November 2007.

**2008 Projected mortality impacts (mt) of overfished groundfish species under inseason proposals and California Recreational Harvest Guidelines.**

**3/14/08**

| Fishery | Bocaccio b/ | Canary | Cowcod | Dkbl | POP | Widow | Yelloweye |
|---|---|---|---|---|---|---|---|
| **Limited Entry Trawl- Non-whiting** | **11.7** | **9.1** | **0.0** | **258.9** | **81.5** | **7.1** | **0.6** |
| **Limited Entry Trawl- Whiting** | | | | | | | |
| At-sea whiting motherships a/ | | 4.7 | | 25.0 | 1.9 | 275.0 | 0.0 |
| At-sea whiting cat-proc a/ | | | | | | | 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 | | | | | 2.2 |
| Sablefish | 13.4 | | 0.0 | 0.6 | 0.3 | 0.9 | |
| Non-Sablefish | | | 0.1 | 0.4 | | 0.5 | |
| **Open Access: Directed Groundfish** | | 1.0 | | | | | |
| Sablefish DTL | 0.0 | 0.2 | 0.1 | 0.2 | 0.1 | 0.0 | 0.3 |
| Nearshore (North of 40°10' N. lat.) | 0.0 | 2.6 | | 0.0 | 0.0 | 0.5 | 1.6 |
| Nearshore (South of 40°10' N. lat.) | 0.1 | | | 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 | | | | | 6.2 |
| OR | | | | | | 1.4 | |
| CA | **66.3** | **9.0** | **0.3** | | | **8.0** | **2.1** |
| **EFPs** | 11.0 | 0.1 | 0.2 | 1.0 | | 3.4 | 0.1 |
| **Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/** | | | | | | | |
| | 2.0 | 5.5 | 0.2 | 2.0 | 2.0 | 1.1 | 3.0 |
| **TOTAL** | 116.4 | 44.0 | 0.9 | 288.2 | 90.1 | 344.4 | 18.9 |
| **2008 OY** | 218 | 44.0 | 4.0 | 330 | 150 | 368 | 20 |
| **Difference** | 101.6 | 0.0 | 3.1 | 41.9 | 59.9 | 23.6 | 1.1 |
| **Percent of OY** | 53.4% | 100.0% | 22.5% | 87.3% | 60.1% | 93.6% | 94.3% |
| Key | | = either not applicable; trace amount (<0.01 mt); or not reported in available | | | | | |

a/ Non-tribal whiting numbers reflect bycatch limits for the non-tribal whiting sectors.

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 for WA and OR. However, harvest guidelines for 2008 are as follows: canary in WA and OR combined = 8.2 mt; yelloweye in WA and OR combined = 6.8 mt. For California, harvest guidelines are represented.

f/ Research projections updated November 2007.

**2008 Projected mortality impacts (mt) of overfished groundfish species. Updated at the March Council meeting with the latest bycatch rates for the LE non-whiting fishery, Limited Entry Fixed Gear fishery, and Open Access fishery, status quo impacts for California Recreational prior to inseason action.**

3/14/08

| Fishery | Bocaccio b/ | Canary | Cowcod | Dkbl | POP | Widow | Yelloweye |
|---|---|---|---|---|---|---|---|
| **Limited Entry Trawl- Non-whiting** | **11.5** | **16.3** | **1.4** | **209.1** | **80.9** | **6.6** | **0.5** |
| **Limited Entry Trawl- Whiting** | | | | | | | |
| At-sea whiting motherships a/ | | | | | 1.9 | | 0.0 |
| At-sea whiting cat-proc a/ | | 4.7 | | 25.0 | | 275.0 | 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 | | | | | **2.2** |
| Sablefish | 13.4 | | 0.0 | **0.6** | **0.3** | **0.9** | |
| Non-Sablefish | | | 0.1 | **0.4** | | 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 | **2.6** | 0.1 | 0.0 | 0.0 | 0.5 | **1.6** |
| Nearshore (South of 40°10' N. lat.) | **0.1** | | | 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 | | | | | 6.2 |
| OR | | | | | | 1.4 | |
| CA | **49.5** | **11.5** | **0.1** | | | **6.1** | **8.5** |
| **EFPs** | 11.0 | 0.1 | 0.2 | 1.0 | | 3.4 | 0.1 |
| **Research: Includes NMFS trawl shelf-slope surveys, the IPHC halibut survey, and expected impacts from SRPs and LOAs. f/** | | | | | | | |
| | 2.0 | 5.5 | 0.2 | 2.0 | 2.0 | 1.1 | 3.0 |
| **TOTAL** | 99.4 | 53.7 | 2.1 | 238.4 | 89.5 | 342.0 | 25.2 |
| **2008 OY** | 218 | 44.0 | 4.0 | **330** | 150 | 368 | 20 |
| **Difference** | 118.6 | -9.7 | 1.9 | 91.7 | 60.5 | 26.0 | -5.2 |
| **Percent of OY** | 45.6% | 122.0% | 52.5% | 72.2% | 59.7% | 92.9% | 125.8% |
| Key | | = either not applicable; trace amount (<0.01 mt); or not reported in available | | | | | |

a/ Non-tribal whiting numbers reflect bycatch limits for the non-tribal whiting sectors.

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 for WA, OR, and CA under status quo management measures.

f/ Research projections updated November 2007.

# GROUNDFISH ADVISORY SUBPANEL REPORT ON FINAL CONSIDERATION OF INSEASON ADJUSTMENTS

The Groundfish Advisory Subpanel (GAP) discussed inseason adjustments necessary to balance the scorecard as well as bycatch caps for the whiting fishery and has the following comments and recommendations:

## Recreational

The GAP heard a report from John Budrick of the California Department of Fish and Game (CDFG) on the bycatch rate for yelloweye rockfish in the recreational fishery between Point Arena and the Oregon border.

The GAP supports the CDFG proposed management measures for addressing these problems, including a depth restriction of 20 fathoms, weekly catch tracking and a preliminary catch estimate with a one-month lag time to prevent the fishery from exceeding its harvest guideline of 2.1 metric tons. Ideally, the tracking methods would allow CDFG to project when the harvest guideline would be reached and time closures prior to the harvest guideline being exceeded. The GAP supports a new management line at Point Arena, since most of the yelloweye bycatch occurs to the north of that line. It is our understanding that the Director of CDFG can close any region within ten days notice based on this information.

The GAP supports the CDFG proposed temporary area closures to avoid yelloweye rockfish, and heard from members of the public in the region who supported the area closure at Shelter Cove. Fort Bragg fishermen had some concerns about the placement of two area closures close to the port. Although they were supportive of using the temporary area closures as a management tool to extend the fishing season, they wanted some further discussions with the CDFG about refining these boundaries. If tracking lower than the expected bycatch rates, these areas could be reopened as the season progresses.

An aggressive education and enforcement effort needs to be undertaken to prevent landings in the fishery. There are strong indications that anglers are unable to identify yelloweye rockfish, as well as other overfished species. The largest savings could come from these efforts. Recreational anglers must be made aware that continued high rates of yelloweye bycatch will result in extremely short fishing seasons.

The GAP strongly recommends that California provide timely and accurate catch data to the Council in order to facilitate inseason adjustments and prudent management of California recreational fisheries in order to stay below the yelloweye and canary harvest guidelines.

Commercial

*Bycatch Caps for the Whiting Fishery*

The GAP agrees with the Groundfish Management Team (GMT) rationale and recommendation for increasing the darkblotched bycatch limit to 40 mt. The limits are not meant to punish the whiting fishery, rather they are meant to be upper limits to prevent inseason impacts to non-whiting fisheries. The bycatch limits are the only numbers in the scorecard that result in immediate closure if attained. With that in mind, the GAP recommends maintaining the canary cap at 4.7 mt. The whiting sectors have learned to manage operations to stay below 4.7 mt. Amounts lower than 4.7 mt will induce changes in fishing behavior, creating a potential race for bycatch. Negative impacts from this behavior could disproportionately harm the shoreside sector because they start after the at-sea sectors. For widow rockfish the GAP supports the current 275 mt amount in the scorecard. The GAP heard from all three sectors of the whiting fishery and all support our recommendations about the bycatch limits.

*Limited Entry non-whiting Trawl*

The GAP supports the GMT recommended management measures to reduce the canary impacts in the limited entry non-whiting trawl fishery to 9.1 mt which includes some adjustments in trip limits as well as line changes to the RCA.

*Open Access DTL Fishery*

The GAP agrees with reducing the bi-monthly limit north of the Conception area from 2,400 lbs to 2,200 lbs.

*Open Access Nearshore South of 40 10 and north of 34 27*

Observer data indicates that the open access nearshore fishery south of 40 10 has projected impacts that are higher than 1.7 mt as was projected during 2007. With the data available to the GMT at this meeting, draconian measures would be necessary for the open access nearshore fishery in order to reduce impacts to 1.7 mt. Instead, the trawl limited entry non-whiting option is willing to make up the difference on canary savings in order to balance the scorecard while additional data is gathered on what is happening in the open access nearshore fishery south of 40 10. That is, the GAP recommends that the observer data be explored to determine if there is a "hot spot" area that is driving the increased interception of canary rockfish and measures could be taken at a later meeting to close these areas and bring the impacts back closer to 1.7 mt. Our understanding is that there has been some resistance from NMFS in the past to provide this data and the GAP requests that the Council encourage the Science Center to cooperate with this data request. This data will also be important as we move into the 2009-2010 SPEX process. We also request that the GMT explore alternate management measures to reduce open access nearshore fishery impacts on canary closer to 2007 levels in the absence of receiving the observer data or if the data results do not send a clear picture of "hot spot" areas that could be closed. The GAP would like to revisit this issue at the April meeting to review the progress that is made between now and then.

Summary of GAP recommendations:

1. Approve CDFG recommendations for changes to the recreational fishery in order to reduce yelloweye and canary catches to keep the state within its harvest guideline for these species. These should be implemented PRIOR to the start of the fishery.
2. Approve bycatch limits for the whiting fishery:
    a. Canary 4.7 mt
    b. Darkblotch 40 mt
    c. Widow 275 mt
3. Approve the trawl limited entry non-whiting trawl to reduce canary impacts to 9.1 mt.
4. Approve the reduction in bi-monthly limits in the open access DTL fishery north of the conception area from 2,400 lbs to 2,200 lbs.
5. No change to the open access nearshore fishery south of 40 10 at this point, explore the observer data to determine if there are areas where canary interceptions are higher and could be closed to fishing in order to reduce impacts.

PFMC
03/14/08